Conant, Cameron

From: Lanterman, Jeff
Sent: Monday, April 20, 2015 1:17 PM
To: Barfield, David; Beightel, Chris; Conant, Cameron; Letourneau, Lane; Bagley, Jim
Subject: Quivera

Got a call from Mike Oldham the manager.

They are diverting the most recent slug of water. Had 2 pretty good peaks with the latest storms. He thought they got about 4" total on the refuge.

He asked on one of their meters the cable got chewed by wildlife. He wants to use the clawson rule on it.

I told him how we do this elsewhere under other water rights when a meter is required. In those locations if a meter goes down we ask for alternate records of some kind. I thought thatsince they had used the Clawson rule in the past I would be ok using that while the meter was down. We might talk more about this during our meeting.

He was unsure how many times they meter the water or what the plans were using the clawson rule so we may hear more about that.

1. Do they do it more often when the stage is changing rapidly?
2. How often do they do it. (He thought once per day)

I think part of the meeting on Wednesday is going to be a request from them to go back to the Clawson Rule for water use.

Jeff

Conant, Cameron

From: Oldham, Mike <mike_oldham@fws.gov>
Sent: Tuesday, March 31, 2015 12:04 PM
To: Beightel, Chris; Barfield, David
Cc: Lanterman, Jeff; Conant, Cameron; Meg Estep; Peter Striffler; Rachel Laubhan; Murray Laubhan; Carrie Cordova; Brent Waters; David McCauley; Barbara Boyle
Subject: Quivira Water Use - Request - and Meeting Time
Attachments: Qvr Water Need Est_for KWO_v3-17-15.docx

Chris, David

Attached is a "draft" water use document that best describes the need for our management, and the seasonal periods for that use. I'm always reluctant in sending out this type of information as is, but we'll certainly have time on April 22nd to help explain anything that's not made clear in the scenario's or description of use. The document is still considered a "draft" at this point, and not intended for use outside of your investigation.

I believe our meeting time on April 22 can be set by the schedule for Secretary McClaskey at this point. If you'll set the appropriate time for the meeting, then we'll adjust our travel time to meet that need. If 11:00am is a good start time, that works for us. If not, let's push it to just after lunch so we're not having to break off for anyone's lunch hour.

Let us know what that time preference is, and we'll make our travel plans accordingly.

thanks,

Mike Oldham
Project Leader
Quivira NWR
Stafford, KS 67578
Office: 620-486-2393
Cell: 620-405-0140

Preliminary Rattlesnake Creek Water Use Estimates for Quivira National Wildlife Refuge, March 2015

At the request of the Kansas Department of Agriculture, Division of Water Resources, the U.S. Fish and Wildlife Service (Service) developed the following preliminary seasonal water use estimates (Table 1) for Water Right 7571 on Rattlesnake Creek held by Quivira National Wildlife Refuge (Refuge).

Table 1.	Preliminary Rattlesnake Creek Water Use Estimates for Quivira NWR												
	Seasonal Water Use Estimates (Acre-Feet)												
Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Preliminary Estimates	1,500		3,500		2,000		3,500			3,632		500	14,632

The seasonal estimates in Table 1 were developed after considering two scenarios: (1) past annual water use exceeding 7,000 acre-feet (ac-ft) and (2) seasonal water requirements necessary to meet the Refuge's Comprehensive Conservation Plan objectives following a drought year (Table 2). Both scenarios were developed based on quantitative information; however, estimates were constrained by limitations (see notes below Table 2) that precluded either scenario from being used to directly estimate seasonal water needs. In general, the estimate based on past water use was limited by both the seasonal and annual availability of water, which resulted in the use of water during suboptimal times and the inability to use the entire refuge water right. In contrast, the estimate based on water needs following drought exceeded the refuge water right even though important factors (e.g., water infiltration in ditches, plant transpiration) that would have increased water needs were not included in the estimate. Therefore, the Service used information from both Scenario 1 and Scenario 2 to adjust water use so total annual use matches the current water right of 14,632 ac-ft.

Table 2.	Comparison of Rattlesnake Creek Water Use Scenarios for Quivira NWR												
	Seasonal Water Use Estimates (Acre-Feet)												
Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1. Past Use	1,917		2,585		1,909		3,208			3,142		1,329	14,091
2. Meet CCP Objectives	3,144	7,427			2,895		4,053				5,881		23,400

Scenario 1 (Past Use) is based on historic Refuge water-use records. Only years (n = 21) when water use on the Refuge exceeded 7,000 ac-ft were considered in developing estimates to minimize variability caused by extreme low water conditions. Seasons (groups of months) were based on both water management considerations (e.g., logistics, constraints) and seasonal environmental factors (e.g., precipitation). For each of the 21 years, the total volume of water used during each season was summed and the year with the greatest value was removed to further minimize variability caused by extreme high water years. The remaining 5 values were averaged to estimate water use during each season. This estimate is biased due to the following:

- Historic use does not accurately reflect water needs during any given year or season.
- Average historic water use in a given season may not accurately reflect the volume of water that would have been used if water had been available.
- The use of records that exceeded 7,000 ac-ft was arbitrary and only represents approximately 50% of the Refuge water right. As such, these estimates likely are biased low, particularly since the highest seasonal use estimate also was excluded prior to calculating the average.

Will CORR chg / Address chg.

CORR PID 18302 Seq 5 -.

Note add Flint Hills address line.

FD1

pplication N	Certificate No	Station
48,666		FLINT HILLS NWR
46,249-A		FLINT HILLS NWR
43,589		FLINT HILLS NWR
	17,597	FLINT HILLS NWR
	17,601	FLINT HILLS NWR
	17,602	FLINT HILLS NWR
	17,606	FLINT HILLS NWR
	17,608	FLINT HILLS NWR
	17,609	FLINT HILLS NWR
	38,271	FLINT HILLS NWR
	38,273	FLINT HILLS NWR
	38,274	FLINT HILLS NWR
	38,275	FLINT HILLS NWR
	38,276	FLINT HILLS NWR
	38,277	FLINT HILLS NWR
	38,278	FLINT HILLS NWR
	38,279	FLINT HILLS NWR
	38,280	FLINT HILLS NWR
	38,281	FLINT HILLS NWR
	38,282	FLINT HILLS NWR
	38,283	FLINT HILLS NWR
	38,284	FLINT HILLS NWR
	38,285	FLINT HILLS NWR
	38,286	FLINT HILLS NWR
	38,287	FLINT HILLS NWR
	39,115	FLINT HILLS NWR
	39,579	FLINT HILLS NWR

ownership will all be 18302 seq 1

PID for Corr.
18302 seq. 5

Note: Add Flint Hills to address line

√	39,580	FLINT HILLS NWR
√	39,581	FLINT HILLS NWR
√	39,582	FLINT HILLS NWR
√	39,583	FLINT HILLS NWR
√	42,848	FLINT HILLS NWR
√	45,024	FLINT HILLS NWR
√	46,088	FLINT HILLS NWR
√	46,090	FLINT HILLS NWR
√	46,093	FLINT HILLS NWR
√	46,094	FLINT HILLS NWR
√	46,097	FLINT HILLS NWR
41,825 √		KIRWIN NWR
18,264 √	9,473	KIRWIN NWR
46,741 √		MARAIS DES CYGNES NWR
√	44,739	MARAIS DES CYGNES NWR
√	45,327	MARAIS DES CYGNES NWR
√	7,571	QUIVIRA NWR

PID: for Corr chg to 18302 seq. 2
* Add Kirwin to address line

PID: for Corr chg to 18302 seq 3
Add Marais Des Cygnes to address line

PID for Corr chg to 18302 seq. 4
Add Quivira to address line.

As per request from Carrie Cordova from U.S. Fish & Wildlife.

AAT 2/18/2015
2/19/2015 LCM

Scenario 2 (Meet CCP Objectives) is based on achieving minimum requirements of seasonal CCP objectives following a drought year and water use was not constrained by the current water right. Data used to develop this scenario included area estimates and area-capacity curves developed by the Service for individual wetlands, published long-term precipitation and pan evaporation data (including the use of a coefficient to account for shallow wetlands), soil infiltration rates calculated based on information in NRCS soil survey data (SSURGO), LiDAR data to estimate volume of ditches, and aerial imagery to estimate surface flooding of specific wetlands. This estimate is biased due to the following:

- Water loss due to plant transpiration was not included in water use estimates (which would increase water needs to meet objectives).
- Water loss due to soil infiltration in some wetlands was underestimated because values for the available water capacity of 2,300 acres of wetland soils were not available (which would increase water needs to meet objectives).
- Water loss due to horizontal seepage in ditches during initial flooding was not estimated (which would increase water needs to meet objectives).
- Estimate based on a "normal precipitation" year following a drought year (all units dry); thus, a large volume of water (3,144 acre-feet) is needed to initially flood the Little Salt Marsh before water can be diverted elsewhere on the Refuge. This volume would be lower in years not preceded by drought.
- Estimate based on initially flooding only units and infrastructure on the south end of the Refuge. If north portion of Refuge were flooded early in the year, water use estimates would increase.
- Seasons are based on habitat objectives and do not always reflect the water management activities/schedules (e.g., time required for water to travel from diversion to wetland of interest).

2014

WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 564-6638. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
1320 Research Park Drive
Manhattan, KS 66502

IMPORTANT

COMPLETE AND RETURN BY MARCH 1, 2015

CERTIFIED MAIL RECOMMENDED

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	3100N 1150W 35-21S-11W 1 RCA	3 0								
7571-00	4450N 1000W 13-22S-11W 1 DArrynane	A 472.76 →								
7571-00	1250N 3850W 25-22S-11W 1 LHle Salt Marsh	A 1705.10 →								
	Total	2177.86								

WATER RESOURCES RECEIVED
FEB 18 2015
KS DEPT OF AGRICULTURE

All Acre feet Surface Water diverted

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown. All dates are for the previous calendar year.

900797

	March 1				July 1				November 1			
	Empty	< ¼	½	¾	Full	Empty	< ¼	½	¾	Full	Empty	< ¼	½	¾	Full
		(circled)					(circled)					(circled)			

Date: 1/20/15 Telephone: (620-486-2393

14 11735 18302 1 1 - REC Staff SF
Office Use FO CO GMD

Mike Oldham, Refuge Manager
Name (Printed or Typed)

Water M. Oldham
Name (Signature)

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

_____ Owner _____ Tenant X Agent

Quivira

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

David Barfield, P.E., Chief Engineer
Kansas Department of Agriculture
Division of Water Resources
1320 Research Park Drive
Manhattan, Kansas 66502

DEC 10 2014

Dear Mr. Barfield:

The U.S. Fish and Wildlife Service appreciate the efforts being made by your office to respond to our request for an impairment investigation, and to inform us of GMD5's request for additional modeling for an augmentation scenario. As you are aware, the Refuge Manager and I were unable to attend the November meeting and have not seen the presentation of model scenarios run to date. We look forward to better understanding the current information and considering other potential model runs, as was thoughtfully offered to Service staff at the meeting. The Service believes that such modelling should be useful in evaluating the reality of using augmentation as a means of reducing the impacts to the Quivira National Wildlife Refuge and Water Right No. 7,571.

However, we must restate that the Service still has fundamental issues with using groundwater pumping to resolve a problem created by pumping. Although we agree that augmentation might be an option as an interim solution to ensuring the Refuge is able to use more water in relatively normal to dry years, we do not believe that it is the final or sole solution. Instead, pumping water into the stream should be viewed as a stop-gap measure to be used while finding a more permanent, sustainable solution.

The Service has questions about the time, cost, and logistics involved with developing, operating, and maintaining augmentation wells. The Service lacks the funding and personnel to develop, operate or maintain the wells. Refuge staff is already stretched thin, limiting their ability to deal with other responsibilities, in order to operate and maintain the water monitoring equipment your office required us to install on the Refuge. Also, how would the amount of water actually reaching the Refuge be measured? There is likely to be significant loss between where the water is put into the stream and the Refuge boundary. Will these losses be taken into account?

More importantly, will putting off a more sustainable, long-term solution be more costly in the end? What is it costing to address water issues in the more desperate situations in western Kansas and those states farther west? The Service feels that a more appropriate action would be to focus effort (and cost) on sustainable water conservation solutions as early as possible for both environmental and socioeconomic reasons and for the long-term benefit of Kansas as a whole.

RECEIVED
DEC 15 2014
Stafford Field Office
Division of Water Resources

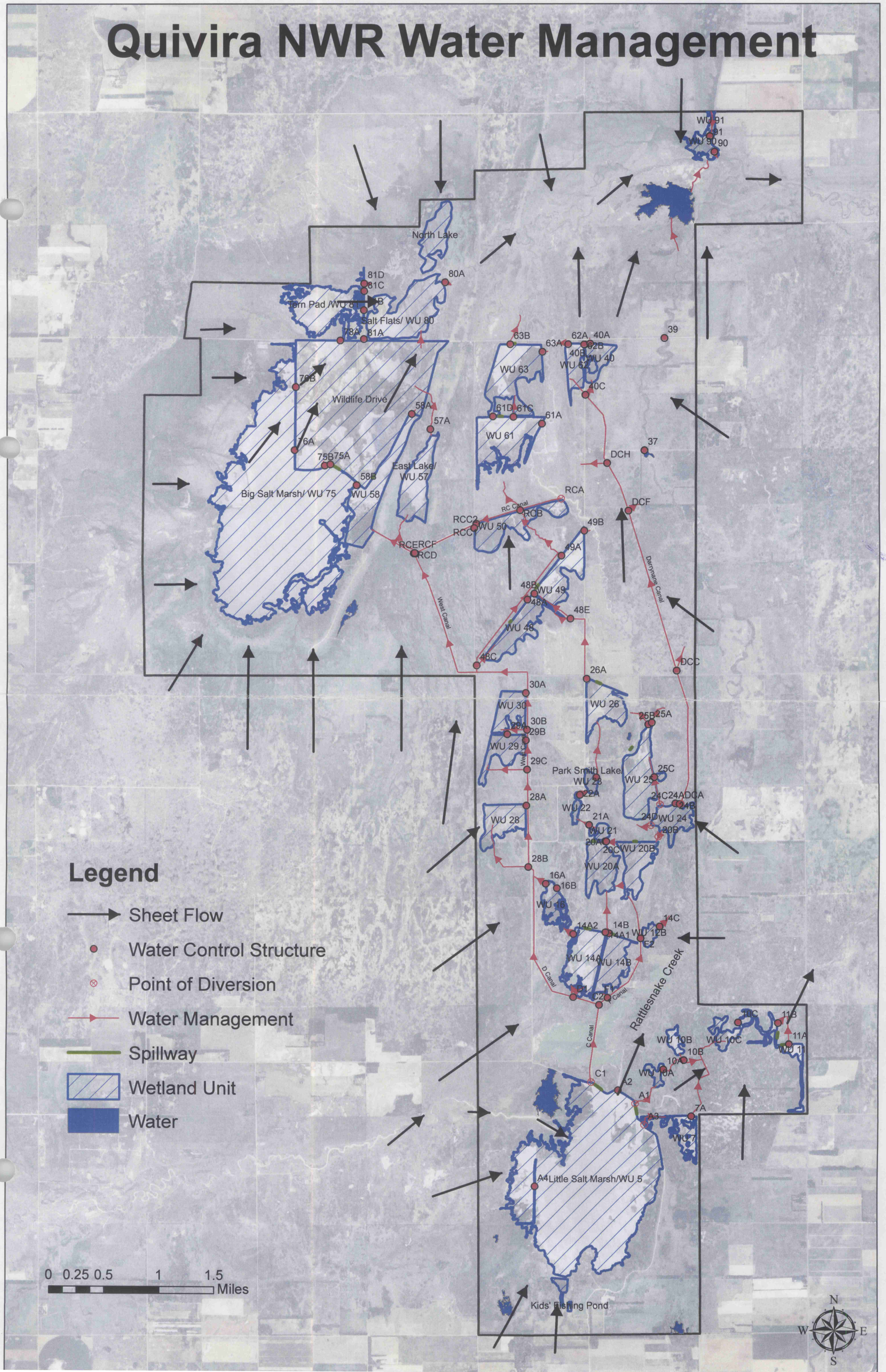
Thank you for any information you or the GMD No. 5 can provide. Please contact me at meg_estep@fws.gov or give me a call if you have any questions.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

cc: Project Leader, Quivira NWR
Refuge Supervisor (CO, KS, NE)
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Groundwater Management District No. 5

Quivira NWR Water Management



Legend

- Sheet Flow
- Water Control Structure
- Point of Diversion
- Water Management
- Spillway
- Wetland Unit
- Water

0 0.25 0.5 1 1.5 Miles

Flex 7571

Quivira NWR Water Use

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL AF
1956													0.00
1957													0.00
1958													0.00
1959													0.00
1960													0.00
1961													0.00
1962													0.00
1963													150.00
1964													3,500.00
1965													750.00
1966													6,900.00
1967	150.00	200.00	440.00	650.00	720.00	1,020.00	1,060.00	930.00	960.00	820.00	680.00	270.00	7,800.00
1968	180.00	230.00	520.00	480.00	445.00	460.00	185.00	150.00	150.00	4,280.00	1,925.00	340.00	9,345.00
1969	50.00	670.00	495.00	284.00	510.00	520.00	275.00	657.00	594.00	741.00	980.00	1,070.00	6,846.00
1970	279.00	558.06	748.56	273.54	575.48	744.60	785.02	533.60	798.94	1,444.14	282.24	106.40	7,129.58
1971	558.00	572.00	204.00	1,028.00	947.00	974.00	427.00	1,053.00	45.00	713.00	1,968.00	1,579.00	10,068.00
1972	575.00	365.00	1,167.00	866.00	833.00	483.00	571.00	439.00	1,551.00	720.00	1,116.00	101.00	8,787.00
1973	117.00	146.00	437.00	635.00	74.00	394.00	330.00	577.00	451.00	51.00	20.00	20.00	3,252.00
1974	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,323.98	1,941.04	486.10	604.74	4,355.86
1975	0.00	0.00	238.66	392.94	29.30	989.60	2,681.16	518.56	639.50	401.12	639.94	920.64	7,451.42
1976	129.70	206.76	61.10	118.00	32.00	155.36	0.00	767.94	500.20	1,123.26	936.00	66.50	4,096.82
1977	76.00	323.66	580.96	558.12	799.90	866.20	554.88	514.72	914.00	1,310.80	1,468.00	485.80	8,453.04
1978	22.88	24.64	18.48	340.00	40.00	220.00	82.00	296.00	529.80	989.00	876.00	1,612.80	5,051.60
1979	1,302.00	966.00	0.00	0.00	232.50	555.00	1,491.60	1,442.00	213.60	46.00	425.40	183.20	6,857.30
1980	145.90	128.90	118.30	29.81	636.69	518.83	1,108.81	358.43	12.01	0.00	23.45	300.20	3,381.33
1981	575.20	908.00	996.70	1,332.20	928.00	1,012.10	919.90	740.00	122.00	581.10	793.50	470.00	9,378.70
1982	47.20	90.00	358.70	539.90	824.70	150.90	584.70	717.80	317.90	223.40	13.50	78.90	3,947.60
1983	663.00	211.00	30.00	39.00	150.00	0.00	608.00	397.00	77.00	0.00	183.00	177.00	2,535.00
1984	400.00	214.00	747.00	194.00	53.00	379.00	36.00	31.00	85.00	20.00	6.00	464.00	2,629.00
1985	185.00	1,651.00	1,895.00	937.00	315.30	477.46	509.70	214.40	315.70	1,154.90	471.50	512.20	8,639.16
1986	450.15	537.20	420.30	181.00	348.00	318.10	1,123.00	286.00	854.00	986.00	1,769.40	1,119.20	8,392.35
1987	1,283.50	705.80	165.00	136.20	104.60	449.20	502.00	851.50	763.40	1,714.00	1,497.20	2,002.60	10,175.00
1988	1,830.35	1,727.07	1,785.18	1,325.32	108.60	385.60	149.96	312.80	0.00	40.00	111.10	262.30	8,038.28
1989	208.89	340.00	527.94	473.40	622.68	1,616.80	0.00	161.62	150.36	683.53	381.30	436.65	5,603.17
1990	862.00	889.98	901.20	1,263.60	1,019.04	1,095.26	199.20	0.00	83.52	256.00	208.80	0.00	6,778.60
1991	0.00	505.00	320.90	721.20	644.30	397.00	0.00	0.00	0.00	0.00	0.00	0.00	2,588.40

Quivira NWR Water Use

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL AF
1992	0.00	0.00	0.00	446.00	112.90	712.20	1,867.60	891.70	169.20	0.00	358.20	848.40	5,406.20
1993	714.30	270.70	525.70	114.40	1,386.80	1,214.50	2,038.90	84.20	469.30	1,599.90	1,371.00	1,423.40	11,213.10
1994	1,049.60	948.00	30.10	127.90	326.90	45.70	112.30	245.90	330.50	75.00	0.00	0.00	3,291.90
1995	286.90	614.60	567.40	533.60	1,269.40	240.50	357.40	167.60	618.40	403.10	423.70	521.00	6,003.60
1996	7.98	1,014.40	709.30	492.00	1,017.00	160.60	37.90	687.40	1,947.80	1,479.30	1,308.50	1,160.40	10,022.58
1997	1,116.90	971.20	367.80	250.70	293.70	431.40	314.00	1,297.70	1,867.30	1,423.20	153.30	138.80	8,626.00
1998	0.00	0.00	24.80	63.70	0.00	1,105.80	1,872.40	595.80	730.20	946.20	977.10	791.90	7,107.90
1999	498.80	348.70	33.30	0.00	0.00	296.90	0.00	573.90	547.50	729.50	451.60	1,172.90	4,659.10
2000	1,079.00	888.20	188.50	125.50	146.40	306.10	339.40	1,010.60	219.10	10.10	809.60	1,531.90	6,654.40
2001	1,419.70	1,051.20	49.10	48.20	926.40	140.80	0.00	0.00	326.90	418.30	0.00	0.00	4,381.10
2002	925.70	1,061.40	1,411.40	1,480.90	1,485.00	794.70	579.20	0.00	468.70	255.00	717.00	1,148.90	10,327.90
2003	857.80	317.50	316.10	0.00	0.00	0.00	118.80	0.00	0.00	0.00	40.00	77.20	1,727.40
2004	322.50	647.00	1,553.10	1,286.10	295.40	77.20	642.90	2,137.90	1,594.30	285.40	261.40	576.20	9,678.50
2005	1,255.20	874.60	128.50	0.00	0.00	0.00	0.00	122.50	1,534.60	0.00	0.00	643.90	4,559.30
2006	868.70	1,003.40	709.60	528.20	300.80	488.80	101.40	0.00	653.20	194.00	27.30	0.00	4,875.40
2007	827.60	859.20	575.80	841.30	125.70	0.00	0.00	547.80	1,169.40	925.80	748.60	825.40	7,446.60
2008	842.90	0.00	0.00	0.00	875.60	165.30	0.00	0.00	537.00	469.70	147.20	294.50	3,322.40
2009	0.00	0.00	0.00	0.00	0.00	60.00	185.00	0.00	999.60	275.00	85.40	154.70	1,759.70
2010	0.00	784.04	0.00	251.40	228.60	148.00	64.00	487.30	1,265.48	2,257.04	1,705.70	1,333.90	8,525.46
2011	1,297.45	273.03	681.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	196.35	871.60	3,319.73
2012	320.95	749.65	887.10	290.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,248.47
2013	0.00	0.00	138.38	345.14	363.40	363.23	262.15	472.63	218.30	212.60	191.07	145.00	2,711.90

File # 7571 Quivera

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Quivira National Willdlife Refuge
1434 NE 80th Street
Stafford, KS 67558
Phone: (620) 486-2393 FAX: (620) 486-2315

October 24, 2014

David and Jeff,

In July 2014, we received approval of the water metering protocol for Quivira National Wildlife Refuge subject to certain conditions requested by your office. We appreciate your cooperation in this effort. The purpose of this letter is to provide updates and to officially secure written permission for an extension of time to satisfy certain conditions requested by your office, as described below.

1) Refuge staff has plugged site 20B and informed Jeff Lanterman. Periodic rains throughout the growing season delayed this action, but the diversion gate at this location remained shut until the plug was put in place.

2) Electrical cords connecting the meter sensors with the modules are best protected from damage typically caused by wildlife when they are enclosed in flexible metal conduits. Therefore, this is a condition requested by your office. We identified this problem early on and have been replacing the original cords as our budget allows (cost is $1,225/conduit). In the meantime, threading electrical cord through pvc pipe has helped deter damage caused by wildlife. We currently have 5 flexible metal cables for use in the field. Two additional cables will be purchased in the next fiscal year as funding is available to do so.

3) Currently, meters are enclosed in wooden boxes with lids. Because your office would prefer casings that better protected meters from vandalism, we purchased new casings. They are synthetic plastic with lockable lids and a concrete foundation that will be set at least partially below the ground to prevent tampering. The location of some of the meters above water structures prevents installation of meters completely belowground. The new meter casings will be installed as the new cables arrive. In the meantime, the wooden boxes that protect the meters will continue to be used.

I do believe that we can continue to move forward on meeting conditions outlined in your letter, but will need part of the next federal fiscal year to complete. You have indicated having staff shortages in the past that have prevented moving forward on water issues, and the refuge is experiencing similar shortfalls--having 5 field positions become vacant since the hiring freeze began in 2012. Feel free to call me if you have any concerns, or arrange a site visit if you would like to discuss progress.

On a separate note, progress has been made in recent weeks on wetland re-contouring (unit 48 finished and 26 remains), which has always been part of our Rattlesnake Creek Partnership Plan. This project (grant award) had a deadline of September 2014, and has already been given a time extension once in 2013 due to wet conditions last summer. This project will need to remain our priority project until completed.

Sincerely,

Mike Oldham
Refuge Manager

Cc: Stafford Field Office
GMD#5

Conant, Cameron RE File # 7571

From: Conant, Cameron
Sent: Friday, October 03, 2014 9:34 AM
To: 'Laubhan, Rachel'; Lanterman, Jeff; Mike Oldham; Brent Waters (brent_waters@fws.gov)
Subject: RE: FYI -Diversion at Quivira NWR has been plugged--photo

Thanks Rachel, this will be added to the file.

Cameron

From: Laubhan, Rachel [mailto:rachel_laubhan@fws.gov]
Sent: Friday, October 03, 2014 7:20 AM
To: Lanterman, Jeff; Conant, Cameron; Mike Oldham; Peter Striffler; Meg Estep; Carrie Cordova; Brent Waters
Subject: FYI -Diversion at Quivira NWR has been plugged--photo

Jeff, Cameron -

Just wanted to inform you that the diversion point between water units 24 and 20b has been plugged. Prior to plugging, the concern was some backward flow into unit 20b during or following significant flood/rain events.

Attached is a photo for your records.

Rachel

File # 7571

1320 Research Park Drive
Manhattan, Kansas 66502
(785) 564-6700

Kansas
Department of Agriculture
agriculture.ks.gov

900 SW Jackson, Room 456
Topeka, Kansas 66612
(785) 296-3556

Jackie McClaskey, Secretary

Governor Sam Brownback

July 8, 2014

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
ATTN: PETER STRIFFLER
PO BOX 25486
DENVER CO 80225

RE: Water Right, File No. 7571
Proposed Monitoring Plan

Dear Mr. Striffler:

We have reviewed the USFWS Flow Monitoring Plan for Rattlesnake Creek Diversions, which was originally received in this office in its current form on July 19, 2012. This plan was submitted in response to an Order of the Chief Engineer dated February 3, 2011, requiring water flowmeters on all point of diversions authorized under the reference water right.

Our review of the plan, along with information obtained from several site visits by staff of our Stafford Field Office, most recently on May 21, 2014, indicates that we can approve the proposed monitoring plan subject to the following conditions.

The following sites are to be equipped as indicated below.

- Site RCA, associated with the point of diversion authorized as 3100 feet north and 1150 feet west of the southeast corner of Section 35, Township 21 South, Range 11 West in Stafford County, Kansas.

- Sites 24C, 24D, and DCA, associated with the point of diversion authorized as 4450 feet north and 1100 feet west of the southeast corner of Section 13, Township 22 South, Range 11 West in Stafford County, Kansas.

- Sites A1, A3, and C1, associated with the point of diversion authorized as 1250 feet north and 3850 feet west of the southeast corner of Section 25, Township 22 South, Range 11 West in Stafford County, Kansas.

- Site 20B is to be permanently plugged so that no water can be diverted at that site.

Each of these sites will be equipped with an Isco 2150 Area Velocity Flow Module installed as described in the monitoring plan and confirmed by the Meter Compliance Investigation Memorandum dated June 2, 2014 by Jeff K. Lanterman and Cameron R. Conant of our Stafford Field Office which documents their site visit on May

21, 2014. In addition, the electrical cords connecting the meter sensors with the modules shall be enclosed in flexible metal conduits to protect from damage which might be caused by wildlife. The modules themselves shall be installed in a vault or housing of sturdy construction, preferably located in PVC casings with lockable lids, situated below ground level to protect from vandalism.

We expect the meters to remain installed at all times because diversion through the structures could be expected anytime during which Rattlesnake Creek has adequate flow. There may be instances where refuge staff would like to temporarily remove the meters for servicing or where no diversion is expected through the diversion works for an extended period. Please contact the Water Commissioner in advance to secure permission to temporarily remove the meters. While the meter is removed, no diversion through the structure may take place.

The meters shall be installed as described above within 30 days or approved extension of time..

If you have any questions about this, please feel free to contact me or Jeff Lanterman.

Sincerely,

David W. Barfield, P.E.
Chief Engineer

Pc: Stafford Field Office
GMD#5

Conant, Cameron

From: Bagley, Jim
Sent: Friday, June 27, 2014 10:59 AM
To: Lanterman, Jeff; Conant, Cameron
Cc: Barfield, David; Letourneau, Lane; Beightel, Chris
Subject: Quivira Metering Plan Approval
Attachments: Quivira Metering Plan Approval.docx

Here's my first draft of a letter approving the monitoring plan. I don't think a waiver is needed because our rules provide for other means for metering diversions that are not through closed conduits. Please make any corrections or additions as necessary.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 564-6671
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

Conant, Cameron

From: Lanterman, Jeff
Sent: Wednesday, June 04, 2014 9:56 AM
To: Barfield, David; Letourneau, Lane; Beightel, Chris; Conant, Cameron; Bagley, Jim
Subject: FW: quivira meter report
Attachments: compliance investigation memo.docx

Here is a memorandum regarding Quivera's metering. Cameron and I visited the site and Rachel and Mike took us to all the diversion points. They appear to be fully metered and plan to permanently plug 20b so that no water can be diverted there. Therefore all of our concerns will be addressed with that diversion point.

So now I guess it is up to us to approve their metering plan. It appears that all their diversion points are metered. Although during our inspection there were very few actual Doppler meters installed at the points. They plan to keep them away from the site due to possible vandalism.

Field Office Concerns which we think could be addressed in an approval letter:

1. The little plywood housings built for the meters are flimsy and poorly constructed. They could make a simple vault or housing as described in the memo that would protect from vandalism with a lock and ***permanently*** house the meters.
2. As we discussed there were very few meters actually installed when we went out there. Since they (as they have stated) need water all the time we believe their meters should be permanently installed in a more hardy permanent structure. Letting people take their meters in and out during a time when we can reasonably expect diversion to occur is not something we let other water users do. We typically send a NONC if we find a meter missing.
3. Reinforce that it will not be in compliance unless 20b is plugged.

Let me know if you have any questions.

From Rachel Laubhan:
Cameron,

Brent will permanently plug the 20B structure (no flap gate). So, it will not be an issue. FYI - In the past, it was used to alleviate flooding. It would start running only after water had been running over both spillways on the north side of 20A and B. We are talking about ~5 acre-feet of water according to Brent.

Thanks,
Rachel

Conant, Cameron

From: Laubhan, Rachel <rachel_laubhan@fws.gov>
Sent: Monday, June 02, 2014 12:58 PM
To: Conant, Cameron
Cc: Oldham, Mike (mike_oldham@fws.gov); Lanterman, Jeff; Peter Striffler (peter_striffler@fws.gov)
Subject: Re: Quivira NWR meter serial numbers

Cameron,

Brent will permanently plug the 20B structure (no flap gate). So, it will not be an issue. FYI - In the past, it was used to alleviate flooding. It would start running only after water had been running over both spillways on the north side of 20A and B. We are talking about ~5 acre-feet of water according to Brent.

Thanks,
Rachel

On Wed, May 28, 2014 at 10:50 AM, Conant, Cameron <Cameron.Conant@kda.ks.gov> wrote:

Thanks for the additional meter information Rachel. I'll look forward to receiving the pictures and will complete the compliance investigation at that time.

The currently unmetered 20B site will be noted on the compliance check along with the option of installing a check valve which as I understood it in the most basic sense, would prevent unmetered water from moving north to south. Once the valve was installed it would not be possible to pass stored water in WU24 through the 20B diversion point and into WU20B. But, under some circumstances the valve would allow stored water in WU20B to be diverted slightly uphill into WU24 through the 20B diversion point if the Refuge decided to operate in that manner.

If that is not the correct thought process on the 20B diversion point please let me know.

Thanks,

Cameron Conant, Assistant Water Commissioner

Kansas Department of Agriculture

Division of Water Resources

Stafford Field Office

(620)234-5311

agriculture.ks.gov

From: Laubhan, Rachel [mailto:rachel_laubhan@fws.gov]
Sent: Wednesday, May 28, 2014 8:46 AM
To: Conant, Cameron
Cc: Mike Oldham; Brent Waters; Lanterman, Jeff; Peter Striffler
Subject: Quivira NWR meter serial numbers

Cameron and Jeff,

Pete Striffler (Water Resources, Regional Office) sent us photos and serial number information for the Quivira NWR water meters that he gathered some time ago. The serial number information that you need is attached.

We will send the photos soon, once we confirm how each meter matches more specifically with different diversion points. Brent is still on leave. It is my current understanding that the missing meter (6 instead of 7) relates to the diversion point that will have a flap gate installed or will otherwise become non-functional (where water could possibly run backwards in certain situations).

Please let us know if you need anything else.

Thank you, Rachel

KANSAS DEPARTMENT OF AGRICULTURE

Division of Water Resources

Stafford Field Office

M E M O R A N D U M

TO: File No 7,571 **DATE: 6/2/2014**

FROM: Cameron R Conant
& Jeff K Lanterman **RE:** Meter Compliance Investigation

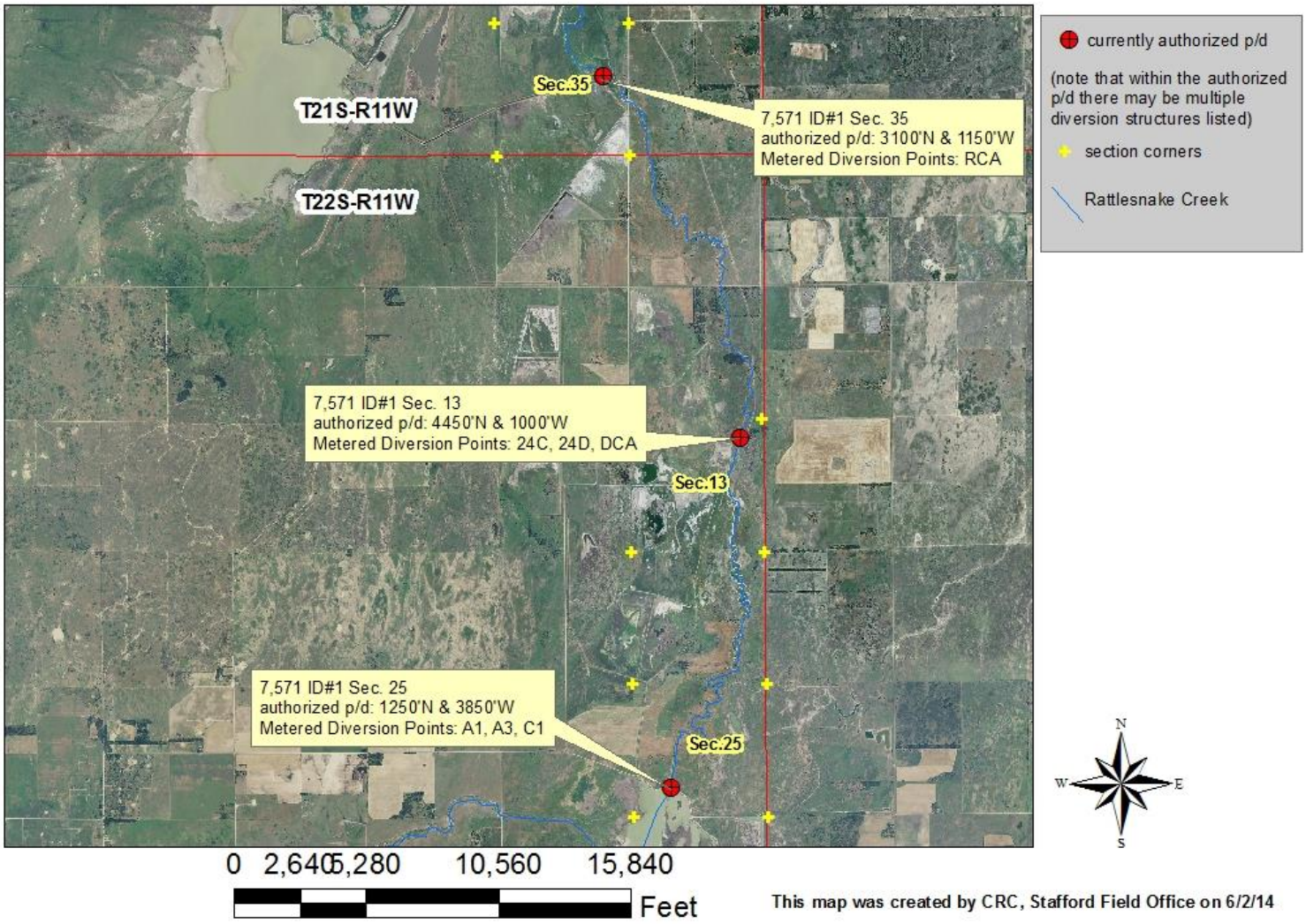
On May 21, 2014 Cameron Conant and Jeff Lanterman met Mike Oldham and Rachel Laubhan at Quivira National Wildlife Refuge to view meter sites and points of diversion. This compliance check was necessary for a variety of reasons, most notably the ongoing impairment study and the recent meter order issued by the Stafford Field Office on February 3, 2011. The original meter order was sent to the refuge in 1996 but for a variety of well documented reasons the refuge has been unable to adequately meter the existing points of diversion.

The recent meter order directed the refuge to have meters installed by December 31, 2012. Peter Striffler and other refuge staff have been in contact with the Stafford Field Office and Technical Services since February of 2012 to develop a metering plan that Technical Services approves of. Since that time the refuge has also equipped the diversion points with meters that measure all water diverted from the Rattlesnake Creek into the refuge. The deadline of 12/31/12 was extended by DWR because the refuge was working towards properly metering the refuge in an acceptable manner and the refuge was keeping DWR apprised of its progress.

The refuge has provided the Stafford Field Office and Technical Services with a current *USFWS Flow Monitoring Plan for Rattlesnake Creek Diversions*. Please reference this plan for additional details on how the water moves through the metered structure points and into different areas of the refuge.

The refuge has 3 authorized points of diversion from the Rattlesnake Creek. Two of the authorized points of diversion have 3 separate diversion structures that must be metered and one of the authorized points of diversion has a single diversion structure that must be metered. There are a total of 7 diversion structure locations at the 3 authorized points of diversion that are considered direct diversions from Rattlesnake Creek and must be metered. (see attached map)

7,571 Meter Compliance Investigation Map
Sec.13 & 25-T22S-R11W &
Sec. 35-T21S-R11W in Stafford County



7,571 ID#1 Section 25-T22S-R11W in Stafford County (1250'N & 3,850'W):
KDA-DWR PDIV ID for the South Diversion is 28295

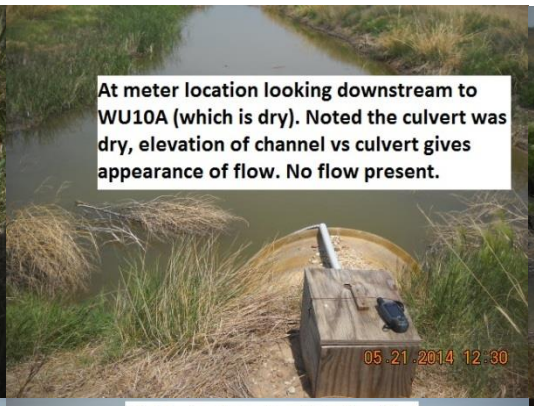
This point of diversion is the first diversion from Rattlesnake Creek and is made up of 3 separate diversion structures which are all required to have a meter. Diversion structure A1, A3, and C1 make up the most southern point of diversion. The three diversion structures are located on the Northeast end of the Little Salt Marsh. These diversions appear to meter all water diverted from the Rattlesnake Creek and into the refuge. Control Structure A2 is utilized to pass flows through the Little Salt Marsh back into the Rattlesnake Creek channel and is not required to have a meter.

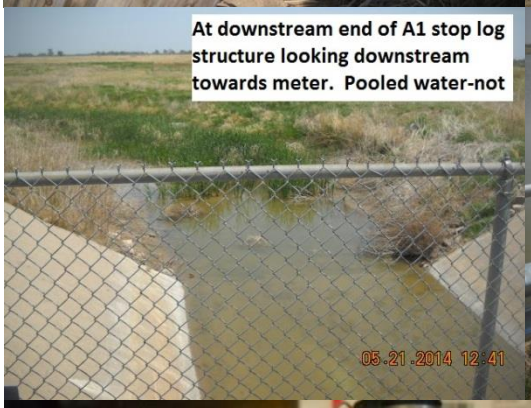
Individual descriptions of the 3 direct diversion points are located below.

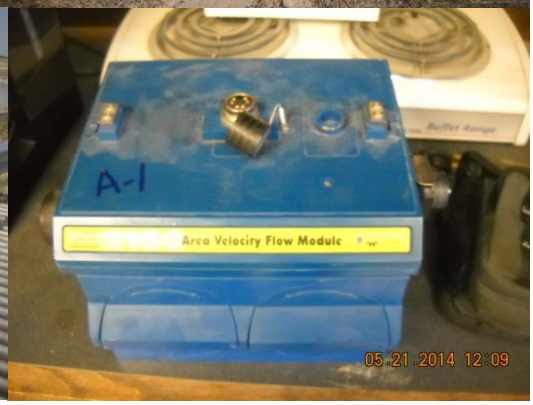
Diversion Structure A1:

Diversion Structure A1:				
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.10153	-98.48286	150	5.9'
GPS @ Meter:	38.10276	-98.4803	150	6.4'
Structure from SE corner	521'N & 3,059'W			
Meter from SE corner	969'N & 2,322'W			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01437			
Meter Model/Brand:	2150/Isco			
Comments: Meter located ~250 yards Northeast of A1 diversion in culvert prior to WU10A, the meter was not installed at time of check.				

Pictures related to A1:



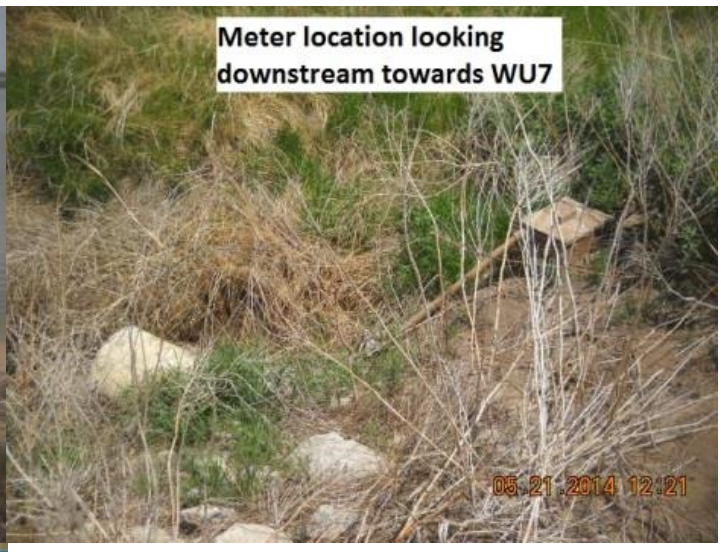




Diversion Structure A3: (this structure is located in Section 36)

Diversion Structure A3:	**structure actually located in Section 36**			
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.09873	-98.48132	210	5.9'
GPS @ Meter:	n/a-meter is located on East side of road near diversion structure			
Structure from SE corner	4,770'N & 2,634'W			
Meter from SE corner	n/a			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01550			
Meter Model/Brand:	2150/Isco			
Comments: Meter located across the road from A3 diversion structure in 18" culvert. A3 structure is operated by a screwgate valve. No meter installed at time of check, not diverting during check.				

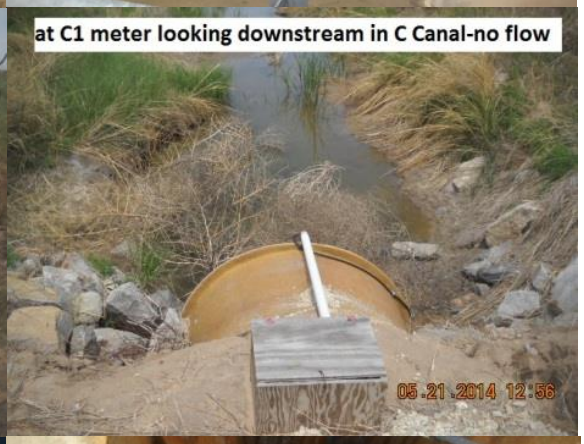
Pictures related to A3:



Diversion Structure C1:

Diversion Structure C1:				
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.1044	-98.48943	95	5.9'
GPS @ Meter:	38.11082	-98.48943	20	7.3'
Structure from SE corner	1,567'N & 4,950'W			
Meter from SE corner	3,905'N & 4,950'W			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01549			
Meter Model/Brand:	2150/Isco			
Comments: Meter located ~350 yards downstream of C1 structure in C Canal prior to WU14A & B. Meter installed at time of check, not diverting through this structure at this time.				

Pictures related to C1:



7,571 ID#1 Section 13-T22S-R11W in Stafford County (4,450'N & 1,000'W):
KDA-DWR PDIV ID for the Middle Diversion is 48617

This point of diversion is the second diversion from Rattlesnake Creek and is made up of 3 separate diversion structures which are all required to have a meter. Diversion structure 24C, 24D, and DCA make up the middle point of diversion. The three diversion structures are located within WU24. It should be noted that DWR had concerns with the refuge not wanting to install a meter on structure 20B. The refuge said it was rarely used and water could actually pass both ways so they did not want to meter it. This was discussed during the investigation and Rachel and Mike thought that Brent was considering installing a check valve to only allow water to move South to North during flood events which would make a meter unnecessary. There was also discussion that the entire structure might be plugged because it was so rarely used. During subsequent email conversations between Rachel and Cameron, it was determined that the structure would be filled in. Rachel thought the refuge would complete the dirt work by the end of June. They will send pictures that confirm the structure has been plugged (if plugged, there is no reason to worry about metering this site).

If 20B is plugged, the remaining three diversions appear to meter all water diverted from the Rattlesnake Creek into the refuge. Control structures 24A and 24B are utilized to pass flows back into the Rattlesnake Creek channel and are not required to have a meter.

Individual descriptions of the 3 direct diversion points are located below.

Diversion Structure 20B:

This diversion structure will be plugged, water will not be allowed to pass through 20B in either direction. No meter required.
Lat. 38.13633 Long. -98.47915 Count-55 Estimated Accuracy-10.7'
Footages from SE corner of section- 2,598'N & 1,956'W

Pictures related to 20B:

Diversion Structure 24D:

Diversion Structure 24D:				
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.13851	-98.48001	150	5.0'
GPS @ Meter:	n/a-meter located 20' downstream of structure			
Structure from SE corner	3,392'N & 2,203'W			
Meter from SE corner	n/a			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01438			
Meter Model/Brand:	2150/Isco			
Comments: Meter located about 20' downstream of structure. Meter not installed at time of check. Not diverting through this structure at time of check.				

Pictures related to 24D:

Diversion Structure 24C:

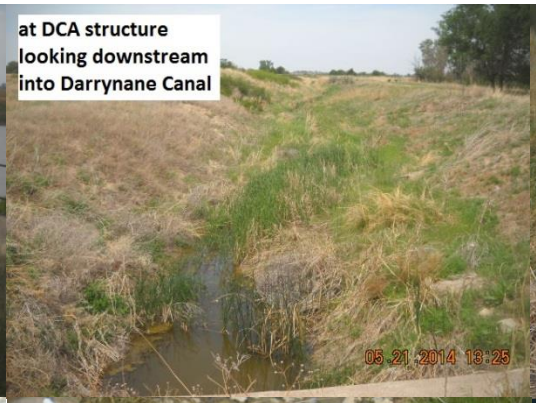
Diversion Structure 24C:				
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.1412	-98.47841	135	5.2’
GPS @ Meter:	n/a-meter located 30' downstream of structure			
Structure from SE corner	4,371'N & 1,743'W			
Meter from SE corner	n/a			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01548			
Meter Model/Brand:	2150/Isco			
Comments: Meter located about 30' downstream of structure. Meter not installed at time of check. Not diverting through this structure at time of check.				

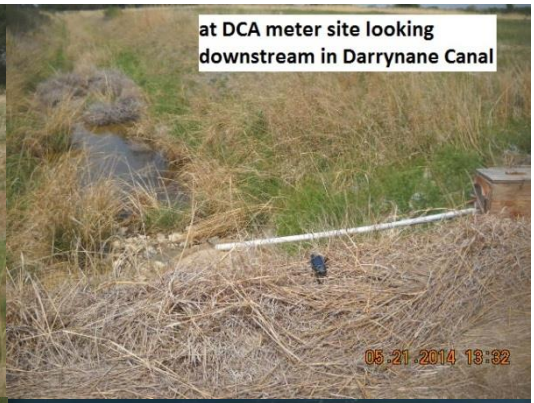
Pictures related to 24C:

Diversion Structure DCA:

Diversion Structure DCA:				
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.1413	-98.47504	160	4.7'
GPS @ Meter:	38.15114	-98.47376	160	5.6'
Structure from SE corner	4,408'N & 773'W			
Meter from SE corner	2,735'N & 335'W			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01547			
Meter Model/Brand:	2150/Isco			
Comments: Meter site located in Darrynane Canal about 3,600' NE of DCA structure(sec. 12). Meter not installed at time of check. Not diverting from DCA structure but ponded water from Darrynane Canal was passing through the 48" culvert at time of check.				

Pictures related to DCA:





7,571 ID#1 Section 35-T21S-R11W in Stafford County: (3,100'N & 1,150'W):
KDA-DWR PDIV ID for the North Diversion is 53524

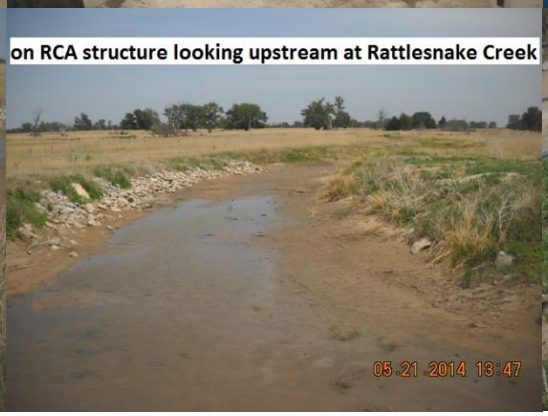
This point of diversion is the final diversion from Rattlesnake Creek and is made up of a single 6 bay stop log structure. The diversion is called RCA structure and is required to have a meter. This diversion is able to feed water to the Big Salt Marsh by the most direct route (RC Canal) providing there is adequate flow in the Rattlesnake Creek at this point in the refuge. This is also a direct route to supply water into the WU60's. The meter location appears to meter all water diverted from the Rattlesnake Creek and into the refuge. Flow can be passed into the Rattlesnake Creek channel via a concrete overflow structure. This portion of the Rattlesnake was dry at the time of our investigation.

An individual description of the RCA diversion point is located below.

Diversion Structure RCA:

Diversion Structure RCA:				
	GPS lat.	GPS long.	GPS count	GPS accuracy
GPS @ Structure:	38.1811	-98.4948	116	9.9'
GPS @ Meter:	n/a-meter installed ~30 yards downstream of structure			
Structure from SE corner	3,054'N & 1,168'W			
Meter from SE corner	n/a			
Meter Type:	cont. wave doppler			
Meter Serial:	211G01436			
Meter Model/Brand:	2150/Isco			
Comments: Meter site located ~30 yards downstream of RCA structure. Meter not installed at time of check. Not diverting from RCA structure. No flow in Rattlesnake Creek.				

Pictures related to RCA:



The Rattlesnake Creek was also viewed from the west edge of the refuge boundary at the bridge located between the SW¼ of section 26 and the SE¼ of section 27. The flow at the Zenith Gage read ~2.7cfs. The Zenith gage is located about 2 miles upstream of this photo.

Field Office Comments:

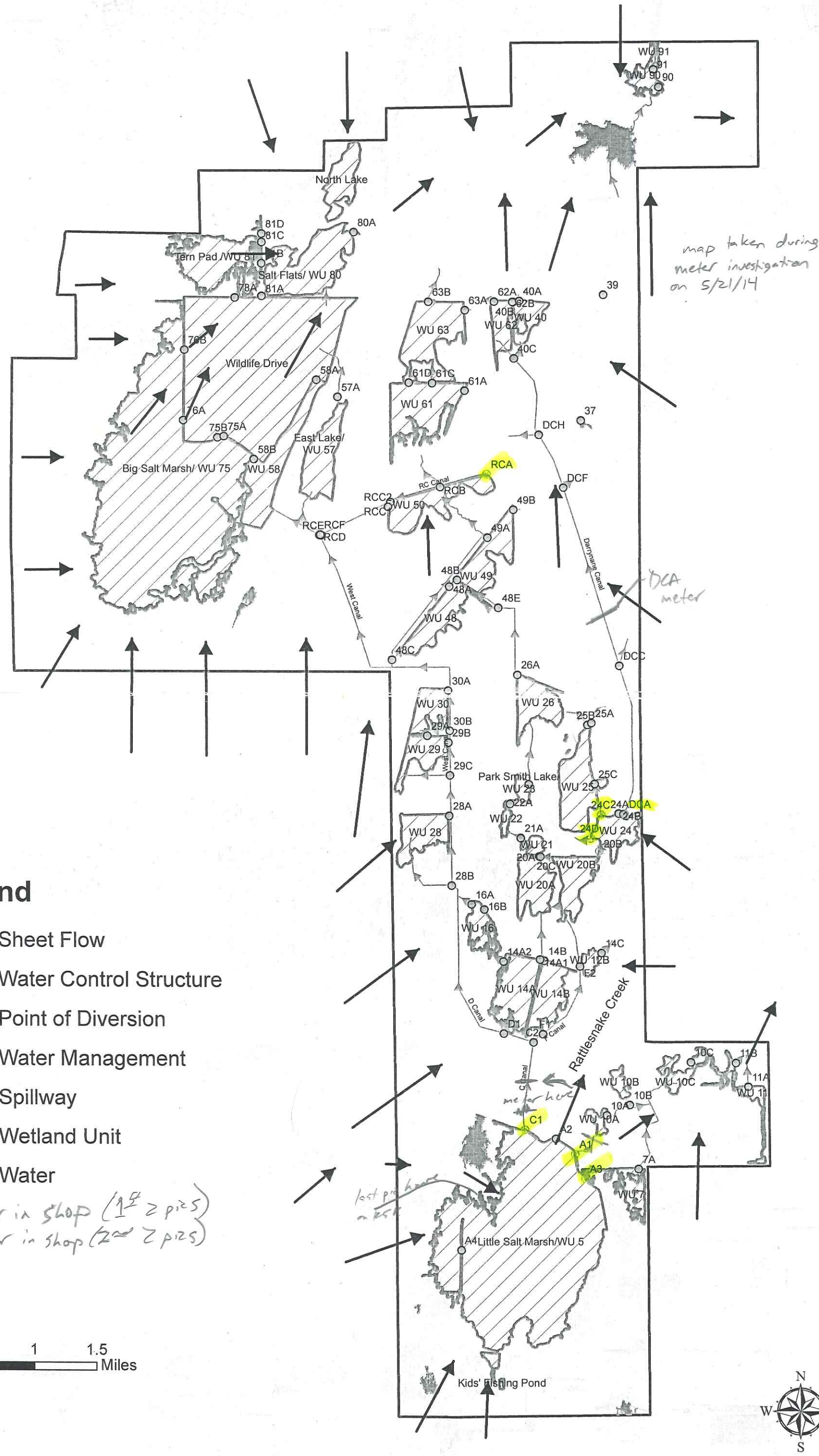
The compliance investigation for the installation of water flow meters has been completed. For additional technical information regarding the ISCO 2150 Flow Modules the Metering Plan entitled "USFWS Flow Monitoring Plan for Rattlesnake Creek Diversions" should be consulted.

The Stafford Field Office is unable to make a determination of compliance with regards to the metering plan and meters. Technical Services needs to provide review and input into this meter report as well as the metering plan provided by USFWS. These meters are not on the "approved flowmeter list" so if Technical Services deems the meters and plan acceptable, the Chief Engineer should provide a waiver to allow this meter. Technical Services also needs to review the meter plan and formally accept or reject it.

The Stafford Field Office feels like the meter plan is good and the ISCO meters should be granted the waiver. They are located and installed in a manner that meters all flow diverted from the Rattlesnake Creek into the refuge.

The only concern the field office has is that the refuge plans to remove meters when the diversion are not be operated (while on-site only 1 meter was actually installed). We understand and have read the refuges concerns with possible damages from vandalism, wildlife, ect if the meters are installed year round. We believe better protective casings would greatly decrease the chance of vandalism and wildlife damages. It seems installing the modules underground in 18-24" PVC and fitting a lockable cap on the PVC is possible. This should keep them out of site for vandalism and impervious to wildlife while still easily accessible to refuge staff. We think the refuge should have the meters installed year round.

Quivira NWR Water Management



map taken during meter investigation on 5/21/14

DCA meter

meter here

last pic here

Legend

- Sheet Flow
- Water Control Structure
- Point of Diversion
- Water Management
- Spillway
- Wetland Unit
- Water

A1 - meter in shop (1st ≥ pic 5)
24c - meter in shop (2nd ≥ pic 5)
A3 -

0 0.25 0.5 1 1.5 Miles

INPUTS	
Target Section Definition	
Section	25
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.4803
Target Latitude	38.10276

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or *NAD83* longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 A1 Meter estimated accuracy-6.4'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.09995865	-98.49107651
NW	38.11475941	-98.49103041
NE	38.11479042	-98.47265761
SE	38.10011153	-98.47258167
Degrees Longitude per Foot		3.47523128E-06
Degrees Latitude per Foot		2.74604228E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	1020	-3101
NW	-4370	-3088
NE	-4381	2199
SE	964	2221

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.09994500	-98.49072300
NW	38.11474600	-98.49067700
NE	38.11477700	-98.47230500
SE	38.10009800	-98.47222900
Degrees Longitude per Foot		3.47523064E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	1025	-2999
NW	-4365	-2986
NE	-4376	2301
SE	969	2322

INPUTS	
Target Section Definition	
Section	36
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.48132
Target Latitude	38.09873

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or ***NAD83*** longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 A3 Structure estimated accuracy-5.9'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.08555468	-98.49090870
NW	38.09995865	-98.49107651
NE	38.10011153	-98.47258167
SE	38.08564554	-98.47252082
Degrees Longitude per Foot		3.47454050E-06
Degrees Latitude per Foot		2.74604750E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	4798	-2760
NW	-447	-2808
NE	-503	2515
SE	4765	2532

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.08554100	-98.49055500
NW	38.09994500	-98.49072300
NE	38.10009800	-98.47222900
SE	38.08563200	-98.47216800
Degrees Longitude per Foot		3.47453986E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	4803	-2658
NW	-442	-2706
NE	-498	2616
SE	4770	2634

INPUTS	
Target Section Definition	
Section	25
Township	22
Range	11
Range Direction	W
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.48943
Target Latitude	38.1044

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or ***NAD83*** longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 C1 Structure
estimated accuracy-5.9'

Loaded Section Data
From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.09995865	-98.49107651
NW	38.11475941	-98.49103041
NE	38.11479042	-98.47265761
SE	38.10011153	-98.47258167
Degrees Longitude per Foot		3.47523128E-06
Degrees Latitude per Foot		2.74604228E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	1617	-474
NW	-3772	-461
NE	-3784	4826
SE	1562	4848

Loaded Section Data
From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.09994500	-98.49072300
NW	38.11474600	-98.49067700
NE	38.11477700	-98.47230500
SE	38.10009800	-98.47222900
Degrees Longitude per Foot		3.47523064E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	1622	-372
NW	-3768	-359
NE	-3779	4928
SE	1567	4950

INPUTS	
Target Section Definition	
Section	25
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.48943
Target Latitude	38.11082

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or *NAD83* longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 C1 Meter estimated accuracy-7.3'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.09995865	-98.49107651
NW	38.11475941	-98.49103041
NE	38.11479042	-98.47265761
SE	38.10011153	-98.47258167
Degrees Longitude per Foot		3.47523128E-06
Degrees Latitude per Foot		2.74604228E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	3955	-474
NW	-1435	-461
NE	-1446	4826
SE	3900	4848

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.09994500	-98.49072300
NW	38.11474600	-98.49067700
NE	38.11477700	-98.47230500
SE	38.10009800	-98.47222900
Degrees Longitude per Foot		3.47523064E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	3960	-372
NW	-1430	-359
NE	-1441	4928
SE	3905	4950

INPUTS	
Target Section Definition	
Section	13
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.47915
Target Latitude	38.13633

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or *NAD83* longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 20B Structure estimated accuracy-10.7'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12914829	-98.49118229
NW	38.14379717	-98.49118229
NE	38.14364412	-98.47294729
SE	38.12920931	-98.47270338
Degrees Longitude per Foot		3.47660820E-06
Degrees Latitude per Foot		2.74602943E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	2615	-3461
NW	-2719	-3461
NE	-2664	1784
SE	2593	1854

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12913500	-98.49082900
NW	38.14378400	-98.49082900
NE	38.14363100	-98.47259500
SE	38.12919600	-98.47235100
Degrees Longitude per Foot		3.47660757E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	2620	-3359
NW	-2715	-3359
NE	-2659	1885
SE	2598	1956

INPUTS	
Target Section Definition	
Section	13
Township	22
Range	11
Range Direction	W
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.48001
Target Latitude	38.13851

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or *NAD83* longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 24D Structure estimated accuracy-5.0'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12914829	-98.49118229
NW	38.14379717	-98.49118229
NE	38.14364412	-98.47294729
SE	38.12920931	-98.47270338
Degrees Longitude per Foot		3.47660820E-06
Degrees Latitude per Foot		2.74602943E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	3409	-3214
NW	-1925	-3214
NE	-1870	2031
SE	3387	2102

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12913500	-98.49082900
NW	38.14378400	-98.49082900
NE	38.14363100	-98.47259500
SE	38.12919600	-98.47235100
Degrees Longitude per Foot		3.47660757E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	3414	-3112
NW	-1921	-3112
NE	-1865	2133
SE	3392	2203

INPUTS	
Target Section Definition	
Section	13
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.47841
Target Latitude	38.1412

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or ***NAD83*** longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 24C Structure estimated accuracy-5.2'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12914829	-98.49118229
NW	38.14379717	-98.49118229
NE	38.14364412	-98.47294729
SE	38.12920931	-98.47270338
Degrees Longitude per Foot		3.47660820E-06
Degrees Latitude per Foot		2.74602943E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	4389	-3674
NW	-946	-3674
NE	-890	1571
SE	4367	1641

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12913500	-98.49082900
NW	38.14378400	-98.49082900
NE	38.14363100	-98.47259500
SE	38.12919600	-98.47235100
Degrees Longitude per Foot		3.47660757E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	4394	-3572
NW	-941	-3572
NE	-885	1673
SE	4371	1743

INPUTS	
Target Section Definition	
Section	13
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.47504
Target Latitude	38.1413

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or ***NAD83*** longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 DCA Structure estimated accuracy-4.7'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12914829	-98.49118229
NW	38.14379717	-98.49118229
NE	38.14364412	-98.47294729
SE	38.12920931	-98.47270338
Degrees Longitude per Foot		3.47660820E-06
Degrees Latitude per Foot		2.74602943E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	4425	-4643
NW	-909	-4643
NE	-854	602
SE	4403	672

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.12913500	-98.49082900
NW	38.14378400	-98.49082900
NE	38.14363100	-98.47259500
SE	38.12919600	-98.47235100
Degrees Longitude per Foot		3.47660757E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	4430	-4541
NW	-905	-4541
NE	-849	703
SE	4408	773

INPUTS	
Target Section Definition	
Section	12
Township	22
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.47376
Target Latitude	38.15114

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or ***NAD83*** longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 DCA Meter estimated accuracy-5.6'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.14379717	-98.49118229
NW	38.15807910	-98.49112110
NE	38.15813995	-98.47291728
SE	38.14364412	-98.47294729
Degrees Longitude per Foot		3.47729466E-06
Degrees Latitude per Foot		2.74602101E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	2674	-5010
NW	-2527	-4993
NE	-2549	242
SE	2730	234

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.14378400	-98.49082900
NW	38.15806600	-98.49076800
NE	38.15812700	-98.47256500
SE	38.14363100	-98.47259500
Degrees Longitude per Foot		3.47729404E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	2679	-4909
NW	-2522	-4891
NE	-2544	344
SE	2735	335

INPUTS	
Target Section Definition	
Section	35
Township	21
Range	11
Range Direction	w
Target Point Coordinates (*NAD27* or *NAD83*)	
Target Longitude	-98.4948
Target Latitude	38.1811

Load Data and Compute

Instructions

1. Enter values for section, township, range and range direction.
2. Enter ***NAD27*** or *NAD83* longitude and latitude of target point.
3. Click "Load Data and Compute" button.
4. Use feet distances corresponding to datum of target point.

Water Right, File No. 7,571 RCA Structure estimated accuracy-9.9'

Loaded Section Data From LEOBASE using *NAD83*

Corner	Corner Latitudes	Corner Longitudes
SW	38.17269697	-98.50955492
NW	38.18722281	-98.50952474
NE	38.18723790	-98.49101499
SE	38.17272698	-98.49109109
Degrees Longitude per Foot		3.47867507E-06
Degrees Latitude per Foot		2.74600666E-06

Target Point Distances from Corners using NAD83

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	3060	-4242
NW	-2230	-4233
NE	-2235	1088
SE	3049	1066

Loaded Section Data From LEOBASE using *NAD27*

Corner	Corner Latitudes	Corner Longitudes
SW	38.17268400	-98.50920100
NW	38.18721000	-98.50917100
NE	38.18722500	-98.49066200
SE	38.17271400	-98.49073800
Degrees Longitude per Foot		3.47867446E-06
Degrees Latitude per Foot		2.74598553E-06

Target Point Distances from Corners using NAD27

Corner	Feet North(+)/South(-)	Feet East(-)/West(+)
SW	3065	-4140
NW	-2225	-4131
NE	-2231	1190
SE	3054	1168

handout from Quivira during 5/21/14 meter investigation showing wetland plants grown during spring + discussion on need to "dry down" @ certain times to promote growth

Conant, Cameron

From: Conant, Cameron
Sent: Friday, May 23, 2014 9:10 AM
To: Brent Waters (brent_waters@fws.gov)
Cc: Oldham, Mike (mike_oldham@fws.gov); Rachel Laubhan (rachel_laubhan@fws.gov); Lanterman, Jeff
Subject: Quivira National Wildlife Refuge-meter tour

Hello Brent, we missed having you on the tour of the refuge metering sites earlier in the week but we still had a really good tour and discussions.

We were able to get a lot of meter information, pictures, and GPS coordinates at structure locations and meter sites that will make up the majority of the compliance check write-up. One meter was installed during our investigation and Mike located two in the shop. We still need some additional information on the four meters that were not installed and not found in the shop.

I have the meter information and pictures of the following meters: A1, 24C, C1

I need the meter information for the meters located at: A3, 24D, DCA, RCA

Could you please send a picture of the blue box with the structure name written on it and a picture of the back of the blue box so I can get the serial numbers for the meters installed at A3, 24D, DCA, and RCA.

At this point I can't think of any additional information I need to complete the compliance check write-up. If something does come up and we need more information or clarification, I'll be sure to get in touch with you.

Thanks,

Cameron Conant, Assistant Water Commissioner
Kansas Department of Agriculture
Division of Water Resources
Stafford Field Office
(620)234-5311
agriculture.ks.gov

Conant, Cameron

From: Conant, Cameron
Sent: Monday, May 12, 2014 10:39 AM
To: 'Oldham, Mike'; Lanterman, Jeff; Feril, Orrin; Bagley, Jim
Cc: Rachel Laubhan; Brent Waters; Meg Estep; Carrie Cordova; Peter Striffler; Bill Waln; David McCauley
Subject: RE: Quivira site visit for Water planning/measure - DWR and GMD5

Thanks Mike,

We'll want to look at each meter location and obtain the meter information from each installed meter (model, serial number, ect). We'll GPS the diversion points and the meter locations and take pictures of each installation.

We can also look at and discuss the options for 20B.

We plan to submit the completed compliance checks to our Technical Services section since these meters are not on the approved meter list and will require a waiver from the Chief Engineer.

Let us know if you have any questions before the meeting.

Thanks,

Cameron Conant, Assistant Water Commissioner
Kansas Department of Agriculture
Division of Water Resources
Stafford Field Office
(620)234-5311
agriculture.ks.gov

From: Oldham, Mike [mailto:mike_oldham@fws.gov]
Sent: Monday, May 12, 2014 10:01 AM
To: Conant, Cameron; Lanterman, Jeff; Feril, Orrin
Cc: Rachel Laubhan; Brent Waters; Meg Estep; Carrie Cordova; Peter Striffler; Bill Waln; David McCauley
Subject: Quivira site visit for Water planning/measure - DWR and GMD5

Cameron,

It looks like Wednesday, May 21 would work fine with our schedule as well. Let's plan for 1:00pm and see how long it takes to get and look at everything you want to.

Orrin - Hopefully this is something you can schedule in.

Thanks,

Mike Oldham
Refuge Manager
Quivira National Wildlife Refuge
1434 NE 80th Street
Stafford, KS 67578

CRC

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

RE: File No. 7571

MAR 04 2014

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

Dear Mr. Barfield:

Staff from Quivira National Wildlife Refuge (Refuge) and the U.S. Fish & Wildlife Service Region 6 Division of Water Resources (Service) recently attended the monthly board meeting for Big Bend Groundwater Management District No. 5 (GMD#5). At the request of the Service, they met with Jeff Lanterman and yourself afterwards to discuss the ongoing impairment investigation and impacts to the Refuge's senior surface Water Right, File No. 7571.

It appears that the investigation and report generation may take a considerable amount of time to complete. Kansas statutes do not address a specific time period that the Chief Engineer has to complete the investigation and report. The Service recognizes that your agency may be dealing with other water right or resource issues, however, the Service raised concerns as early as 1971 about potential impairment to our senior water right, and they have not been addressed to date. At the meeting, you requested that the Service answer questions contained in your October 21, 2013, letter regarding impairment. The Service indicated that much of the information you were seeking was contained in the 1998 Burns and McDonnell study, Quivira National Wildlife Refuge Water Resource Study. You indicated that you have not reviewed the report and the Service came away with the impression that your office has committed little focus to the impairment investigation. You suggested that we could provide you with the location of the information in the report that we believe provides information regarding your questions. The Service feels very strongly that answers to these questions have been provided numerous times over the past 25 years, both in letters and in reports paid for using Service resources. If the Service agrees to spend time and resources to review and mark up the Burns and McDonnell report, we expect you to make a commitment to a definite time period to complete the impairment investigation and report.

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MAR 06 2014
Stafford Field Office
Division of Water Resources

Both the Service and the water users continue try to plan for the future with great uncertainty concerning the availability of water. It is in the interest of all water users within the Rattlesnake

SCANNED

Creek Subbasin, the thousands of visitors to the Refuge, and the State of Kansas that progress be made toward reaching a long-term solution to protecting and sustaining water resources. During the February meeting of GMD#5, the Service first learned that GMD#5 submitted a proposal for a 5-year water management plan to your office. It was equally interesting to learn that WaterPACK is active again after years of being relatively inactive. The Service was proceeding under the impression that there is still a functioning Partnership. Under the terms of the Partnership, communication should be transparent and all partners should be kept informed concerning the activities of the other Partners.

The Service has been an active and patient partner as attempts were made to implement the programs identified in the 12-year Rattlesnake Creek Subbasin Management Plan. The 12-year review conducted by your office concluded that water reduction targets were not met, groundwater use has increased, groundwater levels continue to decline, the target flow for January for the Rattlesnake Creek at the USGS Zenith gage is not being met, and junior irrigators continue to pump. The Chief Engineer's office was a signatory to the Plan, as well as GMD#5 and WaterPACK. The Plan was not developed solely to address the impairment of the Refuge's water right, and the water use reductions identified were meant to address other issues such as the high decline areas. Section VIII. Alternative Action Management Strategies states: "If, after the 12-year time line, the goals have not been achieved, then sufficient reductions in water rights would be imposed to achieve the goals. Reductions in appropriations will be calculated by dividing the remaining amount of water use needed to reach the goal by 72%." This section goes on to describe the goals and present alternatives to put into effect if these reductions do not result in meeting these goals, including the possible establishment of an Intensive Groundwater Use Control Area. It has now been over 13 years since the Partners, including your office, signed this agreement. We respectfully request that the groundwater use reductions agreed to by all of the Partners be achieved now. The impairment investigation being conducted by your office can continue concurrently.

Enclosed are copies of Kansas Geological Survey Open-File Reports 92-6 and 92-37 that may assist you in the impairment investigation. These are examples of studies that were funded by the Service. We also strongly encourage you to schedule a visit to the Refuge to help you better understand how the Refuge operates and manages its water resources to support wildlife and its associated habitat for current and hopefully future generations.

If you have any questions, please contact me at meg_estep@fws.gov or call (303) 236-4491.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

Enclosures

Enclosures

cc: Project Leader, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Big Bend Groundwater Management District #5
WaterPACK

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Year 2013
Monthly Record of Water Usage - Rattlesnake Creek Diversions on Quivira National Wildlife Refuge
Acre-Feet of Water Diverted

	Little Salt Marsh			Darrynane						Rattle-snake		
	A-1	A-3	C-1	DC-A	24A	24B	24C	24D	20B-1	RCA	Total	Cum Total
Jan	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	88.7	49.68	0	0	0	0	0	0	0	138.38	138.38
Apr	0	42.2	302.94	0	0	0	0	0	0	0	345.14	483.52
May	61	0	289.2	0	0	0	13.2	0	0	0	363.4	708.54
Jun	62.37	0	131.86	169	0	0	0	0	0	0	363.23	1210.15
Jul	42.7	0	98.45	121	0	0	0	0	0	0	262.15	1472.3
Aug	138	0	193.05	141.58	0	0	0	0	0	0	472.63	1944.93
Sept	64	69.2	21.3	0	0	0	63.8	0	0	0	218.3	2163.23
Oct	0	0	212.6	0	0	0	0	0	0	0	212.6	430.9
Nov	0	0	191.07	0	0	0	0	0	0	0	191.07	403.67
Dec	0	0	145	0	0	0	0	0	0	0	145	**336.07**
Total	368.07	200.1	1635.15	431.58	0	0	77	0	0	0	**2711.9**	

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File # 75 ;

CC

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

MAR 04 2014

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

Dear Mr. Barfield:

Staff from Quivira National Wildlife Refuge (Refuge) and the U.S. Fish & Wildlife Service Region 6 Division of Water Resources (Service) recently attended the monthly board meeting for Big Bend Groundwater Management District No. 5 (GMD#5). At the request of the Service, they met with Jeff Lanterman and yourself afterwards to discuss the ongoing impairment investigation and impacts to the Refuge's senior surface Water Right, File No. 7571.

It appears that the investigation and report generation may take a considerable amount of time to complete. Kansas statutes do not address a specific time period that the Chief Engineer has to complete the investigation and report. The Service recognizes that your agency may be dealing with other water right or resource issues, however, the Service raised concerns as early as 1971 about potential impairment to our senior water right, and they have not been addressed to date. At the meeting, you requested that the Service answer questions contained in your October 21, 2013, letter regarding impairment. The Service indicated that much of the information you were seeking was contained in the 1998 Burns and McDonnell study, Quivira National Wildlife Refuge Water Resource Study. You indicated that you have not reviewed the report and the Service came away with the impression that your office has committed little focus to the impairment investigation. You suggested that we could provide you with the location of the information in the report that we believe provides information regarding your questions. The Service feels very strongly that answers to these questions have been provided numerous times over the past 25 years, both in letters and in reports paid for using Service resources. If the Service agrees to spend time and resources to review and mark up the Burns and McDonnell report, we expect you to make a commitment to a definite time period to complete the impairment investigation and report.

Both the Service and the water users continue try to plan for the future with great uncertainty concerning the availability of water. It is in the interest of all water users within the Rattlesnake

RECEIVED
MAR 10 2014
Stafford Field Office
Division of Water Resources

Creek Subbasin, the thousands of visitors to the Refuge, and the State of Kansas that progress be made toward reaching a long-term solution to protecting and sustaining water resources. During the February meeting of GMD#5, the Service first learned that GMD#5 submitted a proposal for a 5-year water management plan to your office. It was equally interesting to learn that WaterPACK is active again after years of being relatively inactive. The Service was proceeding under the impression that there is still a functioning Partnership. Under the terms of the Partnership, communication should be transparent and all partners should be kept informed concerning the activities of the other Partners.

The Service has been an active and patient partner as attempts were made to implement the programs identified in the 12-year Rattlesnake Creek Subbasin Management Plan. The 12-year review conducted by your office concluded that water reduction targets were not met, groundwater use has increased, groundwater levels continue to decline, the target flow for January for the Rattlesnake Creek at the USGS Zenith gage is not being met, and junior irrigators continue to pump. The Chief Engineer's office was a signatory to the Plan, as well as GMD#5 and WaterPACK. The Plan was not developed solely to address the impairment of the Refuge's water right, and the water use reductions identified were meant to address other issues such as the high decline areas. Section VIII. Alternative Action Management Strategies states: "If, after the 12-year time line, the goals have not been achieved, then sufficient reductions in water rights would be imposed to achieve the goals. Reductions in appropriations will be calculated by dividing the remaining amount of water use needed to reach the goal by 72%." This section goes on to describe the goals and present alternatives to put into effect if these reductions do not result in meeting these goals, including the possible establishment of an Intensive Groundwater Use Control Area. It has now been over 13 years since the Partners, including your office, signed this agreement. We respectfully request that the groundwater use reductions agreed to by all of the Partners be achieved now. The impairment investigation being conducted by your office can continue concurrently.

Enclosed are copies of Kansas Geological Survey Open-File Reports 92-6 and 92-37 that may assist you in the impairment investigation. These are examples of studies that were funded by the Service. We also strongly encourage you to schedule a visit to the Refuge to help you better understand how the Refuge operates and manages its water resources to support wildlife and its associated habitat for current and hopefully future generations.

If you have any questions, please contact me at meg_estep@fws.gov or call (303) 236-4491.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

Enclosures

Enclosures

cc: Project Leader, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Big Bend Groundwater Management District #5
WaterPACK

CRC

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

RE: File No 7571

MAR 04 2014

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

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RECEIVED
MAR 06 2014
Stafford Field Office
Division of Water Resources

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If you have any questions, please contact me at meg_estep@fws.gov or call (303) 236-4491.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

Enclosures

Enclosures

cc: Project Leader, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Big Bend Groundwater Management District #5
WaterPACK

Table 4: Summary of Progress

Groundwater Use vs. Program Water Use Goals (acre-feet)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	1987-1996 Average
Groundwater Unit 10-Yr Rolling Avg. Water Use	90,932	95,462	100,109	97,906	98,272	102,099	103,653	102,085	101,635	100,750	102,447	
Groundwater Unit Actual Water Use	115,445	117,220	112,620	88,854	92,292	107,838	85,448	93,765	91,162	101,851	132,418	101,476
*Goal	84,996	84,996	84,996	84,996	84,996	84,996	84,996	84,996	84,996	84,996	84,996	
Stream Corridor 10-YR Rolling Avg. Water Use	29,831	31,163	32,515	31,112	30,803	31,858	32,004	31,665	31,430	31,345	31,987	
Stream Corridor Actual Water Use	37,542	36,455	37,098	26,096	29,294	34,411	23,536	28,572	27,354	33,094	43,957	33,204
Goal	31,876	31,876	31,876	31,876	30,548	30,548	30,548	30,548	29,284	29,284	29,284	
Basinwide 10-YR Rolling Avg. Water Use	48,931	50,848	52,744	51,734	51,683	53,424	54,173	53,532	53,388	53,736	54,985	
"Basinwide" Actual Water Use	61,681	59,140	59,377	49,108	48,100	57,982	44,623	50,138	49,339	57,870	74,175	50,709
Goal	46,906	46,906	46,906	46,906	46,906	46,906	46,906	46,906	46,906	46,906	46,906	
Sum of All Rolling Avg. Water Use	169,649	177,405	185,283	180,668	180,641	187,265	189,713	187,165	186,318	185,696	188,728	
Goal	163,778	163,778	163,778	163,778	162,450	162,450	162,450	162,450	161,186	161,186	161,186	

*Water use goals were established in 2000 with the original management program for priority areas and all progress is evaluated based on the 10-year rolling averages (Goal).

RECEIVED
Water Resources

FEB 11

FWS - Region 6
(60189)

2013
WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

IMPORTANT

COMPLETE AND RETURN BY MARCH 1, 2014

CERTIFIED MAIL RECOMMENDED

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Ending Water Meter Reading	Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Depth to Water	Date
.	7571-00 3100N 1150W 35-21S-11W	1	3 0								
	RCA										
.	7571-00 4450N 1000W 13-22S-11W	1	A 508.6+		→						
	Darrynane										
.	7571-00 1250N 3850W 25-22S-11W	1	A 2203.3+		→						
	Little Salt Marsh										
	860841										
	Total		2711.9+								

+ - Acre Feet of Surface Water diverted

WATER RESOURCES
RECEIVED
FEB 14 2014
KS DEPT OF AGRICULTURE

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown. All dates are for the previous calendar year.

March 1					July 1					November 1				
Empty	¼	½	¾	(Full)	Empty	(¼)	½	¾	Full	Empty	¼	(½)	¾	Full

Date: 1/29/14 Telephone: (620) 486-2393

13 11631 18302 1 1 - REC Staff SF
Office Use FO CO GMD

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

Mike Oldham, Refuge Manager
Name (Printed or Typed)

Mike M. Oldham
Name (Signature)

_____ Owner _____ Tenant X Agent

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

APR 0 8 2013

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

Dear Mr. Barfield:

The U.S. Fish and Wildlife Service (Service) owns and manages the Quivira National Wildlife Refuge (Refuge). The Refuge holds Water Right No. 7571, priority date August 15, 1957, at a combined diversion rate not to exceed 300 cubic feet per second and a quantity not to exceed 14,632 acre-feet per calendar year for recreational use. Based on available studies and the results of the Rattlesnake Creek Subbasin Management Plan, the Service believes that our water right is impaired by junior well use. We hereby request that your office commence an impairment investigation.

The Refuge is important to natural resource conservation not only regionally and nationally, but globally as well. The Refuge is designated as a Western Hemisphere Shorebird Network site, a Wetland of International Importance (RAMSAR site), an Important Bird Area (American Bird Conservancy), and is critical habitat for federally endangered whooping cranes. The federally endangered piping plover and interior least tern also use the refuge and the State has designated refuge lands (waters) as critical habitat for the western snowy plover and Arkansas darter, both of which are state listed as threatened species.

Surface water originating from Rattlesnake Creek and groundwater discharge from the shallow, saline Precambrian bedrock are critical to sustaining Refuge wetlands that attract and support the vast variety of associated migratory and resident bird species. Without both of these components, groundwater upwelling or sufficient streamflow, the ecology of the entire system will change. The Refuge and its values will not be sustained unless the aquifer system is brought into balance.

Like a farmer, the Refuge needs water during critical time periods. The values of wetlands on refuge lands for migratory birds can only be sustained by providing flooded conditions at proper times during the year, particularly during spring and fall migration. Simply because 14,632 ac-ft

is available on an annual basis in most years does not meet Refuge habitat management needs. Water is typically unavailable in the late summer and early fall when the Refuge is trying to flood migration habitat for birds. Irrigation pumping is usually greatest during this time as well. Water shortages typically occur during the months of July, August and September, when as little as a few hundred acre-feet may be available.

The Service has been patient as the 12-year Rattlesnake Creek Subbasin Management Plan was allowed to run its course. The Service was a supportive and sincere partner in the effort to utilize an incentive-based plan to reduce groundwater use. At the end of the 12 years, groundwater use has increased, groundwater levels have not improved, and streamflow goals have not been met. Streamflow continues to decline, and junior irrigators are allowed to continue to pump. We respectfully request that you conduct your investigation and take whatever administrative actions are necessary to protect the Service's senior water right and, we believe, the ability of the Rattlesnake Creek watershed to support all current land uses over the long term.

Please contact me at meg_estep@fws.gov or a call if you have any questions at (303) 236-4491.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

cc: Refuge Manager, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Groundwater Management District #5
Water Pack

Conant, Cameron

From: Lanterman, Jeff
Sent: Monday, March 25, 2013 3:17 PM
To: Letourneau, Lane; Conant, Cameron; Barfield, David; Beightel, Chris
Cc: Bagley, Jim
Subject: Meg Estep USFW

Just got off the phone with Meg.

1. They are having wildlife problems with their Doppler meters. Beavers have chewed up the cables on a few of the meters and it is costing $900 to get each one repaired. They are getting them repaired but in the meantime they are metering with the Clawson Rule Weir stick. (The old way). I told them that is the best they could do. We did discuss the metering at the refuge and that they are still under NONC for metering until they get the plan finalized and submitted to Jim. She said they would try to get that all finished up and in compliance. They plan to run the lines through conduit in the future.

2. She fielded the Wichita Eagle reporter phone call for USFW. She kept it pretty simple and told him that they were not suing but were working administratively through us. I told her we had the same call.

3. They will be having CCP public hearings and wanted me to know about them. It is a Comprehensive Conservation Plan with regard to how the refuge will operate for 15 years. Water is a part of the CCP but it addresses the overall operation of the refuge. I will probably attend these hearings just to hear what is up. She said these are mandated by law.

4. She is going to try to do some damage control regarding the impairment claim (She didn't really elaborate but said to watch for it) She does think it is finally time for an answer.

She is going to follow up with an email regarding some of these things. It would be good to finalize the metering and get that in compliance before we move much further.

Jeff

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

MAR 05 2013

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

Dear Mr. Barfield:

As you are aware, the U.S. Fish and Wildlife Service (Service) holds Water Right No. 7571, priority date August 15, 1957, at a combined diversion rate not to exceed 300 cubic feet per second and a quantity not to exceed 14,632 acre-feet per calendar year for recreational use for the Quivira National Wildlife Refuge (Refuge). Some of the last points of diversion from Rattlesnake Creek occur on the Refuge, and the Service has not been receiving water within our right due to declining flows that limit the volume of water reaching the Refuge. We are concerned about future regulation of water use in the watershed as it may affect our ability to reliably achieve the legislative purpose of the Refuge, which includes conservation of wetland-dependent migratory birds, including endangered species such as the whooping crane.

The Service has expressed this concern in various manners during the past 4 decades. As early as 1971, in a letter to the Stafford Water Commissioner, the Service expressed concern over unauthorized appropriators and junior appropriators upstream of the Refuge taking water that affected the amount of streamflow from Rattlesnake Creek available to meet the needs of the Refuge. We requested comments and assistance from the Stafford Water Commissioner. He met with the Refuge Manager to try to determine whether these users held vested water rights

In a 1986 letter to the Chief Engineer, the Service reported a decline in the amount of water discharged by Rattlesnake Creek into the Refuge. We expressed concern about unauthorized pumping or diversion of surface water upstream of the Refuge during the late summer and early fall, when streamflow is naturally at its lowest. We also expressed concern about the dramatic increase in groundwater development and use in the Rattlesnake Creek subbasin, including the expansion of wheel-line and center pivot systems. We requested that the Division of Water Resources investigate the problem.

The state's response was that the Service needed to file a formal complaint with the Stafford Office and that it needed to be in writing. The response also stated that there was insufficient understanding of the relationship between surface and groundwater, so it was not possible to administer individual wells to prevent interference. For this reason, negotiation, combined with research and monitoring, were decided to be the most productive actions to address the concerns and maintain partnerships at that time.

In 1993, the Service used funds identified for water rights identification and protection to contract with Kansas Geological Survey to evaluate the effect of groundwater pumping on streamflow in Rattlesnake Creek. This study concluded that the wells depleted streamflow by at least 8,456 acre-feet in 1987. Based partly on this information, the Service again expressed concern about the declining streamflow in Rattlesnake Creek. The Service continually asserted that the Refuge water right was being negatively impacted by junior groundwater during negotiations to perfect Water Right No. 7571 (letters dated November 12, 1993; August 23, 1994; January 9, 1995).

In a letter dated February 7, 1996, the Service again expressed concern that water available to the refuge had exhibited a steady decline since 1962, and that junior water users were negatively impacting the Refuge water right by reducing streamflow. We also pointed out that in 1984 the Kansas Water Office acknowledged the extensive groundwater appropriations in the Big Bend Prairie Aquifer and their contribution to extreme low flows in Rattlesnake Creek.

Starting in 1993, with the formation of the Quivira Partnership, the Service has tried to work cooperatively with the water users and Big Bend Groundwater Management District #5 (GMD) to reach a cooperative solution to resolve the issue of stream depletion due to groundwater pumping, as well as address areas of high groundwater decline within the subbasin. The Service agreed to be a partner in the Rattlesnake Creek Subbasin Management Plan (Plan), a 12-year plan that was supposed to utilize several different programs to meet groundwater use reduction goals. All the partners, including the Service, signed this agreement on November 30, 1999, and the Plan was approved by the Chief Engineer in June of 2000. The progress of the Plan was reviewed every four years by the Kansas Division of Water Resources.

The first four-year review, presented on January 31, 2005 at a Partnership meeting indicated that very little progress toward water use reduction goals was being achieved. The second four-year review dated December 1, 2009 was never signed by GMD or the Water Protection Association of Central Kansas. It showed very little progress in achieving the Plan goals, and groundwater levels continued to decline. At this point, the Service requested the Chief Engineer consider whether the implementation of an Intensive Groundwater Use Control Area (IGUCA) would be necessary to meet groundwater use reduction goals if more progress was not made over the remaining four years. The Service did not receive a response.

The final four-year review draft was released on November 15, 2012 and has yet to be approved or signed by the Partners. However, for a variety of reasons, very few of the

programs identified in the Plan have been implemented, with only increased enforcement and compliance actually being implemented on a broad scale. As a result, groundwater use in the sub-basin has increased, groundwater levels are not recovering or are continuing to decline despite several years of above average precipitation, and streamflow targets are not being met.

Based on correspondence from GMD (January 3, 2013), it is apparent that the original intent of reducing groundwater pumping is no longer their focus, and they are looking to maintain the status quo by artificially supplying the Refuge with water through augmentation wells. The Service has repeatedly stated that we do not find augmentation of streamflow through additional development of groundwater to be an acceptable solution to this problem. The problem with overappropriation of groundwater will not go away just because additional water is pumped into Rattlesnake Creek by groundwater wells. GMD#5 asked if water quality was the only issue we had with the idea of augmenting streamflow with groundwater. Water quality is only one of the issues we have with augmentation as a solution. The Service is, and must continue to be, concerned with the impacts to wildlife habitat beyond the borders of the Refuge, as well as the overall sustainability of the aquifer. The GMD and the State of Kansas need to look beyond the impacts to the Refuge, and evaluate the sustainability of existing groundwater development.

The Service has been a patient and sincere participant in the process of working together to conserve water resources in the watershed. Although the Service thought the other partners were sincere in their original commitment to meet the groundwater use reduction goals, this no longer appears to be the case. The Service has spent a considerable amount of time and resources trying to find resolution for the impacts to the Refuge's water right. Realistically, it will take another decade or more to develop an augmentation plan, and we are concerned about the source of funding to actually drill and operate augmentation wells. There are various other considerations regarding augmentation, such as potential impacts on the ecosystem as a result of long term changes in water quality. Again, we do not support augmentation as a long-term solution.

Last year's drought resulted in the complete drying of almost all Refuge wetlands and we believe the magnitude of this drying was exacerbated by groundwater pumping by junior users. This year the drought is predicted to be worse and, coupled with a relative new water law that allows the use of more water in drought years in the Rattlesnake Creek Watershed and elsewhere, the Service is concerned that aquifer depletion could be more severe than in the past. Concerns go beyond Refuge boundaries and impact ecosystems at state, national, and international scales. The Service generally supports other land uses and human economic concerns, but we have responsibilities to the public and future generations, and everyone involved needs to think about these larger landscape issues. Continuation of no significant action related to water resource conservation will also lead to increasingly adverse impacts to agricultural and other economic land uses that are water-dependent.

Based on these concerns that have remained unresolved despite repeated attempts to work in partnership with other water users in the watershed, the Service is respectfully requesting that the Chief Engineer evaluate and implement an administrative remedy, such as an Intensive Groundwater Use Control Area, to protect the senior water right of Quivira National Wildlife Refuge and restore the aquifer to a sustainable condition.

Please contact me at meg_estep@fws.gov, or give me a call if you have any questions at (303)236-4491.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

cc: Refuge Manager, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Groundwater Management District #5
Water Pack

2012
WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

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CERTIFIED MAIL

7001 0360 0003 9863 9506

ordinator
t of Agriculture
r Resources
cond Floor
66612-1283

COMPLETE AND RETURN BY MARCH 1, 2013

PART A: POINTS OF DIVI

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
. 7571-00 3100N 1150W 35-21S-11W 1 (RCA)		A	366.3*		→						
. 7571-00 4450N 1000W 13-22S-11W 1 (Darrynane)			1299.6*		→						
. 7571-00 1250N 3850W 25-22S-11W 1 (Little Salt Marsh)			582.5*		→						
Total			~~2248.5~~*								

* Acre feet Surface Water diverted

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown. All dates are for the previous calendar year.

	March 1					July 1					November 1			
	Empty	¼	½	(¾)	Full	Empty	(¼)	½	¾	Full	Empty	(¼)	½	¾	Full

Date: 1/18/13 Telephone: (620) 486-2393

12 18302 1 1 - REC Staff SF 76 340
Office Use FO CO GMD

Mike Oldham, Refuge Manager
Name (Printed or Typed)

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

WATER RESOURCES RECEIVED
FEB 13 2013
KS DEPT OF AGRICULTURE

Mike M. Oldham 2
Name (Signature)

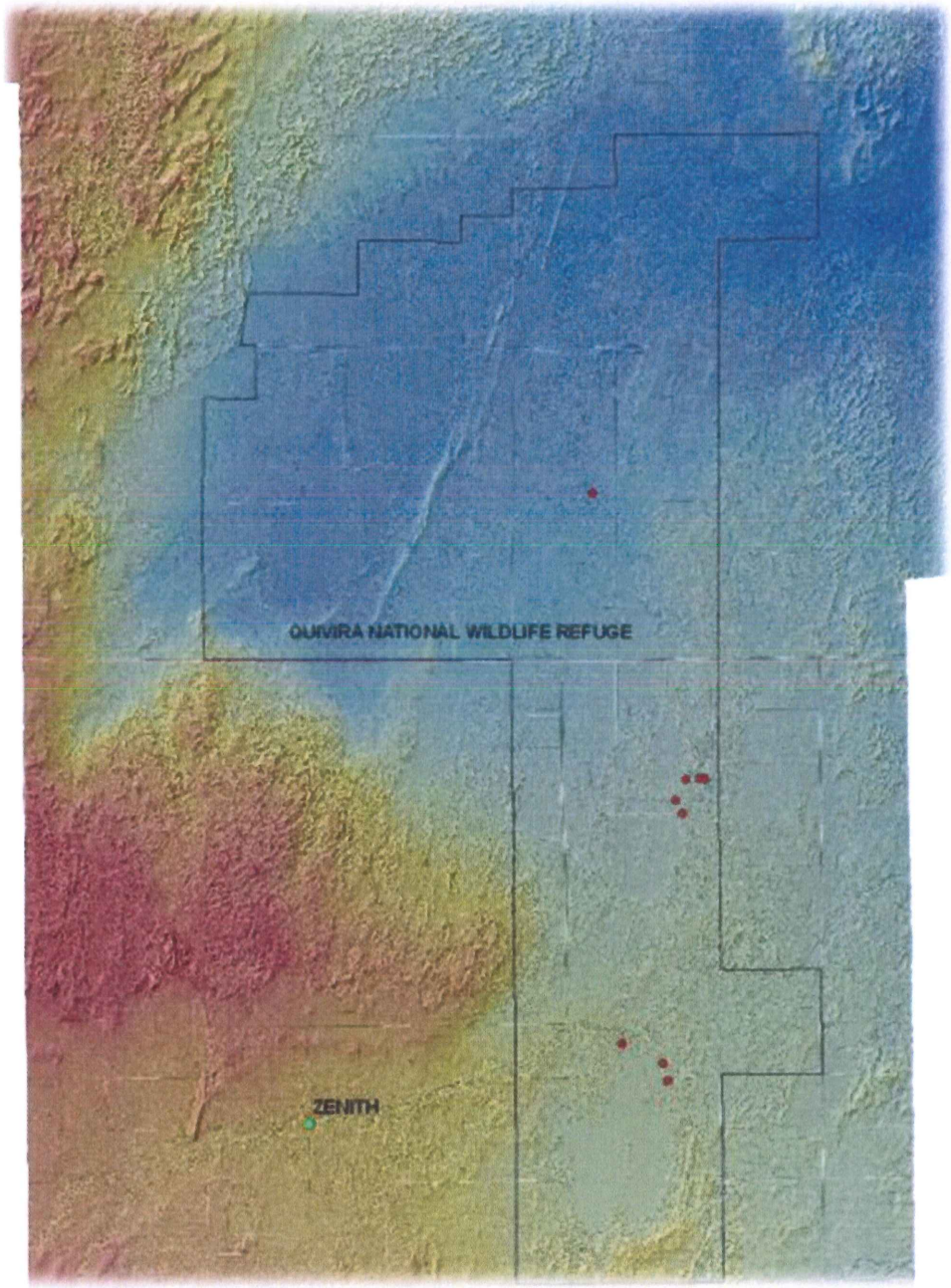
801112

_____ Owner _____ Tenant X Agent

DWR 1-513 (Revised 10/19/2010) RECREATIONAL WATER USE REPORT

USFWS FLOW MONITORING PLAN for RATTLESNAKE CREEK DIVERSIONS

Quivira National Wildlife Refuge



1: LIDAR Data Covering the Quivira National Wildlife Refuge, with PODs and Zenith

Scope and Objectives

The objective of this monitoring plan is to quantify surface water flows diverted from Rattlesnake Creek on the Quivira National Wildlife Refuge (Refuge) with the use of continuous monitoring flow meters. Flow meter locations were determined based on historic flow diversions, management practices, Water Right 7571, and equipment limitations. Flow meters were selected based on ease of operation, accuracy of data collection, and product durability. Data collected will enable time sequence examination of discharge, and will include a totalizing feature for reporting, as required by Kansas DWR. This plan is limited to water diversions from the Rattlesnake Creek channel or intermediate storage. No attempt is made to meter water flow between wetland management units on the Refuge or to measure water flow back into the Rattlesnake Creek channel for water budgeting purposes.

Background Information

Refuge boundaries encompass over 22,000 acres, with approximately 6470 acres of semi-permanent marshes, more seasonal wetlands, and managed impoundments. There are 17 canals, 24 dikes, and 108 water control structures being used to move water throughout the Refuge. For water use reporting on the Refuge, continuous monitoring flow meters will be installed at or near Points of Diversion (PODs) of surface water to provide a continuous record, and increase accountability and data transparency. Flow metering is required by the Kansas Chief Engineer (DWR) for all PODs of surface water. A Summary of Communication between the U.S. Fish and Wildlife Service and the State of Kansas, DWR regarding efforts to accurately report water use at the Refuge is attached as Appendix C.

The Refuge is supplied with water from Rattlesnake Creek under a senior surface water right. The water right is sufficient for the needs of the Refuge; however over-development of regional groundwater resources reduces the amount of surface water delivered to the Refuge by reducing baseflow in Rattlesnake Creek and its tributaries. The surface water and groundwater systems are hydrologically connected. Insufficient base-flow is especially detrimental to Refuge management during the dry periods (months and years) largely due to the combined factors:

- streamflow is periodically low due to seasonal variation in natural environmental conditions;
- groundwater pumping is often at its highest during dry periods;
- and seasonal water needs of the Refuge are critical in relatively dry periods to provide food and habitat requirements of wildlife.

Substantial reductions in groundwater levels were recorded in January 2012 by the DWR throughout western and south-central Kansas. GMD#5 groundwater levels changed from +0.63 feet in 2010 to –0.44 feet in 2011, and were averaging –2.95 feet in January 2012 (Kansas Geological Survey, 2012). These monitoring data indicate dramatic declines following slight increases between 1996 and 2011 (Basin Management Team, 2009).

USFWS Water Rights

The US Fish and Wildlife Service (Service) applied for the right to divert 22,200 AFY of surface water from Rattlesnake Creek soon after Refuge establishment on August 15, 1957. The Service filed a Notice of Proof of Completion of Works for Permit #7571 on July 15, 1982. Because the Refuge could not show that it had diverted 22,200 AFY of water during the highest use year, Kansas DWR certified a smaller amount. On April 9, 1996 DWR certified Permit #7571 at 14,632 AFY based on area-capacity estimates of refuge wetland areas and the recorded water use. On April 30, 1996 the Service recorded the permit with the Stafford County Register of Deeds.

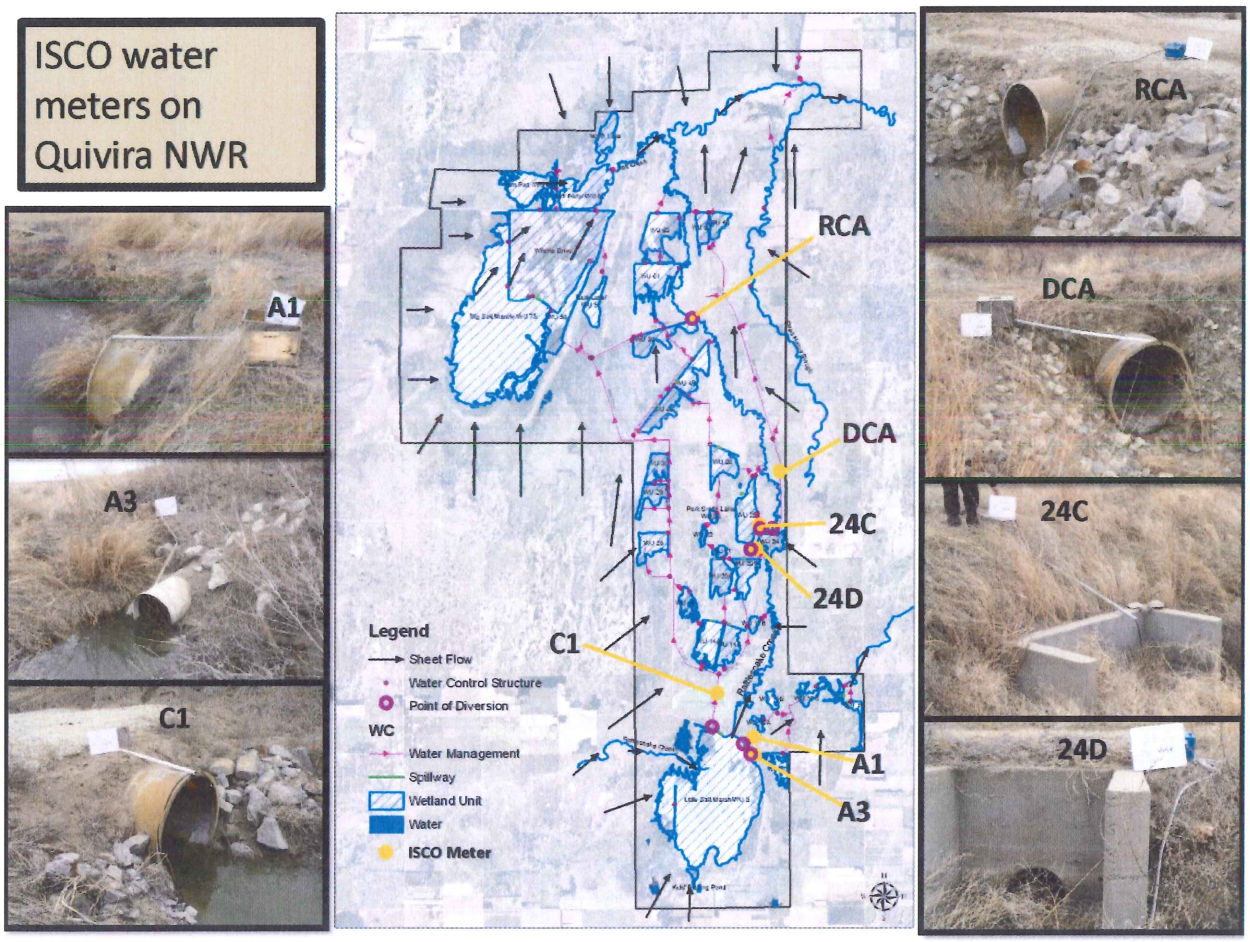
Water Rights for the Refuge: Number A 7571 00 (WIMAS Water Right Query, 2012).

Water Rights Quantities/Flows: 14,632 AFY @ 134,640 gallons/minute, or 300 cubic feet/second, (cfs).
Source of Water: Rattlesnake Creek.

Priority Date for A 7571 00: 8/15/1957

Points of Diversion for A 7571 00:
22S 11W 25 NCSW 1: Diversions from the Little Salt Marsh at A1, A3 and C1 structures
21S 11W 35 SWSENE 1: Diversion from Rattlesnake Creek at Darrynane, 24A, 24B, 24C, DCA
22S 11W 13 SWNENE 1: Diversion from Rattlesnake Creek at RCA

Place of Use:
Stafford County: the south 80 acres of SE¼ sec15: S½ of sec14; NE¼, SW¼, and SE¼ of sec21 and 29; all of sec13, 22, 28, 32, 33, 34, 35, 36 in T21SR11W; and all of section 1 through 5, 11 through 14, 23 through 26, and section 35 and 36 in T22SR11W; and all of sections 1 and 2 in T23SR11W; and Rice County Section 18 in T21SR10W; and Reno County Section 30 in T22SR10W.



2: ISCO Water Meters on Quivira NWR

Approach

The Service has successfully used Isco 2150 Flow Meters for flow measurements in round pipe, natural channel, and concrete culverts. The Isco 2150 Flow Meter uses continuous wave Doppler technology to measure mean velocity. The sensor transmits a continuous ultrasonic wave, and then measures the

frequency shift of returned echoes reflected by air bubbles or particles in the flow.

The Doppler beams are basically a shot-gun array (23 degree spread). Installation of the Isco meters in open channel conditions requires a calibration. Open channels, with flow wider than deep present additional challenges. Accurate measurement of flow in a round pipe uses internal factory calibrations, where the meter is calibrated according to the dimensions of the pipe to appropriately calculate discharge based on how full the pipe is (level) and how fast the water moves (velocity). These meters are installed only in round culvert pipes at the Refuge. Continuous flow-meters will provide a continuous record and increase accountability and data transparency.

Schedule

Several of the Refuge PODs from Rattlesnake Creek did not historically have round pipe for meter installation. Round culvert pipes are now installed in all canals, at or near the PODs. Isco flow meters are currently being used to measure all water diversions from Rattlesnake Creek.

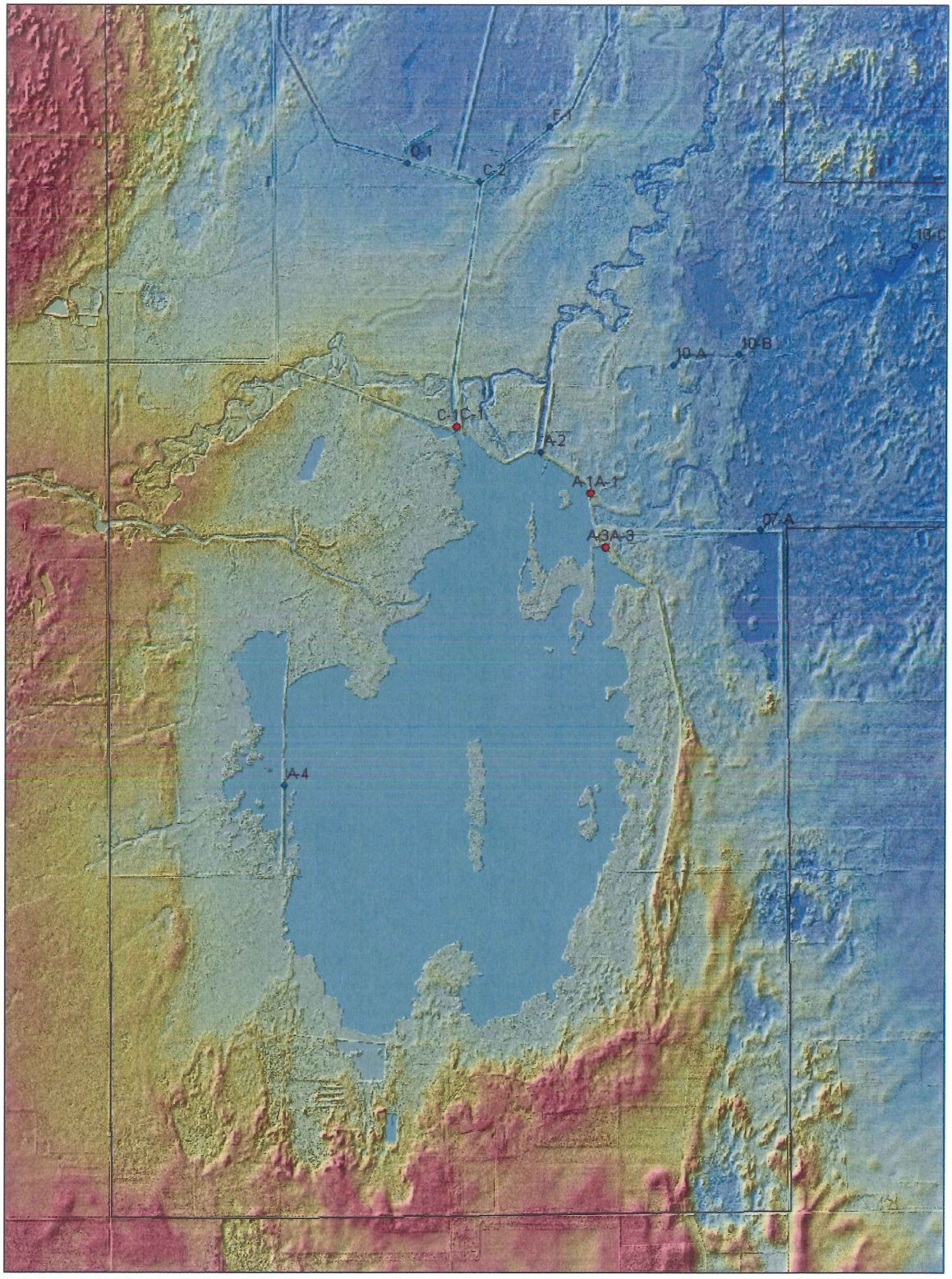
Equipment and Instrumentation

APPENDIX A lists the technical specifications for the Isco 2150 Flow Modules, used for continuous flow metering (TELEDYNE Isco, 2012).

Stations

Seven water control structures (WCS) at three PODs from the Rattlesnake Creek system into Refuge infrastructure are currently reported to the State. Structures for flow metering from the Little Salt Marsh are: WCS A1, WCS A3, and WCS C1. Diversions from Darrynane Lake Unit 24 are: WCS 24C, WCS 24D, and WCS DCA. Other water control structures on Unit 24 are either not being used (WCS 20B), or move water from the Darrynane Lake into the Rattlesnake Creek channel (WCS 24A and WCS 24B), and are not diversions. The final water control structure for flow metering is the WCS RCA structure, diverting water from the Rattlesnake Creek to the Rattlesnake Creek Canal, which moves water westward towards the Big Salt Marsh. The majority of Refuge water management relies on WCS C-1, WCS 24-C, and WCS RCA.

Little Salt Marsh



3: Little Salt Marsh, Quivira NWR.

WCS A1

Water control Structure WCS A1 diverts water out of Little Salt Marsh. Diversion WCS A1 is a three-bay concrete diversion structure modified for stoplogs. In order to capture all flow, the Isco 2150 Flow Meter is installed in a round 48 inch fiberglass culvert recently installed approximately 200 meters downstream of the bridge, at a position that ensures no flow bypasses the meter. Flow control is accomplished at the WCS A1 structure using stoplogs.

4: Downstream Apron at Water Control Structure A1.

WCS A3

Water control structure WCS A3 diverts water from the Little Salt Marsh into Management Units 7 and 10. WCS A3 is an 18 inch PVC culvert with a screwgate for flow control. The upstream side of the culvert is usually completely submerged in Little Salt Marsh. The downstream end empties into a small pool at the head of a ditch heading eastward. The Isco 2150 Flow Meter is currently installed into the downstream end of the 18 inch pipe and is collecting data during water diversions through WCS A3.

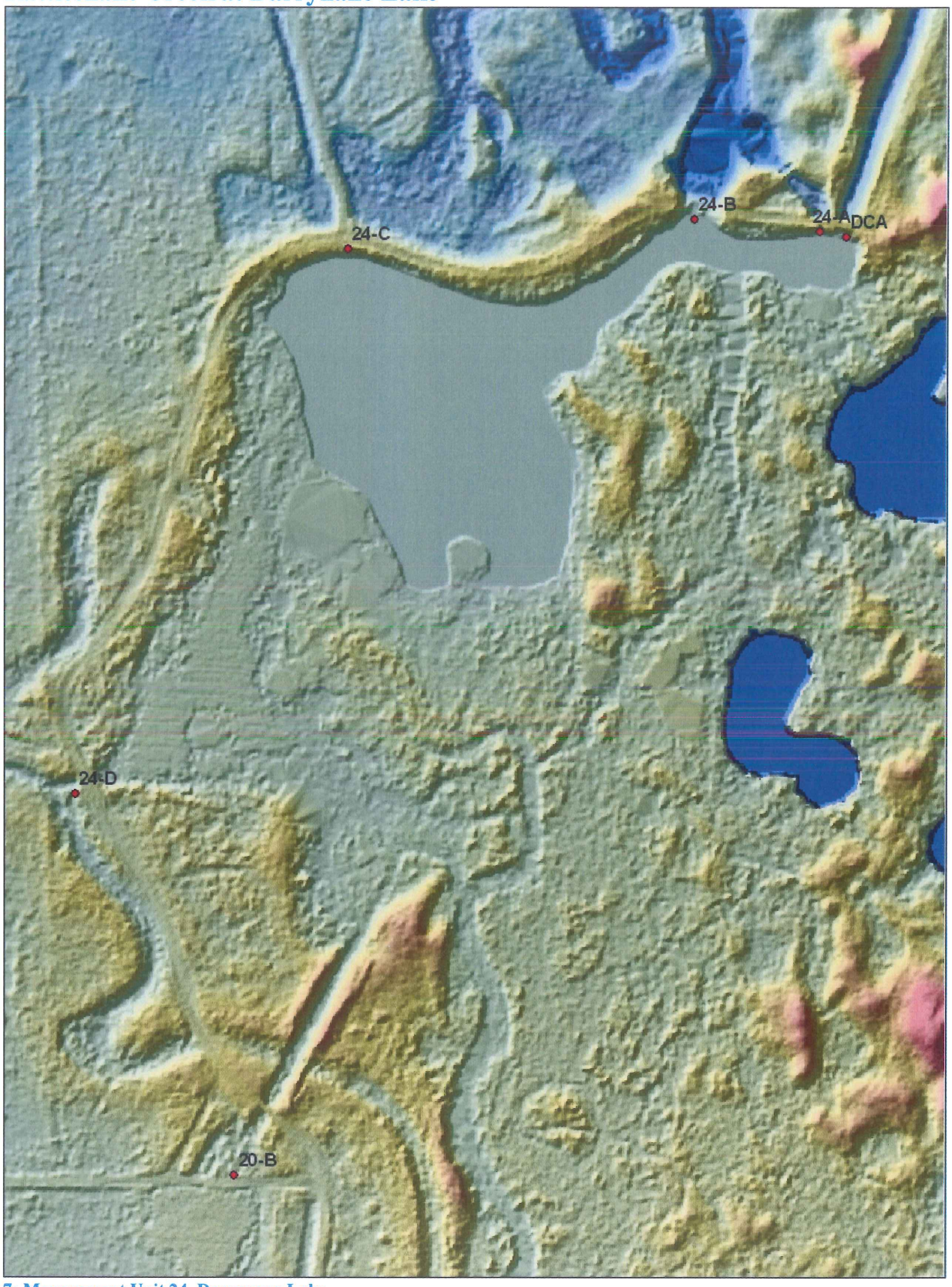
5: Downstream End of Water Control Structure A3.

WCS C1

WCS C1 diverts water from Little Salt Marsh into the C-Canal for distribution. The C-Canal is relied upon heavily by Refuge management. WCS C1 is a three-bay concrete diversion structure with a trapezoidal apron on the downstream side. A 48 inch round fiberglass culvert installed downstream of the concrete apron approximately 400 meters provides a conduit that captures all flow from the WCS C1 structure and provides a location for the Isco 2150 Flow Meter. Flow control is accomplished at the WCS C1 structure using stoplogs.

6: Downstream Apron at Water Control Structure C1.

Rattlesnake Creek at Darrynane Lake



7: Management Unit 24, Darrynane Lake.

WCS 24A and WCS 24B

WCS 24A is the Unit 24 overflow structure that puts water from Lake Darrynane back into Rattlesnake Creek. WCS 24B is a nine-bay stoplog structure/bridge that is the primary structure on Rattlesnake Creek channel in Unit 24. It allows water flow through Management Unit 24 into the Rattlesnake Creek channel. Since these structures do not divert water out of Rattlesnake Creek, they will not be metered by Isco 2150 Flow Meters. These structures have not been monitored historically and will not be monitored as part of this Flow Monitoring Plan; they are not diversion structures.

WCS 24C

WCS 24C is a single stoplog structure that diverts water out of Management Unit 24 and into Management Unit 25. The Isco 2150 Flow Meter is currently installed into the 18 inch PVC culvert, on the downstream side of the structure and is collecting flow data during diversion from Darrynane Lake.

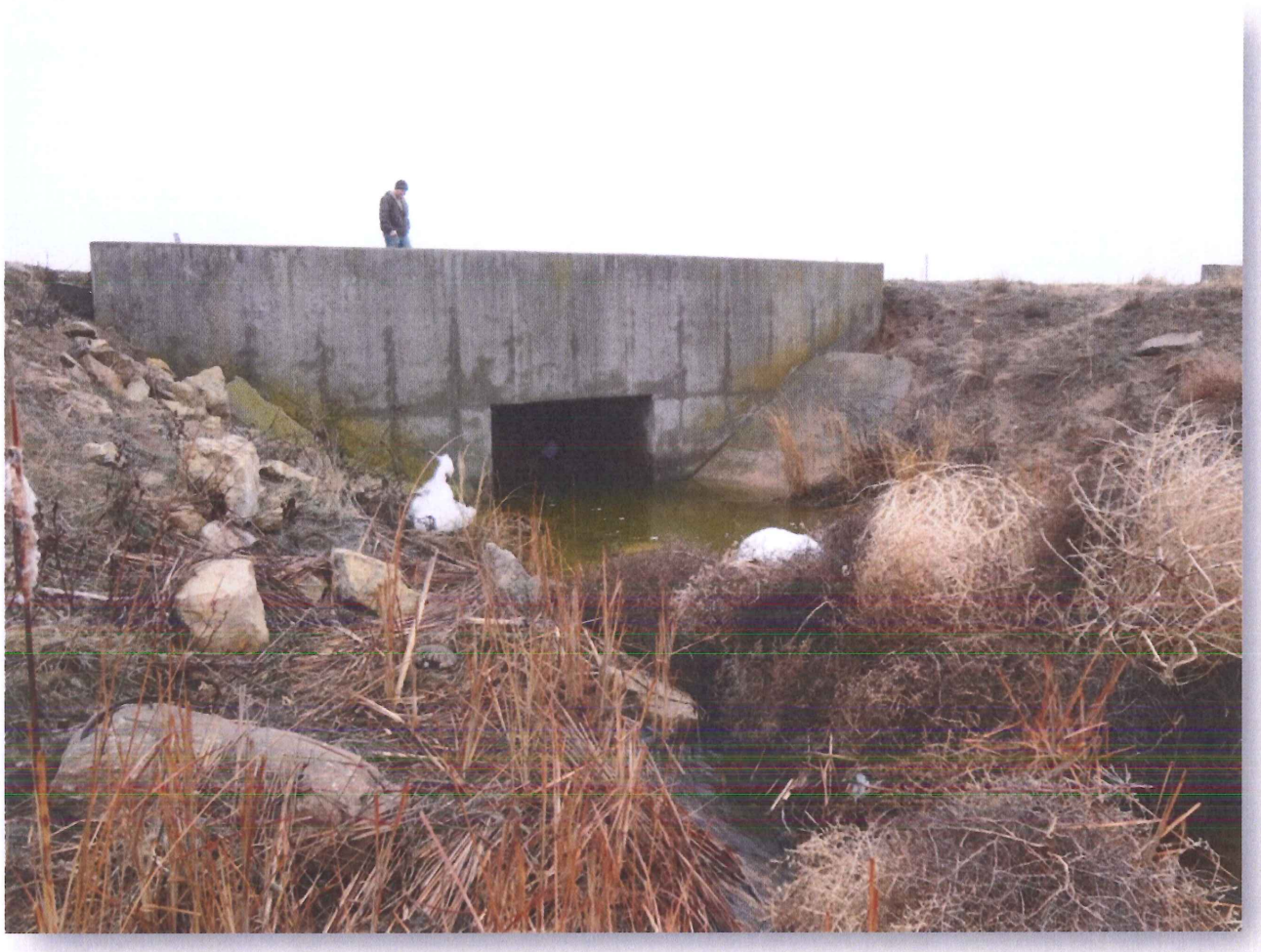
8: Downstream Culvert at Water Control Structure 24C.

WCS 24D

Water Control Structure WCS 24D moves water from Management Unit 24 to the west and into Management Unit 21. The Isco flow meter is placed in a 18 inch PVC culvert, located at the WCS 24D structure, and is collecting flow data during diversion.

WCS DCA

WCS DCA is a double stoplog structure that diverts water from Management Unit 24 into the Darrynane Canal. The Isco meter is placed in a 48" fiberglass culvert located in the Darrynane Canal approximately 1200 meters north of the WCS DCA water control structure.



9: Water Control Structure DCA.

WCS 20B

WCS 20B is located at the southern end of Management Unit 24 and is very rarely used to divert water out of Unit 24 to the south, into Management Unit 20. Water flow is also possible the other direction, from Unit 20 into Unit 24. The 20B structure is not used frequently and will not be metered with an Isco 2150 Flow Meter. If WCS 20B structure is ever used it will be monitored manually.

10: Rattlesnake Creek at WCS RCA.

WCS RCA

Water Control Structure WCS RCA is the final diversion out of Rattlesnake Creek. WCS RCA moves water from Rattlesnake Creek westward into the Rattlesnake Creek Canal toward the Big Salt Marsh. RCA has two concrete bays modified for stoplogs. In order to assure maximum flexibility in management options, all six stoplog structures will be preserved. The Isco 2150 Flow Meter is installed into a 48 inch round fiberglass culvert installed into the Rattlesnake Creek Canal 30 meters downstream of the WCS RCA structure.

11: Water Control Structure RCA.

Impacts

Impacts on data quality and completeness are possible in any long-term equipment installation. Equipment failure through vandalism, negligence, or environmental factors are possible, but can be mitigated through prudent equipment checks and visual inspections.

Vandalism

Intentional and non-intentional impacts from public access to the Isco Flow Meters are a concern. Though the meters will be located in areas not used by the general recreational Refuge visitor, the presence of new and interesting equipment at well-known structures may lure visitors to inspection. With the Isco Flow Module in water it is fairly well isolated from interference, but the cable connecting the Flow Module to the Blue-Box could be a tripping hazard for unwary canal hikers. The cable will be hidden or buried as much as possible to prevent accidental contact.

The Isco Blue-Box contains the power pack, datalogger, and command interface. The Blue-Box is highly visible and could present a challenging target for unsuccessful duck hunters or bored children with a pocketful of rocks. Care will be taken during Isco installation to hide or cover the Blue-Box as much as possible. The Blue-Boxes at all PODs are kept in small wooden boxes for camouflage and protection.

Negligence

Negligence to the Isco system can come from two sources: negligence to data collection and negligence during maintenance. Continuous data collection will be ensured frequently by Refuge staff. Though data on Isco Flow Meters is stored on non-volatile Flash Memory, data over-writing is possible. Data downloads will prevent data loss before over-writing becomes a problem. Battery voltage is recorded with each measurement and can be monitored and maintained before voltages drop below critical levels. A silica-gel desiccant will need periodic inspection. Staff will replace the desiccant when it becomes ineffective, as evidenced by color change.

Environmental Factors

The Isco system is very robust, but as with any equipment, is susceptible to lightning strikes, displacement during tornados or floods, and damage related to ice build-up or shift. To the extent possible, Refuge staff will prevent damage to the equipment and rectify damage as soon as possible.

Equipment maintenance will be necessary to minimize the occurrence of siltation around the flow meter, which otherwise prevents or alters data collection. A schedule for cleaning out silt and debris will be determined by initial observation during sustained flow diversion. Some meters will require more frequent attention than others. Care will be exercised during cleaning to prevent damage to the meter, the cable, and the Blue-Box. A silt-trap to capture silt before it gets to the meter has been successful. A hole is dug into the canal upstream of the culvert. Silt settles out of the water, reducing the silt-load through the measuring device. The silt trap needs to be cleaned, based on the amount of water diverted through the canal.

Wind can present problems in measurement. No flow or slow flow can be affected by wind and cause the meter to record velocity that is not representative of actual conditions. It is assumed that this wind effect will affect water velocities in both positive and negative directions, and the net-affect will be minimal.

Wildlife interference can affect data collection. Isco flow module cables seem to be attractive to beavers and rodents for chewing. Several cables have been destroyed. New cables contained in flexible metal conduit prevent chewing but are beginning to oxidize from the high salinity water. Cables protected by PVC conduit merely slow down the chewing. Attempts to rectify the problems caused by wildlife are only partially successful.

Reporting

Data generated from implementation of this plan will be contained on the Isco Blue-Box until downloaded onto a FWS Laptop computer. Data will be downloaded from the Isco Flow Meters at a pre-determined schedule, based on water diversion schedules, sampling frequency, and battery use. Data will be backed up to prevent loss or damage during storage, and will be reported to DWR as part of annual water use reports. Flow data will include a totalizing feature to simplify data viewing. Appendix B shows an example of Isco data.

Data Types

Data collected by the Isco 2150 consists of: level; velocity; flow rate; total flow; battery voltage; and temperature. Data storage interval will be 900 seconds (15 minutes). Additionally, the Isco will be programmed to collect diagnostics data, to aid in analyzing erratic data.

Data Processing

Data retrieval is by serial connection to PC at a communication speed of 38,400 bps. Proprietary FlowLink software is required for setup, data retrieval, editing, analysis, and reporting.

[end]

Sources

Basin Management Team. (2009). *Rattlesnake Creek Partnership, Second Four-Year Review of Management Program 2005-2008.* Topeka, KS: Kansas Department of Agriculture.

Kansas Geological Survey. (2012, February 7). *Groundwater Level Decline Continues Across western and Central Kansas.* Retrieved February 13, 2012, from Kansas Geological Survey: http://www.kgs.ku.edu/General/News/2012/2012groundwaterlevels.html

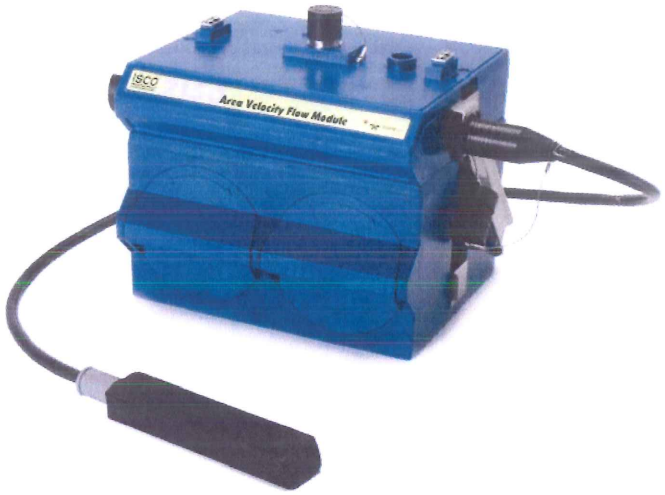
TELEDYNE Isco. (2012). *Teledyne isco- Products - 2150 Area Velocity module*. Retrieved March 05, 2012, from http://www.isco.com/products/products3.asp?PL=2021010

WIMAS Water Right Query. (2012, February 12). *WIMAS Query Results*. Retrieved February 12, 2012, from http://hercules.kgs.ku.edu/geohydro/wimas/query_results.cfm

Table of Figures

Isco Product Data

APPENDIX A: Spec Sheet for Isco Flow Modules (TELEDYNE Isco, 2012)



Isco 2150 Area Velocity Flow Module

The 2150 Flow Module uses continuous wave Doppler technology to measure mean velocity. The sensor transmits a continuous ultrasonic wave, then measures the frequency shift of returned echoes reflected by air bubbles or particles in the flow.

The 2150's "smart" area velocity probe is built on digital electronics, so the analog level is digitized in the sensor itself to overcome electromagnetic interference. The probe is also factory-calibrated for 10-foot (3 meter) span at different temperatures. This built-in calibration eliminates drift in the level signal, providing long-term level stability that reduces recalibration frequency and completely eliminates span recalibration.

In field use, the 2150 is typically powered either by two alkaline, or Isco Rechargeable Lead-acid batteries, within a 2191 Battery Module. Highly efficient power management extends battery life up to 15 months at 15-minute data storage intervals. Other power options (including solar) are available.

Applications

- Portable and permanent-site AV flow monitoring for inflow and infiltration, capacity assessment, sewer overflow, and other sewer studies.
- Measuring shallow flows in small pipes. Our low-profile area velocity sensor minimizes flow stream obstruction and senses velocity in flows down to 1 inch (25 mm) in depth.

Standard Features

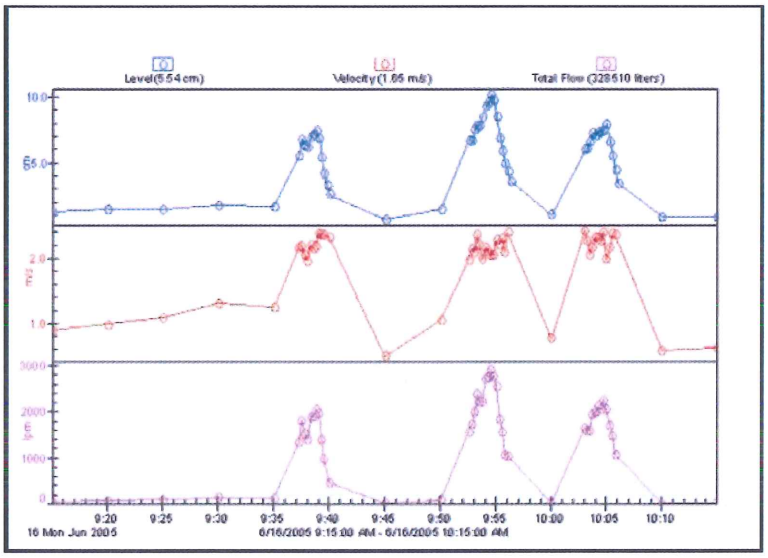
- Rugged, submersible enclosure meets NEMA 4X, 6P (IP68) environmental specs.
- Chemically resistant epoxy-encapsulated sensor withstands abuse, resists oil and grease fouling, and eliminates the need for frequent cleaning.
- Replaceable high-capacity internal desiccant cartridge and hydrophobic filter protect sensor reference from water entry and internal moisture.

- Pressure transducer vent system automatically compensates for atmospheric pressure changes to maintain accuracy.
- The quick-connect sensor can be easily removed and interchanged in the field without requiring recalibration.
- Up to four 2100 Series flow modules can be networked by stacking and/or extension cables.

Above left: Additional modules can be added for redundant or multi-stream measuring (Isco 2110 Ultrasonic Module shown). Right: Optional mounting rings provide quick, secure sensor installation in round pipes from 6 to 80 inches (150 to 2000 mm).

Software Features

- Secure data storage. All data are continuously stored in flash memory to protect against loss in case of power failure
- Easy to upgrade. New operating software can be downloaded into non-volatile flash memory, without affecting stored program and data.
- Records and stores input voltage and temperature data.
- ♦ Variable rate data storage lets you change the data storage interval when programmed conditions occur. This feature assures maximum information about an exceptional event – such as an overflow
- – while conserving power and data capacity during normal conditions.

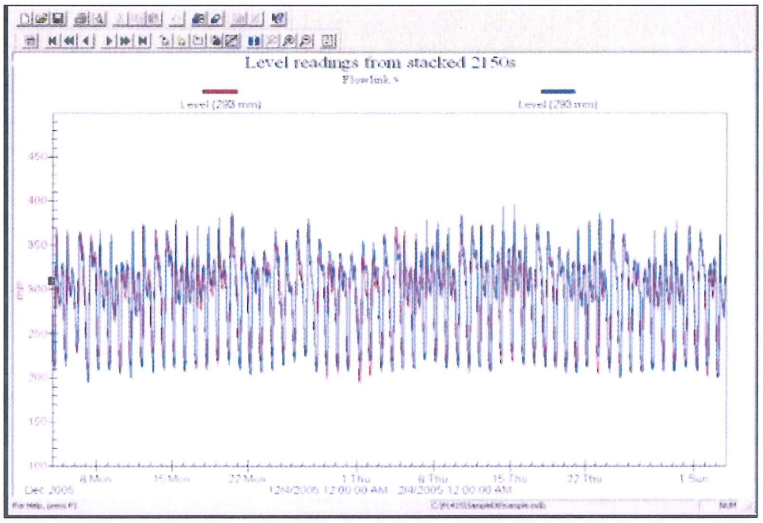


- 38,400 bps communication provides speedy setup and data retrieval.

Variable rate data storage

The 2150 flow module has the ability to automatically switch data storage rates based on varying conditions.

In the example at left, the 5-minute data storage rate automatically changed to 30 seconds when the flow rose above a programmed level.



Level stability

Frequent multipoint level recalibration is a requirement with other area velocity flow meters. Isco's exclusive

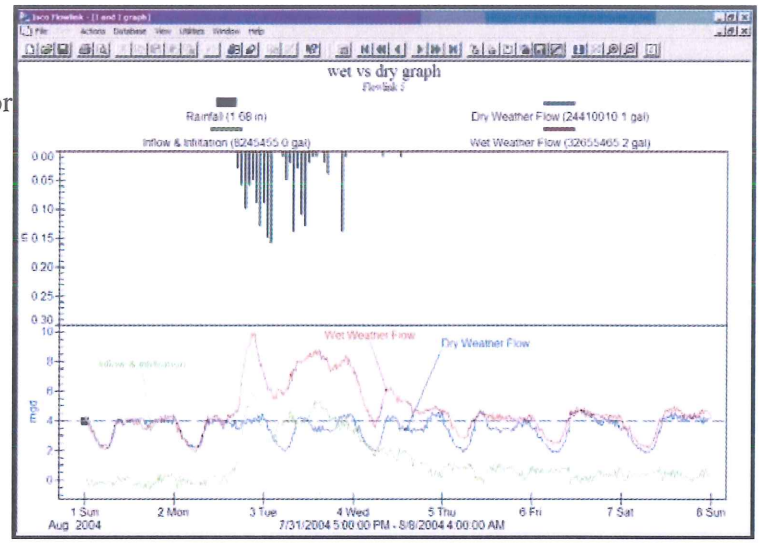
"smart" sensor design in the area velocity probe yields exceptionally low drift in the level signal.

The 2150's factory-calibrated 3-meter span totally eliminates the need for cumbersome span recalibration in the field.

In the example at left, two area velocity probes were installed at the same site. The level readings from both sensors track closely without any drift, over an 8-week period.

Flowlink® Data Analysis

Isco Flowlink® Software is a powerful tool for analyzing flow and water quality data. It provides site setup, data retrieval, and comprehensive data analysis, as well as advanced reporting and graphing. See separate datasheets for details on Flowlink and Flowlink Pro software.



external communication modules, SCADA systems, or other devices.

The Flowlink screen shown above gives a comparison of dry and wet weather flows, plus rainfall typical of an inflow & infiltration study

Information Delivery

Isco 2100 Series Flow Modules offer a wide variety of communication and retrieval options, to minimize the need for expensive on-site visits and confined space entry. These include:

Isco 2103 Land-line Modem Module
Reliable two-way dial-up communication between down-hole 2100 Flow Modules and your desktop computer, equipped with Isco Flowlink Software. A dial-out feature enables the system to transmit a text message alarm to your digital cell phone or pager.

Isco 2103c Cellular Modem Module
All the features of the 2103 Modem with the convenience of cell phone access. And the 2103c can automatically send data via the Internet to a designated server running Flowlink Pro software, using economical 1xRTT packet-switched data transmission.

Isco 2108 Analog Output Module
Provides current outputs for use with Isco 2100 Series Area Velocity and Ultrasonic Flow Modules. It allows easy interface with SCADA/DCS or other secondary instrument systems.

Modbus
2100 Series Flow Modules provide digital RS 232 Modbus output that can be used to interface with

On-site Data Retrieval

Isco Flowlink Software
Download and process data on-site. Enjoy unmatched data management capability, advanced data editing and analysis, powerful reporting and presentation choices, and a variety of downloading and data handling options.

Isco 2101 Field Wizard
A durable, weatherproof module for on-site data retrieval. Don't risk damage to your fragile notebook PC. The 2101 Field Wizard provides on-site display of current readings, information about stored data, diagnostics, and more. Interrogate all 2100 Series Flow Modules in the stack at one time, and store more than 14 days' data from up to 20 modules!

Isco 2102 Communication Module
Connect with your Isco 2100 Series Flow Modules from the safety and convenience of your vehicle.

Digital spread-spectrum radio signals enable "driveup" data retrieval, system configuration, and level calibration, with minimum power consumption. "Plug and Play" setup – no interfacing needed.

2150 Flow Module	
Size (HxWxD):	2.9 x 11.3 x 7.5 in (74 x 287 x 191 mm)
Weight:	2.0 lb (0.9 kg)
Materials of construction:	High-impact polystyrene, stainless steel
Enclosure (self-certified):	NEMA 4X, 6P (IP68)
Temperature Range:	-40° to 140° F (-40° to 60° C) operating and storage
Power Required:	12 VDC nominal (7.0 to 16.6 VDC), 100 mA typical, 1 mA standby
Power Source:	Typically, an Isco 2191 Battery Module, containing 2 alkaline or 2 rechargeable lead-acid batteries. (Other power options are available; ask for details.)
Typical Battery Life:	Using 15-minute data storage interval Energizer® Model 529 alkaline - 15 months Isco rechargeable lead-acid - 2.5 months
Program Memory:	Non-volatile programmable flash; can be updated using PC without opening enclosure; retains user program after updating.
Built-in Conversions	
Flow Rate Conversions:	Up to 2 independent level-to-area conversions and/or level-to-flow rate conversions.
Level-to-Area Conversions:	Channel Shapes - round, U-shaped, rectangular, trapezoidal, elliptical, with silt correction; Data Points - Up to 50 level-area points.
Level-to-Flow Conversions:	Most common weirs and flumes; Manning Formula; Data Points (up to 50 level-flow points); 2-term polynomial equation
Total Flow Calculations:	Up to 2 independent, net, positive or negative, based on either flow rate conversion
Data Handling and Communications	
Data Storage:	Non-volatile flash; retains stored data during program updates. Capacity 395,000 bytes (up to 79,000 readings, equal to over 270 days of level and velocity readings at 15-minute intervals, plus total flow and input voltage readings at 24-hour intervals)
Data Types:	Level, velocity, flow rate 1, flow rate 2, total flow 1, total flow 2, input voltage, temperature
Storage Mode:	Rollover; 5 bytes per reading.
Storage Interval:	15 or 30 seconds; 1, 2, 5, 15, or 30 minutes; or 1, 2, 4, 12, or 24 hours Storage rate variable based on level, velocity, flow rate, total flow, or input voltage
Data Retrieval:	Serial connection to PC or optional 2101 Field Wizard module; optional modules for spread spectrum radio; land-line or cellular modem; 1xRTT. Modbus and 4-20 mA analog available.
Software:	Isco Flowlink for setup, data retrieval, editing, analysis, and reporting
Multi-module networking:	Up to four 2100 Series Flow Modules, stacked and/or remotely connected. Max distance between modules 3300

2150 Area Velocity Sensor	
Size (HxWxD):	0.75 x 1.3 x 6.0 in (19 x 33 x 152 mm)
Cable (Length x Diameter):	25 ft x 0.37 in (7.6 m x 9 mm) standard. Custom lengths available on request.
Weight (including cable):	2.2 lbs (1 kg)
Materials of construction:	Sensor - Epoxy, chlorinated polyvinyl chloride (CPVC), stainless steel Cable - Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC)
Operating Temperature:	32° to 140° F (0° to 60° C)
Level Measurement:	Method - Submerged pressure transducer mounted in the flow stream Transducer Type - Differential linear integrated circuit pressure transducer Range (standard) 0.033 to 10 ft (0.010 to 3.05 m); (optional) up to 30 ft (9.15 m). Maximum Allowable Level 34 ft (10.5 m) Accuracy ±0.01 ft from 0.033 to 10 ft, (±0.003 m from 0.01 to 3.05 m,) Long-Term Stability ±0.023 ft/yr (±0.007 m/yr) Compensated Range 32° to 122°F (0° to 50°C)
Velocity Measurement:	Method - Doppler ultrasonic, frequency 500 kHz Typical Minimum Depth 0.08 ft (25 mm) Range -5 to +20 ft/s (-1.5 to +6.1 m/s) Accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s (±0.03 m/s from -1.5 to +1.5 m/s) ±2% of reading from 5 to 20 ft/s (1.5 to 6.1 m/s)
Temperature Measurement:	Accuracy ±3.6° F (±2° C)

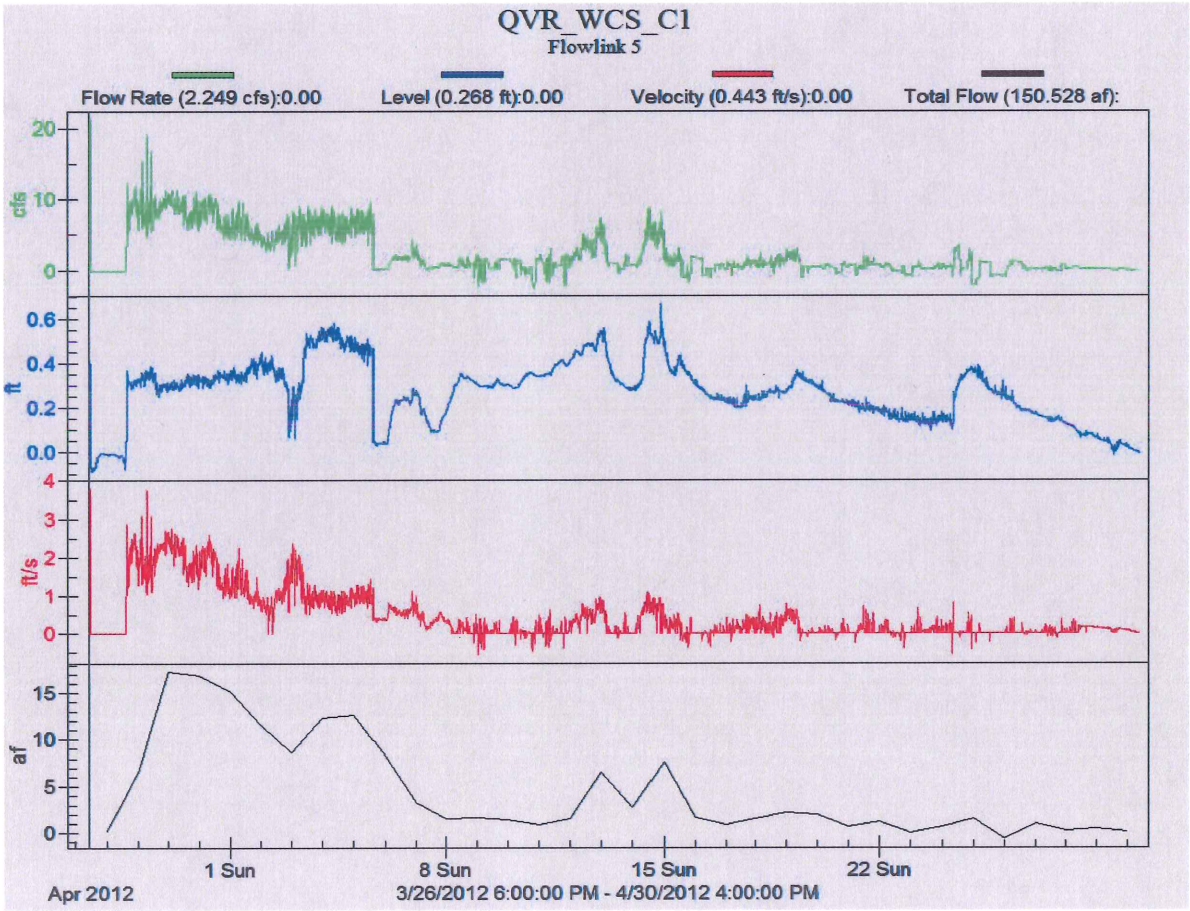
2191 Battery Module	
Size (HxWxD):	6.0 x 9.6 x 7.6 in (152 x 244 x 193 mm)
Weight (without batteries):	3.2 lb (1.4 kg)
Materials of construction:	High-impact polystyrene, stainless steel
Enclosure (self certified):	NEMA 4X, 6P, (IP68)
Batteries:	Two 6-volt Energizer Model 529* alkaline (25 Ahrs capacity) or Isco Rechargeable Lead-acid (5 Ahrs capacity) recommended. *Note – Energizer 529 ER does not give specified life.

Description	Part No.
2150 with AV sensor, 2191 Battery Module, and Handle	68-2050-002
2150 Mdule with AV sensor (only)	68-2050-001
Isco Flowlink® 5 Software	68-2540-200
Energizer® Model 529 Aline Lantern Battery (2 required)	340-2006-02
Isco Rechargeable Lead-acid Battery (2 required)	60-2004-041
Charger for Lead-acid Batteries (holds 2 batteries)	60-2004-040

APPENDIX B: Example of Data

Figure XX shows Isco Flow meter data collected at the WCS C1 diversion structure between March 27, 2012 and April 30, 2012. The legend at the top shows an average flow rate of 2.249 cfs, determined by Isco measurements of level (average 0.268 ft) and velocity (average of 0.443 ft/sec). Total flow is calculated as 150.528 acre feet.

Water was diverted past the flow meter on March 28, 2012 at about 3:30pm. Diversion was stopped at about 3:30pm on April 5, 2012. Discharge data measured after this time represents leakage past the flow control, wind interference, and precipitation inputs. Total discharge during the actual diversion outweighs the residual discharge, such that the total of 150 acre feet is fairly representative.



APPENDIX C: Monitoring History

Attachment: Summary of Communication between the U.S. Fish and Wildlife Service (USFWS) and the State of Kansas, DWR, (KS-DWR) regarding efforts to accurately report water use at Quivira National Wildlife Refuge (Refuge).

Certificate for Appropriation for Beneficial Use of Water – Water Right File No.7571 (04/30/96)
The certificate lists: three PODs; place of use covering the entire Refuge; authority to store and accumulate water in the marsh areas within the boundaries; a water use rate of 300cfs up to 14,632AFY; check valves to prevent pollution of the water supply; requirement to maintain records from which quantity of water can be readily determined, with records provided to the State by March 1.

In a letter from David Pope, KS-DWR State Engineer to Terry Grosz, USFWS, (April 10, 1996) Mr. Pope uses Rattlesnake Creek flow recorded at the USGS Zenith gage to justify flow quantities in his issuance of the Certificate to Appropriate, File No.7571. Quantity was based on 1987 flow readings at Zenith totalizing 47,357AFY with 87% flowing 300cfs or less.

In a letter from David Pope to USFWS (9/27/96), Mr. Pope orders recording flow meters to provide continuous daily data for all PODs from Rattlesnake Creek under Refuge control. In a response letter (Cheryl Willis, USFWS, to David Pope, Jan.17, 1997) a summary of costs and benefits are documented. In order to accurately monitor flow at the three PODs, water control structures (fixed crest weirs) are necessary to achieve sufficient drop for accurate measurements. The cost to construct fixed crest weirs is in addition to an estimated $43,405 (1997 dollars) for the installation of the measurement devices. Installation of water control structures compromises the efficient use of water across the Refuge and adds significant financial burden.

Concerns over the salinity of the water in the Refuge affecting the sensors used for sonic flow metering encouraged the USFWS to seek metering alternatives. A contract with Bureau of Reclamation (BOR) to install long-throated flumes was explored, at an estimated $150,000 for four locations. The intent of USFWS was to pursue BOR construction of a flume/stilling-well/datalogger system. Design plans by BOR called-out specific fill material which increased the cost projection to $325,000, with additional increases expected due to trucking in the fill material.

In a letter from Cheryl Willis, USFWS to Bruce Falk, KS-DWR (06/08/01), USFWS requested permission to use meter readings from the USGS Zenith gage for metering water use on the Refuge. Water use will be better metered at Zenith because it captures water losses in Little Salt Marsh (storage, ET, seepage) which would be missed by metering the PODs. The letter also volunteers manual measurements at the PODs by Refuge staff and annual reporting of those data.

A similar case exists at Bear River National Wildlife Refuge. Measurements in the diversions are very difficult, but a USGS gage on the Bear River provides accurate measurements of flow to the Refuge. The State of Utah allows the USGS gage readings for water use reporting at the Bear River Refuge.

Following a site visit by Thomas Huntzinger, KS-DWR, the practice of Clausen weir measurements and summary annual water use report for the Refuge were recommended. Huntzinger's findings were that the frequency and accuracy of manual measurements, as described in the Water Measurements Procedures for the Refuge, are adequate to document the quantities diverted and to manage flows within the Refuge, and that automated data recorders are not necessary, (Huntzinger to Estep, USFWS, 03/15/02).

Flow measurements at structure A-3, with a submerged outlet pipe, were not accurate. An attempt to develop a rating curve failed. A Marsh-McBirney flow meter was suggested but recommendations to use a simple mathematical formula relating upstream and downstream water surface elevations was favored.

A follow-up letter, (Huntzinger to Estep, 08/08/02), documents Mr. Huntzingers acceptance of Refuge flow measurements for state water use reporting, and acceptance of the USGS Zenith gage to measure Refuge in-flows. Huntzinger also encourages USFWS/USGS collaboration to install water elevation gages at structure A-3, and for development of rating curves to monitor flow.

USFWS pursued USGS cooperation for Doppler flow meters at the PODs, however installing Doppler flow-meters at the PODs neglects storage losses in Little Salt Marsh. The proposal included $55,500 for evaluation, $22,500 for purchase and installation, and $37,500 annually for operation and maintenance. This was outside the budget possibilities for the Refuge.

In a letter to Huntzinger, (Estep to Huntzinger, 06/18/03), Estep requests clarification from Pope concerning the initial order for metering. If flow accounting is the primary purpose, then measurements at Zenith are most applicable. The letter also reminds Huntzinger that the Refuge rarely releases water outside its boundaries, and that there are no downstream users affected by Refuge operations. If the purpose of flow metering is to prepare for administration of Rattlesnake Creek, the letter states that any calls for administration will be based on measurements from Zenith. Finally, if the intent of the order is to document beneficial use of water, USFWS states its willingness to work with the State to develop a water budget for the Refuge, to enable a better understanding of the water use and management at the Refuge.

Meter Order (Lanterman, KS-DWR to USFWS, 02/03/11) instructs USFWS to install totalizing flow meter on all points-of-diversion by 1/1/12. KS-DWR Chief Engineer requires meters on all surface water pumpsites within GMD-1, GMD-3, and GMD-5, for which meters have not been previously required. The purpose for the meter order is to facilitate the need for increased water management and to promote the efficient use of water in the area. Since PODs on Refuge are not "pump sites" and all meters on the DWR approved equipment list is for pumps, the meter order for Quivira requires special acceptance.

Flow Monitoring Plan version 1 submitted to DWR, (Striffler to Bagley). Bagley indicates acceptance of the Plan 3/28/2012, with stipulations for monitoring 24D and 20B. Flow Monitoring Plan ver.2 submitted to DWR (Striffler to Bagley, email communication 7/19, 2012) identifies complex hydraulics on concrete aprons. Relocation to round culverts suggested. WCS 24D is not a diversion and will not be metered, WCS 20B is not being used.

Notified DWR of meter installation (Striffler to Bagley, email comm. 8/1/2012). All meters installed into round culvert, except RCA. Meter cost is approximately $4,000.00 per site. No water in Rattlesnake Creek to divert, so nothing being measured across the Refuge. Invite Bagley and Lanterman to visit the Refuge. Bagley inquires about the possibility of installing a flume at RCA (Bagley to Striffler, email comm. 8/2/2012).

Monitoring update (Striffler to Bagley, email comm. 10/4/2012). No water diverted through WY2012. Identified cable problems from rodent chewing.

RCA Work-around proposed by DWR (Lanterman to Striffler, email comm. 5/8/2013). Proposed routing water using the C-canal, D-canal, West canal. Striffler indicates it is possible, though with much loss.

Refuge procures metal clad cables (Oldham to Striffler, email comm. 8/21/2013). Metal rings for culvert installations and cables delivered to Refuge 9/11/2013. Installed protected cables into round culvert at all PODs, including RCA. Cost for metal-clad cables with a sensor is approximately $800 each.

Conant, Cameron

From: Conant, Cameron
Sent: Wednesday, August 01, 2012 1:34 PM
To: Lanterman, Jeff; Bagley, Jim
Subject: RE: USFWS Flow Monitoring Plan for Quivira National Wildlife Refuge
Attachments: RCA (1) upstream.JPG; RCA (2) downstream 1.JPG; RCA (3) rattlesnake creek bypass structure and valve.JPG; RCA (4) downstream 2.JPG

I have some pictures of that RCA structure from when Jeff and I took the tour.

Wonder if that means they did figure out a way to meter 20B and 24D?

From: Lanterman, Jeff
Sent: Wednesday, August 01, 2012 1:31 PM
To: Bagley, Jim
Cc: Conant, Cameron
Subject: FW: USFWS Flow Monitoring Plan for Quivira National Wildlife Refuge

If you would like to go look at the site we could sure take you out there Jim.

From: Peter_Striffler@fws.gov [mailto:Peter_Striffler@fws.gov]
Sent: Wednesday, August 01, 2012 11:53 AM
To: Bagley, Jim
Cc: Lanterman, Jeff; Brent_Waters@fws.gov
Subject: RE: USFWS Flow Monitoring Plan for Quivira National Wildlife Refuge

Jim-

All of the structures have been installed and are instrumented with our Isco Acoustic Doppler current meters. We currently do not have water to test the meters, but all of them are in and have been programmed. The only exception to this is the structure at WCS RCA. This diversion structure moves water from Rattlesnake Creek towards the Big Salt Marsh through a 2 bay/6 compartment control structure into the large Rattlesnake Creek Canal. We need to maintain the ability to use one or all of the 6 compartments for varying water flow potentials. Our Isco meters will not work in these conditions and we are asking for your input to find a workable solution. If you would like to visit the Refuge to look at the RCA structure and also see our Isco installations, we could arrange a tour with our Refuge Water Manager. Let me know how you would like to proceed.

Pete

Peter S. Striffler
Hydrologist, Division of Water Resources
US Fish and Wildlife Service, Region 6
134 Union Blvd. Ste-250
Lakewood, CO 80228
(303) 236-4494

"Bagley, Jim" <Jim.Bagley@KDA.KS.GOV>

07/19/2012 12:03 PM

To "Peter_Striffler@fws.gov" <Peter_Striffler@fws.gov>
cc "Lanterman, Jeff" <Jeff.Lanterman@KDA.KS.GOV>
Subject RE: USFWS Flow Monitoring Plan for Quivira National Wildlife Refuge

Thanks, Peter. We'll take another look at this and get back with you.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

From: Peter_Striffler@fws.gov [mailto:Peter_Striffler@fws.gov]
Sent: Thursday, July 19, 2012 12:16 PM
To: Bagley, Jim
Cc: Lanterman, Jeff
Subject: RE: USFWS Flow Monitoring Plan for Quivira National Wildlife Refuge

Jim-

Attached is the revised Flow Monitoring Plan for diversions from Rattlesnake Creek on the Quivira National Wildlife Refuge. During the week of March 26th, we installed Isco Flow Meters at all POD's, and the ones with round culverts worked very well and are collecting data during water diversion. As noted in Jeff's email, we installed the Isco meters on the concrete aprons at POD's without round culverts, but due to complex hydraulics we were measuring back-eddy flow at some flow levels. We tried to rectify this with minimal success, and decided that the best solution was to install round culverts downstream of the concrete aprons. I am waiting to hear final confirmation that a round culvert location is available for the RCA structure, and then will either install the Isco Meters myself, or will help Refuge staff install them by providing support.

Regarding the structures at WCS 20B and WCS 24D, we do not have meters for these locations. These structures are not used very frequently, and only if the water levels are high in Darrynane Lake. There is currently no possibility of diverting Rattlesnake Creek Water through either of these structures due to low lake levels from drought conditions in Kansas. In the unlikely event that we move water through either of these, we will do manual measurements of flow.

Thank you for your patience regarding our compliance with the meter-order. I was waiting until we could get all of the meters working and have some data to look at before contacting you. I will keep you apprised of our progress.

Peter S. Striffler
Hydrologist, Division of Water Resources
US Fish and Wildlife Service, Region 6
134 Union Blvd. Ste-250
Lakewood, CO 80228
(303) 236-4494

"Bagley, Jim"
<Jim.Bagley@KDA.KS.GOV>

07/17/2012 12:40 PM

To "Lanterman, Jeff" <Jeff.Lanterman@KDA.KS.GOV>, "peter_striffler@fws.gov" <peter_striffler@fws.gov>
cc "Conant, Cameron" <Cameron.Conant@KDA.KS.GOV>, "Letourneau, Lane" <Lane.Letourneau@KDA.KS.GOV>
Subject RE: USFWS Flow Monitoring Plan for Quivera National Wildlife Refuge

Conant, Cameron

From: Bagley, Jim
Sent: Tuesday, July 17, 2012 1:40 PM
To: Lanterman, Jeff; peter_striffler@fws.gov
Cc: Conant, Cameron; Letourneau, Lane
Subject: RE: USFWS Flow Monitoring Plan for Quivera National Wildlife Refuge

Thanks. Keep me posted.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

From: Lanterman, Jeff
Sent: Tuesday, July 17, 2012 1:39 PM
To: Bagley, Jim; peter_striffler@fws.gov
Cc: Conant, Cameron; Letourneau, Lane
Subject: RE: USFWS Flow Monitoring Plan for Quivera National Wildlife Refuge

Jim,

Regarding the metering plan by Quivera I wanted to bring you up to speed regarding our conversation with USFW today.

Apparently the ISCO Doppler meters when installed on the aprons of those sites did not work very well leading to some incorrect readings. Quivera is now working on tubes to install those meters in at all the locations suggested by DWR. 24 D is seldom used but they are purchasing a meter for that site and the meter will be installed before it is used.

It appears that the original metering plan has changed but significant progress has been made.

Peter,

I want to urge you to revise your metering plan and keep DWR(Jim and I) up to speed on your progress. Meters were actually due at Quivera on 12/31/2011 as part of the Surface Water Meter Order(SWMO) and USFW was notified of this requirement February 3, 2011. So until the metering is fully completed you are technically out of compliance with the SWMO. We do not plan to take action on the compliance issue at this time because we understand infrastructure improvements need to be made in order to fully implement metering at your site.

Also the metering plan, installation and meters will have to be specially approved in your case in order to be acceptable to the DWR because your meters do not meet current regulation. This is not unusual in cases like yours we just need to work together to come to an acceptable solution.

If you have any questions please don't hesitate to give me a call.

Jeff Lanterman, Water Commissioner
Kansas Department of Agriculture
Division of Water Resources

Conant, Cameron

From: Lanterman, Jeff
Sent: Monday, April 16, 2012 1:47 PM
To: Conant, Cameron; Beightel, Chris
Subject: RE: Position Document - FWS

Follow Up Flag: Follow up
Flag Status: Flagged

What we could do is NONC cease diversion them and just tell them.... Before they use them they need to be metered. What do you think? They are a threat.

From: Conant, Cameron
Sent: Monday, April 16, 2012 1:46 PM
To: Lanterman, Jeff; Beightel, Chris
Subject: RE: Position Document - FWS

Jeff, I talked to Jim B and he has heard nothing back from Pete regarding the March 28 email that Jim sent that said we think the other 2 diversion points should be metered.

The refuge position paper says they are going to meter 6 pd's from the Rattlesnake Creek in the spring of 2012. That means at this point they are not planning to meter the 2 pd's that are "rarely used" but were being used when we visited. I think we all agree that both of those must be metered or not used at all. I don't like the position paper stating they will meter 75% of the diversion points, especially when they gave us a metering plan, we reviewed it and said it was pretty good but lacking because those 2 diversions were not metered.

What should we do to continue poking the metering plan in the correct direction? I feel like we have a chance to get it metered the way we want right now. I don't want follow-up metering issues with this thing since we are involved before the meters are installed.

I guess if they only meter the 6 points, we could always NONC cease diversion on the other 2 points. I don't like that cause there is no way we can monitor if they are actually being used or not, certainly the threat to divert would always be present.

Cameron

From: Lanterman, Jeff
Sent: Monday, April 16, 2012 1:29 PM
To: Conant, Cameron
Subject: RE: Position Document - FWS

Probably wouldn't hurt to get that clarified.

From: Conant, Cameron
Sent: Monday, April 16, 2012 1:27 PM
To: Lanterman, Jeff
Subject: FW: Position Document - FWS

Jeff I was reading the position paper for Quivira and they mention metering towards the end of the report under moving forward. In that paragraph they say they are planning to meter 6 points of diversion. I counted that they need to meter 8 pd's with the 2 that are "rarely used" but could divert from I believe it was WU24.

We sent Jim an email saying we thought those 2 points needed to be metered and he agreed and sent an email to Pete Striffler. Did we ever hear back from Pete about that?

Should I check with Jim?

Cam

From: Beightel, Chris
Sent: Friday, April 13, 2012 10:28 AM
To: Paull, Darci; Lanzrath, Tara; Lyon, Andrew; Lanterman, Jeff; Conant, Cameron; Barfield, David
Subject: FW: Position Document - FWS

fyi

From: Peter_Striffler@fws.gov [mailto:Peter_Striffler@fws.gov]
Sent: Friday, April 13, 2012 10:21 AM
To: Beightel, Chris
Subject: Position Document - FWS

Chris-

Attached is a short write-up concerning how the USFWS views water needs for the Quivira National Wildlife Refuge and the status of water management by the Partnership in the Rattlesnake Creek Subbasin.

Peter S. Striffler
Hydrologist, Division of Water Resources
US Fish and Wildlife Service, Region 6
134 Union Blvd. Ste-250
Lakewood, CO 80228
(303) 236-4494

US Fish and Wildlife Service (USFWS) –

USFWS Perspective

The USFWS is interested in the protection of water quantity and quality that is required to meet legal responsibilities. Quivira National Wildlife Refuge (Refuge) was established primarily to conserve habitat for spring and fall migrating and wintering birds in the Central Flyway, but also to support nesting and resident wildlife and their associated environments. A complex system allows management of over thirty wetlands that are designated important or critical habitat for hundreds of thousands of waterfowl and shorebirds, and many federal and state threatened and endangered species. The availability of water resources is important year-round on the Refuge to provide food and cover requirements for different wildlife and life cycle events. It is necessary to vary water management prescriptions on the Refuge within and among years generally to maintain productive wetlands and due to changing weather patterns. Despite having a senior water right, water is not always available for use when the Refuge needs it to manage habitat for wildlife, particularly in late summer when pumping for croplands is still occurring within the Rattlesnake Creek Subbasin.

Water Use and Water Management

Many studies and models describe the water resource system in the Great Bend region of south central Kansas and areas within Groundwater Management District Number 5 (GMD-5) (Jantzen, 1960; Koelliker, Zovne, Steichen, & Berry, 1981; Cobb, Colarullo, & Hiedari, 1983; GEI Consultants, Inc,; Burns and McDonnell, 1998; Balleau Groundwater, Inc., 2010). This includes documentation of the saline aquifers and their relationship to the surface water system, theories on the dynamics of the system, and suggestions regarding management and socio-political solutions. Based on this information, achieving sustainable aquifer levels requires changes for appropriate future management and administration. As stewards of our natural resources, the Rattlesnake Creek Partnership has an urgent challenge to act responsibly with effective water use and protection.

While experiencing record drought in south-central Kansas in 2011, several revisions to Kansas water law occurred that do not consistently support conservation of water resources and protection of senior water rights. To relieve drought stresses on agricultural crops, temporary Emergency Drought Term Permits were allowed to permit pumping irrigation water beyond appropriated quantities. In these cases, pump overages were borrowed from 2012 allotments. Also, the Kansas Legislature passed SB-272 that enables multi-year flexibility in water use (Kansas Legislature Committee on Agriculture, SB-272, 2012). Multi-Year Flex Accounts encourage water conservation by "saving" unused water in a particular year for "possible" use in subsequent years. Wording in SB-272 forgives water debts from Emergency Drought Term Permits in 2011. The immediate effect of these Multi-Year Flex Accounts allows groundwater pumping during times when aquifer levels are most susceptible to depletion, affecting streamflow in Rattlesnake Creek and water deliveries to the Refuge.

Preliminary data for the 12 year review of the Rattlesnake Creek Partnership proposal show that instead of reducing groundwater use in the Rattlesnake Creek sub-basin, most areas increased groundwater use (Basin Management Team, 2012). Despite above average precipitation in recent years, groundwater use in the stream corridor area, priority areas 1, 3, and 4 (12% target reduction) increased from 29,194 acre feet in 2001 to 30,647 acre feet in 2010. Average annual groundwater use in the groundwater management area, priority areas 2, 5, and the Mystery River area (reduction objective to 85,000 acre

feet) increased from 91,734 acre feet in 2001 to 101,342 acre feet in 2010. Average annual groundwater use in priority area 7 and the mineral intrusion area (reduction objective to about 47,000 acre feet) increased from 49,064 acre feet in 2001 to 53,837 acre feet in 2010.

Aquifer Depletion

Groundwater use for irrigation in GMD-5 is lowering the static water level in wells. Substantial drops in groundwater levels were recorded in 2012 by the DWR throughout western and south-central Kansas. GMD-5 groundwater levels changed from +0.63 feet in 2010 to –0.44 feet in 2011, and were averaging –2.95 feet in January 2012 (Kansas Geological Survey, 2012).

Groundwater discharge from the Alluvial and Great Bend Aquifer is the primary mechanism that provides base-flow in Rattlesnake Creek. Streamflow in Rattlesnake Creek was reduced to zero during the summer, 2011. Solving the surface water depletion problem is dependent upon solving the groundwater depletion problem. Water conservation programs and administration by the State are necessary to preserve the groundwater resources in the region and protect the water rights of the Refuge.

Moving forward

The USGS monitors Rattlesnake Creek flows into the Refuge at the Zenith gage. From Zenith, Rattlesnake Creek enters the Refuge system and transports water to the Little Salt Marsh for storage and subsequent use. Water released from the Refuge returns to Rattlesnake Creek, eventually flowing into the Arkansas River. There are no downstream users of water exiting the Refuge and the Refuge does not meter streamflow leaving the Refuge. Regardless, the Service received a Meter Order from Kansas Chief Engineer David W. Barfield (February 3, 2011) requiring installation of flow-meters on all points of diversion on the Refuge, in order to facilitate increased water management and to promote the efficient use of water in the Western Kansas, Southwest Kansas, and Big Bend Groundwater Management Districts. The difficulty in installing continuous flow-meters in the multiple water diversions from Rattlesnake Creek has delayed compliance with the meter order. A recent (February, 2012) meeting on the Refuge with DWR representatives led to an agreement for locations of flow metering equipment, and the development of a Flow Monitoring Plan (Striffler, 2012). Installation of continuous monitoring Doppler velocity meters at six points of diversion from Rattlesnake Creek is planned for spring 2012.

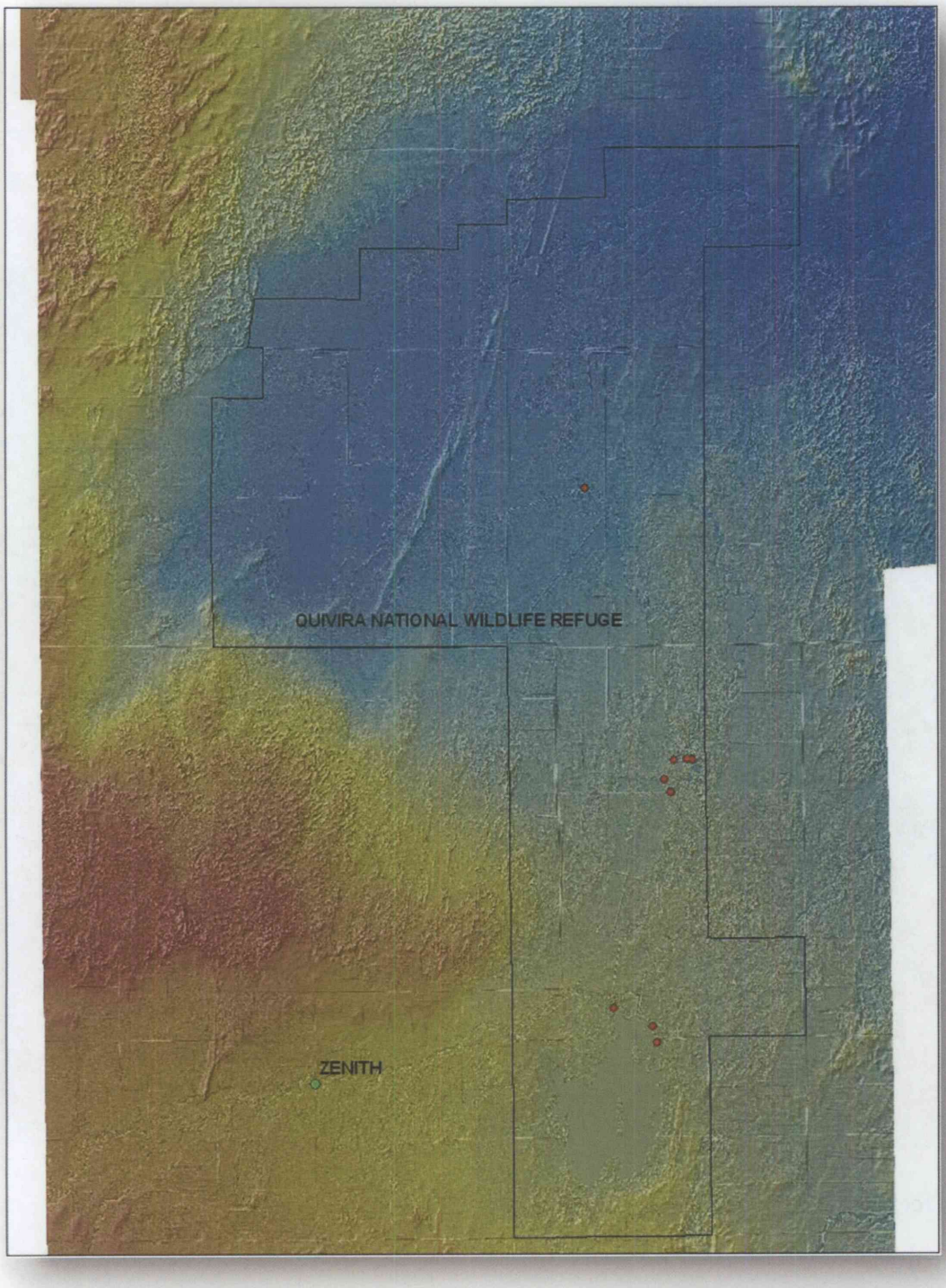
The Service has formally issued a recommendation to the DWR to: 1) determine whether an IGUCA is warranted for the Rattlesnake Creek sub-basin, and 2) to determine the administrative actions required ensuring groundwater use goals spelled out in the Rattlesnake Creek Sub-basin Management Plan are met, and that actions are ready to implement in 2012. After water use reduction goals in the Rattlesnake Creek Management Plan are met, it may be beneficial to optimize groundwater pumping curtailments using the Balleau GMD-5 Groundwater Model, as long as groundwater use reductions are maintained. The Service may be forced to pursue legal measures if the Service's water right is not protected.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Hydrologic Observations in Preparation for RCP-12.2

1: Rattlesnake Creek with Zero Flow, 2011, Credit: D.Severson/USFWS

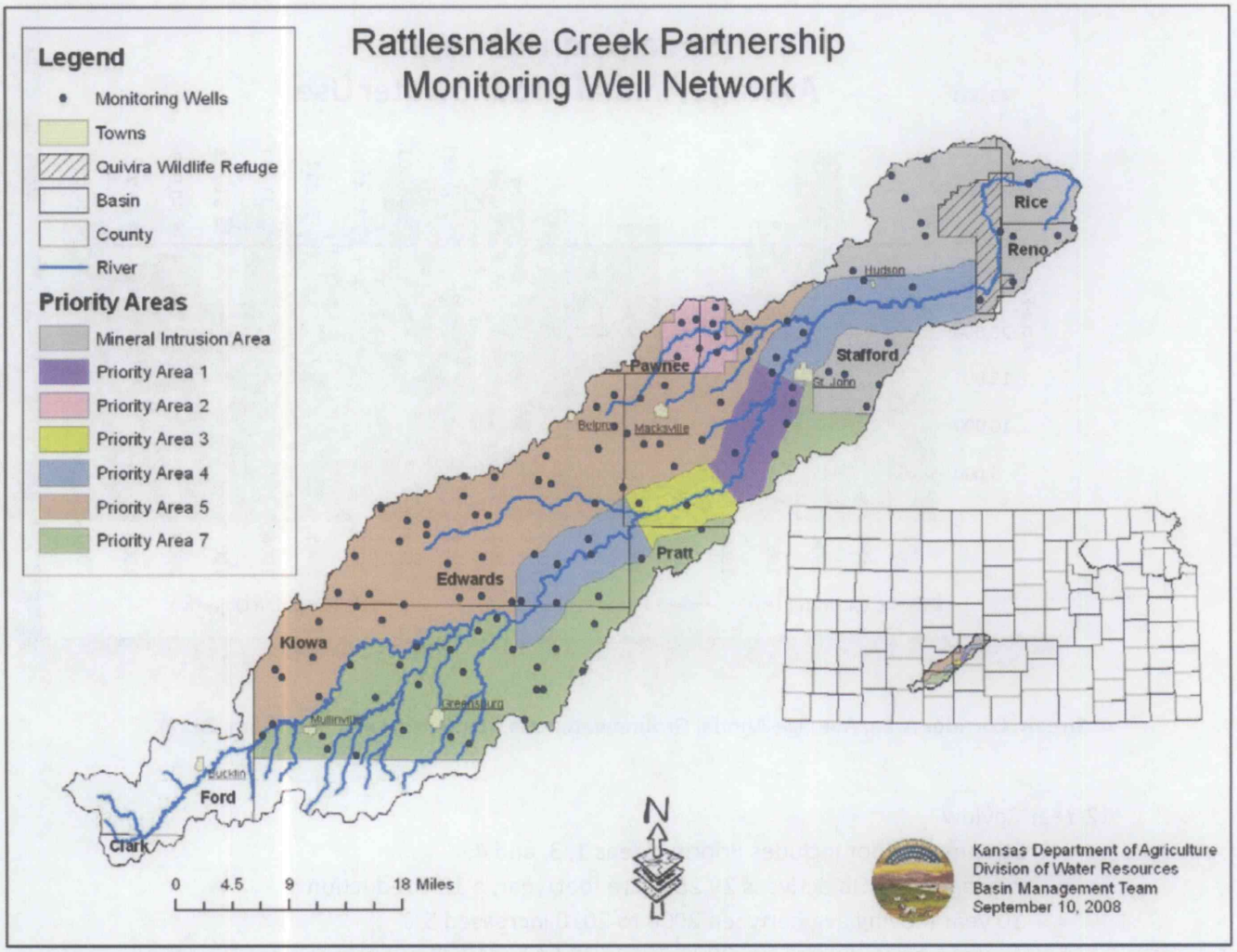
Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO



2: Quivira National Wildlife Refuge - Points of Diversion

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

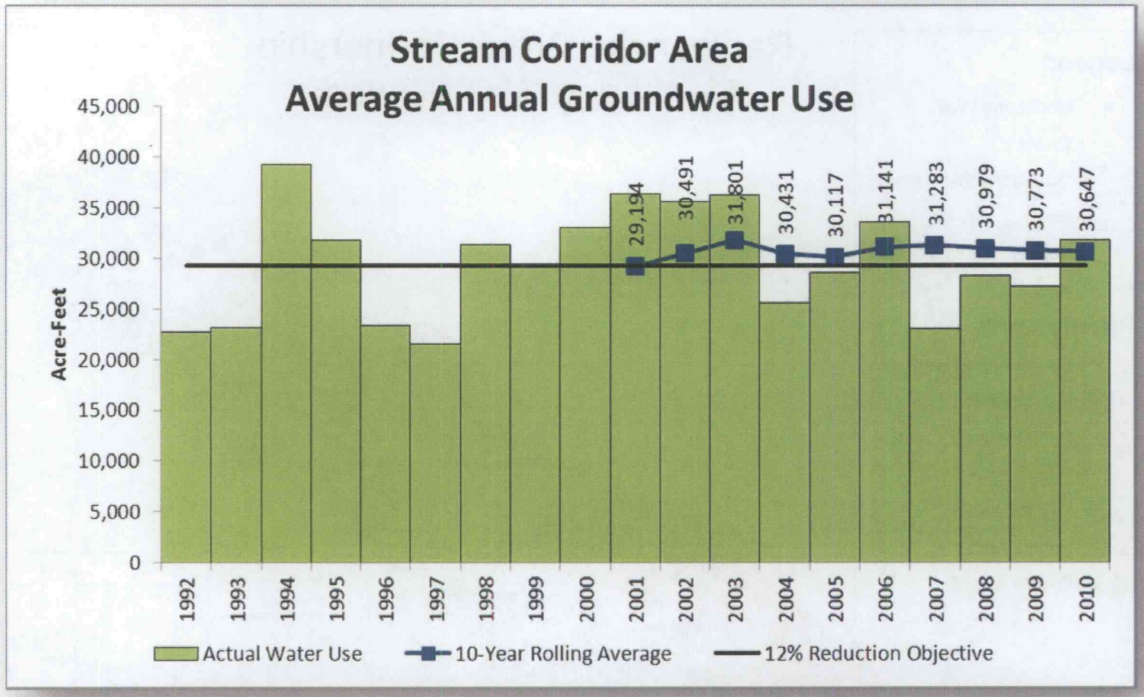
Map of Rattlesnake Creek Sub-Basin and Priority Areas



3: Map of Rattlesnake Creek Priority Areas, (Basin Management Team, 2009)

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Stream Corridor - Priority Areas 1, 3, 4



4: Stream Corridor Area, Average Annual Groundwater Use, (Basin Management Team, 2012)

12-Year Review

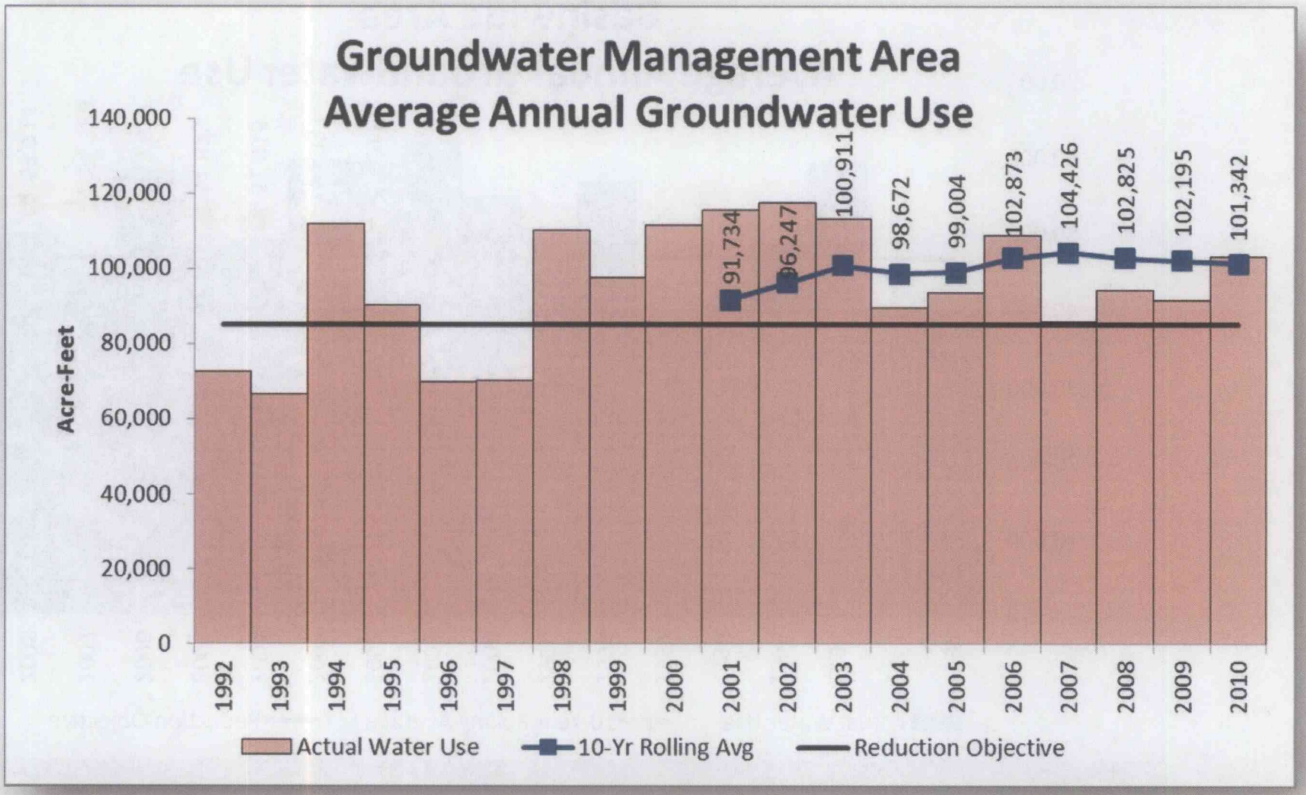
- Stream Corridor includes Priority Areas 1, 3, and 4.
- Management Objective is 29,284 acre feet/year, a 12% reduction
- 10 year moving avg between 2000 to 2010 increased 5%
- Average groundwater use 2001-2012= 30,647.....105% of Management Objective

Summary

- Management Objectives were not met.
- Hydrologic Conditions moved further away from goals.
- Management Programs are ineffective.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Groundwater Management Area – Priority Areas 2, 5, and Mystery River



5: Groundwater Management Area, Avg Annual Groundwater Use, (Basin Management Team, 2012)

12-Year Review

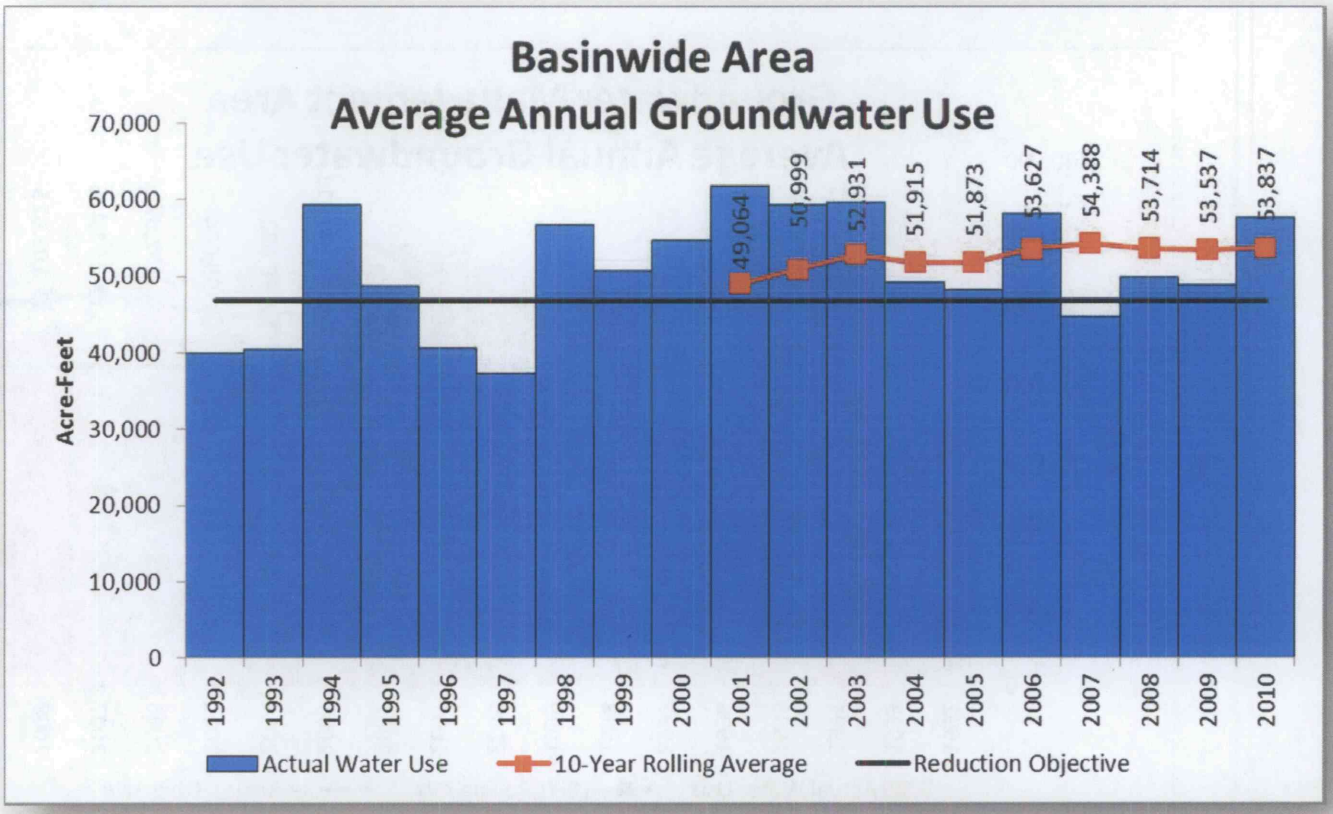
- Groundwater Management Area includes Priority Areas 2 and 5, and the Mystery River Area
- Groundwater use reduction goal is 84,996 acre feet/year
- 10 year moving avg from 2000 to 2010 increased 10%
- 10 year moving avg in 2010 is 16,346 acre feet above the reduction objective
- Year 2002 had the highest groundwater use: 117,637 acre feet
- Average groundwater use 2001-2012 is 101,342= 120% of Management Objective

Summary

- Management Objectives were not met.
- Hydrologic Conditions moved further away from goals.
- Management Programs are ineffective.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Priority Areas 7 and Mineral Intrusion Area



6: "Basin-wide" Area, Average Annual Groundwater Use, (Basin Management Team, 2012)

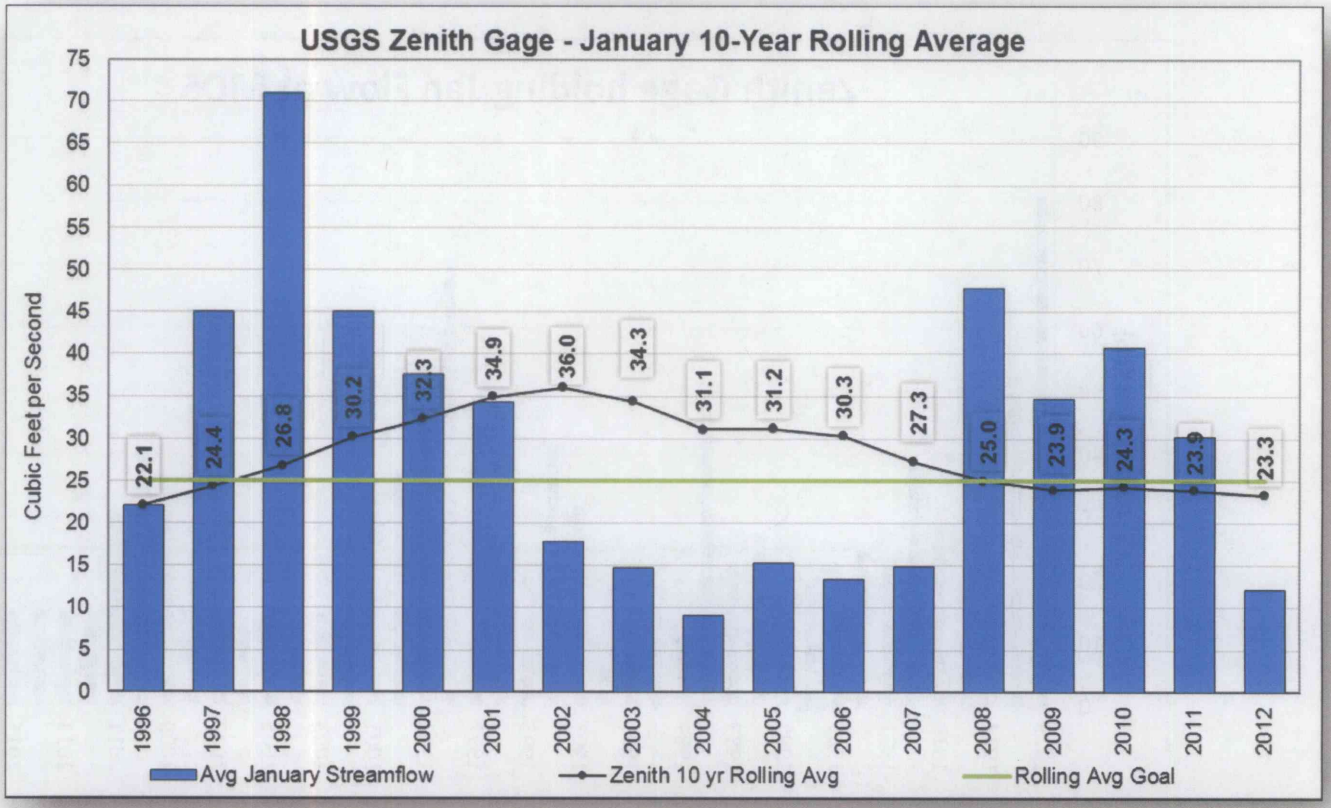
- Area includes Priority Area 7 and the Mineral Intrusion Area
- Groundwater use reduction goal is 46,906 acre feet/year
- 10 year moving avg from 2000 to 2010 increased almost 10%
- 10 year moving avg in 2010 is 6931 acre feet above the reduction objective
- Year 2001 had the highest groundwater use: 61,848 acre feet
- Average groundwater use 2001-2012 is 53,837=115% of Management Objective

Summary

- Management Objectives were not met.
- Hydrologic Conditions moved further away from goals.
- Management Programs are ineffective.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Zenith 10 Year January Rolling Average



7: Zenith 10 Year January Moving Average, (Basin Management Team, 2012)

12-Year Review

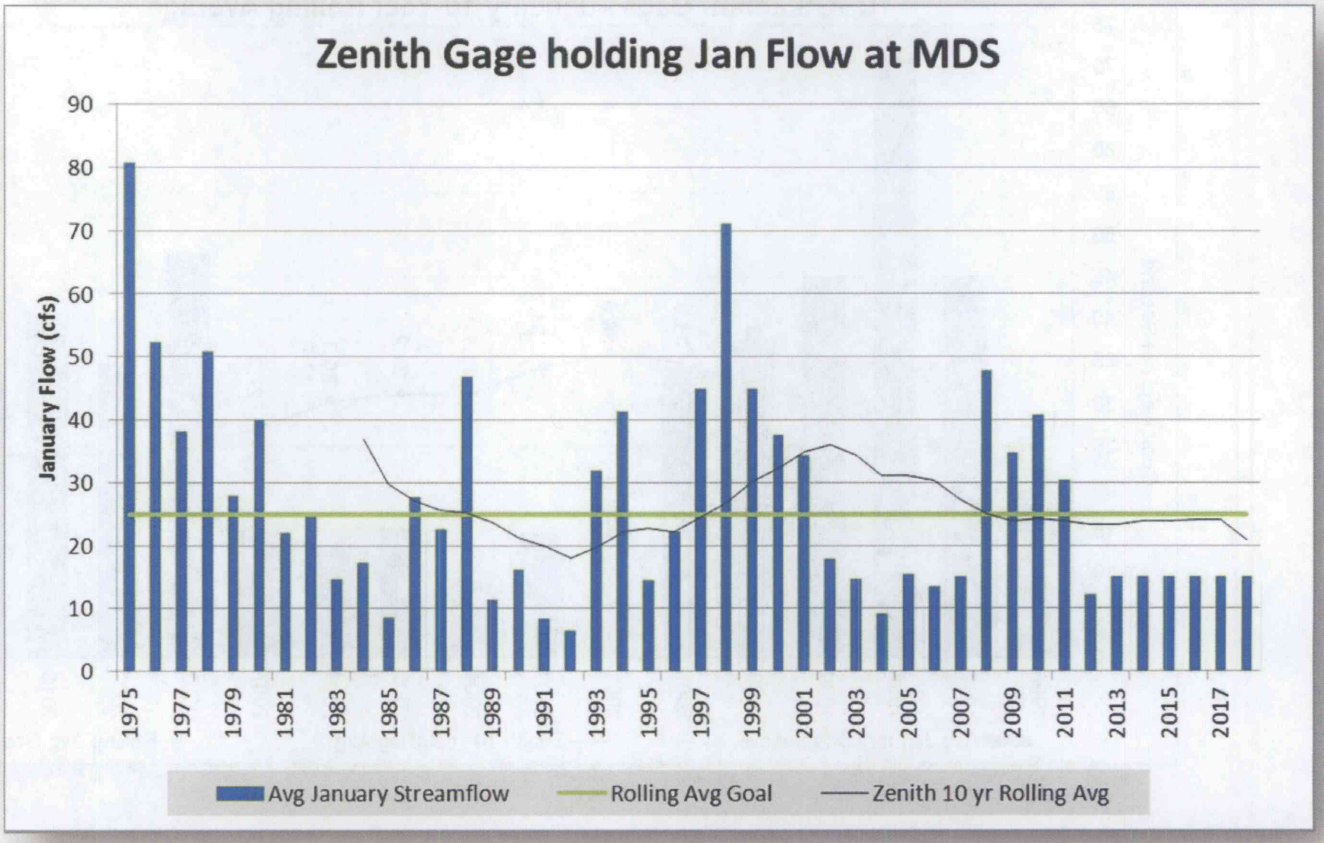
- Management goal for January 10 year rolling avg is 25 cfs
- Goal has not been met since 2007 despite wet years in 2007, 2008, 2009, and 2010
- 10 year moving average has declined steadily since 2002

Summary

- Management Objectives were not met.
- Hydrologic Conditions moved further away from goals.
- Management Programs are ineffective.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Zenith 10 Year January Rolling Average- Projected



8: Zenith Gage Projected Flow

12-Year Review

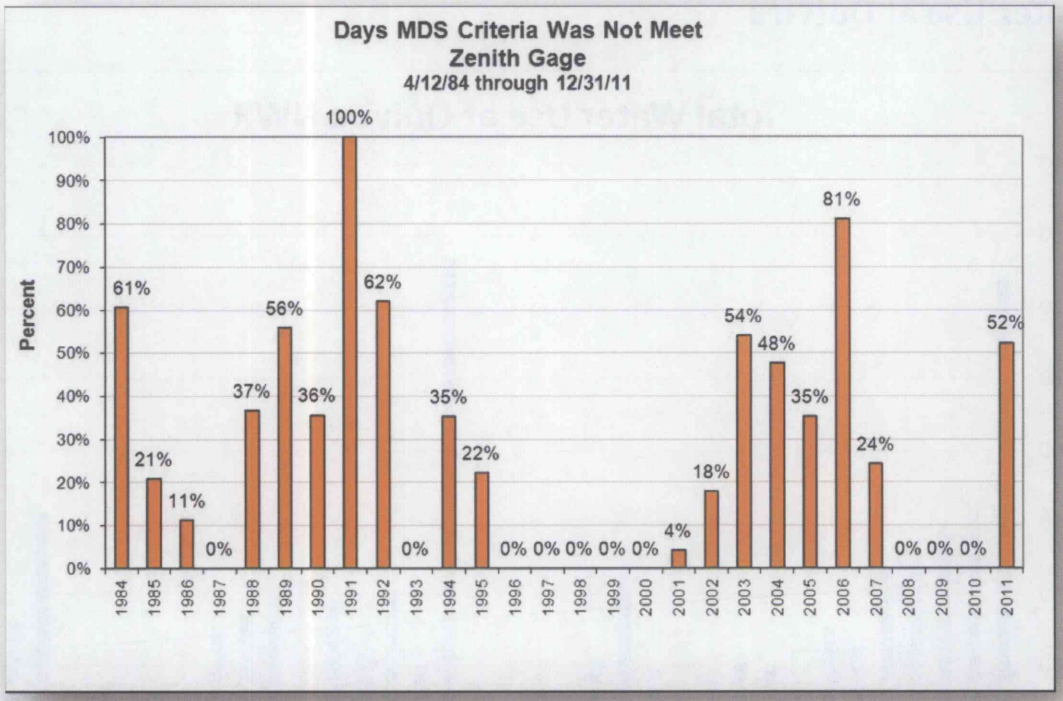
- Holding January flow at the 15 cfs MDS criteria (2013 to 2018) does not raise the 10 yr rolling avg above the 25 cfs mandate
- More than MDS flows are needed to bring the rolling avg above 25 cfs rolling avg in January

Summary

- Management Objectives were not met.
- Hydrologic Conditions moved further away from goals.
- Management Programs are ineffective.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Zenith MDS



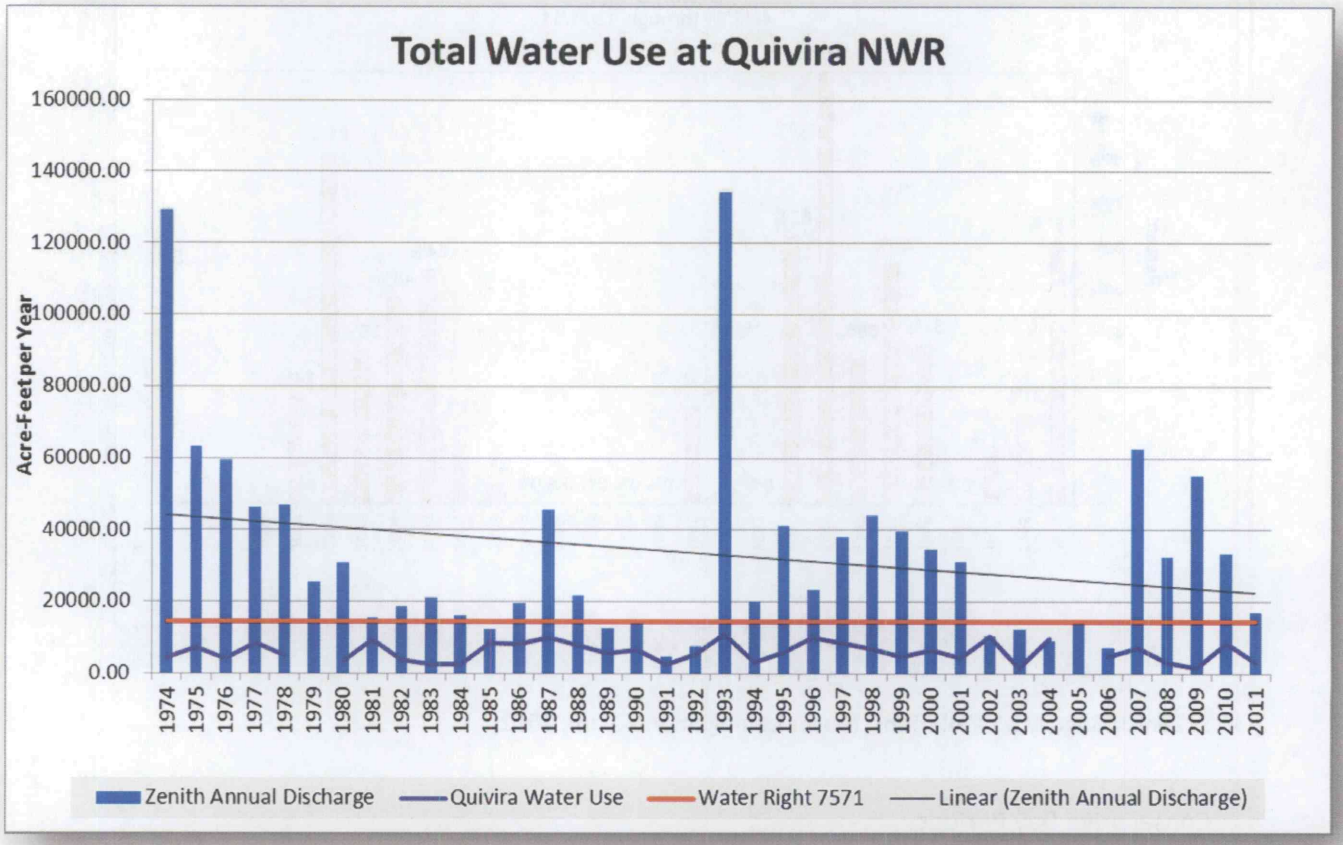
9: Zenith Gage MDS Violations, (Basin Management Team, 2012)

Consecutive Day Periods

- 11/2001 8 days
- 12/2001 12 days
- 06/2002 15 days
- 06/2002 8 days
- 12/2002 36 days
- 06/2003 8 days, 9 days
- 07/2003 22 days
- 08/2003 20 days
- 09/2000 35 days
- 11/2003 124 days
- 04/2004 45 days
- 05/2004 29 days
- 06/2004 8 days
- 01/2005 21 days
- 05/2005 11 days
- 11/2005 26 days
- 12/2005 10 days
- 12/2005 47 days
- 04/2006 31 days
- 05/2006 29 days
- 06/2006 18 days
- 07/2006 20 days
- 09/2006 10 days, 11 days
- 11/2006 50 days
- 12/2006 6days
- 01/2007 40 days
- 03/2007 18 days
- 06/2011 23 days
- 07/2011 31 days
- 08/2011 48 days
- 10/2011 22 days
- 11/2011 14 days
- 12/2011 67 days

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Total Water Use at Quivira



10: Total Water Use* at Quivira NWR

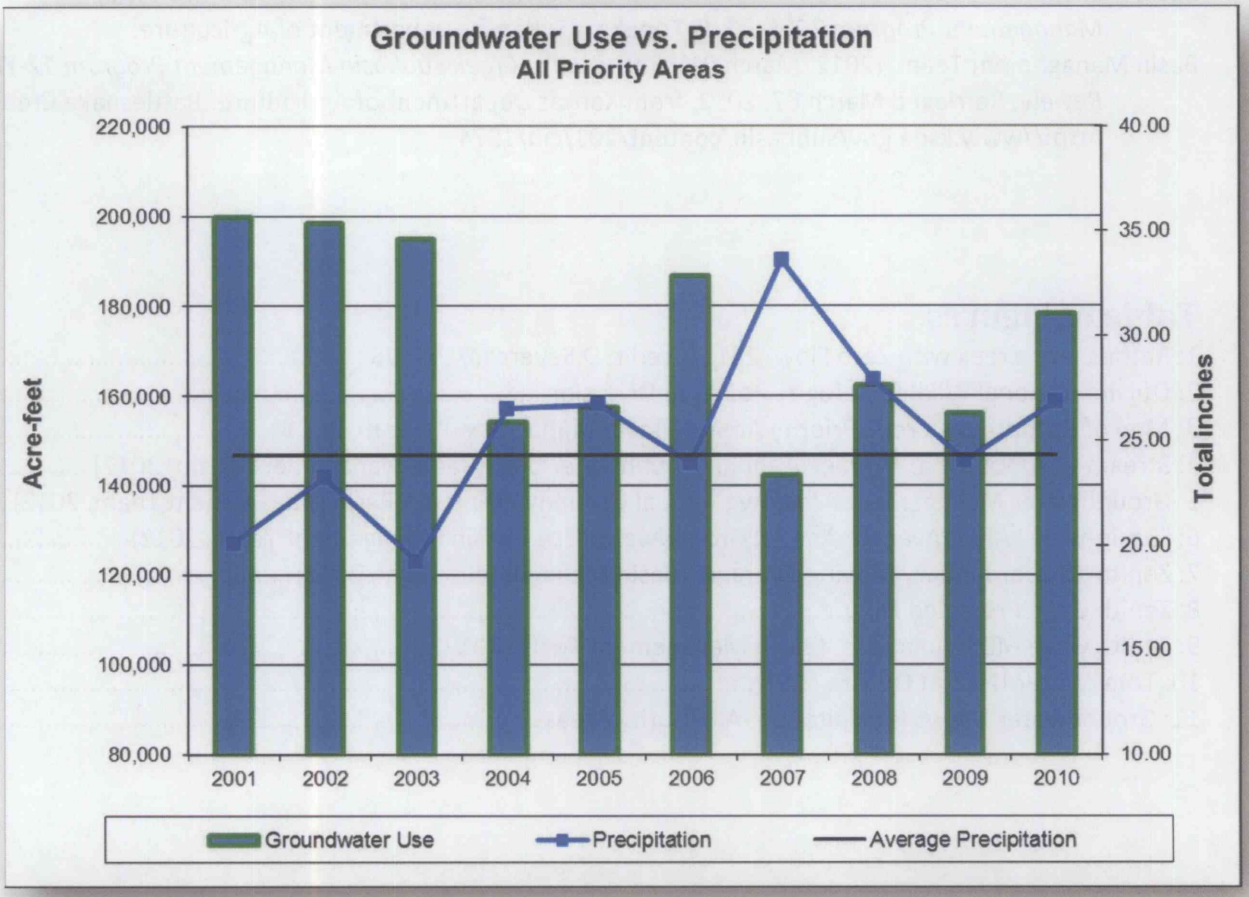
12 Year Review

- Total discharge past the Zenith gage from 1974 to 2011
- Linear trend line shows nearly 20,000 AFY decline in Rattlesnake Creek annual discharge
- 5 years (2002-2006) during the 12 Partnership Management years (2001-2012) , flow at Zenith Gage was less than Water Right 7571
- Quivira NWR Water Use Summary
    - Years with the greatest need have the lowest water available
    - Years with the greatest flows have the lowest needs for wildlife habitat management
    - Highest water use year at Quivira was 1993 with 11,213 AFY, 77% of water right 7571

* Total water use does not include water used to refill Little Salt Marsh, ET or conveyance losses.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

All Areas- Groundwater Use vs Precipitation



11: Groundwater Use vs Precipitation, All Priority Areas

12-Year Review

- Groundwater use reductions are a result of above average precip since 2003
- Groundwater Use Reduction Goal is 161,187 AFY
- Average groundwater use 2001-2010 was 173,056…11,869 acre feet above goal (107% of target)

Summary

- GW use meets target level only in above average precip years
- 2008 had 115% average annual precip, and GW use above target by 1000AFY
- Management Objectives were not met.
- Hydrologic Conditions moved further away from goals.
- Management Programs are ineffective.

Striffer, P.S.
Hydrologist, U.S. Fish and Wildlife Service
Region 6 Division of Water Resources
Denver, CO

Works Cited

Basin Management Team. (2009). *Rattlesnake Creek Partnership, Second Four-Year Review of Management Program 2005-2008.* Topeka, KS: Kansas Department of Agriculture.

Basin Management Team. (2012, March 01). *Rattlesnake Creek Subbasin Management Program 12-Year Review*. Retrieved March 07, 2012, from Kansas Department of Agriculture::Rattlesnake Creek: http://www.ksda.gov/subbasin/content/201/cid/1974

Table of Figures

WATER PACK

Water Protection Association of Central Kansas

Water PACK's Position Paper

Part of the original management plan called for incentive based reduction programs as a way to reduce groundwater pumping. This in the most part relied on legislative action to approve and fund these new programs. During the first several years of this partnership agreement and management plan, virtually little progress was made through the legislature and no new programs were established to help to achieve our goals. Water PACK was actively lobbying along with others to create some new programs and incentives. In the last five years or so, more programs have been created and are newly implemented. Such as WTAP, AWEP, EQUIP, WATER BANKING, CREP and newly eliminated "USE IT OR LOSE IT" pumping laws. We feel that these programs that have more recently been put to use have the potential to greatly contribute to the reduction of ground water pumping Had these programs been implemented earlier we believe more progress would be realized or achieved by now. It is our opinion there are so many factors that affect stream flow, such as excessive number of volunteer mature trees and improved farming practices all along the Rattlesnake creek. The trees are tapping the water and the farming techniques greatly reduce run off from high rainfall events, which dramatically effect stream flow. We do not think additional reduction in groundwater pumping will guarantee the stream will flow when USFWS needs it.

We feel we can all agree on our usage for water is supply oriented, whether through irrigation pumping, stream flow or rainfall. We feel if USFWS has needs or demands that can't be met when there is little supply, they should pursue other options that may meet their needs, such as augmentation.

Phone (620) 549-3331 • Fax (620) 549-3332 • 306-A N. Main Street • St. John, Kansas 67576
E-mail waterpack@stjohnks.net

KSA 45-221(a)(20) – notes, drafts, memos, opinions

BIG BEND GROUNDWATER MANAGEMENT DISTRICT
NUMBER FIVE
125 SOUTH MAIN
STAFFORD, KANSAS 67578
TEL: 620-234-5352 - FAX: 620-234-5718

April 3, 2012

RE: Rattlesnake Creek Partnership Agreement Review

To the Rattlesnake Creek Partnership Partners:

It is the feeling of the board of directors of GMD #5 that the issues related to the Rattlesnake Creek Partnership have been conversed and addressed quite thoroughly.

The analysis of the data and the model that has been presented clearly shows that the problems described in the initial agreement occur on a far less frequent basis than what was put forth by the other partners. As stated in the Certificate of Appropriation for Water Right File No. 7571 "the right of the appropriator shall relate to a specific quantity of water and such right **must allow for a reasonable raising or lower of the static water level and for the reasonable increase or decrease of the stream flow at the appropriators point of diversion.**" The information shows that even though the flows were not available when USFWS **wanted** them, adequate flows were still available in all but eleven years in the records. In fact, in most years there was water in amounts substantially greater than what is allowed to be diverted by WR # 7571. In a letter sent to the USFWS in 1994 the Chief Engineer cautioned the Service that "even under pristine conditions, most of the streams in central and western Kansas are **not** a continuously dependable source of supply" thus reiterating the fact that, at times, low flows should be expected.

The processes which the District has diligently worked trying to appease the partnership agreement has cost the District hundreds of thousands of dollars. The actual programs first envisioned were not able to be implemented until 2006 and have had little to no use due to restrictions placed upon them by the state authority. These restrictions have led to difficulty in meeting the demands of the agreement. While we failed to meet them for the entirety of the 10-year rolling average there are signs of conservation and decreased use when looked at on a yearly basis.

The data presented by the Balleau Model is showing that even if all MDS wells within the boundaries of the sub-basin were to be shut off it would take approximately thirty years to see a result of 1 cfs increase in stream flow. This is by far a substantially greater impact on water users up stream than the resulting benefit at the point of diversion for WR #7571.

In closing, even though the water use goals that were agreed to were not met, we feel that they may have been extremely unreasonable considering the timeframe and lack of programs in place. The stream flow is available in more years than it is not and based on more accurate information being available now we believe there is no real issue to be addressed by the partnership, especially considering that the conditions of low flows was explicitly stated in the Certificate of Appropriation for Water Right File No. 7571.

Sincerely,

The Big Bend Groundwater Management #5 Board of Directors

Darrell Wood Edwards County	Phillip Martin Barton County	Curtis Tobias Rice County
John Janssen Kiowa County	Kent Lamb Stafford County	Fred Grunder Pratt County
Bob Standish Pawnee County	Ed Shultz Reno County	Tom Taylor Kiowa County Director–At-Large

KANSAS DEPARTMENT OF AGRICULTURE

Division of Water Resources

Stafford Field Office

MEMORANDUM

TO: Technical Services

DATE: February 29, 2012

FROM: Jeff Lanterman/ Cameron Conant

RE: Metering QNWR **File No. 7571**

See attached map regarding water management within the Refuge(QNWR). Doppler velocity sensors will be used on all these metering points. See the attached spec. sheet on the Doppler Sensor that they would like to use.

Pete Striffler is a hydrologist with the NWR out of Denver. He is coming up with the metering plan and applications for the refuge. (contact info: peter_striffler@fws.gov, 303-236-4494) We were urged to contact Pete if we had any questions about the metering they are proposing. We feel like the proposed metering plan should be approved by Technical Services prior to installing all the meters.

For the PD authorized NC SW 25–22S–11W:

This PD is the first PD out of the Little Salt Marsh, the furthest south PD for the refuge. Essentially they divert water in three places shown on the map, C1 A3 and A1.

A1 is a concrete box with 3 bays. The bays open up into an open box. Essentially they plan to install a sensor in the floor of the box. (downstream concrete) (upstream stop log)

A3 is a screw gate on an 18" Pipe. They will install the Doppler sensor in the bottom of the pipe. I guess Pete has said this would be a good application for this sensor. (upstream screw gate-18" pipe below WL)

C1 is a concrete box with 3 bays. They are considering putting in a flume with Doppler level sensor in the C Canal almost halfway to WU 14 and 14B or they may install a meter in similar fashion as A1 in the concrete downstream structure. (upstream stop log) (current downstream structure) (possible flume location in C Canal)

For the PD authorized SW NE NE 13–22S–11W:

They have 2 diverging diversions here 24D and 24C. 24D is hardly ever used, this is the first time in 10 years that they have used this structure.

Conant, Cameron

From: Bagley, Jim
Sent: Wednesday, March 28, 2012 2:36 PM
To: peter_striffler@fws.gov
Cc: Lanterman, Jeff; Conant, Cameron
Subject: USFWS Flow Monitoring Plan for Quivera National Wildlife Refuge

Follow Up Flag: Follow up
Flag Status: Flagged

Peter,

I have reviewed the subject plan and discussed it with our Stafford field office staff. In general I believe this is workable plan and I am impressed by how much thought has been given to this, however we do have one concern. The diversion represented by Lake Darrynane, which appears to be the authorized point of diversion in Section 13, T22S, R11W, still has two outlets which are not proposed to be metered: 20B and 24D. In your plan you indicated that those are rarely used and you proposed to manually monitor them when they are. While they may be difficult to meter, we still believe that it is in the best interest of everyone that these either be metered or not used at all. I am open to suggestions about how these might be modified so that they could be metered.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

24D This is a submerged structure 18 or 24" pipe. They did not think they could meter this point the way it is currently set up and were not planning on metering it as long as we agreed to that. (I think they DO need to meter this point of diversion since it could be considered a threat to divert) (upstream box)

24C This is a primary diversion point box structure. They would put a Doppler sensor in the ouflow pipe similar to the proposed setup on A3. (upstream stop log) (downstream)

DCA Currently a stop log and they plan to meter it on the apron of the box similar to A1 or they may install a flume in the DCA canal before the first real diversion out. (upstream) (upstream stop log) (downstream structure) (possible flume location in canal)

For the PD authorized SW SE NE 35–21S–11W:

RCA This is a main diversion for the Big Salt Marsh and others that direction. This has a wide apron and they thought they could install the Doppler sensor similar to A1. This is a wide concrete box with 4 stop log structures split by a concrete stem wall (wondered how the meter could be effected by flowing around the stem wall). Water can also be bypassed and dumped straight into Rattlesnake Creek. (upstream structure) (downstream apron and stem wall) (rattlesnake bypass structure and valve)

Miscellaneous Notes:

Mike told us that ever since he has become manager (4 years now) he has made a concerted effort to upgrade the efficiency of the water management at the refuge.

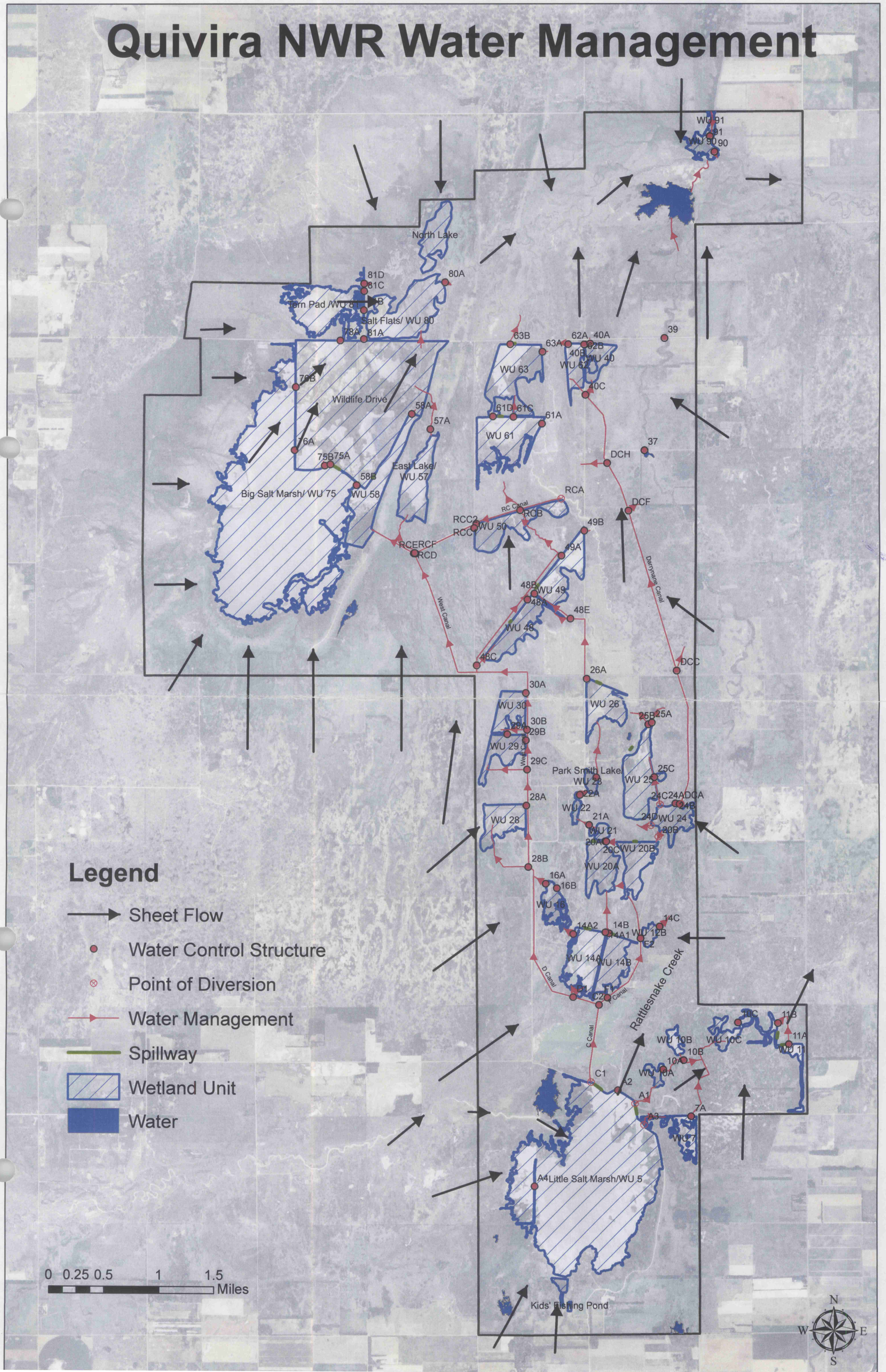
1. He has been working very hard to eradicate salt cedar and control cattails.
2. He has been cleaning out canals to make it easier to move the water around.
3. They have been reshaping their pools filling in the deeper areas so they can have more even coverage in the pools. Essentially going for a more even distribution and larger pool surface for habitat. More efficient use of the water diverted.

Miscellaneous Pictures:
(rattlesnake into quivira)
(rattlesnake leaving quivira near 63A)
(salt creek leaving refuge near 80A prior to dumping into rattlesnake)
(@ C1 looking south into little salt marsh)

pictures located at SFFO shared drive

H:\Shared Data\Misc\Quivira NWR Metering Project

Quivira NWR Water Management



Legend

- Sheet Flow
- Water Control Structure
- Point of Diversion
- Water Management
- Spillway
- Wetland Unit
- Water

0 0.25 0.5 1 1.5 Miles

Conant, Cameron

From: Bagley, Jim
Sent: Wednesday, March 28, 2012 2:36 PM
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Cc: Lanterman, Jeff; Conant, Cameron
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Kansas Department of Agriculture
Water Management Services
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(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

Conant, Cameron

From: Bagley, Jim
Sent: Tuesday, March 27, 2012 4:31 PM
To: Lanterman, Jeff; Conant, Cameron
Subject: RE: USFWS Flow Monitoring Plan

OK. Thanks.

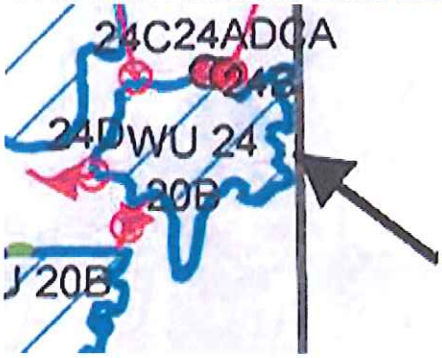
James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

From: Lanterman, Jeff
Sent: Tuesday, March 27, 2012 1:42 PM
To: Bagley, Jim; Conant, Cameron
Subject: RE: USFWS Flow Monitoring Plan

Jim;

Cameron and I have been chatting about this and pouring over the map.

We do believe that if 20B can be discharged to the south it needs to be metered. (The arrow on 20B only goes one way)



We also think 24D should be metered. We saw it in operation. That is the whole authorized 2nd PD. If they would give us notice that 24D and 20B are not going to be used then I think we could give them a pass on it. But it seems like a threat to divert.

Also this came up at the last partnership meeting. I guarantee we could get hit on this if we don't get it metered right. Wes came in and looked at the files and picked up our metering file and looked at it and immediately picked up on the issue at 24D.

We understand this will be hard for them but in order to catch all diverted flows we believe that both should be metered.

Jeff

From: Bagley, Jim
Sent: Tuesday, March 27, 2012 1:16 PM
To: Conant, Cameron; Lanterman, Jeff
Subject: RE: USFWS Flow Monitoring Plan

I think after looking at this again, you are correct that normally water is moved from Unit 24 to Unit 20 through site 20B. They can, however, move water either way through 20B. They claim that 20B and 24D are rarely used and that if they are, they would be monitored manually (see page 14 of the Flow Monitoring Plan). Also, it appears to me that if water is moved to Unit 20 south through 20B, it is water already captured by 24B (which appears to be the main diversion point for Unit 24). Sites 24C and 24DCA appear to be control structures to release water out of Unit 24 to the north. How big an issue do we need to make out of metering these two (20B and 24D) sites? I think the rest of the plan is probably as good as can be expected.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

From: Conant, Cameron
Sent: Tuesday, March 27, 2012 12:47 PM
To: Bagley, Jim; Lanterman, Jeff
Subject: RE: USFWS Flow Monitoring Plan

After reviewing it again, here is what I think. The way I understood it is that WU24 is basically a pool on the Rattlesnake, any diversion not going straight back to the creek from that pool would need to be metered (24C, 24D, DCA and 20B appear to require meters). Seems like structure 20B could be used to take water from WU24 and put it into 20B therefore bypassing the metered point at C1. I don't believe water could move from WU 20B into WU24, I think it could only go the other way, from WU24 into WU20B through the 20B structure.

We did not discuss control structure 20B while "on site" but looking at the map it appears to be a similar situation as what was explained on 24D. Looking at it like this, it appears that 20B could be considered a direct diversion and if so, should be metered.

Jeff, feel free to add anything if I'm off track here.

Cameron

From: Bagley, Jim
Sent: Tuesday, March 27, 2012 11:41 AM
To: Lanterman, Jeff
Cc: Conant, Cameron
Subject: RE: USFWS Flow Monitoring Plan

I've had a chance to look at this again. I don't think 20B is actually a diversion from Rattlesnake Creek. It appears to be a control structure on a pond into which diversions from c1 flow. The 20B structure does one or both of two things, I think: 1) releases water back to RSC, 2) releases water into Darrynane Lake Unit 24. Let me know if you think this is correct. If it is, then I don't know that 20B would need to be metered.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services

Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

From: Lanterman, Jeff
Sent: Thursday, March 08, 2012 4:45 PM
To: Bagley, Jim
Cc: Conant, Cameron
Subject: RE: USFWS Flow Monitoring Plan

Jim;

For the PD authorized NC SW 25–22S–11W: We think they should meter at a1, a3 and c1.

For the PD authorized SW NE NE 13–22S–11W: We think they should meter at DCA, 24D and 24C.

Quivera does not want to meter at 24D as they think with the current structure being submerged all the time they couldn't meter it accurately. And they rarely use it. We think because they do divert there they need to meter it. This is probably the only point of contention between us so far. I see that they did not list 24D as a metered location on the plan that they sent you. If this is not metered and the diversion is used then all water use under 7571 is not being metered. (I don't think we were showed 20B on our tour but if it diverts water from the creek it may need a meter also)

For the PD authorized SW SE NE 35–21S–11W: They need to meter it at the RCA Structure.

We have pictures of the locations linked to the document. Should give you an idea of what they are talking about. If the links work in the document for you guys up in Topeka.

Dan did tell us that if you would like to come out and tour Quivera with Peter and look at the diversions he would be happy to come out and discuss this all with you.

I copied Cameron on this to see if he had anything to add.

Jeff

From: Bagley, Jim
Sent: Thursday, March 08, 2012 2:20 PM
To: Lanterman, Jeff
Subject: FW: USFWS Flow Monitoring Plan

Jeff,

I have begun reviewing this. I need your help in determining whether the number and selection of sites they have chosen to meter is adequate. I will determine whether the methods and equipment are acceptable.

James O. Bagley, P.E., Section Head
Kansas Department of Agriculture
Water Management Services
Technical Services
(785) 296-6083
Jim.Bagley@kda.ks.gov
www.ksda.gov/dwr

From: Peter_Striffler@fws.gov [mailto:Peter_Striffler@fws.gov]
Sent: Thursday, March 08, 2012 12:25 PM
To: Bagley, Jim
Subject: USFWS Flow Monitoring Plan

Jim-

Attached is the flow monitoring plan for Quivira National Wildlife Refuge to provide continuous metering of the diversions from Rattlesnake Creek under KS water right 7571. I have attached as appendices the specifications for the Doppler velocity profilers as well as the electromagnetic flow meters used for stream gaging. Please review this plan and provide comments back to me.

Peter S. Striffler
Hydrologist, Division of Water Resources
US Fish and Wildlife Service, Region 6
134 Union Blvd. Ste-250
Lakewood, CO 80228
(303) 236-4494

Conant, Cameron

From: Meg_Estep@fws.gov
Sent: Friday, March 23, 2012 12:55 PM
To: Beightel, Chris
Cc: Lyon, Andrew; 'Kent Askren'; 'Balleau Groundwater, Inc. (balleau@balleau.com)'; 'Barbara Boyle'; Conant, Cameron; 'Carrie Cordova (carrie_cordova@fws.gov)'; Gnau, Chris; 'Dan_Severson@fws.gov'; Paull, Darci; Barfield, David; 'Dennis Dutton (ddscc@gbta.net)'; Coe, Diane; Lanterman, Jeff; Allen, Lisa; Feril, Orrin; 'Peter Striffler'; 'Rachel_Laubhan@fws.gov'; Frost, Steve; Stover, Susan; Lanzrath, Tara; 'Wes Essmiller'
Subject: RE: Rattlesnake Creek Partnership 12-Year Review 2nd Kickoff Meeting

All:

Since there appeared to be some confusion as to the basis for the Refuge's water right and what is measured, I am writing this email to provide clarification. First, the Refuge has three State-recognized points of diversion, C-1 at the outlet of the Little Salt Marsh, DCA at the entrance to the Darrynane Canal, and RCA at the entrance to the Rattlesnake Creek Canal. There are actually mutiple outlets at each of these diversions (see Pete Striffler's map on the DWR website).These three points of diversion have historically been measured at all of those outlets, and that is the water use that has been reported to the State. None of these diversions include the water used to fill the Little Salt Marsh or the net evapotranspiration from the Little Salt Marsh. At the time we perfected our water right, it was based on the highest reported diversion (1987, 10,172 ac-ft) plus the capacity of the Little Salt Marsh (1865 ac-ft) , plus net ET from the Little Salt Marsh (2595 ac-ft) for a total water right of 14,632 ac-ft. We actually diverted 11,213 ac-ft as measured at the points of diversion listed above in 1993, but this was after the water right had been perfected.

One other point of clarification that I want to make concerns a comment about our apparent non-use of all of the flow of Rattlesnake Creek. Just like the farmers cannot benefit from precipitation that occurs outside of the growing season, it is pointless for us to divert water when we can't beneficially use it. If we are managing some units to promote the growth of certain plants, we may not want to fill them. If all the units are filled to the management target elevation that meets the needs of the birds and other wildlife we are trying to manage, we likewise would not divert additional water into them. We have always (since the inception of the Partnership) stressed that one of the biggest issues for us is the timing of water availability. Most of the water shortages occur in the late summer/fall period when we are trying to refill units for fall migration.

I hope this helps clarify things and addresses some questions that are out there.

Megan A. Estep
Chief, Division of Water Resources
Region 6
P.O. 25486, DFC
Denver, CO 80225

(303)236-4491
Meg_Estep@fws.gov

RECEIVED
Water Resources

FEB 11

FWS - Region 6
(60189)

2013
WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

IMPORTANT

COMPLETE AND RETURN BY MARCH 1, 2014

CERTIFIED MAIL RECOMMENDED

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Ending Water Meter Reading	Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Depth to Water	Date
.	7571-00 3100N 1150W 35-21S-11W	1	3 0								
	RCA										
.	7571-00 4450N 1000W 13-22S-11W	1	A 508.6+		→						
	Darrynane										
.	7571-00 1250N 3850W 25-22S-11W	1	A 2203.3+		→						
	Little Salt Marsh										
	860841										
	Total		2711.9+								

+ - Acre Feet of Surface Water diverted

WATER RESOURCES
RECEIVED
FEB 14 2014
KS DEPT OF AGRICULTURE

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown. All dates are for the previous calendar year.

March 1					July 1					November 1				
Empty	¼	½	¾	(Full)	Empty	(¼)	½	¾	Full	Empty	¼	(½)	¾	Full

Date: 1/29/14 Telephone: (620) 486-2393

13 11631 18302 1 1 - REC Staff SF
Office Use FO CO GMD

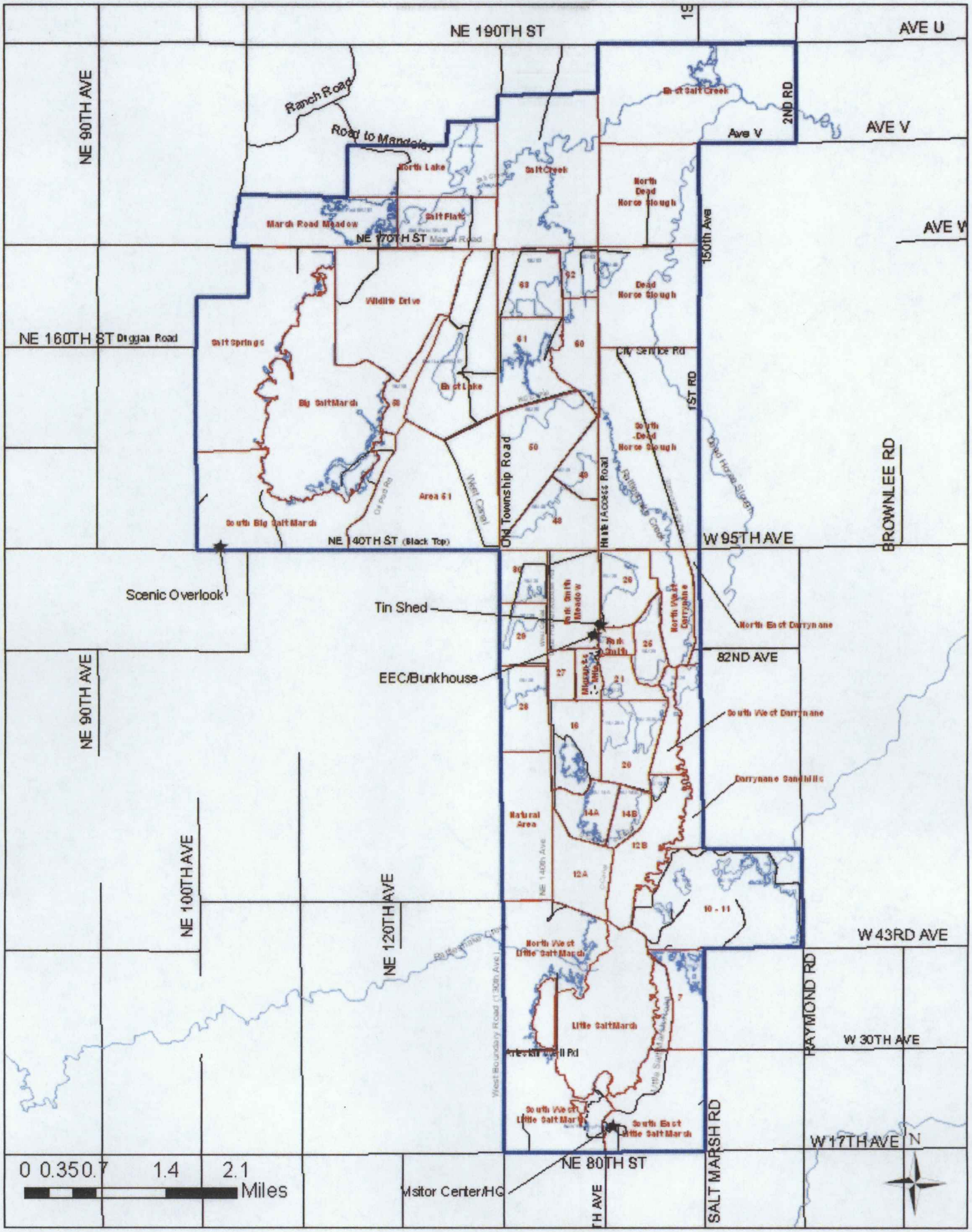
US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

Mike Oldham, Refuge Manager
Name (Printed or Typed)

Mike M. Oldham
Name (Signature)

_____ Owner _____ Tenant X Agent

Quivira National Wildlife Refuge Locality Map



Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

phone: (785) 296-3717
fax: (785) 296-1176
www.ksda.gov/dwr

Dale A. Rodman, Acting Secretary
David W. Barfield, Chief Engineer

Kansas Department of Agriculture

Sam Brownback, Governor

February 3, 2011

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

Re: Meter Order
File No(s). 7571

Dear Sir/Madam:

Enclosed is an Order requiring that the owners of the referenced files install water flowmeters on the authorized point(s) of diversion by December 31, 2011. Water right owners will be required to report metered quantities on all water diverted on or after January 1, 2012.

The enclosed Order requires your immediate attention. Please read it very carefully, as it affects your use of water as authorized by the above listed files(s) and sets forth deadlines you must meet in order to preserve your legal rights. This is the only notice you will receive prior to the meter installation.

The Chief Engineer is requiring the installation of meters on all surface water pumpsites located within the boundaries of Western Kansas Groundwater Management District No. 1, Southwest Kansas Groundwater Management District No. 3 and Big Bend Groundwater Management District No. 5 for which meters have not been previously required. The purpose of requiring the installation of meters is to facilitate the need for increased water management and to promote the efficient use of water in the area. Most areas in Kansas are already required to have meters.

The deadline for installing meters will be strictly enforced. Enforcement may include civil penalties and/or modification or suspension of the water right. Any request for an extension of time to install the required meter(s) must be made in writing to the Garden City Field Office or the Stafford Field Office at least 30 days prior to the meter installation deadline. Any extension request must state compelling reasons why additional time is needed. Please contact your field office if you have questions concerning proper meter installations.

A copy of the current meter regulations and the list of certified meters can be found online at www.ksda.gov/appropriation/content/274. A "Report of Installation of Water Flow Meter" form is enclosed. A separate Report of Installation form must be submitted for each meter that is installed to the address shown on the form, within 30 days after the meter installation. **If a meter is currently installed, the Report of Installation form must be submitted by April 1, 2011.**

It is understood that many surface water diversions in the western portions of the state are no longer in use because of a lack of water. A field visit will be made to the authorized pumpsites in order to determine whether or not a meter is installed. If no meter is found, for whatever reason, then an order will be issued requiring any diversion of water for non-domestic uses to cease until a meter is installed and the installation is verified by the field office that maintains jurisdiction in your area.

If you have any questions, please feel free to contact the Stafford Field Office at 620.234.5311. When you contact us, please refer to the referenced file number(s) and indicate you have questions regarding this meter order.

Sincerely,

Jeff Lanterman
Water Commissioner
Stafford Field Office

Enclosures

cc: Stafford Field Office

THE STATE OF KANSAS

KANSAS DEPARTMENT OF AGRICULTURE
Dale A. Rodman, Acting Secretary of Agriculture

DIVISION OF WATER RESOURCES
David W. Barfield, Chief Engineer

BEFORE THE KANSAS DEPARTMENT OF AGRICULTURE DIVISION OF WATER RESOURCES

IN THE MATTER OF
US DEPT OF INTERIOR

File No(s). 7571

ORDER REGARDING INSTALLATION OF WATER FLOWMETERS ON SURFACE WATER RIGHTS WITHIN THE BOUNDARIES OF WESTERN KANSAS GROUNDWATER MANAGEMENT DISTRICT NO. 1, SOUTHWEST KANSAS GROUNDWATER MANAGEMENT DISTRICT NO. 3 AND BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5

The Chief Engineer, Division of Water Resources, Kansas Department of Agriculture, under authority of Kansas Statutes Annotated (K.S.A.) 82a-701 *et seq.*, after due consideration, hereby makes the following Findings and Order:

FINDINGS OF FACT

1. Installation of totalizing water flowmeters on all surface water points of diversion located within the boundaries of Western Kansas Groundwater Management District No. 1, Southwest Kansas Groundwater Management District No. 3 and Big Bend Groundwater Management District No. 5, with the exception of those points of diversion used solely for domestic purposes or authorized by temporary permits, will provide accurate water use data to enable the Chief Engineer to manage the water resources of the State, and will enable holders of water rights to report their water use accurately and in a timely manner, as required by K.S.A. 82a-732.

2. Installation of totalizing water flowmeters on all surface water points of diversion located within the boundaries of Western Kansas Groundwater Management District No. 1, Southwest Kansas Groundwater Management District No. 3 and Big Bend Groundwater Management District No. 5, with the exception of those points of diversion used solely for domestic purposes or authorized by temporary permits, will implement elements of the Kansas Water Plan, which recommends the installation of water flowmeters on all non-domestic points of diversion by the end of calendar year 2015.

3. The points(s) of diversion authorized by the Water Right(s), Appropriation(s) of Water or Term Permit(s) identified above is/are within the boundaries of Western Kansas Groundwater Management District No. 1, Southwest Kansas Groundwater Management District No. 3 and Big Bend Groundwater Management District No. 5 and is/are not used solely for domestic purposes or authorized by a temporary permit(s).

CONCLUSIONS OF LAW

4. The Chief Engineer is required to control, conserve, regulate, allot, and aid in the distribution of the water resources of the State pursuant to K.S.A. 82a-706.

5. The Chief Engineer is authorized, pursuant to K.S.A. 82a-706c, to require the installation of water flowmeters and has adopted minimum specifications for such meters. K.S.A. 82a-706c also authorizes the Chief Engineer to require water users to report the reading of such meters at reasonable intervals.

ORDER

NOW, THEREFORE, it is the decision and order of the Chief Engineer, Division of Water Resources, Kansas Department of Agriculture:

6. That the owner of the Water Right(s), Appropriation(s) of Water or Term Permit(s) identified in this order shall install a totalizing water flowmeter which meets or exceeds specifications adopted by the Chief Engineer on each authorized point of diversion no later than **December 31, 2011.**

7. The totalizing water flowmeter shall be maintained in operating condition satisfactory to the Chief Engineer as set forth in K.A.R. 5-1-8.

8. The owner of the Water Right(s), Appropriation(s) of Water or Term Permit(s) shall notify the Chief Engineer, in writing, within 30 days of completion of the meter installation required under this order. Such notice shall be provided on a Report of Installation of Flowmeter form obtained from the Division of Water Resources.

9. If a water flowmeter was installed on any point of diversion included within this order prior to the date of this order, the owner shall notify the Chief Engineer, in writing, by **April 1, 2011.** Such notice shall be provided on a Report of Installation of Flowmeter form obtained from the Division of Water Resources. Any water flowmeter installed prior to this order, installed according to specifications at the time of the installation and maintained in accordance with those specifications, shall be considered in compliance with this order unless the meter's accuracy is in question.

10. The owner of the Water Right(s), Appropriation(s) of Water or Term Permit(s) shall report on the annual water use report, pursuant to K.S.A. 82a-732 and K.A.R. 5-3-5e, by March 1 following the end of the calendar year in which the meter was installed, the following information:
    A) Usage for the portion of the year in which the diversion was not metered; and
    B) Beginning and ending meter readings for the portion of the year in which the diversion was metered.
    The owner shall report meter readings each subsequent year on the annual water use report thereafter.

11. The conditions of this order requiring installation, maintenance and use of water flowmeters shall become conditions of the Water Right(s), Appropriation of Water or Term Permit(s) identified in this order.

12. This is a final agency action as defined in K.S.A. 77-607(b) (2). You may pursue judicial review of this order as provided in the Kansas Act for Judicial Review (K.S.A. 77-601 *et seq.*). A petition for judicial review must be filed in a Kansas court of competent jurisdiction within 30 days after service of this order as provided in K.S.A. 77-613. The agency officer designated to receive service of a petition for judicial review on behalf of the Kansas Department of Agriculture is Chief Legal Counsel, Kansas Department of Agriculture, 109 SW 9th Street, 4th Floor, Topeka, Kansas 66612.

13. This order contains terms, conditions, and limitations imposed by the Chief Engineer on the referenced Water Rights(s), Appropriation(s) of Water or Term Permit(s). Failure to comply with the provisions of this order may result in civil penalties of up to $1000 per day of violation and/or the modification or suspension of the water right or use of water under this water right or appropriation of water permit pursuant to K.S.A. 82a-737.

14. The Chief Engineer specifically retains jurisdiction in this matter to make such changes, additions, or deletions to this order, as he deems necessary in the public interest.

Dated at Topeka, Kansas, this 3rd day of February, 2011.

David W. Barfield

David W. Barfield, P.E.
Chief Engineer

Certificate of Service

A copy of the foregoing Order was sent by First Class mail service this 3rd day of February, 2011, to the following:

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

Cathy Darnall

Cathy Darnall

2010
WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

COMPLETE AND RETURN BY MARCH 1, 2011

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
.	7571-00	3100N 1150W 35-21S-11W 1	S								
.	7571-00	4450N 1000W 13-22S-11W 1									
.	7571-00	1250N 3850W 25-22S-11W 1									

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown. All dates are for the previous calendar year.

March 1					July 1					November 1				
Empty	¼	½	¾	Full	Empty	¼	½	¾	Full	Empty	¼	½	¾	Full

Date: _____ Telephone: (___) _____

10 18302 1 1 - REC Staff SF 63 2291
Office Use FO CO GMD

691328
Name (Printed or Typed)

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

WATER RESOURCES
RECEIVED
FEB 28 2011
KS DEPT OF AGRICULTURE

Name (Signature)

_____ Owner _____ Tenant _____ Agent

2010
WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

COMPLETE AND RETURN BY MARCH 1, 2011

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
.	7571-00 3100N 1150W 35-21S-11W 1 (RCA)	A	569.2*								
.	7571-00 4450N 1000W 13-22S-11W 1 (Darrynane)		1113.7*								
.	7571-00 1250N 3850W 25-22S-11W 1 (Little Salt Marsh)		6842.5*								
	Total		8525.4*								

CERTIFIED MAIL
7001 0360 0003 9863 9421

* Acre-feet surface water diverted

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown. All dates are for the previous calendar year.

March 1					July 1					November 1				
Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)	Empty	¼	½	(¾)	Full

WATER RESOURCES
RECEIVED
JAN 24 2011
KS DEPT OF AGRICULTURE

Date: 1/10/2011 Telephone: 620 486-2393

10 18302 1 1 - REC Staff SF 63 2291
Office Use FO CO GMD

691023

DAN SEVERSON, Refuge Manager
Name (Printed or Typed)

Dan Severson
Name (Signature)

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

_____ Owner _____ Tenant X Agent

2009 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2010.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	3100N 1150W 35-21S-11W 1 (RCA)	S	0.0 *		0						
7571-00	4450N 1000W 13-22S-11W 1 (Darrynane)	A	646.8 *		646.8						
7571-00	1250N 3850W 25-22S-11W 1 (Little Salt Marsh)	A	1112.9 *		1112.9						
	Total		1759.7 *								

CERTIFIED MAIL

7000 1670 0005 4908 6595

632291

* Acre-feet surface water diverted.

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown.

March 1, 2009					July 1, 2009					November 1, 2009				
Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)

WATER RESOURCES
RECEIVED
FEB 09 20[illegible]

Date: _____ Telephone: (620) 486-2393

KS DEPT OF AGRICULTURE

09 11815 18302 1 1 - REC Staff SF

Office Use FO CO GMD

Dan Severson, Refuge Manager
Name (Printed or Typed)

Dan Severson
Name (Signature)

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

_____ Owner _____ Tenant X Agent

Quivira

2009 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2010.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	3100N 1150W 35-21S-11W 1	S									
7571-00	4450N 1000W 13-22S-11W 1										
7571-00	1250N 3850W 25-22S-11W 1									632594	

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown.

March 1, 2009					July 1, 2009					November 1, 2009				
Empty	¼	½	¾	Full	Empty	¼	½	¾	Full	Empty	¼	½	¾	Full

WATER RESOURCES
RECEIVED
MAR 01 2010
KS DEPT OF AGRICULTURE

RECEIVED
JUN 08 2011
Stafford Field Office
Division of Water Resources

Date: _____ Telephone: (___) _____

09 11815 18302 1 1 - REC Staff SF

Office Use FO CO GMD

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

_____
Name (Printed or Typed)

_____
Name (Signature)

_____ Owner _____ Tenant _____ Agent

2008 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2009**. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
. 7571-00	3100N 1150W 35-21S-11W 1 (RCA)	A 364 0 *			Q					
. 7571-00	4450N 1000W 13-22S-11W 1 (Darrynane)	A 1079 5 *			Q					
. 7571-00	1250N 3850W 25-22S-11W 1 (Little Salt Marsh)	A 1878 9 *			Q					
	Total	3322.4 *								

CERTIFIED MAIL

7000 1670 0005 4908 6632

* Acre feet surface water diverted,

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown.

March 1, 2008					July 1, 2008					November 1, 2008				
Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)

572403

Date: 2/9/2009 Telephone: 620 486-2393

08 11880 18302 1 1 - REC Staff SF
Office Use FO CO GMD

DAN SEVERSON, Refuge Manager
Name (Printed or Typed)

Dan Severson
Name (Signature)

US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

WATER RESOURCES
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FEB 20 2009
KS DEPT OF AGRICULTURE

____ Owner ____ Tenant X Agent

DWR 1-513 (Revised 11/5/2008) 2008 RECREATIONAL WATER USE REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO

BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

OCT - 7 2008

Ms. Tina Alder, Subbasin Water Resource Management Program
Kansas State Board of Agriculture
Division of Water Resources - Basin Team
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612

Dear Ms. Alder:

The U.S. Fish and Wildlife Service (Service) and the other Partners have been asked to provide goals (or more appropriately termed, "action items") to promote accomplishment of the original goals of the Rattlesnake Creek Subbasin Management Plan over the last four years of the Plan. Again, it was agreed during the 8-year review meeting that these action items are not meant to replace or change the original Plan goals. In response to the request for action items, the Service has provided: (1) an update on the Service's progress in the accomplishment Plan goals; and (2) our perspective of overall progress-to-date and recommendations regarding action items that are not our responsibility.

Service Progress in the Accomplishment of Plan Goals:
In an attempt to do our part to conserve available water, the Refuge has re-contoured five wetland basins to remove deep borrow areas and produce better waterfowl habitat with less water demand. During the past eight years the Refuge has removed over 60,000 trees that were consuming water, rehabilitated numerous water control structures to better manage available water, and cleaned out canals and removed invasive cattails to allow better water delivery with less seepage and evapotranspiration loss.

Service Perspective of Basin Team Progress and Recommendations of Action Items:
The Service feels very strongly that, given the lack of progress in almost all of the proposed water use reduction programs, the Division of Water Resources needs to begin determining whether an Intensive Ground Water Use Control Area (IGUCA) will be implemented, and exactly what administrative actions will be taken in order to ensure that the agreed upon ground water use reduction goals will be met. The Service agreed to work through this Plan in order to allow irrigators a chance to adjust their operations to meet water use reductions without severely impacting them economically. We have been very patient over the past eight years, and have been disappointed in the amount of water use reduction that has taken place. We do not feel that we should be subjected to waiting an additional amount of time for the Division of Water

Resources to develop an IGUCA if the ground water reduction goals are not met by 2012. The plan should be fully developed and ready to implement at that time.

While we agree that it is useful to proceed with the proposed ground water modeling effort, and concede that the new model may offer insight into adjusting some of the reduction goals, the goals were agreed on by all of the Partners at the time the Plan was written. These are the goals that the Division of Water Resources needs to be prepared to enforce.

The Service is also concerned about the change in land use currently taking place in the area. The Service has spent considerable time and effort to remove high water-use invasive species from Refuge lands (tamarisk, sand plum, Russian olive, cedar), with a goal of reducing water use by these plants. Concurrently, we have witnessed the transformation of adjacent agriculture and grassland areas to "hunting" areas, where trees are encouraged and/or allowed to grow. This type of land use consumes more water than the crops or grassland habitats they replace. The Service is equally concerned about the change in cropping patterns from lower water-use crops to higher water demand crops, such as corn. We feel that the ongoing changes in land use and the recent changes in cropping patterns in the Subbasin should be incorporated into the modeling.

If you need additional information, please contact Megan Estep at meg_estep@fws.gov or call (303) 236-4491.

Sincerely,

for J. Paul Cowan, Acting

Bud Oliviera, Deputy Assistant Regional Director
Refuges and Wildlife

cc: Big Bend Groundwater Management District No. 5
125 South Main Street
Stafford, Kansas 67578-0007

Water Protection Association of Central Kansas
306 N. Main Street #A
Saint John, KS 67576

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

MAILING ADDRESS:
P.O. Box 25486, DFC
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Boulevard
Lakewood, Colorado 80228-1807

BA WTR
WR KS
Mail Stop 60189

CERTIFIED 7001 0360 0003 9863 9957

FEB 22 2008

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Sir or Madam:

Enclosed is the 2007 Water Use Report for Permit 7571 for Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5399.

Sincerely,

Carrie Cordova

Carrie Cordova
Water Rights Specialist

Enclosure

WATER RESOURCES
RECEIVED
FEB 27 2008
KS DEPT OF AGRICULTURE

511192

2007 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON USUAGE, IN ORDER TO PROTECT YOU RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2008.** Please begin by reading the instruction for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of you interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, pleas contact the Water Use Coordinator at (785)298-1054. Please make a copy of the entire Water Use Report for you records, and return the original report to:

Water Use Coordinator
Kansas Depart of Agriculture
Division of Water Resources
109 S. W. 9th, Second Floor
Topeka, Kansas 66612-1283

CERTIFIED MAIL

7001 0360 0003 9863 9957

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (GPM)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00 3100N 1150W 35-21-11W (RCA)	1	9	1,230.7*								
7571-00 4450N 1000W 13-22-11W (Darrynane)	1	9	1,731.6*								
7571-00 1250N 3850W 25-22-11W (Little Salt Marsh)	1	9	4,484.3*								
	Total										

* Acres of Surface Water Diverted

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir.

March 1, 2007: Empty ¼ ½ ¾ (Full)

July 1, 2007: Empty ¼ ½ (¾) Full

November 1, 2007: Empty ¼ ½ ¾ (Full)

WATER RESOURCES RECEIVED
FEB 27 2008
KS DEPT OF AGRICULTURE

511191

Date: 1/31/2008 Telephone: (620) 486-2393

04 12172 18302 1 1 – REC Staff SF
Office Use FO CO GMD

James Sellers, Acting Refuge Manager
Name (Printed or Typed)

Name (Signature)

U S Dept of Interior
Fish & Wildlife Service
PO Box 25486
Denver CO 80225

___ Owner ___ Tenant X Agent

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

MISCELLANEOUS WORKSHEET

1. File No(s).	1a. ☐ Vested Right ☐ Water Right ☐ Appropriation of Water	2. FO	3. GMD
7,541		2	

4. Type and Purpose of Letter APPROVAL

Type of Extension _____ ~~Completion~~ Date 10-23-2000

Date Received _____ ~~Perfection~~ Date _____

☐ Completion of Diversion Works: ☐ Permit ☐ Change Approval

☐ Meter Installed _____

☐ Dismissal _____

☑ Other WATER CONSERVATION PLAN APPROVED

5. Name and Address PID_____

5a. PC Name and Address PID_____

Name and Address PID_____

Name and Address PID_____

★ ALL OF THIS NEEDS TO BE MICROFILMED ★

6. General Information

Priority Date _____

Certificate Date _____

Vested Right Order Date _____

Approval Date _____

Priority Date of Change _____

Approval of Change Date _____

Completion Date _____

Perfection Date _____

7. Use of Water ☐ Groundwater ☐ Surface Water

☐ DOM ☐ IND ☐ IRR
☐ MUN ☐ REC ☐ STK
☐ WTR ☐ ART ☐ CON

RECEIVED
MAY 25 2007
STAFFORD FIELD OFFICE
DIVISION OF WATER RESOURCES

8. Battery Number _____

9. Special Use _____

10. Aquifer _____

Date Prepared 4/13/07 By RSL

Date Entered 4/16/07 By JAE

(see reverse for point of diversion and place of use)

DWR 1-664 (Rev. October 18, 1999)

MICROFILMED

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
109 SW 9th Street
Topeka, Kansas 66612-1280
(785) 296-3558
FAX: (785) 296-8389

Division of Water Resources
David L. Pope, Chief Engineer
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283
(785) 296-3717 FAX (785) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

October 23,2000

United States Department of Interior
Fish and Wildlife Service, Mountain-Prairie Region
Post Office Box 25468, Denver Federal Center
Denver, Colorado, 80225
Attn: Megan A. Estep-Johnson, refuge Hydrologist

Dear Ms. Estep-Johnson:

Thank you for providing the additional information concerning the Quivira National Wildlife Refuge Water Conservation Plan. My apologies for not responding sooner to your correspondence.

It appears that by including the additional information that you discussed in your letter that was received in this office on August 25, 2000, the Refuge's Water Conservation Plan will meet the requirements outlined in the Findings and Order of the Chief Engineer dated September 26, 1996. That includes an implementation schedule based upon streamflow conditions and climatic factors, and a drought contingency plan. Also, we still need the documentation of installation of the water flow measurement devises and structures for monitoring the amount of natural flows diverted from Rattlesnake Creek for recreational use at the Refuge.

Thanks again for developing an acceptable water conservation plan for the Refuge. If you have any questions please feel free to contact me.

Sincerely,

Robert F. Lytle Jr.

Robert F. Lytle Jr.
Environmental Scientist

Pc: Stafford Field Office

2006 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON USUAGE, IN ORDER TO PROTECT YOU RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2007.** Please begin by reading the instruction for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of you interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, pleas contact the Water Use Coordinator at (785)298-1054. Please make a copy of the entire Water Use Report for you records, and return the original report to:

Water Use Coordinator
Kansas Depart of Agriculture
Division of Water Resources
109 S. W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (GPM)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00 3100N 1150W 35-21-11W (RCA)	1	A	1512.9*			Q					
7571-00 4450N 1000W 13-22-11W (Darrynane)	1		1506.4*								
7571-00 1250N 3850W 25-22-11W (Little Salt Marsh)	1		1856.1*								
	Total		~~4875.4~~*								

CERTIFIED MAIL

7001 0360 0003 9863 9902

* Acre feet of surface water diverted.

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir.

March 1, 2006					July 1, 2006					November 1, 2006				
Empty	¼	½	¾	(Full)	Empty	¼	(½)	¾	Full	Empty	(¼)	½	¾	Full

WATER RESOURCES
RECEIVED
FEB 0 8 2007
KS DEPT OF AGRICULTURE

45 856

Date: 1/18/2007 Telephone: (620)486-2393

OL
~~04~~ 12192 18302 1 1 – REC Staff SF
Office Use FO CO GMD

David Hilley, Refuge Manager
Name (Printed or Typed)

David Hilley
Name (Signature)

U S Dept of Interior
Fish & Wildlife Service
PO Box 25486
Denver CO 80225

___ Owner ___ Tenant X Agent

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 0 6 2006

CERTIFIED 7001 0360 0003 9863 9865

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2005 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5399.

Sincerely,

Carrie Cordova

Carrie Cordova
Water Rights Specialist

Enclosure

WATER RESOURCES
RECEIVED
FEB 10 2006
KS DEPT OF AGRICULTURE

39 820

2005 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON USUAGE, IN ORDER TO PROTECT YOU RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH1, 2004.** Please begin by reading the instruction for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of you interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, pleas contact the Water Use Coordinator at (785)298-1054. Please make a copy of the entire Water Use Report for you records, and return the original report to:

Water Use Coordinator
Kansas Depart of Agriculture
Division of Water Resources
109 S. W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (GPM)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00 3100N 1150W 35-21-11W (RCA)	1	A	1259.3*			Q					
7571-00 4450N 1000W 13-22-11W (Darrynane)	1	A	1237.4*								
7571-00 1250N 3850W 25-22-11W (Little Salt Marsh)	1	A	2062.6*								
	Total		4559.3*								

CERTIFIED MAIL

7001 0360 0003 9863 9865

* Acre Feet of Surface Water Diverted.

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir.

March 1, 2005					July 1, 2005					November 1, 2005				
Empty	¼	½	¾	[redacted]	Empty	¼	½	¾	[redacted]	Empty	¼	½	¾	Full

WATER RESOURCES
RECEIVED

FEB 1 0 2006

KS DEPT OF AGRICULTURE

39 812

Date: 1/24/2006 Telephone: (620)486-2393

05 12116 18302 1 1 – REC Staff SF
Office Use FO CO GMD

David Hilley, Refuge Manager
Name (Printed or Typed)

U S Dept of Interior
Fish & Wildlife Service
PO Box 25486
Denver CO 80225

Name (Signature)

___ Owner ___ Tenant X Agent

QUIVIRA NATIONAL WILDLIFE REFUGE

STAFFORD, KANSAS

ANNUAL WATER MANAGEMENT PLAN

2005 WATER USE REPORT

2006 RECOMMENDATIONS

Submitted by _____ Date 1/24/06
Refuge Manager

Reviewed by _____ Date 2-5-06
Refuge Supervisor, Region 6

Reviewed by _____ Date 2/6/06
Water Resources
Acting

39 813

WATER RESOURCES
RECEIVED

FEB 10 2006

KS DEPT OF AGRICULTURE

2005 WATER USE REPORT
2006 WATER MANAGEMENT PLAN

I. Water Rights

The US Fish and Wildlife Service (FWS) had applied for the right to divert 22,200 acre feet of surface water from Rattlesnake Creek soon after establishment of the refuge on August 15, 1957. The Service had filed a Notice of Proof of Completion of Works for Permit #7571 on July 15, 1982. Because the Service could not show that it had diverted the 22,200 acre feet of water during the refuge's highest use year, Kansas Division of Water Resources had offered to certify a smaller use amount. On April 9, 1996, DWR certified Permit #7571 at 14,632 acre feet based on the recorded usage. FWS disagreed with this determination and certified amount but decided not to take the situation to Court and on April 30, 1996 recorded the permit in Book 134, page 729 with the Stafford County Register of Deeds.

II. Actual Use

The actual appropriation of water from Rattlesnake Creek in 2005 from refuge diversion points was 4,559.3 acre feet, down from the up significantly from the 9,678.5 acre feet diverted in 2004. Figure 1 shows the amount of water measured in acre feet at each diversion point for each month of the year. Diverted water was used for storage in impoundments and wetlands and to provide flushing action for saline areas of the refuge. There are no irrigated crops on Quivira National Wildlife Refuge (NWR) and all diverted water was used for wetland management, primarily for endangered species, waterfowl and shorebird habitat.

A. Other Water Facilities

There are presently 32 cattle watering facilities maintained on Quivira National Wildlife Refuge; 2 windmills with sandpoints; 25 windmills with cased wells; 3 PVC cased shallow well systems equipped with electric submersible pumps and 2 with solar pumps. The windmill units have been developed with small overflow ponds that have proven of great value to wildlife, especially during times of drought. Three other cased wells for domestic use are located on Quivira, two at Refuge Headquarters and one at the Bunkhouse/EEC building.. One of these wells located near the maintenance building has a very high salt content, is not potable and is only used to provide water for fire control operations. One artesian well, drilled under a permit to the L.D. Davis Oil Company, Great Bend, has been turned over to the FWS and is located in Section 5, T22S, R11W, Stafford, KS. The small flow from this well (< five gal/min) is used to supplement a natural spring that provides habitat for a breeding population of Arkansas darters, a state endangered fish.

39 814

39 815

Year 2005

MONTHLY RECORD OF WATER USAGE - RATTLESNAKE CREEK DIVERSIONS

Acre Feet of Water Diverted												Monthly	Cumulative
Month	A-1	A-3	C-1	DC-A	24A	24B	24C	24D	20B-1	RCA		Total	Total
January	185.3		131.9	161.6				60.6		715.8		1,255.2	1,255.2
February	123.6		263.7	107.7			42.8	30.3		306.5		874.6	2,129.8
March				128.5								128.5	2,258.3
April												0.0	2,258.3
May												0.0	2,258.3
June												0.0	2,258.3
July												0.0	2,258.3
August	47.9		45.5				29.1					122.5	2,380.8
September	424.0		588.6	454.1			67.9					1,534.6	3,915.4
October												0.0	3,915.4
November												0.0	3,915.4
December			252.1				154.8			237.0		643.9	4,559.3
Totals	780.8	0.0	1,281.8	851.9	0.0	0.0	294.6	90.9	0.0	1,259.3	0.0	4,559.3	

In 1998, a new 8" domestic water well was drilled and cased, west of the Headquarters site, (T23, R11, Sec.2) CKLEPG Permit # SFWW0877, to provide better quality drinking water and to relieve a fine sand infiltration problem persistent with the original domestic water well. Water from this new well is pumped through a pipeline to the Headquarters site, providing potable water for the shop, Visitors Center and two residences. While the quality of this water is far superior to the previous well, at both Refuge residences and at the Visitors Center, this water is still passed through a reverse osmosis purification system to provide the public with drinking water that meets health standards.

B. Precipitation

Precipitation in 2005 totaled 28.84 inches according to the National Weather Service station in Hudson, KS, eight miles west of the refuge. This amount is 4.96 inches above the 50-year average of 23.88 inches. The precipitation was good to excellent until late summer, then the weather turned dry, windy, and with warm temperatures, caused a lot of evaporation from the Refuge wetlands. Precipitation ended the year above the long term average but the timing of the moisture and the evaporative weather conditions caused severe fluctuations in the Refuge wetlands throughout the year.

Figure 2. compares the actual monthly precipitation for 2005 with the 50-year average for that month.

Figure 2. Annual Precipitation Data, 2005, Quivira National Wildlife Refuge

MONTH	2005	50 YR. AVERAGE
Jan	1.72	0.57
Feb	1.96	0.84
Mar	1.10	1.40
Apr	1.59	2.19
May	3.44	3.77
Jun	5.30	3.67
Jul	4.52	2.93
Aug	3.77	2.59
Sept	0.70	2.42
Oct	1.76	1.80
Nov	2.32	0.93
Dec	0.66	0.77
TOTALS	28.84	23.88

III. Impoundment Data

Late winter and early spring precipitation was adequate. This precipitation, plus residual water remaining in the wetlands from the high rainfall in 2004, maintained the wetland levels for the Spring migratory bird migration. Good moisture continued into the summer and Rattlesnake Creek continued to flow throughout the year. Late August, September, and early October saw high winds and warm temperatures pull moisture from the Refuge wetlands and put a stop to all water diversions in an attempt to conserve as much water as possible.

By fall migration , most wetlands on the Refuge were below their management levels. Late October and November saw some heavy downpours and the resulting precipitation, plus flows increasing in Rattlesnake Creek due to the end of irrigation season, allowed some water diversions to refresh the wetlands.

Groundwater recharge or "underflow" as it is called locally started during late fall and provided some additional water to the Big Salt Marsh and the north salt flat.

IV. Water Management Facilities

The Refuge staff sheared Russian olive and salt cedar south of the Big Salt Marsh, in the Rice County section along the banks of Rattlesnake Creek and along the dikes and canals of the water distribution system. Trees were removed using the Marshall tree saw attachment and the Davco brush cutter for the crawler tractor. These invasive plant species have become a more serious threat to refuge wetlands since the 1993 flooding that transported the invader's seeds into the area. Over 2500 Russian olive, salt cedar and eastern red cedar trees were removed from Quivira NWR in 2005.

Previous drought conditions and the resulting mud flats along the Big Salt Marsh had allowed salt cedar to establish along the west edge of the Wildlife Drive. Several methods were used in an attempt to control these invading plants but the best kill was obtained from keeping the areas flooded. During 2004, adequate water conditions allowed this area to be flooded for the entire growing season, and this practice was continued into 2005, as long as the wetland levels allowed. Two years of flooding has reduced the salt cedar regeneration and prevented this invader from re-establishing.

The Refuge staff planned to continue in 2005 with an aggressive vegetation control program on refuge wetlands. Dry conditions allowed the equipment to enter several wetland units to mow, disk, or a combination, to reduce the cattail stands.

Additional wetland work completed in 2005 included, replacement of rusted out water control structure guides, rip-rap placed on erosion spots adjacent to numerous water control structures and along dikes and canals, additional surge rock placement along the Big Salt Marsh dike, and canal clean-outs for better water distribution. Water control structure RC-B had a complete wall failure discovered in the summer of 2005, requiring an emergency rehabilitation of this critical structure before any Fall water diversions were initiated.

Several meetings were conducted of the Rattlesnake Creek/Quivira Partnership to work on addendums to the Basin Management Plan that were needed to adjust for changing political situations and basin needs.

V. Recommendations for Water Management in 2006

1. Maintain levels in the Little Salt Marsh as high as possible throughout the year, while using stored water as needed for management of other wetland units. Be ready to discharge water on short notice to prevent flooding should heavy rains occur in the watershed.

2. Ensure that plenty of water is present throughout the nesting and brood rearing period for water units that have goose nesting structures.

3. Continue rehabilitation work planned for the few remaining water control structures in need of rehab or replacement. Remove cattail growth and silt accumulations from canals to improve water delivery capabilities. Use crawler tractor and mower to facilitate mowing cattails in water delivery canals to better move water throughout the system.

4. Continue to collect data on water levels, diversions, and water quality readings for refuge baseline information and to support on-going projects as well as monitor habitat changes with water manipulations.

5. Continue to cooperate with USGS, Fish & Wildlife Enhancement, and other personnel concerning water contamination studies and other research activities.

6. Attempt to detect and report any unauthorized diversions from Rattlesnake Creek, upstream from Quivira NWR.

7. If drought conditions occur, discontinue all draw downs to conserve as much water as possible within the system. Units that are most important during drought conditions are the Little Salt Marsh and the Big Salt Marsh. Water from the Little Salt Marsh can be used to re-flood other smaller units if needed and the Big Salt Marsh is a major waterfowl, shorebird staging area.

8. After the spring migration, draw down any wetland units in need of vegetation control to allow the disking, mowing and burning to control the invader species. Re-flood these units prior to fall migration to provide habitat.

9. Attempt to obtain some control over Russian olive and salt cedar that is invading the wetlands and increasing adjacent to Rattlesnake Creek, by the use of mechanical and limited chemical means. The Marshall tree saw attachment and the Davco brush cutter will be used on the crawler tracked vehicle to remove these species from areas previously too wet to allow control attempts. The Davco brush cutter will be used to shred salt cedar clumps at ground level to control without chemicals. The herbicide, Pathfinder, may be used for spot spraying some salt cedar areas inaccessible to equipment.

10. Continue to work with the Rattlesnake Creek/Quivira Partnership to develop long term solutions to the water quality and quantity concerns within the entire watershed.

2008 WATER USE REPORT
RECREATIONAL USE

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Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

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. 7571-00	3100N 1150W 35-21S-11W 1 (RCA)	A 364 0 *			Q					
. 7571-00	4450N 1000W 13-22S-11W 1 (Darrynane)	A 1079 5 *			Q					
. 7571-00	1250N 3850W 25-22S-11W 1 (Little Salt Marsh)	A 1878 9 *			Q					
	Total	3322.4 *								

CERTIFIED MAIL

7000 1670 0005 4908 6632

* Acre feet surface water diverted,

If water was diverted by a dam or other physical structure to create a water impoundment, please circle the approximate stages of the impoundment below. If more than one impoundment is shown above, duplicate this information for each impoundment shown.

March 1, 2008					July 1, 2008					November 1, 2008				
Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)	Empty	¼	½	¾	(Full)

572403

Date: 2/9/2009 Telephone: 620 486-2393

08 11880 18302 1 1 - REC Staff SF
Office Use FO CO GMD

DAN SEVERSON, Refuge Manager
Name (Printed or Typed)

Dan Severson
Name (Signature)

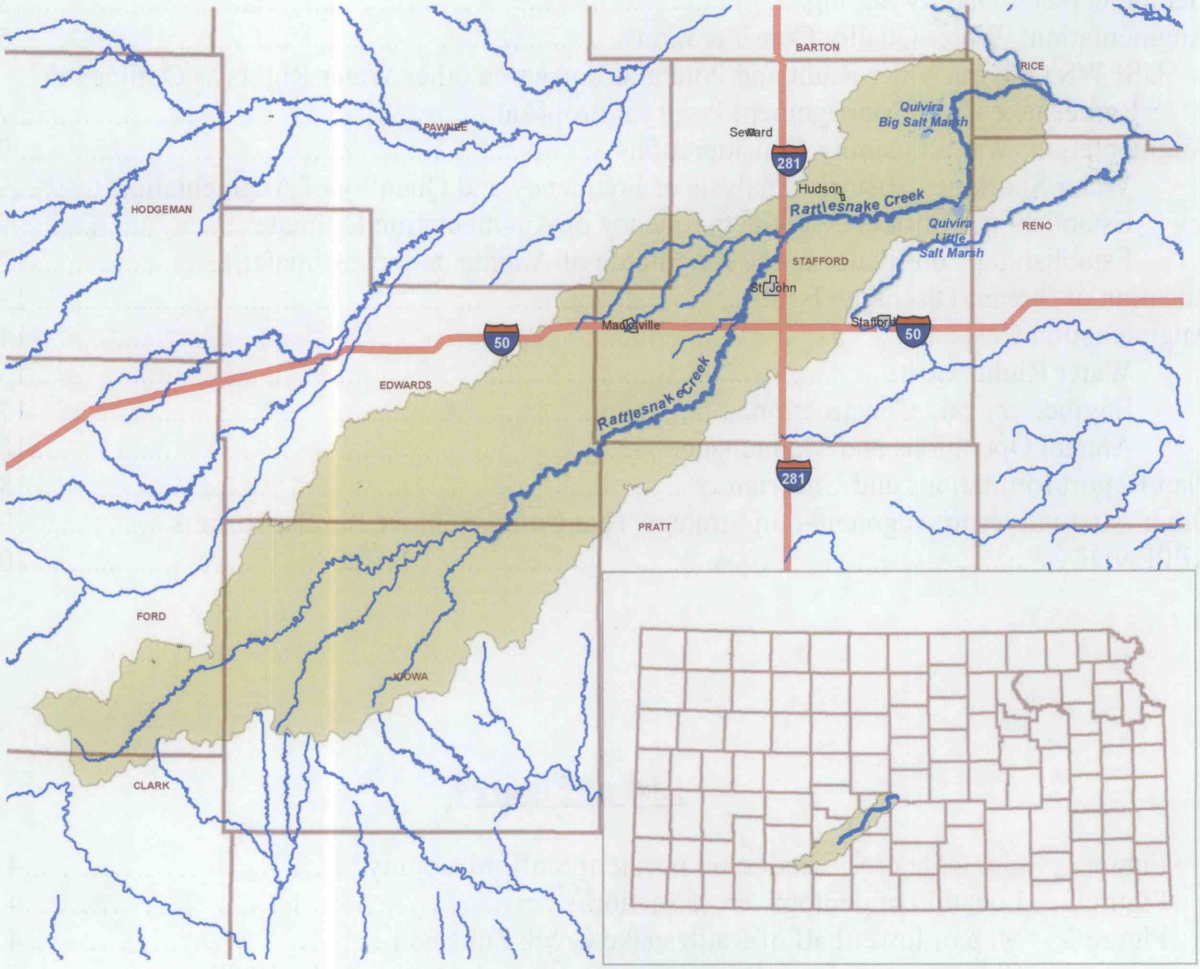
US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER, CO 80225

WATER RESOURCES
RECEIVED
FEB 20 2009
KS DEPT OF AGRICULTURE

____ Owner ____ Tenant X Agent

DWR 1-513 (Revised 11/5/2008) 2008 RECREATIONAL WATER USE REPORT

Stream Flow Augmentation of Rattlesnake Creek



Kansas Water Office

January 31, 2006

Table of Contents

List of Figures

List of Tables

Executive Summary

Stream flow augmentation was one of a number of the management strategies introduced in the June 29, 2000, Rattlesnake Creek Management Program Proposal by the Rattlesnake Creek/Quivira Partnership to address stream flow shortages due to fluctuating aquifer levels in the subbasin.

The Kansas Water Office estimates the frequency that an augmentation year would occur in the future is about 50 percent. The typical quantity of water needed for augmentation during a year that augmentation is necessary is about 1,460 acre-feet.

Should the augmentation strategy be implemented, the Kansas Water Office recommends the use of freshwater sources for augmentation, that water rights be purchased, rather than leased, for the supply of augmentation water and that the Big Bend Groundwater Management District No. 5 be responsible for the strategy's operation and maintenance.

Based upon the projected frequency and magnitude of augmentation in the future and the recommendations of it source, supply and operation, the Kansas Water Office estimates the total water right purchase cost for the augmentation strategy at $2.9 million, the total engineer and construction cost of the strategy at $2.2 million, the annual operation and maintenance cost of the strategy should average about $74,370 per year (with an augmentation year operation and maintain cost of $92,000 per year) and a 10 year total strategy cost of $5.9 million.

Introduction

2005 Session HB2482 § 76 (d) directed the Kansas Water Officer to,

> complete a study on augmentation of the Rattlesnake creek basin and report the results of the study to the House of Representatives agriculture and natural resources budget committee on or before February 1, 2006.

This report is in response to that directive.

Groundwater augmentation of the natural base flow in Rattlesnake Creek was one of a number of the management strategies introduced in the June 29, 2000, Rattlesnake Creek Management Program Proposal (RCMP) by the Rattlesnake Creek/Quivira Partnership (Partnership) to address stream flow shortages due to fluctuating aquifer levels in the subbasin. In the program proposal, the Partnership acknowledged that these aquifer fluctuations,

> may result in stream flows that are inadequate for the appropriated surface water demand for periods of time during some years. (Page 3, RCMP)

Groundwater augmentation of stream flow was a specific management strategy included in the program to address this concern.

In the Rattlesnake Creek subbasin there are three main issues that will be addressed in this study of the augmentation proposal:

1) Water quality; assurance that the augmentation discharge meets existing water quality criteria,
2) Water quantity; the frequency with which augmentation may be required and magnitude or total volume of water which may be needed to satisfy surface water right requests, and
3) Cost of augmentation; estimate the costs associated with the recommended augmentation scenario.

Rattlesnake Creek Management Program Augmentation Strategy

The following is reproduced from the June 29, 2000, Rattlesnake Creek Management Program Proposal (RCMP) by the Rattlesnake Creek/Quivira Partnership and outlines the augmentation assessment process established by that program.

> Augmentation will be utilized to meet Quivira's objective of having a water supply in the Fall when stream flows are inadequate for their appropriated surface water right. The partnership agrees that approximately 2,100 acre-feet is needed during August and September to meet the Refuge's needs. Augmentation would not be required in years of extreme drought.
>
> The Little Salt Marsh needs to be maintained at a [staff] gage height of 4.0 ft. in order to assure that water can be delivered to the other units the [U.S. Fish and Wildlife] Service wants to maintain. The Service would like to be able to fill and maintain Units 7, 10A, 10B, 10C, 11A, 11B, 14A, and 14B (surface area 306 acres, capacity 1,101 acre-feet). The Refuge would not operate to artificially create a situation where augmentation would be called for.
>
> An augmentation program will be developed using the following 4-step assessment process:
>
> 1. An augmentation year shall be designated when the average flow in January, at the Zenith gage, is less than 25 cfs.
>
> 2. A review will be made in July using the Palmer Drought Severity Index to determine if drought conditions exist. Augmentation will not be implemented when conditions in region 8 of Kansas depict an index value for a severe drought of -3.0 or worse.
>
> 3. Augmentation may begin on August 1, or when requested by the [Quivira National Wildlife Refuge] QNWR, if and when natural flows of 21 cfs are not being maintained and the staff [gage] water level at the Little Salt Marsh is below 4 feet. Augmentation will continue for up to 45 days if necessary. An average of 21 cfs for 45 days is needed to fill the pools and allow for evaporation. The rate of augmentation will be regulated to maintain the desired flow.

4. Augmentation will continue from September 15 through September 30 when natural flows of 7.05 cfs are not being maintained. 7.05 cfs is needed to offset evaporation in the refuge.

The quality of augmentation water supplied by wells will vary, but shall not exceed a maximum of 1,500 mg/l chloride, or as approved by KDHE standards. (Page 13, RSMP)

Geologic/Water Quality Setting

To understand the water quality complexities associated with the augmentation of Rattlesnake Creek, the issue is framed by the geologic setting of the basin. The geologic setting helps to explain the source of the water quality issues in the basin and identifies the primary pollutant of concern, chloride.

The predominate source of chlorides found in the surface water of Rattlesnake Creek is from the Permian formation that underlies much of Stafford County. In fact, water obtained from Permian rocks in a large portion of Stafford County would be too highly mineralized for most ordinary uses. Cheyenne Sandstone is absent in much of eastern Stafford County where it was removed by erosion after the Cretaceous Period. Elsewhere, the Cheyenne overlies Permian rocks and it exists from a featheredge to more than 100 feet thick (shown as cross-section J - J' in **Figures 1** and **2**) in the area. Kiowa Shale is encountered by test holes and oil wells beneath younger deposits in most of the western half of Stafford County. Elsewhere, it was removed by post-Cretaceous erosion (**Figures 1** and **2**).

As one moves from upstream to downstream on Rattlesnake Creek the effects from the presence of Permian rocks and the absence of a Cheyenne sandstone and Kiowa shale cap is clearly evident. The base flow contribution in areas lacking a sandstone/shale cap over the Permian formation (generally in the lower quarter of the Rattlesnake Creek subbasin downstream of Highway 281 and north of Highway 50- see **Figure 3**) is notably higher in chloride concentration.

Kansas Department of Agriculture, Division of Water Resources (KDA/DWR) and Big Bend Groundwater Management District #5 (GMD5) collected concurrent chloride samples from various locations in Rattlesnake Creek in the 1990's. **Figure 4** shows, for the general season that augmentation would likely occur, the results of this sampling effort. For the reach of Rattlesnake Creek under consideration for augmentation, chloride concentrations are lowest upstream of Highway 281 and then increase toward the Zenith gage location. The largest incremental increase in chloride concentration is between Sites #1 and #5 (**see Figure 5** to locate these stream sites); the sites at Highway 281 and the next site downstream. This area would correspond to the transition where the Cheyenne sandstone/Kiowa shale cap occurs and is absent within the watershed.

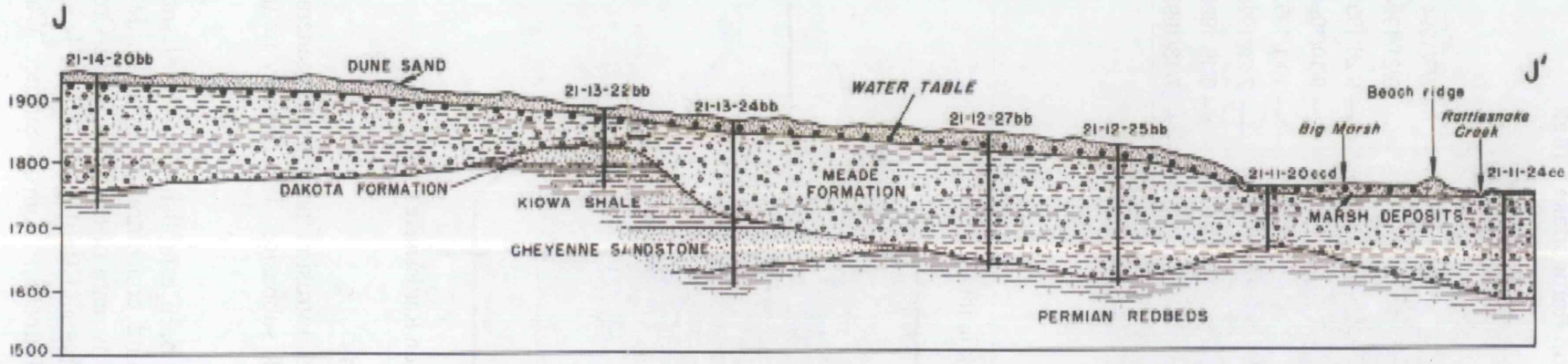


Figure 1: Geologic cross section of northern Stafford County (use Figure 2 as reference to locate the cross section).

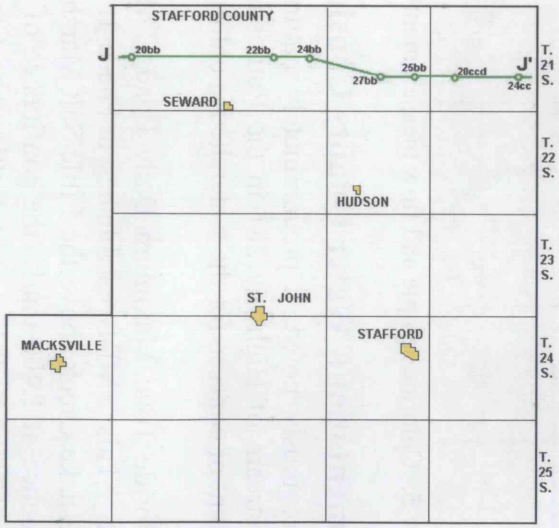


Figure 2: Location of cross section shown in Figure 1

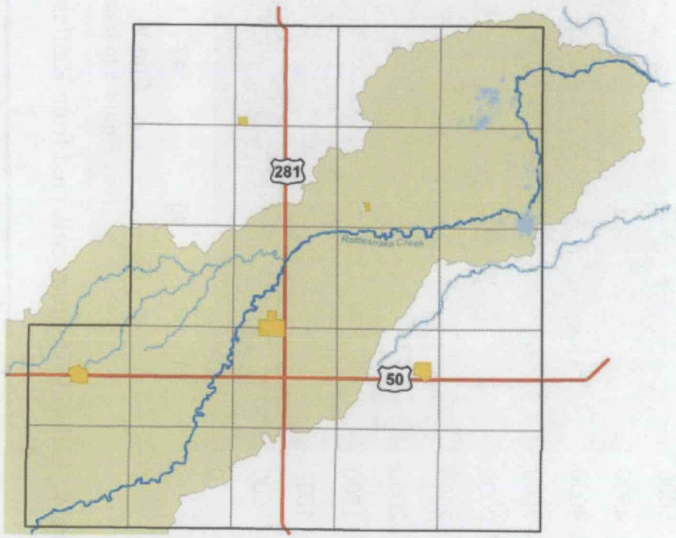


Figure 3: Map showing lower half of Rattlesnake Cr. subbasin

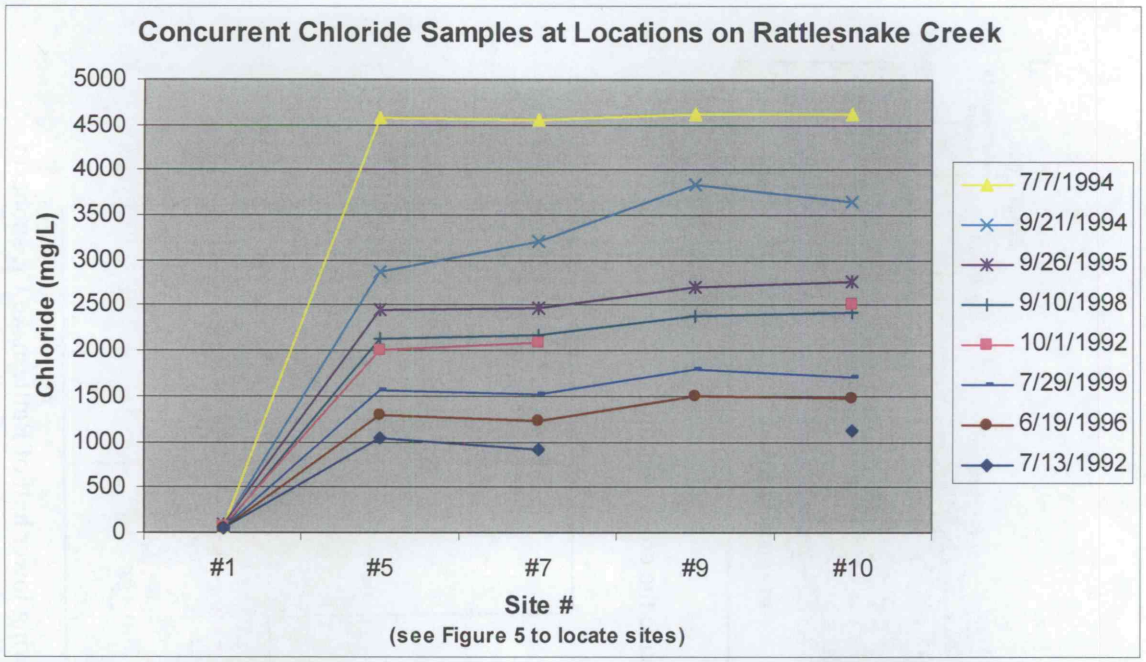


Figure 4: Chloride samples collected from Rattlesnake Creek in the 1990s

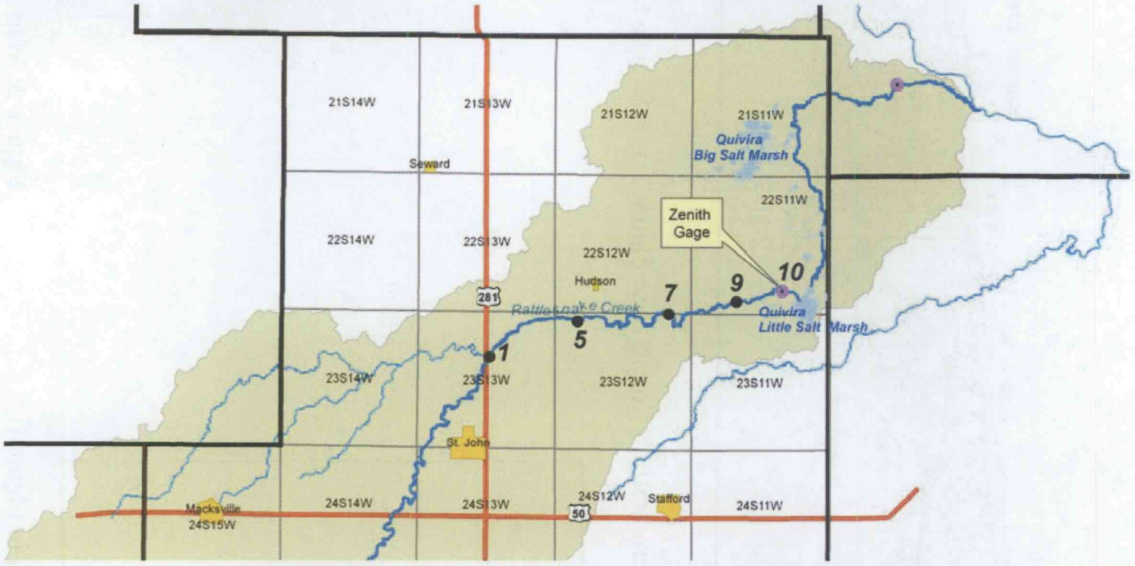


Figure 5: Chloride sample and flow measurement locations on Rattlesnake Creek

Augmentation: Water Quality Considerations

As previously noted, a predominately natural mineral intrusion area exists generally downstream of Highway 281 in the Rattlesnake Creek subbasin. The primary natural pollutant of concern for the watershed is chloride.

A chloride Total Maximum Daily Load (TMDL) has been established for Rattlesnake Creek. This TMDL establishes a Phase II background concentration of chloride in Rattlesnake Creek above the Little Salt Marsh and downstream of the Wild Horse Creek confluence at 1,400 mg/L (the confluence of Wild Horse and Rattlesnake Creek is also where Highway 281 crosses Rattlesnake Creek on **Figure 5**). Kansas Surface Water

Quality Standards subsequently established the same chloride concentration for that reach of Rattlesnake Creek.

The November 5, 2004, Kansas Surface Water Register designates Quivira Big Salt Marsh and Little Salt Marsh as an outstanding national resource waters. The Antidegradation Policy for the State of Kansas provides Tier 3 protection (the highest level of water quality and designated use protection) for outstanding national resource waters.

Within the context of Rattlesnake Creek augmentation, Kansas Department of Health and Environment (KDHE) has suggested an augmentation discharge method that addresses both the TMDL and antidegradation water quality issues. This method establishes a natural chloride concentration across all flows that would be encountered when augmentation would be needed and uses this relationship to set a maximum chloride concentration, thereby limiting the chloride concentration of augmentation water, based upon the stream flow at the Zenith gage.

Using this same concept, the Kansas Water Office (KWO) analyzed a separate data set of flow and chloride concentration in Rattlesnake Creek to determine if a similar result could be produced. The KWO analyzed hourly flow (less than 21 cfs) and estimated chloride concentrations during July 15 through September 30 (the most likely augmentation period) for 1999-2003 at the USGS Zenith continuous water quality gage site. The median chloride concentration was calculated for small incremental flow ranges and plotted across the entire 0-21 cfs flow range (**Figure 6**). A linear regression was fit to the resulting data to establish a relationship between chloride concentration and flow for Rattlesnake Creek near Zenith. Although the KWO used different data to establish discharge/chloride concentration relationship than did KDHE in their analysis, the results were essentially the same (compare KWO and KDHE regression lines in **Figure 6**).

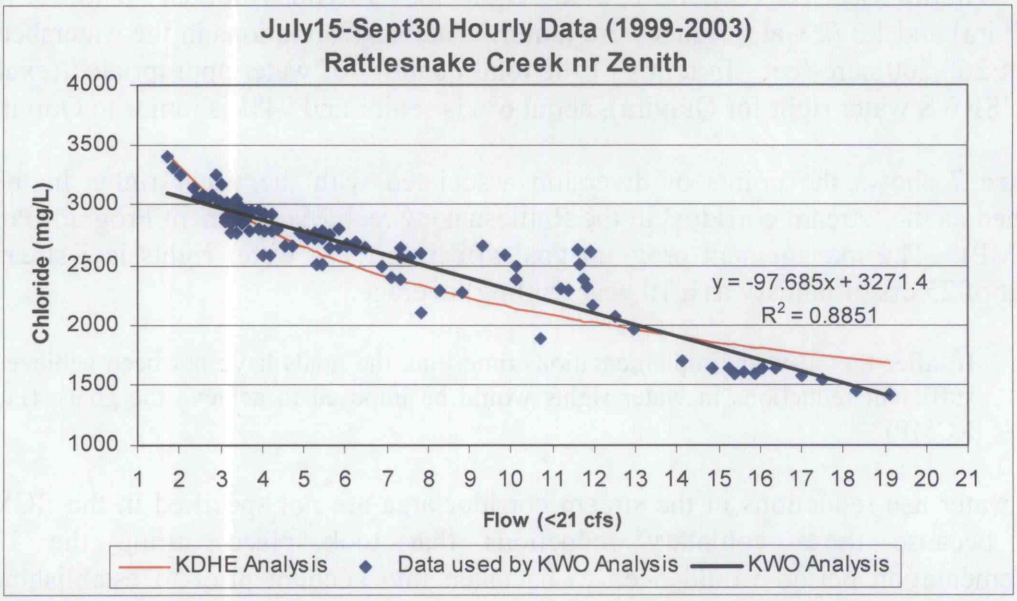


Figure 6: Relationship of flows less than 21 cfs during anticipated augmentation season and median chloride concentrations.

Using this inverse relationship between flow and natural background chloride concentrations, the following procedure could be applied when augmentation is required:

1. Note the flow at the Zenith gage
2. Calculate estimated chloride concentration for that flow using regression equation
3. Calculate target flow (augmentation + existing stream flow) chloride concentration
4. Calculate augmentation chloride concentration
5. Monitor chloride concentration of augmentation wells to confirm they are mixing to the correct augmentation chloride concentration
6. Use conductivity sensor at Zenith gage site as assurance that the target flow's chloride concentration is being achieved.

If all augmentation water is from areas outside the mineral intrusion area in Rattlesnake Creek subbasin, the only monitoring necessary would be at the Zenith gage site. This is because augmentation water from this fresh water source would actually dilute the chloride concentration in the natural flows so that the target flow would always be less than the relationship established between natural flows and chloride concentrations resulting in an overall improvement in the chloride concentration trend in the stream.

USFWS Water Right at Quivira and Potential Impact on other Water Rights as outlined in Rattlesnake Creek Management Program Proposal

As of September 19, 2005, there were about 1,450 active water rights in the Rattlesnake Creek basin. Seventy-seven of those water rights were senior to the United States Fish and Wildlife Service (USFWS) water right for Quivira National Wildlife Refuge (Quivira) and 1,372 water rights were junior. Total appropriations in the watershed were about 268,200 acre-feet. In terms of the total quantity of water appropriated (excluding the USFWS water right for Quivira), about 6% is senior and 94% is junior to Quivira.

Figure 7 shows the points of diversion associated with the water rights in the area defined as the 'stream corridor' in the Rattlesnake Creek Management Program Proposal (RCMP). The management program goal affecting these water rights is a streamflow target of 25 cfs in January as a 10 year (rolling) average.

> If, after the 12-year [implementation] time line, the goals have not been achieved, then sufficient reductions in water rights would be imposed to achieve the goals. (Page 16, RCMP)

The water use reductions in the stream corridor area are not specified in the RCMP, in part because those voluntary reductions that took place during the 12-year implementation period would need to be taken into account prior to establishment of reductions. However, relative reductions in water use based upon water right groups have been established within the management strategy.

Water Right Group A (Shown as blue dots in **Figure 7**): These are water rights senior to the USFWS water right at Quivira and would receive no reduction.

Water Right Group B (Shown as green dots in **Figure 7**): These are the senior half of the water rights junior to the USFWS water right at Quivira right and senior to Minimum Desirable Streamflow (MDS). This group would receive a reduction but the quantity of that reduction is expressed in the management program in terms of the reductions associated with Water Right Groups C and D.

Water Right Group C (Shown as yellow dots in **Figure 7**): These are the junior half of the water rights junior to the USFWS water right at Quivira right and senior to MDS. This group would receive a reduction that is 2.5 times greater than that of Group B.

Water Right Group D (Shown as red dots in **Figure 7**): These are the water rights junior to MDS. This group would receive a reduction that is 5 times greater than that of Group B.

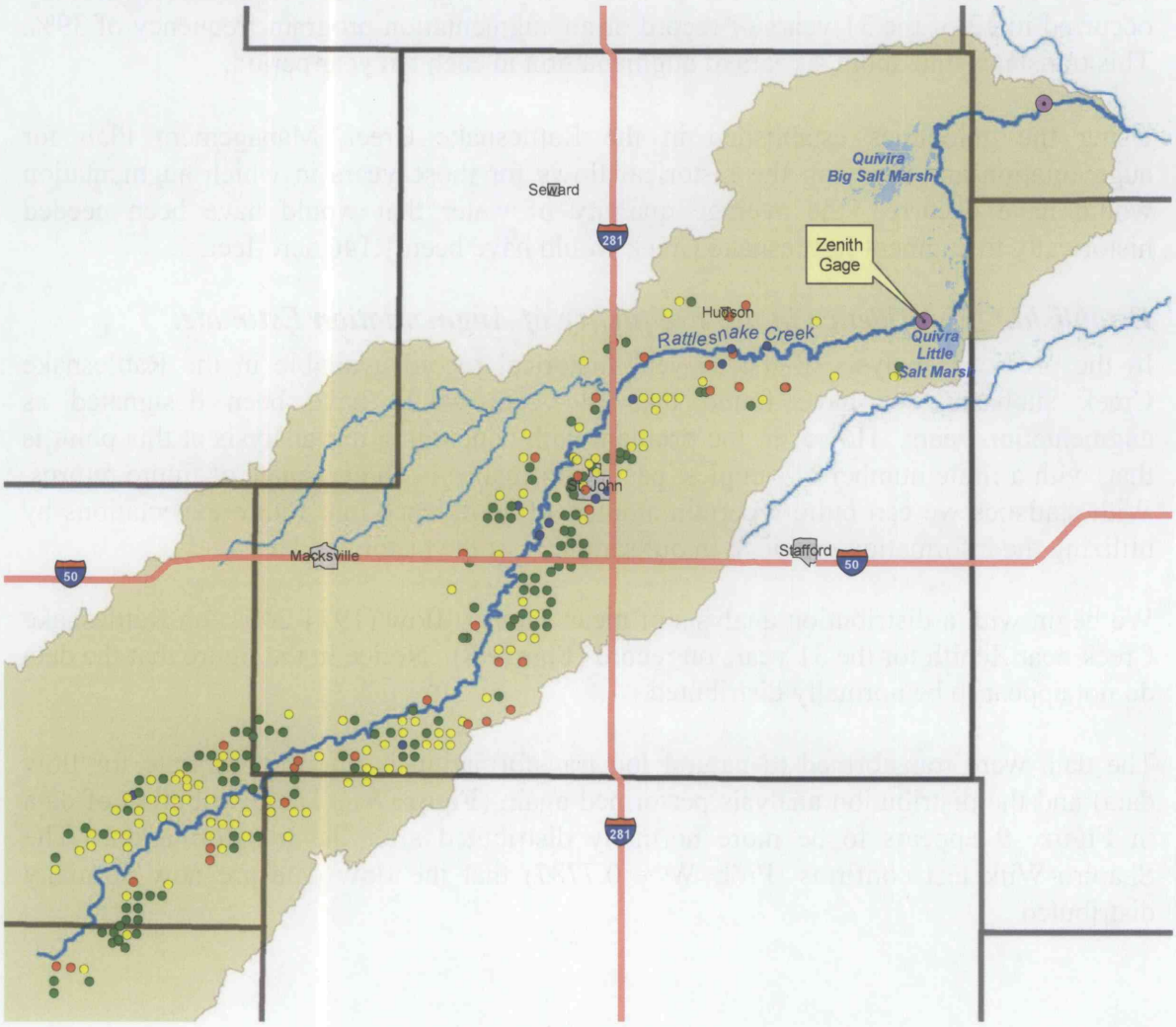


Figure 7: Color-coded water right groups for those points of diversion located in the stream corridor as defined by the Rattlesnake Creek Management Program.

Augmentation: Water Quantity Considerations

Water Shortage: Historic Analysis of Frequency and Quantity of Augmentation

The guidelines established in the Rattlesnake Creek Management Program for augmentation (see Page 2) were applied to the 31 years of flow data for the United States Geological Survey (USGS) gage on Rattlesnake Creek near Zenith to ascertain when the augmentation plan would have been applied historically. This review showed that an augmentation year, which is a year when the average January stream flow was less than 25 cfs, would have been designated in 14 years of the 31-year record. The year 1991 would have been designated as an augmentation year based on its average January flow, however augmentation would not have occurred because of the drought contingency on the augmentation strategy (see item #2 on Page 2). The year 1987 would also have been designated as an augmentation year, but no augmentation would have occurred because the minimum flows were met during the augmentation period (see items #3 and #4 on Page 2 of this report). Therefore, historically, augmentation would have actually occurred in 12 of the 31 years of record or an augmentation program frequency of 39%. This translates into about 4 years of augmentation in each ten year period.

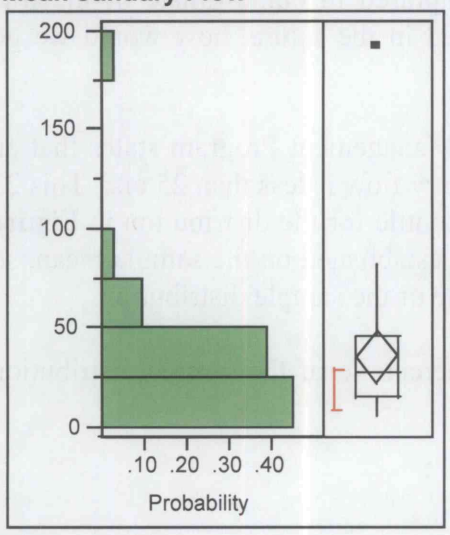
Using the guidelines established in the Rattlesnake Creek Management Plan for augmentation and applying the historical flows for those years in which augmentation would have occurred, the average quantity of water that would have been needed historically to augment Rattlesnake Creek would have been 1,146 acre-feet.

Establishing Confidence in the Frequency of Augmentation Estimate:

In the previous analysis of the 31-year historical record available in the Rattlesnake Creek subbasin, we have found that 14 years would have been designated as augmentation years. However, the problem with concluding our analysis at this point is that, with a finite number of samples, past performance is no guarantee of future returns. With statistics we can build a certain amount of confidence into future expectations by utilizing the information provided in our sampling of the historical data.

We begin with a distribution analysis of mean January flow (1974-2004) on Rattlesnake Creek near Zenith for the 31 years on record (**Figure 8**). Notice in the figure that the data do not appear to be normally distributed.

The data were transformed (a natural log transformation is often appropriate for flow data) and the distribution analysis performed again (**Figure 9**). The distribution of data in **Figure 9** appears to be more normally distributed after the transformation. The Shapiro-Wilk test confirms (Prob<W = 0.7787) that the flow data are now normally distributed.



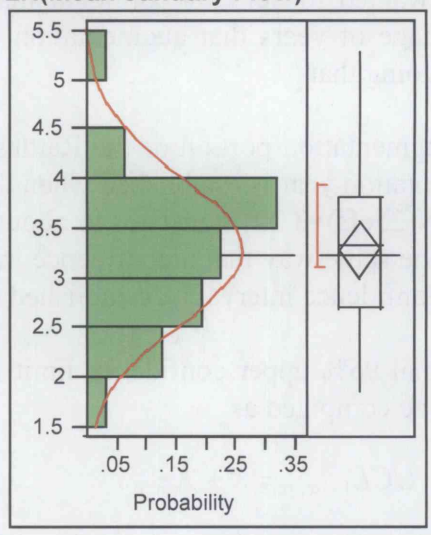
Quantiles

100.0%	maximum	192.00
99.5%		192.00
97.5%		192.00
90.0%		67.28
75.0%	quartile	45.00
50.0%	median	27.70
25.0%	quartile	14.70
10.0%		8.69
2.5%		6.48
0.5%		6.48
0.0%	minimum	6.48

Moments

Mean	35.260323
Std Dev	34.336852
Std Err Mean	6.1670806
upper 95% Mean	47.855181
lower 95% Mean	22.665464
N	31

Figure 8: Mean January Flow 1974-2004



Quantiles

100.0%	maximum	5.2575
99.5%		5.2575
97.5%		5.2575
90.0%		4.2019
75.0%	quartile	3.8067
50.0%	median	3.3214
25.0%	quartile	2.6878
10.0%		2.1619
2.5%		1.8687
0.5%		1.8687
0.0%	minimum	1.8687

Moments

Mean	3.2721669
Std Dev	0.7490082
Std Err Mean	0.1345258
upper 95% Mean	3.5469053
lower 95% Mean	2.9974285
N	31

Fitted Normal: Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.978808	0.7787

Figure 9: LN(Mean Jan. Flow) 1974-2004

At this point we have a sample of data (31 years of mean January flow) that are normally distributed. The distribution analysis in **Figure 8** has provided, among other things, a sample mean and a sample standard deviation as an estimate of the population (true) mean and population (true) standard deviation. Because we can never know with 100% certainty what the true mean and standard deviation are, we offset the uncertainty we have in our sample estimates by building a certain amount of confidence in our new estimate of the true distribution of mean January flows. The amount of confidence is a management decision and in this case has been established as 95%.

If we wanted to be 95% confident that we have captured in our estimate of the true percentage of years that augmentation will be needed in the future, how would we go about doing that?

The augmentation portion of the Rattlesnake Creek Management Program states that an augmentation year is established when the mean January flow is less than 25 cfs. This 25 cfs (LN(25cfs)=3.22) translates to about the 46th percentile for the distribution in **Figure 8**. In the same way that a confidence interval can be established on the sample mean, so can a confidence interval be established on a percentile of the sample distribution.

A normal 95% upper confidence limit for the 46th percentile of the sample distribution would be computed as

$$UCL_{1-\alpha,p} = \bar{x} + K_{\alpha,p}s$$

where $\bar{x}$ is the sample mean of the x_i flow values in each of the m measurement years from the stream gage site,

$$\bar{x} = \sum_{i=1}^{m} \frac{x_i}{m}$$

and s is the observed sample standard deviation,

$$s = \sqrt{\sum_{i=1}^{m} \frac{(x_i - \bar{x})^2}{m-1}}$$

and $K_{\alpha,p}$ is the one-sided normal tolerance limit factor for (α) confidence and (p) percentile, both expressed as decimals. These $K_{\alpha,p}$ values were generated using a program titled *StInt*. This command-driven DOS program and user's manual is available at: http://www.public.iastate.edu/~wqmeeker/other_pages/wqm_software.html.

From Figure 8,$\bar{x}$ is 3.272, and s is 0.75. The $K_{\alpha,p}$ value for the 46th percentile with an upper 95% confidence limit; $K_{0.95,0.46} = 0.2$. Therefore,

$$UCL_{0.05,0.46} = 3.272 + 0.2 * 0.75 = 3.42$$

Exponentiation of the resulting limit yields 30.6 cfs.

Using 30.6 cfs rather than 25 cfs as the minimum flow requirement and applying this new minimum flow requirement to the 31 years on record we find that 17 of the 31 years would be designated as augmentation years. Assuming that, as before, one augmentation year would be excluded under the drought contingency and in one augmentation year augmentation would not be needed because minimum flow requirements would be met during the augmentation period, the actual number of augmentation years would be 15 out of the 31 years of record (15/31 = 48%). This translates into about half the years in any period (e.g., 5 years of augmentation in a 10 year period).

Therefore, if we wanted to be 95% confident that we have captured in our estimate of the true percentage of years that augmentation will be needed in the future, we would increase our estimated percentage of years that augmentation would be needed from the historical estimate of 39% (about 4 in 10 years) to 48% (about 5 in 10 years).

Establishing Confidence in the Magnitude of Augmentation Estimate:

From the previous analysis of the 31-year historical record we established that during those years that would have been designated as augmentation years, the average quantity of water used to augment Rattlesnake Creek was 1,146 acre-feet. Again, the problem with concluding our analysis at this point is that, with a finite number of samples, past performance is no guarantee of future returns. We once again can use statistics to build a certain amount of confidence into future expectations utilizing the information provided in our sampling of the historical data.

If we wanted to be 95% confident that we have captured in our estimate the true quantity of augmentation water necessary to meet the expected augmentation needs in the future, how would we go about doing that?

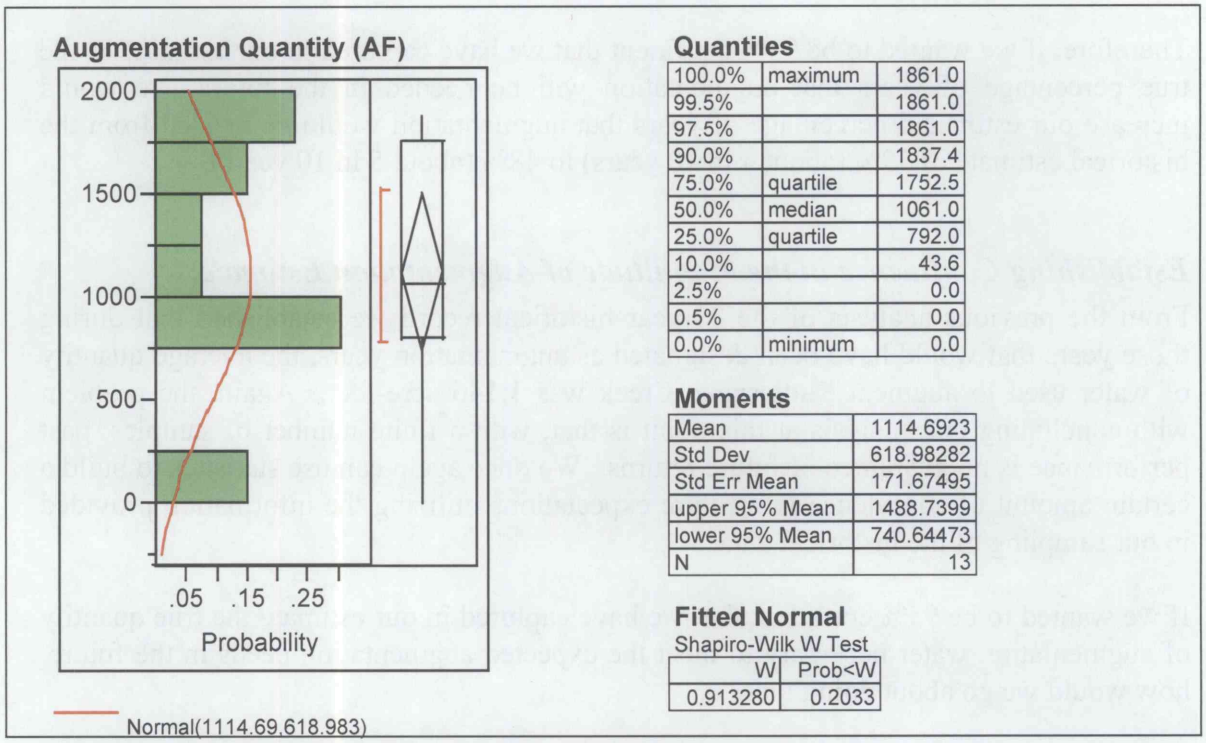
We start with a distribution analysis of the calculated quantity of water augmented to Rattlesnake Creek for the 13 years[1] that augmentation would have occurred during our 31 year period of record (**Figure 10**). Although at first glance these data do not appear to be normally distributed (our sample size is quite small and some degree of caution in this conclusion is advised), our Shapiro-Wilk test (Prob<W=0.2033) does indicate that they are.

At this point we have a sample of data (13 years of estimated augmentation quantity) that are now normally distributed. The distribution analysis in **Figure 10** has again provided us a sample mean and a sample standard deviation as an estimate of the population (true) mean and population (true) standard deviation. The sample mean falls at the 52nd percentile of our distribution. Using the information in the distribution analysis, we proceed as we did in the frequency analysis, except this time we will set an upper 95% confidence level on the 52nd percentile of the distribution.

From Figure 9, $\bar{x}$ is 1,115 af and s is 619 af. The $K_{\alpha,p}$ value for the 52nd percentile with an upper 95% confidence limit, in this case; $K_{0.95,0.52} = 0.552$. Therefore,

$$UCL_{0.05,0.52} = 1{,}115 + 0.552 * 619 = 1{,}460 \text{ acre-feet}$$

[1] Our previous historic assessment of the frequency of augmentation suggested that there were only 12 actual augmentation years in the historic 31 year record, but recall that one of the years (1987) was excluded from this total because it required no augmentation. Since the flows in Rattlesnake Creek exceeded the minimum flow requirement according to the augmentation strategy in the Rattlesnake Creek Management Program, this year should now be included in the accounting for the magnitude of augmentation; however the quantity of water augmented for this year is 0 acre-feet.



Quantiles

100.0%	maximum	1861.0
99.5%		1861.0
97.5%		1861.0
90.0%		1837.4
75.0%	quartile	1752.5
50.0%	median	1061.0
25.0%	quartile	792.0
10.0%		43.6
2.5%		0.0
0.5%		0.0
0.0%	minimum	0.0

Moments

Mean	1114.6923
Std Dev	618.98282
Std Err Mean	171.67495
upper 95% Mean	1488.7399
lower 95% Mean	740.64473
N	13

Fitted Normal

Shapiro-Wilk W Test

W	Prob<W
0.913280	0.2033

Figure 10: Estimates of augmentation quantity from historical analysis

Location of Stream Discharge Issues

Using the information that KDA/DWR and GMD5 collected when they did their seepage runs down the length of Rattlesnake Creek in the 1990's we can determine the flow gains and losses between stretches of stream. The seepage run results that were collected during the general time period that augmentation would have occurred are plotted in **Figure 11**. For the stream reach of Rattlesnake Creek under consideration, flows are generally lowest upstream of Highway 281 and then increase to the Zenith gage location. The largest incremental increase in flow is, again, between Site #1 and #5 (**see Figure 12** to locate these sites); the sites at Highway 281 and the next site downstream.

The reaches where stream flow is being gained and lost is important because the most effective and cost efficient place to discharge augmented water to Rattlesnake Creek is at a point below which the stream is consistently gaining flow. Augmentation to a gaining reach provides assurance that a large portion of the augmented quantity actually arrives at its intended destination. Alternatively, a much smaller fraction of an augmented quantity of water would actually arrive at its intended destination if discharge from augmentation were to occur in a losing stream reach. In a losing reach, a portion of the augmented water would be lost to recharge of the aquifer underlying the stream. Based upon the data available from the KDA/DWR and GMD5 seepage runs, the best location to discharge augmentation water would be below Highway 281. The closer the discharge point(s) to Quivira the lower the anticipated loss to groundwater recharge and evapotranspiration during transit.

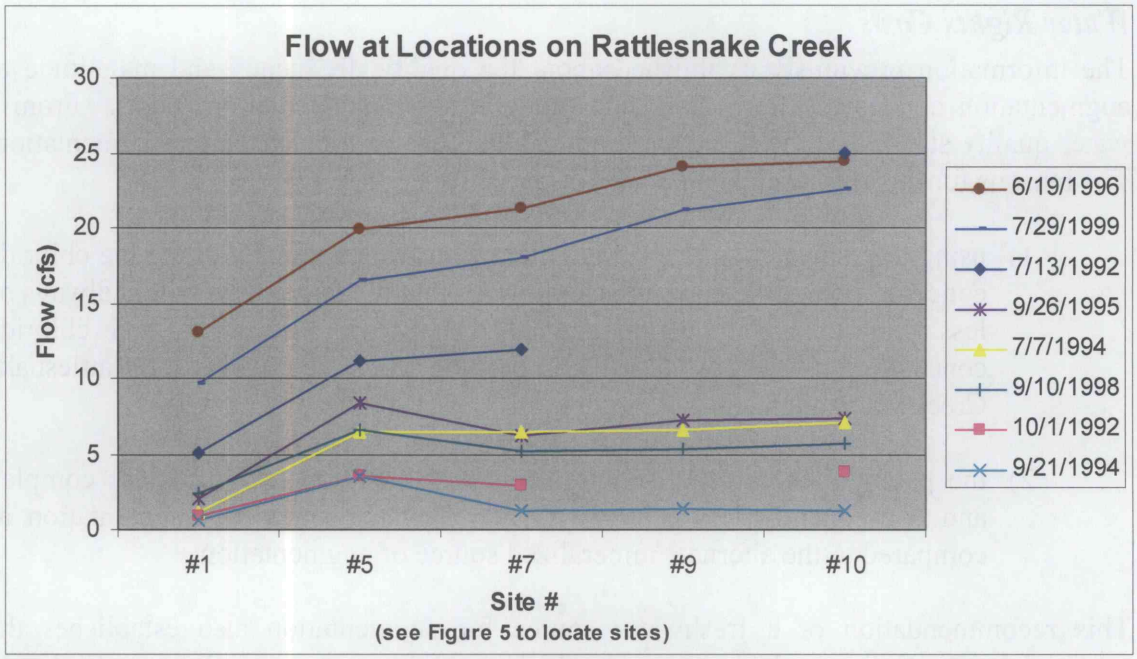


Figure 11: Stream flows measured on Rattlesnake Creek in the 1990s

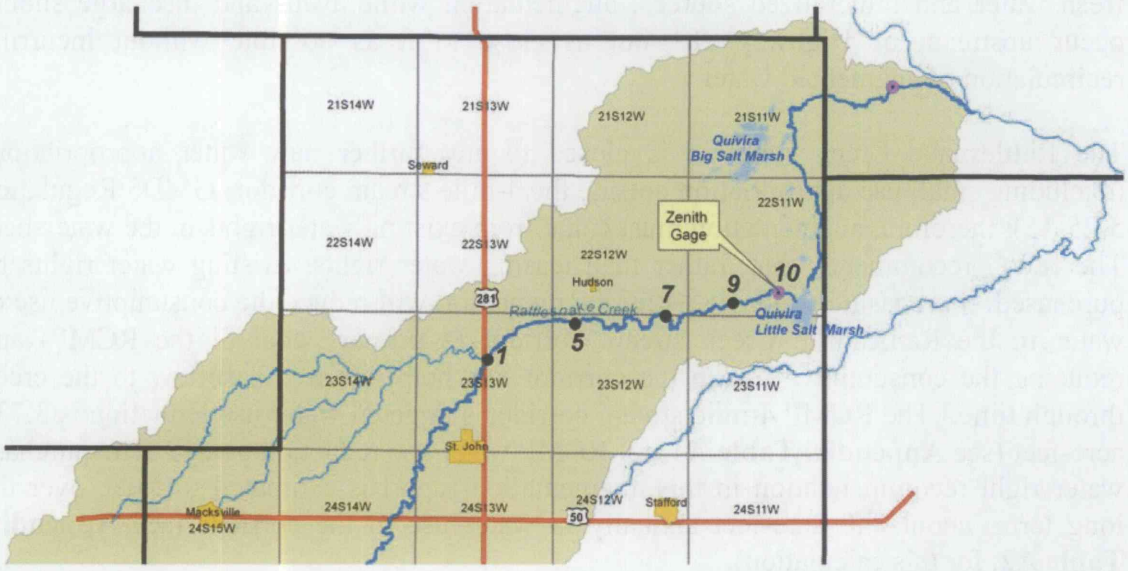


Figure 12: Chloride sample and flow measurement locations on Rattlesnake Creek

Augmentation Costs

In 2001 and 2002 Big Bend GMD5 spent a considerable amount of time and money developing an estimate for the cost of Rattlesnake Creek augmentation. During the final phase of that study, GMD5 contracted with Kansas Livestock Association Environmental Services, Inc. to engineer the augmentation design and provide cost estimates. The KWO cost estimates in this report are essentially updates to the pertinent portions of that GMD5 study.

Water Rights Costs

The information previously established about the quality, frequency and magnitude of augmentation creates the framework and guidelines for augmentations costs. From a water quality standpoint the KWO recommends the use of freshwater for augmentation. The reasons for this recommendation are:

1) using a freshwater source for augmentation would actually dilute the chloride concentration in the current base flows so that the target flow would always be less than the relationship established between base flows and chloride concentrations thereby actually improving the water quality of Rattlesnake Creek when augmentation occurs.

2) the potential monitoring requirements are operationally much less complex and consequently less costly with a freshwater source of augmentation as compared to the alternate mineralized source of augmentation.

This recommendation of a freshwater source for augmentation also establishes the 'optimal location' from which water should be withdrawn. Since Rattlesnake Creek commonly gains flow starting at Highway 281 and this point also generally divides the fresh water and mineralized sources, augmentation withdrawals and discharge should occur upstream of Highway 281 but as close to it as possible without incurring recirculation of augmented water.

The Rattlesnake Creek subbasin is closed to any further new water appropriations (excluding small use appropriation outside the 4-mile stream corridor; GMD5 Regulation 5-25-15); therefore, augmentation must come from existing water rights in the watershed. The KWO recommends that, rather than leasing water rights, existing water rights be purchased. Purchasing water rights for augmentation will reduce the consumptive use of water in the Rattlesnake Creek stream corridor (a primary goal of the RCMP) and reducing the consumptive use in the corridor can help improve baseflow to the creek through time. The RCMP 4-mile stream corridor's targeted water use reduction is 3,737 acre-feet (see **Appendix, Table A1**, for RCMP water use reduction goals). The purchase water right recommendation in this augmentation report is estimated to save, over the long term, about 840 acre-feet annually in water use in the corridor (see **Appendix, Table A2**, for this calculation).

Leasing water rights for augmentation is more complicated from a legal and management perspective and does not reduce consumptive use in the stream corridor to the same level as the purchase option, since irrigation from leased wells would occur in those years that are not designated as stream augmentation years. Also, leases would necessarily have to be renewed from time to time and once the plumbing for augmentation is constructed during the initial lease period, the value of a particular well to the augmentation project is increased by that well's plumbing cost (plus the cost of plumbing an alternate well if a lease agreement could not be renewed).

To estimate the potential costs of augmentation, a sample of 23 water rights in the previously defined 'optimal location' were selected and reviewed. The median number of acres certified under these water rights was 130, the median certified quantity of water was 195 acre-feet and the median rate was 880 gpm (**Table 1**). These median values, coupled with the projected quantity of water necessary for augmentation; the frequency with which that augmentation is anticipated; and the rate of augmentation (**Table 2**), create the starting point for the augmentation cost estimate.

Table 1

Summary results for wells sampled from general target area		
Median Rate	880	gpm
Median Quant.	195	af
Median Acres	130	acres
n	23	water rights

Table 2

Projected Augmentation Targets		
Target Quant.	1,457	af
Max Quant.	1,861	af
Max Rate	21	cfs

KDA/DWR has specific regulations (K.A.R. 5-5-9) regarding a change in the use made of water from irrigation to another use. The input values for this regulation are from **Table 1**. In **Table 3**, the number of water rights was varied until the calculated median and maximum quantity and rate satisfied the projected augmentation needs in **Table** 2. The result indicates that 12 water rights would need to be purchased to meet augmentation needs.

Because of the drought contingency in the RCMP augmentation strategy and the previous assessment of the historic distribution of potential augmentation quantity, the likelihood of ever needing to augment the entire 2,100 acre-feet in the augmentation strategy is very remote. In fact, using the normal distribution curve established in **Figure 7**, the chance of needing to augment 2,100 acre-feet is less than 2%. Therefore, the KWO believes the maximum reasonable quantity of water needed for augmentation is less than 2,100 acre-feet and we have used the historic maximum as the target high for augmentation (1,861 acre-feet).

The number of water rights in the 'optimal location' for augmentation is relatively small. Scarcity of product will drive the price of the product up. GMD5's last estimate (early 2002) in their study of this augmentation project estimated the price per acre-foot of water under the water right purchase option at $1,000. Because of the market dynamics in the target area KWO believes a reasonable price may now be around $1,250 per acre-foot.

Table 3

Application of 5-5-9 to Determine Number of Water Rights (WRs) Needed for Augmentation Project

KAR 5-5-9			Projected Augmentation Targets		
Median Acres Certified for WR	130	ac			
SF Co. 50% Net Irr. Requirement	1.03	ft			
SF Co. 80% Net Irr. Requirement	1.21	ft			
Straight UMW Change	133.9	af			
Quantity-check					
KAR 5-5-9 (5-Yr Allocation)					
5-yr Allocation	669.5	af			
Max Quant (5-yr Alloc'n)	157.3	af			
Water Rights	**12**				
Median Quantity from WRs	*1,606.8*	af	Target Quant.	**1,457**	af
Max Quantity from WRs	*1,887.6*	af	Max Quant.	**1,861**	af
Total Quantity from WRs	8034	af			
Rate-check					
Rate	880	gpm			
Max Rate from WRs	*23.57*	cfs	Max Rate	**21**	cfs

Table 4 shows that using the $1,250 per acre-foot value, the purchase price of 12 water rights is $2,925,000.

Table 4

Estimate WR Purchase Cost

Median Irrigation WR	195	af
Total AF Purchased (12 WR)	2,340	af
Est. Cost to purchase 1 AF	$1,250	$/af
Total Purchase Cost	**$2,925,000**	

Engineering and Construction

The diversion works plan originally developed for GMD5 was to install and connect 4 wells in loose clusters and divert water from those groups of wells into a single supply line to Rattlesnake Creek via a stream discharge structure engineered to minimize the scour and bank erosion at the augmentation discharge point. For 12 water rights, 3 of these discharge points would be required. **Table 5** updates the construction costs for such a design. Almost all construction items have increased substantially from the 2002 GMD5 cost estimates, most notably the installed price of PVC pipe whose cost has been inflated by the effects of hurricanes in the Fall of 2005 on its manufacture and availability.

Table 5

Diversion Works Cost Estimate (redrill 12 wells, connection systems and stream discharge systems)				
	Quant	Unit	Unit Cost	Item Cost
Test Drill	12	Ea	$800	$9,600
Meter	12	Ea	$,1050	$12,600
16" Cased and Gravel Packed Well	960	Ft	$60	$57,600
Test Pump and Develop Well	12	Ea	$600	$7,200
110 HP Diesel Pumping Plant and Fixtures	12	Ea	$9,800	$117,600
10" Dia PVC Pipe (Schedule 40; 3' cover; installed)	3900	Ft	$26	$102,570
12" Dia PVC Pipe (Schedule 40; 3' cover; installed)	3900	Ft	$31	$122,148
15" Dia PVC Pipe (Schedule 40; 3' cover; installed)	3900	Ft	$52	$202,059
18" Dia PVC Pipe (Schedule 40; 3' cover; installed)	19800	Ft	$71	$1,398,474
Stream Discharge Structure (@ 20 Cu Yds Ea)	60	Cu Yd	$366	$21,960
500 Gallon Fuel Tank on Skids	12	Ea	$400	$4,800
1000 GPM Pump with Bowl and Shaft Drive	12	Ea	$13,000	$156,000
Total Cost				$2,212,611

Annual Operations and Maintenance

The KWO recommends that GMD5 be responsible for the operation and maintenance of Rattlesnake Creek augmentation.

The annual operation and maintenance costs are based on the projected 1,460 af necessary for augmentation at an augmentation frequency of 50% (five years out of ten). This quantity would average about 730 af/yr and forms the basis for the fuel cost estimate. A USGS continuous water quality monitoring gage would be needed to insure compliance with chloride limitations associated with the augmented water. **Table 6** summarizes the operation and maintenance costs.

Table 6

Estimated Annual Operating Costs	
Fuel Costs	$34,239
GMD5 Overhead	$45,000
USGS Continuous WQ Monitoring Gage	$12,500
Total Annual Cost	$91,739

Plan/Report Limitations and Uncertainty

The uncertainty in the estimates in the frequency and quantity of augmentation water was established at an error level of 5%. However, any long-term climate change that would affect the distribution of annual precipitation (and consequently streamflow) would violate some of the assumptions used to set the confidence intervals on the frequency and magnitude of the projected augmentation needs.

The largest amount of uncertainty in the augmentation cost estimate would be associated with the costs of water rights, PVC pipe and the general effect of fuel prices on all items.

Alternatives to Augmentation Strategy

The estimated water use reductions established by the RCMP (see **Appendix, Table A1** for these water use reduction goals) were set,

> to achieve long-term sustainable management in the Rattlesnake Creek subbasin, as well as where suggested reductions in water use would have to occur to achieve the desired effect. (Page 3, RCMP)

and that the 4-mile stream corridor water use reduction goal of 3,737 acre-feet was established,

> in order to obtain a target 10 year average January streamflow of 25 cfs at the Zenith Gage. (Page 3, RCMP)

Since the current estimate of the cost of augmentation, excluding annual operations costs, is about $5.1 million, one can use this water use reduction goal for the stream corridor and back-calculating the water right purchase quantity necessary to meet the water use RCMP reduction target of 3,737 acre-feet in the stream corridor. Using the current water right purchase estimate of $1,250 per acre-foot, the entire water use stream corridor reduction target from the RCMP could be met by using the current augmentation cost estimate of $5.1 million plus one year of annual operation costs to purchase and retire water rights.

APPENDIX

Table A1

Rattlesnake Management Alternative Numbers and Funding (Table reproduced, as updated in January 2005, from Rattlesnake Creek Management Program Proposal)								
	Groundwater Unit		**4-mile Corridor**		**Basinwide**		**Totals**	
Program Goals								
Total Appropriations within Target Area	118,989	AF	42,798	AF	59,281	AF	221,068*	AF
Avg. WU/Yr. (72% of Total Apprn)	83,967	AF	31,144	AF	43,078	AF	158,189	AF
Total Appropriations Goal in Target Area	99,951	AF	37,662	AF	54,835	AF	192,448	AF
Average Water Use per Year Goal (72% of Appropriations)	70,532	AF	27,407	AF	39,847	AF	137,786	AF
Savings Needed From Current Appropriations to Reach Goal	**19,038**	AF	**5,136**	AF	**4,446**	AF	**28,620**	AF
Water Use Savings Needed to Reach Goal	**13,435**	AF	***3,737***	AF	**3,231**	AF	**20,403**	AF

* Note that the total appropriations value calculated by KDA/DWR in this table is not the same value provided on Page 7 of this report. The difference is that the KDA/DWR number doesn't include a portion of the Rattlesnake Creek subbasin in Ford and the western part of Kiowa County.

Table A2
Calculation of Anticipated Water Use Saving under Water Right Purchase for Augmentation Recommendation

Median WR Quant.	195	af
Water Use as % of Total Appropriation (From RCMP Table A1 above)	72	%
Calculated Frequency that Augmentation DOES NOT occur	50	%
# of WR to be Purchased	12	WRs
Long Term Water Use Saving in 4-Mile Corridor	842.4	af

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

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FEB 2005

CERTIFIED 7001 0360 0003 9863 9827

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2004 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5399.

Sincerely,

Carrie Cordova

Carrie Cordova
Water Rights Specialist

Enclosure

332428

2004 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON USUAGE, IN ORDER TO PROTECT YOU RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH1, 2004.** Please begin by reading the instruction for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of you interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, pleas contact the Water Use Coordinator at (785)298-1054. Please make a copy of the entire Water Use Report for you records, and return the original report to:

Water Use Coordinator
Kansas Depart of Agriculture
Division of Water Resources
109 S. W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (GPM)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00 3100N 1150W 35-21-11W (RCA)	1	A	2543.1*								
7571-00 4450N 1000W 13-22-11W (Darrynane)	1		4202.6*								
7571-00 1250N 3850W 25-22-11W (Little Salt Marsh)	1		2932.8*								
	Total		~~9678.5*~~								

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*~~Acres of~~ Surface Water Diverted (Acre-Feet)

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir.

March 1, 2004					July 1, 2004					November 1, 2004				
Empty	¼	½	¾	■	Empty	¼	½	■	Full	Empty	¼	½	¾	■

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332427

Date: 1/27/2005 Telephone: 620-486-2393

04 12172 18302 1 1 – REC Staff SF
Office Use FO CO GMD

David Hilley, Refuge Manager
Name (Printed or Typed)

U S Dept of Interior
Fish & Wildlife Service
PO Box 25486
Denver CO 80225

Name (Signature)

___ Owner ___ Tenant X Agent

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 09 2004

CERTIFIED 7001 0360 0003 9863 9766

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2003 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321.

Sincerely,

Linda Coe

Linda Coe
Water Rights Specialist

Enclosure

27 909

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2003 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON USUAGE, IN ORDER TO PROTECT YOU RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH1, 2004.** Please begin by reading the instruction for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of you interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, pleas contact the Water Use Coordinator at (785)298-1054. Please make a copy of the entire Water Use Report for you records, and return the original report to:

Water Use Coordinator
Kansas Depart of Agriculture
Division of Water Resources
109 S. W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (GPM)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00 3100N 1150W 35-21-11W (RCA)	1	219.8*								
7571-00 4450N 1000W 13-22-11W (Darrynane)	1	568.3*								
7571-00 1250N 3850W 25-22-11W (Little Salt Marsh)	1	939.3*								
	Total	1,727.4*								

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7001 0360 0003 9863 9766

*Acre Feet Surface Water Diverted

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir.

March 1, 2003: Empty ¼ ½ ¾ (Full)
July 1, 2003: Empty ¼ ½ (¾) Full
November 1, 2003: Empty (¼) ½ ¾ Full

27 908

Date: 1/28/04 Telephone: 620/486-2393

03 12263 18302 1 1 REC STAFF SF
Office Use FO CO GMD

DAVID Hilley, Refuge Manager
Name (Printed or Typed)

David Hilley
Name (Signature)

U S Dept of Interior
Fish & Wildlife Service
PO Box 25486
Denver CO 80225

___ Owner ___ Tenant XX Agent

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3/4/04

No response was prepared. Discussed it with Jim Putnam at USGS. He contacted Megan on "traditional" rating at structures. No agreement was reached on how to proceed. Little motivation from either agency. DNR has main diversion from USGS gaging station for water use. No reliable measurements of water within the wetland to show proper management & beneficial use.

Choose not to enforce order as of this date. Therefore no response to this letter is planned at this time.

Tom Huntington

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Write letter back - says a "base minimum" measurement at the main diversion is now covering the annual water use reporting requirement. Documented & beneficial use without waste is not. We will choose not to enforce the latter.

Mr. Thomas L. Huntzinger
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283

JUN 18 2003

Dear Mr. Huntzinger:

I spoke with Jim Putnam of the U.S. Geological Survey today concerning water measurement at Quivira National Wildlife Refuge. He told me that he had spoken with you and you agreed that USGS could develop conceptual rating curves for the structures and install staff plates for determining stage. Jim and I discussed the pros and cons of this approach, and there are several issues we have with this idea.

First, developing rating curves for structures with multiple bays and stoplogs is not going to be very straightforward. Using these rating curves means that the Refuge staff will have to read the staff gage and measure the stop log heights every time there is a change in the openings on the structures. Also, to get good data, Refuge staff would have to read the water levels on a daily basis at every structure. Quivira does not have the staff to do this.

Second, the rating curves developed will be extremely rough at first, especially for the stop log structures. Refuge staff will be forced to continue to take Claussen-rule readings to improve the rating curves, and this work will be in addition to reading the staff gages and measuring the board heights. Again, the Refuge has limited staff time to devote to water measurement.

Finally, we would like to have a better understanding of the purpose for using this method. It will not give either a continuous or a complete picture of water use at Quivira. The measurements made at the diversions you have specified do not include water used in the Little Salt Marsh, or ground water contributions to marshes on the north end of the Refuge.

In his September 25, 1996, order, Chief Engineer Pope required the Fish and Wildlife Service to provide plans for constructing a water measurement system "sufficient to provide continuous, daily data detailing the volume of water diverted from Rattlesnake Creek." The Service has spent nearly $70,000 and an inordinate amount of staff time over the last 6-1/2 years attempting to comply with that order. I think that we need additional direction from Mr. Pope about this.

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purpose he intends a measurement system to serve. If it is to get continuous data, the Zenith gage is the most efficient and cost-effective method. The Refuge does not ordinarily release any water downstream unless it is an unusually high flow. Water that exits the Refuge is typically ground water seeping into the Big Salt Marsh and Salt Creek, and not surface water from Rattlesnake Creek. The gage is clearly the most accurate measurement of how much Rattlesnake Creek water is used. And, if the need is to prepare for administration of Rattlesnake Creek, any calls for administration made by the Service will be based on the flow at the Zenith gage.

If the intent of measuring water is to document better the beneficial use of water, the Service would be happy to work with you to develop a Refuge water budget. We believe that this would be a much more useful tool for understanding Quivira's water management and use.

Please give me a call at (303)236-5322, X232 if you have any questions.

Sincerely,

Megan A. Estep
Regional Private Lands Hydrologist

cc: Refuge Manager, Quivira NWR

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 03 2003

CERTIFIED 7000 0520 0021 8892 6842

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2001 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe

Linda Coe
Water Rights Specialist

Enclosure

21 757

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

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Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Thomas L. Huntzinger
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

JAN 22 2003

1571

Dear Mr. Huntzinger:

The U.S. Fish and Wildlife Service recently received a proposal from the U.S. Geological Survey to provide an evaluation of the flow characteristics of Rattlesnake Creek Diversion Structures in the Quivira National Wildlife Refuge. The proposal involves the installation and testing of Doppler velocity sensors at three of the Diversion points, two of which are multiple gated structures flowing into concrete aprons, and one of which is a PVC pipe. The estimated cost of the evaluation is $55,500. This cost includes the purchase of the sensors plus an **annual** operation and maintenance cost of $22,500. If the USGS determines that the Doppler sensors work adequately, the Service would still be looking at purchasing and testing equipment at two additional diversion sites. If this equipment could be used at those two sites, the Service would be looking at an annual operation and maintenance cost of about $37,500. This is well outside the ability of the Refuge to fund within its existing budget.

As you may be aware, the Service has already invested $69,441.35 in the evaluation of using long-throated flumes to measure water on the Refuge. When the total cost of the design and construction of these flumes escalated to over $325,000 due to the lack of suitable material for the foundation of the flumes, the Service determined that this alternative was not financially feasible. The Service then attempted to reprogram the funds, and lost $35,000 of Refuge dollars (non-construction moneys) during the reprogramming since the Refuge money could not be carried over into a new fiscal year. At that time, the Service suggested using the Zenith gage in concert with periodic measurements made with a Claussen-Pierce Weir Rule would be adequate to determine Refuge water use at four of the five diversion points (this method could not be used at location A1, the PVC pipe that diverts water to Unit 7). Also at that time, the Service pointed out that the State of Utah allows the Service to use a USGS gage to measure inflow to a Refuge there since measurement of diversions to the Refuge from the source river is so difficult.

None of the other proposed water measurement scenarios that the Service has investigated, including the installation of Doppler sensors, included water use in the Little Salt Marsh. Water

use in the Little Salt Marsh can, at times, be a significant quantity of the total amount of water used from Rattlesnake Creek. Finally, there are no other water users on Rattlesnake Creek below the Refuge, so there is no possibility that other users will demand that the Refuge release water for downstream purposes.

The Service cannot economically support a long-term water measurement plan that requires an annual outlay of $37,500 plus annual increases for cost-of-living adjustments. Funding for this type of program is not in the Refuge budget, nor is it available from discretionary funds from the Division of Water Resources. We respectfully request that your office reevaluate the need for and purpose of collecting continuous water measurement data at Quivira National Wildlife Refuge, especially in light of the fact that what has been proposed does not include all of the Refuge's water use. We are attempting to meet your measurement requirements, but must be realistic in terms of the dollars expended to collect the information, information which we view as having limited usefulness for Refuge water management.

Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep
Regional Private Lands Hydrologist

cc: Refuge Manager, Quivira NWR
Chief, Stafford Field Office, Kansas DWR

2002 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2003.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 S.W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Ending Water Meter Reading	Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Depth to Water	Date
7571-00	3100N 1150W 35-21-11W (RCA)	1 A	2,912.3		Acre Feet	Surface Water	Diverted				
7571-00	4450N 1000W 13-22-11W (Darrynane)	1 A	3,426.7		Acre Feet	Surface Water	Diverted				
7571-00	1250N 3850W 25-22-11W (Little Salt Marsh)	1 A	3,988.9		Acre Feet	Surface Water	Diverted				
	TOTAL		10,327.9		Acre Feet	Surface Water	Diverted				

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7000 0520 0021 8892 6842

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 2002					July 1, 2002					November 1, 2002				
Empty	¼	½	(¾)	Full	Empty	¼	½	(¾)	Full	Empty	¼	½	(¾)	Full

21 756

Date: 1/17/03 Telephone: (620) 486-2393

02 18302 1 1 - REC Staff SF
Office Use FO CO GMD

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

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FEB 07 2003
KS DEPT OF AGRICULTURE

Dave Hilley, Refuge Manager
Name (Printed or Typed)

Name (Signature)

___ Owner ___ Tenant XX Agent

2002 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2003**. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 S.W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

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7571-00	3100N 1150W 35-21-11W 1									
7571-00	4450N 1000W 13-22-11W 1									
7571-00	1250N 3850W 25-22-11W 1									

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 2002					July 1, 2002					November 1, 2002				
Empty	¼	½	¾	Full	Empty	¼	½	¾	Full	Empty	¼	½	¾	Full

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KS DEPT OF AGRICULTURE

21 824

Date: _____ Telephone: (___) _____

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Office Use FO CO GMD

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

_____
Name (Printed or Typed)

_____
Name (Signature)

___ Owner ___ Tenant ___ Agent

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
David L. Pope, Chief Engineer
Division of Water Resources

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(~~316~~ 620) 234-5311 FAX (~~316~~ 620) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

December 4, 2002

Ms. Megan Estep
United States Department of the Interior
Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

Re: Water flow meter requirements / Water Right, File No. 7,571

Dear ~~Ms. Estep~~ Meg:

This office has received your letter dated November 27, 2002 requesting additional time to meet the water flow metering requirements of the Chief Engineer. We are aware through our contacts with the United States Geological Survey (U.S.G.S.), and your office, of the recent efforts and plans to devise an adequate metering system for Quivira National Wildlife Refuge.

We remain optimistic that an accurate metering system can be developed so that all water diverted from the Rattlesnake Creek, for subsequent use at the refuge, will be continuously monitored and recorded. We also are aware that additional testing of the metering system in cooperation with the U.S.G.S. will be necessary before it can be fully implemented. Therefore, your request for additional time to complete the metering system is hereby granted until December 31, 2003.

If you have any additional questions, please feel free to contact this office.

Sincerely,

M Bruce Falk

M. Bruce Falk
Water Commissioner

c: Tom Huntzinger (microfilm)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

NOV 2 7 2002

Bruce
Dear Mr. ~~Falk~~:

As you are aware, the Quivira National Wildlife Refuge is in the process of working with the U.S. Geological Survey to determine whether it is feasible to continuously monitor water diverted at the four major points of diversion as your agency has ordered us to do. We are working with Jim Putnam of USGS to try to test some new equipment. In the meanwhile, we are still taking Claussen rule readings as we have done in the past and utilizing the Zenith gage to quantify the total amount of water reaching the Refuge via Rattlesnake Creek. At present, we cannot estimate the length of time that will be needed for USGS to investigate the possibility of utilizing the new equipment at the Refuge, and cannot predict whether the equipment will function satisfactorily. However, we would like to request an extension in time to meet your agency's metering requirements until December 31, 2003.

Please call me at (303)236-5322, X232 if you have any questions.

Sincerely,

Megan Estep
Hydrologist, Water Resources Division

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Kansas Department of Agriculture

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WATER RESOURCES
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DEC 0 6 2002
KS DEPT OF AGRICULTURE

7571

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
109 SW 9th Street
Topeka, Kansas 66612-1280
(785) 296-3558
FAX: (785) 296-8389

Division of Water Resources
David L. Pope, Chief Engineer
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283
(785) 296-3717 FAX (785) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

March 15, 2002

Megan Estep
Hydrologist, Water Resources Division
United States Department of the Interior
Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, CO 80225-0486

I would like to take the opportunity to thank you and Dave Hilley for taking time to meet with Bruce Falk and myself to tour the water control structures on March 12, 2002. It was beneficial for us to see the actual structures to provide insight in assessing the ability of them for measuring flows diverted from Rattlesnake Creek into the Quivera Refuge under water rights held by the U.S. Fish and Wildlife Service. It was enlightening to see the approach of the individual management units that will avoid wasting water within the refuge. Following is a brief review of the tour/inspection:

Observations:

The refuge has a system of concrete control structures installed in earth berm impoundments. All structures appeared to be structurally stable and refuge management has a maintenance program to ensure the earth berms remain intact around the concrete structures. The structures basic design is a variable head inlet to a round or square culvert that conveys water through the berm to canals or adjacent bermed impoundments. All structures had concrete wing walls or abutments and either concrete or rock embankment protection. The inlets use wooden timber slats or "stop logs" to adjust the elevation on the upstream impoundment allowing water to spill over the top of the sill into the culvert. Canals or basins downstream from the control structures have insufficient gradient to ensure critical flow over the top of the stop logs, often causing submergence of the structure. Flows are determined by the Clausen formulas for weir flows when critical flow conditions exist. Refuge management acknowledges that a measurement method has not been developed for the weirs when they are submerged. Measurements of depth of flow over the weirs are recorded at appropriate frequency to estimate continuous flow rates and to compute the quantity of flow through the structures. Records of flow computations are retained and used to prepare annual water use reports. Measurements at the control structures are also retained in the files as field notes. A USGS operated gaging station on Rattlesnake Creek upstream of the refuge monitors stream inflows to the refuge.

In addition to the USGS gaging station, structures most important to DWR for water measurement are A1, A2, A3, C1, 24C, 24D, DCA and RCA that divert water from Rattlesnake Creek directly or through impoundments on Rattlesnake Creek. Other important structures are A2, 24A and 24B that release water from impoundments directly on Rattlesnake Creek that allow flows to progress downstream. Additional structures that control water within the refuge are important for management but less important for flow measurement.

Significant ground water inflows occur from springs located at the northwestern corner of the refuge. These inflows maintain wetland areas on the northern end of the refuge and maintain flows in Salt Creek. There is no records of this flow in Salt Creek since the gage was discontinued in 1991. These inflows should not be confused with flows from Rattlesnake Creek that may bypass the refuge.

Results of the inspection:

Flow measurement and control structures are stable concrete structures. The design of the structures are generally adequate for establishing procedures for flow measurement and to allow proper control of water.

Depth versus flow ratings obtained from the Clausen weir formulas and the associated field measurements using the Clausen calibrated rule are well established methods. During conditions of critical depth at the structures the Clausen rule should be an accurate measurement of flow. When structures are under backwater submergence, accurate measurements are obtained from the hydraulic relationship between flow and the decrease in the upstream and downstream water surface elevations at the control structure. Refuge management is aware of this challenge and have suggested establishing submergence ratings using standard submerged culvert hydraulic analysis equations. This approach should be an acceptable method when verified by a few current meter measurements over a range of flows to establish accurate structure coefficients. A staff gage will be needed both upstream and downstream of the structure to obtain flow measurements during submerged flow conditions. In most cases staff gages could be mounted on the concrete wing walls. Most of the wing walls are sloped and the staff gage mounted there would require accounting for this slope in determining true vertical measurement of water surface elevation. However, mounting on a slope may address the problems with ice build up that has damaged vertical staff gage installations in the past. Upstream staff gages or measurement points should be located a distance away from the inlet that is at least equivalent to one or two inlet widths. This will ensure that the upstream measurement is not within the approach contraction or draw down zone of the inlet.

Field measurements are made and recorded manually. Staff on site are aware of changes in inflows and make appropriate adjustments in the flow controls as often as needed. It is common to require automatic data recorders for diversions. The frequency of manual monitoring and measurements is adequate to document quantities diverted and to manage flows within the refuge. Records are kept on file for reference. Therefore it is not necessary to install automated data recorders assuming the current operational procedures are continued. The management of the refuge agreed to prepare a written description of the procedures used to measure, record, and report flows and diversions and to maintain records on file at the refuge and duplicates at the office in Denver.

Ground water feeds springs at the northwest side of the refuge when irrigation wells are not pumping and evapotranspiration is minimal. This inflow maintains flows in Salt Creek that are not spills from the refuge. Ground water contributions to Salt Creek should be documented by a current meter discharge measurement at the infrequent times when no water is flowing from the refuge or Rattlesnake Creek. Refuge management has agreed to request a discharge measurement on Salt Creek by DWR or the USGS at these times.

Respectfully,

Thomas L. Huntzinger
Water Appropriation Program Manager

TLH:ajm
cc: Dave Hilley, Refuge Manager, Quivera Wildlife Refuge
Bruce Falk, Water Commissioner, Stafford Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 20 2002

CERTIFIED 7000 0520 0025 4794 2513

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2001 Water Use Report for Permit 7571, Quivira National Wildlife Refuge. The report does not include water utilized within Little Salt Marsh.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe
Water Rights Specialist

Enclosure

151101

2001 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2002.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the wa**ter rights. If you have questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire report for your records before returning the report to:

CERTIFIED MAIL

7000 0520 0025 4794 2513

Water Use Coordinator
sas Department of Agriculture
ivision of Water Resources
09 S.W. 9th, Second Floor
opeka, Kansas 66612-1283

PART A: POIN

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	3100N 1150W 35-21-1iW (RCA)	1	A	2089.5 Acre Feet Surface Water Diverted							
7571-00	4450N 1000W 13-22-11W (Darrynane)	1	A	695.8 Acre Feet Surface Water Diverted							
7571-00	1250N 3850W 25-22-11W (Little Salt Marsh)	1	A	1595.8 Acre Feet Surface Water Diverted							
	TOTAL			4381.1 Acre Feet Surface Water Diverted							

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 2001					July 1, 2001					November 1, 2001				
Empty	¼	½	¾	(Full)	Empty	¼	½	(¾)	Full	Empty	(¼)	½	¾	Full

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FEB 25 2002
KS DEPT OF AGRICULTURE

151098

Date: 2/12/02 Telephone: (620) 486-2393

Office Use: 01 18302 1 1 - REC F Staff CSF GMD

Dave Hilley, Refuge Manager
Name (Printed or Typed)

Dave Hilley
Name (Signature)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

___ Owner ___ Tenant XX Agent

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS DISTRICT 01/24/2002

STATION NUMBER 07142575 RATTLESNAKE C NR ZENITH, KS STREAM SOURCE AGENCY USGS
LATITUDE 380537 LONGITUDE 0983245 DRAINAGE AREA 519.00 DATUM 1785.00 STATE 20 COUNTY 185
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, CALENDAR YEAR JANUARY TO DECEMBER 2001
DAILY MEAN VALUES

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	e21	41	84	48	37	85	22	9.6	5.6	7.4	8.6	14
2	e20	44	85	47	37	98	21	8.9	5.4	7.5	8.6	14
3	e25	44	84	48	36	214	20	8.5	4.4	7.1	8.9	15
4	e30	42	78	48	61	307	19	8.2	4.9	7.2	9.3	16
5	e35	44	76	48	209	252	19	7.9	5.1	7.4	9.5	15
6	e40	47	71	48	168	225	18	7.7	5.9	7.4	9.7	14
7	e38	48	71	50	126	191	17	7.6	5.7	7.4	9.8	15
8	37	47	63	48	88	376	16	7.4	5.5	7.3	10	15
9	34	82	65	46	69	554	15	7.3	5.4	7.5	11	15
10	36	86	68	45	86	452	14	7.4	4.0	7.6	11	15
11	36	79	73	51	158	276	14	7.8	3.6	7.5	12	15
12	35	89	77	57	136	162	13	7.6	3.5	7.7	12	15
13	35	80	e75	52	78	91	13	7.2	3.8	7.8	13	16
14	35	69	e73	50	61	65	13	6.9	4.1	7.6	14	16
15	34	62	e75	49	54	53	16	7.5	5.1	6.8	13	16
16	34	62	79	47	e50	47	16	7.3	4.9	5.3	12	16
17	32	e61	79	47	e48	43	16	7.3	5.5	4.5	13	15
18	33	e60	e68	46	e48	39	14	7.2	9.1	4.8	13	15
19	e33	60	e64	45	e47	36	13	6.6	22	5.3	13	15
20	e34	71	60	44	e46	34	12	6.3	20	5.6	13	16
21	e33	67	58	44	e44	33	11	5.9	16	6.1	13	17
22	e34	60	56	45	42	32	10	5.7	12	6.5	13	17
23	35	61	54	43	40	31	10	5.7	9.4	6.9	13	16
24	39	100	52	42	39	30	9.9	5.7	8.2	7.2	14	22
25	40	136	52	40	39	29	9.4	5.8	7.7	7.6	14	35
26	37	108	51	39	37	27	9.6	5.7	7.5	7.6	14	44
27	35	87	51	38	37	26	9.7	5.5	7.2	8.0	13	33
28	e37	72	50	37	41	25	14	5.3	7.1	8.3	12	43
29	39	---	49	37	44	25	16	5.1	7.5	8.2	29	58
30	38	---	49	36	76	23	11	5.5	7.3	8.6	18	45
31	40	---	48	---	87	---	11	5.8	---	9.0	---	42
TOTAL	1064	1909	2032	1364	2169	3881	442.6	213.9	223.4	220.7	367.4	673
MEAN	34.3	68.2	65.5	45.5	70.0	129	14.3	6.90	7.45	7.12	12.2	21.7
MAX	40	136	85	57	209	554	22	9.6	22	9.0	19	58
MIN	20	41	48	36	36	23	9.4	5.1	3.5	4.5	8.6	14
AC-FT	2110	3790	4030	2710	4300	7700	878	424	443	438	729	1330

e Estimated

Jan 2001 - Dec 2001

151099

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS DISTRICT 01/24/2002

STATION NUMBER 07142575 RATTLESNAKE C NR ZENITH, KS STREAM SOURCE AGENCY USGS
LATITUDE 380537 LONGITUDE 0983245 DRAINAGE AREA 519.00 DATUM 1785.00 STATE 20 COUNTY 185
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.2	71	29	e21	41	84	48	37	85	22	9.6	5.6
2	3.4	53	29	e20	44	85	47	37	98	21	8.9	5.4
3	3.6	38	29	e25	44	84	48	36	214	20	8.5	4.4
4	3.6	42	29	e30	42	78	48	61	307	19	8.2	4.9
5	4.0	42	29	e35	44	76	48	209	252	19	7.9	5.1
6	4.1	41	29	e40	47	71	48	168	225	18	7.7	5.9
7	4.8	40	30	e38	48	71	50	126	191	17	7.6	5.7
8	5.1	39	29	37	47	63	48	88	376	16	7.4	5.5
9	5.4	38	30	34	82	65	46	69	554	15	7.3	5.4
10	5.8	37	30	36	86	68	45	86	452	14	7.4	4.0
11	6.2	38	e27	36	79	73	51	138	276	14	7.8	3.6
12	6.4	40	e26	35	89	77	57	135	162	13	7.6	3.5
13	6.5	38	e25	35	80	e75	52	78	91	13	7.2	3.8
14	6.5	39	e25	35	69	e73	50	61	65	13	6.9	4.1
15	7.0	37	e25	34	62	e75	49	54	53	16	7.5	5.1
16	7.5	36	e24	34	62	79	47	e50	47	16	7.3	4.9
17	8.2	35	e23	32	e61	73	47	e48	43	16	7.3	5.5
18	8.5	34	e24	33	e60	e68	46	e48	39	14	7.2	9.1
19	8.2	33	e22	e33	60	e64	45	e47	36	13	6.6	22
20	8.0	32	e23	e34	71	60	44	e46	34	12	6.3	20
21	8.2	32	e22	e33	67	58	44	e44	33	11	5.9	16
22	9.8	31	e21	e34	60	56	45	42	32	10	5.7	12
23	10	31	e20	35	61	54	43	40	31	10	5.7	9.4
24	14	31	e20	39	100	52	41	39	30	9.9	5.7	8.2
25	27	31	e20	40	136	52	40	39	29	9.4	5.8	7.7
26	39	30	e22	37	108	51	39	37	27	9.6	5.7	7.5
27	38	30	e24	35	87	51	38	37	26	9.7	5.5	7.2
28	37	29	e25	e37	72	50	37	41	25	14	5.3	7.1
29	44	29	e24	39	---	49	37	44	25	16	5.1	7.5
30	48	30	e23	38	---	49	36	76	23	11	5.5	7.3
31	56	---	e22	40	---	48	---	87	---	11	5.8	---
TOTAL	445.0	1107	781	1064	1909	2032	1364	2169	3881	442.6	213.9	223.4
MEAN	14.4	36.9	25.2	34.3	68.2	65.5	45.5	70.0	129	14.3	6.90	7.45
MAX	56	71	30	40	136	85	57	209	554	22	9.6	22
MIN	3.2	29	20	20	41	48	36	36	23	9.4	5.1	3.5
AC-FT	883	2200	1550	2110	3790	4030	2710	4300	7700	878	424	443

e Estimated

2001 water year

#7571

United States Department of the Interior

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FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

DEC 1 1 2001

Dear Mr. ~~Falk~~ Bruce:

Enclosed is a copy of a letter from the Utah State Engineer to the Bear River Migratory Bird Refuge concerning their water measurement difficulties. In this letter, the State Engineer recognized the problems that the Refuge had concerning required monitoring of diverted water, and allowed them to utilize the U.S. Geological Survey gage at Corrine as a basis for determining their water use. I believe that we have a similar problem at the Quivira National Wildlife Refuge, and that we can use the Zenith gage as a basis for water measurement, in concert with other water measurement methods. Please send a copy of this letter on to your office in Topeka. Perhaps they will feel more comfortable with the idea of using the Zenith gage if they are aware of a case where another state has approved a similar methodology.

Please call me at (303)236-5322, X232 if you have any questions.

Sincerely,

Megan Estep
Hydrologist, Water Resources Division

Enclosure

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Kansas Department of Agriculture

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Division of Water Resources
Kansas Department of Agriculture

Claire / Jan
Return — Az

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert L. Morgan
State Engineer

1594 West North Temple, Suite 220
Box 146300
Salt Lake City, Utah 84114-6300
801-538-7240
801-538-7467 (Fax)

February 3, 1997

MR AL TROUT
BEAR RIVER BIRD REFUGE
USA FISH & WILDLIFE
866 S MAIN ST
BRIGHAM CITY UT 84302

Dear Mr. Trout:

Representatives of the State Engineer's office met with a delegation of Bear River Bird Refuge representatives on January 24, 1997, in Brigham City, Utah. The purpose of the meeting was to discuss water measurement difficulties at the refuge diversions. The refuge is studying alternatives to determine how to meet state distribution and refuge operation measurement needs. Based on the explanation of the water head differences and other associated difficulties at the diversions used by the refuge, the State Engineer will accept a creative approach for diversion measurement, using the Corinne gage as a basis for the reporting of water diverted for refuge uses. We recognize that you will need to continue to refine your methods.

We appreciate the cooperation your staff and associates have demonstrated as the water rights needs of the refuge are being resolved. Your agency's filing of additional applications to request the authorization of additional flow will be helpful to resolve the measurement issues.

Thank you again for you cooperation.

Sincerely,

Robert L. Morgan

Robert L. Morgan, P.E.
State Engineer

RLM:LHS:BF:bd

cc: Bob Fotheringham, Logan Regional Engineer
Lee H. Sim, Assistant State Engr. for Distribution

#7571

United States Department of the Interior

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FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

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Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
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105 North Main, Drawer F
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DEC 1 1 2001

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Please call me at (303)236-5322, X232 if you have any questions.

Sincerely,

Megan Estep
Hydrologist, Water Resources Division

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Stafford Field Office
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JAN 0 2 2002
Division of Water Resources
Kansas Department of Agriculture

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KANSAS DEPARTMENT OF AGRICULTURE
DIVISION OF WATER RESOURCES
STAFFORD FIELD OFFICE

M E M O R A N D U M

TO: David Pope and Tom Huntzinger **DATE: September 6, 2001**

FROM: Bruce Falk **RE: Water Right, File 7,571 (Quivira Refuge)**

On June 13, 2001 I forwarded a letter that I had received from USFW Service requesting that we eliminate their requirement to install continuous metering at their diversion works for Quivira National Wildlife Refuge. Since I have not had a response, and I have received telephone inquiries from USFW, it occurred to me that neither of you probably have the background materials necessary to evaluate the situation. I will attempt to provide both of you with additional information as follows.

Sept. 25, 1996 - DWR issued a Findings and Order requiring flow measurement structures sufficient to provide daily data and that a water conservation plan be developed. Plans were to be submitted by July 1, 1997 and the metering devices to be constructed by Dec. 31, 1997.

Jan. 17, 1997 - Letter from USFW that they had contracted with R.E. Pedrotti Co. to evaluate metering. It appeared that the cost would be $43,405 or greater to install the meters. They also requested until Jan 1, 1998 to develop their conservation plan.

June 9, 1997 - Extension was granted allowing to Jan. 1, 1998 for conservation plan and meter plans and to construct meters by June 1, 1998.

Dec. 23, 1997 - USFW requested extension to Dec. 31, 1998 for meter installation.

Jan. 13, 1998 - Extension was granted allowing to April 1, 1998 for meter plans, Dec. 31, 1998 for meter installation and June 1, 1999 for conservation plan.

Dec. 31, 1998 - USFW requested until June 30, 1999 to complete meter installation.

Jan. 4, 1999 - Extension was granted allowing to March 31, 1999 for meter plans, June 30, 1999 for installation of meters and June 1, 1999 for conservation plan.

March 26, 1998 - USFW submitted plans for metering the refuge.

April 30, 1998 - Lloyd Stullken provided response to metering plan.

Dec. 3, 1998 - Letter from USFW was received indicating that previous plans for metering will not operate adequately. Now working with Bureau of Reclamation to design meters. Requested extension to June 30, 1999 to supply metering plans.

April 12, 1999 - Letter from USFW stating that they are contracting with BOR to design metering system. Extension requested for meter plans and installation.

June 14, 1999 - Extension granted to Aug. 1, 1999 for meter plans, July 31, 2000 for meter installation and Jan 1, 2000 for conservation plan.

Dec. 15, 1999 - USFW requests extension to submit conservation plan until March 31, 2000.

Dec 27, 1999 - Extension granted to April 1, 2000 for conservation plan.

Oct. 5, 2000 - USFW requests extension until Aug. 31, 2001 for meter installation.

Oct. 23, 2000 - Conservation plan accepted by Bob Lytle

Oct. 30, 2000 - Extension to Aug. 31, 2001 to install meters.

Feb. 13, 2001 - Metering plans submitted by USFW

April 10, 2001 - Metering plans accepted after Lloyd Stullken's review

April 27, 2001 - Letter from USFW acknowledging Lloyds letter and accepting his additional recommendations.

June 8, 2001 - USFW letter asking to allow them to use the USGS gaging station as Zenith and manual measurements at their diversion locations. Cost of accurate meter installations is too high due to materials required and extremely flat terrain.

As you noticed USFW is currently working under our Aug. 31, 2001 deadline to install their meters and are now expecting a reply to their letter of June 8, 2001. I have attached most of the documents listed above for your review. Hopefully, we can review this situation at some time in the near future.

Falk, Bruce

From: Falk, Bruce
Sent: Wednesday, June 13, 2001 9:24 AM
To: Huntzinger, Tom
Cc: Pope, David L.; Bagley, Jim; Grauer, Julie
Subject: Required meters for Quivira Wildlife Refuge

In September of 1996 an order was issued by the Chief Engineer to U.S. Fish and Wildlife Service to develop a conservation plan and to construct a metering system for water diverted from Rattlesnake Creek into the refuge. The conservation plan was accepted by Bob Lytle in October of 2000. The metering issue continues to be unresolved. USFW has worked diligently on the metering project. They contracted with the Bureau of Reclamation to design the meters. Problems with the installations include the lack of any power source at the sites and the topography of the area which is very flat. The final meter design submitted by the refuge was for four long throated flumes which would involve a considerable amount of construction when water conditions were low. The plan had basically been accepted by Lloyd Stullken.

Recently the BOR informed USFW that 4300 cubic yards of specific fill material (clay) would be needed to not only narrow the channels to be metered, but also to provide for a stable foundation for the flumes. This new addition to the plan apparently would add too much to installation costs. This type of material is not available locally, and if it could be found on site any borrow site would have to be mitigated in some manner. They report that the cost, because of the material requirements, has now gone from $150,000 to $325,000 or more. The BOR indicates that the material would be subject to erosion in years of flood flows.

USFW are requesting now that we continue to rely on the USGS gage on the Rattlesnake Creek immediately upstream of the refuge. They do manually measure the amount of water diverted into different units on the refuge. They are proposing that they continue to monitor their water use as they have in the past and are willing to incorporate any other suggestions that we might have.

I have received a letter from USFW that I will be forwarding to you today. The above information will hopefully help you understand the situation a little easier. I feel that USFW has made a genuine attempt to comply with our meter order. Discussion needs to take place on where we go from here. Let me know if you have any questions.

Claire / Jan
Return — Az

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert L. Morgan
State Engineer

1594 West North Temple, Suite 220
Box 146300
Salt Lake City, Utah 84114-6300
801-538-7240
801-538-7467 (Fax)

February 3, 1997

MR AL TROUT
BEAR RIVER BIRD REFUGE
USA FISH & WILDLIFE
866 S MAIN ST
BRIGHAM CITY UT 84302

Dear Mr. Trout:

Representatives of the State Engineer's office met with a delegation of Bear River Bird Refuge representatives on January 24, 1997, in Brigham City, Utah. The purpose of the meeting was to discuss water measurement difficulties at the refuge diversions. The refuge is studying alternatives to determine how to meet state distribution and refuge operation measurement needs. Based on the explanation of the water head differences and other associated difficulties at the diversions used by the refuge, the State Engineer will accept a creative approach for diversion measurement, using the Corinne gage as a basis for the reporting of water diverted for refuge uses. We recognize that you will need to continue to refine your methods.

We appreciate the cooperation your staff and associates have demonstrated as the water rights needs of the refuge are being resolved. Your agency's filing of additional applications to request the authorization of additional flow will be helpful to resolve the measurement issues.

Thank you again for you cooperation.

Sincerely,

Robert L. Morgan

Robert L. Morgan, P.E.
State Engineer

RLM:LHS:BF:bd

cc: Bob Fotheringham, Logan Regional Engineer
Lee H. Sim, Assistant State Engr. for Distribution

3

Quivira NWR, Kansas

Steve Robertson
Date: 29 Oct 00
Rev. 15 Nov 00
Rev. 27 Dec 00
Rev. 24 Apr 01

Amount spent during the Spec Contract phase in FY00

Estimate the amount spent by Groups since the job went into Spec Contract in late May (Pay Period 13)

Estimate is based on the MIS report #35 of 9/29/00.

		d8140	d8160	8170 Spec	8170 Est	d8180	d8311	d8822 Soil lab work	d8340 soils lab	d7810 Contracting	Sum		
Jun	PP13										$0		
Jun/Jul	PP14	$300.00		$300.00							$600		
Jul	PP15	$1,462.50		$1,650.00							$3,113		
Jul	PP16	$825.00	$222.50	-$1,087.50							$2,135		
Aug	PP17	$1,237.50	$222.50	$118.00	$262.50						$1,841		
Aug	PP18	$975.00	$356.00								$1,331		
Sept	PP19	$2,737.50	$267.00	$75.00			$623.00				$3,703		
Sept	PP20	$262.50		$461.00	$1,200.00					1286.28	$3,210		
Oct	PP21	$516	$215	$560		$288		$462	$569		$2,610		
Oct	PP22							$448			$448		
Nov	PP23										$0		
Nov	PP24										$0		
											TOTAL contracting FY00 June and later		Design FY00 Before Jun
		$8,316.00	$1,283.00	$4,251.50	$1,462.50	$288.00	$623.00	$910.00	$568.50	$1,286.28	$18,988.78	Actual	$25,590
Amount estimated		$5,000.00	$0.00	$5,000.00	$1,000.00						$11,000.00	Estimated	
											$7,988.78	Diff	

over estimate - Increase due to unanticipated difficulties of if Refuge is to complete borrow haul and to modify contract to allow construction to stay within available budget

Estimate FY01 budget to carry through construction

				SD -Lvl 1	SD -Lvl 2	SD -Lvl 3	Labor	NonLab	End of May est
d7810 - Contracting					15	1	$9,328		$8,000
d8140 - Water Conveyance Group				0	10	3	$8,074		$0
d8160 - Construction Management						5	$3,440	$600	$4,000
Inspector		Rate	Cost						
35	days perdiem @	$85.00	$2,975						
35	days truck rental @	$14.00	$490						
4000	miles @	$0.14	$560						
35	days salary @	$400.00	$14,000				$14,000	$4,225	$18,225
(26 workdays, 4 travel days, 5 OT days)									
misc			$200						
d8170 - Spec and Est					6		$3,629	$500	$4,000
D8560 - Water Lab - Tony Wahl to setup water level instrument					4		$2,944	$1,360	$3,200
						TOTAL	$41,415	$6,685	$37,425

TOTAL amount spent in FY00 for contracting and estimated for FY01 Spec Contracting plus Construction phases	$18,988.78	Spent FY00 contracting
	$9,328.00	Estimate for FY01 Spec Contracting
	$38,771.52	Estimate for FY01 Construction phase
	$67,088.30	Estimated in Nov 2000
	$50,000.00	Estimated in late May 2000
	$17,088.30	Diff

Increase due to unanticipated difficulties of whether Refuge is to complete borrow haul and to modify contract to allow construction to stay within available budget ($8,000), also increased FY01 SD costs for Laboratory and WCG contingencies ($9,000)

Estimate for FY01 change for borrow pit exploration and selection

ACTUALS		d8010	d8140	d8160	8170 Spec	8170 Est	d8180 Material Eng	d8822	d8340 soils lab	d7810 Contracting	URS and Terracon		
Nov	PP01											$0	
Dec	PP02											$0	
Dec	PP03											$0	
Feb	PP04		$720									$720	
Feb	PP05		$432		$28				$96			$556	
Mar	PP06		$144									$144	
Mar	PP07	$224	$1,890									$2,114	
Mar/Apr	PP08		$144									$144	
Apr	PP09		$576							$851		$1,427	
Apr	PP10											$0	
May	PP11											$0	
May	PP12										$11,000	$11,000	
		$224	$3,906	$0	$28	$0	$0	$0	$96	$851	$11,000	$16,105	Actual

Amount spent in each year and for each phase

FY99 Actual	$16,531.78	
FY00 Actual	$44,578.78	
FY01 Actual + est	$64,204.52	
TOTAL	$125,315.08	

		Est Constr $200,000
Measurment structure study	$5,000	2.5%
Design and Technical Spec	$37,122	18.6%
Spec Contract 1	$18,989	9.5%
Borrow pit exploration and selection	$16,105	8.1%
Spec Contract 2	$13,457	6.7%
Construction management	$12,114	6.1%
Construction Inspection	$18,225	9.1%
Setup water level instrument	$4,304	2.2%
TOTAL Overhead	$125,315	63%

Estimate amount of construction money available

			IAG Amount
IAG	27-Jan-99	Report for water measurement	$5,000
IAG amendment 1	6-Apr-99	Increased budget to include design and extend date to Jul 30, 99	$43,500
IAG amendment 2	31-Aug-99	extend agreement end date to Feb 28, 2000	$43,500
IAG amendment 3	1-Mar-00	extend agreement end date to Apr 30, 2000	$43,500
IAG amendment 4	30-May-00	Increased budget to include construction and extend date to Jan 31, 01	$188,616
IAG amendment 5	15-Aug-00	Increased budget $35,000, mainly for contracting and construction	$223,616
IAG amendment 6	18-Dec-00	Increased budget $11,271, mainly for contracting and construction	$234,887
IAG amendment 7	1-Feb-01	extend agreemant end date to Dec 31, 2001	$234,887
~~IAG amendment 8~~		~~Increased budget $4,000 for borrow pit exploration and selection~~	~~$238,887~~

Amount available for construction: $113,572

FWS may complete some work and construct during low ground water time to save money

haul borrow material =	$30,000.00
Low dewatering =	$10,000.00
TOTAL reduction	$40,000.00

Est total construction cost =	$200,000
TOTAL reduction	$40,000
FWS construction funds required	$160,000
However, this will be an 8a type contract, construction could be	15% higher than est bid costs
FWS construction funds that may be required	$184,000

J:_Regions\FWS\Reg6\Quivira\[FY01 budget.xls]Detail costs

7571

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

JUN 0 8 2001

WATER RESOURCES
RECEIVED

JUN 1 4 2001

KS DEPT OF AGRICULTURE

Dear Bruce Falk:

This letter is a follow up to your telephone conversation of June 5, 2001, with Megan Estep, concerning the Service's attempts to comply with Chief Engineer Pope's order to install a continuous water measurement system at Quivira National Wildlife Refuge.

The measuring flumes that have been designed for the Refuge by the USDI, Bureau of Reclamation, require in excess of 4,300 cubic yards of fill material. This material will be used to create a stable foundation for the flumes as well as to choke down the canals to the proper width in front of the flumes. The BOR has very tight requirements regarding the characteristics of the material that can be used, and we do not currently have any borrow sites containing material that meets these requirements.

The BOR has contracted for a geotechnical exploration to determine whether suitable material can be found on the Refuge. Unfortunately, all of the sites identified by the BOR appear to be potential wetlands and would fall under Section 404 of the Clean Water Act. In addition, development of a borrow area of the size needed to obtain that quantity of material would require that the Service prepare an Environmental Assessment, as required by the National Environmental Policy Act. Conformance with the requirements of Section 404 and NEPA could potentially take months, and, if the Corps of Engineers determines that the area or areas being considered are jurisdictional wetlands, we may not be able to proceed.

The cost of constructing the flumes has increased substantially since we initiated the project. Our original cost estimate for flume construction was approximately $150,000. With the costs added by contracting with the BOR and the costs for the geotechnical exploration, the total cost for flume design and construction is now over $325,000 (see attached Budget/Expenditure Summary). If we have to haul in borrow material from any distance, the cost could exceed

Stafford Field Office
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JUN 1 1 2001
Division of Water Resources
Kansas Department of Agriculture

JUN 1 9 2001
Division of Water Resources
Kansas Department of Agriculture

$400,000. We do not have the funds available to meet the cost, even without the additional task of hauling borrow material. Further, the BOR concedes that the flumes would be susceptible to disturbance or even washing out in very high flood years.

We request that the Chief Engineer consider using the USGS stream gage, Rattlesnake Creek near Zenith, as a means of measuring the volume of water entering the Refuge. The data from this gage is available in real time on the USGS web site, and would provide accurate information concerning the flow rate into the Refuge. This system would also document the total volume of water entering the Refuge from Rattlesnake Creek, including the amount used to fill and maintain the Little Salt Marsh, and would actually provide a more accurate assessment of the volume of water which the Refuge uses than monitoring only the water diverted out of the Little Salt Marsh, Darrynane Lake and at Structure RCA. In low and average water years, all inflow is utilized and no Rattlesnake Creek water exits the Refuge. Any need to curtail upstream use to meet the Refuge's water right would occur in these years.

Refuge staff will continue to make Claussen Rule measurements on diversions, and record water levels in major Units, such as the Little Salt Marsh, as we have done in the past, and we can continue to report this information annually. We would be happy to work with your office to develop a standardized monitoring program where measurements are taken on a more frequent basis and at specified times. We also would be willing to measure and record water levels in major units and utilize data from the Refuge Fire Weather Station to compute evaporation from those units in order to get an accurate summary of Refuge water use.

If your office has any other suggestions as to how we should proceed, we would be happy to consider them. Please call Megan Estep at (303)236-5322, X232 if you have any questions.

Sincerely,

for Cheryl C. Williss
Chief, Water Resources Division

Enclosure

Quivira NWR, Kansas

Steve Robertson

Flow Measurement Flumes A1, C1, DCA, RCA

Date: 4/24/01

Budget/Expendature Summary

Budget

FWS IAG Budget amount =	$238,887

Expendatures (Actual and future estimates)
(Does not include construction contract)

DATE	ACTIVITY	COST
FY99	Measurment structure study	$5,000
FY99-May 00	Design and Technical Spec	$37,122
Sept 00	Spec Contract 1	$18,989
Feb thru May 01	Borrow pit exploration and selection	$16,105
Jun 01	Spec Contract 2	$13,457
Jul thru Aug 01	Construction management	$12,114
Aug 01	Construction Inspection	$18,225
Sep 01	Setup water level instrument	$4,304
	TOTAL	$125,315

Construction Contract

Amount available for construction:	$113,572	
Est total construction cost =	$200,000	
Reduction for FWS borrow haul, no dewatering =	$40,000	
FWS construction funds required	$160,000	
However, this will be an 8a type contract, construction could be	15%	higher than est bid costs
FWS construction funds that may be required	$184,000	
20% Contracting Contingencies	$36,800	
FWS contracting funds that should be available	$220,800	
Amount available for construction:	$113,572	
FWS contracting fund shortfall	-$107,228	

7571

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDR
Post Office B x 2
Denver Fede al C
Denver, Col rad

STRE T LOCATION:
ica P vd.
olorado 80228-1807

APR 2 7 2001

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear Mr. Falk:

This is in response to your April 10, 2001 letter and the attached March 20 letter from Lloyd Stullken. We agree with Mr. Stullken that the placement of the flumes by a local contractor according to design will be difficult. We currently plan to have someone, either from this office or from the Bureau of Reclamation, on site during construction to ensure proper placement.

We anticipate having to do post-construction surveys of all **four** flumes. (NOTE: although we only have three listed points of diversion, there are two canals leaving the Little Salt Marsh, and we will have a flume on each of these canals) We have benchmark elevations established on the concrete water control structures that release water into the canals where the flumes will be placed. The Service will work with the Bureau of Reclamation on the development of accurate rating curves for the flumes. These will be provided to DWR. We will also research the amount of acceptable sediment in the flumes, and perform any necessary clean out work required to maintain accuracy.

We intend to install staff gages on all of the flumes. This is necessary to set the offset on the data loggers, as well as to check that the loggers are operating properly. We will work with Refuge staff to ensure that the flumes are inspected frequently. This will not be a problem when we are diverting water, as visits to the headgates must be made on a regular basis to adjust flow rates, and the flumes will be easily accessible from the headgates.

Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
David L. Pope, Chief Engineer
Division of Water Resources

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

April 10, 2001

Megan A. Estep
Refuge Hydrologist
Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver, Colorado 80225-0486

Re: Water Right, File No. 7,571

Dear Ms. Estep:

This office has completed its review of the metering plan submitted for the above referenced water right. We acknowledge that the refuge presents many challenges in regard to metering and appreciate your efforts to find a suitable method of measuring the amount of water diverted from Rattlesnake Creek.

Our reviewer, Lloyd Stullken, in his letter dated March 20, 2001 (attached), has made three recommendations that should be implemented with the installation of the meters.

Therefore, the Division of Water hereby accepts the metering plan submitted by your office with the inclusion of the recommendations made by Mr. Stullken. If you need to discuss the additional recommendations, please feel free to contact this office.

Sincerely yours,

M Bruce Falk

M. Bruce Falk
Water Commissioner

Enc.
pc: Lloyd Stullken
Tom Huntzinger (microfilm)
Julie Grauer

ISAS DEPARTMENT OF AGRICULTUR
Division of Water Resources

FLOWMETER VARIANCE/WAIVER/EXEMPTION WORKSHEET

1. File No(s). 7571	1a. ☐ Vested Right ☐ Water Right ☐ Appropriation of Water	2. FO 2	3. GMD 5

4. Type and Purpose of Letter

Type of Extension _____ Completion Date _____

Date Received _____ Perfection Date _____

☐ Completion of Diversion Works: ☐ Permit ☐ Change Approval

☐ Meter Installed _____

☐ Dismissal _____

☒ Other **METER ACTION TRAIL ENTRY**: Code 35 = Mtr Spc Waived = Meter Specifications Waived before Installation

5. Name and Address PID_____

5a. PC Name and Address PID_____

Name and Address PID_____

Name and Address PID_____

6. General Information

Priority Date _____

Certificate Date _____

Vested Right Order Date _____

Approval Date _____

Priority Date of Change _____

Approval of Change Date _____

Completion Date _____

Perfection Date _____

7. Use of Water ☐ Groundwater ☐ Surface Water

☐ DOM	☐ IND	☐ IRR	☐ DEW
☐ MUN	☒ REC	☐ STK	☐ FPR
☐ WTR	☐ ART	☐ CON	☐ HYD
			☐ THX

8. Battery Number _____

9. Special Use _____

10. Aquifer _____

MICROFILMED

12. Point of Diversion (one worksheet for each PD)

✓	MOD / DEL / ENT	PDIV_ID	Qualifier	S	T	R	ID	Ft N	Ft W
	ENT	53524		~~18~~ 35	21	11	1		

Comments on reverse: Yes No

Date Prepared 3/20/01 By MS

Date Entered 3-21-01 By MS

DWR 1-664+(Rev. January 9, 2001)

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
109 SW 9th Street
Topeka, Kansas 66612-1280
(785) 296-3558
FAX: (785) 296-8389

Division of Water Resources
David L. Pope, Chief Engineer
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283
(785) 296-3717 FAX (785) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

March 20, 2001

Bruce Falk, Water Commissioner, Stafford Field Office
105 N. Main St.
Stafford, KS 67578-1342

RE: File No. 7571, Flume to measure diversion.

Dear Mr. Falk,

The plan Megan Estep-Johnston, U.S. Fish and Wildlife Service (USF&WS) has proposed to quantify diversions for Quivera National Wildlife Refuge is appropriate for the very-difficult-to-measure situation. She has consulted with the U.S. Bureau of Reclamation (USBR) who recommends a long-throated flume. From the USBR's Online Water Measurement Manual, "Long-throated flumes can be computer-calibrated to within ±2 percent plus head measurement error and have submergence limits up to 90 percent." The percent accuracy is within the bounds placed by our water flowmeter specifications and the submergence limit addresses the low gradient channel. The hardcopy presented to me for evaluation concerned itself entirely with the design of the flume and foundation for its placement. Ms Johnston returned a phone call 3/19/01 to add that water level in the flume will be monitored by a float in the stilling well and recorded by a yet-to-be-selected datalogger. She also indicated that a clay fill appropriate for the foundation is being sought because it is not available at the site.

The plan is good but there are numerous pitfalls to be encountered. In my experience, getting the flume placed by a local contractor according to design will be the most difficult. Here are my recommendations:

1) Post-construction geometry and elevations need to be determined (possibly within .005 ft?) to generate a custom rating table. The elevations need to be tied by survey to some reference marks that are independent of the structure and rechecked by an annual survey to assure that the flume is oriented properly. It is recommended that the USF&WS obtain the calculation/program that generates the rating table for this particular flume to adjust for any future shifts in orientation. DWR should have a copy of the current flume rating table in its file also. USF&WS needs to find out from USBR how much sediment can be tolerated in the upstream throat of the flume without affecting the rating.

2) A staff gage or other stage-measuring device independent of the stilling well needs to be installed to readily determine if the stilling well is communicating properly.

3) A plan/commitment for regularly-scheduled visits to maintain the flume and its instrumentation will be needed. Once or twice a year visits risk too much loss of record. If the recorder should not be working, daily visits to read the staff/outside gage are in order.

It is clear that a flowmeter meeting the specifications for water flowmeters in effect at the time the approval was made is not appropriate for this case. The long-throated flume described above should perform the intent of the flowmeter specifications in this special case. An exemption to those specifications is therefore granted to place instrumented, long-throated flumes to measure the 3 points of diversion for File No. 7571. Those 3 points of diversion are identified in our files as:
pdivid 53524 at sec. 35, T.21 S., R.11 W., section sequence ID 1
pdivid 48617 at sec. 13, T.22 S., R.11 W., section sequence ID 1
pdivid 28295 at sec. 25, T.22 S., R.11 W., section sequence ID 1

Sincerely yours,

Lloyd E. Stullken, P.E.
Division of Water Resources, Technical Services
109 SW Ninth St., Topeka, KS 66612-1283

Phone: 785 / 296-6084
FAX: 785 / 296-1176
email: lstullken@kda.state.ks.us

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

FLOWMETER VARIANCE/WAIVER/EXEMPTION WORKSHEET

1. File No(s). 7571	1a. ☐ Vested Right ☐ Water Right ☐ Appropriation of Water	2. FO 2	3. GMD 5

4. Type and Purpose of Letter

Type of Extension _____ Completion Date _____

Date Received _____ Perfection Date _____

☐ Completion of Diversion Works: ☐ Permit ☐ Change Approval

☐ Meter Installed _____

☐ Dismissal _____

☒ Other **METER ACTION TRAIL ENTRY**: Code 35 = Mtr Spc Waived = Meter Specifications Waived before Installation

5. Name and Address PID_____

5a. PC Name and Address PID_____

Name and Address PID_____

Name and Address PID_____

6. General Information

Priority Date _____

Certificate Date _____

Vested Right Order Date _____

Approval Date _____

Priority Date of Change _____

Approval of Change Date _____

Completion Date _____

Perfection Date _____

7. Use of Water ☐ Groundwater ☐ Surface Water

☐ DOM	☐ IND	☐ IRR	☐ DEW
☐ MUN	☒ REC	☐ STK	☐ FPR
☐ WTR	☐ ART	☐ CON	☐ HYD
			☐ THX

8. Battery Number _____

9. Special Use _____

10. Aquifer _____

MICROFILMED

12. Point of Diversion (one worksheet for each PD)

✓	MOD / DEL / ENT	PDIV_ID	Qualifier	S	T	R	ID	Ft N	Ft W
		48617		13	22	11			

Comments on reverse: Yes No

Date Prepared 3/20/01 By BS

Date Entered 3-21-01 By my

DWR 1-664+(Rev. January 9, 2001)

ISAS DEPARTMENT OF AGRICULTUR
Division of Water Resources

FLOWMETER VARIANCE/WAIVER/EXEMPTION WORKSHEET

1. File No(s) 7571	1a. ☐ Vested Right ☐ Water Right ☐ Appropriation of Water	2. FO 2	3. GMD 5

4. Type and Purpose of Letter

Type of Extension _____ Completion Date _____

Date Received _____ Perfection Date _____

☐ Completion of Diversion Works: ☐ Permit ☐ Change Approval

☐ Meter Installed _____

☐ Dismissal _____

☒ Other **METER ACTION TRAIL ENTRY**: Code 35 = Mtr Spc Waived = Meter Specifications Waived before Installation

5. Name and Address PID_____

5a. PC Name and Address PID_____

Name and Address PID_____

Name and Address PID_____

6. General Information

Priority Date _____

Certificate Date _____

Vested Right Order Date _____

Approval Date _____

Priority Date of Change _____

Approval of Change Date _____

Completion Date _____

Perfection Date _____

7. Use of Water ☐ Groundwater ☐ Surface Water

☐ DOM	☐ IND	☐ IRR	☐ DEW
☐ MUN	☒ REC	☐ STK	☐ FPR
☐ WTR	☐ ART	☐ CON	☐ HYD
			☐ THX

8. Battery Number _____

9. Special Use _____

10. Aquifer _____

MICROFILMED

12. Point of Diversion (one worksheet for each PD)

✓ MOD DEL ENT	PDIV_ID	Qualifier	S	T	R	ID	Ft N	Ft W
	28295		25	22	11			

Comments on reverse: Yes No

Date Prepared 3/20/01 By LBS

Date Entered 3-21-01 By MP

DWR 1-664+(Rev. January 9, 2001)

7571

Falk, Bruce

From: Falk, Bruce
Sent: Thursday, February 22, 2001 8:41 AM
To: Stulliken, Lloyd
Subject: Meter specs for Quivira

Lloyd, today I am placing the meter design specs in the mail to you for U.S Fish and Wildlife Service's facilities at Quivira Wildlife Refuge. They need approval of the plan from DWR prior to starting construction. The cover letter states that they intend to begin the contracting process next month and would DWR written approval prior beginning the contracting procedure.

Bruce - Packet received for your files.
4/25/01

WATER RESOURCES
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FEB 26 2001
KS DEPT OF AGRICULTURE

Stafford Field Office
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APR 27 2001
Division of Water Resources
Kansas Department of Agriculture

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 1 3 2001

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear Mr. Falk:

Enclosed is a copy of the design plans for water measurement devices for the Quivira National Wildlife Refuge. We would like to receive written approval for these devices prior to contracting for construction. We anticipate beginning the contracting process next month. Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

WATER RESOURCES
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Stafford Field Office
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Kansas Department of Agriculture

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Kansas Department of Agriculture

SOLICITATION/SPECIFICATIONS

U.S. Fish & Wildlife Service
QUIVIRA NATIONAL WILDLIFE REFUGE, KANSAS

FLOW MEASUREMENT STRUCTURES
Structures A1, C1, DC-A, and RC-A

Trimming Canal Embankment
Constructing Flow Measurement Structures and Transitions

SPECB2

May 1, 2000

Flow Measurement Structures
Structures A1, C1, DC-A, and RC-A
Quivira National Wildlife Refuge, Kansas
U.S. Fish & Wildlife Service

FOREWORD

Work to be performed under these specifications includes:

- Trimming prior to placing concrete.
- Furnishing and placing sheet piling.
- Excavation, backfill, and compacting backfill for measuring well.
- Constructing measuring well.
- Furnishing and placing rigid foam insulation.
- Placing reinforced concrete canal lining and unreinforced second stage concrete.
- Installing PVC drain pipe for structures C1 and RC-A.
- Placing coarse gravel protection or concrete lining in lieu of coarse gravel protection.
- Placing riprap and bedding for riprap or concrete lining in lieu of riprap and bedding.

NOTE TO BIDDERS: *Compacted embankment shown on drawings is existing (to be provided by others).*

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 06 2001

CERTIFIED Z114 756 483

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2000 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe

Linda Coe
Water Rights Specialist

Enclosure

WATER RESOURCES
RECEIVED

MAR 6 2001

KS DEPT OF AGRICULTURE

9

2000 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2001**. Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-1054. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 S.W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
~~43589-00~~	~~3500N 1450W 36-20-14E~~ 1	P									
	aka: COMMINGLE APP										
7571-00	3100N 1150W 35-21-11W 1 (RCA)	A	2510.1	Acre Feet	Surface Water Diverted						
7571-00	4450N 1000W 13-22-11W 1 (Darrynane)	A	1729.5	Acre Feet	Surface Water Diverted						
7571-00	1250N 3850W 25-22-11W 1 (Little Salt Marsh)	A	2414.8	Acre Feet	Surface Water Diverted						
Total			6654.4	Acre Feet	Surface Water Diverted						

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 2000					July 1, 2000					November 1, 2000				
Empty	¼	½	(¾)	Full	Empty	¼	(½)	¾	Full	Empty	(¼)	½	¾	Full

9 2910

Date: 1/25/01 Telephone: (816) 486-2393

00 18302 1 7 - REC Staff SF

Office Use FO CO GMD

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

WATER RESOURCES RECEIVED
MAR 6 2001
KS DEPT OF AGRICULTURE

Dave Hilley, Refuge Manager
Name (Printed or Typed)

Dave Hilley
Name (Signature)

____ Owner ____ Tenant XXX Agent

WATER USE REPORT

NOTE: If you hold water rights for eport(s) will be mailed under separate cover.

INSTRUCTIONS AND DEFINITIONS

Water Right File Number: f Water Resources to the application for permit to s originally assigned to the order determining and r.

Point of Diversion: **no water was used from one or more points of the points of diversion.**

Legal Descriptions: **rect portion and enter the correct description** by a qualifier followed by the section, township, and f diversion within the section. For example, "NC S2 The qualifiers may be the number of feet North and ases, a portion is included on the next line following

Water Meter Data: in this space. If the meter has malfunctioned during

Beginning Meter Reading: READING (this is the same as last year's ending meter HE FACE OF THE METER.

Ending Meter Reading: DING, APPLYING ANY MULTIPLICATION FACTOR

Meter Quantity: ading and this year's ending meter reading and report N ON THE FACE OF THE METER. Please have the by a qualified person within the past three years.

Meter Unit: for acre-feet, "AI" for acre-inches or "G" for gallons).

Hours Pumped: ndar year, if you **do not** have a water meter, or meter

Est. Pump Rate: **not** have a water meter, or meter readings can not be

Well Data:

ent.

INSTRUCTIONS FOR NAME, AD

1. Please check your name an r left corner. If it is incorrect or incomplete, make any necessary changes in the sp npleting this report for one or more of the water right file numbers listed on the revers

Check one: ___ A ___ New Owner

Water Right File Number(s): _____

Name of New Owner/Title: _____

Address: _____

_____

_____

Date of Change: Telephone: (___) _____

IF YOU HAVE ADDITI IDE BELOW OR ATTACH ANOTHER PAGE.

CERTIFIED

Z 114 756 463

MAIL

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
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TABLE OF CONTENTS

SECTION 02302 - COMPACTING EARTH MATERIALS

PART 1 GENERAL

1.01 COST

A. Include cost of compacting earth materials, including furnishing water and moistening materials, in applicable unit price per cubic yard bid in the schedule for materials to be compacted.

1.02 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1.	ASTM D 422-63 (1990)	Particle-Size Analysis of Soils
2.	ASTM D 653-97	Terminology Relating to Soil, Rock, and Contained Fluids
3.	ASTM D 698-91	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
4.	ASTM D 1140-97	Amount of Material in Soils Finer than the No. 200 (75-Micrometer) Sieve
5.	ASTM D 1556-96	Density and Unit Weight of Soil In-Place by the Sand Cone Method
6.	ASTM D 2216-92	Laboratory Determination of Water Content of Soil and Rock
7.	ASTM D 2487-93	Classification of Soils for Engineering Purposes
8.	ASTM D 2488-93	Description and Identification of Soils (Visual Manual Procedure)
9.	ASTM D 2922-96	Density of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth)
10.	ASTM D 3017-96	Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
11.	ASTM D 3740-99c	Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
12.	ASTM D-4318-98	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13.	ASTM D 4718-87 (1994)e2	Correction of Unit Weight and Water Content of Soils Containing Oversized Particles

B. BUREAU OF RECLAMATION (USBR)

1. USBR EM-1990 Earth Manual, Part 2, Third Edition, containing the procedures and titles listed below.

2. Procedures and Titles:

a.	USBR 3900-89	Standard Definitions of Terms and Symbols Relating to Soil Mechanics
b.	USBR 5515-89	Procedure for Compaction of Soils Containing Gravel
c.	USBR 7205-89	Determining Unit Weight of Soils In-Place by the Sand-Cone Method
d.	USBR 7230-89	Determining Unit Weight and Moisture Content of Soil In-Place - Nuclear Moisture Density Gage

1.03 DEFINITIONS

A. Refer to ASTM D 653.

B. Percent Compaction: Ratio expressed a percentage of dry unit weight of a soil to maximum dry unit weight obtained in laboratory compaction test.

C. Optimum Moisture Content: Moisture content at which a soil can be compacted to maximum dry unit weight by a given compactive effort.

D. Control Fraction: Portion of a soil sample consisting of particles smaller than a designated sieve size. This fraction is used to compare in-place unit weight with standard laboratory unit weight. Control sieve size depends on the laboratory maximum density test used.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals.

B. Qualifications of independent testing laboratory, for approval.

PART 2 PRODUCTS

2.01 CLASSIFICATION, GRADATION, AND PLASTICITY

A. When required, classify earth materials using the Unified Soil Classification System (USCS) in accordance with ASTM D 2487 or ASTM D 2488.

B. Perform gradation tests for classification in accordance with ASTM D 422 or ASTM D 1140. Gradation and plasticity characteristics are specified in Section 02330 - Compacting Embankment, Section 02372 - Coarse Gravel Protection, and Section 02374 - Riprap and Bedding for Riprap.

C. Determine plasticity index in accordance with ASTM 4318.

2.02 SUITABLE MATERIAL

A. Clean fill material of soil classification except Peat (PT) and Organic Silts and Organic Clays (OL and OH).

B. Free of roots, stumps, limbs, vegetation, organic matter, and ice.

C. Does not contain construction debris, scrap materials, refuse, man-made wastes, or chemical or hydro-carbon contamination.

D. Do not use frozen soils.

2.03 SOIL DESIGNATIONS

A. Specified lift thicknesses and compaction methods depend on whether soil is considered to be silty or clayey, or cohesionless.

B. Silty or Clayey Soils:

1. Contain appreciable amounts of fines, generally more than 12 percent.
2. Classified as GM, GC, SM, SC, CL, ML, CH, MH, or any dual symbol or borderline soil beginning with one of these symbols in accordance with ASTM D 2487.

C. Cohesionless Soils:

1. Contain few fines, generally less than12 percent.
2. Classified as GW, SW, GP, SP, or any borderline soil beginning with any of these symbols in accordance with ASTM D 2487.

2.04 MAXIMUM PARTICLE SIZE

A. Maximum particle size shall be smaller than specified compacted lift thickness.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Clear, grub, and strip.

B. Prepare surface so that first compacted lift will be placed on firm, stable material.

C. Compact foundation surface if necessary to achieve a percent compaction equal to or greater than the compacted fill to be placed over it.

D. Scarify and moisten foundation for compacted embankment to provide satisfactory bonding surface before placing embankment material.

3.02 MOISTURE CONTENT

A. Moisten or aerate material, as necessary, to provide moisture content that will readily facilitate obtaining specified compaction. Add water to soil only in increments that will permit moisture content to be uniform and homogenous throughout each layer after mixing.

B. Silty and Clayey Materials:

1. Moisture content during compaction: Unless specified otherwise, not greater than 2 percentage points wet or not less than 2 percentage points dry of optimum moisture content.
2. If fill contains dry clods of clay, water may be added to the fill by sprinkling just prior to compaction. Do not add more than 2 percent water.
3. If clayey borrow soils are more than 2 percent below optimum moisture, pre-condition and cure soils to obtain uniform and homogenous distribution of moisture in the clods. Use disks, harrows, or rakes to blend moisture in the borrow area.
4. Determine moisture content in accordance with ASTM D 2216:
   a. Minus No. 4 sieve size: ASTM D 698 Method A.
   b. Minus 3/8-inch size: ASTM D 698, Method B.
   c. Minus 3/4-inch size: ASTM D 698, Method C.
5. Determine field compaction moisture content in accordance with ASTM D 3017.
   a. Correct nuclear gage measurement error for specific soil tested.
   b. Moisture content of total material may require adjustment for control fraction in accordance with USBR 7230, Method C.

C. Cohesionless Materials:

1. Add water only as necessary to obtain specified density.

3.03 PLACEMENT

A. Place soils to be compacted in horizontal layers.

B. Blend materials so that compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations, or other imperfections.

3.04 MEASURE OF COMPACTION

A. Determine degree of soil compaction by one of the following methods.

1. Laboratory Maximum Density for soils to be compacted in accordance with ASTM D 698, Methods A, B or C.
   a. Compaction curves need not be run for every in-place density test, but laboratory maximum density shall be representative of soil to be compacted and tested.
   b. If soil to be compacted changes in gradation, plasticity, or amount of oversize particles, perform additional compaction tests.
2. Dry Density of Soils In-place:
   a. Either ASTM D 1556 or ASTM D 2922 and ASTM D 3017.

B. Corrections for oversize particles:

1. Sand cone test for soils containing more than 5 percent oversize particles:
   a. Determine in-place density of control fraction by screening oversize gravel, washing, and determining mass and volume by assuming surface saturated dried moisture in accordance with ASTM 4718 and USBR 7205.
2. Nuclear gauge test for soils containing more than 5 percent oversize particles:
   a. Convert laboratory maximum dry density of control fraction ASTM D 698 to laboratory dry density of total material in accordance with ASTM D 4718 by measuring percentage of oversize particles at the nuclear gauge test location.
3. Percent compaction for soils containing from 5 percent to 30 percent oversize particles:
   a. ASTM D 1556 method to determine dry unit weight: Compare in-place dry density of control fraction to laboratory maximum dry density determined in accordance with ASTM D 698.
   b. ASTM D 2992 and D 3017 method to determine in-place dry density: Compare field dry density of total material to a laboratory maximum dry density from ASTM D 698 computed for total material, using percentage of oversize particles present.
4. Percent compaction for soils containing more than 30 percent oversize particles:
   a. Reduce required percent compaction in accordance with appropriate curve on Figure 6 in USBR 5515. Figure 6 shows the Percent Compaction

requirement on the minus No. 4 control fraction is reduced as gravel content increases.

b. Similar reduction factors can be applied to other control fractions and degrees of compaction if oversize particles content does not exceed 60 percent. For instance, these reduction factors can be applied to the 19 millimeter control fraction if ASTM D 698, Method C is used.

3.05 COMPACTING SILTY OR CLAYEY MATERIAL

A. Compact soil to achieve a density of not less than 95 percent compaction.

B. Tamping Rollers:

1. Drum length: Maximum 6 feet.
2. Tamping feet:
   a. Staggered and uniformly spaced of sufficient weight for proper compaction.
   b. Sheepfoot, chevron, or padfoot designs.
   c. Length: Minimum 7 inches from surface of drum to surface of tamper head
3. Properly maintain tamping heads and cleaner bars.
4. Keep spaces between the tamping feet clear of materials which impair effectiveness of the tamping roller.

C. Water-Retaining Embankment:

1. Compact with toothed tamping roller.
2. Compact in horizontal layers to compacted thickness of 6 inches or less.
3. Apply sufficient number of uniformly distributed roller passes to achieve specified density or percent compaction.
4. If poor bonding is revealed by examination in test pits, scarify lifts to achieve bond. Scarify by disking through the next loose lift placed to break up and mix the loose lift and cut the top of the compacted lift below.

D. Other Embankment and Backfill:

1. Compact with tamping rollers, vibrating pad foot rollers, rubber tire rollers, or other suitable compaction equipment.
2. Compact in horizontal layers to compacted thickness of 6 inches or less.
3. Apply a sufficient number of uniformly distributed roller passes to achieve specified density or percent compaction.

E. Backfill Adjacent to Structures or in Confined Areas:

1. Compact with hand held impact tampers, wheel rolling, or small tamping equipment designed for use in confined areas.
2. Compact in horizontal layers to compacted thickness of 4 inches or less.
3. Apply a sufficient number of uniformly distributed compaction passes to achieve specified density or percent compaction.

3.06 COMPACTING COHESIONLESS FREE-DRAINING MATERIAL

A. Compact soil to achieve a density of not less than 95 percent compaction.

B. Equipment and Lift Thickness:
1. Tampers or rollers: Compact in lift thicknesses not to exceed 6 inches.
2. Crawler-type tractors, vibrating drum rollers, or similar equipment: Compact in lift thickness not to exceed 12 inches
3. Saturation and internal vibrations: Compact in lift thicknesses not to exceed penetrating depth of the vibrator.

C. Cohesionless Free-Draining Backfill Adjacent to Structures or in Confined Areas:
1. Compact with hand held impact tampers, vibrating plate compactors, or other small compaction equipment designed for use in confined areas.
2. Apply a sufficient number of compaction passes with effort uniformly distributed on the soil to result in the specified density or percent compaction.
3. Compact in horizontal layers to maximum compacted thickness of 6 inches.

3.07 EQUIPMENT DEMONSTRATION

1. Lift thicknesses may vary depending on equipment and procedures.
2. Lift thickness may be increased if degree of compaction can be met.
3. Before changing requirements in this section, demonstrate that required density will be obtained by:
   a. Perform test rolling.
   b. Determine percent compaction.
   c. Perform visual examination in test pits.

3.08 WEATHER LIMITATIONS

A. Do not place and compact material under following conditions:
1. Air temperature below freezing in shade.
2. Rain that creates puddles in clayey or silty materials.
3. Heat or wind or both that dries material below special moisture conditions.

3.09 FIELD QUALITY CONTROL

A. Testing:

1. Perform specified tests to verify that type of soil used, placement of soil, and compaction of soil conform to contract requirements.
2. Testing shall be performed by an independent materials testing agency meeting requirements of ASTM D 3740.
3. Notify materials testing agency 24 hours before compaction work begins and 24 hours before significant change in compaction equipment or procedures.
4. Notify materials testing agency immediately of equipment change due to breakdown, or re-deployment. Change of equipment will require immediate testing to ensure proper compaction is being obtained.

B. Testing Frequency:

1. Frequency of testing is at discretion of the Government. Testing shall be performed during the first day of compaction operations. The Government may request testing any time the degree of compaction is suspect.
2. Greater frequency of testing shall be performed at the beginning of new work, new work crew, or new equipment.
3. After a successful work operation pattern is established, test at the minimum frequency specified below:
   a. Compacted embankment, for each structure: One test every 500 cubic yards placed.
   b. Backfill adjacent to structures or in confined areas: One test every 200 cubic yards placed.
   c. Perform additional tests, as directed by Contracting Officer's Representative, at locations where incomplete compaction is suspected, where surfaces have become excessively wet or dry since compaction, and where compacted surfaces have been disturbed or damaged.

C. Tests:

1. Test compacted material in accordance with standards listed in table 02302A - Standard Used for Testing. Substitution or modification of standards shall be done only with concurrence of Contractor and Contracting Officer's Representative.

Table 02302A - Standard Used For Testing

PROCEDURE	STANDARD NO.
Soil Classification	ASTM D 2487 ASTM D 2488
Gradation Analysis	ASTM D 422 ASTM D 1140
Atterberg Limits	ASTM D 4318
Moisture Content	ASTM D 2216 ASTM D 3017
In-Place Density: Sand Cone	ASTM D 1556 ASTM D 2922
Laboratory Maximum Density	ASTM D 698, Procedure A, B or C

D. Contractor Support:

1. Dig test pits as directed to examine compacted soil. Inspect test pits for uniformity of compaction throughout compacted lifts.
2. Backfill test pits to original requirements.
3. Provide timely access to areas for density testing. Excavate and level an area in compacted material to provide a surface for testing.
4. Fills compacted by tamping (sheepsfoot) rollers are normally tested at least 1 to 2 lifts below the surface.
5. When density is being measured by a sand-cone device, cease construction activity in immediate vicinity of testing.

END OF SECTION

SECTION 02303 - STRUCTURAL EXCAVATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Excavation:

1. Measurement:
   a. Volume, measured in excavation to paylines described below.
   b. Excavation paylines for PVC pipe: Excavation below existing ground surface to specified depth, one foot wide at the pipe invert, and to slopes of 1:1.
   c. Excavation paylines for measuring well: Excavation below existing ground to specified depth, one foot outside the limits of the base slab to slopes of 1:1.
   d. Measurement will made only once for volume of excavation within overlapping paylines.
2. Payment: Unit price per cubic yard bid in schedule.

1.02 DEFINITIONS

A. Unsuitable Material: As defined in Section 02302 - Compacting Earth Materials.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.01 REMOVAL OF WATER

A. Maintain excavation free from standing water during construction.

3.02 EXCAVATION FOR FLOW MEASUREMENT STRUCTURES

A. Excavate for measurement structures to the lines, grades, and dimensions shown on drawings.

3.03 EXCAVATION FOR MEASURING WELLS

A. Concrete pad:

1. Depth: Excavate to 6 inches below base of concrete pad.
2. Bottom width of excavation: Extend excavation to 1 foot beyond the limits of the base slab.
3. Side slopes of excavation: As required for safety.

B. PVC pipe:

1. Excavate to elevation of pipe invert.
2. Width of excavation at invert of pipe: 1 foot.
3. Side slopes of excavation: As required for safety.

C. Compact disturbed or loosened foundation material.

D. Refill below base of concrete pad with compacted material in accordance with Section 02317 - Structural Backfill.

3.04 DISPOSAL

A. Dispose of unsuitable or excess excavated earth materials in accordance with Section 02304 - Disposal of Excavated Materials.

END OF SECTION

SECTION 02304 - DISPOSAL OF EXCAVATED MATERIALS

PART 1 GENERAL

1.01 COST

A. Include cost in applicable price bid in the schedule for excavation or trimming.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DISPOSAL OF EXCAVATED MATERIALS

A. Dispose of excess or unsuitable excavated materials.

B. Deposit materials at designated waste areas as directed by Contracting Officer's Representative.

C. Do not dispose of materials within 12 feet of drainage channels or in wetlands.

D. Do not dispose of materials by dumping from the top of a natural slope.

E. Grade disposal areas to drain and match adjacent terrain.

END OF SECTION

SECTION 02312 - TRIMMING CANAL EMBANKMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Trimming:
   1. Measurement: Surface area, measured in place.
   2. Payment: Unit cost per cubic yard bid in schedule.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 TRIMMING

A. Moisten, trim, and finish earth surfaces of canal prism prior to placing concrete at the following locations.
   1. Flow measurement structures.
   2. Concrete lining in upstream transition placed in lieu of coarse gravel protection.
   3. Concrete lining in downstream transition placed in lieu of riprap and sand and gravel bedding for riprap.

B. Accurately finish bottom and side slopes, including surfaces of compacted embankment over which lining is to be placed, to the lines and grades shown on drawings.

C. Trim by grading to form uniform surfaces.

D. If foundation surface is disturbed or loosened, moisten and compact to prepare foundation surface in accordance with Section 02302 - Compacting Earth Materials.

E. Fill low areas, voids, and areas excavated beyond the neatlines shown on drawings.
   1. Place select material in horizontal layers, moisten if required, and compact in accordance with Section 02302 - Compacting Earth Materials.
   2. On slopes, layers may be placed parallel to the surface of the foundation.

F. Trimming surfaces containing rock or boulders:

1. Excavate to remove oversize material.
2. Refill with select embankment material in horizontal layers, moisten if required, and compact in accordance with Section 02302 - Compacting Earth Materials.

G. Perform final trimming within 48 hours of placing concrete. Keep trimmed surfaces moist until concrete is placed.

END OF SECTION

SECTION 02317 - STRUCTURE BACKFILL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Structural Backfill:
   1. Measurement:
      a. Volume, within the paylines of excavation.
      b. Includes backfill placed beneath structures.
   2. Payment:
      a. Unit price per cubic yard bid therefor in the schedule.
      b. Includes cost of compaction and special compaction.

PART 2 PRODUCTS

2.01 MATERIAL WITHIN 2 FEET OF STRUCTURES AND PIPE

A. Reasonably well-graded mixture of silts, sands, and gravel to 1-1/2 inches in maximum dimension.

2.02 OTHER STRUCTURAL BACKFILL

A. Reasonably well-graded mixture of silts, sands, gravel, and cobbles to 3 inches in maximum dimension, except as specified below.

PART 3 EXECUTION

3.01 PLACING BACKFILL

A. Do not place backfill when backfill materials or foundation surfaces are frozen.

B. Conform to the requirements of Section 02302 - Compacting Earth Materials.

C. Place backfill in continuous and approximately horizontal layers, not to exceed 12 inches in thickness after compaction.

D. Place material to approximately the same elevation on all sides of structure.

3.02 COMPACTING BACKFILL

A. Compact materials in accordance with Section 02302 - Compacting Earth Materials.

3.03 FIELD QUALITY CONTROL

A. Perform field quality control in accordance with Section 02302 - Compacting Earth Materials.

END OF SECTION

SECTION 02372 - COARSE GRAVEL PROTECTION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Coarse Gravel protection:

1. Measurement: Volume measured to lines, grades, and dimensions shown on drawings.
2. Payment:
   a. Unit price per cubic yard.
   b. Includes cost of excavation prior to placement of coarse gravel protection.

PART 2 PRODUCTS

2.01 COARSE GRAVEL PROTECTION

A. Angular, hard, dense, durable, resistant to abrasion, and relatively free of earth, roots, and debris.

B. Larger particles shall be free of open or incipient cracks, seams, planes of weakness, or other defects that would tend to unduly increase their deterioration from natural causes and from handling and placing operations.

C. Gradation: As specified in table 02372A - Gradation for coarse gravel protection.

Table 02372A. - Gradation for coarse gravel protection

Screen/sieve size	Percent passing, by weight
6-inch	100
3-inch	95 to 65
1-1/2-inch	65 to 35
3/4-inch	35 to 0
3/8-inch	0 to 5

2.02 CONCRETE LINING

A. 4-inch thick concrete lining may be constructed in lieu of coarse gravel protection where approved by the Contracting Officer's Representative. See Section 03300 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place to the lines, grades, and dimensions shown on drawings.

B. Tolerances:

1. Allowable deviation from specified thickness: Plus or minus 2 inches from the thicknesses shown on the drawings will be allowed on the finished surfaces.
2. Allowable deviation from specified El. A: See Table 03300C - Deviations from Specified Lines, Grades, and Dimensions.

C. Place material to full layer thickness in one operation without dumping or dozing.

D. Minimize segregation of material during placement.

E. Do not use heavy plates or other placement and finishing methods which break down in-place materials.

F. Coarse gravel protection need not be compacted.

END OF SECTION

SECTION 02374 - RIPRAP AND BEDDING FOR RIPRAP

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Sand and gravel bedding:

1. Measurement: Volume measured to lines, grades, and dimensions shown on drawings.
2. Payment: Unit price per cubic yard.

B. Rirap:

1. Measurement: Volume, in cubic yards, measured in place to lines, grades, and dimensions shown on drawings.
2. Payment: Unit price per cubic yard.

PART 2 PRODUCTS

2.01 SAND AND GRAVEL BEDDING

A. Angular, hard, dense, durable, resistant to abrasion, and relatively free of earth, roots, and debris.

B. Larger particles shall be free of open or incipient cracks, seams, planes of weakness, or other defects that would tend to unduly increase their deterioration from natural causes and from handling and placing operations.

C. Provide material conforming to the gradation specified in table 02374A - Gradation for sand and gravel bedding.

Table 02374A. - Gradation for sand and gravel bedding

Screen/sieve size	Percent passing, by weight
3-inch	100
1-1/2-inch	65 to 80
3/4-inch	45 to 60
3/8-inch	25 to 40
No. 4	15 to 30
No. 100	0 to 5

2.02 RIPRAP

A. Angular, hard, dense, durable, resistant to abrasion, and relatively free of earth, roots, and debris.

B. Larger particles shall be free of open or incipient cracks, seams, planes of weakness, or other defects that would tend to unduly increase their deterioration from natural causes and from handling and placing operations.

C. Provide riprap conforming to the gradations specified in tables 02374B - Gradation for riprap.

Table 02374B. - Gradation for riprap

Screen/sieve size	Percent passing, by weight
8 inches	70 to 100
5 inches	35 to 60
2 inches	0 to 15

2.03 CONCRETE LINING

A. 4-inch thick concrete lining may be placed in lieu of riprap and sand and gravel bedding where approved by Contracting Officer's Technical Representative. See Section 03300 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.01 BEDDING PLACEMENT

A. Place to the lines, grades, and dimensions shown on the drawings.

3.02 RIPRAP PLACEMENT

A. Place to the lines, grades, and dimensions shown on the drawings.

B. Tolerances:

1. Allowable deviation from specified thickness: Plus 4 inches from the thicknesses shown on the drawings will be allowed on the finished surfaces of the riprap.
2. Allowable deviation from specified El. A: See Table 03300C - Deviations from Specified Lines, Grades, and Dimensions.

C. Place riprap material to full layer thickness in one operation without dumping or dozing.

D. Place riprap so as to minimize segregation.

E. Do not use heavy plates or other placement and finishing methods which break down in-place riprap.

F. Riprap need not be compacted.

G. After placement, arrange the riprap in a stable configuration such that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments to result in a well-keyed, densely placed, uniform layer of riprap slope protection of the specified thickness and gradation.

H. Place rocks that break along flat surfaces, such as bedding planes, so that these planes do not parallel the embankment face.

I. Hand placing will be required only to the extent necessary to secure the results specified above.

END OF SECTION

SECTION 02455 -SHEET PILING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Sheet piling:
   1. Measurement: Area of sheet piling in place, installed as shown on drawings.
   2. Payment: Unit price per square foot bid in the schedule.

1.02 SUBMITTALS

A. Submit the following, in accordance with Section 01330 - Submittals.
   1. Manufacturer's Product Data.
   2. Shop drawings: Fabrication and installation details.
   3. Pile driving equipment: Description, type.

PART 2 PRODUCTS

2.01 VINYL SHEET PILING

A. Series 300 ShoreGuard/GeoGuard vinyl sheet piling manufactured by Materials International, Inc., 4501 Circle 75 Parkway, E-5370, Atlanta GA 30339, telephone (800) 256-8857; or equal, having the following essential characteristics:
   1. Tensile strength: 6,300 psi, minimum.
   2. Impact strength: 13,750 in-lb/square inch, minimum.
   3. Modulus of elasticity: 380,000 psi.
   4. Manufactured of weatherable, co-extruded PVC, ASTM 4216, cell classification 1-4013-13-0101. Virgin PVC compounds or recycled and virgin compounds may be used.
   5. Thickness: Minimum 0.25 inch.
   6. Section modulus: Minimum 10.9 in^3/ft.
   7. Interlocking panels.

B. Provide accessories required to complete installation as shown on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions, to the line, grade, and dimensions shown on drawings.

B. Use rigid driving guide to ensure accurate alignment.

C. Tolerances:

1. Location:
   a. Plus or minus 3/4-inch from specified location after initial driving.
   b. Plus or minus 1 inch after pile driving is completed.
2. Plumb: Maintain 1 inch in 10 feet from vertical.
3. If tolerances are exceeded, widen concrete cap at Contractor's expense, as directed by Contracting Officer's Representative.

D. Withdraw damaged or defective piles. Fill void with approved bentonite slurry prior to installing new pile.

END OF SECTION

SECTION 02522 - PVC MEASURING WELL AND DRAIN PIPE

PART 1 GENERAL

1.01 PAYMENT

A. PVC measuring well:
   1. Payment: Lump sum price bid in the schedule.

B. Include cost of PVC drain pipe in the unit price per cubic yard bid in the schedule for second stage concrete.

1.02 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
   1. ASTM D 1785-99 Poly(Vinyl Chloride) (PVC)Plastic Pipe, Schedules 40, 80, and 120

PART 2 PRODUCTS

2.01 PVC PIPE

A. ASTM D 1785, size and schedule as shown on drawings.

2.02 CAST-IN-PLACE CONCRETE PAD

A. In accordance with Section 03300 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.01 CONSTRUCTING MEASUREMENT WELL

A. Locate inspection well installation as shown on drawings.

B. Construct concretep pad, in accordance with Section 03300 - Cast-in-Place Concrete, to elevation as shown on drawings (El. B).

C. Prevent shifting of well and inlet pipe during embankment and concrete placement operations.

D. Drill hole for inlet pipe in field at El. B as shown on drawings. Drill in accordance with pipe manufacturer's recommendations to form a smooth uniform surface.

E. Install inlet pipe. Seal pipe entrance by solvent welding to form watertight seal.

F. Cut ends of pipe flush with inside of well.

3.02 EMBANKMENT PLACEMENT

A. Carefully place embankment about pipe well and inlet pipe to prevent displacement of pipe. Place and compact embankment concurrently about pipe well to avoid displacement.

3.03 TOLERANCES

A. Tolerances:

1. Allowable deviation from specified El. B: See Table 03300C - Deviations from Specified Lines, Grades, and Dimensions.

END OF SECTION

A. Reinforced concrete:

SECTION 07211 - RIGID FOAM INSULATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Rigid foam insulation:
   1. Measurement: Area of insulation installed to the lines and dimensions shown on drawings.
   2. Payment: Unit price per square foot bid in the schedule.

1.02 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
   1. ASTM C 578-95 Rigid, Cellular Polystyrene Thermal Insulation

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site in the manufacturer's original unopened packaging. Store in an area protected from weather.

B. Identify materials by manufacturer, brand name, and applicable standards.

C. Remove damaged materials from the site.

PART 2 PRODUCTS

2.01 RIGID FOAM INSULATION

A. ASTM C 578, type IV, minimum 24-inch-wide insulation, thickness shown on drawings.

PART 3 EXECUTION

3.01 PREPARATION OF SURFACES

A. Prior to installing insulation, ensure that areas that will be in contact with insulation are flat, smooth, compact, and free of snow, ice, and standing water.

B. Remove projections or voids on contact surfaces which could compress, puncture, crack, or cause voids in the insulation.

3.02 INSTALLATION

A. Install insulation as shown on the drawings.

B. Install insulation in panels as large as practicable to minimize the number of joints. Install insulation pieces in the longest sections practicable.

C. Cut and fit insulation to produce clean, sharp edges and corners.

D. Fit insulation closely around penetrations.

E. Install insulation without gaps or offsets between insulation sections.

F. Secure insulation to prevent movement and opening of joints in insulation during concrete placement.

G. Remove loose, improperly fit, or damaged insulation and replace.

END OF SECTION

SECTION B - BIDDING

B.1 BIDDING SCHEDULE

(a) Bids will be considered for award on the following schedule, but no bid will be considered for award on only a part of the schedule.

(b) Bids are subject to the terms and conditions of this solicitation.

(c) Quantities in the schedule are estimated quantities for comparison of bids only, and except as provided in the contract clause entitled "Variation in Estimated Quantity," no claim shall be made against the Government for overruns or underruns.

SCHEDULE - OPTION A

Item	Section	Work or Material	Quantity and unit	Unit Price	Amount
1		Mobilization and preparatory work	For the lump sum of		$
2	02303	Excavation	50 yd^3		$
3	02312	Trimming	140 yd^2		$
4	02317	Structural backfill	50 yd^3		$
5	02372	Coarse gravel protection	45 yd^3		$
6	02374	Sand and gravel bedding	45 yd^3		$
7	02374	Riprap	100 yd^3		$
8	02455	Sheet piling	840 ft^2		$
9	02522	PVC measuring well	For the lump sum of		$
10	03300	Reinforced concrete	30 yd^3		$
11	03300	Second stage concrete	9 yd^3		$
12	07211	Rigid foam insulation	1,090 ft^2		$

TOTAL FOR SCHEDULE $_____

SCHEDULE - OPTION B

Item	Section	Work or Material	Quantity and unit	Unit Price	Amount
1		Mobilization and preparatory work	For the lump sum of		$
2	02303	Excavation	50 yd^3		$
3	02312	Trimming	490 yd^2		$
4	02317	Structural backfill	50 yd^3		$
5	02455	Sheet piling	840 ft^2		$
6	02522	PVC measuring well	For the lump sum of		$
7	03300	Reinforced concrete	30 yd^3		$
8	03300	Unreinforced concrete in transitions	38 yd^3		
9	03300	Second stage concrete	9 yd^3		$
10	07211	Rigid foam insulation	1,090 ft^2		$

TOTAL FOR SCHEDULE $_____

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 06 2001

CERTIFIED Z114 756 483

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 2000 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe

Linda Coe
Water Rights Specialist

Enclosure

WATER RESOURCES
RECEIVED

MAR 6 2001

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9

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
David L. Pope, Chief Engineer
Division of Water Resources

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

October 30, 2000

Megan A. Estep-Johnston
Refuge Hydrologist
Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver, Colorado 80225-0486

Re: Water Right, File No. 7,751

Dear Ms. Estep-Johnston:

This office has received your recent letter dated October 15, 2000. The letter is requesting additional time for the installation of metering devices at Quivira National Wildlife Refuge as required by the Kansas Department of Agriculture, Division of Water Resources. It is our understanding that progress continues to made toward the installation of the meters and that the main reason that additional time is needed is due to construction problems with high wintertime water levels and the need to divert water during this time of year. It is stated that construction will begin with the advent of dryer conditions next summer.

For the above reasons your request for additional time is hereby granted until August 31, 2001.

Please continue to keep this office informed as progress is made toward the installation of the meters. The final design specifications for your metering system will need to be approved by this agency prior to construction. Please feel free to call or write if you have any questions.

Sincerely,

M Bruce Falk

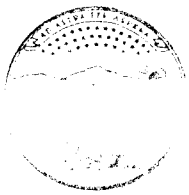
M. Bruce Falk
Water Commissioner

MBF/mbf

cc: Jim Bagley (microfilm)
Lloyd Stullken
Tom Huntzinger
File 7,571

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
109 SW 9th Street
Topeka, Kansas 66612-1280
(785) 296-3558
FAX: (785) 296-8389



Division of Water Resources
David L. Pope, Chief Engineer
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283
(785) 296-3717 FAX (785) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

October 23,2000

United States Department of Interior
Fish and Wildlife Service, Mountain-Prairie Region
Post Office Box 25468, Denver Federal Center
Denver, Colorado, 80225
Attn: Megan A. Estep-Johnson, refuge Hydrologist

Dear Ms. Estep-Johnson:

Thank you for providing the additional information concerning the Quivira National Wildlife Refuge Water Conservation Plan. My apologies for not responding sooner to your correspondence.

It appears that by including the additional information that you discussed in your letter that was received in this office on August 25, 2000, the Refuge's Water Conservation Plan will meet the requirements outlined in the Findings and Order of the Chief Engineer dated September 26, 1996. That includes an implementation schedule based upon streamflow conditions and climatic factors, and a drought contingency plan. Also, we still need the documentation of installation of the water flow measurement devises and structures for monitoring the amount of natural flows diverted from Rattlesnake Creek for recreational use at the Refuge.

Thanks again for developing an acceptable water conservation plan for the Refuge. If you have any questions please feel free to contact me.

Sincerely,

Robert F. Lytle Jr.

Robert F. Lytle Jr.
Environmental Scientist

RECEIVED

OCT 25 2000

FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Pc: Stafford Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

OCT 0 5 2000

Dear Mr. Falk:

The U.S. Fish and Wildlife Service requests another extension in time for the installation of flumes at the Quivira National Wildlife Refuge. We contacted with the USDI Bureau of Reclamation to design the flumes with the intention of using Refuge staff to do the construction. Once the specifications were complete, the Refuge staff reviewed them, and did not feel confident that they could meet the tolerances required. Therefore, we made the decision to contract out the construction work, and we have contracted with the BOR to oversee the contracting process.

Due to unforseen difficulties in finalizing the design, locating adequate borrow material, and other problems, the projected award date for the contract has been revised by the BOR to November 24, 2000. The groundwater at the Refuge is beginning to rise and by November 24 will cause significant problems for the contractor, and will result in significant cost increases. In addition, the additional water will make it difficult to ensure that the flumes are constructed properly, and will not be subjected to movement or erosion in the future. We would like to postpone construction until next summer when drier conditions prevail. Therefore, we request that the date for completion of the flumes be extended from December 31, 2000, to August 31, 2001.

We will supply you with copies of the final design specifications as soon as we receive them from the BOR. Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

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DIVISION OF WATER RESOURCES
STAFFORD

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STAFFORD

cc: Refuge Manager, Quivira NWR

This is your future. Don't leave it blank. - *Support the 2000 Census.*

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
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MAILING ADDRESS:
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Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

AUG 2 3 2000

Mr. Robert F. Lytle Jr.
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283

Dear Mr. Lytle:

Please find enclosed a revised text copy of our draft Water Conservation Plan. Please insert the tables and figures supplied with the previous draft in the appropriate place in this document. We look forward to receiving your comments.

Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

cc: Refuge Manager, Quivira NWR

Quivira National Wildlife Refuge Water Conservation Plan

BACKGROUND

The Quivira National Wildlife Refuge (NWR) is located in the Rattlesnake Creek Basin in South-central Kansas in the northeast corner of Stafford County. The Refuge consists of about 32 square miles of marshes, ponds, and uplands that provide habitat for a variety of wildlife and waterfowl. The natural wetlands and marshes have been modified by a series of canals and constructed dikes. Water is supplied by Rattlesnake Creek, and through natural upwelling of groundwater.

The water supply for the Refuge is highly variable. Often, streamflow in the spring is too high for the Refuge to make beneficial use of all available water, but is too low later in the season to offset evapotranspiration. In some years, there is insufficient water to fill even some of the units, while in other years floods damage water control structures.

The Refuge was established in 1957. The Service filed for a right to divert 22,200 acre feet of water from Rattlesnake Creek soon after establishment of the Refuge, and filed a Notice of Proof of Completion of Works for Permit #7571 on July 15, 1982. The Service was unable to demonstrate that is had diverted 22,200 acre-feet of water during the period of proof, and the Kansas Division of Water Resources certified Permit #7571 for 14,632 acre feet based on the recorded usage on April 9, 1996.

Since about 1970, development of groundwater irrigation in the Rattlesnake Creek Basin has increased dramatically. The result of the increase in groundwater withdrawals has been a decline in the baseflow component of Rattlesnake Creek streamflow. This has increased the severity of the problem of low late-season streamflows, and is particularly injurious during drought years.

The Refuge Manager and Regional Office personnel have been participating in the Rattlesnake Creek/Quivira Partnership to develop the Rattlesnake Creek Subbasin Management Plan since 1993. This Management Plan provides an array of incentive-based programs for reducing irrigation water use in the Subbasin. It is hoped that by the end of the twelve-year time frame outlined in the Management Plan, water use reductions will be adequate to meet streamflow targets and assure the Refuge receives enough water to meet Refuge management objectives.

DESCRIPTION OF REFUGE WATER CONTROL AND CONVEYANCE STRUCTURES

The Refuge has three points of diversion. Water diverted at these three points can be moved to numerous conveyance canals, or nearly directly into a water management unit, as is the case with Unit 7. Water enters the Refuge along the southwest boundary, and flows into the Little Salt Marsh (Unit 5). From the Little Salt Marsh, water can be conveyed into Unit 7 through structure A-3; water can be conveyed through structure A-1 to Units 10A 10B, 10C and 11; water can be conveyed into the West Canal through structure C-1; or water can flow back into the Rattlesnake Creek through structure A-2.

From structure A-2, water that flows back into the Rattlesnake Creek flows north until it reaches Unit 24, also known as Darrynane Lake. From Darrynane Lake, water can be diverted through structure DCA into the Darrynane Canal, through structure 24C into Unit 25, through structure 24D into 21, through a short canal and water control structure into 20B, and through structure 24A back into Rattlesnake Creek. Water can also flow through structure 24B back to Rattlesnake Creek.

North of Unit 49, the third point of diversion is structure RCA. Water diverted at RCA flows to structure RCB where it can be used to fill Unit 61, or it can flow further west to structure RCC, and eventually to structure RCD.

In addition to the appropriated surface water used by the Refuge, there are presently 31 cattle watering facilities maintained on the Refuge, and three domestic wells. An artesian well, drilled under a permit to the L.D. Davis Oil Company, Great Bend, has been turned over to the Refuge and is located in Section 5, T22S, R11W. The flow from this well, estimated to be less than 5 gpm, is used to supplement a natural spring that provides habitat for a breeding population of Arkansas darters, a state endangered fish.

DESCRIPTION OF WATER MANAGEMENT UNITS

There are 34 constructed water management units on the Refuge (Table 1). The areas and capacities of these units were determined in 1990 by conducting surveys of cross-sections through the units. Better information could potentially be collected using modern GPS equipment, and the areas and capacities of the units might be revised if this is done. Work is currently being done in Units 25, 29, 49, and 63 to fill in borrow areas that were created at the time the dikes were constructed on these units. These borrow areas are quite deep, and must be filled before water can begin to fill the rest of the unit. This work will alter the area/capacity relationships for these units, but will allow the units to be filled to management levels with less water. Similar work is planned for Units 30,

40, 48, and 28. The areas and capacities based on the 1990 survey are shown in Table 1.

The water management currently done at the Refuge consists of storing as much water as is available starting in February to create habitat for migrating waterfowl and shorebirds. Water is diverted into management units and the units are held as full as possible to offset the possibility that water will not be available to refill the units later in the summer and early fall. The Little Salt Marsh(Unit 5)is the primary water storage unit on the Refuge, but also provides important habitat. The west edge of the Little Salt Marsh is maintained as shallow wet meadow type habitat that is preferred by some shorebirds, white-face ibis, sandhill cranes, and the endangered whooping cranes. Because of the value of this shallow, grassy marsh type habitat, it is not desirable to raise the level of the Little Salt marsh above a point where this habitat would be inundated more deeply. The Refuge attempts to keep water in Unit 5 all year.

During the period from March through May, some units are drawn down, if possible, to attract and provide habitat for migrating shorebirds. The salt flat area at Quivira National Wildlife Refuge is designated as a "Wetland of Regional Importance" by the Western Hemisphere Shorebird Reserve Network (WHSRN). This classification designates sites that annually host more than 20,000 shorebirds, or over 5% of a flyway population. Shorebird species currently exhibiting population declines that use Quivira NWR include least sandpipers, semi-palmated sandpipers and Wilson's phalaropes. The area north of the Big Salt Marsh and North Lake have been used by endangered Piping Plovers for nesting. These salt flats also provide valuable habitat for a colony of endangered interior least terns. These terns require the unvegetated flats for nesting, in close proximity to deeper water areas that can support the small minnow populations the least terns use for food. The salt flats are also valuable to numerous shorebird species which take advantage of the Kansas wind's effects on the shallow water covering the flats. As the wind moves the shallow water back and forth on the flats, this action constantly exposes new food resources for the shorebirds as the water's edge advances or retreats. The Big Salt Marsh is also highly attractive to shorebirds, and in a normal year almost all water that is found in the Big Salt Marsh is a result of groundwater upwelling and local runoff.

From May until September, most units are managed so that they dry out gradually. It is impractical to attempt to maintain all the units during the hot summer months, except when precipitation is unusually high. Letting these units to dry out also achieves the objective of allowing moist soil plants to grow. These units can then provide excellent waterfowl habitat if they can be reflooded

in the fall. The moist soil plants growing on these areas are rich in protein and high energy, and can produce more available food for migrating waterfowl than an equivalent area of irrigated corn.

The Refuge would like to have adequate water in the fall to reflood as many units as possible. Most years, water is not available until after the irrigation season has ended and groundwater flow into the Big Salt Marsh has recovered. Ideally, the Refuge would like to keep water in both the Big Salt Marsh and the Little Salt Marsh all year, and be able to reflood Unit 7, Unit 10A, Unit 10B, Unit 10C, Unit 11, and Units 14A and 14B in the fall even in drought years. This would provide at least minimum habitat for migrating waterfowl and shorebirds.

WATER MEASUREMENT

Water measurement is currently done using a Claussen Rule, an instrument that is placed on top of the stop logs on the diversion structure and gives a reading that can be converted to cfs based on the width of the stoplogs. This method of measurement was checked by the State Engineer's office and was found to be within 5% accuracy. However, it is not continuous, and the Refuge entered into a cooperative agreement with the USDI Bureau of Reclamation to design flumes for structures A-1, C-3, DCA and RCA. A continuous data logger will be installed on the flumes. The flumes have been designed, and a contract for construction should be awarded this Fall. The Refuge also plans to purchase an ultrasonic water measurement device to place inside the PVC pipes in structures A-3, 24D and 24A. This should result in much more accurate data collection and reporting of water use.

Inflow to the Refuge is measured at a U.S. Geological Survey gaging station, Rattlesnake Creek at Zenith. This station has been operating since 1973, and essentially measures all streamflow entering the Little Salt Marsh. A USGS gaging station operated on the Rattlesnake Creek near Raymond from 1960 until 1998, but has been discontinued due to lack of funding. This gage measured all flow leaving the Refuge. Ungaged runoff and upwelling groundwater are not measured. Local runoff probably does not contribute substantially to the inflow to Refuge water management units, but groundwater is a significant source of water for the Big Salt Marsh (Unit 75), and, most times, is the only source of water leaving the Refuge.

ENGINEERING FEASIBILITY STUDY

In 1996 through 1998, the Service utilized funds obtained from Congress through efforts by the Quivira Coalition, particularly

WaterPACK, to hire Burns and McDonnell, Inc., to conduct an engineering feasibility study. The members of the Rattlesnake Creek/Quivira Partnership wanted to look at off-Refuge storage, artificial recharge, and on-Refuge storage or any other alternatives that would provide additional operational flexibility for the Refuge's water diversion and conveyance system. The contractor was tasked with evaluating the different engineering alternatives and developing a basis to determine their benefits and costs. Criteria used in evaluating the benefits and costs included water supply capability, water quality, legal issues, policy and political issues, future availability, environmental issues, wetland habitat enhancement, and cost estimates and economic comparisons.

An operations model was developed by the contractor to determine the water needs of the Refuge, and the needs were based on a comparison of the operations modeling for the Refuge under baseline conditions and an "ultimate" (assumed the Refuge would have all the water needed for management) water use scenario.

Off-Refuge storage was evaluated and 18 potential reservoir sites were identified. Nine of the potential sites were eliminated early in the process because of wetland presence, economics in terms of construction and oil and gas relocation costs, or other environmental parameters. Four other reservoir sites were eliminated due to high water conveyance losses, the need to relocate residences, and their long distances from the Refuge.

The study concluded that the remaining five reservoirs would be only marginally successful in providing a supplemental water supply to the Refuge. In dry years, all of the water available for diversion from Rattlesnake Creek must be used directly on the Refuge, so there is not water available for storage in an upstream reservoir. Water for storage is only available in wetter years, and there is little carryover storage available due to high evaporation from any of the reservoir sites. The benefit/cost ratios for the five reservoir sites ranged from 0.01 to -0.02.

Two approaches for aquifer recharge were examined in the engineering feasibility study. One was conventional aquifer storage and recovery, where excess water is captured from available sources and stored in an aquifer for future use and recovered later by wells for delivery to the Refuge. The other was enhancing natural recharge in the basin to raise groundwater levels and, thus, increase base flow in the creek.

Five aquifer storage locations suitable for aquifer storage and recovery were identified. Only one of these sites was evaluated in detail due to the high conveyance losses associated with the

other four. In evaluating this final site, it was determined that the limiting factor was, again, the quantity of excess water available for storage and the time that the water was available. The benefit-cost ratio for this alternative was 0.03.

The on-Refuge alternatives evaluated were:

- Raise dikes in Little Salt Marsh
- Construct cross dikes in Little Salt Marsh
- Develop additional water storage units
- Line conveyance canals
- Remove sediment from Little Salt Marsh
- Construct bypass canal around Little Salt Marsh
- Recontour additional areas to develop moist soil units
- Fill borrow areas
- Supplement water supply with Arkansas River water
- Supplement water supply with groundwater wells

If the dikes surrounding the Little Salt Marsh were raised by two feet, the storage potential of the Marsh could be increased by 2,000 acre-feet. The additional storage in the Little Salt Marsh would extend the period of time water is available in wet years, but cannot provide multi-year carryover storage during droughts. A circular ring dike could also be constructed in the Little Salt marsh to increase storage without inundating the entire marsh area. Again, the additional storage would extend the supply during wet periods, but would not provide carry-over storage during droughts. In addition, raising the dikes or constructing a circular ring dike would create deep water habitat in the Little Salt Marsh that is undesirable from a wildlife management aspect.

The raising of dikes or construction of new dikes to increase storage capacity on five management units on the Refuge was assessed. The resulting additional storage would not provide multi-year carryover storage during droughts.

Lining of approximately 13 miles of conveyance canals on the Refuge was evaluated. This option did increase the total amount of wetland habitat available 80 percent of the time by 21

percent, but conveyance losses are highly dependent on antecedent conditions. This may be an alternative that the Refuge will pursue in the future, if funding becomes available for additional study on seepage losses.

Removal of sediment from the Little Salt Marsh that has accumulated over the years would result in additional storage capacity in the Little Salt Marsh. However, the small increase in storage capacity was determined to have little affect on the Refuge's ability to supply water to other management units.

Construction of a bypass canal around the Little Salt Marsh to eliminate the deposition of sediment during flood events was evaluated. This alternative would not have eliminated all sediment deposition, but would have greatly reduced it since most sediment is deposited during large flood events. This alternative was not found to have substantial benefits in terms of increasing the water supply for the Refuge, or in helping the Refuge better utilize the existing water supply.

The recontouring of additional areas to develop moist soil units would not appreciably impact wetland habitat on the Refuge. It also does not enhance the ability of the Refuge to manage water.

There are eight existing management units in which large borrow areas exist, and this alternative evaluated the benefits of filling these borrow areas. Although this alternative was not found to have a substantial impact on the overall Refuge water supply, it was felt that the improvement in the ability to manage these units made it worthwhile to pursue. Currently, four units are being recontoured to remove the borrow areas. Less water per unit will then be needed to bring the units up to target management elevation. The other four units will be recontoured in the future.

The development of a supplemental water supply for the Refuge from the Arkansas River was evaluated. Although this alternative had the potential to greatly improve the water supply to the Refuge, the construction cost and operations and maintenance costs were extremely high. Another negative aspect of this alternative was that of water rights, and the ability of the Service to obtain rights to pump from the Arkansas River. This alternative only had a cost-benefit ratio of 0.09 to 0.29, depending on the diversion capacity that could be obtained.

The last alternative was providing a supplemental water supply to the Refuge from groundwater wells. This alternative was found by Burns and McDonnell to provide the most benefit to the Refuge at the least cost. However, this alternative also involves some problems with water rights, particularly in a basin that is

closed to further development of groundwater. The Service is also concerned that drilling more wells should not be seen as a solution to the problem of overappropriation in the Rattlesnake Creek Subbasin. This option is, however, being pursued by the Rattlesnake Creek/Quivira Partnership. The augmentation plan has not yet been finalized or funded, nor has the question of how the water rights needed will be obtained been fully answered. This option is included in the draft Management Plan for the Rattlesnake Creek Subbasin.

WATER MANAGEMENT PLAN

The OPONDS model developed by the U.S. Geological Survey (USGS WRI Report 97-4289) was utilized to evaluate water management on the Refuge. The USGS used actual streamflow data and evaporation data from 1991 (a very dry year) and 1996 (a wet year), and developed sample simulations. This data was calibrated to the extent possible to actual outflow data as measured at the Raymond gage, and the pool elevation data that were available.

In working with this model, it became evident that there are some problems and limitations. The first involves the elevation/area/capacity tables provided to USGS by the Service. The depth of Unit 11 derived from the table far exceeds what has been observed by Refuge staff. A new survey of this unit would provide better data. Additional survey work is also needed for Units 5W, Units 55 and 56, and the north part of Unit 75, for which there currently is no topographic data. Also, a resurvey of the units where borrow areas are filled in will have to be conducted in the future. An additional problem is that the model currently operates only to satisfy the linear-network optimization equations for the pools and canals, and does not incorporate the actual hydraulics of Refuge water control structures. We hope to gather additional data on the hydraulics in the future and incorporate them into the model. Finally, we need to gain a better understanding of the effect of changing the cost coefficients in the linear-network optimization equations on the model output. This will only come with additional experimentation and experience in using the model.

Given the above limitations, we believe the model output presented reasonably approximates Refuge water management for the climatic conditions of 1991 and 1996. We have data for 1997 and 1998 that we plan to input to the model in the future to simulate an average year.

The following table lists the Units included in the model. Areas are in square feet, and perimeters are in feet. Depth listed is maximum depth except for those units lacking an elevation/area/capacity table (-99.00).

In 1991, the Little Salt Marsh is less than 0.5 feet deep at the end of 365 days (Figure 4). The Big Salt Marsh holds 3 to 4 feet of water, as does Unit 78. Units 10A, 29, 28, 14A and 14B have between 1.5 and 3 feet of water, while Unit 10B has between 0.5 and 1 feet of water and Unit 7 has between 1 and 1.5 feet of water. Unit 11 appears to have over 7 feet of water, when it actually was much drier.

On August 1, 1991, the Little Salt Marsh held 2 to 3 feet of water and the big Salt Marsh held 3 to 4 feet of water (Figure 5). Most other units had between 2 and 5 feet of water. Most of this water was gone by the end of the November.

Following these labeled Figures are the modeled inflow and outflow, and the precipitation and evaporation used in the 1991 model run. Inflow rarely exceeded 10 cfs and was much less during the fall. A series of rainfall events in July produced one flow peak of about 42 cfs. Outflow was typically less than 4 cfs, but never quite reached zero because of the groundwater inflow on the North end of the Refuge which was responsible for keeping water in the Big Salt Marsh. Precipitation was low and evaporation was high.

In years like 1991, the Refuge would attempt to hold all units as high as possible, in anticipation of inadequate flows later in the summer and fall. Emphasis would be put on trying to keep some water in units 5, 7, 10A, 10B, 10C, 11, 14A and 14B. In 1991, the Refuge was not successful in keeping adequate water in Unit 5 (Little Salt Marsh), or in Units 10B and 10C. Many other units on the Refuge also were dry or nearly dry by the end of the year, and the Refuge had to depend on groundwater inflow to maintain the units on the north end of the Refuge.

In 1996, a wet year, adequate water was available to keep all pools at or above optimum management levels. At the end of the 365 day period, the Little Salt Marsh contained 3 to 4 feet of water (average depth), the Big Salt Marsh contained 4 to 5 feet of water, and most other units contained over 3 feet of water (Figure 6). The exceptions are Pools 80 and 81, which contained less than a foot of water and are managed primarily for shorebird habitat.

On August 1, 1996, the Little Marsh contained 3 to 4 feet of water (Figure 7), and the Big Salt marsh contained 4 to 5 feet of water. Most other units ranged in average depth from 3 to 7 feet. Again, Pool 80 had less than one foot of water.

Following the labeled Figures are the modeled inflow and outflow, and the precipitation and evaporation used in the 1996 model run. The time step used in this simulation was 2 days, so the time

steps at the bottom of these graphs should be multiplied by a factor of 2. Inflow was relatively low (about 10 cfs) during the early spring, but increased to between 20 to 50 cfs in May and June. In early July, a peak flow of over 400 cfs occurred, with a second high flow of about 195 cfs occurring in August. Rainfall was abundant throughout the spring and summer, resulting in high pool levels in the Refuge. Many units were one to two feet higher than the preferred management elevations during the summer. During years like 1996, management is hampered by the excess water, and peak flows must be released when pools are full. This is reflected in the relatively high outflows shown by the model. Evaporation was higher in the spring, but lower in the late summer in fall in 1996 as compared to 1991.

In an average year, the Refuge would hold spring flows, storing as much as practical in the Little Salt Marsh, units 14A and B, units 20A and 20B, Unit 29, Unit 48, and Unit 61. Stored water in these units could be released later to adjacent units if insufficient streamflow is available in late summer and fall. The optimum mix of desired habitat for each unit is shown in Table 2.

If insufficient water is available, an effort would be made to primarily maintain the Little Salt Marsh, Unit 7, Unit 10A, Unit 10B, Unit 10C, Unit 11, and Units 14A and B (surface area 954 acres, capacity approximately 2900 ac-ft) will be maintained, as opposed to the potential 6553 surface acres and 14,179 acre-feet contained in all of the units on the Refuge. Units 7, 10A, 10B, 11, 14A, and 14B are all located a short distance from Unit 5 (Little Salt Marsh), so transmission losses are minimized.

The implementation plan for initiating the Drought Contingency Plan is as follows:

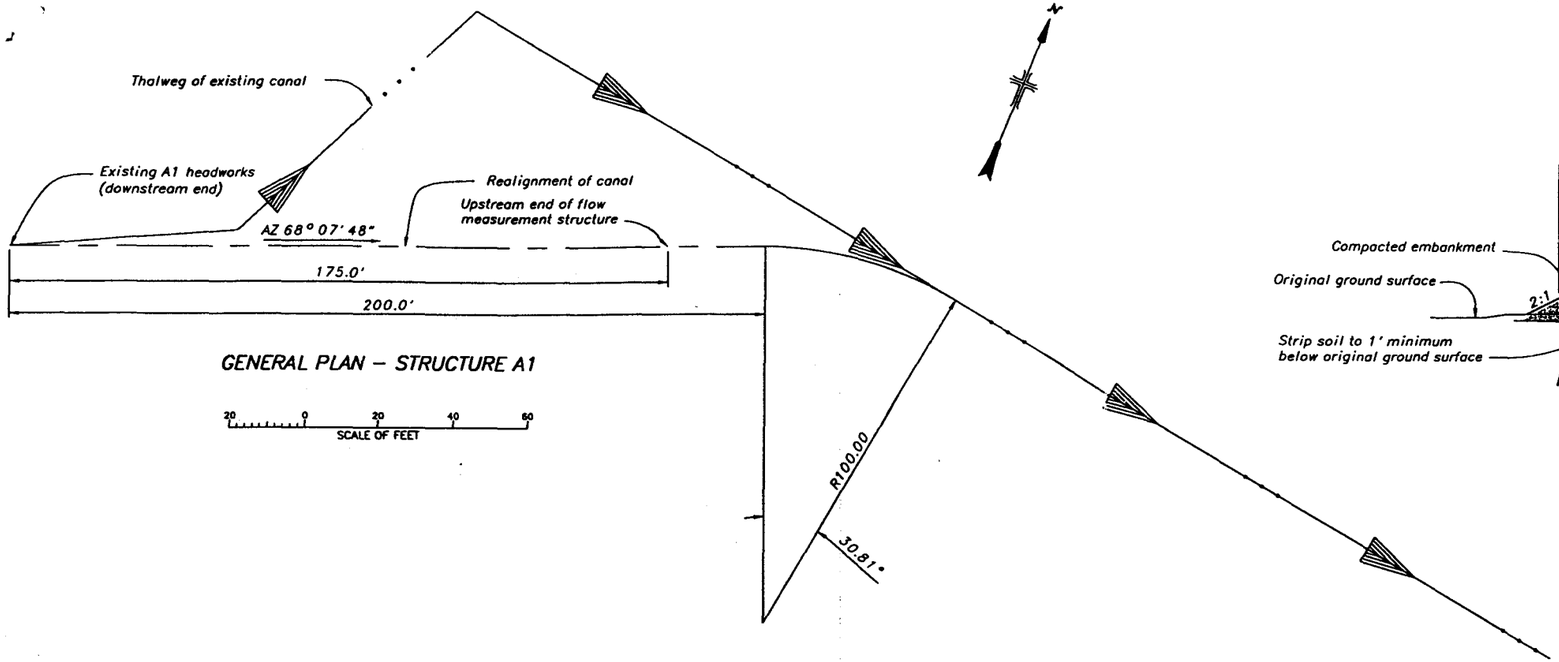
1. If the mean daily January flow at the Zenith gage (Rattlesnake Creek near Zenith) is less that 25 cfs, the Refuge will anticipate that a drought year may occur.

2. A review will be made in July using the Palmer Drought Severity Index to determine if drought conditions exist. If the Palmer Drought Severity Index in Region 8 of Kansas is -3.0 or lower, most diversions to the north of Pools 14A and 14B will cease, and water will be primarily concentrated in Pools 5, 10A, 10B, 11, 14A and 14B.

3. Diversions from the Little Salt Marsh (Pool 5) will continue to be made until it is determined that wildlife habitat in the Little Salt Marsh is being detrimentally affected to the point that it offsets the benefits of putting it in another unit, at which time all diversions out the Little Salt Marsh will cease.

4. Water will primarily be maintained in Pools 5, 7, 10A, 10B, 11, 14A and 14B, unless sufficient precipitation occurs to raise the Palmer Drought Index to greater than -1.0, or streamflow recovers to the point where it becomes possible to fill units to the north of the designated units.

OA-62-3



GENERAL PLAN – STRUCTURE A1

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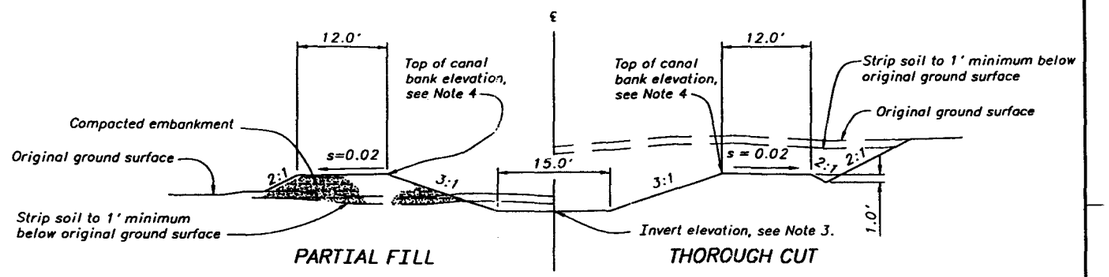
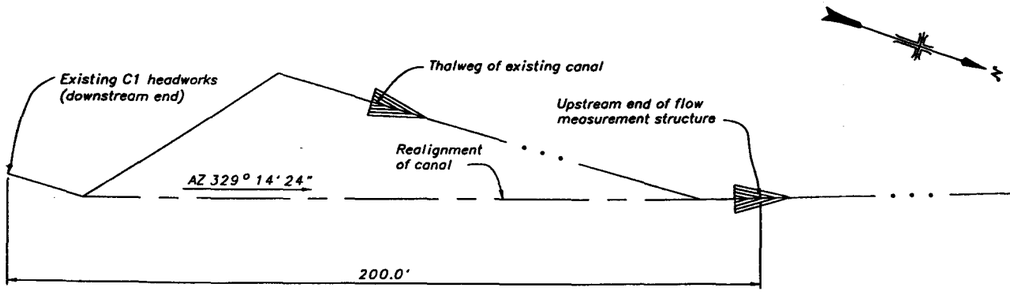
SCALE OF FEET



PARTIAL FILL THOROUGH CUT

TYPICAL CANAL REALIGNMENT SECTION



GENERAL PLAN – STRUCTURE C1

20 0 20 40 60
SCALE OF FEET

NOTES

1) Flow measurement structure DC–A shall be located 200 feet downstream of the downstream end of the DC–A headworks structure
2) Flow measurement structure RC–A shall be located 200 feet downstream of the downstream end of the RC–A headworks structure
3) The canal invert shall be uniformly sloped between the downstream side of the headworks structure and El. A (see OA–62–1) of the measuring flume.
4) The top of canal bank shall be the greater of the height of the existing canal banks or El. D (see OA–62–1).

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FLOW MEASUREMENT STRUCTURES

STRUCTURES A1, C1, DC–A AND RC–A

GENERAL PLANS AND SECTION

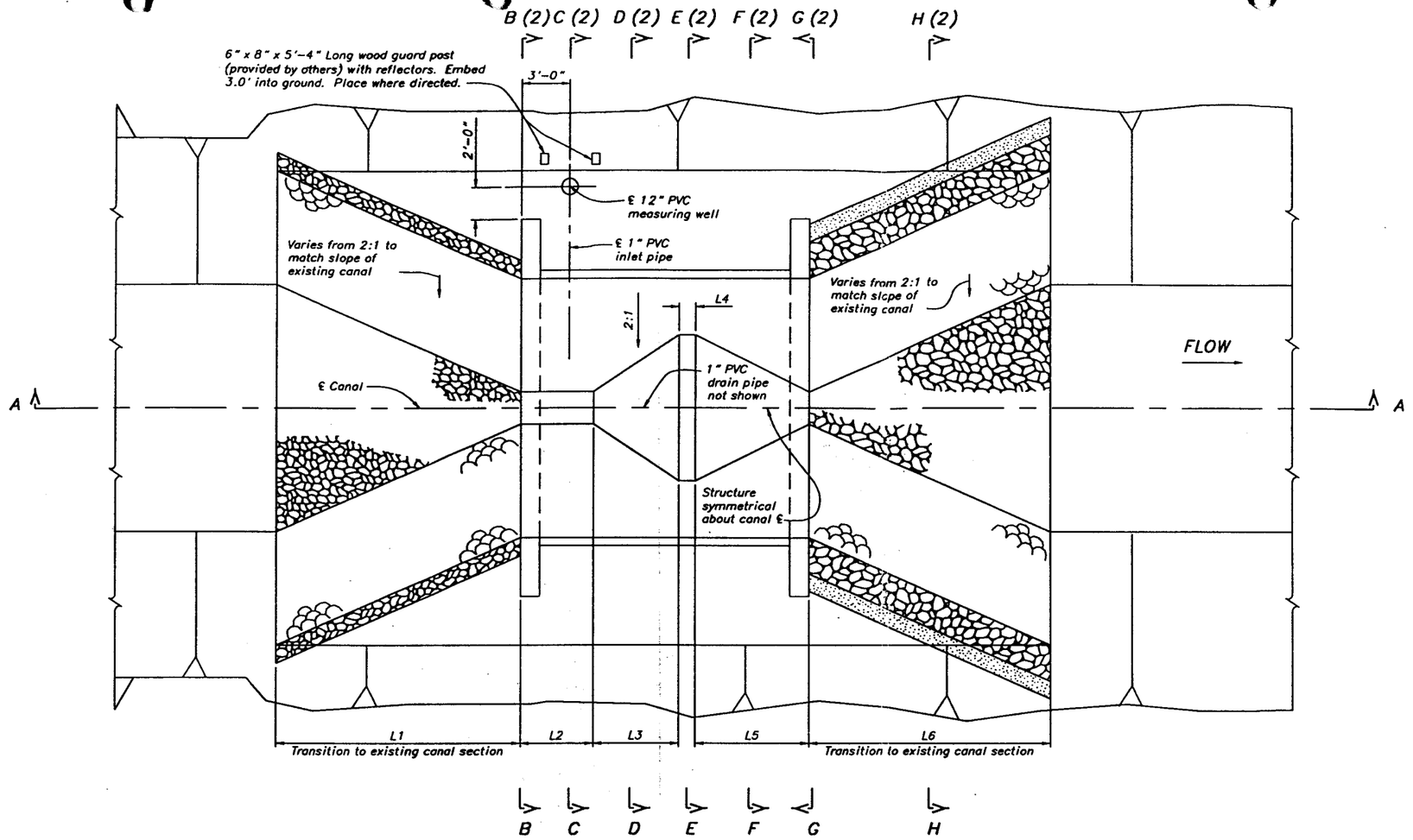
DESIGNED R.B. Austin CHECKED S.J. Robertson
DRAWN R.B. Austin TECH. APPR. S.J. Robertson
APPROVED R.P. Jones
PEER REVIEWED

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
AUTOCAD RM 14.01 DENVER, COLORADO	OA-62-3A.DWG JANUARY 28, 2000	APRIL 19, 2000, 08:28

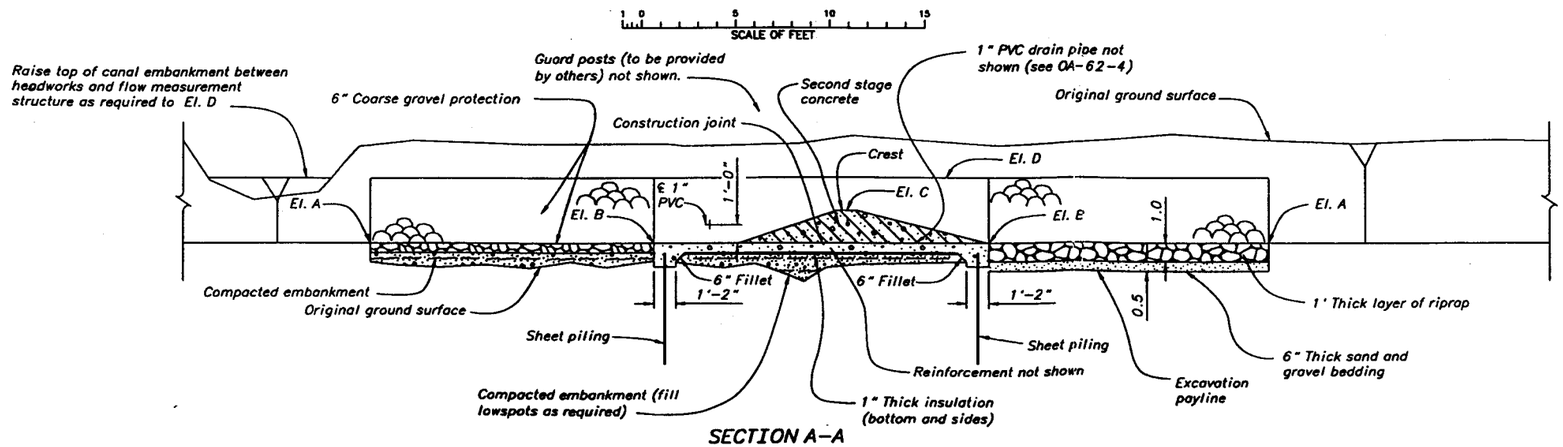
SHEET 1 OF 1

OA-62-3

OA-62-1



TYPICAL SITE PLAN



SECTION A-A

TABLE OF DIMENSIONS AND ELEVATIONS

	Structure			
	A1	C1	DC-A	RC-A
L1	15.0'	15.0'	7.5'	35.0'
L2	4'-6"	4'-6"	4'-6"	4'-6"
L3	5'-3"	5'-3"	5'-3"	5'-3"
L4	1'-0"	1'-0"	1'-0"	1'-0"
L5	7'-0"	7'-0"	7'-0"	7'-0"
L6	15.0'	15.0'	7.5'	35.0'
El. A	1778.36	1779.41	1765.30	1744.20
El. B	1779.61	1779.41	1766.55	1744.20
El. C	1781.36	1781.16	1768.30	1745.95
El. D	1783.11	1782.91	1770.05	1747.70

NOTES

1) For flow measurement structure locations and general plan of canal realignments, see OA-62-3.
2) In areas of construction, the top 12 inches of soil shall be stripped and wasted.
3) Low density or other unsuitable material in the foundation shall be overexcavated as directed by the COR and replaced with compacted embankment.
4) For flow measurement structure details, see OA-62-4.
5) The accuracy of measurement of the water level sensor of the water surface shall be within ± 0.08 inches.
6) 1" PVC shall be ASTM D1785, Schedule 80.
7) 12" PVC shall be ASTM D1785, Schedule 40.

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FLOW MEASUREMENT STRUCTURES

STRUCTURES A1, C1, DC-A AND RC-A

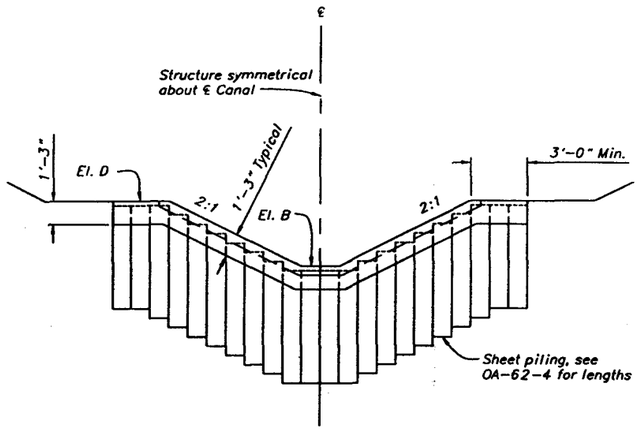
PLAN, SECTION AND TABLE

DESIGNED P.K. Ahuja CHECKED S.J. Robertson
DRAWN P.K. Ahuja TECH. APPR. S.J. Robertson
APPROVED R.D. Ruegg FOR REVIEW

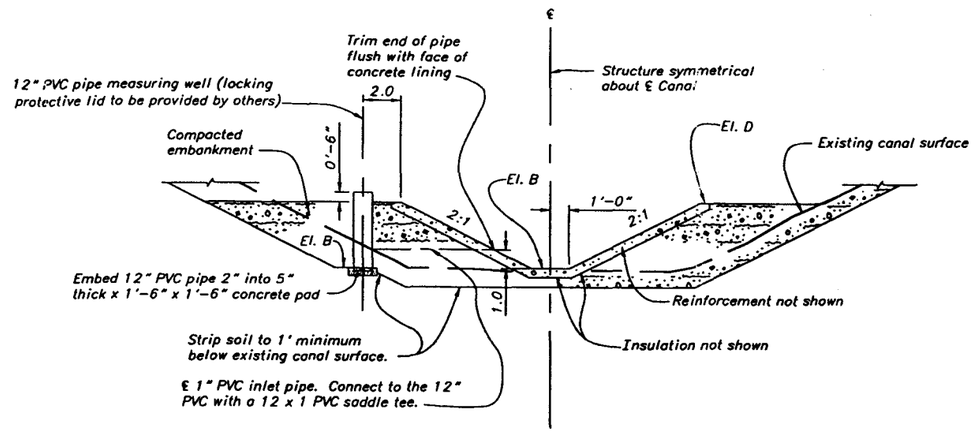
CADD SYSTEM	DRAFT (LENGTH)	DATE AND TIME PLOTTED
MICRO DWG 14.01 DENVER, COLORADO	OA-62-1 MICRO DWG SHEET 1 OF 2 JANUARY 28, 2000	APRIL 19 2000 14:28

OA-62-1

KATHWATER



SECTION B-B (1)
(SECTION G-G (1) similar)



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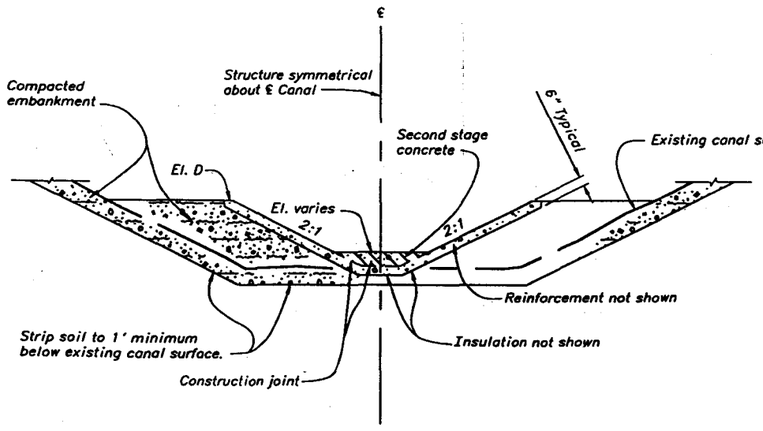
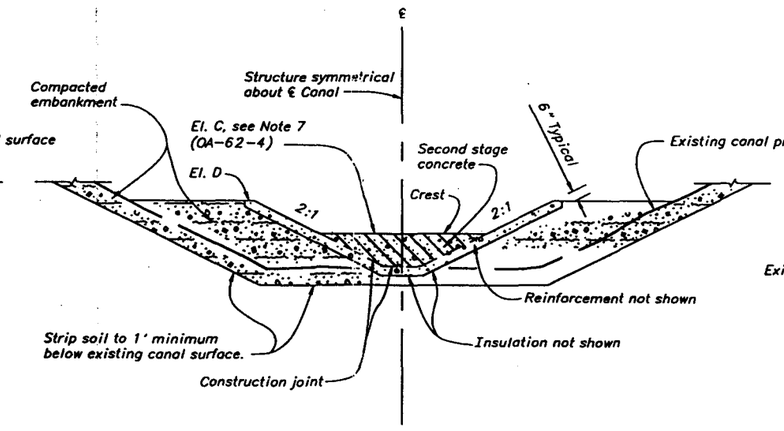


SECTION D-D (1)
(SECTION F-F (1) similar)



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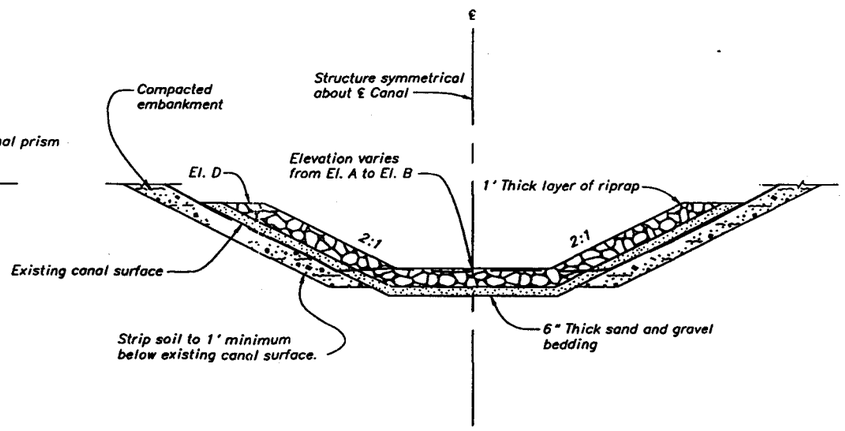

SECTION H-H (1)

1 0 5 10 15
SCALE OF FEET

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QUIVIRA NATIONAL WILDLIFE REFUGE, KANSAS

FLOW MEASUREMENT STRUCTURES
STRUCTURES A1, C1, DC-A AND RC-A

SECTIONS

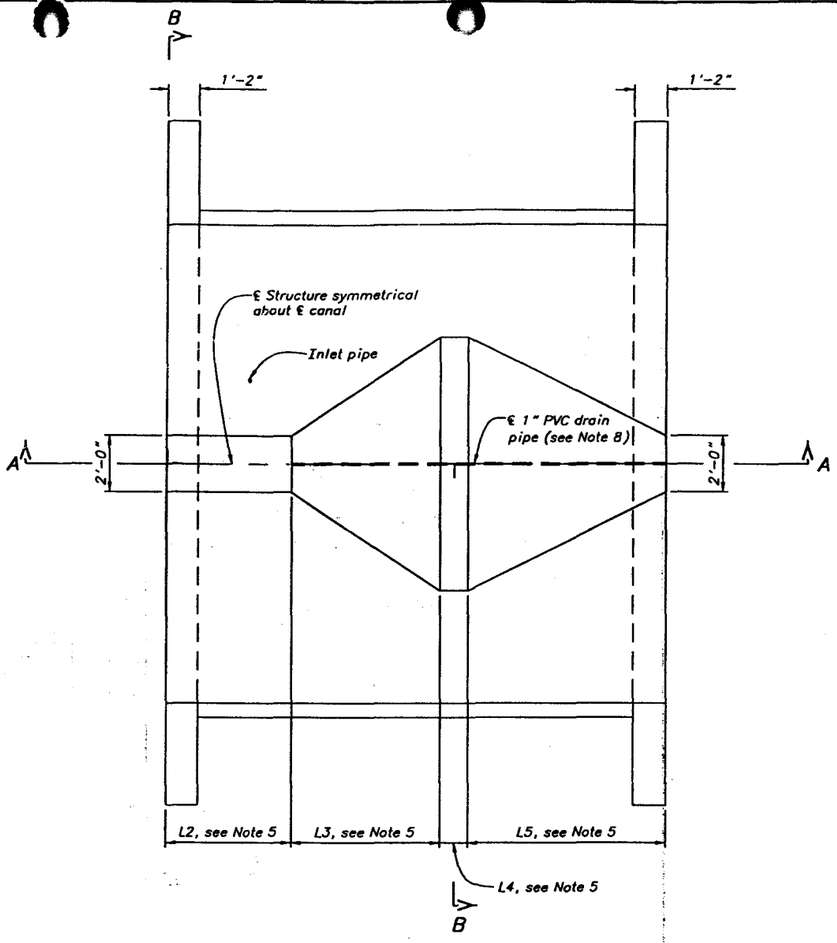
DESIGNED K.B. Ahuja — CHECKED S.J. Robertson
DRAWN D.K. Shoup — TECH. APPR. S.J. Robertson
APPROVED R.C. Swain — PEER REVIEWER

CADD SYSTEM	CAD FILE/DGN	DATE AND TIME PLOTTED
MicroStation V8 XM 14.01	OA-62-1 AND 2.DGN	APRIL 19, 2000 14:28
DENVER, COLORADO	JANUARY 28, 2000	OA-62-2

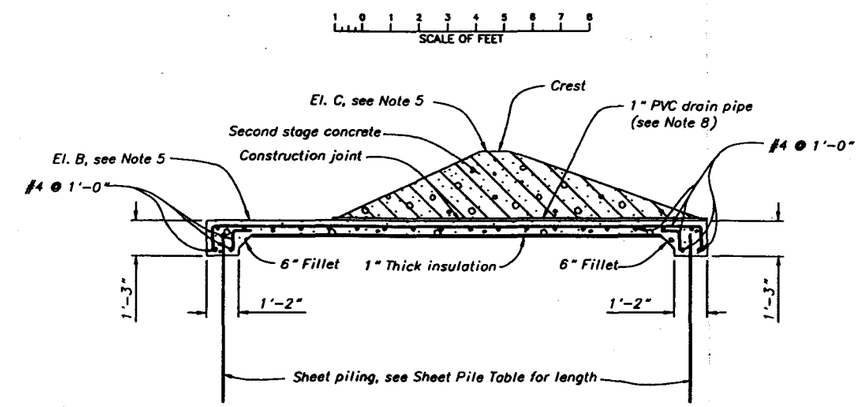
SHEET 2 OF 3

KATWATER

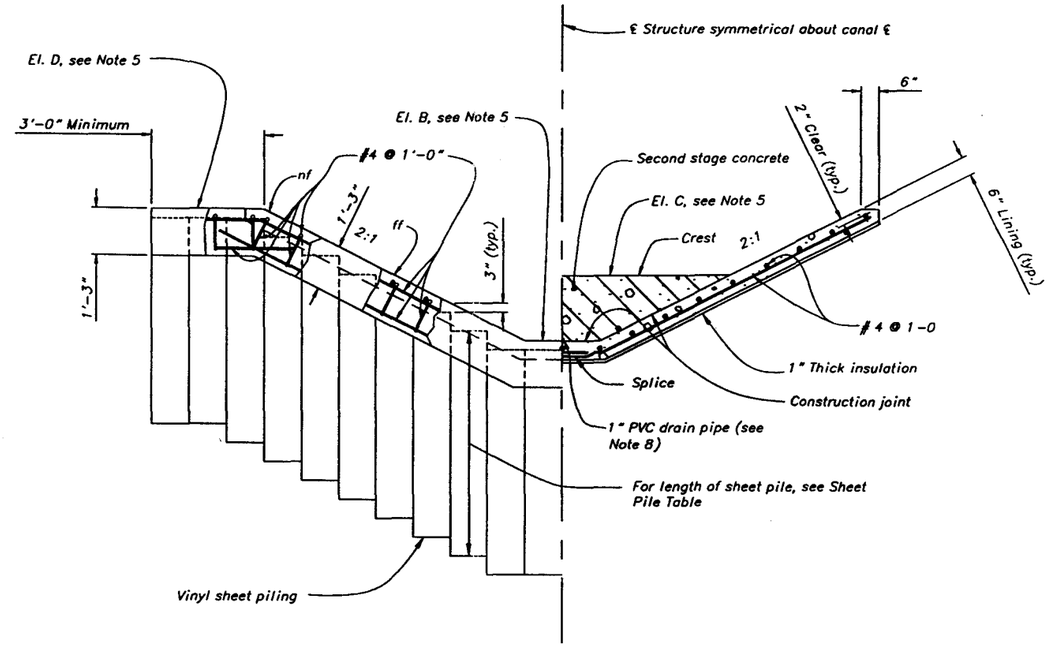
OA-62-4



TYPICAL PLAN



SECTION A-A



SECTION B-B

SCALE OF FEET

NOTES

1) For General Notes and Minimum Requirements for Detailing Reinforcement, see 40-D-6263.
2) The 28 day compressive strength of concrete shall be 4,000 p.s.i.
3) Reinforcement shall have a yield strength of 60,000 p.s.i.
4) All exposed concrete edges shall have 3/4" chamfers unless otherwise shown.
5) For Table of Dimensions and Elevations, see OA-62-1.
6) For Typical Site Plan, see OA-62-1.
7) Crest shall be level and smooth. The slope of the crest in the direction of flow shall be less than 0.5 degree.
8) Provide 1" diameter PVC drain pipe with plug at upstream end for structures C1 and RC-A only.

SHEET PILE TABLE

Flow Measurement Structure	Length of Sheet Pile
A1	6'-0"
C1	3'-6"
DC-A	6-0"
RC-A	3'-6"

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QUIVIRA NATIONAL WILDLIFE REFUGE, KANSAS

FLOW MEASUREMENT STRUCTURES

STRUCTURES A1, C1, DC-A AND RC-A

TYPICAL PLAN, SECTIONS AND TABLE

DESIGNED D.K. Schuetz — CHECKED J. Rabenstein
DRAWN D.K. Schuetz — TECH. APPR. J. Rabenstein
APPROVED R.L. Frueh — FIELD REVIEWER

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
AutoCAD Rel. 14.01 DENVER, COLORADO	OA-62-4.DWG JANUARY 28, 2000	APRIL 18, 2000 13:13

SHEET 1 OF 1

OA-62-4

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
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KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Robert F. Lytle Jr.
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283

AUG 25 2000

Dear Mr. Lytle:

Thank you for your recent letter commenting on the Draft Quivira National Wildlife Refuge Water Conservation Plan. We appreciate your taking the time to review this document. We will attempt to develop a drought contingency plan and implementation schedule, however we feel that most of your other comments are addressed in the draft plan.

First, our management practice to avoid waste of water during severe drought is to reduce the units to which water will be supplied (see last page of plan). Only units 5, 7, 10A, 10B, 11, 14A, and 14B (surface area 954 acres, capacity approximately 2900 ac-ft) will be maintained, as opposed to the potential 6553 surface acres and 14,179 acre-feet contained in all of the units on the Refuge. Units 7, 10A, 10B, 11, 14A, and 14B are all located a short distance from Unit 5 (Little Salt Marsh), so transmission losses are minimized. This was not adequately elaborated on in the document, and additional verbage will be added describing this scenario. We will address an implementation schedule as well.

The on-Refuge alternatives discussed in your letter included building cross-dikes in the Little Salt Marsh, constructing a bypass canal around the Little Salt Marsh, and filling borrow areas in the eight identified management units. We have decided that building cross dikes in the Little Salt Marsh is not the best alternative because it greatly decreases the habitat value of the marsh itself. The Marsh provides significant habitat, especially during periods of drought, and cross dikes would greatly reduce the amount and quality of that habitat. Construction of a bypass canal around Little Salt Marsh would only really be of benefit to the Refuge during floods. The idea would be to bypass flood flows and eliminate sediment deposition in the Little Salt Marsh. While a bypass canal might result in an increased ability to deliver water to units farther north on the Refuge during periods of low flow, it would take the small amount of water available out of the Little Salt Marsh and reduce habitat there. We feel that our plan to only try to maintiain units in the southern part of the Refuge acheives the purpose of water conservation and best use, and that we can accomplish this without constructing cross-dikes and a by-pass canal. This discussion can be included in the document.

RECEIVED
MAY 25 2007
STAFFORD FIELD OFFICE
DIVISION OF WATER RESOURCES

AUG 30 2000

KS DEPT OF AGRICULTURE

MICROFILMED

We are currently filling the borrow areas in four of the eight identified management units (seventh page of text). This work is nearly completed, and we intend to fill the other four units as time and funding becomes available.

The plans and specifications for the measuring devices are nearly complete, and a contract for construction should be issued by September 6. Copies of these plans and specifications will be submitted to the Chief Engineer as soon as they become available.

Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

cc: Refuge Manager, Quivira NWR

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
109 SW 9th Street
Topeka, Kansas 66612-1280
(785) 296-3558
FAX: (785) 296-8389

Division of Water Resources
David L. Pope, Chief Engineer
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283
(785) 296-3717 FAX (785) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE #7571

August 2, 2000

United States Department of Interior
Fish and Wildlife Service, Mountain-Prairie Region
Post Office Box 25468
Denver Federal Center
Denver , Colorado 80225
Attn: Megan A. Estep-Johnston, Refuge Hydrologist

Dear Ms. Estep-Johnston:

The Draft Quivera National Wildlife Refuge Water Conservation Plan submitted to the Stafford Field Office of the Kansas Division of Water Resources was forwarded to me for review and comment. Thank you for compiling the draft plan. A review of the plan finds it to be a good start to a comprehensive water conservation plan required by the Findings and Order of the Chief Engineer dated September 25, 1996.

The draft plan does a good job of describing the physical characteristics of the Refuge, as well as the amount of water that may be available to the Refuge. However, it fails to address in any detail what management practices are, and will be used to avoid waste of water, minimize losses and optimize the efficient use and management of water. The Plan also does not include a drought contingency plan, nor does it include an implementation schedule, as required in the previously noted Findings and Order of the Chief Engineer.

The Engineering Feasibility Study evaluated several management options, both off-Refuge and on-Refuge. The purpose of evaluating operational management options should have been for the purpose of achieving water conservation and maximizing the efficient use of the available water, and not for purely attempting to increase the water supply for the Refuge. It appears that at least three of the on-Refuge alternatives would help conserve water and improve the Refuge's ability to locate the water supply in desired locations. Constructing cross dikes in Little Salt Marsh, constructing a bypass canal around Little Salt Marsh, and filling the borrow areas in the eight identified management units, would all help with the efficient use and distribution of water.

The water measurement efforts that are scheduled to be made should fulfill the water monitoring requirements of the Chief Engineer's Findings and Order. However, the specifications and the plans for the construction and installation of the measuring structures and devices need to be submitted to the Chief Engineer for approval prior to their installation.

Thank you again for providing us with your draft water conservation plan. If you can incorporate into the plan, a discussion of potential management practices that the Refuge intends to utilize to make the most efficient use of the water that the OPONDS model predicts, along with a drought contingency plan and implementation schedule, the plan can be accepted by the Chief Engineer.

Sincerely

Robert F. Lytle Jr.

Robert F. Lytle Jr.
Environmental Scientist

RFL
pc: Stafford Field Office

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture
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KANSAS DEPARTMENT OF AGRICULTURE

August 2, 2000

United States Department of Interior
Fish and Wildlife Service, Mountain-Prairie Region
Post Office Box 25468
Denver Federal Center
Denver , Colorado 80225
Attn: Megan A. Estep-Johnston, Refuge Hydrologist

Dear Ms. Estep-Johnston:

The Draft Quivera National Wildlife Refuge Water Conservation Plan submitted to the Stafford Field Office of the Kansas Division of Water Resources was forwarded to me for review and comment. Thank you for compiling the draft plan. A review of the plan finds it to be a good start to a comprehensive water conservation plan required by the Findings and Order of the Chief Engineer dated September 25, 1996.

The draft plan does a good job of describing the physical characteristics of the Refuge, as well as the amount of water that may be available to the Refuge. However, it fails to address in any detail what management practices are, and will be used to avoid waste of water, minimize losses and optimize the efficient use and management of water. The Plan also does not include a drought contingency plan, nor does it include an implementation schedule, as required in the previously noted Findings and Order of the Chief Engineer.

The Engineering Feasibility Study evaluated several management options, both off-Refuge and on-Refuge. The purpose of evaluating operational management options should have been for the purpose of achieving water conservation and maximizing the efficient use of the available water, and not for purely attempting to increase the water supply for the Refuge. It appears that at least three of the on-Refuge alternatives would help conserve water and improve the Refuge's ability to locate the water supply in desired locations. Constructing cross dikes in Little Salt Marsh, constructing a bypass canal around Little Salt Marsh, and filling the borrow areas in the eight identified management units, would all help with the efficient use and distribution of water.

The water measurement efforts that are scheduled to be made should fulfill the water monitoring requirements of the Chief Engineer's Findings and Order. However, the specifications and the plans for the construction and installation of the measuring structures and devices need to be submitted to the Chief Engineer for approval prior to their installation.

Thank you again for providing us with your draft water conservation plan. If you can incorporate into the plan, a discussion of potential management practices that the Refuge intends to utilize to make the most efficient use of the water that the OPONDS model predicts, along with a drought contingency plan and implementation schedule, the plan can be accepted by the Chief Engineer.

Sincerely

Robert F. Lytle Jr.

Robert F. Lytle Jr.
Environmental Scientist

RFL
pc: Stafford Field Office

U.S. FISH & WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
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Post Office Box 25486
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Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear Mr. Falk:

Enclosed is a draft of the water conservation plan for the Quivira National Wildlife Refuge. We are still working to better quantify average water use with the model written by the U.S. Geological Survey. Please review this document and let us know if there are any changes or additions the your office requires.

Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

cc: Refuge Manager, Quivira NWR

Quivira National Wildlife Refuge Water Conservation Plan

BACKGROUND

The Quivira National Wildlife Refuge (NWR) is located in the Rattlesnake Creek Basin in South-central Kansas in the northeast corner of Stafford County. The Refuge consists of about 32 square miles of marshes, ponds, and uplands that provide habitat for a variety of wildlife and waterfowl. The natural wetlands and marshes have been modified by a series of canals and constructed dikes. Water is supplied by Rattlesnake Creek, and through natural upwelling of groundwater.

The water supply for the Refuge is highly variable. Often, streamflow in the spring is too high for the Refuge to make beneficial use of all available water, but is too low later in the season to offset evapotranspiration. In some years, there is insufficient water to fill even some of the units, while in other years floods damage water control structures.

The Refuge was established in 1957. The Service filed for a right to divert 22,200 acre feet of water from Rattlesnake Creek soon after establishment of the Refuge, and filed a Notice of Proof of Completion of Works for Permit #7571 on July 15, 1982. The Service was unable to demonstrate that is had diverted 22,200 acre-feet of water during the period of proof, and the Kansas Division of Water Resources certified Permit #7571 for 14,632 acre feet based on the recorded usage on April 9, 1996.

Since about 1970, development of groundwater irrigation in the Rattlesnake Creek Basin has increased dramatically. The result of the increase in groundwater withdrawals has been a decline in the baseflow component of Rattlesnake Creek streamflow. This has increased the severity of the problem of low late-season streamflows, and is particularly injurious during drought years.

The Refuge Manager and Regional Office personnel have been participating in the Rattlesnake Creek/Quivira Partnership to develop the Rattlesnake Creek Subbasin Management Plan in 1993. This Management Plan provides an array of incentive-based programs for reducing irrigation water use in the Subbasin. It is hoped that by the end of the twelve-year time frame outlined in the Management Plan, water use reductions will be adequate to meet streamflow targets and assure the Refuge receives enough water to meet Refuge management objectives.

DESCRIPTION OF REFUGE WATER CONTROL AND CONVEYANCE STRUCTURES

Sounds like they want to convert for their personal and subsequent use.

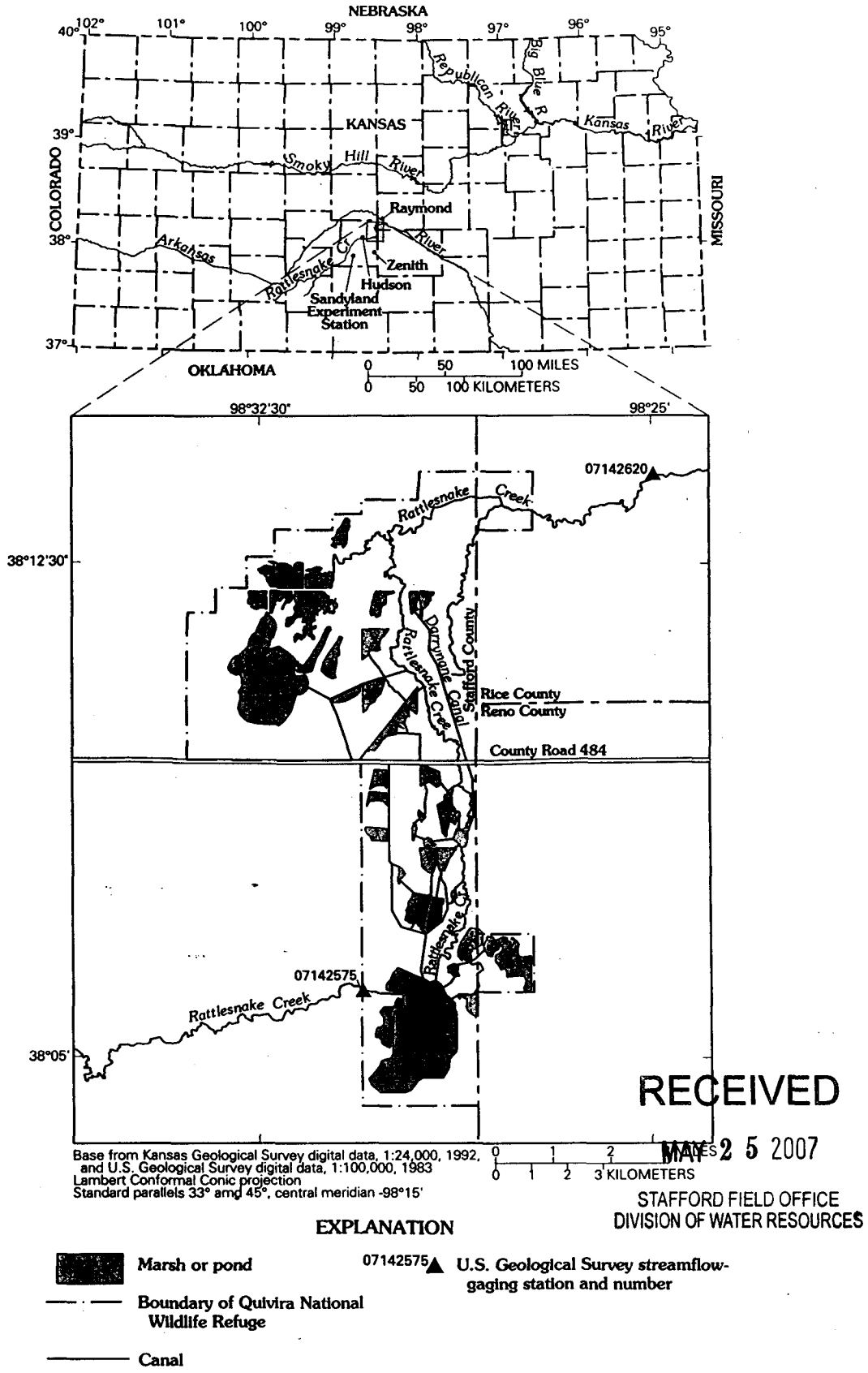
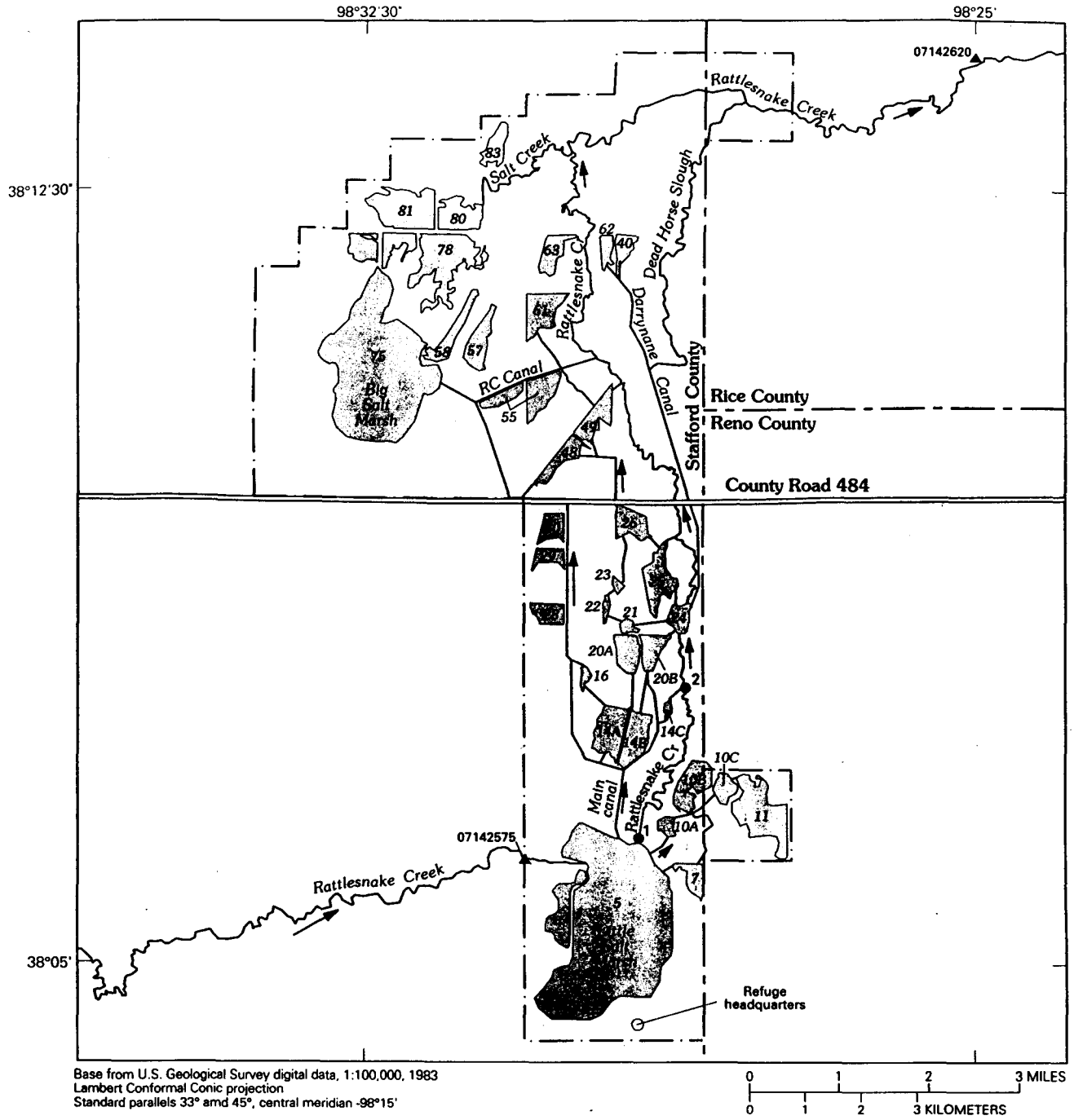


Figure 1. Location of Quivira National Wildlife Refuge, south-central Kansas.



EXPLANATION

- Marsh or pond—Number is water-unit number used for identification in tables
- Boundary of Quivira National Wildlife Refuge
- Canal
- Direction of flow
- 07142575 U.S. Geological Survey streamflow-gaging station and number
- Seepage test site and number

The Refuge has three points of diversion. Water diverted at these three points can be moved to numerous conveyance canals, or nearly directly into a water management unit, as is the case with Unit 7. Water enters the Refuge along the southwest boundary, and flows into the Little Salt Marsh (Unit 5). From the Little Salt Marsh, water can be conveyed into Unit 7 through structure A-3; water can be conveyed through structure A-1 to Units 10A 10B, 10C and 11; water can be conveyed into the West Canal through structure C-1; or water can flow back into the Rattlesnake Creek through structure A-2.

From structure A-2, water that flows back into the Rattlesnake Creek flows north until it reaches Unit 24, also known as Darrynane Lake. From Darrynane Lake, water can be diverted through structure DCA into the Darrynane Canal, through structure 24C into Unit 25, through structure 24B to 21, through a short canal and water control structure into 20, and through structure 24A back into Rattlesnake Creek. Water can also flow through structure 24B back to Rattlesnake Creek.

North of Unit 49, the third point of diversion is structure RCA. Water diverted at RCA flows to structure RCB where it can be used to fill Unit 61, or it can flow further west to structure RCC, and eventually to structure RCD.

In addition to the appropriated surface water used by the Refuge, there are presently 31 cattle watering facilities maintained on the Refuge, and three domestic wells. An artesian well, drilled under a permit to the L.D. Davis Oil Company, Great Bend, has been turned over to the Refuge and is located in Section 5, T22S, R11W. The flow from this well, estimated to be less than 5 gpm, is used to supplement a natural spring that provides habitat for a breeding population of Arkansas darters, a state endangered fish.

DESCRIPTION OF WATER MANAGEMENT UNITS

There are 34 constructed water management units on the Refuge (Table 1). The areas and capacities of these units were determined in 1990 by conducting surveys of cross-sections through the units. Better information could potentially be collected using modern GPS equipment, and the areas and capacities of the units might be revised if this is done. Also, work is currently being done in Units 25, 29, 49, and 63 to fill in borrow areas that were created at the time the dikes were constructed on these units. These borrow areas are quite deep, and must be filled before water can begin to fill the rest of the unit. This work will alter the area/capacity relationships for these units, but will allow the units to be filled to management levels with less water. Similar work is planned for Units 30,

TABLE 1. QUIVIRA NATIONAL WILDLIFE REFUGE AREA/CAPACITY SUMMARY

POOL	FULL POOL ELEV., FT		SURFACE AREA, AC	CAPACITY, AC-FT	MANAGEMENT ELEVATION, FT.	SURFACE AREA, AC	CAPACITY, AC-FT	
5	1783	(SPILLWAY)	864	1866	1783	864	1866	
7	1778	(TOP OF STOPLOG SLOT)	26	40	1777.36	20	25	
10A&B	1779	(TOP OF STOPLOG SLOT)	64	145	1778.83	60	135	
10C	1774.4	(TOP OF GAGE)	11	13	1774.09	7	11	
11A	1774.9	(SPILLWAY)	50	338	1774.9	50	338	
11B	1774.8	(SPILLWAY)	57	112	1774.8	57	112	
14A	1778	(SPILLWAY)	87	196	1778	87	196	
14B	1776.7	(SPILLWAY)	65	96	**1777.19**	ABOVE TABLE		
14C	1777	14C BM - 0.67'	7	16	**1778.05**	ABOVE TABLE		
16	1775	(TOP OF STOPLOG SLOT)	31	80	1774.42	28	63	
20	1770.7	(SPILLWAY)	138	195	**1770.96**	147	232	
21	1770	(TOP OF STOPLOG SLOT)	30	81	1769.3	26	62	
22	1766	22A BM - 0.6'	10	13	1765.35	8	7.5	
23	1764.3	(TOP OF GAGE)	9	15	1764.74	10	19	
24	1769.4	(SPILLWAY)	31	35	**1771.41**	ABOVE TABLE		
25	1768.4	(TOP OF GAGE)	94	296	1766.88	81	157	
26	1762	(SPILLWAY)	59	111	1761.9	58	105	
28	1768	28A BM - 0.86'	85	153	1767.56	73	118	
29	1762	29C BM - 0.58'	61	91	1761.25	46.5	51	
30	1759	HIGH WATER	78	119	1759.18	ABOVE TABLE		
40	1742.5	40B BM - 0.65'	32	66	**1742.62**	33	70	
48	1754.4	(SPILLWAY)	89	113	1751.93	5	1	
49	1754.2	(SPILLWAY)	95	159	1754.03	91	143	
57	1743.5	57A BM - 0.6'	127	212	1743.26	117	183	
58	1742	58B BM - 0.5'	99	251	1740.7	71	140	
61	1745.5	62B BM - 0.58'	218	498	1743.91	137	215	
62	1744	(TOP OF STOPLOG SLOT)	47	120	1742.56	33	63	
63	1741.2	(TOP OF GAGE)	154	339	1740.49	136	236	
75	1740.8	(SPILLWAY)	1768	2446	1740.76	1717	2378	
78	1740.2	(top of structure)	1169	2792	1738.7	877	1272	
80	1736.7	80A BM -0.5'	231	355	1736.19	216	242	
81	1736.7	80A BM -0.5'	56	25	1736.19	27	4	(NOTE: this is 27 acres of water 1.8 inches deep
83	1736.7	80A BM -0.5'	196	314	1736.19	167	222	
TOTAL			6138	11701				

*** Elevations in bold type are above spillway elevation.

40, 48, and 28. The areas and capacities based on the 1990 survey are shown in Table 1.

The water management currently done at the Refuge consists of storing as much water as is available starting in February to create habitat for migrating waterfowl and shorebirds. Water is diverted into management units and the units are held as full as possible to offset the possibility that water will not be available to refill the units later in the summer and early fall. The Little Salt Marsh(Unit 5)is the primary water storage unit on the Refuge, but also provides important habitat. The west edge of the Little Salt marsh is maintained as shallow wet meadow type habitat that is preferred by some shorebirds, white-face ibis, sandhill cranes, and the endangered whooping cranes. Because of the value of this shallow, grassy marsh type habitat, it is not desirable to raise the level of the Little Salt marsh above a point where this habitat would be inundated more deeply. The Refuge attempts to keep water in Unit 5 all year.

During the period from March through May, some units are drawn down, if possible, to attract and provide habitat for migrating shorebirds. The salt flat area at Quivira National Wildlife Refuge is designated as a "Wetland of Regional Importance" by the Western Hemisphere Shorebird Reserve Network (WHSRN). This classification designates sites that annually host more than 20,000 shorebirds, or over 5% of a flyway population. Shorebird species currently exhibiting population declines that use Quivira NWR include least sandpipers, semi-palmated sandpipers and Wilson's phalaropes. The area north of the Big Salt Marsh and North Lake have been used by endangered Piping Plovers for nesting. These salt flats also provide valuable habitat for a colony of endangered interior least terns. These terns require the unvegetated flats for nesting, in close proximity to deeper water areas that can support the small minnow populations the least terns use for food. The salt flats are also valuable to numerous shorebird species which take advantage of the Kansas wind's effects on the shallow water covering the flats. As the wind moves the shallow water back and forth on the flats, this action constantly exposes new food resources for the shorebirds as the water's edge advances or retreats. The Big Salt Marsh is also highly attractive to shorebirds, and in a normal year almost all water that is found in the Big Salt Marsh is a result of groundwater upwelling and local runoff.

From May until September, most units are managed so that they dry out gradually. It is impractical to attempt to maintain all the units during the hot summer months, except when precipitation is unusually high. Letting these units to dry out also achieves the objective of allowing moist soil plants to grow. These units can then provide excellent waterfowl habitat if they can be reflooded

in the fall. The moist soil plants growing on these areas are rich in protein and high energy, and can produce more available food for migrating waterfowl than an equivalent area of irrigated corn.

The Refuge would like to have adequate water in the fall to reflood as many units as possible. Most years, water is not available until after the irrigation season has ended and groundwater flow into the Big Salt Marsh has recovered. Ideally, the Refuge would like to keep water in both the Big Salt Marsh and the Little Salt Marsh all year, and be able to reflood Unit 7, Unit 10A, Unit 10B, Unit 10C, Unit 11, and Units 14A and 14B in the fall even in drought years. This would provide at least minimum habitat for migrating waterfowl and shorebirds.

WATER MEASUREMENT

Water measurement is currently done using a Claussen Rule, an instrument that is placed on top of the stop logs on the diversion structure and gives a reading that can be converted to cfs based on the width of the structure. This method of measurement was checked by the State Engineer's office and was found to be within 5% accuracy. However, it is not continuous, and the Refuge has entered into a cooperative agreement with the UDSI Bureau of Reclamation to design flumes for structures A-1, C-3, DCA and RCA. A continuous data logger will be installed on the flumes. The Refuge also plans to purchase an ultrasonic water measurement device to place inside the PVC pipes in structures A-3, 24D and 24A. This should result in much more accurate data collection and reporting of water use.

Inflow to the Refuge is measured at a U.S. Geological Survey gaging station, Rattlesnake Creek at Zenith. This station has been operating since 1973, and essentially measures all streamflow entering the Little Salt Marsh. A USGS gaging station operated on the Rattlesnake Creek near Raymond from 1960 until 1998, but has been discontinued due to lack of funding. This gage measured all flow leaving the Refuge. Ungaged runoff and upwelling groundwater are not measured. Local runoff probably does not contribute substantially to the inflow to Refuge water management units, but groundwater is a significant source of water for the Big Salt Marsh (Unit 75), and, most times, is the only source of water leaving the Refuge.

ENGINEERING FEASIBILITY STUDY

In 1996 through 1998, the Service utilized funds obtained from Congress through efforts by the Quivira Coalition, particularly WaterPACK, to hire Burns and McDonnell, Inc., to conduct an engineering feasibility study. The members of the Rattlesnake

Creek/Quivira Partnership wanted to look at off-Refuge storage, artificial recharge, and on-Refuge storage or any other alternatives that would provide additional operational flexibility for the Refuge's water diversion and conveyance system. The contractor was tasked with evaluating the different engineering alternatives and developing a basis to determine their benefits and costs. Criteria used in evaluating the benefits and costs included water supply capability, water quality, legal issues, policy and political issues, future availability, environmental issues, wetland habitat enhancement, and cost estimates and economic comparisons.

An operations model was developed by the contractor to determine the water needs of the Refuge, and the needs were based on a comparison of the operations modeling for the Refuge under baseline conditions and an "ultimate" (assumed the Refuge would have all the water needed for management) water use scenario.

Off-Refuge storage was evaluated and 18 potential reservoir sites were identified. Nine of the potential sites were eliminated early in the process because of wetland presence, economics in terms of construction and oil and gas relocation costs, or other environmental parameters. Four other reservoir sites were eliminated due to high water conveyance losses, the need to relocate residences, and their long distances from the Refuge.

The study concluded that the remaining five reservoirs would be only marginally successful in providing a supplemental water supply to the Refuge. In dry years, all of the water available for diversion from Rattlesnake Creek must be used directly on the Refuge, so there is not water available for storage in an upstream reservoir. Water for storage is only available in wetter years, and there is little carryover storage available due to high evaporation from any of the reservoir sites. The benefit/cost ratios for the five reservoir sites ranged from 0.01 to -0.02.

Two approaches for aquifer recharge were examined in the engineering feasibility study. One was conventional aquifer storage and recovery, where excess water is captured from available sources and stored in an aquifer for future use and recovered later by wells for delivery to the Refuge. The other was enhancing natural recharge in the basin to raise groundwater levels and, thus, increase base flow in the creek.

Five aquifer storage locations suitable for aquifer storage and recovery were identified. Only one of these sites was evaluated in detail due to the high conveyance losses associated with the other four. In evaluating this final site, it was determined that the limiting factor was, again, the quantity of excess water

available for storage and the time that the water was available. The benefit-cost ratio for this alternative was 0.03.

The on-Refuge alternatives evaluated were:

- Raise dikes in Little Salt Marsh
- Construct cross dikes in Little Salt Marsh
- Develop additional water storage units
- Line conveyance canals
- Remove sediment from Little Salt Marsh
- Construct bypass canal around Little Salt Marsh
- Recontour additional areas to develop moist soil units
- Fill borrow areas
- Supplement water supply with Arkansas River water
- Supplement water supply with groundwater wells

If the dikes surrounding the Little Salt Marsh were raised by two feet, the storage potential of the Marsh could be increased by 2,000 acre-feet. The additional storage in the Little Salt Marsh would extend the period of time water is available in wet years, but cannot provide multi-year carryover storage during droughts. A circular ring dike could also be constructed in the Little Salt marsh to increase storage without inundating the entire marsh area. Again, the additional storage would extend the supply during wet periods, but would not provide carry-over storage during droughts.

The raising of dikes or construction of new dikes to increase storage capacity on five management units on the Refuge was assessed. The resulting additional storage would not provide multi-year carryover storage during droughts.

Lining of approximately 13 miles of conveyance canals on the Refuge was evaluated. This option did increase the total amount of wetland habitat available 80 percent of the time by 21 percent, but conveyance losses are highly dependent on antecedent conditions. This may be an alternative that the Refuge will pursue in the future, if funding becomes available for additional study on seepage losses.

Removal of sediment from the Little Salt Marsh that has accumulated over the years would result in additional storage capacity in the Little Salt Marsh. However, the small increase in storage capacity was determined to have little affect on the Refuge's ability to supply water to other management units.

Construction of a bypass canal around the Little Salt Marsh to eliminate the deposition of sediment during flood events was evaluated. This alternative would not have eliminated all sediment deposition, but would have greatly reduced it since most sediment is deposited during large flood events. This alternative was not found to have substantial benefits in terms of increasing the water supply for the Refuge.

The recontouring of additional areas to develop moist soil units would not appreciably impact wetland habitat on the Refuge. It also does not enhance the ability of the Refuge to manage water.

There are eight existing management units in which large borrow areas exist, and this alternative evaluated the benefits of filling these borrow areas. Although this alternative was not found to have a substantial impact on the overall Refuge water supply, it was felt that the improvement in the ability to manage these units made it worthwhile to pursue. Currently, four units are being recontoured to remove the borrow areas. Less water per unit will then be needed to bring the units up to target management elevation. The other four units will be recontoured in the future.

The development of a supplemental water supply for the Refuge from the Arkansas River was evaluated. Although this alternative had the potential to greatly improve the water supply to the Refuge, the construction cost and operations and maintenance costs were extremely high. Another negative aspect of this alternative was that of water rights, and the ability of the Service to obtain rights to pump from the Arkansas River. This alternative only had a cost-benefit ratio of 0.09 to 0.28 depending on the diversion capacity that could be obtained.

The last alternative was providing a supplemental water supply to the Refuge from groundwater wells. This alternative was found by Burns and McDonnell to provide the most benefit to the Refuge at the least cost. However, this alternative also involves some problems with water rights, particularly in a basin that is closed to further development of groundwater. The Service is also concerned that drilling more wells should not be seen as a solution to the problem of overappropriation in the Rattlesnake Creek Subbasin. This option is, however, being pursued by the Rattlesnake Creek/Quivira Partnership. The augmentation plan has not yet been finalized or funded, nor has the question of how the

water rights needed will be obtained been fully answered. This option is included in the draft Management Plan for the Rattlesnake Creek Subbasin.

WATER MANAGEMENT PLAN

The OPONDS model developed by the U.S. Geological Survey (USGS WRI Report 97-4289) was utilized to evaluate water management on the Refuge. The USGS used actual streamflow data and evaporation data from 1991 (a very dry year) and 1996 (a wet year), and developed sample simulations. This data was calibrated to the extent possible to actual outflow data as measured at the Raymond gage, and the pool elevation data that were available.

In working with this model, it became evident that there are some problems and limitations. The first involves the elevation/area/capacity tables provided to USGS by the Service. The depth of Unit 11 derived from the table far exceeds what has been observed by Refuge staff. A new survey of this unit would provide better data. Additional survey work is also needed for Units 5W, Units 55 and 56, and the north part of Unit 75, for which there currently is no topographic data. Also, a resurvey of the units where borrow areas are filled in will have to be conducted in the future. An additional problem is that the model currently operates only to satisfy the linear-network optimization equations for the pools and canals, and does not incorporate the actual hydraulics of Refuge water control structures. We hope to gather additional data on the hydraulics in the future and incorporate them into the model. Finally, we need to gain a better understanding of the effect of changing the cost coefficients in the linear-network optimization equations on the model output. This will only come with additional experimentation and experience in using the model.

Given the above limitations, we believe the model output presented reasonably approximates Refuge water management under the climatic conditions of 1991 and 1996. We have data for 1997 and 1998 that we plan to input to the model in the future to simulate an average year.

The following table lists the Units included in the model. Areas are in square feet, and perimeters are in feet. Depth listed is maximum depth except for those units lacking an elevation/area/capacity table (-99.00).

In 1991, the Little Salt Marsh is less than 0.5 feet deep at the end of 365 days (Figure 4). The Big Salt Marsh holds 3 to 4 feet of water, as does Unit 78. Units 10A, 29, 28, 14A and 14B have between 1.5 and 3 feet of water, while Unit 10B has between 0.5 and 1 feet of water and Unit 7 has between 1 and 1.5 feet of

Shape	Area	Perimeter	Fullname
Polygon	222579.321	2530.306	Unit 83 (North lake)
Polygon	712478.216	4223.729	Unit 81
Polygon	374380.658	3154.684	Unit 80
Polygon	216745.588	3261.767	
Polygon	886742.936	9120.882	Unit 78
Polygon	160377.729	2031.048	Unit 40
Polygon	228247.947	2724.611	
Polygon	242402.054	2488.876	Unit 63
Polygon	112638.758	1739.199	Unit 62
Polygon	3823443.445	9524.691	Unit 75 (Great Salt Marsh)
Polygon	271165.244	3650.371	Unit 58
Polygon	379945.004	2970.875	Unit 61
Polygon	300479.652	2887.620	Unit 57
Polygon	298059.395	3267.681	Unit 49
Polygon	235622.235	3077.462	Unit 48
Polygon	268242.369	2358.790	Unit 26
Polygon	182242.609	1971.209	Unit 30
Polygon	414505.065	3618.204	Unit 25
Polygon	146398.425	1995.741	Unit 29
Polygon	38194.362	862.631	Unit 23
Polygon	45249.676	1159.517	Unit 22
Polygon	191516.204	1838.530	Unit 28
Polygon	165022.090	1719.187	Unit 24
Polygon	60396.264	1055.312	Unit 21
Polygon	222933.221	2194.468	Unit 20B
Polygon	260574.185	2047.976	Unit 20A
Polygon	51789.767	1122.102	Unit 16
Polygon	36772.420	1026.860	Unit 14C
Polygon	422002.232	2876.754	Unit 14A
Polygon	365349.145	2703.975	Unit 14B
Polygon	384365.968	3267.486	Unit 10B
Polygon	163616.248	1627.353	Unit 10C
Polygon	787576.374	5375.762	Unit 11
Polygon	85727.120	1206.801	Unit 10A
Polygon	5362474.876	10758.262	Unit 05 (Little Salt Mars
Polygon	181491.142	2315.013	Unit 7
Polygon	370885.493	3758.798	Unit05w (Little Salt Ma
Polygon	323941.951	2571.938	Unit 56
Polygon	151178.671	1955.302	Unit 55

Label	Name	Node	Depth	TimeStep
83	Unit 83	Unit83	2.08	184
81	Unit 81	Unit81	0.22	184
80	Unit 80	Unit80	1.20	184
			-99.00	-99
78	Unit 78	Unit78	4.71	184
40	Unit 40	Unit40	6.51	184
			-99.00	-99
63	Unit 63	Unit63	3.64	184
62	Unit 62	Unit62	7.64	184
75	Unit 75	Unit75	4.07	184
58	Unit 58	Unit58	4.68	184
61	Unit 61	Unit61	3.25	184
57	Unit 57	Unit57	3.41	184
49	Unit 49	Unit49	3.91	184
48	Unit 48	Unit48	3.94	184
26	Unit 26	Unit26	3.56	184
30	Unit 30	Unit30	3.56	184
25	Unit 25	Unit25	4.63	184
29	Unit 29	Unit29	4.51	184
23	Unit 23	Unit23	2.59	184
22	Unit 22	Unit22	2.85	184
28	Unit 28	Unit28	5.56	184
24	Unit 24	Unit24	5.33	184
21	Unit 21	Unit21	5.02	184
20B	Unit 20B	Unit20B	3.70	184
20A	Unit 20A	Unit20A	3.70	184
16	Unit 16	Unit16	6.36	184
14C	Unit 14C	Unit14C	1.04	184
14A	Unit 14A	Unit14A	5.67	184
14B	Unit 14B	Unit14B	5.28	184
10B	Unit 10B	Unit10B	4.79	184
10C	Unit 10C	Unit10C	2.79	184
11	Unit 11	Unit11	20.90	184
10A	Unit 10A	Unit10A	5.00	184
05	Unit 05	Unit05	3.10	184
7	Unit 07	Unit07	4.92	184
05W	Unit05w (Little Salt Marsh WE)		-99.00	-99
56	Unit 56	Unit56	-99.00	-99
55	Unit 55	Unit55	0.00	184

Rough	Width_ft	Area_ac	Area_ft	FullDep_ft	InitDep_ft
				0.00	1.00
				0.00	1.00
				0.00	1.00
				0.00	1.00
				0.00	1.00
1742.50	66.00	32.00	1736.00	0.00	1.00
				0.00	1.00
1741.20	339.00	154.00	1736.00	0.00	1.00
1744.00	120.00	47.00	1735.00	0.00	1.00
1740.80	2446.00	1768.00	1736.00	0.00	1.00
1742.00	251.00	99.00	1736.00	0.00	1.00
1745.50	498.00	218.00	1740.00	0.00	1.00
1743.50	212.00	127.00	1740.00	0.00	1.00
1754.20	159.00	95.00	1750.00	0.00	1.00
1754.40	113.00	89.00	1750.00	0.00	1.00
1762.00	111.00	59.00	1758.00	0.00	1.00
1759.00	119.00	78.00	1756.00	0.00	1.00
1768.40	296.00	94.00	1762.00	0.00	1.00
1762.00	91.00	61.00	1757.00	0.00	1.00
1764.30	15.00	9.00	1762.00	0.00	1.00
1766.00	13.00	10.00	1764.00	0.00	1.00
1768.00	153.00	85.00	1762.00	0.00	1.00
1769.40	35.00	31.00	1765.00	0.00	1.00
1770.00	81.00	30.00	1764.00	0.00	1.00
1770.70	195.00	138.00	1767.00	0.00	1.00
1770.70	195.00	138.00	1767.00	0.00	1.00
1775.00	80.00	31.00	1768.00	0.00	1.00
1777.00	16.00	7.00	1774.00	0.00	1.00
1778.00	196.00	87.00	1772.00	0.00	1.00
1776.70	96.00	65.00	1772.00	0.00	1.00
1779.00	145.00	64.00	1774.00	0.00	1.00
1774.40	13.00	11.00	1772.00	0.00	1.00
1774.90	338.00	90.00	1754.00	0.00	1.00
1779.00	145.00	64.00	1774.00	0.00	1.00
1783.00	1866.00	864.00	1780.00	0.00	1.00
1778.00	40.00	26.00	1774.00	0.00	1.00
				0.00	1.00
				0.00	1.00
				0.00	1.00

Name	Value
40B BM - 0.65'	2.00
(TOP OF GAGE)	2.00
(TOP OF STOPLOG SLOT)	3.00
(SPILLWAY)	1.00
58B BM - 0.5'	3.00
62B BM - 0.58'	2.00
57A BM - 0.6'	2.00
(SPILLWAY)	2.00
(SPILLWAY)	1.00
(SPILLWAY)	2.00
HIGH WATER	2.00
(TOP OF GAGE)	3.00
29C BM - 0.58'	1.00
(TOP OF GAGE)	2.00
22A BM - 0.6'	1.00
28A BM - 0.86'	2.00
(SPILLWAY)	1.00
(TOP OF STOPLOG SLOT)	3.00
(SPILLWAY)	1.00
(SPILLWAY)	1.00
(TOP OF STOPLOG SLOT)	3.00
14C BM - 0.67'	2.00
(SPILLWAY)	2.00
(SPILLWAY)	1.00
(Top of stoplog slot)	2.00
(TOP OF GAGE)	1.00
(Spillway)	4.00
(Top of Stoplog slot)	2.00
(SPILLWAY)	2.00
(Top of Stoplog slot)	2.00

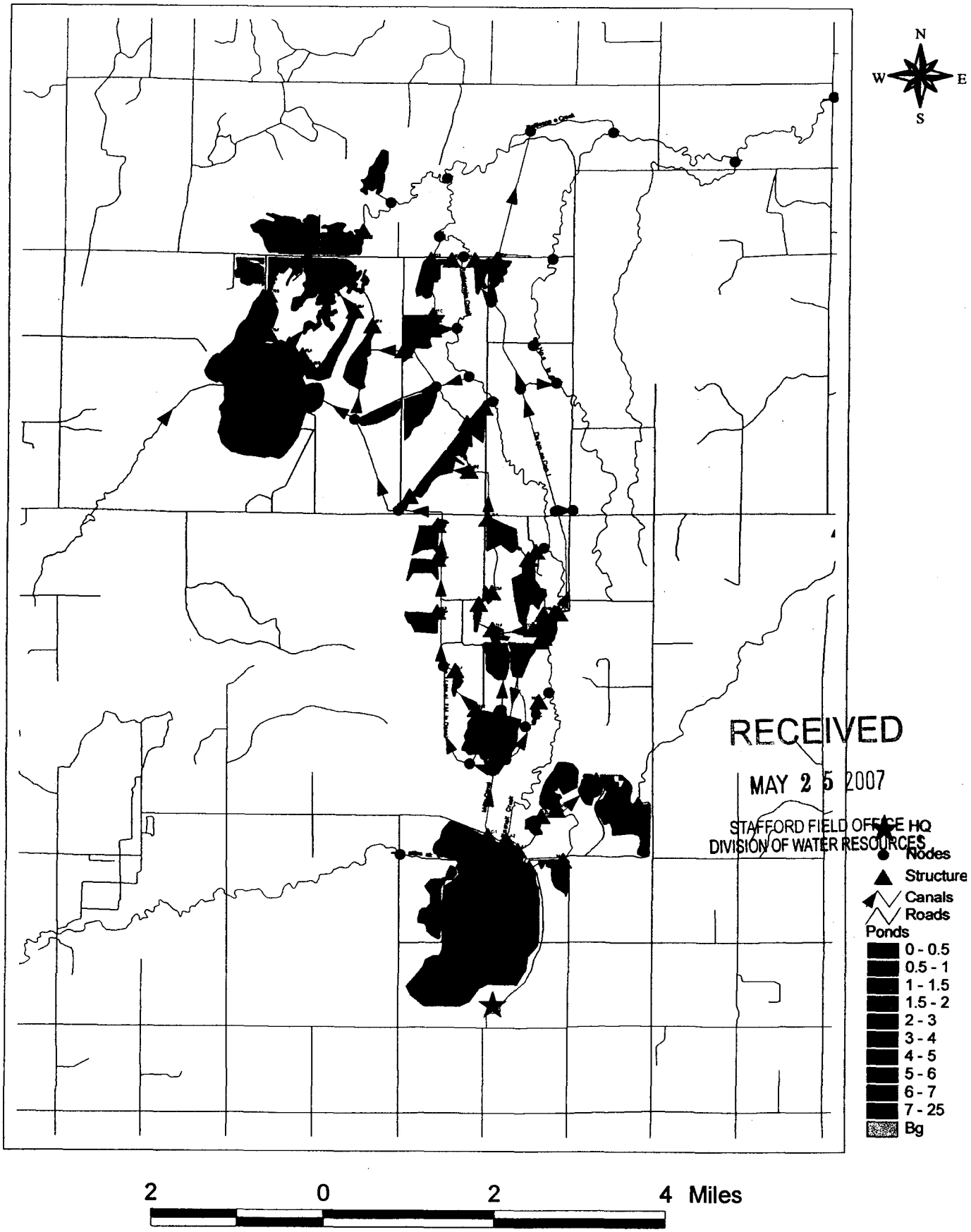


Figure 4. Quivira NWR Pond Levels. 1991 OPONDS Simulation, 365 days

water. Unit 11 appears to have over 7 feet of water, when it actually was much drier.

On August 1, 1991, the Little Salt Marsh held 2 to 3 feet of water and the big Salt Marsh held 3 to 4 feet of water (Figure 5). Most other units had between 2 and 5 feet of water. Most of this water was gone by the end of the November.

Following these labeled Figures are the modeled inflow and outflow, and the precipitation and evaporation used in the 1991 model run. Inflow rarely exceeded 10 cfs and was much less during the fall. A series of rainfall events in July produced one flow peak of about 42 cfs. Outflow was typically less than 4 cfs, but never quite reached zero because of the groundwater inflow on the North end of the Refuge which was responsible for keeping water in the Big Salt Marsh. Precipitation was low and evaporation was high.

In years like 1991, the Refuge would attempt to hold all units as high as possible, in anticipation of inadequate flows later in the summer and fall. Emphasis would be put on trying to keep some water in units 5, 7, 10A, 10B, 10C, 11, 14A and 14B. In 1991, the Refuge was not successful in keeping adequate water in Unit 5 (Little Salt Marsh), or in Units 10B and 10C. Many other units on the Refuge also were dry or nearly dry by the end of the year, and the Refuge had to depend on groundwater inflow to maintain the units on the north end of the Refuge.

In 1996, a wet year, adequate water was available to keep all pools at or above optimum management levels. At the end of the 365 day period, the Little Salt Marsh contained 3 to 4 feet of water (average depth), the Big Salt Marsh contained 4 to 5 feet of water, and most other units contained over 3 feet of water (Figure 6). The exceptions are Pools 80 and 81, which contained less than a foot of water and are managed primarily for shorebird habitat.

On August 1, 1996, the Little Marsh contained 3 to 4 feet of water (Figure 7), and the Big Salt marsh contained 4 to 5 feet of water. Most other units ranged in average depth from 3 to 7 feet. Again, Pool 80 had less than one foot of water.

Following the labeled Figures are the modeled inflow and outflow, and the precipitation and evaporation used in the 1996 model run. The time step used in this simulation was 2 days, so the time steps at the bottom of these graphs should be multiplied by a factor of 2. Inflow was relatively low (about 10 cfs) during the early spring, but increased to between 20 to 50 cfs in May and June. In early July, a peak flow of over 400 cfs occurred, with a second high flow of about 195 cfs occurring in August.

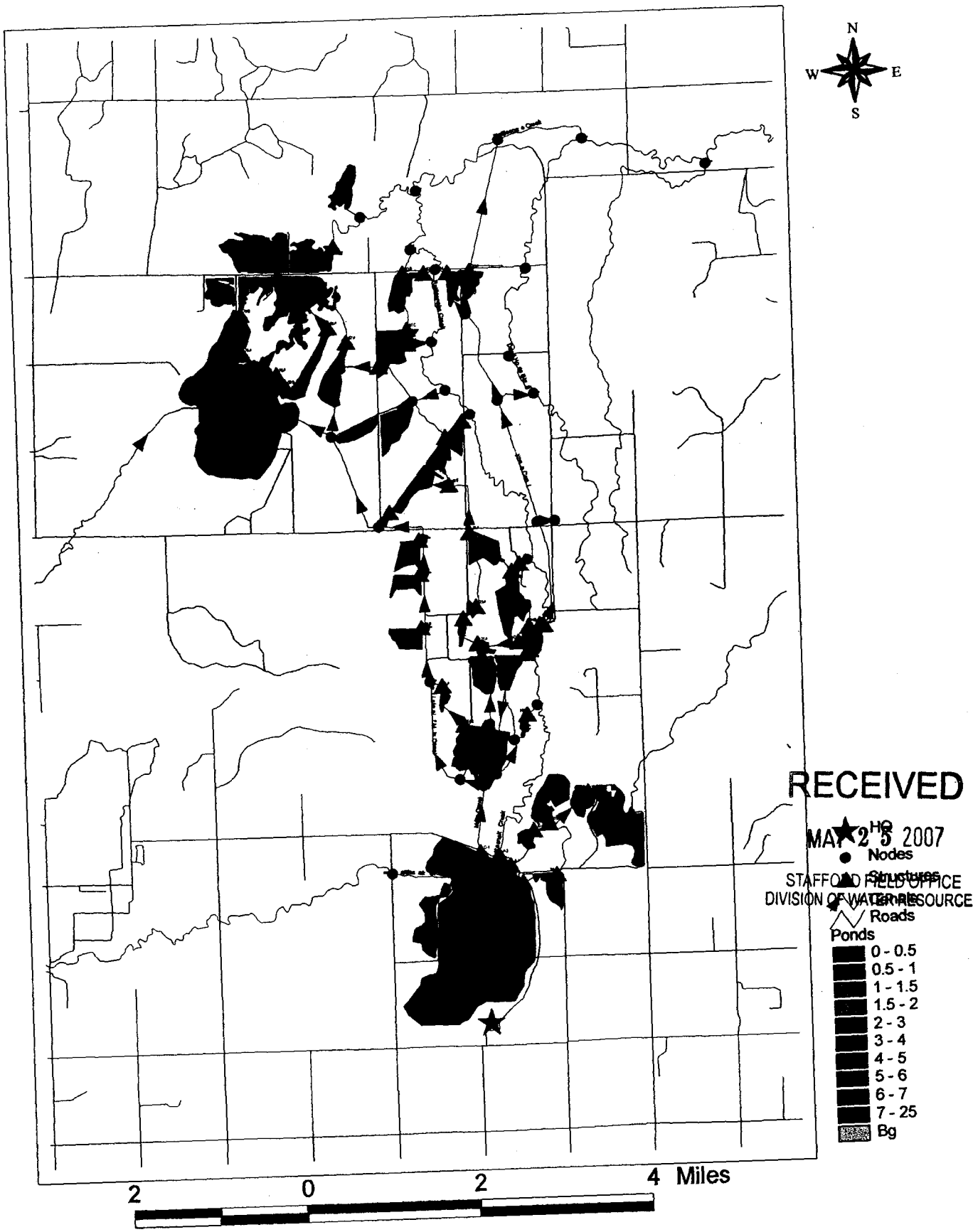
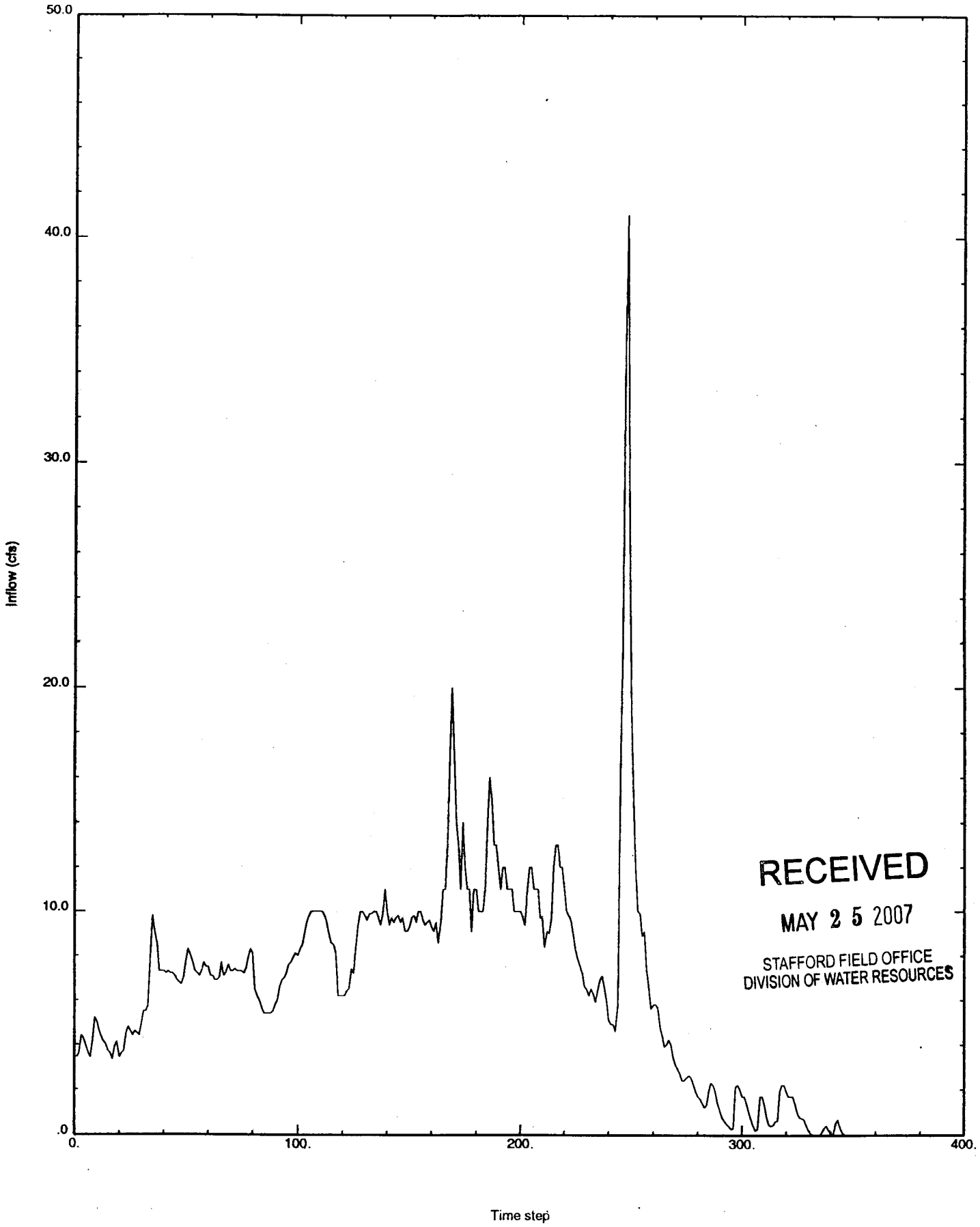
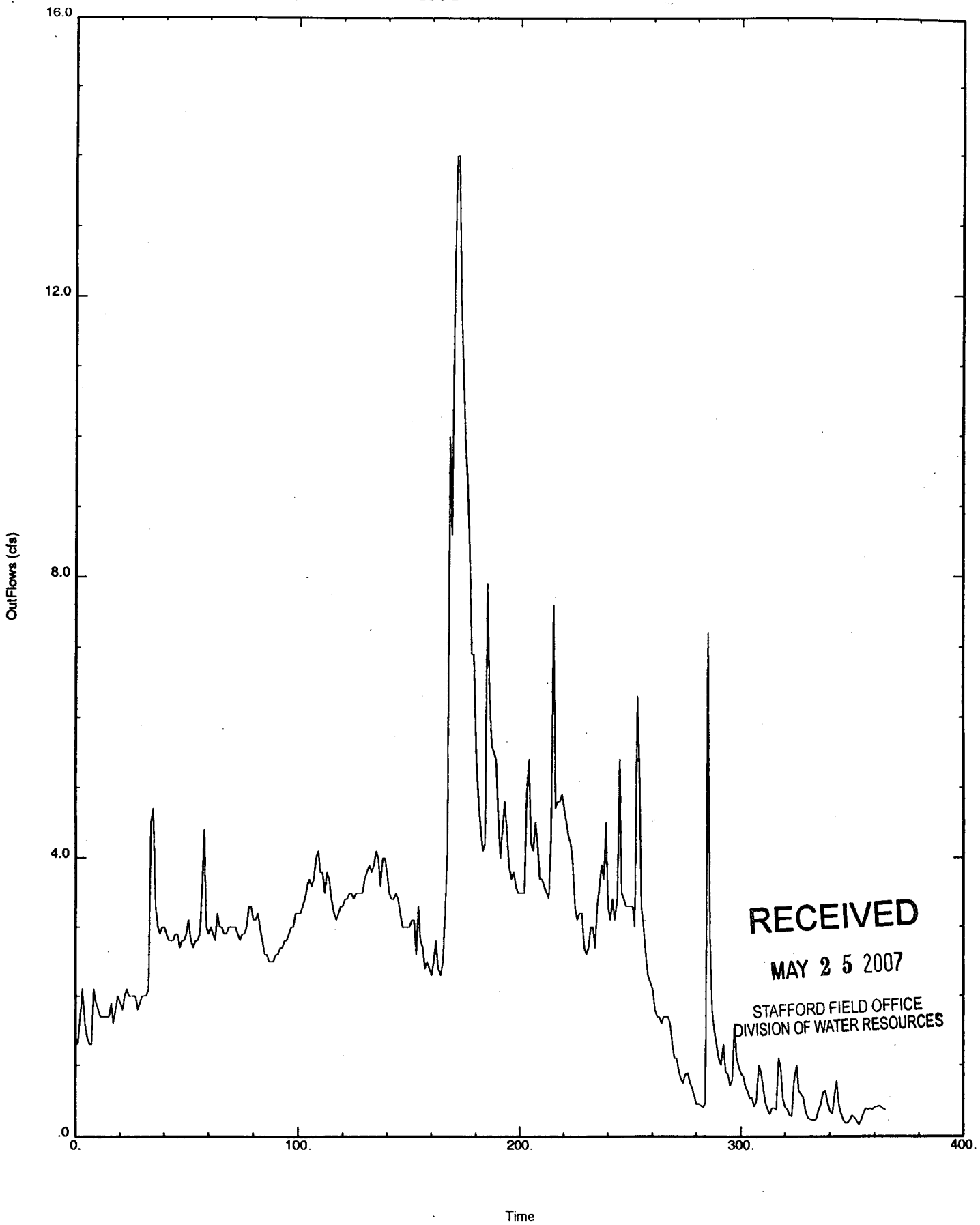


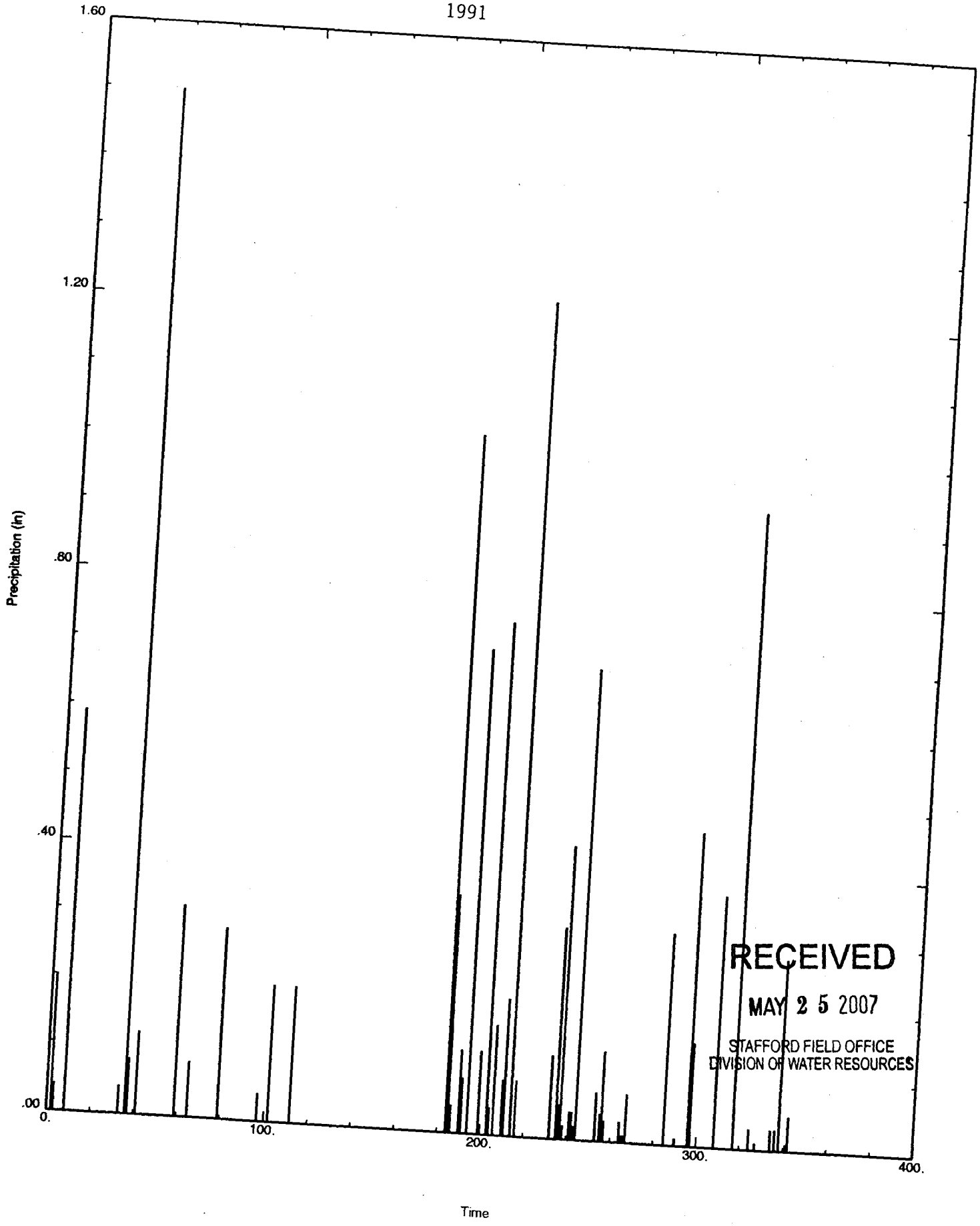
Figure 5. Quivira NWR Pond Levels. 1991 OPONDS Simulation, 212 days



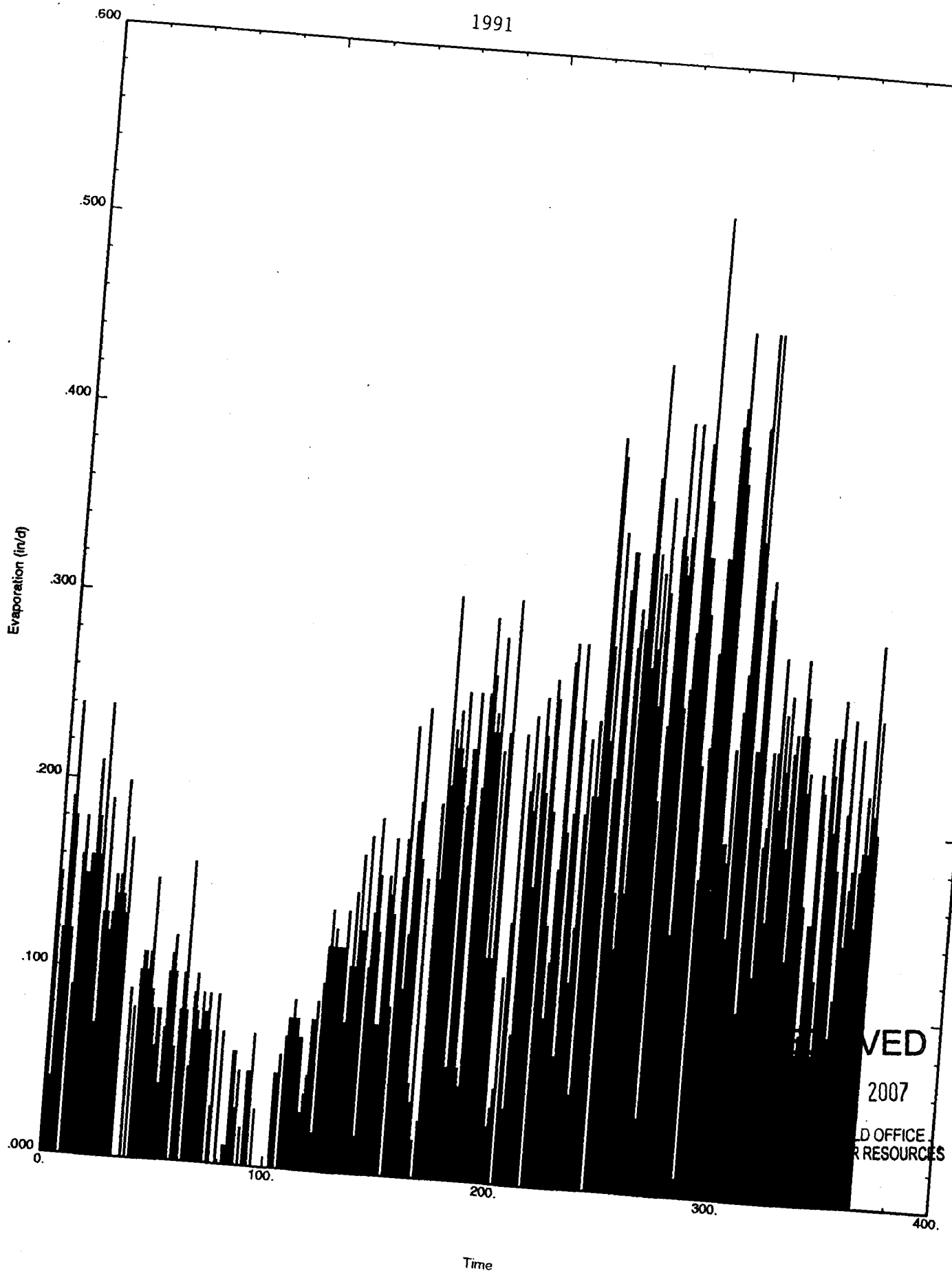
1991



1991



1991



outflow, and the precipitation and evaporation used in the 1991 model run. Inflow rarely exceeded 10 cfs and was much less during the fall. A series of rainfall events in July produced one flow peak of about 42 cfs. Outflow was typically less than 4 cfs, but never quite reached zero because of the groundwater inflow on the North end of the Refuge which was responsible for keeping water in the Big Salt Marsh. Precipitation was low and evaporation was high.

In years like 1991, the Refuge would attempt to hold all units as high as possible, in anticipation of inadequate flows later in the summer and fall. Emphasis would be put on trying to keep some water in units 5, 7, 10A, 10B, 10C, 11, 14A and 14B. In 1991, the Refuge was not successful in keeping adequate water in Unit 5 (Little Salt Marsh), or in Units 10B and 10C. Many other units on the Refuge also were dry or nearly dry by the end of the year, and the Refuge had to depend on groundwater inflow to maintain the units on the north end of the Refuge.

In 1996, a wet year, adequate water was available for to keep all pools at or above optimum management levels. At the end of the 365 day period, the Little Salt Marsh contained 3 to 4 feet of water (average depth), the Big Salt Marsh contained 4 to 5 feet of water, and most other units contained over 3 feet of water (Figure 6). The exceptions are Pools 80 and 81, which contained less than a foot of water and are managed primarily for shorebird habitat.

On August 1, 1996, the Little Marsh contained 3 to 4 feet of water (Figure 7), and the Big Salt marsh contained 4 to 5 feet of water. Most other units ranged in average depth from 3 to 7 feet. Again, Pool 80 had less than one foot of water.

Following the labeled Figures are the modeled inflow and outflow, and the precipitation and evaporation used in the 1996 model run. The time step used in this simulation was 2 days, so the time steps at the bottom of these graphs should be multiplied by a factor of 2. Inflow was relatively low (about 10 cfs) during the early spring, but increased to between 20 to 50 cfs in May and June. In early July, a peak flow of over 400 cfs occurred, with a second high flow of about 195 cfs occurring in August. Rainfall was abundant throughout the spring and summer, resulting in high pool levels in the Refuge. Many units were one to two feet higher than the preferred management elevations during the summer. During years like 1996, management is hampered by excess water, and peak flows must be released when pools are full. This is reflected in the relatively high outflows shown by the model. Evaporation was higher in the spring, but lower in the late summer in fall in 1996 as compared to 1991.

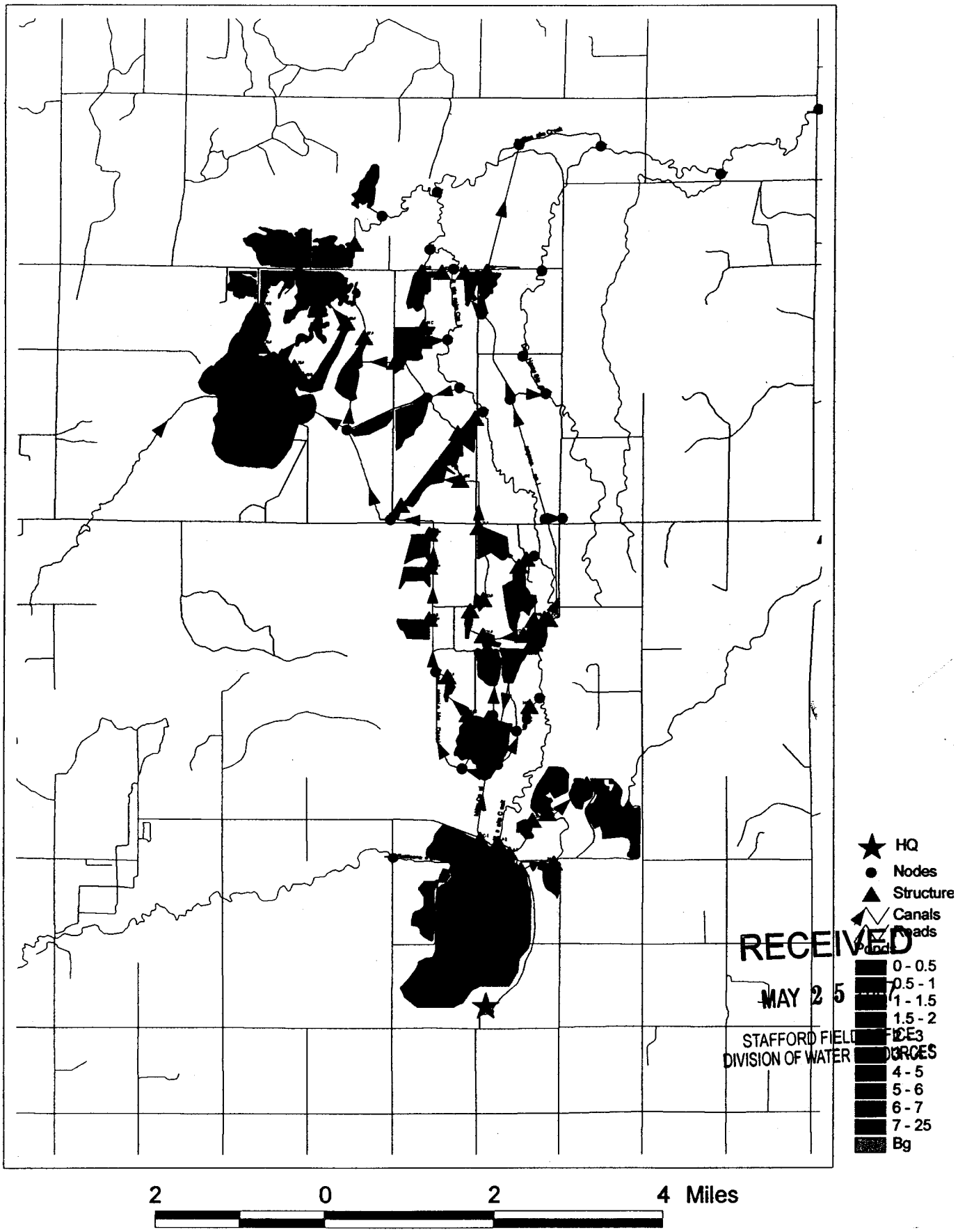


Figure 6. Quivira NWR Pond Levels. 1996 OPONDS Simulation. 365 days.

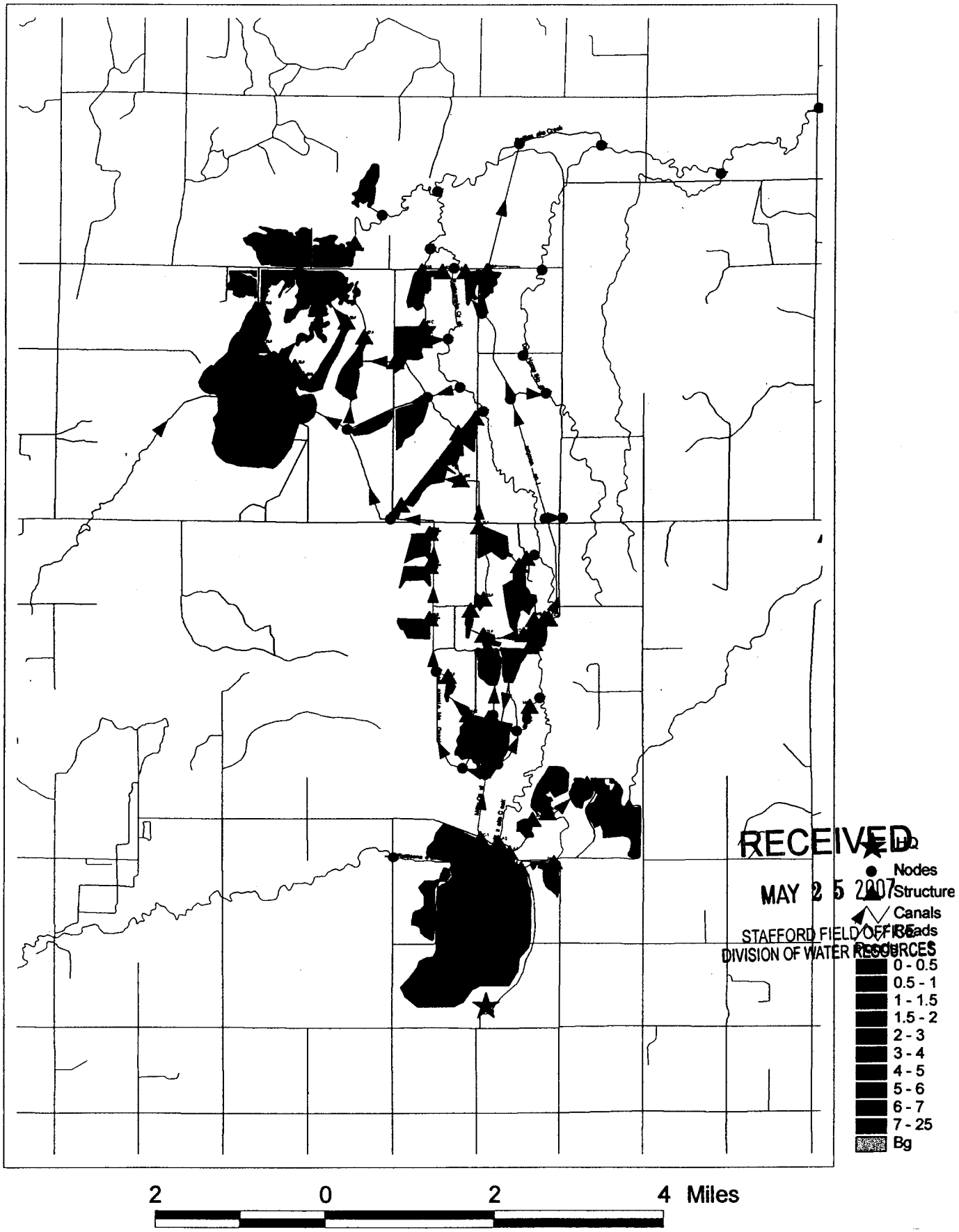
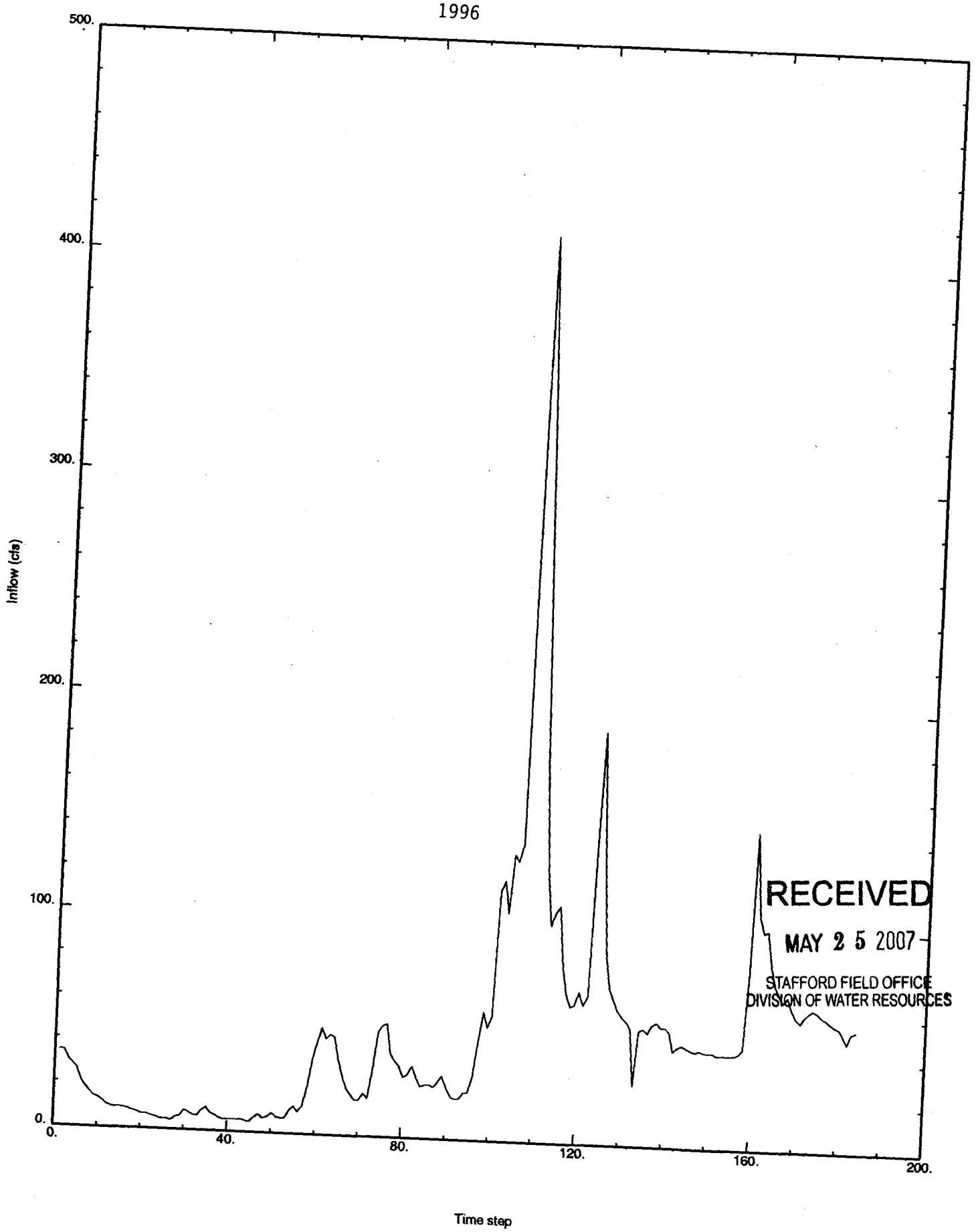
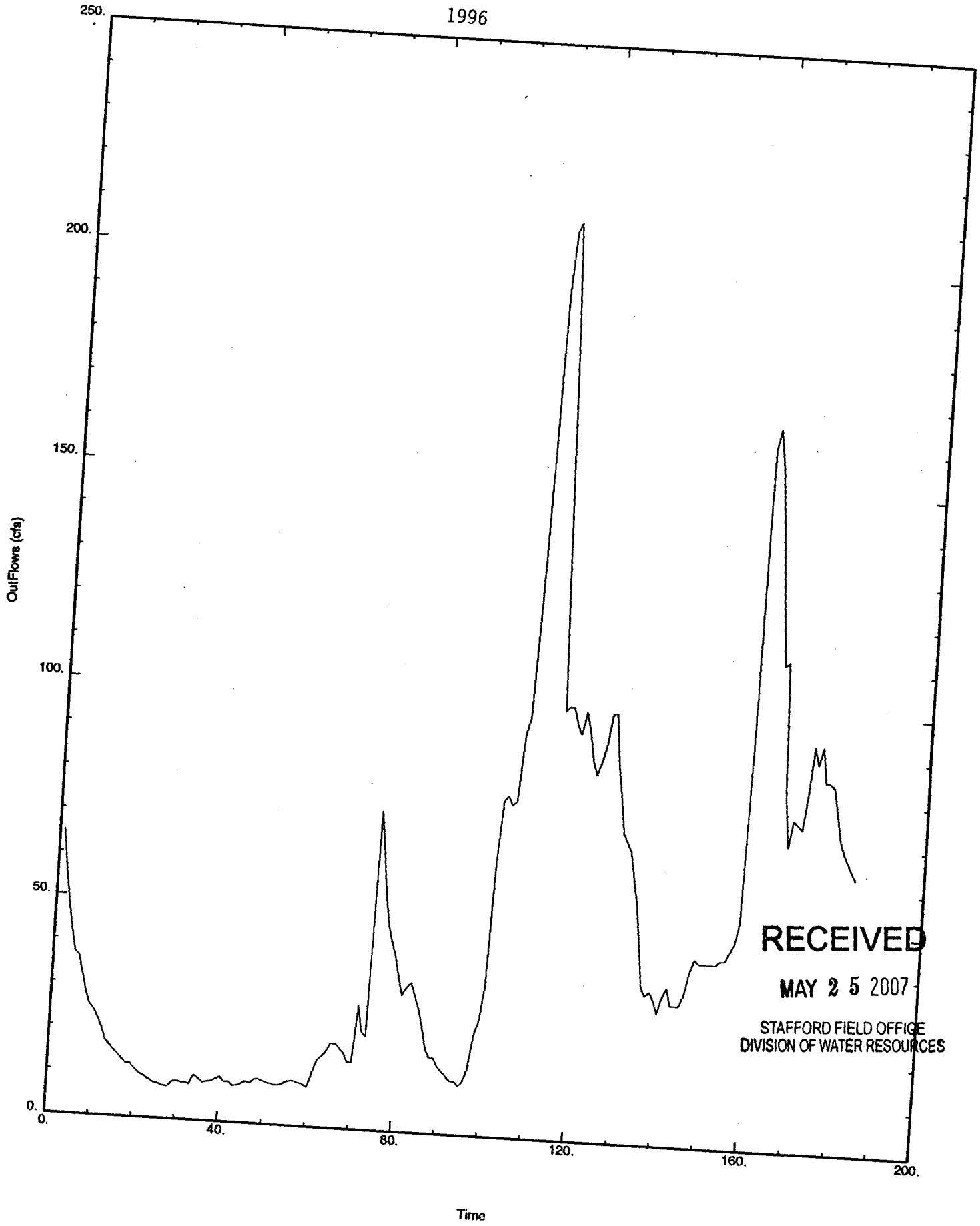


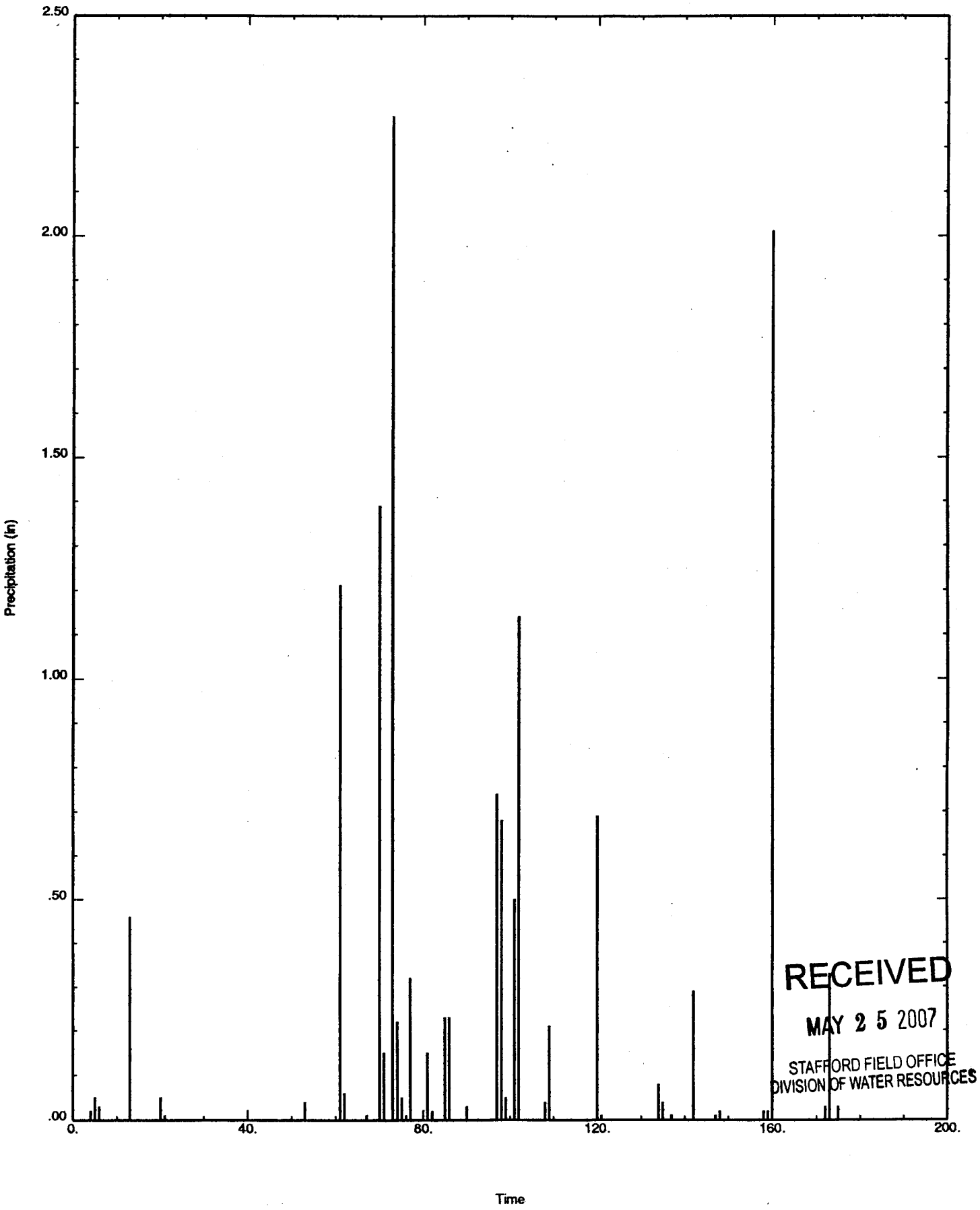
Figure 7. Quivira NWR Pond Levels. 1996 OPONDS Simulation, 212 days

1996

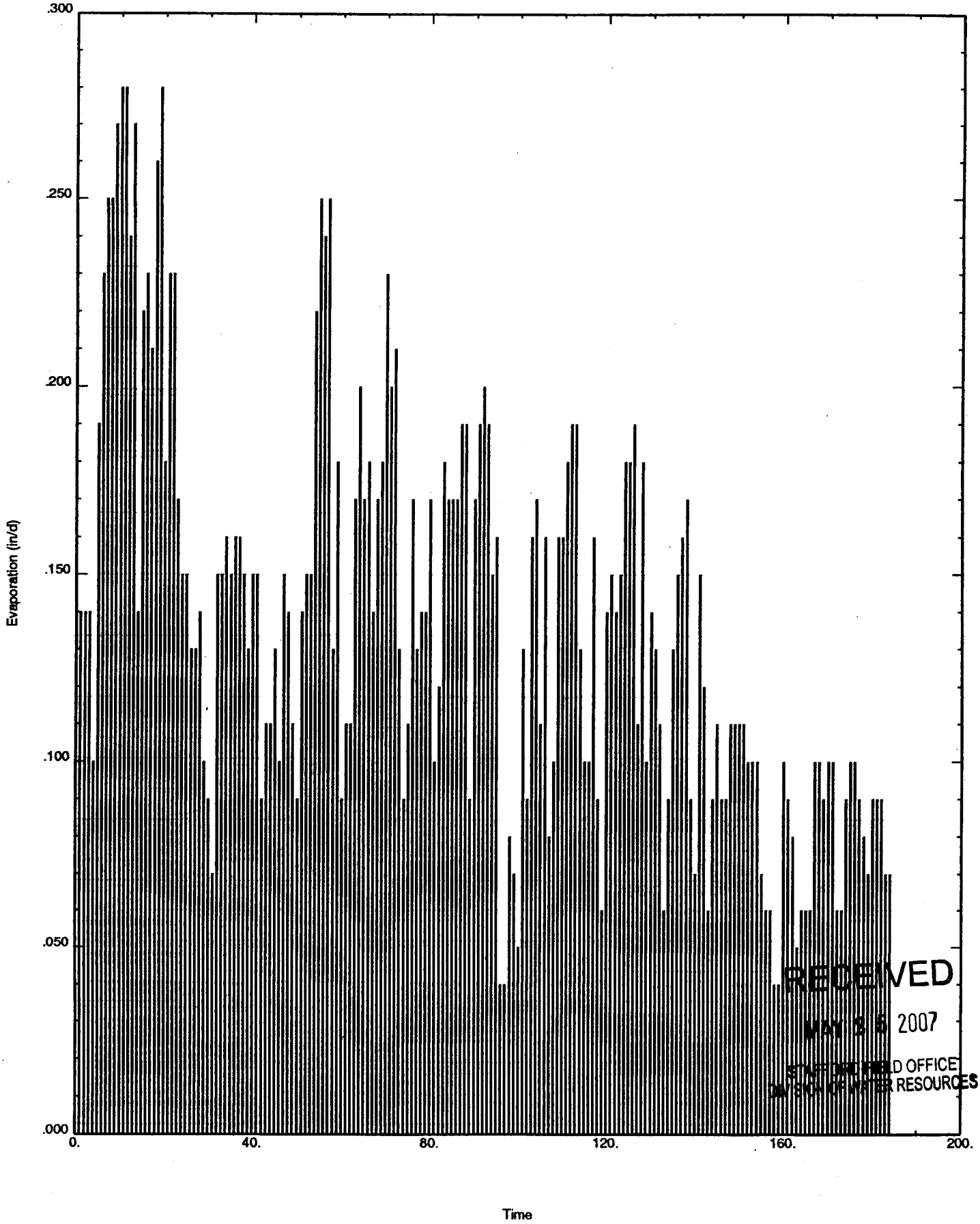




1996



1996



Rainfall was abundant throughout the spring and summer, resulting in high pool levels in the Refuge. Many units were one to two feet higher than the preferred management elevations during the summer. During years like 1996, management is hampered by the excess water, and peak flows must be released when pools are full. This is reflected in the relatively high outflows shown by the model. Evaporation was higher in the spring, but lower in the late summer in fall in 1996 as compared to 1991.

In an average year, the Refuge would hold spring flows, storing as much as practical in the Little Salt Marsh, units 14A and B, units 20A and 20B, Unit 29, Unit 48, and Unit 61. Stored water in these units could be released later to adjacent units if insufficient streamflow is available in late summer and fall. The optimum mix of desired habitat for each unit is shown in Table 2. If insufficient water is available, an effort would be made to maintain the Little Salt Marsh, Unit 7, Unit 10A, Unit 10B, Unit 10C, Unit 11, and Units 14A and B. Total acre feet of water needed to maintain these units from August through September has been determined to be about 2,000 acre-feet.

Send email to Dave Fair and recommend what he can tell Stop Jonathan about this report.

TABLE 2
FULL (Wet Year)

UNIT NO.	HABITAT	TYPE	VOL	ACRES
5	Wet Meadow SP Marsh	20% 80%		172.8 691.2
7	Wet Meadow SP Marsh	10% 90%		5.5 49.5
10 A/B	SP Marsh	100%	221	88
10C	SP Marsh	100%	13	11
11E	SP Marsh	100%	388	50
11W	SP Marsh	100%	112	57
14A	Wet Meadow SP Marsh	10% 90%		8.7 78.3
14B	Wet Meadow SP Marsh	10% 90%		6.5 58.5
14C	SP Marsh	100%		8
16	Wet Meadow SP Marsh	15% 85%		5.1 28.9
20 A/B	Wet Meadow SP Marsh	10% 90%		13.9 125.1
21	Wet Meadow SP Marsh	10% 90%		3 27
22	SP Marsh	100%		12
23	SP Marsh	100%		9
24	SP Marsh	100%		30
25	SP Marsh	100%		94
26	SP Marsh Wet Meadow	95% 5%		56.05 2.95
28	SP Marsh	100%		110
29	SP Marsh	100%		76
30	SP Marsh	100%		78
40	Wet Meadow SP Marsh	5% 95%		1.9 [illegible]
48	SEMP Marsh Wet Meadow	90% 10%		80.1 8.5
49	Wet Meadow SEMP Marsh	10% 90%		9.5 85.5

57	SEMP Wetland	100%		188
58	SEMP Marsh	100%		98
61	Wet Meadow SP Marsh	10% 90%		21.5 193.5
62	Wet Meadow SP Marsh	10% 90%		2.7 24.3
63	Wet Meadow SP Marsh	10% 90%		15.4 138.6
BIG SALT 75 MARSH 78	Mudflat Wet Meadow SP Marsh Temp Marsh	30% 20% 40% 10%	(within Wildlife Dr)	904.4 602.9 1205.9 301.5
80	Mudflat	100%		231
81	Mudflat	100%		208
83	Wet Meadow SP Marsh	10% 90%		15.6 140.4

NOTE: Mudflat goes North of Road, too.

	Mudflat	Wet Meadow	Semi Perm Marsh	Temp Marsh
Acres	1,343.4	896.85	3,927.85	301.5
Percent	20.8	13.8	60.7	4.7
	Area NW of 48 & 49		All Wet Meadow - Need Area	

11/13/96
w:/linda/ks/quivira.cht

U.S. FISH & WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

FEB 22 2000

CERTIFIED Z110 878 399

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 1999 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe

Linda Coe
Water Rights Technician

Enclosure

980003

1999 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 2000.** Please begin by reading the instructions fo Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-3495. Please mak a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
109 S.W. 9th, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
~~43589-00~~	~~5279N 1700W 31-19-13E~~	~~1~~									
	~~aka: COMMINGLE APP~~										
~~43589-00~~	~~3500N 1450W 36-20-14E~~	~~1~~									
	~~aka: COMMINGLE APP~~										
7571-00	3100N 1150W 35-21-11W (RCA)	1	A	1350.7	ACRE FEET SURFACE WATER DIVERTED						
7571-00	4450N 1000W 13-22-11W (DARRYNANE)	1	A	1316.9	ACRE FEET SURFACE WATER DIVERTED						
7571-00	1250N 3850W 25-22-11W (LITTLE SALT MARSH)	1	A	1991.5	ACRE FEET SURFACE WATER DIVERTED						
	TOTAL			4659.1	ACRE FEET SURFACE WATER DIVERTED						

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1999					July 1, 1999					November 1, 1999				
Empty	¼	½	(¾)	Full	Empty	¼	(½)	¾	Full	Empty	¼	½	(¾)	Full

980002

99 18302 1 7 - REC Staff SF

Date: 2/1/00 Telephone: (816) 486-2393

WATER RESOURCES RECEIVED
FEB 24 2000
KS DEPT OF AGRICULTURE

Office Use FO CO GMD

Dave Hilley, Refuge Manager
Name (Printed or Typed)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

Dave Hilley
Name (Signature)

___ Owner ___ Tenant XX Agent

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Jamie Clover Adams, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

December 27, 1999

Megan A. Estep-Johnston
Refuge Hydrologist
Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver, Colorado 80225-0486

Re: Water Right, File No. ~~7,751~~ 7571

Dear Ms. Estep-Johnston:

This office has received your recent letter dated December 15, 1999 requesting additional time to complete the required water conservation plan for Quivira National Wildlife Refuge. By telephone today you indicated that the plan is almost complete and that an additional 90 days will almost certainly allow enough time to finish the project.

Based on our conversation and the reasons provided in your letter, the request for additional time to complete the conservation plan is hereby granted until April 1, 2000.

Please feel free to call or write if you have any questions or if we can be of further service.

Sincerely,

M Bruce Falk

M. Bruce Falk
Water Commissioner

cc: Microfilm
File

U.S. FISH & WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

U.S. Department of the Interior
1849•1999

Mr. Bruce Falk
Kansas Department of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

DEC 15 1999

Dear Mr. Falk:

The U.S. Fish and Wildlife Service requests an extension in time to complete the required Water Conservation Plan. The Service is currently utilizing model developed by the U.S. Geological Survey to help quantify the volume of water needed to meet Refuge objectives under different environmental conditions. In order to utilize the model with new data, some additional training time is necessary. The Service would like an additional 90 days (until March 31, 2000) to complete the water conservation plan.

Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

WATER RESOURCES RECEIVED
DEC 28 1999
KS DEPT OF AGRICULTURE

cc: Refuge Manager, Quivira NWR

MICROFILMED

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Mary Jane Stattelman, Acting Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

June 14, 1999

Megan A. Estep-Johnston
Refuge Hydrologist
Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver, Colorado 80225-0486

RE: Water Right, File No. 7,571

Dear Ms. Estep-Johnston:

This office has received your recent letter dated April 12, 1999. The letter is requesting additional time to have measuring flumes designed by the Bureau of Reclamation. It is our understanding that special design is needed because of the lack of hydraulic gradient and the special operating needs of the refuge. Other metering methods previously investigated have proven unsatisfactory.

For the above reasons your request for additional time is hereby granted as listed below:

Time allowed to submit new plans for metering water diverted under authority of Water Right, File No. 7,571: **August 1, 1999**

Time allowed for completing the actual meter installations: **July 31, 2000**

Time allowed to submit the water conservation plan: **January 1, 2000**

Once again, thank you for keeping this office informed as each metering strategy has been investigated. Please feel free to call or write if you have any questions.

Sincerely,

M Bruce Falk

M. Bruce Falk
Water Commissioner

MBF/mbf

cc: Jim Bagley (microfilm)
Lloyd Stullken
File

U.S. FISH & WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

U.S. Department of the Interior 1849•1999

BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Clorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

APR 12 1999

Dear Mr. Falk:

The Service has contracted with the Bureau of Reclamation for design of measuring flumes for our points of diversion at the Quivira National Wildlife Refuge. A copy of the contractual document and the BOR proposal are enclosed. As you can see, the BOR has requested a period of performance until June 30, 1999. We will submit the designs to you office as soon as we receive them from the BOR.

Following receipt of the design, we will have to determine whether we can construct these devices using Refuge staff or whether we will have to contract the work out. If the work has to be contracted out, it may take up to six months to complete the contracting process. Actual construction may be affected by weather conditions as we will have to dewater the canals in order to pour concrete.

We request an extension on the submittal of plans for metering until July 16, 1999, and an extension on the time for meter installation until July 31, 2000.

We also request an extension on the time for completion of our water conservation plan until January 1, 2000. We would like to wait until the Water Management Plan for the Rattlesnake Creek Subbasin is completed and implemented. This will enable us to better estimate our water supply and determine what our water management options will be.

The BOR will be traveling with me to the Refuge on May 5, 1999, to investigate the measurement sites. You are welcome to accompany us. Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosures

cc: Refuge Manager, Quivira NWR

RECEIVED
APR 15 1999
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

OMB Approval 2700-0042

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
ONE (1)	04/06/99		

6. ISSUED BY CODE
U.S. Fish and Wildlife Service, CGS, Mail Stop 60181
P.O. Box 25486, DFC
Denver, CO 80225-0486

7. ADMINISTERED BY *(If other than Item 6)* CODE
Attention: Howard J. Cole
(303) 236-5412 ext. 225

8. NAME AND ADDRESS OF CONTRACTOR *(No. Street, county, State and ZIP: Code)*
U.S. BUREAU OF RECLAMATION
ATTN: BETTY DINNEEN MS D-8010
TECHNICAL SERVICE CENTER
DENVER FEDERAL CENTER, BLDG 67
DENVER, CO 80225

CODE FACILITY CODE

(✓)	
	9A. AMENDMENT OF SOLICITATION NO.
	9B. DATED *(SEE ITEM 11)*
X	10A. MODIFICATION OF CONTRACT/ORDER NO. 1448-60181-99-N135
	10B. DATED *(SEE ITEM 13)* 01/27/99

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a) By completing Items 8 and 15, and returning one (1) copy of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATA SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and data specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*
DCN: 60181-9-N135 60189-2810-E6QR (FY-99) = $38,500.00

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(✓)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
X	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER Specify type of modification and authority)

E. IMPORTANT: Contractor x is not, is required to sign this document and return - copies to the issuing office.

Project Title: Evaluation of measurement devices for diversion structures at Quivira NWR.

A. The funding has been increased by $38,500.00 from $5,000.00 to $43,500.00.

B. The performance period is extended to July 30, 1999.

C. BOR will complete hydraulic and structural design with construction drawings for flumes for measuring water at the following diversion structures at Quivira NWR: A-1, A-2, C-1, & DCA. Also complete limited earthwork and concrete specifications, and develop water level device and data logger specifications. Funds are included for one trip to the Refuge.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)* Howard J. Cole Contracting Officer FWS-6-9-098	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		BY *(Signature of Contracting Officer)*	

8. FWS PROJECT OFFICER	9. AGENCY PROJECT OFFICER
Megan Estep-Johnston Refuge Hydrologist P.O. Box 25486, DFC Denver, Colorado 80225 (303)236-5322 X232	Steve Robertson U.S. Bureau of Reclamation ~~Western~~ Technical Service Center 8140 ~~Water Conveyance Group,~~ MS-D~~8010~~ Denver Federal Center, Bldg. 67 Denver, CO 80225 (303)445-3123

10. PERIOD OF PERFORMANCE

The analysis and cost estimates shall be transmitted to the Service by March 31, 1999.

11. ESTIMATED COST

The estimated cost to perform this work is $5,000.

12. METHOD OF PAYMENT AND BILLING INSTRUCTIONS

OPAC FWS ALC= 14-16-0006

13. OTHER ORGANIZATION'S ACCOUNTING DATA:

14. AUTHORITY

Economy Act of 1932 (42 STAT. 417)

15. APPROVALS: NAME AND TITLE OF AUTHORIZING OFFICIAL FOR FWS **Howard J. Cole** **Contracting Officer** Phone Number: (303) 236-5412 X225	SIGNATURE: Howard J. Cole	DATE: 1/19/99
NAME AND TITLE OF AUTHORIZING OFFICIAL FOR OTHER AGENCY ALBERT K. BOURLAND, ACTING DIRECTOR TECHNICAL SERVICE CENTER	SIGNATURE: Albert K Bourland	DATE: 1-27-99

WTR

U.S. DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE 2/5/99 KEB ENTERED	1. FWS NO: 1 -60181-99-N135 OTHER ORG NO: 2. DCN NO: 60181-9-N135 AMOUNT: $5,000 APPROPRIATION #: 60189-2810-E6QR(fy-99)
3. NAME AND ADDRESS OF FWS ORGANIZATION U.S. Fish and Wildlife Service CGS-Mail Stop 60181 P.O. Box 25486, DFC Denver, Colorado 80225	4. NAME AND ADDRESS OF OTHER ORGANIZATION U.S. Bureau of Reclamation Technical ~~Western~~ Service Center ~~Water Conveyance Group~~ Denver Federal Center, Bldg. 67 Denver, CO 80225 Attn: Betty Dinneen MS D-8010

5. PROJECT TITLE: Evaluation of measurement devices for diversion structures at Quivira National Wildlife Refuge.

6. SCOPE OF WORK

The BOR will evaluate options for flow measurement devices for diversion structures at the Quivira National Wildlife Refuge. Information of the size of these structures, as well as photographs of the structures shall be provided to the BOR by the Service. The BOR will evaluate whether long-throated , or ramp, flumes can be used in water measurement at the Refuge. The BOR will develop an estimate of the amount of time and the cost involved in installing measurement structures.

7. SPECIAL PROVISIONS

A. Modifications: This Agreement may be modified at any time during the period of performance by either party. Modifications shall be in writing using a SF-30 and signed by the Contracting Officer for the Service and an authorized representative for the other Agency.

B. Terminations: This Agreement may be terminated by giving written notice of the termination to the other party, not less than thirty (30) days in advance of the effective date of the termination.

C. Renewals: This Agreement may be renewed yearly, for a period not to exceed an additional four (4) years, if agreeable to both parties. Renewals shall be issued on a SF-30, and shall cite the appropriation data from which monies will be obligated. Renewals are contingent upon Congressional appropriations being made available for future work; and it is hereby agreed that failure of Congress to make such appropriations available shall relieve the parties from any liabilities and future commitment under this Agreement.

FLOW MEASUREMENT DESIGN SERVICES

Option	Service Description	Cost
1	Complete hydraulic and structural design with construction drawings. Limited earthwork and concrete specifications. Water level devise and data logger specifications.	$33,500
2	Hydraulic and structural design and construction drawings. No specifications included.	$24,500
3	Hydraulic analysis and structure sizing sketch	$14,000

The design time associated with Options 2 and 3 will be 3 and 5 weeks less, respectively, than outlined in this letter for Option 1.

A significant amount of effort is expected to be devoted in determining the acceptable upstream and downstream channel water surface elevations: Options 1 and 2 allows about $10,000 and Option 3 allows about $6,000 budget for this. Through the combined effort of the service and Reclamation these elevations maybe determined at a lesser cost. The cost shown in the table is a most probable maximum cost and you will be billed only for the effort expanded.

Contact me with preferred option or to discuss this offer.

Sincerely,

Steven J Robertson

Steven J. Robertson, P.E.
Technical Specialist
Water Conveyance Group
Technical Service Center

A standard measurement device is one that has been fully described, accurately calibrated, correctly made or installed, and sufficiently maintained to fulfill the original requirements. Standard discharge equations and tables or curves may then be relied upon to provide accurate water measurement.

Most water measurement devices require a drop in head. On existing projects, such additional head may not be available. Sharp crested weirs may have a maximum downstream water surface level no higher that 0.2 feet below crest elevation. Broad-crested weirs or long throated flumes are not affected by downstream submergence of up to 80 percent. Flume head loss is less than about one-fourth of that needed to operate a sharp-crested weir having the same control width. Velocity of flow in flumes can usually be designed to minimize sediment deposition within the structure. Gradual convergence sections at the entrance tend to improve the passage of floating debris.

Flumes can be more expensive than sharp-crested weirs or submerged orifices in unlined channels. This is because a gradual convergence section at the entrance is necessary to improve the velocity distribution of the approach flow.

Planned Construction: The Service is planning to perform the construction of the flow measurement flumes with their own forces. Reclamation's designs and specification paragraphs will not be to the detail customary for contractor bid projects. Location and general map drawings are not required. A construction cost estimate is not needed when the construction is performed by Service forces.

Additional Design Data Requirements: Additional information to be provided by the Service to facilitate the final design efforts are:

1. The flow measurement range desired at each of the sites.

2. Any specific structure type, flow measurement accuracy, recording requirements, etc. from the state.

3. The water level in each channel at the structure is a critically important piece of information, as is the creek water surface elevation. The channel water levels greatly influence the sill height necessary to keep the downstream water surface below the submerged limit, thus obtaining modular flow for the needed discharge range. It is our understanding that this information had not been historically collected and recorded on a regular basis. To date, the flow rate has been estimated using a Clausen Rule at weir-type structures and the creek level had not been noted. Available records of flow rate and water levels at structures Little Salt Marsh, pond 10A, pond 24A (Darrynae Lake), and RCA will be reviewed. Reclamation and Service personnel will join in a combined effort to agree on the water levels to be used for design of these features.

   The refuge personnel should start taking downstream water depth measurements periodically in association with the normal flow measurements. This information will be used to verify the channel roughness used during the hydraulic design phase. If this

2. A short description of the water diversion sites. Additional structure dimension measurements and design drawings along with photographs and slides were delivered to Reclamation on February 4, 1999. The elevations on the design drawings are about 10.5 feet higher than that shown on the strip topography map provided. The elevations associated with the 1994 channel survey is to be used as the reference.

The Bureau of Reclamation (Reclamation) was requested to determine whether long-throated flumes are an option for installation to measure water quantities diverted to the refuge and to develop an estimate of the amount of time and the cost to design the features.

An initial Interagency Agreement (FWS No. 1448-60181-99-N135) was enacted to facilitate the contractual requirements for Reclamation to develop a design cost assessment and a schedule for the design of flow measurement flumes at the four sites.

Water Measurement Basics: Selecting the proper water measurement device for a particular site or situation can be made only after site-specific factors and variables are considered and weighed. Irrigation system operators commonly use weirs, flumes, submerged orifices and current meters as standard water measurement devices. A variety of other devices for open channels and closed conduits are available. Discussions of flow measuring devices can be found in several reference literature [1] [2]. The discussion here will not pertain to submerged orifices nor current meters. Submerged orifices require larger head loss than weirs or flumes and are susceptible to fouling with debris carried in the water. Current meters normally do not provide a continuous flow reading.

The desired accuracy of the measurement system is an important consideration in the selection of the device. Most water measurement devices can produce overall accuracies of ±5 percent under field conditions. Accuracy of an overall device is the combined primary measurement for a weir which is the mathematical relationship between head and discharge and the secondary measurement which is the physical measurement of the head.

Canal systems often carry a significant amount of sediment and debris in the water. Whether this causes a problem depends on the specific structure and the volume of sediment and debris in the water. Any measurement device with metallic parts and electronic sensors is subject to failure if it is not compatible with the site environment. Mineral encrustation and biological growths can accumulate on metallic surfaces or plug head measurement ports. Measurement devices that depend on electronic devices and transducers must have appropriate protective housings for harsh environments. When the flow carries sediment or debris, most weirs, flumes,
and orifices require periodic cleaning of the approach channel. Electronic sensors need occasional maintenance to assure that they are performing properly.

---

[1] U.S. Department of the Interior, Bureau of Reclamation, *Water Measurement Manual*, Third Edition, 1997

[2] Bos, M.G., (ed.), *Discharge Measurement Structures*, third revised edition, International Institute for Land Reclamation and Improvement, Publication No. 20, Wagengen, The Netherlands, 1989.

United States Department of the Interior

BUREAU OF RECLAMATION
Reclamation Service Center
P.O. Box 25007
Building 67, Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO:

D-8140
PRJ-8.10

MAR 18 1999

U.S. Fish and Wildlife Service
Refuge Hydrologist
Attention: Megan Johnston
Division of Water Resources
PO Box 25486, Region 6
Denver CO 80225-0486

Subject: Long-Throated Flumes for the Quivira National Wildlife Refuge, Kansas

On December 10, 1998, we received your letter requesting assistance with providing for measurement of flows being diverted from Rattlesnake Creek to the Quivira National Wildlife Refuge.

Refuge History Summary: Located in south central Kansas, Quivira National Wildlife Refuge, provides food, water, cover, and space for hundreds of species of birds, mammals, reptiles, amphibians, fish and plants. The 21,820 acre refuge was purchased between 1955 and 1969.

Channels were dug permitting Rattlesnake Creek to flow directly into Little Salt Marsh to improve habitat. Additional channels are providing the entire area with a more dependable water supply. Canals about 21 miles in length and consisting of numerous water control structures divert water over 30 wetlands ranging in size from 10 to 1,500 acres and totaling over 6,000 acres of marsh lands.

General Requirement Outline: The state of Kansas has required U.S. Fish and Wildlife Service (Service) to install devices to measure flow being diverted to the Refuge. The devices are to have solar powered continuous recording devices. Diversions are generally made from April through October.

Scope of Work Requested: Your December 10, 1998 letter requested assistance with the requirement that flows being diverted from the Rattlesnake Creek to the Quivira National Wildlife Refuge be measured. Your letter included the following information:

1. Strip topography contour map (AutoCAD file) of the refuge canal system and the creek. The topography had been developed about 1994 for another study. The contours at one foot intervals were generated based upon channel cross sections collected at about 500 foot intervals. Cross sections near structure sites were between 25 and 100 feet integral. The topography will be utilized to determine an average channel invert slope.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Clorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

FEB 23 1999

CERTIFIED Z110 878 355

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 1998 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe
Water Rights Technician

Enclosure

962219

WATER RESOURCES RECEIVED

FEB 26 1999

KS DEPT OF AGRICULTURE

1998 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. COMPLETE AND RETURN BY MARCH 1, 1999. Please read the applicable instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-3495. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	4450N 1000W 13-22-11W (DARRY NANE)	1			1017.2 Acre Feet Surface Water Diverted	A					
7571-00	1250N 3850W 25-22-11W (LSM)	1			2653.5 Acre Feet Surface Water Diverted	A					
7571-00	3100N 1150W 35-21-11W (RCA)	1			3437.2 Acre Feet Surface Water Diverted	A					

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1998					July 1, 1998					November 1, 1998				
Empty	¼	½	¾	Full	Empty	¼	½	¾	Full	Empty	¼	½	¾	Full

CERTIFIED

Z 110 878 355

MAIL

962218

Date: 2/10/99 Telephone: (316-486-2393

98 18302 1 7 - REC Staff SF

Office Use FO CO GMD

WATER RESOURCES RECEIVED FEB 26 1999 KS DEPT OF AGRICULTURE

Dave Hilley, Refuge Manager
Name (Printed or Typed)

Dave Hilley
Name (Signature)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

___ Owner ___ Tenant XX Agent

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

January 4, 1999

Ms. Megan A. Estep-Johnston
Refuge Hydrologist
Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver, Colorado 80225-0486

RE: Water Right, File No. 7,571

Dear Ms. Estep-Johnston:

This office has received your recent letter dated December 3, 1998. The letter is requesting additional time in which to install the required continuous flow measurement equipment at Quivira National Wildlife Refuge.

This office is aware of the special considerations and design criteria that are necessary to develop an accurate metering strategy for the refuge. It is also our desire that the metering system be dependable over the long term without compromising the ability to move water between management areas.

For the above reasons your request for additional time is hereby granted as listed below:

Time allowed to submit new plans for metering water diverted under authority of Water Right, File No. 7,571: **March 31, 1999.**

Time allowed for completing the actual meter installations: **June 30, 1999.**

As a reminder, the water conservation plan is due on: **June 1, 1999.**

Thank you for your continued efforts to keep this office informed of progress made to find suitable metering equipment for the refuge. Please feel free to call or write if you have any questions.

Sincerely,

M Bruce Falk

M. Bruce Falk
Water Commissioner

MBF/mbf

cc: Jim Bagley (microfilm)
Lloyd Stullken

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ► 1

To Bruce	From Meg
Dept./Agency DWR	Phone # FWS
Fax # 316 234 6900	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

BA WTR
KS30.00.10
Mail Stop 60189

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear Mr. Falk:

The U.S. Fish and Wildlife Service requests an extension in time to install continuous flow measurement equipment. We have pursued the installation of the ultrasonic flow measurement equipement manufactured by Badger Meter and have determined that it would not operate adequatelly without compromising water management to an unacceptable degree. The height of the sharp crested weirs would impair our ability to move water through those water control structures where they are required. The Badger 5000 Compound Area Velocity Flowmeter involves the placement of sensors in the channel as well as a sensor mounted over the channel. We have serious concerns for the ability of these sensors to withstand the high level of salt in the water, the ability of the sensors to withstand periodic canal cleaning, and the ability of this equipment to withstand flooding.

We are currently communicating with the Bureau of Reclamation concerning the possible installation of Long-throated (or ramp) flumes at our diversion points. These flumes have proven to be workable for low head situations where there is a high degree of submergence. They would be installed with automated data loggers to maintain continuous records. I do not know at this time how long a design will take, but would like an extension of six months, until June 30, 1999. Depending on design time and climatic constraints, we hope to have these devices in place by then.

I hope this satisfactorily meets your office's requirements for flow measurement. Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

RECEIVED
JAN 07 1999
TOPEKA FIELD OFFICE
DIVISION OF WATER RESOURCES

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure
RECEIVED

cc: Refuge Manager, Quivira NWR

MICROFILMED

WATER RESOURCES
RECEIVED
JAN 5 1999
KS DEPT OF AGRICULTURE

JAN 11 1999
bcc: WR rf RO rf WTR:MEJohnst:ca:12/3/98
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

7571

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas Department of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

DEC 0 3 1998

Dear Mr. Falk:

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Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

cc: Refuge Manager, Quivira NWR

Water Resources Data Kansas Wateryear 1987 U.S.G.S. Report KS-87-1

07142575 RATTLESNAKE CREEK NEAR ZENITH, KS

LOCATION.--Lat 38 deg 06 min 01 sec, long 98 deg 30 min 32 sec, in SW1/4 SW1/4 SW1/4 sec.26, T.22 S., R.11 W., Stafford County, Hydrologic Unit 11030009, on right bank at downstream side of highway bridge, 1.1 mi upstream from Little Salt Marsh, 10.0 mi north of Zenith, and at mile 19.3.

DRAINAGE AREA.--1,052 sq mi, of which 519 sq mi is noncontributing.

PERIOD OF RECORD.--May 1973 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,785 ft above sea level, from topographic map.

REMARKS.--Estimated daily discharges: Nov. 11-15, Dec. 10-12, and Jan. 1, 2, 9-12, 16-29. Records good except those for estimated daily discharges, which are poor. Natural flow of stream affected by ground-water withdrawals, diversions for irrigation, and return flow from irrigated areas.

AVERAGE DISCHARGE.--14 years, 54.3 cu ft per sec, 39,340 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 18,200 cu ft per sec Sept. 26, 1973, gage height, 9.95 ft, maximum discharge, no flow Sept. 14-18, 1984.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 400 cu ft per sec and maximum (*):

Date	Time	Discharge (cu ft per sec)	Gage Height (ft)	Date	Time	Discharge (cu ft per sec)	Gage Height (ft)
Mar. 27	1800	*1,080	*8.21				

Minimum recorded discharge, 12 cu ft per sec Oct. 21, 22, but may have been less during period of ice effect Nov. 11-15, Dec. 10-12, and Jan. 1, 2, 9-12, 16-29.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	18	21	20	23	31	42	414	47	60	88	23	34
2	20	21	21	23	30	39	351	51	53	79	21	34
3	24	21	21	24	29	37	283	49	51	87	20	32
4	22	23	11	25	29	36	227	48	47	123	30	29
5	21	23	21	31	29	34	186	61	45	270	31	24
6	20	24	21	25	29	32	158	99	42	277	30	27
7	19	23	23	24	28	31	145	104	39	186	41	28
8	18	24	25	23	28	31	127	93	37	201	55	31
9	21	23	27	17	28	30	118	87	35	258	52	31
10	24	24	19	15	28	31	105	91	36	227	38	30
11	27	15	14	14	29	31	97	83	40	167	33	28
12	31	15	17	18	27	30	90	66	40	175	37	27
13	22	13	28	31	28	30	91	58	37	170	32	28
14	26	15	29	31	28	29	156	53	35	142	200	29
15	26	18	28	30	30	28	173	49	32	106	192	33
16	24	22	27	15	31	30	132	46	31	87	133	32
17	23	22	26	15	32	49	175	44	29	78	73	31
18	22	21	26	16	30	59	132	41	40	73	56	30
19	22	20	26	21	30	54	97	39	45	67	47	29
20	21	20	26	23	30	48	82	38	43	61	42	29
21	17	20	26	21	30	44	74	38	40	56	36	28
22	13	20	26	25	29	44	67	38	37	53	34	28
23	18	19	25	24	29	205	64	38	35	47	35	28
24	22	19	25	18	28	534	61	40	32	44	39	28
25	22	19	25	19	25	616	58	46	32	39	39	28
26	21	19	24	18	30	563	54	52	30	39	43	28
27	21	20	24	19	37	937	52	74	29	35	45	28
28	21	20	24	20	42	938	50	93	30	32	45	28
29	21	20	24	28	---	725	47	91	40	30	42	28
30	21	20	24	33	---	599	47	80	87	27	39	---
31	21	---	23	32	---	495	---	71	---	25	36	---
TOTAL	669	604	724	700	836	6430	3963	1908	1209	3348	1658	860
MEAN	21.6	20.1	23.4	22.6	29.9	207	132	61.5	40.3	108	53.5	28.7
MAX	31	24	29	33	42	938	414	104	87	277	200	34
MIN	13	13	11	14	27	28	47	38	29	25	20	23
AC-FT	1330	1200	1440	1390	1660	12750	7860	3780	2400	6640	3290	1710

CAL YR 1986 TOTAL 8506.2 MEAN 23.3 MAX 390 MIN 4.6 AC-FT 16870
WTR YR 1987 TOTAL 22909.0 MEAN 62.8 MAX 938 MIN 11 AC-FT 45440

07142575 RATTLESNAKE CREEK NEAR ZENITH, KS

LOCATION.--Lat 38 deg 06 min 01 sec, long 98 deg 30 min 32 sec, in SW1/4 SW1/4 SW1/4 sec.26, T.22 S., R.11 W., Stafford County, Hydrologic Unit 11030009, on right bank at downstream side of highway bridge, 1.1 mi upstream from Little Salt Marsh, 10.0 mi north of Zenith, and at mile 19.3.

DRAINAGE AREA.--1,052 sq mi, of which 519 sq mi is noncontributing.

PERIOD OF RECORD.--May 1973 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,785 ft above sea level, from topographic map.

REMARKS.--Estimated daily discharges: Nov. 30, Dec. 14-22, and Dec. 25 to Feb. 15. Records good except those for estimated daily discharges, which are poor. Natural flow of stream affected by ground-water withdrawals, diversions for irrigation, and return flow from irrigated areas.

AVERAGE DISCHARGE.--15 years, 52.7 cu ft per sec, 38,180 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 18,200 cu ft per sec Sept. 26, 1973, gage height, 9.95 ft; minimum discharge, no flow Sept. 14-18, 1984.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 400 cu ft per sec and maximum (*):

Date	Time	Discharge (cu ft per sec)	Gage Height (ft)	Date	Time	Discharge (cu ft per sec)	Gage Height (ft)
Apr. 2	1900	*153	*5.00	No peak greater than base discharge.			

Minimum recorded discharge, 0.76 cu ft per sec Sept. 26, 27.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	22	29	34	45	42	40	64	45	36	9.6	5.0	1.3
2	22	29	36	47	38	41	136	47	37	10	3.8	1.9
3	21	29	37	48	36	42	131	46	36	10	3.3	2.5
4	21	30	37	42	35	42	112	45	36	9.0	4.3	2.0
5	17	29	37	35	36	43	87	44	33	7.8	6.2	1.9
6	15	29	37	30	37	44	69	43	30	6.8	5.0	1.5
7	19	29	37	28	40	44	60	42	28	5.8	3.6	1.3
8	21	29	37	30	42	42	56	39	27	5.6	3.0	1.3
9	21	29	37	33	40	41	54	38	26	5.7	3.3	1.5
10	20	29	36	37	38	41	52	38	24	6.0	3.5	1.4
11	20	30	36	38	35	40	51	37	23	5.2	4.0	1.3
12	13	31	36	39	38	38	50	36	22	4.4	3.0	1.1
13	16	32	36	41	40	52	48	35	21	4.6	2.5	1.0
14	21	31	36	45	42	58	47	34	21	4.3	2.4	1.3
15	23	32	36	56	45	41	47	32	21	3.6	2.1	1.4
16	25	33	36	64	50	41	46	31	21	6.5	1.7	1.9
17	26	32	34	66	48	53	46	30	20	9.4	1.6	2.1
18	28	33	42	60	47	67	52	28	19	7.8	1.7	2.1
19	28	33	47	54	45	47	57	27	18	7.3	1.9	1.6
20	26	32	48	47	45	48	56	27	18	7.4	2.2	1.3
21	26	32	50	50	44	48	53	28	16	8.0	2.0	1.1
22	27	33	46	56	43	47	50	30	14	6.7	1.6	.94
23	28	33	46	56	42	45	48	32	13	5.8	1.7	1.5
24	28	34	45	56	41	44	46	33	11	7.3	1.6	2.3
25	28	34	42	54	42	42	50	32	10	26	1.5	1.5
26	28	34	39	56	41	41	50	30	11	31	1.4	.84
27	29	37	41	54	41	40	50	29	16	23	1.5	.95
28	27	40	46	50	41	39	49	27	21	18	1.8	1.4
29	28	45	56	47	41	39	48	27	14	14	1.8	.89
30	28	40	50	45	---	39	46	26	11	9.8	1.6	1.0
31	29	---	48	42	---	40	---	29	---	7.0	1.4	---
TOTAL	731	972	1261	1451	1195	1369	1811	1067	654	293.4	82.0	44.12
MEAN	23.6	32.4	40.7	46.8	41.2	44.2	60.4	34.4	21.8	9.46	2.65	1.47
MAX	29	45	56	66	50	67	136	47	37	31	6.2	2.5
MIN	13	29	34	28	35	38	46	26	10	3.6	1.4	.84
AC-FT	1450	1930	2500	2880	2370	2720	3590	2120	1300	582	163	88

CAL YR 1987	TOTAL	23876.00	MEAN 65.4	MAX 938	MIN 13	AC-FT	47360	
WTR YR 1988	TOTAL	10930.52	MEAN 29.9	MAX 136	MIN .84	AC-FT	21680	

07142620 RATTLESNAKE CREEK NEAR RAYMOND, KS

LOCATION.--Lat 38 deg 13 min 50 sec, long 98 deg 25 min 00 sec, in SW1/4 NW1/4 NW1/4 sec.15, T.21 S., R.10 W., Rice County, Hydrologic Unit 11030009, on left bank at downstream side of highway bridge, 3.5 mi south of Raymond, and 5.4 mi upstream from mouth.

DRAINAGE AREA.--1,167 sq mi, of which 569 sq mi is probably noncontributing.

PERIOD OF RECORD.--April 1960 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,701.64 ft above sea level. Prior to July 27, 1960, nonrecording gage at same site and datum.

REMARKS.--Estimated daily discharges: Nov. 11, 13-15, Dec. 11, Jan. 11, 16-26, June 10-23, and Sept. 23-30. Records good except those for estimated daily discharges, which are poor. Flow regulated at times by Quivera National Wildlife Refuge.

AVERAGE DISCHARGE.--27 years, 52.6 cu ft per sec, 38,110 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,140 cu ft per sec Sept. 29, 1973, gage height, 8.74 ft; no flow at times in 1964, 1968-69, 1984.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Sept. 29, 1973 was the maximum known since at least 1891, from information by local resident.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 956 cu ft per sec Mar. 28, gage height, 7.08 ft; minimum recorded discharge, 5.3 cu ft per sec Sept. 21 but may have been less during periods of ice effect Nov. 11, 13-15, Dec. 11, Jan. 11, 16-26 or periods of no gage-height record June 10-23 and Sept. 23-30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.2	20	8.1	22	39	76	842	43	126	49	11	9.7
2	6.5	19	8.0	21	38	74	683	54	109	71	8.0	9.0
3	7.9	21	8.5	19	36	79	630	54	70	62	8.2	8.2
4	12	22	8.6	19	35	107	612	54	29	98	11	7.3
5	13	22	8.6	19	33	156	579	73	22	162	9.8	7.9
6	13	24	8.4	19	33	135	539	100	27	182	10	11
7	12	31	6.4	20	32	101	498	154	26	236	11	8.3
8	12	30	6.2	22	32	56	463	203	25	231	11	7.3
9	14	28	6.8	24	31	48	422	193	25	212	12	8.6
10	21	27	7.2	22	32	46	380	168	30	198	13	9.0
11	26	25	5.3	11	31	47	249	149	32	196	14	8.3
12	31	25	9.8	21	20	47	143	138	27	189	22	9.4
13	29	7.1	11	21	16	45	136	126	25	173	38	8.3
14	31	9.7	13	23	16	46	190	113	23	158	38	7.7
15	29	17	14	24	18	53	210	79	20	147	63	7.6
16	26	16	15	13	21	42	279	41	19	128	101	8.5
17	24	16	16	6.7	24	78	339	37	18	121	104	8.3
18	22	15	16	7.2	39	92	371	37	15	87	100	9.0
19	20	14	16	13	41	96	351	35	17	51	90	7.7
20	17	14	15	9.6	42	96	302	35	16	45	54	6.1
21	16	13	15	8.5	40	95	248	35	15	42	41	5.4
22	21	13	24	13	38	91	221	33	14	28	38	5.5
23	23	6.9	22	12	37	375	167	34	12	16	34	5.0
24	23	5.8	22	14	38	716	131	39	10	15	35	4.7
25	23	6.3	24	12	38	795	99	42	9.5	15	24	4.7
26	22	6.9	24	16	45	737	68	51	8.2	14	18	4.4
27	22	7.6	22	37	68	781	60	76	8.7	15	16	4.8
28	22	8.3	22	42	79	899	50	121	7.4	14	15	4.3
29	25	8.4	24	41	---	912	45	153	11	13	13	4.3
30	23	8.5	23	39	---	901	51	150	25	13	11	4.3
31	21	---	22	39	---	866	---	139	---	13	10	---
TOTAL	613.6	487.5	451.9	630.0	992	8688	9358	2759	821.8	2994	984.0	214.6
MEAN	19.8	16.3	14.6	20.3	35.4	280	312	89.0	27.4	96.6	31.7	7.15
MAX	31	31	24	42	79	912	842	203	126	236	104	11
MIN	6.2	5.8	5.3	6.7	16	42	45	33	7.4	13	8.0	4.3
AC-FT	1220	967	896	1250	1970	17230	18560	5470	1630	5940	1950	426

CAL YR 1986 TOTAL 6728.4 MEAN 18.4 MAX 214 MIN 1.2 AC-FT 13350
WTR YR 1987 TOTAL 28994.4 MEAN 79.4 MAX 912 MIN 4.3 AC-FT 57510

07142620 RATTLESNAKE CREEK NEAR RAYMOND, KS

LOCATION.--Lat 38 deg 13 min 50 sec, long 98 deg 25 min 00 sec, in SW1/4 NW1/4 NW1/4 sec.15, T.21 S., R.10 W., Rice County, Hydrologic Unit 11030009, on left bank at downstream side of highway bridge, 3.5 mi south of Raymond, and 5.4 mi upstream from mouth.

DRAINAGE AREA.--1,167 sq mi, of which 569 sq mi is probably noncontributing.

PERIOD OF RECORD.--April 1960 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,701.64 ft above sea level. Prior to July 27, 1960, nonrecording gage at same site and datum.

REMARKS.--Estimated daily discharges: Oct. 1-6, Dec. 14-18, Dec. 26 to Feb. 13, and Aug. 3 to Sept. 8. Records good except those for estimated daily discharges, which are poor. Flow regulated at times by Quivera National Wildlife Refuge.

AVERAGE DISCHARGE.--28 years, 51.4 cu ft per sec, 37,240 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,140 cu ft per sec Sept. 29, 1973, gage height, 8.74 ft; no flow at times in 1964, 1968-69, 1984.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Sept. 29, 1973 was the maximum known since at least 1891, from information by local resident.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 113 cu ft per sec Apr. 8, gage height, 4.85 ft; minimum daily discharge, 0.76 cu ft per sec Aug. 16 and Sept. 1, but may have been less during period of no gage-height record, Aug. 3 to Sept. 8.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.3	4.0	24	26	25	23	32	63	31	3.6	1.5	.76
2	4.3	4.8	26	25	24	22	52	66	30	3.7	1.5	.88
3	4.0	5.4	30	24	24	16	66	62	28	3.6	1.4	1.1
4	4.0	5.9	32	20	25	19	81	58	28	3.4	1.3	1.3
5	3.8	6.5	34	18	30	21	91	58	27	3.2	1.6	1.2
6	3.7	6.7	34	16	35	22	91	72	26	3.0	1.4	1.1
7	3.5	7.2	33	15	40	23	107	82	26	2.8	1.1	1.0
8	3.5	7.1	29	14	45	21	111	76	27	2.7	1.3	1.1
9	3.4	6.6	29	15	43	12	102	66	23	3.1	1.4	1.0
10	3.2	6.9	29	15	27	11	88	58	21	3.0	1.3	1.1
11	3.4	7.5	28	16	35	11	85	50	22	2.7	1.2	1.0
12	3.5	7.9	27	16	40	12	81	45	22	2.5	1.1	1.0
13	3.5	5.8	27	17	43	18	90	35	21	2.5	1.0	1.1
14	3.5	5.5	23	18	46	23	87	36	19	2.4	.90	1.2
15	3.9	7.0	22	18	47	15	94	36	16	2.1	.80	1.4
16	4.1	7.6	23	19	48	11	78	32	13	4.2	.76	1.5
17	4.1	7.6	25	20	47	12	72	31	10	4.4	.82	1.4
18	4.2	7.8	27	20	46	21	76	30	8.5	3.7	.94	1.3
19	4.1	11	31	20	45	17	75	27	7.4	3.2	1.1	1.4
20	4.0	11	32	17	42	17	75	22	6.7	2.9	1.0	1.3
21	4.1	11	32	18	41	18	73	22	6.0	2.6	.95	1.3
22	3.8	11	30	22	36	23	66	21	5.2	2.4	.87	1.2
23	3.6	9.3	27	22	34	23	66	22	4.9	2.2	.96	1.6
24	3.7	9.6	26	19	36	20	65	22	4.5	2.1	.90	2.1
25	3.7	9.7	24	18	30	19	67	21	4.3	2.1	.84	1.7
26	3.8	11	21	21	29	18	64	22	4.7	2.2	.92	1.6
27	3.9	14	22	23	25	18	62	22	6.5	2.2	1.0	1.7
28	3.9	18	25	27	24	24	67	23	4.4	2.0	1.0	2.4
29	3.9	21	26	32	23	17	66	22	3.8	1.8	.98	1.7
30	4.0	23	27	29	---	19	63	22	3.6	1.7	.96	1.6
31	4.1	---	26	27	---	18	---	23	---	1.7	.86	---
TOTAL	118.5	277.4	851	627	1035	564	2293	1247	460.5	85.7	33.66	40.04
MEAN	3.82	9.25	27.5	20.2	35.7	18.2	76.4	40.2	15.4	2.76	1.09	1.33
MAX	4.3	23	34	32	48	24	111	82	31	4.4	1.6	2.4
MIN	3.2	4.0	21	14	23	11	32	21	3.6	1.7	.76	.76
AC-FT	235	550	1690	1240	2050	1120	4550	2470	913	170	67	79

CAL YR 1987 TOTAL 28688.30 MEAN 78.6 MAX 912 MIN 3.2 AC-FT 56900
WTR YR 1988 TOTAL 7632.80 MEAN 20.9 MAX 111 MIN .76 AC-FT 15140

QUIVIRA NATIONAL WILDLIFE REFUGE
SELF-GUIDED AUTO TOUR
(Watch for Yellow Numbered Signs on Green Posts)

1. Quivira National Wildlife Refuge is managed by the U.S. Fish and Wildlife Service (USFWS). The USFWS is an agency of the federal government within the Department of the Interior.

Quivira is one of over 500 National Wildlife Refuges, covering over 92 million acres in all 50 states and several territories. Quivira was established in 1955, to provide wintering habitat and a migration stop for migratory birds moving up and down the Central flyway. In 1998, Quivira reached its present size for 22,135 acres, a medium size for the refuge system, which contains refuges as large as the 19.2 million acre Arctic NWR (Alaska) and as small as the half-acre Mille Lacs NWR (Minnesota).

An interpretive foot trail is located on the West side of the Visitor's Center parking lot. This is a short, 1000 ft. concrete trail that is wheel chair accessible. This trail, named the "Birdhouse Boulevard" is bordered by numerous bird houses and feeders that you may wish to construct and place in your own yard. Be sure to visit this trail before you leave Quivira.

2. Looking west (left side) from this location you can see the Little Salt Marsh. This 900 acre wetland is the main water storage basin for the Refuge. Water is the life's blood of Quivira and Rattlesnake Creek is our main artery. Rattlesnake Creek starts far west of the Refuge near the town of Greensberg, in Kiowa County.

Water enters Quivira through Rattlesnake into the Little Salt Marsh. From here the water is moved through over 80 water control structures, and 21 miles of canals to fill the 34 managed wetland units on the Refuge. Quivira's approximately 7000 surface acres of water provides habitat for the wildlife using the Refuge.

3. The information kiosk (east side of road) describes some of the history of Quivira *(May Wish to Park to View Kiosk). Quivira was named after a tribe of Indians that were living in this area when the Spanish explorer, Coronado, visited in1541. Coronado was leading an expedition in quest of treasures and the fabled "Seven Cities of Ciboloa, reputed to contain great riches. Instead of gold, Coronado found fertile grasslands, marshes abundant with wildlife and small agricultural villages of Indians. The Indians hunted water fowl in the salt marshes and buffalo in the surrounding grasslands. Early white men used the salt marshes for "market hunting", killing the ducks, geese and shorebirds and selling them to restaurants back East. They could shoot the ducks, use the salt they found on the ground and package the birds for shipment, all in one area.

Following the decline in market hunting, the lands and marshes of Quivira were acquired by private hunting clubs to provide exclusive hunting rights for their members only. Over a dozen clubs owned portions of the marshes. Disagreements arose between the members, clubs and surrounding landowners and some people were able to see the value of the area as a National Wildlife Refuge.

On May 3, 1955, the Migratory Bird Conservation Commission approved the establishment of the Quivira National Wildlife Refuge, and the rest is history.

4. You are about to cross one of two spillways designed to carry flood waters out of the Little Salt Marsh and eastward to the Arkansas River. In 1973, a major flood did extensive damage to Refuge facilities. These spillways were designed following the 1973 event to handle future floods. In 1993, the spillways were put to the test, when another major flood hit Quivira.

Rattlesnake Creek generally flows at a rate of 20-40 cubic feet per second, during the summer months. In July, 1993, flood waters were entering the Little Salt Marsh at over 15,000 cubic feet per second. These spillways were flowing with water over two feet deep, preventing damage to other refuge structures.

Grass is a crop, just as corn or wheat are crops, and must be managed to be productive. Grassland management on Quivira follows a historic pattern of grazing and burning, that was developed before the entrance of man into the area.

Historically, great herds of bison grazed the grasslands, grazing in a area for a short time and constantly moving across the prairie. They seldom over grazed an area, moving on before the grass plants were stressed. Quivira uses a system of management called high intensity/short duration grazing, which attempts to duplicate that pattern. The bison have been replaced by cattle, which belong to local ranchers who are permitted to graze livestock on Quivira.

Large grassland units are broken into small areas called "cells" and these are grazed with a large number of cattle for a very short period of time. Cattle may stay in one cell only a day or two but seldom more than a week, before being moved. They may not return to that cell for several months, if at all during the season. This allows the plants to recover, increases their productivity, provides excellent wildlife habitat and follows the historic scheme.

12. This bridge also crosses Rattlesnake Creek which enters Salt Creek approximately 1/2 mile north of this site.

13. This is the start of the Quivira Wildlife Drive, a four mile loop on elevated dikes, which affords some of the best wildlife viewing areas on the Refuge. Travel slowly, keep the noise level down, be observant and enjoy the wildlife. The birds are accustomed to vehicles and will generally be less disturbed if you remain in your car.

An excellent viewing time is early morning, just after sunrise, before the birds go out to surrounding fields to feed. Viewing is also good just before sunset as the birds return to roost on the marsh.

For waterfowl, the spring migration is most visible from mid-February through March, while the fall migration generally starts in mid-September and continues through November. Up to 500,000 ducks and geese may use Quivira during their migrations.

Fire was also an historic factor that shaped the grasslands, whether caused by lightning or later by Indian hunting parties to improve an area and attract game. Prescribed fires are used on Quivira, under very controlled conditions, to remove old vegetation, release stored nutrients and stimulate new growth.

14. At this site, the 1500 acre Big Salt Marsh stretches out south of the Wildlife Drive. The smaller wetland unit to the East is Unit 58.

The Big Salt Marsh is not very deep, approximately 4-5 feet when full. The salt comes from groundwater, traveling to the surface after crossing through salt layers, deep within the earth. As the water in the Big Salt Marsh evaporates during the dry summer months, the salt concentration rises. In 1991, when drought reduced the Big Salt Marsh to only about 20 acres in size, the salt concentration in the remaining water was measured at three times that of seawater.

15. This is one of the favorite wildlife viewing spots on the Refuge. With the Big Salt marsh spreading out before you, during migrations, the waterfowl viewing can be spectacular.

The shallow west edge of the Big Salt Marsh is a favorite area for sandhill cranes that use Quivira. Up to 97,000 sandhill cranes have been recorded using this area during their fall migration.

Quivira is critical habitat for several endangered or threatened species. Bald eagles, a threatened species, can often be seen from this spot, feeding on the weak in the waterfowl flocks.

5. This is one of the over 80 water control structures on the Refuge. By adjustments to the structure gates, water can be moved throughout the Refuge canal system, to flood the marsh units. Because of reduced flows in Rattlesnake Creek, resulting from development within the watershed, the Refuge must conserve water during spring high flows to last throughout the dry Kansas summers.

6. Agricultural crops are planted on Quivira in cooperation with local farmers, who work on a share basis. Over 1300 acres are planted to crops to provide food for the migrating birds and the resident wildlife that use the Refuge throughout the year. the crops are rotated between winter wheat and milo, with cow peas being planted periodically to enrich the soil. All farming on Quivira is done without the use of chemical pesticides that could harm the wildlife.

Farmers get a 2/3 share of the milo, while leaving the Refuge 1/3 share standing in the field as wildlife food. Wheat is on a 3/4 to 1/4 share because the farmers are required to harvest the Refuge share of the crop. Geese prefer the clean wheat stubble field and the growing green wheat, to crops left standing that might hide predators.

7. The timber area to the west is part of an old "tree claim". Following the Homestead Act of 1862, settlers could claim a quarter section (160 acres) of free land by living on the property and making certain improvements. They could secure an additional quarter section as a "tree claim" by planting and tending ten acres of trees on the new quarter, not an easy task in the drought prone prairie.

Sources of trees for planting were limited on the vast grasslands and trees were brought from as far away as Medicine Lodge, KS, 75 miles to the south. This was a rather long trip in the days when a horse and wagon was the main form of transportation.

8. This is the start fo the "Migrants Mile" interpretive trail, named for both the human and wildlife migrants that have crossed the Refuge. This trail winds through shaded woodlands, along marshy edges and through native grasslands before returning to this spot. The 1.2 mile trail contains a 3/4 mile loop that is surfaced and wheel chair accessible. The trail crosses several marsh areas on elevated wooden boardwalks. One boardwalk is 335 ft. in length, with a central deck area where you can stop for a close-up view of the marsh.

9. The building on the west side of the road is the former Refuge headquarters and shop. These facilities were moved to their present location because of a lack of suitable water at this site. This building has been converted to an environmental education classroom with accessible restroom facilities. This facility is available on a reservation basis for school groups and organizations.

The south portion of the building is now the Refuge bunkhouse used to house visiting researchers. This bunkhouse is also available for schools and organized groups that might be volunteering time on the Refuge or extending their environmental education trip for an overnight stay.

The wetland to the east is called Park Smith Lake, named for the former owner of this marsh.

10. This bridge crosses over the Rattlesnake Creek, as it continues its journey through the Refuge. Approximately 3 miles north, the Rattlesnake enters Salt Creek for its final push to the Arkansas River.

11. The largest habitat type on Quivira is the grassland. The Refuge contains over 13,000 acres of grasslands. Some of the grasslands are native sod that have not been disturbed by man, while other areas have been disturbed and re-seeded to native grasses. Still other areas were once part of unsucessful attempts at farming and have been allowed to "go-back" to the native species.

Whooping cranes, an endangered species once reduced to only 16 individuals during the 1940's, also use the habitat on Quivira. The whooping crane spring migration generally occurs in mid-March to mid-April. The cranes move through quickly in the spring, often only staying overnight as the breeding urge pushes them northward. In the fall migration, usually during October, the whoppers may spend up to two weeks on the Refuge, going slower as the young of the year make their first trip south. The West edge of the Big Salt Marsh is one of their favorite roosting areas. Up to 19 whooping cranes, out of a wild population of approximately 150, have been recorded using this area at one time.

16. The salt flats north of the road are very important to another endangered species that uses Quivira. The interior least tern, a small fish eating bird, uses this salt flat area for nesting. The least terns are endangered because of loss of their breeding habitat which was unvegetated beaches and sandbars in rivers. These areas were historically kept vegetation free by the spring floods that normally occurred. Man controlled that flooding and as a result the vegetation encroached on the beaches and sandbars, forcing out the least terns. Quivira is fortunate to have a breeding colony of these terns, who find the unvegated areas of the salt flats to their liking. Management of this area has been a little unique to accommodate the nesting terns.

One of the problems the least terns encountered in attempting to live on the flats was periodic flooding of their nests. An inch of rain would often flood out the nests, which were located in small scraped out depressions on the ground. In order to eliminate this problem, the Refuge, with the aid of volunteers, constructed small mounds of rock and gravel as nest platforms that would elevate the tern nests above the surface of most flooding. These small mounds are visible on the flats north of the road.

Coyotes, a common predator on Quivira, quickly discovered that the pads contained an egg meal on top and something had to be done to prevent the destruction. An electric fence was constructed around the tern pad area in hopes of keeping out the coyotes. Unfortunately, as with any electric fence, when an animal runs into the fence, you have about a 50:50 chance of the animal bouncing back from the fence or bouncing through. One coyote hit the fence but continued on and destroyed 17 nests in one night.

To slow the coyotes and train them to avoid the fenced area, a scheme was devised. The fence is erected early in the spring, before the terns arrive. A very smelly mixture of cat food, dog food, and cooking oil is spread on the electric wires with a paint roller. Now instead of running through the fence, the coyotes stop and cautiously approach the fence to smell this mixture. Envision a coyote standing on wet ground, sticking his wet nose on an electric wire to get a sniff and you can imagine the results. Prior to the pads and fence, production in the tern colony was down to only two chicks reaching flight stage. Following the nest pads and fence construction, that production rose to a fledging of 36 young to flight. The salt flats on the north side of the road are very important habitat for the thousands fo shorebirds that use Quivira. The major shorebird migration occurs from May through mid-June in the spring and August through mid-September during the fall.

As the wind blows, the shallow water on these flats moves around on the ground surface. As this water moves and shifts due to changing wind directions, it exposes new feeding areas to the shorebirds.

THIS CONCLUDES THE REFUGE TOUR. FEEL FREE TO RETRACE YOUR ROUTE BACK TO HEADQUARTERS TO VIEW THE WILDLIFE EXHIBITS OR WALK THE "BIRDHOUSE BOULEVARD" NATURE TRAIL. YOU MAY WANT TO STOP AT THE "MIGRANT MILE" NATURE TRAIL FOR A LITTLE FRESH AIR AND EXCERISE.

PLEASE REMEMBER THAT THE REFUGE IS "HOME" FOR THE WILDLIFE AND TO TREAT THEIR HOME WITH RESPECT. THE REFUGE STAFF HOPES THAT YOU ENJOY YOUR VISIT AND WILL RETURN SOON AND OFTEN.

CHAPTER 8 - FLUMES

8. Long-Throated Measurement Flumes

Long-throated flumes are coming into general use because they can be easily fitted into complex channel shapes as well as simple shapes (Replogle, 1975; Bos et al., 1991). Long-throated flumes have many advantages compared to other measuring devices, including Parshall flumes. Long-throated flumes are more accurate, cost less, have better technical performance, and can be computer designed and calibrated. Thus, long-throated flumes are preferred over Parshall flumes for new installations. However, some states may have laws or compact agreements mandating the use of Parshall flumes in certain situations.

(a) Characteristics of Long-Throated Flumes

The cross-sectional flexibility of long-throated flumes allows them to fit various channel shapes more conveniently than short-throated flumes, which have fixed sizes and shapes. Because of the ability to match the channel shape, the construction of forms is usually simplified. In contrast, the fixed geometry of short-throated (including Parshall) flumes usually makes upstream and downstream transitions necessary and may require long wingwalls. Because of their flexibility and capability to fit any channel shape, long-throated flumes have more gradual transitions. Thus, floating debris presents fewer problems. Also, field observations have shown that the structure can be designed to pass sediment transported by channels with subcritical flow.

A simple type of long-throated flume developed and described by Replogle et al. (1991) consists of a flat raised sill or crest across a trapezoidal channel with an approach ramp transition from the approach channel invert. The crest drops vertically at the downstream end back to the downstream canal invert. These flumes (figure 8-5) have been called Replogle flumes, modified broad-crested weirs, and ramp flumes. This simple version of the long-throated flume is formed with only two bottom planes. An optional third plane can be used for maximum head recovery. The lined canal shape serves as the flume approach section, compared to constructing 9 to 12 planes for Parshall flumes. It is usually easier to construct the two to three planes of the long-throated flumes.

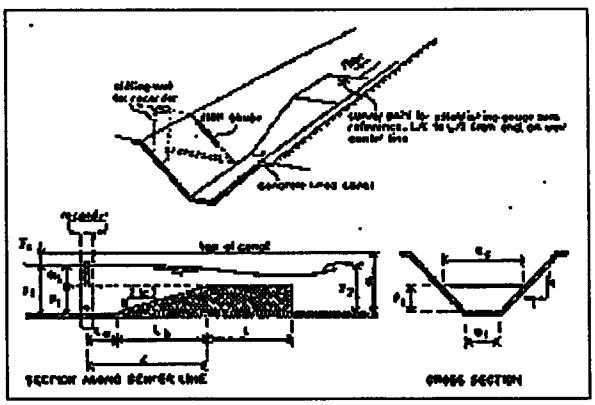

Figure 8-5 -- Flat-crested, long-throated flume in concrete-lined canal.

Some confusion of terminology exists here. Some investigators would consider the ramp flume a broad-crested weir because the flow constriction is produced from a bottom transition alone, whereas a flume would depend to some extent on side convergence. Both long-throated flumes and broad-crested weirs can be accurately rated by analysis using fluid flow concepts. The energy principle, critical depth relationships, and boundary layer theory are combined when computer calibrating these flumes and weirs. Because of this close connection, this manual will consider and call both the long-throated flumes and broad-crested weirs longthroated measurement structures.

Cost estimates for a large 930ft3/s ramp flume varied from about 45 to 60 percent of that for a Parshall flume in a retrofit situation. Clemmens and Replogle (1980) cited costs of onetenth to onethird of equivalent Parshall flumes for a small ramp-type, long-throated flume. Some of the cost differences between small and large structures result from the need for service roads, foundation differences, and repair of approach channel surfaces in retrofit designs.

Long-throated flumes can be computer calibrated to within ±2 percent plus head measurement error and have submergence limits up to 90 percent. Even when the listed submergence limits are near 70 percent, the absolute head loss or water surface drop through the long-throated flumes may be smaller than the older structures, depending on the particular design selection from among the many choices of shape.

Short-throated flumes can measure free flow accurately in the range of ±3 to ±5 percent plus head measurement error and have submer-gence limits from 50 to 80 percent. Increased uncertainty occurs when using flow corrections to obtain discharge rates beyond submergence limits commonly up to 95 percent. However, Peck (1988) found large correction errors caused by hysteresis shifts of the downstream wave front at a submergence of 90 percent. Correction is frequently done above 90-percent submergence with Parshall flume measurements. Using submergence corrections commonly results in discharge errors ranging from 7 to ±20 percent, and possibly much more, as differences in upstream and downstream measuring heads become small.

With most flumes, close adherence to tolerances during construction is required to rely on empirical equations and calibrations provided for each specific short-throated flume. Dimensional errors and slippage of the forms frequently cause unacceptable errors that are difficult to resolve without laborious field calibrations. Field calibrations for submergence correction are very cumbersome and time consuming because of the usual project operational limitations, difficulties of controlling heads, and the need for long lag times for heads to settle to asymptotic levels. However, long-throated flumes can usually be computer recalibrated using as-built dimensions if form slippage has not caused crest slope in the direction of flow. Even then, crest correction may be practical and relatively inexpensive.

The measured heads in the short-throated flumes do not always indicate system head loss. For example, the upstream measured head of a Parshall flume is located about one-third of the way into its converging crest section, and the water surface may have a considerable drawdown from the approach canal surface elevation. This factor makes size selection and crest elevation setting more complicated than for long-throated flumes that approximate

existing channel dimensions and shape.

Because long-throated flumes have greater tolerance to submergence than short-form flumes and weirs, they can deliver more discharge without having to consider the effects of submergence, which usually requires observation of a downstream depth. For example, Parshall flumes require 3 to 4 times the absolute water surface fall through the structure for free-flow measurements than long-throated flumes (Bos et al., 1991). Longthroated flumes, with tolerances for high submergence ratios, require only one head measurement. They are considered to be more accurate and economical than, for example, extending Parshall flume measurement range by submerging up to comparable long-throated flume submergence limits and making corrections using two head measurements.

Because long-throated flumes fit nicely into existing flow channels, they are convenient for making portable measurement devices. Portable long-throated devices for flow rates up to about 2 ft3/s are described in Bos et al. (1991), for trapezoidal and rectangular cross sections.

(b) Summary of Long-Throated Flume Advantages

The main advantages of long-throated flumes are:

(1) Provided that critical flow occurs in the throat (not excessively submerged), a rating table can be calculated with an error less than ± 2 percent. This calculation can be done for any combination of a prismatic throat and an arbitrarily shaped approach channel.

(2) Long-throated flumes can have nearly any desired cross-sectional shape and can be custom fitted into most canal-site geometries. The throat cross section can be shaped in such a way that the complete range of discharge can be measured accurately.

(3) Long-throated flumes can be made into portable devices that fit conveniently into open channels with considerably less complicated construction forming.

(4) The required head loss over the long-throated flume to obtain a unique relationship between the upstream sill-referenced head and the discharge is small. This head-loss requirement may be estimated with sufficient accuracy for any of these flumes placed in any channel.

(5) Because of their gradual converging transition, these flumes have few problems with floating debris and sediment. Field observations have shown that the flume can be designed to pass sediment transported by channels with subcritical flow.

(6) Provided that the throat is horizontal in the direction of flow, a rating table can be produced that is based on postconstruction dimensions. This horizontal orientation is required to allow an accurate rating table to be made to compensate for deviations from design.

(7) Under similar hydraulic and other boundary conditions, long-throated flumes are usually the most economical of all structures for accurately measuring flow.

(8) Long-throated flumes are amenable to selection, design, and calibration by computer techniques.

(c) General Design Procedures for Long-Throated Flumes

The major steps of the design process for long-throated flumes are: (l) selection of site, (2) selection of head measurement techniques previously discussed, and (3) selection of an appropriate structure. Design is an iterative process between these steps. The order and importance of these steps depend on the specific conditions encountered.

To properly select and design a measurement structure, all demands and operational requirements to be made on the structure should be listed and matched with the properties of the known structures. These demands and operational requirements originate from four sources: (1) the hydraulic performance, (2) the construction or installation cost, (3) the ease with which the structure can be operated, and (4) the cost of maintenance. The imposed demands will be discussed in more detail. Factors that affect design and selection such as submergence, site characteristics, workmanship, and head measurement systems are discussed earlier in this chapter.

(d) Determining Shape and Size of the Structure

Long-throated flumes operate by using a channel contraction to cause critical flow. Insufficient contraction will prevent critical flow. Under this condition, flow is then nonmodular or submerged and gage readings are meaningless. Too much contraction may raise the water surface upstream and cause canal overtopping or sediment deposition problems. The designer's problem is to select the shape of the control section or throat such that critical flow occurs through-out the full range of discharge measurement and produces required accuracy. Also, the designer must provide acceptable head reading sensitivity. Usually, the sensitivity of the structure at maximum flow is selected such that a change in measurement head, $h1$, of about 0.03 ft causes less than a 10-percent change in discharge. Achieving these design requirements may seem difficult, but existing design aids and rating tables make this task more manageable.

(e) Computer Design Versus Sets of Precalibrated Long-Throated Flumes

A thorough treatment of the computational process and several precomputed, standard-size, long-throated flumes for a variety of canals and natural channels are presented in Bos et al. (1991). The U.S. Water Conservation Laboratory, Agriculture Research Service, U.S. Department of Agriculture, developed computer programs for designing and calibrating long-throated flumes.

Clemmens et al. (1993) provide personal computer software and instructions for selecting, designing, and calibrating long-throated flumes. The program is solution-by-trial that incorporates boundary layer theory for determination of friction losses and checks for head-to-crest-length criteria and submergence limit violations, as well as the appropriateness of the selected shape and size for the selected channel size and conditions.

Bos et al. (1991) provides calibration tables in metric (S.I.) and English units for a set of long-throated flume dimensions that covers a discharge range from about 2.8 to 280 ft3/s for trapezoidal channel shapes with side slopes of 1:1 to 1:1.5 horizontal and with bottom widths from about 1 to 5 ft. They also provide instructions for construction and field placement. Calibration tables for long-throated rectangular flumes are also presented. The S.I. tables are reproduced in Cheremisinoff et al. (1988). Statistically fitted equations in S.I. units that closely reproduce the computed tables are presented in Hoffman et al. (1991).

The above references and this manual provide design and calibration tables for selecting and sizing long-throated structures from sets of predetermined, dimensioned, and precalibrated structures or from dimensionless design tables for some special structures. However, computer techniques are much preferred for all installations, designs, and calibrations for long-throated flumes. Thus, when practical, long-throated flumes should be designed using a computer program equivalent to that provided by Clemmens et al. (1993). Using restricted sets of dimensions reduces the capability of more exact custom fitting to shapes of existing channels, which can make it difficult to attain discharge range requirements. The need for computer techniques becomes much more important for large long-throated structures.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS30.00.10
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear Mr. Falk:

Enclosed is a copy of the flow metering equipment that the Service plans to purchase for the Quivira National Wildlife Refuge. This is our proposal to obtain continuous flow data for all of our points of diversion.

Sharp crested weirs will be constructed downstream of structures A-1, C-1, and DCA. The Badger 2100 Flowmeter will then be installed above the weirs. The Badger 2100 Flowmeter can be installed on the center gate on structure A-2.

At Sites A-3 and 24D, the outlet is a pipe. The Q-Tracker is inserted into the pipe to determine the flow. Since we never operate both A-3 and 24D simultaneously, we will only purchase one Q-Tracker, and install it on the structure at the time of operation.

For Site RCA, we will purchase a Badger 5000 Compound Area Velocity Flowmeter. This instrument can calculate the flow through the canal below the structure.

The Badger 2100 and Badger 5000 Flowmeters will be equipped with data-loggers, so we will have continuous records for those structures. The Q-Tracker will have to be read manually, but since the flow at Sites A-3 and 24D is small and neither structure is used extensively, we should be able to obtain reasonably good records.

I hope this satisfactorily meets your office's requirements for flow measurement. Please give me a call if you have any questions at (303)236-5322, X232.

Sincerely,

Megan A. Estep-Johnston
Refuge Hydrologist

Enclosure

cc: Refuge Manager, Quivira NWR

RECEIVED
MAR 30 1998
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Sent to Chad & Matt 4/29/98

Memorandum

Date: April 30, 1998

Kansas Department of Agriculture, Division of Water Resources

To: Bruce Falk, Water Commissioner, Stafford Field Office

From: Lloyd Stullken, Water Management Section, Technical Services

Subj: Quivera Nat'l Wildlife Refuge flow metering proposal dated Mar. 26, 1998
****

Metering the surface water flow around Quivera is a challenging problem and I applaud the efforts made by Megan Estep-Johnston of the Fish and Wildlife Service. The proposal dated March 26, 1998 does not give the details of installation at each site so I will restrict my comments to the capabilities of the tools mentioned. Because these tools are new to DWR, I do recommend that we make our best check measurement possible as a confidence builder.

I suggest that Quivera be requested to annually archive an electronic file of mean daily flow for each site logged, complete with site identification, in a universally-usable format. This will be unique and valuable information required to study the water budget of that area and it should be retrievable from either the Fish and Wildlife Service or the USGS ADAPS.

Tool No. 1--A sharp-crested weir and a Badger 2100 Ultrasonic level flowmeter. The "flowmeter" consists of an overhead depth-to-water ultrasonic sensor and a cpu into which a 16-point stage-discharge curve is programmed. I have no experience with the pitfalls of the overhead ultrasonic sensor and will assume it works as advertised which means a stage measurement of +/- .01ft. As with most surface water measurements, ice is a problem as the sensor will only "see" the surface, be it floating ice, bridged ice or water over ice. Ice will also affect the stage-discharge relation over the v-notch weir during severe cold spells.
Note--Quivera NWR staff should expect to plot the individual data-logger readings to be sure gage is working as expected and that all readings used for flow computations are rational. The FLARS software is expected to provide a graph suitable for visual inspection. Missing or erratic data should be revised/purged before computation of the final record.

Tool No. 2--An in-pipe installation using a Badger Q-Tracker. The Q-Tracker consists of a pressure transducer and doppler transducer mounted on a metal band and installed in the bottom of a pipe. It measures stage in the pipe with the pressure transducer and velocity of flow with the doppler. This setup allows measurement of partial or full flow in the pipe. A pitfall of the setup is that the doppler may not give a reasonable average velocity of the fluid depending on where the suspended particles are in the cross-section. The note in tool no. 1 discussion also applies here.

Tool No. 3--a rectangular open-channel and a Badger 5000 Ultrasonic compound flowmeter. This instrument must be installed in a dimensionally-stable channel so that the area-stage relation never changes. It consists of a suspended acoustic sensor to determine stage in the channel, two transit-time acoustic sensors mounted on opposing channel sides to measure velocity across the channel, and a Q-Tracker-type probe that provides backup for stage measurement with a pressure transducer and backup for velocity measurement with a doppler transducer. Theoretically, the Q-Tracker sensors are calibrated to measure with the time-of-flight sensors and are called on when the time-of-flight sensors register a fault condition. The instrument is designed for a channel that is continuously flooded (in backwater) with no reliable stage-discharge relation. This tool, like tool no. 1, will be seriously affected by ice in the winter and records of flow will need to be reduced for the thickness of ice present. The note in tool no. 1 discussion also applies here.

Accuracy — I do not presume that record accuracies better than +/- 5 percent are possible for these applications in spite of our +/- 2 percent requirement. From all appearances, the W&P proposal is a reasonable attempt to instrument the existing flow channels with flow measurement devices that may prove to provide solutions at other difficult locations. The sensors used individually provide 2 percent or better accuracy but the combination of multiple error sources precludes accuracies better than +/- 5 percent.

Reliability — It is likely that much attention will need to be paid to these instruments to get a full record. Quivera NWR staff will need to monitor these sites closely to determine where the weak areas are that need to be fixed. Installation of the devices will not be sufficient to provide water use record in and of themselves.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
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Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 18 1998

CERTIFIED Z110 878 287

Mr. Lane P. Letourneau
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, 2nd Floor
Topeka, Kansas 66612-1283

Dear Mr. Letourneau:

Enclosed is the 1997 Water Use Report for Permit 7571, Quivira National Wildlife Refuge.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe
Water Rights Technician

Enclosure

902316

WATER RESOURCES
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FEB 23 1998
KS DEPT OF AGRICULTURE

1997 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1998.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion		Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	4450N 1000W 13-22-11W (DarryNane)	1 A	2344.8		Acre Feet Surface Water Diverted	A					
7571-00	1250N 3850W 25-22-11W (LSM)	1 A	3801.1		Acre Feet Surface Water Diverted	A					

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1997					July 1, 1997					November 1, 1997				
Empty	¼	½	(¾)	Full	Empty	¼	½	(¾)	Full	Empty	¼	½	¾	(Full)

CERTIFIED

Z 110 878 287

MAIL

902314

Date: 1/28/98 Telephone: (316) 486-2393

97 18302 1 - REC Staff SF

Office Use

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Z 110 878 287
FEB 23 1998

U S DEPT OF INTERIOR
PO BOX 25486
DENVER

KS DEPT OF AGRICULTURE
CO 80225

David Hilley, Refuge Manager
Name (Printed or Typed)

David Hilley
Name (Signature)

___ Owner ___ Tenant XX Agent

GD

1997 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1998.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of your interest in any one or more of the water right file numbers listed below. If you have any questions on how to complete this form, please contact the Water Use Coordinator at (785) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	3100N 1150W 35-21-11W 1 (RCA)	A	2480.1	Acre Feet Surface Water Diverted	A					

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1997					July 1, 1997					November 1, 1997				
Empty	¼	½	(¾)	Full	Empty	¼	½	(¾)	Full	Empty	¼	½	¾	(Full)

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Date: 01/28/98 Telephone: (316) 486-2393

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FEB 23 1998
KS DEPT OF AGRICULTURE

David Hilley, Refuge Manager
Name (Printed or Typed)

David Hilley
Name (Signature)

U S DEPT OF INTERIOR
PO BOX 25486
DENVER CO 80225

___ Owner ___ Tenant X Agent

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS DISTRICT 02/17/98

STATION NUMBER 07142620 RATTLESNAKE C NR RAYMOND, KS STREAM SOURCE AGENCY USGS
LATITUDE 381350 LONGITUDE 0982500 DRAINAGE AREA 600.00 DATUM 1701.54 STATE 20 COUNTY 159

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	177	25	84	52	46	137	58	57	40	50	15	29
2	126	25	87	59	47	120	57	61	40	52	16	27
3	85	27	80	63	49	116	54	56	40	48	15	22
4	86	32	79	64	50	107	58	55	39	48	15	24
5	86	35	78	59	48	96	62	57	37	52	15	23
6	82	34	72	53	49	93	62	52	36	53	17	20
7	80	34	67	e46	50	100	58	53	34	47	18	19
8	85	34	64	e42	49	91	60	50	33	46	17	18
9	81	34	62	e38	49	86	60	46	32	40	17	18
10	75	34	60	36	49	79	68	45	31	38	17	16
11	72	35	58	e34	48	78	80	45	31	36	21	13
12	75	35	57	e32	48	75	81	43	e32	35	21	13
13	79	36	57	e32	47	76	120	42	e35	33	20	13
14	85	38	56	e30	46	68	124	42	36	31	21	12
15	85	44	54	e30	48	68	123	41	37	29	22	11
16	75	85	52	e36	49	72	105	39	42	28	21	11
17	68	156	48	e30	51	77	97	40	40	26	24	13
18	61	162	40	e32	57	68	96	38	40	23	28	11
19	59	152	e44	e36	49	63	87	36	39	22	49	9.4
20	57	138	e48	43	57	64	78	35	39	22	44	9.9
21	51	120	e55	49	103	64	70	36	38	22	49	9.7
22	45	105	58	53	125	61	64	36	37	21	77	9.7
23	37	106	e57	56	130	62	60	38	37	20	93	12
24	28	75	e55	54	123	63	59	37	42	19	135	15
25	27	64	e55	52	123	59	60	36	41	19	109	28
26	27	71	e55	48	131	58	60	34	40	19	75	25
27	26	69	e55	35	131	61	60	32	40	18	57	23
28	23	68	e55	35	134	60	61	32	39	19	46	21
29	26	77	e55	42	---	54	61	34	41	18	41	17
30	28	87	52	38	---	54	62	43	46	16	38	17
31	25	---	49	43	---	55	---	42	---	15	37	---
MEAN	65.2	67.9	59.6	43.6	70.9	76.9	73.5	43.0	37.8	31.1	37.7	17.0
MAX	177	162	87	64	134	137	124	61	46	53	115	29
MIN	23	25	40	30	46	54	54	32	31	15	15	9.4
AC-FT	4010	4040	3670	2680	3940	4730	4370	2650	2250	1910	2320	1010

CAL YR 1996 MEAN 37.7 MAX 281 MIN 1.0 AC-FT 27340
WTR YR 1997 MEAN 51.9 MAX 177 MIN 9.4 AC-FT 37580

e Estimated

902317

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

January 13, 1998

Cheryl C. Williss
Chief, Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

RE: Water Right, File No. 7571

Dear Ms. Williss:

This office has received your recent letter dated December 23, 1997 in which you requested additional time to complete the required water conservation plan and meter installations at Quivira National Wildlife Refuge.

Your letter mentioned that your agency is contracting to complete a user interface that will allow you to use the water budget model in developing the water conservation plan. The interface will be completed by December of 1998, with the conservation plan following by June 1999.

The letter also stated that installation of a metering system would be best accomplished during dryer conditions so that concrete could be poured in canals without distrupting spring water deliveries at the refuge.

For the above reasons, your request for additional time is hereby granted as listed below:

Time allowed to submit plans for metering water diverted under authority of Water Right, File No. 7571: April 1, 1998

Time allowed for completing the actual meter installations: December 31, 1998.

Time allowed to submit the required water conservation plan: June 1, 1999

Should you have any additional questions, please feel free to contact this office.

Sincerely,

M Bruce Falk

M. Bruce Falk
Water Commissioner

pc: H.Q. files

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear Mr. Falk:

The U.S. Fish and Wildlife Service has been funding the development of a water budget model for the Quivira National Wildlife Refuge since 1996. This model was supposed to have been completed in September, and then we intended to use the model to aid in the development of a conservation plan for the Refuge, which is due on January 1, 1998. However, due to problems with the prime cooperator, the model was not completed in a form that would enable us to utilize it in developing a conservation plan. The Service is currently exploring a new contract with U.S. Geological Survey to develop a user-interface that will enable us to use the model developed under the previous contract. However, it is anticipated that this will take until December 1998. Therefore, we are requesting an extension of time to complete the water conservation plan until June 1999.

During the period of time that the Service is having the user-interface developed, the Service will be working on the identification and prioritization of habitat types on the Refuge, and the quantification of water needed to maintain different types of habitat. At the completion of the user-interface, we should be able to use this information and the model to help us write the conservation plan.

The Service previously requested and received a cost estimate for the installation of ultrasonic metering devices on the diversions from Rattlesnake Creek on the Quivira National Wildlife Refuge. This equipment would meet the requirements contained in the Findings and Order issued September 27, 1996. The original cost estimate for this equipment was about $43,000, and, in our January 17, 1997, letter, we asked for your input on the cost of the meters and whether you were aware of a less costly alternative. In your response, dated June 9, 1997, you indicated that you did not know of any alternatives, and that you thought that on a per volume basis, the cost for metering Refuge water was comparable to costs incurred by other water users.

We have been unable to find alternative equipment that would provide continuous, accurate flow data, and are currently pursuing the installation of the ultrasonic metering equipment. In order to utilize this equipment, two sharp-crested weirs will have to be installed, and this

will involve pouring concrete in two major canals. The Refuge would prefer to do this under relatively dry conditions so that spring water deliveries are not affected. Therefore, the Service requests that the DWR grant us until December 31, 1998, to install the monitoring equipment. We will submit detailed designs for the proposed monitoring as soon as we obtain them from the contractor.

Please contact Megan Estep-Johnston at (303)236-5322, X232, if you have any questions.

Sincerely,

Cheryl C. Williss
Chief, Division of Water Resources

REP R.E. Pedrotti Co., Inc.

3520 W. 75th STREET • SUITE 304, PRAIRIE VILLAGE, KANSAS 66208

(913) 677-3366 FAX (913) 677-3460

January 12, 1998

US Fish & Wildlife Services
Water Resources Region 6
134 Union Boulevard
Lakewood, CO 80228

Attention: Megan Estep-Johnston
Reference: Quivera National Wildlife Refuge
REP#2QUIV

Dear Megan:

Per our recent visit to Quivera Wildlife Refuge, I am pleased to provide quotation for the following equipment.

SITES A-1, A-2, C-1, DC8

QTY DESCRIPTION

4 Badger 2100 Flowmeter with Datalogger and Solar Power Supply

Each of these sites will require Weir plates to be installed with the exception of A-2, in which the ultrasonic will be mounted on the lowering center gate.

We would be responsible for starting up and calibrating the equipment. The Refuge staff will be responsible for the installation.

TOTAL COST: $17,702.00 **

SITES A-3 AND 24D

For these sites I would recommend the Badger Q-Tracker, it is a portable device. The Q-Tracker with (1) 18" mounting band with configuration software and start-up assistance is $5,345.00 each.
These devices are configured through a PC and the mounting band is slid into the PVC pipe.
SITE RCA

QTY DESCRIPTION

1 Badger 5000 Compound Area Velocity Flowmeter with:
* Solar Power Source
* Start-up, Training, and Freight

TOTAL COST: $21,273.00 **

QTY DESCRIPTION

1 Flares Software Pack for downloading of Dataloggers

TOTAL COST: $ 465.00 **

**Pricing includes start-up and freight and exclusive of any taxes or installation. Terms: Net 30 days.

Should you have any questions, please feel free to contact me.

Sincerely,
R. E. PEDROTTI COMPANY, INC.

Gary Moxley
GM/pb

Enclosure(s)

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

MISCELLANEOUS WORKSHEET

1. File No(s).	1a. Vested Right Water Right Appropriation of Water	2. FO	3. GMD
7571		2	—

4. Routin g

☐ Letter

Document Processing _____

Typist _____

☒ No Document or Letter (Information only)

Data Entry

5. Date of Letter 6-9-97

6. Type and Purpose of Letter

☐ Extension Letter Number _____ Completion Date _____

Date Received _____ Perfection Date _____

☐ Notice and Proof ☐ Full ☐ Partial

☐ Entire Right ☐ Change Approval

☐ Reinstatement ☐ Vested Right Closed

☐ Dismissal _____

☒ Other Conservation Plan Req. Extended to 1-1-98 [code 21]

7. Name and Address

7a. PC

8. General Information
Priority Date _____
Certificate Date _____
Vested Right Order Date _____
Approval Date _____
Priority Date of Change _____
Approval of Change Date _____
Completion Date _____
Perfection Date _____

9. Use of Water

☐ DOM ☐ IND ☐ IRR

☐ MUN ☐ REC ☐ STK

☐ WTR PWR ☐ ATR ☐ CMR

☐ HYD

MICROFILMED

10. Battery Number _____

11. Special Use _____

12. Alluvial Valley _____

13. Formation _____

15. Previous Modifications and Amendments

Document Type	Date	Information

Date Prepared 7-13-97 By MB

Date Entered 7-15-97 By BLC

RECEIVED

~~(see reverse for point of diversion and place of use)~~

No Information on reverse

JUL 17 1997

FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

DWR 1-664 (Rev. 05/02/97)

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

MISCELLANEOUS WORKSHEET

1. File No(s).	1a. Vested Right Water Right Appropriation of Water	2. FO	3. GMD
7571		2	5

4. Routin g

☐ Letter
Document Processing _____

Typist _____

☒ No Document or Letter (Information only)
Data Entry

5. Date of Letter 6-9-97

6. Type and Purpose of Letter

☐ Extension Letter Number _____ Completion Date _____

Date Received _____ Perfection Date _____

☐ Notice and Proof ☐ Full ☐ Partial
☐ Entire Right ☐ Change Approval
☐ Reinstatement ☐ Vested Right Closed

☐ Dismissal _____

☒ Other Meter Installation Req. Extended to 1-1-98 Ecode 213

7. Name and Address

7a. PC

8. General Information
Priority Date _____
Certificate Date _____
Vested Right Order Date _____
Approval Date _____
Priority Date of Change _____
Approval of Change Date _____
Completion Date _____
Perfection Date _____

9. Use of Water

☐ DOM ☐ IND ☐ IRR
☐ MUN ☐ REC ☐ STK
☐ WTR PWR ☐ ATR ☐ CMR
☐ HYD

10. Battery Number _____
11. Special Use _____
12. Alluvial Valley _____
13. Formation _____

MICROFILMED

15. Previous Modifications and Amendments

Document Type	Date	Information

Date Prepared 7-13-97 By MAS

Date Entered 7-15-97 By BLC

RECEIVED
JUL 17 1997
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

(see reverse for point of diversion and place of use)

No information on reverse

DWR 1-664 (Rev. 05/02/97)

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

June 9, 1997

Cheryl C. Williss
Chief, Division of Water Resources
United States Department of the Interior
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

RE: Water Right, File No. 7571

Dear Cheryl:

Thank you for graciously accepting my recent verbal apology to you for the tardiness of my response to your letter. Again, I apologize.

In your letter you asked for clarification of data requirements and what is meant by the term "continuous". The word continuous in our Findings and Order refers to instruments or devices that would accurately provide measurements on the volume of water diverted from the Rattlesnake Creek into the refuge on a regular cycle of every hour or less. Consideration can be given to other options that are supported by valid reasons for less frequent measurement cycles. Accuracy is the primary goal.

This office has not had an opportunity to explore different permanent stream gaging equipment and their associated costs. Perhaps other state or federal refuges may have information to provide on that subject.

We understand your desire to clarify the requirements of a metering system due to the cost involved. When comparing the metering costs incurred by other water users in the basin, the cost of metering per unit of water authorized appears to compare favorably with the cost per unit of water authorized at Quivira. This office may be able to suggest options to meter at a lower cost once we have seen your initial proposal.

Your request for additional time to submit the Refuge's Water Conservation plan until January 1, 1998 is hereby granted. In addition, the time allowed to submit detailed plans of the proposed monitoring system is extended until January 1, 1998, with installation of the approved monitoring system to be completed by June 1, 1998.

Should you have any additional questions, please feel free to contact this office.

Sincerely,

Bruce

M. Bruce Falk
Water Commissioner

MBF/mbf

cc: Matt Scherer

Falk, Bruce

From: SCHERER, MATT
Sent: Wednesday, March 12, 1997 7:06PM
To: Falk, Bruce; STULLKEN,LLOYD
Cc: ZARTA GIER, DEBORAH
Subject: RE: Quivira metering

Although they are perhaps a bit testy, I generally agree with Lloyd's remarks.

For those who enjoy such computations, let's say the average water right in the Rattlesnake authorizes 240 AF/yr from one point of diversion, and the average cost to meter is $750. Quivira's right authorizes 14,632 AF/yr. Then, in some obscure way, an equitable cost to meter Quivira might be computed by determining the average cost of a meter in dollars per AF/yr and multiplying it by Quivira's authorized quantity:

14,632*750/240 = $45,725

which just happens to be about what their consultant estimated. I won't propose that this means Quivira shouldn't be concerned about the cost of metering their installation, but maybe the cost isn't as out of line as they seem to think.

From: STULLKEN,LLOYD
Sent: Wednesday, March 12, 1997 4:20 PM
To: Falk, Bruce
Cc: SCHERER, MATT; ZARTA GIER, DEBORAH
Subject: Quivera metering

It pains me to run up against this sort of thing. Our answer to F&W should be that we need to have diversion records accurate to X% and they certainly have the expertise to figure it out from there. Now if they had come back and said "It will cost us $XX to provide 2% records and only $X to provide 5 or 10% records, will you give us an exemption to your accuracy standards?" then this would be a more reasonable request. Whining about being put to more cost than other area users is not a negotiable point. If they want to pump the water through a pipeline then they can get on a par with their neighbors--and that's about all the consulting I think is appropriate before they submit their plans. The exemption to accuracy standards needs to be the Chief Engineer's call.

Without observing the sites or knowing what Pedrotti & Co. recommended it is almost impossible to make any recommendations. From what you mention in your letter, I'd say Quivera is revolting at any effort required on their part to keep these gages maintained. Siltation and beaver dams simply require periodic removal--there is no other way. Flooding is a function of the gage design as is electrical use. Flooding isn't charged to them so what's the problem? Solar-charged battery operation works great in Kansas. Is the cost of fixed-crest weirs over and above the $43,405 installation fee?

I can't believe this Claussen Rule thing. I never heard of it in USGS and cannot find it in the USBR measurement manual or the Missouri Well Driller's Manual. I assume this is an instantaneous measurement like a current meter measurement. How do they figure discharge between measurements and what is their current probable accuracy? +/-50%?

OK, enough of my bitching. DWR's consultation in this matter should come AFTER Quivera presents their plans to us for review. If they don't like what Pedrotti gave them they should make some other arrangements or tell Pedrotti that they didn't solve the problem and send it back to them.

As for what "continuous" means, in my mind "continuous daily data" comes from a recorder that hourly, or more often, records some appropriate physical feature of the diversion that can be accurately transformed into mean daily flow. If it can be shown that less often observations will provide the same accuracy of mean daily flow then we might consider less than hourly observations. I can only assume that the Chief Engineer had in mind something that corresponded with USGS streamflow standards when he required "...continuous daily data...".

If I were them I would be figuring out some type of telemetry on these things as well as a data recorder. Maybe they did?

KANSAS DEPARTMENT OF AGRICULTURE
DIVISION OF WATER RESOURCES
STAFFORD FIELD OFFICE

M E M O R A N D U M

To: Lloyd Stulken

Date: March 4, 1997

From: Bruce Falk

Re: Metering requirements for Quivira Wildlife Refuge

Lloyd, attached is a letter from the United States Department of the Interior, Fish and Wildlife Service. We have required them by order to develop a conservation plan and implement a continuous water metering system. As you can see in the letter, they are having problems developing a metering system that will work under their conditions. The manager of the refuge has indicated that some of the problems are siltation, beaver dams, flooding, and the fact that the metering system may have to be solar powered since electricity is not available at these sites. Other problems are noted in their letter.

I have consulted with Matt on how to answer the enclosed letter. He suggested consulting with you on the metering problem. If you have any ideas or suggestions, Matt and I would appreciate hearing from you as soon as possible. Consulting fees are in the mail, please be patient.

Enc.

PC: Matt Scherer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

JAN 17 1997

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Stafford Fieid Office
105 North Main, Drawer F
Stafford, Kansas 67578-0357

Dear ~~Mr. Falk:~~ Bruce

The U.S. Fish and Wildlife Service received a letter from David L. Pope, Chief Engineer, concerning Water Right File No. 7571, dated September 27, 1996. This letter informs the Service of the requirement to measure the diversion of water to the Quivira National Wildlife Refuge and develop a Water Conservation Plan. Finding No. 2 states that "it is necessary that appropriate water flow measuring structures and devices be constructed and maintained at locations sufficient to provide continuous daily data detailing the volume of water diverted from the Rattlesnake Creek." Finding No. 5 states that the Chief Engineer shall review and approve plans for these measurement structures to ensure that they will accurately measure water use.

As you are aware, the Refuge currently utilizes a Claussen Rule to measure flow at all diversion points, and reports this information to the Chief Engineer on an annual basis. Measurements are not taken during periods of flooding when the Refuge is not actively diverting water.

Following receipt of this letter, the Service contacted R.E. Pedrotti Co., Inc., concerning water measurement devices. They sent a representative to the Refuge, and all diversion points were visited. The measurement devices recommended by this firm would cost the Service $43,405 to install. In addition, because of the lack of significant drop at the locations of the diversions, it was recommended that the Service install fixed-crest weirs at three of the sites, adding additional cost and compromising the Refuge's ability to transport water at these sites.

The Service does not believe that other water users in the Basin have incurred this kind of cost in the installation of acceptable water meters, and we are hesitant to expend this amount of money when it is not clear what data is really needed by the Chief Engineer. We would appreciate a clarification of data requirements, particularly what is meant by "continuous," and would also appreciate any suggestions you might have concerning means to obtain that data at a lower cost.

Called Matt 3/3/97

As you are aware, the Service has entered into a contractual agreement with Kansas Geological Survey to obtain a water budget model for the Refuge. This model will help the Service to develop the Refuge's Water Conservation plan. However, it will not be completed by the July 1, 1997, date given in the September 27, 1996, letter. The Service hereby requests an extension until January 1, 1998, for the development of the Water Conservation Plan.

Please contact Megan Estep-Johnston at (303)236-5322, X232 if you have any questions.

Sincerely,

Cheryl C. Williss
Chief, Division of Water Resources

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

FEB 18 1997

CERTIFIED Z110 878 256

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, 2nd Floor
Topeka, Kansas 66612-1283

Dear Sir or Madam:

Enclosed are the required 1996 Annual Use Water Reports for Flint Hills, Kirwin, and Quivira National Wildlife Refuges.

If you have questions or require additional information, please contact me at (303) 236-5321 ext. 227.

Sincerely,

Linda Coe

Linda Coe
Water Rights Technician

Enclosures

842918

DIV. OF WATER RES
RECEIVED
FEB 20 1997
Z 110 878 256
KS DEPT OF AGRICULTURE

Kansas State Board of Agriculture
Division of Water Resources

FINDINGS & ORDER or CORRECTIONAL ORDER WORKSHEET

1. File No(s)	1a. ~~Vested Right~~ Water Right Appropriation of Water	1b. Document Date	1c. FO	1d. GWMD
7571		9-25-96	2	—

2. Name and Address
United States Dept. of Interior
Attn: Cheryl Williss
Fish & Wildlife Service
P.O. Box 25486
Denver, Colo. 80225

2a. PC

3. ☑ Approval Date
☑ Certificate Date ?
☐ Vested Right Order Date

3a. Use of Water ☐ GROUNDWATER ☑ SURFACE WATER
☐ Dom ☐ Ind ☐ Irr
☐ Mun ☑ Rec ☐ Stk
☐ Wtr Pwr ☐ Art Rechg

4. Findings & Order Paragraph Numbers	Correctional Order Paragraph Numbers	Attachment(s)
See attached	NA	Yes

PD	PU	LIMITATION	RATE	QUANTITY
Correct	Correct	Correct	Correct	Correct
Delete	Delete	Delete	Delete	Delete
Add	Add	Add measuring devices & conservation plan	Add	Add
			Reduce	Reduce

Cease & Desist Order NA

5. Old Information to be Changed (New information to be written in 7, 9, 11, & 12)
NA

6. Previous Modifications and Amendments

Document Type		
Change	Pld	11-11-71

7. Additional Paragraphs See Jacket

Limitation _____ af/yr at _____ gpm (_____ cfs) when combined with file numbers _____

8. Name and Address of New Landowner(s)
NA

8a. WUR Correspondence or Misc. Correspondence
NA

RECEIVED
SEP 30 1996
KDWR

9. Point of Diversion NA

Groundwater to be withdrawn by means of [_____ well(s)] [_____ pit(s)]

Surface water in the _____ to be diverted

[at a point] [at _____ points] [_____ pit(s)] [_____ dam(s)]

DWR 1-663
(Revised 02/22/90)

(See reverse for additional points of diversion & places of use)

MICROFILMED

10. Additional Points of Diversion NA

REP DEL NEW	ID	Qualifier	S	T	R	'N	'W

____ _____ County

11. Rate & Quantity

Authorized Rate gpm/cfs	Authorized Qty af/mgy	Additional Rate gpm/cfs	Additional Qty af/mgy	Overlap PD Files	CHG ?

12. Place of Use NA

MOD

ENT N/O

DEL ID N A S T R

NE¼				NW¼				SW¼				SE¼				Total
NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

Owner	Chg?	Overlap Files	Ovlp Chg?

13. Comments

F&O Requiring measuring devices & conservation plan for Quivira National Wildlife Refuge water rights.

Date Prepared 8-17-93 by MAS

Date Entered 9-26-96 by PSH

1996 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1997.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	Unit	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
7571-00	3100N 1150W 35-21-11W 1	416.81 ACRE FEET SURFACE WATER DIVERTED			A					
aka:	SW SE NE (RCA)									
7571-00	4450N 1000W 13-22-11W 1	2602.88 ACRE FEET SURFACE WATER DIVERTED			A					
aka:	SW NE NE (DARRYNANE)									
7571-00	1250N 3850W 25-22-11W 1	7002.90 ACRE FEET SURFACE WATER DIVERTED			A					
aka:	NC SW (LSM)									

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1996					July 1, 1996					November 1, 1996				
Empty	1/4	1/2	(3/4)	Full	Empty	1/4	1/2	(3/4)	Full	Empty	1/4	1/2	3/4	(Full)

Date: 2/6/97 Telephone: ( )316/486-2393

I submit this report as the best information available. I understand that knowingly falsifying the report is a violation of state law.

842916

96 18302 1 1-REC Staff SF 0

DAVID HILLEY, REFUGE MANAGER

Office Use FO CO GW Name (Printed or Typed)

DIV. OF WATER RES
RECEIVED
FEB 20 1997
KS DEPT OF AGRICULTURE

Name (Signature)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

2110 878 25

___ Owner ___ Tenant XX Agent

1996 WATER USE REPORT DWR 1-513 (Rev. 11/15

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS 02/18/97

STATION NUMBER 07142620 RATTLESNAKE C NR RAYMOND, KS STREAM SOURCE AGENCY USGS
LATITUDE 381350 LONGITUDE 0982500 DRAINAGE AREA 600.00 DATUM 1701.64 STATE 20 COUNTY 159
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1995 TO SEPTEMBER 1996
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.4	4.0	3.8	4.7	e1.8	e6.0	10	7.6	250	8.8	5.3	34
2	4.5	3.8	3.9	4.5	e1.6	6.6	11	7.5	229	7.7	5.1	31
3	4.4	4.0	4.0	4.8	e1.3	6.8	11	9.1	220	7.1	5.2	28
4	4.4	4.0	4.0	4.5	e1.0	7.1	11	9.7	231	6.4	5.8	24
5	4.3	4.0	3.8	e3.9	e1.4	7.2	10	9.9	237	5.9	6.2	19
6	4.3	4.1	3.7	e3.4	e2.0	e6.3	9.9	12	237	5.6	6.4	17
7	4.5	4.1	4.1	e3.0	e3.0	e6.0	10	20	184	5.1	5.8	17
8	4.5	4.0	4.0	e4.0	e4.7	e6.0	10	29	133	4.9	5.6	15
9	4.3	4.0	e3.8	e4.6	7.2	e6.1	10	52	107	5.7	5.1	14
10	4.3	4.0	e3.7	5.1	8.6	7.7	11	51	86	5.8	7.6	13
11	4.3	4.6	e3.6	5.1	7.4	7.8	11	44	65	5.5	10	12
12	4.2	4.0	3.5	5.0	8.4	7.8	9.8	41	55	5.4	11	12
13	4.0	3.9	3.6	5.0	9.7	8.2	10	37	48	5.0	12	11
14	4.0	4.0	3.8	5.2	6.9	9.7	11	35	42	6.7	13	12
15	4.1	4.1	3.9	5.1	5.4	9.5	11	37	37	5.7	13	15
16	4.1	4.1	3.9	5.3	e5.0	9.4	11	34	36	5.1	12	23
17	4.0	4.1	3.9	5.5	5.3	9.6	11	32	32	5.0	12	26
18	4.0	4.0	4.0	e3.9	5.4	20	10	29	28	5.2	10	34
19	3.8	4.1	4.0	e3.0	5.4	9.6	9.9	25	25	5.5	10	63
20	3.7	4.1	4.1	e3.3	5.7	9.4	9.3	22	24	6.0	27	77
21	3.8	4.1	4.1	e3.9	5.9	9.3	9.5	17	22	5.2	22	78
22	4.0	4.1	4.0	e4.0	6.0	9.2	9.0	16	18	5.3	21	76
23	3.5	4.1	4.0	e3.8	6.3	9.0	8.9	14	17	4.7	73	77
24	3.5	4.1	4.0	e3.1	7.1	8.9	9.2	13	16	4.7	64	92
25	3.7	4.3	4.3	e2.8	7.7	e8.0	8.6	19	15	5.0	54	96
26	3.8	4.2	4.3	e2.5	7.9	e8.0	8.0	105	13	5.5	47	120
27	3.6	3.9	4.3	e2.2	7.8	7.8	8.2	238	12	5.2	43	153
28	3.5	5.0	4.3	e2.1	e7.0	8.0	8.2	234	11	6.0	40	192
29	3.7	4.0	4.3	e2.0	e6.0	8.4	7.7	263	10	6.1	35	207
30	3.7	4.0	4.7	e2.0	---	9.1	7.6	281	9.8	5.6	31	208
31	3.8	---	4.8	e2.0	---	9.5	---	233	---	5.4	33	---
TOTAL	124.7	122.8	124.2	119.3	158.9	252.0	292.8	1976.8	2450.8	176.9	651.1	1796
MEAN	4.02	4.09	4.01	3.85	5.48	8.13	9.76	63.8	81.7	5.71	21.0	59.9
MAX	4.5	5.0	4.8	5.5	9.7	10	11	281	250	8.8	73	208
MIN	3.5	3.8	3.5	2.0	1.0	6.0	7.6	7.5	9.8	4.7	5.1	11
AC-FT	247	244	246	237	315	500	581	3920	4860	351	1290	3560

CAL YR 1995 TOTAL 26116.7 MEAN 71.6 MAX 1480 MIN 3.1 AC-FT 51800
WTR YR 1996 TOTAL 8246.3 MEAN 22.5 MAX 281 MIN 1.0 AC-FT 16360

e Estimated

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 South Kansas Avenue, 2nd Floor
Topeka, Kansas 66612-1283
(913) 296-3717 FAX (913) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

September 27, 1996

TERRY GROSZ
ACTING REGIONAL DIRECTOR
FISH AND WILDLIFE SERVICE
U S DEPARTMENT OF THE INTERIOR
P O BOX 25486
DENVER FEDERAL CENTER
DENVER CO 80225

RE: Water Right
File No. 7,571

Ladies and Gentlemen:

Enclosed is the Findings and Order by the Chief Engineer, Division of Water Resources, Kansas Department of Agriculture, setting forth the requirement for measuring the diversion of water to the Quivira National Wildlife Refuge and development of a Water Conservation Plan.

Please be reminded that reports of water usage must be submitted to this office annually. Records indicating the amount of water used should be furnished to the Chief Engineer by March 1 following the end of the previous calendar year so that the continued use of water becomes a matter of record in this office.

If you have any questions, please contact our office. If you wish to discuss a specific file, please have the file number ready so that we may help you more efficiently.

Sincerely,

David L. Pope
Chief Engineer

DLP:DEB:jt
Enclosures
pc: Stafford Field Office

THE STATE OF KANSAS

DUPLICATE COPY

KANSAS DEPARTMENT OF AGRICULTURE
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

IN THE MATTER OF MEASURING THE DIVERSION OF WATER
TO THE QUIVIRA NATIONAL WILDLIFE REFUGE AND
DEVELOPMENT OF A WATER CONSERVATION PLAN
WATER RIGHT, FILE NO. 7,571

After due consideration, the Chief Engineer, Division of Water Resources, Kansas Department of Agriculture (hereinafter referred to as the "Chief Engineer"), makes the following findings and order:

FINDINGS

1. That K.S.A. 82a-732(a) states that "The owner of a water right ... shall file an annual water use report on a form prescribed by the chief engineer ... on or before March 1 following the end of the previous calendar year. The report shall completely and accurately set forth such water use information as requested by the chief engineer."

2. That in order to monitor the use of water made by the United States Fish and Wildlife Service, Department of the Interior, under its existing water right to appropriate the natural flows of the Rattlesnake Creek for recreational use at the Quivira National Wildlife Refuge and to obtain complete and accurate water use reports, it is necessary that appropriate water flow measuring structures and devices be constructed and maintained at locations sufficient to provide continuous, daily data detailing the volume of water diverted from the Rattlesnake Creek.

3. That adequate measuring structures and devices to monitor water flows as set forth in Findings No. 2 have not been constructed to date.

4. That K.S.A. 82a-706c provides that "the chief engineer shall have full authority to require any water user to install meters, gages, or other measuring devices, which devices he or she or his or her agents may read at any time, and to require any water user to report the reading of such meters, gages, or other measuring devices at reasonable intervals."

5. That in order to assure accurate measurement of water use the Chief Engineer should review plans for the construction of the water measurement structures and devices and that the structures and devices should not be installed until the Chief Engineer has approved the plans for the same.

6. That K.S.A. 82a-733a provides that "the chief engineer may require ... the owner of a water right ... to adopt and implement conservation plans and practices."

7. That K.S.A. 82a-733 (a) further states "In selecting ... water rights ... for which conservation plans and practices are required to be adopted and implemented, the chief engineer shall give priority to ... Water users that share a common source of supply that could be insufficient during times of drought ....".

8. That the Rattlesnake Creek may be insufficient, during times of drought, to provide a supply of water sufficient to meet the needs of all water users dependent upon the creek.

9. That there is insufficient information available to determine how much water is reasonable for the operation of the Quivira National Wildlife Refuge under various climatological conditions.

10. That for the reasons noted in Findings No. 8 and No. 9, and to avoid waste of water, minimize unnecessary losses and optimize efficient use of water for the authorized purpose, it is for the public benefit and in the public interest to require that a Water Conservation Plan be developed for the Quivira National Wildlife Refuge.

ORDER

NOW, THEREFORE, It is the decision and order of the Chief Engineer, Division of Water Resources, Kansas Department of Agriculture, that the United States Fish and Wildlife Service, Department of the Interior, cause to be constructed by December 31, 1997, or within any authorized extension of time thereof for good cause shown by the United States Fish and Wildlife Service,

water flow measurement structures and devices and a monitoring system sufficient to provide continuous, daily data relative to the diversion of the natural flows of the Rattlesnake Creek for recreational use at the Quivira National Wildlife Refuge, that it is further ordered that detailed plans for all such structures and the monitoring system be submitted to the Chief Engineer by July 1, 1997, and shall have received his approval prior to construction, that it is further ordered that a Water Conservation Plan be developed and submitted to the Chief Engineer by July 1, 1997, which sets forth plans and practices to avoid waste of water, minimize losses and optimize efficient use of water for the authorized purpose and that such plan shall include the development of an operational plan for the improved conservation and management of water at the Quivira National Wildlife Refuge, a drought contingency plan and a schedule for the implementation of the Water Conservation Plan.

Dated at Topeka, Kansas, this 25th day of September, 1996.

DIVISION OF WATER RESOURCES
DAVID L. POPE
CHIEF ENGINEER
KANSAS DEPARTMENT of AGRICULTURE

David L. Pope, P.E.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture

State of Kansas)
) SS
County of Shawnee)

The foregoing instrument was acknowledged before me this 25th day of September, 1996, by David L. Pope, P.E., Chief Engineer, Division of Water Resources, Kansas Department of Agriculture.

DENISE J. ROLFS
NOTARY PUBLIC
MY APPT. EXP. 3-1-98
STATE OF KANSAS

Notary Public

Kansas State Board of Agriculture
Division of Water Resources

MISCELLANEOUS WORKSHEET

1. File No(s) 7571	Vested Right 1a. Water Right Appropriation of Water	2. FO 2	3. GMD —

4. Routing

☐ Letter

Document Processing _____

Typist _____

☒ No Document or Letter (information only)

Data Entry

5. Date of Letter

6. Type and Purpose of Letter

☐ Extension Letter Number _____ Completion Date _____

Date Received _____ Perfection Date _____

☐ Notice and Proof ☐ Full ☐ Partial

☐ Entire Right ☐ Change Approval

☐ Reinstatement ☐ Vested Right Closed

☒ ~~Diversion~~ Meter Reg. by FJO by 12-31-97 [code 08]

☒ Other Plan Reg. by FJO by 12-31-97 [code 08]

7. Name and Address

7a. PC

8. General Date Information

Priority Date _____

Certificate Date _____

Vested Right Order Date _____

Approval Date _____

Priority Date of Change _____

Approval of Change Date _____

Completion Date _____

Perfection Date _____

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SEP 30 1996
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DIVISION OF WATER RESOURCES
STAFFORD

9. Use of Water:

☐ Dom ☐ Ind ☐ Irr

☐ Mun ☐ Rec ☐ Stk

☐ Wtr Pwr ☐ ATR ☐ CMR

☐ HYD

10. Battery Number _____

11. Special Use _____

12. Alluvial Valley _____

13. Formation _____

15. Previous Modification and Amendments

Document Type	Date	Information

Date prepared 8-17-93 by MAS

Date entered 9-26-96 by PSH

(~~See reverse for point of diversion and place of use~~)

MICROFILMED

DWR 1-664 (Rev. 12/11/92)

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Larry Sheets
Certificate Unit

DATE: June 4, 1996

FROM: Matt A. Scherer MAS
Basin Team Leader

RE: Proposed Findings and Order regarding metering and conservation plan for File No. 7571

Sorry for the delay in responding. Earl Lewis has reviewed the proposed Findings and Order and has several suggestions (attached is a copy of his memo to me). I agree with all of the specific language he recommends and suggest it be added to the draft Order. Note in his memo that he has italicized all of the new language he proposes although you need to read the rest of it because he does recommend some deletions.

I still think that the deadlines are too ambitious. I suggest the first part of the Order read:

> ... that the United States Fish and Wildlife Service, Department of the Interior, cause to be constructed by December 31, 1997, or within any authorized extension of time thereof for good cause shown by the United States Fish and Wildlife Service, water flow measurement ...

As Bruce noted in his Office Vision note, it takes a long time for the engineering design and actual construction of measurement systems of the kind that need to be installed here. There isn't much point in requiring them in a time period the Service can't meet and then having to deal with extension requests.

Also, from Earl's recommendations, I suggest we change the last phrase of the Order to read:

> ... that it is further ordered that a Water Conservation Plan be developed and submitted to the Chief Engineer by July 1, 1997, or within any authorized extension of time thereof for good cause shown by the United States Fish and Wildlife Service, which sets forth plans and practices to avoid waste of water, minimize losses and optimize the efficient use of water for the authorized purpose and that the plan shall include the development of an operational plan for the improved conservation and management of water at the Quivira National Wildlife Refuge, a drought contingency plan and a schedule for implementation of the Water Conservation Plan.

Assuming Bruce has no problems with the Order in this state, I think we are ready to finalize it and mail it. Again, I apologize for taking so long to complete my review.

Attachment
MAS
pc: Bruce Falk, Water Commissioner, Stafford
Earl Lewis, Basin Team Water Conservation Engineer

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director

STAFFORD FIELD OFFICE
M. Bruce Falk, Water Commissioner
105 North Main Street, Drawer F
Stafford, Kansas 67578-0357
(316) 234-5311 FAX (316) 234-6900

KANSAS DEPARTMENT OF AGRICULTURE

May 10, 1996

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

RE: File No. 7,571

Dear Sir or Madam:

In recent years, the Division of Water Resources (DWR) has become aware of situations where water right conditions and limitations are being violated. In order to obtain better data about the extent of these situations and address them in the future, DWR is initiating a pilot program in your area. This pilot program will evaluate compliance with water right conditions and help us develop a more comprehensive, fair, efficient and effective program. We welcome and encourage any comments you may have as public input into this process is essential to the program's success.

Our records show that you are a landowner and/or operator for the above referenced file number. If this information is not correct, please notify us so that we can update our records.

Under Kansas law, the water right owner is responsible for complying with all of the conditions and limitations of the water right. The water right conditions are listed in the permits, certificates and orders issued on every water right or vested right. Common water right conditions state that:

- water must not wasted,
- water flow meters (if required) must be installed according to specifications and must be operating correctly at all times,
- water must not be used for unauthorized purposes or on unauthorized land,
- the annual authorized quantity and rate of diversion are not to be exceeded, and
- accurate records of the amount of water used must be maintained and be available to DWR.

Many water rights have additional conditions or Groundwater Management District requirements unique to their special circumstances. I encourage you to review the documents related to File No. 7,571 at this time to ensure that each condition is being met. If you cannot find your documents, or have questions about them, please contact our Stafford Field Office for copies or clarification. Failing to adhere to the conditions of your water right can result in administrative action, revocation of the water right, or prosecution for a class C misdemeanor.

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APR 25 1997
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

(Over)

Under DWR's pilot program, staff will be conducting field visits of selected wells later this year. Receipt of this letter does not necessarily mean that your's will be visited. However, if your installation is checked and it is found that the conditions of your water right are not being followed, appropriate action will be taken.

If during the water use season, your meter experiences problems which can not be solved immediately, please notify DWR's Stafford Field Office as soon as possible. While your meter is not working, you should keep a record of pumping time.

We recognize that the lack of rainfall to date indicates that 1996 could be a dry year. Please plan your water management accordingly so that you will not exceed your authorized quantity.

If you have questions, please feel free to contact any of our staff at the Stafford Field Office telephone number noted in the letterhead. If you wish to visit the office to review your files please call ahead for an appointment. When you contact us, please indicate your file number so we can serve you more quickly.

Sincerely,

M. Bruce Falk

M. Bruce Falk
Water Commissioner
Stafford Field Office

pc: Compliance and Enforcement Unit
Groundwater Management District

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA WTR
KS WR
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

MAY 13 1996

Mr. David L. Pope
Chief Engineer-Director
Division of Water Resources
901 South Kansas Avenue
Topeka, Kansas 66612-1283

Dear Mr. Pope:

I appreciate your efforts to work with the Fish and Wildlife Service to help protect the water supply for Quivira National Wildlife Refuge. Although I believe the Service's legal arguments would prevail if the issue were to be appealed to the courts, I have decided to accept the Certificate of Appropriation for File No. 7571 forwarded with your letter of April 10, 1996. However, I urge you to emphasize to the other users that perfecting the Refuge's right for 14,632 acre-feet does not free up 8,000 acre-feet for additional use by others.

I am encouraged by the spirit of cooperation and the various activities which have been initiated in the area aimed at resolving the problems of an insufficient water supply for all of the uses currently occurring. I hope that the result of these cooperative efforts will be coordinated water management that allows most of the existing uses to continue. However, I feel that I must reiterate my position that if the Rattlesnake Creek Basin Management Plan and ongoing conservation efforts do not prove to be sufficient, the Service will pursue other remedies to prevent continued impairment of the Refuge's senior water right.

Thank you again for your cooperation and assistance.

Sincerely,

DEPUTY TERRY T. TERRELL
Regional Director

cc: Mr. Bruce Falk
Division of Water Resources
Stafford Field Office
105 North Main, Drawer F
Stafford, KS 67578-0357

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STAFFORD

DIV. OF WATER RES
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MAY 16 19
KS DEPT OF AGRICULTURE

Orig-File
Copy to DLP, WSM, EFE, WER, KS, MS

V01 Note

From: MBF5311 --LSOB03 Date and time 04/18/96 13:04:06
To: LMS7064 --LSOB03 Larry Sheets

From: Bfalk
Subject: Quivira/metering/conservation
Larry, I agree with Matt that the time frames are too short for the scope of this project. From past experience with Cheyenne Bottoms the engineering, design, and installation will take considerable time. I would recommend extending all the deadlines by one year.

The remainder of the draft looks really good. As a suggestion another item in the findings could be that: all other permitted uses of water in the Rattlesnake Creek Basin have been required to install meters or gages to record water use to better monitor the use of water in the basin.

Bruce

E N D O F N O T E

Command ===>
F1=Help F2=File F3=Exit F4=Discard F5=Route F6=Reply F7=Backward
F8=Forward F9=Keep F10=Resend F11=Print F12=Cancel

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

MEMORANDUM

TO: Matt A. Scherer
Water Conservation Engineer

DATE: April 17, 1996

FROM: Earl D. Lewis, Jr. EDL
Water Conservation Engineer

RE: Findings and Order for Quivira National Wildlife Refuge

When reading through this, a few things stick out to me. First Finding No. 4 sounds more like an order than a finding. Second, and related, I don't think you have established a legal need for monitoring water use and installing measuring devices other than the chief engineer can require water measurement if he wants to. Therefore, I propose that a finding be added at the start that establishes the legal need for accurate water measurement.

1. *That K.S.A. 82a-732(a) states that "The owner of a water right . . . shall file an annual water use report on a form prescribed by the chief engineer . . . on or before March 1 following the end of the previous calendar year. The report shall completely and accurately set forth such water use information as requested by the chief engineer."*

Next I would change Finding No. 2 (No. 1 on the current draft) to link it to the legal requirement in Finding No. 1.

2. That in order to monitor the use of water made by the United States . . . . at Quivira National Wildlife Refuge, *and to obtain complete and accurate water use reports*, it is necessary . . . .

Finding No. 2 now Finding No. 3

3. That adequate measuring structures and devices to monitor water flows as set forth in *Finding No. 2* . . . .

Finding No. 3 now Finding No. 4 - no change

Finding No. 4 now Finding No. 5

I think that the first sentence is redundant with Finding No. 1 in the current draft and should be removed as it sounds like an order. The remaining portion of the finding should be reworded to:

5. That *in order to assure accurate measurement of water use,* the Chief Engineer should review plans for the construction of the *water measurement* structures and devices, *and* that the structures and devices should not be installed until the Chief Engineer has approved the plans for the same.

Finding No. 5 now Finding No. 6 - That K.S.A. 82a-*733 (a)* provides . . .

I would then add another finding to further our case that this is legally in the public interest to require a water conservation plan.

7. That K.S.A. 82a-733 (a) further states "In selecting . . . water rights . . . for which conservation plans and practices are required to be adopted and implemented, the chief engineer shall give priority to . . . Water users that share a common source of supply that could be insufficient during times of drought . . . .".

Finding No. 6 now Finding No. 8 - No change, however are you sure you just want to refer to it as the "Creek" at the end of the finding.

Finding No. 7 now Finding No. 9. - no change

Finding No. 8 now Finding No. 10

10. That for the reasons noted in Findings No. *8 and No. 9,* . . . .

I would also change line 4 of the Order to stay consistent with the findings:

by July 31, 1997, water flow measurement structures *and devices* and a monitoring system . . . .

Finally, do we want them to address drought through a Drought Contingency section of the conservation plan.

MEASURING IRRIGATION WATER

MEASURING IRRIGATION WATER

CONTENTS

CLAUSEN WEIR RULE COMPANY

~~BOX 6156~~ ~~PHOENIX, ARIZONA~~

FOREWORD

The **Weir Rule** needs little introduction to the irrigation world. Its wide acceptance by all of the irrigated United States (with a few scattered users in Mexico, Egypt, and Austraila) has been due to its proven value as an instrument capable of measuring water-flow with accuracy, low operating cost, and with a minimum of time.

On free-flowing weirs the measurement of flow with the **Weir Rule** is so simple that any ditch rider can make an accurate measurement in minutes. For a quick proof of this fact read the opening instructions on pages 3 thru 7 for use of the Weir Rule on free-flowing weirs.

But many users of the **Weir Rule** believe that its greatest value lies in its use on submerged weirs. Authorities have long known the usefulness of the submerged weir but have shunned it because of the difficulty in obtaining the field data necessary to apply to the various submerged-weir formulas. The **Weir Rule** not only gathers this data, but eliminates the necessity of knowing or using any weir formulas, for the **Weir Rule** is a self-reading instrument. To discover how true this is read the operating instructions on pages 8 thru 13 on the use of the **Weir Rule** on submerged weirs.

The Improved **Weir Rule** embodies many new features, all of which add to the ease of operation and the accuracy obtained. These improvements will be apparent to those who are familiar with the old **Weir Rule** after this booklet has been read. The **Weir Rule,** as now constructed, is made of a special aluminum-magnesium alloy which is highly corrosion resistant and has a strength greatly exceeding any conceivable need. A special long-life etching process has been used on the linear and surge scales.

The last portion of this booklet shows hows simple it would be to convert your project for use with the **Weir Rule.** A casual study will show the low cost entailed in building a submerged weir that will measure water accurately at the high point of delivery.

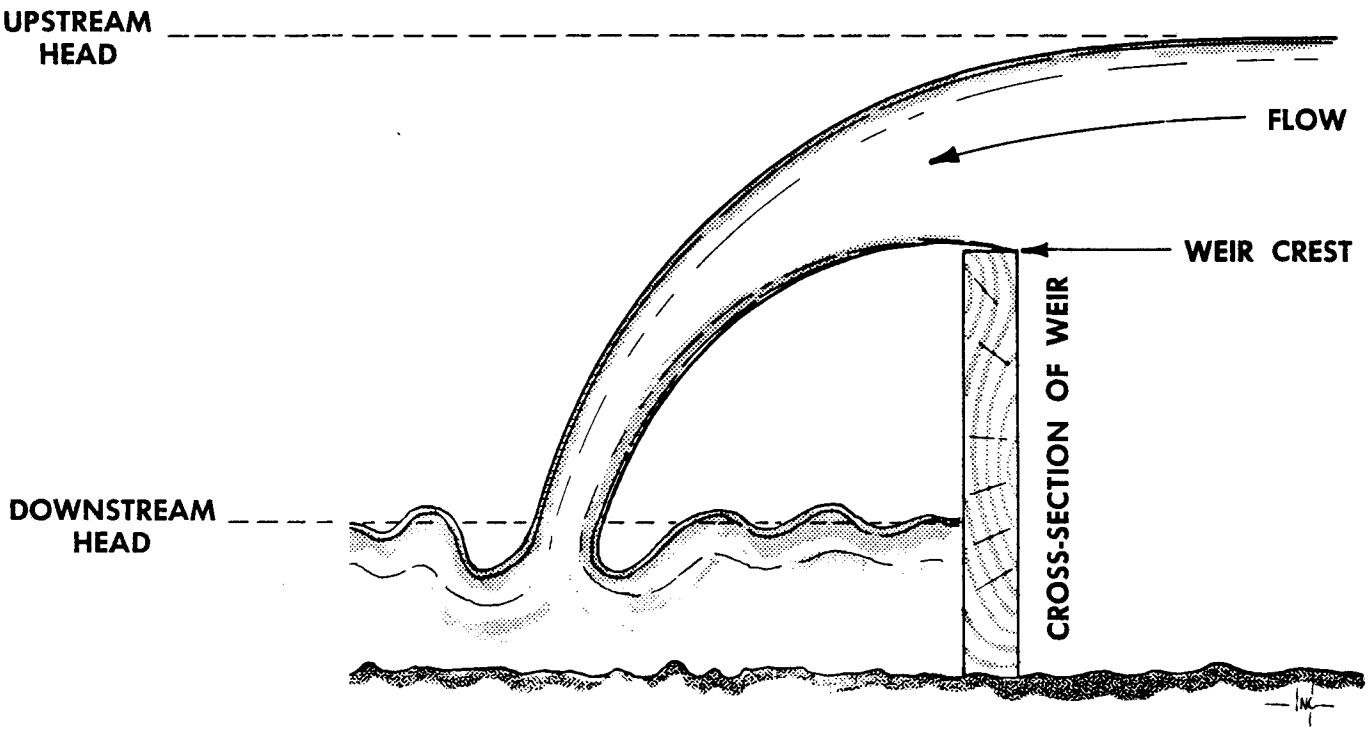
FREE-FLOWING WEIR MEASUREMENTS

The *Clausen Improved Weir Rule* is used in measuring water flow over two types of weirs: free-floing and submerged. We will deal with the free-flowing measurement first, since this provides a basis for submerged weir measurement.

A free-flowing weir is an obstruction to water flow over which water at an upstream level falls freely to a downstream level lower than the height of the weir crest. (There should be free access to air under the falling water column.)

FREE-FLOWING WEIR

FIG. 1



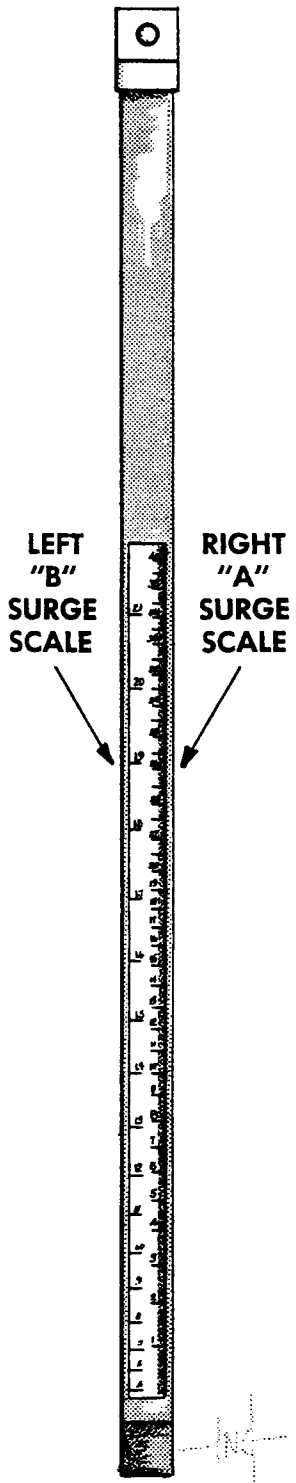
Measuring water flow over a free-flowing weir was once a problem because of the cost and technical difficulty involved in obtaining:

1. The head of the water on the weir.
2. The velocity of the water approaching the weir.

The *Clausen Improved Weir Rule* has outmoded the stilling wells, current meters, and other devices used for determining these factors. By utilizing the principal of surge, it makes measuring water flow over a free-flowing weir a simple matter of taking one reading on a graphic scale, which is the basis of the *Weir Rule.*

FREE-FLOWING WEIR MEASUREMENTS

FIG. 2



FIRST STEP

Notice the surge scales on the front of the *Weir Rule.* The right "A" scale and the left "B" scale scale are labeled on Fig. 2 at left. *Only the right "A" scale is used in free-flowing weir measurements.*

Wet the surge scales by dipping them in water.

Sprinkle the surge scales with a light coat of dry dust — the finer and drier the dust the better. The dampened surface of the scales will make this dust adhere to the scales in a thin film.

Now note the collar and clamp on the *closed Weir Rule,* as shown in Fig. 3 at right. Grasp the clamp of the *Weir Rule* in one hand, and grasp the collar just below it in the other. Extend the *Weir Rule* by pulling these two members about a foot apart. Fig. 4 shows the *Weir Rule* in the extended position.

FIG. 3

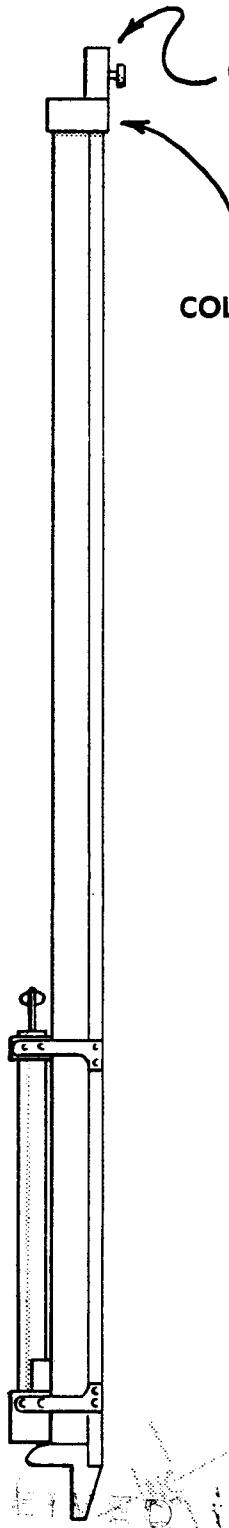
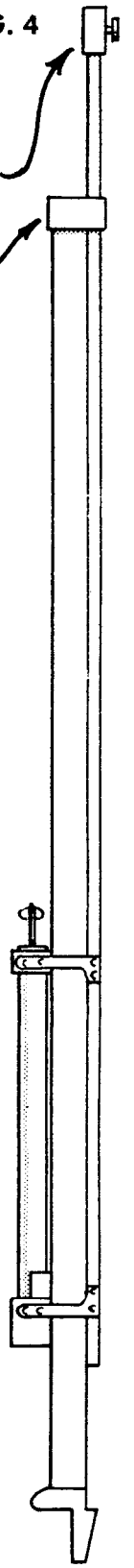
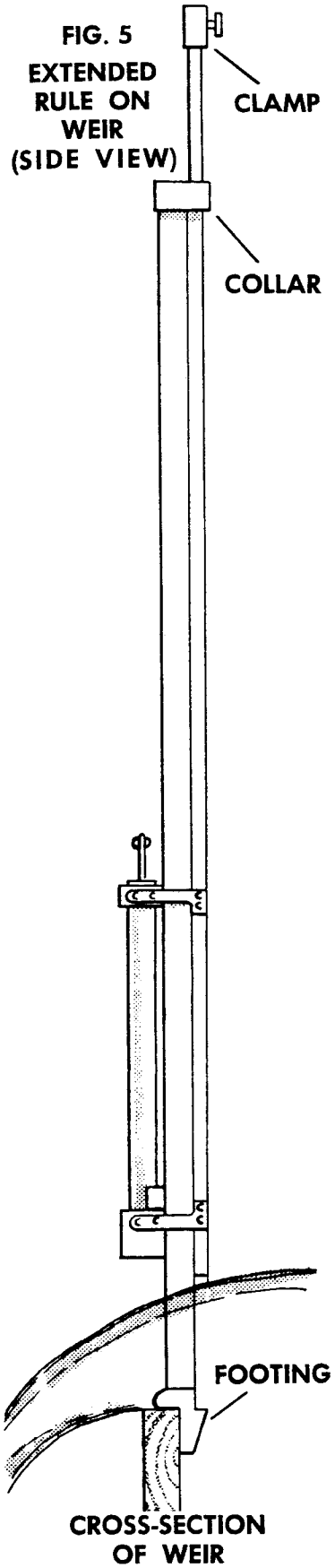


FIG. 4



FREE-FLOWING WEIR MEASUREMENTS

FIG. 5
EXTENDED RULE ON WEIR (SIDE VIEW)



SECOND STEP

Place the footing of the extended *Weir Rule* on the approximate center of the weir crest so that the surge scale faces upstream. Fig. 5 shows how the Weir fits in the notch of the footing on the *Weir Rule.*

With the *Weir Rule* still on the weir crest, close the *Weir Rule* by pushing the clamp down to its original position on the collar, as shown in Fig. 6.

The flowing water will now surge up on the surge scale and wash away part of the dust coat put on the scale. Notice the surge in Fig. 6.

(If the *Weir Rule* had not been extended before being placed on the weir crest, a slip in placing the footing on the crest might have washed away the dust at such a height as to give an inaccurate result.)

After a few seconds remove the *Weir Rule* from the water.

FIG. 6
CLOSED RULE ON WEIR (SIDE VIEW)

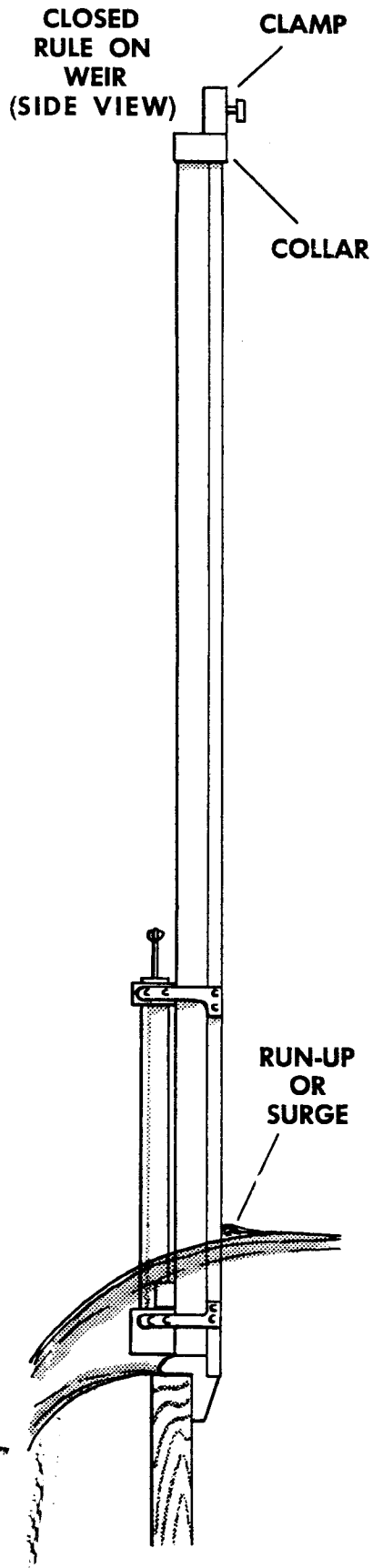
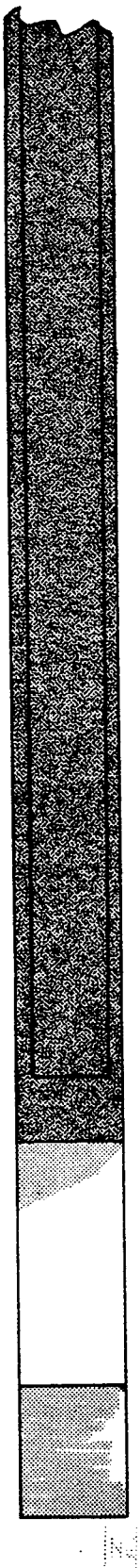
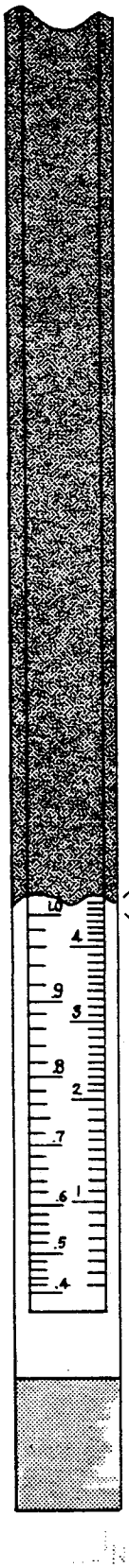


FIG. 7



RULE WITH DUST COAT, EXTENDED

FIG. 8



RULE AFTER SURGE CLOSED

THIRD STEP

You will note that the surge scales, formerly covered with a coat of dust (as shown in Fig. 7), are now partially washed clean by the water (as shown in Fig. 8). The surge of water up the face of the *Weir Rule* cleaned the scale to a definite line. This line is called the run-up line or surge line. Take a reading on the right "A" scale at the *highest* point the surge cleaned the surge scale of its dust coating.

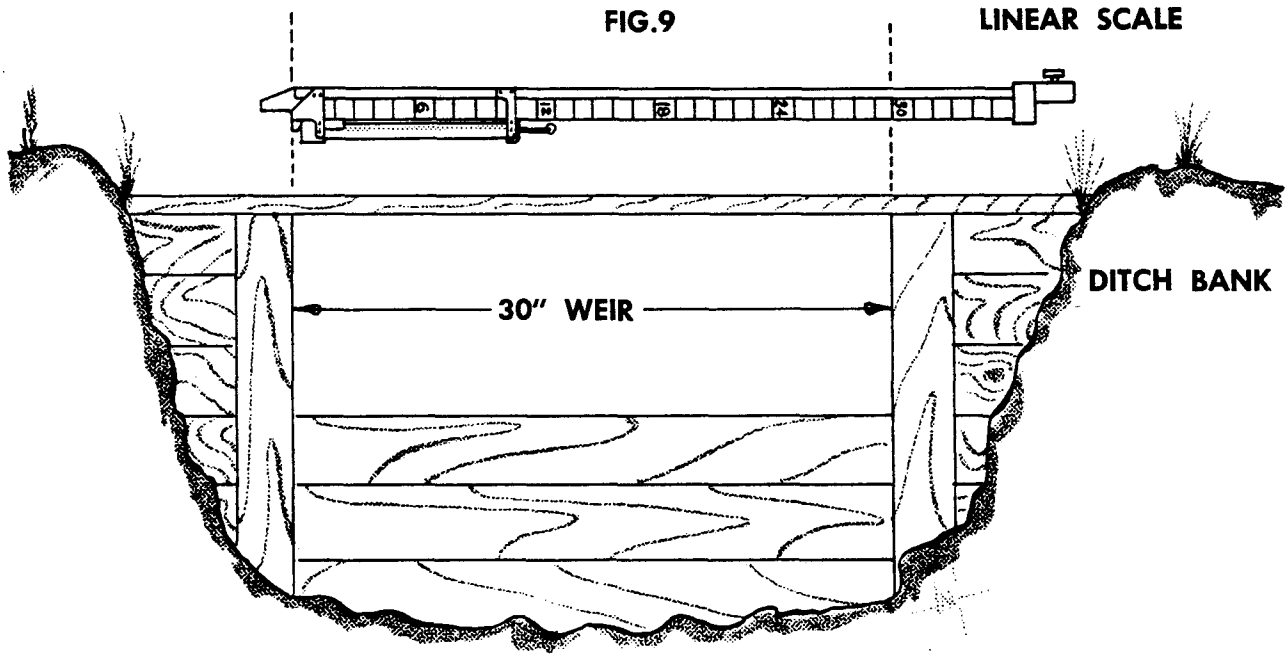
On the illustration at right (Fig. 8) the water washed away the dust to a run-up line that gives a reading of 4.8 on the "A" scale.

FREE-FLOWING WEIR MEASUREMENTS

FOURTH STEP

This "A" scale reading is the flow over the free-flowing weir in Arizona Miner's Inches per inch of weir length. *(The Arizona's Miner's Inch equals 1/40th of a cubic foot per second.)* To measure the inches of weir length, the measuring scale on the side of the *Weir Rule* is used. Note this scale in Fig. 9 below — it is on the side of the footing rod, and thus is entirely separate from the surge scales previously used.

Using this scale, as shown in Fig. 9, measure the length of the weir. The illustration shows that the notch of the footing is the bottom edge of the measuring scale, the zero point for all linear measurements made with the *Weir Rule.*



FIFTH STEP

Thus, from Fig. 8, if the "A" scale reading is 4.8, and from Fig. 9, if the weir length is 30", then the total flow is computed as follows:

"A" scale reading Fig 8	X	Weir Length Fig. 9	=	Total Flow
4.8	X	30	=	144.0 Miner's inches

To convert this to CFS divide by 40: $\frac{144}{40}$ = 3.6 Cubic feet per second.

The reason for use of the Arizona Miner's Inch instead of second-feet is explained on page 13.

SUBMERGED WEIR MEASUREMENTS

A submerged weir is an obstruction over which water flows to a downstream level higher than the weir crest. Note that in the free-flowing weir the downstream level is lower than the weir crest, Fig. 11, while in the submerged weir the downstream level is higher than the weir crest, Fig. 10.

FIG. 10

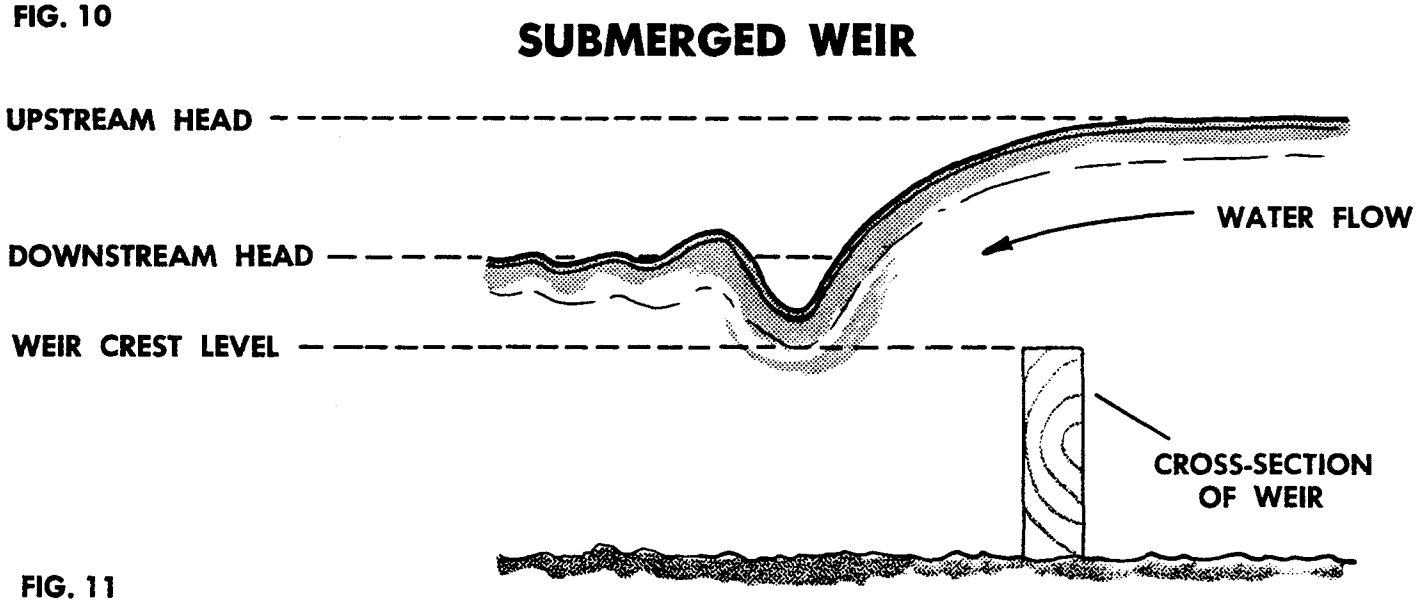
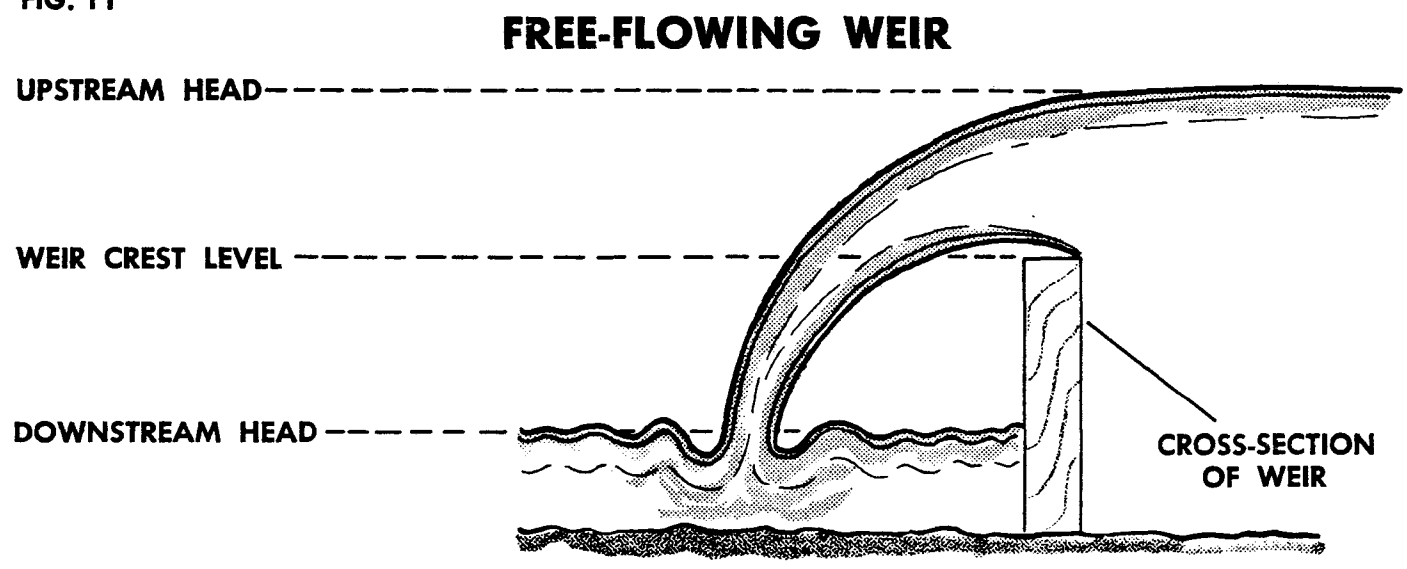


FIG. 11



Heretofore the measuring of water flow over a submerged weir in the field has been considered a very difficult engineering problem. The services of a skilled hydraulic engineer were necessary to measure flow over such a structure. This has been unfortunate for irrigation projects because the submerged weir has an important advantage over a free-flowing weir: water loses very little head in passing over a submerged weir, and because of this small loss, the submerged weir is the most inexpensive structure that it is possible to build and maintain.

The *Weir Rule* solves the problem of measuring water flow over a submerged weir. Because of this, it is possible to measure water even in the farmer's ditch where there can be almost no head loss. Furthermore, the *Weir Rule* functions almost as well where the ditch is fouled with weeds and obstructions as it does in a clean channel.

SUBMERGED WEIR MEASUREMENTS

FIG. 12

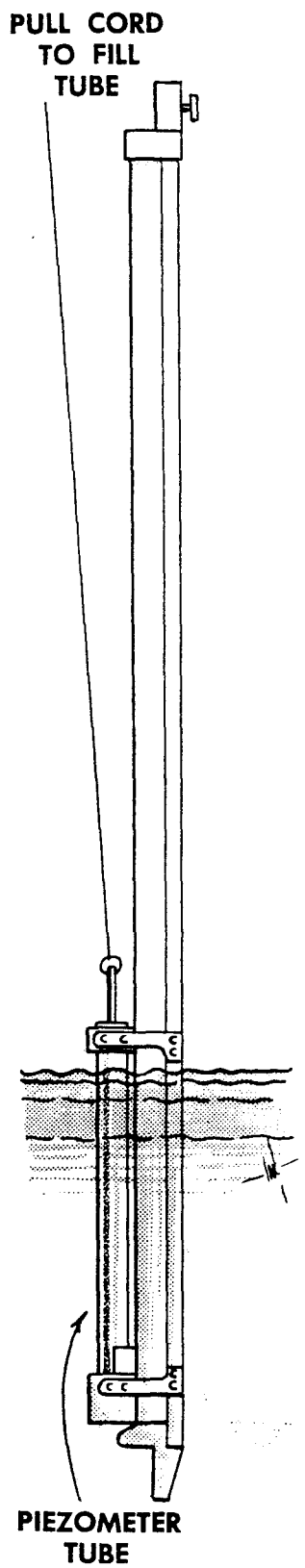
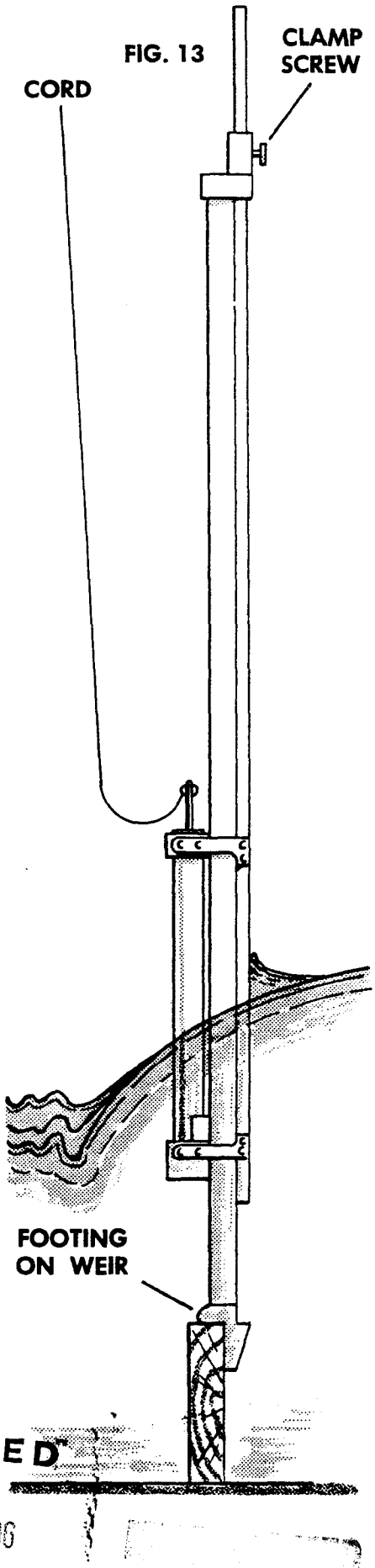


FIG. 13



FIRST STEP

Fill the piezometer tube with water by partially submerging the *Weir Rule* and pulling on the cord attached to the needle valve, as shown in Fig. 12 at left.

(Experienced operators learn to save time by filling the tube the minimum amount necessary to make the measurement.)

Release the cord, thus closing the valve, and remove the *Weir Rule* from the water. Observe that the water has remained in the piezometer tube.

SECOND STEP

Place the footing of the *Weir Rule* on the center of the weir crest with the surge scales facing upstream and the piezometer tube facing downstream. Fig. 13 at right shows how the weir fits in the notch of the footing.

Grasping the clamp in one hand and the collar just below it in the other, extend the *Weir Rule* by pulling these two members apart. Extending the *Weir Rule* will raise the piezometer tube up from the weir crest. By moving this clamp up and down, submerge the bottom of the tube until it is about two or three inches beneath the *downstream* water level.

Holding the *Weir Rule* just below the collar so that it remains extended as just positioned, release the clamp screw and slide the clamp down until it is seated on the collar. Tighten it there so that the piezometer tube is held securely in its required position.

SUBMERGED WEIR MEASUREMENTS

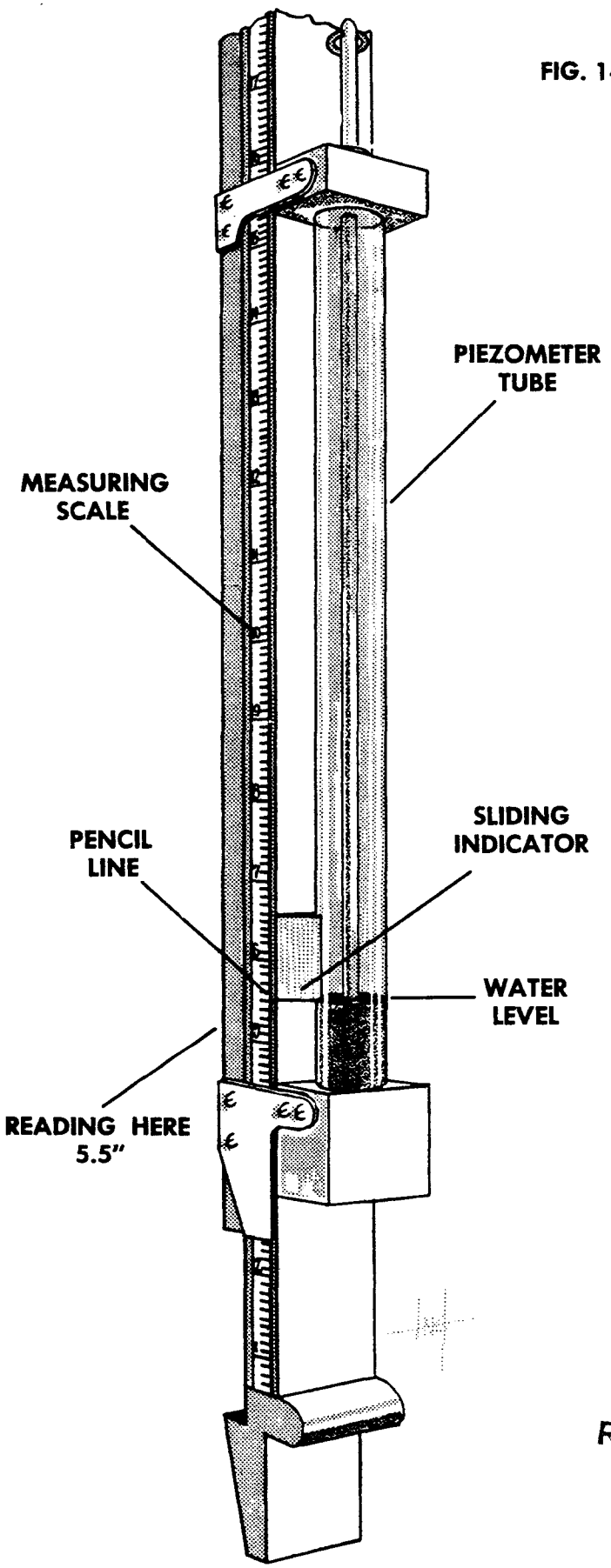


FIG. 14

THIRD STEP

With the *Weir Rule* still on the weir crest, pull the cord attached to the piezometer tube valve. This will permit the water in the tube to *flow out* until itis at the level of the downstream head. When the water ceases to escape, that is, in about a half minute, release the tension on the string — thus closing the valve. Remove the *Weir Rule* from the weir crest.

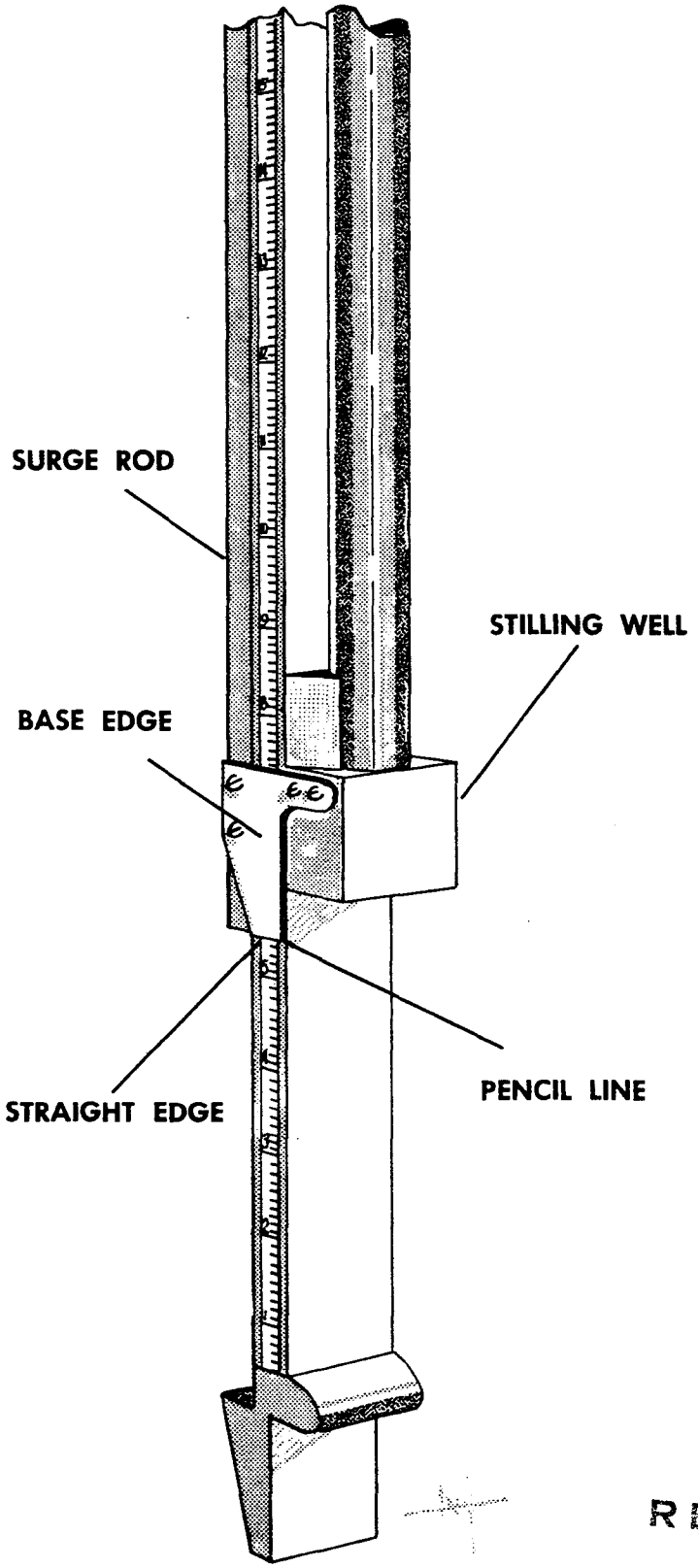
FOURTH STEP

In this step you use the measuring scale and the sliding indicator. Notice the measuring scale shown in Fig. 14 — it is on the side of the footing rod. Notice also the sliding indicator illustrated. This indicator slides up and down between the piezometer tube and the footing rod.

Hold the *Weir Rule* perpendicularly with the measuring scale side facing you, and with the *Weir Rule* still clamped in position. The water level in the piezometer tube is labelled in the illustration. This is the level you are to measure on the measuring scale. In this case it is between 5" and 6". Move the sliding indicator up until its bottom edge is even with the water level in the tube, just as shown in Fig. 14.

Using the bottom edge of the sliding indicator in its present position as a marker place a short, straight pencil line at the water level on the footing rod near the measuring scale. Then record the height of the water in the piezometer tube. In Fig. 14 the reading is 5.5".

FIG. 15



FIFTH STEP

Notice the base edge close to the bottom of stilling well in Fig. 15. It is the plate that connects the stilling well to the surge rod, as shown in the illustration. This plate is called the base edge because of the straight-edge at its base. This straight edge marks the theoretical base of the surge scales — this can be seen by noticing that it is on the same level as the bottom of the surge rod.

Extend the *Weir Rule* until the straight edge is above the pencil line made in the Fourth Step. Then slowly close the *Weir Rule* until the straight edge just covers the pencil line.

Holding the *Weir Rule* firmly so that the base edge will not move, release the clamp screw, and slide the clamp down until it is seated on the collar. Tighten the clamp screw.

The careful observer will note that the purpose of the previous steps has been, first, to measure the height of the downstream water level, and then, to position the surge scales so that their base is at this same height.

SUBMERGED WEIR MEASUREMENTS

FIG. 16

RULE WITH DUST COAT OVER-EXTENDED

SIXTH STEP

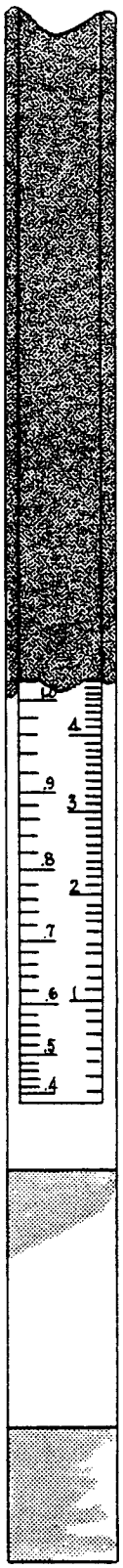
With the *Weir Rule* in this clamped, extended position, the surge scales are dipped in the water and sprinkled with a light coat of dry dust. Over-extend the *Weir Rule,* as it is called, by again separating the clamp and collar. (Caution: Be sure that the tightened clamp remains clamped to the surge rod, just as you tightened it in Step 5. Merely separate the collar and the clamp.) This is done so that when you place the footing on the weir crest, a slip will not wash away the dust coat in the wrong place. When the *Weir Rule* is placed on the weir crest, re-seat the clamp on the collar by pressing the two together. The *Weir Rule* is again in the extended position.

Water will run up on the surge scales and wash away the dust, leaving a line at the point where readings are to be taken. Take readings from both the "A" scale and the "B" scale.

Fig. 16 shows the *Weir Rule* in the over-extended position with the dust coat.

Fig. 17 shows the *Weir Rule* in the extended position after the surge has washed away part of the dust coat to a sharp run-up line. Notice that the "A" scale reading is 4.8 and the "B" scale reading is 1.02.

FIG. 17



RULE AFTER SURGE EXTENDED

SUBMERGED WEIR MEASUREMENTS

SEVENTH STEP

The reading from the "B" scale is multiplied by the downstream head, which was previously recorded. The reading from the free-flowing "A" scale is added to the product of the "B" scale and the lower head, and the sum is multiplied by the length of the weir.

Thus if the downstream head was 5.5", as shown in Fig. 17, and the length of the weir was 30", as shown in Fig. 9

"B" scale reading Fig. 17	X	Downstream head Fig. 14	=	Unit orifice flow
1.02	X	5.5	=	5.61

This product, 5.61, is added to the "A" scale reading,

Product from above	+	"A" scale reading	=	Unit total flow
5.61	+	4.8	=	10.41

This sum, 10.41 is multiplied by the weir length, 30", and the result is the total flow in Arizona miner's inches.

Sum from above	X	Weir length	=	Total flow
10.41	X	30	=	312.1 Arizona miner's inches

To convert this to CFS divide by 40:

$$\frac{\text{312.3 Arizona miner's inches}}{40} = \text{7.81 CFS (second-feet)}$$

Or, if it is preferred, the miner's inches may be converted to GPM by multiplying by 11.22, as follows:

312.3 miner's inches	X	11.22	=	3504 GPM

The second foot (cubic foot per second) is such a large unit of measuring that its use on a Weir Rule would result in readings involving three place decimals; e.g., 0.012 second feet. The Weir Rule is calibrated in Arizona miner's inches because this unit lends itself to easier reading and simpler handling. The Arizona miner's inch is 1/40 of a second foot, and if the discharge is required in second feet all that is necessary is to divide the miner's inch result by 40 to get second feet.

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Larry Sheets
Certificate Unit

DATE: April 13, 1996

FROM: Matt A. Scherer MAS
Water Conservation Engineer

RE: Proposed Findings and Order regarding metering and conservation for File No. 7571

I looked over the Findings and Order that would require a conservation plan and metering system for Quivira Wildlife Refuge, and my old memo about the issue, and have the following suggestions. I'll list my suggestions in order because I think we need to add a couple of Findings.

Finding 1 No change

Finding 2 No change

New Finding 3:

3. That K.S.A. 82a-706c provides that "[t]he chief engineer shall have full authority to require any water user to install meters, gages, or other measuring devices, which devices he or she or his or her agents may read at any time, and to require any water user to report the reading of such meters, gages, or other measuring devices at reasonable intervals."

Finding 3 Becomes Finding No. 4, modified as follows:

4. That water flow measurement structures and devices for the purposes described in Finding No. 1 should be installed and maintained at Quivira National Wildlife Refuge; that the Chief Engineer should review plans for the structures and devices to be installed prior to construction; that the structures and devices should not be installed until the Chief Engineer has approved the plans for the same.

Finding 4 Delete

New Finding 5:

5. That K.S.A. 82a-733a provides that "[t]he chief engineer may require . . . the owner of a water right . . . to adopt and implement conservation plans and practices."

GMD 5

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 South Kansas Avenue, 2nd Floor
Topeka, Kansas 66612-1283
(913) 296-3717 FAX (913) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

April 10, 1996

TERRY GROSZ
ACTING REGIONAL DIRECTOR
FISH AND WILDLIFE SERVICE
U S DEPARTMENT OF THE INTERIOR
P O BOX 25486
DENVER FEDERAL CENTER
DENVER CO 80225

Re: Appropriation of Water,
File No. 7,571
BA WTR
WR KS
Mail Stop 60189

Dear Mr. Grosz:

Thank you for your recent letter regarding the draft Certificate of Appropriation for the above referenced file. I appreciate the U. S. Fish and Wildlife Service's interest in appropriately determining the extent of the Quivira Refuge water right and your desire to work within the procedures established by Kansas law to fulfill your obligations as a water right holder.

Upon review of the above referenced file and the information included in your letter of February 7, 1996, it appears that a Certificate of Appropriation can and should be issued. Therefore, enclosed is a final Certificate of Appropriation for File No. 7,571. The Water Appropriation Act requires that the original certificate of appropriation shall be recorded in the office of the Register of Deeds in the county or counties wherein the point of diversion is located as other instruments affecting real estate. You should record the certificate in the Register of Deeds office at your earliest convenience so that it becomes a matter of record to protect your right. A duplicate copy of the certificate has been placed on file in this office.

Based upon the information provided in your February 7, 1996, 1987 water use records for File No. 7,571 have been modified to reflect actual diversions of 1,861.1 acre-feet as the diversion you noted as DC-A and 11G1. This correction of 1987 water use is also reflected in the enclosed Certificate of Appropriation.

Also corrected from the most recent draft Certificate sent to you in our letter of December 22, 1995, is a legal description for one of the three authorized points of diversion. This error was discovered by my staff during final review of the file.

However, while I have chosen to issue the Certificate of Appropriation, I also want to further address the concerns expressed in your letter.

You suggested that our handling of perfection of water rights and issues related to abandonment of rights was inconsistent and that the concept of "due and sufficient cause" for failure to put water to use ought to extend to certification. These are two separate and generally unrelated issues. A "permit and approval of application" is a document approving the applicant's plan to use water as set forth in the application. This permit authorizes the applicant to proceed with the construction of diversion works and attempt to use water in accordance with the terms of the permit. As you noted in your letter, this plan is based upon estimates provided by the applicant and the Division's evaluation of the appropriateness of those estimates at the times the application is reviewed. Once these estimates are agreed upon by the applicant and the Chief Engineer, the applicant is given permission to construct the diversion works and put water to the intended use. It is this process of putting water to use which will ultimately determine the extent of the actual water right. This process of developing a water right, which is called "perfection," is fundamental to western water law in general and Kansas law in particular. Simply certifying the quantity approved in the original permit for all water rights would not be consistent with my statutory duties under the Kansas Water Appropriation Act.

To reiterate, every appropriation of water in Kansas must be properly developed by the actual application of water for the approved use during a reasonable time period in accordance with the terms of the permit. The maximum annual quantity of water determined to have been put to beneficial use during the perfection period defines the maximum extent of the water right. The process of perfecting a water right is one of determining how much water was actually used to operate the project (the Refuge in this case). A water user generally can not abandon a water right during the perfection process.

As you noted, I have stated numerous times, and still hold, that Kansas statutes, rules and regulations forbid me from issuing a Certificate of Appropriation for more water than was beneficially used in any year during the perfection period. As you also noted, this standard is clearly stated in the original Permit to Appropriate Water. The reading of the Kansas rules and regulations (specifically, K.A.R. 5-3-8) proposed by the Service in a letter dated August 23, 1994, and repeated in your most recent letter, that the Chief Engineer can issue a Certificate for either the amount of water diverted or the amount permitted is neither legally, nor grammatically, correct.

The suggestion that the Service suffered significant impairment of its right to divert water during 1987 is difficult to accept given the stream flow records of that year at the U. S. Geological Survey's gage located near Zenith, at the point the Rattlesnake Creek enters Quivira Wildlife Refuge. The records show

that 47,357 acre-feet of water passed the gaging station in 1987 and 41,065 acre-feet of that water passed the gaging station flowing at a rate below 300 cubic feet per second, the maximum rate of diversion under File No. 7,571.

From all the records provided to us by the Service and collected by Division staff during the process of determining the extent of water right perfected, it appears that water was available at the Quivira Wildlife Refuge in 1987 to meet the Refuge needs. Ascertaining this quantity of water is the fundamental purpose of the perfection process and this quantity of water is legally the maximum quantity that can be certified. Your letter of February 7, 1996, suggests that the quantity of water that "could" have been used in the twelve ponds not managed for wildlife for maintenance reasons ought to be included in the Certificate. This is unacceptable for the same reason that I can not certify an irrigation right for water that "might" have been used if all the land authorized had been irrigated in a year when only part of the land was irrigated.

Finally, you summarized as the Service's position that the State of Kansas could not "overappropriate the stream-aquifer system, and then limit the Refuge's senior water right to the volume of water physically available because of interference by junior users." As noted above, the amount of water available to the Refuge in 1987 was 1.8 times the maximum quantity of water authorized by the Permit to Appropriate Water. From the water use records the Service submitted to the Division it is not possible to determine if water was continually available when needed at the refuge during 1987, but it certainly does not appear, from the available records, that the Refuge suffered from inadequate water or that there was an unreasonable decrease in streamflow to the refuge in 1987. As you know, Kansas Water Law does provide a mechanism to prevent impairment of senior water rights, but that does not necessarily mean that the natural flow of a stream will continually be available for use when an appropriator desires, no matter what priority date the appropriator holds.

Further, our office is committed to resolving overall concerns regarding the conservation, management and use of both surface water and groundwater in the Rattlesnake Creek basin. We are accomplishing this through the sub-basin Water Resources Program with the cooperation of various interested parties, such as your agency. We are also utilizing existing regulatory and management programs of the division and the Big Bend Groundwater Management District. For example, I would call your attention to the modifications and additions to the District, which will be effective May 20, 1996 (copy enclosed).

Finally, I would also note that you could file a new application for permit to appropriate surface water from the excess flows of Rattlesnake Creek in the event the quantity of water certified herein is not adequate for your future needs so that additional water could potentially be diverted when water is available. While I can not pre-determine action on such an application, if it were to be filed, it certainly would be given consideration.

I have chosen to issue the enclosed Certificate of Appropriation on the basis that, aside from the correction in 1987 water use offered and incorporated in the Certificate, no new information pertinent to the process of perfecting and certifying the water right was included in your letter of February 7, 1996. As no new information appears to be available, it is my responsibility to issue the Certificate. If you or your staff wish to discuss issues that might not have been clarified here, please feel free to contact Division staff, especially Bruce Falk, Lee Rolfs or Larry Sheets.

Any appeal of the issuance of this Certificate of Appropriation must be filed with the appropriate district court within 30 days of the date of this letter. In filing such an appeal, a copy of the petition for judicial review must be served on David L. Pope, Chief Engineer of the Division of Water Resources, Kansas Department of Agriculture.

Records to indicate the amount of water used should be furnished to the Chief Engineer by March 1 following the end of the previous calendar year so that the continued use of water becomes a matter of record in this office.

Sincerely,

David L. Pope

David L. Pope, P.E.
Chief Engineer

DLP:LMS:jt
Enclosure
pc: Groundwater Management District No. 5
Cheryl C. Williss, Chief Water Resources Division, USFWS, Denver
Leland Rolfs, Senior Legal Counsel
Guy Ellis, Water Rights Section
Bruce Falk, Water Commissioner, Stafford Field Office
Larry Sheets, Certificate Unit
Matt Scherer, Conservation Engineer

Kansas State Board of Agriculture
Division of Water Resources

5-19-93 jt

CERTIFICATE WORKSHEET

1. File No	2. Field Office	3. GMD
7571	#2	#5

4. Instruction for transmittal letter(s):

United States Dept. of Interior
Fish and Wildlife Service
P.O. Box 25486
Denver Co., 80225

~~attention Cheryl Williss~~

5. C - 3 Letter ____ Modified C - 3 Letter ✓ (see attached or below)

Ownership Paragraph A D above
(If C, see attached or below)

Drainage Basin Paragraph yes / (no) Old Basin
Old Stream
New Basin
New Stream

Chemigation Paragraph yes / (no) / modified

Prorate Paragraph A / B / Modified (see attached or below)

pc: Needed in addition to FO

6. Certificate Transmittal Letter ✓ Modified Certificate Transmittal Letter ____ (see attached or below)

Ownership Paragraph D Same as 5
(If C, see attached or below)

Extension of Time Required (yes) / no Paragraph A Year 1987

If C, requested by:

Overpump Paragraph yes / (no)

pc: Needed in addition to FO and GMD

7. W U R Correspondent: Same as 4

8. Additional Information or Instructions:

insert in both letter as third paragraph

Please be aware, the diversion rate and quantity of water defined in the Certificate of Appropriation are for maximum conditions. The available water in most years will not facilitate utilization of water to that extent. Management plans for the refuge Area should be based on probable flows in Rattlesnake Creek.

RECEIVED
APR 26 1996
DIVISION OF WATER RESOURCES
STAFFORD FIELD OFFICE

4-16-03 jat

Date Prepared 1/17/93 by MBF
Date Entered 4-10-96 by BJB

DWR 1-662 (Revised 06/11/90)

MICROFILMED

Natural flows

File No. 7571 Priority Date August 15, 1957 Stream ~~Drainage Basin~~ of ~~the~~ Rattlesnake Creek

9. Point(s) of Diversion ☐ G ☒ S

MOD ENT DEL	ID	Qualifier	S	T	R	'N	'W
Mod	01	NC	SW¼	25	22	11W	1250	3850
Mod	01	SW	NE	NE	13	22	11W	4450	1000
Mod	01	SW	SE	NE	35	21	11W	3100	1150

Rate & Quantity

Authorized Rate gpm	Authorized Rate (cfs)	Authorized Qty (af/~~mgy~~)	Additional Rate gpm	Additional Rate cfs	Additional Qty af/mgy	Overlap PD Files	CHG ?
	300 cfs	14,632 AF	—	—		None	No
	134,640 gpm						

Remove storage

Stafford County

Recreational Use

10. Limitation? (No,) remove ____; Yes, as is ____; Yes, modify to _____ af/yr _____ gpm _____ (c.f.s.) when combined with _____

11. Place of Use

MOD (ENT) DEL	ID	S	T	R	NE¼ NE¼	NE¼ NW¼	NE¼ SW¼	NE¼ SE¼	NW¼ NE¼	NW¼ NW¼	NW¼ SW¼	NW¼ SE¼	SW¼ NE¼	SW¼ NW¼	SW¼ SW¼	SW¼ SE¼	SE¼ NE¼	SE¼ NW¼	SE¼ SW¼	SE¼ SE¼	Total
	*		21	11W	Section 13, 15, 21 through 24, 32 thru 36																
			22	11W	Section 1 thru 5, 11 thru 14, 23 thru 26, 35, 36																
		18	21	10W	31 sections above sec 18 along rattlesnake Creek Quivira																
		30	22	10W	National Wildlife Refuge																

Owner	Chg?	Overlap Files	Chg?
4a	No	None	No

12. Comments

* Place of use is large - listed in separate memo with Field Inspection.

Year of Record 1987 Max and Rate Normal 300 cfs - Retest None

13. File No. _____

134,640 gpm

14. Date Certificate Issued: 4-~~9~~-96

15. Certificate No. _____

THE STATE OF KANSAS

DUPLICATE COPY

KANSAS DEPARTMENT OF AGRICULTURE
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

CERTIFICATE OF APPROPRIATION FOR BENEFICIAL USE OF WATER

Water Right, File No. 7,571
Priority Date August 15, 1957

WHEREAS, It has been determined by the undersigned that construction of the appropriation diversion works has been completed, that water has been used for beneficial purposes and that the appropriation right has been perfected, all in conformity with the conditions of approval of the application pursuant to the water right referred to above and in conformity with the laws of the laws of the State of Kansas.

NOW, THEREFORE, Be It Known that DAVID L. POPE, the duly appointed qualified and acting Chief Engineer of the Division of Water Resources of the Kansas Department of Agriculture, by authority of the laws of the State of Kansas, and particularly K.S.A. 82a-714, does hereby certify that, subject to vested rights and prior appropriation rights, the appropriator is entitled to make use of natural flows of Rattlesnake Creek to be diverted at three (3) points:

One (1) point located in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW¼ SE¼ NE¼) of Section 35, more particularly described as being near a point 3,100 feet North and 1,150 feet West of the Southeast corner of said section,

in Township 21 South, Range 11 West, Stafford County, Kansas, and

one (1) point located in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW¼ NE¼ NE¼) of Section 13, more particularly described as being near a point 4,450 feet North and 1,000 feet West of the Southeast corner of said section,

in Township 22 South, Range 11 West, Stafford County, Kansas, and

one (1) point located near the center of the Southwest Quarter (SW¼) of Section 25, more particularly described as being near a point 1,250 feet North and 3,850 feet West of the Southeast corner of said section,

in Township 22 South, Range 11 West, Stafford County, Kansas,

at a combined maximum diversion rate not in excess of 300 cubic feet per second and a quantity not to exceed 14,632 acre-feet of water per calendar year for recreational use. Such quantity can subsequently be stored and accumulated in marsh areas within the Quivira National Wildlife Refuge, to the extent perfected by December 31, 1987, located on the following described property:

The South 80 acres of the Southeast Quarter (SE¼) of Section 15; the South Half (S½) of Section 14; the Northeast Quarter (NE¼), Southwest Quarter (SW¼) and Southeast Quarter (SE¼) of Section 21 and 29; and all of Sections 13, 22 through 28, and 32 through 36 in Township 21 South, Range 11 West;

and all of Section 1 through 5, 11 through 14, 23 through 26, and Section 35 and 36 in Township 22 South, Range 11 West;

and all of Sections 1 and 2 in Township 23 South, Range 11 West,

all in Stafford County, Kansas, and

Section 18 in Township 21 South, Range 10 West, in Rice County, Kansas;

and Section 30 in Township 22 South, Range 10 West, in Reno County, Kansas.

The appropriator shall maintain in an operating condition, satisfactory to the Chief Engineer, all check valves installed for preventing chemical or other foreign substance likely to cause pollution of the water supply.

The appropriator shall maintain records from which the quantity of water actually diverted during each calendar year may be readily determined. Such records shall be furnished to the Chief Engineer by March 1 following the end of the previous calendar year.

The appropriation right shall be deemed abandoned and shall terminate when without due and sufficient cause no lawful beneficial use is made of water under this appropriation for three (3) successive years.

The right of the appropriator shall relate to a specific quantity of water and such right must allow for a reasonable raising or lowering of the static water level and for the reasonable increase or decrease of the stream flow at the appropriator's point of diversion.

IN WITNESS WHEREOF, I have hereunto set my hand at my office at Topeka, Kansas, this 9th day of April ,1996.

DIVISION OF WATER RESOURCES
DAVID L. POPE
CHIEF ENGINEER
KANSAS DEPARTMENT of AGRICULTURE

David L. Pope, P.E.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture

State of Kansas, Shawnee COUNTY, SS

The foregoing instrument was acknowledged before me this 9th day of April , 1996, by David L. Pope, P.E., Chief Engineer, Division of Water Resources, Kansas Department of Agriculture.

DENISE J. ROLFS
NOTARY PUBLIC
My Appt. Exp. 3-1-98
STATE OF KANSAS

Notary Public

My appointment expires:

(Record in the Office of Register of Deeds in the county or counties wherein the point of diversion is located)

CERTIFICATE OF APPROPRIATION
FOR BENEFICIAL USE OF WATER

STATE OF KANSAS

Water Right, File No. 7,571

STATE OF KANSAS, ____ COUNTY, ss.

Filed for record this ____ day of ____, 19____

at ____ o'clock ____ m. and

Recorded in Book ____ Page ____

Fee $ ____

Register of Deeds.

New Finding 6:

6. That the Rattlesnake Creek may be insufficient, during times of drought, to provide a supply of water sufficient to meet the needs of all water users dependent upon the Creek.

Finding 5 Becomes Finding No. 7 except that the word "required" in the second line should become "reasonable".

Finding 6 Becomes Finding No. 8 rewritten as follows:

8. That for the reasons noted in Findings No. 6 and No. 7, and to avoid waste of water, minimize unnecessary losses and optimize efficient use of water for the authorized purpose, it is for the public benefit and in the public interest to require that a Water Conservation Plan be developed for the Quivira National Wildlife Refuge.

I have a couple of suggestions for the Order also. In the fourth line, it reads a little better to say ". . . measurement structures and a monitoring system . . .". Also, I think we should include our regular phrase regarding authorized extensions of time after each of the deadline dates. In particular, the July 31, 1997 date is unrealistic unless they submit the plan well ahead of December 30 and we review and approve the plan rapidly.

Thanks for letting me take a look at the Order. I think Bruce Falk might also like to see it before it is signed by the Chief Engineer.

MAS:ms

Kansas State Board of Agriculture
Division of Water Resources

5-19-93 jt

CERTIFICATE WORKSHEET

1. File No	2. Field Office	3. GMD
7571	#2	#5

4. Instruction for transmittal letter(s):

United States Dept. of Interior
Fish and Wildlife Service
P.O. Box 25486
Denver Co., 80225

~~attention Cheryl Williss~~

5. C - 3 Letter ____ Modified C - 3 Letter ✓ (see attached or below)

Ownership Paragraph A D above
(If C, see attached or below)

Drainage Basin Paragraph yes / (no) Old Basin
Old Stream
New Basin
New Stream

Chemigation Paragraph yes / (no) / modified

Prorate Paragraph A / B / Modified (see attached or below)

pc: Needed in addition to FO

6. Certificate Transmittal Letter ✓ Modified Certificate Transmittal Letter ____ (see attached or below)

Ownership Paragraph D Same as 5
(If C, see attached or below)

Extension of Time Required (yes) / no Paragraph A Year 1987

If C, requested by:

Overpump Paragraph yes / (no)

pc: Needed in addition to FO and GMD

7. W U R Correspondent: Same as 4

8. Additional Information or Instructions:

insert in both letter as third paragraph

Please be aware, the diversion rate and quantity of water defined in the Certificate of Appropriation are for maximum conditions. The available water in most years will not facilitate utilization of water to that extent. Management plans for the refuge Area should be based on probable flows in Rattlesnake Creek.

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STAFFORD FIELD OFFICE

4-16-03 jat

Date Prepared 1/17/93 by MBF
Date Entered 4-10-96 by BJB

DWR 1-662 (Revised 06/11/90)

MICROFILMED

Natural flows

File No. 7571 Priority Date August 15, 1957 Stream ~~Drainage Basin~~ of ~~the~~ Rattlesnake Creek

9. Point(s) of Diversion ☐ G ☒ S

MOD ENT DEL	ID	Qualifier	S	T	R	'N	'W
Mod	01	NC	SW¼	25	22	11W	1250	3850
Mod	01	SW	NE	NE	13	22	11W	4450	1000
Mod	01	SW	SE	NE	35	21	11W	3100	1150

Rate & Quantity

Authorized Rate gpm	Authorized Rate (cfs)	Authorized Qty (af/~~mgy~~)	Additional Rate gpm	Additional Rate cfs	Additional Qty af/mgy	Overlap PD Files	CHG ?
	300 cfs	14,632 AF	—	—		None	No
	134,640 gpm						

Remove storage

Stafford County

Recreational Use

10. Limitation? (No,) remove ____; Yes, as is ____; Yes, modify to _____ af/yr _____ gpm _____ (c.f.s.) when combined with _____

11. Place of Use

MOD (ENT) DEL	ID	S	T	R	NE¼ NE¼	NE¼ NW¼	NE¼ SW¼	NE¼ SE¼	NW¼ NE¼	NW¼ NW¼	NW¼ SW¼	NW¼ SE¼	SW¼ NE¼	SW¼ NW¼	SW¼ SW¼	SW¼ SE¼	SE¼ NE¼	SE¼ NW¼	SE¼ SW¼	SE¼ SE¼	Total
	*		21	11W	Section 13, 15, 21 through 24, 32 thru 36																
			22	11W	Section 1 thru 5, 11 thru 14, 23 thru 26, 35, 36																
		18	21	10W	31 sections above sec 18 along rattlesnake Creek Quivira																
		30	22	10W	National Wildlife Refuge																

Owner	Chg?	Overlap Files	Chg?
4a	No	None	No

12. Comments

* Place of use is large - listed in separate memo with Field Inspection.

Year of Record 1987 Max and Rate Normal 300 cfs - Retest None

13. File No. _____

134,640 gpm

14. Date Certificate Issued: 4-~~9~~-96

15. Certificate No. _____

KANSAS DEPARTMENT OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Files

DATE: February 26, 1996

FROM: Larry M. Sheets

RE: Appropriation of Water
File No. 7,571

This memorandum has been prepared to present my recommendations concerning the certification of File No. 7,571 (the water right for Quivira National Wildlife Refuge). The first draft Certificate of Appropriation was transmitted to the Fish and Wildlife Service by letter dated August 18, 1993. Comments regarding the draft were received from the Fish and Wildlife Service in a letter dated November 12, 1993. A memorandum dated January 6, 1994, presents my thoughts regarding the content of the November 12, 1993, letter.

A response to the November 12, 1993, letter concerning the draft certificate was dated December 20, 1994. Our December 20, 1994, letter responded to some of the concerns of the Fish and Wildlife Service and indicated a meeting would be set up.

After a July 25, 1995, meeting by letter dated August 8, 1995, the Fish and Wildlife Service requested a delay in issuing the Certificate of Appropriation until after July 31, 1997. We responded with a December 22, 1995, transmittal of a revised draft Certificate of Appropriation with a review period through January 22, 1996. The review period was extended through February 8, 1996, because of Federal employees being on furlough. A letter from the Fish and Wildlife Service dated February 7, 1996, presents information regarding the use in 1987, presents three (3) "if" situations and asked for a delay in issuance of the Certificate of Appropriation.

The revised use for 1987 indicates a transposition of numbers for one of the points of diversion. The revised numbers indicate an increased use of 45 acre-feet. It is suggested that the quantity per calendar year be revised to 14,632 acre-feet.

The first "if" relates to impairment or if junior appropriator had not been allowed to deplete the available water the service would have fully perfected the approved quantity. There is an attempt to say that unavailable water is good cause for not perfecting the water right.

The second "if" is the use of a computer program with assumptions to show that well pumping depleted the available water by 8,456 acre-feet. It is implied that this depletion should be added to the water used. There is no documentation that the additional water could have been put to beneficial use.

Big Bend Groundwater Management District No. 5

125 South Main • P.O. Box 7 • Stafford, Kansas 67578 • Phone 316-234-5352

February 8, 1996

David L. Pope
Chief Engineer-Director
Division of Water Resources
Kansas Department of Agriculture
109 SW Kansas Ave
Topeka, Kansas

Dear Mr. Pope:

The Board of Directors, Big Bend GMD #5 took the following action regarding the proposed certificate for the Quivira National Wildlife Refuge, United States Fish and Wildlife Service.

With a unanimous vote, the Board of Directors recommends that no further extensions be granted to the United States Fish and Wildlife Service in the perfection of Water File #7571. The Board would like to see the certificate on this water right issued as soon as possible.

If you have questions or comments concerning the action taken, please do not hesitate to call the District office.

Sincerely,

Kevin R Schultz

Kevin Schultz, President
Big Bend GMD #5

cc: LR, GE, LS, MRF, MS

The third "if" is that if maintenance efforts and management plans in 1987 had not been in place a larger quantity of water would have been used. My review of the management plans do not support this contention. Most wet lands management would require dewatering to establish desirable species. It appears the dewatering and refilling would have resulted in a peak level of need. The 1988 plan indicates no effort to maintain pools during the high evaporation times.

It is my recommendation that the Certificate be drafted again with the revised quantity and a correction of a typo in the description of the place of use (the last section contains an extra 9).

A simple statement should be put in the transmittal letter indicating that the if situations do not substantiate use of water. We should allow an additional 30 days to provide any information that will substantiate use within the terms and conditions of the Approval of Application and Permit to Proceed issued May 9, 1963.

Larry M. Sheets
Environmental Scientist

LMS:jt

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RECIPIENT'S COPY

1 Date: 2/7/96

From (Your Name) Please Print: Cheryl Willies
Your Phone Number (Very Important): (303) 236-4773
Company: US FISH & WILDLIFE SERVICE
Department/Floor No.:
Street Address: 134 UNION BLVD STE 201
City: LAKEWOOD State: CO ZIP Required: 80228

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2 To (Recipient's Name) Please Print: David L. Pope
Recipient's Phone Number (Important): ( )
Company: Kansas State Board of Agriculture
Department/Floor No.:
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): 901 S. Kansas Avenue, 2nd Floor
City: Topeka State: KS ZIP Required: 66612-1285 55512-1285

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.)
60889-1261

H IF HOLD AT FEDEX LOCATION, Print FEDEX Address Here
Street Address:
City: State: ZIP Required:

3 PAYMENT 1 ☐ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card
5 ☐ Cash/Check

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Priority Overnight (Delivery by next business morning†)	Standard Overnight (Delivery by next business afternoon. No Saturday delivery†)
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16 ☐ FEDEX LETTER*	56 ☒ FEDEX LETTER*
12 ☐ FEDEX PAK*	52 ☐ FEDEX PAK*
13 ☐ FEDEX BOX	53 ☐ FEDEX BOX
14 ☐ FEDEX TUBE	54 ☐ FEDEX TUBE
Economy Two-Day (Delivery by second business day †)	**Government Overnight** (Restricted for authorized users only)
30 ☐ ECONOMY*	46 ☐ GOV'T LETTER
	41 ☐ GOV'T PACKAGE

* Economy Letter Rate not available. Minimum charge: One pound Economy rate.

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70 ☐ OVERNIGHT FREIGHT** (Confirmed reservation required)
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†Delivery commitment may be later in some areas.
*Declared Value Limit $500.
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5 DELIVERY AND SPECIAL HANDLING (Check services required)

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2 ☒ DELIVER WEEKDAY

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31 ☐ HOLD AT FEDEX LOCATION SATURDAY (Fill in Section H)
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6 ☐ DRY ICE Dangerous Goods Shipper's Declaration not required
Dry Ice, 9, UN 1845, _____ X _____ kg. 904 III
☐ DESCRIPTION
12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

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7 Release Signature:

Emp. No. Date
☐ Cash Received
☐ Return Shipment
☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold
Street Address
City State Zip
Received By: X
Date/Time Received FedEx Employee Number

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Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 12/92
PART #137204 FXEM 6/93
FORMAT #158
158

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

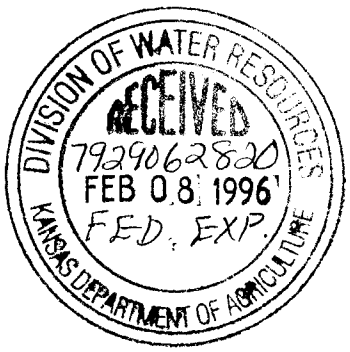
IN REPLY REFER TO:

BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

FEB 7 1996



Mr. David L. Pope
Chief Engineer-Director
Division of Water Resources
901 S. Kansas Avenue, 2nd Floor
Topeka, Kansas 55512-1283

Dear Mr. Pope:

I appreciate your desire to complete the process of issuing the perfected permit for Quivira National Wildlife Refuge (Refuge). However, I feel that I must reiterate the conditions which affected the Fish and Wildlife Service's (Service) ability to use water at the Refuge.

First, I would like to correct the Water Use Report for 1987, the year which your office has used to determine the quantity to be perfected for Permit No. 7571. The Service reported a total use of 10,129.7 acre-feet. However, the Water Use Report filed with the Regional Office in Denver showed total diversions of 10,174.8 acre-feet. The diversion at RC-A was reported correctly as 1,157.5 acre-feet. The diversions at A-1, A-3, and C-1 were reported correctly as 7,156.2 acre-feet. However, the diversions at DC-A and 11G1 were reported as 1,816.0 acre-feet instead of 1,861.1 acre-feet. I have enclosed a copy of the first page of the Refuge's 1987 Water Use Report for your reference. Please correct your records to reflect the actual diversion of 10,175 acre-feet.

The statement accompanying amended application No. 7571, filed in 1962, contained the following information:

> It is estimated that the average annual runoff from Rattlesnake Creek is about 30,000 acre-feet. With this amount of water it is estimated that about 6,000 acres of pond and marsh area can be maintained with a maximum storage of about 15,800 acre-feet. It is estimated that to maintain this amount of water area the annual water requirement will be 22,200 acre-feet per annum.

Construction of Refuge impoundments and canals proceeded slowly, but in accordance with the development plan, and the Service finally advised your office in 1982 that construction was completed. The survey and new area-capacity tables completed in 1992 shows total storage to be 13,246 acre-feet and total surface area of impoundments to be 6470 acres, close to the 1962

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STAFFORD

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estimates. However, the quantity of water available for Refuge management has steadily declined from the 1962 estimate.

You have stated numerous times to Service representatives that Kansas statutes, rules, and regulations prevent you from issuing a Water Right Certificate for more water than has been diverted, and I recognize that the Permit to Appropriate Water issued in 1963 stated that the applicant would not acquire a water appropriation for a quantity in excess of the amount found by the Chief Engineer to have been actually used. Therefore, as you state in your December 20, 1994, letter, "impairment" is not relevant to the perfection process. However, I don't believe that such an interpretation of the statutes, rules, and regulations is justifiable in cases where junior diversions were affecting the amount of water available to the appropriator.

Kansas Rules and Regulations, Water Appropriation Act, at 5-7-1, define "due and sufficient cause" with respect to abandonment to include cases where water is not available from the source for the authorized use at times needed. It does not seem consistent for the Chief Engineer to recognize the unavailability of water as sufficient to excuse non-use of a water right, but unavailability of water because of impairment by junior users is sufficient cause to perfect the Water Right of a senior appropriator for a smaller quantity than the appropriator can demonstrate he needs.

A number of reports in the 1980's documented stream-aquifer interaction and declining aquifer levels. According to information in our files, the Kansas Water Office recognized in 1984 that extensive groundwater appropriations in the Big Bend Prairie Aquifer contributed to extreme low flows in Rattlesnake Creek. In that year, even though rainfall was near normal at 22.54 inches, the Creek dried up completely during September. On October 31, 1986, the Service advised your office that Rattlesnake Creek flows were declining because of increased groundwater pumping and requested an investigation of the problem so that the Refuge water supply could be protected. The response was that the relationship of groundwater diversions to surface water flows was not clearly established so groundwater users could not be regulated. The letter also advised that new groundwater appropriations were being "curtailed" through adoption of a safe yield policy. I have enclosed copies of both letters for your reference.

The Service's review of the appropriations records from your office indicates that in excess of 300,000 acre-feet is currently appropriated as groundwater in this basin. Unless average annual recharge exceeds 4 inches, the basin is overappropriated. Studies currently underway by Kansas Geological Survey (KGS) have found that average annual recharge is less than 2 inches per year, although it can range up to 5 inches in a flood year, such as 1993.

The Service has spent more than $100,000 to fund cooperative studies by KGS to identify the impact of groundwater development on the Refuge water supply. As stated in a previous letter, the groundwater model developed by KGS predicts that well pumping depleted Rattlesnake Creek flows by at least 8,456 acre-feet in 1987. The Service does not yet have the ability to identify how much of this could, and would, have been beneficially used had it been available. The same model also predicts that if pumping continues at the current level,

streamflow will decline by 40 percent by the year 2010 (KGS Open File Report 93-7, page 111). Therefore, the Service's Water Right will be further impaired.

A review of the Refuge's Water Use Report for 1987 reveals that twelve ponds were not managed for wildlife because of the need to dewater them to rehabilitate water control structures. Using the new area-capacity tables, mean evapotranspiration (0.7 * Class A Pan evaporation), and actual precipitation at Hudson, Kansas, my staff has calculated that an additional 1470 acre-feet could have been used on these areas had the construction activity not been necessary. I have enclosed a report by Megan Estep-Johnston documenting this review. Kansas Rules and Regulations also cite cases where physical problems exist with the point of diversion, distribution system, place of use, or the operator as being due and sufficient cause for not declaring the Water Right abandoned. It would be consistent with this rule to add the above quantity of water to the Refuge's reported use.

To summarize, it is the Service's position that the State of Kansas cannot overappropriate the stream-aquifer system, and then limit the Refuge's senior water right to the volume of water physically available because of interference by junior users. I believe that it would be appropriate to delay the perfection process until the water budget model is completed. You are correct that the purpose of the model is to better define the Refuge demands. However, the model will also allow the Service to run those demands using 1987 data to identify how much would have been needed to meet Refuge objectives that year and whether there was sufficient water available at the time it was needed. In the alternative, a certificate could be issued for the original permitted amount, as I believe you are authorized to do under Kansas laws, rules, and regulations.

I appreciate the opportunity to provide these additional comments.

Sincerely,

LARRY GROSZ
Acting Regional Director

cc: Stafford Field Office
Stafford Kansas
Leland Rolfs, Senior Legal Counsel
State of Kansas, Department of Agriculture
Guy Ellis, Water Rights Section Head
State of Kansas, Department of Agriculture
Larry Sheets, Supervisor, Certificate Unit
State of Kansas, Department of Agriculture
Bruce Falk, Water Commissioner
Stafford Field Office
Matt A. Scherer, Conservation Engineer
State of Kansas, Department of Agriculture

1987 WATER USE DATA

I. Water Rights

There has been no change in water rights since 1986. The Service filed Notice of Proof of Completion of Works for Permit # 7571 on July 15, 1982 and requested an inspection of works so that a certificate could be issued. To date, there has been no inspection and no certificate issued. The Service has applied for rights to 22,200 acre feet of water annually.

II. Actual Use

The actual appropriation of water in 1987 from seven diversion points was 10,174.8 acre feet. Figure 1 shows the amount of water diverted at each point for each month of the year. Diverted water was used for storage in impoundments and marshes and to provide flushing action for same. There are no irrigated crops on the refuge and all diverted water was used for wetland management, primarily waterfowl habitat. Figure 2 shows the location of each diversion point.

Figure 1. Monthly Record of Water Usage 1987
Rattlesnake Creek Diversions

Month	A-1	A-3	C-1	DC-A	11G1	RC-A	Total
January	254.4	332	352.4	0	170.5	174.2	1283.5
February	216.9	191.8	205	0	98.1	0	705.8
March *	15	60	0	0	90	0	165.0
April	136.2	0	0	0	0	0	136.2
May	0	104.6	0	0	0	0	104.6
June	0	233.2	20	0	0	196.0	449.2
July	273.0	203.0	0	0	0	26.0	502.0
August	592.0	0	259.5	0	0	0	851.5
September	162.6	10	478.5	0	100	12.3	763.4
October	34.1	316	1013	224	18.3	108.6	1714.0
November	111.3	43.2	659.5	446.7	42	194.5	1497.2
December	210	358.7	316.5	600.4	71.1	445.9	2002.6
Totals	1999.5	1852.5	3304.4	1271.1	590	1157.5	10,174.8

* March 23-31, estimate flood water from creek at 12,864 ac.ft. All flood waters released and not counted in total above.

1987 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT **ANNUAL USAGE** OR THE REASON FOR **NON-USAGE**, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report **required** to retain all Vested or Appropriated Rights. **COMPLETE AND RETURN WITHIN 30 DAYS.** Please begin by reading the instructions for PART A on the reverse of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water rights listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
109 Southwest 9th Street Suite 202
Topeka, Kansas 66612-1283

PART A: POINT(S) OF DIVERSION

File Number	Legal Descriptions of Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date of Measure
007571-00	SW SE NE 35-21-11W 01	1,157.5	ac/ft	surface water diverted				
007571-00	SW NE NE 13-22-11W 01	1,816.0	ac/ft	surface water diverted				
007571-00	SW NW SW 25-22-11W 01	7,156.2	ac/ft	surface water diverted				

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If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

As of March 1	As of July 1	As of November 1
Empty 1/4 1/2 3/4 (Full)	Empty 1/4 1/2 3/4 (Full)	Empty 1/4 1/2 3/4 (Full)

018302- 1 NNNNYNN Staff 093 00
Office Use FO CO GMD

Date: 1/29/88 Telephone (316) 486-2393

James E McCollum
(Signature)

Refuge Manager
(Title)

✓ Agent ____ Other

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

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DIVISION OF WATER RESOURCES
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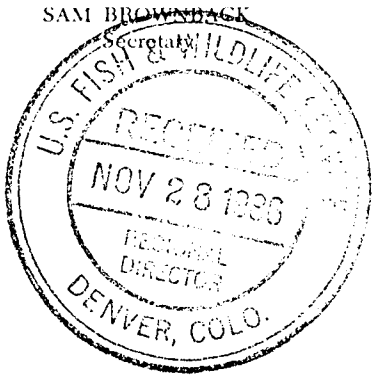
KANSAS STATE BOARD OF AGRICULTURE

DIVISION OF WATER RESOURCES
DAVID L. POPE, Chief Engineer-Director
109 SW Ninth Street, Suite 202
TOPEKA, KANSAS 66612-1283
(913) 296-3717

SAM BROWNBACK
Secretary

November 26, 1986



United States
Department of the Interior
Fish and Wildlife Service
P. O. Box 25486
Denver Federal Center
Denver, CO 80225

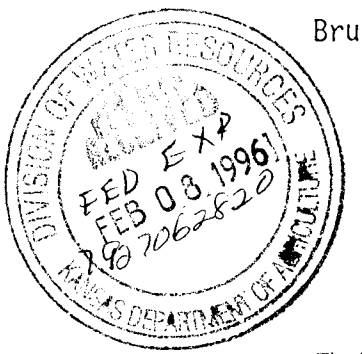
Attention: John L. Spinks, Jr., Acting Regional Director

Re: Appropriation of Water
File No. 7571

Dear Mr. Spinks:

This will acknowledge receipt of your letter of October 31, 1986 concerning the above-referenced file number which pertains to the Quivera National Wildlife Refuge. In response to your concerns we are providing the following information.

1. At anytime that you believe your right to divert water under File No. 7571 is being impaired by junior upstream surface water diversions, you should contact the Water Commissioner at our Stafford Field Office (address given below) and file a complaint. The complaint may be made by telephone, but must later be confirmed in writing. Our field office will then make an investigation of the physical conditions involved and make a written report setting forth the findings of the investigation. If the investigation shows that there is no basis for further action, the complainant will be so advised. If the investigation indicates that impairment does exist, the complainant may elect to sign a written request to secure water. Subsequent to such signed request, appropriate legal notices(s) will be served on the party(ies) causing the impairment directing the regulation or cessation of the use of water which is impairing the complainant's right to divert water. Enclosed is a copy of K.A.R. 5-4-1 (our regulation) pertaining to this matter.



Bruce W. Frisbie, Water Commissioner
Stafford Field Office
Division of Water Resources
105 North Main, Drawer F
Stafford, Kansas 67570
(316) 234-5311

The Division of Water Resources administers laws relating to water supply conservation, management and utilization of the water resources of Kansas, dam safety, flood control and drainage of the water.

2. As an alternative, the complainant may file for injunctive relief as set forth in K.S.A. 82a-716.

3. The relationship that groundwater diversions in the basin have to the surface water flows in Rattlesnake Creek has not been clearly established at this point. The problem of identifying the impact of specific wells is very complex, and without such information it is impossible to determine which users to regulate. Consequently, we are not in a position to regulate individual groundwater users at this time. However, in part due to a new "safe-yield" policy of Big Bend Groundwater Management District No. 5, new appropriations of groundwater in the basin have been sharply curtailed.

Hopefully this addresses your concerns. If you have further questions, please feel free to contact this office.

Very truly yours,

James O. Bagley, P.E.
Civil Engineer

JOB:pg
Enclosure
cc: Stafford Field Office

BA/WTR

Mail Stop 60189

FEB 07 1996

Memorandum

To: Chief, Division of Water Resources, Region 6

From: Refuge Hydrologist

Subject: Water use at Quivira NWR in 1987

After reviewing the Water Management and Action Plan for Quivira for 1987, it became apparent that twelve of the units were not operational. These units were all scheduled for structure rehabilitation, and were dried out to facilitate construction. I reviewed the 1988 Water Management and Action Plan in order to determine what the most likely management of these twelve units would have been if they had not been scheduled for structure rehabilitation.

I utilized the 1987 and 1988 Water Management and Action Plans, the reported end of month gage readings for 1987, and survey data collected in 1992 through 1994 to calculate areas and capacities for actual and projected elevations of the twelve units on a monthly basis. I used 0.7 times the mean monthly Class A Pan evaporation at Wichita (NOAA Technical Report NWS 34), and the total monthly precipitation data for the station at Hudson, Kansas, to calculate net evapotranspiration. All of this data is attached.

I summarized the information in the attached table. The table consists of a comparison of actual versus projected (planned) water use for the twelve pools by month. The month of January is slightly different than all of the other months:

Column 1 lists the Unit designations. Column 2 lists the Full Pool gage heights as given in the 1987 Water Management and Action Plan. These gage heights were assumed not to have changed from 1987 to 1992 (when the survey was conducted), with the exception of Pool 29 and Pool 57. In all cases except Pool 29 and 57, the management elevation given in the 1987 Water Management and Action Plan was used directly to determine a mean sea level (MSL) elevation. In the case of Pool 29, the gage appears to have been moved because subtracting the difference between the full pool gage height in 1987, 2.1, and the full pool gage height in 1995, 4.5, resulted in MSL elevations below the area/capacity information generated from survey data. Therefore, it was assumed that the gage had been moved and that the full pool gage heights for the two years were the same MSL. Pool 57 had and has no gage, so full pool is assumed to be one-half foot below the benchmark on structure 57A.

Column 3 lists the MSL elevations corresponding to the "Full Pool" gage heights.

Column 4 lists the measured end-of-month (EOM) gage heights for the twelve pools. Column 5 lists the MSL elevations for those gage heights. Column 6 lists the capacity of the unit at that gage height if it is different than the planned capacity.

Column 7 lists the planned gage height based on the 1988 Water Management and Action Plan, and is believed to reflect the water management that would have taken place if the water control structures hadn't needed rehabilitation. Column 8 lists the MSL for the planned gage heights; and column 9 lists the planned capacity for all units where it would have been greater than actual. Column 10 is the difference between columns 9 and 6.

Column 11 is estimated net evapotranspiration derived from the mean monthly Class A Pan evaporation at Wichita and the actual total monthly precipitation at Hudson. Column 12 is the actual area of a unit in the case where the unit is below the planned management elevation. Column 13 is the estimated evapotranspiration that would have occurred based on the actual surface area (Column 12 * Column 11). Column 14 is the planned area for those units that would have had a greater surface area. Column 15 is Column 11 times Column 14. Column 16 is the difference between Columns 15 and 13. Column 17 is the total of Column 10 and 16.

The remaining months are similar to January except that the evapotranspiration volume is computed first, and any change in capacity is computed based on the change in storage from the last month to the current month (eg. pools 62 and 63 would have been filling in March). Only those pools where an increase in storage was planned show any change in storage, and the volume of fill is the difference between the previous and current month's capacity.

A footnote on the table indicates that the MSL for "natural dry" is computed by subtracting ET (converted to feet) from the previous month's end-of-month MSL. "Natural dry" was the planned management for several of the units where moist soil management was the objective. In the mid-1980's, the Refuge Manager was experimenting with this practice on several units. These units were filled, allowed to dry naturally and then refilled to provide food and habitat during waterfowl migration. This practice is no longer being conducted.

This analysis indicates that about 1470 additional acre-feet of water could have been used in 1987 if the twelve pools had been operational. If you have any questions, please let me know.

Quivira Impoundments Subject to Water Control Structure Rehabilitation in 1987

Unit	Full Pool	MSL Elev	Jan.87	Jan. msl	Jan. Cap.	Planned	plan msl	plan cap.	Vol	ET*	AREA	ACT ET	PL AREA	PLAN ET	Actual-Plan ET VOL	Actual-Plan Total Vol
14A	6	1778	4.72	1776.72	103	6	1778	196	93	-0.07	58	-0.34	87	-0.51	-0.17	92.83
14B	4.5	1776.72	4.7	1776.92		4.5	1776.72		0	-0.07		0.00		0.00	0.00	0.00
16	2.85	1773.97	1.18	1772.3		1	1772.12		0	-0.07		0.00		0.00	0.00	0.00
24	4.5	1770.61	4.84	1770.95		4.8	1770.91		0	-0.07		0.00		0.00	0.00	0.00
29	2.1	1761.25	1.14	1760.29	17	2.1	1761.25	51	34	-0.07	23	-0.13	46.5	-0.27	-0.14	33.86
40	4	1741.62	0.34	1737.96	1	4	1741.62	41	40	-0.07	1	-0.01	24	-0.14	-0.13	39.87
48	4.2	1752.33	3.72	1751.85	3.5	4.2	1752.33	7.6	4.1	-0.07	1	-0.01	15	-0.09	-0.08	4.02
49	4.7	1752.93	4.62	1752.85		4.7	1752.93		0	-0.07		0.00		0.00	0.00	0.00
57	NG	1743.26		1743.26		full	1743.26		0	-0.07		0.00		0.00	0.00	0.00
62	3.7	1741.76	1.34	1739.4		1.34	1739.4		0	-0.07		0.00		0.00	0.00	0.00
63	6.7	1740.19	dry	1733.49	0	4	1737.49	14	14	-0.07	0	0.00	18	-0.11	-0.11	13.90
80	3.9	1736.7	3.96	1736.76		3.9	1736.7		0	-0.07		0.00		0.00	0.00	0.00
															Total	184.47

*ET is 0.7 * Monthly Mean Pan from NOAA Tech. Rep. NWS 34 for Wichita - total monthly precip. at Hudson

Unit	Full Pool	MSL Elev	Feb.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Jan.. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	6	1778	-0.13		0.00	6	1778		0.00	0.00				
14B	4.5	1776.72	4.3	1776.52	-0.13	60	-0.65	4.5	1776.72	65	-0.70	-0.05				
16	2.85	1773.97	1.1	1772.22	-0.13		0.00	1	1772.12		0.00	0.00				
24	4.5	1770.61	4.98	1771.09	-0.13		0.00	4.8	1770.91		0.00	0.00				
29	2.1	1761.25	drained	1759.15	-0.13	5.5	-0.06	2.1	1761.25	46.3	-0.50	-0.44				
40	4	1741.62	BG	1737.62	-0.13	1	-0.01	4	1741.62	24.2	-0.26	-0.25				
48	4.2	1752.33	4	1752.13	-0.13	9	-0.10	4.2	1752.33	14.9	-0.16	-0.06				
49	4.7	1752.93	4.9	1753.13	-0.13		0.00	4.7	1752.93		0.00	0.00				
57	NG	1743.26		1743.26	-0.13		0.00	full	1743.26		0.00	0.00				
62	3.7	1741.76	BG	1738.06	-0.13	1	-0.01	1.34	1739.4	5	-0.05	-0.04				
63	6.7	1740.19	dry	1733.49	-0.13	0	0.00	4	1737.49	18	-0.20	-0.20				
80	3.9	1736.7	4.06	1736.86	-0.13		0.00	3.9	1736.7		0.00	0.00				
											Total	-1.05				11.87

Unit	Full Pool	MSL Elev	Mar.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Feb. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	6	1778	-4.19		0.00	6	1778		0.00	0.00				0.00
14B	4.5	1776.72	4.34	1776.56	-4.19	62	-21.65	4.5	1776.72	65	-22.70	-1.05				-1.05
16	2.85	1773.97	1.18	1772.3	-4.19		0.00	1	1772.12		0.00	0.00				0.00
24	4.5	1770.61	5.4	1771.51	-4.19		0.00	4.8	1770.91		0.00	0.00				0.00
29	2.1	1761.25	0.24	1759.39	-4.19	8	-2.79	2.1	1761.25	46.5	-16.24	-13.44				-13.44
40	4	1741.62	1.48	1739.1	-4.19	6	-2.10	4	1741.62	24	-8.38	-6.29				-6.29
48	4.2	1752.33	4.86	1752.99	-4.19		0.00	4.2	1752.33		0.00	0.00				0.00
49	4.7	1752.93	5.48	1753.71	-4.19		0.00	4.7	1752.93		0.00	0.00				0.00
57	NG	1743.26		1743.26	-4.19		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	1.48	1739.54	-4.19	6	-2.10	3.7	1741.76	25.6	-8.94	-6.84	5	40	35	28.16
63	6.7	1740.19	3.16	1736.65	-4.19	8.5	-2.97	6.5	1739.99	123	-42.95	-39.98	14	172	158	118.02
80	3.9	1736.7	4.44	1737.24	-4.19		0.00	2.9	1735.7		0.00	0.00				0.00
											Total	-67.60				125.40

Unit	Full Pool	MSL Elev	Apr.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Mar. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	3	1775	2.87		0.00	6	1778		0.00	0.00				0.00
14B	4.5	1776.72	3.68	1775.9	2.87	46	11.00	natural dry**	1776.481	58.8	14.06	3.06				3.06
16	2.85	1773.97	1.76	1772.88	2.87		0.00	3	1774.12		0.00	0.00				0.00
24	4.5	1770.61	3.6	1769.71	2.87	38	9.09	natural dry	1770.671	44	10.52	1.44				1.44
29	2.1	1761.25	0.22	1759.37	2.87	7.7	1.84	2.1	1761.25	46.5	11.12	9.28				9.28
40	4	1741.62	0.6	1738.22	2.87	2.2	0.53	natural dry	1741.381	22	5.26	4.74				4.74
48	4.2	1752.33	3.06	1751.19	2.87	2	0.48	4.2	1752.33	15	3.59	3.11				3.11
49	4.7	1752.93	3.9	1752.13	2.87	31	7.41	4.7	1752.93	62	14.83	7.41				7.41
57	NG	1743.26		1743.26	2.87		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	0.6	1738.66	2.87	2.6	0.62	1.1	1739.16	4	0.96	0.33				0.33
63	6.7	1740.19	1.4	1734.89	2.87	0	0.00	6.6	1740.09	126	30.14	30.14	172	185	13	43.14
80	3.9	1736.7	2.28	1735.08	2.87		0.00	2	1734.8		0.00	0.00				0.00
											Total	59.50				72.50

Unit	Full Pool	MSL Elev	May.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Apr. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	1.6	1773.6	0.05		0.00	0.5	1772.5		0.00	0.00				0.00
14B	4.5	1776.72	1.6	1773.82	0.05	9.2	0.04	natural dry	1776.477	59.6	0.25	0.21				0.21
16	2.85	1773.97	1.8	1772.92	0.05	16.2	0.07	3.5	1774.62	29.2	0.12	0.05	27	29.2	2.2	2.25
24	4.5	1770.61	2.58	1768.69	0.05	19	0.08	natural dry	1770.667	44	0.18	0.10				0.10
29	2.1	1761.25	BG	1759.15	0.05	5.5	0.02	natural dry	1761.246	46.5	0.19	0.17				0.17
40	4	1741.62	BG	1737.62	0.05	1	0.00	natural dry	1741.377	22	0.09	0.09				0.09
48	4.2	1752.33	1.76	1749.89	0.05	0	0.00	3.7	1751.83	5	0.02	0.02				0.02
49	4.7	1752.93	1.58	1749.81	0.05	0	0.00	2	1750.23	1	0.00	0.00				0.00
57	NG	1743.26		1743.26	0.05		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	BG	1738.06	0.05	2	0.01	natural dry	1739.156	4	0.02	0.01				0.01
63	6.7	1740.19	dry	1733.49	0.05	0	0.00	6.7	1740.19	128	0.53	0.53	185	197	12	12.53
80	3.9	1736.7	1.6	1734.4	0.05		0.00	2	1734.8		0.00	0.00				0.00
											Total	1.19				15.39

Unit	Full Pool	MSL Elev	June.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	May cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	dry	1772	1.32	4	0.44	0.5	1772.5	5	0.55	0.11				0.11
14B	4.5	1776.72	dry	1772.22	1.32	1.2	0.13	natural dry	1776.367	57.4	6.31	6.18				6.18
16	2.85	1773.97	1.6	1772.72	1.32	14.2	1.56	3.5	1774.62	29.2	3.21	1.65				1.65
24	4.5	1770.61	1.2	1767.31	1.32	4.1	0.45	natural dry	1770.557	44	4.84	4.39				4.39
29	2.1	1761.25	dry	1759.15	1.32	5.5	0.61	natural dry	1761.136	44.8	4.93	4.32				4.32
40	4	1741.62	BG	1737.62	1.32	1	0.11	natural dry	1741.267	21.7	2.39	2.28				2.28
48	4.2	1752.33	BG	1748.13	1.32	0	0.00	2.7	1750.83	1	0.11	0.11				0.11
49	4.7	1752.93	BG	1748.23	1.32	0	0.00	0.6	1748.83	0	0.00	0.00				0.00
57	NG	1743.26		1743.26	1.32		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	BG	1738.06	1.32	1	0.11	natural dry	1739.046	3	0.33	0.22				0.22
63	6.7	1740.19	3.52	1737.01	1.32	12	1.32	6.7	1740.19	128	14.08	12.76				12.76
80	3.9	1736.7	1.14	1733.94	1.32		0.00	drain	1732.8		0.00	0.00				0.00
											Total	32.02				32.02

Unit	Full Pool	MSL Elev	Jul.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Jun. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	dry	1772	4.04	4	1.35	0.5	1772.5	5	1.68	0.34				0.34
14B	4.5	1776.72	dry	1772.22	4.04	1.2	0.40	natural dry	1776.03	48	16.16	15.76				15.76
16	2.85	1773.97	ND	1771.12	4.04	6	2.02	3.5	1774.62	29.2	9.83	7.81				7.81
24	4.5	1770.61	3.6	1769.71	4.04		0.00	natural dry	1770.22	44	14.81	14.81				14.81
29	2.1	1761.25	0.48	1759.63	4.04		0.00	fill/dry***	1761.25/dry		0.00	34.00				34.00
40	1	1741.62	0.5	1738.12	4.04	2	0.67	natural dry	1740.93	18.3	6.16	5.49				5.49
48	4.2	1752.33	2.08	1750.21	4.04		0.00	1.7	1749.83		0.00	0.00				0.00
49	4.7	1752.93	2.2	1750.43	4.04		0.00	natural dry	1748.493	0	0.00	0.00				0.00
57	NG	1743.26		1743.26	4.04		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	0.05	1738.11	4.04		0.00	natural dry	1738.709	3	1.01	1.01				1.01
63	6.7	1740.19	1.2	1734.69	4.04	0	0.00	6.7	1740.19	128	43.09	43.09				43.09
80	3.9	1736.7	2.1	1734.9	4.04		0.00	drain	1732.8		0.00	0.00				0.00
											Total	122.31				122.31

***Volume calculated as water needed to fill from previousEOM capacity

Unit	Full Pool	MSL Elev	Aug.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Jul. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	dry	1772	2.05	4	0.68	0.5	1772.5	5	0.85	0.17				0.17
14B	4.5	1776.72	dry	1772.22	2.05	1.2	0.21	4.5	1776.72	43.2	7.38	7.18	26	109	83	90.18
16	2.85	1773.97	0.2	1771.32	2.05	5	0.85	2.3	1773.42	21.2	3.62	2.77				2.77
24	4.5	1770.61	dry	1766.11	2.05	1	0.17	natural dry	1770.049	44	7.52	7.35				7.35
29	2.1	1761.25	dry	1759.15	2.05	5.5	0.94	0.4	1759.55	9.5	1.62	0.68				0.68
40	4	1741.62	drained	1737.62	2.05	1	0.17	natural dry	1740.759	16.6	2.84	2.67				2.67
48	4.2	1752.33	drained	1748.13	2.05	0	0.00	1.7	1749.83	0	0.00	0.00				0.00
49	4.7	1752.93	drained	1748.23	2.05		0.00	natural dry	1748.323	0	0.00	0.00				0.00
57	NG	1743.26		1743.26	2.05		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	drained	1738.06	2.05		0.00	natural dry	1738.538	2	0.34	0.34				0.34
63	6.7	1740.19	drained	1733.49	2.05	0	0.00	6.2	1739.69	108	18.45	18.45				18.45
80	3.9	1736.7	0.94	1733.74	2.05		0.00	drain	1732.8		0.00	0.00				0.00
											Total	39.60				122.60

Unit	Full Pool	MSL Elev	Sep.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Aug. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	0.7	1772.7	3.12		0.00	0.5	1772.5		0.00	0.00				0.00
14B	4.5	1776.72	1.44	1773.66	3.12	8.6	2.24	4.5	1776.72	66	17.16	14.92				14.92
16	2.85	1773.97	BG	1771.12	3.12	6	1.56	1.5	1772.62	14	3.64	2.08				2.08
24	4.5	1770.61	3.6	1769.71	3.12		0.00	natural dry	1769.789	39.9	10.37	10.37				10.37
29	2.1	1761.25	2.8	1761.95	3.12		0.00	0.4	1759.55		0.00	0.00				0.00
40	4	1741.62	drained	1737.62	3.12	1	0.26	natural dry	1740.499	15	3.90	3.64				3.64
48	4.2	1752.33	drained	1748.13	3.12	0	0.00	2.7	1750.83	1	0.26	0.26	0	1	1	1.26
49	4.7	1752.93	drained	1748.23	3.12	0	0.00	2.5	1750.73	3	0.78	0.78	0	1	1	1.78
57	NG	1743.26		1743.26	3.12		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	drained	1738.06	3.12	1	0.26	2.8	1740.86	17.6	4.58	4.32	1	17	16	20.32
63	6.7	1740.19	drained	1733.49	3.12	0	0.00	5.2	1738.69	21	5.46	5.46				5.46
80	3.9	1736.7	3.18	1735.98	3.12		0.00	3	1735.8		0.00	0.00	0	161	161	161.00
											Total	41.83				220.83

Unit	Full Pool	MSL Elev	Oct.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Sep. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	3.52	1775.52	2.65	34.4	7.60	6	1778	87	19.21	11.62	2	196	194	205.62
14B	4.5	1776.72	2.74	1774.96	2.65	28	6.18	4.5	1776.72	66	14.58	8.39			0	8.39
16	2.85	1773.97	BG	1771.12	2.65	6	1.33	1.5	1772.62	14	3.09	1.77			0	1.77
24	4.5	1770.61	3.36	1769.47	2.65	32	7.07	4.5	1770.61	44	9.72	2.65	9.7	57	47.3	49.95
29	2.1	1761.25	2.76	1761.91	2.65		0.00	2.1	1761.25		0.00	0.00	6.5	51	44.5	44.50
40	4	1741.62	1.46	1739.08	2.65	6	1.33	2.9	1740.52	15.2	3.36	2.03	4	19.4	15.4	17.43
48	4.2	1752.33	1.08	1749.21	2.65	0	0.00	3.7	1751.83	5	1.10	1.10	0	3.3	3.3	4.40
49	4.7	1752.93	3.24	1751.47	2.65		0.00	2.5	1750.73		0.00	0.00			0	0.00
57	NG	1743.26		1743.26	2.65		0.00	full	1743.26		0.00	0.00			0	0.00
62	3.7	1741.76	BG	1738.06	2.65	1	0.22	2.8	1740.86	17.6	3.89	3.67			0	3.67
63	6.7	1740.19	dry	1733.49	2.65	0	0.00	4.2	1737.69	21	4.64	4.64			0	4.64
80	3.9	1736.7	2.68	1735.48	2.65	148.2	32.73	3.9	1736.7	231	51.01	18.29	161	355	194	212.29
											Total	54.15				552.65

Unit	Full Pool	MSL Elev	Nov.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	Oct. cap.	Plan. Cap.	Diff.	Total Vol.
14A	6	1778	3.76	1775.76	1.24	38.6	3.99	6	1778	87	8.99	5.00				5.00
14B	4.5	1776.72	3.56	1775.78	1.24	43.8	4.53	4.5	1776.72	65.6	8.99	5.00				5.00
16	2.85	1773.97	3.16	1774.28	1.24		0.00	2.85	1773.97		6.78	2.25	23.4	50.4		2.25
24	4.5	1770.61	3.7	1769.81	1.24	40.2	4.15	4.5	1770.61	44	0.00	0.00				0.00
29	2.1	1761.25	3.46	1762.61	1.24		0.00	2.1	1761.25		4.55	0.39				0.39
40	4	1741.62	2.7	1740.32	1.24	13.2	1.36	2.9	1740.52	15.2	0.00	0.00				0.00
48	4.2	1752.33	2.84	1750.97	1.24	1	0.10	4.2	1752.33	15	1.57	0.21	1	8		0.21
49	4.7	1752.93	3.58	1751.81	1.24		0.00	2.5	1750.73		1.55	1.45				1.45
57	NG	1743.26		1743.26	1.24		0.00	full	1743.26		0.00	0.00				0.00
62	3.7	1741.76	2.32	1740.38	1.24	12.6	1.30	2.8	1740.86	17.6	0.00	0.00				0.00
63	6.7	1740.19	3.64	1737.13	1.24		0.00	3.2	1736.69		1.82	0.52				0.52
80	3.9	1736.7	3.72	1736.52	1.24	225.6	23.31	3.9	1736.7	231	0.00	0.00				0.00
											Total	14.82				14.82

Unit	Full Pool	MSL Elev	Dec.87	MSL	ET*	AREA	ACT ET	Planned	MSL	PL AREA	PLAN ET	Actual -Plan ET VOL	
14A	6	1778	3.64	1775.64	0.81	36.8	2.48	6	1778	87	5.87	3.39	3.39
14B	4.5	1776.72	3.62	1775.84	0.81	44.8	3.02	4.5	1776.72	65.6	5.87	3.39	3.39
16	2.85	1773.97	3.34	1774.46	0.81		0.00	2.85	1773.97		4.43	1.40	1.40
24	4.5	1770.61	3.66	1769.77	0.81	39	2.63	4.5	1770.61	44	0.00	0.00	0.00
29	2.1	1761.25	3.82	1762.97	0.81		0.00	2.1	1761.25		2.97	0.34	0.34
40	4	1741.62	2.74	1740.36	0.81	13.6	0.92	2.9	1740.52	15.2	0.00	0.00	0.00
48	4.2	1752.33	2.3	1750.43	0.81	1	0.07	4.2	1752.33	14.9	1.03	0.11	0.11
49	4.7	1752.93	3.66	1751.89	0.81		0.00	2.5	1750.73		1.01	0.94	0.94
57	NG	1743.26		1743.26	0.81		0.00	full	1743.26		0.00	0.00	0.00
62	3.7	1741.76	2.74	1740.8	0.81	17	1.15	2.8	1740.86	17.6	0.00	0.00	0.00
63	6.7	1740.19	4.3	1737.79	0.81		0.00	3	1736.49		1.19	0.04	0.04
80	3.9	1736.7	3.96	1736.76	0.81		0.00	3.9	1736.7		0.00	0.00	0.00
											Total	9.61	9.61

Annual Total 1472.606

Note: For Pool 29, it was assumed that the staff gage was moved because subtracting the difference in managment elevations resulted in an elevation significantly below the elevations obtained by the surveys.

Station: **HUDSON**
Parameter: Precipitation
Year: 1948-1994
State: KANSAS
County: STAFFORD

ID: 3847
Statistic: (None)
Latitude: 38:06:00
Longitude: 098:39:00
Elevation: 1870.00

Monthly Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	0.000	0.770	0.840	3.150	2.200	2.860	5.390	7.020	2.900	3.310	0.440	0.800
1987	1.230	1.600	7.090	1.250	5.200	4.810	2.720	4.370	1.080	0.630	0.600	1.170
1988	0.880	0.070	0.500	4.350	1.230	3.140	2.580	0.200	1.160	0.620	0.180	0.070
1989	0.460	0.190	1.030	0.300	6.020	6.320	2.820	2.680	2.030	0.610	0.000	0.040
1990	0.780	2.110	1.870	3.990	8.350	2.040	1.680	3.310	3.440	1.130	2.000	0.350
1991	0.470	0.000	1.450	2.420	2.150	2.430	0.630	1.120	0.570	1.060	1.420	1.530
1992	0.890	0.230	1.750	0.600	4.240	8.300	2.560	4.820	0.690	1.640	4.300	1.450
1993	1.870	2.570	2.750	1.070	6.710	7.390	9.760	2.970	1.090	0.930	0.800	0.820
1994	0.700	0.400	0.000	3.000	1.360	0.920	4.530	1.030	0.650	2.430		

Station: **HUTCHINSON 10 SW**
Parameter: Precipitation
Year: 1953-1994
State: KANSAS
County: RENO

ID: 3930
Statistic: (None)
Latitude: 37:56:00
Longitude: 098:02:00
Elevation: 1570.00

Monthly Data: Average

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1953					0.086	0.075	0.085	0.012	0.022	0.075	0.051	0.045
1954	0.000	0.024	0.008	0.049	0.117	0.050	0.035	0.093	0.043	0.032	0.000	0.005
1955	0.015	0.034	0.004	0.061	0.105	0.161	0.023	0.045	0.138	0.155	0.000	0.000
1956	0.014	0.020	0.007	0.025	0.094	0.017	0.146	0.008	0.000	0.100	0.017	0.016
1957	0.002	0.019	0.132	0.118	0.323	0.360	0.086	0.065	0.121	0.073	0.044	0.018
1958	0.015	0.074	0.106	0.051	0.112	0.082	0.330	0.034	0.218	0.011		0.006
1959	0.003	0.020	0.075	0.042	0.192	0.083	0.181	0.050	0.053	0.162	0.003	0.023
1960	0.043	0.065	0.028	0.047	0.165	0.116	0.080	0.063	0.097	0.112	0.019	0.043
1961	0.001	0.029	0.066	0.059	0.163	0.084	0.195	0.071	0.102	0.046	0.065	0.019
1962	0.033	0.022	0.010	0.036	0.086	0.223	0.284	0.123	0.120	0.040	0.040	0.011
1963	0.013	0.000	0.061	0.011	0.067	0.097	0.132	0.084	0.301	0.082	0.035	0.006
1964	0.017	0.012	0.031	0.027	0.137	0.054	0.047	0.209	0.082	0.008	0.149	0.029
1965	0.008	0.022	0.007	0.069	0.118	0.326	0.100	0.095	0.161	0.015	0.000	0.069
1966	0.016	0.033	0.001	0.046	0.014	0.098	0.154	0.078	0.040	0.013	0.000	0.018
1967	0.010	0.005	0.004	0.090	0.057	0.358	0.172	0.037	0.140	0.057	0.035	0.043
1968	0.003	0.007	0.001	0.092	0.186	0.078	0.056	0.155	0.093	0.180	0.086	0.028
1969	0.006	0.051	0.048	0.142	0.076	0.147	0.065	0.116	0.064	0.064	0.000	0.024
1970	0.005	0.004	0.064	0.121	0.070	0.208	0.035	0.027	0.198	0.175	0.005	0.005
1971	0.028	0.103	0.005	0.032	0.098	0.071	0.161	0.035	0.064	0.125	0.074	0.009
1972	0.006	0.005	0.027	0.041	0.123	0.145	0.095	0.094	0.071	0.034	0.100	0.049
1973	0.068	0.064	0.306	0.094	0.043	0.010	0.120	0.031	0.332	0.157	0.020	0.068
1974	0.008	0.005	0.080	0.277	0.214	0.064	0.007	0.159	0.054	0.067	0.037	0.055
1975	0.035	0.079	0.047	0.044	0.155	0.283	0.008	0.120	0.036	0.006	0.096	0.020
1976	0.003	0.010	0.046	0.284	0.144	0.055	0.088	0.003	0.167	0.093	0.003	0.001
1977	0.021	0.002	0.101	0.129	0.246	0.272	0.060	0.308	0.267	0.076	0.063	0.015
1978	0.007	0.063	0.045	0.066	0.206	0.083	0.027	0.060	0.121	0.005	0.056	0.018
1979	0.053	0.006	0.158	0.035	0.120	0.098	0.244	0.051	0.003	0.372	0.056	0.033
1980	0.049	0.060	0.142	0.036	0.109	0.038	0.062	0.174	0.022	0.042	0.001	0.052
1981	0.001	0.007	0.069	0.050	0.208	0.098	0.094	0.036	0.096	0.115	0.151	0.005
1982	0.023	0.043	0.059	0.008		0.164	0.116	0.069	0.068	0.023	0.027	0.049
1983	0.017	0.087	0.099	0.115	0.225	0.121	0.072	0.047	0.019	0.089	0.093	0.028
1984	0.004	0.030	0.211	0.193	0.048	0.122	0.022	0.001	0.017	0.135	0.031	0.114
1985	0.024	0.063	0.032	0.178	0.031	0.193	0.140	0.116	0.200	0.116	0.039	0.023
1986	0.000	0.016	0.035	0.156	0.145	0.097	0.235	0.234	0.194	0.137	0.019	0.039
1987	0.036	0.058	0.146	0.029	0.171	0.220	0.144	0.216	0.055	0.034	0.029	0.048
1988	0.036	0.002	0.049	0.121	0.078	0.118	0.189	0.022	0.046	0.024	0.004	0.004
1989	0.012	0.008	0.046	0.006	0.189	0.306	0.092	0.198	0.093	0.010	0.000	0.002
1990	0.026	0.082	0.089	0.066	0.107	0.060	0.024	0.078	0.171	0.016	0.053	0.014

Station: **HUTCHINSON 10 SW**
Parameter: Precipitation
Year: 1953-1994
State: KANSAS
County: RENO

ID: 3930
Statistic: (None)
Latitude: 37:56:00
Longitude: 098:02:00
Elevation: 1570.00

Monthly Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	0.011	0.001	0.066	0.165	0.134	0.032	0.072	0.120	0.078	0.061	0.057	0.041
1992	0.025	0.011	0.061	0.033	0.119	0.238	0.123	0.145	0.042	0.058	0.126	0.050
1993	0.040	0.090	0.094	0.046	0.293	0.099	0.248	0.059	0.059	0.025	0.037	0.014
1994	0.022	0.027	0.005	0.146	0.020	0.142	0.209	0.023	0.055	0.056		

Station: **STERLING**
Parameter: Precipitation
Year: 1952-1994
State: KANSAS
County: RICE

ID: 7796
Statistic: (None)
Latitude: 38:13:00
Longitude: 098:12:00
Elevation: 1640.00

Monthly Data: Average

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1952												0.025
1953	0.013	0.030	0.066	0.031	0.046	0.113	0.087	0.107	0.046	0.045	0.070	0.057
1954	0.000	0.025	0.012	0.042	0.103	0.117	0.015	0.119	0.041	0.045	0.000	0.009
1955	0.014	0.043	0.024	0.065	0.157	0.082	0.040	0.021	0.175	0.087	0.003	0.000
1956	0.031	0.010	0.006	0.037	0.114	0.028	0.059	0.034	0.000	0.131	0.023	0.004
1957	0.000	0.027	0.178	0.144	0.328	0.374	0.050	0.083	0.142	0.090	0.050	0.037
1958	0.016	0.049	0.117	0.038	0.203	0.130	0.281	0.066	0.142	0.027	0.024	0.013
1959	0.031	0.021	0.073	0.060	0.217	0.080	0.118	0.076	0.083	0.147	0.001	0.015
1960	0.050	0.078	0.056	0.051	0.100	0.206	0.039	0.097	0.117	0.070	0.010	0.050
1961	0.002	0.035	0.089	0.065	0.113	0.132	0.155	0.115	0.074	0.067	0.074	0.019
1962	0.037	0.023	0.020	0.063	0.091	0.195	0.227	0.050	0.116	0.026	0.050	0.012
1963	0.016	0.001	0.042	0.017	0.075	0.105	0.093	0.060	0.063	0.185	0.008	0.014
1964	0.003	0.010	0.029	0.077	0.092	0.158	0.032	0.143	0.059	0.011	0.182	0.039
1965	0.029	0.035	0.012	0.055	0.149	0.299	0.089	0.069	0.128	0.045	0.000	0.084
1966	0.007	0.034	0.000	0.040	0.013	0.069	0.150	0.115	0.018	0.009	0.000	0.029
1967	0.008	0.001	0.023	0.122	0.073	0.268	0.224	0.042	0.080	0.069	0.011	0.039
1968	0.003	0.008	0.002	0.051	0.082	0.067	0.092	0.047	0.014	0.165	0.071	0.055
1969	0.006	0.075	0.055	0.091	0.084	0.100	0.065	0.173	0.035	0.085	0.000	0.028
1970	0.006	0.004	0.071	0.157	0.068	0.177	0.026	0.027	0.095	0.062	0.001	0.004
1971	0.024	0.140	0.006	0.063	0.145	0.074	0.173	0.055	0.043	0.138	0.109	0.015
1972	0.004	0.004	0.015	0.072	0.154	0.150	0.075	0.082	0.065	0.056	0.094	0.048
1973	0.045	0.032	0.285	0.073	0.063	0.053	0.255	0.036	0.427	0.174	0.038	0.073
1974	0.005	0.002	0.048	0.093	0.189	0.073	0.031	0.176	0.026	0.118	0.035	0.027
1975	0.024	0.075	0.045	0.034	0.153	0.230	0.024	0.110	0.034	0.000	0.134	0.019
1976	0.001	0.011	0.050	0.189	0.146	0.074	0.050	0.006	0.072	0.082	0.003	0.000
1977	0.020	0.000	0.069	0.125	0.206	0.178	0.176	0.217	0.137	0.066	0.054	0.023
1978	0.018	0.067	0.049	0.076	0.142	0.143	0.035	0.066	0.236	0.003	0.088	0.024
1979	0.050	0.009	0.160	0.041	0.081	0.058	0.207	0.072	0.004	0.223	0.076	0.028
1980	0.045	0.074	0.144	0.045	0.091	0.018	0.008	0.185	0.000	0.054	0.003	0.062
1981	0.010	0.000	0.136	0.059	0.194	0.153	0.120	0.100	0.129	0.113	0.101	0.014
1982	0.048	0.071	0.065	0.018	0.236	0.246	0.216	0.110	0.043	0.046	0.028	0.048
1983	0.025	0.062	0.082	0.114	0.132	0.134	0.005	0.084	0.104	0.076	0.045	0.031
1984	0.016	0.010	0.168	0.152	0.039	0.135	0.065	0.010	0.011	0.110	0.015	0.118
1985	0.018	0.094	0.042	0.165	0.038	0.177	0.076	0.152	0.166	0.147	0.041	0.007
1986	0.000	0.024	0.097	0.092	0.085	0.103	0.139	0.066	0.160	0.073	0.015	0.024
1987	0.036	0.059	0.217	0.052	0.138	0.157	0.122	0.152	0.040	0.036	0.026	0.026
1988	0.029	0.002	0.046	0.110	0.098	0.042	0.118	0.062	0.056	0.030	0.018	0.004
1989	0.017	0.009	0.034	0.009	0.163	0.338	0.140	0.215	0.168	0.010	0.001	0.004

Station: **STERLING**
Parameter: Precipitation
Year: 1952-1994
State: KANSAS
County: RICE

ID: 7796
Statistic: (None)
Latitude: 38:13:00
Longitude: 098:12:00
Elevation: 1640.00

Monthly Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	0.023	0.069	0.101	0.066	0.283	0.041	0.052	0.148	0.088	0.035	0.051	0.015
1991	0.015	0.000	0.050	0.076	0.109	0.069	0.053	0.089	0.006	0.054	0.044	0.061
1992	0.013	0.008	0.097	0.022	0.114	0.236	0.185	0.131	0.034	0.096	0.081	0.047
1993	0.047	0.108	0.089	0.043	0.212	0.200	0.302	0.130	0.048	0.020	0.035	0.017
1994	0.022	0.004	0.000	0.125	0.020	0.039	0.153	0.020	0.043	0.053		

Station: **HUDSON**
Parameter: Precipitation
Year: 1948-1994
State: KANSAS
County: STAFFORD

ID: 3847
Statistic: (None)
Latitude: 38:06:00
Longitude: 098:39:00
Elevation: 1870.00

Monthly Data: Total

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1948								5.110	0.660	0.300	2.360	0.370
1949	2.920	0.820	1.400	1.410	6.390	6.100	3.030	1.020	0.520	1.100	0.020	0.480
1950	0.030	0.130	0.350	1.500	2.370	2.730	8.370	4.100	1.030	0.380	0.240	0.150
1951	0.610	1.190	1.070	2.530	6.310	4.750	3.820	3.660	2.460	1.610	0.680	0.040
1952	0.230	0.210	2.650	3.680	3.160	0.000	3.290	2.210	0.090	0.000	0.850	0.940
1953	0.280	0.720	1.480	0.770	1.660	4.710	3.010	1.860	1.580	1.380	1.800	1.590
1954	0.030	0.480	0.390	2.650	4.100	3.880	1.190	2.530	1.330	1.520	0.000	0.180
1955	0.480	1.080	0.140	2.020	2.880	4.740	0.650	0.570	5.260	1.540	0.070	0.000
1956	1.080	0.380	0.190	1.870	3.400	0.570	2.480	0.620	0.000	3.740	0.260	0.080
1957	0.110		4.340	3.290	10.020	6.740	2.170	1.120	5.390	4.060	1.490	0.280
1958	0.570	1.620	2.900	1.830	4.890	5.250	6.970	1.690	5.070	1.660	0.240	0.490
1959	0.780	0.730	2.110	0.970	6.650	0.770	8.980	1.790	2.480	4.040	0.100	0.630
1960	1.460	2.730	1.530	1.330	3.580	4.550	1.420	2.310	2.040	2.730	0.300	1.520
1961	0.000	0.560	2.010	1.300	4.010	3.280	3.840	5.100	0.850	2.040	1.990	0.470
1962	1.130	0.500	0.550	1.390	1.540	6.280	5.400	2.690	2.620	1.390	1.220	0.360
1963	0.250	0.030	1.080	0.380	2.660	4.520	5.670	1.100	3.260	1.430	0.190	0.550
1964	0.110	0.380	0.630	1.600	3.220	1.750	1.500	3.140	1.670	0.200	3.420	1.460
1965	0.670	1.360	0.120	2.340	4.980	9.280	1.700	1.380	4.050	1.840	0.000	3.510
1966	0.380	2.190	0.020	1.980	0.940	1.640	5.720	2.080	0.940	0.190	0.000	1.240
1967	0.410	0.010	0.250	4.000	1.780	9.240	2.260	0.530	3.790	1.170	0.590	0.910
1968	0.020	0.150	0.150	1.120	3.110	1.970	3.910	2.100	0.210	6.160	1.880	0.450
1969	0.050	2.130	1.490	2.490	3.670	2.820	2.720	7.370	3.340	3.130	0.050	0.210
1970	0.090	0.020	2.450	2.960	2.730	3.460	0.600	1.380	3.800	2.470	0.080	0.080
1971	0.670	2.130	0.380	1.810	3.710	2.130	4.680	0.940	1.350	3.880	2.720	0.410
1972	0.160	0.120	0.020	0.970	3.540	3.850	2.360	3.250	1.400	0.760	2.650	1.100
1973	0.890	0.800	7.810	2.630	1.750	1.360	4.150	1.290	15.060	3.210	0.700	2.240
1974	0.350	0.040	1.370	4.040	3.230	2.190	0.610	4.140	1.010	2.850	0.550	0.830
1975	0.650	1.480	1.130	1.130	4.060	4.030	0.440	2.250	1.490	0.000	2.790	0.850
1976	0.110	0.950	1.560	8.270	3.730	2.640	1.280	0.560	4.000	2.270	0.070	0.000
1977	0.730	0.010	2.110	2.570	5.920	5.100	1.260	4.670	4.170	2.070	1.480	0.590
1978	0.100	0.720	0.820	0.710	4.760	2.870	1.380	1.040	3.660	0.140	1.760	0.220
1979	1.240	0.020	3.250	1.260	3.590	2.530	3.540	2.960	0.130	3.970	0.630	0.810
1980	1.130	0.770	3.500	0.960	2.190	0.910	0.390	3.830	0.000	1.700	0.070	1.250
1981	0.020	0.090	2.710	1.210	6.190	5.130	5.700	1.010	1.970	2.750	2.770	0.180
1982	0.260	0.690	1.380	0.390	6.140	4.130	4.700	1.930	1.460	1.720	0.700	0.810
1983	0.620	1.270	1.420	3.360	4.010	2.750	0.400	0.770	1.110	2.040	0.960	0.810
1984	0.150	0.360	4.760	4.560	0.570	2.730	0.230	0.670	0.780	3.620	0.110	4.000
1985	0.540	1.670	1.050	5.350	1.300	4.240	3.190	3.150	2.240	5.190	0.890	0.630

QUIVIRA NATIONAL WILDLIFE REFUGE AREA/CAPACITY SUMMARY

POOL	FULL POOL ELEV., FT	SURFACE AREA, AC	CAPACITY, AC-FT	MANAGEMENT ELEVATION, FT.	SURFACE AREA, AC	CAPACITY, AC-FT	
5	1783 (SPILLWAY)	864	1866	1783	864	1866	
7	1778 (TOP OF STOPLOG SLOT)	26	40	1777.36	20	25	
10A&B	1779 (TOP OF STOPLOG SLOT)	64	145	1778.83	60	135	
10C	1774.4 (TOP OF GAGE)	11	13	1774.09	7	11	
11A	1774.9 (SPILLWAY)	50	338	1774.9	50	338	
11B	1774.8 (SPILLWAY)	57	112	1774.8	57	112	
14A	1778 (SPILLWAY)	87	196	1778	87	196	
14B	1776.7 (SPILLWAY)	65	96	**1777.19**	ABOVE TABLE		
14C	1777 14C BM - 0.67'	7	16	**1778.05**	ABOVE TABLE		
16	1775 (TOP OF STOPLOG SLOT)	31	80	1774.42	28	63	
20	1770.7 (SPILLWAY)	138	195	**1770.96**	147	232	
21	1770 (TOP OF STOPLOG SLOT)	30	81	1769.3	26	62	
22	1766 22A BM - 0.6'	10	13	1765.35	8	7.5	
23	1764.3 (TOP OF GAGE)	9	15	1764.74	10	19	
24	1769.4 (SPILLWAY)	31	35	**1771.41**	ABOVE TABLE		
25	1768.4 (TOP OF GAGE)	94	296	1766.88	81	157	
26	1762 (SPILLWAY)	59	111	1761.9	58	105	
28	1768 28A BM - 0.86'	85	153	1767.56	73	118	
29	1762 29C BM - 0.58'	61	91	1761.25	46.5	51	
30	1759 HIGH WATER	78	119	1759.18	ABOVE TABLE		
40	1742.5 40B BM - 0.65'	32	66	**1742.62**	33	70	
48	1754.4 (SPILLWAY)	89	113	1751.93	5	1	
49	1754.2 (SPILLWAY)	95	159	1754.03	91	143	
57	1743.5 57A BM - 0.6'	127	212	1743.26	117	183	
58	1742 58B BM - 0.5'	99	251	1740.7	71	140	
61	1745.5 62B BM - 0.58'	218	498	1743.91	137	215	
62	1744 (TOP OF STOPLOG SLOT)	47	120	1742.56	33	63	
63	1741.2 (TOP OF GAGE)	154	339	1740.49	136	236	
75	1740.8 (SPILLWAY)	1768	2446	1740.76	1717	2378	
78	1740.2 (top of structure)	1169	2792	1738.7	877	1272	
80	1736.7 80A BM -0.5'	231	355	1736.19	216	242	
81	1736.7 80A BM -0.5'	56	25	1736.19	27	4	(NOTE: this is 27 acres of water 1.8 inches deep)
83	1736.7 80A BM -0.5'	196	314	1736.19	167	222	
TOTAL		6138	11701				

*** Elevations in bold type are above spillway elevation.

Quivira National Wildlife Refuge Staff Gage Elevations

POOL	GAGE	0.0 ELEV.
5	A1	1778.37
	A2	1777.38
	C1	1779.47
7	none	
10A&B	10A	1775.53
10C	10C	1768.59
11A	none	
11B	none	
14A	14A1	1772.04
	14A2	1773.61
14B	14B	1772.22
14C	none	
16	none	
20	20A	1765.96
21	21A	1763.99
22	none	
23	23A	1761.34
24	24B	1766.11
25	25A	1762.38
26	26A	1757.4
28	none	
29	29B	1756.91
30	none	
40	40A	1737.62
48	none	
49	none	
57	none	
58	none	
61	none	
62	62A	1738.06
63	63B	1738.49
75	75A	1736.81
78	none	
80	none	
81	none	
83	none	

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT • 14 A

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 221. Acre Feet of Storage 548

Full Elevation 6.0 Moist Soil Area Elevation ____

Inflow WCS's D-1 Outflow WCS's D-2, D-3

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Replace water control structure and manage for moist soil plants.

Reflood in fall to provide food for migrating waterfowl.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain full level	3/1/87	Unit full but unable to read gauge, culvert blocked.
5/1	Drain and begin drying out by	4/1	Began pulling boards, but water out to 16 - No accurate gauge readings.
	5/15		
7/15	Excavate old pipe and refill	7/15	Began work on WCS.
	trench. Install new pipe and	8/1	Unit almost dry - good carp kill.
	WCS.	9/20	Construction Complete.
10/15	Begin refilling in stages of		Begin to refill.
	0.3' per week til full hold at 3.4 - 3.6 until		10/31 - raise about 6" -
12/1	maintain at full level until full about	12/31	-

Remarks:
Schedule grazing so that moist soil plants have time to grow and mature.

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 14 B

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 10. Acre Feet of Storage 10.

Full Elevation 4.50 Moist Soil Area Elevation _____

Inflow WCS's F-1, D-3 Outflow WCS's D-3

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Replace water control structure and raise spillway and install concrete slab. Keep water levels high to drown out invading brush and trees.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain at full level		Unit filled to 4.70 by 1/27.
5/1	Drain and dry out		Began lowering water level on
7/15	Excavate old pipe and refill		4/1. Construction of new WCS
	trench. Install new pipe and		complete on 9/20 and reflooding
	WCS. Install concrete slab		began. Unit filled by mid-November
	spillway 2.5 ft. higher than		and level maintained thru end of
	current level.		year. Some dirt work was done on
8/15	Refill unit to full and		spillway, but not completed.
	maintain.		

Remarks:

OPTIONAL FORM 99 (7-90)
FAX TRANSMITTAL
# of pages ► 1
To Dave Hilley
Dept./Agency
Fax # Quivira 316 486 2315
From Meg
Phone #
Fax #
NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 16

Water Unit Type: Permanent X Moist Soil ___

Unit Surface Acres 83. Acre Feet of Storage 143.

Full Elevation 2.85 Moist Soil Area Elevation _____

Inflow WCS's D-2 Outflow WCS's 16a, 3G6A*

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for deep water habitat and submergent vegetation. Burn island to encourage goose nesting. Lower water in fall to make submergents more accessable for waterfowl.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain at 1.0'		Island was not burned. Began raising level on 4/1 but unable to reach planned levels because unit 14 A was drained. On 8/4 level was already below 1.5. Was able to begin filling unit in October and unit was full by mid-November. Remained full thru end of year.
3/15	Burn island to attract nesting geese.		
5/1	Raise level in 0.3' increments to 3.5 by 6/15 and maintain.		
8/1	Stage down 0.3' per week thru 9/15.		
9/15	Hold at 1.5'		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 24 (Darrynane Lake)

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 16. Acre Feet of Storage 16.

Full Elevation 4.5 Moist Soil Area Elevation _____

Inflow WCS's A-2 Outflow WCS's 6G1, 11G1, DC-A, Creek

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Maintain full in winter and spring for migration resting habitat. Draw down in early March and burn. Build new stoplog structure at DC-A. Disc cattail areas for control. Reflood in fall.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain at about 4.5-4.8'		Drawdown was delayed due to flood
3/1	Drain and dry out.		waters in March and April. Too
6/15	Burn cattails and disc		late to burn cattails by time unit
7/1	Rebuild WCS		was down enough. WCS was not
10/1	Begin staging up 0.5' per week		rebuilt this year. Unit was dry mo
	to 4.5'		of the summer except for some flow
12/1	Maintain at 4.5'		thru. Level brought up to 3.60 in
			Sept. so water could be diverted.
			On 10/13 decided to leave water lev
			low with most water flowing thru
			unit.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 29

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 91. Acre Feet of Storage 265.

Full Elevation 2.10 Moist Soil Area Elevation _____

Inflow WCS's 29c Outflow WCS's 29a, 29b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Continue conversion to mmoist soil unit. Control cattails by mowing at bloom stage. Replace WCS 29b at level of West Canal.

Date	Planned Activity	Date	Accomplishment
1/1	Fill to 2.1' and maintain.		Could not fill unit due to hole in
4/15	Drain and dry out.		old CMP WCS. Drained unit in late
7/1	Mow cattails at bloom stage.		Feb. Cave-in around old structure.
7/15	Excavate WCS 29b and lower.		Cattails were mowed in late June.
9/1	Reflood unit so shallow areas		Two structures were replaced with
	are covered with 6" water and		concrete stoplog structures. Bega
	maintain with continuous flow		to fill unit on 9/9. Unit remaine
	thru if water available.		3/4 full for remainder of year.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1987
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 40

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 50. Acre Feet of Storage 75.

Full Elevation 4.0 Moist Soil Area Elevation _____

Inflow WCS's DL4A Outflow WCS's 40b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Maintain full thru winter and early spring. Allow water level to decline and dry up by mid-summer. Mow paths thru cattails and refill in fall to flood shallow areas.

Date	Planned Activity	Date	Accomplishment
1/1	Fill and maintain.		Unit had to be lowered because
4/15	Shut off inflow and let unit		of seepage thru north dike. Unit
	gradually dry out.		below gauge on 2/17. New water
6/15	or when dry enough, mow paths		control structure constructed in
	thru cattails. Let cattle graze		September. Unit refilled in
	new cattail growth but exclude		October and held at that level thru
	them after July 15.		end of year. Flow thru to unit
10/1	Refill to flood shallow areas		41 north of Marsh Road.
	and maintain.		Cattails were not mowed in unit.
			Were mowed along proposed fence li
			around unit.

Remarks:

Schedule grazing in unit to enhance cattail control in mowed strips.

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 48

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 100. Acre Feet of Storage 150.

Full Elevation 4.20 Moist Soil Area Elevation _____

Inflow WCS's 48c, 48d Outflow WCS's 48a, 48b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Develope as moist soil area. Rehab water control structures. Maintain full thru winter then gradually drain for shorebird migration in April. Dry out unit in summer to facilitate rehab work.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain or or near full level.		Unit managed as planned. Some
3/1	Begin to stage down at 0.3' per		delay in drawdown due to rains
	week to expose mud flats.		in late March and April.
5/1	Drain and dry out.		
7/1	Mow cattail growth in unit.		
8/1	Begin WCS rehab.		
10/1	Begin refilling in stages to		
	spred water over mud flats for		
	waterfowl migration.		

Remarks:

Enter Monitoring information on Form 50

CALENDER YEAR 1987
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 49

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 140. Acre Feet of Storage 210.

Full Elevation 4.70 Moist Soil Area Elevation _____

Inflow WCS's 48b, 48d Outflow WCS's 49a, 49b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Develop as moist soil area. Rehab water control structures. Maintain full thru winter then gradually drain for shorebird migration in April. Dry out unit in summer to facilitate rehab work.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain at or near full level.		Unit managed as planned.
3/1	Begin to stage down at 0.3' per		Some delay in drawdown due to
	week to expose mud flats.		rains in March and April.
5/1	Drain and dry out.		
7/1	Mow cattail growth in unit.		
8/1	Begin WCS rehab.		
10/1	Begin refilling in stages to		
	spred water over mud flats for		
	waterfowl migration.		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1987
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 57

Water Unit Type: Permanent X Moist Soil ___

Unit Surface Acres 154. Acre Feet of Storage 319.

Full Elevation No gauge Moist Soil Area Elevation _____

Inflow WCS's 61e Outflow WCS's None

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Due to poor facilities for delivering water to this unit, no water management is planned for this year. Work will instead be concentrated on rehabilitation of water control.

Date	Planned Activity	Date	Accomplishment
6/15	Begin clean-out of ditch from Unit 61		Began clean out of ditch in March but had to delay completion due to heavy rains. Did not do any work on RC-D. Ditch clean out complet during summer. Started flooding unit on 11/5. Unit full on 12/21 and water flowing thru to unit 78.
9/1	Begin work on WCS RC-D in Rattlesnake Canal.		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 62

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 150. Acre Feet of Storage 300.

Full Elevation 3.70 Moist Soil Area Elevation _____

Inflow WCS's DL4A, 40b Outflow WCS's 62a

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for moist soil plants. Complete WCS rehab work. Mow paths in cattails for control, provide edge, and to promote growth of moist soil plants. Refill in fall to flood shallow areas.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain at current level with no boards in WCS.		On 2/17 water was lowered below pipe and gauge because work was still not completed on WCS.
4/15	Shut-off inflow and allow to dry out.		Unit dry most of summer. Cattails not mowed. WCS completed in late September. Unit reflooded in late October and remained 3/4 full for remainder of the year.
6/15	or when dry enough mow paths thru cattails.		
7/15	Complete WCS rehab.		
10/1	Refill and maintain.		
		RECEIVED	

Remarks:
Check into using electric fence to exclude cattle after July 1 to protect moist soil plants.

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 63

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 270. Acre Feet of Storage 650.

Full Elevation 6.70 Moist Soil Area Elevation _____

Inflow WCS's 61b,c,d Outflow WCS's 63 a & b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Keep unit dry through late summer. Complete rehab of WCS. Burn cattails for control. Refill only to 2.5 to provide resting areas for waterfowl.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain dry.		Unit was dry until November except for several times when heavy rains and flood waters from the creek temporarily raised the water level. Cattails were not burned. Most have died after being dried out for almost two year
6/1	Burn cattails.		
7/15	Complete WCS rehab.		
10/1	Begin refilling to 2.5 and maintain.		
			Unit reflooded in November. Was receiving excellent waterfowl use before freeze-up. Level at 4.0 with lots of food remaining at end of the year.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1987
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 80 (Salt Creek)

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres _____. Acre Feet of Storage _____.

Full Elevation 3.90 Moist Soil Area Elevation _____

Inflow WCS's 58c, 75a & b Outflow WCS's 80a

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Maintain full thru late winter. Lower for shorebird migration and then drain. Refill for hunting season. Install bagged rip-rap at discharge end of WCS pipe and palce gauge on structure.

Date	Planned Activity	Date	Accomplishment
1/1	Maintain full.		Drawdown delayed due to heavy
3/1	Begin staging down thru 4/14		rains and run-off. On 4/30 level
	at 0.3' increments to 2.0'		was at 2.28. Unit was dry most
4/15	maintain at 2.0'		of summer. Delayed refilling
6/15	drain unit to permit vegetative		because of needed repair work
	growth		on downstream side of structure.
9/1	begin refilling from Unit 58 to		Pipe joints were sealed with
	full by 9/15 and maintain full		concrete. Began refilling in mid-
	thru hunting season.		Sept. and maintained near full
			thru end of year.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 19 87
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 5 (Little Salt Marsh)

Water Unit Type: Permanent X Moist Soil ___

Unit Surface Acres 950. Acre Feet of Storage 2260*.

Full Elevation 5.50 Moist Soil Area Elevation _____

Inflow WCS's Rattlesnake Crk. Outflow WCS's A-1,2,3 & C-1

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

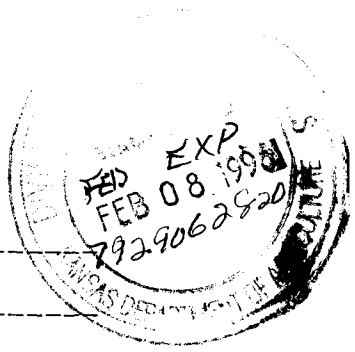
Maintain near full throughout year. Be ready to discharge waters on short notice if heavy rains occur in watershed. Divert water whenever needed for management of refuge water units.

Date	Planned Activity	Date	Accomplishment
1/1	maintain at or near 5.0 but		Water levels ranged from a high of
thru	use water as needed for unit		5.95 in late March to a low of
12/31	management. Prevent uncontrolled		3.85 in late June. For most of
	discharge over east spillway.		the year the level was 4.5 or high
	Haul in and place 1' of soil		Water was over both spillways from
	fill along water side of spill-		3/26 to 4/4 because of flood water
	way. Level and reseed.		No work was accomplished on the
1/15	or ASAP - burn islands for		spillways. Several islands were
	spring goose nesting.		burned on 3/13.

Remarks:
* silt has diminished storage capacity

Enter Monitoring information on reverse side

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 14A



Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 221. Acre Feet of Storage 548

Full Elevation * Moist Soil Area Elevation ____

Inflow WCS's D-1 Outflow WCS's 14Aa, 14Ab

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for moist soil plant production and waterfowl feeding area for fall and winter. Graze as per RMP.

Date	Planned Activity	Date	Accomplishment
			Average Gage Reading
1/1	Maintain current level until	1/27/88	3.70
	ice-out, then raise 4-6", hold	2/15/88	4.60
		~~3/29/88~~	~~5.60~~
	until spring migration over.	4/05/88	5.42 Pulled one 2X6.
		~~4/14/88~~	~~3.20 Pulled one 2X4.~~
3/15	Drop level until water off mois	4/21/88	3.06 Pulled one 2X4.
		~~4/27/88~~	~~2.78 Pulled one 2X4.~~
	soil areas, Maintain some water	5/05/88	2.36 Pulled one 2x4.
		~~5/12/88~~	~~1.88 Pulled one 2x4.~~
	in deeper areas.	5/19/88	1.34
		~~5/25/88~~	~~.88 Pulled last 2x6.~~
6/1	Scheduled to be grazed.	6/1/88	.70 Water remaining in most areas.
		~~6/8/88~~	~~.50 Water receding to~~ borrow areas.
10/1	Begin to refill in stages to	6/15/88	.18
		6/30/88	Dry at structure. Some water remaining in borrow areas. Placed rip-rap
	utilize waterfowl foods.	~~7/30/88~~	~~Unit dry.~~
12/1	Fill and maintain.	8/30/88	Unit dry.
		~~9/30/88~~	~~Unit dry.~~
		10/30/88	Unit dry.
		~~11/30/88~~	~~Unit dry.~~
		12/30/88	Unit dry.

Remarks:

* Establish new full level and gauge reading.

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CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 14 B

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 10. Acre Feet of Storage 10.

Full Elevation *_____ Moist Soil Area Elevation _____

Inflow WCS's F-1 Outflow WCS's 148

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Keep unit as high as possible to drown out salt cedars and other brush.

Raise spillway by 1 ft. Graze according to RMP.

Date	Planned Activity	Date	Accomplishment
			Average Gage Reading
1/1	Maintain full level.	1/27/88	3.64
		2/15/88	4.00
6/1	Scheduled for early season	3/29/88	4.18
	grazing.	4/05/88	4.36 Allowing water to recede at its own rate.
		4/14/88	4.10
6/1	Raise spillway level by 1 ft.	4/21/88	4.08
		4/27/88	4.08
9/1	Stop inflow, lower to concentrate	5/5/88	4.10
	food for fall migration, maintain	5/12/88	3.88
		5/19/88	3.60
	lower level.	5/25/88	3.58
		6/1/88	3.54
		6/8/88	3.30
		6/15/88	2.90
		6/22/88	2.42
		6/30/88	1.80
		7/13/88	.94 Water receding to borrow areas
		7/30/88	Unit almost dry.
		8/30/88	Unit dry.
		9/30/88	Unit dry.
		10/30/88	Unit dry.
		11/30/88	Unit dry.
		12/30/88	Unit dry..

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 19_88_
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 16

Water Unit Type: Permanent X Moist Soil ___

Unit Surface Acres 83. Acre Feet of Storage 143.

Full Elevation 2.85 Moist Soil Area Elevation _____

Inflow WCS's 14Ab Outflow WCS's 16a, 16b (3G6A)*

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for deep water habitat and submergent vegetation. Maintain full as long as possible then allow natural decline.

Date	Planned Activity	Date	Accomplishment Average Gage Reading
1/1	Maintain at 3.0 as long as can	1/27/88	3.40
		2/15/88	3.32
	get inflow from 14Ab	3/29/88	3.42
		4/5/88	3.30
4/1	Allow natural decline in water	4/14/88	3.26 Cleaned out beaver dam from front of water control structure
	level	4/27/88	3.22 Unplugged beaver dam.
		5/5/88	3.14 " "
10/1	Reflood whenever water avail-	5/12/88	3.04 " " "
		5/25/88	3.00 " " "
	able from 14Ab, fill to full	6/1/88	3.00 Structure silted in with debris. Allowed water to recede at its own rate for the rest of the year.
	level.	6/30/88	
		7/30/88	2.50 Beaver activity continuing.
		8/30/88	Water receded from most of borrow areas.
		9/30/88	Unit dry.
		10/88	Unit dry.
		11/88	Unit dry.
		12/88	Unit dry.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 24

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 16. Acre Feet of Storage 16.

Full Elevation 4.50 Moist Soil Area Elevation _____

Inflow WCS's A-2 Outflow WCS's 6G1, 11G1, DC-A, Creek

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Cattail control through grazing. Maintain low level through summer, then flood in early winter.

Date	Planned Activity	Date	Accomplishment Average Gage Reading
1/1	Maintain current level through	1/27/88	3.50
	summer	2/15/88	4.00 Repaired washout beneath struct
		3/29/88	3.48
5/15	Graze several times according	4/05/88	3.70
		4/21/88	3.60
	to grazing plan.	5/05/88	Dropped boards in all structures to
		5/25/88	store more water in Darynane Lake.
10/15	Begin staging up by 3-4" every	6/1/88	4.90 Water receding on its own.
		6/15/88	4.72
	two weeks until full.	7/15/88	4.10
		8/30/88	2.67 Water continuing to recede.
		9/9/88	1.20Pulled all the boards to try to dry unit out for wcs replacement.
		10/30/88	Pushed up five islands with Bulldoze for goose nesting. Cleared several acres of cattails during process. Replaced whistle tube wcs (11G1) wit concrete structure. Poured foundatio for new structure which will provide water into Unit 21. Cleaned out dit
		11/30/88	3.26 Began refilling Unit 24
		12/30/88	3.98 Continued refilling unit, while sending water into Units 20A&B,

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 29

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 91. Acre Feet of Storage 265.

Full Elevation * Moist Soil Area Elevation ____

Inflow WCS's 29c Outflow WCS's 29a, 29b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for moist soil plants and public hunting.

Date	Planned Activity	Date	Accomplishment
			Average Gage Reading
1/1	Maintain current level until	1/27/88	3.76
		2/15/88	3.78
	ice-out, then fill another 3-5"	3/29/88	4.62
		4/05/88	5.04 Pulled one 2X6, one 2X4.
	and maintain.	4/14/88	4.68 Pulled one 2X4.
		4/21/88	4.44 Pulled all brds in canal, #29.
5/1	Begin staging down by 3-4" per	4/27/88	4.42 Pulled one 2X4.
		5/05/88	4.00 Pulled two 2X6's.
	week to expose moist soil areas	5/12/88	2.08 Pulled two 2X6's.
		5/19/88	1.04 Pulled one 2X6.
	Leave water in borrow area.	5/25/88	.70 Switched 2X6 for 2X4.
		6/1/88	.60 Allowed water to recede by itse
7/15	Irrigate by quickly raising	6/8/88	.40 Unit produced good moist soil c
		6/30/88	Unit holding water in borrow areas.
	water to cover moist soil areas	Unit remained dry for the rest of the year	
		through December 1988. No water available for	
	an then quickly lowering.	diversions.	
9/1	Raise level so that there is 3-4"		
	of water on lowest plants. Maintain.		
10/1	Begin to stage up 3-4" every two		
	weeks until full.		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 40

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 50. Acre Feet of Storage 75.

Full Elevation 4.0 Moist Soil Area Elevation _____

Inflow WCS's DL4A Outflow WCS's 40a, 40b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Graze unit for cattail control and encourage moist soil plants for waterfowl foods. Provide public hunting opportunities.

Date	Planned Activity	Date	Accomplishment
			Average Gage Reading
1/1	Fill unit to capacity when ice-	1/27/88	2.80
	out. Est. new full gauge reading	2/15/88	2.88
		3/29/88	4.29
		4/05/88	2.14
4/15	Fast drawdown.	4/14/88	1.76 Pulled one 2X4.
		4/21/88	1.38
5/1	Short duration grazing for cattail	4/27/88	1.56
	control. Do not graze water unit	5/05/88	1.46 Dropped boards in structure up to the top of structure.
	after June 15.	5/19/88	Water receded leaving structure silted in.
		5/25/88	Cleaned out silt in supply ditch with backhoe.
7/1	Irrigate moist soil plants if	6/1/88	.30
	needed.	6/22/88	Water below gage. Unit held water in borrow area until late September. Unit dry for the rest of the year.
9/1	Begin staging up for waterfowl		
	season. Maintain at 2.90 thru		
	hunting season.		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 48

Water Unit Type: Permanent ____ Moist Soil 48

Unit Surface Acres 100. Acre Feet of Storage 150.

Full Elevation 4.20 Moist Soil Area Elevation _____

Inflow WCS's 48c, 26a Outflow WCS's 48a, 48b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for waterfowl food production, mostly invertebrates.

Date	Planned Activity	Date	Accomplishment
1/1	After ice-out raise 3-6" and		Average Gage Reading
		1/27/88	3.44
	hold.	2/15/88	3.22
		3/29/88	4.37
5/1	Stage down 3-4" every two weeks	4/14/88	3.08 Pulled one 2X4.
		4/21/88	2.56 Pulled one 2X4.
	until water only in borrow area	4/27/88	2.50
		5/05/88	2.22 Pulled one 2X4.
	Area will be grazed for a short	5/12/88	1.16 Water receding on its own.
		5/19/88	.96
		5/25/88	.70 Pulled one 2X4.
	time.	6/1/88	.42
		6/8/88	.20
8/1	Begin staging up 3-4" every two	6/22/88	Water below gage.
		Unit remained dry for the rest of the year.	
	weeks as food is consumed.	No water	available for diversions.
11/1	Fill unit to capacity.		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 49

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 140. Acre Feet of Storage 210.

Full Elevation 4.70 Moist Soil Area Elevation _____

Inflow WCS's 26a, 48b Outflow WCS's 49a, 49b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for invertebrate production for fall migration.

Date	Planned Activity	Date	Accomplishment
			Average Gage Reading
1/1	After ice-out, stage up to max.	1/27/88	4.20
		2/15/88	4.40
	depth, hold thru spring migration.	3/29/88	4,79
		4/5/88	5.10 Pulled two 2X4's.
5/1	Fast drawdown to expose moist	4/15/88	4.54
		4/21/88	4.39
	soil areas. Leave some water in	4/27/88	4.30
		5/5/88	4.22 Pulled one 2X6 and one 2X4.
	borrow areas. Graze unit for	5/12/88	3.22 Pulled one 2X6.
		5/19/88	2.40 Pulled one 2X6.
	short duration.	5/25/88	2.00 Pulled one 2X6.
		6/1/88	1.82 Pulled one 2X4.
8/1	Quickly flood mature vegetation	6/15/88	1.76 Pulled one 2X4.
		6/22/88	1.16
	(should be mostly cockleburs)	6/30/88	.64 Pulled last 2X6.
9/15	Begin to stage down to concentrate	7/15/88	Unit almost completely dry.
			Unit remained dry throughout the res
	food. Lower 3-4" per week to about		of the year. No water was available
			for diversions.
	2.5 and hold.	8/88	Water control structure RC-B was rehabilitated.

Remarks:

Note: May need to reverse management for 48 and 49 due to water flow patterns.

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 57

Water Unit Type: Permanent X Moist Soil X

Unit Surface Acres 154. Acre Feet of Storage 319.

Full Elevation No gauge Moist Soil Area Elevation _____

Inflow WCS's 61e Outflow WCS's Drains to unit 78

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for waterfowl and to drown out cattails.

Date	Planned Activity	Date	Accomplishment
1/1	Keep unit full as long as possible		Unit was kept as full as possible ~~through the early spring~~. Water
	with flow thru from 61e		was cut off to the unit during May
	If unable to keep full because		~~so that Unit 61 could be drained fo~~ water control structure repairs.
	of management of unit 61, allow		Unit 57 was allowed to dewater naturally until it was dry in July.
	natural decline. Refill in fall		Unit remained dry throughout the rest of the year.
	as soon as possible.		Water control structure RC-D was rehabilitated and a diversion
6/1	Build diversion to unit from		structure to East Lake was built.
	junction of Rattlesnake Canal		
	and West Canal.		

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 62

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 150. Acre Feet of Storage 300.

Full Elevation * Moist Soil Area Elevation _____

Inflow WCS's DL4A, 40b Outflow WCS's 62a

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for waterfowl. Use grazing for cattail control.

Date	Planned Activity	Date	Accomplishment
1/1	Fill unit to capacity and est.		Average Gage Reading
		1/27/88	2.44
	new full level for gauge.	2/15/88	2.48
		3/29/88	2.61
4/15	Fast drawdown	4/5/88	1.74 Pulled one 2X4.
		4/14/88	1.38 Pulled one 2X6.
5/1	Graze for short periods, severa	4/21/88	.96
		4/27/88	1.26 Pulled one 2X6.
	times prior to June 15.	5/5/88	1.10 Pulled last 2X6.
7/1	Irrigate Moist soil plants if	5/12/88	.70
		5/19/88	.48
	needed.	5/25/88	.40
		6/1/88	.40
9/1	Stage up 3-4" every two weeks	6/8/88	.20
		6/15/88	Below gage.
	to 2.80 for hunting season and	6/30/88	Water receded on its own throughout year. Some water remained in borro area all year.
	hold.	8/24/88	Cleaned gage.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 63

Water Unit Type: Permanent ____ Moist Soil X

Unit Surface Acres 270. Acre Feet of Storage 650.

Full Elevation 6.70 Moist Soil Area Elevation _____

Inflow WCS's 61b,c,d Outflow WCS's 63a, 63b

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Manage for waterfowl food production and goose production area.

Date	Planned Activity	Date	Accomplishment
			Average Gage Reading
1/1	After ice-out continue to stage	1/27/88	4.74
		2/15/88	5.46
	up to full level by 5/1	3/29/88	6.48
		4/6/88	7.38 Pulled one 2X6 and one 2X4.
5/1	Maintain full level thru	4/14/88	6.76 Pulled one 2X6.
		4/21/88	6.00 Pulled one 2X6.
	growing season.	4/27/88	5.36 Pulled one 2X6.
		5/5/88	4.84 Pulled one 2X4.
8/15	Begin to stage down 3-4" per	5/12/88	4.36
		5/19/88	3.94 Water continuing to recede on its
	week to concentrate waterfowl		own.
		5/25/88	3.90 Strong south winds caused silting
	foods. Stop lowering at 3.0		in problems. Shoveled silt out.
		6/1/88	3.90
	and hold.	6/8/88	3.20
		6/15/88	2.68
		7/13/88	Water level below gage.
			Unit remained dry during the rest of the year.
			No water available for diversions.

Remarks:

Enter Monitoring information on reverse side.

CALENDER YEAR 1988
WATER MANAGEMENT AND ACTION PLAN
for
WATER UNIT 80

Water Unit Type: Permanent ____ Moist Soil X and salt flats

Unit Surface Acres _____. Acre Feet of Storage _____.

Full Elevation 3.90 Moist Soil Area Elevation _____

Inflow WCS's 58c, 75a & b Outflow WCS's 80a

Narrative: Describe briefly but specifically what is to be accomplished in this unit this year.

Maintain at current level thru late winter. Lower for shorebird migration and then drain. Refill for hunting season. Install gauge on structure while unit drained.

Date	Planned Activity	Date	Accomplishment
			Average Gage Readings
1/1	Maintain full	2/12/88	3.0
		3/29/88	2.88
3/1	Begin staging down 3-4" per	4/1-21/88	3.90
		4/27/88	3.72
	week to 2.0 and hold.	5/05/88	3.58 Pulled last three 2X6's.
		5/12/88	2.40 Least Terns observed using the
5/15	Pull all boards and drain unit.		surrounding areas.
		5/19/88	1.60
	Put gauge in.	5/25/88	1.40
		6/1/88	1.10
9/1	Begin refilling from unit 58 to	6/15/88	.60
		6/22/88	~~water stopped flowing~~ through structure
	full by 10/15. Maintain thru	6/30/88	.30 Water present in low areas only
		7/10/88	~~Most areas dry.~~
	hunting season.		Unit remained dry through the rest of ~~the year.~~

Remarks:

Enter Monitoring information on reverse side.

05-26-1995

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$$CAPACITY = A3*X^2 + A2*X + A1$$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 14A

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1772.00	0	0.0000	3.6700	1.7150
2	1774.00	14	14.2000	10.5300	7.9625
3	1776.00	67	67.1100	42.3800	11.0625

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 14A

05-26-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1772	4	4	4	5	5	5	6	6	6	7
1773	7	7	8	8	8	9	9	10	10	10
1774	11	12	14	15	17	18	20	22	23	25
1775	26	28	30	31	33	34	36	38	39	41
1776	42	45	47	49	51	53	56	58	60	62
1777	65	67	69	71	73	76	78	80	82	84
1778	87									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 14A

05-26-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1772	0	0	1	1	2	2	3	3	4	5
1773	5	6	7	8	8	9	10	11	12	13
1774	14	15	17	18	20	21	23	25	28	30
1775	33	35	38	41	45	48	51	55	59	63
1776	67	71	76	81	86	91	97	102	108	114
1777	121	127	134	141	148	156	163	171	179	188
1778	196									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$CAPACITY = A3*X^2 + A2*X + A1$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-26-1995

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 14B

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1772.00	0	0.0000	0.0800	2.5050
2	1774.00	10	10.1800	10.1000	9.5525
3	1776.00	68	68.5900	48.3100	12.1175

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 14B

05-26-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1772	0	1	1	2	2	3	3	4	4	5
1773	5	6	6	7	7	8	8	9	9	10
1774	10	12	14	16	18	20	22	23	25	27
1775	29	31	33	35	37	39	41	43	44	46
1776	48	51	53	56	58	60	63	65	68	70
1777	73									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 14B

05-26-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1772	0	0	0	0	0	1	1	1	2	2
1773	3	3	4	4	5	6	7	7	8	9
1774	10	11	13	14	16	18	20	22	24	27
1775	30	33	36	39	43	47	51	55	59	64
1776	69	74	79	84	90	96	102	108	115	122
1777	129									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$$CAPACITY = A3*X^2 + A2*X + A1$$

05-26-1995

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 16

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1768.00	0	0.0000	0.4700	0.9075
2	1770.00	4	4.5700	4.1000	0.9850
3	1772.00	16	16.7100	8.0400	4.5925
4	1774.00	51	51.1600	26.4100	2.3550

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 16

05-26-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1768	0	1	1	1	1	1	2	2	2	2
1769	2	2	3	3	3	3	3	4	4	4
1770	4	4	4	5	5	5	5	5	6	6
1771	6	6	6	7	7	7	7	7	8	8
1772	8	9	10	11	12	13	14	14	15	16
1773	17	18	19	20	21	22	23	24	25	25
1774	26	27	27	28	28	29	29	30	30	31
1775	31	32	32	33	33	33	34	34	35	35
1776	36									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 16

05-26-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1768	0	0	0	0	0	0	1	1	1	1
1769	1	2	2	2	2	3	3	3	4	4
1770	5	5	5	6	6	7	7	8	8	9
1771	10	10	11	12	12	13	14	14	15	16
1772	17	18	19	20	21	22	23	25	26	28
1773	29	31	33	35	37	39	41	44	46	49
1774	51	54	57	59	62	65	68	71	74	77
1775	80	83	86	89	93	96	99	103	106	110
1776	113									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$$CAPACITY = A3*X^2 + A2*X + A1$$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-26-1995

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 24

QUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1765.00	0	0.0000	0.1600	0.3700
2	1766.00	0	0.5300	0.9000	0.6200
3	1767.00	2	2.0500	2.1400	3.5750
4	1768.00	7	7.7650	9.2900	6.8600
5	1769.00	23	23.9150	23.0100	10.3950

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 24

05-26-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1765	0	0	0	0	0	1	1	1	1	1
1766	1	1	1	1	1	2	2	2	2	2
1767	2	3	4	4	5	6	6	7	8	9
1768	9	11	12	13	15	16	18	19	20	22
1769	23	25	27	29	31	33	35	38	40	42
1770	44									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 24

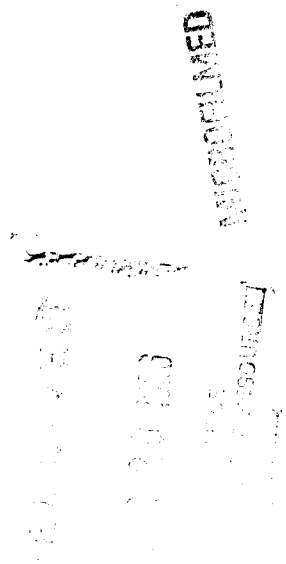
05-26-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1765	0	0	0	0	0	0	0	0	0	0
1766	1	1	1	1	1	1	1	1	2	2
1767	2	2	3	3	3	4	5	5	6	7
1768	8	9	10	11	13	14	16	18	20	22
1769	24	26	29	32	35	38	41	45	49	53
1770	57									

---------- END OF REPORT ----------



EQUATIONS --> AREA = A2 + X*(A3 + A3) 05-26-1995

--> CAPACITY = A3*X² + A2*X + A1

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 29

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1757.00	0	0.0000	0.0600	0.2650
2	1758.00	0	0.3250	0.5900	1.6500
3	1759.00	2	2.5650	3.8900	5.2800
4	1760.00	11	11.7350	14.4500	13.6450
5	1761.00	39	39.8300	41.7400	9.4300
6	1762.00	91	91.0000	60.6000	12.8350

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 29

05-26-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1757	0	0	0	0	0	0	0	0	0	1
1758	1	1	1	2	2	2	3	3	3	4
1759	4	5	6	7	8	9	10	11	12	13
1760	14	17	20	23	25	28	31	34	36	39
1761	42	44	46	47	49	51	53	55	57	59
1762	61	63	66	68	71	73	76	79	81	84
1763	86									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 29

05-26-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1757	0	0	0	0	0	0	0	0	0	0
1758	0	0	1	1	1	1	1	2	2	2
1759	3	3	4	4	5	6	7	8	9	10
1760	12	13	15	17	20	22	25	29	32	36
1761	40	44	49	53	58	63	68	74	79	85
1762	91	97	104	110	117	125	132	140	148	156
1763	164									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

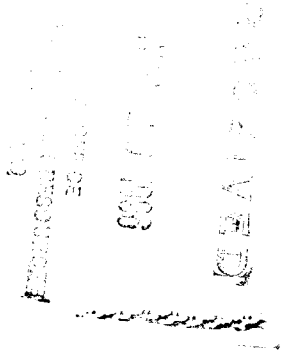
$$CAPACITY = A3*X^2 + A2*X + A1$$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-01-1995

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 40

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1736.00	0	0.0000	0.1900	0.2650
2	1738.00	1	1.4400	1.2500	2.2725
3	1740.00	13	13.0300	10.3400	4.3375
4	1742.00	51	51.0600	27.6900	4.4375



QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 40

05-01-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1736	0	0	0	0	0	0	1	1	1	1
1737	1	1	1	1	1	1	1	1	1	1
1738	1	2	2	3	3	4	4	4	5	5
1739	6	6	7	7	8	8	9	9	9	10
1740	10	11	12	13	14	15	16	16	17	18
1741	19	20	21	22	22	23	24	25	26	27
1742	28	29	29	30	31	32	33	34	35	36
1743	37	37	38	39	40	41	42	43		

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 40

05-01-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1736	0	0	0	0	0	0	0	0	0	0
1737	0	1	1	1	1	1	1	1	1	1
1738	1	2	2	2	2	3	3	3	4	4
1739	5	6	6	7	8	8	9	10	11	12
1740	13	14	15	17	18	19	21	22	24	26
1741	28	30	32	34	36	38	41	43	46	48
1742	51	54	57	60	63	66	69	73	76	80
1743	83	87	91	95	99	103	107	111		

---------- END OF REPORT ----------

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 48

05-01-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1750	0	0	0	1	1	1	1	1	1	1
1751	1	2	2	3	3	3	4	4	5	5
1752	6	8	11	14	17	20	23	26	28	31
1753	34	38	43	47	51	55	60	64	68	73
1754	77	80	83	86	89	92	96	99	102	105
1755	108									

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$CAPACITY = A3*X^2 + A2*X + A1$

05-01-1995

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 48

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1750.00	0	0.0000	0.2700	0.4750
2	1751.00	0	0.7450	1.2200	2.1400
3	1752.00	4	4.1050	5.5000	14.3300
4	1753.00	23	23.9350	34.1600	21.3150
5	1754.00	79	79.4100	76.7900	15.6400

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 48

05-01-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1750	0	0	0	0	0	0	0	0	1	1
1751	1	1	1	1	2	2	2	3	3	4
1752	4	5	6	7	9	10	13	15	18	21
1753	24	28	32	36	41	46	52	58	65	72
1754	79	87	95	104	113	122	131	141	151	161
1755	172									

---------- END OF REPORT ----------

QUIVIRA NWR AREA/ELEVATION/CAPACITY 05-01-1995
POOL49

THE AREA TABLE IS IN ACRES THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1750	0	1	1	1	2	2	2	3	3	3
1751	4	6	8	10	13	15	17	19	22	24
1752	26	30	34	38	42	46	49	53	57	61
1753	65	67	70	72	75	77	80	82	85	87
1754	90	92	95	97	100	102	105	107	110	112
1755	115	117	120	122						

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$$CAPACITY = A3*X^2 + A2*X + A1$$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-01-1995

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL49

QUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1750.00	0	0.0000	0.4600	1.6450
2	1751.00	2	2.1050	3.7500	11.2350
3	1752.00	17	17.0900	26.2200	19.3450
4	1753.00	62	62.6550	64.9100	12.4750

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL49

05-01-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1750	0	0	0	0	0	1	1	1	1	2
1751	2	3	3	4	5	7	8	10	12	15
1752	17	20	23	27	31	35	40	45	50	56
1753	63	69	76	83	91	98	106	114	123	131
1754	140	149	159	168	178	188	198	209	220	231
1755	242	254	266	278						

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$$CAPACITY = A3*X^2 + A2*X + A1$$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-03-1995

QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 57

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1740.00	0	0.0000	5.5300	14.5825
2	1742.00	69	69.3900	63.8600	20.9075

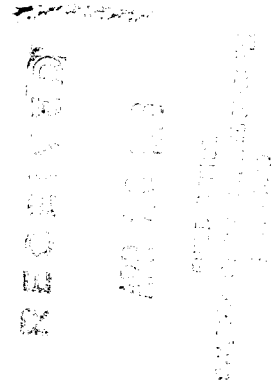
QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 57

05-03-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1740	6	8	11	14	17	20	23	26	29	32
1741	35	38	41	43	46	49	52	55	58	61
1742	64	68	72	76	81	85	89	93	97	101
1743	106	110	114	118	122	127	131	135	139	143
1744	147	152	156	160	164	168	173	177	181	185
1745	189									



QUIVIRA NWR AREA/ELEVATION/CAPACITY
POOL 57

05-03-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1740	0	1	2	3	5	6	9	11	14	17
1741	20	24	28	32	36	41	46	52	57	63
1742	69	76	83	90	98	107	115	124	134	144
1743	154	165	176	188	200	212	225	238	252	266
1744	281	296	311	327	343	360	377	394	412	430
1745	449									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$CAPACITY = A3*X^2 + A2*X + A1$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-08-1995

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 62

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1735.00	0	0.0000	0.0100	0.1000
2	1736.00	0	0.1100	0.2100	0.1900
3	1737.00	0	0.5100	0.5900	0.3150
4	1738.00	1	1.4150	1.2200	1.0550
5	1739.00	3	3.6900	3.3300	2.4350
6	1740.00	9	9.4550	8.2000	5.4750
7	1741.00	23	23.1300	19.1500	4.0800
8	1742.00	46	46.3600	27.3100	4.8150

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 62

05-08-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1735	0	0	0	0	0	0	0	0	0	0
1736	0	0	0	0	0	0	0	0	1	1
1737	1	1	1	1	1	1	1	1	1	1
1738	1	1	2	2	2	2	2	3	3	3
1739	3	4	4	5	5	6	6	7	7	8
1740	8	9	10	11	13	14	15	16	17	18
1741	19	20	21	22	22	23	24	25	26	26
1742	27	28	29	30	31	32	33	34	35	36
1743	37	38	39	40	41	42	43	44	45	46
1744	47									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 62

05-08-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1735	0	0	0	0	0	0	0	0	0	0
1736	0	0	0	0	0	0	0	0	0	0
1737	1	1	1	1	1	1	1	1	1	1
1738	1	2	2	2	2	2	3	3	3	3
1739	4	4	4	5	5	6	7	7	8	9
1740	9	10	11	12	14	15	16	18	20	21
1741	23	25	27	29	31	34	36	39	41	44
1742	46	49	52	55	58	61	64	68	71	75
1743	78	82	86	90	94	98	102	107	111	116
1744	120									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$CAPACITY = A3*X^2 + A2*X + A1$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-25-1995

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 63

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1736.00	0	0.0000	0.3800	6.0175
2	1738.00	24	24.8300	24.4500	24.6250
3	1740.00	172	172.2300	122.9500	13.0675

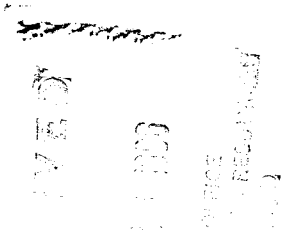
QUIVIRA AREA/ELEVATION/CAPACITY
POOL 63

05-25-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1736	0	2	3	4	5	6	8	9	10	11
1737	12	14	15	16	17	18	20	21	22	23
1738	24	29	34	39	44	49	54	59	64	69
1739	74	79	84	88	93	98	103	108	113	118
1740	123	126	128	131	133	136	139	141	144	146
1741	149	152	154	157	160	162	165	167	170	173
1742	175									



QUIVIRA AREA/ELEVATION/CAPACITY
POOL 63

05-25-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1736	0	0	0	1	1	2	2	3	4	5
1737	6	8	9	11	12	14	16	18	20	22
1738	25	28	31	34	39	43	48	54	60	67
1739	74	82	90	98	107	117	127	138	149	160
1740	172	185	197	210	224	237	251	265	279	293
1741	308	323	339	354	370	386	402	419	436	453
1742	470									

---------- END OF REPORT ----------

EQUATIONS --> $AREA = A2 + X*(A3 + A3)$

$CAPACITY = A3*X^2 + A2*X + A1$

WHERE X = THE DIFFERENCE BETWEEN THE BASE ELEVATION AND A GIVEN ELEVATION. AREA IS IN ACRES AND CAPACITY IS IN ACRE-FEET

05-25-1995

UNREVIEWED

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 80

EQUATION NUMBER	ELEVATION BASE	CAPACITY BASE	COEFFICIENT A1(INTERCEPT)	COEFFICIENT A2(1ST TERM)	COEFFICIENT A3(2ND TERM)
1	1734.00	0	0.0000	2.6600	45.9600
2	1735.00	48	48.6200	94.5800	57.7100
3	1736.00	200	200.9100	210.0001	14.8849

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 80

05-25-1995

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1734	3	12	21	30	39	49	58	67	76	85
1735	95	106	118	129	141	152	164	175	187	198
1736	210	213	216	219	222	225	228	231	234	237
1737	240									

QUIVIRA AREA/ELEVATION/CAPACITY
POOL 80

05-25-1995

THE CAPACITY TABLE IS IN ACRE FEET

THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1734	0	1	2	5	8	13	18	24	32	40
1735	49	59	70	82	96	110	126	143	161	180
1736	201	222	244	265	287	310	332	355	378	402
1737	426									

---------- END OF REPORT ----------

1995 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1996.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below. If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas Department of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	Unit	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
007571-00	(RCA) SW SE NE 35-21-11W 01	887.0 ACRE	FEET SURFACE WATER DIVERTED		A					
007571-00	(DARRYNANE) SW NE NE 13-22-11W 01	881.6 ACRE	FEET SURFACE WATER DIVERTED		A					
007571-00	(LSM) SW NW SW 25-22-11W 01	4235.0 ACRE	FEET SURFACE WATER DIVERTED		A					

RECEIVED
JAN 13 1997
FIELD OFFICE
DIVISION OF WATER RESOURCE

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1995: Empty 1/4 1/2 3/4 (Full)
July 1, 1995: Empty 1/4 1/2 3/4 (Full)
November 1, 1995: Empty 1/4 1/2 (3/4) Full

Date: 1/30/96 Telephone: ( ) 316-486-2393

I submit this report as the best information available. I understand that knowingly falsifying the report is a violation of state law.

792902

95 018302 - 1 REC Staff 93 0
Office Use FO CO GMD

David Hilley, Refuge Manager
Name (Printed or Typed)

David Hilley
Name (Signature)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

DIV. OF WATER RES RECEIVED FEB 26 1996 878032 KS DEPT OF AGRICULTURE

___ Owner ___ Tenant XX Agent

DWR 1-513 (Rev 11/17/95)

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS 02/16/96

STATION NUMBER 07142575 RATTLESNAKE C NR KENITH, KS STREAM SOURCE AGENCY USGS
LATITUDE 380601 LONGITUDE 0983032 DRAINAGE AREA 533.00 DATUM 1785.00 STATE 20 COUNTY 185
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1994 TO SEPTEMBER 1995
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.88	7.5	8.5	12	15	e14	20	34	246	e150	25	7.0
2	1.7	7.3	9.0	12	15	e14	19	36	147	e500	26	6.7
3	3.1	6.5	9.1	14	14	15	20	35	126	e400	25	6.6
4	3.4	6.1	9.2	13	15	19	19	33	105	e300	23	6.4
5	5.4	6.0	9.0	14	14	18	19	32	82	e200	23	4.4
6	4.5	6.1	12	16	15	17	19	31	68	e150	36	4.0
7	4.1	5.7	15	14	14	14	19	89	60	e120	44	4.3
8	4.3	5.8	15	15	14	14	20	390	111	e90	38	4.5
9	4.3	6.1	14	16	14	19	18	274	313	e70	32	5.2
10	4.8	6.2	13	13	15	19	20	139	319	e50	27	5.5
11	5.3	6.2	10	14	15	19	19	116	201	e45	23	4.9
12	5.5	6.4	11	15	12	19	19	93	172	e40	21	5.1
13	5.6	6.6	14	15	12	18	20	148	132	34	18	4.4
14	5.9	6.5	14	14	17	19	20	419	98	32	17	4.3
15	7.1	5.9	13	14	21	20	20	320	79	30	23	4.6
16	7.2	6.0	13	14	16	19	19	228	68	30	29	4.3
17	8.9	5.9	13	13	16	19	20	165	58	30	20	4.2
18	9.1	6.5	13	13	16	18	19	127	55	29	17	4.4
19	8.4	7.1	13	13	16	18	20	90	51	29	15	6.7
20	7.7	9.3	13	13	16	17	22	65	49	28	14	7.2
21	7.2	9.5	13	15	16	17	23	54	44	29	13	8.8
22	6.9	8.9	13	14	15	16	26	54	44	28	13	9.3
23	6.5	8.6	13	10	15	17	28	797	46	27	12	8.7
24	6.2	8.5	12	10	15	18	27	1480	50	26	11	10
25	6.4	8.4	12	13	14	20	26	1900	51	25	11	6.7
26	7.2	8.6	12	14	15	22	24	1500	47	24	10	6.7
27	6.5	8.0	12	16	15	22	24	1500	43	23	9.4	8.2
28	6.0	8.3	12	16	14	21	24	1360	40	23	8.9	9.9
29	6.6	8.1	12	16	---	20	25	1230	43	22	8.3	16
30	6.6	8.3	12	28	---	20	28	947	e56	21	7.9	14
31	7.6	---	12	16	---	20	---	537	---	21	7.5	---
TOTAL	180.88	214.9	375.8	445	421	562	646	14223	3004	2626	608.0	203.0
MEAN	5.83	7.16	12.1	14.4	15.0	18.1	21.5	459	100	84.7	19.6	6.77
MAX	9.1	9.5	15	28	21	22	28	1900	319	500	44	16
MIN	.88	5.7	8.5	10	12	14	18	31	40	21	7.5	4.0
AC-FT	359	426	745	883	835	1110	1280	28210	5960	5210	1210	403

WTR YR 1995 TOTAL 23509.58 MEAN 64.4 MAX 1900 MIN .88 AC-FT 46630

e Estimated

OPTIONAL FORM 99 (7-90)

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 South Kansas Avenue, 2nd Floor
Topeka, Kansas 66612-1283
(913) 296-3717 FAX (913) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

January 26, 1996

MS CHERYL C WILLISS
CHIEF WATER RESOURCES DIVISION
FISH AND WILDLIFE SERVICE
U S DEPT OF THE INTERIOR
P O BOX 25486
DENVER FEDERAL CENTER
DENVER CO 80225

Re: Appropriation of Water
File No. 7,571
BA WTR
WR KS
Mail Stop 60189

Dear Ms Williss:

Your request for additional time to review the draft Certificate of Appropriation for the water right associated with Quivira National Wildlife Refuse was received on January 22, 1996. The situation of employees being furloughed was indeed unfortunate and is considered a good reason for allowing additional time for your review of the draft Certificate of Appropriation. We do want you to complete any analysis you feel is needed.

Your request for an extension of the deadline is hereby granted. Please provide any comment or additional information you wish to have considered by February 8, 1996. If you have questions, please feel free to contact Leland Rolfs, Senior Legal Counsel for the Division of Water Resources, Kansas Department of Agriculture at 913-296-4623.

Sincerely,

David L. Pope, P.E.
Chief Engineer

DLP:LMS:jt
pc: Stafford Field Office
Leland Rolfs, Senior Legal Counsel
Guy Ellis, Water Rights Section Head
Larry Sheets, Supervisor, Certificate Unit
Bruce Falk, Water Commissioner, Stafford Field Office
Matt A. Scherer, Conservation Engineer

~~90022~~
7571

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

Mail Stop 60189

IN REPLY REFER TO:

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

Mr. David L. Pope
Chief Engineer-Director
Division of Water Resources
901 S. Kansas Avenue, 2nd Floor
Topeka, Kansas 55512-1283

Dear Mr. Pope:

I have received your December 22, 1995, letter requesting any additional comments on the draft water rights certificate for Quivira National Wildlife Refuge. As you are surely aware, most Fish and Wildlife Service employees were furloughed on December 16, 1995, and did not report back to work until January 8, 1996. As a result, the additional analysis of Quivira's water right has not been completed. I request that the January 22, 1996, deadline be extended to February 8, 1996, to allow the full 30-day response period. Please contact me at 303/236-5321, ext. 223, if you have any questions concerning this request.

Sincerely,

Cheryl C. Williss
Chief, Water Resources Division

cc: Leland Rolfs, Senior Legal Counsel
Guy Ellis, Head, water Rights
Larry Sheets, Head, Certificate Unit ✓
Bruce Falk, Water Commissioner, Stafford Field Office
Matt A. Scherer III, Conservation Engineer

RECEIVED
APR 26 1996
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOURCES
JAN 22 1996
KANSAS DEPARTMENT OF AGRICULTURE

MICROFILMED

STATE OF KANSAS

BILL GRAVES, GOVERNOR
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 South Kansas Avenue, 2nd Floor
Topeka, Kansas 66612-1283
(913) 296-3717 FAX (913) 296-1176

KANSAS DEPARTMENT OF AGRICULTURE

December 22, 1995

MS CHERYL C WILLISS
CHIEF DIVISION OF WATER RESOURCES
FISH AND WILDLIFE SERVICE
US DEPT OF THE INTERIOR
PO BOX 25846
DENVER FEDERAL CENTER
DENVER CO 80225

Re: Appropriation of Water
File No. 7571
BA WTR
WR KS
Mail Stop 60189

Dear Ms. Williss:

I have considered the proposal in your letter of August 8, 1995, to delay issuing the certificate for Appropriation of Water, File No. 7571, for the Quivira National Wildlife Refuge, until such time as the Kansas Geological Survey (KGS) completes the water budget model for the Refuge that is now being developed. Based upon your letter, our meeting in Denver on July 25, 1995, and your brief overview of the computer model at the Rattlesnake Creek/Quivira Partnership meeting of November 7, 1995, at the Refuge Education Center, it does not appear that the model KGS is completing will better define the quantity of water that was actually diverted during the proposed period of record under the authority of File No. 7571.

As we discussed at our July meeting, and as I attempted to explain in my December 20, 1994 letter to Mr. Morgenweck, Kansas statutes, and the rules and regulations implementing those statutes, do not provide for the certification of a water right in excess of the quantity actually diverted in the year of record. In addition, please refer to paragraph eight of the Permit to Appropriate Water, dated May 9, 1963, and signed by R.V. Smrha, then Chief Engineer, which further outlines this limitation on perfection. Given that the apparent intent of the KGS model is to better define water demands at the Refuge, and not better quantify the amount of water actually diverted historically, it does not appear to be appropriate to further delay issuing the certificate.

Therefore, I propose to issue a certificate 30 days after the date of this letter. Enclosed is a draft certificate of appropriation similar to the one which was transmitted to the US Fish and Wildlife Service on August 18, 1993. If you wish to present information which better defines the quantity of water diverted during 1987, the proposed year of record, or any other year which might be a preferable year of record, please provide such information to this office before January 22, 1996. If we do not hear from you before January 22, 1996, we will issue the certificate as enclosed.

I appreciate the concerns that you and your staff have expressed regarding this certificate and trust that we have fully and openly explained the decision of the State of Kansas. I believe that the issues have been discussed fully and feel that it is essential that I exercise my duty as Chief Engineer to certify a perfected water right. If you have any questions, please feel free to contact Leland Rolfs, Senior Legal Counsel, at 913-296-4623.

Sincerely,

David L. Pope, P.E.
Chief Engineer

Attachment
DLP:MAS:sam
pc: Leland Rolfs, Senior Legal Counsel
Guy Ellis, Head, Water Rights
Larry Sheets, Head, Certificate Unit
Bruce Falk, Water Commissioner, Stafford Field Office
Matt A. Scherer III, Conservation Engineer

December 5, 1995

MS CHERYL C WILLISS
CHIEF DIVISION OF WATER RESOURCES
FISH AND WILDLIFE SERVICE
US DEPT OF THE INTERIOR
PO BOX 25846
DENVER FEDERAL CENTER
DENVER CO 80225

Re: Appropriation of Water
File No. 7571
BA WTR
WR KS
Mail Stop 60189

Dear Ms. Williss:

I have considered the proposal in your letter of August 8, 1995, to delay issuing the certificate for Appropriation of Water, File No. 7571, for the Quivira National Wildlife Refuge, until such time as the Kansas Geological Survey (KGS) completes the water budget model for the Refuge that is now being developed. Based upon your letter, our meeting in your offices on July 25, 1995, and your brief overview of the computer model at the Rattlesnake Creek/Quivira Partnership meeting of November 7, 1995, at the Refuge Education Center, it does not appear that the model KGS is completing will better define the quantity of water that was actually diverted during the proposed period of record under the authority of File No. 7,571.

Post-it® Fax Note 7671	Date 11-30-95	# of pages ▶ 4
To Bruce Falk	From matt Scherer
Co./Dept. Stafford ED.	Co. DWR Topeka
Phone #	Phone # 296-6088
Fax #	Fax #

As we discussed at our July meeting, and as I attempted to explain in my December 20, 1994 letter to Mr. Morgenweck, Kansas statutes, and the rules and regulations expanding upon those statutes, forbid me from certifying a water right in excess of the quantity actually diverted in the year of record. In addition, please refer to paragraph eight of the Permit to Appropriate Water, dated May 9, 1963, and signed by R.V. Smrha, then Chief Engineer, which further outlines this limitation on perfection. Given that the apparent intent of the KGS model is to better define water demands at the Refuge, and not better quantify the amount of water actually diverted historically, it does not appear to be in the interests of either the US Fish and Wildlife Service or the State of Kansas to further delay issuing the certificate.

Therefore, I propose to issue a certificate 30 days after the date of this letter in the same form as the draft certificate of appropriation which was transmitted to the US Fish and Wildlife Service on August 18, 1993. If you wish to present information which better defines the quantity of water diverted during 1987, the proposed year of record, or any other year which might be a preferable year of record, please provide such information to this office within the 30 days noted.

During these discussions, and during an investigation conducted by my Stafford field staff, you have made us aware that part of the Refuge operation is to divert groundwater seepage which occurs to the north and west of the Refuge. I understand, from your discussion of the KGS computer model at the Partnership meeting, that one of the purposes of the model is to

quantify this groundwater seepage. Once the model is completed, the Fish and Wildlife Service should apply for a permit to divert this water. Indeed, if you have preliminary results which give an upper limit to the possible maximum quantity of seepage water, I encourage you to apply as soon as possible.

I appreciate the concerns that you and your staff have expressed regarding this certificate and trust that we have fully and openly explained the decision of the State of Kansas. I believe that the issues have been discussed fully and feel that it is essential that I exercise my duty as Chief Engineer to certify a perfected water right.

As you may be aware, Constance Owen, Assistant Legal Counsel, who had been dealing with you on these issues, has resigned from her position with the Division of Water Resources. Therefore, if you have any questions, please feel free to contact Leland Rolfs, Senior Legal Counsel, at 913-296-4623.

Sincerely,

David L. Pope, P.E.

Chief Engineer

DLP:MAS:sam

pc: Leland Rolfs, Senior Legal Counsel

Guy Ellis, Head, Water Rights

Larry Sheets, Head, Certificate Unit

Bruce Falk, Water Commissioner, Stafford Field Office

Matt A. Scherer III, P.E., Conservation Engineer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

AUG - 8 1995

Mr. David L. Pope
Chief Engineer
Division of Water Resources
109 SW Ninth Street, Suite 202
Topeka, Kansas 66612

Dear Mr. Pope:

Thank you for arranging to meet with us on July 25, 1995, to discuss the Fish and Wildlife Service's (Service) concerns about the perfection process for Permit No. 7571 for Quivira National Wildlife Refuge (Refuge). I hope that we succeeded in explaining those concerns; I know that we understand your perspective much better as a result of the meeting.

As was discussed, it seems reasonable to postpone perfection of the Quivira water right until after Kansas Geological Survey completes the water budget model. That model should help define Refuge water demands and how those demands relate to the water right.

The model should be delivered by April 1, 1997. The Service plans to meet with you or your representative by July 31, 1997, to provide final comments on the draft certificate.

Sincerely,

Cheryl C. Williss
Chief, Division of Water Resources

Orig - LS
Copy - DUPLICATE, MAP

RECEIVED

DIV. OF WATER RES
RECEIVED

AUG 1 1 1995

MICROFILMED KS DEPT OF AGRICULTURE

KSA 45-221(a)(2) – privileged

KSA 45-221(a)(2) – privileged

KSA 45-221(a)(2) – privileged

INFORMATIONAL BRIEFING PAPER REGARDING APPROPRIATION OF WATER FOR QUIVIRA NATIONAL WILDLIFE REFUGE SUBMITTED TO ALICE DEVINE, SECRETARY KANSAS STATE DEPARTMENT OF AGRICULTURE BY GUY ELLIS, DIVISION OF WATER RESOURCES ON FEBRUARY 1, 1995

The United States Department of Interior, Fish and Wildlife Service filed an application for recreational use with the Division of Water Resources, Kansas State Department of Agriculture on August 15, 1957, for Quivira National Wildlife Refuge in Stafford and Rice Counties, Kansas. This application was assigned Appropriation of Water, File No. 7,571.

Subsequently, this application was approved and the permit to proceed with the intent of the application was issued by the Chief Engineer of the Division of Water Resources on May 9, 1963. The approval of application and permit to proceed authorized a maximum quantity of 22,200 acre-feet of water per calendar year to be diverted at a maximum rate of diversion of 300 cubic feet per second (cfs) from three points of diversion (dams, control gates, etc.) on Rattlesnake Creek drainage. The approval of the application authorized until December 31, 1968, the time to perfect or develop the water right. This time period was subsequently extended until December 31, 1987. Water is diverted into the Refuge to create marshes for wildlife habitat. Quivira National Wildlife Refuge has an area approximately 21,820 acres.

On February 1, 1971, an application for permit to change the point of diversion was filed by Fish and Wildlife Services with the Division of Water Resources. On November 11, 1971, this application for a change in point of diversion was approved by the Chief Engineer of the Division of Water Resources. Based on information submitted by the Fish and Wildlife Service, the Division of Water Resources acknowledged on March 20, 1974, that the diversion works for water were completed. The Division of Water Resources conducted a field inspection of the diversion works on December 21, 1992, to ascertain empirical data concerning the actual development of this water right. This information, water use reports filed by the Fish and Wildlife Service and other data has been used to draft a certificate of appropriation for beneficial use of water for this file. This draft certificate was sent to the Fish and Wildlife Service on August 18, 1993, for their review of the proposed certification of this water right. The Fish and Wildlife Service and the Division of Water Resources are presently discussing the issuance of the certificate of appropriation of water for this file. It is anticipated that a meeting between the Division of Water Resources and the Fish and Wildlife Service will be held in March or April of this year. A water right is based on the actual use of water within the perfection or development period; therefore, the actual quantative values of the certificate of appropriation may be less than the values authorized by the permit and approval of the application.

Summary of relevant facts for File No. 7,571

Priority Date (date filed at DWR) . . . . . August 15, 1957

Type of Beneficial Use . . . . . Recreational

Quantity of Water Presently Authorized per Calendar Year . . . . . 22,200 acre-feet

Maximum Rate of Diversion Presently Authorized . . . . . 300 cfs

Quantity of Authorized Storage . . . . . 15,800 acre-feet

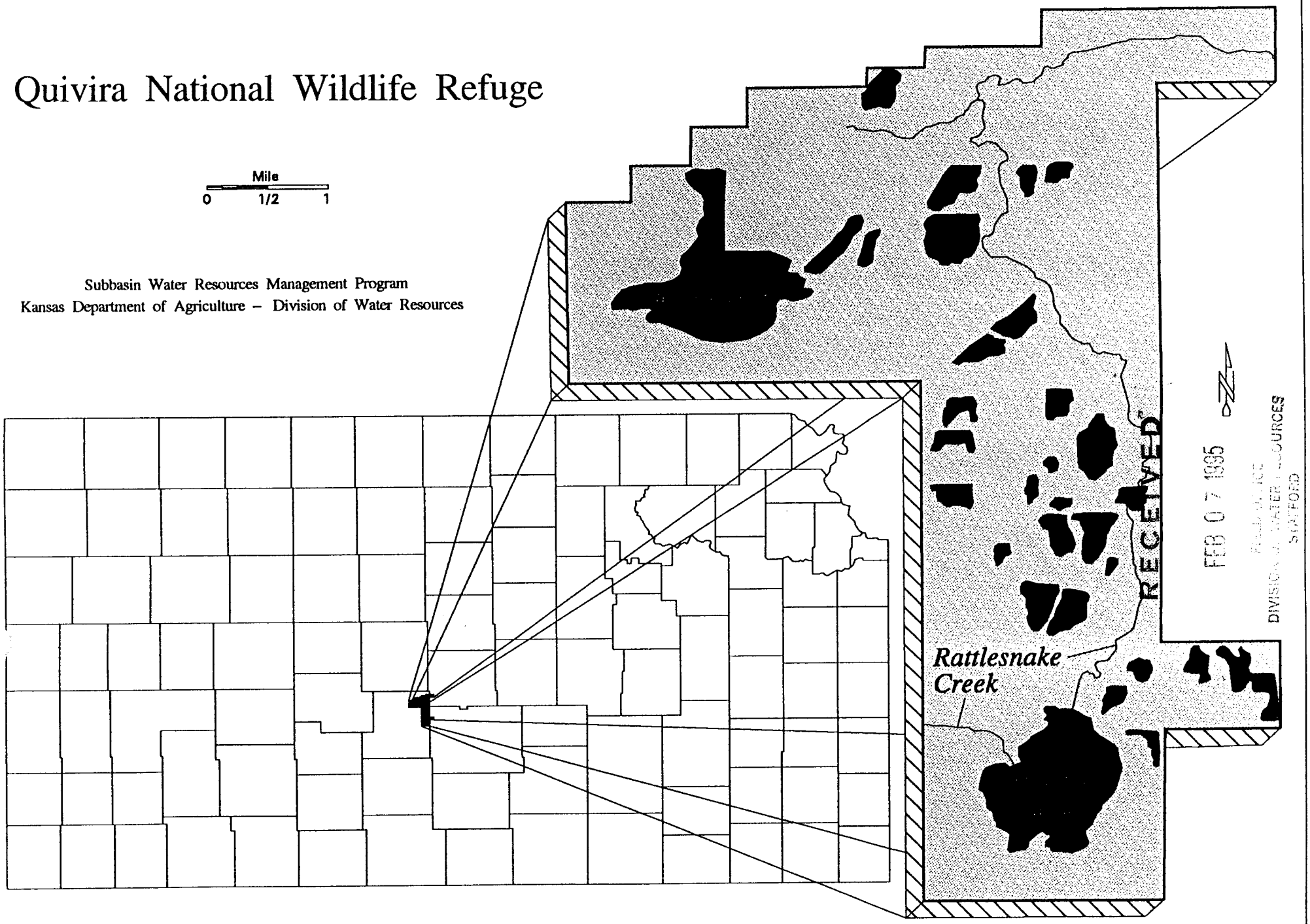
Authorized Points of Diversion 3

Source of Water . . . . . Surface Water of Rattlesnake Creek

Authorized Place of Use . . . . . Quivira National Wildlife Refuge
Stafford and Rice Counties, Kansas
(see attached maps)

Present Status . . . . . Pending issuance of a Certificate of Appropriation of Water for Beneficial Use

Quivira National Wildlife Refuge



February, 1995

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA WTR
WR KS
Mail Stop 60190

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

CERTIFIED

FEB 13 1995

David L. Pope, P.E.
Kansas State Board of Agriculture
Division of Water Resources
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283

Dear Mr. Pope:

Enclosed are 1994 Reports of Water Use for water rights permits utilized at the Flint Hills, Kirwin, and Quivira National Wildlife Refuges. The Project Leader, Quivira National Wildlife Refuge, stated that he would have used more water if it had been available (Permit No. 7571).

Please note Permit No. 035617:

The trailer park is no longer in existence and the *"Trailer Court Well"* has been plugged. Therefore, please cancel Permit No. 035617, located at the Kirwin National Wildlife Refuge.

If you have questions or require further information, please contact Linda Coe at (303) 236-5321.

Sincerely,

Cheryl C. Williss
Chief, Division of Water Resources

Enclosures

122254

DIVISION OF WATER RESOURCES
FEB 17 1995
STATE BOARD OF AGRICULTURE

1994 WATER USE REPORT
RECREATIONAL USE

A

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1995.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Water Meter Data: Beginning Water Meter Reading	Water Meter Data: Ending Water Meter Reading	Water Meter Data: Metered Quantity Of Water	UNIT	Hours	Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date
007571-00	SW SE NE 35-21-11W 01	112.3	Acre Feet Surface Water	Diverted						
007571-00	SW NE NE 13-22-11W 01	776.8	Acre Feet Surface Water	Diverted						
007571-00	SW NW SW 25-22-11W 01	2,402.8	Acre Feet Surface Water	Diverted						

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1994: Empty 1/4 1/2 (3/4) Full

July 1, 1994: Empty 1/4 (1/2) 3/4 Full

November 1, 1994: Empty (1/4) 1/2 3/4 Full

Date: 2/1/95 Telephone: (816) 486-2393

I submit this report with the knowledge that if it contains any false information I will be guilty of a Class C misdemeanor.

94 018302 - 1 REC Staff 93 0 — 22253

Office Use FO CO GMD

David Hilley, Refuge Manager
Name (Printed or Typed)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

CERT FEB 17 1995 D246487130

David Hilley
Name (Signature)

___ Owner ___ Tenant XX Agent

1994 RECREATIONAL WATER USE REPORT DWR 1-513 (Rev. 11/10/94)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA/WTR
KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

JAN 0 9 1995

David L. Pope, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
901 South Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283

Dear Mr. Pope:

I spoke with Connie Owen about your December 20, 1994, letter and offer to meet with the Fish and Wildlife Service (Service) to discuss the Quivira National Wildlife Refuge water right. The Service is still reviewing its information and your response to our earlier comments. Megan Estep-Johnston is also working with Deb Zarta to better identify all of the wells withdrawing groundwater within the Rattlesnake Creek basin. We appreciate your offer to meet with us and anticipate calling soon to schedule a March or April meeting.

Sincerely,

Cheryl C. Williss
Chief, Division of Water Resources

Copy to CCO, BF, GEE, LS

DIVISION OF WATER RESOURCES RECEIVED JAN 12 1995 STATE BOARD OF AGRICULTURE

RECEIVED
APR 26 1996
U.S. OFFICE
OF WATER RESOURCES

MICROFILMED

Larry She

KANSAS STATE BOARD OF AGRICULTURE
Phillip A. Fishburn, Acting Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

December 20, 1994

Mr. Ralph Morgenweck
Regional Director
U.S. Department of the Interior
Fish and Wildlife Service
P. O. Box 25486
Denver Federal Center
Denver, CO 80225

Re: Appropriation of Water, File No. 7571
Certificate of Appropriation
BA EN
KS WR
MAIL STOP 60190

Dear Mr. Morgenweck:

This is to acknowledge Ms. Susan Leebeiver's letter of August 23, 1994, regarding the draft Certificate of Appropriation for File No. 7571. I am interested in the Service's comments regarding the many technical issues that were raised in our earlier correspondence.

In response to the main issue that you raised in your August 23, 1994 letter, the Service's proposal that a certificate for a maximum 22,200 acre-feet per calendar year be issued (the maximum annual quantity set forth in the approval and permit to proceed), it is my position, and has been the position of the Chief Engineer since the passage of the Kansas Water Appropriation Act, that the Act and its related regulations do not allow the flexibility that you read into K.A.R. 5-3-8. That regulation, and related portions of the Act, have always been held to mean all three of the limits set forth in K.A.R. 5-3-8 apply to every certificate. That is, no certification of appropriation shall be determined for a quantity of water in excess of what was set forth in the permit to proceed, nor will it be set forth in excess of what was found to have been applied in accordance with the approval of the application, nor will any quantity of water found to be wasted during the year of record be used as a basis for perfecting a right.

Our interpretation is supported by the statutes, which provide the controlling principles of law. These statutes indicate the three limitations listed above are not optional, rather they each apply to all appropriation rights. K.S.A. 82a-714 governs certification. It refers to two of these limitations and implies the third. The statute speaks to "the actual application of water to the proposed beneficial use within the time allowed," and perfection

"in conformity with the approved application and plans." K.S.A. 82a-714(a). The provision in the Water Appropriation Act on "principles governing appropriations," provides the third limitation. It states, "Appropriation rights in excess of the reasonable needs of the appropriators shall not be allowed." K.S.A. 82-707(e). Water applied to an authorized beneficial use in excess of the needs for such use constitutes waste. K.S.A. 82a-701(cc)(4). Thus, the three limitations are all evident in the Water Appropriation Act.

I should also respond to your request that the certificate "acknowledge that the Service's ability to divert water from Rattlesnake Creek under its senior water right has been impaired by groundwater pumping." As I understand it, your position is that Quivira's water right was impaired during 1987 by groundwater pumping and, as a result, the certificate should reflect a larger quantity than was actually used during 1987, the year of record. As stated above, the law does not allow a certificate to be issued for a quantity greater than was actually perfected. Thus, the reference to "impairment" is not relevant to the perfection of File No. 7571. The controlling principle is that a water right is perfected by actual beneficial use of water as authorized.

I am looking forward to meeting with you, and any of your staff you wish to include, to discuss all the issues raised by the certification process, once the Service has completed its review of our previous letter. If you have any questions, please feel free to contact Connie Owen, Assistant Legal Counsel, at (913) 296-4623.

Sincerely,

David L. Pope, P.E.
Chief Engineer

DLP/MAS/bs

pc: Connie Owen, Assistant Legal Counsel
Guy Ellis, Water Rights Section Head
Larry Sheets, Certificate Unit
Bruce Falk, Stafford Water Commissioner

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA EN
KS WR
Mail Stop 60190

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

AUG 23 1994

Mr. David L. Pope
Chief Engineer-Director
Division of Water Resources
901 S. Kansas Avenue
Topeka, Kansas 66612-1283

Dear Mr. Pope:

Thank you for the May 27 response to the Fish and Wildlife Service (Service) comments on the draft Certificate of Appropriation of Water, File No. 7,571, for Quivira National Wildlife Refuge. The Service is reviewing many of the comments and may provide a detailed response in the near future. However, I did want to raise one issue for your consideration.

The Service noted its concerns about using actual diversion records for quantifying the perfected right, at a time when groundwater pumping by junior users was adversely impacting available streamflows. Your response was that Kansas statutes, rules and regulations require the Division to certify no more than the amount of water actually diverted by the water user. However, it appears from my reading of the Kansas Administrative Regulations that you have some flexibility in how you determine the amount of water.

K.A.R. 5-3-8 states,

> . . . the chief engineer shall issue a certificate of appropriation setting forth the extent to which the appropriation right was perfected. No appropriation shall be determined for a quantity of water or a diversion rate in excess of that set forth in the approval of application and permit to proceed or in excess of that found to have been actually applied to the approved beneficial use or for any quantity of water found to have been wasted during the calendar year of record used as the basis for perfecting the appropriation right.

The Service suggests that you issue a Certificate for 22,200 acre-feet, the amount set forth in the approval of application and permit to proceed, as you are authorized to do under the above quoted regulation. Such action would acknowledge that the Service's ability to divert water from Rattlesnake Creek under its senior water right has been impaired by groundwater pumping, without requiring that the precise impact of the junior diversions be quantified.

I look forward to hearing from you after you have considered this request. If you wish to discuss this issue further, please contact Cheryl Williss of the Division of Engineering at 303/236-5321.

Sincerely,

Susan Lechleiter

Acting Regional Director

KANSAS STATE BOARD OF AGRICULTURE
Phillip A. Fishburn, Acting Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director.
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

May 27, 1994

United States Department of the Interior
Attn: Ralph Morgenweck, Regional Director
Fish and Wildlife Service
Denver Federal Center
P.O. Box 25486
Denver, CO 80225

Re: Appropriation of Water File No. 7,571
BA/EN
WR KS
MAIL STOP 60190

Dear Mr. Morgenweck:

Members of my Water Rights staff and legal counsel have reviewed the concerns you expressed in your November 12, 1993 letter regarding the draft Certificate for Appropriation of Water, File No. 7,571, for the Quivira National Wildlife Refuge. I will attempt to explain in detail our position on each point raised in your letter. However, my staff will contact your Regional Water Rights Specialist, Cheryl Williss, within a month of the date of this letter to set up a meeting to discuss any specific concerns that may remain.

In the second and third paragraphs of your letter you expressed concern about the quantity of water proposed to be certified because the amount diverted in 1987, the year of maximum use during the perfection period 1963 through 1987, may have been reduced by well pumping and may be less than what the U.S. Fish and Wildlife Service would have diverted and used beneficially if more water had been available. We are constrained by Kansas statutes and rules and regulations which require us to certify no more than the amount of water actually diverted by the water user. The pertinent regulation is K.A.R. 5-3-8, which reads in part "No appropriation shall be determined for a quantity of water or a diversion rate .... in excess of that found to have been actually applied to the approved beneficial use... during the calendar year of record used as the basis for perfecting the appropriation right." The intent of a certificate of appropriation in the State of Kansas is to quantify a water right to the maximum extent that water was put to beneficial use, as authorized by the permit to proceed, during the perfection period. It is not appropriate to include in a certificate of appropriation water that could have been diverted, if it had been available.

In the fourth paragraph of your letter you appear to suggest that U.S. Fish and Wildlife Service is entitled to a water right sufficient to include the average annual net evaporation for all major impoundments within the Refuge and sufficient water to fill all the impoundments. In part for the reasons noted above, this cannot be done on the Certificate of Appropriation for File No. 7,571, although the U.S. Fish and Wildlife Service may wish to consider filing a new application to appropriate water if this is a great concern. However, I believe that your concern is perhaps overstated. The proposed certificate would define a water right allowing the diversion of 14,587 acre feet of water at the three points of diversion on Rattlesnake Creek, to be used within the boundaries of the Quivira National Wildlife Refuge. According to the best available records, 14,587 acre feet (10,129.7 acre feet actually diverted and the remainder evaporated from Little Salt Marsh above the first diversion point) is the amount of water that was diverted in 1987. Once this water has been diverted, provided it is retained on the authorized place of use (the Refuge) and not used in a wasteful manner, the water may be used in the manner required for the proper management of the Refuge. Evaporation losses were quantified for the Little Salt Marsh because it is upstream of, and is partially created by, one of the authorized points of diversion. This is not true of the Big Salt Marsh which is merely fed by the two diversions from the Rattlesnake Creek, in addition to naturally occurring waters. To reiterate, the issue is how much water was diverted from Rattlesnake Creek by the U.S. Fish and Wildlife Service in the calendar year when maximum diversion occurred during the perfection period.

In the fifth paragraph of your letter, the first paragraph on page 2, you note that Big Salt Marsh is supplied by waters from springs and groundwater inflow. For several reasons the proposed certificate cannot apply to this water. First, there is an issue of whether or not the spring water and groundwater is actually placed under control by the U.S. Fish and Wildlife Service. Even should this question be answered in the affirmative, it is not diverted by the U.S. Fish and Wildlife Service at the three authorized points of diversion for File No. 7,571 and such water is not from the source of supply authorized by that permit (surface water from Rattlesnake Creek). Therefore, this water cannot be covered by the certificate for File No. 7,571.

You suggest that 612 acre feet of water is needed to maintain riparian habitat on about 204 acres and that the certificate should cover this water. This again takes us to the issue of whether or not U.S. Fish and Wildlife Service diverted and placed under control the water necessary to maintain this riparian habitat, and if such use is authorized under the permit to proceed. It does not appear from the original application that maintenance of riparian habitat was an intended use nor is such use authorized by the permit to proceed. For your information, I would like to note that the State of Kansas has established minimum desirable streamflow levels on Rattlesnake Creek, in part, to help ensure the protection of riparian habitat along the entire length of the stream.

In your seventh paragraph you suggest that the proper terminology for the type of beneficial use is "fish and wildlife." Kansas' Water Appropriation Act and supporting rules and regulations recognize ten beneficial uses of water.

Recreational use, which means use of water to provide entertainment, enjoyment and relaxation, is the type of use shown on the permit to appropriate water and appears to be the closest of those ten to the use of water at the Refuge.

In your next paragraph, you suggest alternative language for the certificate which I do not believe I can accept for reasons noted above. You also note in the proposed language that stored water be carried over from year to year and not assessed against the next year's allocation. This language is unnecessary because once the U.S. Fish and Wildlife Service has diverted water (provided that the water is not used wastefully, the diversion does not impair another senior water right holder, and water is used in accordance with the original permit to appropriate water), that diversion will not be counted against your right to divert water in following years. This is because the permit to appropriate water allows the U.S. Fish and Wildlife Service to divert a specified amount of water each and every year. The amount diverted is measured at the diversion points, not at the place of use (the marshes and ponds on the Refuge).

The next paragraph concerns a reference in the proposed certificate to the Refuge facilities as they existed in 1987. While I generally agree that the U.S. Fish and Wildlife Service should have flexibility to determine how to manage water to meet your wildlife objectives, provided you do so within the constraints of the permit to proceed, it is also my duty to ensure that the consumptive use of water at the Refuge does not increase. The purpose of the reference in this certificate is to protect other water right holders, including those with junior priorities, from changes at the Refuge, such as expanding the area of the marshes or significantly increasing the Refuge's ability to store water, which would increase the consumptive use of water at the Refuge as compared to the consumptive use that occurred during the period of perfection. If the language in the proposed certificate does not convey this meaning, we can certainly reconsider it.

In the tenth paragraph you suggest that the term "all" diversion points should be used rather than "both" on page 2 of the certificate. "Both" is used in this context because the certificate refers to two points of diversion in Township 22 South, while there is a single point of diversion in Township 21 South.

Thank you for correcting the legal description of the place of use. The NW 1/4 of Section 21, Township 21 South, Range 10 West will be deleted when the certificate of appropriation is issued.

In paragraphs 12 and 13 you expressed concern about language in the cover letter regarding the availability of flows of water in Rattlesnake Creek. It is not my intent that this language sanction overuse of the water resources of the Rattlesnake Creek Basin. As you may be aware, I have assigned a special subbasin management team to develop and implement strategies to address the long term management of the entire hydrologic system - Rattlesnake Creek and its related aquifer. The team will address the interrelated issues of groundwater declines, streamflow depletion and mineral intrusion. The caution in the cover letter is

applicable to virtually every water user in the State who is dependent upon surface water flows, particularly those located in Central and Western Kansas, areas which are frequently described as semiarid regions. Even under pristine conditions, most of the streams in Central and Western Kansas are not continuously dependable sources of supply. Particularly in the case of very large water rights, such as the Quivira Refuge right, the water right holder should not expect to be able to fully exercise the right each and every year. I should also point out that a certificate states the maximum quantity of water that may be diverted in any year. Because certificates are based on the maximum year of record, no water right holder should expect to need or have available the maximum authorized quantity every year.

I appreciate your concerns regarding the certificate and hope that I have clearly explained my position with regard to those concerns. My staff will contact Cheryl Williss in the near future to ask if you wish to have a meeting between our respective agencies regarding the certificate. Please feel free to contact this office if you have any further questions.

Sincerely,

David L. Pope, P.E.
Chief Engineer-Director

DLP:MAS:dv

pc: Bruce Falk, Water Commissioner - Stafford
Connie Owen, Assistant Legal Counsel
Cheryl Williss, U.S. Fish and Wildlife Service-Denver

Water Resources Data Kansas Water Year 1987 U.S.G.S. Report KS-87-1

07142575 RATTLESNAKE CREEK NEAR ZENITH, KS

LOCATION.--Lat 38 deg 06 min 01 sec, long 98 deg 30 min 32 sec, in SW1/4 SW1/4 SW1/4 sec.26, T.22 S., R.11 W., Stafford County, Hydrologic Unit 11030009, on right bank at downstream side of highway bridge, 1.1 mi upstream from Little Salt Marsh, 10.0 mi north of Zenith, and at mile 19.3.

DRAINAGE AREA.--1,052 sq mi, of which 519 sq mi is noncontributing.

PERIOD OF RECORD.--May 1973 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,785 ft above sea level, from topographic map.

REMARKS.--Estimated daily discharges: Nov. 11-15, Dec. 10-12, and Jan. 1, 2, 9-12, 16-29. Records good except those for estimated daily discharges, which are poor. Natural flow of stream affected by ground-water withdrawals, diversions for irrigation, and return flow from irrigated areas.

AVERAGE DISCHARGE.--14 years, 54.3 cu ft per sec, 39,340 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 18,200 cu ft per sec Sept. 26, 1973, gage height, 9.95 ft, from rating curve; minimum discharge, no flow Sept. 14-18, 1984.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 400 cu ft per sec and maximum (*):

Date	Time	Discharge (cu ft per sec)	Gage Height (ft)	Date	Time	Discharge (cu ft per sec)	Gage Height (ft)
Mar. 27	1800	*1,080	*8.21				

Minimum recorded discharge, 12 cu ft per sec Oct. 21, 22, but may have been less during period of ice effect Nov. 11-15, Dec. 10-12, and Jan. 1, 2, 9-12, 16-29.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	18	21	20	23	31	42	414	47	60	88	23	34
2	20	21	21	23	30	39	351	51	53	79	21	34
3	24	21	21	24	29	37	283	49	51	87	20	32
4	22	23	11	25	29	36	227	48	47	123	30	29
5	21	23	21	31	29	34	136	61	45	270	31	24
6	20	24	21	25	29	32	158	99	42	277	30	27
7	19	23	23	24	28	31	145	104	39	186	41	26
8	18	24	25	23	28	31	127	93	37	201	55	33
9	21	23	27	17	28	30	118	87	35	258	52	31
10	24	24	19	15	25	31	105	91	36	227	38	30
11	27	15	14	14	28	31	97	83	40	167	33	28
12	31	15	17	18	27	30	90	66	40	175	37	27
13	22	13	28	31	28	30	91	58	37	170	32	28
14	26	15	28	31	28	29	156	53	35	142	200	29
15	26	16	28	30	30	28	173	49	32	106	192	33
16	24	22	27	15	31	30	132	46	31	87	133	32
17	23	22	26	15	32	48	175	44	29	78	73	31
18	22	21	26	16	30	59	132	41	40	73	56	30
19	22	20	26	21	30	54	97	39	45	67	47	28
20	21	20	26	23	30	48	82	38	43	61	42	29
21	17	20	26	21	30	44	74	38	40	56	36	28
22	13	20	26	25	29	44	67	38	37	53	34	28
23	18	19	25	24	29	205	64	38	35	47	35	28
24	22	19	25	18	28	534	61	40	32	44	39	28
25	22	19	25	19	25	616	58	46	32	39	39	28
26	21	19	24	18	30	563	54	52	30	38	43	28
27	21	20	24	19	37	937	52	74	29	35	45	26
28	21	20	24	20	42	938	50	93	30	32	45	27
29	21	20	24	28	---	725	47	91	40	30	42	27
30	21	20	24	33	---	599	47	80	87	27	39	27
31	21	---	23	32	---	495	---	71	---	25	36	---
TOTAL	669	604	724	700	836	6430	3963	1908	1209	3348	1658	860
MEAN	21.6	20.1	23.4	22.6	29.9	207	132	61.5	40.3	108	53.5	28.7
MAX	31	24	28	33	42	938	414	104	87	277	200	34
MIN	13	13	11	14	27	28	47	38	29	25	20	23
AC-FT	1330	1200	1440	1390	1660	12750	7860	3780	2400	6640	3290	1710

CAL YR 1986 TOTAL 8506.2 MEAN 23.3 MAX 390 MIN 4.6 AC-FT 16870
WTR YR 1987 TOTAL 22909.0 MEAN 62.8 MAX 938 MIN 11 AC-FT 454

07142575 RATTLESNAKE CREEK NEAR ZENITH, KS

LOCATION.--Lat 38 deg 06 min 01 sec, long 98 deg 30 min 32 sec, in SW1/4 SW1/4 SW1/4 sec.26, T.22 S., R.11 W., Stafford County, Hydrologic Unit 11030009, on right bank at downstream side of highway bridge, 1.1 mi upstream from Little Salt Marsh, 10.0 mi north of Zenith, and at mile 19.3.

DRAINAGE AREA.--1,052 sq mi, of which 519 sq mi is noncontributing.

PERIOD OF RECORD.--May 1973 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,785 ft above sea level, from topographic map.

REMARKS.--Estimated daily discharges: Nov. 30, Dec. 14-22, and Dec. 25 to Feb. 15. Records good except those for estimated daily discharges, which are poor. Natural flow of stream affected by ground-water withdrawals, diversions for irrigation, and return flow from irrigated areas.

AVERAGE DISCHARGE.--15 years, 52.7 cu ft per sec, 38,180 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 18,200 cu ft per sec Sept. 26, 1973, gage height, 9.95 ft; minimum discharge, no flow Sept. 14-18, 1984.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 400 cu ft per sec and maximum (*):

Date	Time	Discharge (cu ft per sec)	Gage Height (ft)	Date	Time	Discharge (cu ft per sec)	Gage Height (ft)
Apr. 2	1900	*153	*5.00	No peak greater than base discharge.			

Minimum recorded discharge, 0.76 cu ft per sec Sept. 26, 27.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	22	29	34	45	42	40	64	45	36	9.6	5.0	1.3
2	22	29	36	47	38	41	136	47	37	10	3.8	1.9
3	51	29	37	48	36	42	131	46	36	10	3.3	2.5
4	21	30	37	42	35	42	112	45	36	9.0	4.3	2.0
5	17	29	37	35	36	43	87	44	33	7.8	6.2	1.9
6	15	29	37	30	37	44	69	43	30	6.8	5.0	1.5
7	19	29	37	28	40	44	60	42	28	5.8	3.6	1.3
8	21	29	37	30	42	42	56	39	27	5.6	3.0	1.3
9	51	29	37	33	40	41	54	38	26	5.7	3.3	1.5
10	20	29	36	37	38	41	52	38	24	6.0	3.5	1.4
11	20	30	36	38	35	40	51	37	23	5.2	4.0	1.3
12	13	31	36	39	38	38	50	36	22	4.4	3.0	1.1
13	16	32	36	41	40	52	48	35	21	4.6	2.5	1.0
14	21	31	36	45	42	58	47	34	21	4.3	2.4	1.3
15	23	32	36	56	45	41	47	32	21	3.6	2.1	1.4
16	25	33	36	64	50	41	46	31	21	6.5	1.7	1.9
17	26	32	34	66	48	53	46	30	20	9.4	1.6	2.1
18	28	33	42	60	47	67	52	28	19	7.8	1.7	2.1
19	28	33	47	54	45	47	57	27	18	7.3	1.9	1.6
20	26	32	48	47	45	48	56	27	18	7.4	2.2	1.3
21	26	32	50	50	44	48	53	28	16	8.0	2.0	1.1
22	27	33	46	56	43	47	50	30	14	6.7	1.6	.94
23	28	33	46	56	42	45	48	32	13	5.8	1.7	1.5
24	28	34	45	56	41	44	46	33	11	7.3	1.6	2.3
25	28	34	42	54	42	42	50	32	10	26	1.5	1.5
26	28	34	39	56	41	41	50	30	11	31	1.4	.84
27	29	37	41	54	41	40	50	29	16	23	1.5	.95
28	27	40	46	50	41	39	49	27	21	18	1.8	1.4
29	28	45	56	47	41	39	48	27	14	14	1.8	.89
30	28	40	50	45	---	39	46	26	11	9.8	1.6	1.0
31	29	---	48	42	---	40	---	29	---	7.0	1.4	---
TOTAL	731	972	1261	1451	1195	1369	1811	1067	654	293.4	82.0	44.12
MEAN	23.6	32.4	40.7	46.8	41.2	44.2	60.4	34.4	21.8	9.46	2.65	1.47
MAX	29	45	56	66	50	67	136	47	37	31	6.2	2.5
MIN	13	29	34	28	35	38	46	26	10	3.6	1.4	.84
AC-FT	1450	1930	2500	2880	2370	2720	3590	2120	1300	582	163	88

CAL YR 1987 TOTAL 23876.00 MEAN 65.4 MAX 938 MIN 13 AC-FT 47360
WTR YR 1988 TOTAL 10930.52 MEAN 29.9 MAX 136 MIN .84 AC-FT 21680

wy 1987

07142620 RATTLESNAKE CREEK NEAR RAYMOND, KS

LOCATION.--Lat 38 deg 13 min 50 sec, long 98 deg 25 min 00 sec, in SW1/4 NW1/4 NW1/4 sec.15, T.21 S., R.10 W., Rice County, Hydrologic Unit 11030009, on left bank at downstream side of highway bridge, 3.5 mi south of Raymond, and 5.4 mi upstream from mouth.

DRAINAGE AREA.--1,167 sq mi, of which 569 sq mi is probably noncontributing.

PERIOD OF RECORD.--April 1960 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,701.64 ft above sea level. Prior to July 27, 1960, nonrecording gage at same site and datum.

REMARKS.--Estimated daily discharges: Nov. 11, 13-15, Dec. 11, Jan. 11, 16-26, June 10-23, and Sept. 23-30. Records good except those for estimated daily discharges, which are poor. Flow regulated at times by Quivera National Wildlife Refuge.

AVERAGE DISCHARGE.--27 years, 52.6 cu ft per sec, 38,110 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,140 cu ft per sec Sept. 29, 1973, gage height, 8.74 ft; no flow at times in 1964, 1968-69, 1984.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Sept. 29, 1973 was the maximum known since at least 1891, from information by local resident.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 956 cu ft per sec Mar. 28, gage height, 7.08 ft; minimum recorded discharge, 5.3 cu ft per sec Sept. 21 but may have been less during periods of ice effect Nov. 11, 13-15, Dec. 11, Jan. 11, 16-26 or periods of no gage-height record June 10-23 and Sept. 23-30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.2	20	8.1	22	39	76	842	43	126	49	11	9.7
2	6.5	19	8.0	21	38	74	683	54	109	71	8.0	9.0
3	7.9	21	8.5	19	36	79	630	54	70	62	8.2	8.2
4	12	22	8.6	19	35	107	612	54	29	98	11	7.3
5	13	22	8.6	19	33	156	579	73	22	162	9.8	7.9
6	13	24	8.4	19	33	135	539	100	27	182	10	11
7	12	31	6.4	20	32	101	498	154	26	236	11	8.3
8	12	30	6.2	22	32	56	463	203	25	231	11	7.3
9	14	28	6.8	24	31	48	422	193	25	212	12	8.6
10	21	27	7.2	22	32	46	380	168	30	198	13	9.0
11	26	25	5.3	11	31	47	249	149	32	196	14	8.3
12	31	25	9.8	21	20	47	143	138	27	189	22	9.4
13	29	7.1	11	21	16	45	136	126	25	173	38	8.3
14	31	9.7	13	23	16	46	190	113	23	158	38	7.7
15	29	17	14	24	18	53	210	79	20	147	63	7.6
16	26	16	15	13	21	42	279	41	19	128	101	8.5
17	24	16	16	6.7	24	78	339	37	18	121	104	8.3
18	22	15	16	7.2	39	92	371	37	15	87	100	9.0
19	20	14	16	13	41	96	351	35	17	51	90	7.7
20	17	14	15	9.6	42	96	302	35	16	45	54	6.1
21	16	13	15	8.5	40	95	248	35	15	42	41	5.4
22	21	13	24	13	38	91	221	33	14	28	38	5.5
23	23	6.9	22	12	37	375	167	34	12	16	34	5.0
24	23	5.8	22	14	38	716	131	39	10	15	35	4.7
25	23	6.3	24	12	38	795	99	42	9.5	15	24	4.7
26	22	6.9	24	16	45	737	68	51	8.2	14	18	4.4
27	22	7.6	22	37	68	781	60	76	8.7	15	16	4.8
28	22	8.3	22	42	79	899	50	121	7.4	14	15	4.3
29	25	8.4	24	41	---	912	45	153	1.1	13	13	4.3
30	23	8.5	23	39	---	901	51	150	25	13	11	4.3
31	21	---	22	39	---	866	---	139	---	13	10	---
TOTAL	613.6	487.5	451.9	630.0	992	8688	9358	2759	821.8	2994	984.0	214.6
MEAN	19.8	16.3	14.6	20.3	35.4	280	312	89.0	27.4	96.6	31.7	7.15
MAX	31	31	24	42	79	912	842	203	126	236	104	11
MIN	6.2	5.8	5.3	6.7	16	42	45	33	7.4	13	8.0	4.3
AC-FT	1220	967	896	1250	1970	17230	18560	5470	1630	5940	1950	426

CAL YR 1986 TOTAL 6728.4 MEAN 18.4 MAX 214 MIN 1.2 AC-FT 13350
WTR YR 1987 TOTAL 28994.4 MEAN 79.4 MAX 912 MIN 4.3 AC-FT 57510

07142620 RATTLESNAKE CREEK NEAR RAYMOND, KS

LOCATION.--Lat 38 deg 13 min 50 sec, long 98 deg 25 min 00 sec, in SW1/4 NW1/4 NW1/4 sec.15, T.21 S., R.10 W., Rice County, Hydrologic Unit 11030009, on left bank at downstream side of highway bridge, 3.5 mi south of Raymond, and 5.4 mi upstream from mouth.

DRAINAGE AREA.--1,167 sq mi, of which 569 sq mi is probably noncontributing.

PERIOD OF RECORD.--April 1960 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,701.64 ft above sea level. Prior to July 27, 1960, nonrecording gage at same site and datum.

REMARKS.--Estimated daily discharges: Oct. 1-6, Dec. 14-18, Dec. 26 to Feb. 13, and Aug. 3 to Sept. 8. Records good except those for estimated daily discharges, which are poor. Flow regulated at times by Quivera National Wildlife Refuge.

AVERAGE DISCHARGE.--28 years, 51.4 cu ft per sec, 37,240 acre-ft per yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,140 cu ft per sec Sept. 29, 1973, gage height, 8.74 ft; no flow at times in 1964, 1968-69, 1984.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Sept. 29, 1973 was the maximum known since at least 1891, from information by local resident.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 113 cu ft per sec Apr. 8, gage height, 4.85 ft; minimum daily discharge, 0.76 cu ft per sec Aug. 16 and Sept. 1, but may have been less during period of no gage-height record, Aug. 3 to Sept. 8.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.3	4.0	24	26	25	23	32	63	31	3.6	1.5	.76
2	4.3	4.8	26	25	24	22	52	66	30	3.7	1.5	.88
3	4.0	5.4	30	24	24	16	66	62	28	3.6	1.4	1.1
4	4.0	5.9	32	20	25	19	81	58	28	3.4	1.3	1.3
5	3.8	6.5	34	18	30	21	91	58	27	3.2	1.6	1.2
6	3.7	6.7	34	16	35	22	91	72	26	3.0	1.4	1.1
7	3.5	7.2	33	15	40	23	107	82	26	2.8	1.1	1.0
8	3.5	7.1	29	14	45	21	111	76	27	2.7	1.3	1.1
9	3.4	6.6	29	15	43	12	102	66	23	3.1	1.4	1.0
10	3.2	6.9	29	15	27	11	88	58	21	3.0	1.3	1.1
11	3.4	7.5	28	16	35	11	85	50	22	2.7	1.2	1.0
12	3.5	7.9	27	16	40	12	81	45	22	2.5	1.1	1.0
13	3.5	5.8	27	17	43	18	90	35	21	2.5	1.0	1.1
14	3.5	5.5	23	18	46	23	87	36	19	2.4	.90	1.2
15	3.9	7.0	22	18	47	15	94	36	16	2.1	.80	1.4
16	4.1	7.6	23	19	48	11	78	32	13	4.2	.76	1.5
17	4.1	7.6	25	20	47	12	72	31	10	4.4	.82	1.4
18	4.2	7.8	27	20	46	21	76	30	8.5	3.7	.94	1.3
19	4.1	11	31	20	45	17	75	27	7.4	3.2	1.1	1.4
20	4.0	11	32	17	42	17	75	22	6.7	2.9	1.0	1.3
21	4.1	11	32	18	41	18	73	22	6.0	2.6	.95	1.3
22	3.8	11	30	22	36	23	66	21	5.2	2.4	.87	1.2
23	3.6	9.3	27	22	34	23	66	22	4.9	2.2	.96	1.6
24	3.7	9.6	26	19	36	20	65	22	4.5	2.1	.90	2.1
25	3.7	9.7	24	18	30	19	67	21	4.3	2.1	.84	1.7
26	3.8	11	21	21	29	18	64	22	4.7	2.2	.92	1.6
27	3.9	14	22	23	25	18	62	22	6.5	2.2	1.0	1.7
28	3.9	18	25	27	24	24	67	23	4.4	2.0	1.0	2.4
29	3.9	21	26	32	23	17	66	22	3.8	1.8	.98	1.7
30	4.0	23	27	29	---	19	63	22	3.6	1.7	.96	1.6
31	4.1	---	26	27	---	18	---	23	---	1.7	.86	---
TOTAL	118.5	277.4	851	627	1035	564	2293	1247	460.5	85.7	33.66	40.04
MEAN	3.82	9.25	27.5	20.2	35.7	18.2	76.4	40.2	15.4	2.76	1.09	1.33
MAX	4.3	23	34	32	48	24	111	82	31	4.4	1.6	2.4
MIN	3.2	4.0	21	14	23	11	32	21	3.6	1.7	.76	.76
AC-FT	235	550	1690	1240	2050	1120	4550	2470	913	170	67	79

CAL YR 1987 TOTAL 28688.30 MEAN 78.6 MAX 912 MIN 3.2 AC-FT 56900
WTR YR 1988 TOTAL 7632.80 MEAN 20.9 MAX 111 MIN .76 AC-FT 15140

1993 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1994.** Plea begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which includ information needed if you have disposed of your interest in one or more of the water right file numbers listed below.** If you have any questions on ho to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, ar return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Metered Quanity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date Measured
007571-00 (RCA)	SW SE NE 35-21-11W 01	1472.7	A					
007571-00 (DARRYMORE)	SW NE NE 13-22-11W 01	3588.9	A					
007571-00 (LSM)	SW NW SW 25-22-11W 01	6151.5	A					

ACRE FEET SURFACE WATER DIVERTED

LPC/DWR

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1993					July 1, 1993					November 1, 1993				
Empty	1/4	1/2	(3/4)	Full	Empty	1/4	1/2	(3/4)	Full	Empty	1/4	1/2	3/4	(Full)

Date: 1/28/94 Telephone: (316 486-2393

I submit the report as the best information available. I understand that knowingly falsifying the report is a violation of state law.

93 018302 - 1 REC Staff 93 0
Office Use FO CO GMD

David Hilley/ Refuge Manager 631068
Name (Printed or Typed)

David Hilley
Name (Signature)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
PO BOX 25486
DENVER CO 80225

DIV OF WATER RES RECEIVED FEB 22 1994 ST. BD OF AGRICULTURE

___ Owner ___ Tenant X Agen

07142575 RATTLESNAKE CREEK NEAR ZENITH, KS

LOCATION.--Lat 38°06'01", long 98°30'32", in SW1/4 SW1/4 SW1/4 sec.26, T.22 S., R.11 W., Stafford County, Hydrologic Unit 11030009, on right bank at downstream side of county highway bridge, 1.1 mi upstream from Little Salt Marsh, 10.0 mi north of Zenith, and at mile 19.3.

DRAINAGE AREA.--1,052 mi^2, of which 519 mi^2 is noncontributing.

PERIOD OF RECORD.--May 1973 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,785 ft above sea level, from topographic map.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Natural flow affected by ground-water withdrawls, diversions for irrigation, and return flow from irrigated areas. Satellite telemeter at station.

PEAK DISCHARGES GREATER THAN BASE FOR CURRENT YEAR.--Peak discharges greater than base discharge of 400 ft^3/sec and maximum (*):

Date	Time	Discharge (ft^3/sec)	Gage height (ft)	Date	Time	Discharge (ft^3/sec)	Gage height (ft)
May 11	1830	854	7.42	July 18	2030	*29,300	*9.90
June 20	2230	12,500	9.62				

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.7	7.9	e14	23	45	80	118	37	53	188	71	38
2	3.7	8.4	e15	e23	47	231	93	64	49	152	69	37
3	3.7	8.8	15	e23	61	244	69	81	49	113	67	36
4	3.5	8.1	e15	e24	83	249	69	67	48	86	64	34
5	3.5	7.8	e16	e24	95	199	69	64	47	72	69	33
6	3.5	7.7	e16	e24	82	131	64	58	47	68	73	32
7	5.1	7.6	e18	e24	65	100	67	50	45	65	69	23
8	7.6	7.6	e17	e25	62	105	66	70	43	64	67	22
9	7.8	7.6	18	25	48	100	58	176	40	60	70	30
10	7.6	7.6	18	e26	46	78	51	531	38	60	70	30
11	7.0	8.2	18	e26	66	68	45	758	37	60	61	31
12	6.0	9.8	19	e27	74	62	45	806	36	60	55	31
13	5.4	10	e21	e28	73	58	41	639	34	59	52	29
14	5.0	10	e24	29	65	56	41	384	33	203	50	28
15	4.9	9.7	e26	e29	e62	53	40	229	32	581	46	28
16	4.8	9.4	e29	e30	e57	51	39	174	31	787	42	28
17	5.0	9.2	e37	e31	e54	48	38	137	31	767	40	28
18	5.2	9.2	27	32	e52	47	38	121	33	12000	38	29
19	5.3	12	26	e33	e51	47	36	116	966	13600	36	30
20	5.6	12	e26	e34	e50	46	35	103	7500	2050	39	34
21	5.7	12	e26	e35	e49	45	35	88	4880	1020	39	33
22	5.6	12	e26	e36	e48	44	34	76	1100	536	36	29
23	5.4	11	e25	e38	e48	43	33	93	617	353	37	28
24	5.4	12	e24	e39	e47	42	33	122	400	240	35	29
25	5.4	e12	e23	e40	e46	41	32	100	337	180	34	33
26	5.4	e13	e22	e42	e45	40	31	82	357	146	33	33
27	5.6	e13	e22	e43	e44	40	30	69	327	123	32	32
28	5.8	e13	20	45	43	39	31	59	270	106	35	31
29	6.4	e14	20	e44	---	38	32	53	212	95	35	30
30	6.8	e14	22	e42	---	79	32	51	185	86	35	30
31	7.3	---	e23	41	---	175	---	55	---	78	38	---
MEAN	5.44	10.2	21.5	31.8	57.4	86.4	48.2	178	596	1099	49.6	30.6
MAX	7.8	14	37	45	95	249	118	806	7500	13600	73	38
MIN	3.5	7.6	014	23	43	38	30	37	31	59	32	22
AC-FT	335	604	1320	1950	3190	5310	2870	10940	35460	67550	3050	1820

e Estimated

07142575 RATTLESNAKE CREEK NEAR ZENITH, KS--Continued

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1973 - 1993, BY WATER YEAR (WY)

MEAN	50.7	32.1	40.7	37.0	42.4	61.6	66.9	69.7	87.7	85.6	21.5	101
MAX	691	165	270	192	141	207	272	189	596	1099	79.5	1792
(WY)	1974	1974	1974	1974	1974	1987	1976	1976	1993	1993	1975	1973
MIN	.046	3.27	5.56	6.48	6.64	7.78	6.47	5.24	10.2	1.54	.88	.091
(WY)	1992	1985	1992	1992	1992	1992	1992	1992	1991	1991	1991	1991

SUMMARY STATISTICS	FOR 1992 CALENDAR YEAR		FOR 1993 WATER YEAR		WATER YEARS 1973 - 1993	
ANNUAL MEAN	12.7		186		51.5	
HIGHEST ANNUAL MEAN					186	1993
LOWEST ANNUAL MEAN					6.59	1991
HIGHEST DAILY MEAN	174	Jun 11	13600	Jul 19	15500	Sep 27 1973
LOWEST DAILY MEAN	2.8	Sep 25	3.5	Oct 4	.00	Sep 14 1984
ANNUAL SEVEN-DAY MINIMUM	3.1	Sep 19	3.8	Oct 1	.00	Sep 11 1991
INSTANTANEOUS PEAK FLOW			29300	Jul 18	29300	Jul 18 1993
INSTANTANEOUS PEAK STAGE			9.90	Jul 18	9.95	Sep 26 1973
INSTANTANEOUS LOW FLOW			3.4	Oct 4	.00	Sep 14 1984
ANNUAL RUNOFF (AC-FT)	9200		134400		37290	
10 PERCENT EXCEEDS	25		175		85	
50 PERCENT EXCEEDS	7.6		39		27	
90 PERCENT EXCEEDS	4.6		7.8		4.0	

07142620 RATTLESNAKE CREEK NEAR RAYMOND, KS

LOCATION.--Lat 38°13'50", long 98°25'00", in SW1/4 NW1/4 NW1/4 sec.15, T.21 S., R.10 W., Rice County, Hydrologic Unit 11030009, on left bank at downstream side of county highway bridge, 3.5 mi south of Raymond, and at mile 5.4.

DRAINAGE AREA.--1,167 mi^2, of which 569 mi^2 is probably noncontributing.

PERIOD OF RECORD.--April 1960 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,701.64 ft above sea level. Prior to July 27, 1960, nonrecording gage at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow regulated at times by Quivera National Wildlife Refuge.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Sept. 29, 1973 was the maximum known since at least 1891, from information by local resident.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.9	3.4	13	e22	80	125	160	41	66	313	88	37
2	1.8	3.5	15	e22	81	213	178	67	66	260	81	43
3	1.8	3.5	15	e21	85	214	196	86	61	217	85	40
4	1.7	3.2	15	21	101	239	193	99	60	198	86	37
5	1.7	3.1	14	20	125	263	184	110	58	180	105	35
6	1.7	3.1	20	20	137	300	176	107	58	188	126	33
7	3.9	3.3	14	22	136	290	180	102	60	185	111	29
8	7.9	3.3	14	22	131	250	163	106	56	173	95	28
9	4.2	3.3	17	e24	136	204	139	117	48	113	89	26
10	3.6	3.1	19	e25	147	172	139	187	43	73	82	23
11	3.2	3.5	20	e26	164	151	111	372	41	67	78	22
12	3.0	4.7	20	e28	140	143	98	563	33	71	74	23
13	3.0	4.0	24	e29	142	127	86	687	20	71	69	21
14	2.9	3.7	27	e31	139	119	83	694	16	359	52	19
15	2.8	3.6	30	e33	145	101	72	631	12	424	31	17
16	2.8	3.5	48	e35	119	100	67	554	9.1	485	26	16
17	2.8	3.6	38	e37	117	85	71	428	9.0	587	23	16
18	2.7	3.9	39	e39	121	73	71	306	10	1090	21	16
19	2.9	5.9	39	e40	121	75	75	223	440	1430	19	17
20	2.9	5.9	35	e43	119	76	59	204	550	1510	18	16
21	2.9	5.6	33	e47	121	74	50	177	637	1380	17	16
22	2.8	5.6	31	e49	120	79	50	153	820	1220	16	16
23	2.7	6.5	28	52	116	68	53	168	822	1090	17	17
24	2.7	8.2	25	55	113	67	48	163	747	950	15	17
25	2.7	16	25	59	106	65	44	146	664	769	15	17
26	2.7	12	23	61	93	64	43	139	558	589	14	18
27	2.7	e12	23	66	97	63	45	133	496	456	14	18
28	2.7	e12	23	76	99	62	48	113	461	336	18	18
29	3.2	12	23	71	---	62	45	89	411	219	18	18
30	3.4	13	23	73	---	105	39	87	382	128	20	12
31	3.4	---	e22	80	---	181	---	73	---	101	22	---
MEAN	2.94	5.93	24.4	40.3	120	136	98.9	230	257	491	49.8	22.7
MAX	7.9	16	48	80	164	300	196	694	822	1510	126	43
MIN	1.7	3.1	13	20	80	62	39	41	9.0	67	14	12
AC-FT	181	353	1500	2480	6650	8350	5880	14130	15300	30210	3060	1350

e Estimated

07142620 RATTLESNAKE CREEK NEAR RAYMOND, KS--Continued

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1960 - 1993, BY WATER YEAR (WY)

MEAN	33.5	30.0	37.8	40.9	54.8	75.8	82.5	68.7	68.8	47.5	18.0	30.5
MAX	574	227	287	237	176	344	397	256	281	491	160	284
(WY)	1974	1974	1974	1974	1974	1973	1973	1976	1965	1993	1961	1973
MIN	.62	1.41	2.13	2.55	2.05	2.66	2.27	2.76	2.59	.91	.37	.054
(WY)	1965	1992	1984	1989	1989	1989	1989	1992	1991	1964	1968	1968

SUMMARY STATISTICS	FOR 1992 CALENDAR YEAR		FOR 1993 WATER YEAR		WATER YEARS 1960 - 1993	
ANNUAL MEAN	9.29		124		48.8	
HIGHEST ANNUAL MEAN					190	1974
LOWEST ANNUAL MEAN					2.77	1991
HIGHEST DAILY MEAN	80	Jun 10	1510	Jul 20	2070	Sep 29 1973
LOWEST DAILY MEAN	1.7	May 4	1.7	Oct 4	.00	Jul 19 1964
ANNUAL SEVEN-DAY MINIMUM	1.7	May 3	2.1	Oct 1	.00	Jul 19 1964
INSTANTANEOUS PEAK FLOW			1520	Jul 20	2140	Sep 29 1973
INSTANTANEOUS PEAK STAGE			8.63	Jul 20	8.74	Sep 29 1973
INSTANTANEOUS LOW FLOW			1.4	Oct 4	.00	many years
ANNUAL RUNOFF (AC-FT)	6750		89450		35330	
10 PERCENT EXCEEDS	26		302		105	
50 PERCENT EXCEEDS	3.2		52		24	
90 PERCENT EXCEEDS	2.2		3.5		2.1	

KANSAS STATE BOARD OF AGRICULTURE
Division of Water Resources

MEMORANDUM

TO: Water Rights Section, Certificate Unit

DATE: January 11, 1994

FROM: Deborah Zarta DMZ
Environmental Scientist

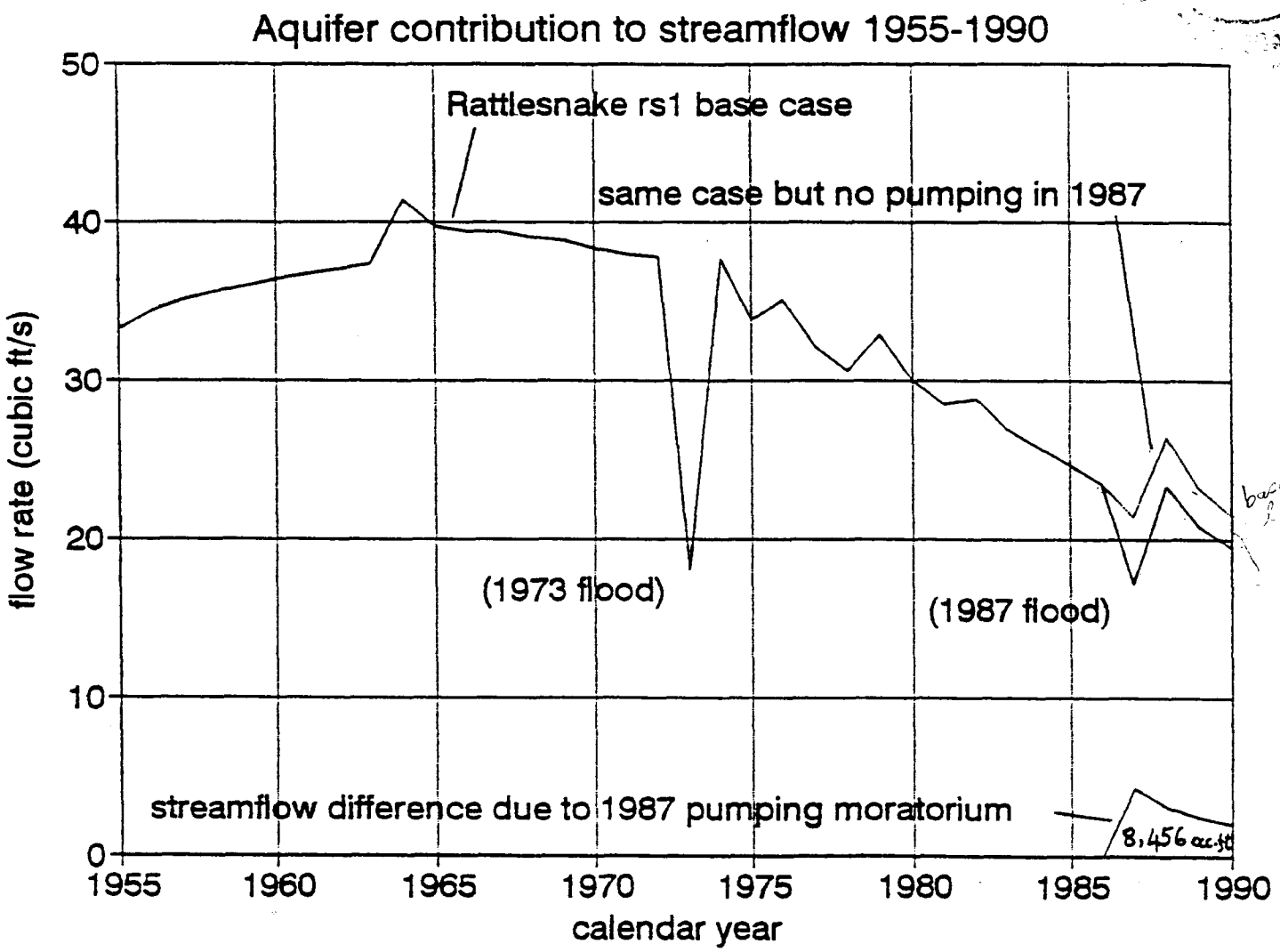
RE: Appropriation of Water File No. 7571, Quivira

This memo serves to review the methods referred to in a letter from U. S. Fish and Wildlife Service (USFS). This review was done at the request of the Certification Unit in order to help answer some questions about certifying Appropriation of Water File No. 7571, for Quivira National Wildlife Refuge. The reason I was asked to assist in this matter is my familiarity with the Rattlesnake Creek basin, which is due to the analysis I have been conducting on the Rattlesnake Creek basin for the Subbasin Water Resources Management Program.

The letter was received at the Division of Water Resources (DWR) from USFS on December 8, 1993, and expressed their discontent with the draft certificate they received from the Division of Water Resources. Generally, it stated that in the year 1987 the proposed year of record groundwater pumping reduced the total streamflow of Rattlesnake Creek by at least 8,456 acre-ft. Attached to this letter was a faximile from Marios Sophocleous, Kansas Geological Survey(KGS). which described the impact that pumping in 1987 had on Rattlesnake Creek streamflow. It was indicated in the letter that the fax graphically displayed the effect of groundwater pumping on the stream(figure attached).

After a phone conversation with Sophocleous about the graph which was faxed to USFS, I learned more of the scientific procedures used. The data for this graph was taken from a report by Sophocleous and Perkins, KGS Open File Report 93-7. which I had already read and summarized for the Rattlesnake Creek project.(summary attached -note- this is not a critique but rather a part of system which allows myself and others to review a synopsis of project references). The estimate of the volume of water pumped that was used for the computer model input was 70% of the appropriated volume in each year. To acquire this data a letter was sent from Sophocleous to DWR Technical Services (Boyd Allen) requesting the data tape on August 2, 1991. A tape was created on August 7, 1991. I later spoke with Sophocleous to discuss specifically which data was used from report 93-7. The data for the baseflow component was taken from the report and plotted. Next, the same computer model used in

the report was run, but this time the pumping component was shut off for the year 1987 only. From this a new curve was drawn (titled: same case but no pumping). The difference between the old and new curve represents the direct impact of groundwater pumping in 1987 on stream flow according to the model. I calculated the area under the new part of the curve by using a scale to measure the height between the two curves for each year, then converting that to cfs and then to acre-feet. The steps can be followed on the attached page of calculations. My results showed 8,688 acre-ft. This is a very similar number to 8,456 acre-ft noted in the USFS letter. The slight difference probably occurred in my rounding off numbers. What this number means, according to the discussion with Sophocleous is that if no groundwater had been pumped during 1987 then that much more water would have remained in the hydrologic system. Apparently, USFS believes that the 8,456 acre-ft would have been specifically in the stream and therefore available to them for use. This I cannot determine from the information provided in the report or in the fax or in communications with the authors of the report. This number appears to represent "some portion" of the net consumptive use of the groundwater pumped that one year. In part, the reason I say some portion is because it would take a number of years for the entire effect of shutting off this one year's pumping to influence the stream. The report and graph include data until the year of 1990, at which the new curve has not yet reached the level of the old curve, which may be showing that the effect is still taking place after that 1990 date.



baseflow c:\rs1std\rs15590.wq!

Comments

The impact of 1987 pumping on Rattlesnake Cr. streamflow is to reduce total streamflow by at least 8,456 acre-ft over the model area. See this effect graphically in the attached figure. Hope this answers your questions, but would be happy to clarify any further questions you may have.

Best regards,

Mario S

KANSAS STATE BOARD OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Files **DATE:** January 6, 1994

FROM: Larry M. Sheets **RE:** Appropriation of Water
File No. 7,571

Comments regarding a draft Certificate of Appropriation for File 7,571 were received from The Fish and Wildlife Service on November 17, 1993. The content of the letter was discussed with Bruce Falk, Matt Scherer, Deborah Zarta on December 9, 1993. This memorandum is to summarize the discussion.

The second paragraph of the November 17 letter expresses concern that the maximum annual diversion is the only component considered in addition to the storage in the Little Salt Marsh. This sets the stage for following paragraphs which explain the additional quantities the Fish and Wildlife Service feels should be considered. The 10,129.7 acre-feet is the quantity shown to have been diverted (reported use in 1987). The water right is based on quantity shown to have been diverted within the terms and conditions of the approval of application and permit to proceed.

The third paragraph asserts that junior water rights affected the availability of water for diversion to the refuge. The assertion is based on a graph generated by a computer model operated by Marios Sophocleous of the Kansas Geological Survey. The graph charts a flow rate (base flow) and attempts to show the affect of no pumping in 1987. The quantity generated appears to be for the period 1987 through 1990. The pumping used in the model is an assumed amount based on the approved water rights and not the reported use for the period. There is no doubt some affect by the pumping of wells in the area and without the pumping more water would be available. Even with more water available the capability to use it in 1987 was not demonstrated. The 1987 monthly flow records from gaging stations on Rattlesnake Creek indicates there was water available for use in the refuge. It appears the Fish and Wildlife Service did not divert all the available water in 1987.

The fourth paragraph ask that consideration be given to the evaporation to the total area of ponds and marshes of the refuge. The quantity identified in the approval of application was to be diverted to ponds and marshes from three points. The quantity of evaporation was defined for the Little Salt Marsh because the marsh is created by the diversion structure at one of the defined points of diversion. The evaporation is a quantifiable amount caused by the points of diversion. The evaporation from other ponds and marshes is an amount of loss attributable to the use made of the water after it has been diverted from the point(s) of diversion. Also the management plan indicates the total pond

and marsh areas are not maintained in a full state during the evaporation period (time) of the year.

The fifth paragraph suggested by noting them, that the Big Salt Marsh supplied water by springs and groundwater inflow to the Northwest corner of the refuge should be included in the water right. These were not recognized as a need or demand at the time the application was submitted. They cannot be added to the application which was approved.

The sixth paragraph references riparian habitat, noting that the Fish and Wildlife Service now has a method of quantifying this. Again the riparian habitat needs were not recognized at the time the application was submitted. It is anticipated that these needs are or will be addressed by the minimum streamflow legislation in 1984.

The seventh paragraph suggests the use should be termed Fish and Wildlife rather than recreational. Fish and Wildlife is a specific type of recreational use. The Water Right legislation and adopted Rules and Regulations are not designed to identify all specific uses. Recreational use is one of the ten (10) currently recognized uses.

The eighth and ninth paragraphs suggest alternative language for the Certificate of Appropriation. The condition of being assessed against the following year's allocation is not a part of any water right. The language is not appropriate for inclusion in the certificate. The specific quantity per calendar year is addressed in other paragraphs. The reference to refuge facilities as they existed in 1987 should be evaluated by other personnel in the Division of Water Resources. The need to define facilities to utilize the allocation should be reviewed.

The tenth paragraph suggested that the term of all diversion points be used rather than both. The term both is used because two (2) points of diversion are in Township 22 South and one (1) point of diversion is in Township 21 South.

The eleventh paragraph suggests a correction of the description of the place of use. This will be verified and the Northwest Quarter (NW¼) of Section 21, Township 21 South, Range 10 West, deleted with the issuance of the Certificate of Appropriation.

The twelfth paragraph expressed concern regarding a note of caution we included in the transmittal letter for the draft Certificate of Appropriation. The language was placed in our letter to advise the Fish and Wildlife Service the situation as we see it. The same language has been placed in the certificate transmittal letter.

The thirteenth paragraph notes the Kansas Geological Service has established a hydrological connection between Rattlesnake Creek and the Great Bend Prairie Aquifer. The concern expressed is that the language referred to in paragraph

twelve is a sanctioning by the Division of Water Resources of a continuated overpumping of the aquifer. This is not the case and can be stated with reference to the team which has been established to define the situation and recommend action to be taken.

All but two of the concerns raised in the Fish and Wildlife Service letter dated November 12, 1993, and received in this office on November 17, 1993, can be responded to by letters. The two concerns which I feel should be addressed in a meeting are the reference to junior water rights adversely impacting the refuge's ability to capture water and concerns regarding language in the transmittal letters. A letter is being drafted regarding the points which can be addressed and to set a meeting time.

Larry M. Sheets
Environmental Scientist

LMS:jt

70% of Appropriated amount as pumpage for 1987

10 cfs = 55 scale 1986 = 23.45 cfs

	No Pump	Pump
1987	21.45	17.27 cfs
1988	26.36	23.27
1989	23.27	20.72
1990	21.63	19.45

1987 4.18 cfs difference

(X) (ft³/sec) (sec/3000) (20 hour/day) (365 day/year) (2.29 cfs / 1 AF)

1 cfs = 724.06656 AF/year

1987	3026.60 AF	
1987	3.09 x 724	= 2,237.37 AF
1989	2.55 x	= 1,846.37 AF
1990		1,576.47

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APR 20 [illegible]

DIVISION OF [illegible]

MICROFILMED

KANSAS STATE BOARD OF AGRICULTURE
Phillip A. Fishburn, Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

December 23, 1993

UNITED STATES DEPARTMENT OF INTERIOR
FISH AND WILDLIFE SERVICES
P O BOX 25486
DENVER FEDERAL CENTER
DENVER CO 80225

Re: Appropriation of Water
File No. 7,571

Dear Sir:

Your letter regarding the above referenced water right was received on November 17, 1993. The Services concerns are being reviewed.

We will be in contact with Cheryl Williss (the Service's Regional Water Rights Specialist) regarding the concerns expressed in your letter.

Please feel free to contact this office either by telephone or in writing should you have any questions. Please identify the file number when communicating with this office.

Sincerely,

David L. Pope, P.E.
Chief Engineer

GE:LMS:jt
pc: Bruce Falk

RECEIVED
DEC 27
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

TITLE: Stream-aquifer modeling and preliminary mineral intrusion analysis of the lower Rattlesnake Creek basin with emphasis on the Quivira National Wildlife Refuge, Kansas. KGS OFR 93-7

AUTHOR: Sophocleous, Marios and Perkins, Samuel

INTRODUCTION: In this report the authors address the problems of groundwater declines, streamflow depletion and mineral intrusion by using a computer model of the lower Rattlesnake Creek basin. Hydrologic budgets were evaluated for both predevelopment and developed conditions by using the computer model program MODFLOW. MODFLOW was used for the numerical modeling with MODINV (MODflow INVerse) being used to calibrate the parameters.

The purpose of the study was to address the following three main objectives:

1.) Analyze the effects of overall regional appropriations and various pumping patterns on the stream flows and aquifer water levels and conduct a preliminary analysis of the effects of mineral intrusion from underlying geologic formations.

2.) Evaluate the outlook for available surface-water and groundwater supplies to the Quivira refuge and develop strategies to maintain or enhance supplies.

3.) Evaluate the hydrologic effectiveness of a couple of management strategies.

The study area includes the lower portion of the Rattlesnake Creek watershed and Quivira refuge.

DESCRIPTION OF METHODOLOGY: In order to obtain an effective computer model the authors first had to identify as many factors which effect the hydrologic budget as was possible. The factors that were taken into account include: aquifer geology, bedrock contours, predevelopment water table, soils, water table history, current water rights, Rattlesnake Creek stream flows, climatic data, saltwater-freshwater interface along with stortivity and transmissivity data.

MODFLOW solves the three-dimensional groundwater flow equation using finite-difference approximations and includes the effects of areal recharge, rivers, drains, evapotranspiration, and pumpage. MODINV calibrated the program by using data from 1955-1990. An analysis was made to determine the sensitivity of the model to variations in the values of selected parameters on both the aquifer and the stream. The input and aquifer parameters considered were pumpage, recharge, hydraulic conductivity and storativity. The stream parameters considered were conductance of the streambed, Manning's roughness coefficient, stream slope, and stream width. "Sensitivity to each parameter was determined by running the model with the optimized parameters for 1990 in a predictive mode from 1990 to 2010 and by varying (increasing and decreasing) each parameter by 50%."

There are two simulations run by the computer model. The first uses transient state data and the second uses revised data.

The original simulations tend to underpredict streamflows and the revised ones tend overpredict them.

A USGS logging vehicle was used to conduct a geophysical logging survey of existing wells in April and May 1990. Purpose being to locate the saltwater-freshwater interface below Great Bend and this allowed them to decide sites where monitoring wells should be drilled. Sittner and Figger well were drilled at two sites near Quivira.

The following general set of scenarios were tested:

1. Effects of climatic fluctuations and changing incoming Rattlesnake Creek streamflows (climatic fluctuations set).

For this scenario, climatic fluctuation cycles were used to observe the effects on streamflow and therefore baseflow.(i.e. flood-drought, drought-flood-normal, flood-drought- normal) The largest flood year 1973 and annual streamflow was 154.6cfs. The lowest flow representing drought years was 1991 water year with a streamflow of 1.5cfs. The average annual streamflow was calculated at 9.3cfs and represented the normal. A few alterations were made to the data in order to make it more representative according to the authors, as follows. "During the flooding periods, recharge was increased by 100% and actual pumping was reduced by 50%. During droughts, recharge was reduced by 100% and pumpage was increased to the nominal appropriated amounts."

2. Effects of changing pumping patterns, establishing protective stream corridors and achieving specified desired Rattlesnake Creek streamflows (stream corridor set). There were three different sets of corridors introduced, three, four and five mile corridors, and then combinations of these. In these corridors irrigation wells pumping was put into moratorium (completely stopped). There were also various percentages of stopped pumping conditions introduced in some of the combinations of corridors, the main one used being a reduction of 50% of appropriated limits. Table 12 (attached) reviews each corridor management strategy and its effect.

DESCRIPTION OF DATA: All water rights data (as of 1990) for the Great Bend Prairie region were obtained on tape from DWR and these rights were processed and displayed on a 1:250,000 map. 80% of the appropriated amounts for the actual amount of irrigation pumpage for the transient simulations was later reduced to 70%.

Two conductivity recording probes, one with an electronic data acquisition system and the other with a recording chart were used at the well sites to gather data on the salt-fresh water interface.

Macksville, Zeinth and Raymond stream gaging stations provided the data used for the streamflow component.

Climatic data were obtained from existing National Oceanic and Atmospheric Administration Climatic stations in Kansas and GMD No. 5-KGS cooperative study on recharge assessment in GMD No. 5, which encompasses most of the Great Bend Prairie region, including the study area. Average annual rainfall in the western most part of Great Bend Region is 20in/yr and the eastern part it increases to 29in/yr.

Water level data comes from unpublished records completed during the 1970's.

Field data collected for the study was minimal. Basically consisted of water level measurements. This data was then combined with DWR annual well measurement for the region.

AUTHOR'S CONCLUSIONS/RECOMMENDATIONS: "The results for the water table levels that are found by the model appear to be very close to present day levels."

The volumetric water budget that is described in the report accounts for all water flowing into and out of the study area.

The stream flow that was simulated as the Zenith gaging station is lower than the actual data and averaged data for the period 1955-1990. Predicted stream flow indicated that if current conditions continue the amount of water flowing past the Zenith gaging station will decrease by 40 percent by the year 2010. And stream flow at all three gaging stations will continue to decrease with current conditions.

It is predicted that if the State imposes a 50 percent reduction in the amount of pumping now groundwater level declines will be reduced by approximately 7 feet by the year 2010.

The models prediction of baseflows, assuming that present conditions (pumpage, recharge, evapotranspiration, incoming streamflows at the Macksville gaging station) persist throughout the 1990-2010 period for the Rattlesnake Creek locations near Macksville, St. John, and the Zenith gaging station. "In all three areas future baseflows will be declining, with the steepest decline of approximately 40% by the year 2010 occurring at the Zenith gaging station near the entrance to the Quivira NWR."

The one management strategy that was recommended by this report is stream corridors. Scenarios were run in which stream corridors of three miles, five miles and complete pumping shut down were all analyzed. Also combinations were run including three mile corridor for the first ten years and four miles for the second ten years, and three miles for the next ten years followed by a five mile corridor.

In the case of the three mile corridors the stream flow would continue to decrease but not at the level that it is currently decreasing.

For a five mile corridor, the stream flow would increase rapidly for about four years then slowly increase to the 2010 level.

Of each of the other corridor possibilities that are presented only the case of a three mile corridor followed by a five mile corridor shows that the stream at Zenith would continue to increase. If all wells within the study area are reduced to 35 percent of their appropriated limits the stream would remain fairly constant at a level about 2 or 3cfs above present day levels.

If a three mile corridor was implemented with all other wells being reduced to 50 percent of their appropriated limits, the stream would increase by about 6 cfs over the next 6 years, then begin to slowly decline.

The results of the data set for climatic fluctuations shows that the effects of droughts on groundwater levels are more severe when they are low and that the sequence drought-flood-normal cycle ends up in higher groundwater levels by the end of the climatic

fluctuation cycle that the flood-drought-normal cycle.

"Results of this study indicate that the present level of groundwater pumpage in the area is not sustainable over the longterm and the desirable stream flows cannot be maintained unless severe measures along the lines indicated in this study are taken to protect and conserve the water resources of the region."

DWR STAFF COMMENTS: Stream flows of the Rattlesnake appear to generally decline from 1973 on according to the results of this study. This appears to be an accurate representation. But after this, it is difficult to get a true sense of how representative the results are because of the real data used as input was not provided in the report, instead a descriptive text is used to provide a general outline of what the data consisted of and where it was acquired.

One indicator that the system is not exact is the fact that evapotranspiration around the stream was ignored. This was done after it was found that including it actually made the results waiver from the actual case.

The climatic fluctuation cycles used provide interesting data. However, it is not clear how representative this data is of the Rattlesnake Creek area.

Overall, this report indicates that it is possible to develop a computer model which would represent the hydrologic conditions of the basin. This model, however, would need to by modified and improved if it were to be used as a basis for the development of a management recommendation. There are too many assumptions and too many data modifications for these results to be considered an objective representation of the system or the conditions it may be experiencing. It would also be necessary to make sure that this program can take into account management practices other than the stream corridors that have been suggested here and be able to be updated as more is learned about the system. The stream corridors that have been suggested may or may not be effective, but they would definitely be near impossible to implement without total disruption of the region.

prepared by Deborah Zarta
November 17, 1993

Table 12. Management alternatives considered for the lower Rattlesnake Creek model area.

Pumping patterns	Effects	Results in figure
1. Base case: 1990 "status quo" maintained (pumpage 70% of appropriations)	40% streamflow decline by 2010 at the Zenith streamgaging station	61, 64a
2. Complete pumpage moratorium throughout model area	Increased streamflows throughout Rattlesnake Creek. Maximum streamflow gain	61, 62
3. 3- to 5-mi stream corridors with pumping moratoria	Only 4-mi stream corridor or larger would maintain present-day streamflows or stabilize flow	61, 64b, 64c
4. Time varying stream corridors with pumping moratoria during a 20-year planning horizon		
a. 3-mi (first decade) followed by 4-mi (next decade)	Present-day streamflows are maintained	65/1[a]
b. 3-mi (first decade) followed by 5-mi (next decade)	Increased streamflow at the entrance to Quivira NWR	65/3
5. Meeting 30 cfs streamflow target within 3 years by employing a 3-mi stream corridor with pumping moratorium, plus ~29% pumpage reduction throughout model area	Streamflows at entrance to Quivira NWR increase to more than 30 cfs in 3 years	65/4
6. 50% pumpage reduction throughout model area	Streamflows stabilized, with flow at Quivira NWR higher than incoming streamflow at upstream model boundary	65/2

a. Numbers following a slash indicate curve in figure.

greater than 4 mi (i.e., 2 mi on either side of the streambanks) with complete pumping shutdown would be effective in stabilizing or increasing streamflows at the entrance to the Quivira marsh, provided present-day (1988–1991) climatic conditions remain constant over the next 20 years. Figure 64 displays the reach-by-reach streamflow gains or losses with time for the base case and for 3-mi and 5-mi corridors with pumping moratoria. Table 13 depicts the relative decreases in pumpage and corresponding gains in streamflows for the different scenarios in the Rattlesnake Creek model area.

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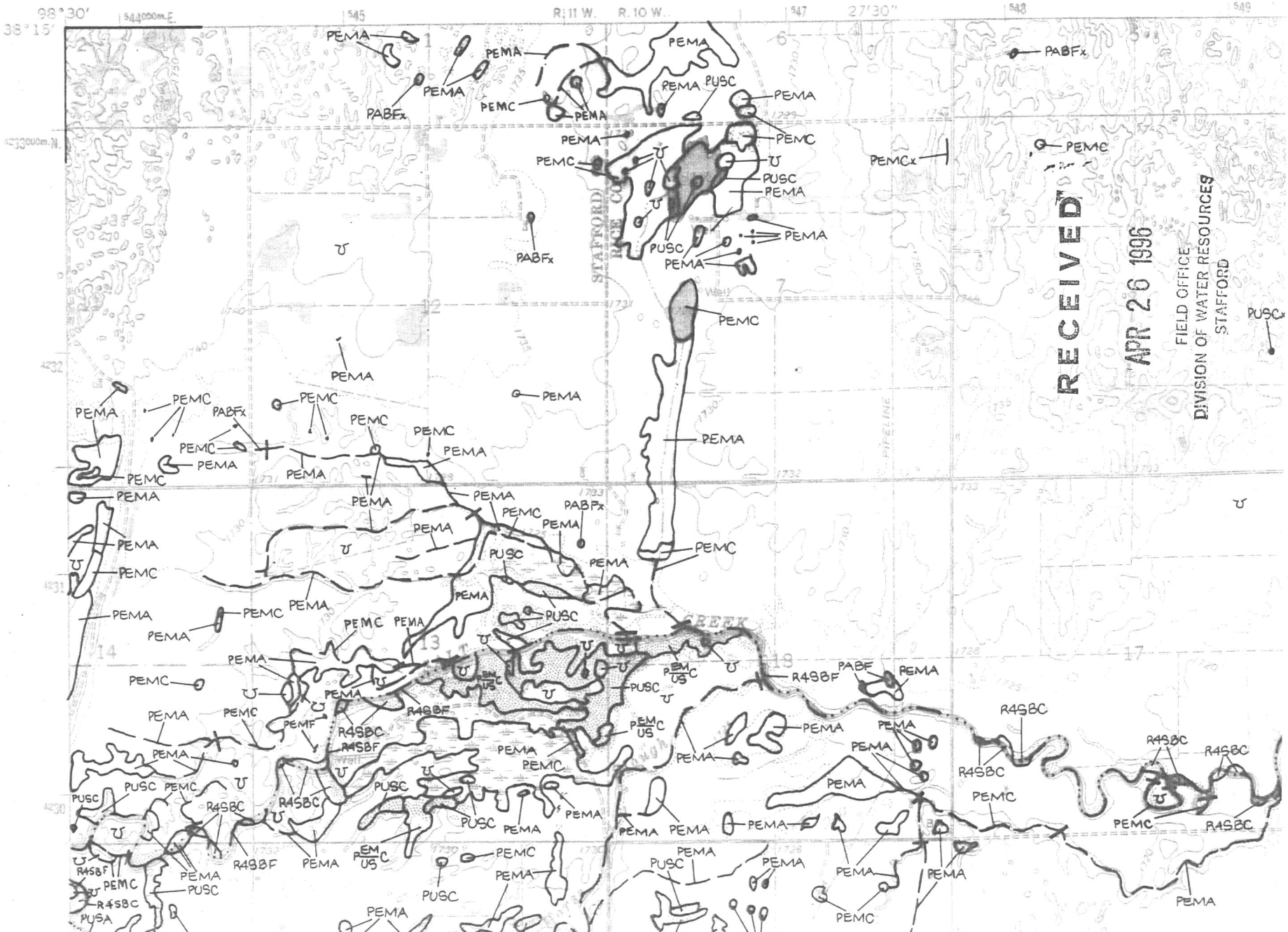

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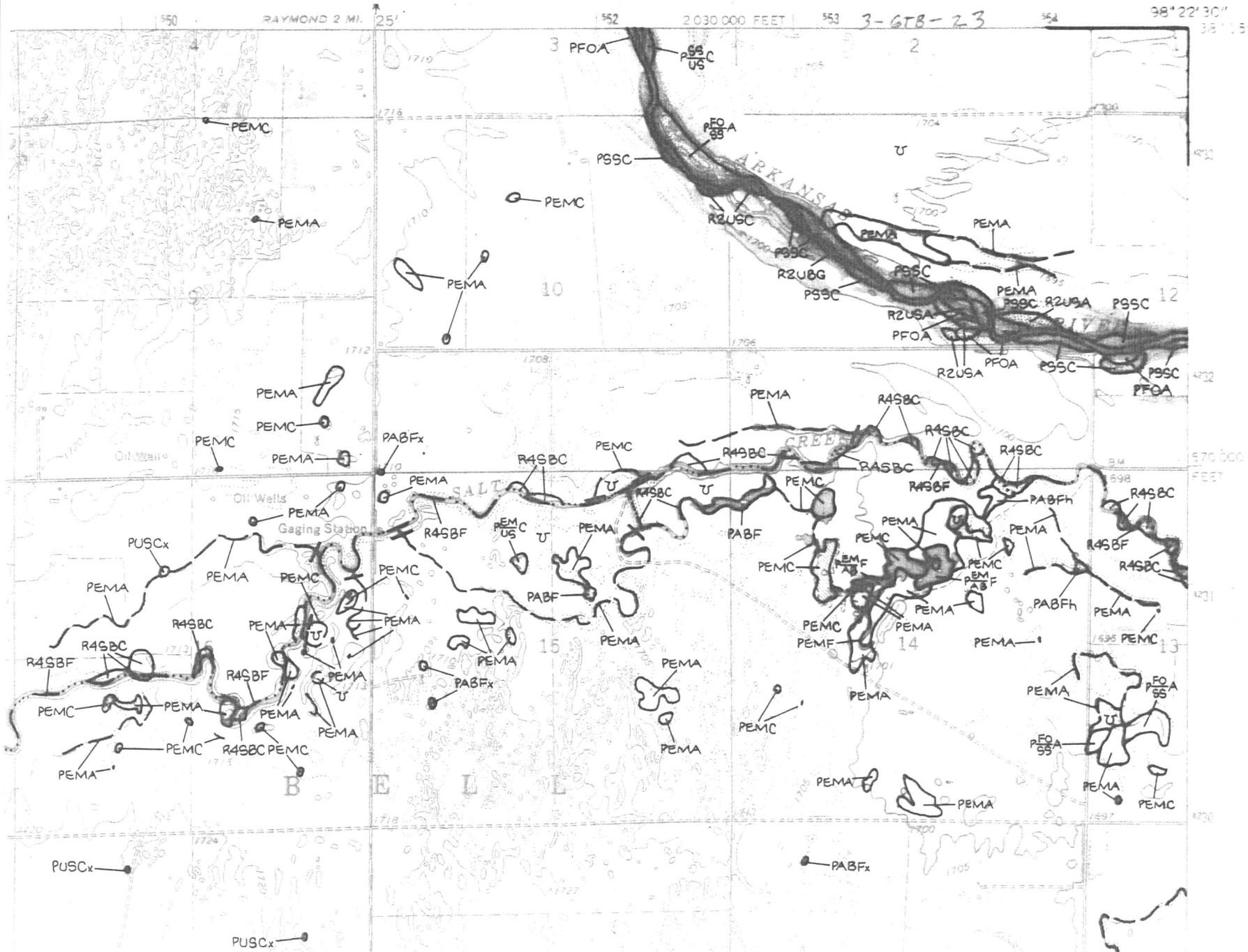

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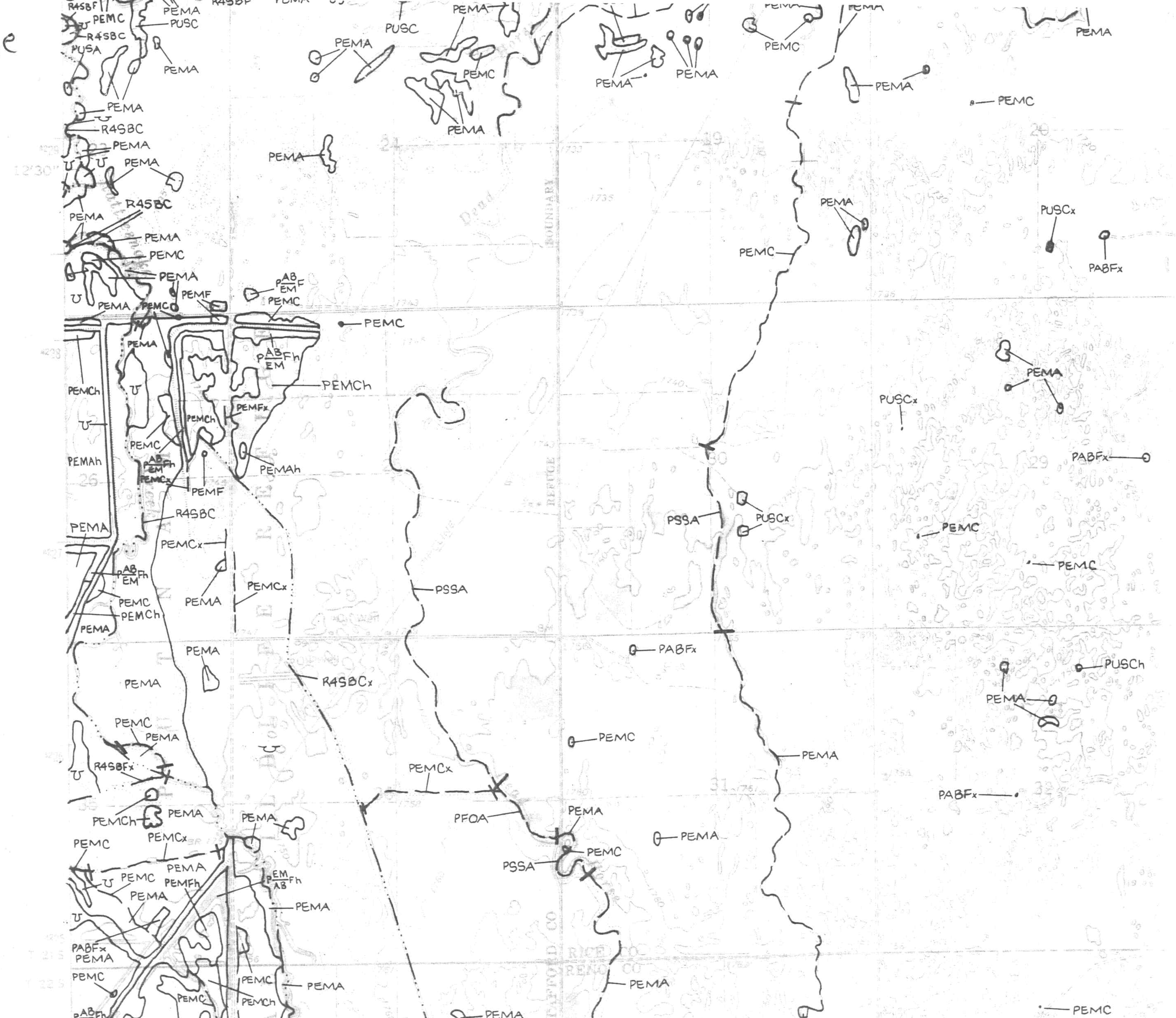

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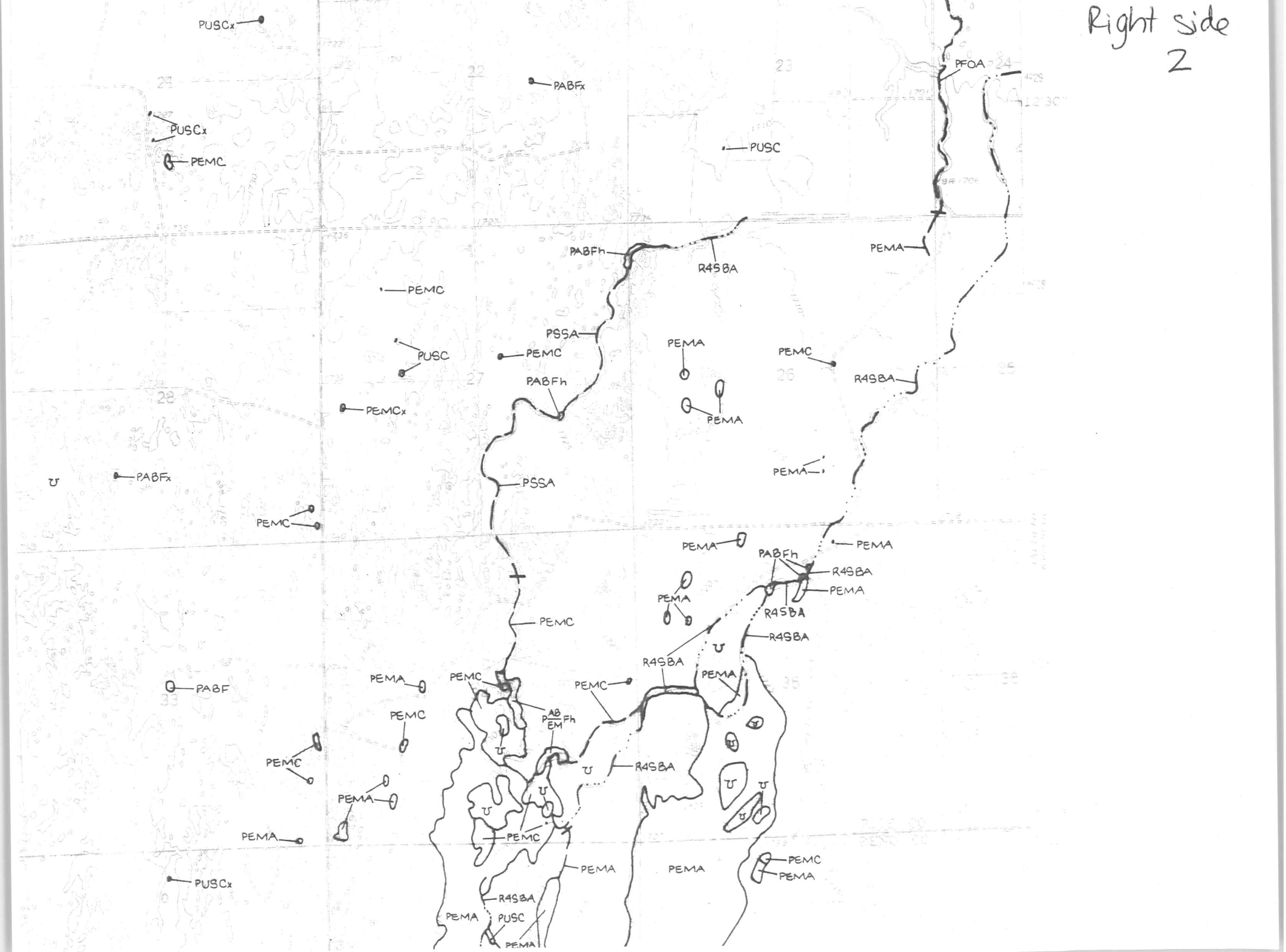
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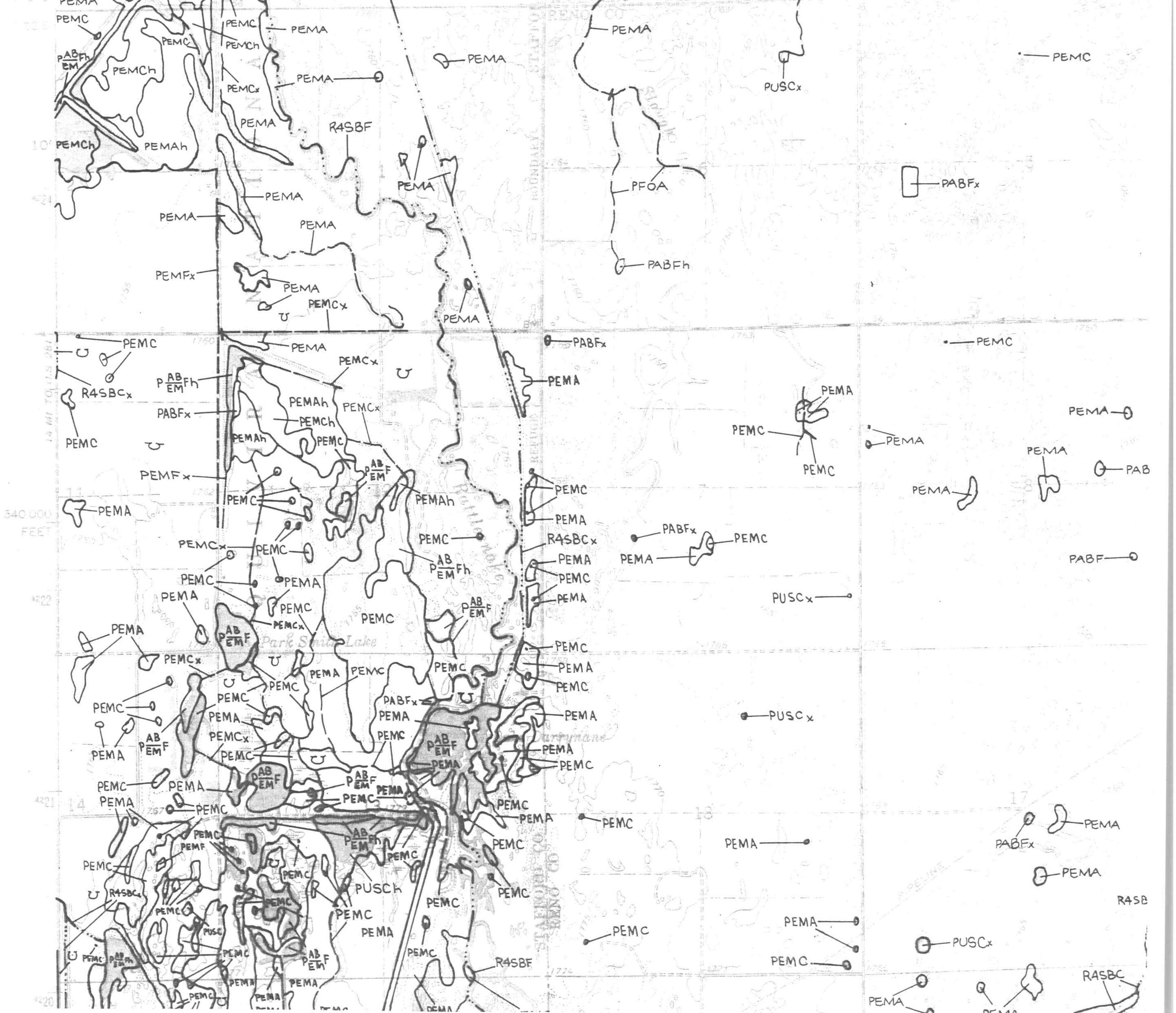

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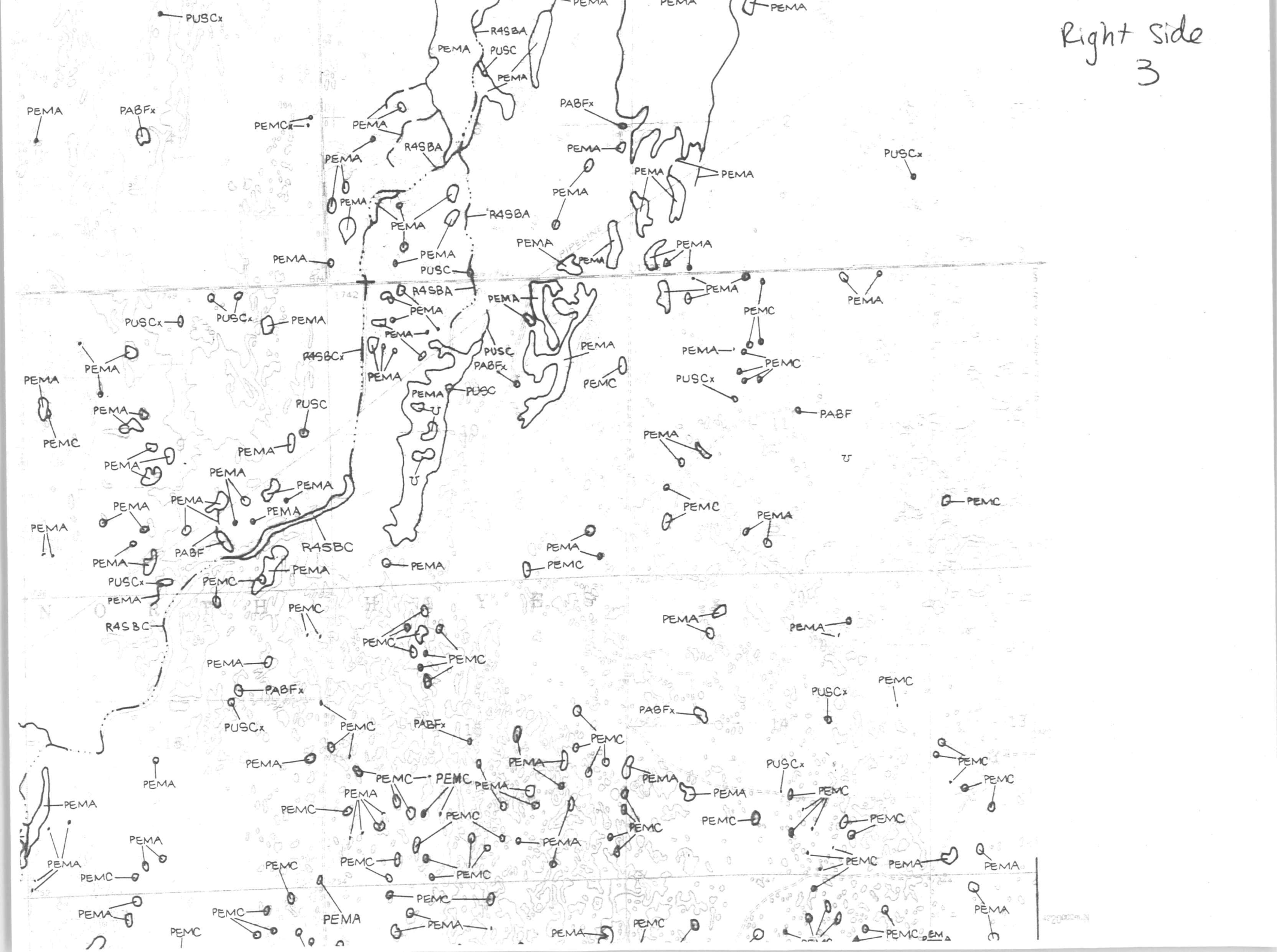
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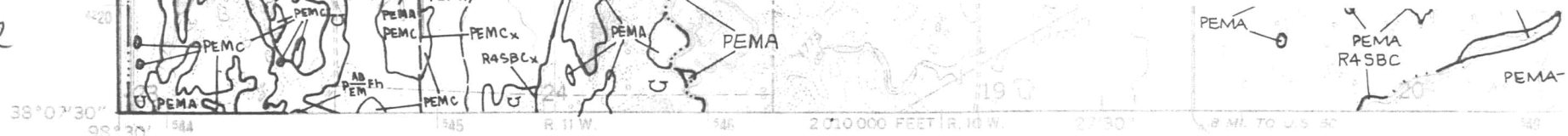

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GREAT BEND

SCALE 1:24 000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER

1 acre

10 acres

20 acres

ACREAGE GUIDE

Other information including a narrative report concerning the wetland resources depicted on this document may be available. For information, contact:

Regional Director (ARDE) Region VI
U.S. Fish and Wildlife Service
P.O. Box 2548, Denver Federal Center
Denver, Colorado 80225

SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.**

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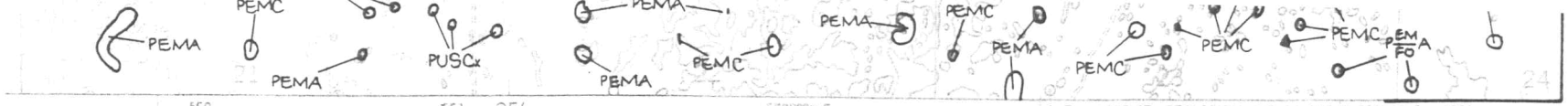
SYSTEM	M — MARINE											
SUBSYSTEM	1 - SUBTIDAL					2 — INTERTIDAL				1 -		
CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	RB — ROCK BOTTOM	UB — UNCONSOLID BOTTOM	
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm		1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	

SYSTEM	R — RIVERINE				
					5 — UNKNOWN PERENNIAL



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ALDEN NW, KANS.

' EXAMPLE

SYSTEM
SUBSYSTEM
CLASS
L2EM2F
SUBCLASS, WATER REGIME

UPLAND (NON-WETLAND)

R2OWH
(LINEAR DEEPWATER HABITAT)

NOTES TO THE USER

- Wetlands which have been field examined are indicated on the map by an asterisk (*).
- Additions or corrections to the wetlands information displayed on this map are solicited. Please forward such information to the address indicated.
- Subsystems, Classes, Subclasses, and Water Regimes in *Italics* were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach/Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Prepared by National Wetlands Inventory

represents **upland** areas, but may include
ed wetlands such as man-modified areas, non
ntifiable areas and/or unintentional omissions.

AERIAL PHOTOGRAPHY

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E — ESTUARINE — **SYSTEM**

3TIDAL — **1 — SUBTIDAL** — **SUBSYSTEM**

AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	**CLASS**
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm		**Subclass**

2 — INTERTIDAL — **SUBSYSTEM**

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	**CLASS**
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	**Subclass**

L — LACUSTRINE — **SYSTEM**

1 — LIMNETIC — **SUBSYSTEM**

2 — LITTORAL — **SUBSYSTEM**

left side
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Other information including a narrative report concerning the wetland resources depicted on this document may be available. For information, contact:

Regional Director (ARDE) Region VI
U.S. Fish and Wildlife Service
P.O. Box 2548, Denver Federal Center
Denver, Colorado 80225

this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.**

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SYSTEM: M — MARINE

SUBSYSTEM: 1 — SUBTIDAL

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB — AQUATIC BED	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*
RF — REEF	1 Coral 3 Worm
OW — *OPEN WATER/ Unknown Bottom*	

SUBSYSTEM: 2 — INTERTIDAL

CLASS	Subclass
AB — AQUATIC BED	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*
RF — REEF	1 Coral 3 Worm
RS — ROCKY SHORE	1 Bedrock 2 Rubble
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SUBSYSTEM: 1 -

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLI BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SYSTEM: R — RIVERINE

SUBSYSTEM	CLASS	Subclass
1 — TIDAL	RB — ROCK	1 Bedrock 2 Rubble
	UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
2 — LOWER PERENNIAL	*SB — STREAMBED	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated
	AB — AQUATIC BED	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*
3 — UPPER PERENNIAL	RS — ROCKY SHORE	1 Bedrock 2 Rubble
	US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
4 — INTERMITTENT	**EM — EMERGENT	2 Nonpersistent
	OW — *OPEN WATER/ Unknown Bottom*	
5 — UNKNOWN PERENNIAL	RB — ROCK BOTTOM	1 Bedrock 2 Rubble

*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS.

SYSTEM: P — PALUSTRINE

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB — AQUATIC BED	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
ML — MOSS-LICHEN	1 Moss 2 Lichen
EM — EMERGENT	1 Persistent 2 Nonpersistent
SS — SCRUB-SHRUB	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*
FO — FORESTED	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*
OW — *OPEN WATER/ Unkno vn Bottom*	

A Temporaril
B Saturated
C Seasonally
D *Seasonally Well Drain*
E *Seasonally Saturated*
F Semiperm
G Intermitter

AERIAL PHOTOGRAPHY

presents **upland** areas, but may include wetlands such as man-modified areas, non fiable areas and/or unintentional omissions.

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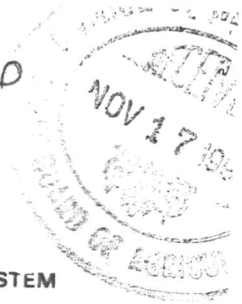

E — ESTUARINE

SYSTEM

IDAL

SUBSYSTEM

— AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
lgal ooted Vascular loating Vascular *Unknown Submergent* *Unknown Surface*	2 Mollusc 3 Worm	

2 — INTERTIDAL

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*

CLASS

Subclass

L — LACUSTRINE

SYSTEM

— LIMNETIC

SUBSYSTEM

CONSOLIDATED TTOM	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*
-Gravel c	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

2 — LITTORAL

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

CLASS

Subclass

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

i	H Permanently Flooded
	J Intermittently Flooded
	K Artificially Flooded
/	W Intermittently Flooded/Temporary
V	Y Saturated/Semipermanent/ Seasonal
Flooded sed	Z Intermittently Exposed/Permanent
	U *Unknown*

Tidal

K *Artificially Flooded*	* S Temporary-Tidal
L Subtidal	* R Seasonal-Tidal
M Irregularly Exposed	* T Semiperm nent-Tidal
N Regularly Flooded	* V Permanent-Tidal
P Irregularly Flooded	U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems

WATER CHEMISTRY

Coastal Halinity

1 Hyperhaline
2 Euhaline
3 Mixohaline *(Brackish)*
4 Polyhaline
5 Mesohaline
6 Oligohaline
0 Fresh

Inland Salinity

7 Hypersaline
8 Eusaline
9 Mixosaline
0 Fresh

pH Modifiers for all Fresh Water

a Acid
t Circumneutral
i Alkaline

SOIL

g Organic
n Mineral

SPECIAL MODIFIERS

b *Beaver*
d *Partially Drained/Ditched*
f Farmed
h *Diked/Impounded*
r Artificial Substrate
s *Spoil*
x Excavated

Left side
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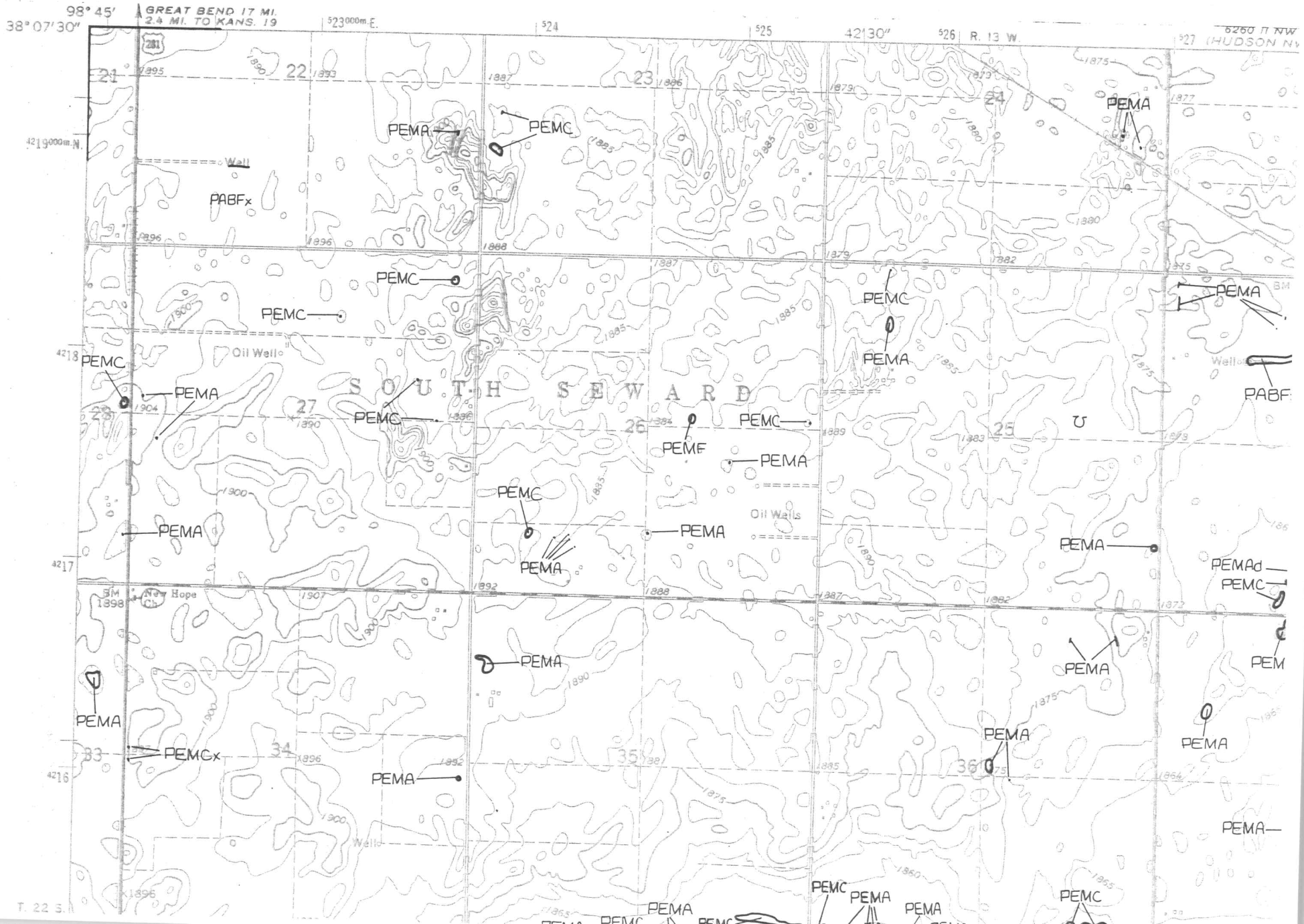

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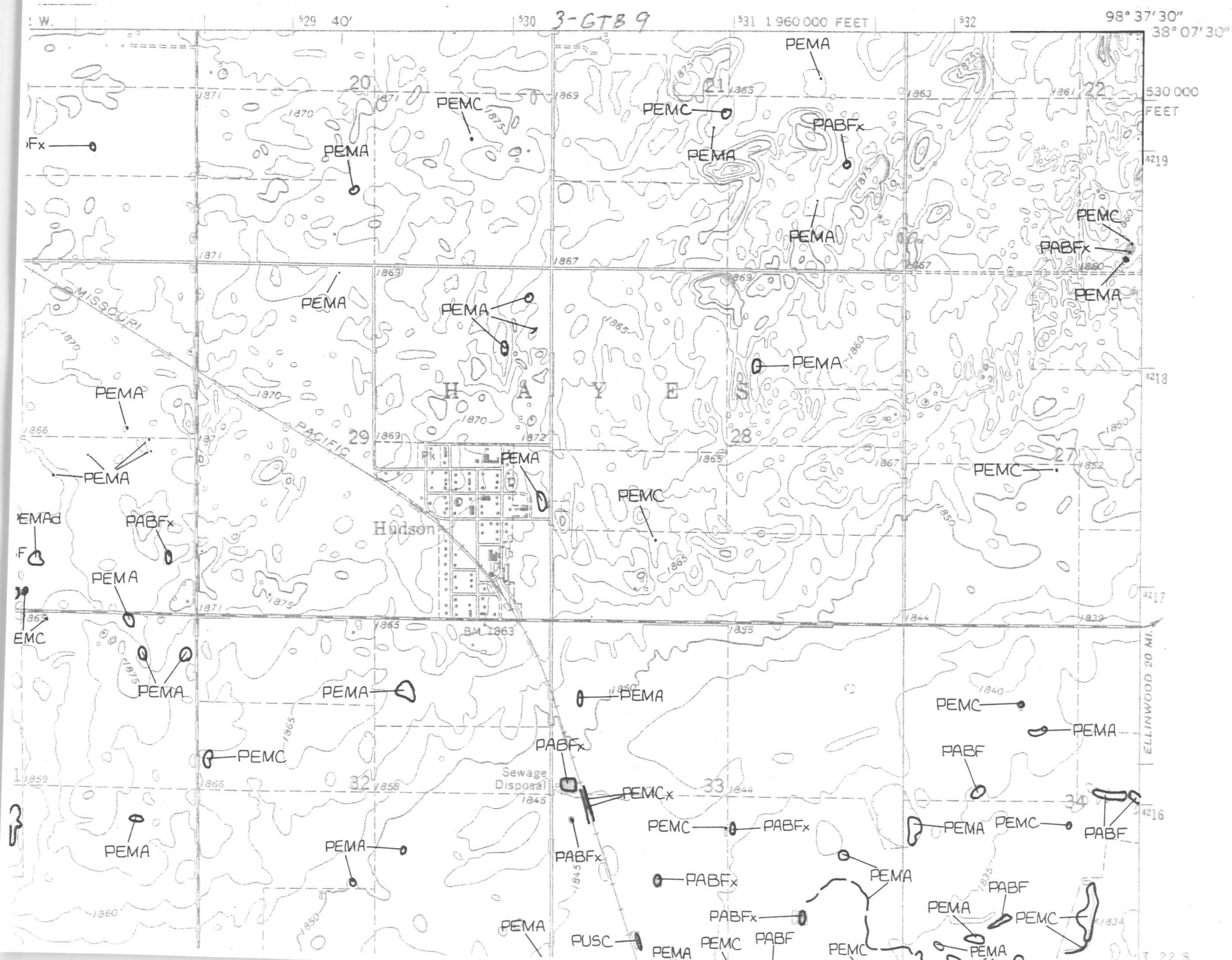

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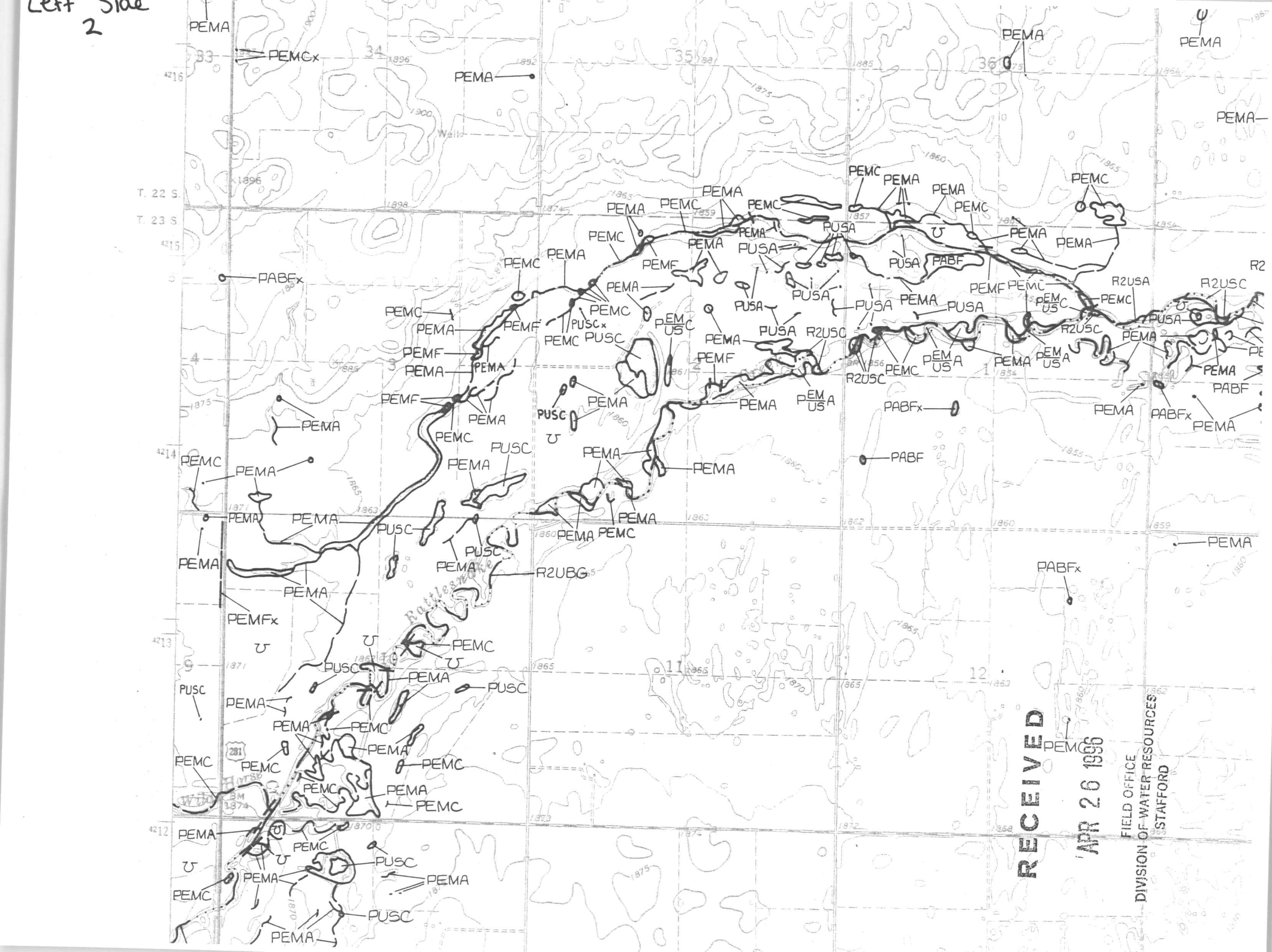
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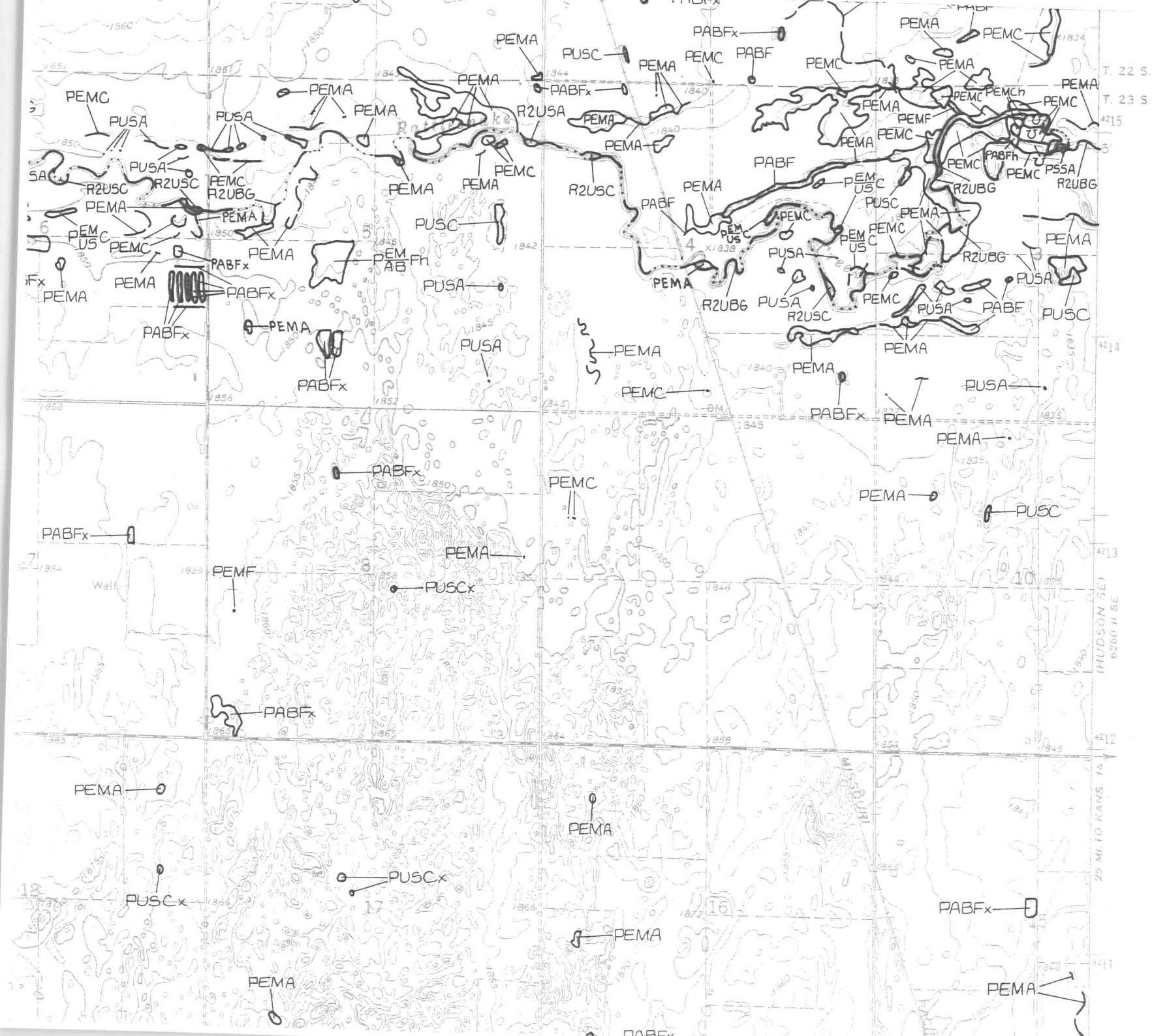
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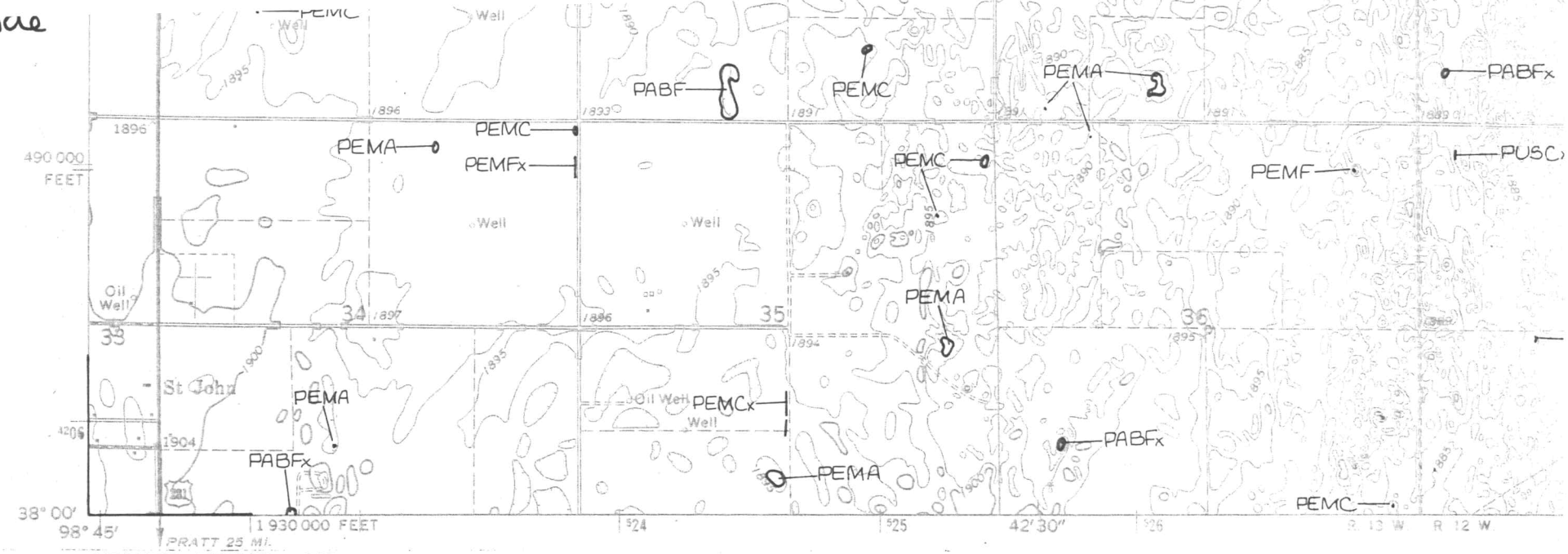


SCALE 1:24000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

1 acre

10 acres

20 acres

ACREAGE GUIDE

Other information including a narrative report concerning the wetland resources depicted on this document may be available. For information, contact:

Regional Director (ARDE) Region VI
U.S. Fish and Wildlife Service
P.O. Box 2548, Denver Federal Center
Denver, Colorado 80225

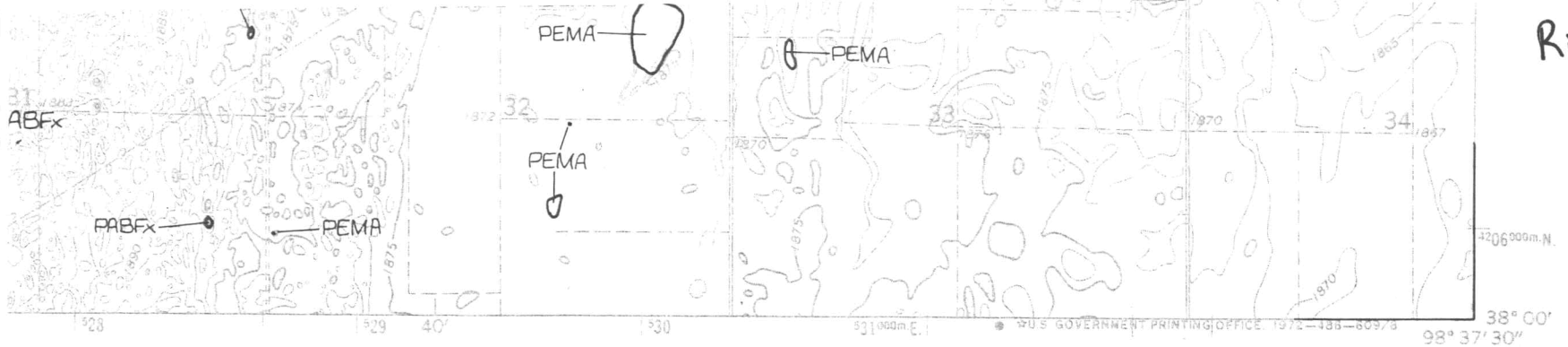
SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.**

SYMBOLOG

U — Primarily unclassif photo-ide



Right Side
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HUDSON, KANS.

XAMPLE

SYSTEM
SUBSYSTEM
CLASS
L2EM2F
SUBCLASS, WATER REGIME

UPLAND (NON-WETLAND)

—**R2OWH**
(LINEAR DEEPWATER HABITAT)

NOTES TO THE USER

- Wetlands which have been field examined are indicated on the map by an asterisk (*).
- Additions or corrections to the wetlands information displayed on this map are solicited. Please forward such information to the address indicated.
- Subsystems, Classes, Subclasses, and Water Regimes in *Italics* were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach/Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory

AERIAL PHOTOGRAPHY

DATE:	9/ /81	DATE: / /
SCALE:	1:58000	SCALE:
TYPE:	CIR	TYPE:

presents **upland** areas, but may include wetlands such as man-modified areas, non able areas and/or unintentional omissions.

E — ESTUARINE

2 — INTERTIDAL

SYSTEM

SUBSYSTEM

AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS SCRUB-SHRUB	FO — FORESTED	CLASS
ıl ted Vascular ting Vascular *nown Submergent*	2 Mollusc 3 Worm		1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous	**Subclass**

5

M — MARINE

SUBSYSTEM: 1 — SUBTIDAL

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB — AQUATIC BED	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*
RF — REEF	1 Coral 3 Worm
OW — *OPEN WATER/ Unknown Bottom*	

SUBSYSTEM: 2 — INTERTIDAL

CLASS	Subclass
AB — AQUATIC BED	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*
RF — REEF	1 Coral 3 Worm
RS — ROCKY SHORE	1 Bedrock 2 Rubble
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SUBSYSTEM: 1 — SI

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SYSTEM: R — RIVERINE

SUBSYSTEM: 1 — TIDAL

CLASS	Subclass
RB — ROCK	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
*SB — STREAMBED	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated
AB — AQUATIC BED	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*
RS — ROCKY SHORE	1 Bedrock 2 Rubble
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
**EM — EMERGENT	2 Nonpersistent
OW — *OPEN WATER/ Unknown Bottom*	

SUBSYSTEM: 2 — LOWER PERENNIAL

SUBSYSTEM: 3 — UPPER PERENNIAL

SUBSYSTEM: 4 — INTERMITTENT

SUBSYSTEM: 5 — UNKNOWN PERENNIAL

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — U B	1 Cobbl 2 Sand 3 Mud 4 Organ

*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS.

SYSTEM: P — PALUSTRINE

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB — AQUATIC BED	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
ML — MOSS-LICHEN	1 Moss 2 Lichen
EM — EMERGENT	1 Persistent 2 Nonpersistent
SS — SCRUB-SHRUB	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*
FO — FORESTED	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*
OW — *OPEN WATER/ Unknown Bottom*	

A	Temporarily Flooded
B	Saturated
C	Seasonally Flooded
D	*Seasonally Flooded/ Well Drained*
E	*Seasonally Flooded/ Saturated*
F	Semipermanently Floo
G	Intermittently Exposed

Right Side
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E — ESTUARINE

SYSTEM

)AL

SUBSYSTEM

AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
il ted Vascular ting Vascular *nown Submergent* *nown Surface*	2 Mollusc 3 Worm	

2 — INTERTIDAL

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS SCRUB-SHRUB	FO — FORESTED
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*

CLASS

Subclass

L — LACUSTRINE

SYSTEM

LIMNETIC

SUBSYSTEM

SOLIDATED M	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*
el	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

2 — LITTORAL

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

CLASS

Subclass

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

n-Tidal

- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent-Tidal
- *V Permanent-Tidal
- U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems

WATER CHEMISTRY

Coastal Halinity

- 1 Hyperhaline
- 2 Euhaline
- 3 Mixohaline *(Brackish)*
- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline
- 0 Fresh

Inland Salinity

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

pH Modifiers for all Fresh Water

- a Acid
- i Circumneutral
- Alkaline

SOIL

- g Organic
- n Mineral

SPECIAL MODIFIERS

- b *Beaver*
- d *Partially Drained/Ditched*
- f Farmed
- h *Diked/Impounded*
- r Artificial Substrate
- s *Spoil*
- x Excavated

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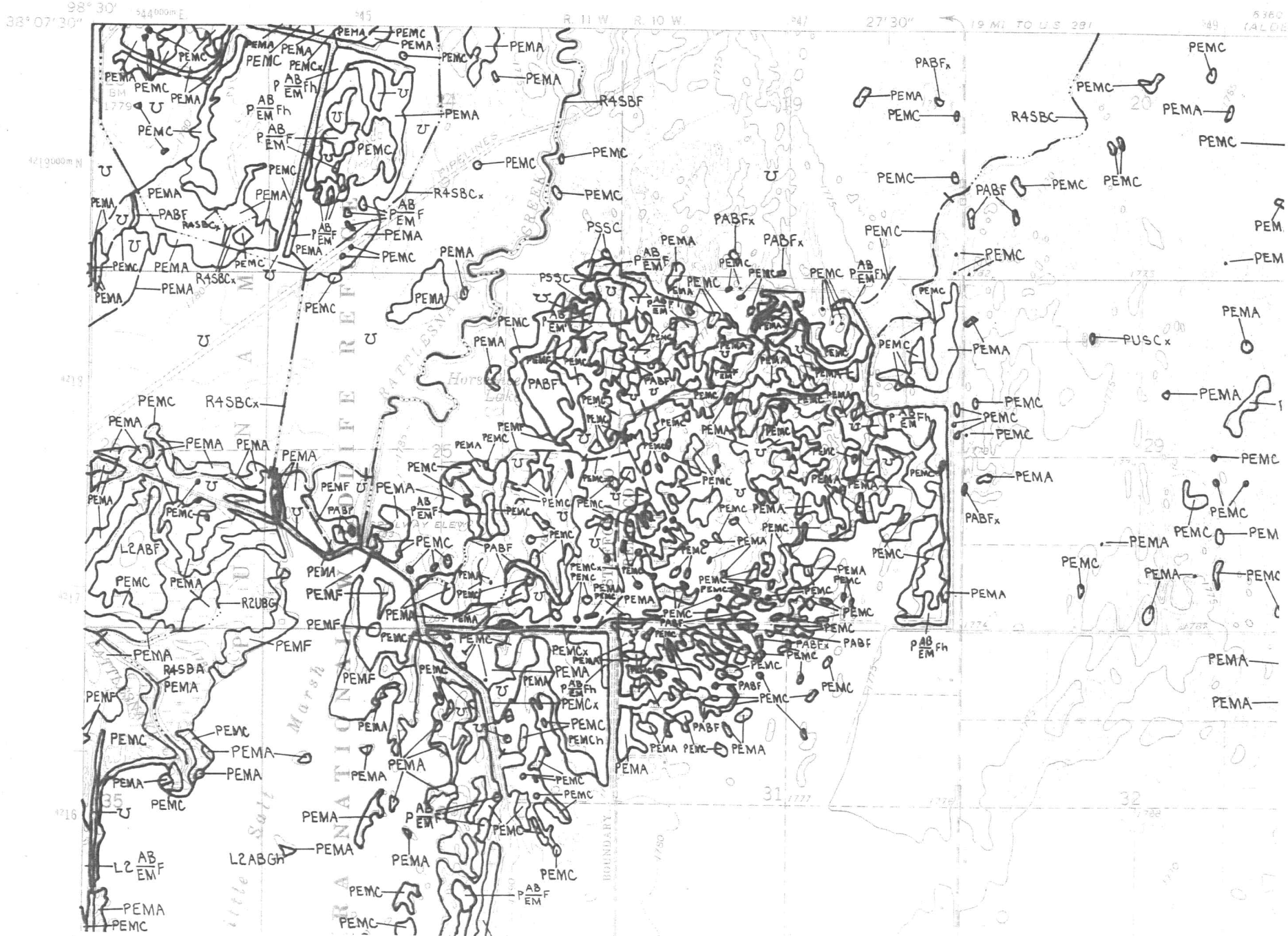
NATIONAL WETLAI

UNITED STATES DEPARTM

LITTLE SALT MARSH, KANS.



S INVENTORY
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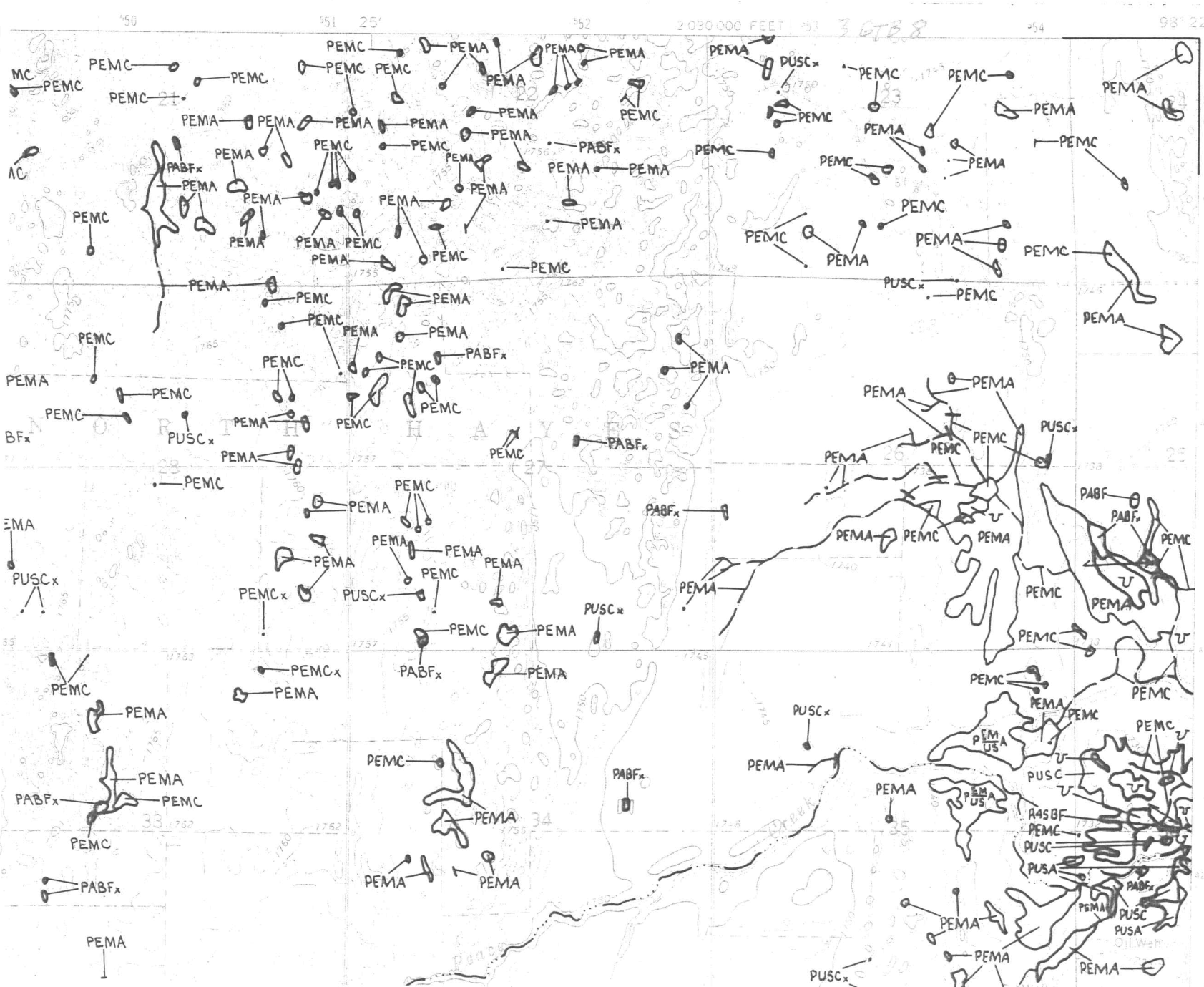

Left Side
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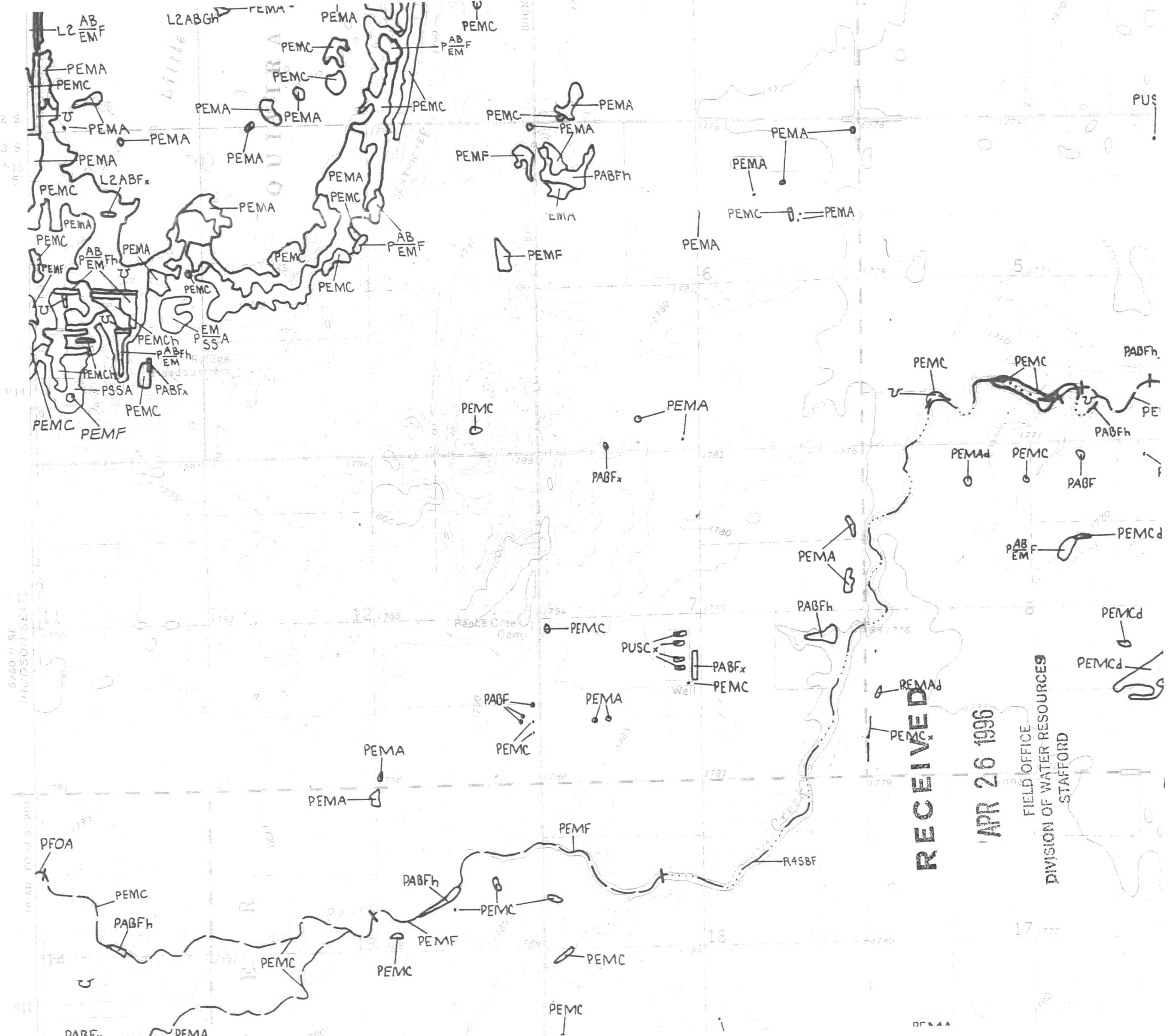
RECEIVED
APR 26 1996
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD
PEMA
PEMC
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PABFh
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PEMCd
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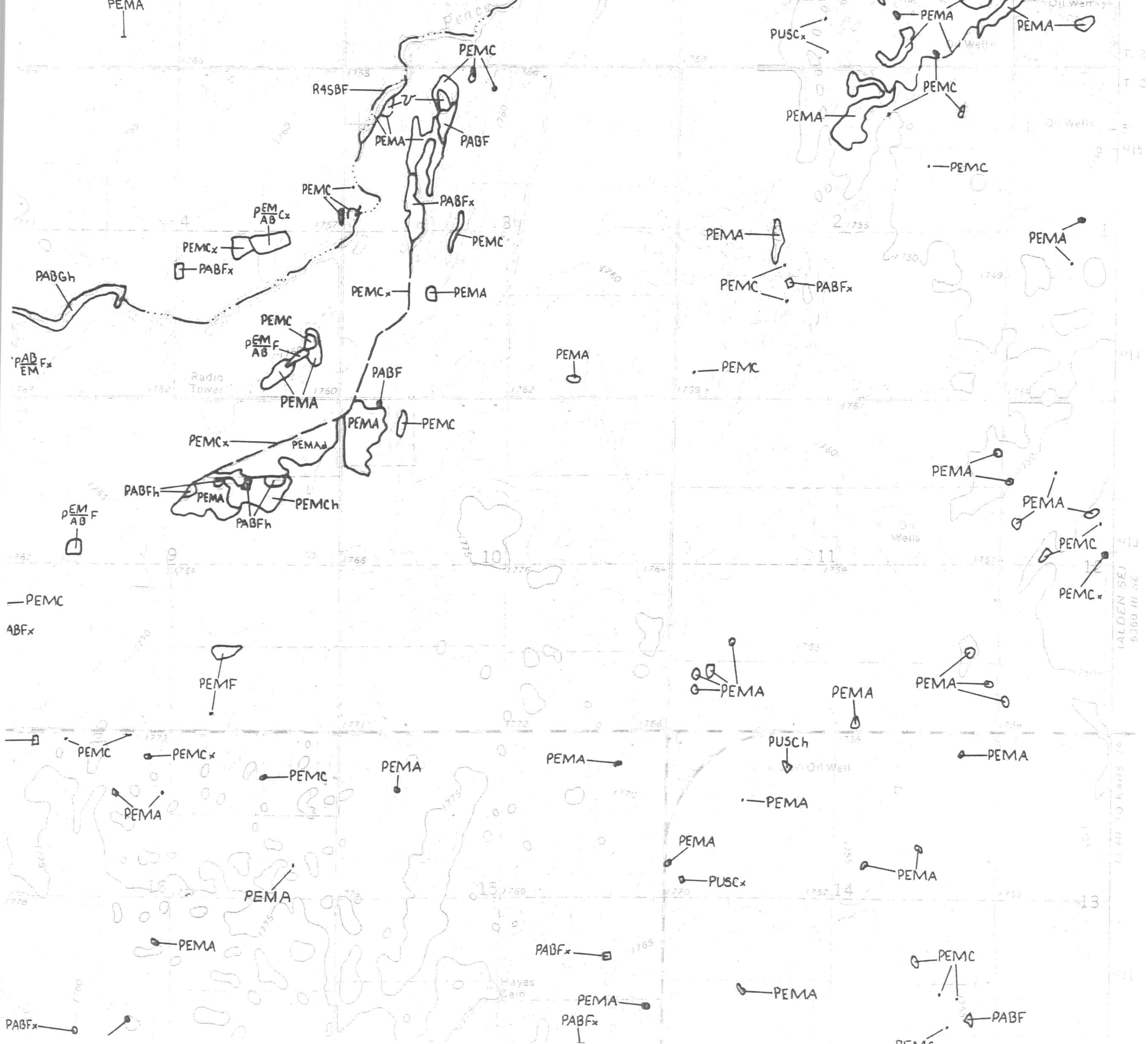
PUSCx
PFOA
PSSA
R4SBF
L2ABFx
L2ABGh
Refuge Headquarters
Well

Right side
2



PEMA
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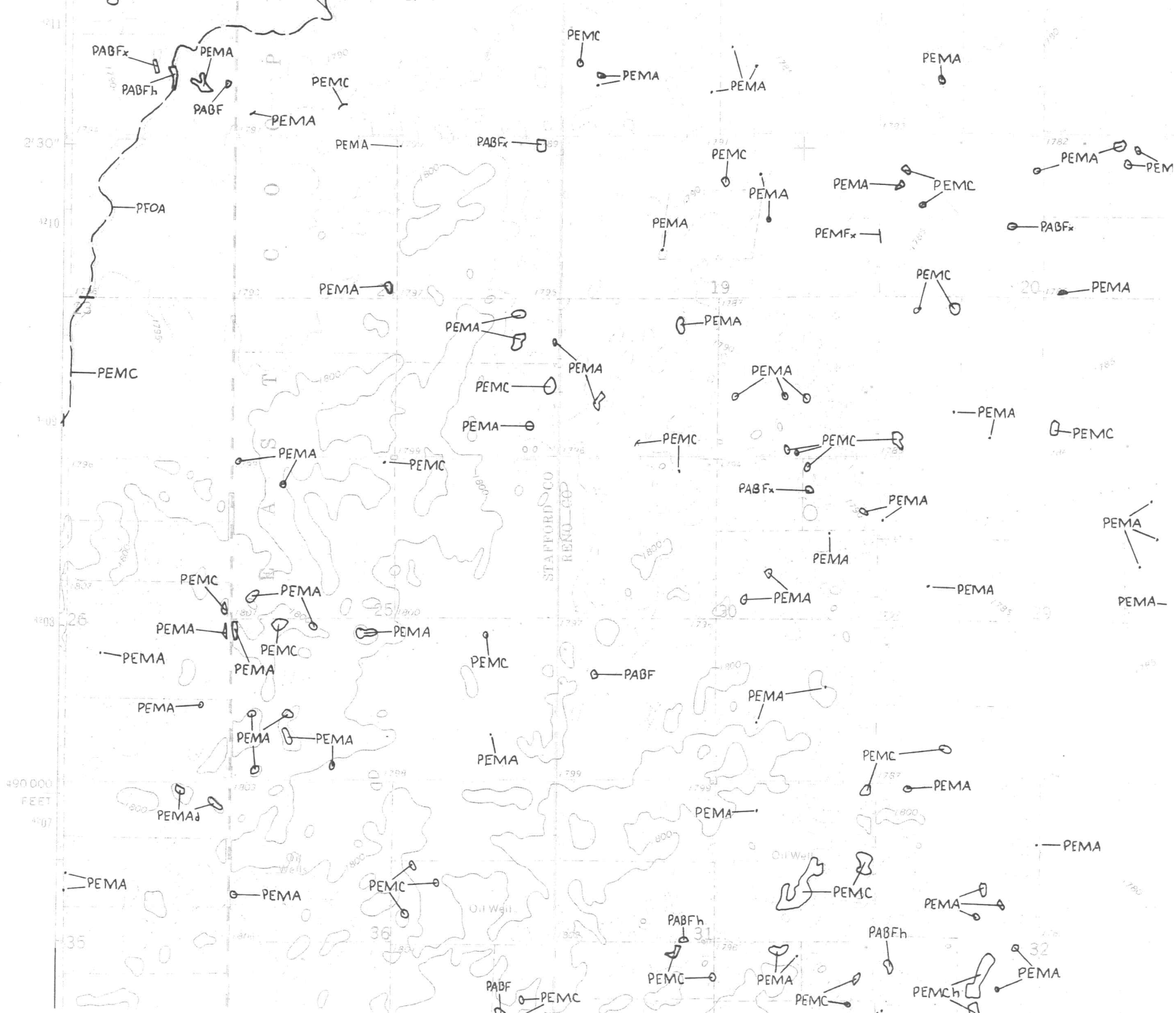
Radio Tower
Oil Wells
Hayes Cem

Left side
3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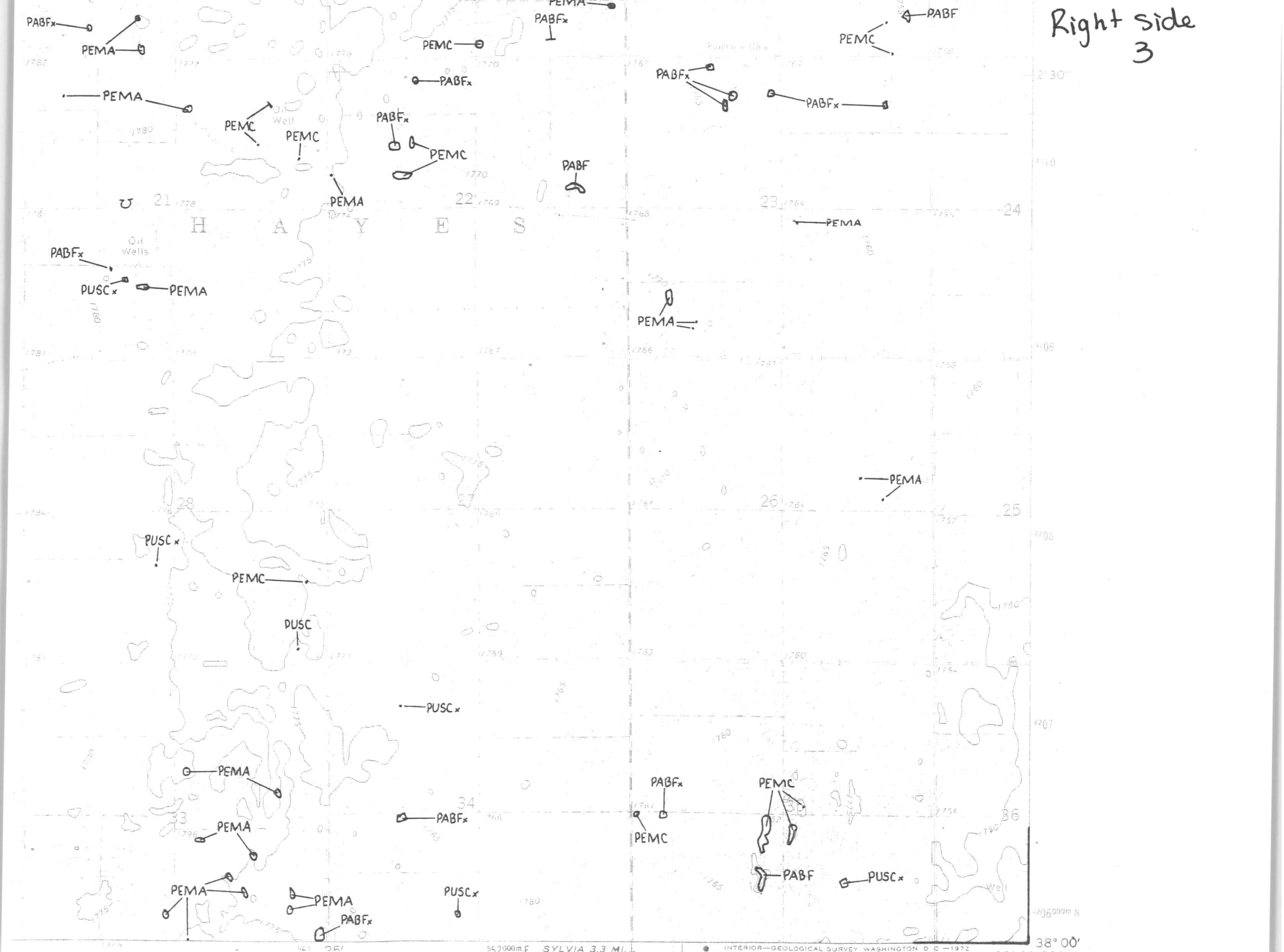
PEMCh
STAFFORD CO
RENO CO
PEMAd
Oil Well
490 000
FEET


Right side
3
PABF
PEMA
PEMC
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H A Y E S
Oil Wells
Well
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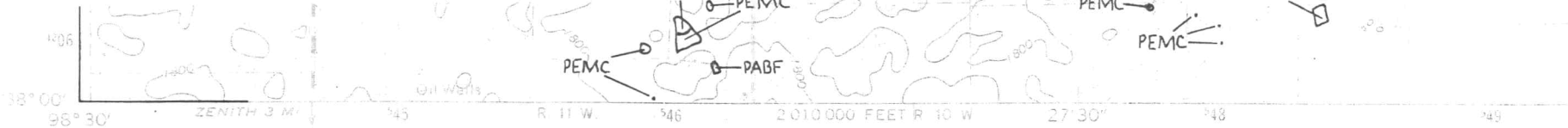
36
SYLVIA 3.3 MI.
38° 00'

Left Side
4



GREAT BEND SE
GREAT BEND

SCALE 1 24 000

1 MILE
7000 FEET
1 KILOMETER

1 acre

10 acres

20 acres

ACREAGE GUIDE

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U.S. Fish and Wildlife Service
P.O. Box 2548, Denver Federal Center
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SYMBOLO

U — Primari
unclass
photo-i

SYSTEM	M — MARINE											
SUBSYSTEM	1 — SUBTIDAL					2 — INTERTIDAL				1 — S		
CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm		1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	

SYSTEM	R — RIVERINE				
SUBSYSTEM	1 — TIDAL	2 — LOWER PERENNIAL	3 — UPPER PERENNIAL	4 — INTERMITTENT	5 — UNKNOWN PERENNIAL

LITTLE SALT MARSH, KANS.

Right side
4

AMPLE

SYSTEM
SUBSYSTEM
CLASS
L2EM2F
SUBCLASS, WATER REGIME

UPLAND (NON-WETLAND)

R2OWH
(NEAR DEEPWATER HABITAT)

esents **upland** areas, but may include
etlands such as man-modified areas, non
ble areas and/or unintentional omissions.

NOTES TO THE USER

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U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory

AERIAL PHOTOGRAPHY

DATE:	9 / 81	DATE:	6 / 85
SCALE:	1:58 000	SCALE:	1:58 000
TYPE:	CIR	TYPE:	CIR

E — ESTUARINE — SYSTEM

AL — SUBSYSTEM

QUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
1 Vascular ig Vascular *wn Submergent* *wn Surface*	2 Mollusc 3 Worm	

2 — INTERTIDAL — SUBSYSTEM

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	CLASS Subclass

L — LACUSTRINE — SYSTEM

.IMNETIC — SUBSYSTEM

)LIDATED	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*
	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

2 — LITTORAL — SUBSYSTEM

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*	
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent		CLASS Subclass

Left side
5

SUBSYSTEM — 1 — SUBTIDAL

CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm	

CLASS	AB — AQUATIC BED	RF — REEF	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE
Subclass	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SYSTEM — R — RIVERINE

SUBSYSTEM — 1 — TIDAL | 2 — LOWER PERENNIAL | 3 — UPPER PERENNIAL | 4 — INTERMITTENT | 5 — UNKNOWN PERENNIAL

CLASS	RB — ROCK	UB — UNCONSOLIDATED BOTTOM	*SB — STREAMBED	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	**EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

CLASS	RB — ROCK BOTTOM	UB —
Subclass	1 Bedrock 2 Rubble	1 Cob 2 San 3 Mu 4 Org

*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS.

SYSTEM — P — PALUSTRINE

CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	US — UNCONSOLIDATED SHORE	ML — MOSS-LICHEN	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	OW — *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	

A Temporarily Floo
B Saturated
C Seasonally Flood
D *Seasonally Flood Well Drained*
E *Seasonally Flood Saturated*
F Semipermanenth
G Intermittently Ex

Right side
5

AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	
1 Algal	2 Mollusc		1 Algal	2 Mollusc	1 Cobble-Gravel	1 Bedrock	1 Cobble-Gravel	1 Persistent	1 Broad-Leaved Deciduous	1 Broad-Leaved Deciduous	**CLASS**
3 Rooted Vascular	3 Worm		3 Rooted Vascular	3 Worm	2 Sand	2 Rubble	2 Sand	2 Nonpersistent	2 Needle-Leaved Deciduous	2 Needle-Leaved Deciduous	
4 Floating Vascular			4 Floating Vascular		3 Mud		3 Mud		3 Broad-Leaved Evergreen	3 Broad-Leaved Evergreen	
5 *Unknown Submergent*			5 *Unknown Submergent*		4 Organic		4 Organic		4 Needle-Leaved Evergreen	4 Needle-Leaved Evergreen	**Subclass**
6 *Unknown Surface*			6 *Unknown Surface*						5 Dead	5 Dead	
									6 *Deciduous*	6 *Deciduous*	
									7 *Evergreen*	7 *Evergreen*	

L — LACUSTRINE — **SYSTEM**

1 — LIMNETIC — **SUBSYSTEM**

NCONSOLIDATED OTTOM	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*	
-Gravel	1 Algal		1 Bedrock	1 Cobble-Gravel	1 Algal	1 Bedrock	1 Cobble-Gravel	2 Nonpersistent		**CLASS**
ic	2 Aquatic Moss		2 Rubble	2 Sand	2 Aquatic Moss	2 Rubble	2 Sand			
	3 Rooted Vascular			3 Mud	3 Rooted Vascular		3 Mud			
	4 Floating Vascular			4 Organic	4 Floating Vascular		4 Organic			**Subclass**
	5 *Unknown Submergent*				5 *Unknown Submergent*		5 Vegetated			
	6 *Unknown Surface*				6 *Unknown Surface*					

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent-Tidal
- *V Permanent-Tidal
- U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

1 Hyperhaline
2 Euhaline
3 Mixohaline *(Brackish)*
4 Polyhaline
5 Mesohaline
6 Oligohaline
0 Fresh

Inland Salinity

7 Hypersaline
8 Eusaline
9 Mixosaline
0 Fresh

pH Modifiers for all Fresh Water

a Acid
t Circumneutral
i Alkaline

SOIL

g Organic
n Mineral

SPECIAL MODIFIERS

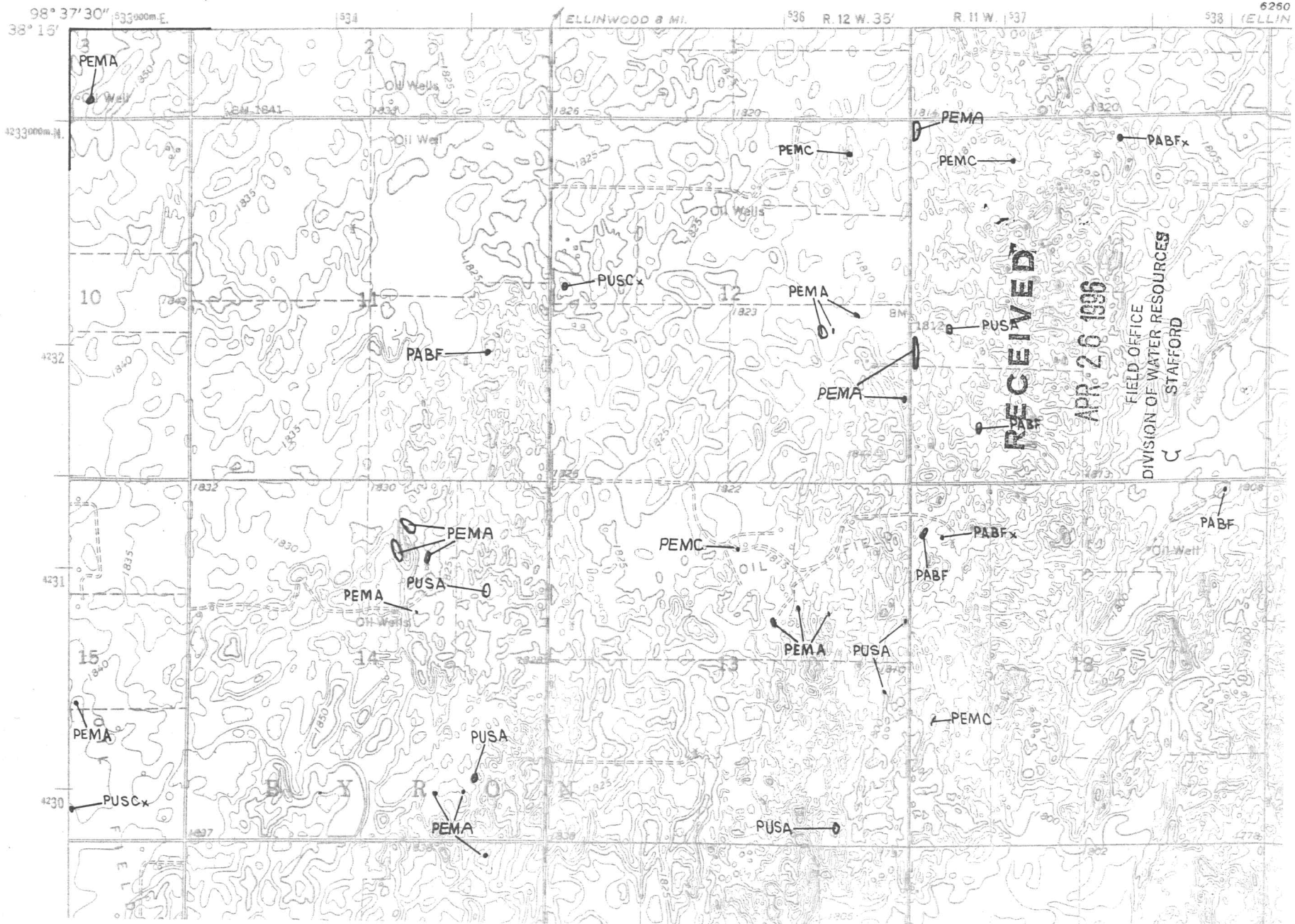
- b *Beaver*
- d *Partially Drained/Ditched*
- f Farmed
- h *Diked/Impounded*
- r Artificial Substrate
- s *Spoil*
- x Excavated

Left Side
1

NATIONAL WETLANI

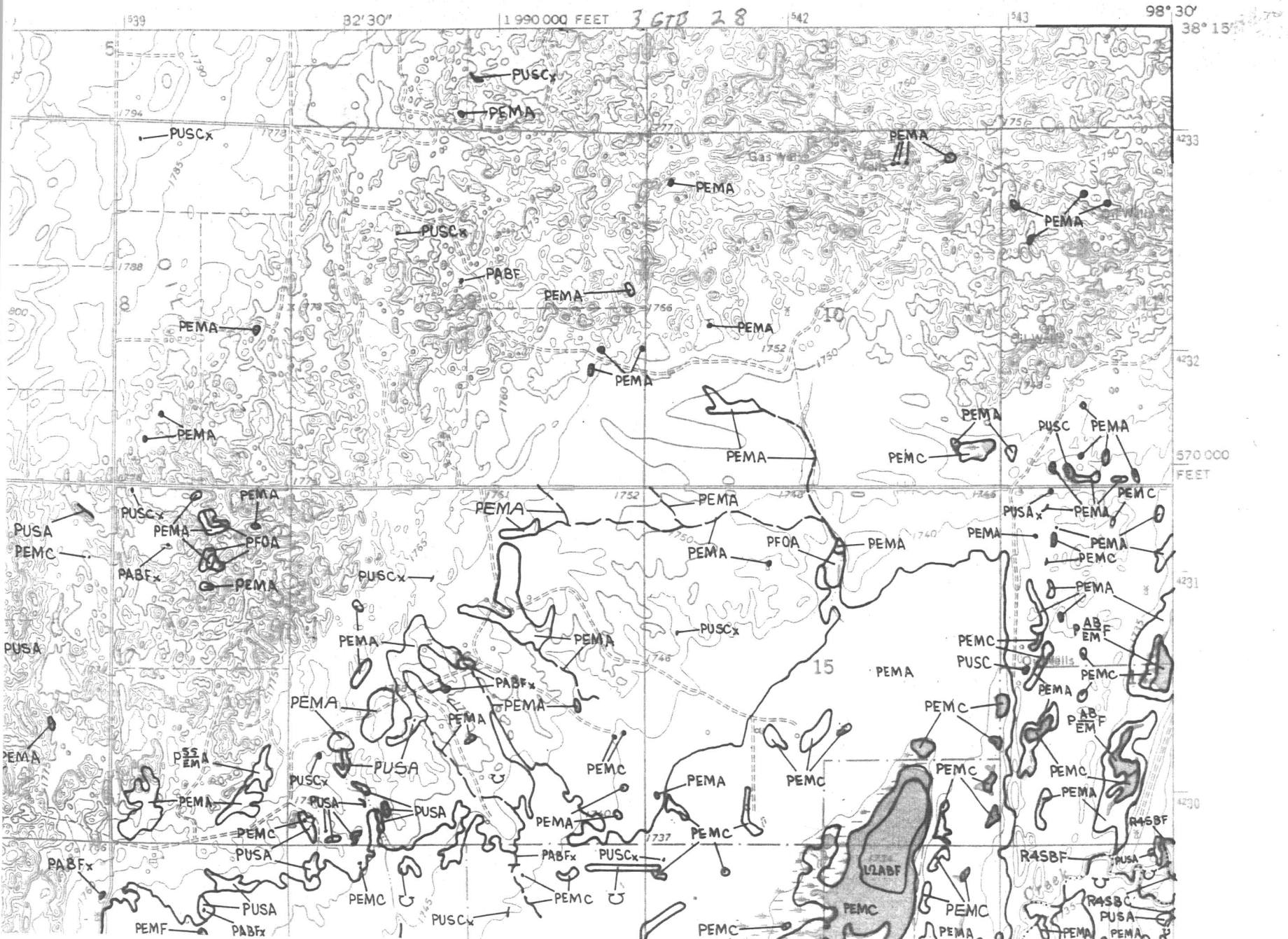
UNITED STATES DEPARTMEN

BIG SALT MARSH, KANS.

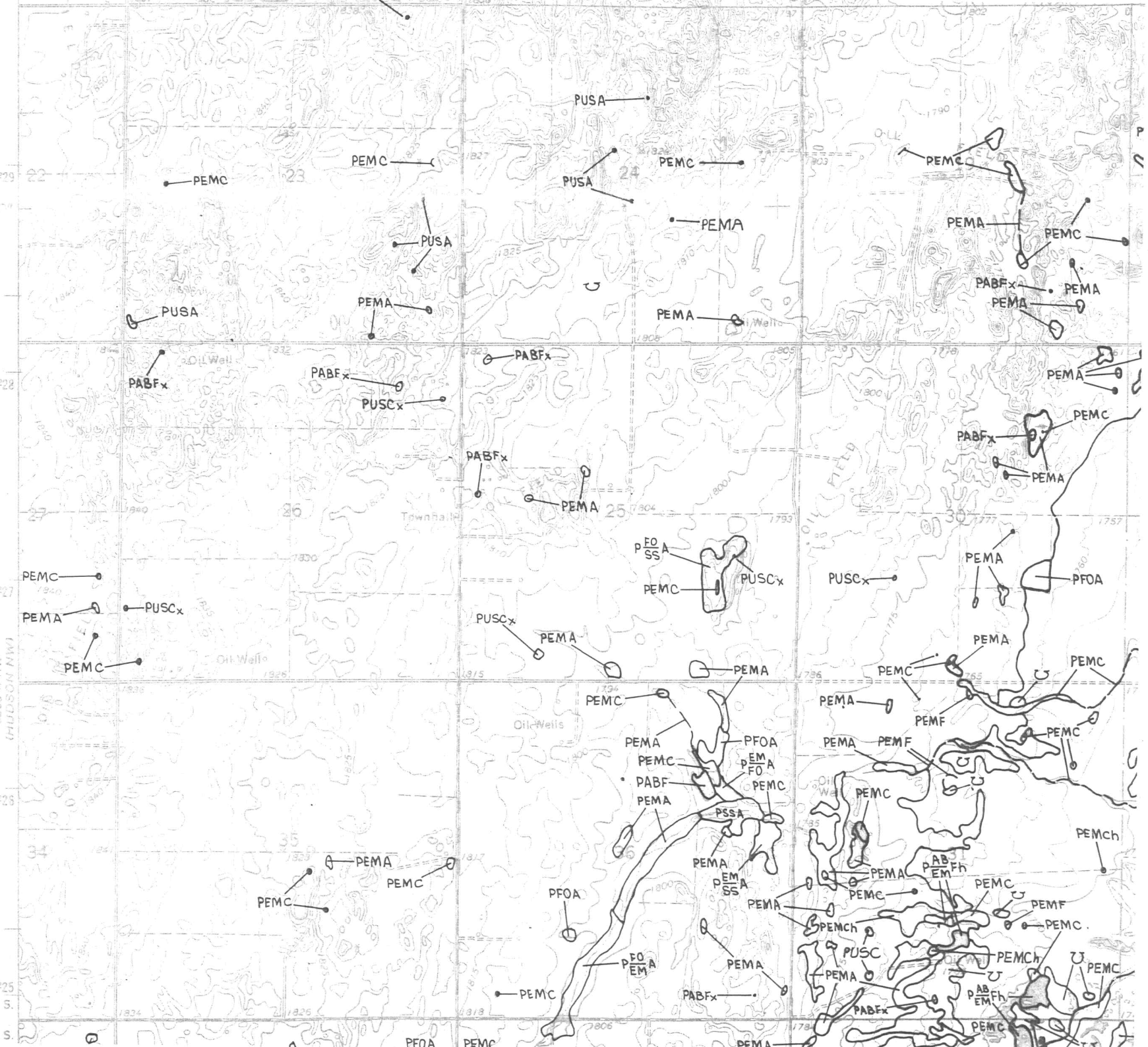


INVENTORY
OF THE INTERIOR

Right side
1



Left side
2


PUSA
PEMC
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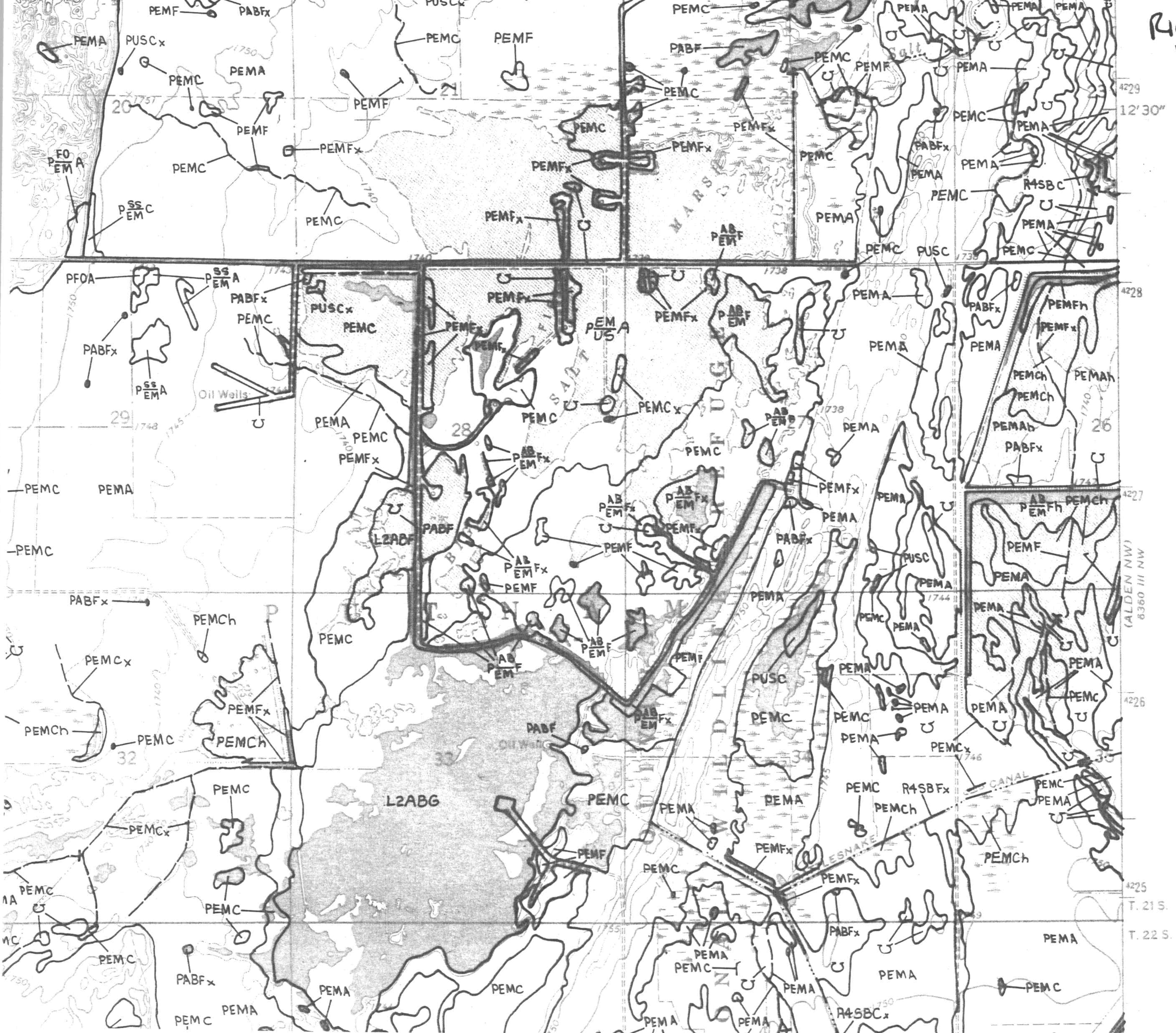
PEMCh
PSSA
PABF
T. 21 S.
T. 22 S.

Right side
2



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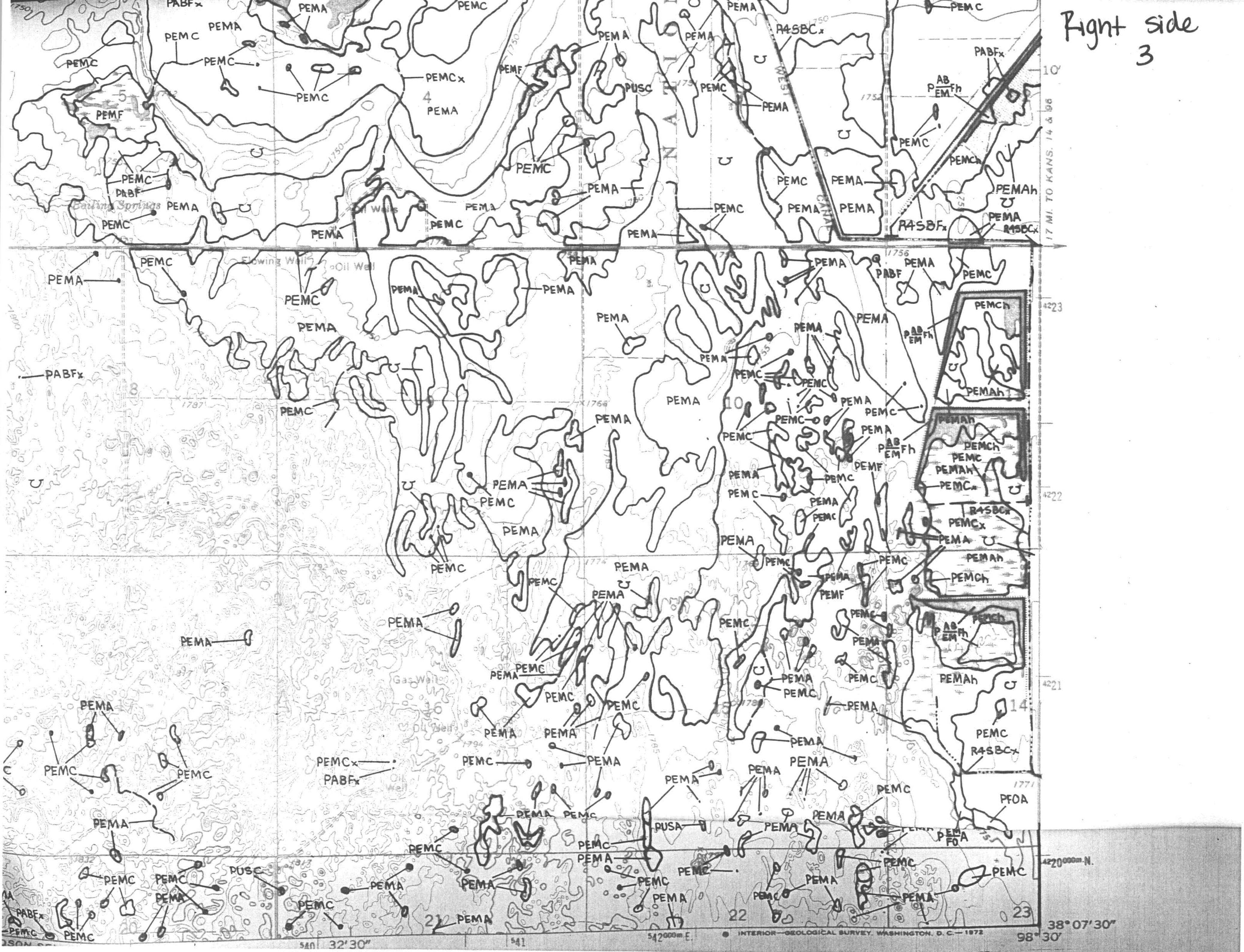
PUSCx
PEMFh
PEMFx
PEMCh
PEMAh
PABF
L2ABF
L2ABG
PUSC
R4SBC
R4SBFx
R4SBCx
SALT
MARSH
Oil Wells
CANAL
12'30"
(ALDEN NW)
T. 21 S.
T. 22 S.
20
21
28
29
26
32
33
34

Left side
3

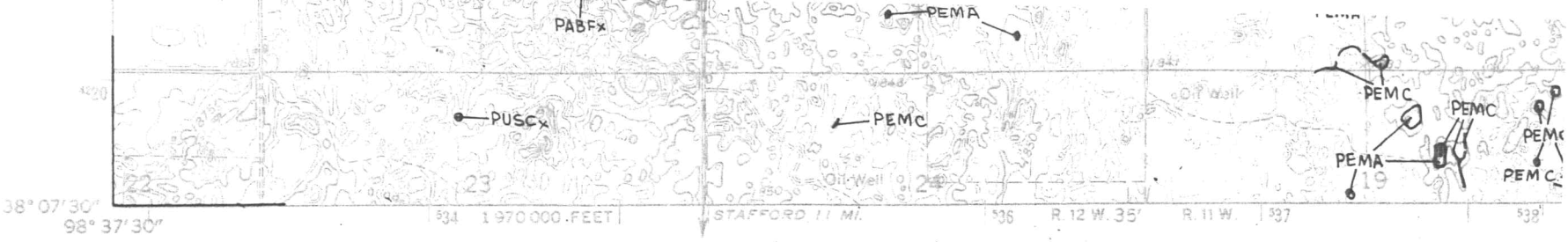

T. 21 S.
T. 22 S.
PABFx
PEMA
PEMC
PFOA
PUSAx
PUSA
PUSC
PABF
PABFh
PEMCh
PEMF
PEI
PUSCx
Substation
Oil Well
Oil Wells
Flowing Well
BM 1939
H A Y E S
540 000 FEET
10'
4224
4222
4221

Right side
3



PEMA
PEMC
PEMCx
PEMF
PABF
PABFx
PUSC
PUSA
PEMAh
PEMCh
R4SBCx
R4SBFx
PFOA
Boiling Springs
Flowing Well
Oil Well
Oil Wells
Gas Well
17 MI. TO KANS. 14 & 96
4220000m N.
542000m E.
32'30"
38°07'30"
98°30'
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1972

Left side
4



GREAT BEND SE
GREAT BEND

SCALE 1 24 000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

☐ 1 acre

10 acres

20 acres

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SYMBC

U — Pr
un
ph

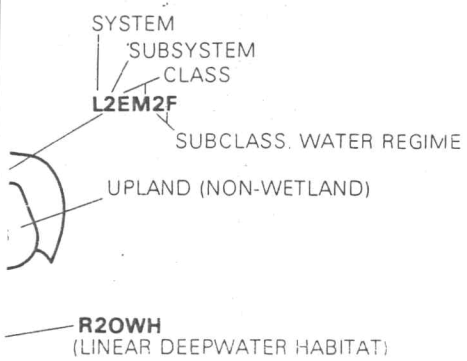
SYSTEM — M — MARINE

SUBSYSTEM	1 — SUBTIDAL					2 — INTERTIDAL				1
CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	RB — ROCK BOTTOM	UB — UNCONSO BOTTOM
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm		1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

BIG SALT MARSH, KANS.

Right side
4

iY EXAMPLE



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U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory

AERIAL PHOTOGRAPHY

DATE:	9 / / 81	/ /
SCALE:	1:58 000	
TYPE:	CIR	

y represents **upland** areas, but may include ified wetlands such as man-modified areas, non dentifiable areas and/or unintentional omissions.

E — ESTUARINE — SYSTEM

UBTIDAL — SUBSYSTEM

) AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	

2 — INTERTIDAL — SUBSYSTEM

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*

CLASS

Subclass

L — LACUSTRINE — SYSTEM

1 — LIMNETIC — SUBSYSTEM

— UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*
obble-Gravel and ud rganic	1 Algal Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

2 — LITTORAL — SUBSYSTEM

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

CLASS

Subclass

Left side

5

SYSTEM: M — MARINE

SUBSYSTEM: 1 — SUBTIDAL

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB — AQUATIC BED	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*
RF — REEF	1 Coral 3 Worm
OW — *OPEN WATER/ Unknown Bottom*	

SUBSYSTEM: 2 — INTERTIDAL

CLASS	Subclass
AB — AQUATIC BED	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*
RF — REEF	1 Coral 3 Worm
RS — ROCKY SHORE	1 Bedrock 2 Rubble
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

1

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSC BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SYSTEM: R — RIVERINE

SUBSYSTEM: 1 — TIDAL

CLASS	Subclass
RB — ROCK	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
*SB — STREAMBED	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated
AB — AQUATIC BED	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*
RS — ROCKY SHORE	1 Bedrock 2 Rubble
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
**EM — EMERGENT	2 Nonpersistent
OW — *OPEN WATER/ Unknown Bottom*	

SUBSYSTEM: 2 — LOWER PERENNIAL

SUBSYSTEM: 3 — UPPER PERENNIAL

SUBSYSTEM: 4 — INTERMITTENT

SUBSYSTEM: 5 — UNKNOWN PERENNIAL

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble

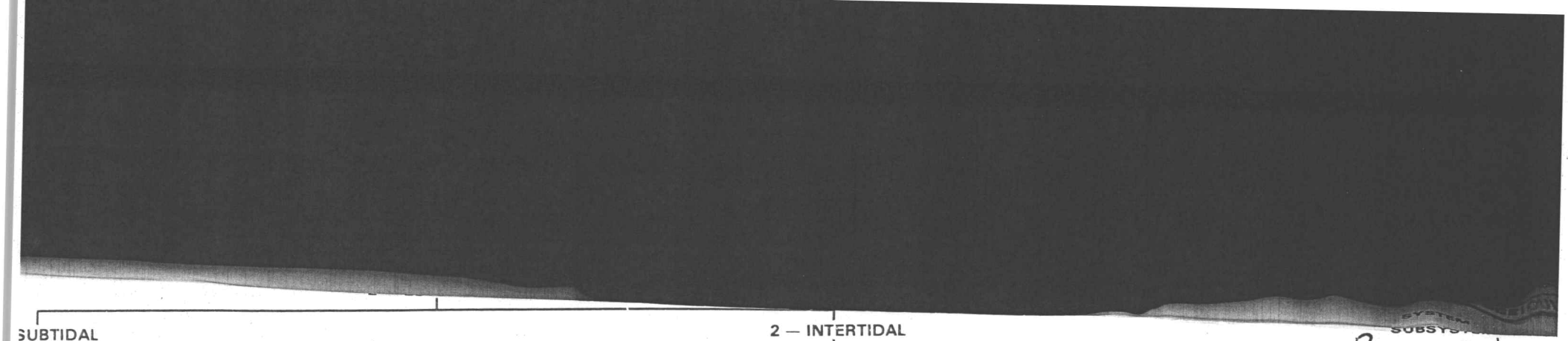
*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS

SYSTEM: P — PALUSTRINE

CLASS	Subclass
RB — ROCK BOTTOM	1 Bedrock 2 Rubble
UB — UNCONSOLIDATED BOTTOM	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic
AB — AQUATIC BED	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*
US — UNCONSOLIDATED SHORE	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
ML — MOSS-LICHEN	1 Moss 2 Lichen
EM — EMERGENT	1 Persistent 2 Nonpersistent
SS — SCRUB-SHRUB	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*
FO — FORESTED	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*
OW — *OPEN WATER/ Unknown Bottom*	

A Temp
B Satur
C Seasc
D Seasc *Well-L*
E Seasc *Satur*
F Semi
G Interr



SUBTIDAL

ED | AB — AQUATIC BED | RF — REEF | OW — *OPEN WATER/ Unknown Bottom*

AB — AQUATIC BED:
1 Algal
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RF — REEF:
2 Mollusc
3 Worm

2 — INTERTIDAL

AB — AQUATIC BED:
1 Algal
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RF — REEF:
2 Mollusc
3 Worm

SB — STREAMBED:
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

RS — ROCKY SHORE:
1 Bedrock
2 Rubble

US — UNCONSOLIDATED SHORE:
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

EM — EMERGENT:
1 Persistent
2 Nonpersistent

SS — SCRUB-SHRUB:
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

FO — FORESTED:
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

SUBSYS... CLASS — Right Side 5

Subclass

SYSTEM

L — LACUSTRINE

1 — LIMNETIC

— UNCONSOLIDATED BOTTOM:
Cobble-Gravel
Sand
Mud
Organic

AB — AQUATIC BED:
1 Algal
Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

OW — *OPEN WATER/ Unknown Bottom*

2 — LITTORAL

RB — ROCK BOTTOM:
1 Bedrock
2 Rubble

UB — UNCONSOLIDATED BOTTOM:
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

AB — AQUATIC BED:
1 Algal
2 Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RS — ROCKY SHORE:
1 Bedrock
2 Rubble

US — UNCONSOLIDATED SHORE:
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
5 Vegetated

EM — EMERGENT:
2 Nonpersistent

OW — *OPEN WATER/ Unknown Bottom*

SUBSYSTEM

CLASS

Subclass

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

looded
ooded
ooded/
ooded/
ntly Flooded
Exposed

H Permanently Flooded
J Intermittently Flooded
K Artificially Flooded
W Intermittently Flooded/Temporary
Y Saturated/Semipermanent/ Seasonal
Z Intermittently Exposed/Permanent
U *Unknown*

Tidal

K *Artificially Flooded*
L Subtidal
M Irregularly Exposed
N Regularly Flooded
P Irregularly Flooded
*S Temporary-Tidal
*R Seasonal-Tidal
*T Semipermanent-Tidal
*V Permanent-Tidal
U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

1 Hyperhaline
2 Euhaline
3 Mixohaline *(Brackish)*
4 Polyhaline
5 Mesohaline
6 Oligohaline
0 Fresh

Inland Salinity

7 Hypersaline
8 Eusaline
9 Mixosaline
0 Fresh

pH Modifiers for all Fresh Water

a Acid
t Circumneutral
i Alkaline

SOIL

g Organic
n Mineral

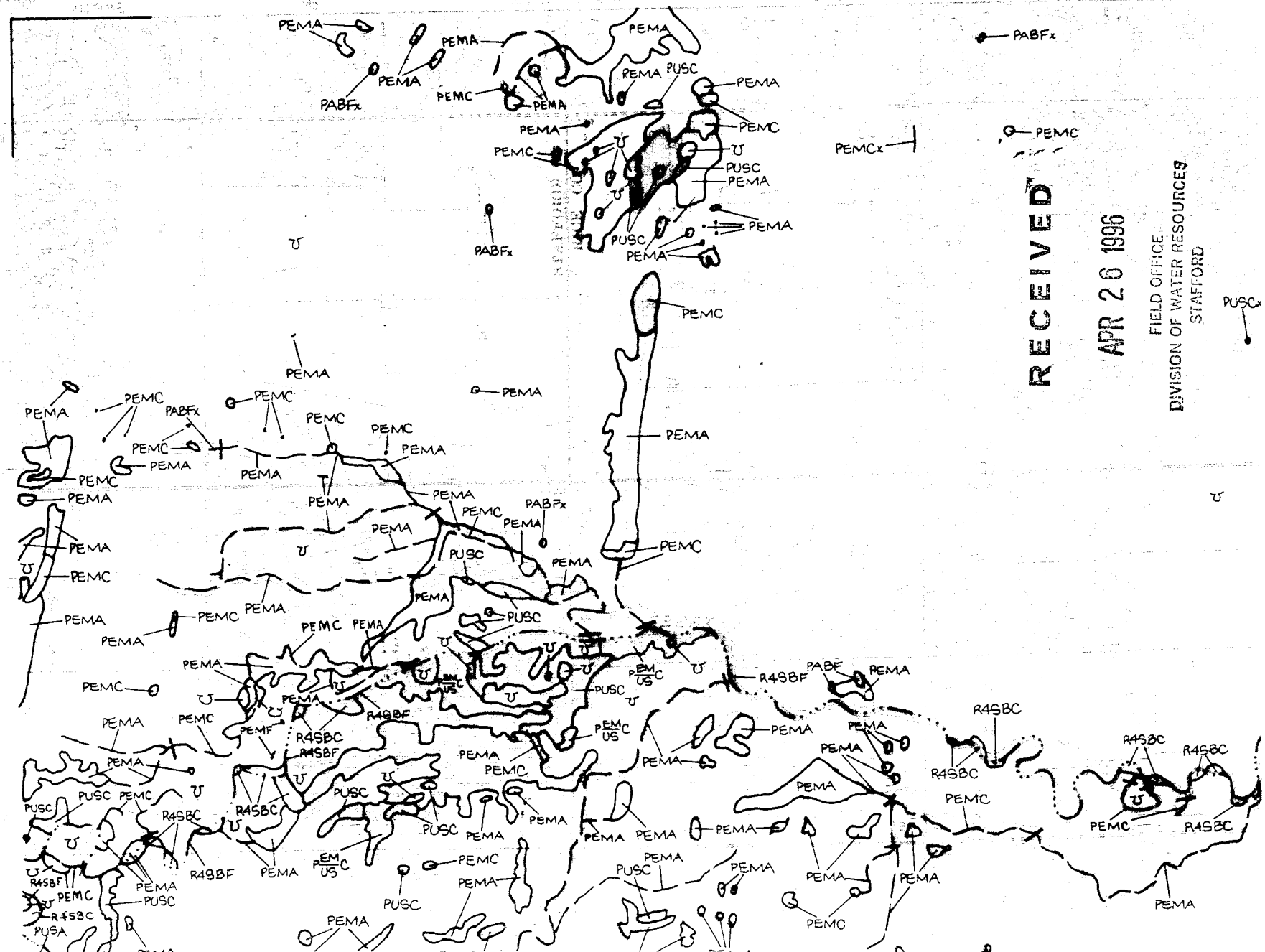
SPECIAL MODIFIERS

b *Beaver*
d *Partially Drained/Ditched*
f Farmed
h *Diked/Impounded*
r Artificial Substrate
s *Spoil*
x Excavated

left side
1

NATIONAL WETLAN
UNITED STATES DEPARTME

ALDEN NW, KANS



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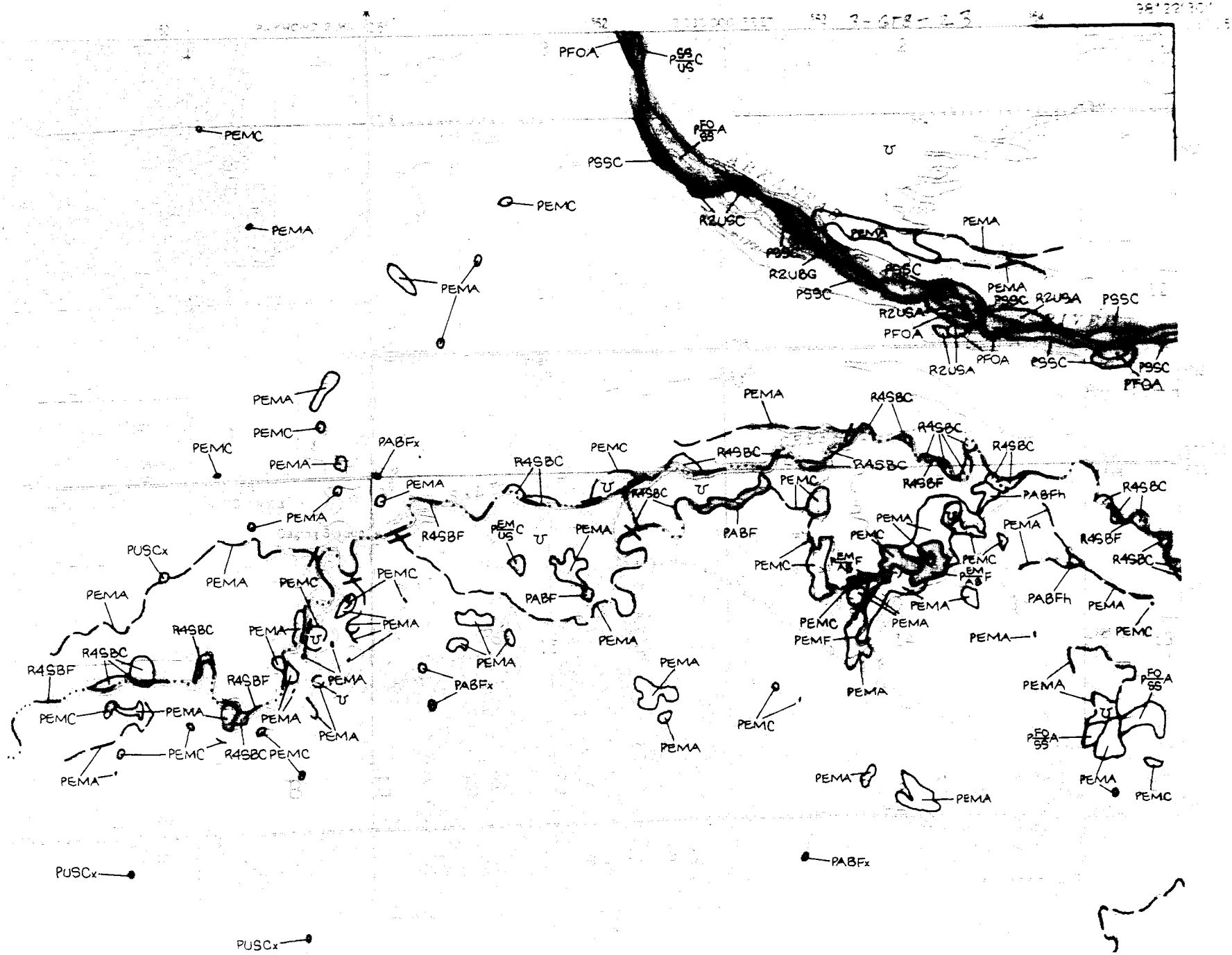
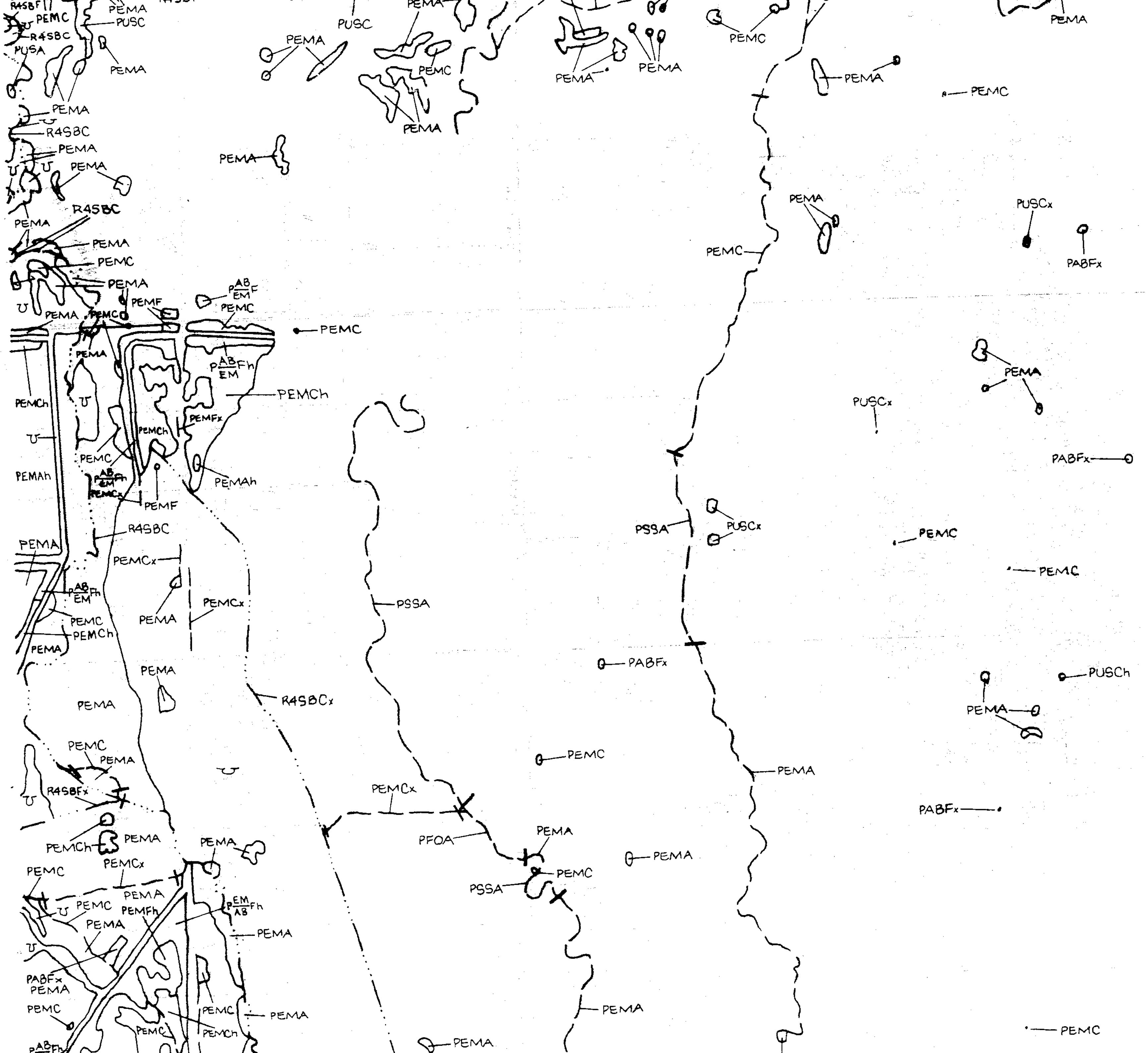
Right side
1



Left side
2



R4SBF
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PUSC
R4SBC
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PEMA
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R4SBC
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P$\frac{AB}{EM}$F
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P$\frac{AB}{EM}$Fh
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PEMCh
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PEMCh
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R4SBC
PEMA
PEMCx
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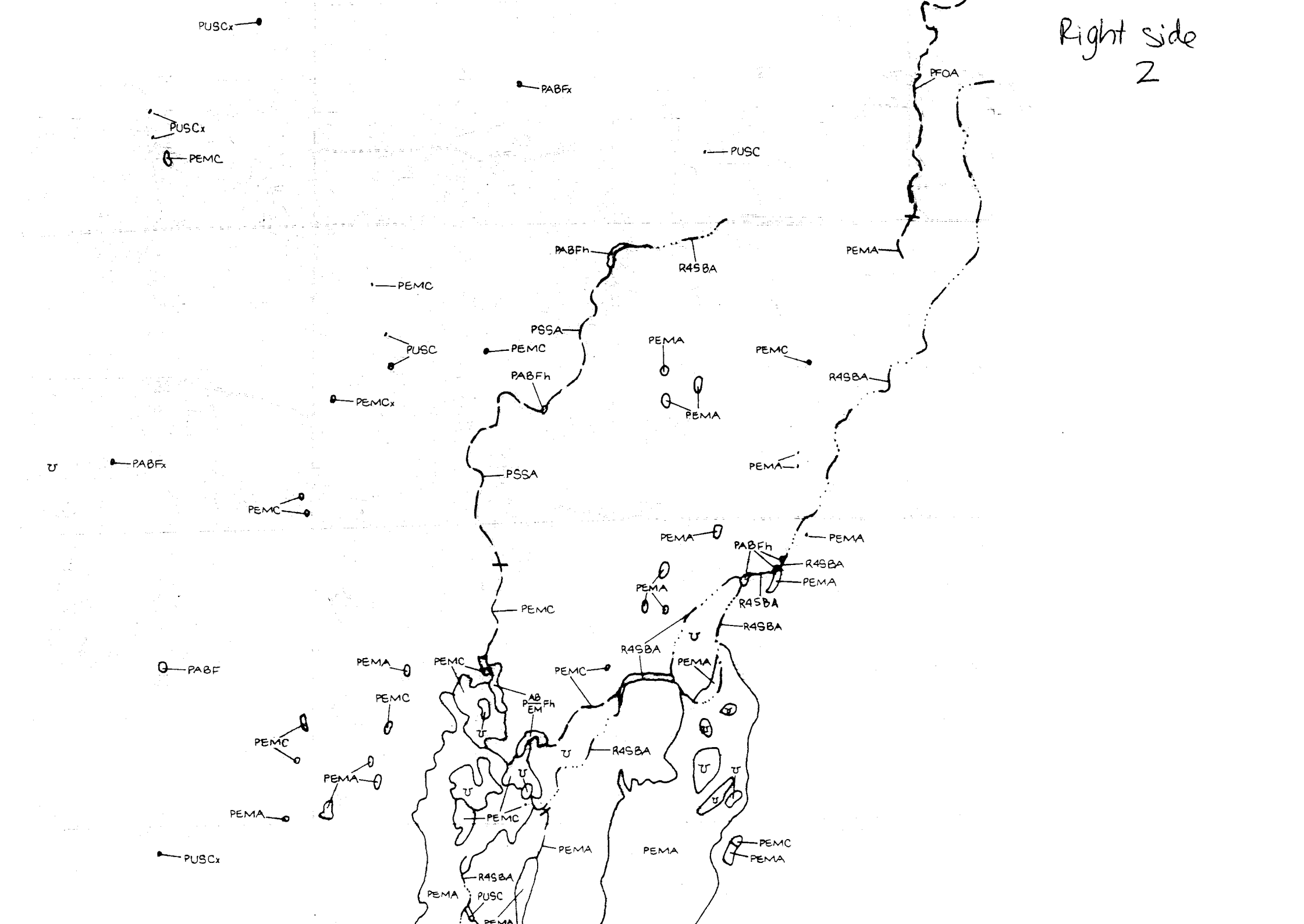
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2
PUSCx
PABFx
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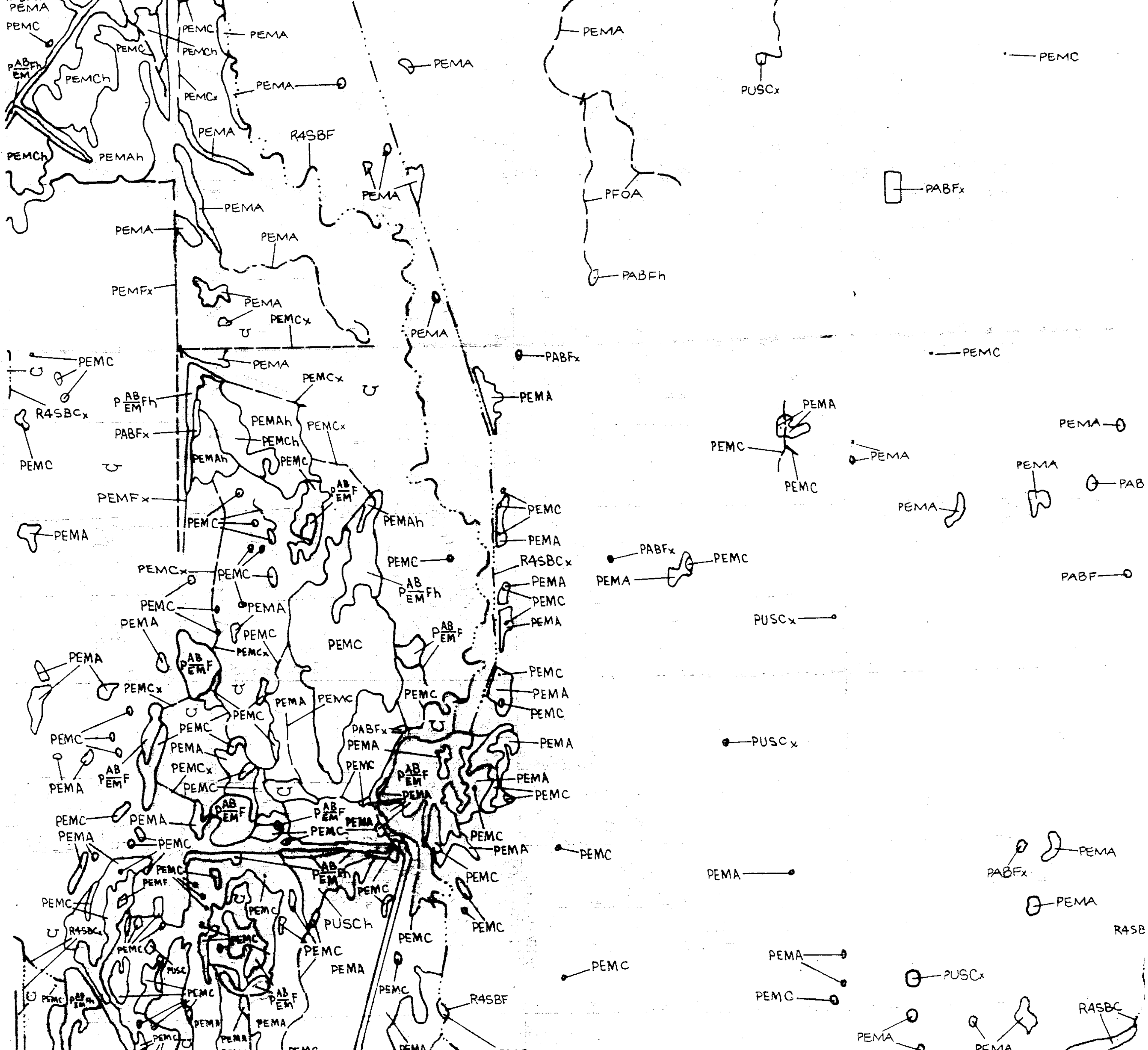
left side
3



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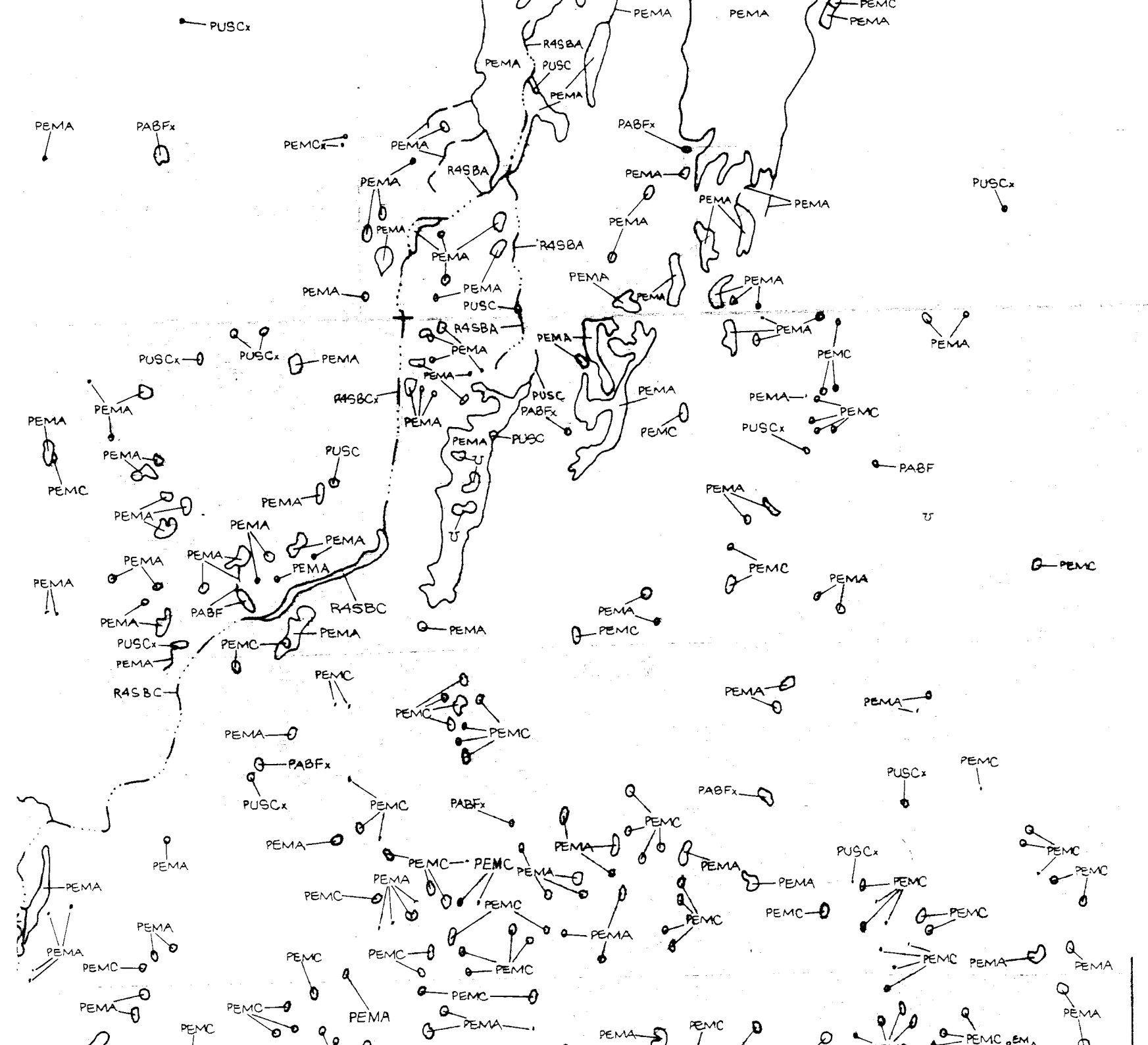
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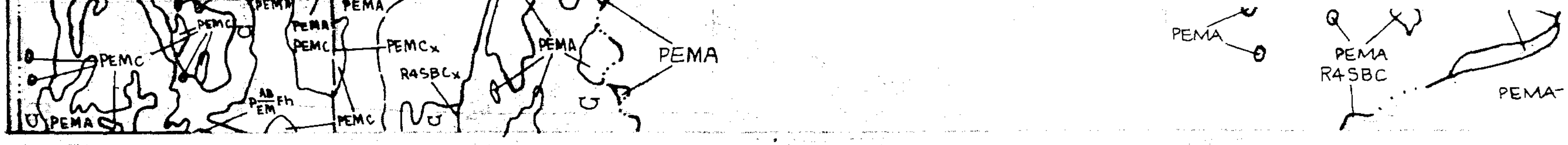
left side
4



GREAT BEND SE
GREAT BEND

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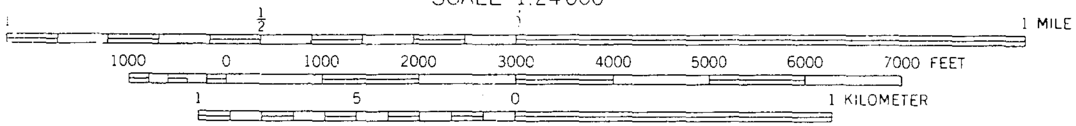


☐ 1 acre ☐ 10 acres ☐ 20 acres

ACREAGE GUIDE

Other information including a narrative report concerning the wetland resources depicted on this document may be available. For information, contact:

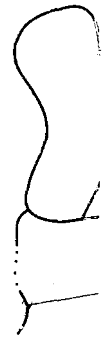
Regional Director (ARDE) Region VI
U.S. Fish and Wildlife Service
P.O. Box 2548, Denver Federal Center
Denver, Colorado 80225

SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.**

SYMBO



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SYSTEM — **M — MARINE**

SUBSYSTEM — **1 - SUBTIDAL** | **2 — INTERTIDAL** | **1 -**

CLASS

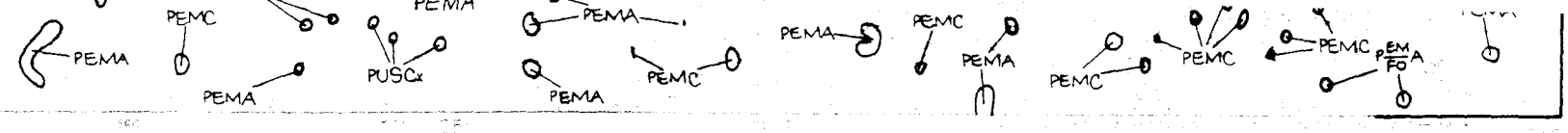
1 - SUBTIDAL:
- RB — ROCK BOTTOM — 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM — 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- AB — AQUATIC BED — 1 Algal, 3 Rooted Vascular, 5 *Unknown Submergent*
- RF — REEF — 1 Coral, 3 Worm
- OW — *OPEN WATER/ Unknown Bottom*

2 — INTERTIDAL:
- AB — AQUATIC BED — 1 Algal, 3 Rooted Vascular, 5 *Unknown Submergent*
- RF — REEF — 1 Coral, 3 Worm
- RS — ROCKY SHORE — 1 Bedrock, 2 Rubble
- US — UNCONSOLIDATED SHORE — 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic

1 -:
- RB — ROCK BOTTOM — 1 Bedrock, 2 Rubble
- UB — UNCONSOLID BOTTOM — 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic

Subclass

SYSTEM — **R — RIVERINE**



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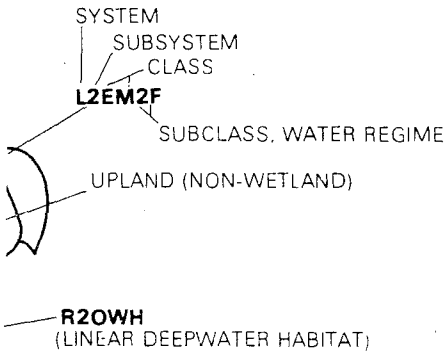

represents **upland** areas, but may include
ed wetlands such as man-modified areas, non
ntifiable areas and/or unintentional omissions.

NOTES TO THE USER

- Wetlands which have been field examined are indicated on the map by an asterisk (*).
- Additions or corrections to the wetlands information displayed on this map are solicited. Please forward such information to the address indicated.
- Subsystems, Classes, Subclasses, and Water Regimes in *Italics* were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach/Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

AERIAL PHOTOGRAPHY

DATE:	9 / 81	DATE: / /
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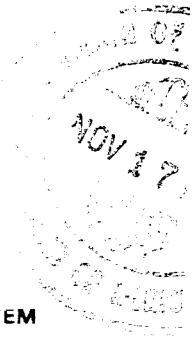
U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory



E — ESTUARINE — **SYSTEM**

3TIDAL

AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
1 Algal	2 Mollusc	
3 Rooted Vascular	3 Worm	
4 Floating Vascular		
5 *Unknown Submergent*		
6 *Unknown Surface*		

2 — INTERTIDAL — **SUBSYSTEM**

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	**CLASS**
1 Algal	2 Mollusc	1 Cobble-Gravel	1 Bedrock	1 Cobble-Gravel	1 Persistent	1 Broad-Leaved Deciduous	1 Broad-Leaved Deciduous	**Subclass**
3 Rooted Vascular	3 Worm	2 Sand	2 Rubble	2 Sand	2 Nonpersistent	2 Needle-Leaved Deciduous	2 Needle-Leaved Deciduous	
4 Floating Vascular		3 Mud		3 Mud		3 Broad-Leaved Evergreen	3 Broad-Leaved Evergreen	
5 *Unknown Submergent*		4 Organic		4 Organic		4 Needle-Leaved Evergreen	4 Needle-Leaved Evergreen	
6 *Unknown Surface*						5 Dead	5 Dead	
						6 *Deciduous*	6 *Deciduous*	
						7 *Evergreen*	7 *Evergreen*	

L — LACUSTRINE — **SYSTEM**

1 — LIMNETIC — **2 — LITTORAL** — **SUBSYSTEM**

left side
5

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U.S. Fish and Wildlife Service
P.O. Box 2548, Denver Federal Center
Denver, Colorado 80225

obscured by dense forest cover may not be included on this document.

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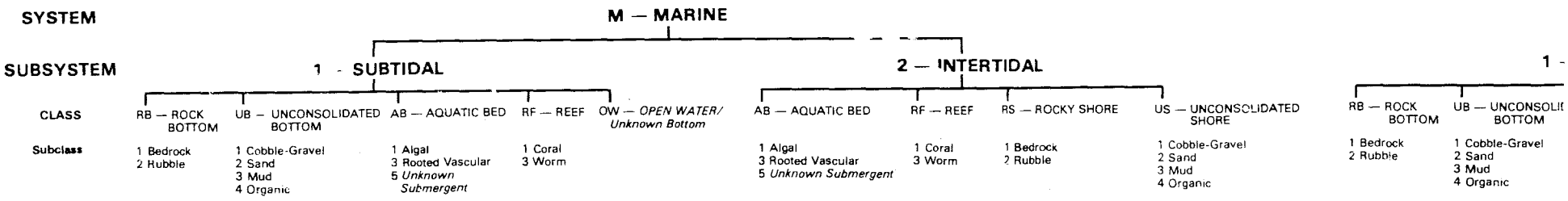
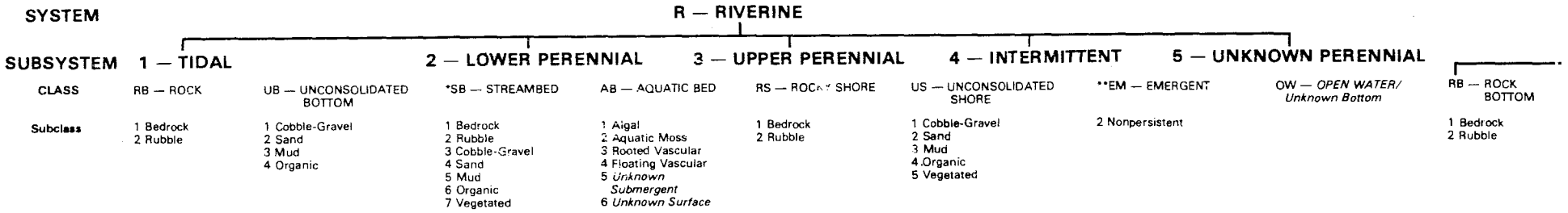
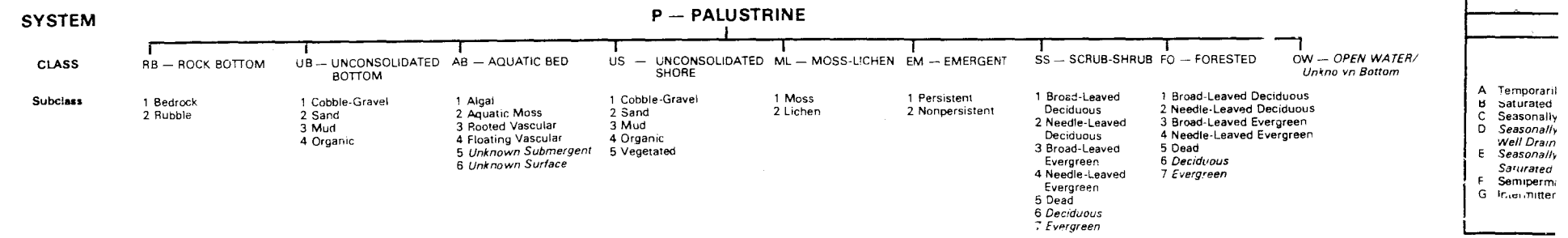




*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS.



Prepared by National Wetlands ...

AERIAL PHOTOGRAPHY

presents **upland** areas, but may include wetlands such as man-modified areas, non liable areas and/or unintentional omissions.

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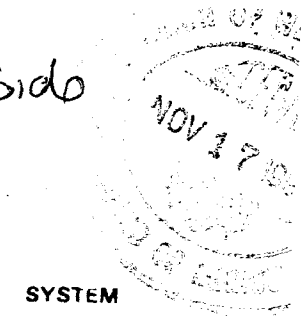


E — ESTUARINE

IDAL

— AQUATIC BED
Algal
Rooted Vascular
Floating Vascular
Unknown Submergent
Unknown Surface

RF — REEF
2 Mollusc
3 Worm

OW — *OPEN WATER/ Unknown Bottom*

2 — INTERTIDAL

AB — AQUATIC BED
1 Algal
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RF — REEF
2 Mollusc
3 Worm

SB — STREAMBED
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

RS — ROCKY SHORE
1 Bedrock
2 Rubble

US UNCONSOLIDATED SHORE
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

EM — EMERGENT
1 Persistent
2 Nonpersistent

SS — SCRUB-SHRUB
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

FO — FORESTED
1 Broad-Leaved Deciduous
2 Needle-Leaved Deciduous
3 Broad-Leaved Evergreen
4 Needle-Leaved Evergreen
5 Dead
6 *Deciduous*
7 *Evergreen*

SYSTEM
SUBSYSTEM
CLASS
Subclass

L — LACUSTRINE

— LIMNETIC

CONSOLIDATED TTOM
Gravel
c

AB — AQUATIC BED
1 Algal
2 Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

OW — *OPEN WATER/ Unknown Bottom*

2 — LITTORAL

RB — ROCK BOTTOM
1 Bedrock
2 Rubble

UB — UNCONSOLIDATED BOTTOM
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic

AB — AQUATIC BED
1 Algal
2 Aquatic Moss
3 Rooted Vascular
4 Floating Vascular
5 *Unknown Submergent*
6 *Unknown Surface*

RS — ROCKY SHORE
1 Bedrock
2 Rubble

US — UNCONSOLIDATED SHORE
1 Cobble-Gravel
2 Sand
3 Mud
4 Organic
5 Vegetated

EM — EMERGENT
2 Nonpersistent

OW — *OPEN WATER/ Unknown Bottom*

SYSTEM
SUBSYSTEM
CLASS
Subclass

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent-Tidal
- *V *Permanent-Tidal*
- U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems

WATER CHEMISTRY

Coastal Halinity

1 Hyperhaline
2 *Euhaline*
3 Mixohaline *(Brackish)*
4 Polyhaline
5 Mesohaline
6 Oligohaline
0 Fresh

Inland Salinity

7 Hypersaline
8 Eusaline
9 Mixosaline
0 Fresh

pH Modifiers for all Fresh Water

a Acid
t Circumneutral
i Alkaline

SOIL

g Organic
n Mineral

SPECIAL MODIFIERS

- b *Beaver*
- d *Partially Drained/Ditched*
- f Farmed
- h *Diked/Impounded*
- r Artificial Substrate
- s *Spoil*
- x *Excavated*

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

BA/EN
WR KS
Mail Stop 60190

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

NOV 12 1993

David L. Pope, Chief Engineer-Director
Division of Water Resources
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283

Dear Mr. Pope:

The Fish and Wildlife Service (Service) has completed its review of the draft Water Rights Certificate, Permit No. 7571, for the Quivira National Wildlife Refuge, and has a number of concerns about the Division's proposed quantification of this right. I suggest that representatives of the Service and the Division meet to discuss the Quivira water right before any further action is taken. The purpose of this letter is to outline some of the Service's concerns and to suggest that, once you have reviewed this letter, you contact Regional Water Rights Specialist Cheryl Williss, at 303/236-5321, with suggested meeting dates.

Bruce Falk provided the Service with information on how the Department computed 14,587 acre-feet as the amount of water to be certificated. While I agree that the capacity and maintenance requirement for Little Salt Marsh should be part of the total, I do not believe that the only other component should be the maximum annual diversion, which was 10,129.7 acre-feet in 1987.

The highest reported Refuge diversions have occurred when pumping by junior users was adversely impacting available stream flow. The computer model developed by Kansas Geological Survey (KGS) predicts that groundwater pumping depleted stream flow in Rattlesnake Creek by at least 8,456 acre-feet in 1987 (see enclosed copy of FAX from KGS). If that amount of water had been available to Rattlesnake Creek, the Refuge would have beneficially used all or some portion of that water, in addition to the 10,129.7 acre-feet reported as diverted.

The Service filed application No. 7571 for 22,200 acre-feet, which was the estimated amount of water required to maintain the pond and marsh areas on the Refuge. The combined surface area of major Refuge impoundments totals 6,469.6 acres, as surveyed in 1992 (see enclosed table). Using isohyet maps in the Kansas State Board of Agriculture, Division of Water Resources, Administrative Procedure No. 84-1, average annual net evaporation for the Quivira area is 36 to 37 inches. Your office computed evaporative losses from Little Salt Marsh using 36 inches for net evaporation. Using the same number results in a need for 19,409 acre-feet annually to keep all Refuge units at management levels. This figure does not include water to fill any of the impoundments (13,246 acre-feet).

Copy to GFS, CO, MS [illegible] w/o maps

The Refuge diversion records also do not include the water supplied to the Big Salt Marsh from springs. Groundwater inflow to the northwestern corner of the Refuge is substantial, but difficult to quantify.

Another critical habitat not accounted for in diversion records is riparian habitat. By digitizing National Wetland Inventory maps (enclosed), the Service has determined that there are approximately 204 acres of riparian habitat along Rattlesnake Creek. Based on 36 inches of average annual net evaporation, 612 acre-feet of water is needed to maintain this habitat.

The beneficial use would be better described as fish and wildlife, as recreation is a secondary use.

The Service would suggest the following alternative volume figure and language:

> 300 cfs up to 20,021 acre-feet each year. Such quantity can subsequently be stored and accumulated in marsh areas within the Quivira National Wildlife Refuge. Stored water may be carried over year to year, and will not be assessed against the following year's allocation.

The reference to Refuge facilities as they existed in 1987 should be deleted. As long as the Service diverts 20,021 acre-feet of water or less each year, it should have flexibility in how and where that water is managed in order to meet its annual wildlife objectives.

On Page 2, reference to township and range should refer to <u>all</u> diversion points, rather than to <u>both</u>.

The legal description should be corrected on Page 2, paragraph (3), by deleting the NW1/4 of Section 21, Township 21 North, Range 10 West. This land was included within the original Refuge boundary, as proposed, but was not acquired.

On Page 2, paragraph (6), the Service does not object to the language concerning "the reasonable increase or decrease of the stream flow at the point(s) of diversion," to the extent that water is required by senior water users to satisfy their water rights. However, the Service finds disquieting the language used in the cover letter, specifically "[i]t is quite probable that the natural flows of water to the full extent of this right <u>will not</u> be available most normal years. Management plans for the Refuge area should be based on probable flows of Rattlesnake Creek."

Recently published reports by the KGS have established a hydrologic connection between Rattlesnake Creek and the Great Bend Prairie Aquifer. The flow of Rattlesnake Creek appears to be driven by base flow from the Aquifer. The KGS study also indicates a long term decline in static groundwater levels, which is indicative of groundwater mining. I am concerned that the above quoted language could be interpreted as sanctioning a continuation of overpumping of the Aquifer to the detriment of the Refuge water supply.

The Service fully intends to develop a plan which provides for efficient and effective management of the Refuge water supply. Service representatives will also continue to work with your office and other interested parties to develop practical solutions for all affected.

Sincerely,

Acting Regional Director

Enclosures

cc: Bruce Falk
Kansas State Board of Agriculture
Stafford, KS

V01 Note

From: MBF5311 --LSOB03 Date and time 11/08/93 14:08:39
To: DLP3710 --LSOB03 David Pope
cc: WJA3718 --LSOB03 Wayland Anderson GEE2116 --LSOB03 Guy Ellis
LMS7064 --LSOB03 Larry Sheets MAS3718 --LSOB03 Matt Scherer
SVB6864 --LSOB03 Stephen Bond

From: Bfalk
Subject: Quivira

Today I visited with Cheryl Willis of U S Fish and Wildlife Service. The subject of their certificate came up. From what she told me, they will be objecting to our draft certificate. They will be arguing that the certificate should reflect their actual needs rather than the amount used. They will imply that water was not always available when needed due to junior upstream users. So be prepared!

END OF NOTE

Command ===>
F1=Help F2=File F3=Exit F4=Discard F5=Route F6=Reply F7=Backward
F8=Forward F9=Keep F10=Resend F11=Print F12=Cancel

Kansas Geological Survey

1930 Constant Avenue--Campus West
The University of Kansas
Lawrence, KS 66047

Phone: (913) 864-3965
FAX: (913) 864-5317

To MEGAN ESTEP-JOHNSTON
U.S. FISH & WILDLIFE SERVICE, DENVER CO.
Phone No. _____
FAX No. 303-236-4759

From MARIOS SOPHOCLEOUS
KANSAS GEOLOGICAL SURVEY

Date SEPT. 20, 1993

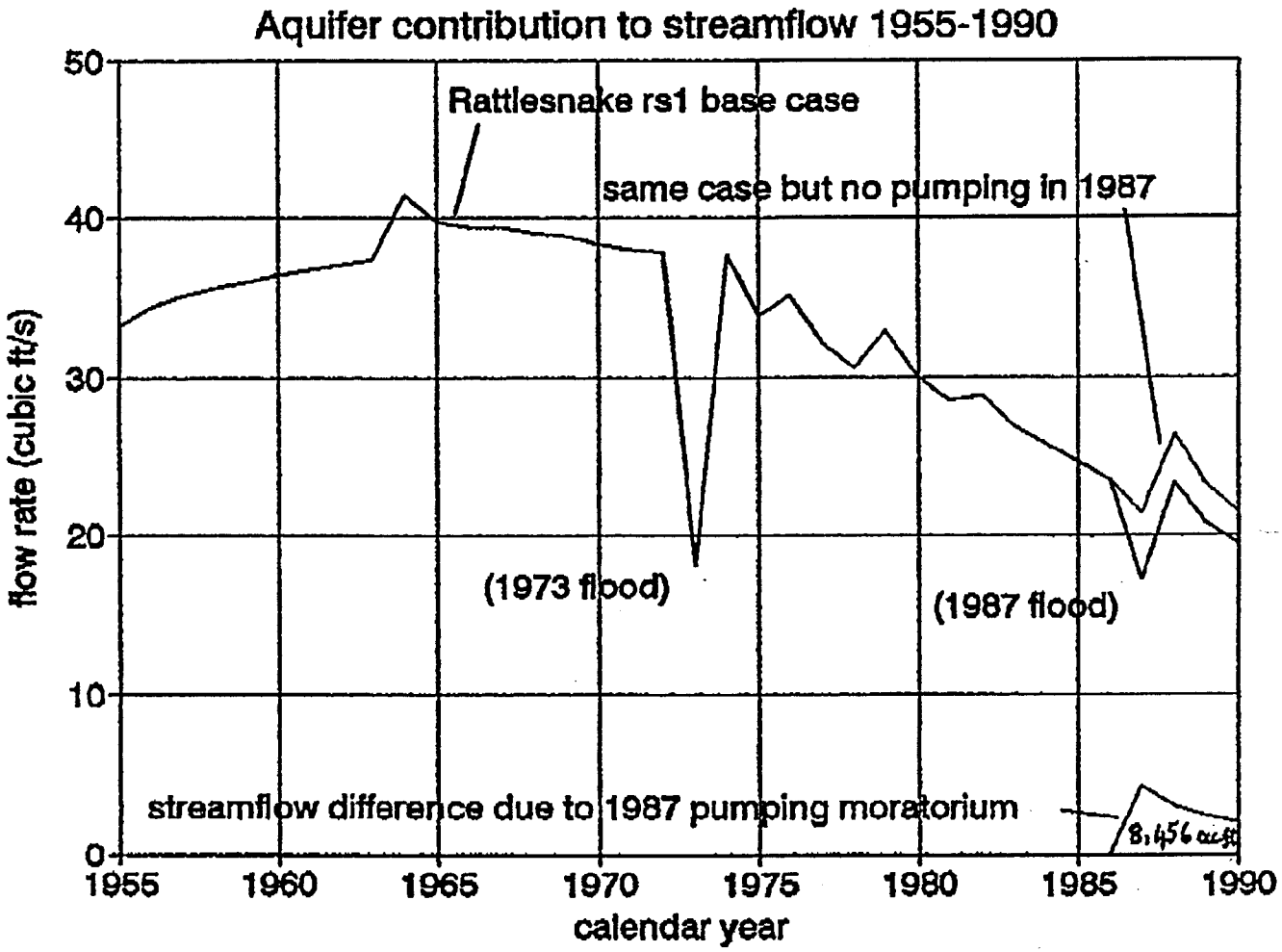
No. of pages (including cover sheet) 2

Priority ( ) Normal (✓) Urgent

Comments

The impact of 1987 pumping on Rattlesnake Cr. streamflow is to reduce total streamflow by at least 8,456 acre-ft. over the model area. See this effect graphically in the attached figure. Hope this answers your questions, but would be happy to clarify any further questions you may have.

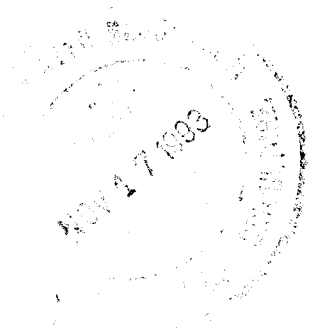
Best regards,
Marios



baseflow c:\rs1std\rs15590.wql

Quivira National Wildlife Refuge Water Requirements

Quivira NWR Area/Capacity Tabulations		
Pool	Surface Area Acres	Capacity Ac-Ft
5	864	1,865
7	55	121
10 A&B	88	221
10C	11	13
11E	50	388
11W	57	112
14A	87	196
14B	65	108
14C	8	31
16	34	99
20	139	199
21	30	81
22	12	20
23	9	15
24	30	33
25	94	296
26	59	108
28	110	241
29	76	156
30	78	119
40	38	89
48	89	113
49	95	162
57	188	449
58	98	246
61	215	485
62	27	46
63	154	339
75	1,716.8	2,377.6
78	1,297.8	3,483.4
80	231	356
81	208	487
83	156	191
TOTAL	6,469.6	13,246



	Area Times Annual Net Evaportation	Water Needs
Capacity Needed to Fill Pools		13,246 acre-feet
Surface Area of Pools	(6,469.6 acres x 36") /12	19,409 acre-feet
Area of Riparian Habitat	(204 acres x 36") /12	612 acre-feet
TOTAL		33,267 acre-feet

KANSAS STATE BOARD OF AGRICULTURE

~~Sam Brownback, Secretary~~
Donald L. Jacka Jr., Acting Secretary
DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

September 17, 1992

U S DEPT OF INTERIOR
FISH AND WILDLIFE SERVICE
ATTN CHERYL WILLISS
P O BOX 25486
DENVER CO 80225

Re: Appropriation of Water
File No. 7,571

Dear Sir:

As per letter received in this office on September 13, 1993, from your office, we are granting you until November 22, 1993, to complete your review of the above referenced draft certificate. After that date, if no additional information is received from your office, the Certificate of Appropriation will be issued.

Should you have any questions, please feel free to contact this office. If you wish to refer to a specific file, please reference it when you contact us.

Sincerely,

Douglas E. Bush

Douglas E. Bush
Hydrologist
Water Rights Section

DEB:jt
Enc.
pc: Stafford Field Office

KANSAS STATE BOARD OF AGRICULTURE

~~Sam Brownback, Secretary~~
Donald L. Jacka Jr., Acting Secretary
DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

8/19/93 - called Meg Johnson - advised her that draft cert had error on 2nd pd. should be Sec 13 instead of 11

August 18, 1993

UNITED STATES DEPT OF INTERIOR
ATTENTION CHERYL WILLISS
FISH AND WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

RE: Appropriation of Water
File No. 7,571

Dear Madam:

Upon review of the above referenced file it appears that a Certificate of Appropriation can be issued. There is enclosed for your consideration and comments a draft Certificate of Appropriation. We request that you examine it carefully as to legal descriptions and content. If there are any corrections needed, please note them on the draft Certificate of Appropriation and submit it with comments for our review.

Information on file in this office indicates United States Department of Interior, Fish and Wildlife Service, is the owner of the project to which this water right is appurtenant. Future correspondence and water use report forms pertinent to the above referenced file will be directed to you. If the above information is incorrect, please notify this office.

Please be advised that the rate of diversion and quantity of water set forth in the enclosed Certificate of Appropriation reflect the extent water was applied the year of maximum usage within the limits of authorization during the period of time allowed to develop this appropriation right. It is quite probable that the natural flows of water to the full extent of this right will not be available most normal years. Management plans for the refuge area should be based on probable flows of Rattlesnake Creek.

If we do not hear from you before September 20, 1993, we will issue the certificate as enclosed. If the proposed certificate is acceptable and you wish to expedite its issuance, you may notify this office in writing prior to the end of the normal thirty (30) day waiting period. Should you have any questions, please feel free to contact this office either by telephone or in writing. Please identify the file number when communicating with this office.

Sincerely,

for Larry Sheets
Hydrologist
Water Rights Section

RECEIVED
AUG 19 1993
Division of Water Resources
Stafford Field Office

LMS:jt
Enc.
pc: Stafford Field Office
Mr. Dave Hilley

THE STATE OF KANSAS

STATE BOARD OF AGRICULTURE
Donald L. Jacka Jr., Acting Secretary

DIVISION OF WATER RESOURCES
David L. Pope, *Chief Engineer*

CERTIFICATE OF APPROPRIATION

FOR BENEFICIAL USE OF WATER

WATER RIGHT, File No. 7,571

PRIORITY DATE August 15, 1957

WHEREAS, It has been determined by the undersigned that construction of the appropriation diversion works has been completed, that water has been used for beneficial purposes and that the appropriation right has been perfected, all in conformity with the conditions of approval of the application pursuant to the water right referred to above and in conformity with the laws of the State of Kansas.

NOW, THEREFORE, Be It Known that DAVID L. POPE, the duly appointed, qualified and acting Chief Engineer of the Division of Water Resources of the Kansas State Board of Agriculture, by authority of the laws of the State of Kansas, and particularly K.S.A. 82a-714, does hereby certify that, subject to vested rights and prior appropriation rights, the appropriator is entitled to make use of natural flows of Rattlesnake Creek to be diverted at three (3) points:

one (1) point located in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW¼ SE¼ NE¼) of Section 35, more particularly described as being near a point 3,100 feet North and 1,150 feet West of the Southeast corner of said section, in Township 21 South, Range 11 West, Stafford County, Kansas, and

one (1) point located in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW¼ NE¼ NE¼) of Section 11, more particularly described as being near a point 4,450 feet North and 1,000 feet West of the Southeast corner of said section, and

one (1) point located near the center of the Southwest Quarter (SW¼) of Section 25, more particularly described as being near a point 1,250 feet North and 3,850 feet West of the Southeast corner of said section,

both in Township 22 South, Ranged 11 West, Stafford County, Kansas.

at a combined maximum diversion rate not in excess of 300 cubic feet per second and a quantity not to exceed 14,587 acre-feet of water per calendar year for recreational use. Such quantity can subsequently be stored and accumulated in marsh areas within the Quivira National Wildlife Refuge, as it existed on December 31, 1987, located on the following described property:

The South 80 acres of the Southeast Quarter (SE¼) of Section 15; the South Half (S½) of Section 14; the Northeast Quarter (NE¼), Southwest Quarter (SW¼) and Southeast Quarter (SE¼) of Section 29; and all of Sections 13, 21 through 28, and 32 through 36 in Township 21 South, Range 11 West;

and all of Section 1 through 5, 11 through 14, 23 through 26, and Sections 35 and 36 in Township 22 South, Range 11 West;

and all of Sections 1 and 2 in Township 23 South, Range 11 West,

all in Stafford County, Kansas, and

Section 18 in Township 21 South, Range 10 West, in Rice County, Kansas;

and Section 30 in Township 22 South, Range 10 West, in Reno County, Kansas.

The appropriation right as perfected is appurtenant to and severable from the land herein described.

The appropriation right shall be deemed abandoned and shall terminate when without due and sufficient cause no lawful beneficial use is made of water under this appropriation for three (3) successive years.

The right of the appropriator shall relate to a specific quantity of water and such right must allow for a reasonable raising or lowering of the static water level and for the reasonable increase or decrease of the stream flow at the appropriator's point of diversion.

IN WITNESS WHEREOF, I have hereunto set my hand at my office at Topeka, Kansas, this day of , 1993.

David L. Pope, P.E.
Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture

State of Kansas)
) SS
County of Shawnee)

The foregoing instrument was acknowledged before me this day of , 1993, by David L. Pope, P.E., Chief Engineer, Division of Water Resources, Kansas State Board of Agriculture.

Notary Public

My appointment expires:

DRAFT

KANSAS STATE BOARD OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Files **DATE:** August 17, 1993

FROM: Matt A. Scherer MAS
Conservation Engineer

RE: Appropriation of Water
File No. 7,571

Upon the recommendation of Bruce Falk, Water Commissioner, and after discussions with Larry Sheets of the Certificate Unit, I drafted a Findings and Order requiring installation of measuring devices and the development of a water conservation plan for the Quivira Wildlife Refuge. The general purpose of the order is to insure better management of water used at the refuge.

The order is patterned after an order prepared several years ago for the Cheyenne Bottoms in the matter of installing measuring devices and those parts of the Walnut Creek IGUCA Order which require a water conservation plan for Cheyenne Bottoms. The order specifically requires that the plans for the water measurement system be submitted to the Chief Engineer for prior approval. The intent of the requirement is to insure that a permanent measuring system exists below the last diversion point, as recommended by the Water Commissioner, and at each of the three authorized points of diversion if feasible. The purpose of the measuring system is to better determine the actual consumptive use at the refuge.

MAS:dv

KANSAS STATE BOARD OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Files **DATE:** August 20, 1993

FROM: Douglas E. Bush **RE:** Appropriation of Water
File No. 7,571

On August 19, 1993, it was learned from Bruce Falk, Water Commissioner, Stafford Field Office, that one (1) of points of diversion were described incorrectly on the draft certificate proposed August 18, 1993. The certificate will be corrected in the office before it is signed and sent. The owner was contacted on August 19, 1993, by Bruce Falk and informed of the error.

Douglas E. Bush

Douglas E. Bush
Hydrologist

DEB:jt

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Mountain-Prairie Region

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

BA/EN
WR KS
Mail Stop 60190

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

SEP - 9 1993

Mr. Guy Ellis
Kansas State Board of Agriculture
Division of Water Resources
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283

Dear Mr. Ellis:

This letter is in reference to the draft Water Rights Certificate, Permit No. 7571, for the Quivira National Wildlife Refuge. Due to previous commitments and projects currently pending in our Water Rights Branch, the Service will be unable to meet the September 20, 1993 deadline for comment on the above referenced Certificate.

The Service requests an additional sixty (60) days, until November 20, 1993, to complete its review of the draft Certificate.

If you have questions, or need additional information, please contact David Schmidt in our Water Rights Branch at (303)-236-5321.

Sincerely,

ACTING Regional Engineer

RECEIVED

APR 26 1996

FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

MICROFILMED

KANSAS STATE BOARD OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Files **DATE:** June 29, 1993

FROM: Larry M. Sheets **RE:** Appropriation of Water
File No. 7,571

A memorandum dated June 18, 1993, from Bruce Falk explains a meeting held on June 17, 1993. Additional information has been presented regarding area capacities of marshes within the refuge. The quantity recommended for the Certificate of Appropriation has been revised. The available information indicated a quantity of 14,587 acre-feet was developed.

It has been decided that reference to a stored quantity should not be made in the certificate. The utilization of the water is considered direct use in that 69.4% of the quantity of water is diverted away for Rattlesnake Creek to marshes. The other 30.6% of the quantity is controlled by low-water structures which create marsh areas adjacent to Rattlesnake Creek. The structure controlling the flow of Rattlesnake Creek should not be considered dams creating storage. The structures are diversion works used to create marsh areas for recreational use within the boundaries of Quivira National Wildlife Refuge. The control structures do not have emergency spillway as a dam and are not as large as most structures used to stop flow and create storage.

Larry M. Sheets
Hydrologist

LMS:jt

Quivira, NWR Area/Capacity Tabulations

Pool	Surface Area	Capacity	Spillway / Benchmark	Management Elevation		
	Acres	Ac-Ft		Feet		
Little Salt Marsh–5	864	1865	SP	1782.97		
7	55	121	BM	1780.27	?	
10A&B	88	221	BM	1780.55	?	
10C	11	13	BM	1776.39	1774.39	Top of Gage
11E	50	388	SP	1774.92		
11W	57	112	SP	1774.82		
14A	87	196	SP	1778.02		
14B	65	108	SP	1776.72		
14C	8	31	BM	1779.05	?	
16	34	99	BM	1775.59	?	
20	139	199	SP	1770.73		
21	30	81	BM	1770.00	1769.99	Top of Gage
22	12	20	BM	1766.60	?	
23	9	15	BM	1765.74	1764.34	Top of Gage
24	30	33	SP	1769.36		
25	94	296	BM	1768.38	1768.38	Top of Gage
26	59	108	SP	1761.98		
28	110	241	BM	1768.89	?	
29	76	156	BM	1762.58	?	
30	78	119	BM	1760.02	1759.00	High Water
40	38	89	BM	1743.15	?	
48	89	113	SP	1754.41		
49	95	162	SP	1754.41		
57	188	449	BM	1745.11	?	
58	98	246	BM	1742.02	?	
61	215	485	SP	1745.45		
62	27	46	BM	1743.08	1742.00	
63	154	339	SP	1741.20	1745.26	
75	1716.8	2377.6	SP	1740.76		
78	1297.8	3483.4	SP	1740.76		
80	231	356	BM	1737.19	1736.70	
81	208	487	BM	1737.19	1736.70	?
83	156	191	BM	1737.19	1736.70	?
TOTAL	6469.6	13246				

Feb. 1993

Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
Memorandum

TO: Larry Sheets

DATE: June 18, 1993

FROM: Bruce Falk BF

RE: Appropriation of Water
File No. 7571

On June 17, 1993 a meeting was held at the Stafford Field Office of the Division of Water Resources with U. S. Fish and Wildlife (USFW) Representatives Megan Johnson and Dave Schmidt. The discussions centered on the final rates and quantities that will be proposed for the certification of File No. 7571.

The USFW representatives presented a summary (attached) of an area capacity survey that was completed in February 1993. The results of the survey indicate that the surface area and capacity of the Little Salt Marsh are actually smaller than older information had indicated. The reason may be that older capacities were calculated from the top of the dikes rather than the spillway elevations used in the new survey. Some siltation may have occurred over the years. Based on the new information, the quantity for the proposed certificate was revised as follows:

Quantity reported in 1987 remains the same:	10129.7 acre-feet
Capacity of Little Salt Marsh, filled in 1987, has changed to:	1865.0 acre-feet
Evaporation from surface acres of Little Salt Marsh changed to: 864 acres X 36 inches =	2592.0 acre-feet
Total:	14586.7 acre-feet

The quantity to be diverted and stored can be stated on the certificate as follows:

"...in a quantity not to exceed 14587 acre-feet per calendar year for direct use. Such quantity can subsequently be stored and accumulated for recreational uses within the Quivira National Wildlife Refuge as it existed on December 31, 1987." *

Of course the above quantity statement can be crafted by you to meet the current procedures of the certificate unit. The proposed certificate should be mailed to the owners as described on the certificate worksheet, but please add "Attention: Cheryl Williss" to the address.

No adverse comments were received from USFW representatives concerning the method used to calculate rates and quantities, or the quantities arrived at. Further review will be required by that agency.

Enc.

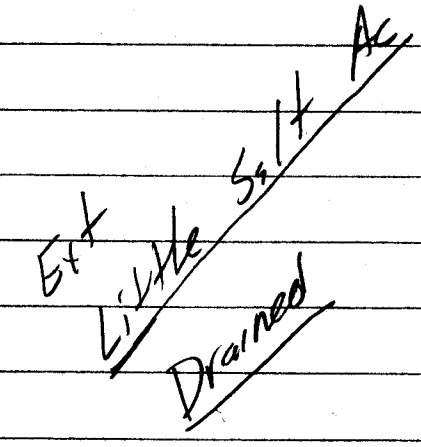
* The recently received area capacity tabulations will document the storage capability in 1987 since no changes have occurred from 1987 to the present.

78 center pivots

7,758 AF if MDS met all year.

Suggestion for storage - Divert a max. of 15240 AF per year which can subsequently be stored and accumulated in a quantity not to exceed the capacity of the refuge as it existed on 12/31/87.

5/26/93 - Meg Johnson - Area capacity figures are complete except for elevations of control structures which will be completed in first week of June.



Storage in Little Salt Marsh and for rec. purposes in Refuge

Find out when survey will be done

KANSAS STATE BOARD OF AGRICULTURE
Sam Brownback, Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

May 21, 1993

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

RE: 38286 38285 38284 38283 38282
38281 38280 38279 38278 38277
38276 38275 38274 38273 38271
17609 17608 17606 17602 17601
39581 39115 38287 07571

Dear Water User:

Our records reflect that you are the owner of the water right(s) and/or permit(s) referenced above. K.S.A. 82a-732 requires the owner of a water right or permit to appropriate water for beneficial use, except for domestic use, to file a complete and accurate water use report on or before March 1 of each year.

We have not received your 1992 water use report. This is our second attempt to notify you that you are assessed a civil penalty of $250 for each of the above referenced file numbers for not submitting your 1992 water use report to this office by March 1, 1993.

If the water use report is received in our office on or before June 1, 1993, the civil penalty will be reduced to $25 per file number on the condition that the $25 civil penalty per file number is received with the water use report at that time. If either the water use report or civil penalty is not received in our office by June 1, 1993, the civil penalty of $250 per file number shall remain in force against you and no reduction shall be allowed. If we receive your water use report by June 1, 1993, but not your payment of the $25 civil penalty by that date, you will be obligated to pay the full $250 civil penalty.

Filing an annual water use report is a condition of maintaining your permit. Failing without cause to comply with provisions of the permit and its terms, conditions and limitations can result in the forfeiture of the priority date, revocation of the permit and dismissal of the application.

If you no longer have an interest in the above referenced file number(s) or have any questions, please contact the Division of Water Resources, Kansas State Board of Agriculture, 901 S. Kansas, Topeka, Kansas 66612-1283, Telephone (913) 296-3717.

Sincerely,

David L Pope

David L. Pope
Chief Engineer

1 0
018302

KANSAS STATE BOARD OF AGRICULTURE
Sam Brownback, Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

COVER PAGE

DATE: May 20, '93 **FAX#** #3

Please deliver the following 8 **pages, including the cover page to:**

NAME: Bruce Falk **PHONE:** _____

FIRM: _____

_____

ADDRESS: _____

_____

SENT BY: Larry Sheets **FAX#** (913) 296-1176
Division of Water Resources
Kansas State Board of Agriculture

If you have any questions concerning this transmission, please contact this phone number (913-296-3710).

BRUCE,

SOME NOTES FROM LARRY;

① QUESTIONS ON HOW STORAGE IS TO BE DEFINED AS IN APPROVAL COMPARED TO CHEYENNE BOTTOMS

② QUESTIONS ON CERTIFING FOR MIN INTENDED WHEN 97% OF THE TIME THAT AMOUNT CAN'T BE ACHIEVED,

③ REVIEW OF HOW QUANTITY WAS ARRIVED AT 1987 MINERS RULE MEASUREMENTS-NEED DETAILS

CALL LARRY: HE WANTS TO KNOW WHEN IS BETTER FOR FULL DISCUSSION; WED 26th OR THUR 27th.

3:13pm: How ABOUT WED 26th @ 1:00pm

KANSAS STATE BOARD OF AGRICULTURE
Division of Water Resources

M E M O R A N D U M

TO: Files **DATE:** May 11, 1993

FROM: Larry M. Sheets **RE:** Appropriation of Water
File No. 7,571

The certification of File No. 7,571 is being proposed as recommended by the Stafford Field Office. The recommendations that a permanent metering system be installed on Rattlesnake Creek immediately downstream of the last diversion point for the refuge and that a water conservation plan be prepared for the refuge are being coordinated with the Division of Water Resources, Conservation officer in the Topeka office.

The year of record 1987 represents a year of maximum available water. It is being noted as part of the certificate of appropriation and transmittal letters that the rate of diversion and quantity are a maximum available condition. In most years the available quantity will be considerable less.

The recommendation of the Water Commissioner was to remove the reference to storage in the Certificate of Appropriation. After some discussion it was decided storage should remain a part of the water right because the Little Salt Marsh is an impoundment of Rattlesnake Creek. The Little Salt Marsh is a 950 acre pool with 2,260 acre-feet storage created by a 5 foot high dam on Rattlesnake Creek near the center of the Southwest Quarter (SW¼) of Section 25, Township 22 South, Range 11 West. The other marsh areas are created by diverting water in canals away from Rattlesnake Creek, a major part of the authorized quantity is utilized for recreation purposed in areas away from Rattlesnake Creek.

The structures creating the Little Salt Marsh were permitted to the Artesian Hunting Association, Stafford, Kansas, on August 6, 1946. The U. S. Department of Interior, Fish and Wildlife Service took over the operation. A June 7, 1960 letter, responding to the Fish and Wildlife Service's notification that modification were being made to the diversion structures, indicated the state would be taking no action (permitting the Work) because it was a Federal Project.

Larry M. Sheets
Hydrologist

LMS:jt

M

Kansas State Board of Agriculture
Division of Water Resources
Stafford Field Office
Memorandum

TO: Warren Lutz

DATE: April 14, 1993

FROM: Bruce Falk MBF

RE: Appropriation of Water,
File No. 7571

Warren, as per our discussion on April 13, 1993 I am elaborating on my meeting with Patrick D. Gonzales, Assistant Manager of Quivira Wildlife Refuge, in July of 1991. From that conversation, it was my understanding that the Little Salt Marsh was essentially drained into other management units early in 1987 to allow work on control structures. Since sufficient water was available at the time, the Little Salt Marsh was immediately refilled. The Little Salt Marsh has been completely dry on several other occasions, once as recently as 1991.

Stafford F.O.

KANSAS STATE BOARD OF AGRICULTURE

Sam Brownback, Secretary

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer-Director
901 S. Kansas Avenue, Second Floor
Topeka, Kansas 66612-1283
(913) 296-3717 Fax (913) 296-1176

RECEIVED
APR 6 1993
Field Office
Division of Water Resources
Topeka

March 30, 1993

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

RE: 007571 only
~~017608~~ 017601 017602 017606
017609 038271 038273
038274 038275 038276 038277
038278 038279 038280 038281
038282 038283 038284 038285
038286 038287 039115 039581

Dear Water User:

Our records reflect that you are the owner of the water right(s) and/or permit(s) referenced above, and that you did not file a 1992 water use report for these water right(s) and/or permit(s) by the March 1, 1993 deadline. K.S.A. 82a-732 requires the owner of a water right or permit to appropriate water for beneficial use, except for domestic use, to file a complete and accurate water use report on or before March 1 of each year.

Failure to file a complete and accurate water use report by March 1 subjects you to a civil penalty not to exceed $250. Furthermore, knowingly falsifying information on the water use report will make you guilty of a Class C misdemeanor.

You are hereby assessed a CIVIL PENALTY of $250 for each of the above referenced file number(s). If the water use report is received in our office on or before June 1, 1993, the civil penalty will be reduced to $25 per file number on the condition that the $25 civil penalty per file number is received with the water use report at that time. In any event, if either the water use report or civil penalty are not received in our office by June 1, 1993, the civil penalty of $250 per file number shall remain in force against you and no reduction shall be allowed. Please submit the water use report, if not already filed, and the civil penalty to the above address.

Filing an annual water use report is a condition of maintaining your permit. Failing without cause to comply with provisions of the permit and its terms, conditions and limitations can result in the forfeiture of the priority date, revocation of the permit and dismissal of the application.

If you no longer have an interest in the above referenced file number(s) or have any questions, please contact the Compliance, Enforcement, and Water Use Unit at (913) 296-3717.

RECEIVED
MAY 19 1993
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Sincerely,

David L. Pope

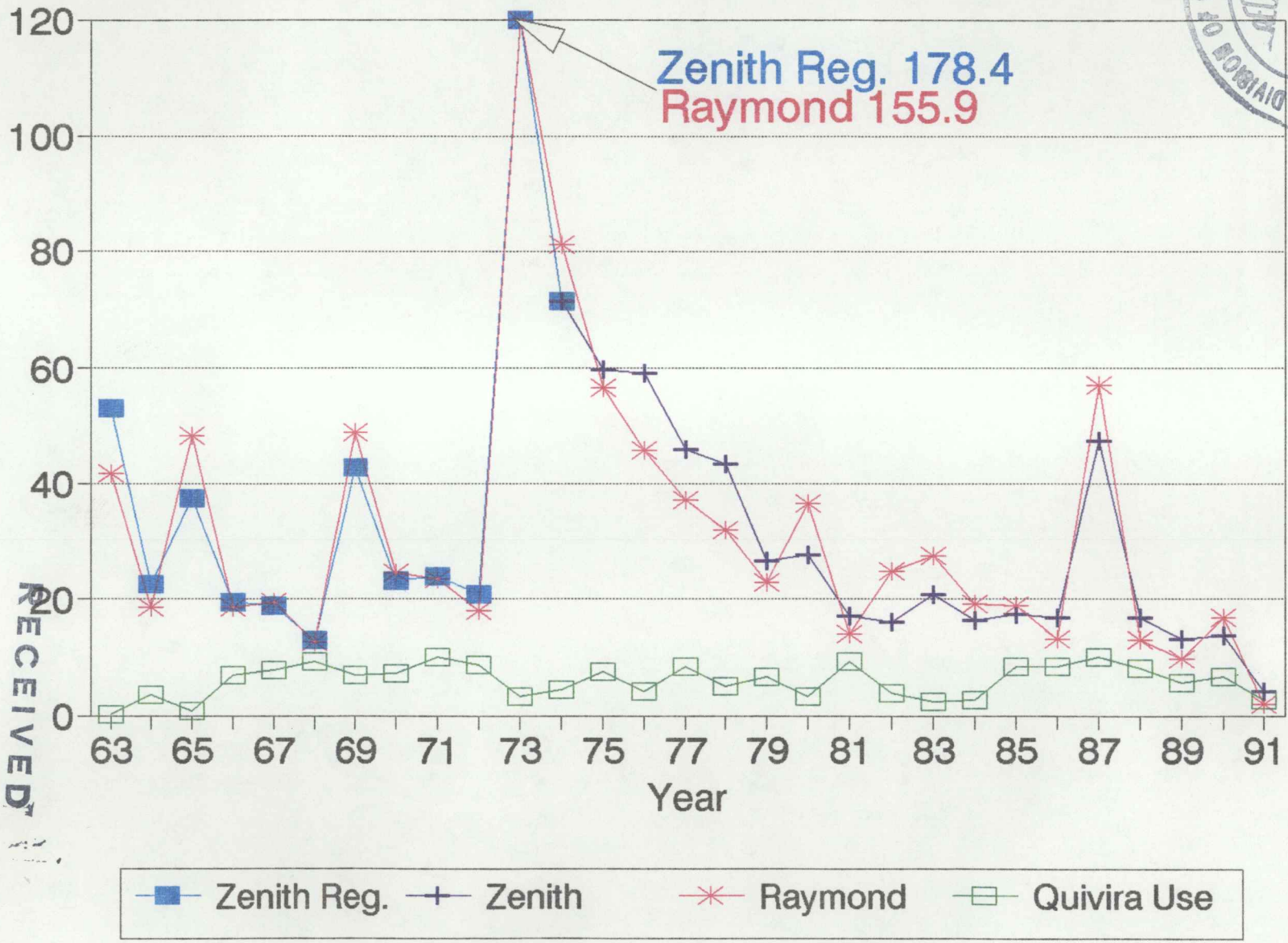
David L. Pope, P.E.
Chief Engineer

1 0
018302

Compliance, Enforcement, Water Use and Certificates 296-3495
Legal 296-4623
Technical Services 296-6081
Office Services 296-2658
Water Structures 296-2933
Water Appropriation Permits and Changes 296-2709

Rattlesnake Creek Discharge

vs Quivira Water Use



Acre-Feet per Calendar Year
(Thousands)

Exhibit I

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Mountain-Prairie Region

IN REPLY REFER TO:
BA/EN
WR KS
Mail Stop 60190

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

DEC 04 1991

Mr. Bruce Falk
Kansas State Board of Agriculture
Division of Water Resources
Drawer F
Stafford, Kansas 67578

Dear Mr. Falk:

This letter is to inform your staff that the Fish and Wildlife Service (Service) believes that the annual water use data which has been submitted to your agency regarding Permit No. 7571, Quivira National Wildlife Refuge, does not accurately reflect the full extent of the Service's water right on Rattlesnake Creek. The records submitted show water use as diverted from structures on the north end of the Little Salt Marsh, and other points downstream on Rattlesnake Creek. Please see enclosed map(s). The data submitted, simply reflects the internal manipulation of water levels in various management units, throughout the Refuge. Also, these records only report a volume (acre-feet) figure and do not address flow rates or evaporation.

It is the Service's position, that the permitted flow rate of 300 cfs should be granted, based on measured peak inflows (USGS gaging station(s)) to the Little Salt Marsh, which is the main storage for 300 cfs, 11 times (Zenith gage, 1973-1988) to 13 times (Macksville gage, 1960-1988). Please see enclosed flow data which illustrates daily flows greater than 300 cfs. Naturally, the flows at the Raymond gage down stream of the Refuge reflect the water management practices at the Refuge. These peak flow rates are required to maintain Refuge impoundments at management levels. Further, high flows are necessary to flush Refuge impoundments of the high concentrations of naturally occurring salts.

Future annual water use reports will include flow data from the Zenith USGS gage, which most accurately delineates Refuge water use.

RECEIVED
DEC 09 1991
DIVISION OF WATER RESOURCES

RECEIVED
APR 20 1992
DIVISION OF WATER RESOURCES

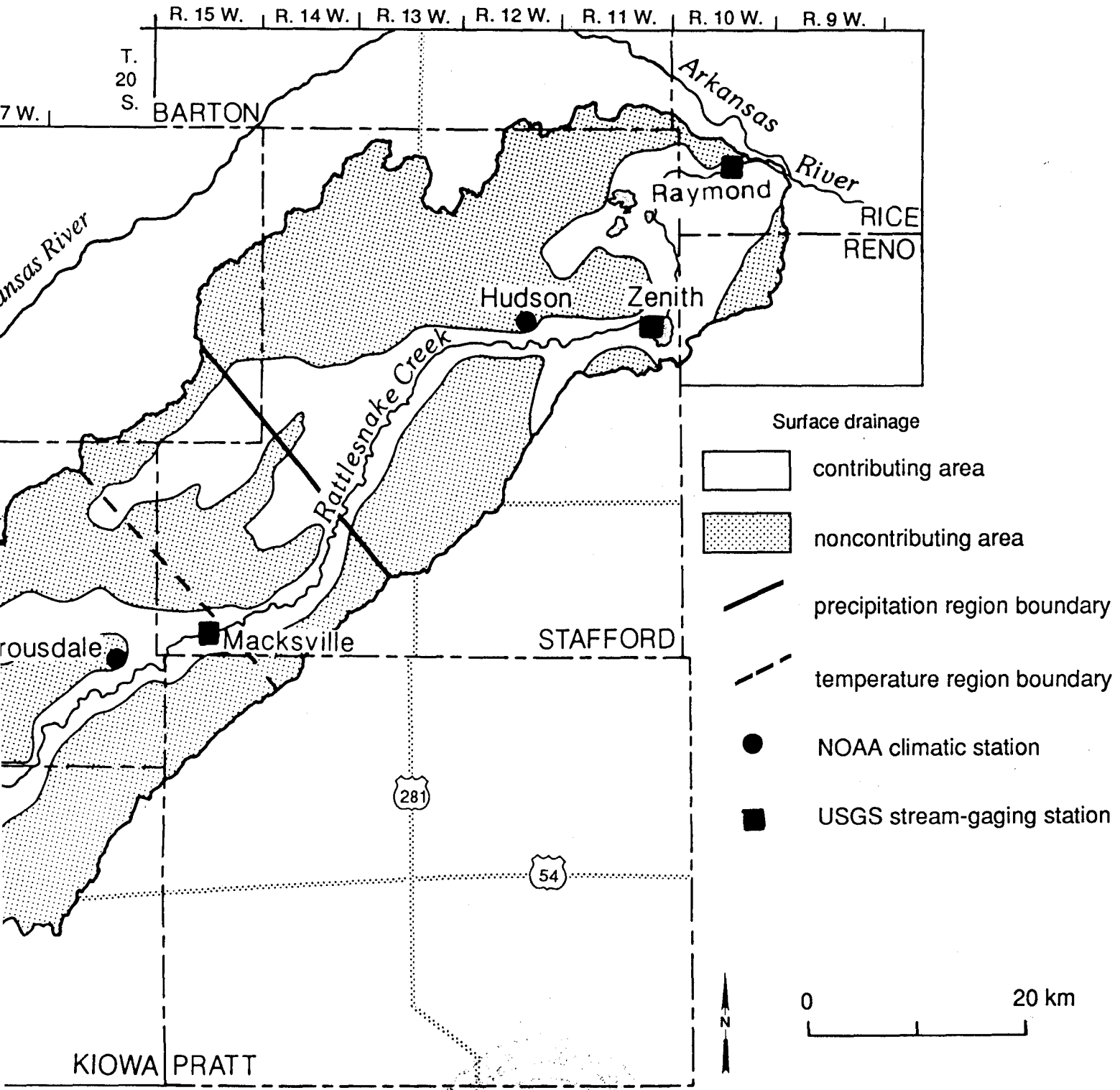
If you have any questions or require further information, please contact David Schmidt in our Engineering office at (303) 236-5321.

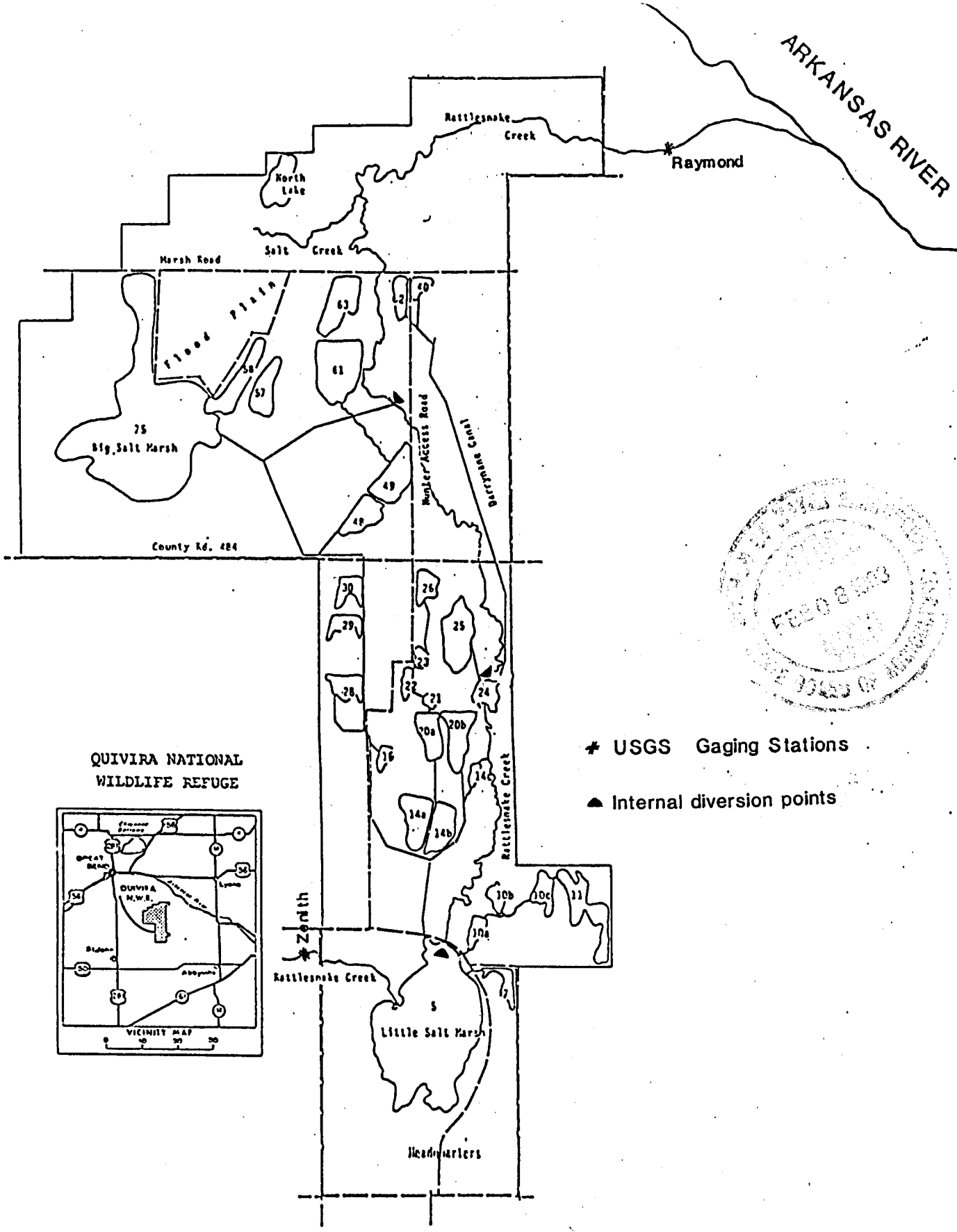
Sincerely,

William A. Godby

William A. Godby
Regional Engineer

Enclosures





Quivira National Wildlife Refuge.

U.S. FISH AND WILDLIFE SERVICE

Date: 11-06-1991
Program: FWS007

Zenith

DAILY FLOWS (CFS)

Year	01/01-12/31 300		TOTAL		CONSECUTIVE # DAYS >= 300
1973	38/	18%*	38/	18%	27
1974	2/	1%	2/	1%	1
1975	9/	2%	9/	2%	7
1976	13/	4%	13/	4%	7
1977	9/	2%	9/	2%	7
1978	10/	3%	10/	3%	8
1979	0/	0%	0/	0%	0
1980	4/	1%	4/	1%	4
1981	1/	0%	1/	0%	1
1982	0/	0%	0/	0%	0
1983	2/	1%	2/	1%	2
1984	0/	0%	0/	0%	0
1985	0/	0%	0/	0%	0
1986	1/	0%	1/	0%	1
1987	10/	3%	10/	3%	10
1988	0/	0%	0/	0%	0
Totals	99/	2%	99/	2%	

* Indicates Incomplete Data for Time Period

U.S. FISH AND WILDLIFE SERVICE

Date: 11-06-1991
Program: FWS007

Macksville

DAILY FLOWS (CFS)

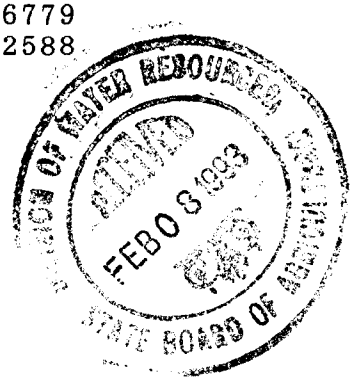
Year	01/01-12/31 300	TOTAL	CONSECUTIVE # DAYS >= 300
1960	6/ 2%	6/ 2%	3
1961	0/ 0%	0/ 0%	0
1962	3/ 1%	3/ 1%	3
1963	6/ 2%	6/ 2%	3
1964	0/ 0%	0/ 0%	0
1965	0/ 0%	0/ 0%	0
1966	0/ 0%	0/ 0%	0
1967	1/ 0%	1/ 0%	1
1968	0/ 0%	0/ 0%	0
1969	3/ 1%	3/ 1%	2
1970	0/ 0%	0/ 0%	0
1971	0/ 0%	0/ 0%	0
1972	1/ 0%	1/ 0%	1
1973	25/ 7%	25/ 7%	9
1974	0/ 0%	0/ 0%	0
1975	9/ 2%	9/ 2%	4
1976	2/ 1%	2/ 1%	2
1977	6/ 2%	6/ 2%	4
1978	9/ 2%	9/ 2%	6
1979	0/ 0%	0/ 0%	0
1980	0/ 0%	0/ 0%	0
1981	0/ 0%	0/ 0%	0
1982	0/ 0%	0/ 0%	0
1983	2/ 1%	2/ 1%	2
1984	0/ 0%	0/ 0%	0
1985	0/ 0%	0/ 0%	0
1986	0/ 0%	0/ 0%	0
1987	6/ 2%	6/ 2%	5
1988	0/ 0%	0/ 0%	0
Totals	79/ 1%	79/ 1%	

* Indicates Incomplete Data for Time Period

Quivira Data

All quanitities are reported in Acre-Feet

Calendar Year	Gaging Stations Macksville	Zenith Regression	Zenith	Raymond	Quivira Reported Water Use
63	31032	53102		41582	150
64	13765	22524		18610	3500
65	14922	37494		48281	750
66	10028	19499		18488	6900
67	8858	18937		19369	7800
68	5762	12844		12746	9345
69	17499	42689		48792	6846
70	10243	23094		24494	7130
71	12177	24062		23517	10068
72	12128	20887		18017	8787
73	111930	178365		155850	3252
74	43710	71600	71600	81110	4356
75	43640		59660	56510	7451
76	26650		59080	45570	4097
77	26460		45850	37030	8453
78	28330		43310	32080	5052
79	14300		26450	22770	6804
80	13670		27860	36540	3381
81	6950		17250	13980	9379
82	4870		15980	24940	3948
83	8930		20880	27540	2535
84	4090		16390	19310	2629
85	5370		17620	18870	8426
86	5670		16870	13350	8392
87	24600		47360	56900	10130
88	7560		16840	13060	8038
89	8800		13320	9670	5603
90	3788		13850	17040	6779
91	1030		4220	1790	2588



Quantity reported in 1987 remains the same:		10129.7 acre-feet
Capacity of Little Salt Marsh, filled in 1987, has changed to:		1865.0 acre-feet
Evaporation from surface acres of Little Salt Marsh changed to: 864 acres X 36 inches	=	2592.0 acre-feet
Total:		14586.7 acre-feet

The quantity to be diverted and stored can be stated on the certificate as follows:

"...in a quantity not to exceed 14587 acre-feet per calendar year for direct use. Such quantity can subsequently be stored and accumulated for recreational uses within the Quivira National Wildlife Refuge as it existed on December 31, 1987." *

Of course the above quantity statement can be crafted by you to meet the current procedures of the certificate unit. The proposed certificate should be mailed to the owners as described on the certificate worksheet, but please add "Attention: Cheryl Williss" to the address.

Faxed to Dave Schmidt 9/1/93

FIELD INSPECTION, FILE 7571
AUTHORIZED POINTS OF DIVERSION

THREE POINTS OF DIVERSION AUTHORIZED BY APPROVED CHANGE IN POINT OF DIVERSION DATED NOVEMBER 11, 1971:

one (1) point in the Southwest Quarter of the Northwest Quarter of the Southwest Quarter (SW1/4 NW1/4 SW1/4)

of Section 25;

one (1) point in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW1/4 NE1/4 NE1/4)

of Section 13;

both in Township 22 South, Range 11 West;

and

one (1) point in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW1/4 SE1/4 NE1/4)

of Section 35, Township 21 South, Range 11 West;

all in Stafford County, Kansas,

ACTUAL POINTS OF DIVERSION

Diversion A: One diversion structure located near the center of the Southwest Quarter (SW1/4), approximately 1250 feet North and 3850 feet West of the SE corner of Section 25; and

Diversion B: One diversion structure located in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW1/4 NE1/4 NE1/4), approximately 4450 feet North and 1000 feet West of the SE corner of Section 13;

both in Township 22 South, Range 11 West;

and

Diversion C: One diversion structure located in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW1/4 SE1/4 NE1/4), approximately 3100 feet North and 1150 feet West of the SE corner of Section 35, Township 21 South, Range 11 West;

all in Stafford County, Kansas.

Quivira Data

All quanitities are reported in Acre-Feet

Calendar Year	Gaging Stations Macksville	Zenith Regression	Zenith	Raymond	Quivira Reported Water Use
63	31032	53102		41582	150
64	13765	22524		18610	3500
65	14922	37494		48281	750
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67	8858	18937		19369	7800
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70	10243	23094		24494	7130
71	12177	24062		23517	10068
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73	111930	178365		155850	3252
74	43710	71600	71600	81110	4356
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77	26460		45850	37030	8453
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88	7560		16840	13060	8038
89	8800		13320	9670	5603
90	3788		13850	17040	6779
91	1030		4220	1790	2588

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS 02/02/93

STATION NUMBER 07142620 RATTLESNAKE C NR RAYMOND, KS STREAM SOURCE AGENCY USGS
LATITUDE 381358 LONGITUDE 0982500 DRAINAGE AREA 596.00 DATUM 1781.64 STATE 20 COUNTY 159
PROVISIONAL DATA SUBJECT TO REVISION

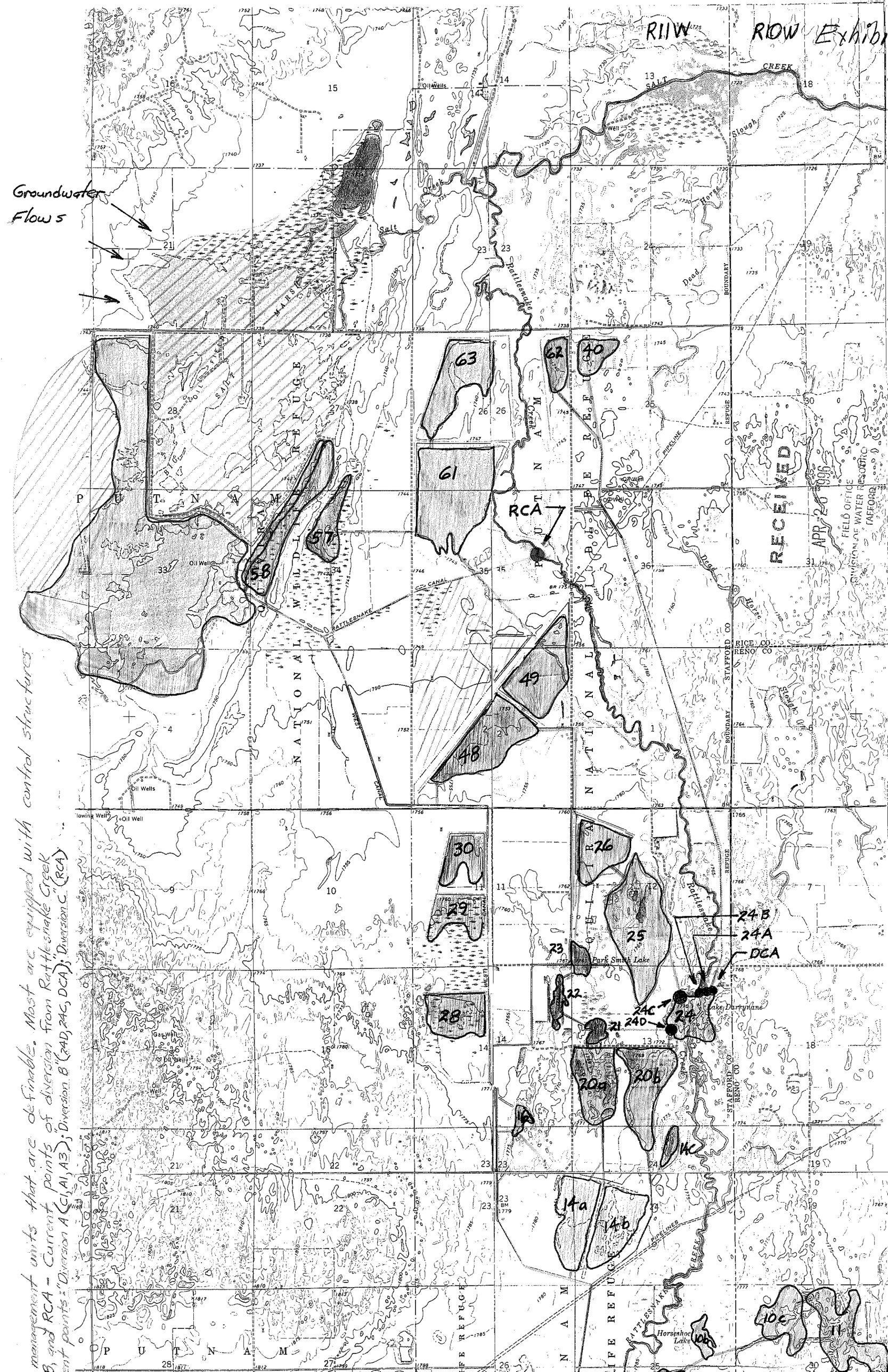
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.41	e.80	e1.6	4.6	2.2	2.2	2.9	2.8	19	36	5.2	4.0
2	.37	e.60	e1.5	3.4	2.3	2.2	2.7	1.8	28	33	4.6	3.9
3	.36	e.70	e1.5	3.0	2.4	2.2	2.7	1.8	44	30	5.0	4.0
4	.40	e.60	e1.6	2.8	2.4	3.2	2.9	1.7	54	27	5.9	3.6
5	.47	e.80	1.7	2.8	2.3	3.4	2.8	1.7	43	25	6.2	3.5
6	.56	e.90	1.7	2.6	2.2	2.8	2.7	1.7	49	22	6.3	3.3
7	.69	e1.0	1.7	3.2	2.2	2.5	2.8	1.8	37	20	4.7	3.3
8	.73	e1.0	1.7	3.0	2.2	2.5	2.8	1.7	30	19	4.2	3.2
9	.68	e1.0	1.6	3.8	2.3	3.2	2.7	1.7	24	16	4.4	3.3
10	.65	1.2	1.6	3.0	2.4	2.6	2.6	1.8	80	16	4.4	2.9
11	.69	1.2	1.7	2.9	2.5	2.5	2.6	2.4	67	12	22	2.8
12	.69	1.4	2.3	2.8	2.7	2.5	2.5	2.2	54	8.2	23	3.0
13	.65	1.4	1.9	2.8	2.5	2.3	2.3	1.9	39	8.8	22	3.0
14	.54	1.4	1.6	3.4	2.5	2.3	2.3	8.6	42	11	20	2.8
15	.63	1.3	1.7	3.1	2.3	2.3	2.2	4.9	53	8.3	17	2.7
16	.72	1.9	1.8	4.5	2.4	2.2	2.0	3.2	53	7.1	15	2.5
17	.68	2.9	1.7	4.4	2.4	2.4	2.1	2.5	53	6.7	13	2.4
18	.53	1.8	1.8	3.3	2.4	3.1	2.5	2.4	43	6.0	11	2.7
19	.57	1.5	2.2	3.2	2.1	3.2	3.2	2.4	34	6.8	9.7	2.5
20	.64	1.5	3.7	2.9	2.1	3.2	2.6	2.5	26	12	8.4	2.8
21	.76	1.5	2.7	2.6	2.3	3.4	2.2	2.8	23	13	7.0	2.6
22	.78	1.5	2.5	2.4	2.2	3.0	2.1	2.8	23	12	6.1	2.3
23	.77	1.8	2.6	2.5	2.4	2.7	2.0	2.8	21	11	5.1	2.1
24	.66	1.7	2.4	2.5	2.4	3.1	2.0	2.6	19	11	4.3	1.9
25	.62	1.5	2.4	2.3	2.1	3.3	1.8	2.6	23	10	7.3	2.0
26	.70	1.5	2.2	2.4	2.2	2.9	1.8	3.2	30	13	7.6	5.1
27	.99	1.5	2.2	2.2	2.3	3.0	1.8	3.2	34	12	6.2	3.3
28	1.2	1.5	2.3	2.2	2.4	3.4	2.1	4.4	37	11	5.5	2.3
29	.98	1.7	2.4	2.3	2.3	3.6	2.1	3.7	40	9.5	4.9	2.1
30	.97	e1.6	2.4	2.3	---	3.0	2.1	3.3	39	7.7	4.3	2.0
31	e.90	---	2.8	2.2	---	2.9	---	3.4	---	6.5	3.9	---
MEAN	.68	1.36	2.05	2.95	2.32	2.81	2.40	2.76	38.7	14.4	8.85	2.93
MAX	1.2	2.9	3.7	4.6	2.7	3.6	3.2	8.6	80	36	23	5.1
MIN	.36	.60	1.5	2.2	2.1	2.2	1.8	1.7	19	6.0	3.9	1.9
AC-FT	42	81	126	181	134	173	143	170	2300	888	544	174

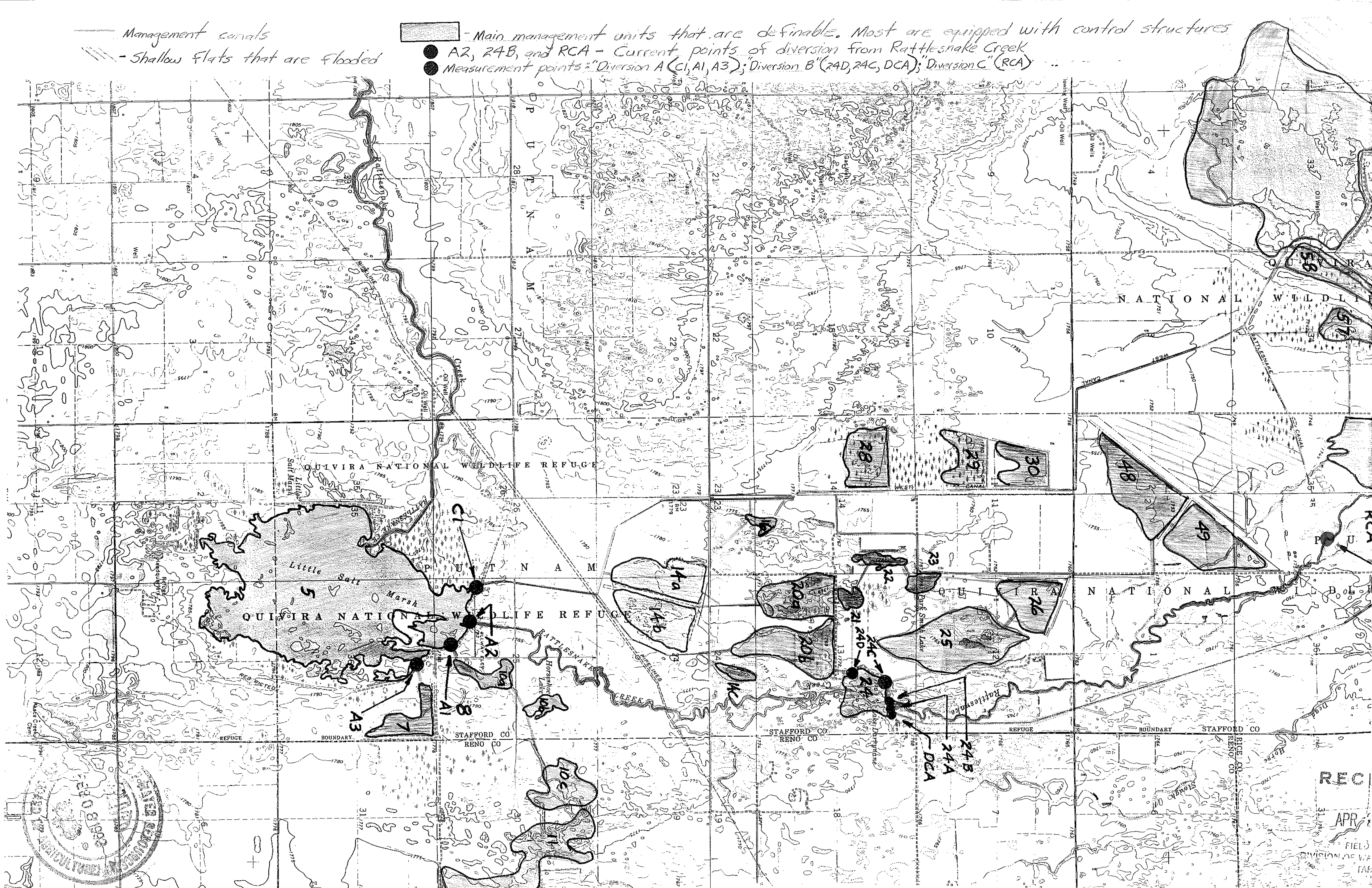
CAL YR 1991 MEAN 2.47 MAX 14 MIN .16 AC-FT 1790
WTR YR 1992 MEAN 6.83 MAX 80 MIN .36 AC-FT 4960

e Estimated

612361



management units that are definable. Most are equipped with control structures and RCA = Current points of diversion from Rattlesnake Creek (C1, A1, A3); Diversion A (24D, 24C, DCA); Diversion B (24D, 24C, DCA); Diversion C (RCA) ...



Management canals
- Shallow flats that are flooded
- Main management units that are definable. Most are equipped with control structures
A2, 24B, and RCA - Current points of diversion from Rattlesnake Creek
Measurement points: "Diversion A" (C1, A1, A3); "Diversion B" (24D, 24C, DCA); "Diversion C" (RCA)
QUIVIRA NATIONAL WILDLIFE REFUGE
Little Salt Marsh
PUTNAM
Rattlesnake Creek
WEST CANAL
REFUGE BOUNDARY
STAFFORD CO
RENO CO
RICE CO
C1
A1
A2
A3
24D
24C
24A
24B
DCA
RCA
5
7
8
10a
10b
10c
11
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14b
14c
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20b
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Exhibit G

SUPPLEMENT TO FIELD INSPECTION
December 21, 1992
File No. 7571

On December 21, 1992, Dave Hilley, Manager of Quivira National Wildlife Refuge, was contacted at Refuge Headquarters. Arrangements had been made to witness the methods used to distribute water throughout the Refuge and also to document how the amount of water diverted each year has been calculated.

Mr. Hilley demonstrated the method used to measure the flow into, and between, the many different management units. A Clausen Rule is used to measure the flow through rectangular weirs at concrete control structures. Adjustable board stops can be placed in the weirs to control the surface water elevation at most units in the Refuge. Basically, the Clausen Rule measures the depth of flow over the stop boards in miners inches. The width of the weir in inches is multiplied by the depth of flow through the structure, then divided by 50 to determine c.f.s. through the weir. Measurements of water movement in the Refuge are made once a week under normal conditions; during rapidly changing conditions, or when water is moved from unit to unit, measurements are sometimes taken on a daily basis.

It is my understanding after visiting with Mr. Hilley that the quantity of water reported from "diversion A", at the north end of the Little Salt Marsh, has always been the sum of the flows through three control structures labeled C1, A1, and A3; these divert water from the Little Salt Marsh to other management units. A fourth control structure, A2, allows overflow to continue downstream in the Rattlesnake Creek Channel. This flow is not measured or included in the quantity reported for "diversion A".

The quantity reported from "diversion B" has been the sum of water diverted to other units from the north end of unit 24. Measurements are made at three control structures labeled 24C, 24D, and DCA. DCA is used to divert into the Darrynane Canal. Overflows through structures 24B and 24A flow downstream into the Rattlesnake Creek and are not measured.

The final "diversion C" quantities reported are the measured amounts diverted at the RCA control structure in Section 35, Township 21 South, Range 11 West, to other management units to the west. Under normal conditions, the complete flow of the Rattlesnake is used before it can bypass "diversion C".

Natural groundwater sheet flows on the north end of the refuge are currently the only contributor to flows recorded at the downstream Raymond Gaging Station during normal conditions.

Supplement to Field Inspection
December 21,1992
File No. 7571

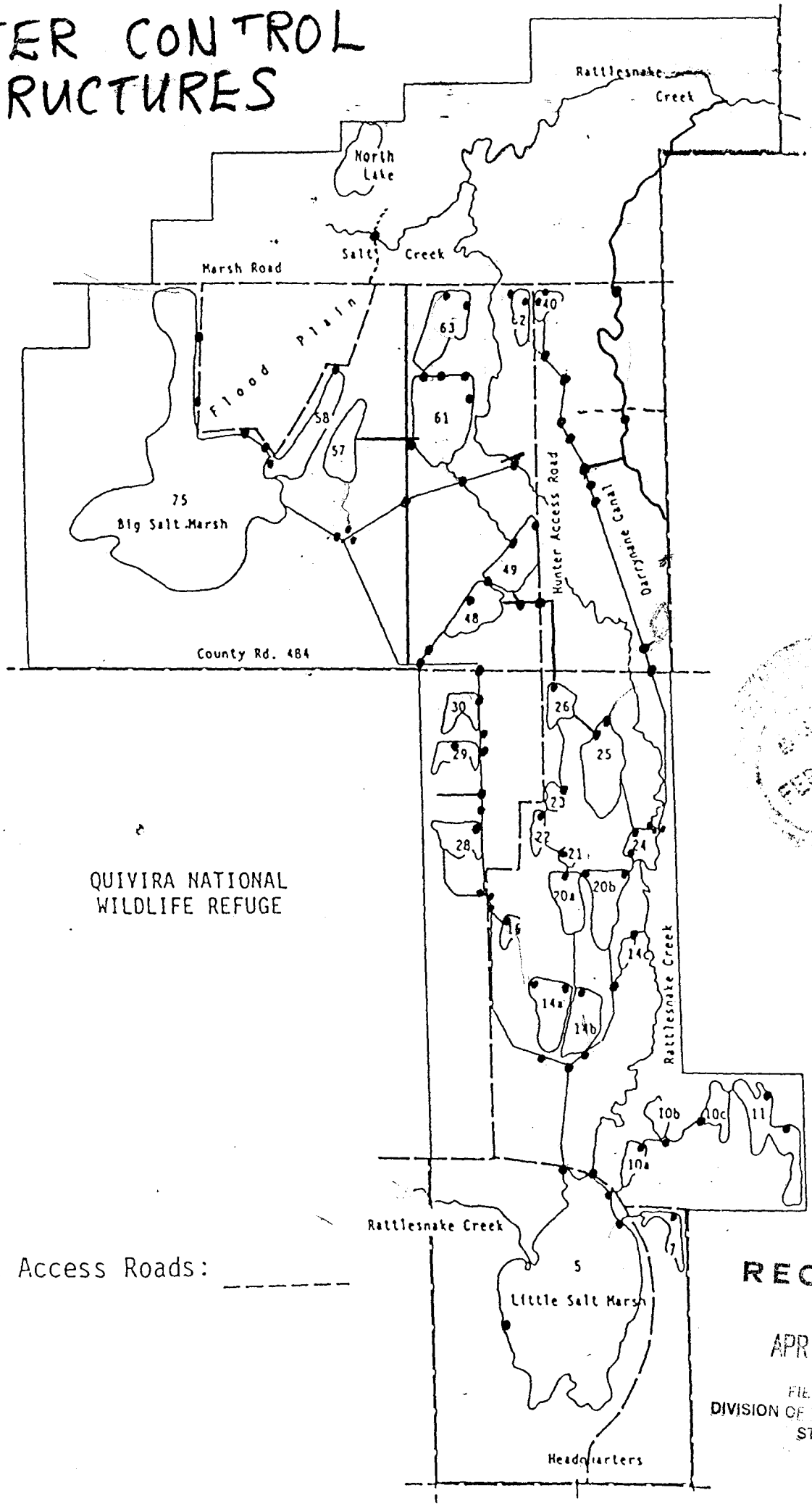
It appears from information obtained at the Refuge that all water diverted from the Rattlesnake Creek is measured and reported accurately, although the measurements are not of a continuous nature. The only discrepancy noted was that all measurements reported do not reflect the amount stored and subject to evaporation in the Little Salt Marsh. The Little Salt Marsh is upstream of the first measurements made at "diversion A".

On January 28, 1993, Dave Hilley was contacted at Quivira Refuge. The purpose of the contact was to conduct an in-depth review of measurement method used over the years to report water use. The instrument in use to measure the main diversion flows is the Clausen Weir Rule (operating manual attached). Mr. Hilley used the weir rule to measure the amount of flow through the C-1 control structure. With the weir rule the depth of flow through the rectangular weir was measured at 4.6 "Arizona" miners inches and the width of the weir was measured at 51". Using the formula for the Clausen Rule: 4.6 X 51" = 234.6 ÷ 40 = 5.87 c.f.s. Even though a miner's inch is normally divided by 50 in Kansas, the Clausen Rule is calibrated in "Arizona" miners inches so 40 is used.

Next a pygmy current meter was used to determine the flow through the same weir (measurement sheet attached). With the current meter a flow rate of 5.719 c.f.s. was obtained. The two readings were within 2.5% of each other which appears to indicate an acceptable level of accuracy for the measurement method used at the refuge.

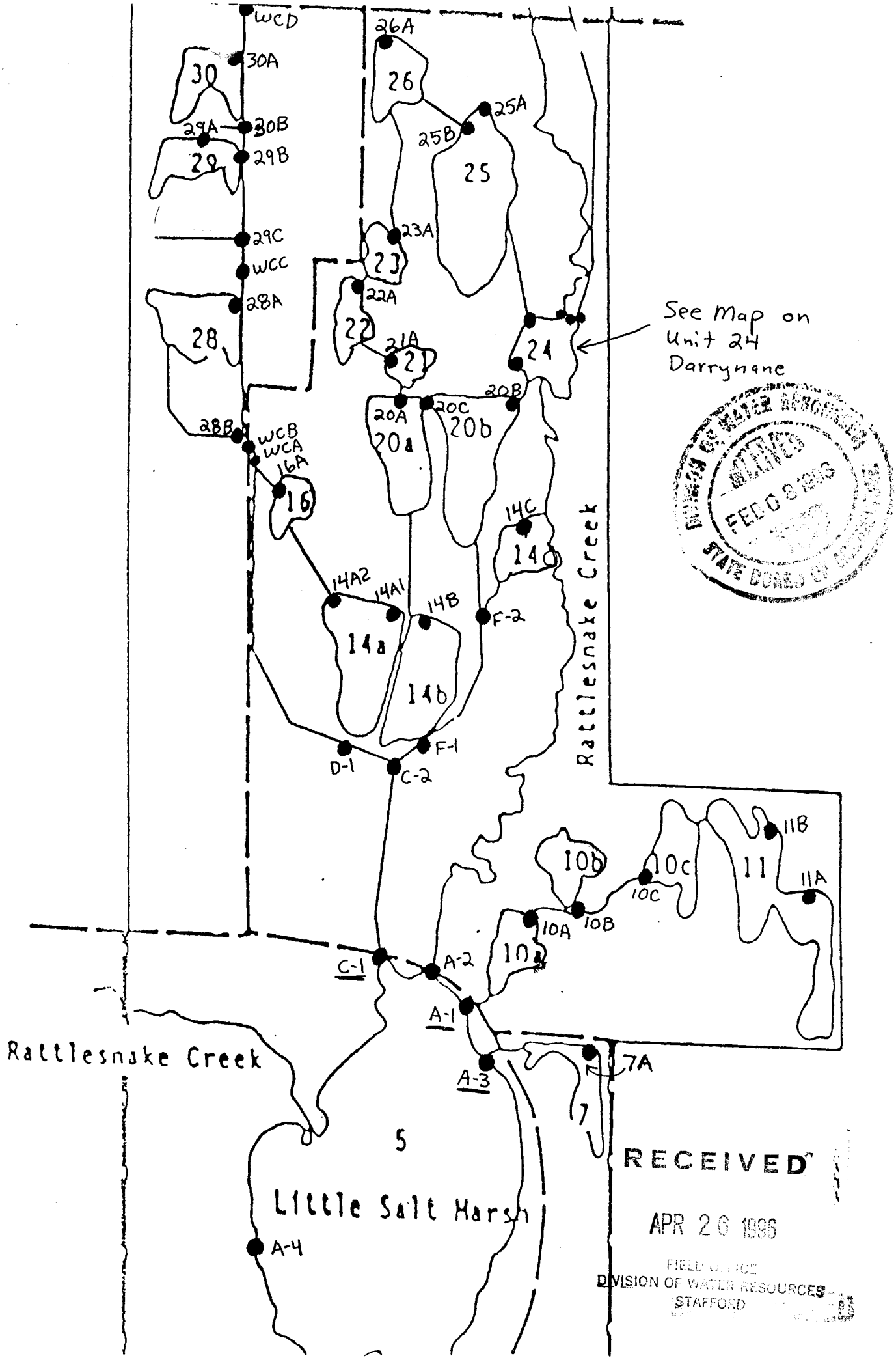
In addition it was learned that beginning in 1991 refuge personnel have been instructed by Denver personnel to divide readings by 50; this may be in error. Mr. Hilley also questioned if any accurate measurement method was in use prior to 1973. This might explain why the word "estimate" was written on water use reports prior to 1973.

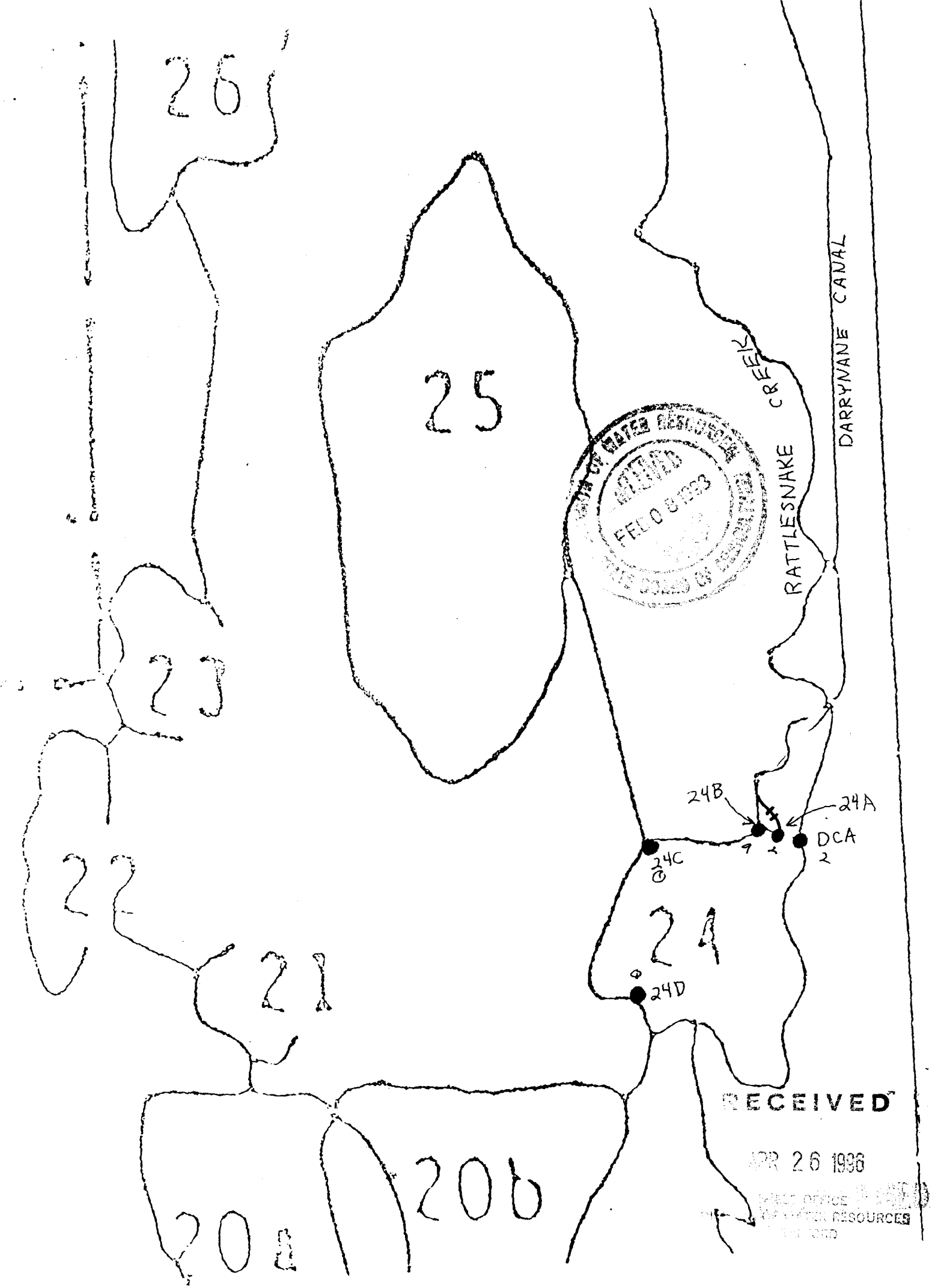
WATER CONTROL STRUCTURES

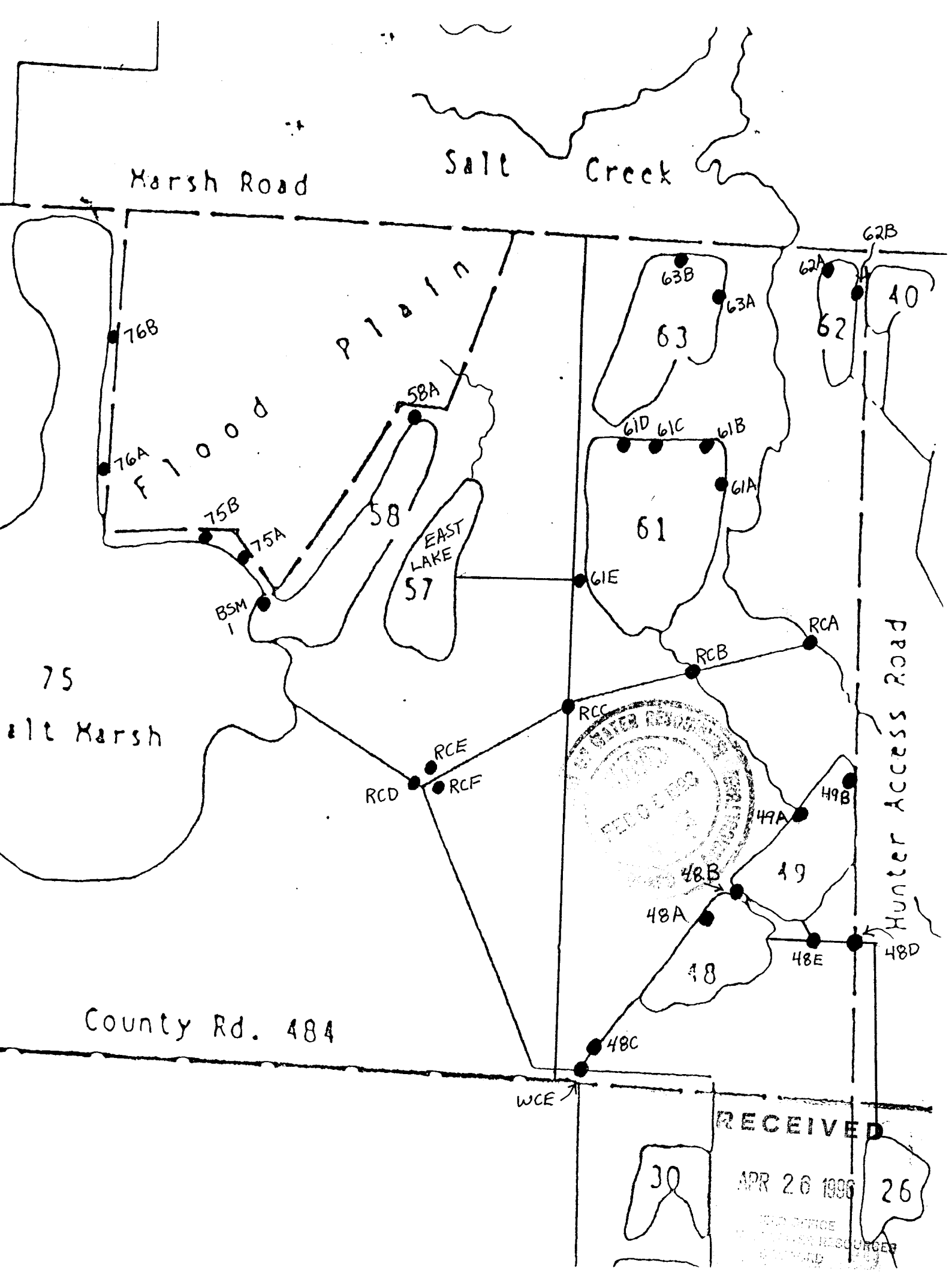


QUIVIRA NATIONAL WILDLIFE REFUGE

Public Access Roads: _____






Marsh Road
Salt Creek
Flood Plain
76B
76A
75B
75A
BSM 1
58A
58
EAST LAKE
57
63B
63A
63
62B
62A
62
40
61D
61C
61B
61A
61
61E
RCA
RCB
RCC
RCD
RCE
RCF
75
alt Marsh
49B
49A
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48B
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48D
Hunter Access Road
County Rd. 484
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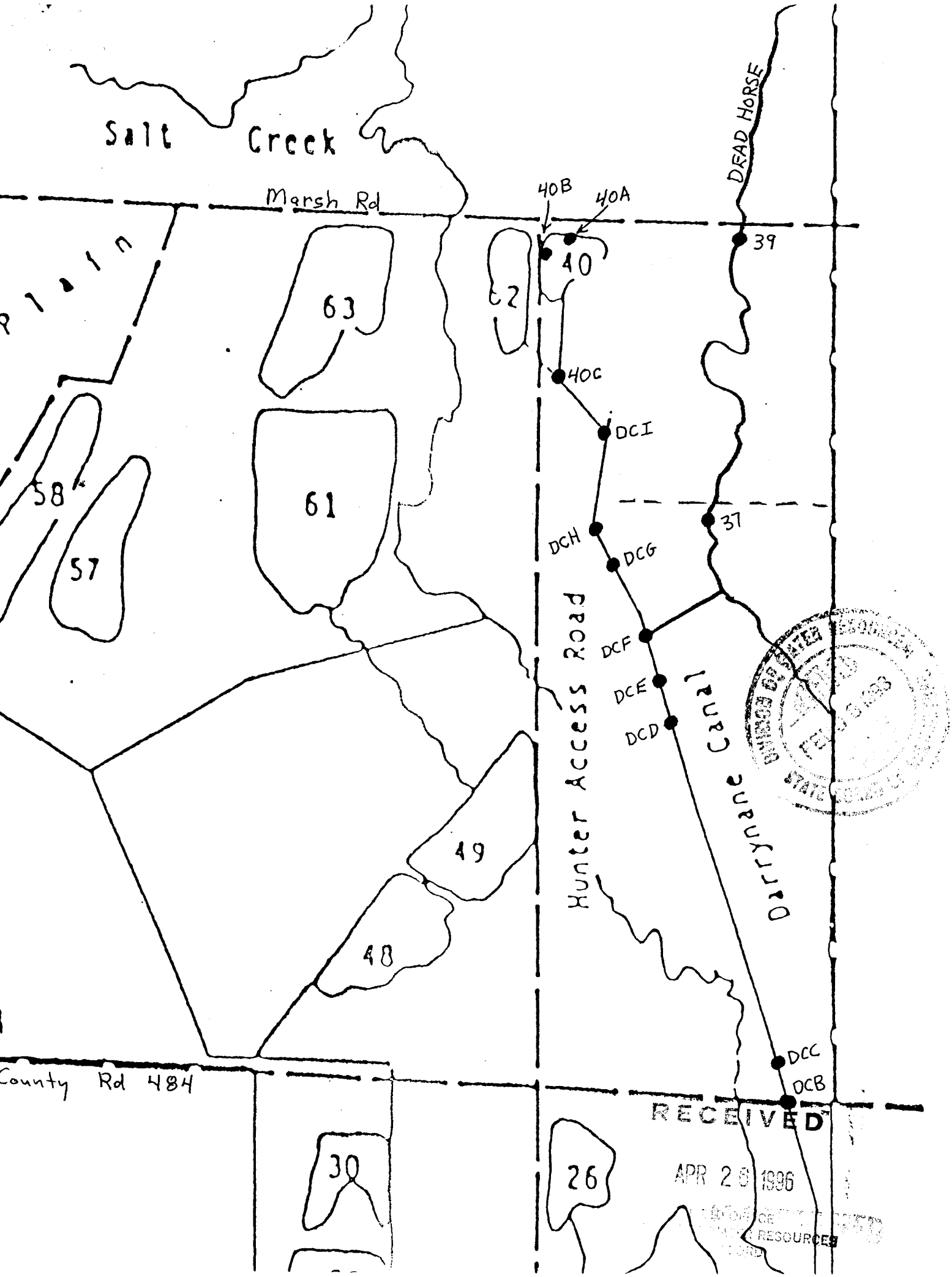
Salt Creek
Marsh Rd
DEAD HORSE
40B
40A
40
39
63
62
40C
DCI
58
61
57
DCH
DCG
37
DCF
DCE
DCD
Hunter Access Road
Darrynane Canal
49
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County Rd 484
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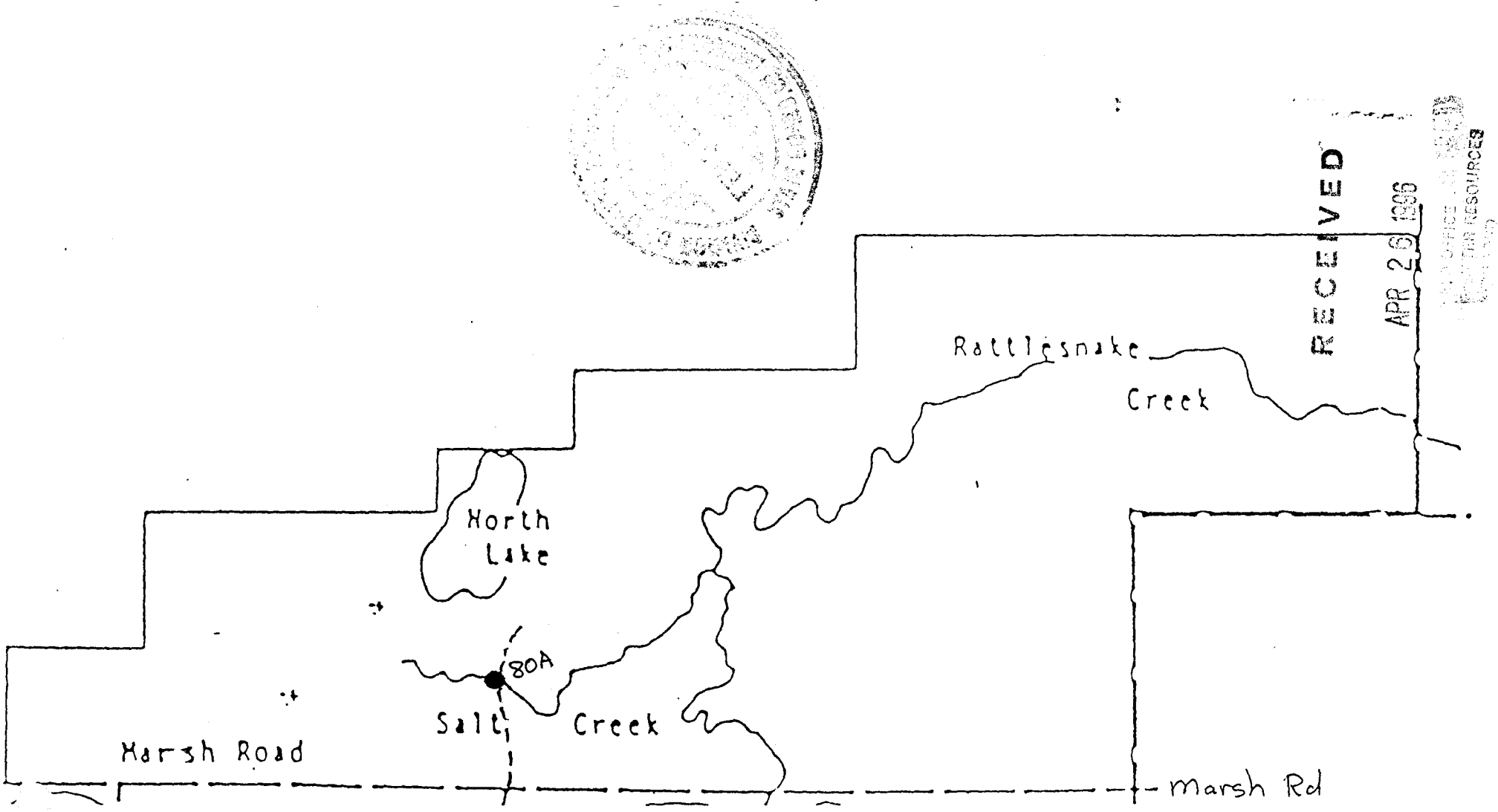
RESOURCES

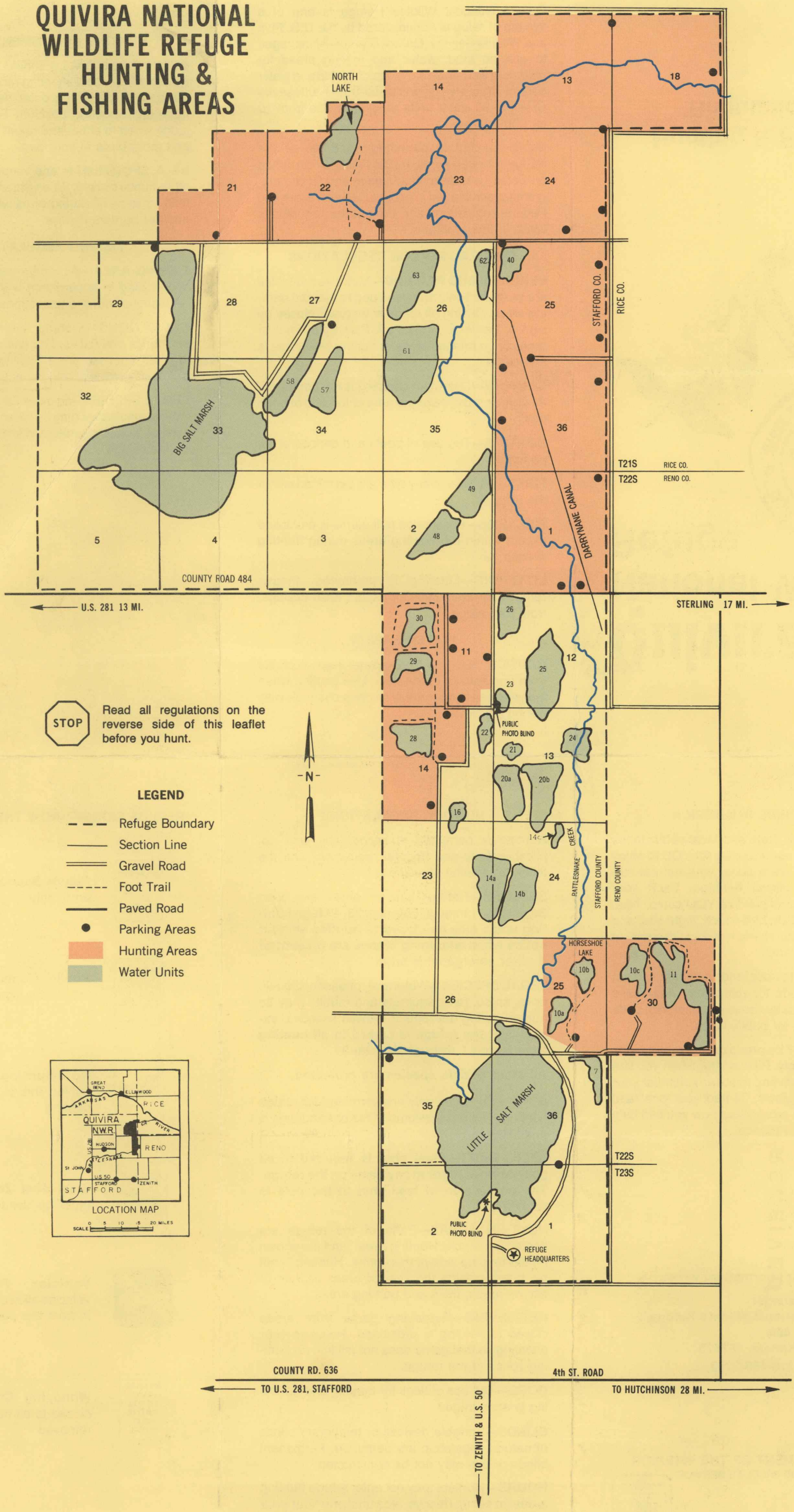


CLAUSEN WEIR RULE COMPANY

~~BOX 6156~~ ~~PHOENIX, ARIZONA~~

MAGMA ENGINEERING CO.
P. O. BOX 161
QUEEN CREEK, AZ 85242

QUIVIRA NATIONAL WILDLIFE REFUGE HUNTING & FISHING AREAS



STOP Read all regulations on the reverse side of this leaflet before you hunt.

N

LEGEND

- Refuge Boundary
- Section Line
- Gravel Road
- Foot Trail
- Paved Road
- Parking Areas
- Hunting Areas
- Water Units

Hunting & Fishing Regulations

Quivira National Wildlife Refuge

For further information, write:

Refuge Manager
Quivira National Wildlife Refuge
Rt. 3 Box 48A
Stafford, Kansas 67578
or call: 1-316-486-2393

TAKE PRIDE IN AMERICA

America's Federal, State and local public lands provide important opportunities for YOU to enjoy the outdoors and learn about your natural surroundings and cultural heritage. Each year millions of Americans just like YOU camp, hike, boat, swim, hunt, fish, bird-watch, sight-see, and learn about the natural and historical diversity of America's public lands.

To help insure that public lands continue to meet increasing demands for recreation, Americans must develop a greater sense of ownership, pride and responsibility for public lands.

What can YOU do? Be proud of your public lands and use them wisely. Pickup litter when you see it. Report vandalism and misuse. Volunteer your time for special projects. Contact your local land managers to learn more about how you can help by taking pride in America.

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

RF6-64620 GPO 832-013 **May 1990**

INFORMATION

Quivira National Wildlife Refuge is one of a system of refuges administered by the U.S. Fish and Wildlife Service. Quivira is primarily managed to provide food, water and resting areas for migratory waterfowl. A system of canals and water control structures diverts water from Rattlesnake Creek to 30 water units ranging in size from 10 to 1,500 acres.

Public hunting is permitted on 8,000 of the refuge's 21,820 acres. Public fishing is permitted on all refuge waters. The hunting and fishing programs are managed in accordance with State and Federal regulations and the special regulations listed in this brochure.

GENERAL REFUGE REGULATIONS

VEHICLES AND PARKING—Motorized vehicles are permitted only on developed roads and parking areas. Driving off roads or on roads closed by sign or barrier is prohibited. Parking in front of gates or on bridges or water control structures is prohibited.

CAMPING—Overnight camping is not permitted. All visitors must leave the area at the end of each day.

BOATING—The use of boats and canoes is not permitted.

FIRES—No fires of any type are permitted within the refuge.

FIREARMS—Possession of firearms is prohibited except within the hunting areas during hunting season.

LITTERING—Littering is prohibited. Please remove all trash, including spent shell casings, from the refuge.

WATER SAFETY

CAUTION DEEP WATER—Water levels fluctuate from one season to the next. Use caution when crossing open water areas as deep channels may not be visible.

HUNTING REGULATIONS

Hunting is permitted in accordance with applicable State and Federal regulations and the following special regulations.

SEASONS—Refuge hunting areas are open September 1 through February 28. **Refuge hunting areas may be closed to hunting without notice when whooping cranes are present or if other emergencies arise.**

LEGAL SPECIES—Waterfowl, pheasants, quail, dove, snipe, rails, squirrels and rabbits may be hunted during the regular Kansas seasons, **except that the refuge is closed to all hunting from March 1 through August 31.**

All other wildlife species are protected.

GUNS—Shotguns only are permitted for refuge hunting. The possession of rifles or handguns is prohibited.

STEEL SHOT—Steel shot is required in all gauges when hunting any game on the refuge. The possession of lead shot in the field is prohibited.

HUNTING AREAS—Parts of the refuge are posted as "Public Hunting Area" and are shown on the reverse side of this leaflet. Hunting is not permitted outside the shaded areas or from or across roads, trails and parking areas.

RETRIEVING—Retrieving game from areas closed to hunting is prohibited. Regulate your shooting so that game does not fall into no hunting zones of the refuge.

DOGS—The use of dogs for hunting and retrieving is encouraged.

BLINDS—Portable devices or temporary blinds of natural vegetation are permitted. Permanent blinds or pits may not be constructed.

HOURS—Hunters may not enter refuge hunting areas (to set up decoys, etc.) until one hour prior to legal shooting time. All decoys must be removed within one hour, following the end of legal shooting time.

HUNTING RECOMMENDATIONS

DECOYS AND CALLS should be used to bring waterfowl into ideal shooting range. When setting out decoys, place the outer decoy at 40 yards from your shooting position. This will help you judge when to shoot and result in fewer cripples and more birds in your bag.

BE A SPORTSMAN and respect the rights of other hunters afield. When entering or leaving the field try to avoid flaring birds which are working another hunters decoys.

FISHING REGULATIONS

FISHING AREA—All refuge waters are open to sportfishing in accordance with Kansas fishing regulations with the exceptions listed below.

EXCEPTIONS—Fishing with trotlines and setlines is prohibited. The use of seines for taking bait is not permitted. Fishing from water control structures and bridges is prohibited.

LEGAL SPECIES—Species listed in the Kansas fishing regulations may be taken. All other wildlife species including turtles and snakes are protected on the refuge.

REFUGE SIGNS—KNOW THEIR MEANING

Refuge Boundary—authorized entry only

Public Hunting Area—area behind this sign open to hunting

No Hunting Zone—area behind this sign closed to all hunting

Steel Shot Zone—steel shot must be used for all hunting

Vehicles Prohibited—no vehicles allowed, you may walk in from this point

Whooping Cranes—area is closed to all hunting until sign removed

Exhibit F

Typical Water Use at Quivira Wildlife Refuge

Pool Unit No.	Operation Procedures - Remarks	Dimensions	Capacity	Likely Annual Evap	Max. Total AF Required
5	Keep full all year	950 Ac	2260 AF	2850 AF	5110 AF
7	Fill in winter - allow to decline	50 Ac	90 AF		90 AF
8	Floodplain - Flood Oct - March (6")	30 Ac	15 AF		15 AF
10a	April - Sept - Dry Sept - Jan; Fill	16 Ac	32 AF		32 AF
10b	April - Sept: Dry Fill twice for hunting	16 Ac	24 AF		48 AF
10c	Dry: - April - Sept Fill three times	45 Ac	66 AF		198 AF
11	Fill twice - maintain water throughout summer	100 Ac	300 AF	300 AF	900 AF
14a; 14b	Grazed in June, Fill once	221 Ac	548 AF		548 AF
14c	Keep full as possible	5 Ac.	5 AF	15 AF	20 AF
16	Fill each yr. and allow evp.	83 Ac	149 AF	249 AF	398 AF
28	Fill twice during winter months	147 Ac	324 AF		648 AF
20a	(Full throughout, winter, drain for moist soil plants	90 Ac	300 AF		300 AF
20b	irrigate if necessary.)	51 Ac	130 AF		130 AF
22	Fill once during winter	10 Ac	20 AF		20 AF
21	Full through summer, shallow during winter	22 Ac	55 AF	66 AF	121 AF
24	Maintain shallow water level in summer, then Fill in winter	20 Ac	35 AF	60 AF	95 AF
29	Sept - Fill, may - drain, July - flood moist soil areas	91 Ac	265 AF	273 AF	538 AF
23	Water in pool all year - fluctuating water levels	17 Ac	42 AF	51 AF	93 AF
25	Dec - Fill, March - drain moist soil areas, Sept - fill deep areas	87 Ac	120 AF		120 AF
30	Sept - begin to fill, April - begin drawdown	91 Ac	265 AF		265 AF
26	Oct - fill, May - drain	82 Ac	82 AF		82 AF
73	No management	100 Ac	100 AF		
48	Nov. - Fill, May - Drain, summer - graze	135 Ac.	45 AF		45 AF
49	Jan. - Fill, May - Drain for moist soil, Aug. - flood vegetation,	154 Ac.	70 AF	1/2 annual evap. 162 AF	1232 AF
75	Jan. - Fill, Maintain full to August, Oct. drain if carp a problem	1490 Ac.	4570 AF	4470 AF	9040 AF
58	Jan. - begin to fill, July - start lowering to 1', maintain	110 Ac	175 AF	330 AF	505 AF
61	Maintain at full level	200 Ac	400 AF	600 AF	1000 AF
77	No management				
57	Maintain at full level	154 Ac.	319 AF	462 AF	781 AF
53	Jan - begin to fill, maintain full, lower in Aug.	270 Ac.	650 AF	810 AF	1460 AF
0	Jan. - fill, April - drain, may - graze, irrigate if needed,	50 Ac.	75 AF		75 AF
2	Jan. - fill, April - drain, May - graze, " " "	150 Ac.	300 AF		300 AF
Totals		4837 Ac	11831 AF	10698 AF	23209 AF

Evaporation calculated only when water is maintained in pool throughout the summer.
Does not include any irrigation flooding, water consumed by plants, seepage, or canal transit losses.

Exhibit E

Unit 5 - Maintain at or near capacity throughout year. Be ready to discharge waters on short notice if heavy rains occur in watershed. Divert water whenever needed for management of refuge water units. Northwest portion will be burned along with grassland. Bleed down to 5.00 steadily (4.80-4.90 acceptable)

1/1 - 12/31 Maintain at or near 5.00, but use water as needed for unit management. Prevent uncontrolled discharge over east spillway until breaks are repaired.

6/1 Repair east spillway. Pump with concrete grout.

Unit 7 - Fill in winter and maintain for waterfowl. Keep water at adequate level until geese hatch off. Allow natural decline through late spring and summer for dabblers and shorebirds. Begin staging up in early winter.

1/1 Fill to 3.80 and maintain.

3/1 Stop all inflow. Allow natural decline through October.

11/1 Begin staging up with flow through to Unit 8.

Unit 8 - Encourage moist soil plants and seed producing grasses. Graze during summer according to Rangeland MP. Flood to provide waterfowl foods and hunting opportunities.

1/1 Maintain full with continuous inflow.

3/1 Stop inflow and pull board at pipe. Let area drain. Potholes will dry out naturally.

6/1 Scheduled for summer grazing.

10/15 Block outlet pipe and begin reflooding. Maintain with inflow through remainder of year.

Unit 10 A - Provide waterfowl feeding area through moist soil plant production. Early grazing for cattail control and to knock down cattail litter and open up areas for moist soil plants. (Mowing is an alternative, but may result in too much litter cover on ground for good plant production.) Reflood for hunting seasons.

1/1 Maintain full at 3.30
3/1 Stop inflow and gradually lower water level

4/1 Drain and dry out unit except for deep water areas. Install a gauge at the WCS.

5/1 to 5/15 Graze unit

6/15 If unable to graze for cattail control, continue to dry out and mow.

9/1 Reflood deeper areas for teal season. Hold at that level.

10/15 Gradually refill as waterfowl foods are consumed.

Unit 10 B - Manage for moist soil plants and waterfowl hunting. Mow bulrush if needed. Reflood in increments to utilize all food plants. Make sure all boards are pulled.

1/1 Maintain current level until ice-out. Reflood to capacity and maintain.

3/1 Stop all inflow.

4/1 Pull all boards and allow to drain as much as possible.

6/1 Evaluate conditions for possible mowing of bulrush.

9/1 Reflood for teal season. Water 2-3" deep on lowest plants.

10/15 Flood to capacity then pull boards 5 days before hunt season. Reflood to capacity during season break to recharge pothole areas. Then pull boards again. Maintain through hunting season.

Unit 10 C - Manage for moist soil plants in low areas adjacent to main water unit. Flood for waterfowl hunting season.

1/1 Maintain current level until ice-out, then fill to capacity.

4/1 Begin drawdown, drain moist soil areas by 4/15 or allow natural decline if cannot drain.

5/15 Use grazing for cattail control.

9/1 Reflood deeper areas only for teal season.

10/1 Raise level to capacity (6.00) to flood

soil areas.

10/15 Lower water for hunting season.

12/1 Recharge potholes if necessary by raising level to capacity and then lowering.

Note: Management will be in conjunction with Unit 11.

Unit 11 - Manage for submergents in deep areas and moist soil plants in shallow areas surrounding main unit. Reflood unit for waterfowl season. Pull one board and hold as previous level until after May

Same steps as 10 C except as below

4/1 Maintain at least 4.00 on gauge throughout summer.

7/1 Rehabilitate hunter walkovers (2).

Unit 14 A - Manage for moist soil plant production and waterfowl feeding area for fall and winter. Pull one board/week through 14A1

1/1 Maintain current level until ice-out, then raise 4-6", hold until spring migration over.

3/15 Drop level until water off moist soil areas. Maintain some water in deeper areas.

6/1 Scheduled to be grazed.

10/1 Begin to refill in stages to utilize waterfowl foods.

12/1 Fill and maintain.

Unit 14 B - Keep unit as high as possible to drown out salt cedars and other brush. Raise spillway by 1 ft.. Same

1/1 Maintain current full level.

6/1 Scheduled for early season grazing

6/1 Raise spillway level by 1 ft.

9/1 Stop inflow, Lower to concentrate food for fall migration and maintain

Unit 14 C - Keep water levels high to control salt cedar and Russian olives. Same

1/1 through 12/31 Keep unit as full as possible to maintain

trees and brush.

1/6 Scheduled for summer grazing.

Note: May want to dry out early in 1989, burn cattails and bulrush and then reflood. Evaluate condition in December 88 to see effect of high water on cattail and bulrush.

Unit 16 - Manage for deep water habitat and submergent vegetation. Maintain full as long as possible then allow natural drawdown. Same

1/1 Maintain at 3.00 as long as can get inflow from 14 A

4/1 Allow natural decline in level.

10/1 Reflood whenever water available from 14 A

Unit 20 A & B - Manage for moist soil plants and waterfowl feeding areas. Unit 20A pull 2 boards at 20A structure/week for next 3 weeks.

1/1 Maintain until ice-out, then fill up to spillway to establish new full levels.

4/15 Drain moist soil areas but leave water in borrow areas

6/15 Irrigate moist soil areas if necessary

10/1 Begin staging water up 3-4" every two weeks until full.

Unit 21 - Manage for submergent vegetation for waterfowl foods. Same

1/1 Maintain at current level

4/1 Raise to full level and maintain through summer

9/1 Begin to stage down 3-4" every two weeks to 1.90, then maintain.

Unit 22 - Control cattails by burning and flooding.

1/1 Maintain at current level with no boards in WCS

3/1 Lower until water below vegetation. (Will need to lower Unit 23 in order to lower 22 sufficiently.) Same

3/15 Burn unit as per burning plan

4/1 Reflood unit as soon as possible to cover cattail stems and maintain through growing season.

or leave unit completely dry if water not available to flood. It may be possible to reburn the water unit in late June to hurt cattails even more.

Unit 23 - Same Manage for submergent vegetation. Stage down in late summer for shorebirds and waterfowl. Raise again in mid-fall.

1/1 Maintain at current level until ice-out or 2/15

2/15 Lower unit about 1 ft. to facilitate lowering unit 22.

4/1 or as soon as unit 22 burned raise level to 3.10 and maintain through growing season

8/1 Begin staging down by 3" every week to 1.50 and maintain

11/1 Begin staging up by 3" every week to 3.10 and maintain

Unit 24 - Cattail control through grazing. Maintain low level through summer then flood in early winter. Same

1/1 Maintain current level through summer

5/15 Graze several times according to grazing plan

10/15 Begin staging up by 3-4" every two weeks until full.

Unit 25 - Manage for moist soil plants for winter and spring migration. pull 1 board/week after measuring with chuster rule or 25A

1/1 Maintain current level until ice-out, then raise level until water goes over natural spillway on NW side, establish gauge level for spillway. Then lower to 3.90 and maintain.

3/1 Begin staging down 3-4" per week until water is out of moist soil areas. Leave some water in borrow area near structure. Maintain through growing season.

9/1 Reflood deep water areas only.

12/1 Begin staging up by 3-4" per week to utilize waterfowl foods. Continue until full.

Unit 26 - Manage for resting and feeding area for waterfowl. Try for moist soil plants and cocklebur control. Same for now, pull all the boards May 1st.

1/1 Begin staging up by 3-4" per week until full

5/1 Fast drawdown. Remove water from moist soil areas only. Allow plants to germinate. When cockleburs are 3-4" tall reflood unit as fast as possible and hold for 3-5 days. Drain off moist soil areas. Check area for cocklebur control.

10/1 Begin staging up 3" per week to 3.20 and maintain.

Unit 28 - Control cattails by burning and flooding. Goose production. Pull all the boards to drain so we can clean out beaver activity Install cattle panel with stakes. Fill unit and flush.

1/1 Fill to at or near full level and maintain until geese hatch.

5/15 Begin staging down 3-4" per week until water remains only in borrow areas. Let cattail areas dry out.

8/1 Burn as soon as possible then begin staging up 2-3" per week to 3.0 to 3.5 and maintain through hunting season. Consider mowing or grazing cattails 1-2 weeks after burning.

Unit 29 - Manage for moist soil plants and public hunting. Pull one board at 29B. let set until May 1 or 2 pull 1 board/week

1/1 Maintain current level until ice-out, then fill another 3-5" and maintain.

5/1 Begin staging down by 3-4" per week to expose moist soil areas. Leave water in borrow areas.

7/15 Irrigate by quickly raising water to cover moist soil areas and then quickly lowering.

9/1 Raise level so that there is 3-4" of water on lowest plants. Maintain.

10/1 Begin to stage up 3-4" every two weeks until full.

Unit 30 - Manage for moist soil plants, waterfowl and shorebird use, and goose production. Pull one board per/week until around 6-7 in goose. Irrigate water in borrow areas

1/1 Maintain at or near full.

4/1 Begin staging down by 3" every two weeks to provide feeding areas for migrating shorebirds. Continue until water out of moist soil areas. Leave some water in borrow areas. Modify this schedule if needed should Canada geese nest

6/1 Complete drawdown if not done.

9/1 Begin staging up by 3" per week for waterfowl season.

10/15 Raise to 3.9 and maintain with flow through if possible.

Unit 40- Graze unit for cattail control and encourage moist soil plants for waterfowl foods. Provide public hunting opportunities. Pull one board and let set

☆ Do not discharge water through 40A until fall.

1/1 Fill unit to capacity when ice-out. Establish new full gauge reading.

4/15 Fast drawdown

5/1 Short duration grazing for cattail control. Do not graze water unit after June 15.

7/1 Irrigate moist soil plants if necessary.

9/1 Begin staging up for waterfowl season. Maintain at 2.90 through hunt season.

Unit 41 - Manage as intermittent wetland.

1/1 Maintain flow from unit 40A

3/15 Shut off flow from unit 40

10/15 Resume flow from unit 40 after first killing frost

Unit 48 - Manage for waterfowl food production.

Hold at current levels then draw down at May 1st.

1/1 After ice-out raise level 3-6" and hold

5/1 Stage down 3-4" every two weeks until water only in borrow areas. Area will be grazed for a short time.

8/1 Begin staging up 3-4" every two weeks as food is consumed.

11/1 Fill unit to capacity

Unit 49 - Manage for invertebrate production for waterfowl foods.

Hold at current levels then draw down quickly May 1st.

1/1 After ice-out, stage up to maximum depth, hold through spring migration.

5/1 Fast drawdown to expose moist soil areas, leave some water in borrow areas, graze unit separate from rest of paddock for short time

8/1 Quickly flood mature vegetation (cockleburs)

9/15 Begin to stage down to concentrate food. Lower 3-4" per week to about 2.5 and hold.

Note: May need to reverse 48 & 49 due to water flow patterns

Unit 57 - Manage for waterfowl and to drown out cattails.
Natural Marsh area.
1/1 Keep unit full as long as possible with flow through. from 61E.

If unable to keep full because of management of unit 61, allow natural decline. Refill in fall as soon as possible.

6/1 Build diversion to unit from junction of Rattlesnake canal and West canal.

Unit 58 - Maintain water levels to encourage over-water nesters. Lower after nesting to concentrate food and provide roosting sites. Keep full through summer. If above 3.4-3.7 pull one 2x4.
Maintain at 3.00.
1/1 Begin to stage up after ice-out. Fill by 4/1.

7/15 Begin to stage down, 3-4" every two weeks to 1.00 then hold level.

11/1 Depending on management of BSM either hold at 1.00 level or begin to stage up while maintaining some flow northward.

Unit 61 - Maintain as full as possible to drown out cattails and provide goose production area. Same for cattails.

1/1 Maintain at full level with outflow to units 57 and 63

4/1 If funding is available for water control structure rehab drain unit for work to begin in June. Flood in fall.

If rehab funding is not available maintain full level.
Shut RCA canal structure. Open [illegible] gate and close one board (1') radial gates.
Unit 62 - Manage for waterfowl. Use grazing for cattail control.
Pull 1 board
1/1 Fill unit to capacity and establish new full level for gauge

4/15 Fast drawdown

5/1 Graze for short periods, several times prior to June 15.

7/1 Irrigate moist soil plants if needed

9/1 Stage up 3-4" every two weeks to 2.80 for hunting season and hold.

Unit 63 - Manage for waterfowl food production.
Continue to drop 6"-8"/week until May then drain [illegible]
1/1 After ice-out continue to stage up to full level by 5/1

5/1 Maintain full level through growing season.

8/15 Begin to stage down 3-4" per week to concentrate waterfowl foods. Stop lowering at 3.00 and hold.

Unit 73 - No management

Unit 75 - Manage for production of submergent vegetation and for resting areas for waterfowl. Same management + If any fuller than 3.24 pull one board

1/1 After ice-out evaluate carp control efforts.
Begin staging up 3-4" every two weeks until at capacity

5/1 Maintain full level through growing season

8/15 Stage down a total of 6-8" over next 30 days to concentrate food and make submergents available.

10/15 Depending on carp need for control efforts either maintain at 2.2-2.5 or draw down completely.

Unit 77 - No management other than to monitor wildlife use.

Unit 78 - Manage for waterfowl and shorebird use. Maintain sheet flow throughout winter, spring and early summer. Dry out during July. Resume sheet flow as water available.

1/1 Maintain sheet flow from units 75 and 58

6/15 Shut-off inflow and permit to dry out

8/1 Resume sheet flow as soon as possible and for as long as possible to encourage shorebird and waterfowl use.

Unit 80 - Maintain at current level through late winter. Lower for shorebird migration and then drain. Refill for hunting season. Install gauge on structure when unit drained.

1/1 Maintain full

3/1 Begin staging down 3-4" per week to 2.0 and hold

5/15 Pull all boards and drain unit. Put gauge in.

9/1 Begin refilling from unit 58 to full by 10/15. Maintain through hunting season.

Unit 83 - No water management except in conjunction with unit 80. Area will be burned according to prescribed burning plan.

Dead Horse Slough - Maintain full level du[illegible] or

waterfowl. Drain for crop planting in summer.

1/1 Maintain current full level

3/1 Shut off flow from Darrynane Canal

4/1 Pull all boards and drain

10/15 After harvest completed reflood to full level. (This will take approximately six weeks from time start diverting water)

Exhibit D
Exhibit D
Acre Feet / Month (x 10 for annual AF)
A.F / Year - Annual Totals
10,000
9000
8000
7000
6000
5000
4000
3000
2000
1000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
12750
17250
18560
3948
6879
10229
codex GRAPH PAPER
IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062
PRINTED IN U.S.A.
NO. 4156. TEN YEARS BY MONTHS X 100 DIVISIONS.
DEC. JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV.
1983
1984
1985
1986
1987
1988
1989
1990
19
19
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Exhibit D

Monthly A.F. (x 10 for annual A.F.)

10,000 9000 8000 7000 6000 5000 4000 3000 2000 1000

90,000 80,000 70,000 60,000 50,000 40,000 30,000 20,000 10,000

Annual Total - A.F.

16740

13001

3500 6000 7800 9345 6846 7187 10063 8787

DEC. JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV. DEC.

1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972

Macksville gage - annual
Macksville gage - monthly
Zenith gage - annual
Zenith gage - monthly
Regression Analysis
Raymond gage - annual
Raymond gage - monthly
Annual quan. used as reported by US Fish & Wildlife

Acre Feet/month (x 10 for annual AF)

10000 9000 8000 7000 6000 5000 4000 3000 2000 1000

100 90 80 70 60 50 40 30 20 10 0

100,000 90,000 80,000 70,000 60,000 50,000 40,000 30,000 20,000 10,000

Acre Feet/Yr. - Annual Totals

DEC. JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV. DEC.

19 73 | 19 74 | 19 75 | 19 76 | 19 77 | 19 78 | 19 79 | 19 80 | 19 81 | 19 82

8787 3757 4355 7451 4096 8463 5057 6809 3381 9378 3948

Mack[illegible] 111,930 AF
Zen[illegible] -not full year
Raymond 155,850 AF

Exhibit C

KANSAS STATE BOARD OF AGRICULTURE

Division of Water Resources

MEMORANDUM

TO: Bruce Falk
Wayland Anderson

DATE: July 22, 1991

FROM: James O. Bagley JOB
Section Head
Technical Services

RE: Flows on Rattlesnake Creek

Per Wayland Anderson's July 15, 1991 request, I have examined flow records for Rattlesnake Creek. Flow records are available for the Rattlesnake Creek near Macksville from October 1959 through July 1987 on the Hydrodata CD-ROM optical disk system. Flow records for the Rattlesnake Creek near Raymond are available from May 1960 through July 1987 on the same Hydrodata system. Flow records are available for June 1973 through September 1987 for the Rattlesnake Creek near Zenith on the same Hydrodata system. Attached are tabulations of monthly flow volumes for these three stations for the periods of record indicated. Please note that the years which head the various columns are water years, which means that the data for October, November and December correspond to calendar years which are numerically one less than the water years.

Also attached is a comparison of flows for these three stations for the periods of records indicated and a regression analysis. Flow data from October 1974 through September 1986 was used for each of the regressions. The first regression uses the monthly flow volumes near Macksville as the independent variable and the monthly flow volumes near Zenith as the dependent variable. This regression has an R-squared of about .79 which indicates an excellent correlation. The coefficient and constant for this regression are shown on the attached table. The second regression uses the monthly flow volumes near Raymond as the independent variable and the monthly flow near Zenith as the dependent variable. This regression has an R-squared of about .83, also indicating an excellent correlation. The coefficient and constant for this regression are also shown on the attached table. The third regression uses the monthly flow volumes near Macksville and near Raymond as two independent variables with the monthly flow volumes near Zenith as the dependent variable. This regression has an R-squared of about .91 indicating an exceptional degree of correlation. The coefficients and the constant for this regression are shown on the attached table.

Also on the attached table are the regression-predicted monthly flow volumes for Zenith using the three different regressions. Although the period of record used to predict these flows is, as indicated earlier, October 1974 through September 1986, the regression predictions were used to predict the flows at Zenith for the period October 1959 through

July 1987. The predictions for 1973 through 1987 are shown merely for comparison. I believe the third regression is the best to use if you need to estimate the monthly flow volumes available at Zenith for the period 1960 through 1972. You should disregard the predicted flow volumes for all three regressions for October 1959 through April 1960 since no records for Raymond are indicated for that period.

While these regressions appear to very good, nonetheless they must be used with caution since there are no other factors included than the flows at the upstream and downstream stations. Statistical correlations, while useful, are not definitive. If data are needed for water years 1988 and later, please let me know and I'll update the tables.

JOB:pg

Rattlesnake Creek Near Hutchville, Kansas

Monthly Flow Volumes (acre-feet) 1.98347 ac-ft/cfs-day

Month	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Oct	3392	1829	1881	2389	1843	732	980	537	1273	1698	1337	566	469
Nov	2867	1757	2013	2071	1644	1456	1657	614	461	487	1172	661	1757
Dec	2202	1892	1896	2176	1714	1416	1349	728	556	429	1186	674	1855
Jan	2180	1797	2055	2509	1682	1275	1365	799	577	566	1154	699	962
Feb	2606	1726	1813	2807	1664	1387	1723	696	572	595	1018	1966	849
Mar	8333	2867	2013	2196	1551	1357	1288	752	598	916	1242	1773	827
Apr	3699	1758	1907	1907	1581	1490	1899	724	448	1226	1712	881	764
May	4497	2033	1438	1541	1284	1298	986	515	447	1545	1142	845	767
Jun	3961	1690	3423	7696	900	1880	541	1657	243	812	932	753	475
Jul	1930	1699	2287	1785	553	1127	456	650	211	410	572	1189	1079
Aug	1634	2507	2085	1299	648	760	656	197	33	2547	283	624	2320
Sep	1174	1958	5880	7642	662	932	601	398	17	5175	295	236	1972
Ann Tot	37595	23803	28431	34949	15367	15138	11519	8267	5437	16407	12845	10786	13296
Yearly Statistics													
Minimum	1174	1690	1438	1299	553	732	456	197	17	410	283	236	469
Mean	3133	1967	2369	2912	1281	1262	960	689	453	1367	1004	899	1108
Maximum	8333	2507	5880	7696	1843	1880	1365	1657	1273	5175	1712	1966	2320

Month	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Oct	549	19793	2297	1876	1260	1012	618	495	409	167	41	142	29	1555	309
Nov	740	7045	2569	2055	1394	1109	700	1688	420	573	87	259	57	416	315
Dec	825	7642	2547	2140	1593	1210	859	1111	619	485	145	276	54	387	361
Jan	950	5786	2636	1974	1412	1323	774	1137	676	557	154	325	162	411	395
Feb	1218	3980	2390	2001	1377	1359	916	1198	625	594	238	343	300	396	372
Mar	11530	5339	2533	2011	1571	1898	1545	1613	780	720	341	531	381	379	6886
Apr	14696	1840	2418	4219	1408	1626	1591	2001	702	572	599	871	416	362	2787
May	3497	8939	2438	4913	9479	9539	1505	1902	850	625	2493	1103	528	254	1765
Jun	2291	3488	14757	2521	4627	7672	1186	2785	1066	1079	3757	653	936	534	1162
Jul	1797	2358	3745	2210	1331	1474	2045	786	725	390	559	83	256	57	4443
Aug	1505	2348	4203	1408	938	943	982	502	245	47	64	22	26	1962	+
Sep	39945	2291	2446	1150	986	521	463	299	58	10	51	14	10	328	+
Ann Tot	79543	70762	44977	28479	27375	29484	13184	15517	7174	5822	8529	4621	3156	7041	+
Yearly Statistics															
Minimum	549	2291	2297	1150	938	521	463	299	58	10	41	14	10	57	
Mean	6629	5897	3748	2373	2281	2457	1099	1293	598	485	711	385	263	587	
Maximum	39945	19793	14757	4913	9479	9539	2045	2785	1066	1079	3757	1103	936	1962	

Rattlesnake Creek Near Zenith, Kansas

Monthly Flow Volumes (acre-feet) 1.98347 ac-ft/cfs-day

Month	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Oct		42462	3281	2025	2039	2408	734	400	146	443	336	187	210	3655	1327
Nov		10998	3955	3211	2612	2648	1676	2636	540	2077	507	538	195	1333	1198
Dec		16592	5064	3542	3804	3011	2033	2206	1448	1551	693	520	967	1593	1436
Jan		11780	4963	3221	2342	3126	1712	2460	1355	1541	902	1064	528	1706	1388
Feb		7809	4790	3759	2654	3215	2561	3431	1192	2650	1615	1214	1313	1581	1658
Mar		10667	5050	3429	3235	5667	4618	5732	1642	2337	1785	3771	1595	1513	12754
Apr		9556	4937	16181	3550	3100	3425	5899	1260	1553	4495	4314	1860	1392	7860
May		6468	4011	11643	9848	7418	2995	3660	2884	2223	4213	2945	2836	1006	3784
Jun	2505	4750	10536	4147	8699	13250	1970	2955	2747	2132	5278	1188	1420	978	2398
Jul	2335	2394	8087	4863	2840	1878	1513	936	1255	1349	1027	384	516	2798	6641
Aug	2073	2797	4889	1410	2013	674	2007	487	518	399	184	93	611	872	3289
Sep	106657	3072	3616	1968	2600	539	409	166	326	254	136	51	357	1065	1706
Ann Tot		129346	63177	59401	46239	46934	25652	30968	15312	18510	21170	16268	12409	19492	45439
Yearly Statistics															
Minimum		2394	3281	1410	2013	539	409	166	146	254	136	51	195	872	1198
Mean		10779	5265	4950	3853	3911	2138	2581	1276	1542	1764	1356	1034	1624	3787
Maximum		42462	10536	16181	9848	13250	4618	5899	2884	2650	5278	4314	2836	3655	12754

Period of Record Statistics (1974-87)

Minimum	51
Mean	3276
Maximum	42462

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Rattlesnake Creek Near Raymond, Kansas

Monthly Flow Volumes (acre-feet) 1.98347 ac-ft/cfs-day

Month	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Oct	0	1769	2859	4774	2949	38	851	182	288	2877	3255	636	215
Nov	0	2828	5907	3683	2877	725	1662	145	330	1668	2981	330	2493
Dec	0	3894	5155	4386	2223	3063	4153	135	858	1187	3698	321	6063
Jan	0	3348	5982	3663	3154	2353	6138	1751	1748	1730	2958	698	3198
Feb	0	4187	6075	4812	2705	4530	5716	1436	1736	2769	2388	2797	2388
Mar	0	4915	6570	4257	2622	2967	5226	722	1343	5824	2343	5770	1215
Apr	0	4387	3420	2464	2539	3486	2965	2791	940	4013	6188	1885	633
May	7020	6389	1916	1468	2159	2795	1251	734	898	4074	2276	1791	2941
Jun	7821	2789	5330	7702	1298	16739	366	3214	328	2160	3437	1704	1568
Jul	2295	4102	3796	6581	56	2916	497	6514	82	682	394	536	629
Aug	1095	9824	2521	986	130	384	489	466	23	3055	97	734	276
Sep	622	3825	4858	6512	181	586	264	271	3	15471	136	64	875
Ann Tot	0	51441	61586	61156	21302	40381	24688	18369	8561	44619	33823	17181	21334

Yearly Statistics

Minimum	1769	1916	986	56	38	264	135	3	682	97	64	215
Mean	4287	4299	4262	1767	3365	2057	1530	713	3718	2753	1428	1778
Maximum	9824	6075	7702	3154	16739	5716	6514	1740	15471	6188	5770	4003

Month	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Oct	174	35276	2220	1538	247	1783	142	178	111	271	220	171	108	4301	1217
Nov	1567	13488	4015	2553	649	3047	231	1164	143	1753	202	231	127	1390	981
Dec	2650	17661	3941	3031	1482	3439	236	2198	189	1620	228	131	382	1926	916
Jan	4633	14584	5722	3562	2140	3312	172	3626	168	1295	318	361	268	2352	2368
Feb	5948	9786	5788	2977	2694	3685	1498	5322	285	3289	2920	1349	985	1886	1968
Mar	11166	12666	6115	4411	3110	7605	7014	7952	1315	3572	3314	4266	912	1148	17232
Apr	13647	12583	5296	6524	3277	3088	5697	13866	1028	1444	7688	6518	1783	1261	18561
May	11115	7656	4118	15715	5316	5183	2938	3110	3790	3467	5421	5064	5290	957	5472
Jun	2668	6274	6722	4691	6478	6651	836	1447	2883	8031	6680	654	1212	797	847205
Jul	2039	2202	8638	4502	3372	1536	326	470	523	2614	411	248	297	1501	5939
Aug	1268	3084	3318	649	696	291	676	215	200	401	141	108	321	118	+
Sep	16922	2115	3671	157	1679	117	77	93	143	176	114	127	185	243	+
Ann Tot	93797	137376	59564	50311	31138	39738	19841	39640	10778	27934	27658	19228	11870	17883	+

Yearly Statistics

Minimum	174	2115	2220	157	247	117	77	93	111	176	114	108	108	118
Mean	7816	11448	4964	4193	2595	3311	1653	3303	898	2328	2305	1602	989	1490
Maximum	23647	35276	8638	15715	6478	7605	7014	13866	3790	8031	7688	6518	5290	4301

Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
1960	Oct	3392	-0-		5838	293	2766
	Nov	2067	-0-		3793	293	1719
	Dec	2202	-0-		4001	293	1825
	Jan	2108	-0-		3858	293	1752
	Feb	2608	-0-		4629	293	2147
	Mar	8333	-0-		13462	293	6670
	Apr	3699	-0-		6312	293	3009
	May	4497	7020		7542	6831	7644
	Jun	3951	7821		6701	7578	7670
	Jul	1930	2295		3582	2431	2920
	Aug	1634	1095		3126	1313	2002
	Sep	1174	622		2416	872	1368
1961	Oct	1829	1769		3426	1941	2540
	Nov	1757	2820		3316	2920	3083
	Dec	1892	3894		3524	3920	3802
	Jan	1797	3340		3377	3404	3411
	Feb	1720	4187		3258	4193	3833
	Mar	2067	4915		3793	4871	4523
	Apr	1755	4387		3313	4380	3976
	May	2033	6389		3741	6244	5337
	Jun	1490	2789		2903	2891	2854
	Jul	1599	4102		3071	4114	3689
	Aug	2507	9824		4473	9444	7671
	Sep	1958	3025		3625	3110	3358
1962	Oct	1801	2059		3383	2211	2683
	Nov	2013	5907		3711	5795	5046
	Dec	1896	5155		3530	5095	4525
	Jan	2055	5982		3775	5865	5122
	Feb	1813	6075		3401	5952	4984
	Mar	2013	4570		3711	4550	4284
	Apr	1807	3420		3392	3478	3464
	May	1438	1916		2823	2078	2315
	Jun	3423	5338		5887	5265	5836
	Jul	2287	3786		4133	3820	4053
	Aug	2085	2521		3821	2641	3171
	Sep	5800	4858		9553	4818	7440
1963	Oct	2309	4774		4167	4740	4634
	Nov	2071	3683		3799	3724	3823
	Dec	2176	4308		3962	4306	4263
	Jan	2509	3663		4476	3705	4158
	Feb	2007	4812		3701	4775	4417
	Mar	2106	4257		3854	4258	4179
	Apr	1807	2404		3392	2532	2885
	May	1541	1468		2982	1660	2141
	Jun	7696	7702		12479	7467	10561
	Jul	1785	6581		[illegible]	[illegible]	[illegible]
	Aug	1299	986		2609	1211	1675
	Sep	7642	6512		12397	6359	9840
1964	Oct	1843	2049		4147	2221	2711
	Nov	1644	2077		3141	2227	2570

Regression 1: Oct 1974 - Sep 1986
X = Macksville
Y = Zenith

Constant	604.1119
Std Err of Y Est	2007.502
R Squared	0.789478
No. of Observations	156
Degrees of Freedom	154
X Coefficient(s)	1.543048
Std Err of Coef.	0.064209

Regression 2: Oct 1974 - Sep 1986
X = Raymond
Y = Zenith

Constant	292.9226
Std Err of Y Est	1798.4
R Squared	0.83105
No. of Observations	156
Degrees of Freedom	154
X Coefficient(s)	0.931486
Std Err of Coef.	0.033844

Regression 3: Oct 1974 - Sep 1986
X1 = Macksville
X2 = Raymond
Y = Zenith

Constant	85.55773	
Std Err of Y Est	1292.483	
R Squared	0.913303	
No. of Observations	156	
Degrees of Freedom	153	
X Coefficient(s)	0.790255	0.570492
Std Err of Coef.	0.065592	0.038593

53384

63

53102

Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
	Dec	1714	2233		3248	2373	2714
	Jan	1682	3154		3199	3231	3214
	Feb	1464	2705		2863	2813	2786
	Mar	1551	2622		2997	2735	2807
	Apr	1501	2539		2921	2658	2721
	May	1204	2159		2462	2304	2268
	Jun	900	1298		1993	1502	1537
	Jul	553	56		1457	345	554
	Aug	648	130		1604	414	672
	Sep	662	181		1626	461	712
1965	Oct	732	38		1733	329	686
	Nov	1456	725		2851	968	1649
	Dec	1416	3003		2789	3090	2918
	Jan	1275	2352		2572	2484	2435
	Feb	1307	4530		2621	4513	3703
	Mar	1357	2987		2698	3075	2862
	Apr	1498	3406		2915	3465	3212
	May	1398	2795		2762	2896	2785
	Jun	1880	16739		3506	15885	11121
	Jul	1127	2916		2343	3009	2639
	Aug	760	304		1777	576	860
	Sep	932	586		2043	839	1157
1966	Oct	980	851		2116	1085	1345
	Nov	1037	1662		2205	1841	1854
	Dec	1349	4153		2685	4162	3521
	Jan	1365	4138		2710	4147	3524
	Feb	1323	5716		2646	5618	4392
	Mar	1208	3326		2468	3391	2938
	Apr	1099	2065		2300	2216	2132
	May	906	1251		2003	1458	1515
	Jun	541	366		1438	634	722
	Jul	455	407		1306	672	677
	Aug	656	489		1616	748	883
	Sep	601	264		1532	539	711
1967	Oct	537	182		1432	463	613
	Nov	614	145		1552	428	654
	Dec	728	135		1727	418	738
	Jan	799	1751		1838	1924	1716
	Feb	696	1436		1678	1631	1455
	Mar	752	722		1764	966	1092
	Apr	724	2791		1721	2892	2250
	May	515	734		1399	976	911
	Jun	1657	3214		3161	3287	3229
	Jul	650	6514		1607	6360	4315
	Aug	197	466		96	727	507
	Sep	398	271		1218	545	554
1968	Oct	1273	288		2569	562	1256
	Nov	461	330		1	600	638
	Dec	556	858		1462	1092	1014
	Jan	577	1740		495	1913	1534

64 22524

65 37494

66 19499

67 18937

Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
	Feb	572	1736		1487	1910	1528
	Mar	598	1343		1527	1544	1324
	Apr	448	940		1295	1169	976
	May	447	890		1295	1122	947
	Jun	243	328		979	598	464
	Jul	211	82		930	369	299
	Aug	33	23		655	314	125
	Sep	17	3		630	296	100
1969	Oct	1698	2877		3225	2972	3069
	Nov	487	1668		1356	1847	1422
	Dec	429	1107		1266	1324	1056
	Jan	566	1730		1477	1904	1519
	Feb	595	2769		1523	2872	2136
	Mar	916	5024		2018	4973	3676
	Apr	1226	4013		2496	4031	3343
	May	1545	4074		2988	4088	3631
	Jun	812	2150		1858	2296	1954
	Jul	410	682		1237	928	799
	Aug	2547	3055		4535	3139	3841
	Sep	5175	15471		8589	14704	13001
1970	Oct	1337	3255		2667	3325	2999
	Nov	1172	2981		2413	3070	2713
	Dec	1186	3600		2434	3646	3077
	Jan	1154	2959		2385	3050	2686
	Feb	1018	2366		2174	2497	2240
	Mar	1242	3342		2520	3406	2973
	Apr	1712	8188		3245	7920	6109
	May	1142	2276		2367	2413	2287
	Jun	932	3437		2043	3495	2783
	Jul	572	394		1487	660	762
	Aug	283	97		1040	384	364
	Sep	295	136		1059	420	396
1971	Oct	566	636		1477	886	896
	Nov	661	330		1624	600	796
	Dec	674	321		1645	592	802
	Jan	699	608		1682	859	985
	Feb	1966	2797		3637	2898	3234
	Mar	1773	5778		3340	5675	4783
	Apr	881	1803		1963	1972	1810
	May	845	1791		1908	1961	1775
	Jun	753	1704		1766	1880	1653
	Jul	1109	536		2315	792	1267
	Aug	624	734		1567	976	997
	Sep	236	64		968	353	309
1972	Oct	469	215		1528	590	579
	Nov	1757	3493		3316	3547	3467
	Dec	1055	4003		2232	4021	3203
	Jan	962	3180		2488	3396	2660
	Feb	849	2309		1914	2443	2074
	Mar	827	1213		1880	1423	1431

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Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith		Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
	Apr	764	633			1782	882	1050
	May	767	2941			1788	3033	2370
	Jun	475	1568			1337	1753	1355
	Jul	1079	629			2270	879	1297
	Aug	2320	276			4183	550	2076
	Sep	1972	875			3646	1108	2143
1973	Oct	549	174			1451	455	618
	Nov	740	1567			1740	1753	1564
	Dec	825	2650			1877	2761	2249
	Jan	950	4633			2070	4609	3480
	Feb	1218	5948			2483	5834	4442
	Mar	11530	21166			18395	20008	21272
	Apr	14696	23647			23280	22320	25189
	May	3497	11115			6000	10647	9190
	Jun	2291	2668	2505		4139	2778	3418
	Jul	1797	2039	2335		3377	2192	2669
	Aug	1505	1268	2073		2927	1474	1999
	Sep	39945	16922	106657		62241	16055	41306
1974	Oct	19793	35276	42462		31146	33152	35852
	Nov	7045	13488	10998		11475	12856	13348
	Dec	7642	17661	16592		12397	16744	16200
	Jan	5786	14584	11780		9532	13878	12978
	Feb	4980	9786	7809		8289	9409	9605
	Mar	6339	12666	10667		10386	12092	12321
	Apr	4840	12583	9556		8072	12014	11089
	May	3939	7656	6468		6682	7425	7566
	Jun	3400	6274	4750		5850	6137	6351
	Jul	2358	2202	2394		4243	2344	3205
	Aug	2348	3084	2797		4228	3166	3701
	Sep	2291	2115	3072		4139	2263	3102
1975	Oct	2297	2220	3281		4148	2361	3167
	Nov	2569	4015	3955		4568	4032	4406
	Dec	2547	3941	5064		4534	3964	4347
	Jan	2636	5722	4963		4672	5623	5433
	Feb	2390	5788	4790		4292	5684	5276
	Mar	2533	6115	5050		4512	5989	5576
	Apr	2418	5296	4937		4335	5226	5018
	May	2438	4118	4011		4366	4128	4361
	Jun	14757	6722	10536		23375	6554	15582
	Jul	3745	8638	8087		6383	8339	7973
	Aug	4203	3318	4889		7089	3384	5300
	Sep	2446	3671	3616		4378	3713	4113
1976	Oct	1876	1538	2025		3499	1726	2446
	Nov	2055	2553	3211		3776	2671	3166
	Dec	2140	3031	3542		3906	3116	3506
	Jan	1974	3562	3221		3649	3611	3677
	Feb	2001	2977	3759		3693	3066	3366
	Mar	2011	4411	3429		3788	4002	4192
	Apr	4219	6524	16181		7114	6370	7141
	May	4913	15715	11643		8185	14931	12933

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20887

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Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
	Jun	2521	4691	4147	4494	4662	4754
	Jul	2210	4502	4863	4014	4487	4400
	Aug	1408	649	1410	2777	898	1569
	Sep	1150	157	1968	2379	439	1084
1977	Oct	1260	247	2039	2548	523	1222
	Nov	1394	649	2612	2756	897	1558
	Dec	1593	1482	3804	3062	1673	2189
	Jan	1412	2140	2342	2783	2286	2423
	Feb	1377	2694	2654	2728	2802	2710
	Mar	1571	3110	3235	3028	3190	3101
	Apr	1408	3277	3550	2777	3345	3068
	May	9479	5316	9848	15231	5244	10609
	Jun	4627	6478	8699	7744	6327	7438
	Jul	1331	3372	2840	2658	3434	3061
	Aug	938	696	2013	2051	941	1223
	Sep	986	1679	2600	2125	1857	1822
1978	Oct	1012	1783	2408	2165	1954	1902
	Nov	1109	3047	2648	2315	3131	2700
	Dec	1210	3439	3011	2471	3497	3004
	Jan	1323	3312	3126	2646	3378	3021
	Feb	1359	3685	3215	2701	3726	3262
	Mar	1898	7605	5667	3533	7377	5924
	Apr	1426	3088	3100	2805	3170	2974
	May	9539	5183	7418	15322	5121	10580
	Jun	7672	6651	13250	12442	6488	9943
	Jul	1474	1536	1878	2878	1724	2127
	Aug	943	291	674	2059	564	997
	Sep	521	117	539	1408	402	564
1979	Oct	618	142	734	1558	425	655
	Nov	700	231	1676	1684	508	770
	Dec	859	236	2033	1929	513	899
	Jan	774	172	1712	1798	453	795
	Feb	916	1498	2561	2018	1688	1664
	Mar	1545	7014	4618	2988	6826	5308
	Apr	1591	5697	3425	3059	5599	4592
	May	1505	2938	2995	2927	3029	2951
	Jun	1186	836	1970	2434	1071	1500
	Jul	2045	326	1513	3760	596	1888
	Aug	982	676	2007	2119	923	1247
	Sep	463	77	409	1318	364	495
1980	Oct	495	178	400	1369	459	579
	Nov	1688	1164	2636	3209	1377	2084
	Dec	1111	2198	2206	2318	2340	2217
	Jan	1137	3626	2460	2358	3670	3052
	Feb	1198	5322	[illegible]	[illegible]	5250	4068
	Mar	1613	7952	5732	3092	7700	5896
	Apr	2801	13866	5899	3692	13209	9578
	May	1902	3110	3660	[illegible]	3190	3363
	Jun	2785	1447	2955	[illegible]	1640	3111
	Jul	786	470	936	1818	731	975

Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
	Aug	502	215	487	1379	493	605
	Sep	299	93	166	1065	379	375
1981	Oct	409	111	146	1236	397	473
	Nov	420	143	540	1252	426	499
	Dec	619	189	1448	1559	469	683
	Jan	676	168	1355	1648	450	716
	Feb	625	285	1192	1568	559	742
	Mar	780	1315	1642	1807	1518	1452
	Apr	702	1028	1260	1687	1251	1227
	May	850	3790	2884	1915	3823	2919
	Jun	1066	2883	2747	2249	2978	2573
	Jul	725	523	1255	1722	780	956
	Aug	245	200	518	982	479	393
	Sep	58	143	326	693	426	213
1982	Oct	167	271	443	862	545	372
	Nov	573	1753	2077	1489	1926	1539
	Dec	485	1620	1551	1352	1802	1393
	Jan	557	1295	1541	1464	1499	1265
	Feb	594	3289	2650	1521	3356	2431
	Mar	720	3572	2337	1715	3620	2692
	Apr	572	1444	1553	1486	1638	1361
	May	626	3467	2223	1571	3523	2559
	Jun	1079	8031	2132	2269	7774	5520
	Jul	390	2614	1349	1206	2728	1885
	Aug	47	401	399	677	666	352
	Sep	10	176	254	620	457	194
1983	Oct	41	220	336	667	497	243
	Nov	87	202	507	738	481	270
	Dec	145	228	693	828	505	330
	Jan	154	318	902	842	589	389
	Feb	238	2920	1615	972	3013	1939
	Mar	341	3314	1785	1131	3380	2246
	Apr	599	7688	4495	1528	7454	4945
	May	2493	5421	4213	4451	5342	5148
	Jun	3757	6680	5278	6401	6516	6865
	Jul	559	411	1027	1466	676	762
	Aug	64	141	184	703	424	217
	Sep	51	114	136	683	399	191
1984	Oct	142	171	187	823	452	295
	Nov	259	231	538	1004	508	422
	Dec	276	131	520	1030	415	378
	Jan	325	361	1064	1106	629	548
	Feb	343	1349	1214	1133	1549	1126
	Mar	531	4266	3771	1423	4267	2939
	Apr	871	6518	4[illegible]	[illegible]	[illegible]	4492
	May	1103	5064	2945	2306	5010	3846
	Jun	653	654	1188	1612	902	975
	Jul	83	248	384	7[illegible]	524	293
	Aug	22	108	93	638	394	165
	Sep	14	127	51	6[illegible]	411	169

Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
1985	Oct	29	108	210	649	393	170
	Nov	57	127	195	693	411	203
	Dec	54	382	967	688	649	347
	Jan	162	268	528	854	543	366
	Feb	300	985	1313	1067	1210	884
	Mar	381	912	1595	1191	1143	907
	Apr	416	1783	1860	1246	1954	1432
	May	528	5290	2836	1419	5220	3521
	Jun	936	1212	1420	2048	1422	1517
	Jul	256	297	516	999	569	457
	Aug	26	321	611	644	592	289
	Sep	10	185	357	620	465	199
1986	Oct	1555	4301	3655	3003	4299	3768
	Nov	416	1390	1333	1245	1588	1207
	Dec	387	1926	1593	1202	2087	1490
	Jan	411	2352	1706	1238	2484	1752
	Feb	396	1886	1581	1216	2050	1475
	Mar	379	1148	1513	1189	1363	1040
	Apr	362	1261	1392	1162	1468	1091
	May	254	957	1006	997	1185	833
	Jun	534	797	978	1428	1035	962
	Jul	57	1501	2798	692	1691	987
	Aug	1962	118	872	3631	403	1703
	Sep	328	243	1065	1110	520	484
1987	Oct	309	1217	1327	1080	1427	1024
	Nov	315	981	1198	1090	1207	894
	Dec	361	916	1436	1161	1146	893
	Jan	395	2368	1388	1214	2499	1749
	Feb	372	1968	1658	1177	2126	1502
	Mar	6886	17232	12754	11230	16345	15358
	Apr	2787	18561	7860	4904	17583	12877
	May	1765	5472	3784	3328	5390	4603
	Jun	1162	847205	2398	2398	789453	484328
	Jul	4443	5939	6641	7460	5825	6985
	Aug	~~0~~	~~0~~	3289	~~604~~	~~293~~	~~86~~
	Sep	~~0~~	~~0~~	1706	~~604~~	~~293~~	~~86~~

Rattlesnake Creek -- Flow Comparisons & Regression Analysis

Water Year	Month	Observed Monthly Flow Volumes (Acre-feet) Macksville	Raymond	Zenith	Regression Predicted Flow Volumes For Zenith (Acre-feet) Reg #1	Reg #2	Reg #3
1985	Oct	29	108	210	649	393	170
	Nov	57	127	195	693	411	203
	Dec	54	382	967	688	649	347
	Jan	152	268	528	854	543	366
	Feb	300	985	1313	1067	1210	884
	Mar	391	912	1595	1191	1143	907
	Apr	416	1783	1860	1216	1954	1432
	May	528	5290	2836	1419	5220	3521
	Jun	936	1212	1420	2048	1422	1517
	Jul	256	297	516	999	569	457
	Aug	26	321	611	644	592	289
	Sep	10	185	357	620	465	199
1986	Oct	1555	4301	3655	3003	4299	3768
	Nov	416	1390	1333	1245	1588	1207
	Dec	337	1926	1593	1202	2087	1490
	Jan	411	2352	1706	1238	2484	1752
	Feb	396	1886	1531	1216	2050	1475
	Mar	379	1148	1513	1189	1363	1040
	Apr	362	1261	1392	1162	1468	1091
	May	254	957	1006	997	1185	833
	Jun	534	797	978	1428	1035	962
	Jul	57	1501	2798	692	1691	987
	Aug	1962	118	872	3631	403	1703
	Sep	328	243	1065	1110	520	484
1987	Oct	309	1217	1327	1080	1427	1024
	Nov	315	981	1198	1090	1207	894
	Dec	361	916	1436	1161	1146	893
	Jan	395	2368	1388	1214	2499	1749
	Feb	372	1968	1658	1177	2126	1502
	Mar	6886	17232	12754	11230	16345	15358
	Apr	2787	18561	7860	4904	17583	12877
	May	1765	5472	3794	3328	5390	4603
	Jun	1162	847205	2398	2398	789453	484328
	Jul	4443	5939	6641	7460	5825	6985
	Aug	~~0~~	~~0~~	3289	~~604~~	~~293~~	~~86~~
	Sep	~~0~~	~~0~~	1706	~~604~~	~~993~~	~~86~~

Exhibit B

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:

BA/WTR
Mail Stop 60189
KS30.00.30

FEB 13 1992

Bruce Falk, District Commissioner
Kansas Division of Water Resources
Stafford, Kansas 67578

Dear Bruce,

Enclosed is the information we discussed during the WATERPAK tour of the Rattlesnake Creek Basin on February 8, 1992. The area and capacity information is derived from old water management plans for the Quivira National Wildlife Refuge. The area figures are based on aerial photographs according to the map legends, but we do not seem to have copies of those photographs. Canal lengths were planimetered from Refuge maps, and the canal and structure elevations were determined during a survey we conducted in February 1991.

The Water Resources Division has recently developed cost estimates for survey work to collect cross-sectional information for the Refuge impoundments. We will also be checking the surface areas of the pools if we can get good aerial photography. Therefore, this information should be considered provisional, especially for the Little and Big Salt Marshes. We hope to have the new information this spring, depending on our budget.

I have also enclosed some items that might be of interest to you. Although they do not hold a candle to the wonderful license plate, they were the best available. I will send you a picture after I get the license plate mounted on my truck (next to the "I LOVE MY MOTORCYCLE" sticker).

If you have any questions, or if we can provide you with any additional information, please call me at (303)236-5322.

Sincerely,

Megan Estep-Johnston
Supervisory Refuge Hydrologist

Enclosures

cc: EN-Williss (60190) w/o enclosures
Project Leader, Quivira NWR (64620) w/o enclosures

Exhibit A

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:

BA/EN
WR KS
Mail Stop 60190

JUL 18 1991

Mr. Bruce Falk
Division of Water Resources
Drawer F
Stafford, Kansas 67578

Dear Mr. Falk:

Enclosed are copies of the water use reports for Quivira National Wildlife Refuge which you requested from Cheryl Williss. We do not have any water management plans from the 1970's. As Cheryl advised you, our Water Resources Division is currently working on a long-range water management plan for the Refuge, and we will be pleased to make that available to you when it is completed. Our new Water Rights Specialist will be coming on board the end of August and one of his first projects will be completing the work on this water permit. After he's had a chance to visit the Refuge and read the files, we will provide additional water use/management information for your review.

Sincerely,

William A. Godby

William A. Godby
Regional Engineer

Enclosures

cc: Quivira National Wildlife
Refuge

RECEIVED

JUL 22 1991

DIVISION OF WATER RESOURCES
STAFFORD

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

RECEIVED IN ENGINEERING

INTER-OFFICE TRANSMITTAL

FEB 6 08:00

- ☐ Director,
- ☑ Regional Director, Denver, CO (EN) USFWS
- ☐ Project Leader,
- ☐

☐ Regular Mail
☐ Air Mail
☐ Action
☐ Information

FROM	OFFICE	DATE
Refuge Manager	Quivira Refuge	2/1/84

SUBJECT Water Use Report - Permit No. 7571

Attached info as requested.

FEB 8 1984

GPO 844-830

ANNUAL WATER USE REPORT - SEE INSIDE BACK OF ENVELOPE FOR INSTRUCTIONS

FILE NUMBER (1)	LOCATION QUALIFIERS (2)	SEC TWP RAN	(3)	HOURS PMPD (4)	AVERAGE RATE (5)	(D)(6)	METERED QUAN (7)	(D)(6)	ACRES IRR (9)	ENERGY AMT (10)	(Y)(11)	WELL DATA DATE (12)	WATER (13)	WELL
7571	SW SE NE	35 21 11W	C1	Surface water diverted						615 acre feet				
	SW NE NE	13 22 11W	C1	Surface water diverted						494 acre feet				
	SW NW SW	25 22 11W	C1	Surface water diverted						1,426 acre feet				
										TOTAL 2,535 acre feet				

RECEIVED
APR 26 1996
DIVISION OF WATER RESOURCES

RECEIVED
JUL 22 1991
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

SIGNATURE: _____ DATE: _____ TELEPHONE NUMBER ( )

CHECK IF: ☐ OWNER ☐ TENANT ☐ AGENT

REPORT FOR | OFFICE USE | FIELD OFFICE | CO | GMD | IF MUNICIPAL POPULATION SERVED | NO. OF CONNECTIONS

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 5486

NNUAL WATER USE REPORT - SEE INSIDE BACK OF ENVELOPE FOR INSTRUCTIONS

FILE NUMBER (1)	LOCATION QUALIFIERS (2)	SEC TWP RAN	(3)	HOURS PMP'D (4)	AVERAGE RATE (5)	CD(6)	METERED QUAN (7)	CD(8)	ACRES IRR (9)	ENERGY AMT (10)	TY(11)	DATE (12)	WELL DATA WATER (13)	WEL
07571	SW SE NE	35 21 11W	01	Surface water diverted						973			acre feet	
	SW NE NE	13 22 11W	C1	Surface water diverted						683			acre feet	
	SW NW SW	25 22 11W	01	Surface water diverted						2292			acre feet	
									TOTAL	3948			acre feet	

USFWS
93 FEB 2 A9:53
RECD CGS

IGNATURE: _____ DATE: _____ TELEPHONE NUMBER ( )

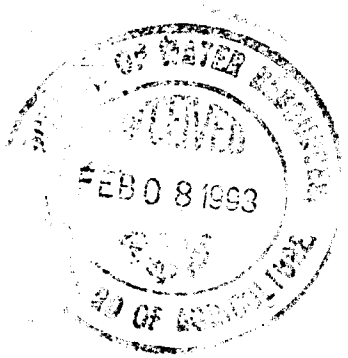
HECK IF: ☐ OWNER ☐ TENANT ☐ AGENT

IF MUNICIPAL POPULATION SERVED _____

NO. OF CONNECTIONS _____

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

EPORT YEAR	OFFICE USE	FIELD OFFICE	CO	GMD
82	1-018302	STAFF SF		



RECEIVED

JUL 22 1991

DIVISION OF

Quivira

NUAL WATER USE REPORT - SEE INSIDE BACK OF ENVELOPE FOR INSTRUCTIONS

FILE NUMBER (1)	LOCATION QUALIFIERS (2)	SEC TWP RAN	(3)	HOURS PMPD (4)	AVERAGE RATE (5)	CD(6)	METERED QUAN (7)	CD(8)	ACRES IRR (9)	ENERGY AMT (10)	TY(11)	WELL DATA DATE (12)	WATER (13)	WELL (14)
7571-00A	SW SE NE	35 21 11W	01	Surface water diverted						3,477.2		acre	feet	
	SW NE NE	13 22 11W	01	Surface water diverted						1,920.5		acre	feet	
	SW NW SW	25 22 11W	01	Surface water diverted						3,981.0		acre	feet	
							TOTAL			9,378.7		acre	feet	

NATURE: _____ DATE: _____ IF MUNICIPAL, POPULATION SERVED _____ NO. OF CONNECTIONS _____

ECK IF: ☐ OWNER ☐ TENANT ☐ AGENT

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

PORT EAR	OFFICE USE	FIELD OFFICE	GROUNDWATER DIST
	018302	STAFFORD	

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STAFFORD

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DIVISION OF WATER RESOURCES
STAFFORD

1961

REPORT OF WATER USE
FOR 1978

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in Stafford County, Kansas

Purpose of use:

( ) Stockwatering; ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Location of Diversion Points						If Water is Metered 1.__ Cu. Ft. or 2.__ Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
	NW	SW	25	22S	11W	1430.8					
	NE	NE	13	22S	11W	360.4					
	SE	NE	35	21S	11W	260.4					
						(calculated					
						acre-feet)					
TOTAL						5051.6					

(Use additional sheets as needed)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.

Units reported in: 1.__ Cubic Feet, 2.__ Gallons, or 3.X Acre-Feet

Indicate whether water is 1.X Raw, 2.__ Treated, 3.__ Sold

Jan.	22.88	July	82.0
Feb.	24.64	Aug.	296.0
Mar.	18.48	Sep.	529.8
Apr.	340.0	Oct.	989.0
May	40.0	Nov.	876.0
June	220.0	Dec.	1612.8
		TOTAL	5051.6

CITY OR RURAL WATER DISTRICTS:

Population served_____ or Number of connections _____.

CITY OR INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:

Gallons_____ or Percent of water intake _____.

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OCT 28 1991
KANSAS DEPT. OF WATER RESOURCES

Signature _____ Date _____

Mailing Address _____

(Rev. 1978) 1978

1988 WATER USE REPORT
RECREATIONAL USE

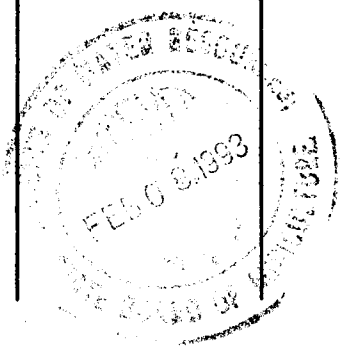
IMPORTANT: YOU MUST REPORT **ANNUAL USAGE** OR THE REASON FOR **NON-USAGE**, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report **required** to retain all Vested or Appropriated Rights. **COMPLETE AND RETURN BY MARCH 1, 1989.** Please begin by reading the instructions for PART A on the reverse of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water rights listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
109 Southwest 9th Street Suite 202
Topeka, Kansas 66612-1283

PART A: POINT(S) OF DIVERSION

File Number	Legal Descriptions of Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date of Measure
007571-00	SW SE NE 35-21-11W 01	2,170.45	Ac/ft	Surface water diverted				
007571-00	SW NE NE 13-22-11W 01	1,768.18	Ac/ft	Surface water diverted				
007571-00	SW NW SW 25-22-11W 01	4,099.65	Ac/ft	Surface water diverted				



If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

As of March 1: Empty 1/4 1/2 3/4 (Full)

As of July 1: Empty 1/4 1/2 (3/4) Full

As of November 1: Empty (1/4) 1/2 3/4 Full

018302- 1 NNNNYNN Staff 093 00 Date: 2/2/89 Telephone (316) 486-2393
Office Use FO CO GMD

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I submit this report with the knowledge that if it contains any false information I will be guilty of a class C misdemeanor.

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

RECEIVED JUL 28 1991 FIELD OFFICE DIVISION OF WATER RESOURCES STAFFORD

Patrick D. Gonzales (Signature)

Acting Refuge Manager (Title)

____ Owner ____ Agent ____ Other

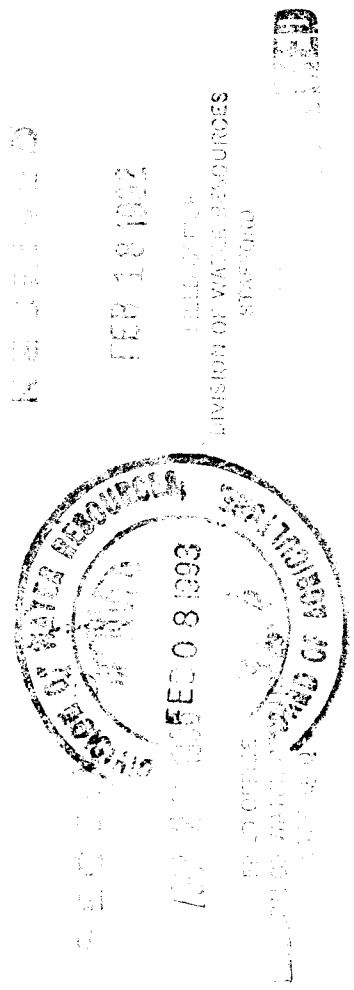
Exhibit A

quivira nwr water control structures analysis- south to north

structure	location	elevation, ft inlet	outlet	length	dimensions	comments
pool 5	Little Salt Marsh, Sec. 1&2, T23S, R11W, Sec. 35&36, T22S, R11W				950 ac 2260 ac-ft	inflow - Rattlesnake Creek outflow - A1, A2, A3, C1
A3	A-line dike, east of pool 5	plugged	1779.34	84'	24" CMP	flow to pool 7 from pool 5
spillway	A-line dike, north of A3	1782.97		326'		
A1	A-line dike, north of spillway	1778.36	1778.34		4'Hx66"Wx18'L	3 bays, no pipe, flow out of pool 5, box culvert
A2	A-line dike, west of A1	1777.38			5.5'Hx12'Wx22'L	3 bays, outlet from Little Salt Marsh to Rattlesnake C
C1	A-line dike, west of A2	1779.41			5.5'Hx4'Wx14'L	3 bays, flow from pool 5 into C-Line Canal
spillway	A-line dike, east of C1	1783.27		480'		
pool 7	east of pool 5, south of I-line dike Sec.36, T22S, R11W				50 ac 90 ac-ft	inflow - A3 outflow - 7A
7A	I-line dike, north side pool 7	1774.45	1774.11	60'	18" PVC	flow out of pool 7 to Ditch 1-G, pool 8
pool 8	north of pool 7				30 ac -m-	inflow - 7a no outflow WCS, floodplain
pool 10a	north of pool 7, east of Rattlesnake Cr Sec. 25, T22S, R11W				16 ac 32 ac-ft	inflow - a1 outflow - 10a
10a	outlet for pool 10a	1775.54			5'Hx4'Wx6'L	3 bays, flow from pool 10a to pool 10b
pool 10b	northeast of pool 10a Sec. 25, T22S, R11W				16 ac 24 ac-ft	inflow - 10a outflow - 10b
10b	outlet for pool 10b	-m-	-m-		5'Hx6'Wx7'L	2 bays, structure not surve
pools 10c & 10d	east of pool 10b Sec. 20, T22S, R10W				45 ac 66 ac-ft	inflow 10b, 7 outflow - 10c
10c	inlet to pool 11	1771.84			4.5'Hx4'Wx6'L	3 bays, flow from pool 10c into pool 11
pool 11	south of pool 10d, inside I-line dike Sec. 30, T22S, R10W				100 ac 300 ac-ft	inflow - 10c outflow - 11a, 11b
11a	I-line dike, eastern outlet for pool 11	1771.85 1771.66	1771.74	52'	18" PVC invert cont. box	flow out of pool 11
spillway	west of 11a	1774.92		155'		
11b	northwest of 11a on I-line dike	1767.34	1766.96	80'	18" PVC	flow out of pool 11
spillway	south of 11b on I-line dike	1774.82		239'		
C2	Jct. of C, F, & D-line dikes	1776.97 1776.97 1776.72	1776.91 1776.94	20' 20'	24" CMP 24" CMP	section on D-line canal section on F-line dike invert cont. box

F1	F-line canal, into pool 14b	1776.88			44"Hx44"Wx67"L	invert at 'T' control on F-line canal with flow into pool 14b
D1	D-line canal, into pool 14a	1776.09 1777.7 1773.53	1777.45	20'	21" PVC	invert of diversion box to diversion into pool 14a invert of diversion box on
pools 14a & 14b	south of D-line dike, north of d-line canal Sec. 23&24, T22S, R11W				pools combined no data	inflow - D1 outflow - 14a1, 14a2
14a2	western outlet on D-line dike	1773.61	1773.69	52'	18" PVC	flow out of pool 14a to 16
spillway	east of 14a2 on D-line dike	1778.02		279'		
14a1	east of 14a2 on D-line dike	1772.09	1771.79	54'	25" PVC	flow into G-line canal from pool 14a
14b	east of 14a1 on D-line dike	1772.28	1771.77	60'	18" PVC	flow into G-line canal from pool 14b
spillway	east of 14b on D-line dike	1776.72				
F2	east end of D-line dike on F-line canal	1775.15 1773.45	1774.78	28'	18" PVC invert cont. box	'T' structure with pipe to pool 20b, and east to 14c
pool 14c	east of pool 14b, west of Rattlesnake Cr Sec. 24, T22S, R11W				5 ac 5 ac-ft	inflow - F2 outflow - 14c
14c	northeast corner of pool 14c	1774.23			5'Hx46"Wx6.5'L	concrete structure, 1 bay flow out of pool 14c
pool 28	west side Sec 14, T22S, R11W west side of W. Main Canal				147 ac 324 ac-ft	inflow - 28b outflow - 28a
28b	east side of 28b on W. Main Canal	1767.13 1765.63	1767.41	30'	24" PVC invert cont. box	pipe flows into pool 28
pool 16	east side of Sec. 14, T22S, R11W, east of W. Main Canal				83 ac 149 ac-ft	inflow - 14a2 outflow - 16a, 16b (3G6A)
16a	northwest side of pool 16, on W. Main Canal	1771.35 1771.14	1771.15	50'	18" PVC invert cont. box	flow from pool 16 to W. Main Canal
pool 20a	west of G-line canal, Sec. 13, T22S, R11W				need area & capacity	inflow - G-line ditch outflow - 20a, spillway
20a	north side pool 20a on G-line canal	1766.26 1765.95	1766.01	40'	18" PVC invert cont. box	flow out of pool 20a
spillway	west of 20a	1770.78		131'		
spillway	east of 20a	1770.73		130'		
pool 20b	east of pool 20a, Sec. 24, T22S, R11W				need area & capacity	inflow - G-line ditch outflow - 20a
20b	between pools 20a and 20b?	-m-	-m-	50'	23" PVC ??	not on map, not surveyed
28a	east side pool 28 on W. Main Canal	1763.03 1762.85	1763.05	45'	18" PVC invert cont. box	invert on W. Main Canal, flow out of pool 28
pool 22	west side Sec. 14, T22S, R11W				10 ac	inflow - 21a

					25 ac-ft	outflow - 22a
22a	Sec. line 14&13	1761.73 1761.58	1761.51	20′	24" PVC invert cont. box	flow from pool 22 to pool 23
21a	Sec. line 14&13	1764.28 1764	1764.21	20′	24" cmp invert cont. box	flow from pool 21 to pool 22
pool 21	west side Sec. 13, T22S, R11W				22 ac 55 ac-ft	inflow - 20a outflow - 21a
24E	west side pool 24	1768.78	1768.33		22" concrete pipe	flows into pool 24
pool 24	east side Sec. 13, T22S, R11W west of Rattlesnake Creek				20 ac 35 ac-ft	inflow - 24e, 20b ? outflow - 24b, 24c, 24d, 24 20b1, DCA
24d	northwest side pool 24	1765.14 1764.99	1764.89		24" PVC invert cont. box	flows north to pool 25
24b	northeast side pool 24	1766.1	1766.06		6′ wide 50"HX6′WX20′L	flow from 24c to Darrynane Canal, 2 bays
24a	northeast side pool 24, into Rattlesnake Creek	plugged	1765.3		6′ wide 50"HX6′WX20′L	flow from 24b to Rattlesnake Cr. Canal, 2 bays
24c	spillway from pool 24 to 24b	1769.36				flows into 24b
pool 29	west side Sec. 11, T22S, R11W				91 ac 265 ac-ft	
29c	southeast side pool 29	1760.11 1759.54	1760.23	30′	21" PVC invert cont box	T-structure on W. Main Canal - flow into pool 29
29b	east side pool 29 on dike	1757.02 1756.87	1756.69	40′	18" PVC invert cont box	outlet from pool 29 to W. Main Canal
29a	between pools 29 & 30	1759.11 1758.95	1758.98	40′	24" PVC invert cont box	flow from pool 29 to pool 30
pool 23	south west corner Sec. 12, T22S, R11W				17 ac 42 ac-ft	inflow - 22 outflow - 23
23a	northeast side pool 23	1761.38 1761.28	1761.25	20′	24" PVC invert cont box	flow from pool 23 to pool 26
pool 25	south side Sec. 12, T22S, R11W				87 ac 120 ac-ft	inflow - 24e outflow - 25a, 25b
25a	northwest side pool 25	1762.55 1762.35	1762.5	70′	18" PVC invert cont box	flow out of pool 25
25b	northeast side pool 25	1764.3 1764.23	1764.4	40′	24" PVC invert cont box	flow out of pool 25 to Rattlesnake Creek
pool 30	northwest side Sec. 11, T22S, R11W				91 ac? 265 ac-ft	inflow - 30b, 29a outflow - 30a
30b	east side pool 30	1757.6 1754.54	1757.55	29′	21" PVC invert cont box	L-structure on W. Main Canal witpipe into pool 30 pool 30
30a	northeast corner pool 30	1754.17	1753.93	44′	18" PVC	outlet from pool 30 to



		1753.97			invert cont box	W. Main Canal
pool 26	northwest corner Sec. 12, T22S, R11W				82 ac 82 ac-ft	inflow - 25a, 23 outflow - 26a
26a	northwest corner pool 26	1757.59 1757.39	1757.51	80'	18" PVC invert cont box	outlet from pool 26 to Ditch L-1
spillway	east of 26a	1761.98		194'		
WCE	jct. SW end pool 48 dike and W. Main Canal	1752.16 1749.59	1752.1	43'	24" cmp invert cont box	L-structure on W. Main Canal witpipe to Ditch D1-2
48c	E of WCE on pool 48 dike	1752.04 1752.02		19'	invert box DL-2A invert box pool 48	L-structure with one conc. box on DLDL-2A and one into into pool 48
spillway	northeast of 48c	1754.41		238'		
CC	jct. E-W paved road and W. Main Canal	1752.24	1752.2		50"Hx4'Wx46'L	2 bays, flow from south to north
DCC	jct. Darrynane Canal and DL1 Ditch	1760.41 1759.29	1760.44	20'	24" CMP invert cont box	L-structure on Darrynane Canal with pipe to DL-1
DCB	south side of DCC on Darrynane Canal	1759.42			50"Hx6'Wx24'L	drop structure, 2 bays no pipe
pool 73 (COMBINED WITH POOL 75)	Sec. 5, T22S, R11W				100 ac 100 ac-ft	no inflow WCS outflow - 73 (not surveyed)
pool 48	Sec 2, T21S, R11W				need area need capacity	inflow - WCE outflow - 48a, 48b
48a	west side pool 48 on dike	1750.53 1750.32	1750.51	46'	18" PVC invert cont box	flow to west of pool 48
48b	on dike between pool 48 and pool 49	1749.53 1749.37	1749.28	60'	18" PVC invert cont box	flow from pool 49 to pool 48
spillway	east of 48b	1754.23		257'		not shown on map
48e	end of dike between pools 48 & 49	1752.3			4'Hx44"Wx52"L	T-structure from pools into a ditch that flows into Ditch L-1
48d	jct. Ditch L-1,ditch draining pool 48, pool 49 E dike	1754.07 1754.07	1753.98	38'	3-36" cmp's invert cont box	flow from pools 48 & 49 to Rattlesnake Creek
pool 49	Sec. 2 & 35, T22S & T21S, R11W, east of pool 48				need area need capacity	inflow - 26, 48b outflow - 49a, 49b
49a	west dike pool 49	1748.41 1748.26	1748.31	60'	18" PVC invert cont box	flow out of pool 49 to Rattlesnake Creek
49b	east dike pool 49	1749.32	1749.32	29'	24" cmp	flow out of pool 49 to Rattlesnake Creek
RCE	jct. Rattlesnake Creek Canal and W. Main Canal, on W. Main	1743.62	1743.62	20'	18" PVC	on W Main Canal, flows into RDD
RCD	jct. Rattlesnake Creek Canal and W. Main Canal, on W. Main	1742.09			3'Hx8'Wx1'L	conc. control structure on channel formed by jct.

RCF	jct. Rattlesnake Creek Canal and W. Main Canal, on Rattlesnake Ck.	1742.18	1742.17	20′	18" PVC	on W Main Canal, flows into RDD
DCH	jct. Darrynane canal and Ditch DL-3	1747.87	1747.81	22′	24" PVC	outlet to Ditch DL3 from control structure on Darrynane Canal
DCF	jct. Darrynane Canal and Ditch DL-2	1752.07	1751.97	23′	24" PVC	outlet to Ditch DL2 from control structure on Darrynane Canal
DCE	control structure on Darrynane Canal south of DCF	1754.15		-m-		concrete drop structure
DCD	control structure on Darrynane Canal south of DCE	1756.84		-m-		concrete drop structure
RCC	control structure on Rattlesnake Creek Canal, Sec line 34 & 35, T21S, R11W	1743			5′Hx107"Wx27′L	bridge with 3 bays
RCB	near ctr. Sec. 35, T21S, R11W, on Rattlesnake Creek Canal and drain from pool 49a	1743.88 1743.68 1743.86	S end cmp N end cmp bottom conc.	30′	18" PVC 18" PVC	Turnout structure under Rattlesnake Creek Canal drainage runs S to N
RCA	jct. Rattlesnake Creek and Rattlesnake Creek Canal	1744.17			76"Hx26′Wx24′L	2 - 11′ wide chutes, main control structure diverting from Rattlesnake Cr to Rattlesnake Creek Canal
spillway	adjacent to RCA on the south	1746.19		-m-		
BSM1	Center sec line Secs. 33 & 34 T21S, R11W	1738.44	1738.39	-m-	4′ wide	flow from west to east
pool 75 & 76	Sec. 33, T21S, R11W				need area need capacity	no inflow WCS outflow - 75a
75b	western-most structure on dike between pools 75 & 76	1736.66	1736.41	42′	30" conc. pipe	flow from pool 75 to pool 78
75a	east of 75b on dike	1736.76	1736.56	61′	30" conc. pipe	flow from pool 75 to pool 76
spillway	east of 75a	1740.76		331′		
pool 58	Secs. 34&27, T21S, R11W				110 ac 175 ac-ft	no inflow WCS outflow - 58a
75/58	jct. n dike 75 & w dike 58	1738.44	1738.39		3′Hx4′Wx26′L	box culvert flow from pool 75 to pool 58??
pool 61	Secs. 35&26, T21S, R11W				200 ac 400 ac-ft	inflow - RCB, 61a outflow - 61b,61c,61d,61e
61e	Sec line 35 & 26, T21S, R11W	1742.46	1742.45	48′	control wheel w/2 - 24" cmp's	flow out of pool 61 to 63
61d	west end of dike between pools 61 & 63	1740	1739.77	36′	18" PVC	flow from pool 61 to 63
spillway	east of 61d	1745.45		165′		

61c	east of 61d and spillway	1737.49	1737.47	56′	18" PVC	flow from pool 61 to 63
61b	east side of dike between pools 61 & 63	1740.02	debris-filled	62′	control wheel w/2 - 24" cmp's	flow out of pool 61 to 63
61a	east dike pool 61	1739.92	1739.86	35′	18" PVC	flow from Rattlesnake Creek to pool 61
39	Sec. line 25 & 36, T21S, R11W across Darrynane Canal	1735.53	1735.35	40′	24" PVC	flow to north
37	Sec. line 25 & 36, T21S, R11W across creek	1744.36	1744.25	20′	24" PVC	flow to north
pool 77 (COMBINED WITH POOL 75)	Sec. 32, T21S, R11W				50 ac N\A	no inflow WCS no outflow WCS
DCI	jct of Darrynane Canal and DL4 non-functional	1745.03 1745.02	1744.27	20′	24" PVC conc. structure	L-structure w/concrete stru Darrynane Canal, pipe to DL
/6a	SW corner Sec 28, T21S, R11W on pool 76 dike	1737.94	1737.77	38′	30" conc pipe	flow into pool 76
76b	north of 76a	1738.28	1738.27	36′	30" conc pipe	flow out of pool 76
pool 78 (COMBINED WITH POOL 75)	SW corner Sec 28, T21S, R11W				-m- -m-	inflow - 75a, 75b no outflow WCS
pool 57	Secs. 34 & 27, T21S, R11W east of pool 58				154 ac 319 ac-ft	inflow - 61e, RCD no outflow WCS
58a	Sec. 27, T21S, R11W, on pool 58 dike	1736.65	1736.27	61′	22" conc. pipe	flow out of pool 58
pool 63	Sec. 26, T21S, R11W, east of pool 61				270 ac 650 ac-ft	inflow - 61b, 61c, 61d outflow - 63a, 63b
63b	west end N. dike pool 63	1733.69	1733.6	52′	24" PVC	flow out of pool 63
spillway	east of 63b	1741.2		150′		
63a	east dike pool 63	1737.27	1737.12	28′	18" conc. pipe	flow out of pool 63
ool 40	S 1/2 Sec. 26, T21S, R11W				50 ac 75 ac-ft	inflow - 40b, 40c outflow - 40a, 40b/62b
pool 62	north of pool 40, Secs. 26&25, T21S, R11W				150 ac 300 ac-ft	inflow - DL4B, 40a outflow - 40b/62b, 62a
62a	jct. pool 40 & 62 dikes	1738.38	1738.25	50′	18" conc. pipe	flow out of pool 62
62b&40a	east dike pools 62 & 40	1738.31	1738.27	60′	18" conc. pipe	flow between pool 40 and pool 62
40a	N. dike 40	1737.8	1737.65	-m-	18" conc. pipe	flow out of pool 40
40c	jct DL4 and DL5	1743.68 1743.68			3′Wx2′Dx3′L 3′Wx2′Dx3′L	conc. box with flow into DL conc. box with flow into DL
DL4B	jct DL4 & DL5	1743.27	1743.07	-m-	36" cmp	flow from DL4 to DL5
pool 80 (COMBINED WITH POOL 75)	SW corner Sec. 22, T21S, R11W				78 ac 42 ac-ft	inflow - 58a outflow - 80a

80a	NE corner pool 80	1732.22	1732 54'	36" conc. pipe	flow from pool 80 to Salt Creek
pool 83	NE corner Sec. 22, T21S, R11W (North Lake)			need area need capacity	no inflow WCS outflow - 80

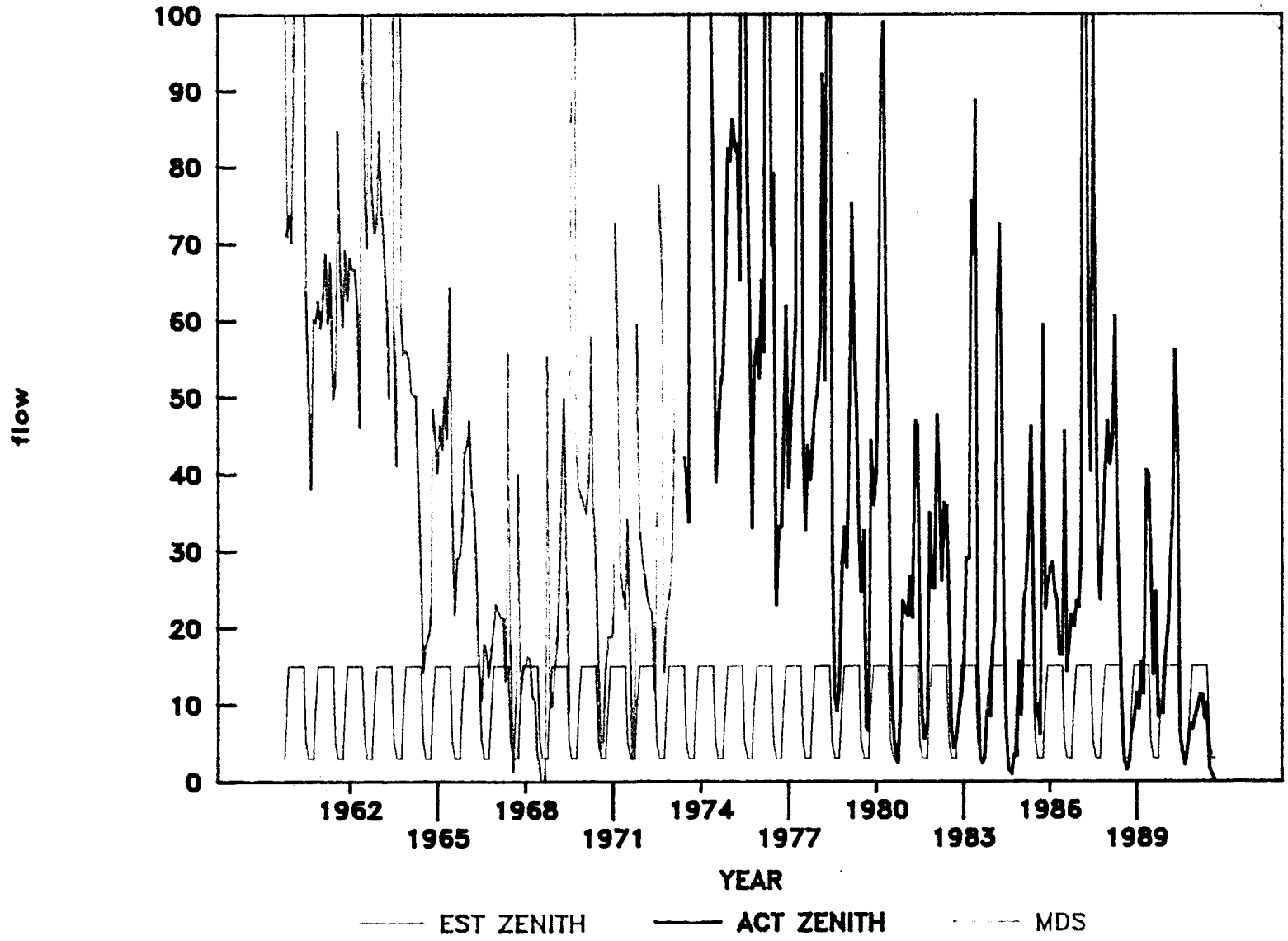
Structure not surveyed - 10b, 20b

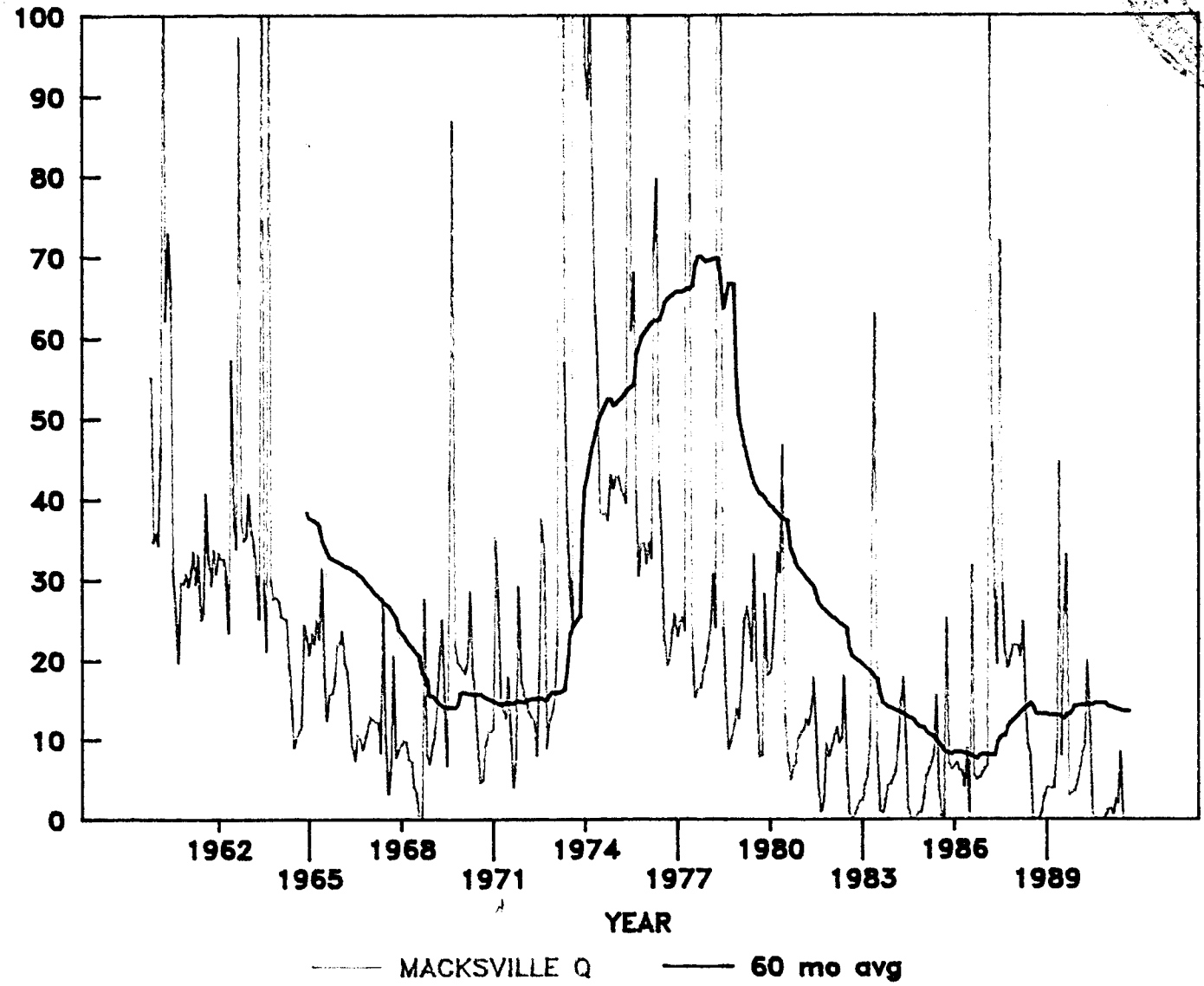
* Spillway elevations = low pooint on spillway

** Invert control box = bottom of concrete on boxes with tubes
bottom of concrete box on "T" and "L" controls

monthly flow at zenith

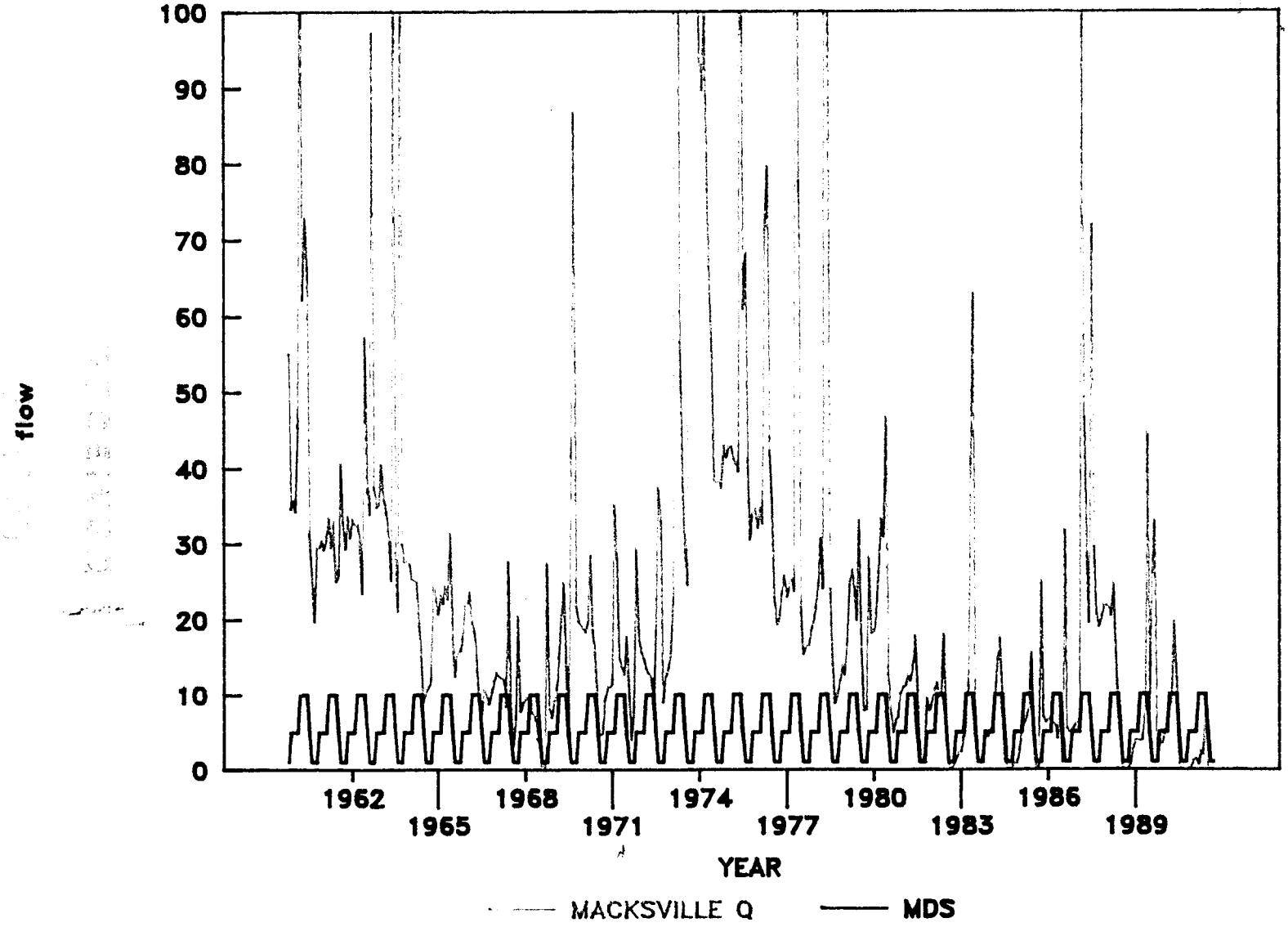
RATTLESNAKE CRK MDS





monthly flow at macksville

RATTLESNAKE CRK MDS



Water Use, File 7571

1963 150 AF Water stored & circulated through units #21, #23, #24

1964 est. 3500 AF Water stored & circ. through units #5, #7, #10-a-b-c, #16, #20b, #22, #23, #24, #25, #26, & #11-a-b diversion from points A & B

1965 est. 750 AF water stored & circ. through units 5, 7, 11, & 20b Diversion from points A & B

1966 6900 AF est. Circ. through units #5, #7, #11, #16, & 20 Flood damage - water control operative for only six mon

1967 7800 AF est. 70 % of works completed div. from NE 13 & SW 25

1968 9345 AF est 80% complete div. from SW NE 13, NW SW 25 - both 22-11W and SE NE 35- 21-11W

1969 6846 AF 80 % complete - same diversion points as in 1968 - less than other years due to timely rains

A	1970	NW SW 25-22-11W	5,165.96 Ac. Ft	Est.
B		SW NE 13-22-11W	793.6 Ac Ft	
C		SE NE 35-21-11W	1170.02 Ac Ft	
			7,129.58 Ac Ft	

About 80% the works are complete

A	1971	NW SW 25-22-11W	5,372 AF	Est
B		NE NE 13-22-11W	756 AF	
C		SE NE 35-21-11W	3,940	
			10068 AF	

80% of the works are complete

A	1972	NW SW 25-22-11W	6,154	Est.
B		NE NE 13-22-11W	1,068	
C		SE NE 35-21-11W	1,565	
			8,787 AF	

80% of the works are completed

A	1973	NW SW 25-22-11W	996	Est
B		NE NE 13-22-11W	1353	
C		SE NE 35-21-11W	903	
			3252 AF	

80% of the works complete

A	1974	NW SW 25-22-11W	2951.34	Calculated AF
B		NE NE 13-22-11W	1404.52	
C		SE NE 35-21-11W	0	
			4355.86	

No water used Jan - Aug Includes est 1000 AF to fill

50% of normal diversion occurred during this period due to flood damage to dike system in

A	1975	NW SW	25-22-11W	6049.62	Calculated
B		NE NE	13-22-11W	966.32	AF
C		SE NE	35-21-11W	435.48	
				7451.42 AF	

"Below normal due to flood damaged dikes"

A	1976	NW SW	25-22-11W	2160.0	Calculated AF
B		NE NE	13-22-11W	1282.2	
C		SE NE	35-21-11W	654.62	
				4096.82	

Water could not be diverted to B.S.M-canal not repaired.

1977 8,453.04 AF

below normal because area received 5" precip. above annual avg. amount. Repairs not complete-water could not be diverted to BSM

A	1978	NW SW	25-22-11W	4430.8	
B		NE NE	13-22-11W	360.4	
C		SE NE	35-21-11W	260.4	
				5051.6	

A	1979	NW SW	25-22-11W	5923.2	calculated
B		NE NE	13-22-11W	187.6	AF
C		SE NE	35-21-11W	692.9	
				6803.7	

A	1980	NW SW 25 22 11W	2213.54	calculated AF
B		NE NE 13 22 11W	836.39	
C		SE NE 35 22 11W	331.40	
			3381.33	

1981	SW SE NE 35-21-11W	3477.2 AF	
	SW NE NE 13-22-11W	1920.5 AF	
	SW NW SW 25-22-11W	3981.0 AF	
		9378.7 AF	

C	1982	SW SE NE	35-21-11W	973 AF
B		SW NE NE	13-22-11W	683 AF
A		SW NW SW	25-22-11W	2292 AF
				3948 AF

C	1983	SW SE NE	35-21-11W	615 AF
B		SW NE NE	13-22-11W	494 AF
A		SW NW SW	25-22-11W	1426 AF
				2535 AF

C	1984	SW SE NE	35-21-11W	539 AF
B		SW NE NE	13-22-11W	462 AF
A		SW NW SW	25-22-11W	1628 AF
				2629 AF
C	1985	SW SE NE	35-21-11W	1159 AF
B		SW NE NE	13-22-11W	1956 AF
A		SW NW SW	25-22-11W	5311 AF
				8426 AF
C	1986	SW SE NE	35-21-11W	2985.7
B		SW NE NE	13-22-11W	833.25
A		SW NW SW	25-22-11W	4573.5
				8392.45 AF
C	1987	SW SE NE	35-21-11W	1157.5
B		SW NE NE	13-22-11W	1816.0
A		SW NW SW	25-22-11W	7156.2
		Full all year		10129.7
	1988		-	8038.3
C	1989	SW SE NE	35-21-11W	675.6
B		SW NE NE	13-22-11W	2401.35
A		SW NW SW		2526.22
				5603.17

C	1990 –	SW	SE NE	35-21-11W	604 AF
B		SW	NE NE	13-22-11W	2678 AF
A		SW	NW SW	25-22-11W	3497.0 AF
		1/4 – 1/2 – 3/4 full			6779 AF

1991	C –	SW	SE NE	35-21-11W	0
	B –	SW	NE NE	13-22-11W	1497.0 AF
	A –	SW	NW SW	25-22-11W	1091.0 AF
					2588.0

10179.7 Acre Feet reported in 1987

2260.0 Capacity of Little Salt Marsh

950 Acres

2850.0 Evap. (36" evap)

15240 - Total

14586

Send atten: Cheryl Williss

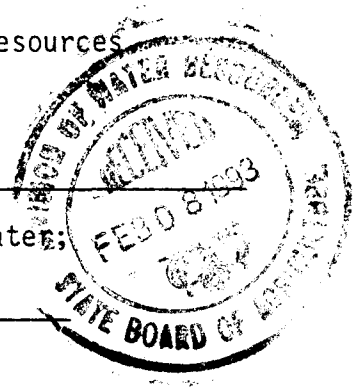
Kansas State Board of Agriculture / Division of Water Resources

STAFFORD Field Office

To: WAYLAND ANDERSON

Re: ___ Vested Right; ___ Water Right; ✓ Appropriation of Water;

File No(s). 7571



Enclosed are the following checked items:

_____ A _____ full field inspection report so it may be entered in the mainframe, microfilmed and returned to the field office.

_____ A _____ partial field inspection report so it may be entered in the mainframe, microfilmed and returned to the field office.

_____ A 7-17-91 & 12-21-92 field inspection report and proposed certificate so it may be entered in the mainframe, microfilmed and delivered to the Certificate Unit.

_____ A Compliance Check Inspection on _____.
[ ] New Appl. [ ] Chg Appl.
[ ] In Compliance [ ] Not in Compliance-see explanation below.
Modify point of diversion? [ ] yes [ ] no
Indicate all overlapping p/d files _____.

_____ An application and judgement sheet with recommendation.

_____ A memorandum dated _____.

_____ A request for an extension of time to perfect [ ] or complete [ ].

_____

_____ Copy of an Approved "Short Move" Change and other pertinent information (for main office use only: [ ] recording completed; [ ] copies made; [ ] to Data Entry; [ ] ready for mailing).

_____ An original "Short Move" Change Application needing main office review and further processing.

_____ A closure request.

_____ A field investigation report.

_____ A water use report for _____.

_____ A letter dated _____.

_____ Other: _____

_____

_____

_____.

M Bruce Falk
Water Commissioner

RECEIVED
APR 26 1996
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

HAND DELIVERED FEB. 8, 1993
Date

DWR 1-308 Rev. 6-11-92

MICROFILMED

CERTIFICATION MEMORANDUM, FILE 7571

The certification of application to appropriate water, File 7571 actually began in July of 1991. A tour of the refuge was made in the company of Patrick D. Gonzales, assistant manager of Quivira National Wildlife Refuge. Mr. Gonzales reviewed the basic operations at the refuge and detailed how water was used among the various management units within the refuge proper. Copies of missing water use reports (exhibit A) were obtained from the U.S. Fish and Wildlife Service in Denver. These reports filled in all the missing gaps in the water use history of the refuge. In February of 1992, contact was made with representatives from U.S. Fish and Wildlife Service (USFWS) headquarters. It was learned that a detailed survey of the refuge was to be conducted in the near future. The survey would include cross sections of each management pool in the refuge and more accurately define the total water holding capacity of the entire project. As of February 1, 1993, the survey has been completed, but the information has not been tabulated or made available for review. Since the new survey has not been completed in a timely manner, older information that was originally computed from aerial photos is being used to prepare the certificate. Much of this information was already in the files and additional information was obtained from USFWS itself (exhibit B).

The Water Resources Data of Kansas published yearly by the U.S. Geological Survey was consulted for the years 1963 through 1990. These publications give the streamflow values for permanent gaging stations on the Rattlesnake Creek at Macksville, Kansas and Raymond, Kansas. The Macksville station gives interesting results, but it is over 30 miles upstream from the diversion points authorized by this file. On a stream such as the Rattlesnake that is often gaining base flow in some areas and losing base flow to the aquifer in other areas, depending on the immediate section of the stream being analyzed, a gaging station over 30 miles away is not of much value as it relates to this project. The Raymond, Kansas gage was also analyzed. This gage should have been useful since it is situated at the outflow from Quivira Refuge. What complicates the readings from this gage is that artesian saltwater flows on the north edge of the refuge enter the stream (referred to as Salt Creek at this location) and are recorded at the gaging station. The result is that at times flow is recorded at the gage even when operations at Quivira are using the entire upstream flow of the Rattlesnake Creek. Flood flows, artesian groundwater, and occasionally normal streamflows reach the Raymond gage, unfortunately, it is impossible to distinguish where the recorded flows may have come from.

In May of 1973 a gaging station was put into service at Zenith, Kansas. This gage is approximately [illegible] miles upstream from the first diversion structure at Quivira Wildlife Refuge. This gage

has the potential to provide the most pertinent data in regards to the certification of File 7571. Since the Zenith gage was not installed until 1973 there is no actual data for that location during prior years. For that reason Jim Bagley, of the Division of Water Resources, prepared streamflow regression analysis charts (exhibit C). While these charts are definitely an asset in obtaining the total picture of past streamflow and appear to correlate exceptionally well with actual flow records at the other gaging stations, Mr. Bagley warns against depending on the regression analysis too much. On a related note, Marios Sophocleaus states in his KGS open file report 92-10 that 19625 acre feet is the average annual streamflow at the Zenith gage during the years 1981 through 1990.

Hydrographs were prepared (exhibit D) to visually display the monthly and annual flows recorded, in acre feet, at all of the above gaging stations from 1963 to 1990. The 1963 to 1973 flows estimated from regression analysis at the Zenith gage were also plotted. In addition, the annual reported quantity of water used at Quivira was plotted against the streamflow quantities. If nothing else, the hydrographs reveal that the water use reports submitted for Quivira do not exceed the quantity shown to have been provided by the Rattlesnake Creek.

Next, information from the area and capacity information (exhibit B) and the Annual Water Management Plan (exhibit E) were combined into one table. This table is titled "Typical Annual Water Use at Quivira Wildlife Refuge" (exhibit F). The purpose of the tabulation is to demonstrate the maximum amount of water the refuge might use if it had sufficient water available and it was able to fulfill all of the management options listed in its Annual Water Management Plan. The tabulation is actually less than the maximum water needs as it does <u>not</u> include unmanaged areas that are often flooded to a depth of two to three inches; it also does <u>not</u> include evapotranspiration by moist soil plants, seepage, lake evaporation through fall and winter months, or transit losses in canals or within the streambed itself. One other item that is not calculated is the fact that at certain times it may be beneficial to drain one management unit, utilizing the drained water into a second unit in need of water, although in most instances the units are allowed to evaporate naturally. Additionally, large salt flats at the north end of the refuge, and the northern end of the Big Salt Marsh itself, appear to receive a portion of their water supply from the artesian seeps and springs that flow into the refuge from the west.

Exhibit F demonstrates that when considering the permanent management pools only, operated under the guidelines of existing management plans, that the quantity of water reported since 1963 appears not only to have been reasonable, but also possible.

On December 21, 1992 and January 28, 1993, Mr Dave Hilley, Manager of Quivira Wildlife Refuge, was contacted for additional information concerning operations at the refuge. The methods used by the refuge to measure water flows were observed, tested, and recorded in a memorandum labeled exhibit G. This document outlines specifically what instrument is used to measure flows, how it works, how quantities are calculated for annual water use reports, and states the one discrepancy found in the water reporting method. That discrepancy was the fact that the quantity of water stored and evaporated from the Little Salt Marsh was not reflected in the refuge's reporting methods. The information obtained on both visits, combined with previously gathered data, were compiled to form exhibit H, which is a detailed map of each management unit, the canals connecting each unit, control structures used to move water within the refuge, and the diversion points on the Rattlesnake Creek.

SUMMARY

Based on the above information and attached exhibits a certificated of appropriation for file 7571 is proposed as follows:

File 7571 was approved in 1963. During the time period 1963 to 1972 many of the water use reports were estimated and during that time the diversion works were reported to be only 80% complete. An actual water measurement program may not have been in place prior to 1973. In 1973, a year of torrential rainfall, the diversion works and control structures at Quivira were destroyed. It was not until 1978 that the damage was finally repaired. The year 1978 was, therefore, the first year that the diversion works were complete and ready to divert and store water according to management plans. Assuming that the water requirements of the refuge are best represented by years after 1978, the year 1987 has been selected as the year of record. Using 1987 will require that an extension of time to perfect be granted to that year.
During 1987 the U.S. Fish and Wildlife Service reported that 10129.7 acre feet of water was diverted from the Rattlesnake Creek and that the refuge was "full all year." As pointed out above and in exhibit G, the measurements reported do not reflect the amount stored and the subsequent evaporation in the Little

Salt Marsh. Using an area of 950 acres in the Little Salt Marsh, and a capacity of 2260 acre feet, one would assume 2850 acre feet of evaporation during a calendar year (36 inches of net evaporation). The proposed certified quantity for file 7571 would then be the sum of the acre feet reported in 1987, the amount stored in the Little Salt Marsh, and the amount evaporated from the Little Salt Marsh: 10129.7 acre feet + 2260 acre feet + 2850 acre feet = 15240 acre feet. It is also proposed that all of the 15240 acre feet be shown as direct use and that the "quantity to be accumulated in reservoirs" as stated in the approval be dropped from the certificate.

It is proposed that the rate of diversion be certified as natural flows not needed for prior downstream diversions. The diversion should be limited to a maximum of 300 c.f.s. Flows of 300 cfs can be verified from streamflow records at the Zenith station (see exhibit I).

Finally, the description of the point of diversion noted as "diversion A" is being proposed differently than originally approved. The stream is not located in that ten acre tract. Therefore it is proposed to correct that description when the certificate is issued.

It is the recommendation of the Stafford Field Office that U.S. Fish and Wildlife Service be required upon issuance of this certificate to install a permanent metering system on the Rattlesnake Creek immediately downstream from their last diversion point and that a water conservation plan be prepared for the refuge, both to be completed by December 31, 1995.

FIELD INSPECTION, FILE 7571

LAND TO BE INCLUDED ON CERTIFICATE

The South 80 acres of the SE1/4 of Section 15; the S1/2 of Section 14; the NE1/4, SW1/4, and SE1/4 of Section 29; and all of Sections 13, 21 through 28, and 32 through 36 in Township 21 South, Range 11 West;

and all of Sections 1 through 5, 11 through 14, 23 through 26, and sections 35 and 36 in Township 22 South, Range 11 West;

and all of Sections 1 and 2 in Township 23 South, Range 11 West;

all in Stafford County, Kansas;

Section 18 in Township 21 South, Range 10 West, in Rice County, Kansas;

and Section 30 in Township 22 South, Range 10 West, in Reno County, Kansas.

PLACE OF USE DURING YEAR OF RECORD

Water was applied to and circulated among the various management units within the place of use described above. Those management units are depicted on the map accompanying this field inspection report.

1992 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1993.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below. If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date Measured
07571-00 (RCA)	SW SE NE 35-21-11W 01	519.7	ACRE FEET		SURFACE	WATER	DIVERTED	
07571-00 (DARRYMORE)	SW NE NE 13-22-11W 01	1620.8	ACRE FEET		SURFACE	WATER	DIVERTED	
07571-00 (LSM)	SW NW SW 25-22-11W 01	3195.9	ACRE FEET		SURFACE	WATER	DIVERTED	
1991-1992 Water Year, Zenith gage October to September, maximum flow 174 cfs, annual acre-feet		7490.0						

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1992				July 1, 1992				November 1, 1992			
Empty	1/4	1/2	3/4 Full	Empty	1/4	1/2	3/4 Full	Empty	1/4	1/2	3/4 Full

Date: 1/12/93 Telephone: (316) 486-2393

I submit this report with the knowledge that if it contains any false information I will be guilty of a Class C misdemeanor.

611427

018302 - 1 REC Staff 93 0
Office Use FO CO GMD

Dave Hilley / Refuge Manager
Name (Printed or Typed)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER, CO 80225

DIV. OF WATER RES
RECEIVED
APR 05 1993
ST. BD. OF AGRICULTURE

Dave Hilley
Name (Signature)

____ Owner ____ Tenant __X__ Agent

1992 RECREATIONAL WATER USE REPORT

DWR 1-513 (Rev. 12/02/92)

1992 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1993.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below. If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

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Date: 1/12/93 Telephone: (316) 486-2393

I submit this report with the knowledge that if it contains any false information I will be guilty of a Class C misdemeanor.

612360

018302 - 1 REC Staff 93 0
Office Use FO CO GMD

Dave Hilley / Refuge Manager
Name (Printed or Typed)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER, CO 80225

DIV. OF WATER RES. RECEIVED FEB 19 1993 ST. BD. OF AGRICULTURE

Dave Hilley
Name (Signature)

____ Owner ____ Tenant X Agent

1992 RECREATIONAL WATER USE REPORT

DWR 1-513 (Rev. 12/02/82)

STATION NUMBER 07142575 RATTLESNAKE C NR KENTH, KS STREAM SOURCE AGENCY USGS
LATITUDE 380601 LONGITUDE 0963032 DRAINAGE AREA 510.00 DATUM 1782.00 STATE 20 COUNTY 185
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.55	3.7	7.6	6.5	6.8	6.8	5.1	13	20	19	8.0
2	.00	2.0	5.4	7.4	6.4	7.0	6.9	1.8	39	16	18	7.9
3	.00	2.5	5.1	7.1	6.5	7.0	6.7	1.4	44	15	14	7.4
4	.00	3.3	5.9	6.9	6.6	8.0	7.2	1.4	36	14	14	6.9
5	.00	5.0	5.0	6.8	6.6	8.1	6.8	1.0	26	14	16	6.8
6	.00	5.6	4.6	e6.8	6.6	7.3	6.4	1.7	23	23	17	6.5
7	.00	4.1	4.5	e7.0	6.8	7.6	6.0	1.7	19	59	15	5.9
8	.00	3.5	4.3	7.5	6.3	7.6	6.2	1.4	15	58	11	5.1
9	.00	3.1	4.3	e6.0	e6.0	8.6	6.4	1.3	13	40	11	5.4
10	.00	2.6	4.2	e6.0	6.6	7.6	6.4	1.4	36	29	10	4.9
11	.00	2.6	4.6	6.3	6.6	8.0	6.4	1.9	174	23	29	4.3
12	.00	2.7	5.6	6.3	6.7	7.7	6.4	1.8	111	19	46	4.4
13	.00	2.7	5.6	e6.0	6.8	7.2	6.2	1.6	54	27	47	4.5
14	.00	2.7	5.3	e5.0	6.8	7.2	6.4	1.5	50	34	34	3.9
15	.00	2.7	5.3	5.1	6.6	7.4	6.0	1.1	56	21	28	3.4
16	.00	4.1	5.4	6.2	7.0	7.1	6.0	1.6	44	22	23	3.3
17	.00	5.0	5.0	7.7	6.4	7.3	6.2	1.0	30	21	25	3.1
18	.00	4.7	4.9	e7.0	6.0	8.5	7.1	5.4	26	17	24	3.0
19	.00	4.4	5.5	e6.0	6.4	9.1	7.9	4.6	20	16	19	3.2
20	.00	3.7	6.3	e6.4	6.7	9.0	7.2	4.5	21	22	17	3.5
21	.00	3.6	7.2	e6.4	6.9	8.7	6.6	4.5	18	23	14	3.2
22	.00	3.8	6.4	6.4	6.9	8.2	7.0	3.1	15	21	12	3.0
23	.00	4.0	6.8	6.3	7.0	7.8	6.6	3.5	13	17	11	2.9
24	.00	4.2	7.3	6.2	6.9	8.0	6.3	5.4	16	15	9.7	2.9
25	.00	4.3	6.1	6.5	6.8	7.8	5.9	5.2	69	13	11	2.8
26	.00	4.2	5.9	6.4	6.6	7.7	6.0	5.1	38	14	12	4.5
27	.00	4.3	6.2	6.5	6.8	7.6	6.0	6.0	24	14	12	3.9
28	.26	4.2	6.4	6.1	6.9	8.0	6.0	6.9	25	17	10	3.7
29	.36	4.3	6.4	6.2	6.9	7.8	6.2	7.1	28	18	9.0	3.8
30	.41	4.7	6.1	6.4	---	7.7	5.9	6.3	24	15	8.2	3.8
31	.35	---	6.6	6.3	---	7.7	---	7.2	---	14	8.0	---
TOTAL	1.44	109.15	172.5	200.8	192.6	241.1	194.1	163.5	1120	691	553.9	135.9
MEAN	.046	3.64	5.56	6.48	6.64	7.78	6.47	5.24	37.3	22.3	17.9	4.53
MAX	.41	5.6	7.3	7.7	7.0	9.1	7.9	6.5	174	59	47	8.0
MIN	.00	.55	3.7	5.0	6.0	6.8	5.9	1.3	13	13	8.0	2.8
AC-FT	2.9	216	342	398	382	478	385	322	2220	1370	1100	270

CAL YR 1991 TOTAL 2127.78 MEAN 5.83 MAX 41 MIN .00 AC-FT 4220
WTR YR 1992 TOTAL 3774.59 MEAN 10.3 MAX 174 MIN .00 AC-FT 7490

e Estimated

STATION NUMBER 07162620 KAPPELMANN C NR RANSOM, KS STREAM SOURCE AGENCY USGS
LATITUDE 381350 LONGITUDE 0982500 DRAINAGE AREA 596.00 DATUM 1701.84 STATE 20 COUNTY 159
PROVISIONAL DATA SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.41	e.80	e1.6	4.6	2.2	2.2	2.9	2.8	19	36	5.2	4.0
2	.37	e.60	e1.5	3.4	2.3	2.2	2.7	1.8	28	33	4.6	3.9
3	.36	e.70	e1.5	3.0	2.4	2.2	2.7	1.8	44	30	5.0	4.0
4	.40	e.60	e1.6	2.8	2.4	3.2	2.9	1.7	54	27	5.9	3.6
5	.47	e.80	1.7	2.8	2.3	3.4	2.8	1.7	43	25	6.2	3.5
6	.56	e.90	1.7	2.6	2.2	2.8	2.7	1.7	49	22	6.3	3.3
7	.69	e1.0	1.7	3.2	2.2	2.5	2.8	1.8	37	20	4.7	3.3
8	.73	e1.0	1.7	3.0	2.2	2.5	2.8	1.7	30	19	4.2	3.2
9	.69	e1.0	1.6	3.8	2.3	3.2	2.7	1.7	24	16	4.4	3.3
10	.65	1.2	1.6	3.0	2.4	2.6	2.6	1.8	80	16	4.4	2.9
11	.69	1.2	1.7	2.9	2.5	2.5	2.6	2.4	67	12	22	2.8
12	.69	1.4	2.3	2.8	2.7	2.5	2.5	2.2	54	8.2	23	3.0
13	.65	1.4	1.9	2.8	2.5	2.3	2.3	1.9	38	8.8	22	3.0
14	.54	1.4	1.6	3.4	2.5	2.3	2.3	8.6	42	11	20	2.8
15	.48	1.3	1.7	3.1	2.3	2.3	2.2	4.9	53	8.3	17	2.7
16	.72	1.9	1.8	4.5	2.4	2.2	2.0	3.2	53	7.1	15	2.5
17	.68	2.9	1.7	4.4	2.4	2.4	2.1	2.5	59	6.7	13	2.4
18	.53	1.8	1.8	3.3	2.4	3.1	2.5	2.4	43	6.0	11	2.7
19	.57	1.5	2.2	3.2	2.1	3.2	3.2	2.4	34	6.8	9.7	2.5
20	.64	1.5	3.7	2.9	2.1	3.2	2.6	2.5	26	12	8.4	2.8
21	.76	1.5	2.7	2.6	2.3	3.4	2.2	2.8	23	13	7.0	2.6
22	.78	1.5	2.5	2.4	2.2	3.0	2.1	2.8	23	12	6.1	2.3
23	.77	1.8	2.6	2.5	2.4	2.7	2.0	2.8	21	11	5.1	2.1
24	.66	1.7	2.4	2.5	2.4	3.1	2.0	2.6	19	11	4.3	1.9
25	.62	1.5	2.4	2.3	2.1	3.3	1.8	2.6	23	10	7.3	2.0
26	.70	1.5	2.2	2.4	2.2	2.9	1.8	3.2	30	13	7.6	5.1
27	.99	1.5	2.2	2.2	2.3	3.0	1.8	3.2	34	12	6.2	3.3
28	1.2	1.5	2.3	2.2	2.4	3.4	2.1	4.4	37	11	5.5	2.3
29	.98	1.7	2.4	2.3	2.3	3.6	2.1	3.7	40	9.5	4.9	2.1
30	.97	e1.6	2.4	2.3	---	3.0	2.1	3.3	39	7.7	4.3	2.0
31	e.90	---	2.8	2.2	---	2.9	---	3.4	---	6.5	3.9	---
MEAN	.68	1.36	2.05	2.95	2.32	2.81	2.40	2.76	38.7	14.4	8.85	2.93
MAX	1.2	2.9	3.7	4.6	2.7	3.6	3.2	8.6	80	36	23	5.1
MIN	.36	.60	1.5	2.2	2.1	2.2	1.8	1.7	19	6.0	3.9	1.9
AC-FT	42	81	126	181	134	173	143	170	2300	888	544	174

CAL YR 1991 MEAN 2.47 MAX 14 MIN .16 AC-FT 1790
WTR YR 1992 MEAN 6.83 MAX 80 MIN .36 AC-FT 4960

e Estimated

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - KANSAS 02/02/93

STATION NUMBER 07142575 RANTOULSMITH C NR SMITH, KS STREAM SOURCE AGENCY USGS
LATITUDE 380601 LONGITUDE 0963036 DRAINAGE AREA 519.00 DATUM 1785.00 NGVD 29 COUNTY 185
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.55	3.7	7.6	6.5	6.8	6.8	5.1	13	20	19	8.0
2	.00	2.0	5.4	7.4	6.4	7.0	6.9	4.8	39	16	18	7.9
3	.00	2.5	5.1	7.1	6.5	7.0	6.7	4.4	44	15	14	7.4
4	.00	3.3	5.9	6.9	6.6	8.0	7.2	4.4	36	14	14	6.9
5	.00	3.0	5.0	6.8	6.6	8.1	6.8	4.0	26	14	16	6.8
6	.00	5.6	4.6	e6.8	6.6	7.3	6.4	3.7	23	23	17	6.5
7	.00	4.1	6.5	e7.0	6.8	7.6	6.0	3.7	19	59	15	5.9
8	.00	3.5	4.3	7.5	6.3	7.6	6.2	3.4	15	58	11	5.1
9	.00	3.1	4.3	e6.0	e6.0	8.6	6.4	3.3	13	40	11	5.4
10	.00	2.6	4.2	e6.0	6.6	7.6	6.4	3.4	36	29	10	4.9
11	.00	2.6	4.6	6.3	6.6	8.0	6.4	4.9	174	23	29	4.3
12	.00	2.7	5.6	6.3	6.7	7.7	6.4	4.8	111	19	46	4.4
13	.00	2.7	5.6	e6.0	6.8	7.2	6.2	4.6	54	27	47	4.5
14	.00	2.7	5.3	e5.0	6.8	7.2	6.4	4.5	50	34	34	3.9
15	.00	2.7	5.3	5.1	6.6	7.4	6.0	4.1	56	21	28	3.4
16	.00	4.1	5.4	6.2	7.0	7.1	6.0	4.6	44	22	23	3.3
17	.00	5.0	5.0	7.7	6.4	7.3	6.2	4.0	30	21	25	3.1
18	.00	4.7	4.9	e7.0	6.0	8.5	7.1	5.4	26	17	24	3.0
19	.00	4.4	5.5	e6.0	6.4	9.1	7.9	4.6	20	16	19	3.2
20	.00	3.7	6.3	e6.4	6.7	9.0	7.2	4.5	21	22	17	3.5
21	.00	3.6	7.2	e6.4	6.9	8.7	6.6	4.5	18	23	14	3.2
22	.00	3.8	6.4	6.4	6.9	8.2	7.0	5.1	15	21	12	3.0
23	.00	4.0	6.8	6.3	7.0	7.8	6.6	5.5	13	17	11	2.9
24	.00	4.2	7.3	6.2	6.9	8.0	6.3	5.4	16	15	9.7	2.9
25	.00	4.3	6.1	6.5	6.8	7.8	5.9	5.2	69	13	11	2.8
26	.00	4.2	5.9	6.4	6.6	7.7	6.0	5.1	38	14	12	4.5
27	.00	4.3	6.2	6.5	6.8	7.6	6.0	6.0	24	14	12	3.9
28	.26	4.2	6.4	6.1	6.9	8.0	6.0	6.9	25	17	10	3.7
29	.36	4.3	6.4	6.2	6.9	7.8	6.2	7.1	28	18	9.0	3.8
30	.43	4.7	6.1	6.4	—	7.7	5.9	6.3	24	15	8.2	3.8
31	.39	—	6.6	6.3	—	7.7	—	7.2	—	14	8.0	—
TOTAL	1.44	109.15	172.5	200.8	192.6	241.1	194.1	162.5	1120	691	553.9	135.9
MEAN	.046	3.64	5.56	6.48	6.64	7.78	6.47	5.24	37.3	22.3	17.9	4.53
MAX	.43	5.6	7.3	7.7	7.0	9.1	7.9	8.5	174	59	47	8.0
MIN	.00	.55	3.7	5.0	6.0	6.8	5.9	3.3	13	13	8.0	2.8
AC-FT	2.9	216	342	398	382	478	385	322	2220	1370	1100	270

CAL YR 1991 TOTAL 2127.78 MEAN 5.83 MAX 41 MIN .00 AC-FT 4220
WTR YR 1992 TOTAL 3774.19 MEAN 10.3 MAX 174 MIN .00 AC-FT 7490

e Estimated

QUIVIRA NATIONAL WILDLIFE REFUGE HUNTING & FISHING AREAS

GW flows

NORTH LAKE

DW

BIG SALT MARSH 1500A

DW

LITTLE SALT MARSH 950A

DW

DW

DW

DW

DW

DW

PUBLIC PHOTO BLIND

PUBLIC PHOTO BLIND

HORSESHOE LAKE

DARRYNANE CANAL

STAFFORD CO.

RICE CO.

STAFFORD COUNTY

RENO COUNTY

PATTI ROWE CREEK

Red Metal Gate

Wire Gate

Spring & water

T21S RICE CO.

T22S RENO CO.

T22S

T23S

COUNTY ROAD 484

U.S. 281 13 MI.

STERLING 17 MI.

COUNTY RD. 636

TO U.S. 281, STAFFORD

4th ST. ROAD

TO HUTCHINSON 28 MI.

TO ZENITH & U.S. 50

REFUGE HEADQUARTERS

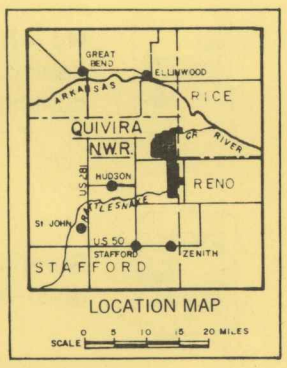
STOP

Read all regulations on the reverse side of this leaflet before you hunt.

N

LEGEND

- Refuge Boundary
- Section Line
- Gravel Road
- Foot Trail
- Paved Road
- Parking Areas
- Hunting Areas
- Water Units



LOCATION MAP

DCA 24D 24C } Div. B

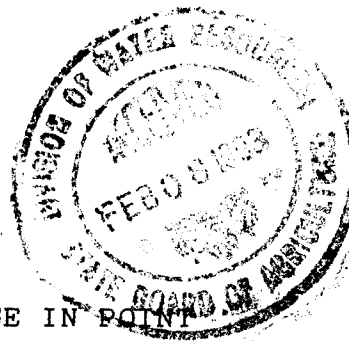
All but DW filled once a year

2' elev. change from S. to N.

AZ – 3 days

Once a week normally. More often if changes occurring or filling units – daily

12/21/92 ~~49~~ 54.49 cfs at Zenith gage



FIELD INSPECTION, FILE 7571
AUTHORIZED POINTS OF DIVERSION

THREE POINTS OF DIVERSION AUTHORIZED BY APPROVED CHANGE IN POINT OF DIVERSION DATED NOVEMBER 11, 1971:

one (1) point in the Southwest Quarter of the Northwest Quarter of the Southwest Quarter (SW1/4 NW1/4 SW1/4)

of Section 25;

one (1) point in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW1/4 NE1/4 NE1/4)

of Section 13;

both in Township 22 South, Range 11 West;

and

one (1) point in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW1/4 SE1/4 NE1/4)

of Section 35, Township 21 South, Range 11 West;

all in Stafford County, Kansas,

ACTUAL POINTS OF DIVERSION

Diversion A: One diversion structure located near the center of the Southwest Quarter (SW1/4), approximately 1250 feet North and 3850 feet West of the SE corner of Section 25; and

Diversion B: One diversion structure located in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW1/4 NE1/4 NE1/4), approximately 4450 feet North and 1000 feet West of the SE corner of Section 13;

both in Township 22 South, Range 11 West;

and

Diversion C: One diversion structure located in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW1/4 SE1/4 NE1/4), approximately 3100 feet North and 1150 feet West of the SE corner of Section 35, Township 21 South, Range 11 West;

all in Stafford County, Kansas.

DIVISION OF WATER RESOURCES -- KANSAS STATE BOARD O[illegible]GRICULTURE

FIELD INSPECTION REPORT

Field Office No. 2
G.M.D. No. 5

☒ Full
☐ Partial
☐ Compliance Check

Test 1 of ___ diversion points. County Stafford

File No. 7571 Inspection Date July 17, 91 (Dec. 21, 92) Firm/Field Office Stafford F.O.

Current Landowner U.S. Dept. of Interior Fish & Wildlife Service Phone No. (303) 236-5372

Address P.O. Box 25486 Denver, Co. 80225

☐ Additional landowners and addresses identified in remarks section.

Water Use ( ) Domestic ( ) Industrial ( ) Irrigation ( ) Municipal ( ) Hydraulic Dredging
Classification: (X) Recreation ( ) Stockwatering ( ) Water Power ( ) Artifical Recharge ( ) Contamination Remediation
Source: ( ) Groundwater (X) Surface Water ~~Basin~~/Stream Rattlesnake Creek

Authorized Point of Diversion: See attached sheet Sec. ___, T. ___, R. ____, ID No. ____
Approximately ____ ft. North and ____ ft. West of SE corner of Sec. ____

Actual Point of Diversion: See attached sheet Sec. ___, T. ___, R. ____
Approximately ____ ft. North and ____ ft. West of SE corner of Sec. ____
How were distances determined? From topographic maps

"Approved" Quantity* 22000 AF "Approved" Diversion Rate 134,640 g.p.m. (300 c.f.s.)

Priority Date Aug. 15, 1957 Approval Date May 9, 1963 Perfection Date (Originally - 12/31/63) (Ext. to 12/31/78

Other applications covering land and/or point of diversion None
(include discussion of overlapping files in remarks section)

*22000 AF direct use, 15800 AF to be accumulated in reservoirs within limits of direct use.

LAND TO BE INCLUDED ON CERTIFICATE:

S	T	R	NE¼				NW¼				SW¼				SE¼				TOTAL ACRES
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
							See attachment												

LAND IRRIGATED—YEAR OF RECORD ____

S	T	R	NE¼				NW¼				SW¼				SE¼				TOTAL ACRES
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
								See attachment											

TESTED DIVERSION RATES
Maximum G.P.M. ____ (c.f.s. ____) Normal G.P.M. Natural Flows (c.f.s. ____)

FOR D.W.R. USE ONLY

Year of Record 1987 Extension of time needed: ☒ Yes ☐ No Attached? ☐ Yes ☒ No

AF Applied = ____ hrs. x ____ g.p.m. x $\frac{4.419}{24 \times 1000}$ = ____ AF

"Approved" land irrigated ____ acres, with ____ AF = ____ AF\acre

See attachments

RECEIVED
APR 26 1996
DIVISION OF WATER RESOURCES
STAFFORD

Perfected Rate Natural Flows g.p.m. (____ c.f.s.) Perfected Quantity 15240 AF
to a maximum of 300 cfs

DWR-101 (Rev. 03/29/91)

GENERAL INFORMATION ~~ON IRRIGATION SYSTEM~~

☐ **Center Pivot**

Manufacturer _____ Model _____ Serial No. _____

Drive: ☐ Water ☐ Electric Length of Pivot Arm _____ Acres Irr. _____

Design Pressure-Pivot _____ p.s.i. Operating Pressure-Pivot _____ p.s.i.

Is there an end gun? ☐ Yes ☐ No Is end gun operating during test? ☐ Yes ☐ No

End Gun Model _____ Rating _____ g.p.m.

☐ **Gravity Irrigation**

Items to be shown on sketch of system: 1) layout of pipe, 2) sizes of pipe, 3) type of pipe, 4) set which was tested, 5) test location and 6) hydrant location See exhibit A for description of

Description diversion structures, canals, and water control structures.

☐ **Other** Type _____

Manufacturer _____ Model _____ Serial No. _____

Unusual condition/other information

POWER UNIT INFORMATION:

Manufacturer _____ Model _____ HP _____

Serial No. _____ Fuel _____ Rated RPM _____

PUMP INFORMATION:

Manufacturer _____ Model _____ No. Stages _____

Serial No. _____ Size/Type _____ Rated RPM _____

GEAR HEAD INFORMATION:

Manufacturer _____ Model _____

Serial No. _____ Drive _____ Ratio _____

WELL INFORMATION:

Date Drilled _____ Original Depth _____ ft. Static Water Level When Drilled _____ ft.

Length of time well has ☐ operated ☐ rested prior to inspection _____ ☐ days ☐ hours

Is measurement tube required? ☐ Yes ☒ No Is measurement tube present? ☐ Yes ☐ No

Depth to water _____ ft. below LSD.

ADDITIONAL REQUIREMENTS:

Is a flow meter required? ☐ Yes ☐ No Make of flow meter _____

Serial No. _____ Size _____ Flow meter conversion factor _____

Is the meter installed properly? ☐ Yes ☐ No _____

Distance front and back of meter: _____

Flow meter units: ☐ Acre-feet ☐ Acre-inches ☐ Gallons ☐ Other _____

Is check valve present? ☐ Yes ☐ No

Is low pressure drain present? ☐ Yes ☐ No Is vacuum breaker present? ☐ Yes ☐ No

Is injection port present? ☐ Yes ☐ No Is injection system being operated? ☐ Yes ☐ No

Was a Plant Health Chemigation Report completed? ☐ Yes ☐ No

File No. _____

MANAGER	
ASST. MGR.	
REF. ASST.	
TRAINEE	

Last Reader Discard

1991 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report **required** to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1992.** Please begin by reading the instructions for Part A on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

RECEIVED
FEB 92
Quivira National Wildlife Refuge

PART A: POINTS OF DIVERSION

Water Right File Number	Legal Descriptions Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date Measured
007571-00	SW SE NE 35-21-11W 01	0 ACRE FEET SURFACE WATER DIVERTED						
007571-00	SW NE NE 13-22-11W 01	1497.0 ACRE FEET SURFACE WATER DIVERTED						
007571-00	SW NW SW 25-22-11W 01	1091.4 ACRE FEET SURFACE WATER DIVERTED						

→ 1990-1991 water year, Zenith gage October to September, maximum flow 41 cfs, annual acre-feet 4772.4

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1991: Empty 1/4 1/2 (3/4) Full

July 1, 1991: Empty 1/4 (1/2) 3/4 Full

November 1, 1991: Empty (1/4) 1/2 3/4 Full

DIV. OF WATER RESOURCES
APR 13 1992
DEPT. OF AGRICULTURE

Date: 2/10/92 Telephone: (316) 486-2393

I submit this report with the knowledge that if it contains any false information I will be guilty of a Class C misdemeanor.

018302 - 1 REC Staff 93 0
Office Use FO CO GMD

Daniel R. Schaad-Assistant Refuge Manager
Name (Printed or Typed)

RECEIVED
DEC 16 1992
FIELD OFFICE
DIVISION OF WATER RESOURCES

Daniel R. Schaad
Name (Signature)

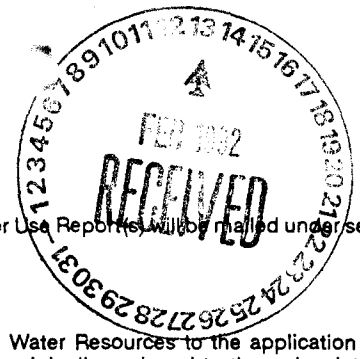
U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER, CO 80225

Owner ____ Tenant ____ Agent

1991 RECREATIONAL WATER USE REPORT

DWR 1-513 (Rev. 11/25/91)

1991 WATER USE REPORT
RECREATIONAL USE



NOTE: If you hold water rights for other than recreational use, such as irrigation, the appropriate Water Use Report(s) will be mailed under separate cover.

INSTRUCTIONS AND DEFINITIONS FOR PART A:

Water Right File Number: The file number that was originally assigned by the Division of Water Resources to the application for permit to appropriate water for beneficial use or the file number that was originally assigned to the order determining and establishing a vested right to continue the beneficial use of water.

Point of Diversion: The point from which water is obtained, be it a well, dam or intake. **If no water was used from one or more points of diversion, then the reason for non-usage must be given for each of the points of diversion.**

Legal Descriptions: **If an error exists in a legal description, mark through the incorrect portion and enter the correct description immediately above it.** The location of each point of diversion is given by a qualifier followed by the section, township, and range. The qualifier is used to describe the specific location of the point of diversion within the section. Codes are NE (Northeast), NW (Northwest), SW (Southwest), SE (Southeast), N2 (North Half), W2 (West Half), S2 (South Half), E2 (East Half), NC (Near Center), CR (Corner), CN (Center of North Side), CW (Center of West Side), CS (Center of South Side), and CE (Center of East Side). For example, "NC S2 NW" reads "near the Center of the South Half of the Northwest Quarter." Another, "SW CR NE NW" reads "the Southwest Corner of the Northeast Quarter of the Northwest Quarter." The qualifiers may be the number of feet North and number of feet West of the Southeast Corner of the section. In some cases, a portion of the legal description or an alternative description is included on the next line following the term "aka" (also known as).

Metered Quantity: If a **WATER METER** is installed, enter the amount of water used. This is the difference between last year's ending meter reading and this year's ending meter reading, applying any multiplication factor shown on the face of the meter. If there is **NO** water meter installed, **DO NOT WRITE IN THIS SPACE.**

Meter Units: Indicate the unit of measure recorded by your water meter (enter "A" for acre-feet, enter "G" for gallons).

Hours Pumped: Enter the number of hours the pump was operated during the calendar year, if you **do not** have a water meter, or meter readings can not be obtained.

Est. Pump Rate: Enter the average rate of pumping in gallons per minute, if you **do not** have a water meter, or meter readings can not be obtained.

Well Data: Well Depth: enter the depth to bottom of well in feet.
Depth to Water: enter the depth to water in feet.
Date Measured: enter the date of the last depth to water measurement.

INSTRUCTIONS FOR NAME AND ADDRESS CHANGES:

1. Please check your name and address, which is printed on the reverse side of this page in the lower left corner. If it is incorrect or incomplete, make any necessary changes in the space provided below. If you are no longer the person responsible for completing this report for one or more of the water right file numbers listed on the reverse side of this page, please print or type the information requested below.

   Check one: _____ Address Correction _____ New Correspondent

   Water Right File Number(s): _____

   Name/Title: _____

   Address: _____

   _____

   Date of Change: Month _____ Year _____ Telephone: (___) _____

2. If the **ownership** has changed for one or more of the water right file numbers listed on the reverse side of this page, please print or type the information requested below.

   Water Right File Number(s): _____

   Name of New Owner/Title: _____

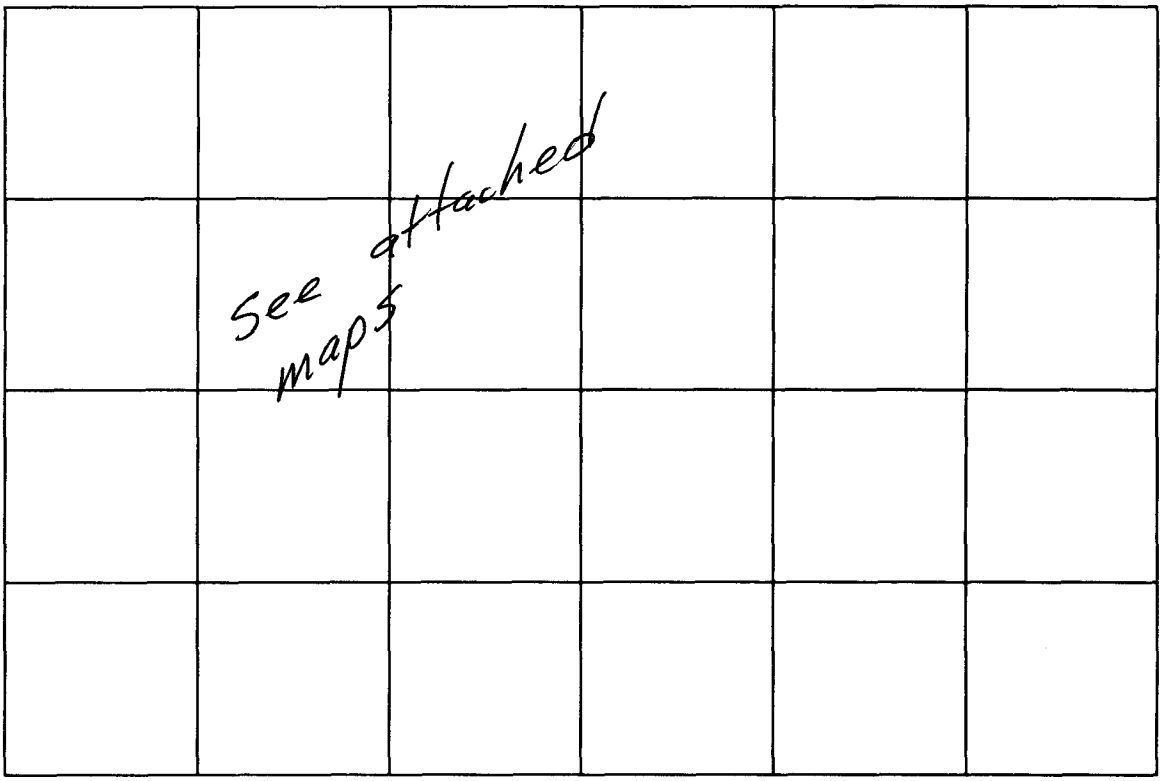
   Address of New Owner: _____

   _____

   Date of Change: Month _____ Year _____ New Owner's Telephone: (___) _____

SKETCH OF ACTUAL PLACE OF USE, LOCATION OF DIVERSION WORKS, AND DISTRIBUTION SYSTEM.
(Indicate distribution system layout at time of field test).

N



Scale
1"=_____ft.

TEST OF DIVERSION RATE: Location of test _____
Pipe Diameter (I.D.) _____ inches

Test No. 1—Normal Conditions
R.P.M. POWER UNIT _____
R.P.M. PUMP UNIT _____
Pressure at Pump _____ psi

Test No. 2—Maximum Conditions
R.P.M. POWER UNIT _____
R.P.M. PUMP UNIT _____
Pressure at Pump _____ psi

☐ **Jacuzzi Meter Test** Meter Identification No. _____

Area Constant K = 2.45 x I.D.^{2} = _____ Q (gpm) = VK

	Velocity (fps)		Velocity (fps)	
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
Total				
Avg.				
G.P.M.				

☐ **Propeller Meter Test** Manufacturer _____ Model _____ Serial No. _____
Meter Diameter _____ inches

Ending _____ gal.
Beginning _____ gal.
Difference _____ gal.
Time _____ min.
Rate _____ gpm

Ending _____ gal.
Beginning _____ gal.
Difference _____ gal.
Time _____ min.
Rate _____ gpm

☐ **Other Flow Meter** Use Supplemental Sheet (include meter identification, data and calculations).

File No. 7571

TABULATION OF WATER USE DETERMINED AT THE TIME OF THIS REPORT:

Year	Hours Pumped (hr)	Reported Pumping Rate (gpm)	Water Used (AF)	Acres Irrigated

See attached reports & tabulation of water use

Indicate Year of Record with (*) Source of Information _____

Crops Irrigated: this year _____ year of record _____

FUEL RECORDS: (Complete only if water use information is not available)

☐ Electricity Supplier _____

Meter Manufacturer _____ Type _____ Serial No. _____

K _____ watt/rev r _____ revolutions t _____ seconds

Rate = $\frac{Kr \times 3.6}{t}$ = _____ kw/hr Hours = $\frac{\text{kw/hr}}{\text{rate}}$ = _____

☐ Other Fuels Type _____ Supplier _____

Rate = $\frac{\text{Volume (test)}}{\text{time}}$ = _____ kw/hr

How was the test volume determined? _____

REMARKS: _____

Person present at ~~test~~ inspection: Dave Hilley (Name) Refuge Manager (relationship)

Water Use Correspondent Same as owner (Name) (Address) (phone number)

Conducted by M Bruce Falk Date 12/21/92

Approved by M Bruce Falk (Signature) Water Commissioner (Title) Date 1/17/93

File No. 7571

9-275-H
(Rev. 6-63)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

M No. .....

Comp. by .....

Sta. No. ..... **DISCHARGE MEASUREMENT NOTES** Checked by .....

Rattlesnake Creek as it exits Little Salt Marsh (Structure C-1)

Date Jan. 28, 1992 Party Falk

Width 4.25 Area 2.125 Vel. 2.69 G.H. — Disch. 5.719

Method .6 No. secs. 10 G.H. change — in ..... hrs. Susp. .....

Method coef. .6 Hor. angle coef. 1.0 Susp. coef. 1.0 Meter No. 8009549

Date rated — Used rating for rod ..... susp. ✓ Meter ..... ft

above bottom of wt. Tags checked ..... Spin before meas. ✓ after ✓

Meas. plots — % diff. from — rating. (Wading), cable, ice, boat, upstr., downstr., side ~~bridge~~ Weir feet, mile, above, below gage. Levels obtained .....

BASE GAGE READINGS				
Time		Recorder	Inside	Outside
Weighted M.G.H.				
G.H. correction				
Correct M.G.H.				

AUX. GAGE READINGS				
Time		Recorder	Inside	Outside
Weighted M.G.H.				
G.H. correction				
Correct M.G.H.				

Check-bar, chain found .....
changed to ..... at .....

Check-bar, chain found .....
changed to ..... at .....

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions: Cross Section ... through weir

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STAFFORD FIELD OFFICE

Flow Steady Weather Clear & windy

Other ..... Air ..... ° F. @ .....

Gage ..... Water ..... ° F. @ .....

..... Record removed ..... Intake flushed U L .....

Observer .....

Control .....

Remarks Measurements taken to check accuracy of Clausen Weir Rule - 5.87 c.f.s. was obtained with Clausen Rule immediately prior to the measurement

G.H. of zero flow ..... ft. Sheet No. ..... of ..... sheets.

.0 .10 .20 .30 .40 .50 .60 .70 .75

Rattlesnake Creek River at— Little Salt Marsh

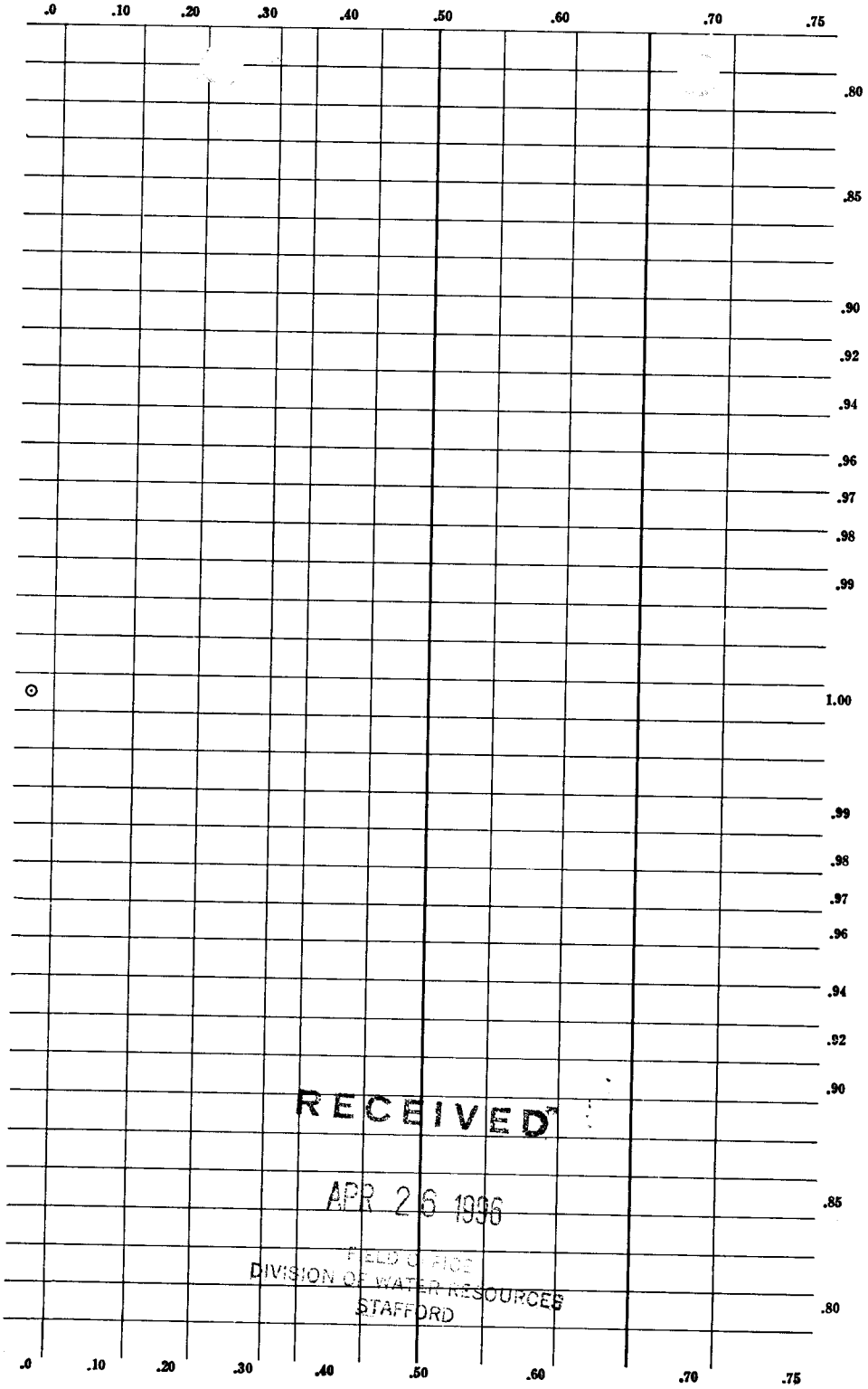
Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or ----------	Area	Discharge
	.25	.25	.5	.6	100	49	2.06			.125	.258
	.50	.25	.5	.6	150	62	2.43			.125	.304
	1.0	.50	.5	.6	100	48	2.10			.25	.525
	1.5	.50	.5	.6	100	40	2.51			.25	.628
	2.0	.50	.5	.6	150	56	2.68			.25	.670
	2.5	.50	.5	.6	150	63	2.39			.25	.598
	3.0	.50	.5	.6	150	49	3.06			.25	.765
	3.5	.50	.5	.6	150	41	3.64			.25	.910
	4.0	.50	.5	.6	150	44	3.40			.25	.850
	4.25	.25	.5	.6	80	48	1.69			.125	.211
										2.125	5.719

Start REW @ 9:25 AM

Finish LEW @ 9:45 AM

.80 .85 .90 .92 .94 .96 .97 .98 .99 1.00

0 .10 .20 .30 .40 .50 .60 .70 .75



.0	.10	.20	.30	.40	.50	.60	.70		.80	.85		
Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY		Adjusted for hor. angle or	Area	Discharge	
							At point	Mean in vertical				.90
												.92
												.94
												.96
												.97
												.98
												.99
⊙												1.00
												.99
												.98
												.97
												.96
												.94
												.92
.0	.10	.20	.30	.40	.50	.60	.70		.80	.85		.90

GAGE READINGS

Time

* GPO : 1963 O—690992

1990 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1991.** Please begin by reading the instructions on the reverse side of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
901 South Kansas, Second Floor
Topeka, Kansas 66612-1283

Water Right File Number	Legal Descriptions of Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date Measured
007571-00	SW SE NE 35-21-11W 01	603.60	Acre Feet	Surface Water Diverted				
007571-00	SW NE NE 13-22-11W 01	2,677.58	Acre Feet	Surface Water Diverted				
007571-00	SW NW SW 25-22-11W 01	3,497.34	Acre Feet	Surface Water Diverted				

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JAN 31 1992
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STAFFORD

RECEIVED
JAN 31 1992
DIVISION OF WATER RESOURCES
STAFFORD

440812

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1990: Empty (1/4) 1/2 3/4 Full

July 1, 1990: Empty 1/4 (1/2) 3/4 Full

November 1, 1990: Empty 1/4 1/2 (3/4) Full

Date: 2/5/91 Telephone: (316) 486-2393

I submit this report with the knowledge that if it contains any false information I will be guilty of a Class C misdemeanor.

018302- 1 REC Staff 93 0
Office Use FO CO GMD

Patrick D. Gonzales (Assistant Refuge Manager)
Name (Printed or Typed)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER, CO 80225

Patrick D. Gonzales
Name (Signature)

____ Owner ____ Tenant XXX Agent

1990 RECREATIONAL WATER USE REPORT

1989 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT ANNUAL USAGE OR THE REASON FOR NON-USAGE, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report required to retain all Vested or Appropriation Rights. **COMPLETE AND RETURN BY MARCH 1, 1990.** Please begin by reading the instructions on the reverse side of this page. Also present are instructions for name and address changes, which include information needed if you have disposed of your interest in one or more of the water right file numbers listed below. If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
109 Southwest 9th Street, Suite 202
Topeka, Kansas 66612-1283

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Division of Water Resources

				Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date Measured
007571-00	SW SE NE	35-21-11W	01	675.60	Acre feet	surface water diverted				
007571-00	SW NE NE	13-22-11W	01	2,401.35	Acre feet	surface water diverted				
007571-00	SW NW SW	25-22-11W	01	2,526.22	Acre feet	surface water diverted				

5603 2

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

March 1, 1989: Empty (1/4) 1/2 3/4 Full
July 1, 1989: Empty 1/4 (1/2) 3/4 Full
November 1, 1989: Empty 1/4 1/2 (3/4) Full

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MAR 25 1991
KANSAS DEPT OF AGRICULTURE
DIVISION OF WATER RESOURCES
STAFFORD

Date: 2/5/90 Telephone: (316) 486 - 2393

I submit this report with the knowledge that if it contains any false information I will be guilty of a Class C misdemeanor.

018302- 5 REC Top: 16 0
Office Use FO CO GMD

Patrick D. Gonzales (Acting Refuge Manager)
Name (Printed or Typed)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER, CO 80225

FEB 26 1990
KANSAS DEPT OF AGRICULTURE

Patrick D. Gonzales
Name (Signature)

____ Owner ____ Tenant XXX Agent

DWR 1-513

1989 RECREATIONAL WATER USE REPORT

1989

WATER USE REPORT\PLAN 1989/1990

Flint Hills National Wildlife Refuge
Hartford, Kansas
February 2, 1990

A. GENERAL

Flint Hills NWR is located along the Neosho River and Eagle Creek in the flood pool of John Redmond Reservoir which was constructed by the U.S. Army Corps of Engineers as a flood control project. When the reservoir is at normal conservation pool, very little refuge land is inundated. During extreme flooding, however, up to 95% of the area can be covered. Floods of this severity are rare (1973, 1985 and 1986). Most precipitation is received during the spring and as a general rule, some degree of flooding can be expected in the spring with fall floods being rare.

1989 presented an unusually dry spring with no major flooding during the spring and little run off during the last half of the year. Most natural and man made wetlands were dry by late summer. Sufficient runoff did occur during October to provide water in all impoundments. Most rains, however occurred such that most moisture was absorbed rather than running off.

Three types of water rights are currently in effect at Flint Hills NWR. Two agricultural permits allow the diversion of water from the Neosho River for irrigation of agricultural crops. Fourteen permits are approved for the diversion of water from the natural flows of tributaries by low profile dikes. Nine additional permits cover pumping of water from the Neosho River or Eagle Creek into man made and natural wetlands.

No water was pumped during 1989. Sufficient water was available via natural flows to preempt the need for pumping. However, natural flows did not occur in timely sequence to provide sufficient water to accomplish planned management objectives.

Monthly Precipitation, Temperatures and
Pool Elevations, Calender Year 1989

Mo.	Precip. inches Total	Norm	Snow	Temp.°F Max.	Min.	Pool elevations Max.	Min.
Jan	1.08	1.24	.00	63	12	1038.16	1037.80
Feb	.43	1.33	2.00	69	-18	1038.41	1038.11
Mar	2.68	2.25	.00	82	12	1038.50	1038.22
Apr	.51	3.38	.00	91	22	1038.45	1038.26
may	4.39	4.91	.00	89	36	1029.48	1037.74
Jun	3.68	4.68	.00	91	50	1042.39	1039.53
Jul	8.15	3.48	.00	98	58	1039.98	1038.53
Aug	6.36	2.96	.00	92	52	1047.78	1039.53
Sep	3.25	4.13	.00	91	35	1048.01	1039.09
Oct	4.70	2.71	.00	90	25	1041.35	1039.05
Nov	.10	1.64	.00	79	14	1042.33	1041.58
Dec	.16	1.54	6.00	69	-21	1042.10	1041.77
				Extremes		Extremes	
Tot.	35.49	34.25	8.00	98	-21	1048.01	1037.74

Weather information is obtained from the official U.S. Weather Station operated by the U.S. Army Corps of Engineers (COE) at John Redmond Reservoir, New Strawn, Kansas, eight miles southeast of refuge headquarters.

COPY FOR YOUR INFORMATION

QUIVIRA NATIONAL WILDLIFE REFUGE

STAFFORD, KANSAS

ANNUAL WATER MANAGEMENT PLAN

1990 WATER USE REPORT

1991 RECOMMENDATIONS

Submitted by _____ Date_____

Reviewed by _____ Date _____

Approved by _____ Date _____

1990 WATER USE REPORT

I. Water Rights

The Service filed Notice of Proof of Completion of Works for Permit # 7571 on July 15, 1982 and requested an inspection of works so that a certificate could be issued. To date, there has been no inspection and no certificate issued. The Service has applied for rights to 22,200 acre feet of water, to be diverted from the Rattlesnake Creek annually.

II. Actual Use

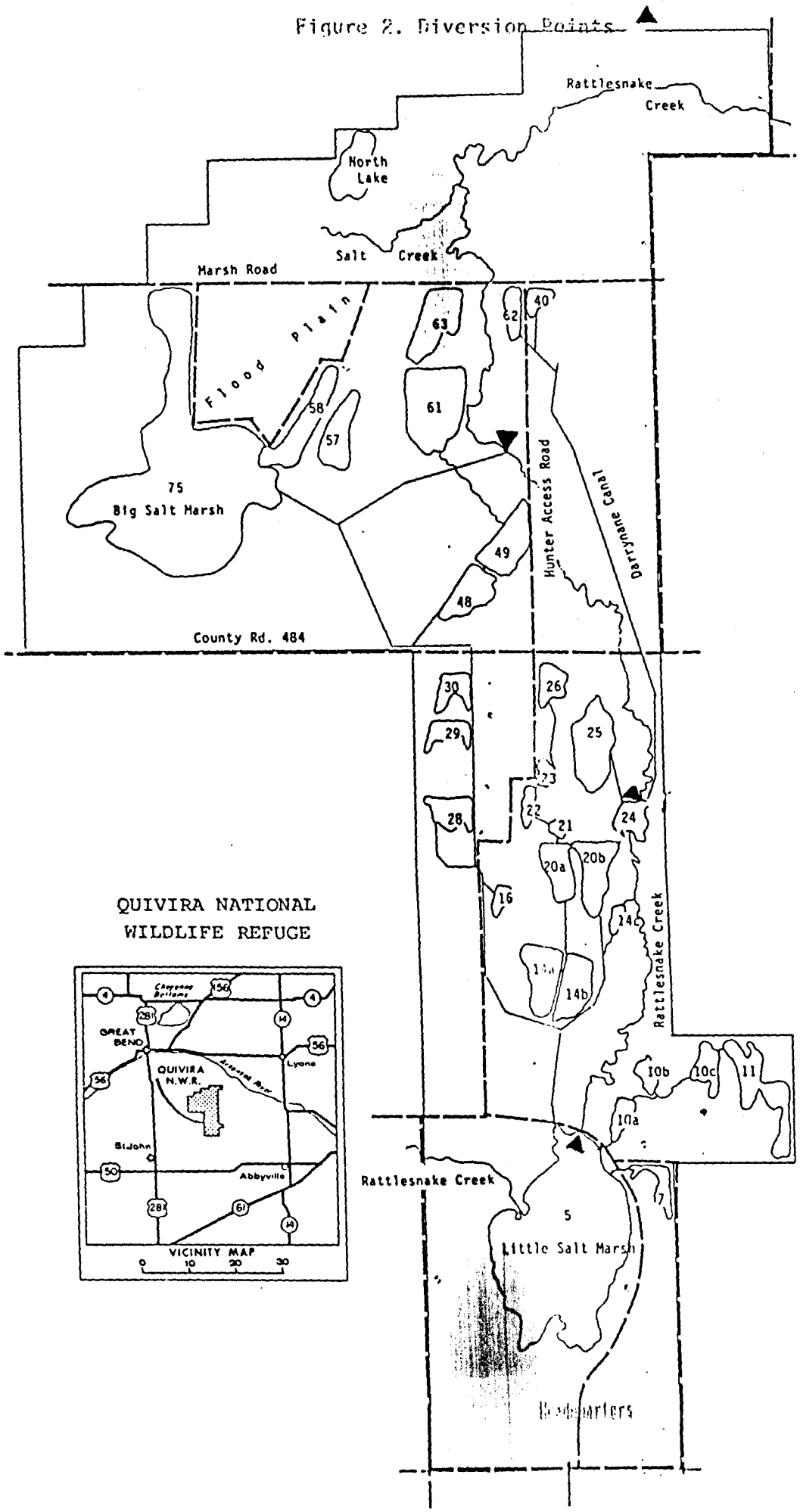
The actual appropriation of water in 1990 from refuge diversion points was approximately 6,778.60 acre feet; an increase of approximately 1,175.43 acre feet more than the 5,603.17 acre feet that was reported for 1989. Figure 1 shows the amount of water measured at each point for each month of 1990. Diverted water was used for storage in impoundments and marshes and to provide flushing action for some saline areas of the refuge. There are no irrigated crops on the refuge and all diverted water was used for wetland management, primarily waterfowl habitat propagation. Figure 2 shows the location of the three diversion areas on the refuge.

Figure 1. Monthly Record of Water Usage 1990
Rattlesnake Creek Diversions

Month	A-1	A-3	C-1	DC-A	24C	20B-1	RC-A	Total
Jan.	0	0	118.00	558.00	116.60	0	74.40	862.00
Feb.	206.40	82.80	180.70	204.00	175.20	0	40.80	889.98
Mar.	270.00	0	409.20	50.40	57.60	0	114.00	901.20
Apr.	270.00	0	540.00	237.60	72.00	0	144.00	1,263.60
May	262.08	0	294.84	112.32	252.60	0	97.20	1.019.04
June	234.00	0	81.00	288.26	384.00	0	108.26	1,095.26
July	0	0	0	0	174.00	0	25.20	199.20
Aug.	NO DIVERSIONS PERFORMED DURING AUGUST 1990							
Sep.	0	46.80	36.72	0	0	0	0	83.52
Oct.	66.00	64.00	126.00	0	0	0	0	256.00
Nov.	0	100.80	108.00	0	0	0	0	208.80
Dec.	NO DIVERSIONS PERFORMED DURING DECEMBER 1990							

Total Diversions During 1990: 6,778.60 acre feet

Figure 2. Diversion Points



A. Other Water Facilities

There are presently 26 cattle watering facilities maintained on the refuge; 22 are windmills and 4 are PVC cased, shallow well systems equipped with electric submersible pumps. The windmill units have been developed with small overflow/reserve ponds, and have proven their value to wildlife, especially during times of drought. Two other wells for domestic use are located at headquarters. One of the wells located next to the maintenance building, has a high salt content and is not potable, although water from the well is used for fire management purposes.

B. Precipitation

Precipitation for 1990 officially totalled 30.95 inches, as was reported to the refuge from the National Weather Service located in Hudson, Kansas. The amount is approximately seven inches above the annual average of 23.87 inches, and is a definite improvement compared with 22.50 inches recorded during 1989.

Figure 3 compares the actual monthly rainfall for 1990 with the 50-year average.

Figure 3. Annual Rainfall Data

Month	1990	50 Year Average
January	0.78	0.57
February	2.11	0.84
March	1.87	1.40
April	3.89	2.19
May	8.35	3.77
June	2.04	3.67
July	1.68	2.93
August	3.31	2.59
September	3.44	2.42
October	1.13	1.80
November	2.00	0.93
December	0.35	0.77
TOTAL	30.95	23.87

Water flow within the Rattlesnake Creek remained adequate for normal springtime diversions. In fact, during the later part of May, it appeared that a flood was imminent. However, we were able to slow the incoming floodwaters by diverting much of the water through most of the 32 impoundments, and by passing the rest of the water directly through and out of the refuge, without damage to any facilities. We were able to accomplish this task, and still achieve all of our wetland management objectives with the abundant water that was present.

Despite the adequate rainfall within the watershed, flows within the creek decreased abruptly during late July. Therefore no diversions were performed during August. Instead, all water entering the refuge was stored in the Little Salt Marsh. This was done so that we might have some water available for use in the fall of the year; in the event that the creek flow remained low for the rest of the year.

As things turned out, water flows within Rattlesnake creek failed to increase to the point that we could meet our Fall diversion objectives adequately. The only option we had at the time, was to slowly divert water to impoundments that are located closest to the Little Salt Marsh. This proved to be a very slow process, and by the time that the Fall waterfowl migration had ended, we still hadn't been able to get any water into some of the remaining moist soil units, located towards the north end of the refuge. We had very good moist soil plant production in many of the refuge impoundments, yet we had no water to divert to provide waterfowl with habitat.

III. Impoundment Data

In 1987 a new format was developed to serve as a guide for monitoring progress of individual water unit plans. A standardized one page "Planning Sheet" for each of the 32 units includes an overall objective for each unit as well as a specific timetable for management activities; such as maintenance needs, drawdown dates for moist soil management, etc.. There is also space to report actual accomplishments. The 1990 planning sheets with actual accomplishments were updated monthly, held on file, and are available for review upon request.

IV. Water Management Facilities

A total of 5 water control structures were rehabilitated during 1990. Three of the structures are located at a critical diversion point (Darrynane Lake), and will provide improved future management capabilities. In addition, several miles of refuge canals were cleaned of silt and cattails with the Bantam excavator while on loan from Seedskadee NWR.

V. Recommendations for Water Management in 1991

1. Maintain levels in the Little Salt Marsh as high as possible throughout the year, while using stored water as needed for management of other units. Be ready to discharge water on short notice to prevent flooding should heavy rains occur in the watershed.

2. Continue water manipulations within various water units for moist soil plant production as described in the Wetland Management Plan. When dewatering a given unit for moist soil plant production, ensure to leave water remaining in the borrow areas if possible; these areas provide excellent shorebird habitat.

3. Ensure that plenty of water is present throughout the nesting and brood rearing time period for water units that have goose nesting structures present. Continue to monitor Canada goose production on the refuge, by maintaining the 42 goose nesting tubs. Annually, each tub should be checked for use and/or production, repaired if needed, and filled with new hay prior to the onset of nesting season.

4. Continue rehabilitation work planned for the few remaining water control structures in need of work/replacement.

5. Continue to collect data on water levels, diversions from Rattlesnake Creek, and water quality readings.

6. At least once during the fall, prior to hunting season, schedule a flight to document any unauthorized diversions upstream from the refuge.

7. Continue to cooperate with Fish & Wildlife Enhancement and other personnel concerning water contamination studies and other activities.

8. If a drought situation develops during early spring, discontinue all draw down activities within the impoundments. Allow the water elevations within most of the units to recede naturally through evaporation and transpiration. Attempt to store water in the Little Salt Marsh, Units 14 A & B, 16, 49, Darrynane Lake, East Lake and the Big Salt Marsh. Units that are most important are the Little Salt Marsh, Big Salt Marsh, Darrynane Lake and East Lake. If rainy conditions develop, proceed with active drawdown activities in water units as scheduled.

1988 WATER USE REPORT
RECREATIONAL USE

G

IMPORTANT: YOU MUST REPORT **ANNUAL USAGE** OR THE REASON FOR **NON-USAGE**, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report **required** to retain all Vested or Appropriated Rights. **COMPLETE AND RETURN BY MARCH 1, 1989.** Please begin by reading the instructions for PART A on the reverse of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water rights listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
109 Southwest 9th Street Suite 202
Topeka, Kansas 66612-1283

PART A: POINT(S) OF DIVERSION

File Number	Legal Descriptions of Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate (gpm)	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date of Measure
007571-00	SW SE NE 35-21-11W 01	2,170.45	Ac/ft	Surface water diverted				
007571-00	SW NE NE 13-22-11W 01	1,768.18	Ac/ft	Surface water diverted				
007571-00	SW NW SW 25-22-11W 01	4,099.65	Ac/ft	Surface water diverted				

333004

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

As of March 1	As of July 1	As of November 1
Empty 1/4 1/2 3/4 (Full)	Empty 1/4 1/2 (3/4) Full	Empty (1/4) 1/2 3/4 Full

018302- 1 NNNNYNN Staff 093 00 Date: 2/2/89 Telephone (316) 486-2393
Office Use FO CO GMD

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

I submit this report with the knowledge that if it contains any false information I will be quilty of a class C misdemeanor.

Patrick D. Gonyaeo
(Signature)

Acting Refuge Manager
(Title)

____ Owner ____ Agent ____ Other

1987 WATER USE REPORT
RECREATIONAL USE

IMPORTANT: YOU MUST REPORT **ANNUAL USAGE** OR THE REASON FOR **NON-USAGE**, IN ORDER TO PROTECT YOUR RIGHT TO USE WATER.

This is the annual Water Use Report **required** to retain all Vested or Appropriated Rights. **COMPLETE AND RETURN WITHIN 30 DAYS.** Please begin by reading the instructions for PART A on the reverse of this page. Also present are instructions for name and address changes, **which include information needed if you have disposed of your interest in one or more of the water rights listed below.** If you have any questions on how to complete this form, please contact the Water Use Coordinator at (913) 296-3717. Please make a copy of the entire Water Use Report for your records, and return the original report to:

Water Use Coordinator
Kansas State Board of Agriculture
Division of Water Resources
109 Southwest 9th Street Suite 202
Topeka, Kansas 66612-1283

PART A: POINT(S) OF DIVERSION

File Number	Legal Descriptions of Point(s) of Diversion	Metered Quantity	Meter Units	Hours Pumped	Est. Pump Rate	Well Data: Well Depth	Well Data: Depth to Water	Well Data: Date of Measure
007571-00	SW SE NE 35-21-11W 01	1,157.5	ac/ft		surface water diverted			
007571-00	SW NE NE 13-22-11W 01	1,816.0	ac/ft		surface water diverted			
007571-00	SW NW SW 25-22-11W 01	7,156.2	ac/ft		surface water diverted			

303054

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

As of March 1: Empty 1/4 1/2 3/4 (Full)
As of July 1: Empty 1/4 1/2 3/4 (Full)
As of November 1: Empty 1/4 1/2 3/4 (Full)

018302- 1 NNNNYNN Staff 093 00
Office Use FO CO GMD

Date: 1/29/88 Telephone (316) 486-2393

James E McCollum
(Signature)

Refuge Manager
(Title)

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

____ Owner ✓ Agent ____ Other

MICROFILMED
1987

REPORT OF WATER USE
FOR 1986
RECREATIONAL USE

IMPORTANT: IN ORDER TO PROTECT THE RIGHT TO USE WATER, **ANNUAL USAGE** OR THE REASON FOR **NON-USAGE** MUST BE REPORTED.

If you have disposed of your interest in this water right, please forward this form to the present holder of the right, or provide the Division of Water Resources with the new owner's name and address.

See the reverse side of this page for instructions.

File Number	Legal Descriptions of Point(s) of Diversion		Hours Pumped	Est. Pump Rate (gpm)	Metered Quantity	Meter Units	Well Data Depth	Well Data Depth to Water	Well Data Date
A 007571-00	~~NE SE SW~~ SW SE NE	35-21-11W 01			2985.7	ac/ft	Surface water diverted		
007571-00	~~NE NE SW~~ SW NE NE	13-22-11W 01			833.25	ac/ft	Surface water diverted		
007571-00	SW NW SW	25-22-11W 01			4573.5	ac/ft	Surface water diverted		
					8392.45	ac/ft			

DIVISION OF WATER RESOURCES
RECEIVED
FEB - 5 1987
STATE BOARD OF AGRICULTURE

270171

If water was diverted by a dam or other physical structure to create a reservoir, please circle the approximate stages of the reservoir:

As of March 1					As of July 1					As of November 1				
Empty	1/4	1/2	3/4	(Full)	Empty	1/4	1/2	3/4	(Full)	Empty	1/4	1/2	3/4	(Full)

018302- 1 NNNNYNN Staff 093 00 Date: 1-15-87 Telephone (316) 486-3383
Office Use FO CO GMD

RECEIVED
FEB 23 1988
DIVISION OF WATER RESOURCES
STATE CO

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

Karen S. Cartledge
(Signature)

___ Owner ___ Tenant X Agent

KANSAS STATE BOARD OF AGRICULTURE

DIVISION OF WATER RESOURCES
DAVID L. POPE, Chief Engineer-Director
109 SW Ninth Street, Suite 202
TOPEKA, KANSAS 66612-1283
(913) 296-3717

SAM BROWNBACK
Secretary

November 26, 1986

United States
Department of the Interior
Fish and Wildlife Service
P. O. Box 25486
Denver Federal Center
Denver, CO 80225

Attention: John L. Spinks, Jr., Acting Regional Director

Re: Appropriation of Water
File No. 7571

Dear Mr. Spinks:

This will acknowledge receipt of your letter of October 31, 1986 concerning the above-referenced file number which pertains to the Quivera National Wildlife Refuge. In response to your concerns we are providing the following information.

1. At anytime that you believe your right to divert water under File No. 7571 is being impaired by junior upstream surface water diversions, you should contact the Water Commissioner at our Stafford Field Office (address given below) and file a complaint. The complaint may be made by telephone, but must later be confirmed in writing. Our field office will then make an investigation of the physical conditions involved and make a written report setting forth the findings of the investigation. If the investigation shows that there is no basis for further action, the complainant will be so advised. If the investigation indicates that impairment does exist, the complainant may elect to sign a written request to secure water. Subsequent to such signed request, appropriate legal notices(s) will be served on the party(ies) causing the impairment directing the regulation or cessation of the use of water which is impairing the complainant's right to divert water. Enclosed is a copy of K.A.R. 5-4-1 (our regulation) pertaining to this matter.

Bruce W. Frisbie, Water Commissioner
Stafford Field Office
Division of Water Resources
105 North Main, Drawer F
Stafford, Kansas 67570
(316) 234-5311

2. As an alternative, the complainant may file for injunctive relief as set forth in K.S.A. 82a-716.

3. The relationship that groundwater diversions in the basin have to the surface water flows in Rattlesnake Creek has not been clearly established at this point. The problem of identifying the impact of specific wells is very complex, and without such information it is impossible to determine which users to regulate. Consequently, we are not in a position to regulate individual groundwater users at this time. However, in part due to a new "safe-yield" policy of Big Bend Groundwater Management District No. 5, new appropriations of groundwater in the basin have been sharply curtailed.

Hopefully this addresses your concerns. If you have further questions, please feel free to contact this office.

Very truly yours,

James O. Bagley

James O. Bagley, P.E.
Civil Engineer

JOB:pg
Enclosure
cc: Stafford Field Office

5-4-1. Distribution of water between users where a prior right is being impaired. When a complaint is received that a prior right to the use of water is being impaired, the following procedure shall be followed:

1. The complaint shall be made to the chief engineer or his or her authorized representative. A complaint may be accepted verbally, in person or by telephone. No action shall be taken by the agency until the complaint is confirmed in writing.

2. An investigation of the physical conditions involved shall be made by the chief engineer or his or her authorized representative.

3. A written report of the investigation shall be prepared and a copy given to the complainant. If the investigation shows there is no basis for further action by the division, the complainant shall be so advised.

4. The complainant shall make a written request to secure water to satisfy his or her prior right.

5. The chief engineer or his or her authorized representative shall give a written legal notice and directive to other water users whose use of water must be regulated to secure water to satisfy the complainant's prior rights.

The request to secure water shall be made on a prescribed form furnished for that purpose by the division of water resources. All water delivered to the user's point of diversion for his or her use at the specified rate or less shall be applied to the authorized beneficial use and count against the quantity of water specified unless the user notifies the chief engineer or his or her authorized representative that diversion and use will be discontinued for a period of time for good reason.

When the quantity of water needed has been delivered to the user's point of diversion or when the user discontinues his or her use of water, those persons who have been directed to regulate their use shall be notified that they may resume the diversion and use of water.

If the available water supply in the source should increase, the chief engineer or his or her authorized representative may allow some or all of the users regulated to resume use depending on the supply. (Authorized by K.S.A. 82a-706a; modified, 1978 HCR 5073, May 1, 1978.)

KANSAS STATE BOARD OF AGRICULTURE

DIVISION OF WATER RESOURCES
DAVID L. POPE, Chief Engineer-Director
109 SW Ninth Street, Suite 202
TOPEKA, KANSAS 66612-1283
(913) 296-3717

SAM BROWNBACK
Secretary

November 26, 1986

United States
Department of the Interior
Fish and Wildlife Service
P. O. Box 25486
Denver Federal Center
Denver, CO 80225

Attention: John L. Spinks, Jr., Acting Regional Director

Re: Appropriation of Water
File No. 7571

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Bruce W. Frisbie, Water Commissioner
Stafford Field Office
Division of Water Resources
105 North Main, Drawer F
Stafford, Kansas 67578
(316) 234-5311

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James O. Bagley

James O. Bagley, P.E.
Civil Engineer

JOB:pg
Enclosure
cc: Stafford Field Office

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United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:

BA/EN
WR KS
MAIL STOP 60190

OCT 31 1986

Chief Engineer-Director
Kansas State Board of Agriculture
Division of Water Resources
109 S.W. Ninth Street, Suite 202
Topeka, KS 66612-1283

Dear Sir:

For the past several years, there has been a decline in the amount of water discharged by Rattlesnake Creek. The Fish and Wildlife Service holds Permit No. 7571 for the Quivira National Wildlife Refuge, which covers the direct diversion not to exceed 300 cfs from Rattlesnake Creek, up to 22,000 acre-feet annually, and the storage of 15,800 acre-feet.

One cause for this decline is the unauthorized pumping or diversion of surface water upstream from the refuge, often occurring in late summer and early fall when the streamflow is normally at its lowest. Diversions at this time could have the effect of drying up the creek when there is the greatest need for water on the refuge.

A more significant cause to which the decline can be attributed is the increase in ground-water development in the Rattlesnake Creek Basin. Irrigation of croplands has been practiced in the Rattlesnake Creek drainage area for many years; but since development of wheel-line and center-pivot sprinkler systems, the acreage being irrigated has expanded dramatically. There were approximately 177 permitted wells in 1960 and by 1984 the number had increased to approximately 1,470. During a normal irrigation season, these wells produce an approximate average of 15 acre-feet of water per well.

Rattlesnake Creek lies in a basin composed primarily of sandy pervious materials. The sandy soils of the basin have the potential for storing a tremendous amount of water which then seeps out via springs along the length of the creek. A single

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:

BA/EN
WR KS
MAIL STOP 60190

OCT 31 1986

Chief Engineer-Director
Kansas State Board of Agriculture
Division of Water Resources
109 S.W. Ninth Street, Suite 202
Topeka, KS 66612-1283

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low precipitation year will not dry up the creek if preceded by normal or wet years. Normally, a high rainfall year will produce steady flow from springs into Rattlesnake Creek for the following year or two. The increased pumping from wells for irrigation is considered to be intercepting the flow of these springs.

A section of the Irrigation Act of 1891, which has never been repealed, forbids any person from appropriating subterranean waters from a supply that naturally discharges into any superficial stream, to the prejudice of prior appropriators of the stream water. (Kansas Laws 1891, ch. 133, art. 1 § 66; Kan. G.S. 1949, 42-306.) With up to 200,000 acre-feet of water being removed from basin aquifers annually, the adverse impact on flows of surface water into the refuge is certainly substantial.

We request that your office investigate this problem and advise this office what, if any, administrative action or procedural steps under Kansas statutes are required, so that we can properly pursue the most expedient solution to ensure the protection of the refuge water supply.

If you have any questions, or require further information, please contact Ginger Chesy of our Water Resources Section at (303) 236-5322.

Sincerely,

John L. Spinks, Jr.

JOHN L. SPINKS, JR.
Acting Regional Director

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Sincerely,

JOHN L. SPINKS, JR.
Acting Regional Director

NNUAL WATER USE REPORT - SEE INSIDE BACK OF ENVELOPE FOR INSTRUCTIONS

FILE NUMBER (1)	LOCATION QUALIFIERS (2)	SEC TWP RAN	(3)	HOURS PMPD (4)	AVERAGE RATE (5)	CD(6)	METERED QUAN (7)	CD(8)	ACRES IRR (9)	ENERGY AMT (10)	TY(11)	WELL DATA DATE (12)	WATER (13)	WELL (14)
07571	SW SE NE	35 21 11W	01				539	A	Surface water diverted					
	SW NE NE	13 22 11W	01				462	A	Surface water diverted					
	SW NW SW	25 22 11W	01				1628	A	Surface water diverted					
							2629	A						

RECEIVED
APR 11 1985
DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE

RECEIVED
FIELD OFFICE
Division of Water Resources
APR 11 1985

GNATURE: James E McCollum DATE: 1/22/85 TELEPHONE NUMBER (316) 486-2393

HECK IF: ☒ OWNER ☐ TENANT ☐ AGENT

REPORT YEAR	OFFICE USE	FIELD OFFICE	CO GMD
84	1-018302	STAFF SF	

IF MUNICIPAL POPULATION SERVED

NO. OF CONNECTIONS

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

170682

NNUAL WATER USE REPORT – SEE INSIDE BACK OF ENVELOPE FOR INSTRUCTIONS

FILE NUMBER (1)	LOCATION QUALIFIERS (2)	LOCATION SEC TWP RAN	(3)	HOURS PMPD (4)	AVERAGE RATE (5)	(CD(6))	METERED QUAN (7)	(CD(8))	ACRES IRR (9)	ENERGY AMT (10)	(TY(11))	WELL DATA DATE (12)	WATER (13)	WELL (14)
							1159	A	Surface water diverted					
							1956	A	Surface water diverted					
							5311	A	Surface water diverted					
							8426	A						

DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOUR
RECEIVED
FEB 3 1986
STATE BOARD OF AGRICU

IGNATURE: Karen S. Cartlidge DATE: 1/21/86 TELEPHONE NUMBER (316) 486-2393

HECK IF: ☒ OWNER ☐ TENANT ☐ AGENT

IF MUNICIPAL POPULATION SERVED

EPORT EAR | OFFICE USE | FIELD OFFICE | CO | GMD

NO. OF CONNECTIONS

STATE OF KANSAS
DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE

In the Matter of Application No. 7571
for Permit to Appropriate Water to Beneficial Use.

NOTICE AND PROOF OF COMPLETION OF WORKS

The undersigned, being the holder of a permit issued by the Chief Engineer of the Division of Water Resources of the Kansas State Board of Agriculture pursuant to application No. 7571 for the appropriation of water, does hereby certify that in accord with the tenor of such permit and the terms, conditions and limitations incorporated therein, he has completed construction and installation of the proposed diversion works.

The well or other works for diversion of water are located as follows:

C. A (well) (pump site) (dam) (check one) X was completed or established on _____, 1968,
and is located in the Southwest Quarter of the Southeast
Quarter of the Northeast Quarter of Section 35, Township 21S,
Range 11W, in Stafford County, Kansas.

A (well) (pump site) (dam) (check one) was completed or established on _____, 19____,
and is located in the _____ Quarter of the _____
Quarter of the _____ Quarter of Section _____, Township _____,
Range _____, in _____ County, Kansas.

Annual records from which the quantity of water actually diverted may be readily determined will be submitted at the end of each calendar year.

Dated this _____ day of JUL 15 1982 RECEIVED, 19____

AUG 16 1982

FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Acting Regional Director
US DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
BOX 25486 -
DENVER CO 80225

33-6743-2-S—2A-72

July 26, 1982

U.S. Department of the Interior
Fish and Wildlife Service
Water Resources Section
Denver Federal Center, Box 25486
Denver, Colorado 80225

Attention: Ms. Ginger Chesy

Re: Appropriation of Water
File No. 7571

Dear Ms. Chesy:

As of July 19, 1982, we are in receipt of forms entitled "Notice and Proof of Completion of Works". These forms show that the works for diversion of water were completed at the authorized locations in 1964, 1966 and 1968.

Our records show that previously on March 20, 1974, we acknowledged Notice and Proof of Completion of Works effective May 4, 1972. Therefore, submission of the forms referred to in the above paragraph were unnecessary, however, we will make them a matter of record.

A field inspection of the above authorized locations will be required and this will be handled by our Stafford Field Office. It will be necessary for you to contact that office regarding a certificate. The Water Commissioner in the Stafford Field Office is:

Mr. Bruce Frisbie, Water Commissioner
Division of Water Resources
105 North Main
Stafford, Kansas 67578
(316)-234-5311.

Should you have any questions, please feel free to contact this office.

Very truly yours,

James O. Bagley, P.E.
Engineer

JOB:KOO:br

CC: Stafford Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:
SS/EN
WR KS

JUL 15 1982

Kansas State Board of Agriculture
Division of Water Resources
109 - 9th St. Southwest
Topeka, KS 66612-1283

Dear Sir:

Enclosed please find Notice and Proof of Completion of Works for Application #7571 at the Quivira National Wildlife Refuge.

The scheduled development under this permit was not fully completed as planned due to lack of funds and no further development is anticipated for the area at this time.

Please schedule an inspection of the works so that a certificate can be issued.

If you have any questions or require further information, please contact Ms. Ginger Chesy of our Water Resources Section at 303/234-3616.

Sincerely,

ROBERT H. SHIELDS
Acting Regional Director

Enclosure

RECEIVED
AUG 16 1982
FIELD SERVICE
DIV OF WATER RESOURCES
STATE KS

MICROFILMED

STATE OF KANSAS
DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE

In the Matter of Application No. 7571
for Permit to Appropriate Water to Beneficial Use.

NOTICE AND PROOF OF COMPLETION OF WORKS

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The well or other works for diversion of water are located as follows:

A. A (well) (pump site) (dam X) (check one) was completed or established on _____, 1964, and is located in the Southwest Quarter of the Northwest Quarter of the Southwest Quarter of Section 25, Township 22N, Range 11W, in Stafford County, Kansas.

B. A (well) (pump site) (dam X) (check one) was completed or established on _____, 1966, and is located in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter of Section 13, Township 22N, Range 11W, in Stafford County, Kansas.

33-6743-2-S—2A-72 11-70-10M

ANNUAL WATER USE REPORT - SEE INSIDE BACK OF ENVELOPE FOR INSTRUCTIONS

FILE NUMBER (1)	LOCATION QUALIFIERS (2)	SEC TWP RAN	(3)	HOURS PMPD (4)	AVERAGE RATE (5)	CD(6)	METERED QUAN (7)	CD(8)	ACRES IRR (9)	ENERGY AMT (10)	TY(11)	WELL DATA DATE (12)	WATER (13)	WELL (
607571-00A	SW SE NE	35 21 11W	01	Surface water diverted						3,477.2		acre	feet	
	SW NE NE	13 22 11W	01	Surface water diverted						1,920.5		acre	feet	
	SW NW SW	25 22 11W	01	Surface water diverted						3,981.0		acre	feet	
				TOTAL						9,378.7		acre	feet	

DIVISION OF WATER RESOURCES
RECEIVED
APR 5 1982
STATE BOARD OF AGRICULTURE

RECEIVED
APR 27 1999
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

SIGNATURE: _____ DATE: _____ IF MUNICIPAL, POPULATION SERVED _____ NO. OF CONNECTIONS _____

CHECK IF: ☐ OWNER ☐ TENANT ☐ AGENT

REPORT YEAR	OFFICE USE	FIELD OFFICE	GROUNDWATER DIST
1	018302	STAFFORD	

U S DEPT OF INTERIOR
FISH & WILDLIFE SERVICE
P O BOX 25486
DENVER CO 80225

United States Department of the Interior
FISH AND WILDLIFE SERVICE

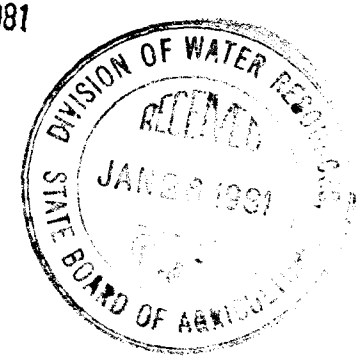
MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:

SS/EN WR KS
Quivira NWR

JAN 2 1 1981



Chief Engineer-Director
Kansas State Board of Agriculture
Division of Water Resources
901 Kansas Avenue
Topeka, KS 66612

Dear Mr. Gibson:

Enclosed is report of Water Use for 1980 under recreational Application #7571 at Quivira National Wildlife Refuge.

Sincerely yours,

For Kenneth C. Rozas
Regional Engineer

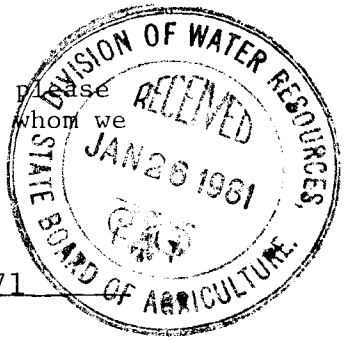
MICROFILMED

Enclosure

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

REPORT OF WATER USE
FOR 1980



If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in Stafford County, Kansas

Purpose of use:

( ) Stockwatering; ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Location of Diversion Points						If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
	NW	SW	25	22S	11W	2213.54					
	NE	NE	13	22S	11W	836.39					
	SE	NE	35	22S	11W	331.40					
						(calculated acre-feet)					
TOTAL						3381.33					

(Use additional sheets as needed)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.

Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold

Jan.	145.90	July	1,108.81
Feb.	128.90	Aug.	356.43
Mar.	118.30	Sep.	12.01
Apr.	29.81	Oct.	-0-
May	636.69	Nov.	23.45
June	518.83	Dec.	300.20
		TOTAL	3,381.33

MICROFILMED

CITY OR RURAL WATER DISTRICTS:
Population served _____ or Number of connections _____.

CITY OR INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
Gallons _____ or Percent of water intake _____.

Signature [signature] Regional Engineer Date January 7, 1981

Mailing Address Quivira National Wildlife Refuge, P.O. Box G, Stafford, KS 67578

(Rev. 1978) 1980

2

KANSAS STATE BOARD OF AGRICULTURE

DIVISION OF WATER RESOURCES
GUY E. GIBSON, Chief Engineer—Director
901 Kansas Avenue
TOPEKA, KANSAS 66612
(913) 296-3717

W. W. DUITSMAN
Secretary

January 5, 1981

Bureau of Sports Fisheries & Wildlife
Regional Director
10597 West Sixth Avenue
Denver, Colorado 80215

Gentlemen:

Enclosed are forms on which reports of water used during 1980 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information our records show that you have an interest in or own the following water rights:

Application Nos.:

7571-2	17,601	17,608
17,595-1	17,602	17,609
17,596-1	17,603	17,610-1
17,597-1	17,604	
17,598-1	17,605	
17,599	17,606	
17,600	17,607	

Very truly yours,

Paul C. Clark
Hydrologist

PCC:dae

United States Department of the Interior
FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

SS/EN WR KS
Quivira NWR

Division of Water Resources
Kansas State Board of Agriculture
901 Kansas Avenue
Topeka, Kansas 66612

Dear Sir:

Attached is Report of Water Use for 1979 for Permit # 7571. Please contact us if you need further information about water use at Quivira National Wildlife Refuge.

Sincerely,

William A. Godby
Regional Engineer

Attachment

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

REPORT OF WATER USE
FOR 1979

2

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in Stafford County, Kansas

Purpose of use:

( ) Stockwatering; ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Location of Diversion Points						If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
	NW	SW	25	22S	11W	5923.2					
	NE	NE	13	22S	11W	187.6					
	SE	NE	35	21S	11W	692.9					
						(calculated					
						acre-feet)					
TOTAL						6803.7					

(Use additional sheets as needed)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.

Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold

Jan.	1302.0	July	1491.6
Feb.	966.0	Aug.	1442.0
Mar.	•	Sep.	172.•
Apr.	0	Oct.	34.0
May	232.5	Nov.	425.4
June	555.•	Dec.	183.2
		TOTAL	6803.7

RECEIVED
JUN 16 1980
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOURCES
MAR 04 1980
BOARD OF AGRICULTURE

CITY OR RURAL WATER DISTRICTS:
Population served _____ or Number of connections _____.

CITY OR INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
Gallons _____ or Percent of water intake _____.

Ralph L. Bryant

Signature Ralph L. Bryant, Acting Refuge Manager Date February 14, 1980

Mailing Address Quivira National Wildlife Refuge, P.O. Box G, Stafford, Kansas 67578

(Rev. 1978) 1979

1-(2)

January 2, 1980

Bureau Of Sports Fisheries & Wildlife
Regional Director
10597 West 6th Avenue
Denver, Colorado 80215

Gentlemen:

Enclosed are forms on which reports of water used during 1979 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information our records show that you have an interest in or own the following water rights:

Application Nos.:

18,422	18,423	18,424
18,425	18,426	18,427
18,428	18,429	18,430
18,431	18,432	18,433
18,434	18,435	18,436
18,437	18,438	18,439
18,440	18,441	18,442
(7571)	17,595	17,596
17,597	17,598	17,599
17,600	17,601	17,602
17,603	17,604	17,605
17,606	17,607	17,608
17,609	17,610	

Very truly yours,

James O. Bagley
Hydrologist

JOB/jw
Encs.

1-2-3

December 26, 1978

United States of America
Department of Interior
Bureau of Sport Fisheries and Wildlife
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225

ATTENTION: Sherryl Williss

Dear Ms. Williss:

As requested during your telephone calls on December 11, 1978, and December 19, 1978, we have examined our records and found that Notice and Proof of Completion of Works for Diversion have been filed as follows on your application:

NOTICE AND PROOF FILED: Application Nos. 7571; 17,597; 17,601; 17,602; 17,606; 17,608; 17,609; 17,610; 18,264; 18,426; 18,431; 18,433; 18,435; 18,436; 18,443.

NOTICE AND PROOF NOT FILED: Application Nos. 17,595; 17,596; 17,598; 17,599; 17,600; 17,603; 17,604; 17,605; 17,607; 18,422; 18,424; 18,425; 18,420; 18,428; 18,429; 18,430; 18,432; 18,434; 18,437; 18,438; 18,439; 18,440; 18,441; 18,442; 18,444.

Please feel free to contact our office if you should need any further assistance.

Very truly yours,

Harvey T. West
Hydrologist

HTW:spb

2 -

197 ATER USE REPORT AND ASSESSMENT M
for
BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5

Name Quivira Nat'l W/L Refuge Water Application # 7571

Address P. O. Box G City Stafford State Kansas Zip Code 67578

County Stafford & Reno Township Name North & South Putnam; North Hayes

Fill out a separate report for each vested right and each appropriation right or permit. Identify each by vested right code or application number above.

This report applies to: (X only 1) ____ A vested right __X__ Appropriation right

Purpose of use: ____ Irrigation; ____ Municipal*; ____ Industrial*; __X__ Recreational*

	Hours Pumped and Average Pumping Rate		If Water is Metered 1 Gallons 2 Acre-feet (Check Units Used)	WELL INFORMATION (if available)		
	Hours	GPM		Date Measured	Depth to Water	Depth of Well
¼ ¼ ¼ Sec T R						
¼ ¼ ¼ Sec T R						
¼ ¼ ¼ Sec T R						
¼ ¼ ¼ Sec T R						
¼ ¼ ¼ Sec T R						
¼ ¼ ¼ Sec T R						
TOTAL						

(See reverse side for example of how to figure acre-feet)

RECEIVED
APR 30 1979
DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOURCES STATE OF KANSAS RECEIVED DEC 14 1978

If irrigation use, total acres irrigated ____ Type of fuel for pump ____

Crop(s) irrigated under this right ____

I hereby affirm that the statement of water use on this form contains a full and true account of such water use by me, to the best of my knowledge and belief.

Date 03/10/78

Charles R. Darling
Signature of person filing this report
Charles R. Darling, Refuge Manager

If tenant, who is the owner REGIONAL DIRECTOR
U, S. FISH & WILDLIFE SERVICE

Owner's address P, O. BOX 25486
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

RECEIVED
DEC 13 1978

THIS FORM MUST BE FILLED OUT BY ALL WATER USERS! [Those using less than one (1) acre-foot total water usage (not per acre) need not report.]

Prescribed under the authority of K.S.A. 82a-1030. Big Bend Groundwater Management District No. 5 P O Box 125, St. John, KS 67576. Call us if you need assistance. (316) 549-3891.

*ALL MUNICIPAL, INDUSTRIAL, AND RECREATIONAL USERS MUST FILL OUT THE REVERSE SIDE OF THIS FORM.

MICROFILMED

ALL MUNICIPAL INDUSTRIAL, AND RECREATIONAL USERS MUST FILL OUT THIS SIDE OF THIS FORM.

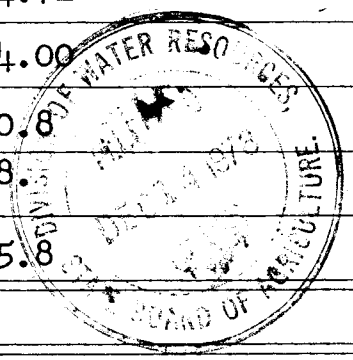
MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.

Units reported in: 1. ___ Cubic feet, 2. ___ Gallons, or 3. X Acre-feet

Indicate whether water is 1. X Raw, 2. ___ Treated, 3. ___ Sold

Jan.	76.00	July	554.88
Feb.	323.66	Aug.	514.72
Mar.	580.96	Sept.	914.00
Apr.	558.12	Oct.	1,310.8
May	799.9	Nov.	1,468.
June	866.2	Dec.	485.8
		TOTAL	8,453.04



CITY OR RURAL WATER DISTRICTS:

Population served _____ or Number of connections _____

CITY OR INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:

Gallons _____ or Percent of water intake _____

EXAMPLE: (Acre-feet can be determined by multiplying pump capacity in gallons per minute X 60 minutes per hour X hours pump was in use, then dividing by 325,851.)

I ran my pump at 1200 gpm for 60 days in 1977. 1200 gpm X 60 mph = 72,000 gph.
72,000 gph X 24 hpd X 60 days = 103,680,000 gal.
103,680,000 gal. ÷ 325,851 gal. per acre-foot = 318.2 acre-feet.

2 - 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:
SS/EN KS WR

Guy E. Gibson, Chief Engineer
Division of Water Resources
1720 South Topeka Avenue
Topeka, KS 66612

Dear Mr. Gibson:

Enclosed are completed Water Use Reports for 1975, 1976, and 1977 for the following application numbers: #7571 at Quivira National Wildlife Refuge and #17595 through #17610 at Flint Hills National Wildlife Refuge.

At Quivira water diversion from Rattlesnake Creek in 1976 was below normal to permit repair and protection of the flood-damaged dikes. The Rattlesnake Creek Canal was not repaired and water could not be diverted to the Big Salt Marsh. In 1977 the water diversion from Rattlesnake Creek was also below normal primarily because the area received five inches of precipitation above the annual average amount. The Rattlesnake Canal repairs had not been completed and water could not be diverted to the Big Salt Marsh. There are no irrigated crops at Quivira.

Water Use Reports for 1975, 1976 and 1977 for application #18264 at Kirwin National Wildlife Refuge will be forwarded in the near future.

For our Flint Hills Refuge we have been working with your office to determine the need for each of our filings. Of the agricultural filings, water has been and is being used only under applications #18429, #18430, #18431, #18433 and #18435. Water Use Reports for these will be submitted in the near future. We have submitted proof of construction under all of our recreational filing applications #17595 through #17610. Data in support of proof of beneficial use was forwarded to your office November 16, 1978. This data and filling of unit pools is directly related to the levels of John Redmond Reservoir and inflow to pools as the reservoir fills in the spring. The acre feet of water in pools as indicated on the 1975, 1976 and 1977 Report of Water Use forms is only approximate as our survey data on pool, dike and control structure elevations is very meager.

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

2 - 1

If we can answer any questions you may have please call or write Don Stewart (telephone 303/234-6015).

Sincerely,

William A. Godby

William A. Godby
Regional Engineer

Enclosures

2

REPORT OF WATER USE
FOR 1977

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

Quivira National Wildlife Refuge
P.O. Box G, Stafford, Kansas 67578

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in Stafford & Reno County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater ( ) Surface Water

Location of Diversion Points						If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
TOTAL											

(Use additional sheets as needed)

DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE
DEC 11 1978

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.

Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold

Jan.	76.00	July	554.88
Feb.	323.66	Aug.	514.72
Mar.	580.96	Sep.	914.00
Apr.	558.12	Oct.	1,310.8
May	799.9	Nov.	1,468.
June	866.2	Dec.	485.8
		TOTAL	8,453.04

RECEIVED
MAY 14 1979
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

CITY OR RURAL WATER DISTRICTS:
Population served _____ or Number of connections _____

CITY OR INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
Gallons _____ or Percent of water intake _____

Signature [signature] Date 5-9-79

Mailing Address Interior-Fish & Wildlife
Box 25486, Federal Center, Denver, CO 80225

MICROFILMED

(Rev. 1977) 1977

2

REPORT OF WATER USE
FOR 1976

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

Quivira National Wildlife Refuge
P.O. Box G, Stafford, Kansas 67578

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Location of Diversion Points						If Water is Metered 1.__Cu. Ft. or 2.__Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
	NW	SW	25	22S	11W	2160.0					
	NE	NE	13	22S	11W	1282.2					
	SE	NE	35	21S	11W	654.62					
						Calculated					
						Acre-feet					
TOTAL						4096.82					

(Use additional sheets as needed)

MONTHLY AMOUNT OF WATER USED:
If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1.__Cubic Feet, 2.__Gallons, or 3.X Acre-Feet

Indicate whether water is 1.__Raw, 2.__Treated, 3.__Sold

Jan.	129.7	July	00.0
Feb.	206.76	Aug.	767.94
Mar.	61.1	Sep.	500.2
Apr.	118	Oct.	1,123.26
May	32	Nov.	936.0
June	155.36	Dec.	66.5
		TOTAL	4,096.82

CITY OR RURAL WATER DISTRICTS:
Population served_____ or Number of connections_____

CITY OR INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
Gallons_____ or Percent of water intake_____

Signature Charles L. Stewart Date May 1979

Mailing Address Interior-Fish & Wildlife
Box 25486, Federal Center, Denver, CO 80225

(Rev. 1976)

1976

2

REPORT OF WATER USE
FOR 1975

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in STAFFORD County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface water

Location of Diversion Points						If Water is Metered 1.__Cu. Ft. or 2.__Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
	NW	SW	25	22S	11W	6049.62					
	NE	NE	13	22S	11W	966.32					
	SE	NE	35	21S	11W	435.48					
						Calculated Acre-feet					
TOTAL						7451.42					

(Use additional sheets as needed)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.

Units reported in: 1.__Cubic Feet, 2.__Gallons, or 3.X Acre-Feet

Indicate whether water is 1.X Raw, 2.__Treated, 3.__Sold

Jan.	00	July	2681.16
Feb.	00	Aug.	518.56
Mar.	238.66	Sep.	639.50
Apr.	392.94	Oct.	401.12
May	29.30	Nov.	639.94
June	989.60	Dec.	920.64
		TOTAL	7451.42 Acre-feet

MUNICIPAL: (City or Rural Water Districts) 1.__Population, or 2.__Number of connections served:_____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:

_____ Gallons or _____ %

Signature [signature] Date May 1979

Mailing Address Interior-Fish & Wildlife Box 25486, Federal Center, Denver,

RECEIVED

MAY 14 1979

FIELD OFFICE
DIVISION OF WATER RESOURCES

(Rev. 1975) 1975

MICROFILMED

1-2-3

May 10, 1977

United States Department of Interior
Fish and Wildlife Service
P. O. box 25486
Denver, Colorado 80225

Re: Water Use in Lyon, Coffey, Phillips, Stafford and Rice Counties, Kansas

Gentlemen:

Enclosed are forms on which reports of water used during 1976 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information our records show that you have an interest in or own the following water rights:

Application Nos: Irrigation

18,422-I	18,426-I	18,430-I	18,434-I	18,438-I
18,423-I	18,427-I	18,431-I	18,435-I	18,439-I
18,424-I	18,428-I	18,432-I	18,436-I	18,440-I
18,425-I	18,429-I	18,433-I	18,437-I	18,441-I
				18,442-I

Application Nos: Recreational and/or Municipal

7571-R	17,598-I	17,602-I	17,606-I	17,610-I
17,595-I	17,599-I	17,603-I	17,607-I	18,264-C
17,596-I	17,600-I	17,604-I	17,608-I	
17,597-I	17,601-I	17,605-I	17,609-I	

RECEIVED
MAY 23 1977
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Very truly yours,

Lucille Gettinger
Records Clerk

lg

Enc

MICROFILMED

1-2-3

DEC 28 1977

Bureau of Sports Fisheries & Wildlife
U. S. Dept. of Interior
Fish & Wildlife Service
P.O. Box 25486
Denver,Colorado 80225

Gentlemen:

Enclosed are forms on which reports of water used during 1977 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information our records show that you have an interest in or own the following water rights:

Application Nos:

18,422	18,429	18,436
18,423	18,430	18,437
18,424	18,431	18,438
18,425	18,432	18,439
18,426	18,433	18,440
18,427	18,434	18,441
18,428	18,435	18,442

Application Nos:
Rec. or Mun.

7571 2	17,600	17,606
17,595	17,601	17,607
17,596	17,602	17,608
17,597	17,603	17,609
17,598	17,604	17,610
17,599	17,605	18,264 3

Very truly yours,

RECEIVED

JAN 31 1978

FIELD OFFICE
DIVISION OF WATER RESOURCES
SALFORD

Emmett E. Dusharm
Civil Engineer

EED;el

Encs.

1, 2 & 3

December 31, 1976

Bureau of Sports Fisheries & Wildlife
Regional Director
10597 West Sixth Avenue
Denver, Colorado 80215

Gentlemen:

Enclosed are forms on which reports of water used during 1976 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information our records show that you have an interest in or own the following water rights:

Application Nos.:

18,422	18,429	18,436
18,423	18,430	18,437
18,424	18,431	18,438
18,425	18,432	18,439
18,426	18,433	18,440
18,427	18,434	18,441
18,428	18,435	18,442

Recreational and/or Municipal use:

Application Nos.:	7571	17,595	17,596	17,597	17,598
	17,599	17,600	16,601	17,602	17,603
	17,604;	17,605	17,606	17,607	17,608
	17,609	17,610	18,264		

Very truly yours,

Clark I. Stocking
Engineer

CIS:bj

Encs.

Copy 2

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
10597 West Sixth Avenue
Lakewood, Colorado
Across From Federal Center

IN REPLY REFER TO:

EN Water Rights

MAY 4 1976

Kansas Department of Agriculture
Division of Water Resources
1720 South Topeka Avenue
Topeka, Kansas 66612

7571

Re: 1975 Report of Water Use
Kirwin NWR & Quivira NWR

Gentlemen:

Please find enclosed completed 1975 Report of Water Use Forms for our Kirwin and Quivira National Wildlife Refuges, Application Nos. 18264 and 7571 respectively.

At the Quivira Refuge water diversions from Rattlesnake Creek were below normal because of flood damaged dikes.

There are no irrigated crops on the Kirwin or Quivira Refuges.

Sincerely yours,

William A. Godby

William A. Godby
Regional Engineer

Enclosures

DIVISION OF WATER RESOURCES RECEIVED MAY 06 1976 STATE BOARD OF AGRICULTURE

RECEIVED
MAY 24 1976
DIVISION OF WATER RESOURCES
STATE BOARD

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

MICROFILMED

REPORT OF WATER USE
FOR 1975

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application 7571

Place of use is in STAFFORD County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface water

Location of Diversion Points						If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	¼	Sec.	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
	NW	SW	25	22s	11W	6049.62					
	NE	NE	13	22S	11W	966.32					
	SE	NE	35	21S	11W	435.48					
						Calculated					
						Acre-feet					
TOTAL						7451.42					

(Use additional sheets as needed)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold

Jan.	00	July	2681.16	
Feb.	00	Aug.	518.56	
Mar.	238.66	Sep.	639.50	
Apr.	392.94	Oct.	401.12	
May	29.30	Nov.	639.94	
June	989.60	Dec.	920.64	
		TOTAL	7451.42	Acre-feet

DIVISION OF WATER RESOURCES RECEIVED MAY 06 1976

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
_____ Gallons or _____ %

Signature David P. Stewart Date 4/22/76

Mailing Address US Fish & Wildlife Service P.O. Box 25486
Denver Federal Center, Denver, CO 80225

RECEIVED

(Rev. 1975) 1975

MAY 24 1976

DIVISION OF WATER RESOURCES STAFFORD

MICROFILMED

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
10597 West Sixth Avenue
Lakewood, Colorado
Across From Federal Center

IN REPLY REFER TO:

EN WU KS
X ADM 5-03

FEB 26 1975

7571

Division of Water Resources
Kansas State Board of Agriculture
Tenth Floor State Office Building
Topeka, KS 66612

Re: Quivira NWR
1974 Report of Water Use
7571

Dear Sir:

Please find enclosed the U.S. Fish and Wildlife Service's Report of Water Use for 1974 on the Quivira National Wildlife Refuge.

The refuge dike system was severely damaged by floods in 1973. Emergency repairs were made to the dikes of the Little Salt Marsh (Unit 5) and to Unit 7. These units were not refilled to their normal levels. During the last 4 months of the year, we were able to divert water to Units 7, 10a, 10b, 14b, 14c, 25, 28, 29, 20, 40, and 62. Water was not diverted to the remaining units because of the unrepaired damage. Designs are presently underway to repair the damaged dikes.

If you have any questions regarding our use or the completion of the Water Use Form, please do not hesitate to contact this Office.

Sincerely yours,

William A. Godby
Regional Engineer

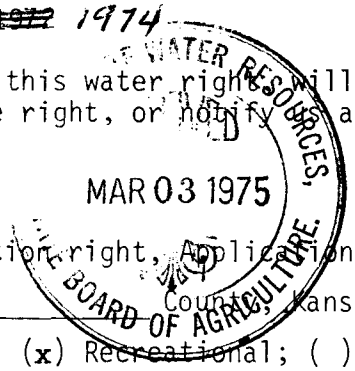
Enclosure

DIVISION OF WATER RESOURCES RECEIVED MAR 03 1975 STATE BOARD OF AGRICULTURE

RECEIVED
MAR 24 1975
DIVISION OF WATER RESOURCES

2

REPORT OF WATER USE
FOR ~~1972~~ 1974



If you have disposed of your interest in this water right will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (x) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (x) ~~Recreational~~; ( ) Water Power Use

Reporting on: ( ) Groundwater (x) Surface Water

Location of Diversion Points					Calculated Acre Feet If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
NW	SW	25	22S	11W	2951.34 *	Includes an estimated 1000 acre feet used to fill the Little Salt Marsh (unit 5).				
NE	NE	13	22S	11W	1404.52					
SE	NE	35	21S	11W	0000.00					
TOTAL					4355.86					

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. x Acre-Feet

Indicate whether water is 1. x Raw, 2. Treated, 3. Sold.

Jan.	00	July	00	
Feb.	00	Aug.	00	
Mar.	00	Sep.	1323.98	Little Salt Marsh filled.
Apr.	00	Oct.	1941.04	
May	00	Nov.	486.1	
June	00	Dec.	604.74	
		Total	4355.86	Acre Feet

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:

_____ Gallons or _____ %

RECEIVED
MAR 24 1975
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Signature _____ Date _____

Mailing Address _____

Approximately 50% of our normal diversion occurred during this period due to heavy flood damage to the dike system in 1973. Most damage is unrepaired.

~~1972~~ 1974

7571

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
10597 West Sixth Avenue
Denver, Colorado 80215
MAILING ADDRESS: P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO:

EN

MAY [illegible] 1974

Kansas State Board of Agriculture
Division of Water Resources
10th Floor, State Office Building
Topeka, Kansas 66612

Gentlemen:

Attached is the completed Report of Water Use for 1973 under Application no. 7571, Stafford County, Kansas.

Sincerely yours,

William A. Godby

William A. Godby
Regional Engineer

2

REPORT OF WATER USE
FOR 1973

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Location of Diversion Points					If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
NW	SW	25	22S	11W	996					
NE	NE	13	22S	11W	1353					
SE	NE	35	21S	11W	903					
					ESTIMATED ACRE FT					
TOTAL					3252					

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold.

Jan.	117	July	330
Feb.	146	Aug.	577
Mar.	437	Sep.	451
Apr.	635	Oct.	51
May	74	Nov.	20
June	394	Dec.	20

About 80% of works completed

Total 3252 Acre ft 1973

DIVISION OF WATER RESOURCES; STATE BOARD OF AGRICULTURE. RECEIVED MAY 09 1974

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet, report _____ Gallons or _____ %

Signature _____ Date _____

Mailing Address _____

1973

Rio - 5

2

N - 4

March 20, 1974

Bureau of Sports Fisheries and Wildlife
Regional Director
10597 West Sixth Avenue
Denver, Colorado 80215

ATTENTION: Mr. Don Stewart

Re: Appropriation of Water
Application No. 7571

Dear Mr. Stewart:

Following our telephone conversation on March 19, 1974, I have made a review of the information on file under Application No. 7571.

This is to inform you that the 1971 report of water use for Application No. 7571 which was received in the office of the Chief Engineer on May 4, 1972, along with other information on file in this office, is considered as constituting the notice required in Section 82a-714 of the Water Appropriation Act and as was required by the approval of Application No. 7571.

On the basis of the above, there will be no need for a reply to our letter of March 15, 1974.

In response to the request by Mr. Frank R. Richardson, Acting Director, which was received on July 20, 1973, the Chief Engineer has extended until December 31, 1978, the time in which to make use of the water to the extent authorized in the permit and approval of Application No. 7571.

Action on this request was delayed until such time as the matter of notice of completion of the diversion works had been resolved.

Should you have any questions, please feel free to write or call us.

Very truly yours,

Harris L. Mackey
Senior Engineer

HLM:llv

cc: Mr. J. Maurice Street
Water Commissioner

March 15, 1974

Bureau of Sports Fisheries & Wildlife
Regional Director
10597 West Sixth Avenue
Denver, Colorado 80215

Re: Appropriation of Water
Application No. 7571

Gentlemen:

Reference is made to your Application No. 7571 for permit to appropriate water for beneficial use.

The time allowed for installation of the proposed diversion works expired on December 31, 1973, and we have not received notice that construction of the works has been completed as is required by the approval of your application.

You are hereby notified that unless you show good cause on or before April 15, 1974, why the time for installation of the proposed diversion works should be extended, the application will be dismissed and the priority assigned to it will be forfeited.

Very truly yours,

Harris L. Mackey
Senior Engineer

HLM:dw

cc: Mr. J. Maurice Street

MICROFILMED

1 - (2) - 3

November 16, 1973

Bureau of Sports Fisheries and Wildlife
Regional Director
10597 West Sixth Street
Denver, Colorado 80215

Gentlemen:

Enclosed are forms on which reports of water used during 1973 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information our records show that you have an interest in or own the following water rights:

IRRIGATION USE -

Application Nos.:

18,422	18,426	18,430	18,434	18,438
18,423	18,427	18,431	18,435	18,439
18,424	18,428	18,432	18,436	18,440
18,425	18,429	18,433	18,437	18,441
				18,442

RECREATIONAL USE -

Application Nos.:

2-7571	17,598	17,602	17,606	17,610
1-17,595	17,599	1-17,603	17,607	
17,596	17,600	17,604	17,608	
17,597	17,601	17,605	17,609	

MUNICIPAL USE -

3 Application No. 18,264

Very truly yours,

MICROFILMED

CIS:slg

Clark I. Stocking
Engineer

Enc.

REPORT OF WATER USE
FOR 1972

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (x) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (x) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (x) Surface Water

Location of Diversion Points					Est. Acre Feet If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
NW	SW	25	22S	11W	6,154					
NE	NE	13	22S	11W	1,068					
SE	NE	35	21S	11W	1,565					
TOTAL					8,787					

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. x Acre-Feet

Indicate whether water is 1. x Raw, 2. Treated, 3. Sold.

Jan.	575.	July	571.
Feb.	365.	Aug.	439.
Mar.	1,167.	Sep.	1,551.
Apr.	866.	Oct.	720.
May	833.	Nov.	1,116.
June	483.	Dec.	101.

FEB 15 1973

About 80% of works are completed.

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
_____ Gallons or _____ %

Signature Charles K. Spencer, Area Manager Date 2-13-73

Mailing Address Fish & Wildlife Service, 601 E 12th Street, Kansas City, Mo. 64106

1972

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
10597 WEST SIXTH AVENUE
DENVER, COLORADO 80215

July 17, 1973

In reply refer to:
Application 7571
Quivira NWR

Kansas State Board
of Agriculture
Division of Water Resources
Tenth Floor
State Office Building
Topeka, KS 66612

Dear Sirs:

The construction of facilities on refuge lands under subject permit is 80 percent complete.

Since the extension of application 7571 in December 1968, we have placed approximately 1,500 cubic yards of riprap material along banks, rechanneled 750 feet of Rattlesnake Creek, and installed two culverts for flood control.

We have also installed 20 permanent water gages in control structures and installed a USGS water gaging station on Rattlesnake Creek. More than 32,000 feet of canals and ditches have been cleaned to maintain use and conserve water.

Estimated cost of remaining construction and development is still approximately $300,000 due to inflation and related maintenance.

Request is hereby made for extension of time for filing proof of beneficial use from December 31, 1973 to December 31, 1978.

Sincerely yours,

Frank R. Richardson

Frank R. Richardson
Acting Regional Director

cc:
Area Manager, Kansas City
Refuge Manager, Quivira NWR

2

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND • SECRETARY
DIVISION OF WATER RESOURCES
GUY E. GIBSON, Chief Engineer
TOPEKA • • KANSAS

FIELD OFFICE, DIVISION OF WATER RESOURCES
J. MAURICE STREET, Water Commissioner
105 North Main
STAFFORD, KANSAS 67578
Telephone (316) 234-5311

May 1, 1973

Mr. Clark I. Stocking
State Board of Agriculture
Division of Water Resources
10th Floor, State Office Building
Topeka, Kansas 66612

Re: Appropriation of Water
Application No. 7571

Dear Mr. Stocking:

We are enclosing a memorandum pertaining to Application Number 7571.
No action is required by your office.

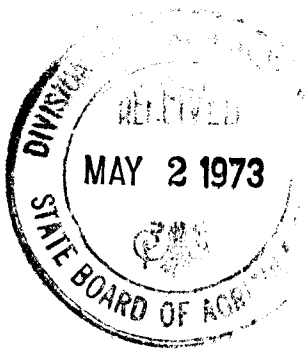
Very truly yours,

J. Maurice Street
J. Maurice Street

JMS:me
Enclosures

RECEIVED
MAY 14 1973
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

MICROFILMED



MEMORANDUM

Application No. 7571
July 11, 1972

A meeting was held in St. John, Kansas to discuss the use of water from Rattlesnake Creek during the waterfowl hunting season in the fall of the year. The wildlife refuge (Application 7571) can use the entire flow of the creek as it is usually running at that time. They wish to enforce their priority to the use of that water. At times, other users have reduced the flow to near zero as they filled their ponds for hunting. Mr. Darling, Refuge Manager, has indicated that he wishes to cooperate with other users so that the flow of the stream will not be reduced so severely at any one time.

I mentioned that several of the users may have a vested right to the use of water which would give them priority over Application 7571. Mr. Garrity, Attorney for the U. S. Fish and Wildlife Service, stated that they too have a vested right to the use of the water although it has not been determined, because of the property purchased which was used by gun clubs prior to 1945. He stated also that previous findings of a District Court case dictated that water was to be divided between vested right holders. The case invilved Rattlesnake Creek. I am not familiar with the case.

The possible vested rights will be investigated as time permits. I will let Mr. Darling know about whatever vested rights might be determined.

J. Maurice Street

July 14, 1972 Re: application 7571

J. Maurice Street, Division of Water Resources

T.A. Garrity Solicitor's Office Albuquerque US Govt.

M.K. Chilcat - Tennant (Hunting) Hutchinson

Edgar Allen Stafford Kansas

Ernest Elmore Hutchinson, Kansas

Henry Edgar Albuquerque, N.M. - U.S. Govt

Charles R. Darling Stafford, Ks. U.S. Govt

Ralph Pound St. Johns, Ks. Husband & owner

Meeting at St. John to discuss the use of water from Rattlesnake Creek.

1-(2)-3

December 29, 1972

United States of America
Department of Interior
Bureau of Sport Fisheries & Wildlife
P. O. Box 1306
Albuquerque, New Mexico 87103

Gentlemen:

Enclosed are forms on which reports of water used during 1972 under your water rights may be submitted. A tabulation showing the information indicated on the form will be satisfactory if you prefer to submit it that way.

For your information, our records show that you own or have an interest in the following water rights:

For irrigation use:

Applications Nos.:

18,422	18,429	18,436
18,423	18,430	18,437
18,424	18,431	18,438
18,425	18,432	18,439
18,426	18,433	18,440
18,427	18,434	18,441
18,428	18,435	18,442

For recreational use:

7571	17,600	17,606
17,595	17,601	17,607
17,596	17,602	17,608
17,597	17,603	17,609
17,598	17,604	17,610
17,599	17,605	18,264

Very truly yours,

Clark I. Stocking
Engineer

CIS:nl

Encs.

2

MEMORANDUM

May 16, 1972 Re: Application Number 7571

Mr. Charles Darling, Refuge Manager, and Mr. Henry Edgar, Hydrologist, from the Albuquerque Office of the Bureau of Fisheries and Wildlife, called at the office to discuss the operation of their project and the application.

The Bureau plans to install two gaging stations on Rattlesnake Creek and possibly one station on Salt Creek. They hope to enter into an agreement with the USGS to install the stations and establish rating curves for them. These stations would provide a better method for determining the amount of water used than the method now being used.

Mr. Darling and Mr. Edgar had discussed the operation of the Ralph Pound project with Mr. Edgar Allen. Mr. Allen apparently operates the project in behalf of the club which leases the project from Mr. Pound. The refuge ponds need filling at the same time that the other hunting ponds need filling. When the Pound pond is filled, the entire flow of Rattlesnake Creek is diverted for from two to four days depending on the rate of flow of the Creek.

They discussed the history of the use of water at the Pound project with Mr. Allen, and it appears that a vested right to the use of water exists and needs to be determined.

J. Maurice Street

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

IN REPLY REFER TO:

(EN)

May 2, 1972

Mr. R. V. Smrha, Chief Engineer
Division of Water Resources
1026-S State Office Building
Topeka, Kansas 66612

Dear Sir:

Attached is Surface Water Use Report for the calendar year 1971, on the Quivira National Wildlife Refuge, Stafford County, Kansas.

Sincerely yours,

Tom Reed

Tom Reed
Regional Engineer

Attachment

1871
1971

REPORT OF WATER USE
FOR 1971

2

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Est. Acre Feet

Location of Diversion Points					If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
NW	SW	25	22S	11W	5,372					
NE	NE	13	22S	11W	756					
SE	NE	35	21S	11W	3,940					
TOTAL					10,068					

(Use additional sheets as needed.)

DIVISION OF WATER RESOURCES, STATE BOARD OF AGRICULTURE. RECEIVED MAY 4 1972

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold.

Jan.	558	July	427
Feb.	572	Aug.	1,053
Mar.	204	Sep.	45
Apr.	1,028	Oct.	713
May	947	Nov.	1,968
June	974	Dec.	1,579

About 30% of the works are completed.

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

RECEIVED JUL 24 1972 FIELD OFFICE DIVISION OF WATER RESOURCES STAFFORD

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet, _____ Gallons or _____ %

Signature _____ Date _____

Mailing Address Bureau of Sport Fisheries & Wildlife, P.O. Box 1306, Albuquerque, N.M. 87103

MICROFILMED 1971

THE STATE OF KANSAS

STATE BOARD OF AGRICULTURE
Roy Freeland, *Secretary*

DIVISION OF WATER RESOURCES
R. V. Smrha, *Chief Engineer*

APPROVAL OF APPLICATION

FOR

CHANGE IN POINT OF DIVERSION

APPLICATION NO. 7571

On this 11th day of November, 1971, the Chief Engineer, Division of Water Resources, Kansas State Board of Agriculture, after due consideration of the written application of the United States of America, Department of the Interior, Fish and Wildlife Service, by Robert F. Stephens, Acting Regional Director, Bureau of Sport Fisheries and Wildlife, P. O. Box 1306, Albuquerque, New Mexico 87103, received on February 1, 1971, for approval of a proposed change in the location of the point of diversion under the approved Application No. 7571 for permit to appropriate water for recreational use, finds that the proposed change is reasonable and will not impair existing rights and that the proposed change relates to the same local source of supply. The application, therefore, is approved and the proposed change is authorized as follows:

The effective date of the change shall be November 11, 1971, after which the authorized points of diversion under the approved Application No. 7571 shall be

one (1) point in the Southwest Quarter of the Northwest Quarter of the Southwest Quarter (SW¼ NW¼ SW¼)

of Section 25 and

one (1) point in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW¼ NE¼ NE¼)

of Section 13,

both in Township 22 South, Range 11 West and

one (1) point in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW¼ SE¼ NE¼)

of Section 35, Township 21 South, Range 11 West,

all in Stafford County, Kansas,

located substantially as shown on the plat accompanying the application to change the point of diversion.

In all other respects, Application No. 7571 for permit to appropriate water for beneficial use is as approved on May 9, 1963.

Dated at Topeka, Kansas, this 11th day of November, 1971.

R. V. Smrha, Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture

S 2

November 11, 1971

United States of America
Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
P. O. Box 1306
Albuquerque, New Mexico 87103

ATTENTION: Mr. Robert F. Stephens
Acting Regional Director

Re: Appropriation of Water
Application No. 7571

Gentlemen:

Enclosed is the Approval of Application by the Chief Engineer, Division of Water Resources, Kansas State Board of Agriculture, dated November 11, 1971, approving your application to change the point of diversion under Application No. 7571 for permit to appropriate water for beneficial use.

Should you have any questions, please feel free to write us.

Very truly yours,

W. H. Sunderland
Senior Engineer

WHS:sa
Enc.

February 4, 1971

Bureau of Sport Fisheries and Wildlife
United States of America
Department of the Interior
Fish and Wildlife Service

Attention: Mr. Robert F. Stephens, Acting Regional Director

Re: Appropriation of Water
Application No. 7571

Gentlemen:

Your application for the approval of the Chief Engineer, Division of Water Resources, Kansas State Board of Agriculture, for the proposed change in the location of the point of diversion under the application referred to above has been forwarded to our Stafford Field Office, 105 North Main Street, for review.

Should you have any questions, please feel free to write or call.

Yours very truly,

Guy E. Gibson
Engineer

GEG:aw

cc: Mr. J. Maurice Street

THE STATE OF KANSAS

STATE BOARD OF AGRICULTURE
Roy Freeland, *Secretary*

DIVISION OF WATER RESOURCES
R. V. Smrha, *Chief Engineer*

APPLICATION FOR APPROVAL TO CHANGE THE PLACE OF USE, THE POINT OF DIVERSION OR THE USE MADE OF THE WATER UNDER AN EXISTING WATER RIGHT

Identify the water right which is the subject of this application

(Check one only)

☐ Vested Right

☒ Appropriation Right under Application No. 7571

To the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture:

1. Name of applicant(s) United States of America
Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

2. Application is hereby made for approval of the Chief Engineer to change

☐ Place of Use

☒ Point of Diversion

☐ Use Made of the Water

under the above-described water right in accordance with the particulars hereinafter described.

DIVISION OF WATER RESOURCES, RECEIVED FEB - 1 1971 10:11 A.M. STATE BOARD OF AGRICULTURE.

DIVISION OF WATER RESOURCES, RECEIVED NOV - 1 1971 STATE BOARD OF AGRICULTURE.

3. **The presently authorized place of use is:**

Owner of Land—NAME: United States of America
Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

ADDRESS: P. O. Box 1306
Albuquerque, New Mexico 75103

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
See attached map																	

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

(If there are more than two landowners, attach additional sheets as necessary.)

4. **It is proposed that the place of use be changed to:**

Owner of Land—NAME: No change

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
No change																	

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

(If there are more than two landowners, attach additional sheets as necessary.)

5. The presently authorized point(s) of diversion (is) (are) three (3) (Give number)
diversion points with control gates (wells, pumps, or other works for diversion of water) located as follows:

One in the southwest quarter of the northwest quarter of the southwest quarter of Section 25, Township 22 South, Range 11 West, in Stafford County, Kansas,

and one in the northeast quarter of the southwest quarter of the northeast quarter of Section 13, Township 22 South, Range 11 West, in Stafford County, Kansas, and one in the southeast quarter of the southwest quarter of the south-
(If more space is needed, attach additional sheets as necessary.) east quarter of Sec. 1,T22S,R11W in Stafford County, Kansas.

6. The proposed location of the point(s) of diversion (is) (are) (Give number)
three (3) diversion points with control gates (wells, pumps, or other works for diversion of water) located as follows:

One in the southwest quarter of the northwest quarter of the southwest quarter of Section 25, Township 22 South, Range 11 West, in Stafford County, Kansas,

and one in the southwest quarter of the northeast quarter of the northeast quarter of Section 13, Township 22 South, Range 11 West, in Stafford County, Kansas., and one in the southwest quarter of the southeast quarter, of the
(If more space is needed, attach additional sheets as necessary.) northeast quarter of Sec. 35,T21S,R11W in Stafford County, Kansas.

7. The works for diversion of water at the proposed location will consist of
diversion points with control gates (wells, pumps, etc.)
and will be completed by August 30, 1968 (date)

8. The presently authorized use of water is for wildlife and recreational purposes.
It is proposed that the use be changed to _____ purposes.

9. The change(s) proposed herein are desired for the reason that of more feasible construction of diversion "C" and more accurate description of diversion "B".

10. Furnish an aerial photograph or a detailed plat from an actual survey. In order to be acceptable for record purposes, this photograph must be a 10-inch by 10-inch print such as can be obtained at nominal cost from the Department of Agriculture, Western Laboratory, Salt Lake City, Utah, through the County ASC Office of the Department of Agriculture. The following information must be shown on the aerial photograph: If a change in the location of the point(s) of diversion is desired, the location of the presently authorized point(s) of diversion (wells, stream-bank installations, dams, or other diversion works) and the proposed location of the point(s) of diversion should be indicated by a point(s) plotted accurately on the photograph so as to establish its or their position to scale with respect to the boundaries of the property. If the source of supply is groundwater, then in the same way also show the exact location of existing water wells of all kinds located within ½ mile of the proposed well or wells. Identify each well as to its use and furnish name and mailing address of the property owner or owners. If the source of supply is surface water, then in the same way also show the exact location of such use or uses one mile upstream and one mile downstream from your point(s) of diversion. If a change in the location of the place of use is desired, the location of the presently authorized place of use and the proposed place of use should be shown by crosshatching or shading on the photograph. On the aerial photograph identify the center of the section, the section lines or the section corners and show the appropriate section, township, and range numbers. Please be certain that the information shown on the aerial photograph agrees with the information shown in the application.

11. Furnish information to show:
    a. That the proposed change(s) will not impair existing water rights, and
    b. That the proposed change(s) relates to the same local source of supply as that to which the presently authorized water right relates.
    (Attach statements, plats, geology reports, and other information as necessary.)

I declare that I am a landowner as identified herein, or that I represent a landowner as identified herein and am authorized to make this application in his behalf, and declare further that the statements contained herein are ture, correct, and complete.

Dated at Albuquerque, New Mex., ~~Kansas~~ this 27th day of January, 1971.

Robert F. Stephens
(Applicant)

(Spouse)

Robert F. Stephens
Acting Regional Director
Bureau of Sport Fisheries and Wildlife
(Applicant)

(Spouse)

(Applicant)

(Spouse)

(Applicant)

(Spouse)

State of ~~Kansas~~ New Mexico
County of Bernalillo } SS

I hereby certify that the foregoing application was signed in my presence and sworn to before me this 27 day of January, 1971.

Margaret C. Prendergast
Notary Public

My Commission Expires November 25, 1972.

NOTE: The application must be signed by each person whose name appears as an applicant and his spouse.

In the event that all applicants cannot appear before one notary public, they may as necessary sign appropriate copies of the application before any notary public conveniently available to them. All copies signed in this manner shall be considered as counterparts of the application.

If the application is signed on behalf of any landowner, by an agent, by one who has power of attorney, or by an executor, executrix, conservator, etc., it will be necessary to furnish with the application a copy of letters or court orders to support the representative capacity indicated.

If such instrument is dated more than six months previous to the date the application is received in the office of the Chief Engineer, it must be accompanied by an instrument showing that the power of attorney, letters of conservatorship or administration (executor, executrix, etc.) are currently in full force and effect.

32-7784-S—6-37-38-39-40 3-69-5M

R11W

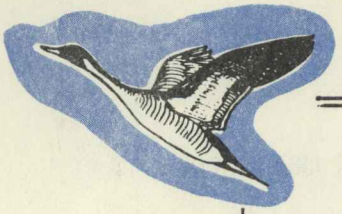
#7571

R11W

#7571

QUIVIRA NATIONAL WILDLIFE REFUGE

STAFFORD, RICE, AND RENO COUNTIES, KANSAS



R 11 W — R 10 W

T 21 S

T 22 S

T 23 S

ELLINWOOD — 11 miles

STAFFORD CO.

MARSH ROAD

QUIVIRA ROAD

CREEK

RICE COUNTY

RENO COUNTY

GREAT BEND — 24 miles

STERLING — 17 miles

REFUGE SHOP

PARK SMITH LAKE

LAKE DORRYANE

RATTLESNAKE CREEK

HORSESHOE LAKE

HUDSON — 9 miles

LITTLE SALT MARSH

ST. JOHN — 18 miles

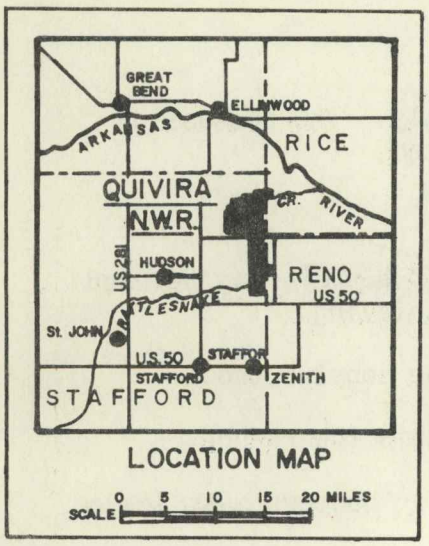
REFUGE HDQ

4th ST.

STAFFORD — 12 miles

ZENITH — 8 miles

SCALE 0 1/2 2 3 MILES



LEGEND

- PARKING AREAS
- (2) NUMBERED HUNTING AREAS
- REFUGE BOUNDARY

U.S. Dept. of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries
and Wildlife

HUNTING REGULATIONS

QUIVIRA NATIONAL WILDLIFE REFUGE
STAFFORD, KANSAS

WATERFOWL SEASON: The hunting of ducks, coots, geese, and mergansers is permitted within the state seasons.

PHEASANTS AND BOBWHITE : The hunting of these birds is permitted within the regular Kansas season.

OTHER SPECIES : The hunting of mourning dove, snipe, rails, squirrels, cottontail rabbits and crows is permitted when the state season for these species is concurrent with the early teal season, the regular waterfowl season, or the state season for pheasant and/or bobwhite.

ALL HUNTING WILL BE IN ACCORDANCE WITH APPLICABLE STATE AND FEDERAL REGULATIONS

HUNTING AREA : Five areas as posted and shown on map on reverse side. Dead or crippled birds cannot be retrieved from closed areas. Hunting is not permitted from or across roads, trails and parking areas.

PARKING : Limited to designated areas.

GUNS : Hunting permitted with shotguns only. The possession of rifles and handguns is prohibited.

BOATS : The use of boats is prohibited.

DOGS : Hunting dogs, not to exceed two per hunter, may be used for the purpose of hunting and retrieving.

BLINDS : Permanent blinds or pits may not be constructed.

FIRES : No fires of any type permitted within the refuge.

CAMPING : Overnight camping is not permitted. Hunters must leave the area at the end of each day.

For further information contact a refuge officer.

B E A S A F E H U N T E R

D O N ' T B E A L I T T E R B U G

IN REPLY REFER TO:

(EN)

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

January 27, 1971

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas 66612

Re: Change Points of Diversion
Application No. 7571

Attn: Mr. R. V. Smrha, Chief Engineer

Gentlemen:

Attached is Application for Approval to Change Points of Diversion "B" and "C" under Permit No. 7571, for reasons stated in the applications.

Also, attached are aerial photographs of the subject areas as requested in the instructions.

Sincerely yours,

Robert F. Stephens
Acting Regional Director

Attachments

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

(EN)

January 21, 1971

Division of Water Resources
1026-S State Office Building
Topeka, Kansas 66612

Attention: Mr. R. V. Smrha

Gentlemen:

Attached is water use report for 1970 on Quivira National Wildlife Refuge, near Stafford, Kansas.

Sincerely yours,

Robert F. Stephens
Acting Regional Director

Attachment

FOR 1970

2

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right ( ) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (X) Surface Water

Est Ac. Ft.

Location of Diversion Points					If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
NW	SW	25	22S	11W	5,165.96 ac. ft.					
SW	NE	13	22S	11W	793.60 ac. ft.					
SE	NE	35	21S	11W	1,170.02 ac. ft.					
TOTAL					7,129.58 ac. ft.					

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold.

Jan.	279.00	July	785.02
Feb.	558.06	Aug.	533.60
Mar.	748.56	Sep.	798.96
Apr.	273.54	Oct.	1,444.10
May	575.48	Nov.	282.24
June	744.60	Dec.	106.60

About 80% of the works are completed.

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet: _____ Gallons or _____ %

Signature R F Stephens Date January 21, 1971

Robert F. Stephens, Act. Regional Director

Mailing Address Bureau of Sport Fisheries & Wildlife, P.O. Box 1306, Albuquerque, N.M. 87103

(See: Attachment)

1970

Supplement to Water Use Report:

Report of Water Use for 1970 -- Application No. 7571

Use of water was limited by alleged unauthorized upstream diversions, drought, fish restocking program, and severe winter freezing.

This report of water use is furnished for informational purposes only. and is not to be used in any way as a limitation upon or as a waiver of, any rights of the United States.

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

(EN)

Quivira NWR

February 4, 1970

Division of Water Resources
Kansas State Board of Agriculture
State Office Building
Topeka, Kansas 66612

Gentlemen:

Attached is the "Report of Water Use for Calendar Year 1969" for the Quivira National Wildlife Refuge, located in Stafford County, Kansas.

Water is being diverted and used from Rattlesnake Creek under Permit No. 7571. The estimated use of water during 1969 was 6,846 acre-feet; the use of which was less than the previous year due to timely rains. Additional use is contemplated upon completion of future construction.

The data supplied in this report is furnished for informational purposes only, and is not to be used in any way as a limitation upon, or as a waiver of, any water rights of the United States.

Sincerely yours,

William T. Krummes
Regional Director

Attachment

REPORT OF WATER USE
FOR 1969

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (✓) Appropriation right; Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (x) Surface Water

Location of Diversion Points					If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
SW	NE	13	22S	11W						
NW	SW	25	22S	11W						
SE	NE	35	21S	11W						
TOTAL										

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED:

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. x Acre-Feet

Indicate whether water is 1. x Raw, 2. Treated, 3. Sold.

Jan.	50	July	275
Feb.	670	Aug.	657
Mar.	495	Sep.	594
Apr.	284	Oct.	741
May	510	Nov.	980
June	520	Dec.	1,070

About 80% of the works are completed. 2,2 3 9,7 0 7,4 8 6

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet: _____ Gallons or _____ %

Signature William T. Krummes Date 2/5/70

William T. Krummes, Regional Director

Mailing Address Bureau of Sport Fisheries & Wildlife
P. O. Box 1306
Albuquerque, New Mexico 87103

1969

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

U. S. Department of Interior
Fish & Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Gentlemen:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1969 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested.

1. The quantity of water used during 1969.
2. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Smrha

R. V. Smrha
Chief Engineer

December 30, 1968

U. S. of America Department of Interior
Fish and Wild Life Service
Bureau of Sport Fisheries and Wild Life
Box 1306
Albuquerque, New Mexico

ATTENTION: Mr. William T. Krummes,
Regional Director, Region 2

Re: Appropriation of Water
Application No. 7571

Gentlemen:

In response to your request, the Chief Engineer has extended, until December 31, 1973, the time in which to perfect the proposed appropriation and maintain records from which the amount of water actually diverted during the calendar year may be readily determined under Application No. 7571.

The Water Appropriation Act provides that "The Chief Engineer shall limit the time for the perfecting of an appropriation to a reasonable period within which the proposed works can be completed by expeditious procedure..."

It is requested that records to indicate the amount of water used be furnished to the Chief Engineer as soon as possible after the close of each calendar year so that the extent of use becomes a matter of record to protect your right. The records of pumping time, water meters, or hour meters may be kept in the enclosed pumping time record book.

If you have any questions, please feel free to write us.

Very truly yours,

R. V. Smrha
Chief Engineer

RVS:GEG:slm
Enc.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

Quivira NWR

December 26, 1968

Division of Water Resources
Kansas State Board of Agriculture
State Office Building
Topeka, Kansas 66612

Gentlemen:

Attached is the "Report of Water Use for Calendar Year 1968" for the Quivira National Wildlife Refuge, located in Stafford County, Kansas.

Water is being diverted and used from Rattlesnake Creek under Permit No. 7571. The estimated use of water for works completed to date is 9,345 acre-feet. Additional use is contemplated upon completion of future construction.

Sincerely yours,

W. O. Nelson, Jr.
Acting Regional Director

Attachment

1968

2

REPORT OF WATER USE
FOR 1968

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

DEC 30 1968

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (X) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater ( ) Surface Water

Location of Diversion Points					If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
SW	NE	13	22S	11W						
NW	SW	25	22S	11W						
SE	NE	35	21S	11W						
TOTAL										

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED: Estimated

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3. X Acre-Feet

Indicate whether water is 1. X Raw, 2. Treated, 3. Sold.

Jan.	180	July	185
Feb.	230	Aug.	150
Mar.	520	Sep.	150
Apr.	480	Oct.	4280
May	445	Nov.	1925
June	460	Dec.	340

About 80% of the works are completed.

RECEIVED
AUG 11 1969
DIVISION OF WATER RESOURCES
FIELD OFFICE
STAFFORD

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
_____ Gallons or _____ %

Signature W O Nelson Jr Date 12/26/68
W. O. Nelson, Jr., Acting Regional Director
Mailing Address Bureau of Sport Fisheries & Wildlife
P. O. Box 1306, Albuquerque, N.M. 87103

1968

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

U. S. Department of Interior
Fish & Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Gentlemen:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1968 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested:

1. The quantity of water used during 1968.
2. In the case of irrigation use, the number of acres irrigated.
3. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

The space at the bottom of the form applies only to those who are using wells. They should show here the location of each well measured with the date of measurement, the depth to water and the depth of the well.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Smrha

R. V. Smrha
Chief Engineer

State of Kansas, Division of Water Resources
State Board of Agriculture, Topeka, Kansas

APPLICATION NO. 7571)
STATE OF NEW MEXICO)
COUNTY OF BERNALILLO)

William T. Krummes, being first duly sworn says that he is the (agent of the) above numbered Application; that he knows of his own knowledge of the construction of works completed to date.

The lands under Application No. 7571 were acquired by the present owner as part of the Quivira National Wildlife Refuge in 1957. Presently, the Refuge is under development and the lands under this application are now part of the Refuge development plan. Construction contracts in the amount of $874,935. for water impoundment facilities and other developments on the Refuge have been completed to date. Further construction funds are unavailable through the 1971 fiscal year. Estimated cost of all remaining construction and development is approximately $300,000. Therefore, it is requested that additional time be granted in which to complete the new works, place the water to beneficial use, and prepare the necessary filing maps to submit proof of appropriation.

Request is made for extension of time for filing proof from December 31, 1968 to December 31, 1973.

U. S. A., Department of Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

William T. Krummes
Regional Director, Region 2

Subscribed and sworn to me on this 29th day of November 1968.

Margaret C. Prendergast
Notary Public

My Commission Expires Nov. 25, 1972

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

7571

Quivira NWR

January 4, 1968

Division of Water Resources
Kansas State Board of Agriculture
State Office Building
Topeka, Kansas 66612

Gentlemen:

Attached is the "Report of Water Use for Calendar Year 1967" for the Quivira National Wildlife Refuge located in Stafford County, Kansas.

Water is being diverted and used from Rattlesnake Creek under Permit No. 7571. The estimated use of water for works completed to date is 7800 acre-feet. A new construction contract has recently been awarded for further development of the refuge.

Sincerely yours,

William T. Krummes
Regional Director

Attachment

REPORT OF WATER USE
FOR 1967

If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (x) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Industrial; (x) Recreational; ( ) Water Power Use

Reporting on: ( ) Groundwater (x) Surface Water

Location of Diversion Points					If Water is Metered 1. Cu. Ft. or 2. Gallons (Check units used)	Hours Pumped and Average Pumping Rate		For Well Users		
¼	¼	Sec	T	R		(Hours)	(GPM)	Date Meas.	Depth to Water	Depth of Well
SW	NE	13	22S	11W						
NW	SW	25	22S	11W						
TOTAL										

(Use additional sheets as needed.)

MONTHLY AMOUNT OF WATER USED: Estimated

If your records show or if you can reasonably estimate the monthly amounts, fill in below. Raw water usage is preferred if available.
Units reported in: 1. Cubic Feet, 2. Gallons, or 3.x Acre-Feet

MICROFILMED

Indicate whether water is 1.X Raw, 2. Treated, 3. Sold.

Jan.	150	July	1,060
Feb.	200	Aug.	930
Mar.	440	Sep.	860
Apr.	650	Oct.	820
May	720	Nov.	680
June	1,020	Dec.	270

About 70% of the works are completed.

RECEIVED
JUL 30 1968
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOURCES JAN - 8 1968 STATE BOARD OF AGRICULTURE

MUNICIPAL: (City or Rural Water Districts) 1. Population, or 2. Number of connections served: _____

MUNICIPAL & INDUSTRIAL: If your records show or if you can reasonably estimate the amount of water discharged from disposal plant or industrial outlet:
_____ Gallons or _____ %

Signature William T. Krummes Date January 4, 1968
William T. Krummes, Regional Director
Mailing Address Bureau of Sport Fisheries & Wildlife, P. O. Box 1306
Albuquerque, New Mexico 87103

1967

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

December 8, 1967

U. S. Department of Interior
Fish & Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Gentlemen:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1967 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested:

1. The quantity of water used during 1967.
2. In the case of irrigation use, the number of acres irrigated.
3. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

The space at the bottom of the form applies only to those who are using wells. They should show here the location of each well measured with the date of measurement, the depth to water and the depth of the well.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Smrha
Chief Engineer

DEC 13 67

2

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

December 21, 1966

Division of Water Resources
Kansas State Board of Agriculture
State Office Building
Topeka, Kansas 66612

Re: Permit No. 7571

Gentleman:

Attached is the "Report of Water Use for Calendar Year 1966" for the Quivira National Wildlife Refuge located in Stafford County, Kansas.

Water is being diverted and used from Rattlesnake Creek under the above numbered permit. The estimated use of water for works completed to date is 6900 acre-feet. Construction is presently being undertaken toward further development of the refuge.

Sincerely yours,

William T. Krummes
Acting Regional Director

Attachment

2

REPORT OF WATER USE
FOR CALENDAR YEAR 1966

A separate report is requested for each vested right and for each application for permit to appropriate water for beneficial use. If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (x) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Irrigation; ( ) Industrial;
(x) Recreational; ( ) Water Power Use

Location of Pump, each well, battery of wells or stream-bank pumping plant under this right or application	Hours Pumped at each location	Average Pumping Rate at each location
Diversion Point "B" SW ¼ NE ¼ Sec. 13, T. 22S, R. 11W		
Diversion Point "A" NW ¼ SW ¼ Sec. 25, T. 22S, R. 11W		
¼ ¼ Sec. , T. , R.		

Quantity of water diverted or withdrawn 6,500 acre-feet Est.
(Metered or Estimated) (gallons or acre/feet)
Circulated throught Units #5, #7, #11, #16, and #20

If water is used for irrigation, show number of acres irrigated under this right during 1966

*Flood damage repaired during mid-summer, water control facilities operative for approximate six months.

If the source of supply is ground water, information regarding the depth to the water surface in each well is requested if it can be readily obtained. Measurements should be made at approximately the same time each year, preferably before pumping is started in the spring. If measurements of more than one well are reported, please identify each measurement according to the well in which it is made.

MICROFILMED

Location of Well	Date of Measurement	Depth to Water	Depth of Well
¼ ¼ Sec. , T. , R.			
¼ ¼ Sec. , T. , R.			
¼ ¼ Sec. , T. , R.			

DIVISION OF WATER RESOURCES
RECEIVED
DEC 23 1966
STATE PLANNING

Date December 21, 1966

Name William T. Bummer
U. S. Department of Interior
Fish & Wildlife Service, B.S.F. & W.
Acting Regional Director
P. O. Box 1306
My mailing address is Albuquerque, New Mexico 87103

1966

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

December 6, 1966

U. S. Department of Interior
Fish and Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Gentlemen:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1966 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested:

1. The quantity of water used during 1966 under each right.
2. In the case of irrigation use, the number of acres irrigated.
3. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

The space at the bottom of the form applies only to those who are using wells. They should show here the location of each well measured with the date of measurement, the depth to water and the depth of the well.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Smrh
Chief Eng. er

November 8, 1966

Mr. R. V. Smrha
Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas 66612

Dear Mr. Smrha:

We are enclosing a report on the water supply at Quivera Refuge and downstream in Rattlesnake Creek.

Enclosed also is a print of the development plan which was submitted with application number 7571. It has already been processed by your office.

Enclosed also is a sketch of the area involved in the report.

If you desire any additional information, please let us know.

Very truly yours,

J. Maurice Street

JMS:mb

Enclosures (3)

Rattlesnake Creek
Water Supply at Quivera Refuge
and
Downstream in Rattlesnake Creek

November 7, 1966

The rate of flow into the Quivera Refuge (Application No. 7571) at the West side of Section 26, Township 22 South, Range 11 West was measured to be 16 cubic feet per second. The entire flow of the stream is diverted to ponds at a point on the North side of the little marsh in the Southwest Quarter (SW¼) of Section 25, Township 22 South, Range 11 West. The creek bed itself is dry and has been dry for several months. The stream bed was found to be dry at the following road crossings:

along the South side of Section 1, Township 22 South, Range 11 West,
along the West side of Section 36, Township 21 South, Range 11 West,
along the South side of Section 23, Township 21 South, Range 11 West,
all in Stafford County.

Along the East side of Section 18, Township 21 South, Range 10 West in Rice County, water covered the bottom of the channel with very little noticeable flow. It was not measurable.

The U.S.G.S. maintains a gage where the creek crosses the East line of Section 16, Township 21 South, Range 10 West. We measured the flow to be 1.3 c.f.s. at this station. The stream was observed at its crossing with the East side of Section 14 and its crossing with the East side of Section 13. The flow was apparently the same as measured at the gaging station and no additional measurements were made.

J. Maurice Street

November 2, 1966

Mr. Charlie Darling
Quivira National Wildlife Refuge
Stafford, Kansas

Dear Mr. Darling:

The water sample collected from your 40-foot deep water supply well on October 5, 1966 had hardness of 168 ppm, alkalinity of 118 ppm, chlorides of 98 ppm, and sulphates of 14 ppm. The water sample was poured to waste in the lab without an iron determination. This is relatively good quality water. The iron, although it was not determined, makes it somewhat objectionable.

If you will send me a small sample of water, we will make that iron determination.

The courtesy extended to Mr. Stanley and myself during our recent visit was greatly appreciated.

Sincerely,

G. J. Stramel
Hydrologist

GJS:lh

cc: Maurice Street
Water Commissioner
Kansas State Dept. of Agriculture
Water Resources Division
Stafford, Kansas

9-275-H
(Rev. 6-63)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

s. No. .....

Comp. by .....

Checked by .....

Sta. No ..... **DISCHARGE MEASUREMENT NOTES**

Date ..., 19.. Party .....

Width ..... Area ..... Vel. ..... G.H. ..... Disch. .....

Method ..... No. secs. ..... G.H. change ..... in ..... hrs. Susp. .....

Method coef. ..... Hor. angle coef. ..... Susp. coef. ..... Meter No. .....

Date rated ..... Used rating for rod ..... susp. Meter ..... f

above bottom of wt. Tags checked ..... Spin before meas. ..... after .....

Meas. plots ..... % diff. from ..... rating. Wading, cable, ice, boat, upstr., downstr., side

bridge ..... feet, mile, above, below gage. Levels obtained .....

BASE GAGE READINGS				
Time		Recorder	Inside	Outside
Weighted M.G.H.				
G.H. correction				
Correct M.G.H.				

AUX. GAGE READINGS				
Time		Recorder	Inside	Outside
Weighted M.G.H.				
G.H. correction				
Correct M.G.H.				

Check-bar, chain found .....

changed to ..... at .....

Check-bar, chain found .....

changed to ..... at .....

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions: Cross section .....

Flow ..... Weather .....

Other ..... Air ..... ° F. @ .....

Gage ..... Water ..... ° F. @ U L .....

..... Record removed ..... Intake flushed .....

Observer .....

.....

Control .....

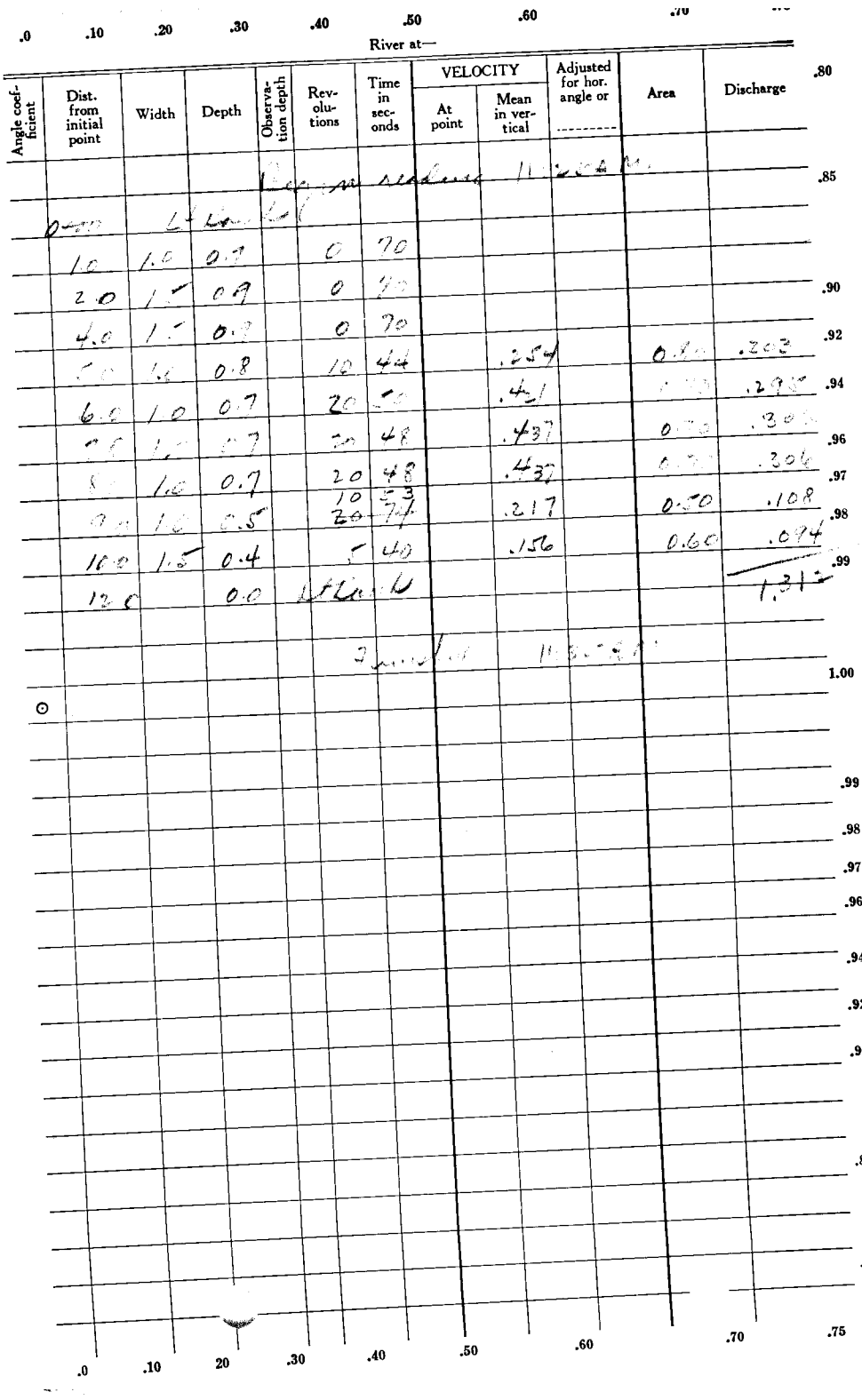
.....

Remarks .....

.....

.....

G.H. of zero flow ..... ft. Sheet No. ..... of ..... sheets.



River at—

Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or	Area	Discharge
	0										
	1.0	1.0	0.7		0	70					
	2.0	1.0	0.7		0	70					
	4.0	1.0	0.8		0	70					
	5.0	1.0	0.8		10	44		.254		0.80	.203
	6.0	1.0	0.7		20	48		.431			.295
	7.0	1.0	0.7		20	48		.437		0.70	.306
	8.0	1.0	0.7		20	48		.437		0.70	.306
	9.0	1.0	0.5		10	53		.217		0.50	.108
	10.0	1.0	0.4		5	40		.156		0.60	.094
	12.0		0.0								1.31
⊙											

.0 .10 .20 .30 .40 .50 .60 .70 .80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80 .75

9-275-H
(Rev. 6-63)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

No. ....

Comp. by ....

DISCHARGE MEASUREMENT NOTES

Sta. No ....

Checked by ....

150' d.s. [illegible] Bridge
[illegible] Refuge entrance

Date [illegible] 7, 1966 Party ....

Width .... Area .... Vel. .... G.H. .... Disch. ....

Method .... No. secs. .... G.H. change .... in .... hrs. Susp. ....

Method coef. .... Hor. angle coef. .... Susp. coef. .... Meter No. ....

Date rated .... Used rating for rod .... susp. Meter .... f above bottom of wt. Tags checked .... Spin before meas. .... after ....

Meas. plots ....% diff. from .... rating. Wading, cable, ice, boat, upstr., downstr., sid bridge .... feet, mile, above, below gage. Levels obtained ....

BASE GAGE READINGS

Time		Recorder	Inside	Outside
9:54	T.D.	10.25'		[illegible]
Top of	D.S.	handrail	[illegible]	
25'	from	S. Abut		
Weighted M.G.H.				
G.H. correction				
Correct M.G.H.				

AUX. GAGE READINGS

Time		Recorder	Inside	Outside
Weighted M.G.H.				
G.H. correction				
Correct M.G.H.				

Check-bar, chain found .... changed to .... at ....

Check-bar, chain found .... changed to .... at ....

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions: Cross section ....

Flow .... Weather [illegible]

Other .... Air .... °F. @ ....

Gage .... Water .... °F. @ ....

.... Record removed .... Intake flushed ....

Observer ....

Control ....

Remarks ....

G.H. of zero flow .... ft. Sheet No. .... of .... sheets.

.0 .10 .20 .30 .40 .50 .60 .70 .75

River at—

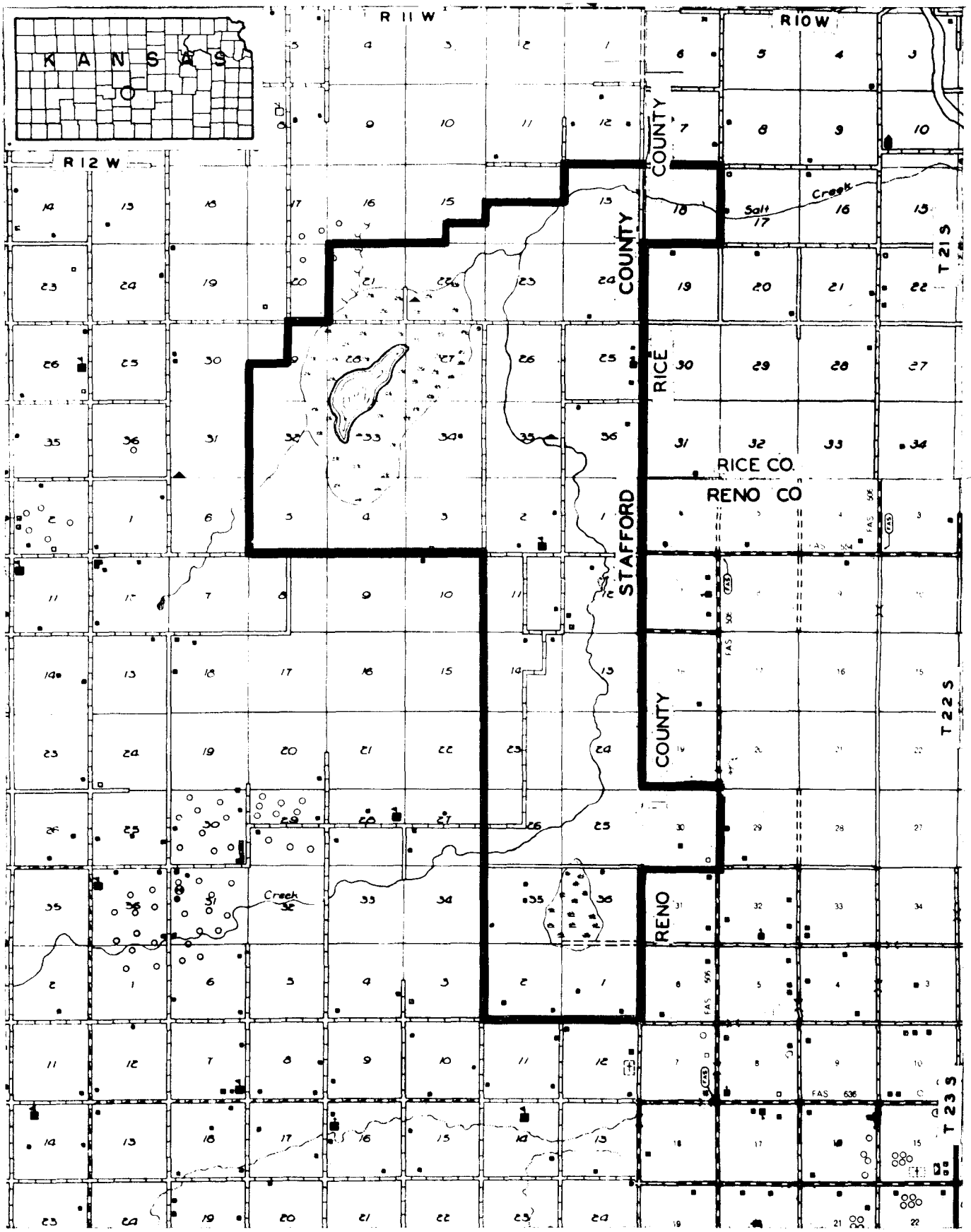
Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY: At point	VELOCITY: Mean in vertical	Adjusted for hor. angle or ----------	Area	Discharge
					8:50 AM.						
	1.5		0.5			42		.42		.075	.037
					30	45		.678		1.05	.711
					30	54		.553		1.20	.663
						60		.518		1.20	.622
					30			.664		1.00	
					30			.592		1.0	
								.643			
			0.3		30						.383
					30						
								.757		0.80	
								.912			
⊙								.954		1.00	
										1.00	
								1.18		1.40	1.65
								1.12			
								1.13			2.07
								.132		1.35	1.78
								.473			.289
											15.859

.0 .10 20 .30 .40 .50 .60 .70 .75

.80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80

QU[illegible] NATIONAL WILDLIFE RE[illegible]C

Rice, Reno, & Stafford Counties, Kansas



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

December 23, 1965

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

RE: Permit No. 7571

Gentlemen:

Attached is the "Report of Water Use for Calendar Year 1965" for the Quivira National Wildlife Refuge located in Stafford County, Kansas.

Water is being diverted and used from Rattlesnake Creek under the above numbered permit. The estimated use of water for the works completed to date is 750 acre-feet. Plans and specifications are presently being prepared for additional work proposed in the development plan.

Sincerely yours,

William T. Krummes
Acting Regional Director

Attachment

2

REPORT OF WATER USE
FOR CALENDAR YEAR 1965

A separate report is requested for each vested right and for each application for permit to appropriate water for beneficial use. If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Irrigation; ( ) Industrial;
(X) Recreational; ( ) Water Power Use
and Wildlife Habitat

Location of Pump, each well, battery of wells or stream-bank pumping plant under this right or application	Hours Pumped at each location	Average Pumping Rate at each location
Diversion Point "B" SW ¼ NE ¼ Sec. 13, T. 22S., R. 11W.		
Diversion Point "A" NW ¼ SW ¼ Sec. 25, T. 22S, R. 11W		
¼ ¼ Sec. , T. , R.		

Quantity of water diverted or withdrawn 750 (Water stored and
(Metered or Estimated) (gallons or acre feet)
Circulated through Unites #5, #7, #11 and #20b.) 750 Acre F

If water is used for irrigation, show number of acres irrigated under this right during 1965 inoperative.

* Because of flood damage in June a great part of our water control facilities were rendered/

If the source of supply is ground water, information regarding the depth to the water surface in each well is requested if it can be readily obtained. Measurements should be made at approximately the same time each year, preferably before pumping is started in the spring. If measurements of more than one well are reported, please identify each measurement according to the well in which it is made.

Location of Well	Date of Measurement	Depth to Water	Depth of Well
¼ ¼ Sec. , T. , R.			
¼ ¼ Sec. , T. , R.			
¼ ¼ Sec. , T. , R.			

MICROFILMED

Date December 19, 1965

RECEIVED
MAY 3 1966
DIVISION OF WATER RESOURCES
STAFFORD

DEC 27 1965
STATE BOARD OF AGRICULTURE. KANSAS

Name U.S. Department of Interior, Fish & Wildlife Service.
William J. Kummerow
Acting Regional Director
P. O. Box 1306
My mailing address is Albuquerque, New Mexico 87103

1965

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

December 7, 1965

U. S. Department of Interior
Fish & Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Gentlemen:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1965 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested:

1. The quantity of water used during 1965 under each right.
2. In the case of irrigation use, the number of acres irrigated.
3. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

The space at the bottom of the form applies only to those who are using wells. They should show here the location of each well measured with the date of measurement, the depth to water and the depth of the well.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Sm
Chief Engineer

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

Quivira NWR

January 14, 1965

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

Re: Permit No. 7571

Gentlemen:

Attached is the "Report of Water Use for Calendar Year 1964" for the Quivira National Wildlife Refuge located in Stafford County, Kansas.

Water is being diverted and used from Rattlesnake Creek under the above numbered permit. The estimated use of water for the works completed to date is 3,500 acre-feet. Plans and specifications are presently being prepared for additional work proposed in the development plan.

Very truly yours,

Carey H. Bennett
Acting Regional Director

Attachment

RECEIVED
NOV 8 1965
DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOURCES
JAN 13 1965
STATE BOARD OF AGRICULTURE

REPORT OF WATER USE
FOR CALENDAR YEAR 1964

A separate report is requested for each vested right and for each application for permit to appropriate water for beneficial use. If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Irrigation; ( ) Industrial;
(X) Recreational; ( ) Water Power Use
and Wildlife Habitat

Location of Pump, each well, battery of wells or stream-bank pumping plant under this right or application	Hours Pumped at each location	Average Pumping Rate at each location
Diversion Point "B" SW ¼ NE ¼ Sec. 13, T. 22 S., R. 11 W.		
Diversion Point "A" NW ¼ SW ¼ Sec. 25, T. 22 S., R. 11 W.		
¼ ¼ Sec. , T. , R.		

Quantity of water diverted or withdrawn 3500 (~~Metered or~~ Estimated) (~~gallons or~~ acre feet). (Water stored and circulated through Units #5, #7, #10-a-b-c, #16, #20b, #22, #23, #24, #25, #26 & #11-b)

If water is used for irrigation, show number of acres irrigated under this right during 1964 _____.

If the source of supply is ground water, information regarding the depth to the water surface in each well is requested if it can be readily obtained. Measurements should be made at approximately the same time each year, preferably before pumping is started in the spring. If measurements of more than one well are reported, please identify each measurement according to the well in which it is made.

Location of Well	Date of Measurement	Depth to Water	Depth of Well
¼ ¼ Sec. , T. , R.			
¼ ¼ Sec. , T. , R.			
¼ ¼ Sec. , T. , R.			

RECEIVED
NOV 8 1965
DIVISION OF WATER RESOURCES
STAFFORD

DIVISION OF WATER RESOURCES
JAN 13 1965
STATE BOARD OF AGRICULTURE

Date January 14, 1965

Name U. S. A. Department of Interior, Fish & Wildlife Service, Bur. of Sport Fisheries and Wildlife
Carroll Bennett
Acting Regional Director

My mailing address is P. O. Box 1306
Albuquerque, New Mexico 87103

1964

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

December 4, 1964

U.S. Department of Interior
Fish & Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Dear Sir:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1964 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested:

1. The quantity of water used during 1964 under each right.
2. In the case of irrigation use, the number of acres irrigated.
3. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

The space at the bottom of the form applies only to those who are using wells. They should show here the location of each well measured with the date of measurement, the depth to water and the depth of the well.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Smr'
Chief Eng[illegible]er

July 21, 1964 4:00 P.M.

Rattlesnake Creek N of Stafford 3.92 cfs. 1760 gpm. measured by Frank Elly

Road construction crew fills a 1500 gal tank in 2 min 8 sec. 705 gpm.
3 trucks, 13 loads each per day.
1500 x 39 = 58 500 gal per day 1.6 ac. ft. / day.

Evaporation on Little Marsh 320 surface acres

assumptions Hot & Windy 2/3" per day
Hot & breezy 1/2" per day
Normal & breezy 1/3" per day (90° max)

assumed for July 21 1/2" per day = 13.33 ac ft/day = 6.74 cfs. 3000 gpm

January 7, 1964

Jim Harmon,
Refuge Director
Quivira National Wildlife Refuge
Stafford, Kansas

Dear Jim:

Your Albuquerque Office sent in 2 copies of their 1963 "pumping report". We need only 1. Here is the extra if you would like to have it.

Very truly yours,

J. Maurice Street

JMS:jk

REPORT OF WATER USE
FOR CALENDAR YEAR 1963

A separate report is requested for each vested right and for each application for permit to appropriate water for beneficial use. If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (X) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas

Purpose of use: ( ) Municipal; ( ) Irrigation; ( ) Industrial;
(X) Recreational; ( ) Water Power Use and Wildlife Habitat

Location of pump, each well, battery of wells or stream-bank pumping plant under this right or application	Hours Pumped at each location	Average Pumping Rate at each location
Diversion Point "B" SW ¼ NE ¼ Sec. 13, T. 22 S, R. 11 W.		
___ ¼ ___ ¼ Sec. ___, T. ___, R. ___		
___ ¼ ___ ¼ Sec. ___, T. ___, R. ___		

Quantity of water diverted or withdrawn 150 acre feet. ~~(Metered, Computed, or Estimated)~~
(gallons or acre feet)
(Water stored and circulated through Units #21, #23, and #24)
If water is used for irrigation, show number of acres irrigated under this right during 1963 _____.

If the source of supply is ground water, information regarding the depth to the water surface in each well is requested if it can be readily obtained. Measurements should be made at approximately the same time each year, preferably before pumping is started in the spring. If measurements of more than one well are reported, please identify each measurement according to the well in which it is made.

Location of Well	Date of Measurement	Depth to Water	Depth of Well
___ ¼ ___ ¼ Sec. ___, T. ___, R. ___			
___ ¼ ___ ¼ Sec. ___, T. ___, R. ___			
___ ¼ ___ ¼ Sec. ___, T. ___, R. ___			

DEC 19 1963
STATE BOARD OF AGRICULTURE

Date _____

United States Department of Interior
Bureau of Sport Fisheries and Wildlife
Name Lewis R. Garlick
Lewis R. Garlick
Acting Regional Director
My mailing address is P. O. Box 1306
Albuquerque, New Mexico

1963

MICROFILMED

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

December 2, 1963

Vested Right

U. S. Department of Interior
Fish & Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Application No. 7571

Dear Sirs:

According to our records, you are the owner of or have an interest in the water right or rights listed above.

In order to establish a record in this office of your use of water, it is requested that you report certain information regarding such use during the calendar year 1963 under each of your vested rights, perfected appropriation rights or permits to appropriate water for beneficial use. Furnishing of this information is in the interest of protecting your water right.

The following information is requested:

1. The quantity of water used during 1963 under each right.
2. In the case of irrigation use, the number of acres irrigated.
3. When water is diverted by means of wells, information regarding the static water level.

On the back of this letter is a form on which the desired information may be furnished. A separate copy should be used for each vested right and each appropriation right or permit and each should be identified by the application number, the location of the well, pump or other diversion works and the purpose for which the water is used. An addressed envelope is enclosed for your convenience in sending the information to us.

If hourly records have been kept, it will be sufficient to show only the number of hours pumped and the average pumping rate at each location. If the water is metered, simply show the measured quantity. If no records are available, please give your best estimate of the quantity of water used. If no water was used, we would appreciate a report to that effect.

The space at the bottom of the form applies only to those who are using wells. They should show here the location of each well measured with the date of measurement, the depth to water and the depth of the well.

Your cooperation in furnishing this report will be appreciated.

Very truly yours,

R. V. Smrha

R. V. Smrha
Chief Engine

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND
Secretary

DIVISION OF WATER RESOURCES
R. V. SMRHA, Chief Engineer
1026-S STATE OFFICE BUILDING
TOPEKA, KANSAS

July 26, 1963

Mr. Maurice Street, Water Commissioner
Stafford Field Office
State Division of Water Resources
112 West Broadway
Stafford, Kansas

Dear Maurice:

In accordance with our telephone conversation this afternoon, I am enclosing a copy of the permit and approval of application number 7571, and a letter of transmittal dated May 9, 1963, signed by R. V. Smrha.

Very truly yours,

Guy

Guy Gibson
Engineer

GG:js
enc.

RECEIVED
JUL 29 1963
DIVISION OF WATER RESOURCES
STAFFORD

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

Quivira NWR

December 16, 1963

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

Re: Permit No. 7571

Gentlemen:

Reference is made to your letter of December 2, 1963, requesting a report on water used during 1963, under the above numbered permit, on the Quivira National Wildlife Refuge in Stafford County, Kansas.

Subsequent to our letter to you dated December 5, 1963, it has been determined that about 150 acre feet of water was diverted from Rattlesnake Creek. "Report of Water Use for Calendar Year 1963" is attached in duplicate.

Very truly yours,

Lewis R. Garlick
Acting Regional Director

Attachments

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

Quivira NWR

December 5, 1963

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

Re: Permit No. 7571

Dear Sirs:

Reference is made to your letter of December 2, 1963, requesting a report on water use for the calendar year 1963 under the above-numbered permit.

The management of water has been limited to natural conditions which exist in the Little Salt Marsh, Big Salt Marsh, and along Rattlesnake Creek. There has been no direct diversion of water under this permit to date. Since some of the legal problems related to land acquisition now have been solved, we expect to solicit bids for approximately $300,000 worth of construction on or before July 1, 1964.

Development on the refuge has been scheduled over a four year period, providing funds are made available. As each phase of the construction is completed a portion of the water under the above permit will be placed in use.

Should you have any questions or if we can be of assistance to you, please feel free to call on us.

Very truly yours,

William T. Krummes

William T. Krummes
Acting Regional Director

DEC -9 1963

May 9, 1963

United States of America
Department of Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
P. O. Box 1306
Albuquerque, New Mexico

Re: Application No. 7571
for Permit to Appropriate
Water for Beneficial Use

Gentlemen:

Your application has been examined and is found to be in proper form. Further, we find that the proposed use is for a beneficial purpose and is within reasonable limitations. If priorities are observed and respected, the proposed use will not conflict with any existing use and will not prejudicially and unreasonably affect the public interest. The application has therefore been approved.

There is enclosed the approval of the application, which constitutes a permit, authorizing you to proceed with construction of the proposed diversion works, to apply the water and otherwise perfect the proposed appropriation. There is also enclosed a memorandum setting forth the procedure to obtain a certificate of appropriation and containing other information which may be helpful to you. If you are unable to develop the project to the extent desired within the time allowed, you should request such extension of time as may be needed. An extension may be given for good cause shown on your request.

Should you have any questions or if we can be of any assistance to you, please feel free to write or call us.

Very truly yours,

R. V. Smrha
Chief Engineer

RVS:CEN:fmw
enc.

STATE OF KANSAS
DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE
TOPEKA, KANSAS

In the Matter of Application No. 7571
for Permit to Appropriate Water for Beneficial Use.

PERMIT
and
APPROVAL OF APPLICATION
(This Is Not a Certificate of Appropriation)

This is to certify that I have examined application No. 7571 of the applicant United States of America, Department of Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, P. O. Box 1306, Albuquerque, New Mexico, for a permit to appropriate water to beneficial use, together with the maps, plans and other submitted data, and that the application is hereby approved and the applicant is hereby authorized, subject to vested rights and prior appropriations, to proceed with the construction of the proposed diversion works and to proceed with all steps necessary for the application of the water to the approved and proposed beneficial use and otherwise perfect the proposed appropriation subject to the following terms, conditions and limitations:

1. The priority date assigned to such application is August 15, 1957.

2. The water sought to be appropriated shall be used for recreational purposes in the development of fish and wildlife in the Quivira National Wildlife Refuge.

3. The source from which the appropriation is made shall be from surface water of Rattlesnake Creek to be diverted at points located in Section 1, Section 12, Section 13, Section 24, Section 25, Section 26, Section 35, and Section 36, all in Township 22 South, Range 11 West in Stafford County, Kansas.

4. The appropriation sought shall be limited to a maximum direct diversion rate not in excess of 300 cubic feet per second and to a quantity of not to exceed 22,200 acre feet for direct use for any calendar year. Subject to vested rights and prior appropriation rights, the natural flows of Rattlesnake Creek may be accumulated in reservoirs to the maximum extent of 15,800 acre feet for subsequent recreational use by the applicant within the limits authorized herein for direct use.

5. The appropriation shall be perfected on or before December 31, 1968, or within any authorized extension of time.

6. The applicant shall notify the Chief Engineer of the Division of Water Resources when construction of necessary works has been completed and water applied to the proposed use.

7. The applicant shall maintain records from which the quantity of water actually diverted during each calendar year may be readily determined. Such records shall be furnished to the Chief Engineer as soon as practicable after the close of each calendar year.

8. The applicant shall not be deemed to have acquired a water appropriation for a quantity in excess of the amount approved herein nor in excess of the amount found by the Chief Engineer to have been actually used for the approved purpose during one calendar year subsequent to approval of the application and within the time specified or any authorized extension thereof.

9. The right of the appropriator shall relate to a specific quantity of water and such right must allow for a reasonable raising of lowering of the static water level and for the reasonable increase or decrease of the streamflow at the appropriator's point of diversion.

10. This permit does not constitute authority under Sections 82a-301 to 305, G. S. Kansas, 1949, to construct any dam or other obstruction; it does not give any right of way, or authorize any injury to, or trespass upon, public or private property; it does not obviate the necessity of obtaining Federal approval, when necessary.

11. Failure without cause to comply with provisions of the permit and its terms, conditions and limitations will result in the forfeiture of the priority date, revocation of the permit and dismissal of the application.

Dated this 9th day of May, 1963.

R. V. Sarma, Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND • SECRETARY
DIVISION OF WATER RESOURCES
R. V. SMRHA, Chief Engineer
TOPEKA • KANSAS

FIELD OFFICE, DIVISION OF WATER RESOURCES
J. MAURICE STREET, Water Commissioner
112 WEST BROADWAY
STAFFORD, KANSAS

April 22, 1963

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

Attention: Mr. W. H. Sunderland

Dear Mr. Sunderland:

We are returning amended application number 7571 for the Quivera Refuge with the additional information requested by your letter of October 12 and corrections to the points of diversion. These additions and corrections are included in Mr. John C. Gatlin's letter of April 17, 1963.

In reviewing the application, I made a separate computation for the annual use required after viewing the area and studying the plan of operation. It is expected (my estimate) that the impoundment and alternate inpoundment areas will lose an average of 48" over an area of 5200 acres which amounts to 20,800 acre feet. These losses are due to evaporation and seepage. The Marsh Meadows will require an estimated 2 acre feet per acre on 1370 acres or 2740 acre feet. My total then, of 23540 acre feet, compares closely with the 22,200 acre feet requested in the application.

Since we have anticipated this application for some time we measured the flow in Rattlesnake Creek upstream from the Refuge each time we made the base flow measurement of the Creek East of Hudson. The upstream reading was taken on the Ellinwook road approximately 5 miles West of the point where Rattlesnake Creek enters the Refuge. The measurements are as follows:

	Ellinwood Road	Near Hudson
November, 1959	55.87 c.f.s.	56.58 c.f.s.
April, 1960	70.70	70.33
November, 1960	46.20	45.80
April, 1962	48.03	47.38
November, 1962	44.82	43.51
March, 1963	40.70	16.30

Because of the large loss in the March 1963 readings I talked with Mr. Harman who explained that high North winds cause the water to spread out over the flats around the Little Marsh which reduces the outflow considerably. High South and Southwest winds

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND • SECRETARY
DIVISION OF WATER RESOURCES
R. V. SMRHA, Chief Engineer
TOPEKA • KANSAS

FIELD OFFICE, DIVISION OF WATER RESOURCES
J. MAURICE STREET, Water Commissioner
112 WEST BROADWAY
STAFFORD, KANSAS

forces the water into the flats to the East and through the diversion to Sections 25 and 30. Water diverted here is not returned to Rattlesnake Creek.

The additions to paragraph 2 were made to include points of diversion which were omitted previously although they are shown on the map.

The correction to paragraph 5 is in accordance with your letter. Mr. Olson and Mr. Garner (see memo) do not consider any of the use of water under this application to be for irrigation per se. The marsh meadow areas will be flooded 2 to 4 times annually to initiate an aquactic growth which is quite tasty to migratory birds. The irrigation provided is incidental to the primary use.

If you desire any additional information please feel free to write us.

Very truly yours,

J. Maurice Street

J. Maurice Street

JMS:jk

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

Quivira NWR

April 17, 1963

Kansas State Board of Agriculture
Field Office, Division of Water Resources
112 West Broadway
Stafford, Kansas

Attention: J. Maurice Street

Dear Sir:

Pursuant to your verbal request to Mr. Francis V. Olson and Mr. W. L. Garner on April 10, 1963 we herewith submit additional information and provisions to be included and made a part of Application No. 7571, filed by the United States of America, Bureau of Sport Fisheries and Wildlife.

The following changes or additions are listed in accordance with numbered paragraphs of the subject application.

Paragraph 2. The location of proposed works for diversion are:

"A" - NE¼NW¼ of Section 36, Twp 22 S., Rge 11 W.
All of SW¼ Section 25, Twp 22 S., Rge 11 W.

"B" - All of NE¼ Section 13, Twp 22 S., Rge 11 W.

"C" - SW¼SE¼ Section 1, Twp. 22 S., Rge 11 W.

Paragraph 5. The water is intended to be appropriated for:
(e) Recreation use in the amount of 22,200 acre-feet per annum.

Reference is made to the "Statement to Accompany Application for Permit," attached thereto, and specifically to the last sentence in the fourth paragraph. The amount of operational storage to be provided by raising water levels in (a) Little Salt Marsh (Unit 5) is estimated to be 1800 acre-feet, and (b) Big Salt Marsh (Unit 72) is estimated to be 1900 acre-feet. The total operational storage of 3700 acre-feet is included in the 22,200 acre-feet requested in this application.

If there is any question or additional information found desirable, please feel free to call on us. Your comments and advice is sincerely appreciated.

Sincerely yours,

John C. Gatlin

John C. Gatlin
Regional Director

cc: Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture
700 Kansas Avenue
Topeka, Kansas

Quivira NWR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

April 16, 1963

Mr. J. Maurice Street
Water Commissioner
Division of Water Resources
112 West Broadway
Stafford, Kansas

Dear Mr. Street:

Reference is made to the discussion between you, Mr. Garner, and Mr. Olson on April 10, 1963 regarding the filing of applications for permit to place diversion structures on Rattlesnake Creek within the Quivira National Wildlife Refuge.

On May 3, 1960 this Bureau submitted formal application along with maps and plans for the construction of the Darrynane Lake water control structure. By letter dated June 7, 1960 from Mr. Louis C. Jordan, Assistant Engineer, to Mr. John C. Gatlin, Regional Director, we were informed that since the proposed works were a Federal project to be constructed on lands owned by the Federal Government there was no need to take action on our application.

In view of the above, we assume that it will not be necessary to submit applications for the other small structures similarly situated.

We would be glad to hear from you if you have any comments on this matter.

Sincerely yours,

John C. Gatlin

John C. Gatlin
Regional Director

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND
Secretary

DIVISION OF WATER RESOURCES
R. V. SMRHA, Chief Engineer
1026-S STATE OFFICE BUILDING
TOPEKA, KANSAS

April 8, 1963

Mr. J. Maurice Street, Water Commissioner
Stafford Field Office
State Division of Water Resources
112 West Broadway
Stafford, Kansas

Dear Mr. Street:

Reference is made to our telephone conversation on April 8, 1963, with reference to Application No. 7571 for permit to appropriate water for beneficial use.

Enclosed is a copy of a letter dated April 3, 1963 and one print of the water use map submitted by Carey H. Bennett, Chief, Division of Technical Services, United States Department of the Interior, P. O. Box 1306, Albuquerque, New Mexico.

Very truly yours,

W. H. Sunderland
Senior Engineer

WHS:GEG:pr
Encs.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

Quivira NWR

April 3, 1963

Kansas State Board of Agriculture
Division of Water Resources
1026-S State Office Building
Topeka, Kansas

Gentlemen:

Re: Application No. 7571

Attached are two prints of the Water Use Map submitted and made a part of Amended Application No. 7571 in the name of the United States of America, Bureau of Sport Fisheries and Wildlife. These prints are replacements for the originals which were misplaced in your office.

Sincerely yours,

Carey H. Bennett

Carey H. Bennett
Chief, Division of Technical Services

Attachments

MEMORANDUM

Application 7571
April 4, 1963

Met Jim Harmon at the Refuge, We checked the locations of the points of diversion with a map of the area and the application in hand. In discussing the operation of the project Mr. Harmon pointed out that the areas disignated as "alternate impoundment and marsh meadow" are ponds which will be drained and cleared of vegatation every few years then refilled and kept filled with diverted water. They are shallow ponds which will permit undersirable plants to grow. The areas shown as marsh meadow will be flooded two to four times a year to a depth of two or three inches to produce an aquatic growth of small organisms which Ducks enjoy eating.

April 10, 1963

Francis V. Olson, Regional Engineer and Willie L. Garner, Hydraulic Engineer, both from the Albuquerque Office were in the office to review the application. They noted the corrections to paragraphs 2 and 5 which I suggested. Since they prefer that the corrections be made by higher authority we can expect a letter making the corrections and furnishing additional information about the quantity of water to be stored for operation use.

J. Maurice Street

Quivera Refuge application 7571

Permanent Storage Area

April 4, 1963

SEC	T	R	NE¼ NE¼	NE¼ NW¼	NE¼ SW¼	NE¼ SE¼	NW¼ NE¼	NW¼ NW¼	NW¼ SW¼	NW¼ SE¼	SW¼ NE¼	SW¼ NW¼	SW¼ SW¼	SW¼ SE¼	SE¼ NE¼	SE¼ NW¼	SE¼ SW¼	SE¼ SE¼	TOTAL
2	23	11	38	30	2	15													85
1	23	11		2			20	32	30	15									99
35	22	11	40	30	39	40				1	1			1	40	40	39	40	311
36	22	11	30	5	16	12	40	40	40	40	40	40	40	87		20	5		405
26	22	11															10	4	14
25	22	11	1		1	17							18	18	2	12	2		71
30	22	10	5	20	16	18	3	10	20	10	2				18	12		20	154
23	22	11	8	18	7	17									28			15	93
24	22	11		5	3			1	23	16	25	40	28	10					151
14	22	11	5			3											5		13
13	22	11	3	6	11	2	8	5	15	4	35	32	25	22		5	1		174
11	22	11																	0
12	22	11			3				1		10	4	7	19		15	25		84
5	22	11	40	30	25	40	6			10	11				17	12			191
4	22	11	10	40	32		40	40	36	37	24	13	2	21		13			308
3	22	11																	0
2	22	11																	0
1	22	11				15									22			4	41
TOTALS			180	186	155	179	117	128	165	133	148	129	120	128	127	129	87	83	2194
			1																

(continued)

Quivera Refuge App. 7571

Permanent Storage Area

April 4, 1963

Sec	T	R	NE 1/4				NW 1/4				SW 1/4				SE 1/4				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
2	21	11	20	1	17	40					40	17	30	38	40	40	39	40	362
3	21	11	5	19	40	37	40	40	40	40	40	40	40	40	38	40	40	24	563
4	21	11	1	22	17		15	15	16	30	32	1	1	7		10	2		169
5	21	11	3	17	3	5	26	40	8	3					20	4			129
6	21	11																	
9	21	11																	
8	21	11					10	1	10	18	5	28	36	34		10	5		157
7	21	11									4			18	5		10	12	49
6	21	11	38	20	13	34	38	7	20	33	25	20	38	40	7	3	15	8	359
5	21	11						30	12										42
1	21	11				16									30	8		19	73
2	21	11		30							31	8		22		10	4		105
3	21	11	20	9	22	26	12	20	14	30	7	4			6	6			170
4	21	11		38	36		6		20	22	35	34	22	5		36	2		256
5	21	11															16	6	22
4	21	11									21		1	20					42
3	21	11									6			5	9	10	6	2	38
8	21	10									8								8
Totals			87	156	148	152	147	153	140	176	254	152	168	229	155	177	139	111	2544

Total permit storage

2194
2544
4738

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

January 7, 1963

Quivira NWR

Re: Application No. 7571

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

Gentlemen:

Reference is made to your letter of December 3, 1962 requesting a report of water use for the calendar year 1962, under the above-numbered application.

Continued legal processes have delayed the acquisition of lands on the Quivira National Wildlife Refuge to the extent that very little development has been possible. However, a declaration of taking has been filed for obtaining a portion of the unacquired lands, and plans are practically complete which will permit initiation of the first stage of construction by June 30, 1963.

The management of water has been limited to natural conditions which exist in the Little Salt Marsh, Big Salt Marsh, and along Rattlesnake Creek. There has been no diversion of water under this application to date.

Sincerely yours,

John C. Gatlin

John C. Gatlin
Regional Director

Quivera Refuge Appr. 7571

Alternate impoundment Area April 5 1963

Sec	T	R	NE 1/4				NW 1/4				SW 1/4				SE 1/4				Total
			NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	
4	22S	11W					20	15	25	37	17	20							134
1	22S	11W					16	1	5	22									44
2	22S	11W					12	36	25	10									83
2	22S	11W	25	23	27	5	18				32	5	4	4		3			146
5	21S	11W													4		2	33	39
	Total		25	23	27	5	66	52	55	69	49	25	4	4	4	3	2	33	446

Marsh Meadow Areas April 5, 1963

Sec	T	R																	
2	22S	11W		17			40	40	40	23	2	35	5						202
33	21S	11W	30	21		1	28												80
34	21S	11W	40	14				22	2										78
35	21S	11W							32	10	30	40	40	40	2	32			226
28	21	11W	40	40	40	40	21			21	5			5	40	30	35	40	357
27	21	11W	10	15	8	20	40	40	40	40	30	40	39	9	25	5	30		391
	Total		120	107	48	61	129	102	114	94	67	115	84	54	67	67	65	40	1334

Summary

Permenent Storage area 4738

alternate Impoundment Area 446

Marsh Meadow Area 1334

(4738 + 446) x 4 = 5184 x 4 = 20736 acre feet

1334 x 2 = 2668 acre feet

23404 acre feet

Paragraph 1

Quantity - 5200 acres lands @ 4' = 20,800 acre feet

1370 acres 4 times land mixed @ 2' meadow = 2740 acre feet

23,540

Rate 300 cfs. O.K.

Paragraph 2:

Diversions

A NE¼ NW¼ Sec 36 T22S R11W

all of SW¼ Sec 25 T22S R11W.

B all of NE¼ Sec 13 T22S R11W

C SW¼SE¼ Sec 1 T22S R11W

Paragraph 3:

O.K.

Paragraph 5:

"Recreational"

STATEMENT TO ACCOMPANY
APPLICATION FOR PERMIT TO
APPROPRIATE WATER FOR BENEFICIAL USE

The project boundary for the Quivira National Wildlife Refuge was approved by the Migratory Bird Conservation Commission on May 3, 1955.

Total area within the approved boundary is 21,353.72 acres. To date about 9,000 acres have been purchased. It is expected that it may take three or four years to acquire the remaining acreage.

To develop the area for the benefit of migratory waterfowl, it will be necessary to construct shallow pond and marsh areas, storage reservoirs, and appurtenant works for the diversion and control of water.

It is estimated that the average annual runoff from Rattlesnake Creek is about 30,000 acre-feet. With this amount of water it is estimated that about 6,000 acres of pond and marsh area can be maintained with a maximum storage of about 15,800 acre-feet. It is estimated that to maintain this amount of water area the annual water requirement will be 22,200 acre-feet per annum. Some operational storage will be provided by raising water levels in Little Salt Marsh and in Big Salt Marsh.

The principal points of diversion from Rattlesnake Creek are as follows:

Point of Diversion "A" - NW¼SW¼ Section 25, T. 22 S., R. 11 W.
Point of Diversion "B" - SW¼NE¼ Section 13, T. 22 S., R. 11 W.
Point of Diversion "C" - SW¼SE¼ Section 1, T. 22 S., R. 11 W.
6th Principal Meridian

Normally the combined diversion rate will not exceed 300 cubic feet per second; however, during periods of flood the flow of the river will be impounded in Little Salt Marsh until the 2,260 acre-feet of storage has been obtained. Spillways for overflow over the low dikes will be provided.

Along with the development of ponds and marsh, it is proposed to carry on a farming program for the production of food for waterfowl. Also, there will be about 1,370 acres of marsh meadow developed by irrigation from Rattlesnake Creek to try to provide aquatic plant food.

Actual development for water control and use cannot be accomplished until land has been acquired in blocks large enough to permit an orderly development program. To date the lands that have been acquired or optioned are scattered over the entire area.

STATE OF KANSAS

DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE
TOPEKA

NUMBER 7571

AMENDED
APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

(The Statutory Filing Fee of $10.00 Must Accompany the Application)

To the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture:

United States of America
(~~Mr.~~) Department of Interior
(~~Mrs.~~) Fish & Wildlife Service
Comes now the applicant (~~Miss~~) Bureau of Sport Fisheries & Wildlife whose post office address is P.O. Box 1306, Albuquerque, New Mexico

and makes application to the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture, for a permit to appropriate for beneficial use such unappropriated surface water (surface water or groundwater) as may be available in Rattlesnake Creek (name of stream or drainage basin) in the county of Stafford & Rice, state of Kansas, to the extent and in accordance with the particulars hereinafter described:

1. The quantity of water desired is in the amount of 22,200 Acre-Feet (acre feet or million gallons) per year, to be diverted at a maximum rate of 300 cubic feet per second (gallons per minute or cubic feet per second)

2. The location of the proposed wells or other works for diversion of water is in the (see attachment and map accompanying this application) quarter of the _____ quarter of section _____, township _____, range _____, in _____ County, Kansas.

3. The works for diversion and distribution of water will consist of Diversion dams, canals, laterals, and water control structures (wells, pumps, ditches, gated pipe, sprinkler system), and will be completed and in operation by Scheduled for completion in 1967. (Date)

4. The first actual application of water for the beneficial use proposed was or is estimated to be 1963 (Date)

5. The water is intended to be appropriated for:

			Amount
(a)	Domestic use	( )	
(b)	Municipal use	( )	
(c)	Irrigation use	( )	
(d)	Industrial use	( )	
(e)	Recreational use	( )	
(f)	Water Power use	( )	
	Fish & Wildlife	(X)	

(check intended use or uses and show intended quantity for each use)

6. If for municipal use, please attach tables or curves showing past, present and estimated future population and water requirements of the city.

7. If for irrigation use list below or attach name and address of each landowner and the legal description of the lands to be irrigated by designating the actual number of acres to be irrigated in each forty acre tract or fractional portion thereof:

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
					(See map attached)												

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

List and describe other applications filed or vested rights held by applicant:

Temporary Application No. 7571 filed August 15, 1957 and given priority of the same number and date.

8. The location of the land to be irrigated and of the proposed works for diversion and distribution of water is shown on the following plat.

NORTH

(See attachment and map accompanying this application)

9. The relation of the subscriber to this application if not the owner is that of Agent (Agent or otherwise), and he is authorized to make this application in behalf of the interest affected.

Dated at Albuquerque, New Mexico, ~~Kansas~~, this 26 day of September, 19 62

United States of America
Department of Interior
Fish & Wildlife Service
Bureau of Sport Fisheries & Wildlife

(Applicant)

By John C. Gatlin
(Agent or Officer)
John C. Gatlin, Regional Director

NOTE:

1 cubic foot per second = 448.8 gallons per minute = 646,317 gallons per day = 1.98 acre feet per day.
1 million gallons per day = 1.547 cubic feet per second = 3.07 acre feet per day.
1 acre foot = 43,560 cubic feet = 325,851 gallons.

26-8963-S—22-46-47-48 6-57-10M

STATEMENT TO ACCOMPANY
APPLICATION FOR PERMIT TO
APPROPRIATE WATER FOR BENEFICIAL USE

The project boundary for the Quivira National Wildlife Refuge was approved by the Migratory Bird Conservation Commission on May 3, 1955.

Total area within the approved boundary is 21,353.72 acres. To date about 9,000 acres have been purchased. It is expected that it may take three or four years to acquire the remaining acreage.

To develop the area for the benefit of migratory waterfowl, it will be necessary to construct shallow pond and marsh areas, storage reservoirs, and appurtenant works for the diversion and control of water.

It is estimated that the average annual runoff from Rattlesnake Creek is about 30,000 acre-feet. With this amount of water it is estimated that about 6,000 acres of pond and marsh area can be maintained with a maximum storage of about 15,800 acre-feet. It is estimated that to maintain this amount of water area the annual water requirement will be 22,200 acre-feet per annum. Some operational storage will be provided by raising water levels in Little Salt Marsh and in Big Salt Marsh.

The principal points of diversion from Rattlesnake Creek are as follows:

Point of Diversion "A" - NW¼SW¼ Section 25, T. 22 S., R. 11 W.
Point of Diversion "B" - SW¼NE¼ Section 13, T. 22 S., R. 11 W.
Point of Diversion "C" - SW¼SE¼ Section 1, T. 22 S., R. 11 W.
6th Principal Meridian

Normally the combined diversion rate will not exceed 300 cubic feet per second; however, during periods of flood the flow of the river will be impounded in Little Salt Marsh until the 2,260 acre-feet of storage has been obtained. Spillways for overflow over the low dikes will be provided.

Along with the development of ponds and marsh, it is proposed to carry on a farming program for the production of food for waterfowl. Also, there will be about 1,370 acres of marsh meadow developed by irrigation from Rattlesnake Creek to try to provide aquatic plant food.

Actual development for water control and use cannot be accomplished until land has been acquired in blocks large enough to permit an orderly development program. To date the lands that have been acquired or optioned are scattered over the entire area.

February 6, 1962

Mr. John C. Gatlin, Regional Director
United States Department of The Interior
Fish and Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Dear Mr. Gatlin:

Thank you for your letter of February 2, 1962, advising us that no water has been used to date under your Application No. 7571 for permit to appropriate water from Rattle Snake Creek at points located in the SW¼ of the SW¼ of Section 26, Township 22 South, Range 11 West in Stafford County, Kansas for fish and wildlife and irrigation use.

Very truly yours,

Guy E. Gibson
Engineer

GEG:lb

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

ADDRESS ONLY THE
REGIONAL DIRECTOR

SOUTHWEST REGION
(REGION 2)
ARIZONA
COLORADO
KANSAS
NEW MEXICO
OKLAHOMA
TEXAS
UTAH
WYOMING

February 2, 1962

Division of Water Resources
Kansas State Board of Agriculture
1026-S State Office Building
Topeka, Kansas

Gentlemen:

Reference is made to your letter of December 28, 1961 requesting a report of water use for the calendar year 1961, under our Application No. 7571.

The acquisition of lands on the Quivira National Wildlife Refuge has been delayed to the extent that little or no development has been possible. The spillway from Darrynane Lake, located in the NW¼ Sec. 13, T. 22 S., R. 11 W., washed out and was replaced with a new concrete spillway about two years ago. This constitutes all of the water development to date. Plans for development are nearing completion and a print of this plan will be forwarded to your office when completed.

There has been no diversion of water under Application No. 7571 to date.

Very truly yours,

John C. Gatlin

John C. Gatlin
Regional Director

Report of Water Use
For Calendar Year 1961

A separate report should be made for each vested right and for each application for permit to appropriate water for beneficial use. A copy of this form is enclosed for each vested right or application recorded in your name. If you have disposed of your interest in this water right, will you please forward this form to the present holder of the right, or notify us as to whom we should contact regarding the water right.

This report applies to: (check one only)

( ) A vested right (✓) Appropriation right, Application No. 7571

Place of use is in Stafford County, Kansas.

Purpose of use ( ) Municipal; (✓) Irrigation; ( ) Industrial; (✓) Recreational; ( ) Water Power.

RECEIVED
MAY 16 1962
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

NONE acres were irrigated under this right during 1961.

Location of each well or pumping plant under this right or application	Hours Pumped at each One	Average Pumping Rate at each One
____¼ ____¼ Sec.____, T.____, R.____	NONE	
____¼ ____¼ Sec.____, T.____, R.____		
____¼ ____¼ Sec.____, T.____, R.____		

Compute from above or give best estimate from other information available, the total quantity of water withdrawn from the source of supply NONE.
(gallons or acre feet)

*Depth to Water in Wells

Location of Well	Date of Measurement	Depth to Water
____¼ ____¼ Sec.____, T.____, R.____		
____¼ ____¼ Sec.____, T.____, R.____		
____¼ ____¼ Sec.____, T.____, R.____		

Date _____

Name John C. Gatlin, Regional Dir. U.S. Dept. of Interior Fish & Wildlife Service

My mailing address is P.O. Box 1306 Albuquerque, New Mexico,

*If the source of supply is ground water, information regarding the depth to the water surface in each well is requested if it can be readily obtained. Measurements should be made at approximately the same time each year, preferably before pumping is started in the spring. If measurements of more then one well are reported, please identify each measurement according to the well in which it is made.

Taken From Information Rec. 2-5-62.

Jim Harmon.
Riviera Refuge
Began watch of Illumy August 12, 1960.

June 2, 1960

Division of Water Resources
Kansas State Board of Agriculture
State Office Building
Topeka, Kansas

Attention: Louis C. Jordan

Dear Mr. Jordan:

Here are the answers to your questions about the proposed spillway rebuilding work at the Quivera Refuge; reference your letter of May 9, 1960.

1. The Government does own the land on which the proposed work is located.
2. The Government does not own all the land proposed for the refuge. A map of the area, showing (shaded blue) the land now acquired is enclosed.
3. The dam was constructed by Ed O'Brien (now deceased) in 1927. Plank spillway was encased in concrete in 1940 by Roy Streeter.*
4. We find no record or knowledge of a permit having been acquired for the project.
5. The contract has not been let or advertised.
6. There are no known down-stream holders of water rights who might be affected by the dam.
7. The estimated size of the reservoir is 30 acres.
8. The original spillway consisted of plank piling. Later (1940) the piling was encased in concrete.
9. The crest elevation of the original spillway is 1780.6. The crest elevation of the new spillway is to be 1780.0 with stop-logs to elevation 1780.6.
10. The crest length of the original spillway is 42 feet.

A court action, Smith vs Hunter's Club in 1939 involved action by Smith to restrict diversion by the Hunter's Club upstream from this lake. Since the Government owns or soon will own both locations involved, I did not pursue the details of the case further.

Very truly yours,

J. Maurice Street

JMS/is

* Not [illegible]

ANALYSES F LOGICAL SURVEY, UNITED STATE ARTMENT OF THE INTERIOR
(parts per million)

Laboratory Number	46105	46106	46107	46108	46109
Date of Collection	9/28/60 12:15pm	9/28/60 1:15pm	9/28/60 5:15pm	9/28/60 6:00pm	11/2/60 11:45am
Silica (SiO_2)	31	20	23	21	19
Iron (Fe)	.06	.01	.01	.11	.11
Manganese (Mn)	0	0	0	0	0
Calcium (Ca)	83	63	75	79	228
Magnesium (Mg)	17	20	16	28	47
Sodium (Na) + Potassium (K)	443	802	604	1440	1780
Bicarbonate (HCO_3)	200	136	192	152	150
Carbonate (CO_3)	0	0	0	0	0
Sulfate (SO_4)	87	139	107	194	623
Chloride (Cl)	695	1220	915	1740	2740
Fluoride (F)	.6	.6	.6	.6	.5
Nitrate (NO_3)	3.5	6.4	4.9	4.0	2.1
Dissolved solids					
Calculated	1460	2340	1840	3280	5510
Residue on evaporation at 180° C	1450	2300	1770	3200	5480
Hardness as $CaCO_3$	276	240	252	314	762
Noncarbonate hardness as $CaCO_3$	112	128	94	190	639
Alkalinity as $CaCO_3$	0	0	0	0	0
Specific conductance (microhms at 25° C)	2620	4250	3310	5770	9000
pH	7.5	7.7	7.8	7.5	7.4
Color	25	12	7	20	17
Tons per acre-foot	1.99	3.18	2.50	4.46	7.49
Percent sodium	78	88	84	89	84
Sodium Adsorption Ratio	12	22	17	28	28

DESCRIPTIONS *

46105 Location: Quivira Refuge. Source: Rattlesnake Creek at Hwy. Bridge - entrance at creek to Refuge. Yld: Est. flow 14 cfs. Coll: Garner.

46106 Location: Quivira Refuge. Source: Rattlesnake Creek at spillway from Lake Darrynane. Yld: Est. flow 20 cfs. Coll: Garner.

46107 Location: Quivira Refuge. Source: Rattlesnake Creek, west channel outflow from Little Salt Marsh. Yld: Est. flow 20 cfs. Coll: Garner.

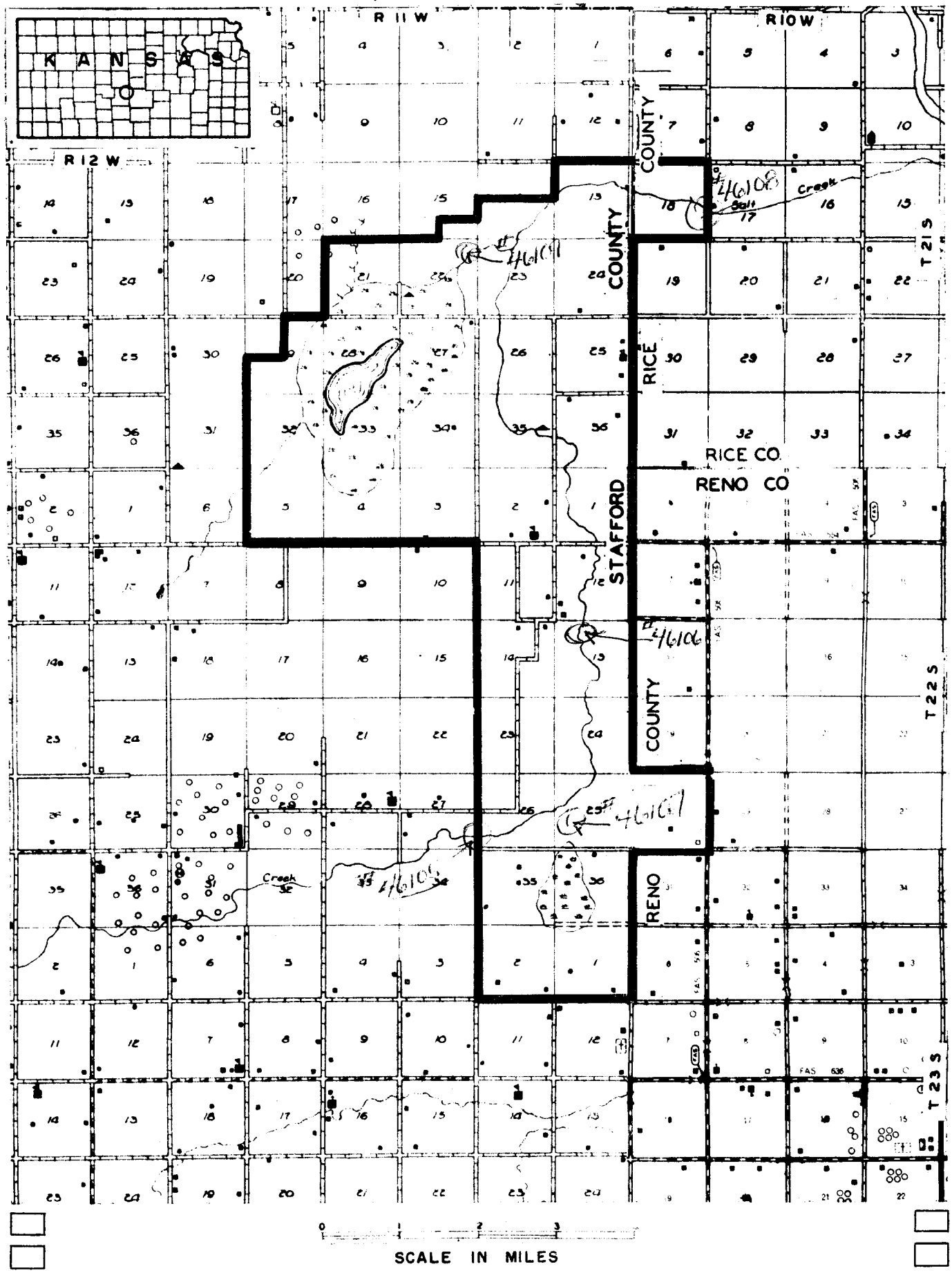
46108 Location: Quivira Refuge. Source: Salt Creek at bridge leaves refuge (no flow from Big Salt Marsh) Yld: Est. flow 10 cfs. Coll: Garner.

46109 Location: Quivira Refuge. Source : Salt Creek, outflow Big Salt Marsh. Yld: Est. flow 2 cfs. Coll: Dale.

* See attached map for sample locations.

QUIV[illegible] NATIONAL WILDLIFE REFI[illegible]

Rice, Reno, & Stafford Counties, Kansas



Quivera Refuge

Telephone call from Jim Harmon May 24, 1960
Quivera – application to repair spillway

Old spillway elevation 1780.6
new spillway elevation 1780.0 with stoplogs to
elevate to 1780.6

Put in Summer of 1927
Ed O'Brian (deceased)
Concrete put in in 1940
Ray Streeter (deceased)

Old Darrynane Spillway dimensions

42 feet wide

30 inches high (free board)

7' across (flat)

20' downstream slope

? upstream apron (missing)

Court action Smith vs Hunting Clubs

re. water in Rattlesnake Creek

Have pictures taken for trial dated

Dec. 1939

Est. size of Reservoir (Darrynane Lake) 30 acres

Paid May 1, 1960

May 12, 1960

Division of Water Resources
Kansas State Board of Agriculture
State Office Building
Topeka, Kansas

Attention: Louis C. Jordan

Dear Louis:

Just a note to let you know that progress is being made toward answering your questions about the Fish and Wildlife plans for rebuilding a spillway for an existing dam on Rattlesnake Creek.

Mr. Ralph Harmon, Refuge Director and I discussed the project today. It will be necessary for him to write to Albuquerque for some of the information and to interview some "old - timers" for the history questions. He plans to get his part of the information in a few days.

Very truly yours,

J. Maurice Street

JMS/fe

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND
Secretary

DIVISION OF WATER RESOURCES
R. V. SMRHA, Chief Engineer
1026-S State Office Building
Topeka, Kansas

May 9, 1960

Mr. J. Maurice Street
Water Commissioner
112 W. Broadway
Stafford, Kansas

Dear Maurice:

We have before us for consideration an application and plan from the Dept. of Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, for the rebuilding of the spillway of a dam across Rattlesnake Creek, located in the NE¼ NE¼ of Section 13, Township 22 South, Range 11 West, Stafford County, Kansas.

Before a disposition can be made of this matter, it is necessary that we have additional information on the subject. Due to the close proximity of the proposed work with your office, we would appreciate your investigating the site and obtaining information on the following:

1. Ownership of the land on which the proposed work is located?
2. Does Federal Gov't. own all lands within refuge area?
3. When and who constructed original dam?
4. Was a permit acquired for the original dam? If so, to whom was it issued?
5. Name and address of the person, persons or group who contracted with the Federal Gov't. for the proposed work, if any?
6. Are there down-stream holders of water rights affected by this dam?
7. A general estimate of the size of reservoir.
8. What type was the original spillway?
9. What was the crest elevation of the original spillway?
10. What was the crest length of the original spillway?

We are enclosing herewith, for informational purposes, verifaxed copies of the correspondence submitted to us by the above mentioned Federal agency. The one copy of the plan is also enclosed herewith for your review. We request that it be returned, however, when you have finished with it.

Your assistance in this matter will be much appreciated.

RECEIVED
MAY 10 1960
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

Very truly yours,

Louis C. Jordan
Assistant Engineer

LCJ:sa
encs.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

May 3, 1960

ADDRESS ONLY THE
REGIONAL DIRECTOR
2-E

SOUTHWEST REGION
(REGION 2)
ARIZONA
COLORADO
KANSAS
NEW MEXICO
OKLAHOMA
TEXAS
UTAH
WYOMING

Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture
700 Kansas Ave.
Topeka, Kansas

Dear Sir:

Attached are the following:

1. Application for compliance with provisions of 82a-301 to 305, G. S. Kansas, 1949.
2. Map of the Quivira National Wildlife Refuge, No. 2R-Kans 477-403, showing location of Lake Darrymane.
3. Sketch No. 1, showing site of the old spillway and site of the new spillway.
4. Drawing No. 2-R-Kans. 477-10.0 (3 sheets) showing plan and profile of new spillway structure.

We would appreciate your processing the application as soon as possible so that we may commence construction at an early date.

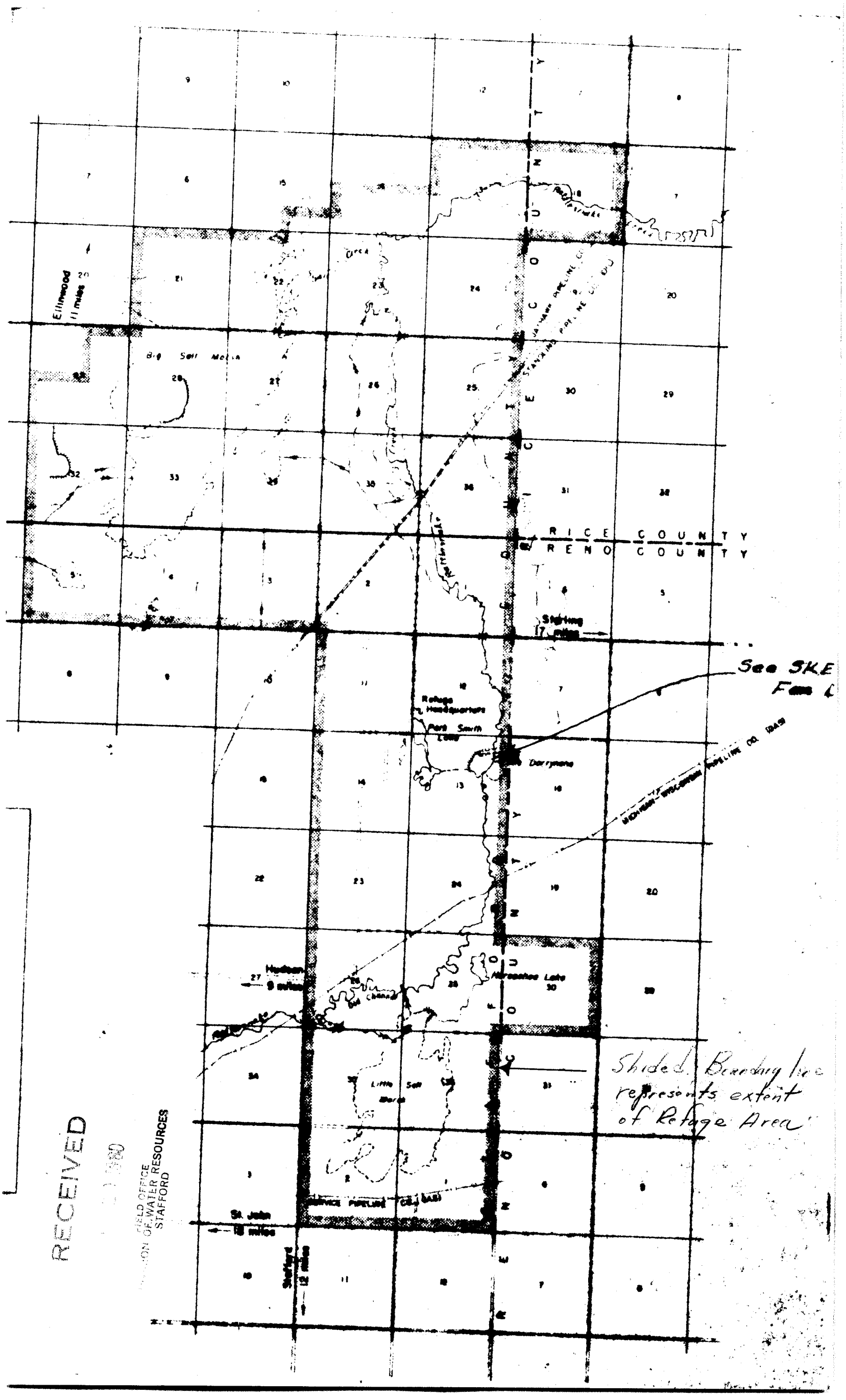
Sincerely yours,

John C. Gatlin

John C. Gatlin
Regional Director

Attachments 4

disposed of
2 duplicates of this duplicate
was received may 10, 1960.
J. M. Street


RICE COUNTY
RENO COUNTY
Ellinwood 11 miles
Sterling 17 miles
Hudson 9 miles
St. John 18 miles
Stafford 12 miles
Refuge Headquarters
Dairyland
Little Salt Marsh
Big Salt Marsh
Shaded Boarding line represents extent of Refuge Area
See SKE
RECEIVED
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

APPLICATION

Albuquerque, New Mexico ~~Kansas~~

May 3, 1960

To the Chief Engineer of the Division of Water Resources,
Kansas State Board of Agriculture:

In compliance with the provisions of 82a-301 to 305, G. S. Kansas, 1949, regulating the placing of dams and other obstructions in streams and the making of changes in the course, current, or cross section of stream within the state and vesting certain powers and duties in the Division of Water Resources, and providing penalties for the violation thereof:

UNITED STATES OF AMERICA, DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE, BUREAU OF SPORT FISHERIES AND WILDLIFE
(Name of person or persons, partnership, association, corporation, county, city, town or township)

hereby makes application for the consent or permit of the Chief Engineer of the Division of Water Resources to rebuild concrete spillway at new location. Remainder of the old spillway will be removed and new spillway to be constructed approximately 800' east on the same dam. New spillway will be approximately 160' west of existing water control structure.
(Construct, make a change in or addition to) (Describe proposed structure or works)

in, along or across Rattlesnake Creek
(Name of stream or watercourse)

at a location in NE¼NE¼ Section 13, Township 22 South, Range 11 West, 6th Principal Meridian, about 17 miles northeasterly from Stafford, Kansas in Stafford County.
(Location in and by section, township and range, city and county)

for the purpose of replacing a concrete spillway which has washed out in what is known as the Darrynane Hunting Club Lake. This structure must be replaced in order to maintain Darrynane Lake.
(State the purpose and necessity of the proposed structure or works)

in accordance with the complete maps, plans, profiles and specifications filed with this application and made a part hereof.

RECEIVED
MAY 19 1960
FIELD OFFICE
DIVISION OF WATER RESOURCES
STAFFORD

John C. Gatlin
(Signature of Applicant)
John C. Gatlin, Regional Director,
Bureau of Sport Fisheries and Wildlife,
U. S. Fish and Wildlife Service, Department of the Interior, United States of America

(Address) P. O. Box 1306
Albuquerque, New Mexico

Note: This application, together with all maps, plans, profiles and specifications, and all papers, information and data filed in connection therewith, will remain on file in the office of the Division of Water Resources, State Board of Agriculture.

26-5385-S—24-6 8-56-2M

August 20, 1957

Mr. Carey H. Bennett
Assistant Regional Director
U. S. Department of the Interior
U. S. Fish and Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Re: Application of U. S. Department of the Interior, U. S. Fish and Wildlife Service, for permit to appropriate water for beneficial use.

Dear Mr. Bennett:

This will acknowledge receipt of your application for permit to appropriate water for beneficial use. The application is endorsed as having been received on August 15, 1957, and has been assigned priority number 7571.

Applications are processed in the order in which they are received. We will advise you further regarding your application as soon as we have had an opportunity to examine it.

This letter will also acknowledge receipt of your fee in the amount of $10 which accompanied your application.

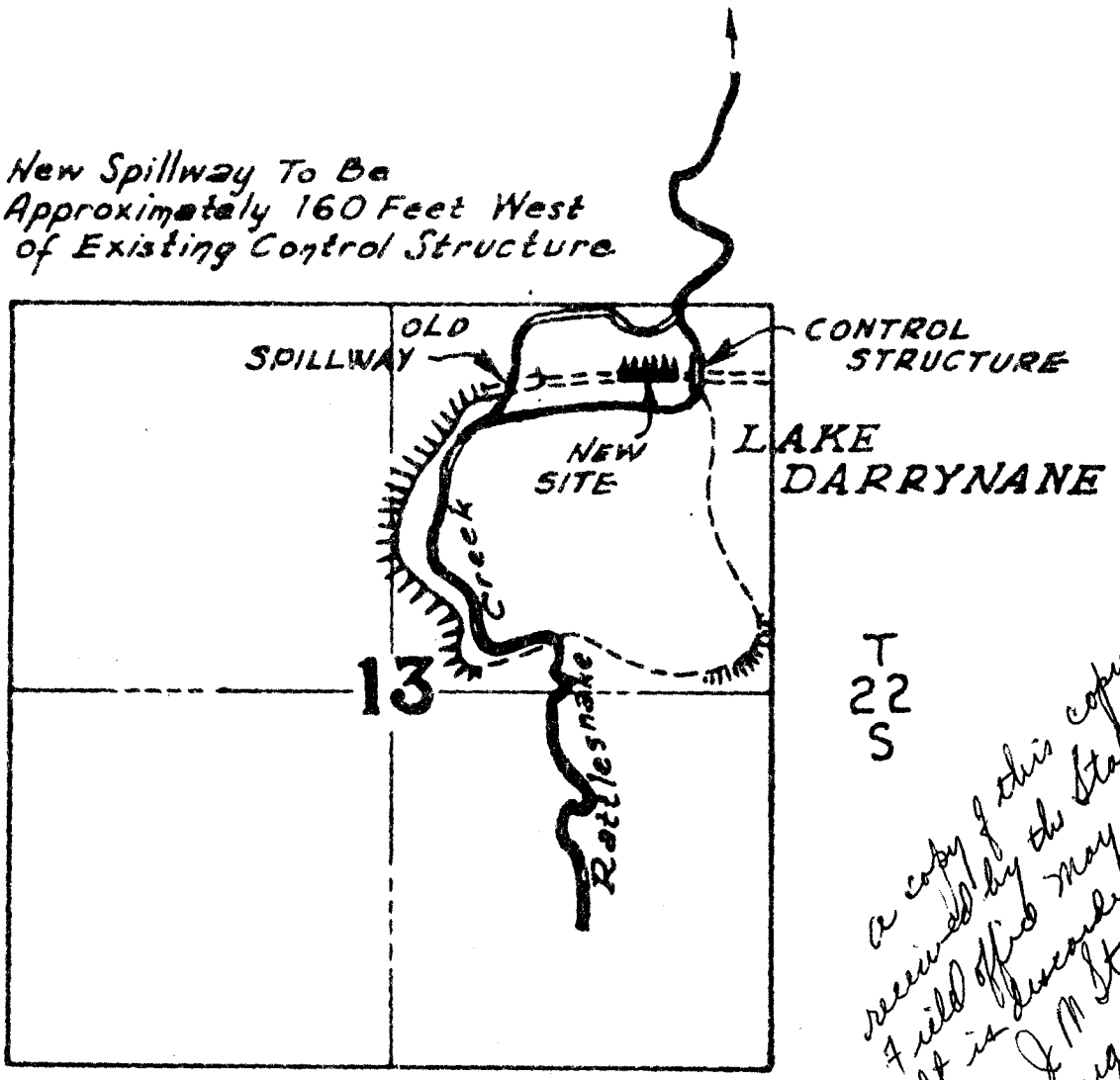
Very truly yours,

W. H. Sunderland
Senior Engineer

WHS:sa

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
QUIVIRA NATIONAL WILDLIFE REFUGE

SKETCH to ACCOMPANY APPLICATION REGULATING THE PLACING OF DAMS AND OTHER OBSTRUCTIONS IN STREAMS



a copy of this copy was received by the Stafford field office may, 10 1960. It is presumed I M Stout aug 13, 1963

SKETCH 1

STATEMENT TO ACCOMPANY
APPLICATION FOR PERMIT TO
APPROPRIATE WATER FOR BENEFICIAL USE

The project boundary for the Quivira National Wildlife Refuge was approved by the Migratory Bird Conservation Commission on May 3, 1955.

Total area within the approved boundary is 21,353.72 acres. To date 5,299.51 acres have either been purchased or options to purchase have been obtained. It is expected that it may take three or four years to acquire the remaining 16,054.21 acres.

To develop the area for the benefit of migratory waterfowl it will be necessary to construct shallow ponds and marsh areas, storage reservoirs, and appurtenant works for the diversion and control of water.

It is conservatively estimated that the average annual runoff from Rattlesnake Creek is between 10,000 and 15,000 acre-feet. With this amount of water it is estimated that a minimum of 1,700 acres of ponded area can be maintained. To fully utilize the water available in Rattlesnake Creek it is estimated that active storage capacity for 6,000 acre-feet or more must be provided. Some storage can be provided by raising water levels in Little Salt Marsh. Other storage can be provided at the south end of Big Salt Marsh.

The principal point of diversion from Rattlesnake Creek is expected to be built in the southwest quarter of Section 26, T.22 S., R.11 W. Other points of diversion for smaller quantities of water probably will be located as follows:

NE¼, Sec. 24, T.22 S., R.11 W.
NE¼, Sec. 13, T.22 S., R.11 W.
SW¼, Sec. 36, T.21 S., R.11 W.
SE¼, Sec. 35, T.21 S., R.11 W.
SW¼, Sec. 13, T.21 S., R.11 W.

However, their actual location will depend upon topographic and other features.

Along with the development of ponds and marsh area, it is proposed to carry on a farming program for the production of food for waterfowl. For the farming program it is anticipated that approximately 884 acres will be developed for irrigation by gravity flow from storage or from Rattlesnake Creek. Such development is considered desirable to try to provide a food crop during dry years.

Actual development for water control and use cannot start until land has been acquired in blocks large enough to permit an orderly development program. To date the lands that have been acquired or optioned are scattered over the entire area.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

OFFICE OF THE REGIONAL DIRECTOR
ALBUQUERQUE, NEW MEXICO
P. O. BOX 1306

ADDRESS ONLY THE REGIONAL DIRECTOR
FISH AND WILDLIFE SERVICE
2-E

REGION 2
ARIZONA
NEW MEXICO
TEXAS
OKLAHOMA
KANSAS
COLORADO
UTAH
WYOMING

August 13, 1957

Mr. R. V. Smrha, Chief Engineer
Division of Water Resources
Kansas State Board of Agriculture
State Office Bldg.
Topeka, Kansas

Dear Mr. Smrha:

In compliance with the instructions in Mr. Sunderland's letter of July 30, 1957, we have prepared in duplicate the Application for Permit to Appropriate Water for Beneficial Use.

Also enclosed is a personal check in the amount of $10.00 for the fee for filing the application.

Very truly yours,

Carey H. Bennett

Carey H. Bennett
Ass't Regional Director

Encl.

Rec'd check 10.00 8/15/57 CH.
(Ck. signed by: Francis V Olson Regl. Engr.)

STATE OF KANSAS

DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE
TOPEKA

NUMBER 7571

APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

(The Statutory Filing Fee of $10.00 Must Accompany the Application)

To the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture:

Comes now the applicant (~~Mr.~~) (~~Mrs.~~) U. S. Department of the Interior (~~Mrs.~~) U.S.Fish and Wildlife Service whose post office address is P. O. Box 1306, Albuquerque, New Mexico and makes application to the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture, for a permit to appropriate for beneficial use such unappropriated surface water (surface water or groundwater) as may be available in Rattlesnake Creek (name of stream or drainage basin) in the county of Stafford and Rice, state of Kansas, to the extent and in accordance with the particulars hereinafter described:

1. The quantity of water desired is in the amount of all of the unappropriated water ~~per year~~ (~~acre feet or million gallons~~) to be diverted at a maximum rate of (presently undetermined) (gallons per minute or cubic feet per second)

2. The location of the proposed wells or other works for diversion of water is in the SW quarter of the SW quarter of section 26, township 22S, range 11W, in Stafford County, Kansas.

3. The works for diversion and distribution of water will consist of a diversion dam, canals, laterals and water control structures (wells, pumps, ditches, gated pipe, sprinkler system) and will be completed ~~and in operation by~~ as soon as a specific plan of development is approved and after lands for the project have been acquired. (~~Date~~)

4. The first actual application of water for the beneficial use proposed was or is estimated to be as soon as possible after a specific plan of development is approved and after lands ~~for the project have been acquired.~~ (Date)

5. The water is intended to be appropriated for:

			Amount
(a)	Domestic use	( )	
(b)	Municipal use	( )	
(c)	Irrigation use	(x)	
(d)	Industrial use	( )	
(e)	Recreational use	( )	
(f)	Water Power use	( )	
	Fish & Wildlife	(x)	

(check intended use or uses and show intended quantity for each use)

6. If for municipal use, please attach tables or curves showing past, present and estimated future population and water requirements of the city.

7. If for irrigation use list below or attach name and address of each landowner and the legal description of the lands to be irrigated by designating the actual number of acres to be irrigated in each forty acre tract or fractional portion thereof:

Owner of Land—NAME: All to be acquired by the United States for the project.

ADDRESS: _____

Sec.	Twp.	Range	NE¼				NW¼				SW¼				SE¼				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
11	22S	11W	40	40	40	40		(To be Purchased)											160
2	22S	11W						(To be Purchased)							40	40	40	40	160
1	22S	11W		(Purchased or option to buy taken by United States)									40	24					64

Owner of Land—NAME: To be acquired by the United States for the Project

ADDRESS: _____

Sec.	Twp.	Range	NE¼				NW¼				SW¼				SE¼				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
34	21S	11W	40	12	20	40									40	30	38	40	260

Owner of Land—NAME: Either purchased or optinn to buy already taken by the United States

ADDRESS: _____

Sec.	Twp.	Range	NE¼				NW¼				SW¼				SE¼				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
25	21S	11W					40			40	40	40	40	40					240

List and describe other applications filed or vested rights held by applicant:

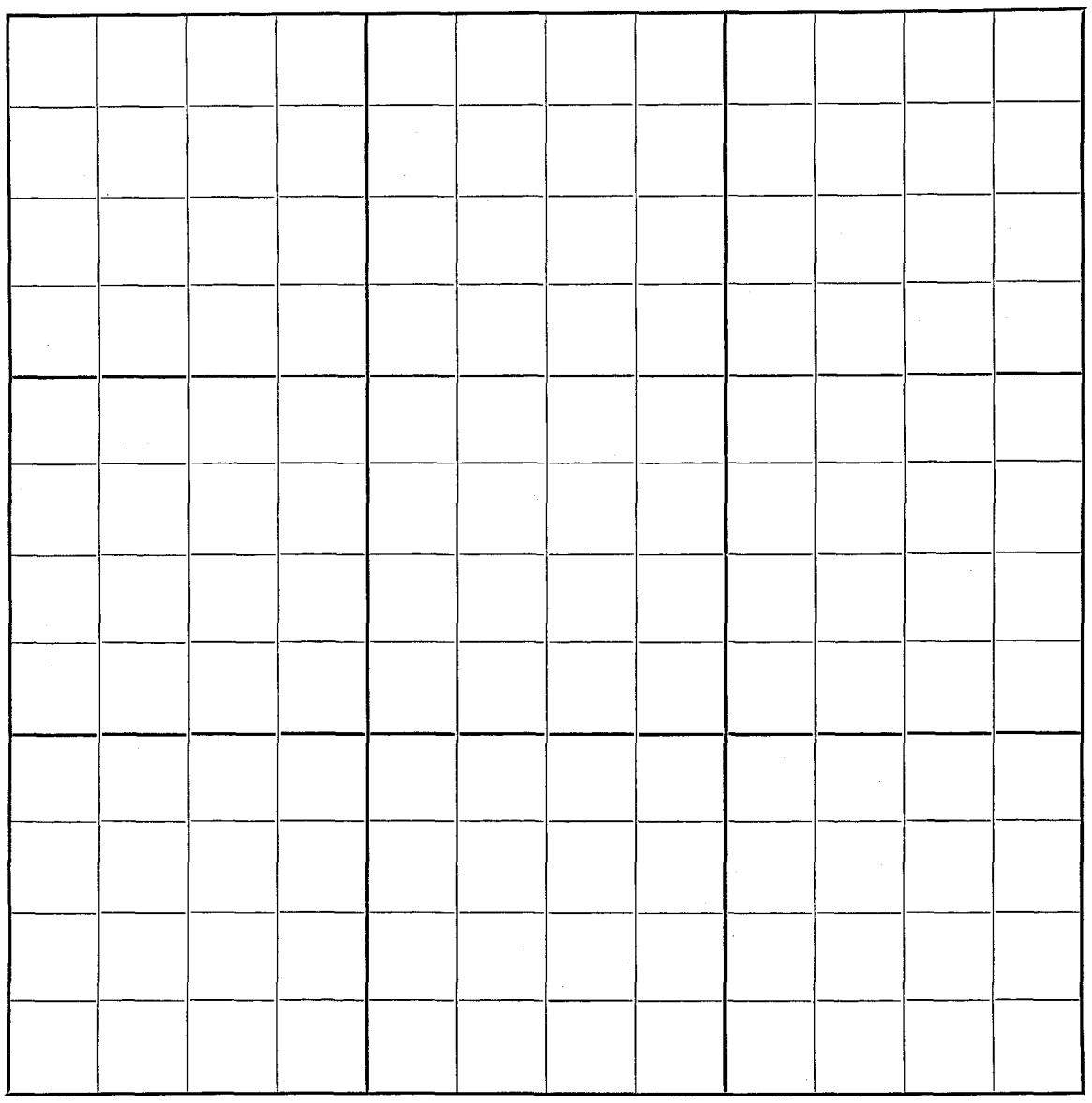
Applicant has no other applications on file on Rattlesnake Creek.

Applicant has no recorded vested appropriative rights on Rattlesnake Creek.

8. The location of the land to be irrigated and of the proposed works for diversion and distribution of water is shown on the following plat.

Note: See attached explanatory statement and map for proposed plan of development.

NORTH



9. The relation of the subscriber to this application if not the owner is that of Agent (Agent or otherwise), and he is authorized to make this application in behalf of the interest affected.

Dated at Albuquerque, New Mexico, this 12th day of August, 1957

U. S. Department of the Interior
U. S. Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
By Francis V. Olson
Francis V. Olson (Applicant) Regional Engineer

By _____
(Agent or Officer)

NOTE:

1 cubic foot per second = 448.8 gallons per minute = 646,317 gallons per day = 1.98 acre feet per day.
1 million gallons per day = 1.547 cubic feet per second = 3.07 acre feet per day.
1 acre foot = 43,560 cubic feet = 325,851 gallons.

26-8963-S—22-46-47-48 6-57-10M

STATE OF KANSAS

DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE
TOPEKA

NUMBER 7571

AMENDED
APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

(The Statutory Filing Fee of $10.00 Must Accompany the Application)

To the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture:

(Mr.) United States of America
(Mrs.) Department of Interior
(Miss) Fish & Wildlife Service
Bureau of Sport Fisheries & Wildlife

Comes now the applicant ~~(Mr.) (Mrs.) (Miss)~~ _____ whose post office address is P.O. Box 1306, Albuquerque, New Mexico

and makes application to the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture, for a permit to appropriate for beneficial use such unappropriated surface water (surface water or groundwater) as may be available in Rattlesnake Creek (name of stream or drainage basin) in the county of Stafford & Rice, state of Kansas, to the extent and in accordance with the particulars hereinafter described:

1. The quantity of water desired is in the amount of 22,200 Acre-Feet (acre feet or million gallons) per year, to be diverted at a maximum rate of 300 cubic feet per second (gallons per minute or cubic feet per second)
(see attachment and map accompanying this application)

2. The location of the proposed wells or other works for diversion of water is in the _____ quarter of the _____ quarter of section _____, township _____, range _____, in _____ County, Kansas.

3. The works for diversion and distribution of water will consist of Diversion dams, canals, laterals, and water control structures (wells, pumps, ditches, gated pipe, sprinkler system) and will be completed and in operation by Scheduled for completion in 1967. (Date)

4. The first actual application of water for the beneficial use proposed was or is estimated to be 1963 (Date)

5. The water is intended to be appropriated for:

			Amount
(a)	Domestic use	( )	_____
(b)	Municipal use	( )	_____
(c)	Irrigation use	( )	_____
(d)	Industrial use	( )	_____
(e)	Recreational use	( )	_____
(f)	Water Power use	( )	_____
	Fish & Wildlife	(X)	

(check intended use or uses and show intended quantity for each use)

SEP 28 1962
STATE BOARD OF AGRICULTURE

MICROFILMED

6. If for municipal use, please attach tables or curves showing past, present and estimated future population and water requirements of the city.

7. If for irrigation use list below or attach name and address of each landowner and the legal description of the lands to be irrigated by designating the actual number of acres to be irrigated in each forty acre tract or fractional portion thereof:

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
					(See map attached)												

Owner of Land—NAME: _____

ADDRESS: _____

Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

Owner of Land—NAME: _____

ADDRESS: _____

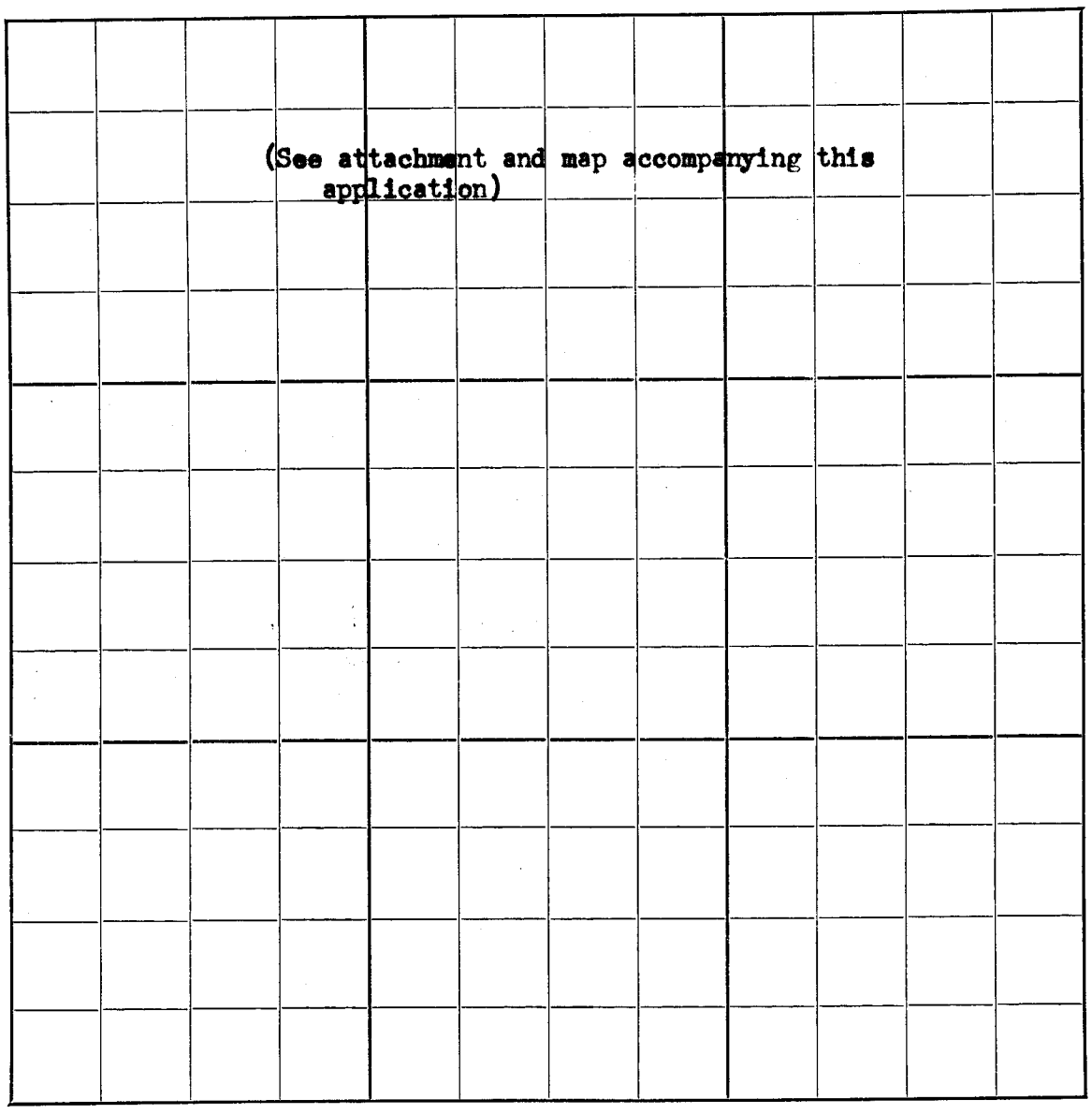
Sec. Twp. Range	NE¼				NW¼				SW¼				SE¼				Total
	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

List and describe other applications filed or vested rights held by applicant:

Temporary Application No. 7571 filed August 15, 1957 and given priority of the same number and date.

8. The location of the land to be irrigated and of the proposed works for diversion and distribution of water is shown on the following plat.

NORTH



9. The relation of the subscriber to this application if not the owner is that of Agent,
(Agent or otherwise)
and he is authorized to make this application in behalf of the interest affected.

Dated at Albuquerque, New Mexico, ~~Kansas~~, this ~~26~~ day of ~~September~~, 19~~62~~

United States of America
Department of Interior
Fish & Wildlife Service
Bureau of Sport Fisheries & Wildlife
(Applicant)

By John C. Gatlin
(Agent or Officer)
John C. Gatlin, Regional Director

NOTE:

1 cubic foot per second = 448.8 gallons per minute = 646,317 gallons per day = 1.98 acre feet per day.
1 million gallons per day = 1.547 cubic feet per second = 3.07 acre feet per day.
1 acre foot = 43,560 cubic feet = 325,851 gallons.

26-8963-S—22-46-47-48 6-57-10M

STATE OF KANSAS

DIVISION OF WATER RESOURCES
STATE BOARD OF AGRICULTURE
TOPEKA

NUMBER 7571

APPLICATION FOR PERMIT TO APPROPRIATE WATER FOR BENEFICIAL USE

(The Statutory Filing Fee of $10.00 Must Accompany the Application)

To the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture:

Comes now the applicant (~~MR.~~) (~~MRS.~~) (~~MISS~~) U. S. Department of the Interior U.S.Fish and Wildlife Service whose post office address is P. O. Box 1306, Albuquerque, New Mexico

and makes application to the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture, for a permit to appropriate for beneficial use such unappropriated surface water (surface water or groundwater) as may be available in Rattlesnake Creek (name of stream or drainage basin) in the county of Stafford and Rice, state of Kansas, to the extent and in accordance with the particulars hereinafter described:

1. The quantity of water desired is in the amount of all of the unappropriated water (acre feet or million gallons) per year, to be diverted at a maximum rate of (presently undetermined) (gallons per minute or cubic feet per second)

2. The location of the proposed wells or other works for diversion of water is in the SW quarter of the SW quarter of section 26, township 22S, range 11W, in Stafford County, Kansas.

3. The works for diversion and distribution of water will consist of a diversion dam, canals, laterals and water control structures (wells, pumps, ditches, gated pipe, sprinkler system), and will be completed and in operation by ~~XXXXXXXXXXXX~~ as soon as a specific plan of development is approved and after lands for the project have been acquired. (~~XXX~~)

4. The first actual application of water for the beneficial use proposed was or is estimated to be as soon as possible after a specific plan of development is approved and after lands for the project have been acquired. (Date)

5. The water is intended to be appropriated for:

			Amount
(a)	Domestic use	( )	
(b)	Municipal use	( )	
(c)	Irrigation use	(~~X~~)	
(d)	Industrial use	( )	
(e)	Recreational use	( )	
(f)	Water Power use Fish & Wildlife	(X)	

(check intended use or uses and show intended quantity for each use)

6. If for municipal use, please attach tables or curves showing past, present and estimated future population and water requirements of the city.

7. If for irrigation use list below or attach name and address of each landowner and the legal description of the lands to be irrigated by designating the actual number of acres to be irrigated in each forty acre tract or fractional portion thereof:

Owner of Land—NAME: All to be acquired by the United States for the project.

ADDRESS: _____

Sec.	Twp.	Range	NE¼				NW¼				SW¼				SE¼				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
11	22S	11W	40	40	40	40		(To be Purchased)											160
2	22S	11W						(To be Purchased)							40	40	40	40	160
1	22S	11W		(Purchased or option to buy taken by United States)									40	24					64

Owner of Land—NAME: To be acquired by the United States for the Project

ADDRESS: _____

Sec.	Twp.	Range	NE¼				NW¼				SW¼				SE¼				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
34	21S	11W	40	12	20	40									40	30	38	40	260

Owner of Land—NAME: Either purchased or optian to buy already taken by the United States

ADDRESS: _____

Sec.	Twp.	Range	NE¼				NW¼				SW¼				SE¼				Total
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
25	21S	11W					40			40	40	40	40	40					240

List and describe other applications filed or vested rights held by applicant:

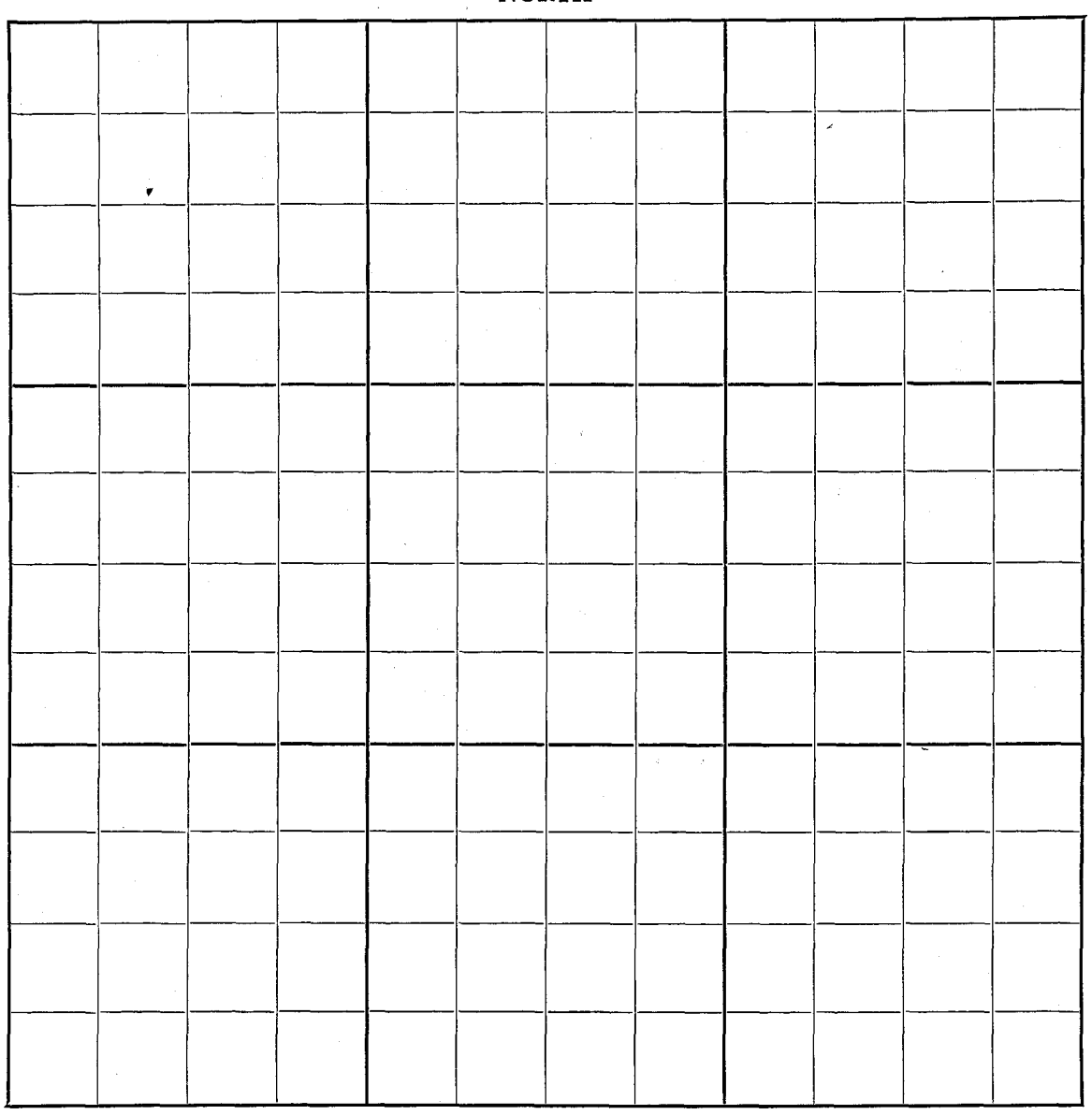
Applicant has no other applications on file on Rattlesnake Creek.

Applicant has no recorded vested appropriative rights on Rattlesnake Creek.

8. The location of the land to be irrigated and of the proposed works for diversion and distribution of water is shown on the following plat.

Note: See attached explanatory statement and map for proposed plan of development.

NORTH



9. The relation of the subscriber to this application if not the owner is that of Agent (Agent or otherwise), and he is authorized to make this application in behalf of the interest affected.

Dated at Albuquerque, ~~Kansas~~ New Mexico, this 12th day of August, 1957

U. S. Department of the Interior
U. S. Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

By Francis V. Olson
Francis V. Olson (Applicant) Regional Engineer

By _____
(Agent or Officer)

NOTE:

1 cubic foot per second = 448.8 gallons per minute = 646,317 gallons per day = 1.98 acre feet per day.
1 million gallons per day = 1.547 cubic feet per second = 3.07 acre feet per day.
1 acre foot = 43,560 cubic feet = 325,851 gallons.

26-8963-5—22-46-47-48 6-57-10M

R. 12 W.

Ellinwood 11 Miles

Salt Creek

Rattlesnake Creek

MARSH

SALT

BIG

PROPOSED STORAGE RESERVOIR

RICE CO.

RENO CO.

Great Bend

State Highwa

Ellinwood
11 Miles

Raymond
5 Miles

T.
21
S.

RICE CO.

RENO CO.

PROPOSED
STORAGE
RESERVOIR

Creek

Salt

Rattlesnake

Creek

MARSH

SALT

BIG

Great Bend

State Highway 96

STANOLIND PIPELINE CO. (OIL)

PROPOSED DIVERSION CANAL

Rattlesnake Creek

Hudson
← 9 Miles

MICHIGAN-WISCONSIN PIPELINE CO. (GAS)

LITTLE SALT MARSH

PROPOSED STORAGE RESERVOIR

DUNN COUNTY

TAFFCO

STANOLIND PIPELINE CO. (OIL)

PROPOSED DIVERSION CANAL

Rattlesnake Creek

MICHIGAN-WISCONSIN PIPELINE CO. (GAS)

Hudson
← 9 Miles

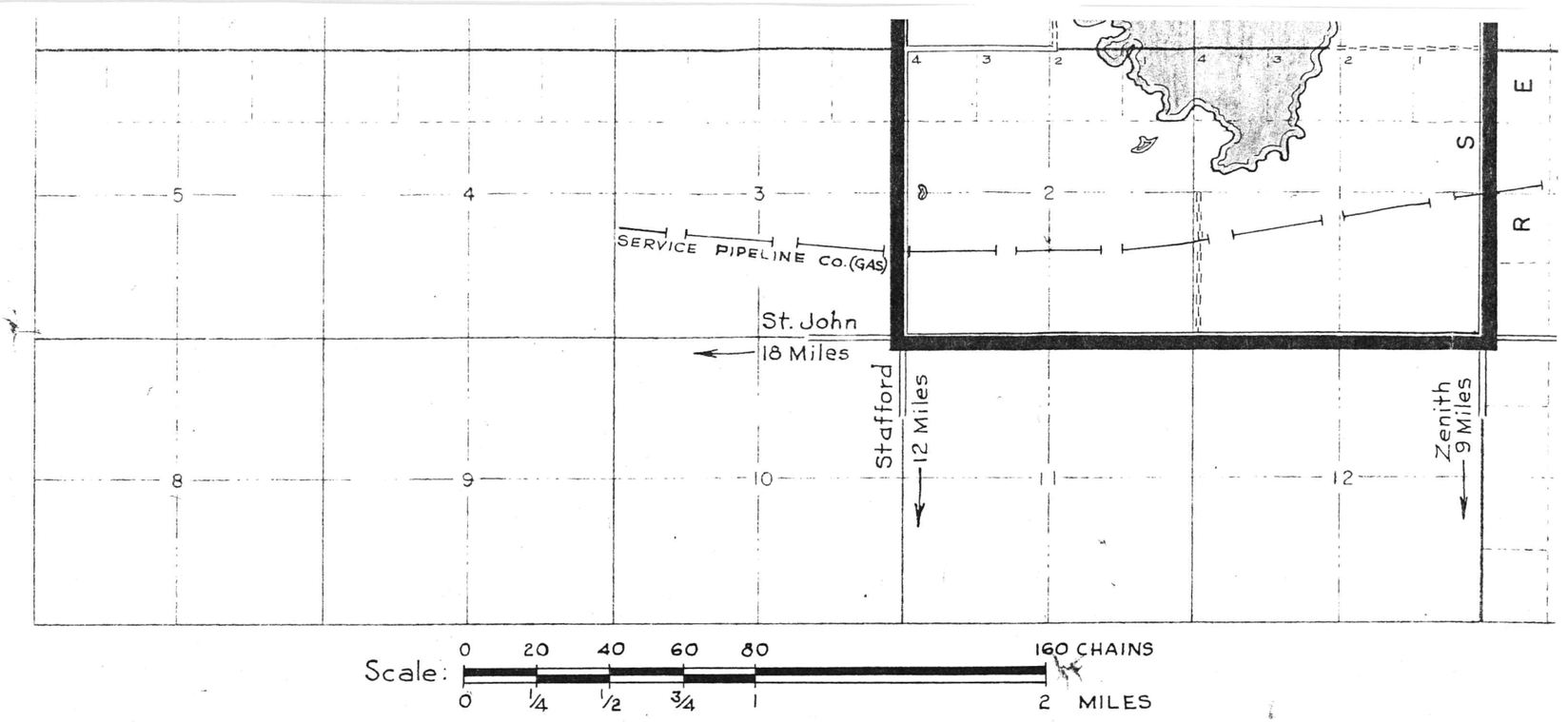
LITTLE SALT MARSH

PROPOSED STORAGE RESERVOIR

T. 22 S.

R. 7 E.

T. 23 N.



LEGEND

- REFUGE BOUNDARY
- IMPROVED ROAD (GRADED)
- SECONDARY ROAD
- PRIMITIVE ROAD (JEEP OR POWER WAGON)
- PIPE LINE
- DITCH
- WATER AREA
- OIL WELL
- MARSH AND POND DEVELOPMENT
- IRRIGATION DEVELOPMENT
- DIKES AND WATER CONTROL
- CANALS

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

PROPOSED DEVELOPMENT PLAN
QUIVIRA NATIONAL WILDLIFE REFUGE

STAFFORD AND RICE COUNTIES
KANSAS
1956

SIXTH PRINCIPAL MERIDIAN

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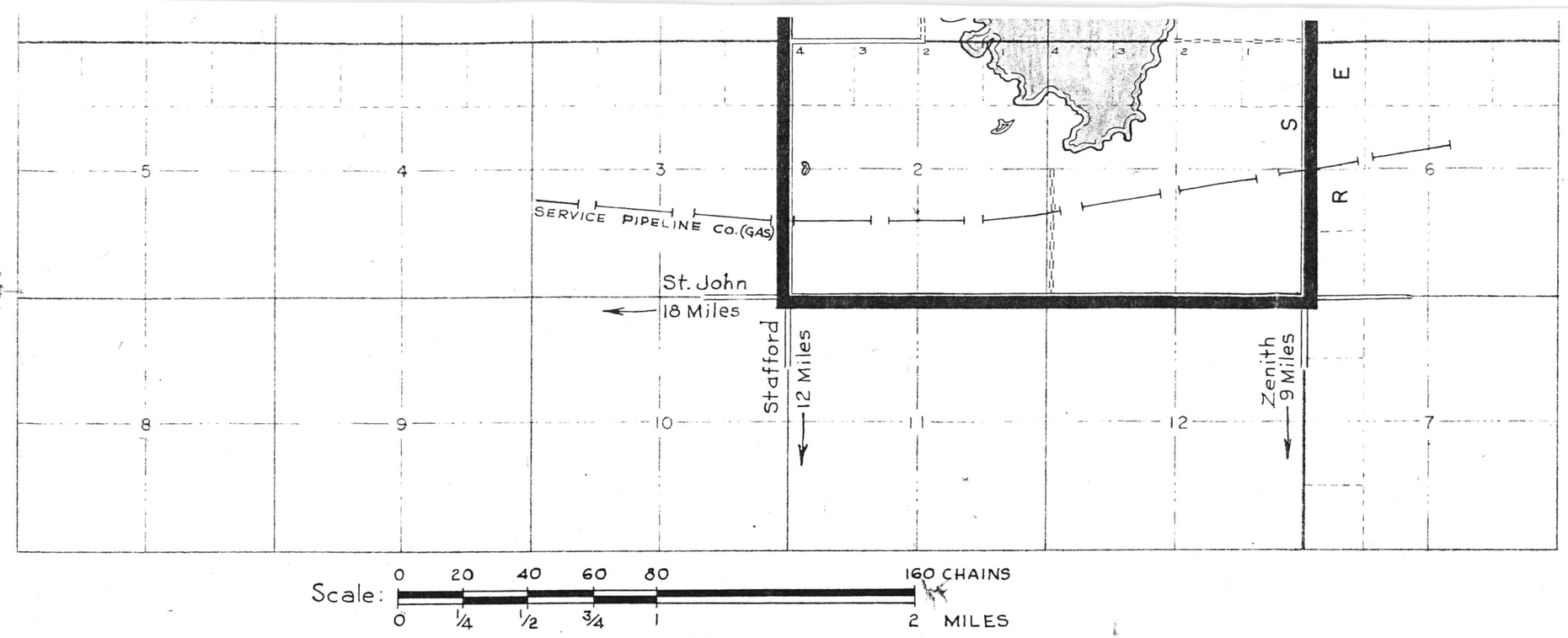
Rev. Oct.

sept. 1956



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

PROPOSED DEVELOPMENT PLAN
QUIVIRA NATIONAL WILDLIFE REFUGE

STAFFORD AND RICE COUNTIES
KANSAS
1956

SIXTH PRINCIPAL MERIDIAN

Traced and drawn by V.C. McDonald, Branch of Engineering, from Cover Type Map compiled and drawn by J.A. Beard from Aerial Photographs and from Field Data, Nov. 1953, by J.A. Beard and R.B. St. John, Branch of Lands.

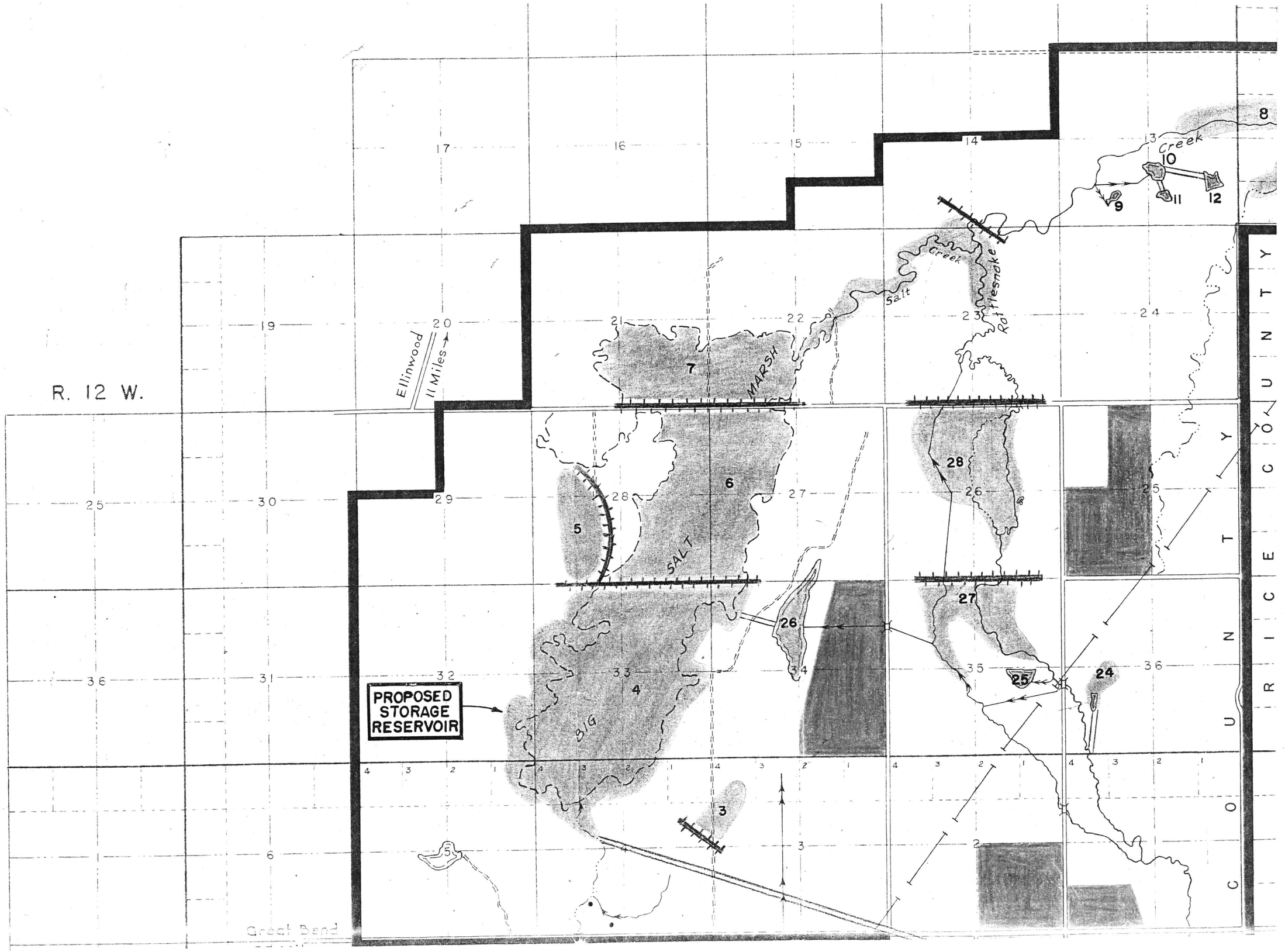
Rev. Oct. 1956

ED)

OR POWER WAGON)

OPMENT
NT
TROL

July 25, 1957


R. 12 W.
Ellinwood
11 Miles
Creek
Salt
Rattlesnake
Creek
MARSH
SALT
BIG
PROPOSED
STORAGE
RESERVOIR
Great Bend
RICE COUNTY

Ellinwood
11 Miles

Raymond
5 Miles

Salt Creek

Rattlesnake Creek

MARSH

SALT

BIG

PROPOSED STORAGE RESERVOIR

RICE CO.

RENO CO.

State Highway 96

Bend

T. 21 S.

RICE COUNTY

STANOLIND PIPELINE CO. (OIL)

PROPOSED DIVERSION CANAL

Rattlesnake Creek

Hudson
← 9 Miles

MICHIGAN-WISCONSIN PIPELINE CO. (GAS)

LITTLE
SALT MARSH

T 4 S
R 5 E
LENAWEE COUNTY

STANOLIND PIPELINE CO. (OIL)

PROPOSED DIVERSION CANAL

Rattlesnake Creek

Hudson
9 Miles

MICHIGAN-WISCONSIN PIPELINE CO. (GAS)

Rattlesnake Creek

LITTLE SALT MARSH

PROPOSED STORAGE RESERVOIR

T. 22 S.

R. 25 E.

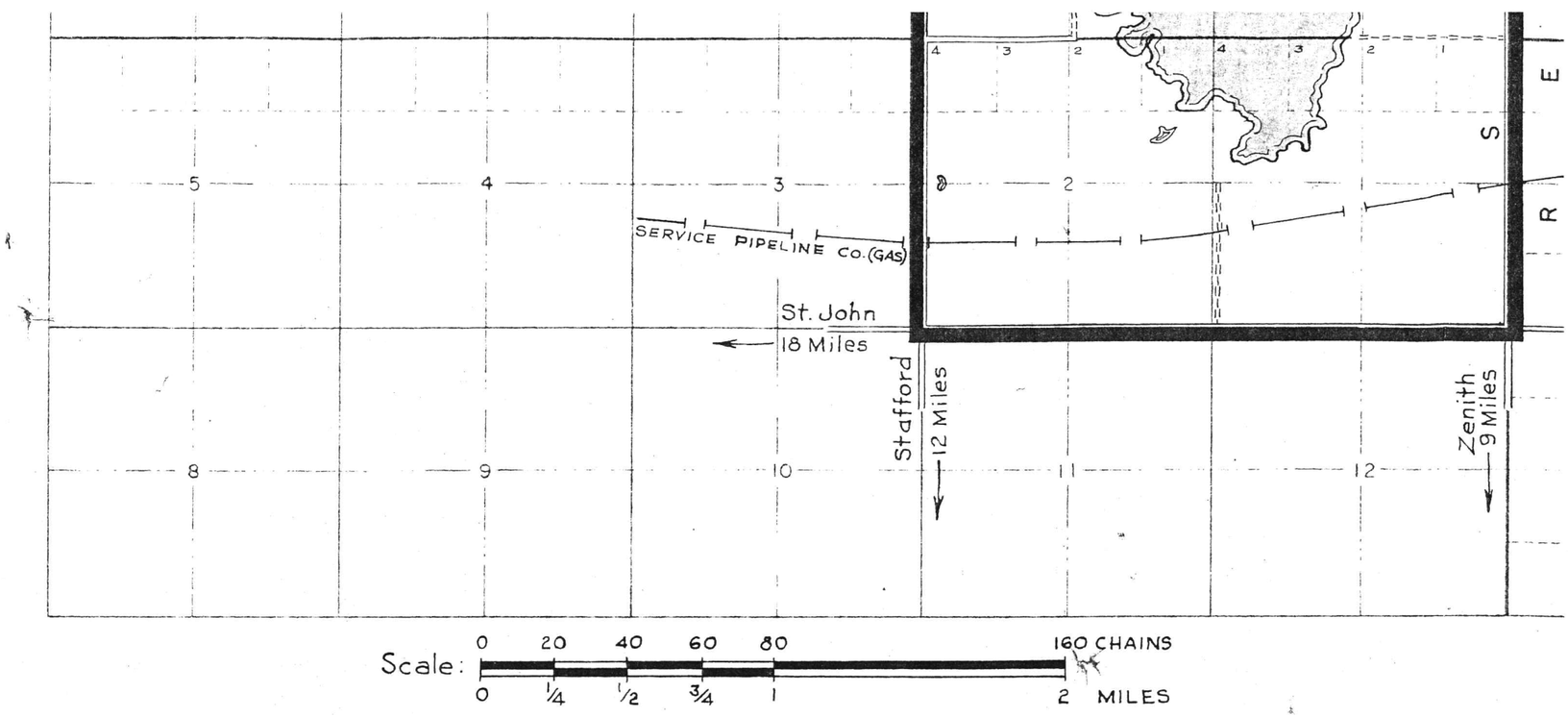
T. 21 N.

R. 24 E.

T. 20 N.

R. 23 E.

T. 19 N.



LEGEND

- REFUGE BOUNDARY
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- SECONDARY ROAD
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- PIPE LINE
- DITCH
- WATER AREA
- OIL WELL
- **MARSH AND POND DEVELOPMENT**
- **IRRIGATION DEVELOPMENT**
- **DIKES AND WATER CONTROL**
- **CANALS**

sept. 1956

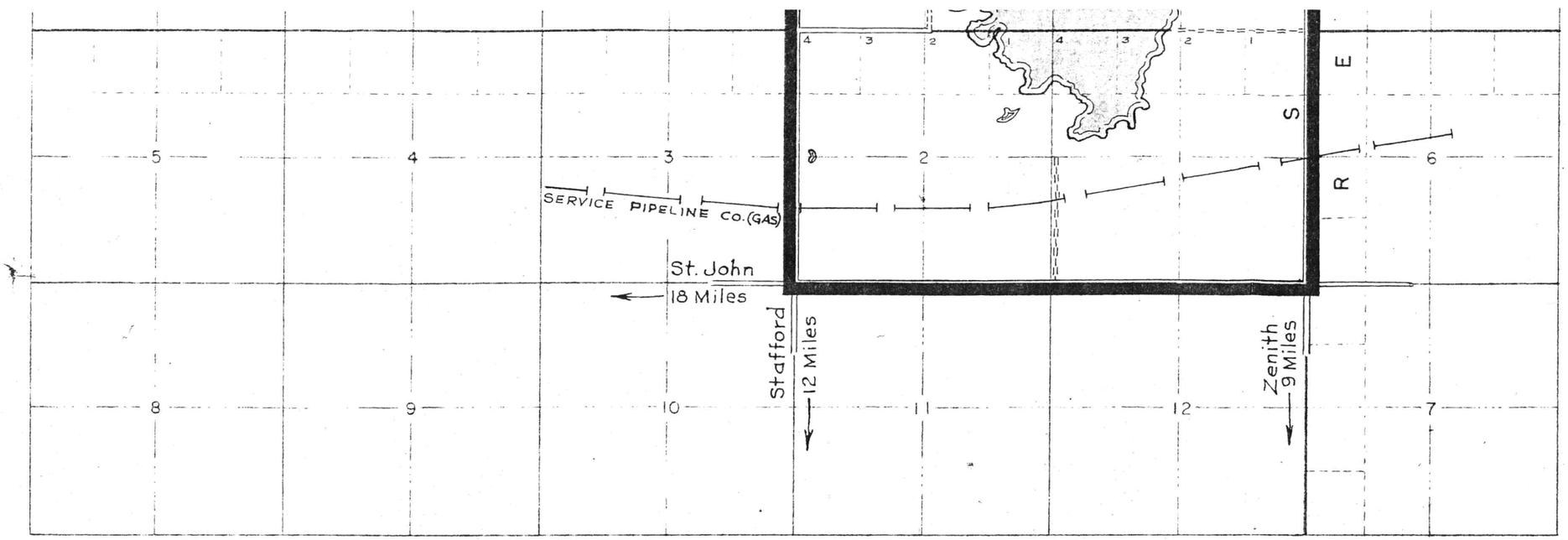
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

PROPOSED DEVELOPMENT PLAN
QUIVIRA NATIONAL WILDLIFE REFUGE

STAFFORD AND RICE COUNTIES
KANSAS
1956

SIXTH PRINCIPAL MERIDIAN

Trace
from
from
by J.
Rev. Oc



Scale: 0 20 40 60 80 160 CHAINS
0 ¼ ½ ¾ 1 2 MILES

ED)

OR POWER WAGON)

OPMENT
NT
TROL

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

PROPOSED DEVELOPMENT PLAN
QUIVIRA NATIONAL WILDLIFE REFUGE
STAFFORD AND RICE COUNTIES
KANSAS
1956

SIXTH PRINCIPAL MERIDIAN

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Rev. Oct. 1956

July 25, 1957