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

IN REPLY REFER TO:

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MAR 02 2016

*BA WTR*
*KS WR*
*Mail Stop 60189*

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

Dear Mr. Barfield:

The Service was asked several questions at the initial meeting on January 27th discussing impairment solutions for the Quivira National Wildlife Refuge's water right. Attached to this letter is a pdf with the questions as we understood them along with our answers. We look forward to the next meeting to discuss these matters further.

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

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

Enclosures

cc:

Dana Jacobsen
Rocky Mountain Regional Office
Office of the Regional Solicitor
U.S. Department of Interior
755 Parfet Street, Room 151
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Jeff Lanterman
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Kansas Department of Agriculture
Division of Water Resources - Stafford Field Office
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Orrin Feril
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1625 N. Waterfront Parkway, Suite 300
Wichita, KS 67206-6620

**Quivira NWR**
**Response to Questions Proposed by GMD5 Regarding Augmentation of Rattlesnake Creek**
**February 23, 2016**

1) **What is the maximum augmentation capacity that GMD 5 should consider?**

We believe that augmentation should have a designed capacity of 1,800 ac-ft per month. This converts to roughly 60 ac-ft per day, or about 13,600 gpm. According to the KDWR initial impairment investigation report, the maximum monthly impairment found by the modeling was 3,200 ac-ft (Oct. /Nov. 1984). The maximum yearly impairment was found to be 8,580 ac-ft (1991). Considering that pumping impacts are playing a larger role in the basin than in 1984, it is reasonable to assume that there may be a dry month when augmentation is needed for the maximum monthly demand of 1,800 ac-ft.

Please note that the stream gauge at Zenith operated by the USGS has always been impaired. There is no known record of streamflow without impairment from junior groundwater pumping. We believe that any augmentation quantity should be determined by the Balleau Groundwater model and the impairment it shows from junior groundwater pumping.

Regular long-term use of this amount of augmentation water without groundwater pumping reductions in GMD5 would increase concerns of water resource sustainability. We encourage increased focus on improving water use efficiencies and/or reduction of water use by junior appropriators that would benefit long-term sustainability of surface and groundwater resources. Additionally, if water quality degrades over time due to brackish water upwelling, potential permanent damage could be done to the aquifer. This damage would affect all groundwater appropriators (including agricultural users near the augmentation wells) in addition to the surface water quality. Furthermore, augmentation would no longer be a viable solution due to inferior water quality being provided.

2) **What water quality is appropriate for augmentation?**

There seems to be general agreement that augmentation water quality should be similar to what was present in the past in Rattlesnake Creek. The USGS collected water samples at the Zenith gauge from December 1998 – March 2001. Assuming that the impairment has not significantly affected the water quality of the stream, then these results can be used as an indicator of the range of acceptable augmentation water quality. A summary of the information is available on the following website (http://ks.water.usgs.gov/quivira-nwr).

The years 1998 – 2001 were fairly "normal" years with annual average precipitation as follows (measured in Great Bend –Station ID COOP: 140119 – source National Climatic Data Center):

| Year | Annual Precipitation (in) |
|---|---|
| 1998 | 27.23 |
| 1999 | 26.42 |
| 2000 | 30.39 |
| 2001 | 23.98 |

The Service is concerned that augmentation water will lead to reduced water quality being delivered to the refuge during certain times of the year. Water quality monitoring at the Zenith gauge would be required in order ensure that water quality will not degrade with augmentation. We suggest that the USGS be contracted to conduct the monitoring in association with their streamflow measurements.

In regards to water quality parameters for augmentation, assigning a specific threshold for each parameter is a difficult task. We recognize that water quality naturally varies throughout the year based on precipitation, runoff water quality, land-use, etc. We are also highly skeptical of the ability of augmentation water to be treated based on the expense. We believe that the in-situ groundwater quality is likely going to be the only available water and that careful monitoring of the mixing of deeper brackish water in the augmentation wells with shallower fresher water will be the determining factor in water quality received.

We hypothesize that pumping from the aquifer at a location east of Highway 281 may cause intrusion of brackish water into the upper fresh water aquifer, due to limited saturated thickness of the productive aquifer units. We would like to see model runs from Balleau indicating that the aquifer transmissivity can support the required pumping and that brackish water will not be intermixed with the upper aquifer.

We suggest that the quality of augmentation water combined with the water free flowing in the stream does not exceed the limits of values measured by the USGS at the Zenith Gauge. A few parameters have been measured beyond 2001, but most results are included in their Water Resources Investigations Report 01-4248 “Characterization of Surface-Water Quality Based on Real-Time Monitoring and Regression Analysis, Quivira National Wildlife Refuge, South-Central Kansas, December 1998 Through June 2001.” Though there are a limited number of samples, we would require that the water quality be assessed on a monthly basis to include seasonal variations. The mean water quality for each parameter should not exceed the mean, plus one standard deviation (where data is available). Table 1 below is given as an example for specific conductance; we would require that the specific conductance measured in March not exceed 3,794 µS/cm. A specific constituent that we are concerned with reduced levels occurring in augmentation water is dissolved oxygen (DO), which is typically lower in groundwater than surface water. We would require that the DO does not fall below historic values as outlined in the USGS report (3.1 mg/L). There should be consideration of actions taken when water quality thresholds are not met. It seems appropriate that water treatment may be a future requirement.

**Table 1:** Specific conductance measured by the USGS at the Zenith Gauge from December 1998 to Oct. 2003. (Source: USGS 07142575 RATTLESNAKE C NR ZENITH, KS)

| Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius, | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **YEAR** | **Monthly mean in µS/cm @25C (Calculation Period: 1998-12-01 -> 2003-10-31)** | | | | | | | | | | | |
| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| **1998** | | | | | | | | | | | | 3,134 |
| **1999** | 2,977 | 2,610 | 2,611 | 2,429 | | | 3,768 | 6,850 | 6,569 | | 4,606 | 4,041 |
| **2000** | 3,317 | | 2,175 | 2,916 | | 4,231 | 3,229 | 5,466 | 9,611 | 6,732 | 3,135 | 3,645 |
| **2001** | 3,144 | 2,598 | 2,823 | 3,066 | 2,675 | 2,758 | 6,708 | 8,827 | 7,660 | | 6,463 | |
| **2002** | | 4,038 | 4,156 | | | | 8,343 | 8,181 | 9,862 | | 7,381 | 7,390 |
| **2003** | 6,933 | 5,894 | | 4,685 | 4,941 | | | 9,735 | 9,308 | 7,777 | | |
| **Mean of monthly Specific cond. at 25C** | 4,090 | 3,790 | 2,940 | 3,270 | 3,810 | 3,490 | 5,510 | 7,810 | 8,600 | 7,250 | 5,400 | 4,550 |
| **STD DEV** | 1,899 | 1,560 | 854 | 979 | 1,602 | 1,042 | 2,429 | 1,680 | 1,425 | 739 | 1,899 | 1,928 |
| **MIN** | 2,191 | 2,230 | 2,086 | 2,291 | 2,208 | 2,448 | 3,081 | 6,130 | 7,175 | 6,511 | 3,501 | 2,622 |
| **MAX** | 5,989 | 5,350 | 3,794 | 4,249 | 5,412 | 4,532 | 7,939 | 9,490 | 10,025 | 7,989 | 7,299 | 6,478 |

**3) What kind of shortages could the Refuge endure in times of drought?**

The Quivira National Wildlife Refuge (Refuge) cannot accept shortages on our water right during times of drought other than what would be available due to natural drought conditions. The Refuge recognizes that drought conditions will occur when streamflow does not meet the Refuges' desired streamflow. The Balleau Groundwater model should be able to show that without pumping, the refuge should have received some reduced quantity of water that would have been available during a drought. We cannot accept any amount less than this during a drought because of the property right implications. We do not have the authority to give up a U.S. Government Federal Property Right and do not want to set a precedent if we were to be complacent with giving up some amount.

We must stress again that the amount of water delivered to the Refuge should be determined by the Balleau Groundwater model. The amount of water delivered to the Refuge via augmentation should be the portion of streamflow that is reduced by junior groundwater pumping that would have gone to meet the Refuges' water needs.

**4) Where are the Refuges' domestic wells located?**

The refuge has several small stock wells powered by windmills spread throughout the refuge, and two active domestic wells. The completion reports for the two domestic wells are attached. The Service does not want these wells impacted by augmentation withdrawals. Information about the stock wells sited on the refuge can be obtained from (http://www.kgs.ku.edu/Magellan/WaterWell/)

**Domestic Well No. 1 (completed in 1998):**
Location: Township: 23S, Range: 11W, Section: 02 NWSWSE
Depth: 33 ft
Screened Interval: 23 – 33 ft
Static Water Level: 3 ft

**Domestic Well No. 2 (completed in 1988):**
Location: Township: 23S, Range: 11W, Section: 01 NENWSE
Depth: 38 ft
Screened Interval: 29 - 37 ft
Static Water Level: 15 ft

**5) How will augmentation water be administered?**

This question is a major concern for the Service regarding how the pumping amount will be determined when augmentation water is needed.

We would like a real-time solution where the Balleau Groundwater model (1-layer version) is run weekly with the new precipitation and runoff data from the preceding week and the pumping amount from the previous year (assuming little change) to determine the augmentation quantity that we should receive. This would prevent the refuge from being shorted for periods longer than a week. If the determination of how much augmentation water is made using longer duration periods (months for example) then the refuge could be shorted for periods of up to a month and may miss out on water during critical times for waterbird habitat. We recognize that this requires a long term commitment for modeling, but it should be considered as part of the cost of performing augmentation.

**6) Regarding how to determine which wells impact the stream and by how much.**

In the San Luis Valley of Colorado, a similar type of impairment exists where groundwater pumping has impacted downstream appropriators. A similar groundwater model was constructed and wells were grouped into "response zones" based on how much water they depleted from the stream and at what time (i.e. lagged effects). This type of system allowed for more certainty in the amount of water needed for augmentation from each response zone and hence each well owner. Perhaps the groundwater model results could be analyzed to create similar response zones. This would aid the State or GMD5 in determining the best method for reduction in groundwater pumping and how to assess costs to the various members of GMD5. This is only a suggestion that we thought we would offer because the topic was brought up at the last meeting.

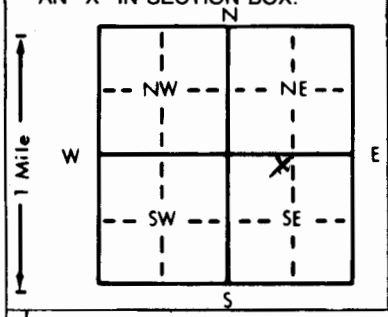
WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: Stafford | Fraction: NE ¼ NW ¼ SE ¼ | Section Number: 1 | Township Number: T 23 S | Range Number: R 11 E (W)

Distance and direction from nearest town or city street address of well if located within city?
E side of Quivira Refuge

2 WATER WELL OWNER: Quivira Refuge
RR#, St. Address, Box # : Rt 3, Box 48A
City, State, ZIP Code : Stafford, KS 67578
Board of Agriculture, Division of Water Resources
Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:




4 DEPTH OF COMPLETED WELL 37 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 15 ft. below land surface measured on mo/day/yr 10-29-88
Pump test data: Well water was 22 ft. after 1 hours pumping 25 gpm
Est. Yield gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 9 in. to 38 ft., and in. to ft.
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
(1) Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering (12) Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Monitoring well Stock
Was a chemical/bacteriological sample submitted to Department? Yes No X; If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes X No

5 TYPE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued X Clamped
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded
(2) PVC 4 ABS 7 Fiberglass Threaded
Blank casing diameter 6 in. to 29 ft., Dia in. to ft., Dia in. to ft.
Casing height above land surface 12 in., weight lbs./ft. Wall thickness or gauge No. 160

TYPE OF SCREEN OR PERFORATION MATERIAL: (2) PVC 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify)
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: 5 Gauzed wrapped (8) Saw cut 11 None (open hole)
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify)

SCREEN-PERFORATED INTERVALS: From 29 ft. to 37 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 24 ft. to 38 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout (3) Bentonite 4 Other
Grout Intervals: From 0 ft. to 20 ft., From ft. to ft., From ft. to ft.

What is the nearest source of possible contamination:
1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage (16) Other (specify below)
13 Insecticide storage Open field
Direction from well? How many feet?

| FROM | TO | LITHOLOGIC LOG | FROM | TO | PLUGGING INTERVALS |
|---|---|---|---|---|---|
| 0 | 9 | Sandy Silt | | | |
| 9 | 24 | Br Clay | | | |
| 24 | 28 | Sandy Br Silt | | | |
| 28 | 38 | C Sand | | | |
| | | Very Salty | | | |
| | | Well No 4 | | | |

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 10-29-88 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 447 This Water Well Record was completed on (mo/day/yr) 6-3-89
under the business name of Miller Drilling by (signature) Ezra Miller

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water Protection, Topeka, Kansas 66620-7320. Telephone: 913-296-5514. Send one to WATER WELL OWNER and retain one for your records.

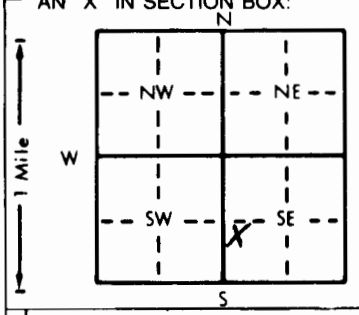
WATER WELL RECORD Form WWC-5 KSA 82a-1212

| 1 LOCATION OF WATER WELL: | Fraction | Section Number | Township Number | Range Number |
|---|---|---|---|---|
| County: Stafford | NW ¼ SW ¼ SE ¼ | 2 | T 23 S | R 11 E (W) |

Distance and direction from nearest town or city street address of well if located within city?
8 mi N of Zenith

2 WATER WELL OWNER: Quivira NWR
RR#, St. Address, Box # : Rt 3, Box 48A
City, State, ZIP Code : Stafford, KS 67578
Board of Agriculture, Division of Water Resources
Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:




4 DEPTH OF COMPLETED WELL 33 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 3 ft. below land surface measured on mo/day/yr 2-24-98
Pump test data: Well water was 5 ft. after ½ hours pumping 25 gpm
Est. Yield gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 12 in. to 34 ft., and in. to ft.
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
(1) Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Monitoring well
Was a chemical/bacteriological sample submitted to Department? Yes No (C); If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes (X) No

5 TYPE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued (X) Clamped
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded
(2) PVC 4 ABS 7 Fiberglass Threaded
Blank casing diameter 8 in. to 23 ft., Dia in. to ft., Dia in. to ft.
Casing height above land surface 24 in., weight lbs./ft. Wall thickness or gauge No. 160

TYPE OF SCREEN OR PERFORATION MATERIAL: (7) PVC 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify)
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: 5 Gauzed wrapped (8) Saw cut 11 None (open hole)
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify)

SCREEN-PERFORATED INTERVALS: From 23 ft. to 33 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 20 ft. to 34 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout (3) Bentonite 4 Other
Grout Intervals: From 0 ft. to 20 ft., From ft. to ft., From ft. to ft.

What is the nearest source of possible contamination:
1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage (16) Other (specify below)
13 Insecticide storage pond
Direction from well? N How many feet? 150

| FROM | TO | LITHOLOGIC LOG | FROM | TO | PLUGGING INTERVALS |
|---|---|---|---|---|---|
| 0 | 17 | F Sandy silt | | | |
| 17 | 22 | F Sand + Sm Gravel | | | |
| 22 | 33 | Sand + Gravel | | | |
| 33 | 34 | Br Clay | | | |

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 2-24-98 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 447 This Water Well Record was completed on (mo/day/yr) 3-4-98
under the business name of Miller Drilling by (signature) Eg Miller

INSTRUCTIONS: Use typewriter or ball point pen. *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

OFFICE USE ONLY T R EW SEC. ¼ ¼ ¼