# Quivira Initial Impairment Investigation Report Presentation St. John, KS December 10, 2015

Kansas Department of Agriculture

# Why are we here?

- Provide a summary of the initial report
- Answer questions
- Listen to your input

# Where do we go from here?

- Take comments, prepare a second draft & then a final report
  - Comment period on initial draft ~ 90 day review
  - KDA-DWR will provide a second draft ~ 30 days
  - Additional input ~ 15 days
  - Finalize report
- We are prepared to begin working with water users in the basin on a workable solution, even during the finalization of the report
- Legislative tool available to allow for augmentation as a remedy
- No administration of groundwater rights in 2016

# Questions we have heard in response to the draft

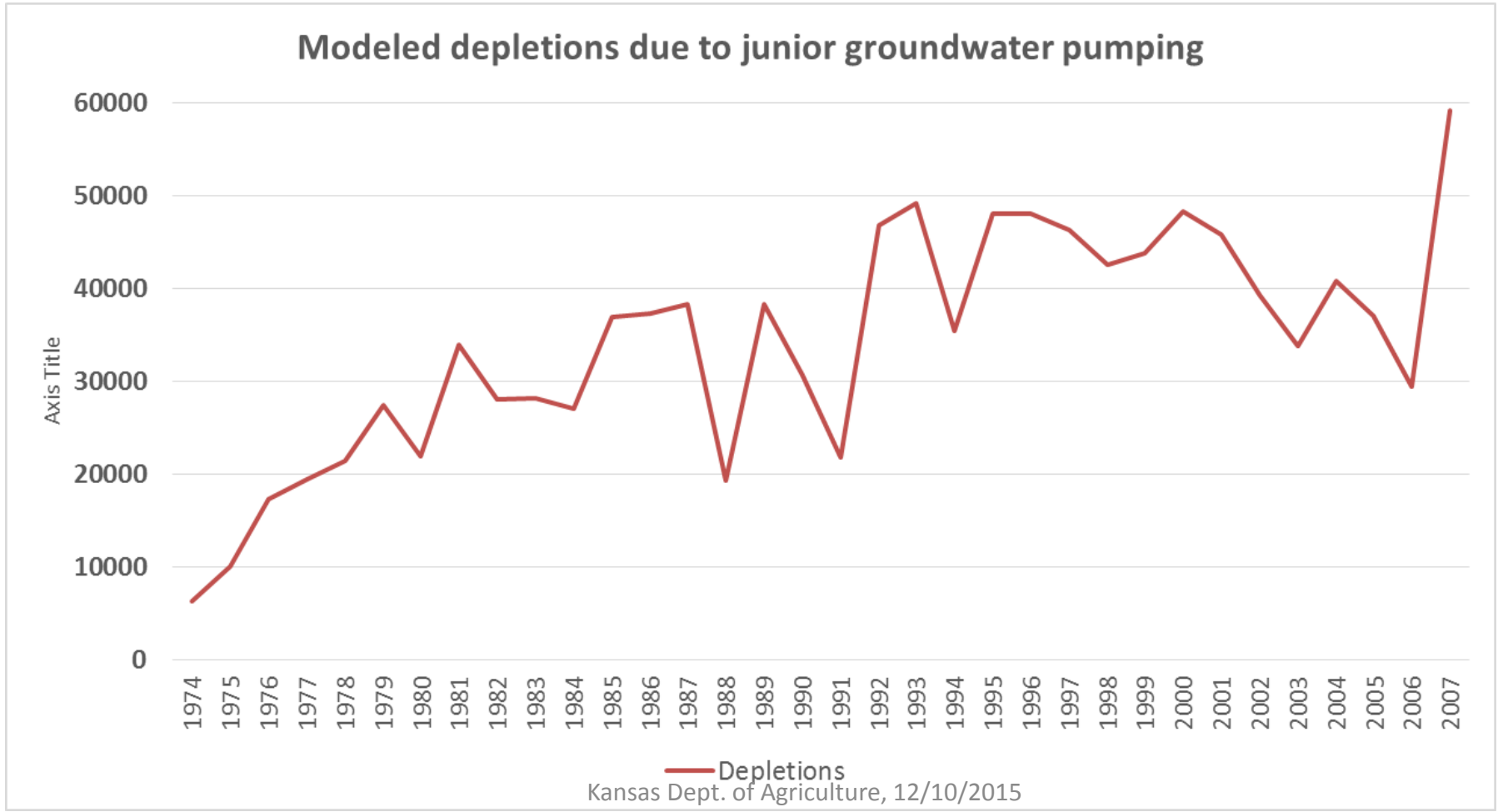
1. How did the USFWS Refuge water right get certified?
2. How did you arrive at the depletions of baseflow of 30,000-60,000 acre-feet for the period 1995-2007?
3. How did you determine an impairment amount of 3,000-5,000 acre-feet on a regular basis?

# How did the USFWS Refuge water right get certified?

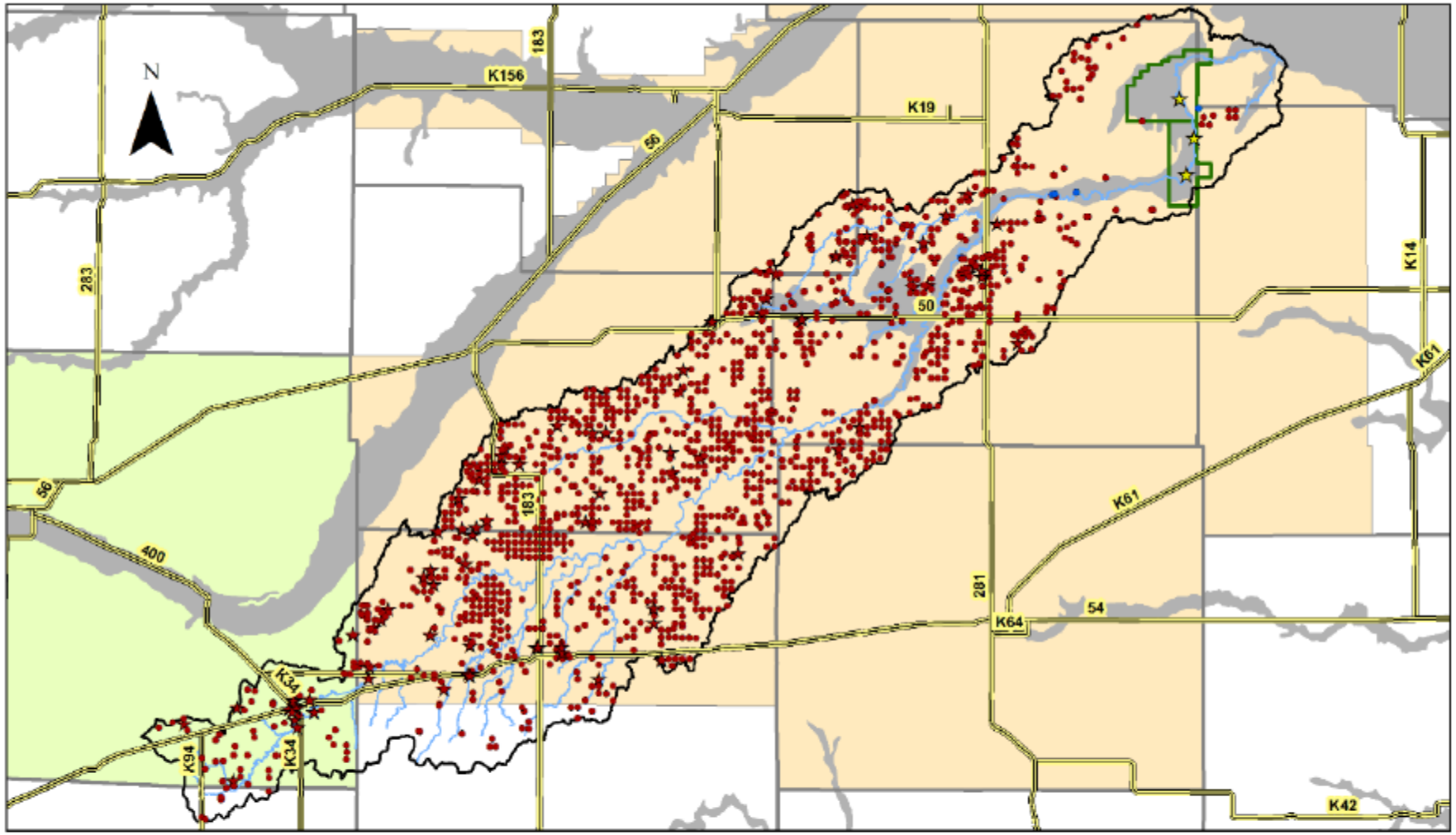
- Water Right File Number 7,571
- Filed: 1957
- Year of  Record: 1987
- Certified: 1996
- Maximum Rate of Diversion: 300 cfs
- Maximum Annual Quantity: 14,632 AF
  - Diversion
  - Evaporation from Little Salt Marsh

# How did you arrive at the depletions of baseflow of 30,000-60,000 acre-feet for the period 1995-2007?

- Determined by use of the GMD 5 groundwater model



# Rattlesnake Creek Basin Groundwater and Suface Water Rights

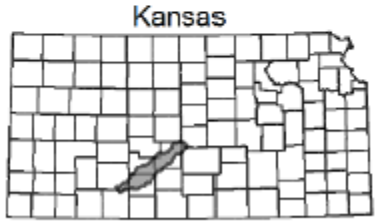



**Points of Diversion**

- Quivira, SW
- Junior, SW
- Junior, GW
- Senior, GW
- Rattlesnake Creek Basin
- Quivira Wildlife Refuge
- Streams
- Alluvial Aquifers

Notes: GW refers to a groundwater source SW refers to a surface water source

Quivira Priority date: August 15, 1957




0 5 10 20 Miles

Kansas Department of Agriculture
Division of Water Resources
October 7, 2015

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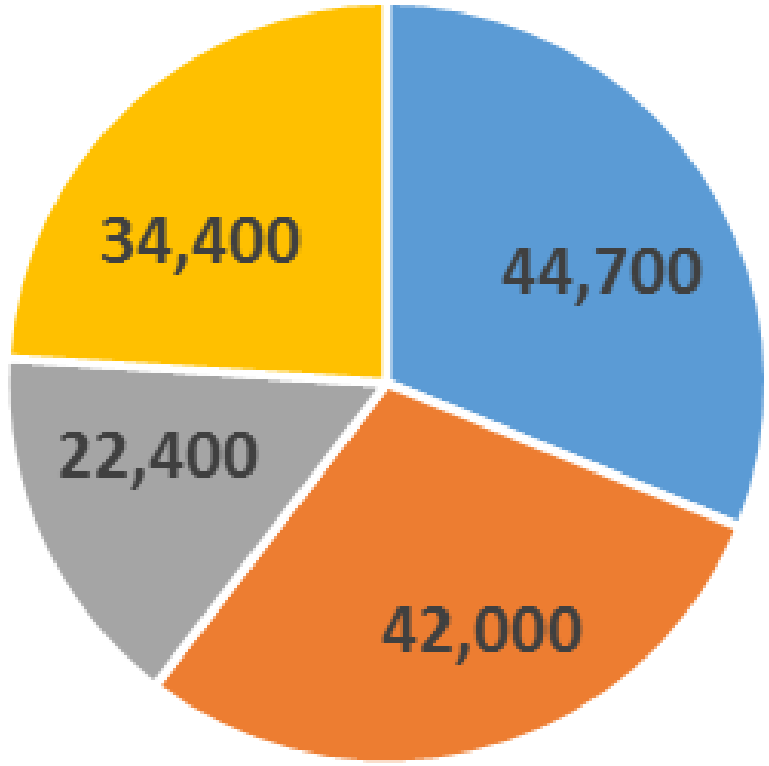
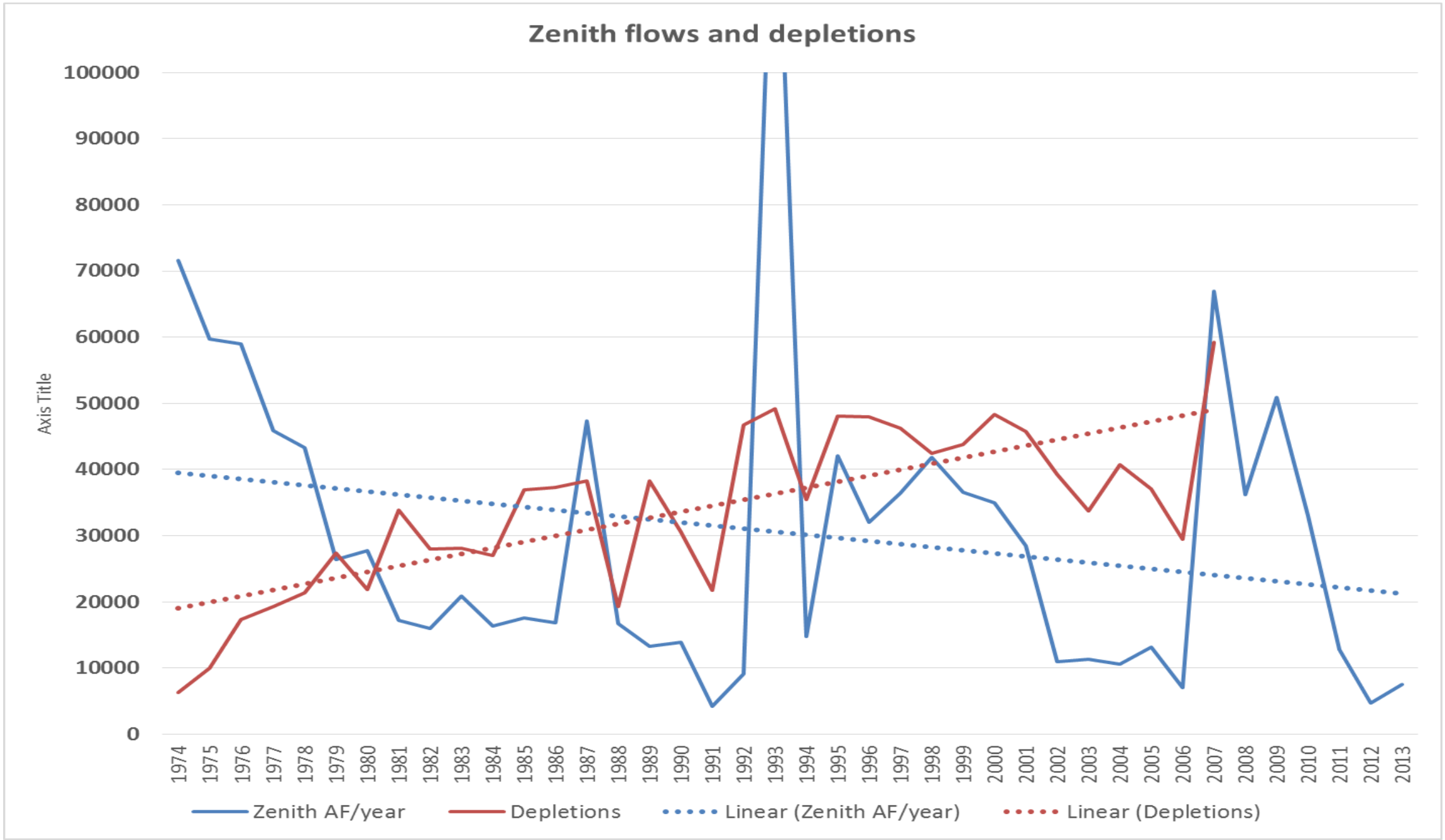
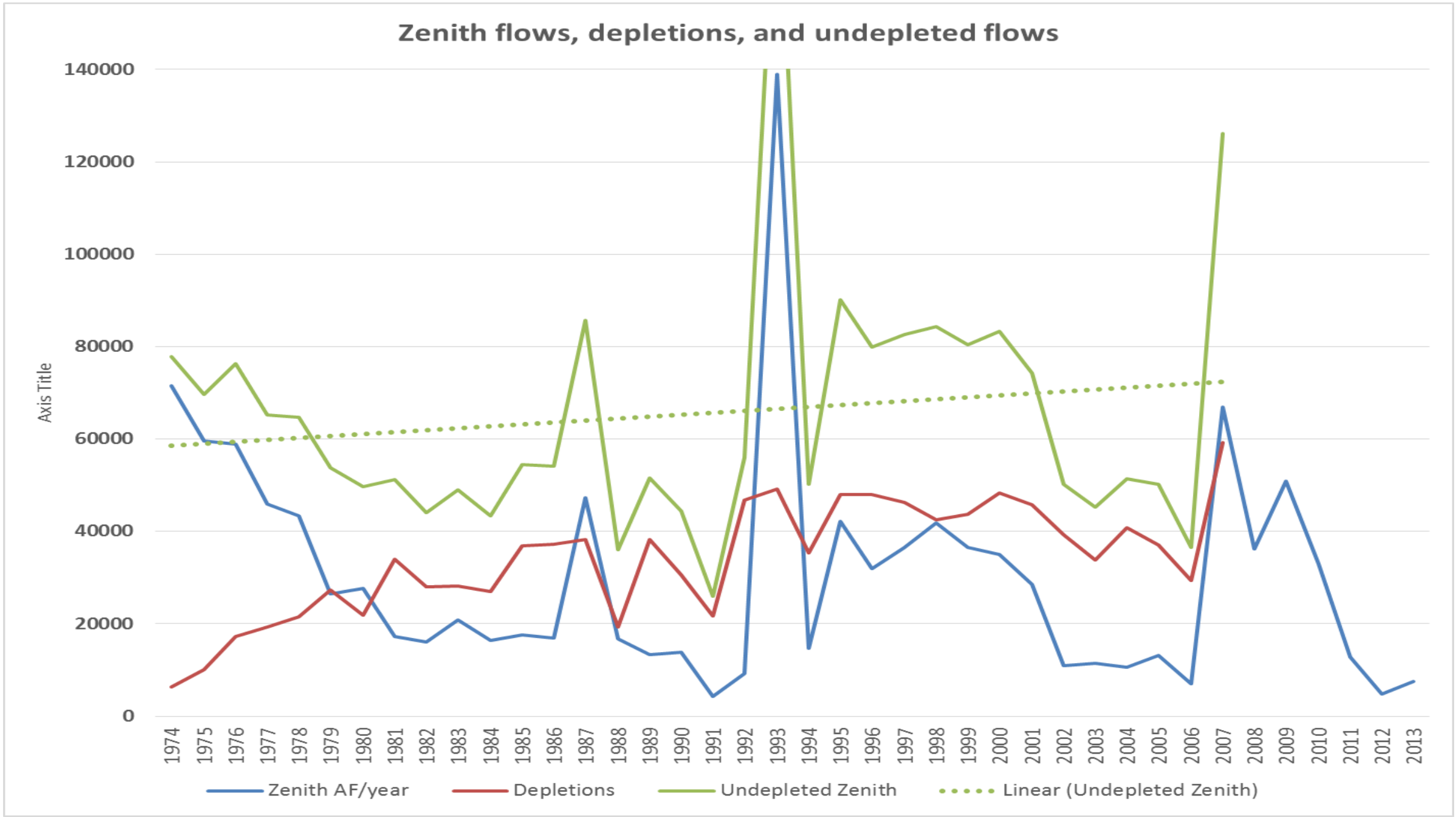
*Figure 2 - Rattlesnake Creek Basin map of water rights*

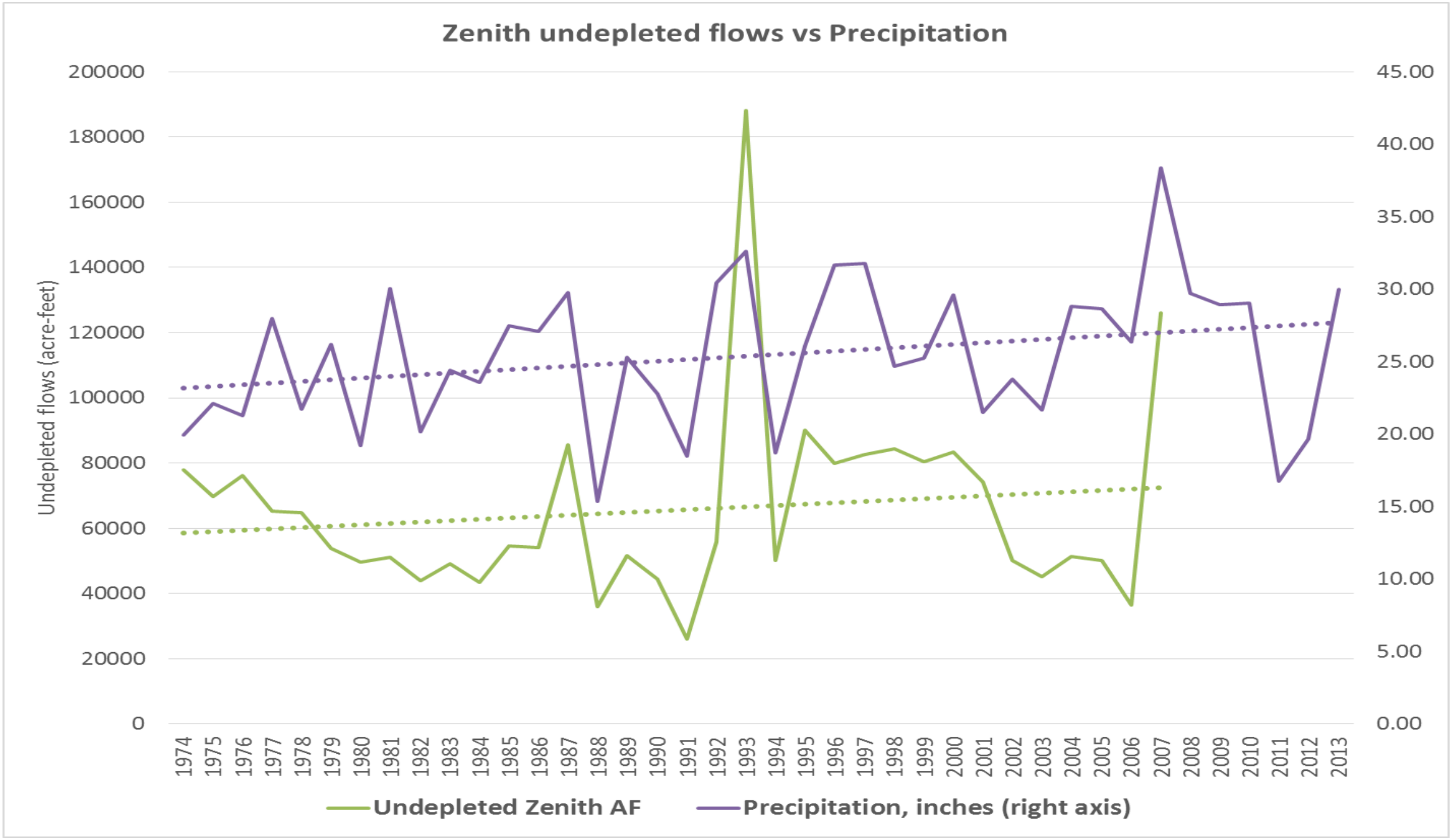
# Impacts of 143,500 AF of junior groundwater pumping




- Reduction in groundwater storage
- Reduction in streamflow
- Reduction in phreatophtye ET
- Inflows from neighboring basins


Zenith flows and depletions
Axis Title
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Zenith AF/year
Depletions
Linear (Zenith AF/year)
Linear (Depletions)


Zenith flows, depletions, and undepleted flows
140000
120000
100000
80000
60000
40000
20000
0
Axis Title
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Zenith AF/year
Depletions
Undepleted Zenith
Linear (Undepleted Zenith)

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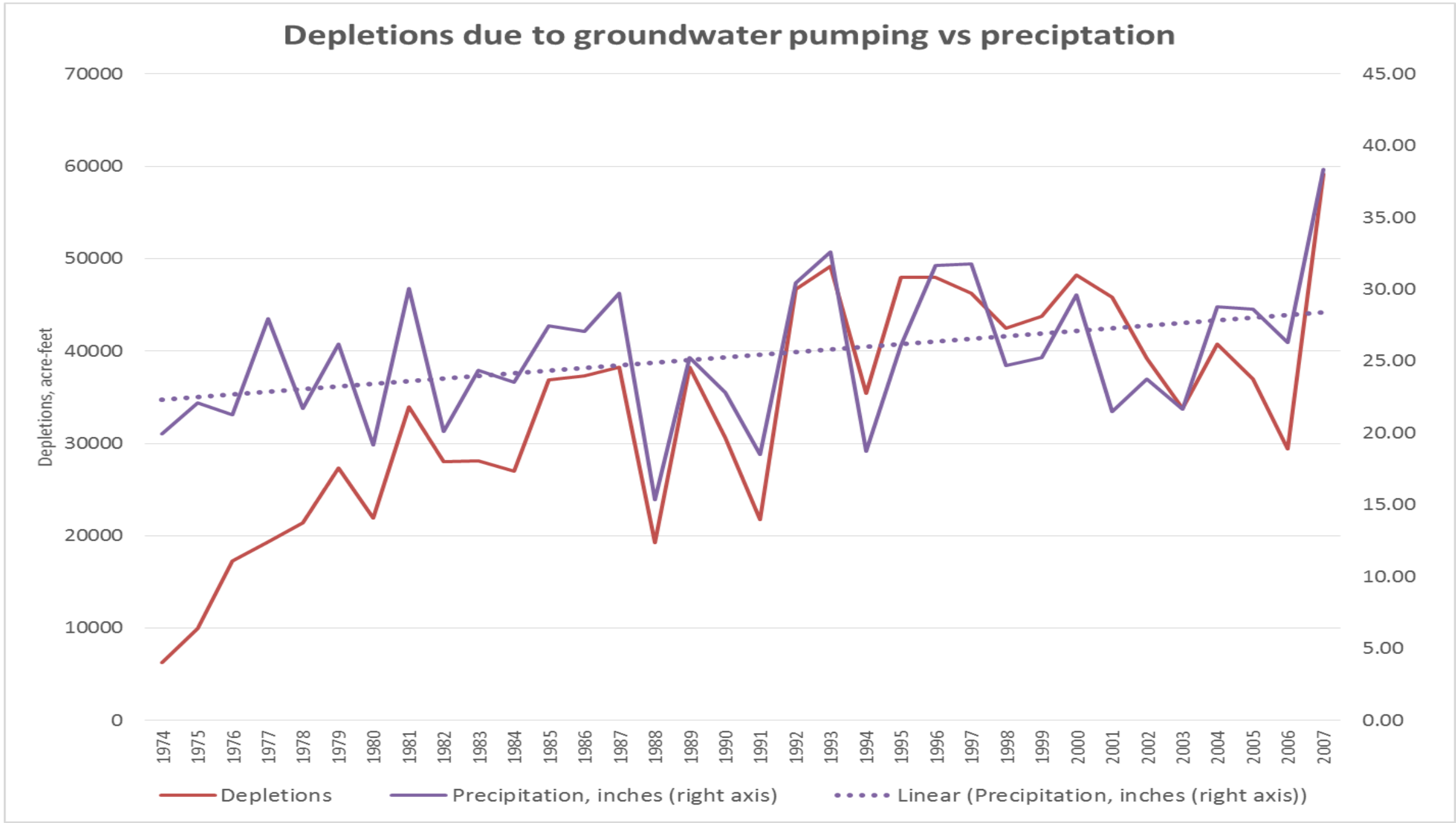

Depletions due to groundwater pumping vs preciptation
Depletions, acre-feet
70000
60000
50000
40000
30000
20000
10000
0
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Depletions
Precipitation, inches (right axis)
Linear (Precipitation, inches (right axis))

# How did you determine an impairment amount of 3,000-5,000 acre-feet on a regular basis?

# Purpose of the analysis

- To use the best data and tools available to understand the magnitude and frequency of the water shortages experienced by the Refuge caused by junior groundwater pumping
- To provide a simple and straightforward methodology for defining the Refuge's historical water shortages caused by junior groundwater pumping
- To facilitate planning and action by the basin community to solve the resource problem

# Elements of the analysis

- Within their water right, how much did the Refuge need and when did they need it?
  - Generalized current operations plan from the Service
  - Refuge diversion records
- How much water was there and when was it available?
  - USGS Gage at Zenith – monthly records
- How much water would have been there but for junior groundwater pumping?
  - GMD5 Model

# Refuge needs within its water right

## May, 2015 – Attachment 5 of Initial Report

Table 1. Significant annual events largely considered in determining seasonal water needs to accomplish management objectives of Quivira National Wildlife Refuge.

| Jan-Feb | Mar-Apr | May-Jun | Jul-Sep | Oct-Nov | Dec |
|---|---|---|---|---|---|
| ***MANAGEMENT TO SUPPORT WILDLIFE FOOD & COVER REQUIREMENTS*** | | | | | |
| Use water where needed to provide/maintain semipermanent wetland habitat. | | | | | |
| | Shallowly flood select units to saturate dry soils that will be used to produce wildlife foods. | | | | |
| | | Dewater select wetlands for suitable germination and growth of desired plants used for wildlife food and cover. Drawdown dates are based on scientific information. | | | |
| | | Irrigate select wetland units to support survival, growth, and seed production of germinated wildlife food plants. | After seeds mature, gradually increase water levels in wetlands to coincide with the food and cover needs of target species. | | |
| ***CHRONOLOGY OF SPECIES ANNUAL EVENTS OR WHEN LIFE REQUIREMENTS NEED TO BE AVAILABLE FOR SPECIES USE*** | | | | | |
| Waterfowl and bald eagle wintering habitat is provided when open water is available (generally where flooded deep and/or where flow prevents ice formation). | Peak spring waterfowl migration (habitat flooded <15 inches). | Main spring shorebird migration (habitat flooded <6 inches and mudflat). | Main fall shorebird migration (habitat flooded <6 inches and mudflat). | Peak fall waterfowl migration (habitat flooded <15 inches). | |
| | Endangered whooping crane spring migration (shoreline & habitat flooded <1 ft). | Breeding-related activities occur for several waterbirds that require flooded habitat for food and/or cover resources, such as for the state-threatened snowy plover, the endangered interior least tern, and for state species in need of conservation (e.g., black rail, black tern). | | Endangered whooping crane fall migration (shoreline and habitat flooded <1 ft). | |

# Refuge needs within its water right

May, 2015 – Attachment 5 of Initial Report

Table 3. Comparison of Rattlesnake Creek surface water use Scenarios 1 and 2 for Quivira NWR.

| Scenario | Seasonal Water Use Estimates (Acre-Feet) | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| 1 | 986 | | 1,115 | | 1,062 | | 2,117 | | | 1,781 | | 684 | 7,746 |
| 2 | 3,144 | 7,427 | | | 2,895 | | 4,053 | | | 5,881 | | | 23,400 |

Table 4. Seasonal Rattlesnake Creek surface water need estimates for Quivira NWR, given the current water right.

| Seasonal Water Use (Acre-Feet) | | | | | | Total |
|---|---|---|---|---|---|---|
| Jan-Feb | Mar-Apr | May-Jun | Jul-Sep | Oct-Nov | Dec | |
| 1,500 | 3,500 | 2,000 | 3,500 | 3,632 | 500 | 14,632 |

# Seasonal water availability at the Refuge

- USGS gage at Zenith
  - About a mile upstream of the Refuge
  - Monthly data for 1974 – 2007
  - Combined into the Service's seasonal periods
  - Table 2 and Attachment 6 of Initial Report

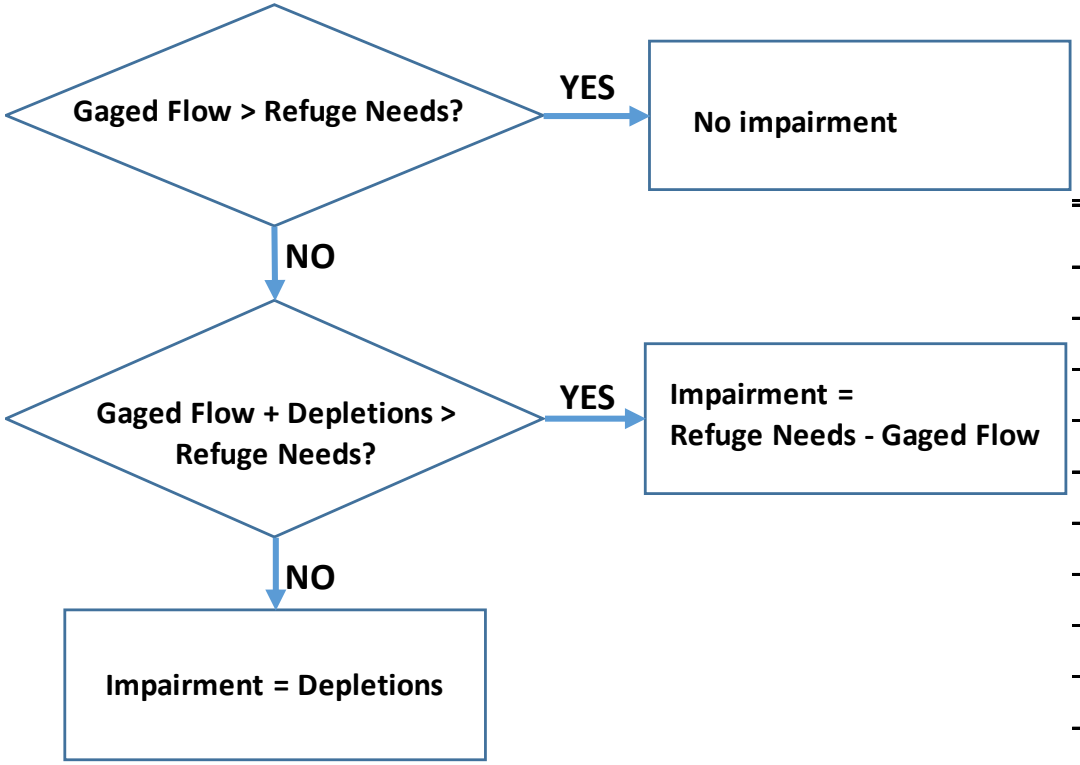
| USFW Management Period | Year | Zenith Gaged Flow | Modeled Impacts to RSC | Refuge Reported Diversions | Refuge Needs |
|---|---|---|---|---|---|
| Jan/Feb | 2003 | **1860** | 7340 | 1180 | 1500 |
| Mar/Apr | 2003 | **4720** | 9640 | 320 | 3500 |
| May/Jun | 2003 | **2770** | 5690 | 0 | 2000 |
| Jul/Aug/Sep | 2003 | **650** | 4040 | 120 | 3500 |
| Oct/Nov | 2003 | **840** | 4290 | 40 | 3600 |
| Dec | 2003 | **540** | 2800 | 80 | 500 |
| Jan/Feb | 2004 | **1050** | 5140 | 970 | 1500 |
| Mar/Apr | 2004 | **2300** | 6270 | 2840 | 3500 |
| May/Jun | 2004 | **1500** | 5430 | 370 | 2000 |
| Jul/Aug/Sep | 2004 | **2960** | 13070 | 4370 | 3500 |
| Oct/Nov | 2004 | **1690** | 7640 | 550 | 3600 |
| Dec | 2004 | **1080** | 3220 | 580 | 500 |
| Jan/Feb | 2005 | **2490** | 7820 | 2130 | 1500 |
| Mar/Apr | 2005 | **2390** | 5630 | 130 | 3500 |
| May/Jun | 2005 | **3000** | 7280 | 0 | 2000 |
| Jul/Aug/Sep | 2005 | **3620** | 8230 | 1660 | 3500 |

# Seasonal reduction to water availability at the Refuge caused by junior groundwater pumping

- GMD5 model simulations
  - "Depletions to streamflow"
  - "Scenario 1" no pumping junior to the Refuge (1957)
    - how much more streamflow would have been at the Zenith gage if there had been no pumping junior to the Refuge's 1957 water right.
- Depletions combined to Service's seasons

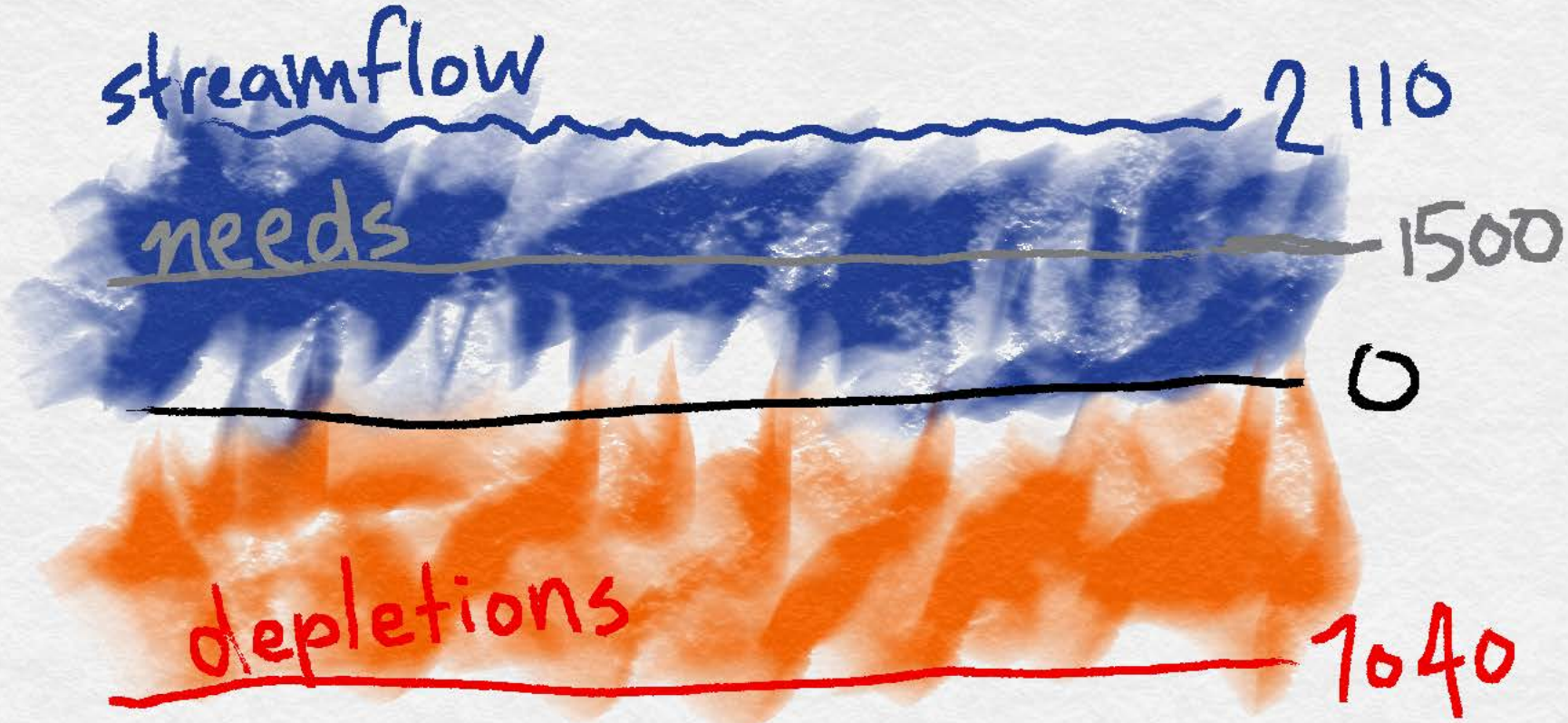
| USFW Management Period | Year | Zenith Gaged Flow | Modeled Impacts to RSC | Refuge Reported Diversions | Refuge Needs |
|---|---|---|---|---|---|
| Jan/Feb | 2003 | 1860 | 7340 | 1180 | 1500 |
| Mar/Apr | 2003 | 4720 | 9640 | 320 | 3500 |
| May/Jun | 2003 | 2770 | 5690 | 0 | 2000 |
| Jul/Aug/Sep | 2003 | 650 | 4040 | 120 | 3500 |
| Oct/Nov | 2003 | 840 | 4290 | 40 | 3600 |
| Dec | 2003 | 540 | 2800 | 80 | 500 |
| Jan/Feb | 2004 | 1050 | 5140 | 970 | 1500 |
| Mar/Apr | 2004 | 2300 | 6270 | 2840 | 3500 |
| May/Jun | 2004 | 1500 | 5430 | 370 | 2000 |
| Jul/Aug/Sep | 2004 | 2960 | 13070 | 4370 | 3500 |
| Oct/Nov | 2004 | 1690 | 7640 | 550 | 3600 |
| Dec | 2004 | 1080 | 3220 | 580 | 500 |
| Jan/Feb | 2005 | 2490 | 7820 | 2130 | 1500 |
| Mar/Apr | 2005 | 2390 | 5630 | 130 | 3500 |
| May/Jun | 2005 | 3000 | 7280 | 0 | 2000 |

# Simulated historical impairment

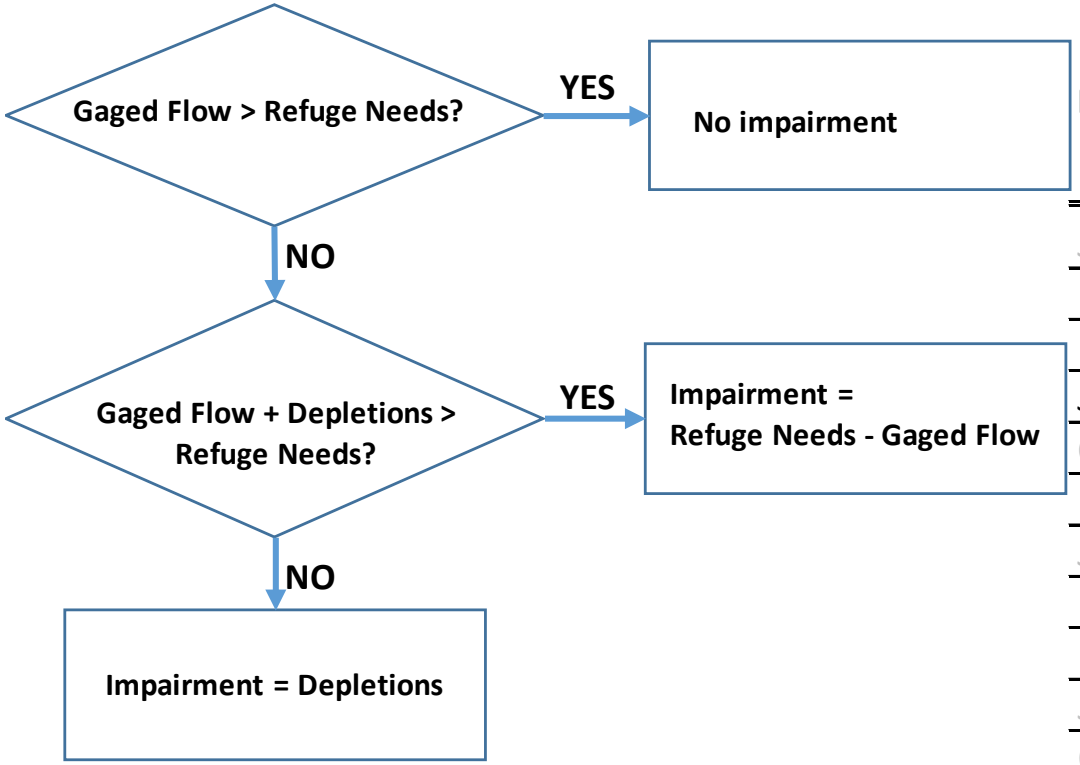



| USFW Management Period | Year | Zenith Gaged Flow | Modeled Impacts to RSC | Refuge Reported Diversions | Refuge Needs | Amount short of needs |
|---|---|---|---|---|---|---|
| Jan/Feb | 1990 | 2110 | 7040 | 1750 | 1500 | 0 |
| Mar/Apr | 1990 | 3810 | 6240 | 2160 | 3500 | 0 |
| May/Jun | 1990 | 6070 | 5790 | 2110 | 2000 | 0 |
| Jul/Aug/Sep | 1990 | 750 | 4800 | 280 | 3500 | 2750 |
| Oct/Nov | 1990 | 700 | 4200 | 460 | 3600 | 2900 |
| Dec | 1990 | 420 | 2540 | 0 | 500 | 80 |
| Jan/Feb | 1991 | 1040 | 4720 | 510 | 1500 | 460 |
| Mar/Apr | 1991 | 1360 | 5710 | 1040 | 3500 | 2140 |
| May/Jun | 1991 | 1110 | 3430 | 1040 | 2000 | 890 |
| Jul/Aug/Sep | 1991 | 150 | 2470 | 0 | 3500 | 2470 |
| Oct/Nov | 1991 | 220 | 2460 | 0 | 3600 | 2460 |
| Dec | 1991 | 340 | 2940 | 0 | 500 | 160 |

# Case 1

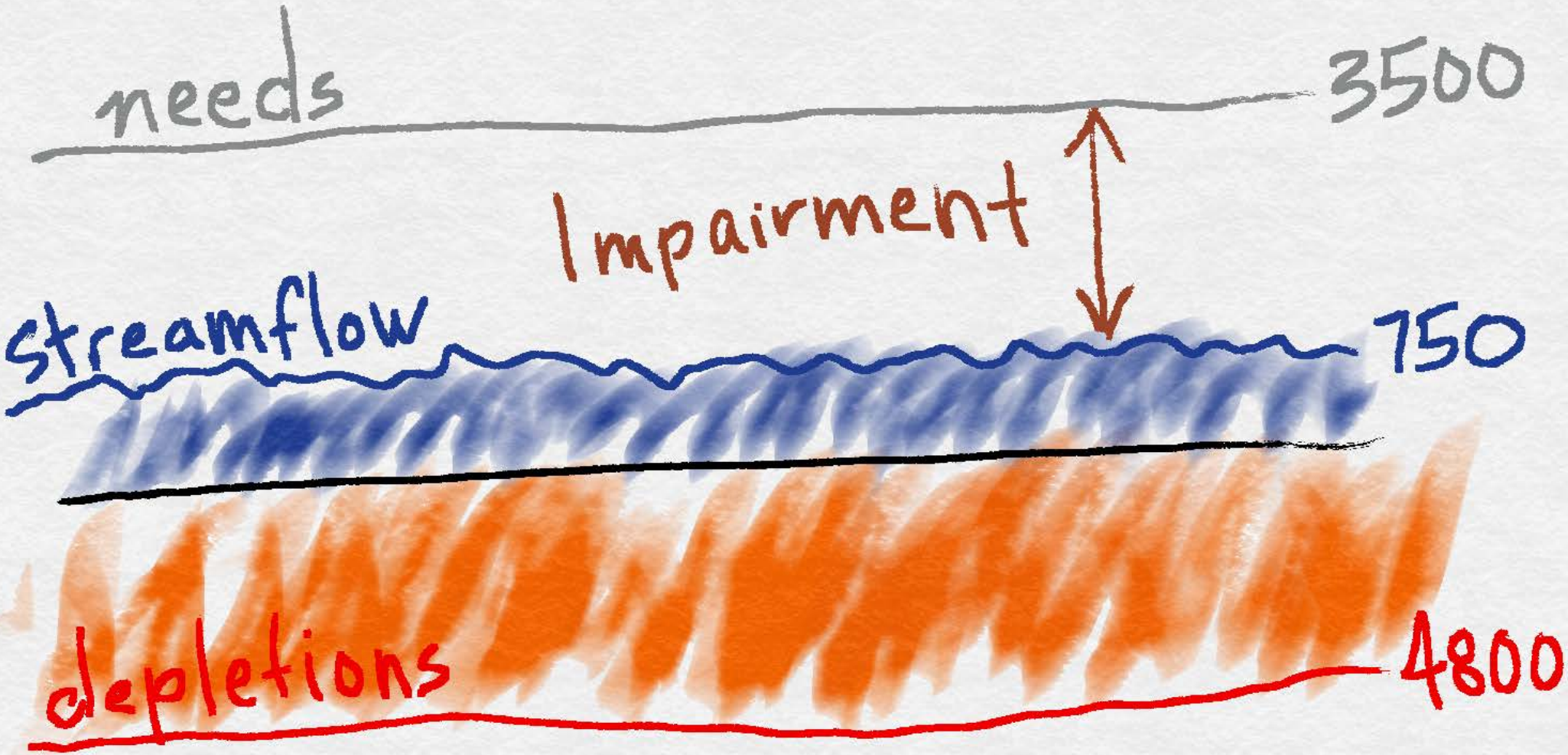


# Simulated historical impairment

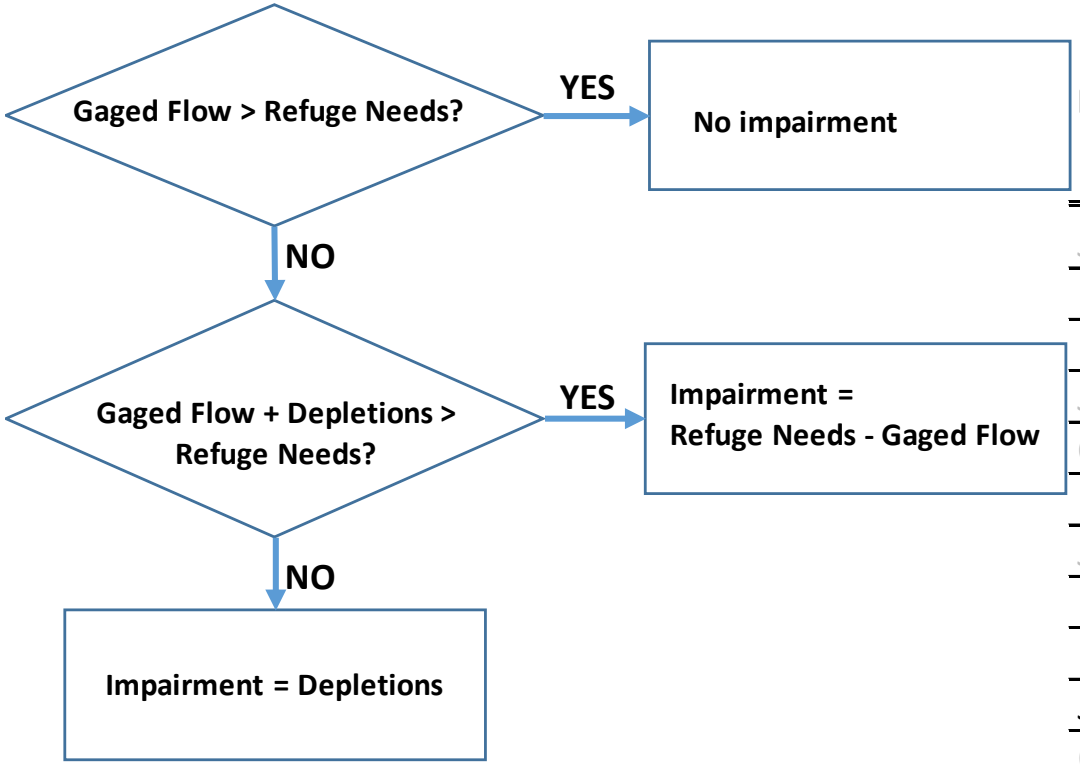



| USFW Management Period | Year | Zenith Gaged Flow | Modeled Impacts to RSC | Refuge Reported Diversions | Refuge Needs | Amount short of needs |
|---|---|---|---|---|---|---|
| Jan/Feb | 1990 | 2110 | 7040 | 1750 | 1500 | 0 |
| Mar/Apr | 1990 | 3810 | 6240 | 2160 | 3500 | 0 |
| May/Jun | 1990 | 6070 | 5790 | 2110 | 2000 | 0 |
| Jul/Aug/Sep | 1990 | 750 | 4800 | 280 | 3500 | 2750 |
| Oct/Nov | 1990 | 700 | 4200 | 460 | 3600 | 2900 |
| Dec | 1990 | 420 | 2540 | 0 | 500 | 80 |
| Jan/Feb | 1991 | 1040 | 4720 | 510 | 1500 | 460 |
| Mar/Apr | 1991 | 1360 | 5710 | 1040 | 3500 | 2140 |
| May/Jun | 1991 | 1110 | 3430 | 1040 | 2000 | 890 |
| Jul/Aug/Sep | 1991 | 150 | 2470 | 0 | 3500 | 2470 |
| Oct/Nov | 1991 | 220 | 2460 | 0 | 3600 | 2460 |
| Dec | 1991 | 340 | 2940 | 0 | 500 | 160 |

# Case 2

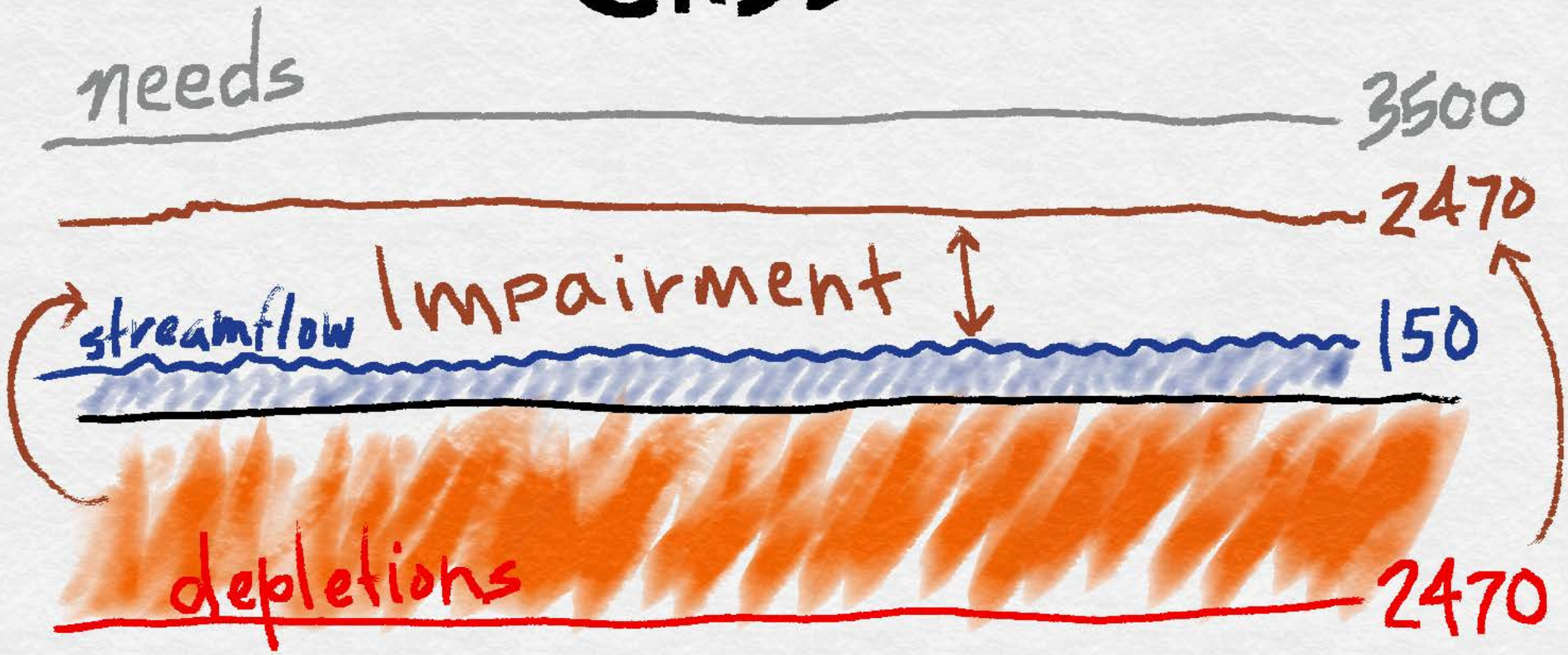


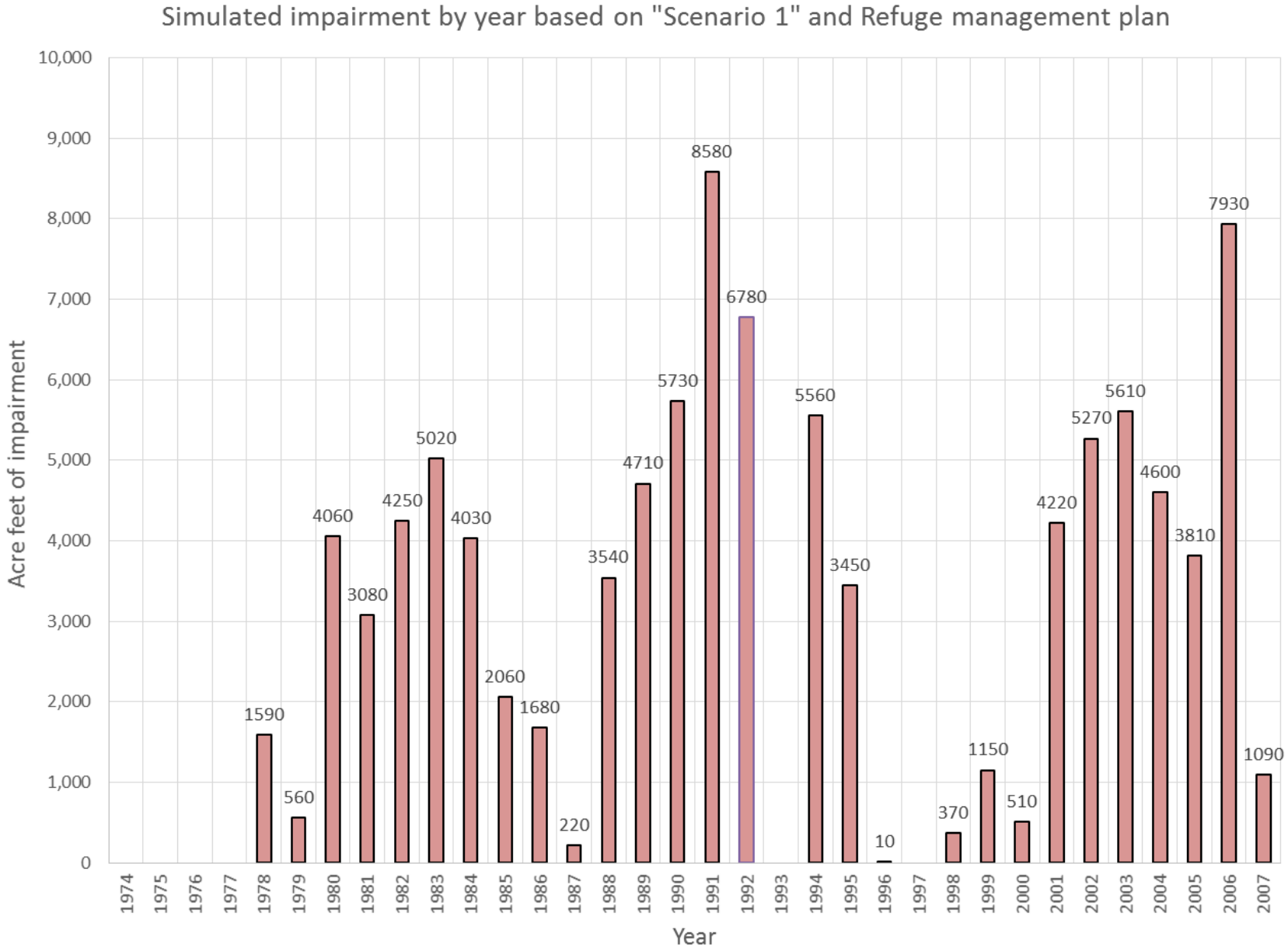
# Simulated historical impairment




| USFW Management Period | Year | Zenith Gaged Flow | Modeled Impacts to RSC | Refuge Reported Diversions | Refuge Needs | Amount short of needs |
|---|---|---|---|---|---|---|
| Jan/Feb | 1990 | 2110 | 7040 | 1750 | 1500 | 0 |
| Mar/Apr | 1990 | 3810 | 6240 | 2160 | 3500 | 0 |
| May/Jun | 1990 | 6070 | 5790 | 2110 | 2000 | 0 |
| Jul/Aug/Sep | 1990 | 750 | 4800 | 280 | 3500 | 2750 |
| Oct/Nov | 1990 | 700 | 4200 | 460 | 3600 | 2900 |
| Dec | 1990 | 420 | 2540 | 0 | 500 | 80 |
| Jan/Feb | 1991 | 1040 | 4720 | 510 | 1500 | 460 |
| Mar/Apr | 1991 | 1360 | 5710 | 1040 | 3500 | 2140 |
| May/Jun | 1991 | 1110 | 3430 | 1040 | 2000 | 890 |
| Jul/Aug/Sep | 1991 | 150 | 2470 | 0 | 3500 | 2470 |
| Oct/Nov | 1991 | 220 | 2460 | 0 | 3600 | 2460 |
| Dec | 1991 | 340 | 2940 | 0 | 500 | 160 |

# Case 3


needs
3500
2470
streamflow
Impairment
150
depletions
2470

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# The impairment resolution process

## *Draft Schedule*

| | | |
|---|---|---|
| June 29, 2000 | | Partnership submits RSC Management Plan to address Quivira shortages |
| | | |
| April 8, 2013 | | Impairment complaint filed |
| | | |
| December 2, 2015<br>December 10, 2015<br>*we are here* | | Initial Report is published<br>Begin 90 day review period<br>Begin woking on remedy<br>**No water right administration in 2016 for this impairment** |
| | 91 days | |
| March 11, 2016 | | End of review period for Initial Report |
| | 34 days | |
| April 15, 2016 | | Second draft initial report |
| | 30 days | |
| May 15, 2016 | | Final report is published |
| | 90 days | |
| August 15, 2016 | | Submit Basin plan to implement remedy |
| | 34 days | |
| September 19, 2016 | | KDA responds to the acceptability to the Basin Plan |
| | 30 days | |
| October 19, 2016 | | Basin Plan is finalized (if reforms are necessary) |

# Developing a remedy

- While KDA-DWR has not developed a remedy, our modeling and impairment analysis suggests the following:
  - Due to the limited amount of pumping near the stream and lag-time between pumping shutoffs and stream benefits, “real-time administration” will not be sufficient to prevent remedy.
  - The plan will likely need to include long-term cuts in groundwater pumping to stop and reverse the upward trend in depletions.
  - Augmentation can be used to reduce the need for the long-term pumping cuts
- DWR will assist the basin in developing and reviewing alternatives

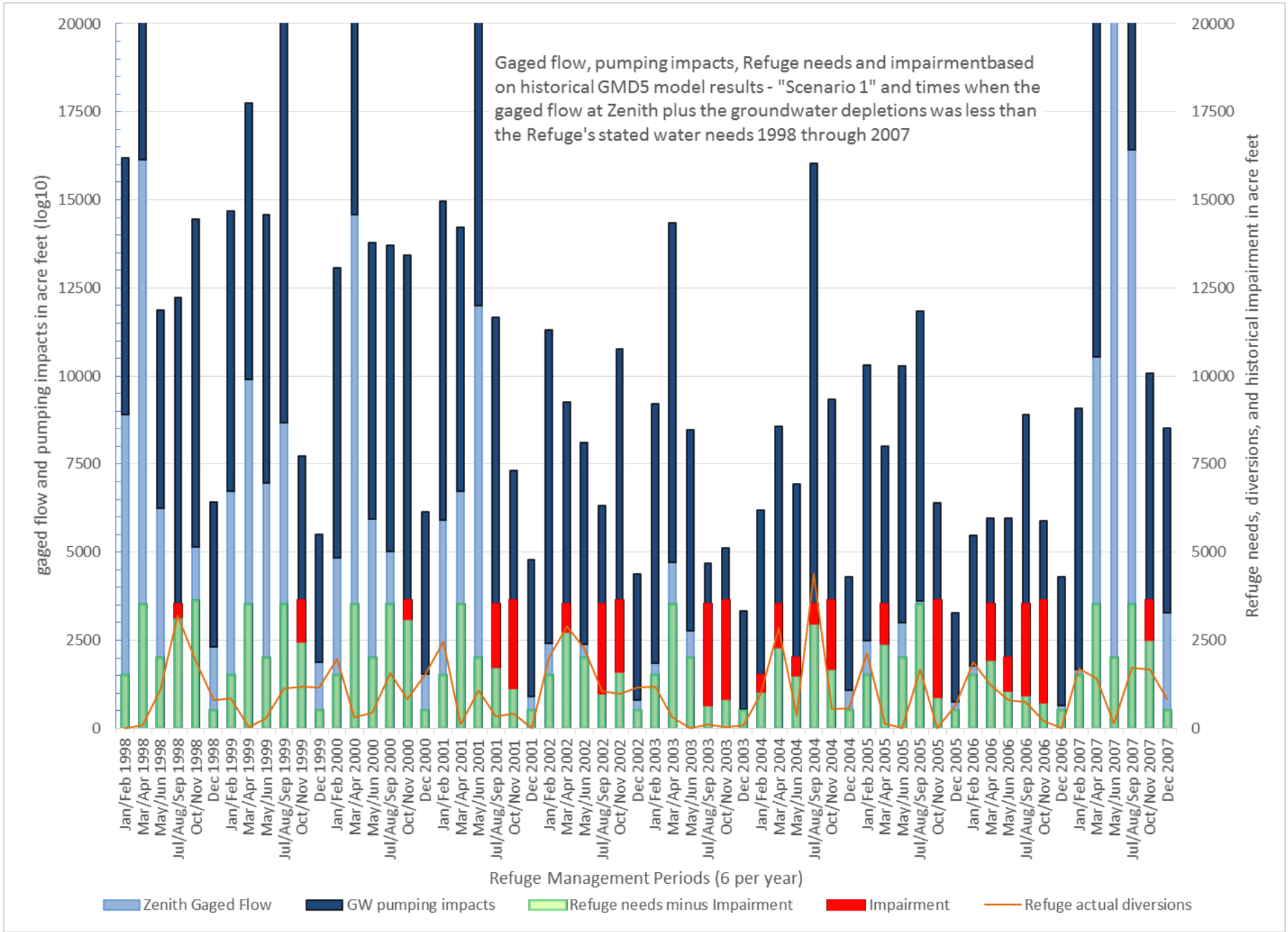
# Rattlesnake Creek Basin impacts

## average: 1998-2007 acre-feet/yr

| scenario | Scenario definition | Δpumping | Δbaseflow | ΔB cfs | ΔB/ΔP | Δstorage | Δ et |
|---|---|---|---|---|---|---|---|
| 1 | basinwide shutoff from 1958 on | (143,529) | 42,053 | 58.0 | 29.3% | 70,505 | 22,387 |
| 2 | basinwide shutoff from 1990 on | (143,529) | 34,420 | 47.5 | 24.0% | 76,837 | 18,007 |
| 2.5 | basinwide 50% pumping | (71,765) | 13,366 | 18.4 | 18.6% | 34,019 | 8,662 |
| 2.75 | basinwide 75% pumping | (35,882) | 5,475 | 7.6 | 15.3% | 18,200 | 4,265 |
| 7 | response zone >70% | (1,059) | 661 | 0.9 | 62.4% | 77 | 253 |
| 8 | response zone >40% | (9,701) | 4,646 | 6.4 | 47.9% | 1,442 | 2,597 |
| 9 | response zone >20% | (19,604) | 8,326 | 11.5 | 42.5% | 3,350 | 4,975 |
| 10 | RSC 1-mi corridor to Macksville | (3,932) | 2,115 | 2.9 | 53.8% | 410 | 1,094 |
| 11 | RSC 2-mi corridor to Macksville | (11,230) | 5,560 | 7.7 | 49.5% | 1,396 | 3,086 |

| | |
|---|---|
| Notes: | [1] Restrict selections to Rattlesnake C basin wells junior to Aug 15 1957 (USF&W File 7571). |
| | [2] Scenario 1 selection begins Jan 1958 (str per 218); others begin Jan 1990 (str per 602). |
| | [3] Scenarios are specified as input to preprocessor by scenario id and pump scaling factor. |

# Questions?


Gaged flow, pumping impacts, Refuge needs and impairmentbased on historical GMD5 model results - "Scenario 1" and times when the gaged flow at Zenith plus the groundwater depletions was less than the Refuge's stated water needs 1998 through 2007
gaged flow and pumping impacts in acre feet (log10)
Refuge needs, diversions, and historical impairment in acre feet
0
2500
5000
7500
10000
12500
15000
17500
20000
Jan/Feb 1998
Mar/Apr 1998
May/Jun 1998
Jul/Aug/Sep 1998
Oct/Nov 1998
Dec 1998
Jan/Feb 1999
Mar/Apr 1999
May/Jun 1999
Jul/Aug/Sep 1999
Oct/Nov 1999
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May/Jun 2004
Jul/Aug/Sep 2004
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Jan/Feb 2005
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Oct/Nov 2005
Dec 2005
Jan/Feb 2006
Mar/Apr 2006
May/Jun 2006
Jul/Aug/Sep 2006
Oct/Nov 2006
Dec 2006
Jan/Feb 2007
Mar/Apr 2007
May/Jun 2007
Jul/Aug/Sep 2007
Oct/Nov 2007
Dec 2007
Refuge Management Periods (6 per year)
Zenith Gaged Flow
GW pumping impacts
Refuge needs minus Impairment
Impairment
Refuge actual diversions

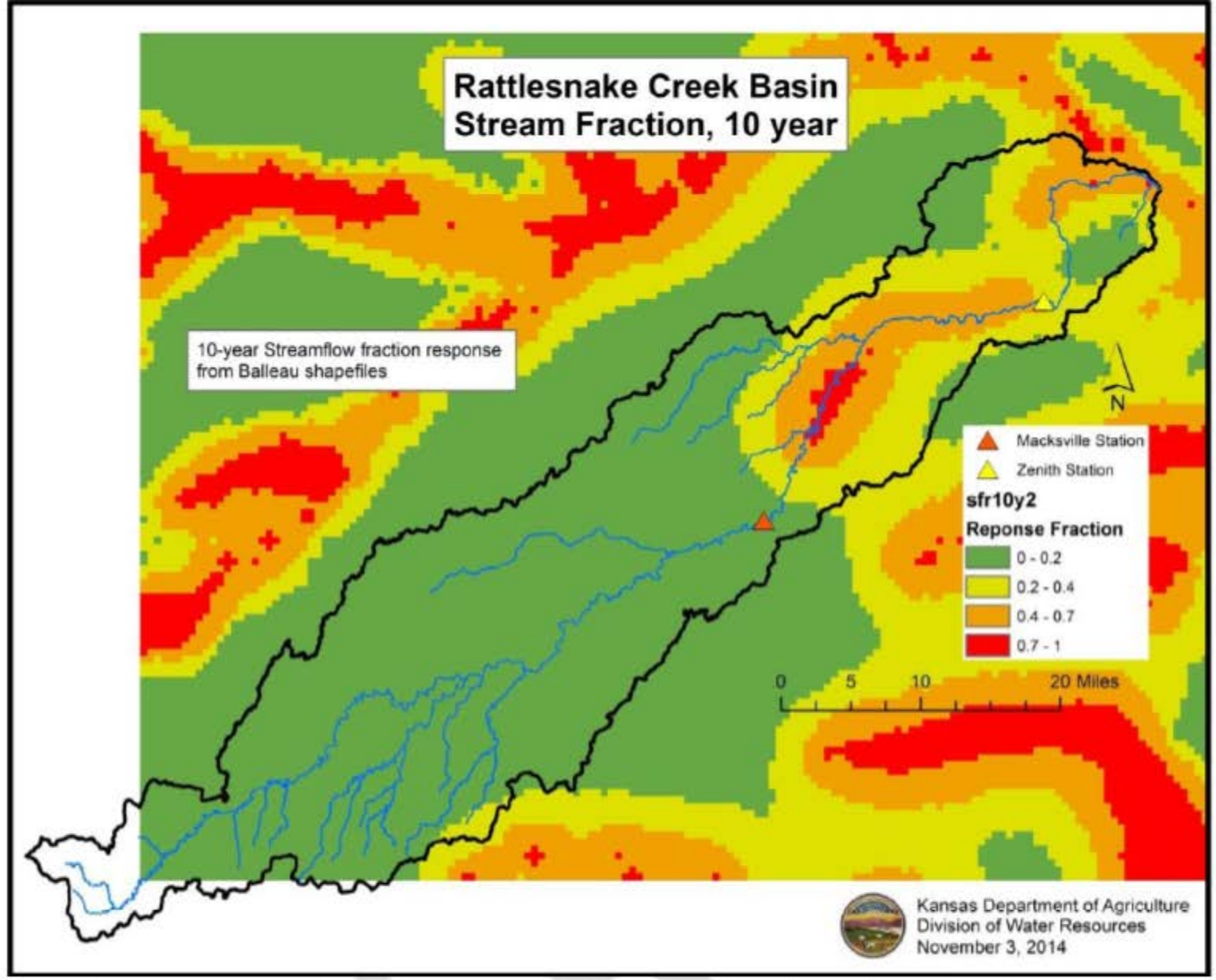


Fig. A4. Map of 10-year streamflow response, the fraction of Rattlesnake streamflow at the Zenith gage depleted by ten years of pumping, evaluated at each model grid cell within the mapped area. (See also Fig. 51, Balleau et al., 2010)