Quivira Impairment: **DRAFT** KDA DWR analysis on remedy requirements beyond 3,000-5,000 AF/year of augmentation

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Division of Water Resources
Kansas Department of Agriculture

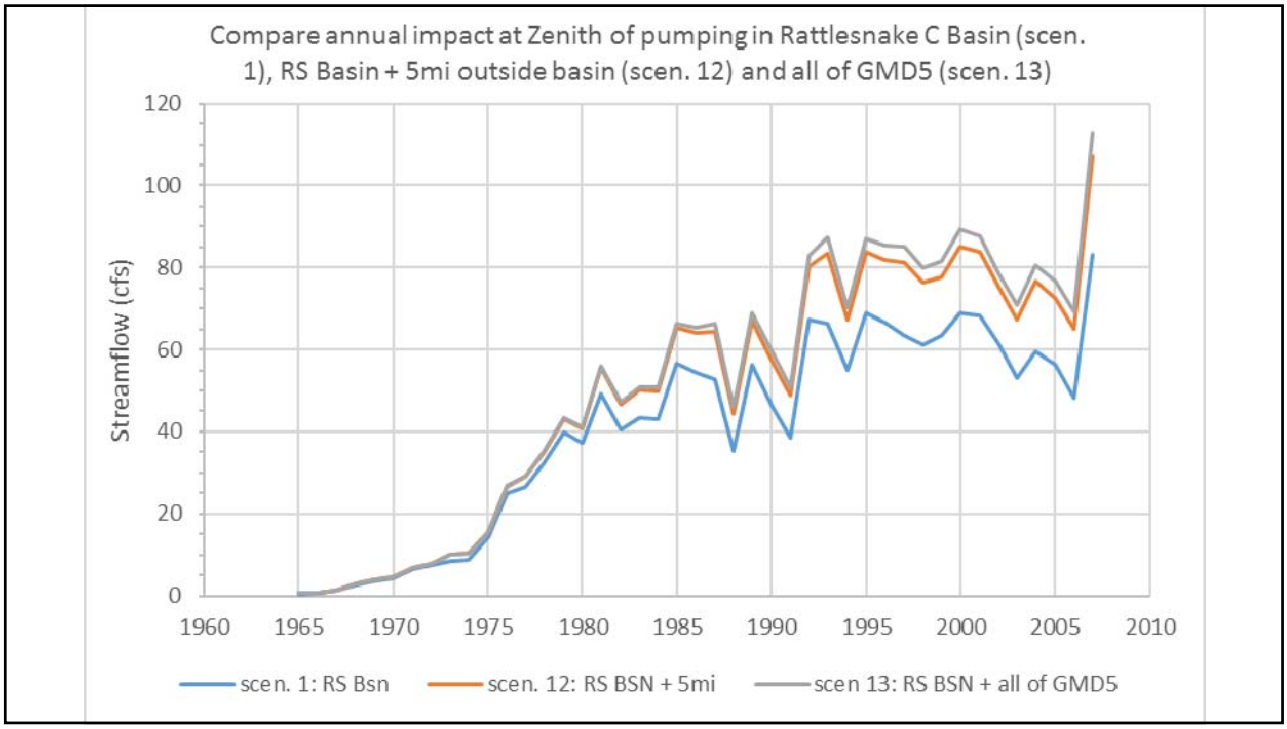
Overview

- Last meeting, we were asked what pumping reductions would we required, combined with augmentation, for a long-term remedy.
- Analysis done using the GMD 5 model:
  - What areas impact streamflows of the Rattlesnake at Zenith?
  - Are depletions to flows at Zenith continuing to increase at the current level of pumping?
  - If so, what level of pumping reductions are required to stabilize the streamflows at Zenith?

Initial analysis to determine if pumping outside the Rattlesnake basin impacts flows at Zenith

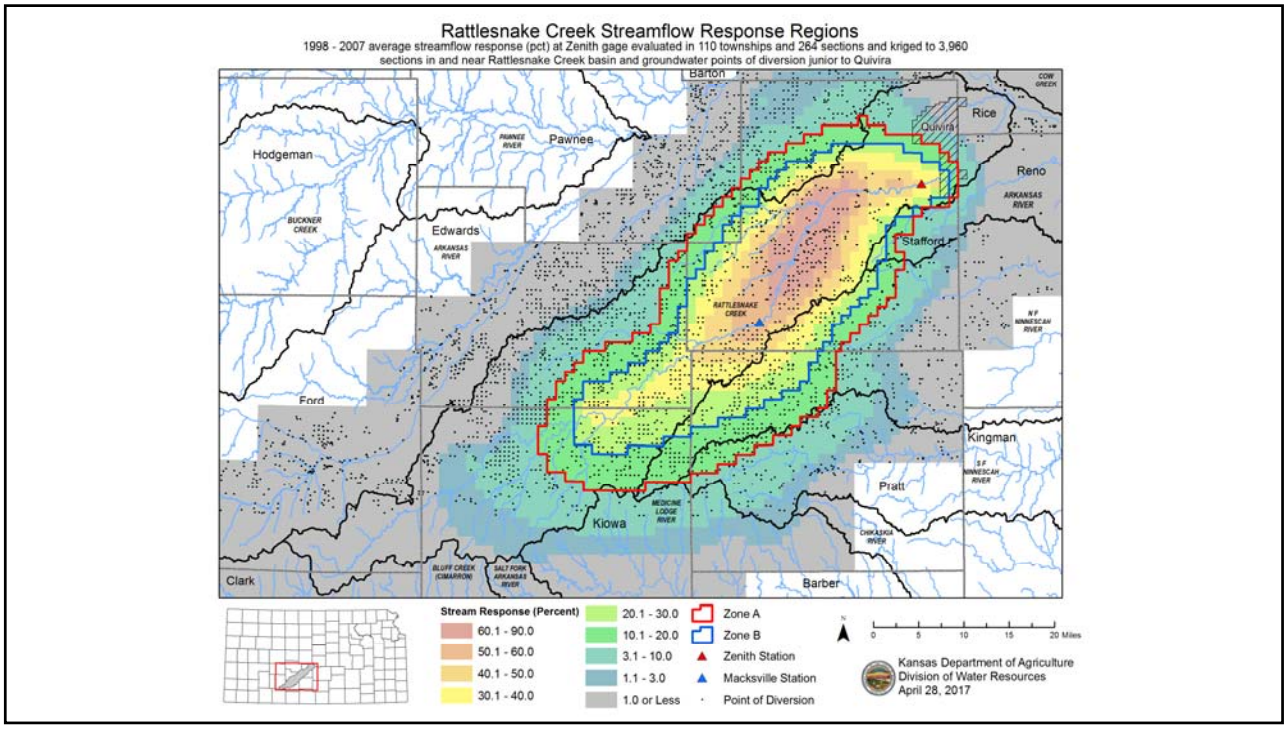
- Scenarios run (comparing actual historic pumping versus shutting off all junior pumping starting in 1958):
  - Scenario 1: Rattlesnake basin shutoff
  - Scenario 12: Rattlesnake basin + a 5-mile buffer shutoff
  - Scenario 13: Rattlesnake basin + all of GMD 5 shutoff

  Note: uses 1-layer model



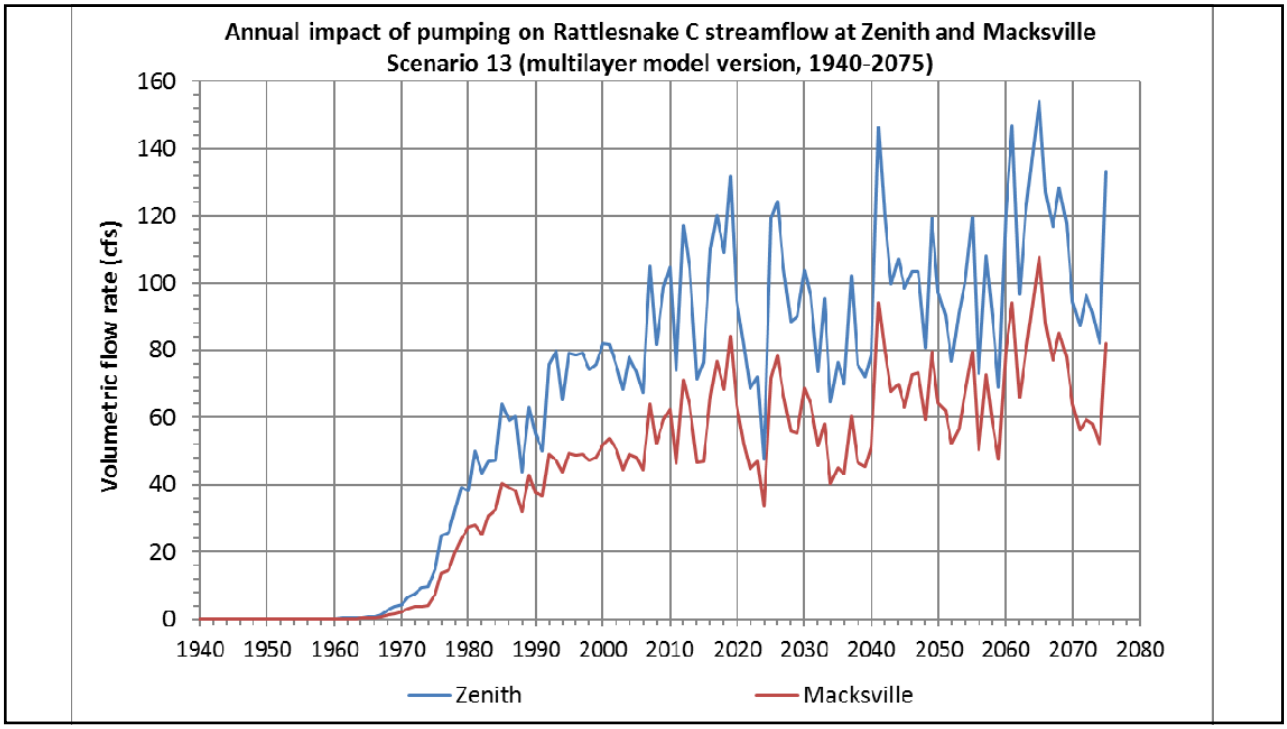
Initial Conclusion / Refined analysis

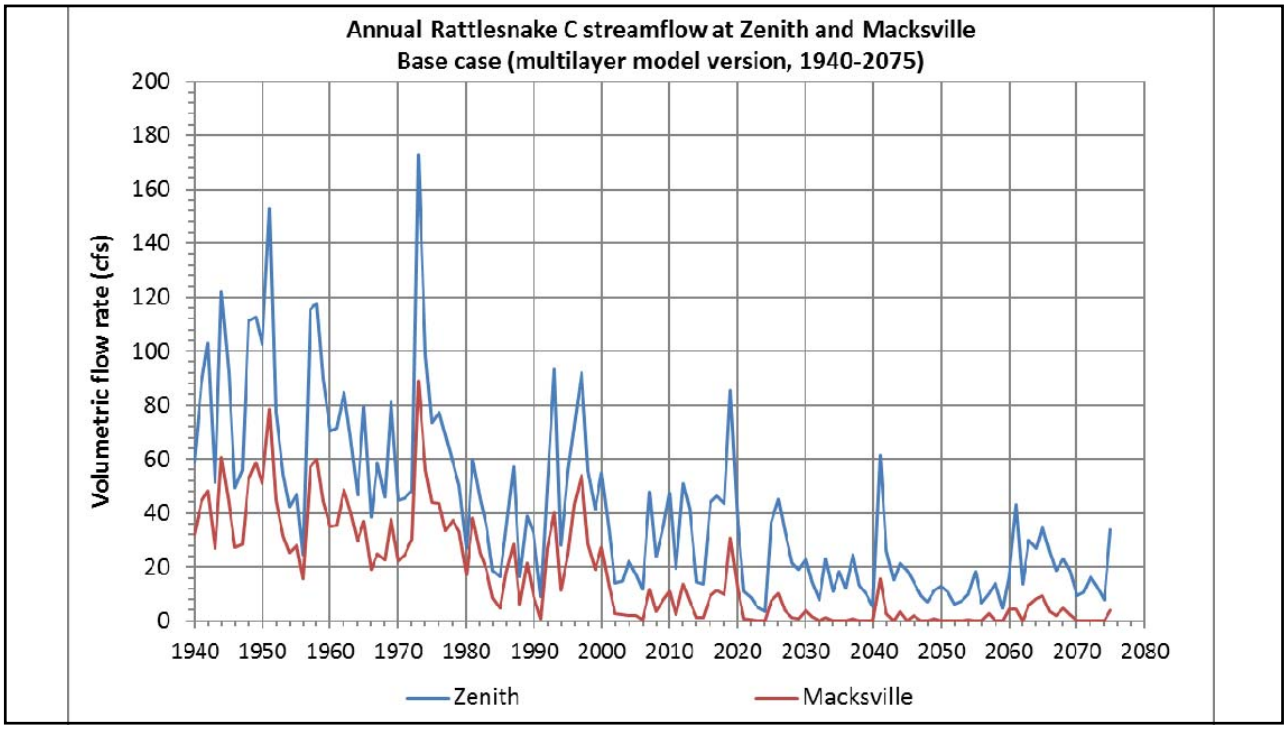
- **Initial Conclusion:** Pumping in areas outside the Rattlesnake basin is responsible for approximately 25% of the depletions to the flows at Zenith.
- **Refined analysis:** DWR completed a second analysis to determine what areas of pumping are having long-term impacts on Zenith flows.
  - Similar to assessment done by Balleau but specific to the impact on flows at Zenith.
  - Using the GMD 5 model, 100 AF of annual pumping was injected into regularly spaced sections and the resulting additional streamflow was determined and graphed.



Have depletions to streamflows at Zenith stabilized?

- To examine this question, we ran Balleau's Baseline Future A through the full 7-layer model.
- Runs compared:
  - For 1940-2007, compared the historic baseline with Scenario 13 (no junior pumping starting in 1958 for the Rattlesnake Basin and all of GMD 5)
  - For 2008-2075, compared Balleau' s Baseline future A with Scenario 13 conditions. Baseline Future A repeats the hydrology of 1940-2007 into the future, adjusting groundwater pumping to the fully developed basin and recharge functions to today's level of conservation practices.



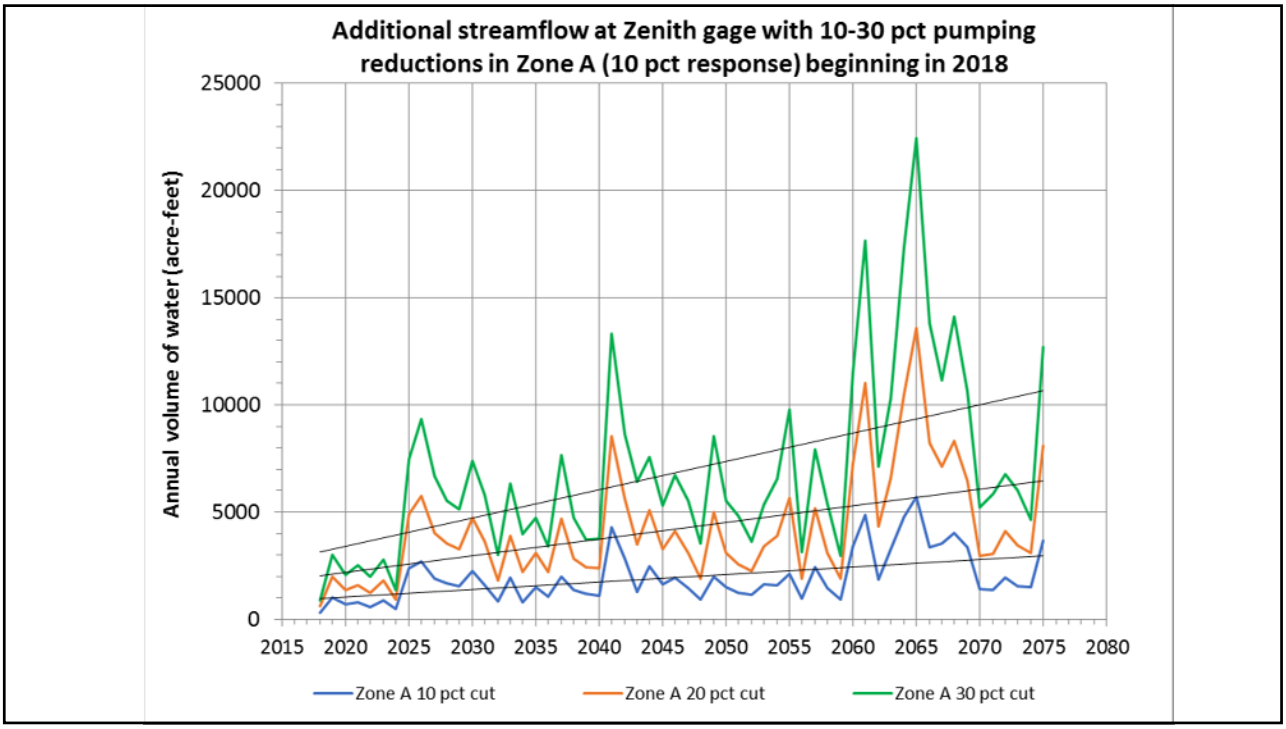


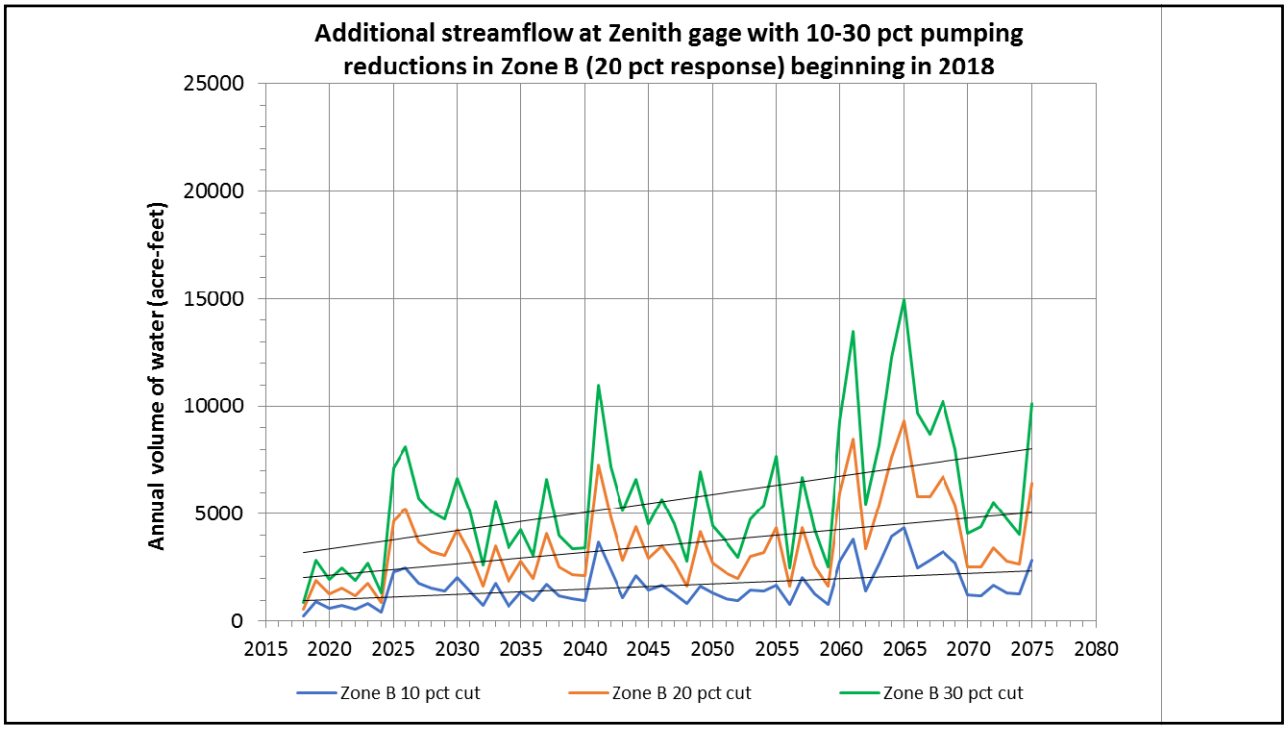
Results:

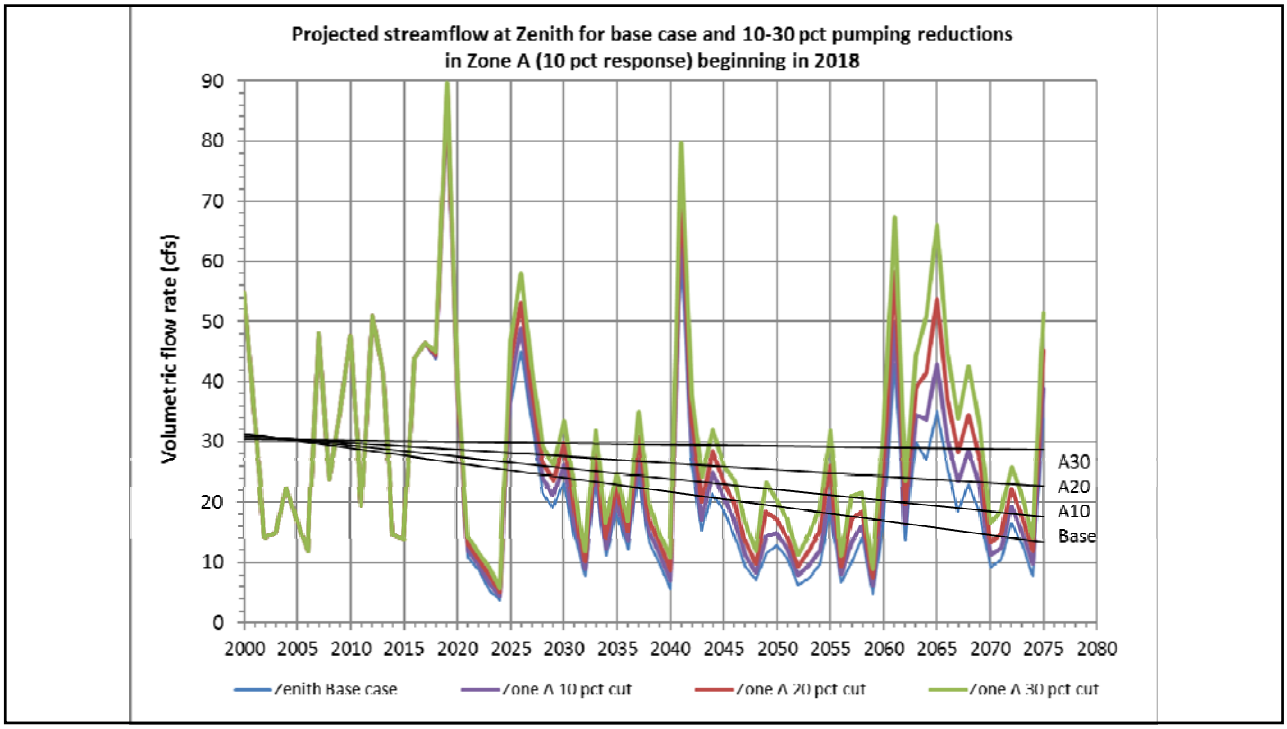
- DWR's model runs show that depletions to Zenith flows from junior groundwater will continue to increase over time resulting in further reductions to Zenith streamflows.

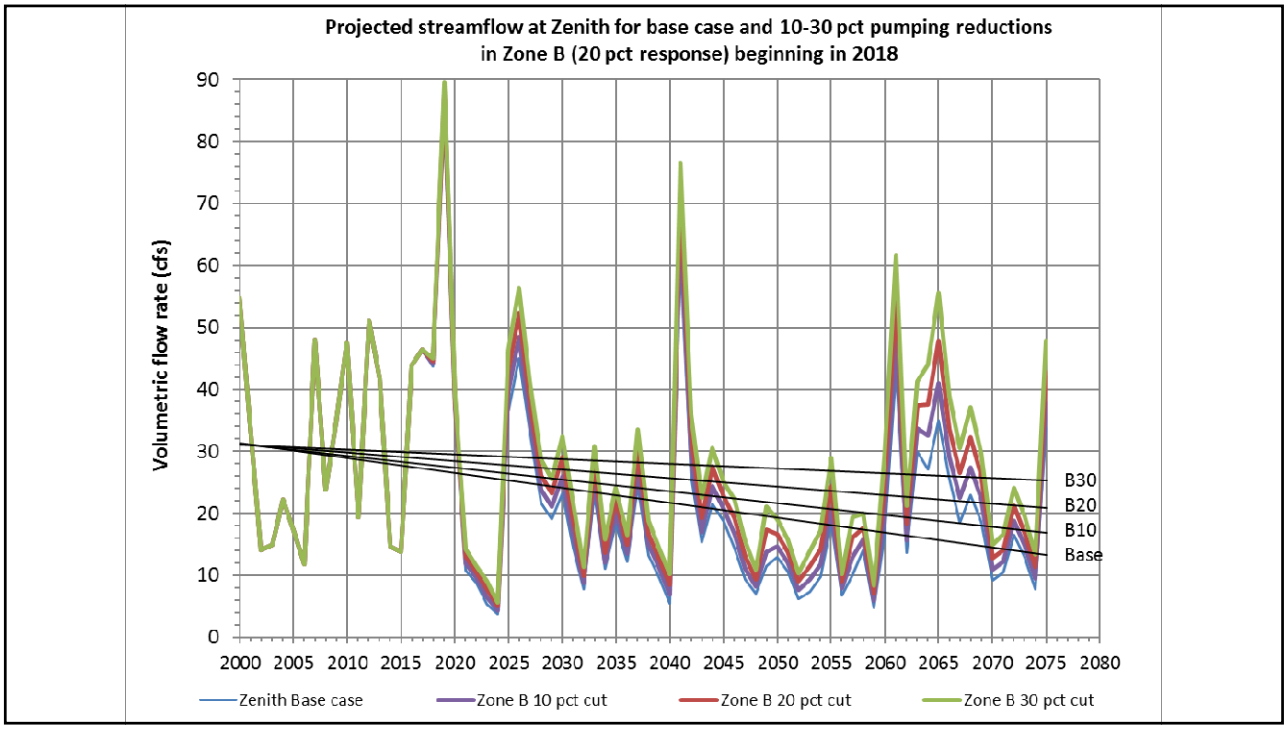
What level of pumping reductions would be required to stabilize the groundwater flows?

- We reviewed the benefit of pumping reductions of 10, 20 and 30% within two zones.
  - **Zone A** – area of 10% or greater long-term impact (approx. 135,000 acres with 160,000 AF of average pumping).
    - 10% reduction, averaging 13,500 AF
    - 20% reduction, averaging 27,000 AF
    - 30% reduction, averaging 40,700 AF
  - **Zone B** – area of 20% or greater long-term impact (approx. 85,000 acres with 100,000 AF of average pumping).
    - 10% reduction, averaging 8,500 AF
    - 20% reduction, averaging 17,000 AF
    - 30% reduction, averaging 25,500 AF




Additional streamflow at Zenith gage with 10-30 pct pumping reductions in Zone B (20 pct response) beginning in 2018
Annual volume of water (acre-feet)
25000
20000
15000
10000
5000
0
2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080
Zone B 10 pct cut
Zone B 20 pct cut
Zone B 30 pct cut


Projected streamflow at Zenith for base case and 10-30 pct pumping reductions in Zone A (10 pct response) beginning in 2018
Volumetric flow rate (cfs)
90
80
70
60
50
40
30
20
10
0
2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080
A30
A20
A10
Base
Zenith Base case
Zone A 10 pct cut
Zone A 20 pct cut
Zone A 30 pct cut



Conclusions of the modeling work

- A minimum of a 25-30% reduction in pumping within Zone A will be required to stabilize streamflows at Zenith over the long-term.

Proposal to remedy impairment to QNWR

- We propose to implement reductions as follows:
  - **Zone A** is the area of 10% or greater long-term impact (approx. 135,000 acres)
  - An immediate 15% reduction in pumping in Zone A for 5 years, 2018-2022.
    - Provided as a 5-year allocation, in inches per acre, with significant flexibility in use. As average use is approx. 14 inches per acre, a 15% reduction would be 11.9 inches per acre (92% of NIR).
  - If Augmentation provided within 5-years:
    - the 15% reduction phase will be extended to 10 years (through 2027).
    - The needed additional reduction to stabilize streamflows beyond 2027 will be determined and implemented via a second IGUCA process (or negotiation)
  - If Augmentation is not provided, a 30% reduction will be implemented in years 2023-2027, and a future process would determine additional reductions required.

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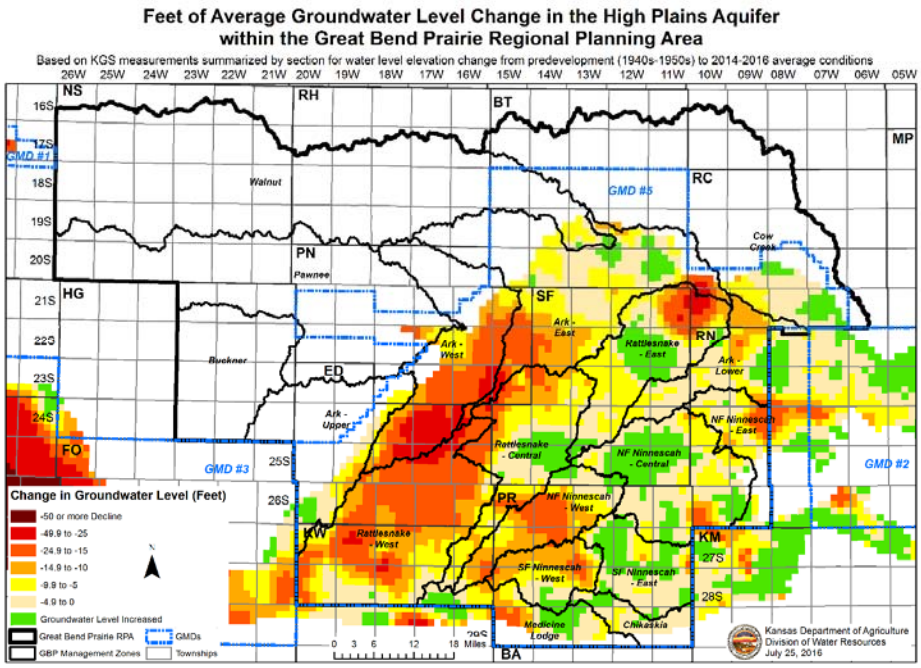
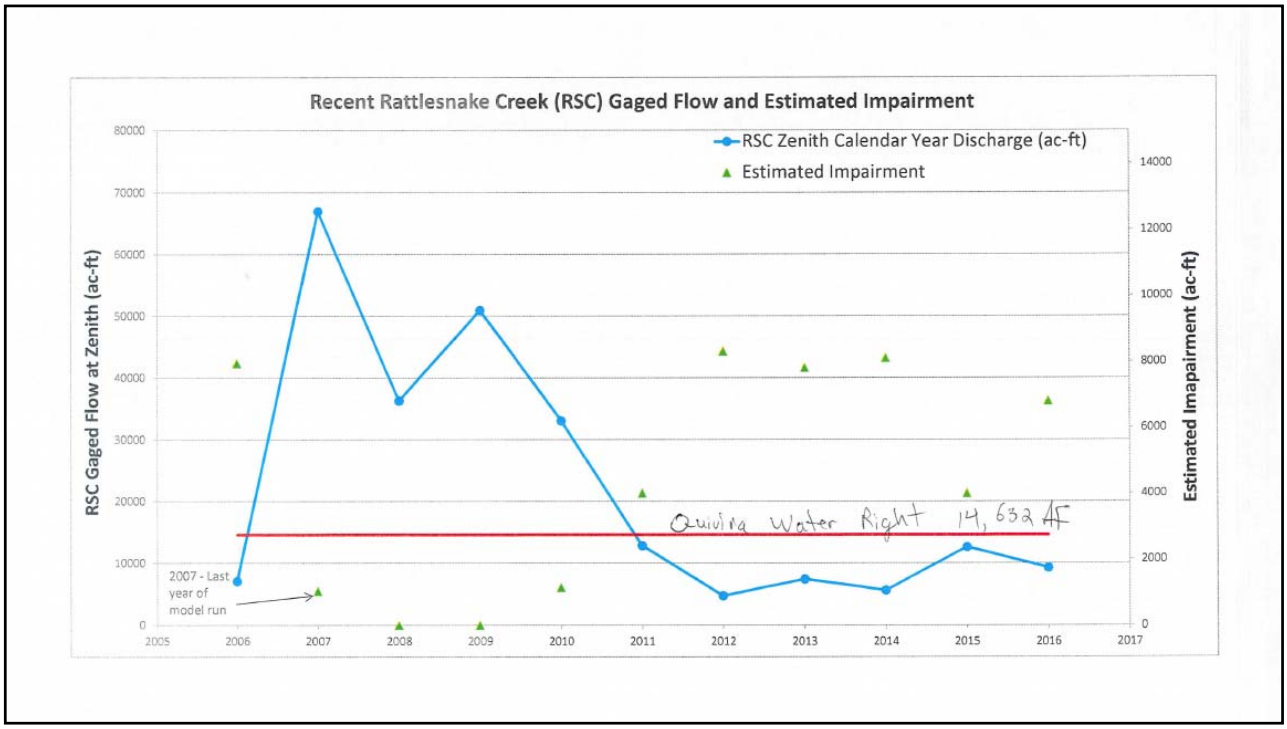
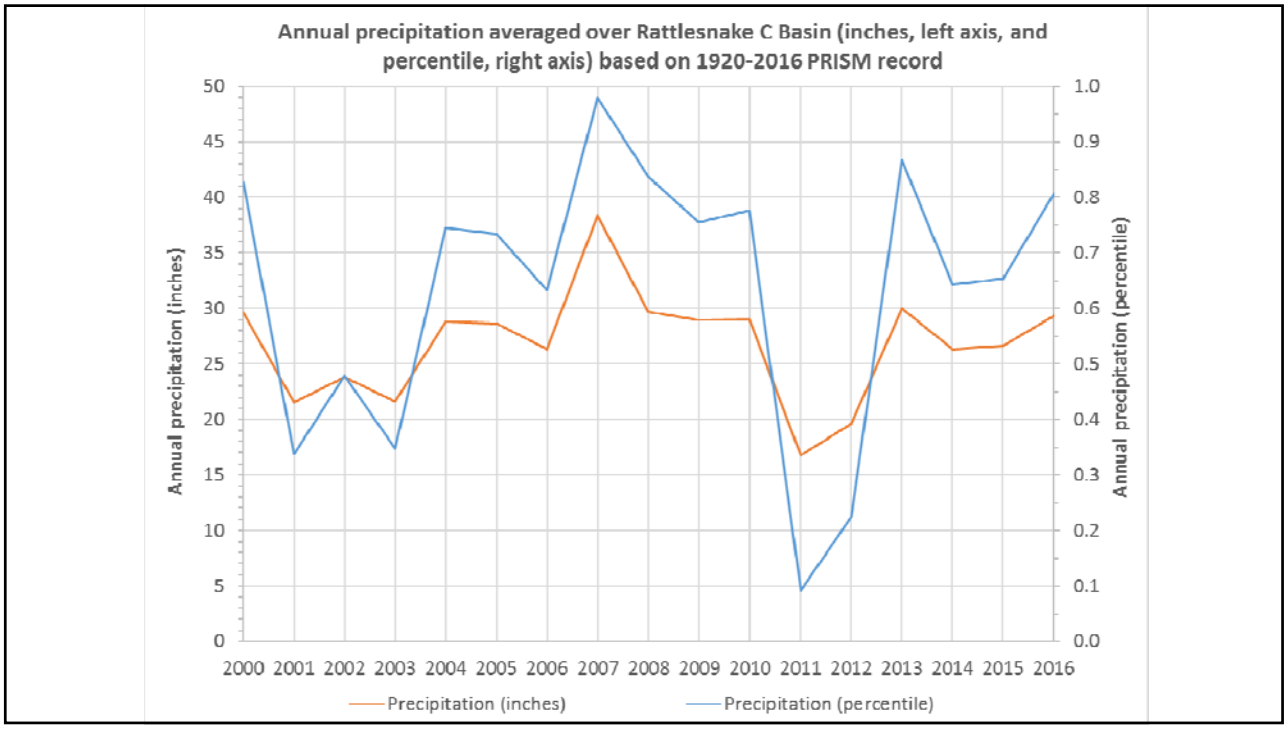
Next steps

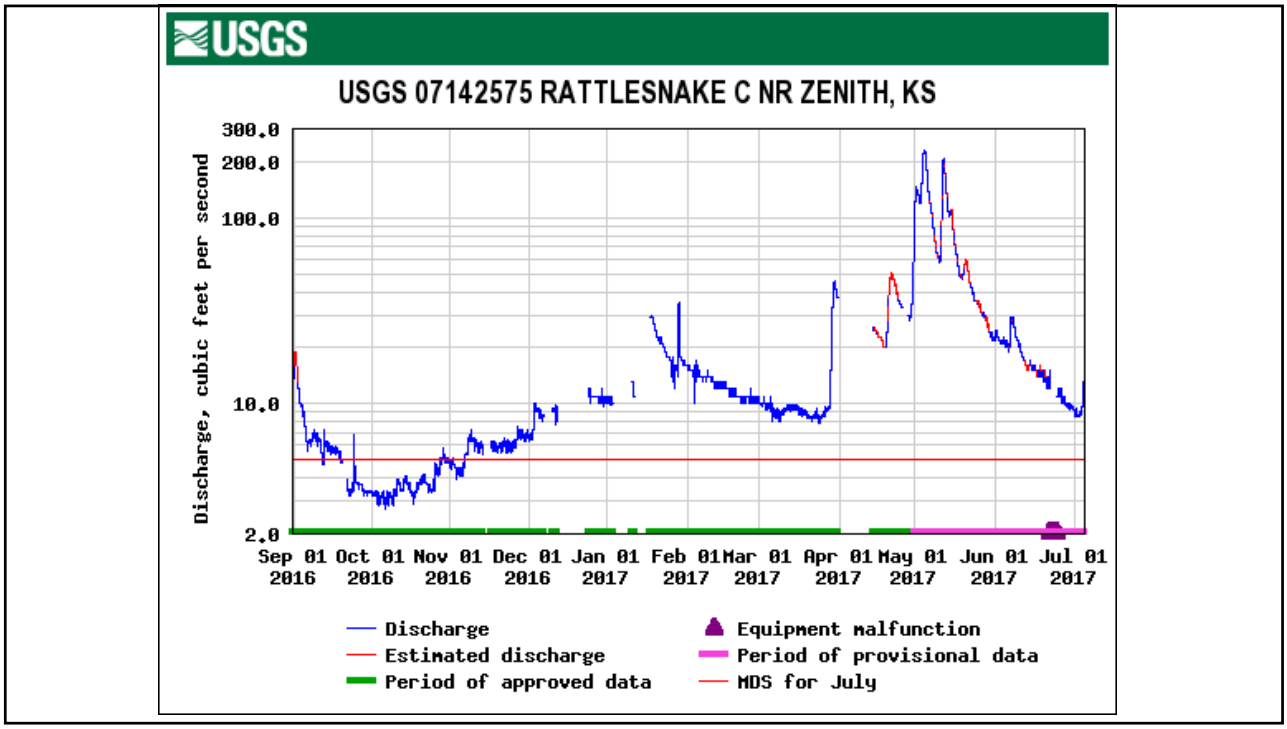
- LEMA or
- IGUCA

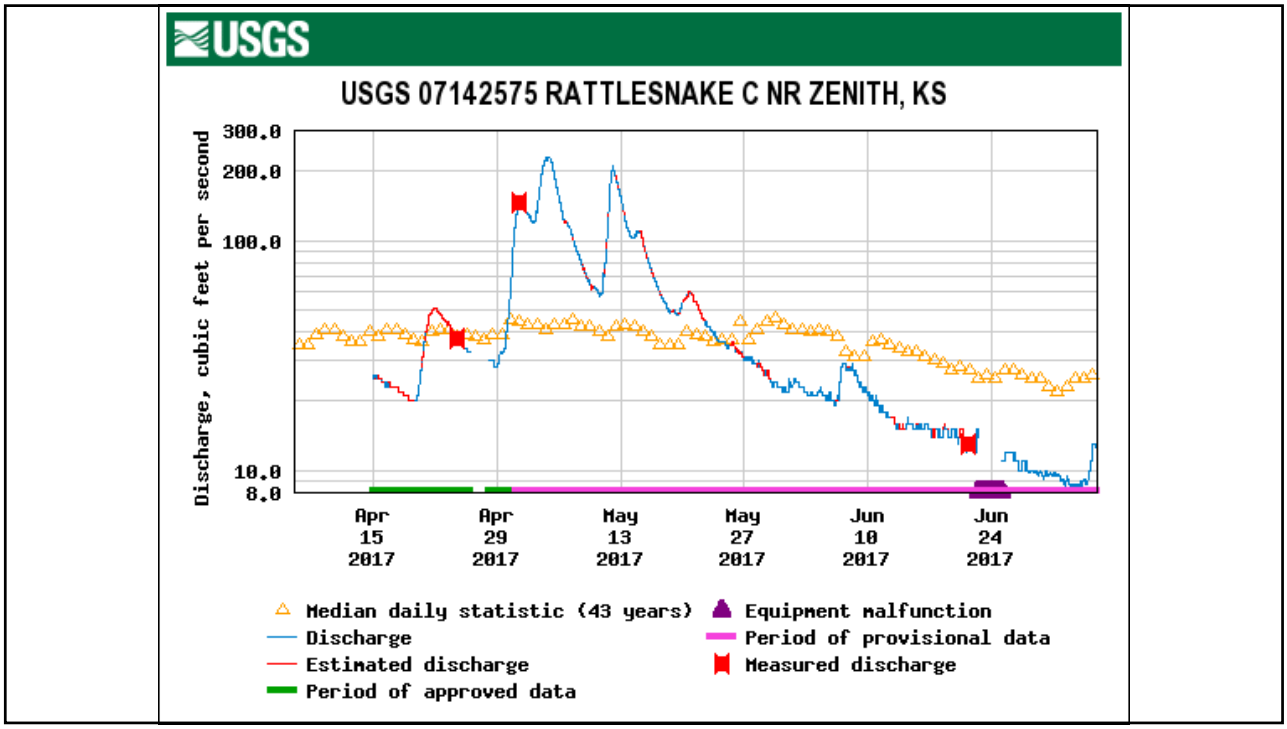
Reference slides follow




Recent Rattlesnake Creek (RSC) Gaged Flow and Estimated Impairment
RSC Zenith Calendar Year Discharge (ac-ft)
Estimated Impairment
RSC Gaged Flow at Zenith (ac-ft)
Estimated Imapairment (ac-ft)
Quivira Water Right 14,632 AF
2007 - Last year of model run
80000
70000
60000
50000
40000
30000
20000
10000
0
14000
12000
10000
8000
6000
4000
2000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Annual precipitation averaged over Rattlesnake C Basin (inches, left axis, and percentile, right axis) based on 1920-2016 PRISM record
Annual precipitation (inches)
Annual precipitation (percentile)
50
45
40
35
30
25
20
15
10
5
0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
Precipitation (inches)
Precipitation (percentile)


USGS
USGS 07142575 RATTLESNAKE C NR ZENITH, KS
Discharge, cubic feet per second
300.0
200.0
100.0
10.0
2.0
Sep 01 2016
Oct 01 2016
Nov 01 2016
Dec 01 2016
Jan 01 2017
Feb 01 2017
Mar 01 2017
Apr 01 2017
May 01 2017
Jun 01 2017
Jul 01 2017
Discharge
Estimated discharge
Period of approved data
Equipment malfunction
Period of provisional data
MDS for July


USGS
USGS 07142575 RATTLESNAKE C NR ZENITH, KS
Discharge, cubic feet per second
300.0
200.0
100.0
10.0
8.0
Apr 15 2017
Apr 29 2017
May 13 2017
May 27 2017
Jun 10 2017
Jun 24 2017
Median daily statistic (43 years)
Discharge
Estimated discharge
Period of approved data
Equipment malfunction
Period of provisional data
Measured discharge