Model Development Update and Preliminary Rules Update Recommendations

Bill Hutchison

September 28, 2023

Before We Get Started

- Groundwater pumping impacts Las Moras spring flow
  - Supported by data
  - July 2022 to May 2023 work and presentations have focused on quantifying pumping impacts to Las Moras Spring
- Once Las Moras spring flow stops, eliminating pumping will not restore the spring to “average” flows
  - Eliminating pumping would result in some groundwater level recovery
  - Rainfall (recharge) is needed to restore “average” spring flow
  - Data analyses in this presentation (not model results) will provide estimates of recent pumping impacts

Reminder of Current Schedule

- July 2022: Outlined an 18-month process to update management plan and rules
- August to January 2022: Updated Management Plan (adopted in January 2023)
- January to May 2023: Preliminary steps to complete groundwater model
- May to September 2023: Complete groundwater model
- September 2023 to January 2024: Development of updated rules
  - Tonight is focused on providing KCGCD Board information needed for rules update

Objectives for Tonight

- Summarize my credentials and background
- Review comments from 9/13 meeting
  - Can be classified as falling within 4 themes
- Presentation is organized around 4 themes from 9/13 comments
- Rules recommendations are based on data analysis (not model results)
- Detail in this presentation cannot be digested tonight
  - Much of the detail in the slides will not be covered
  - Can be used later for review and reference
  - Links and references to supporting data and reports included in slides

KINNEY COUNTY GROUNDWATER CONSERVATION DISTRICT

HOME | DIRECTORS & STAFF | DISTRICT INFO | DOCUMENTS AND FORMS | MEETINGS AND PUBLIC HEARINGS | LINKS | SUBMIT GROUNDWATER PUMPING REPORT

Mission Statement

"The mission of the Kinney County Groundwater District is to develop, promote, and implement water conservation and management strategies to conserve, preserve, and protect the groundwater supplies of the District; to protect and enhance recharge, prevent waste and pollution, and promote efficient and beneficial use of groundwater within the District..."

The District strives to strike a balance between conservation, preservation, efficient and beneficial use of groundwater, along with protection private property rights of landowners...all for the benefit of citizens/landowners of Kinney County...not only now, but for future generations.

SUBMIT GROUNDWATER PUMPING REPORT

NOTICE- The directors voted to change the monthly board meeting to the second Wednesday at 6:00 p.m.

Free Tire Cleanup Event.pdf
Download File

Kinney County Groundwater Model Technical Memoranda.pdf
Download File

Summary of Credentials Education and Licenses

- Born in Nueces County, Texas
- Education
  - B.S. UC Davis, Soil and Water Science (1980)
  - M.S. University of Arizona, M.S. Hydrology (1983)
  - Ph.D. UT El Paso, Env. Science and Engineering (2006)
- Professional Licenses
  - P.G. Geology (Texas) since 2003
  - P.E. Geological (Texas) since 2005
  - R.P.G. Geology (Mississippi) since 2008
  - P.E. Civil (Texas) since 2011
  - Engineering Firm (Texas) since 2012

Summary of Credentials
Professional Employment Summary

- 1983 to 2001: Consultant with various firms in California and Arizona
- 2001 to 2009: Water Resources Manager, El Paso Water Utilities
- 2009 to 2011: Director, Groundwater Division, Texas Water Development Board
- 2011 to present: Consultant
  - Independent consultant since 2012
    - 2012 to 2023: Austin TX, Aberdeen NC, Jamaica Beach TX
    - 2013 to present: Brenham TX

Summary of Credentials
Selected Relevant Project Experience

- Owens Valley and Mono Basin (1985 to 1999)
- Well field and well design for Kay Bailey Hutchison Desalination Plant in El Paso (2001 to 2007)
- Region E representative (2004 to 2009)
- Technical support to GCD for DFCs (2009 to 2011)
- Texas v. New Mexico litigation (2012 to 2023)
  - Expert witness for State of Texas (US Supreme Court case)
- Consultant to 6 GMAs (DFCs) (2012 to present)
- GCD Consultant
  - Bluebonnet GCD (2011 to present)
  - Kinney County GCD (2013 to present)
  - Middle Pecos GCD (2016 to present)
  - Lost Pines GCD (2019 to present)

Summary of Credentials
Selected GCD Consulting Experience

- Bluebonnet GCD
  - Electropurification Permit (application was withdrawn after my report was released showing subsidence impacts)
  - Assisted in developing revised rules related to permitting process
- Middle Pecos GCD
  - Developed monitoring thresholds that were included as special permit conditions related to settlement of litigation associated with Fort Stockton holdings permit
- Lost Pines GCD
  - Expert witness in LCRA permit contested case hearing
  - Consulting expert in Gatehouse permit litigation (now settled)
  - Testimony in Thomas Turfgrass permit hearing related to analyses in my permit application review report

Summary of Credentials Models and Publications

- Groundwater Models
  - Developed (or developing) 40 models since 1983
  - Completed simulations with 68 models since 1983
- Publications
  - 5 peer reviewed publications
    - Dissertation published as a book: Groundwater Management in El Paso, Texas
    - 4 Journal articles: one as lead author (Hydrogeology Journal, Journal of Hydrology, Ground Water)
  - 27 TWDB Agency reports (mostly related to modeling)
  - Co-author of a chapter on Joint Planning a State Bar of Texas book: Essentials of Texas Water Resources (7th edition, 2022)
  - Numerous conference presentations and papers

Summary of Survey Questions (Results Distributed at 9/13 meeting)

- Q1: Automated meters on permitted wells
  - Daily reporting of pumping over cellular network
- Q2: Store pumping data electronically
  - Posted on KCGCD website
- Q3: Monthly scorecard on permit pumping
- Q4: Change “test well permits”
- Q5: Access to property
- Q6: Reset permit limits to 150% of highest use over the past 5 years
- Q7: Implement a Water Protection Plan
  - Triggered by Las Moras flow or monitoring well level
  - Curtailment based on table (not included in results)
  - Relax curtailment after 3 months above both triggers

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Comments from 9/13/2023 (1)

- Pumping data/metering
- Permit production reviews
- Trigger criteria/drought contingency plan
- “Cutbacks are needed so everyone has access to groundwater”
- Examples of other groundwater districts

Comments from 9/13/2023 (2)

- Chapter 36 provisions
  - Limit production
  - Advisory committees
- Las Moras has not been flowing (aquifer is in “trouble”)
- Las Moras spring flow DFC has not been met
  - “No way to reach numbers” after reviewing USGS data
  - Is it drought? (we are not in a drought like 2011)
  - If not in a drought, why are springs low?
  - Is there not as much water as we thought?

Comments from 9/13/2023 (3)

- Permittees need to give us the information we need
- Management plan looks great, but we need to kick into action
- 2 cfs is not acceptable
- Drought or no drought (“where is the data?”)
- Spring flowed in 2011, but not now (pumping has an effect)
- Need action to curtail pumping

Comments from 9/13/2023 (4)

- Other groundwater districts curtail pumping
- Groundwater does not stay in Kinney County
- The district has had 20 years to address this
- Rain is not the only thing that will fix it. Something else is going on?
- Area is becoming more arid
- The swimming pool is not the only thing we care about (habitats and wildlife)
- Impacts of Los Angeles water gathering activities

Los Angeles Activities

- Example of “balance” between maximizing water supply and avoiding environmental impacts
- Experience:
  - 1979: CSUF Hydrology field camp (Owens Valley and Mono Basin) as an undergraduate (adjunct faculty in late 1980s)
  - 1985 to 1999: Consultant to Inyo County (Owens Valley)
  - 1991 to 1994: Consultant to California State Water Resources Control Board for Mono Basin water rights hearing
- LA has imported water from Owens Valley (since 1913) and Mono Basin (since 1941)
  - LA Aqueduct is over 200 miles long
  - Furthest diversion point in Mono Basin is over 300 miles north of LA
- Second aqueduct was constructed in 1970
  - Increased surface water diversions from Mono Basin and Owens Valley
  - Increased groundwater pumping in Owens Valley
  - “Full” use = 480,000 AF/yr

Owens Valley Litigation

- Litigation from 1973 to 1991 on environmental impacts of increased surface diversions and groundwater pumping
  - Settlement agreement finalized in 1997
- Groundwater pumping prior to 1991
  - Routinely above 100,000 AF/yr (as high as 210,000 AF/yr during droughts)
- Groundwater pumping since 1991
  - ~ 65,000 AF/yr (50,000 AF/yr to 80,000 AF/yr)

Mono Basin Water Rights Hearing

- Previous litigation led to a court order to reconsider water rights of LA (SWRCB process)
- Multi-party hearing that lasted over a year
- As a consultant for SWRCB, developed a simulation model that was accepted by all parties to evaluate the impacts of alternative water rights decisions
- Final decision (D-1631) resulted in decreased diversions to aqueduct from Mono Basin to maintain fish habitat and restore Mono Lake
  - Historic low on 1/1/1982 6,372.0 ft MSL
  - Level on 9/28/1994 (D-1631 date) 6,374.6 ft MSL
  - Level on 9/1/2023 6,383.2 ft MSL
  - Management goal 6,392.0 ft MSL

Themes of 9/13 Comments

- Chapter 36 of Water Code
  - Responsibilities and Authority of KCGCD
- Desired Future Conditions
- “State of the Aquifer”
- Pumping and Permits

Chapter 36 of Texas Water Code

- Comments provided at meeting of September 13 highlighted only one aspect of GCD responsibility and authority (conservation and pumping restrictions)
- Section 36.116 (Regulation of Spacing and Production)
  - 36.116(b): "…the district may preserve historic or existing use before the effective date of the rules to the maximum extent practicable consistent with the district's management plan.."

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Management Plan

- Section 1.0 District Mission (second paragraph)

The District strives to strike a balance between conservation, preservation, efficient and beneficial use of groundwater, along with protection private property rights of landowners...all for the benefit of citizens/landowners of Kinney County...not only now, but for future generations.

Similar language in management plans of 2004, 2008, 2010 (amended) 2013, and 2018

Management Plan

- Section 1.0 District Mission (second paragraph)

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KCGCD Policy Decisions

- Balance between property rights (i.e. existing and historic uses) and conservation and preservation of groundwater
  - Fundamental choice that guides management plan and rules
- Early in district's history, policy decision to issue permits for historic and existing use of groundwater
- In 2010, adopted the first desired future condition (DFC) that protected historic Las Moras spring flow
  - DFC reflects historic average spring flow

Themes of Comments

- Chapter 36 of Water Code
  - Responsibilities and Authority of KCGCD
- Desired Future Conditions
- “State of the Aquifer”
- Pumping and Permits

Background on Desired Future Condition (DFC)

- TWC 36.108 (d): lists nine factors that “districts shall consider” before proposing a DFC:
  - Aquifer conditions, water supply needs in state water plan, hydrologic conditions, other environmental impacts, subsidence, socioeconomic impacts, impacts to private property rights, feasibility of achieving the DFC, any other information
- TWC 36.108(d-2): the DFC “must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater”

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Kinney County DFCs

- GMA 7
  - Average Las Moras spring flow of 23.9 cfs (median flow of 24.4 cfs)
- GMA 10
  - Water level in (Tularosa) well shall not fall below 1,184 ft MSL

History of DFC in Kinney County

- DFCs were adopted in 2010 and were not modified during the second or third round of joint planning (2016 and 2021)
- DFCs were based on a model developed in 2010
  - End-of-year DFC (December 31) due to model limitations
- 2010 Model was used by TWDB to estimate Modeled Available Groundwater (MAG)
- Initial (2010) DFCs were adopted when Chapter 36 of the Texas Water Code required districts to permit to the MAG

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Modeled Available Groundwater (MAG)

- The amount of groundwater pumping that will achieve the DFC
- One factor in permitting
- Water marketers/large export project proponents often (incorrectly) rely on MAG to identify areas that are “of interest”

DFC in Groundwater Management

- Districts are required to manage to achieve the DFC
  - TWC 36.1132(a)
  - TWC 36.1132(b)
  - TWC 36.3011(b)(6)
  - TWC 36.3011(b)(7)
- Recognizes that models are imperfect (link between DFC and MAG is based on model results)
- It is better to use data for management decisions and evaluate consistency with the DFC

2010 TWDB Model

- Based on data provided by KCGCD
  - Groundwater pumping data were not actual annual historic pumping data, but permitted pumping amounts
    - Total historic and existing permits = 63,112 AF/yr
  - Resulted in MAGs that were consistent with historic and existing use permits (not actual historic pumping)
    - GMA 7 = 70,341 AF/yr
    - GMA 10 = 6,321 AF/yr
    - Total = 76,662 AF/yr
- Fundamental disconnect between historic and existing use permit totals (MAG) and spring flow DFC

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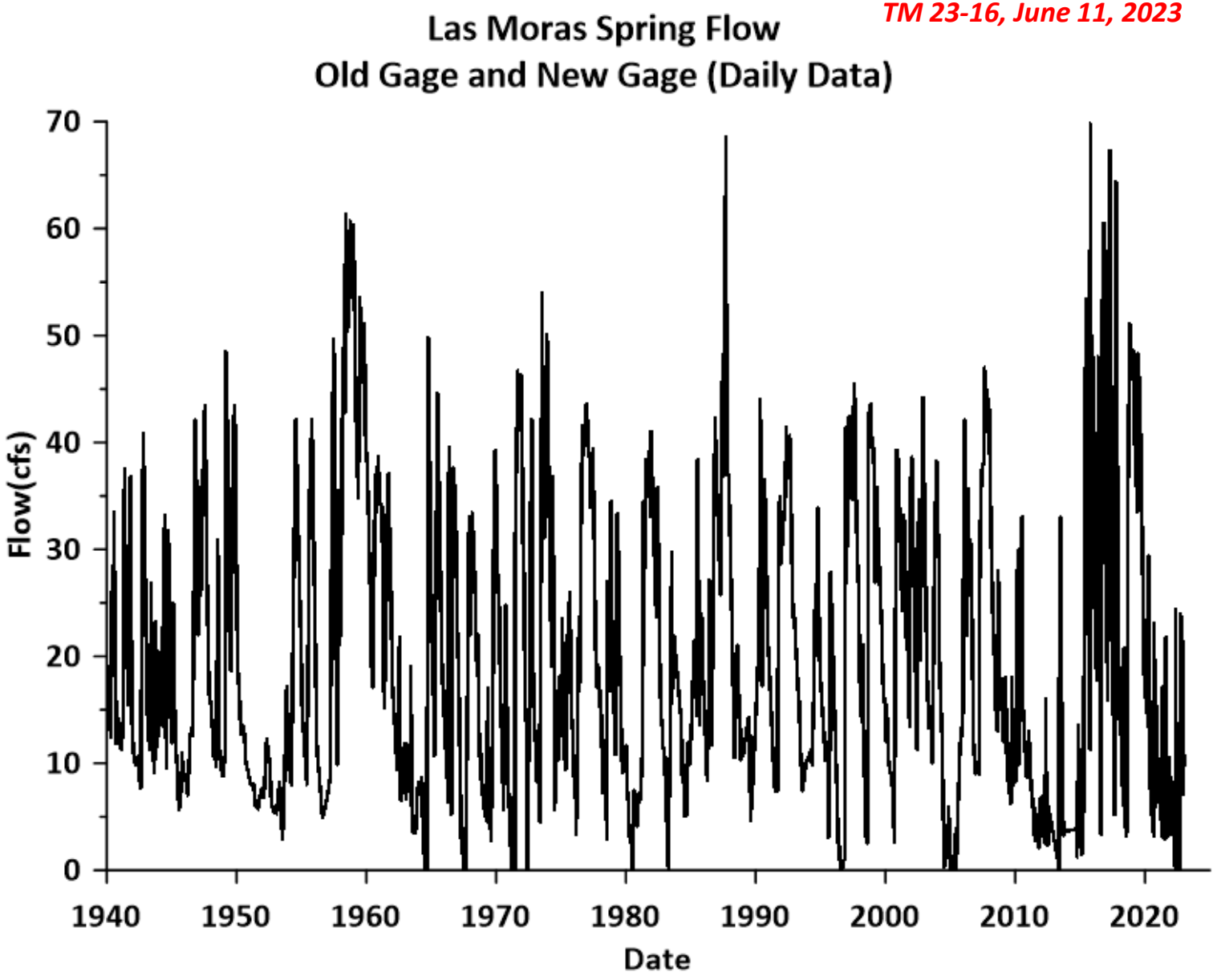
In 2013, KCGCD Recognized the MAG/Permit Total/DFC Issue and Sought to Improve Data and Models

- 2013 to present:
  - Instrument wells for groundwater level data (now over 63)
  - Rainfall gages
    - 8 KCGCD
    - 8 TexMesoNet (TWDB program)
- 2022:
  - Empirical model of spring flow, rainfall, pumping
  - Satellite analysis of irrigation (1995 to 2022)
    - Provided a quality control check on permit reports
- 2023:
  - Updated groundwater model (almost completed)
    - Comprehensive evaluation of all available data
    - Will replace 2010 model for DFC and MAG process
  - Permit pumping reporting “app”

9/13 Questions of Las Moras Spring Flow DFC

- “Las Moras spring flow DFC has not been met”
  - “No way to reach numbers” after reviewing USGS data
  - Is it drought? (we are not in a drought like 2011)
  - If not in a drought, why are springs low?
  - 2 cfs is not acceptable
- Review Las Moras Spring flow data
- Review Section 5.8 of 2023 Management Plan
  - Discussed in detail at Management Plan Committee meeting of October 13, 2022

Data in Las Moras Flow Julian.xlsx (All)
TM 23-16, June 11, 2023



Historic Low Flows in Las Moras Springs

- 1940 to 2014 (old gage) end-of-month data:
  - Did not cease flowing during 1950s drought
  - 0 cfs (12 times), and 0 to 1 cfs (8 times)
    - 1964 (twice)
    - 1967 (three times)
    - 1971 (twice)
    - 1972
    - 1980
    - 1983
    - 1996 (four times)
    - 2004 (twice)
    - 2005 (three times)
    - 2013
- 2014 to 2023 (new gage)
  - 0 cfs in summer of 2022 and summer of 2023

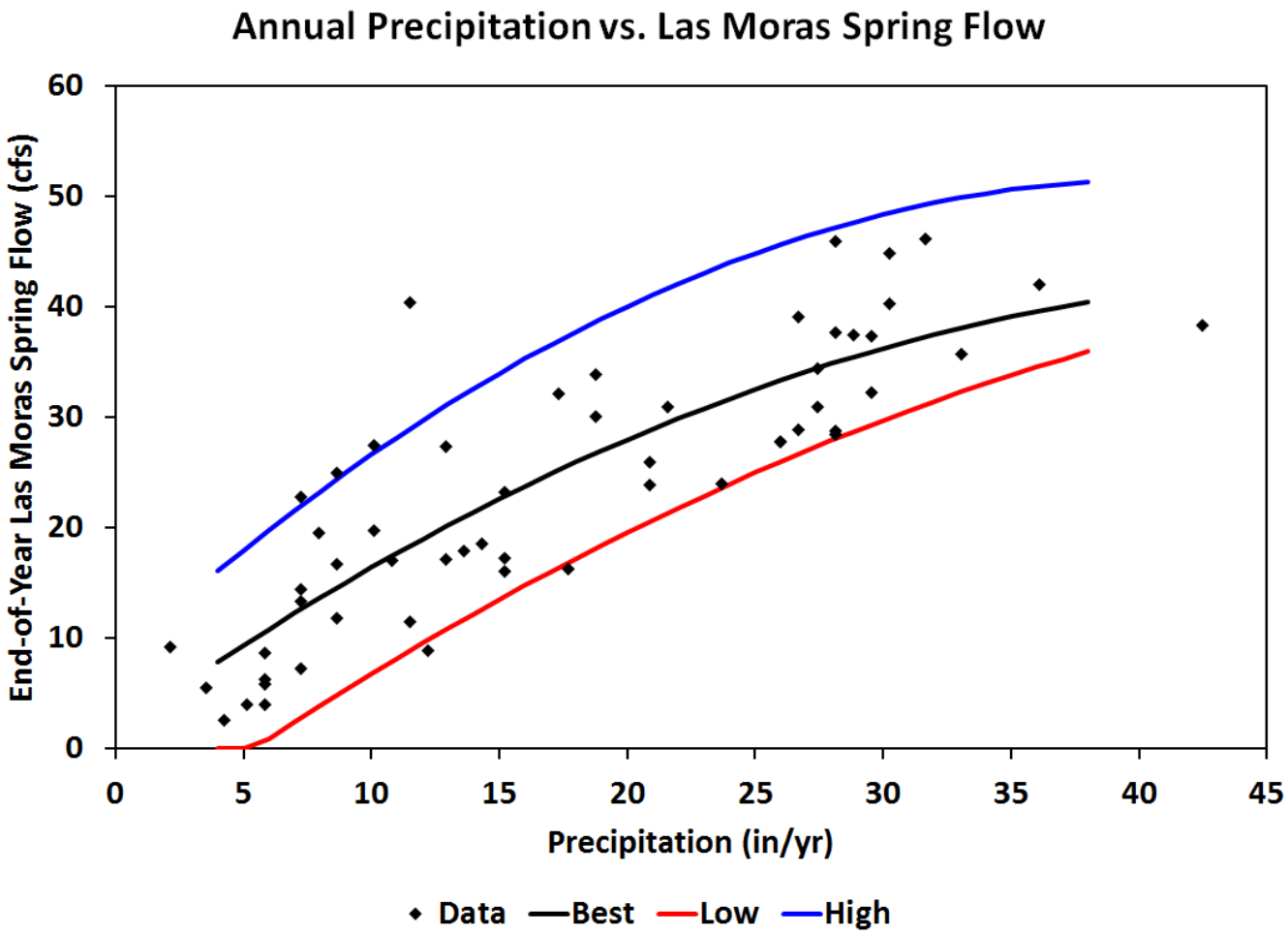
From 10/13/2022
Management Plan Committee Meeting

Section 5.8.1 of Management Plan GMA 7 – Las Moras Spring

- DFC: average spring flow of 23.9 cfs, median flow of 24.4 cfs
  - Based on 56-year simulations completed in 2010
- End-of-year flow
  - Average of all years (wet and dry)
  - Not instantaneous at any time during year
  - Not average of any specific year
- 2013 and 2018 plans included process to evaluate annual rainfall and end-of-year spring flow to evaluate consistency
  - Need to update with new gage data

From 10/13/2022
Management Plan Committee Meeting

2013 and 2018 Management Plan Figure 2 (Based on old gage)



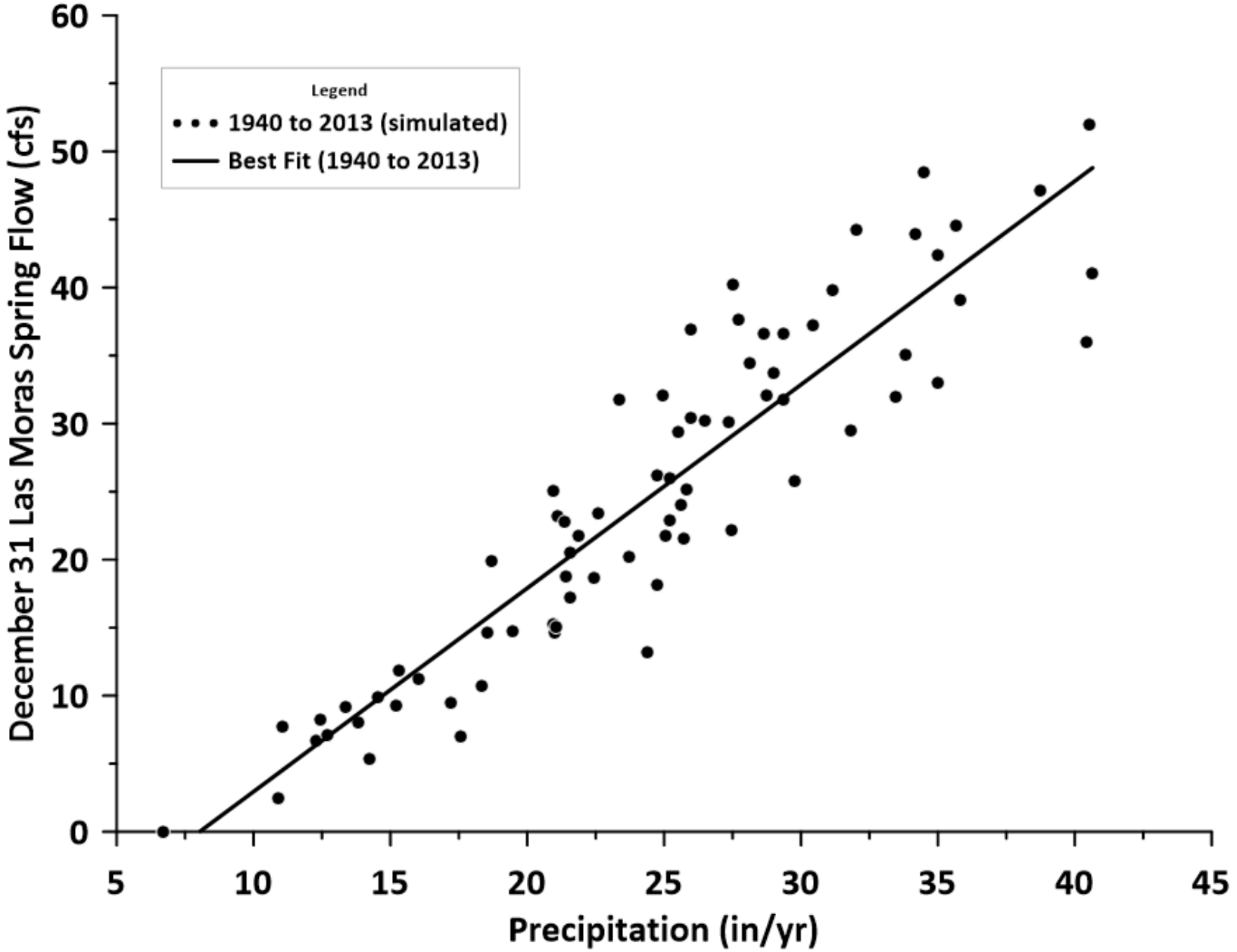
From 10/13/2022
Management Plan Committee Meeting

Update Using New Gage in 2023 Management Plan

- New gage data start in October 2014
  - Only 7 years of “end-of-year” data
- Extended data with empirical model of monthly precipitation and end-of-month spring flow
  - Precipitation from TWDB (Quad 807) - better regional representation

From 10/13/2022
Management Plan Committee Meeting

Annual Precipitation vs. December 31 Las Moras Spring Flow (New Gage)



From 10/13/2022
Management Plan Committee Meeting

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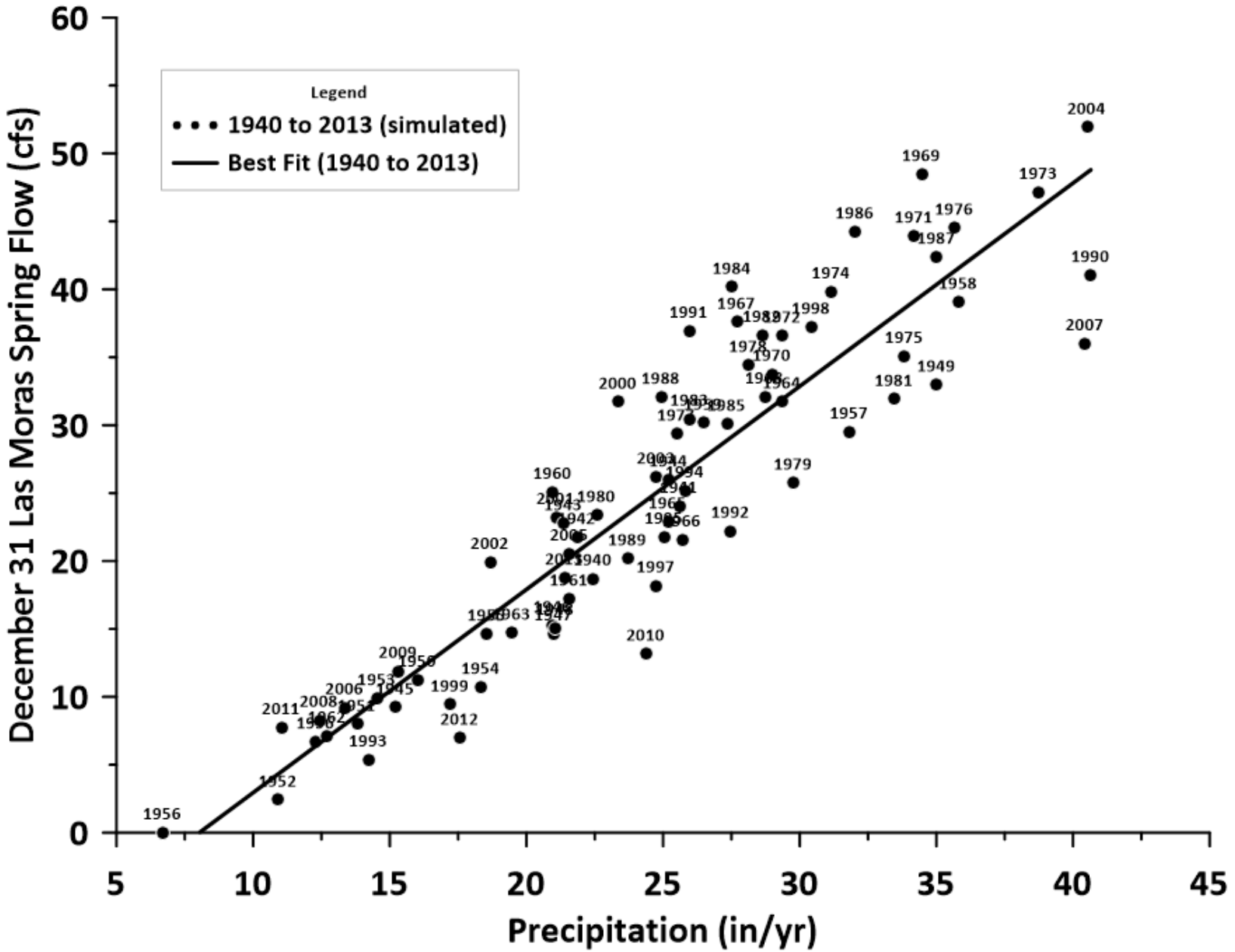

From 10/13/2022
Management Plan Committee Meeting

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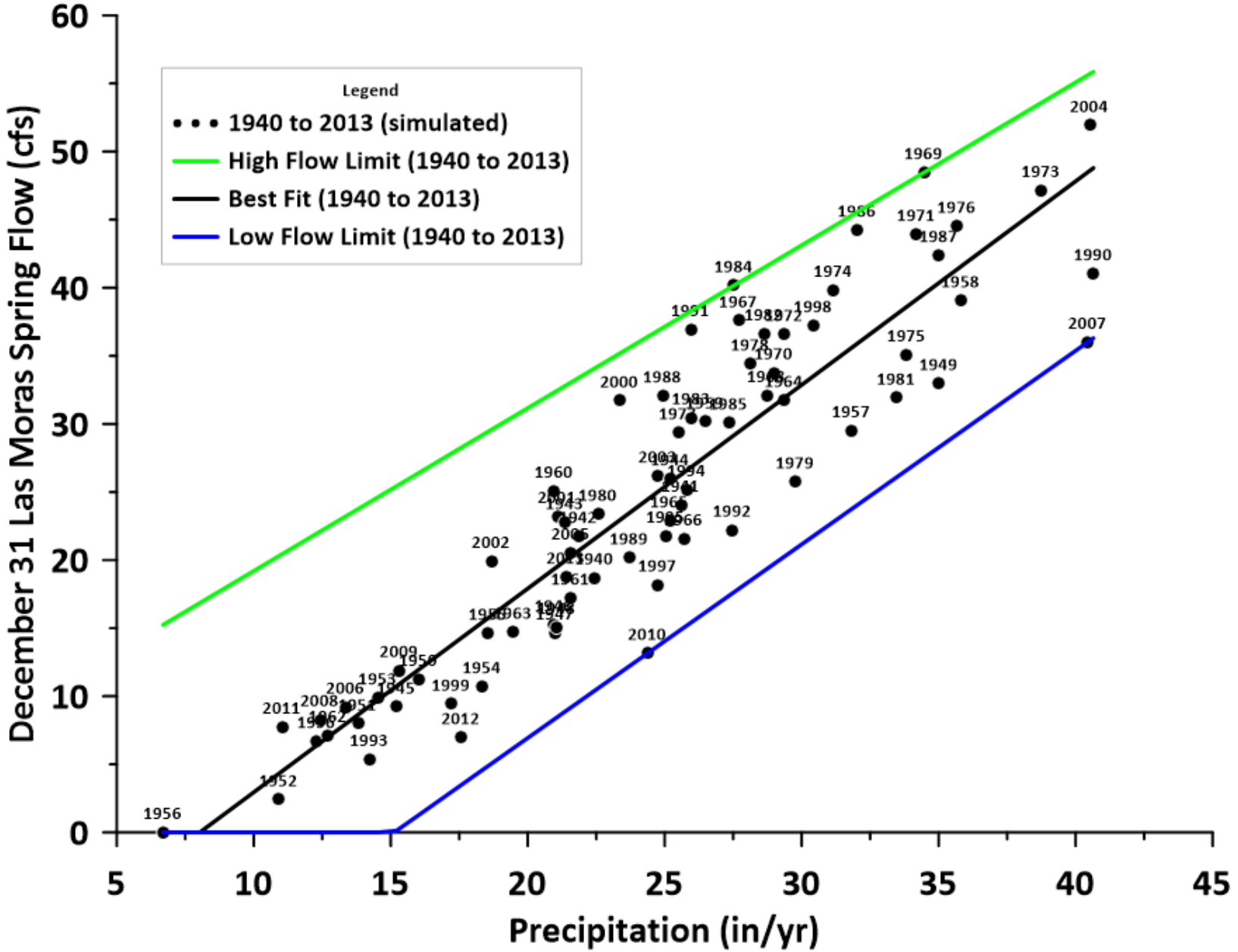

From 10/13/2022
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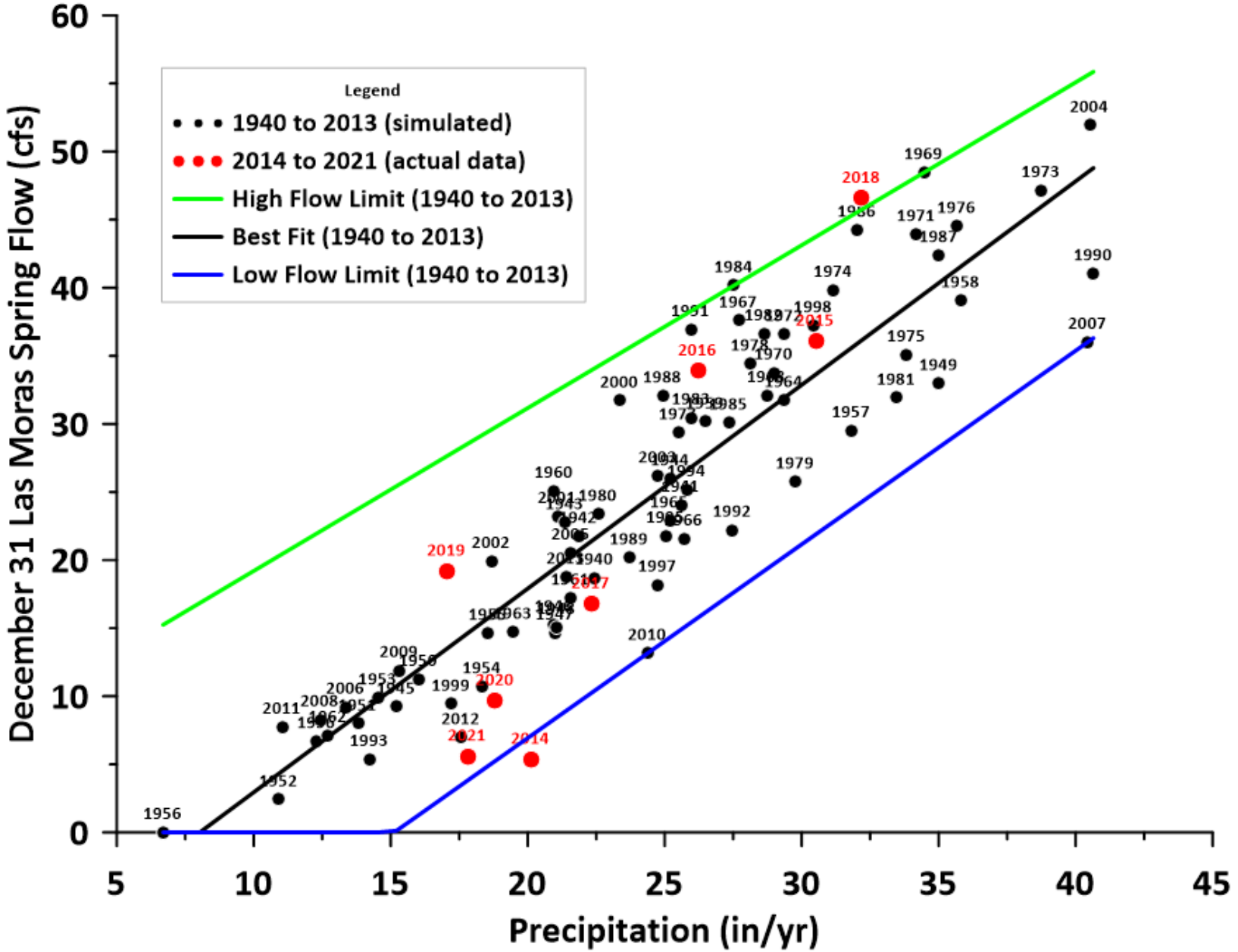

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Management Plan Committee Meeting

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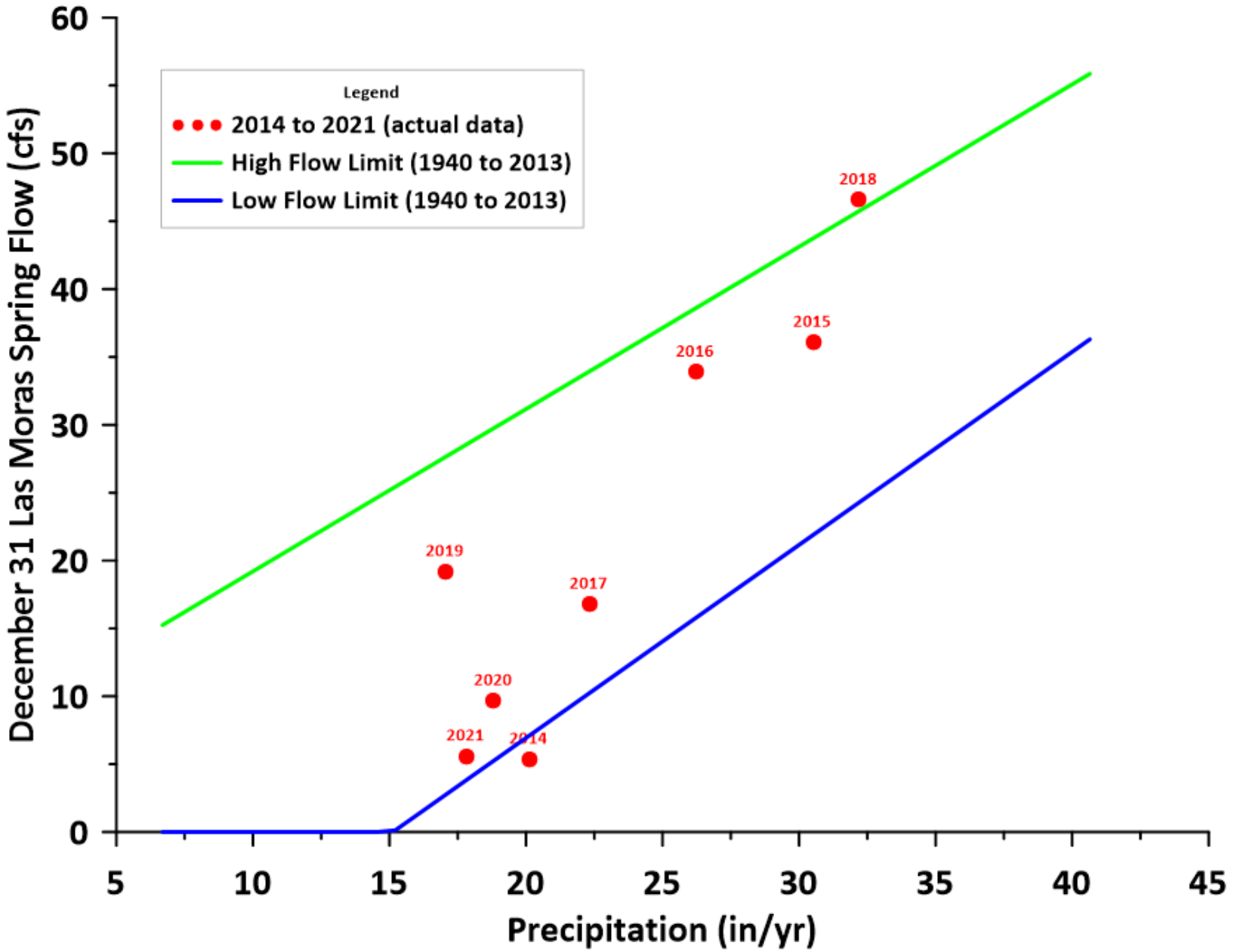
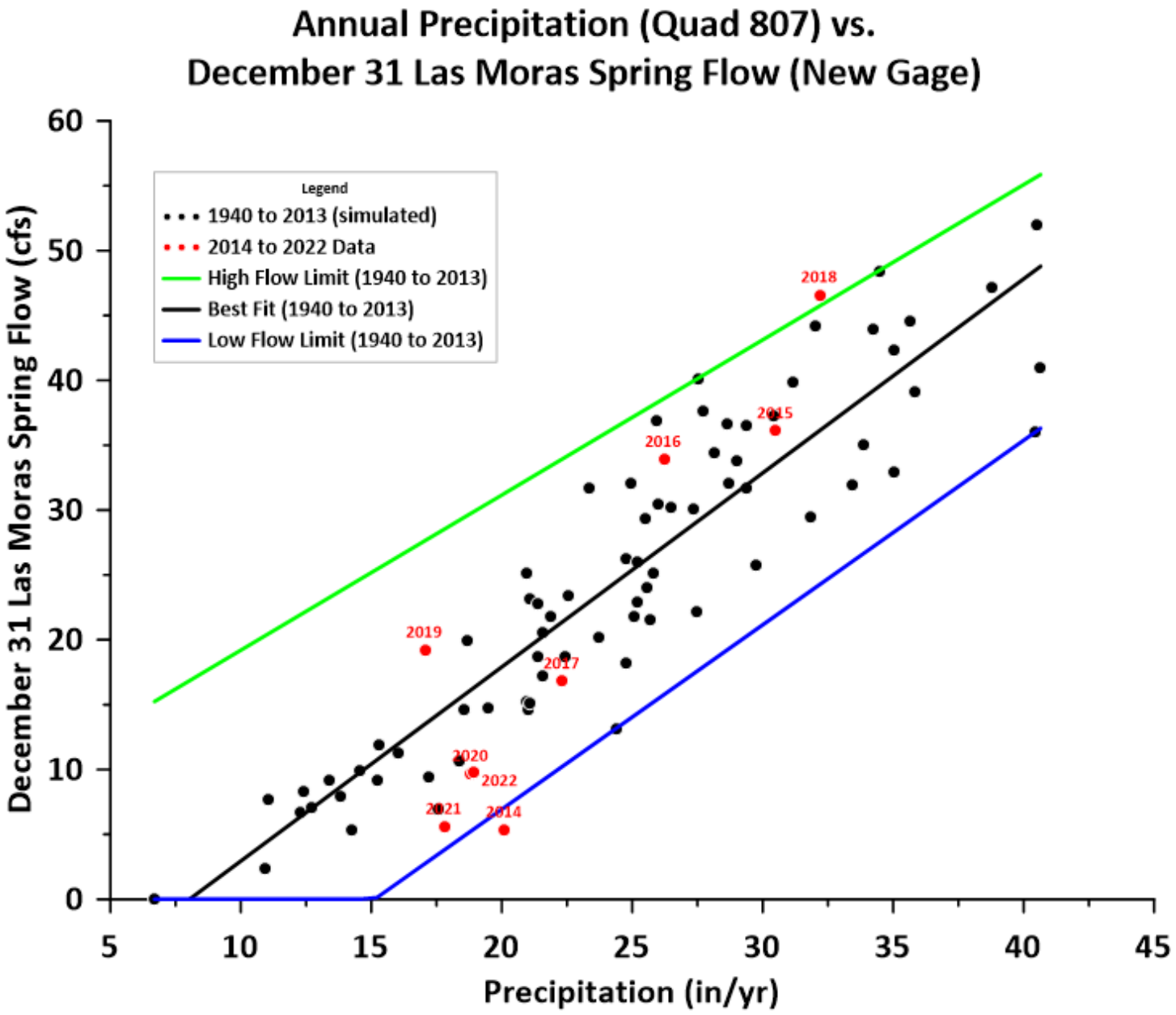


2022 DFC Comparison (Las Moras)

- 5/1/23 letter to Genell Hobbs
  - ***Agenda Item 10, 5/4/23 KCGCD Board Meeting***
- As described in management plan, comparison is made with:
  - Annual precipitation data from Quad 807 (TWDB)
    - Data not available for full year until ~ April of following year
  - Las Moras spring flow data on December 31 (USGS)
    - Uses “official” data (not provisional)
- Comparison point is very close to 2020 point and within expected limits



Agenda Item 10, 5/4/23 KCGCD Board Meeting

Example of "Indexed Compliance"

- Texas v. New Mexico settlement (consent decree)
  - Litigation related to Rio Grande Compact of 1938 (Texas, New Mexico, and Colorado)
- In 2013, Texas alleged that groundwater pumping in New Mexico was capturing surface flow that should have been "delivered" to Texas under the 1938 Compact
  - Groundwater pumping impacting surface flows
- Settlement was based on an "indexed flow" at El Paso gage
  - Texas apportionment is higher in wet years
  - Texas apportionment is lower in dry years

https://www.ca8.uscourts.gov/texas-v-new-mexico-and-colorado-no-141-original

Docket No. 720 = Consent Decree, Docket No. 776 Special Master Report

Themes of Comments

- Chapter 36 of Water Code
  - Responsibilities and Authority of KCGCD
- Desired Future Conditions
- “State of the Aquifer”
- Pumping and Permits

9/13 Comments Related to “State of Aquifer”

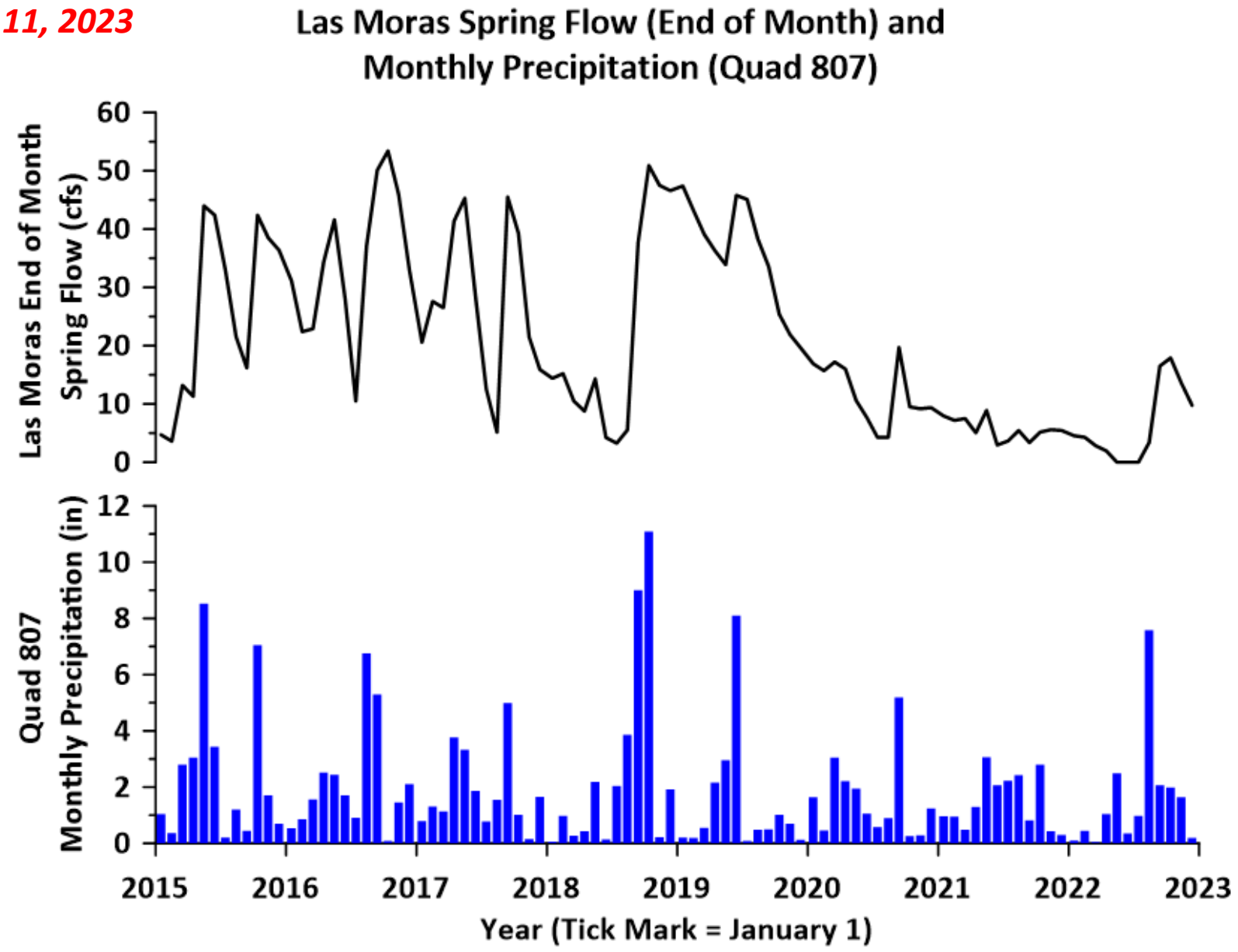
- “Cutbacks are needed so everyone has access to groundwater”
- Las Moras has not been flowing (aquifer is in “trouble”)
- Is there not as much water as we thought?
- Drought or no drought (“where is the data?”)
- Spring flowed in 2011, but not now (pumping has an effect)
- Area is becoming more arid

Analysis of Precipitation and Spring Flow

- Draft Technical Memorandum 23-16
  - June 11, 2023
  - ***Data Analysis of Precipitation and Spring Flow Related to Management Objectives and Simulation Thresholds***
- Tech Memo and supporting data available at:

  https://drive.google.com/drive/folders/1yXQ_WK4lZOt4891K7Oan7Ozbuamq-Jgu?usp=drive_link

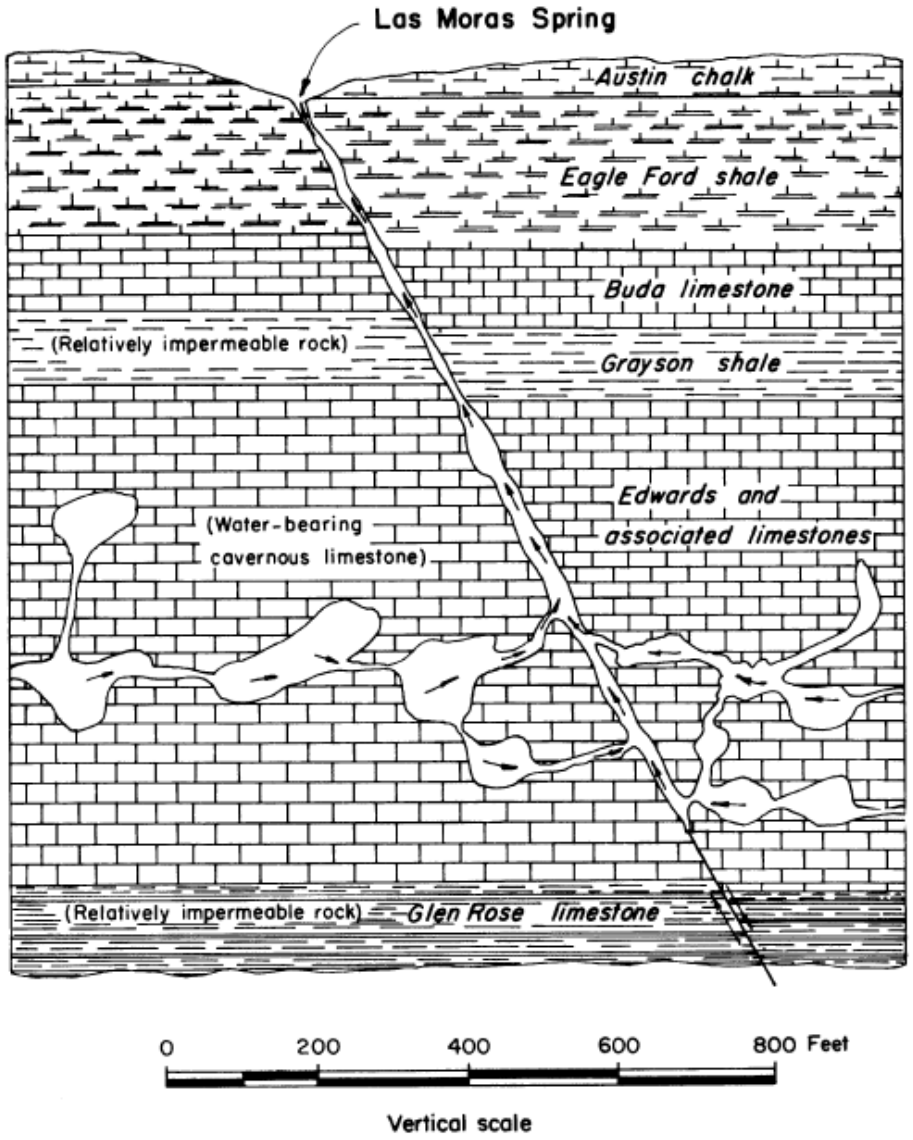
Figure 4, TM 23-16
June 11, 2023



Characterizing Aquifer Conditions

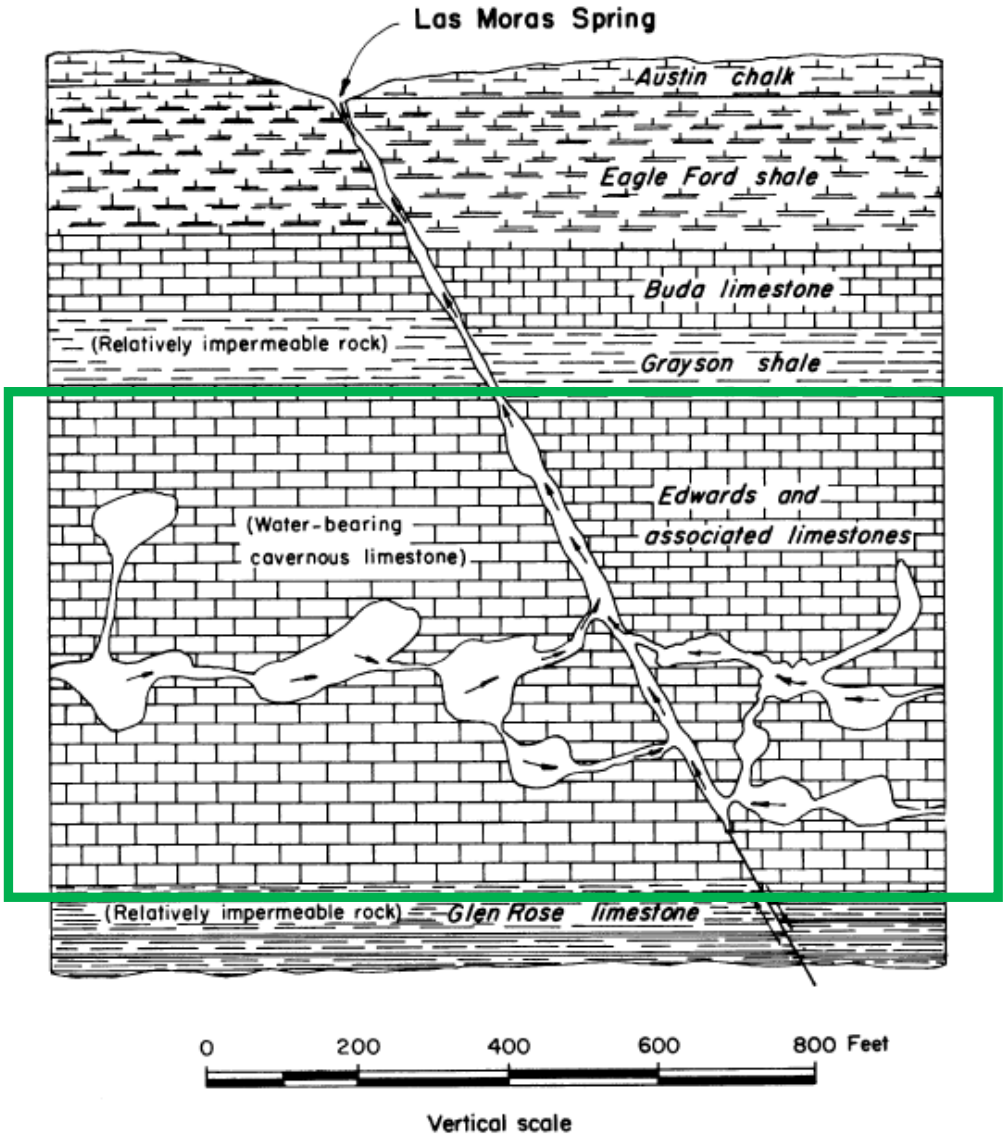
- Las Moras Spring flow
  - Natural outflow from aquifer
  - Flowing spring suggests “high” groundwater levels
- Groundwater level monitoring network
  - Groundwater levels are correlated with spring flow
    - See management plan (Zones 1, 2, and 3)
  - When spring stops flowing, groundwater levels can be used to characterize how much “recovery” is needed to restore spring flow

Las Moras Springs Conceptual Diagram
From Bennett and Sayre (1962, Figure 6, pg. 72)



http://www.twdb.texas.gov/publications/reports/bulletins/doc/Bull.htm/B6216.asp

Las Moras Springs Conceptual Diagram
From Bennett and Sayre (1962, Figure 6, pg. 72)



Edwards Aquifer

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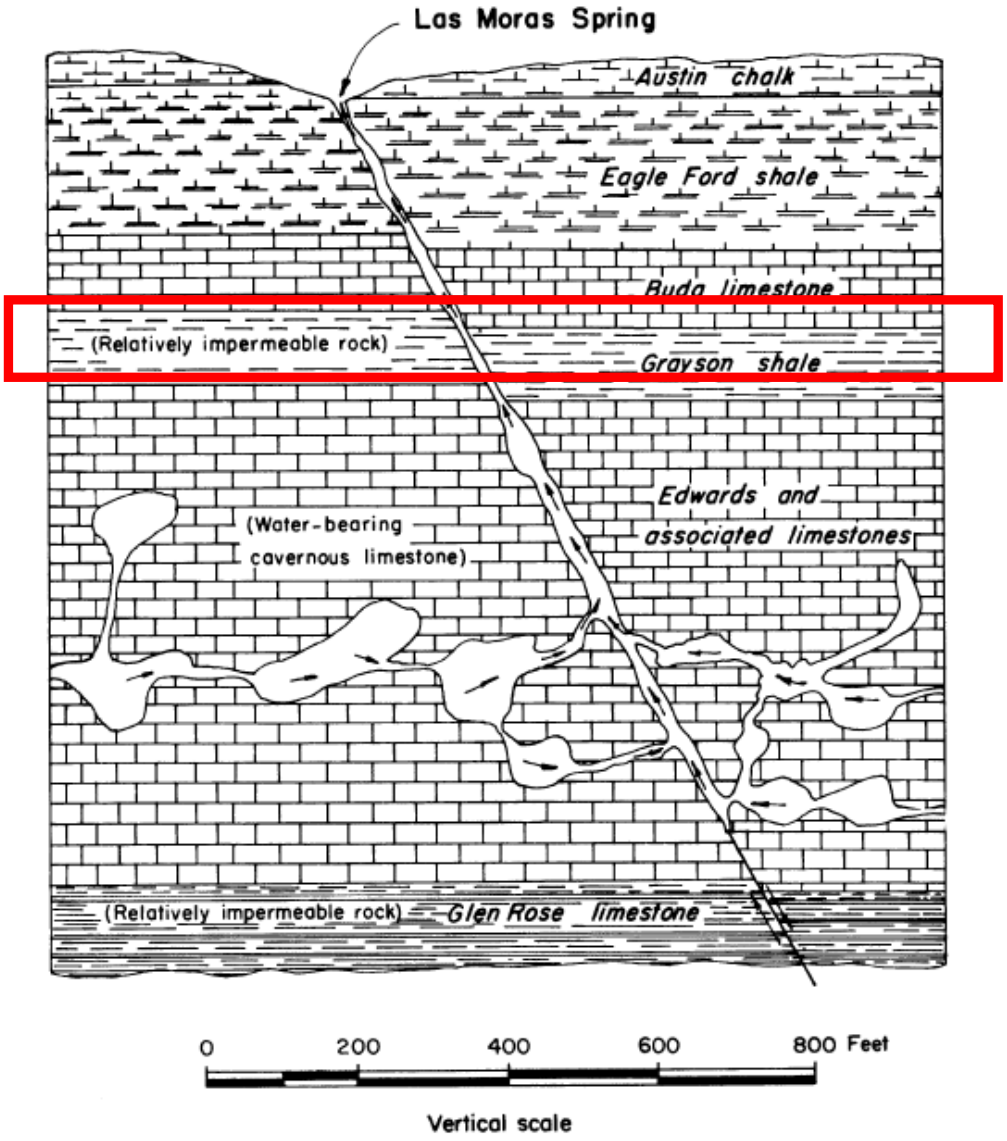

Confining Layer

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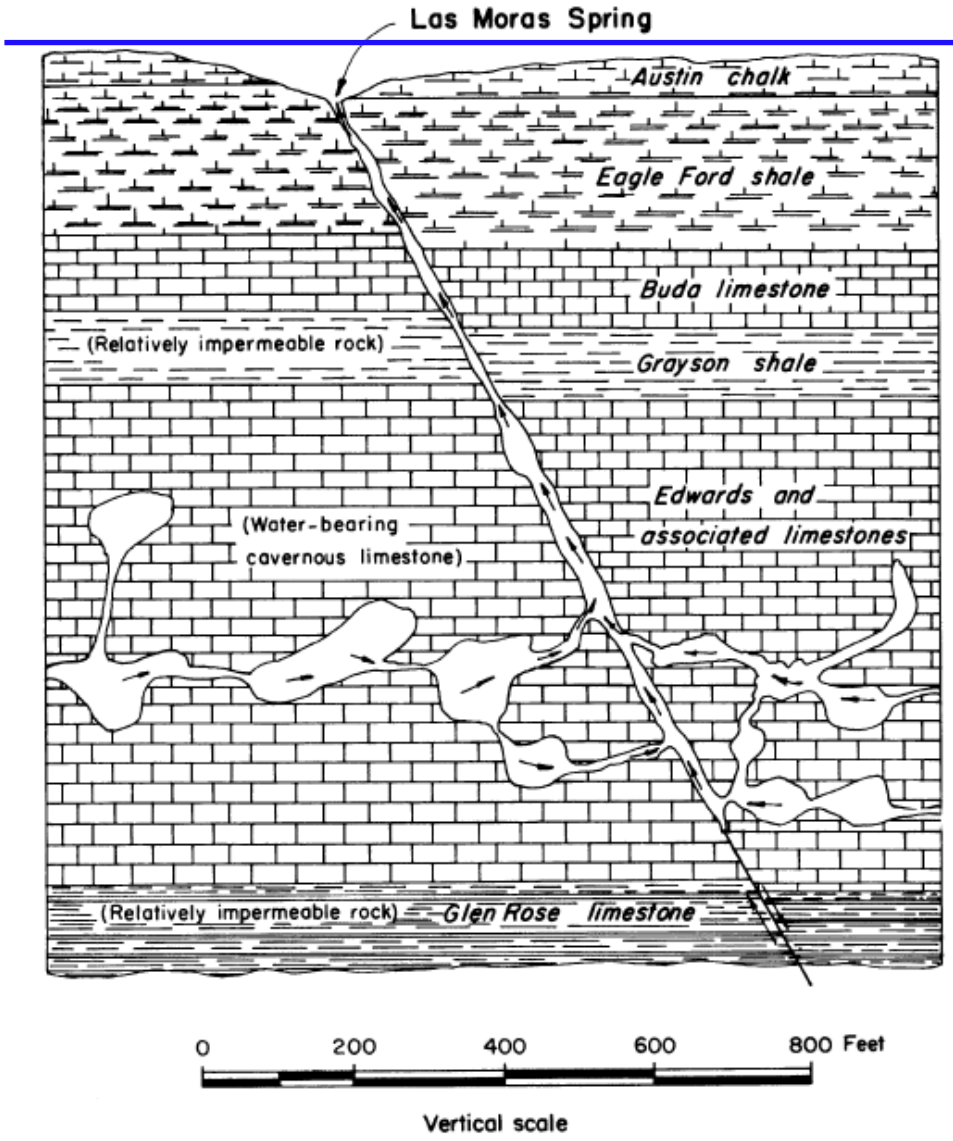

Edwards Aquifer Water Level (pressure head) Above ground surface Flowing Spring (not to scale)

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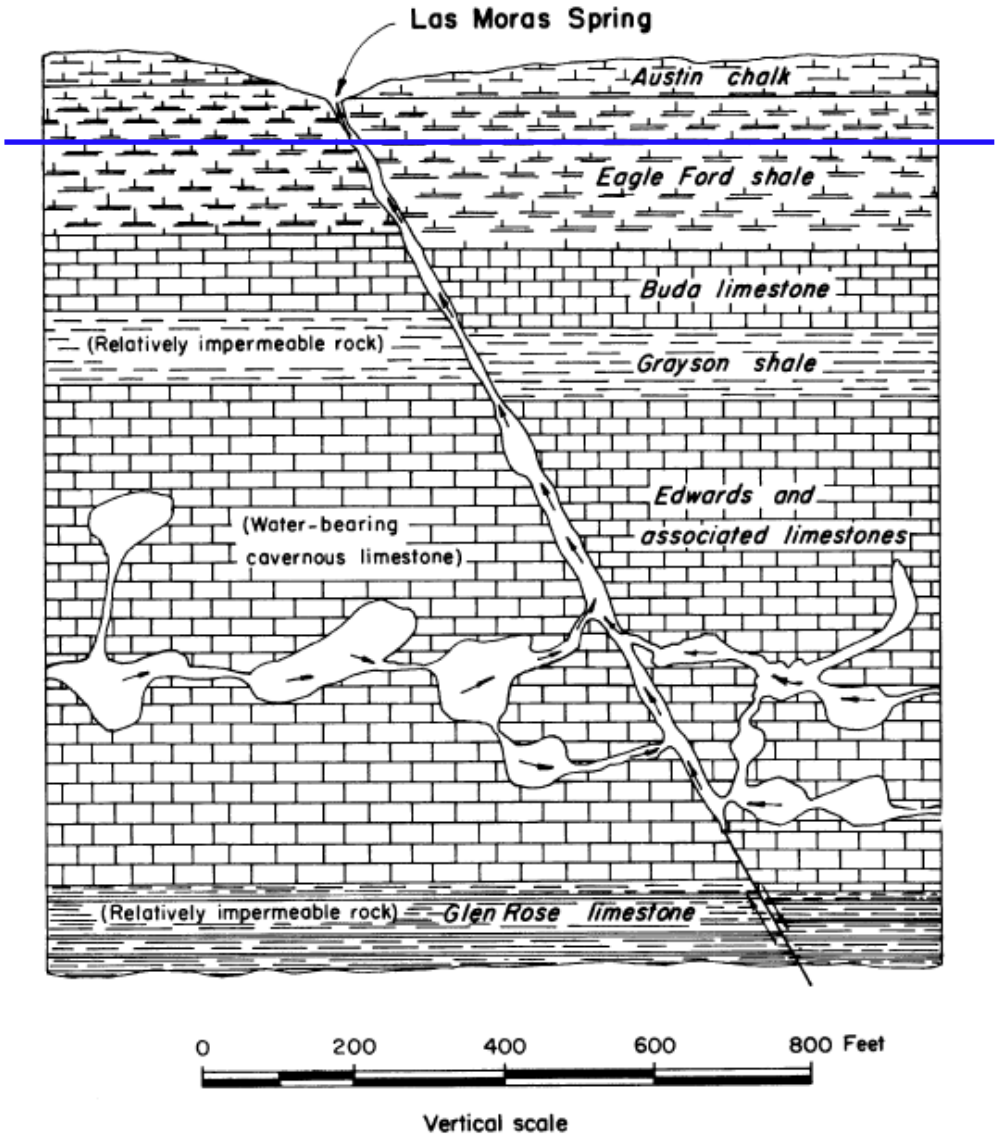


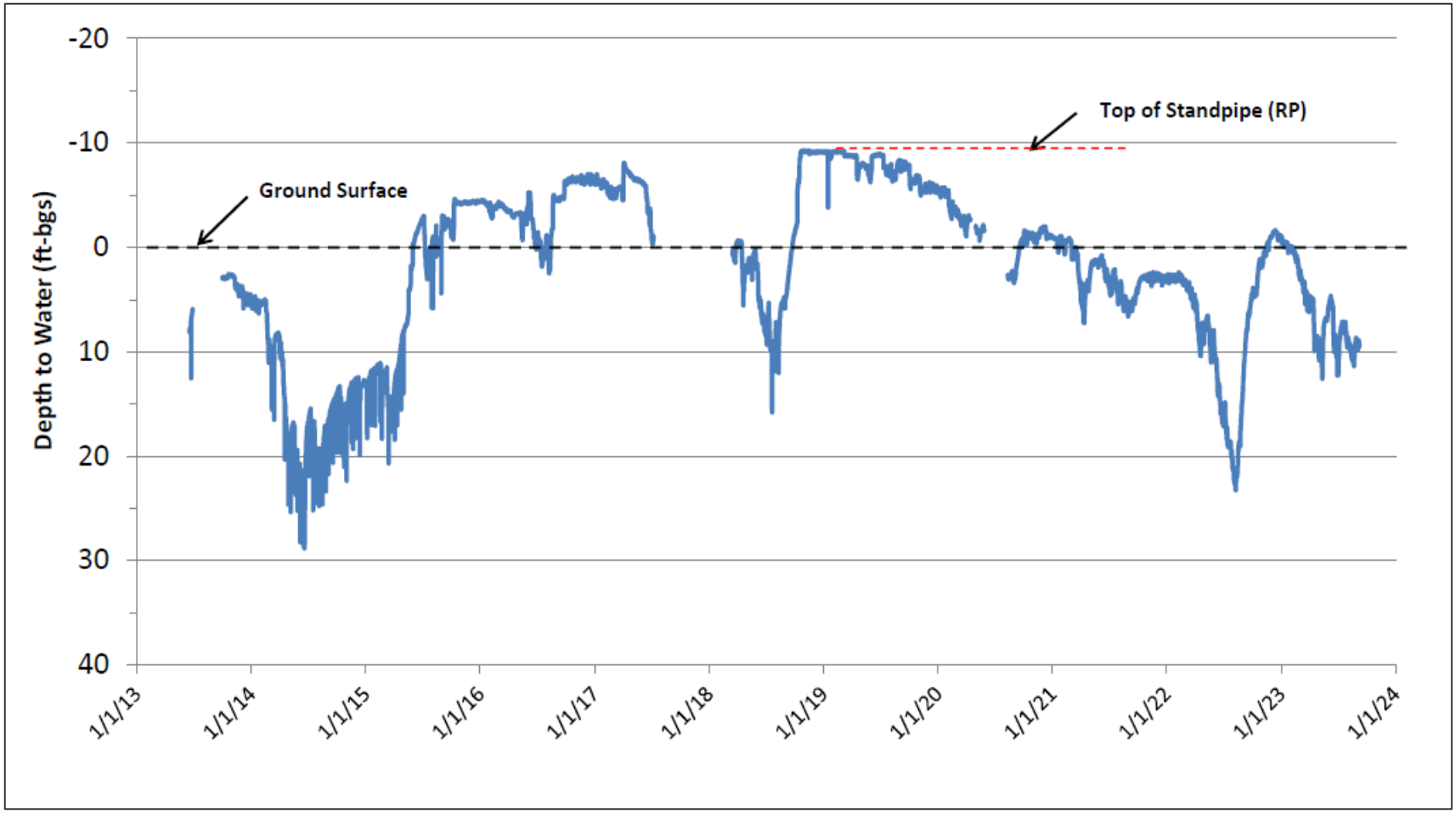
Edwards Aquifer Water Level (pressure head) Below ground surface No Spring Flow (not to scale)

Dooley Well

KCGCD Board Meeting
Agenda Item 11
September 13, 2023

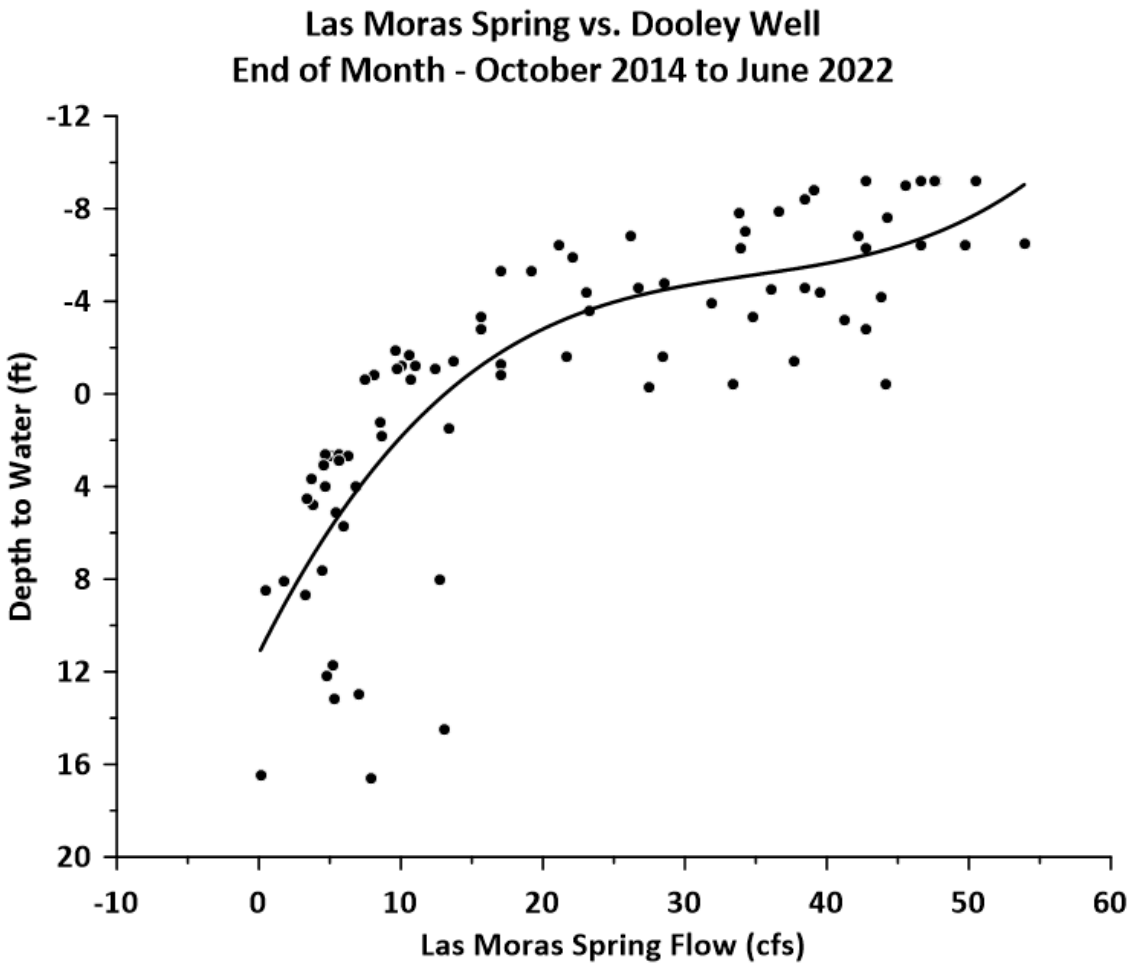
Dooley Well (70-37-704)

Depth to Water (ft- bgs)



PRELIMINARY

KCGCD Board Meeting
Agenda Item 13
September 15, 2022
(Included in Management Plan in Appendix A-2)



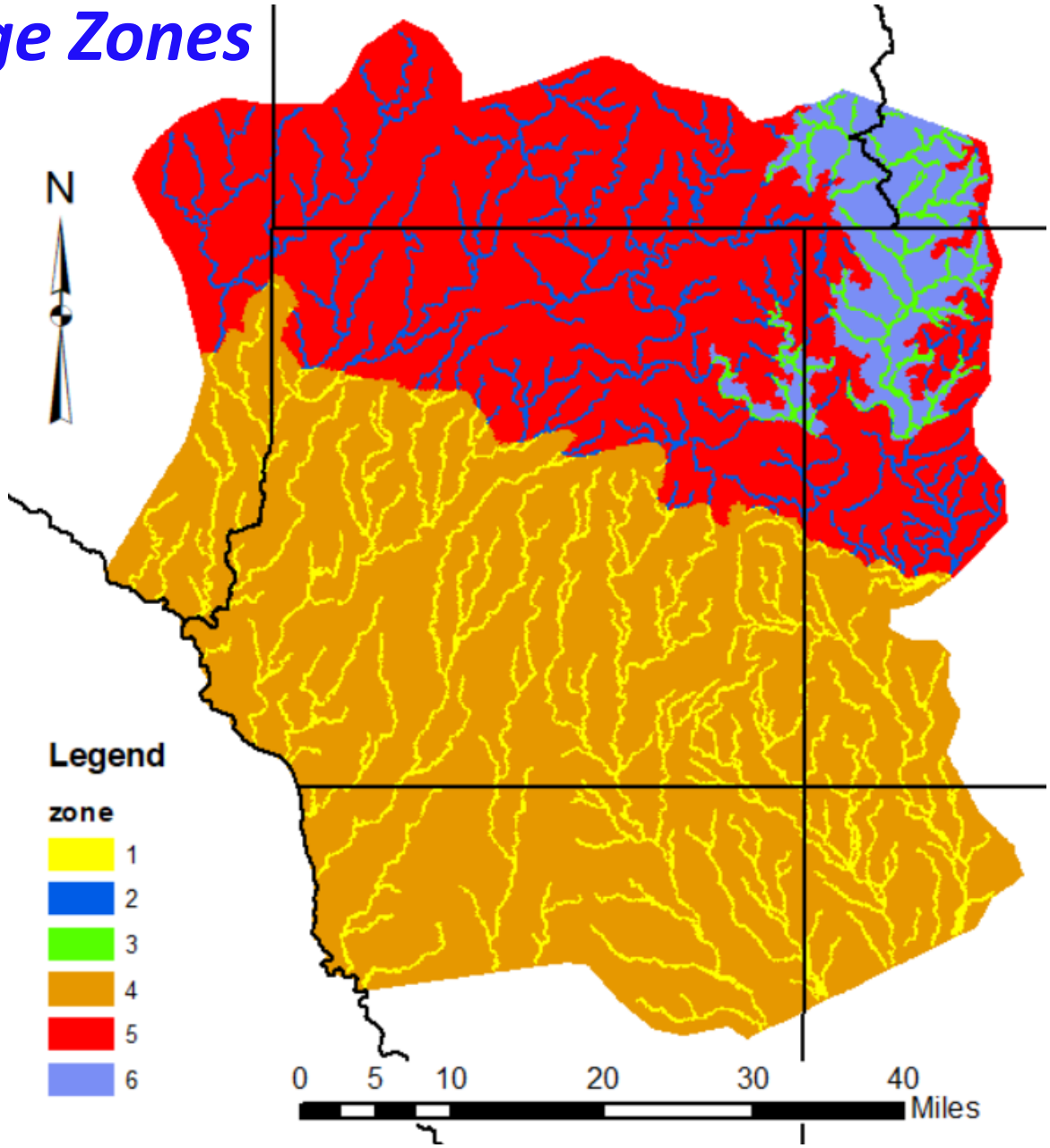
Note that lowest DTWs in 2014 are not plotted due to lack of spring flow data (failure of old gage)

What Causes Pressure Head in Edwards Aquifer?

- Recharge in Edwards outcrop area
  - North of Las Moras Spring
- Annual recharge varies based on rainfall
  - Technical Memorandum 23-10 v2 (April 18, 2023)

https://drive.google.com/drive/folders/1UNDwJiWj80qmsfL-dqEnDKMd7g1it5vC?usp=drive_link

Recharge Zones

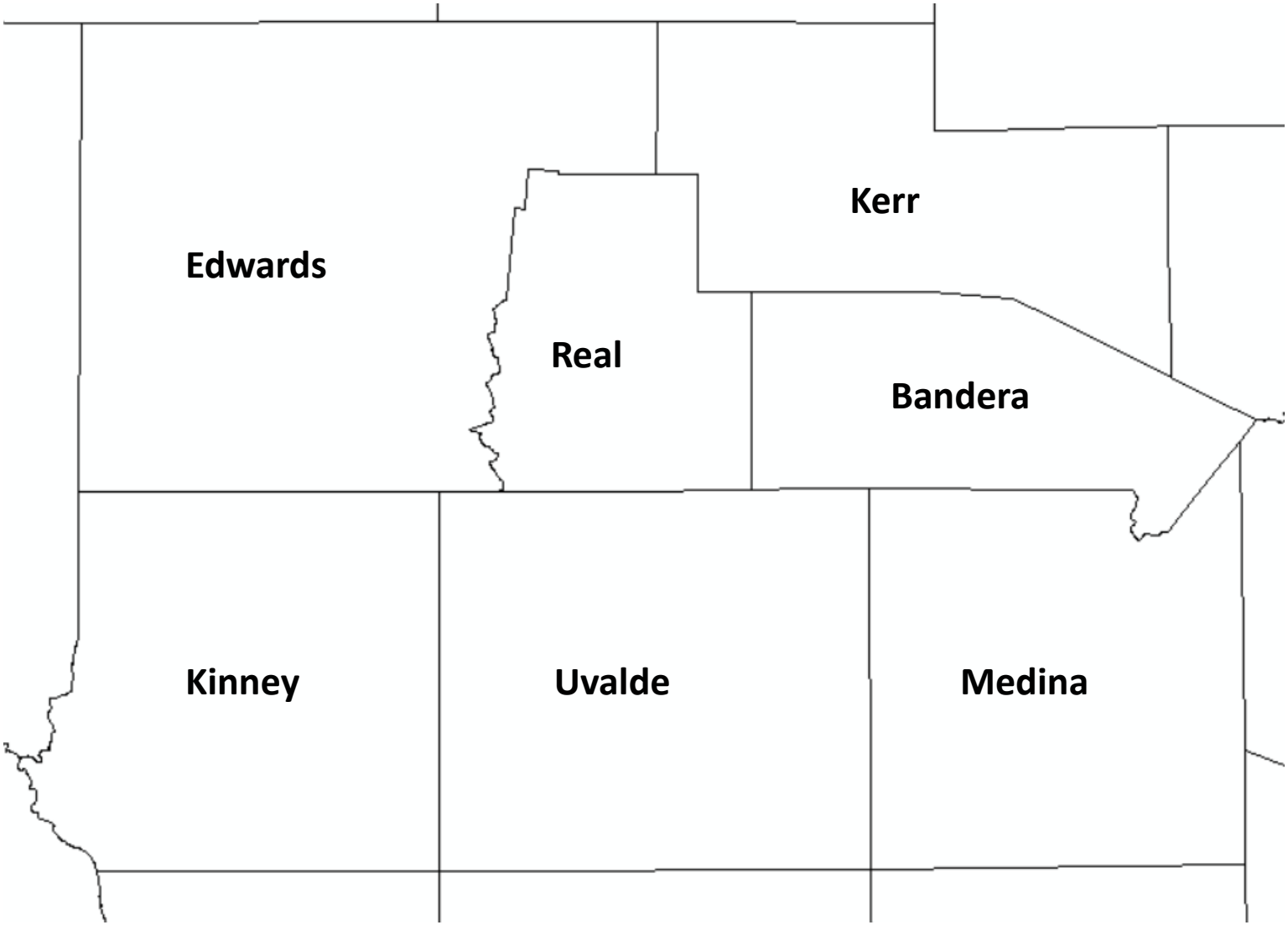


Recharge for Zones 2 and 5 (1995 to 2021)

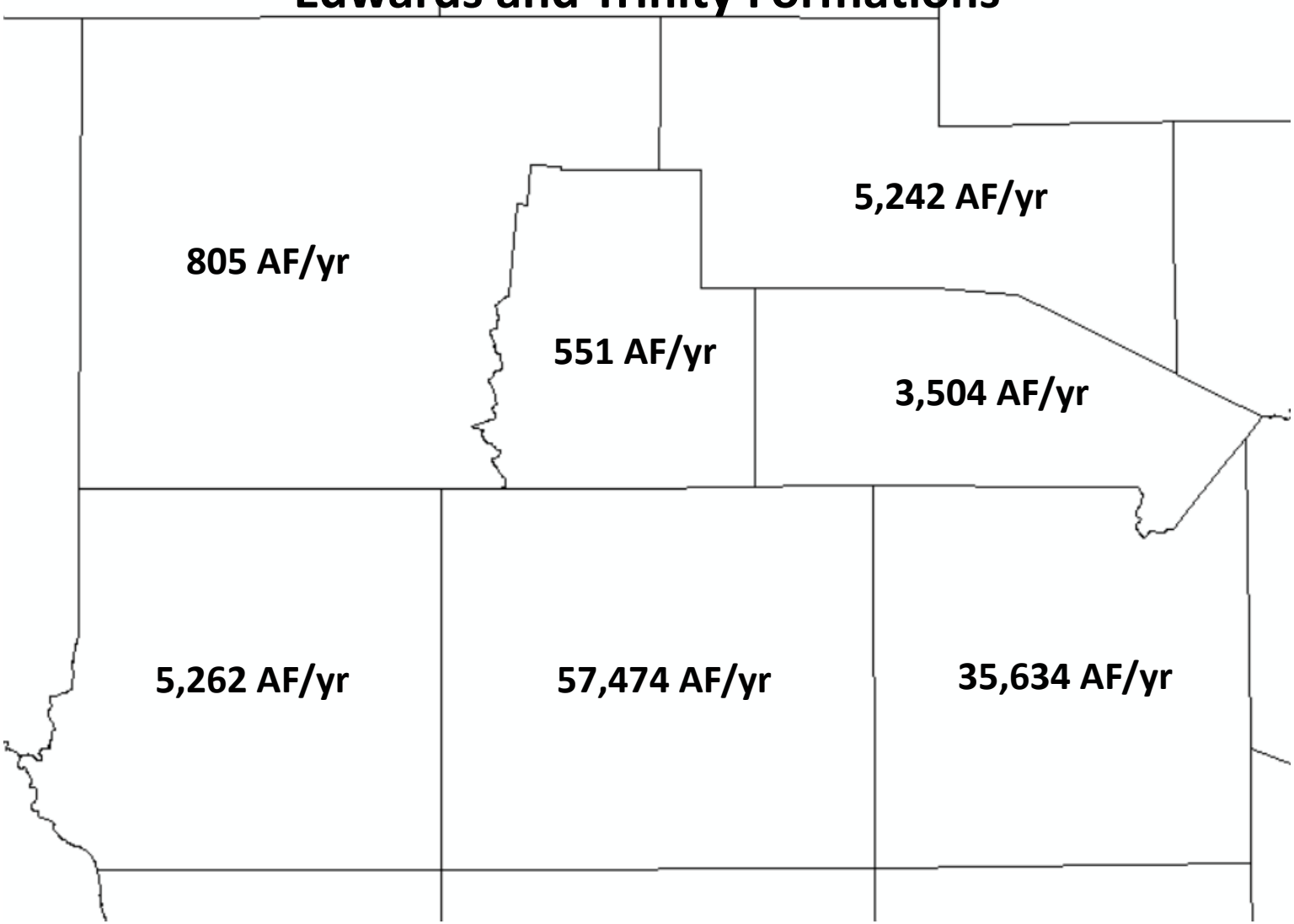
- Annual rainfall range = 11 in/yr to 41 in/yr
  - Average = 22.25 in/yr
- Total recharge area = about 711,000 acres

- Minimum: 27,949 AF/yr (39 cfs) or 0.5 in
- Average: 78,859 AF/yr (106 cfs) or 1.3 in
- Maximum: 147,849 AF/yr (204 cfs) or 2.5 in

Average Recharge = 5.8% of Average Rainfall

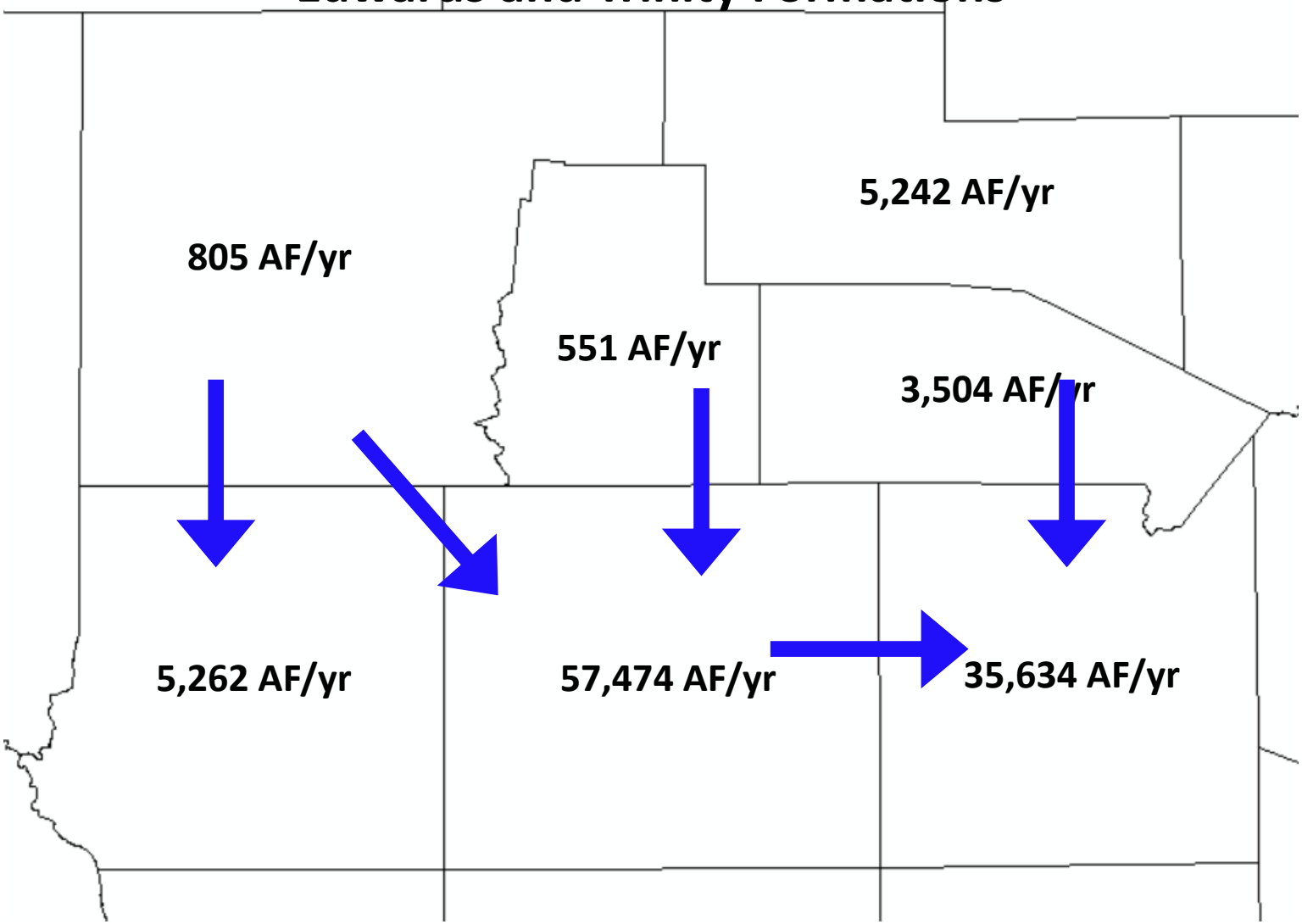

Edwards
Kerr
Real
Bandera
Kinney
Uvalde
Medina

2020 Groundwater Pumping Estimates (TWDB)
Edwards and Trinity Formations



http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp

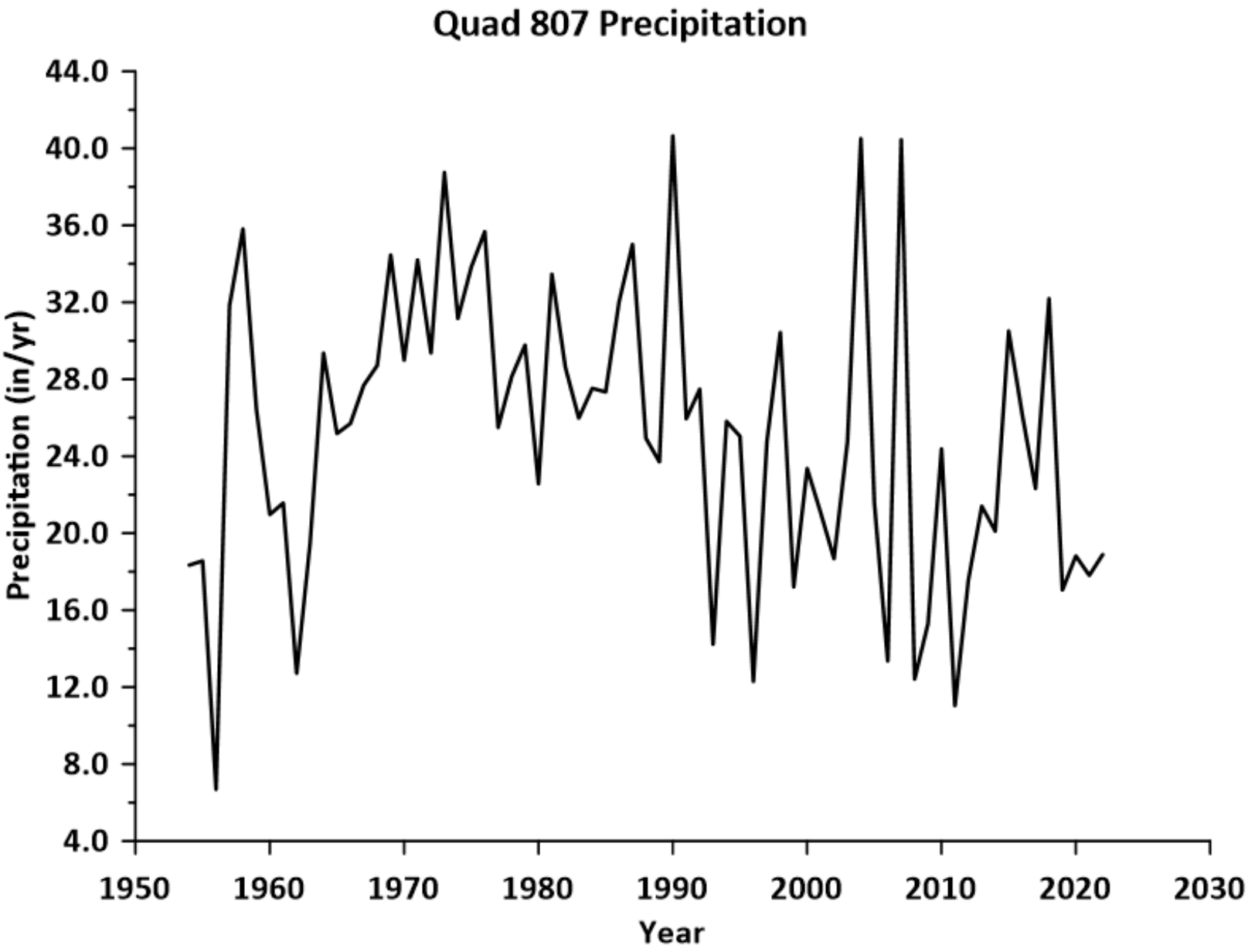
2020 Groundwater Pumping Estimates (TWDB)
Edwards and Trinity Formations

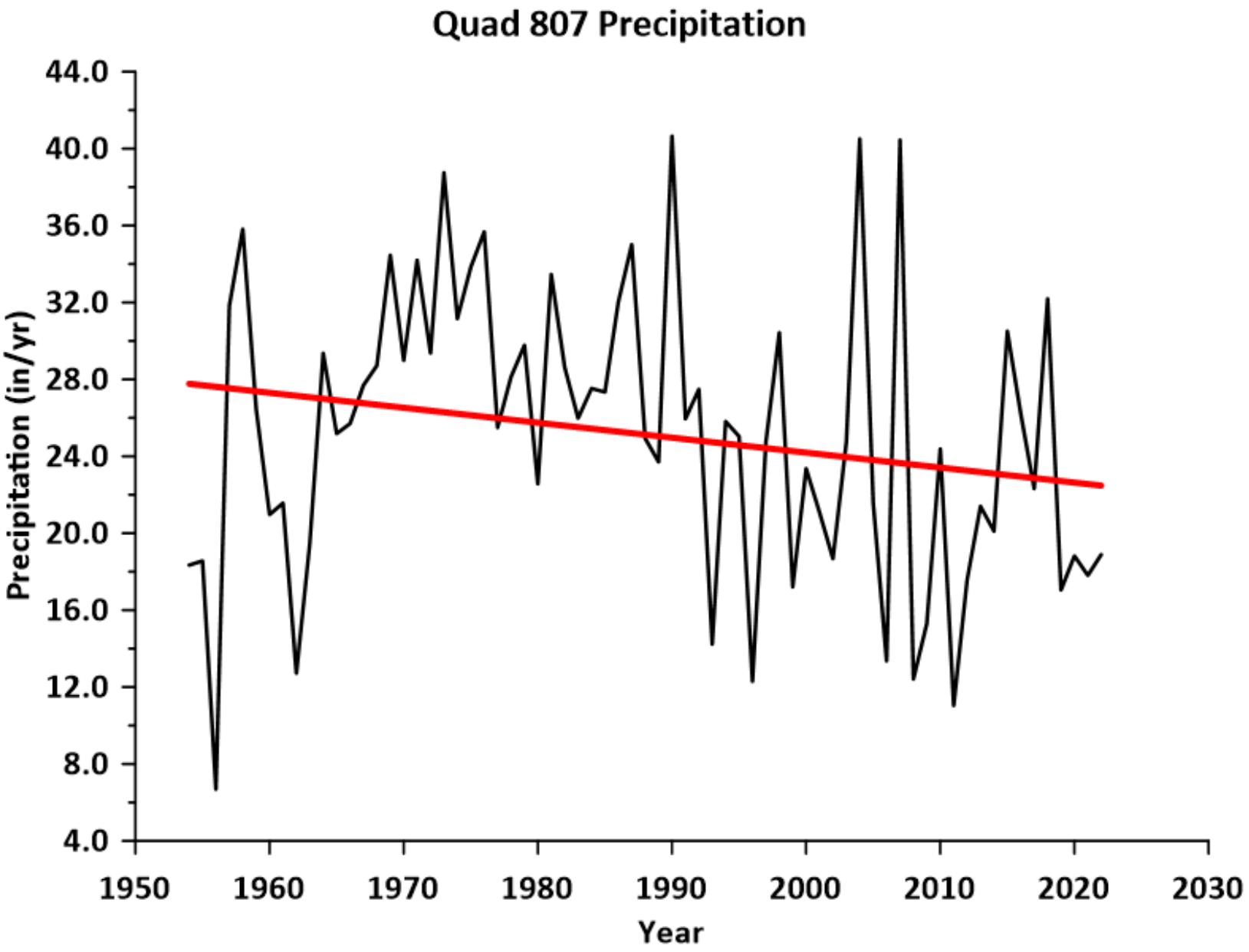


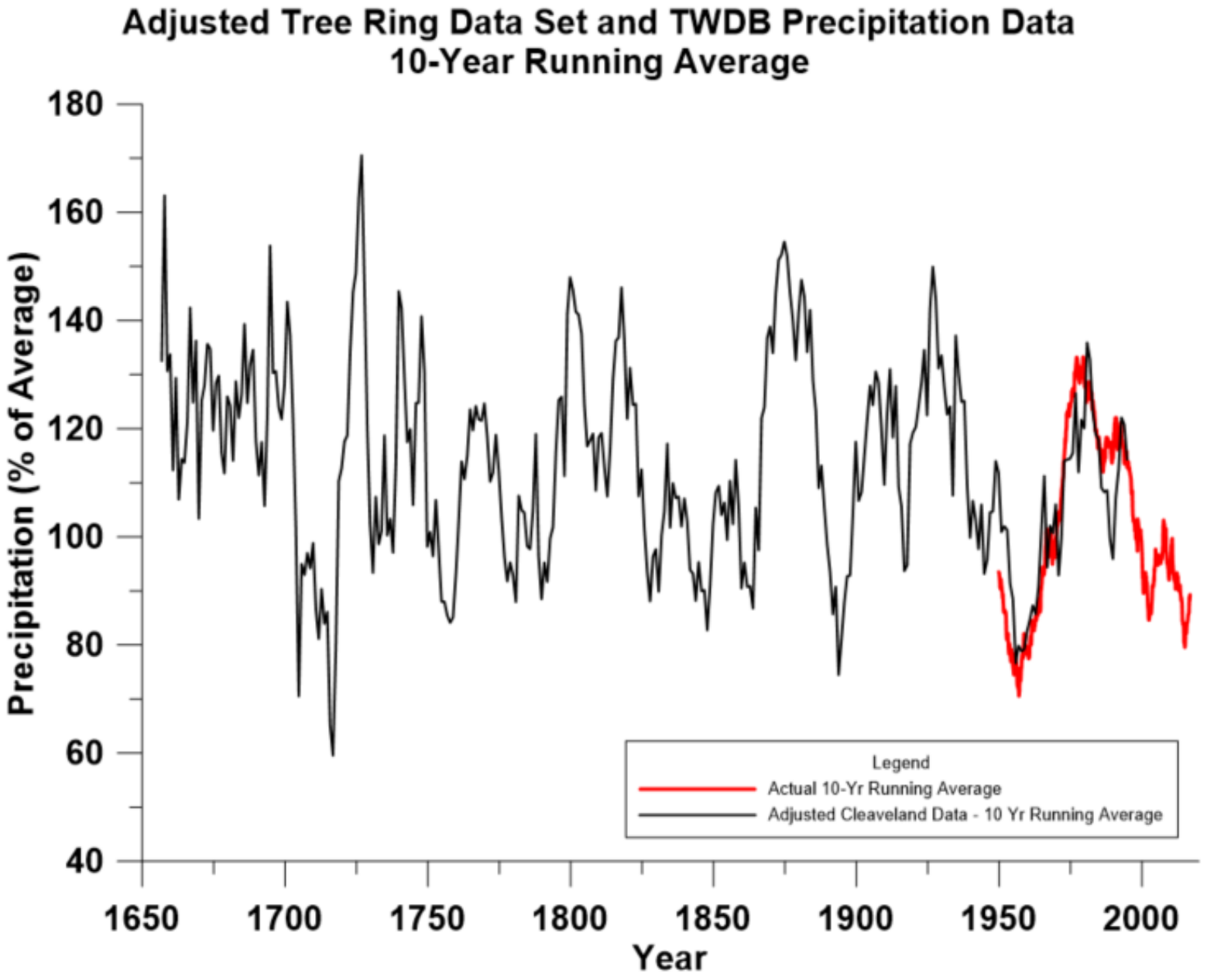
http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp

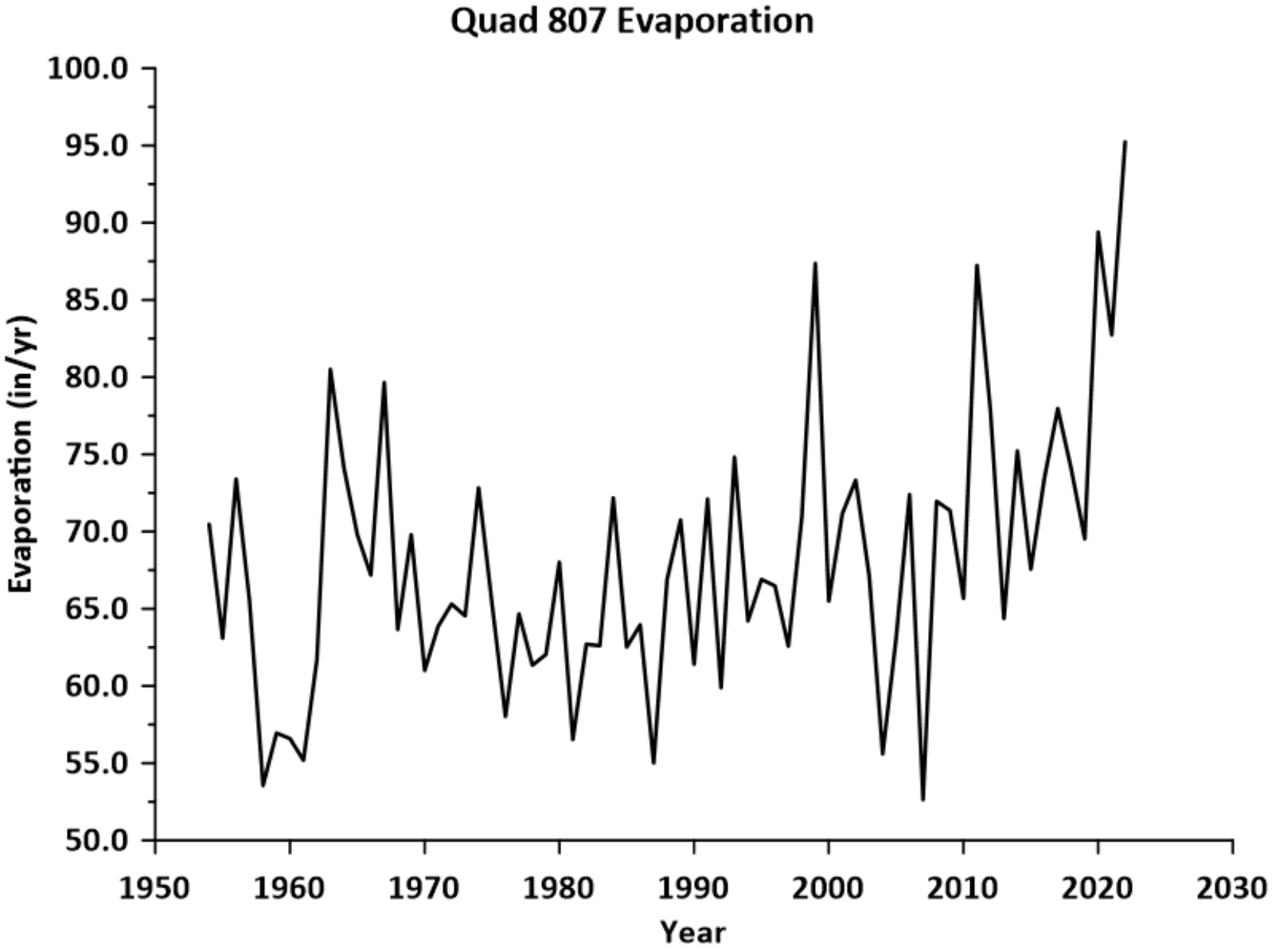
Increased Aridity?

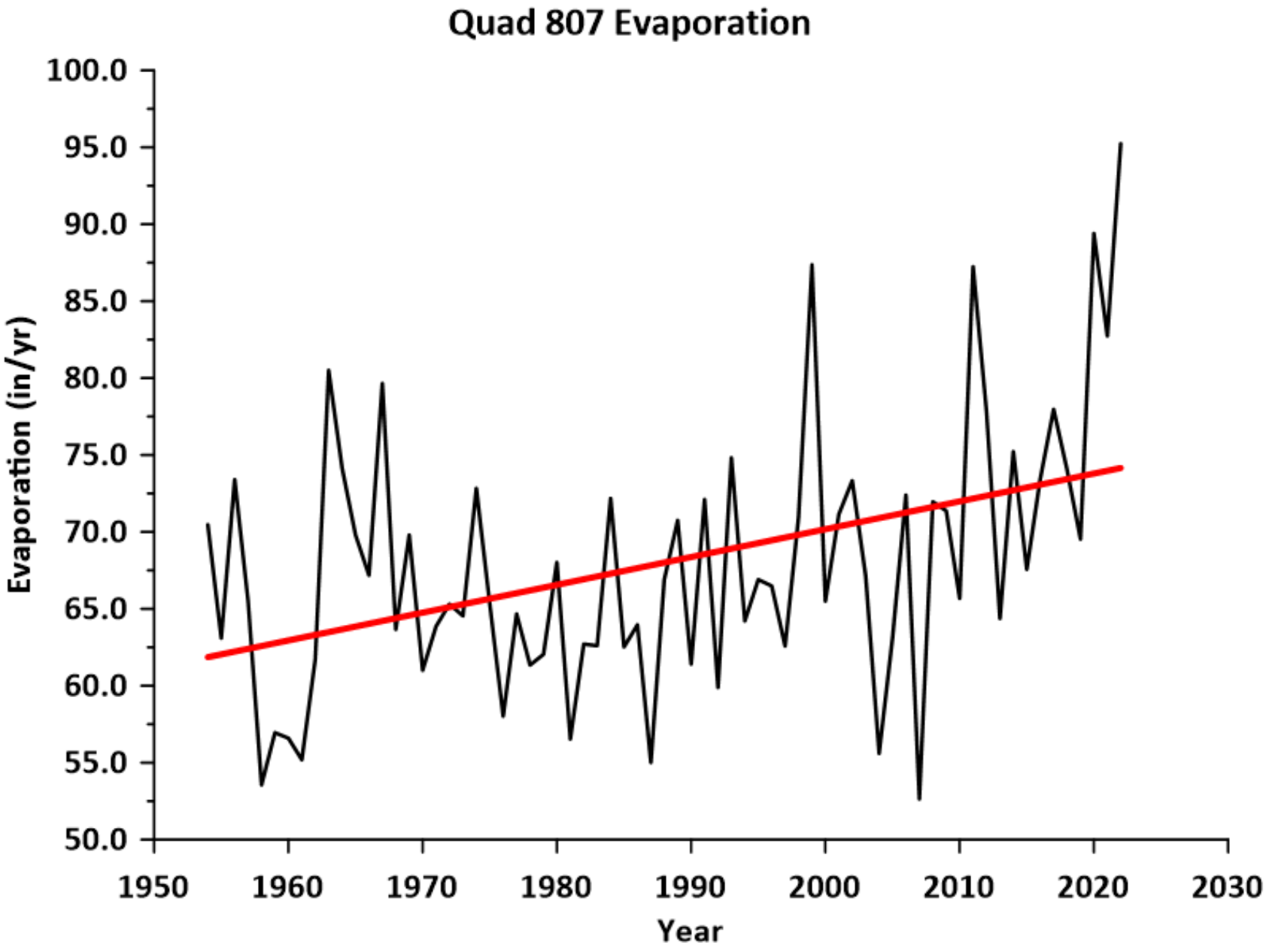
- Data in Kinney County suggests aridity is increasing
  - Data analysis was completed as part of model development (irrigation demands)
- Calculating irrigation “needs” start with precipitation and evaporation data (Quad 807)
  - https://waterdatafortexas.org/lake-evaporation-rainfall
  - “Needs” = Crop factor * (evaporation – precipitation)
- Pumping can be calculated as follows
  - Calculated Pumping = “Needs” * Irrigated Acreage
- Irrigated acreage from 2022 satellite analysis (in management plan)
- Calculated pumping compared with permit reports

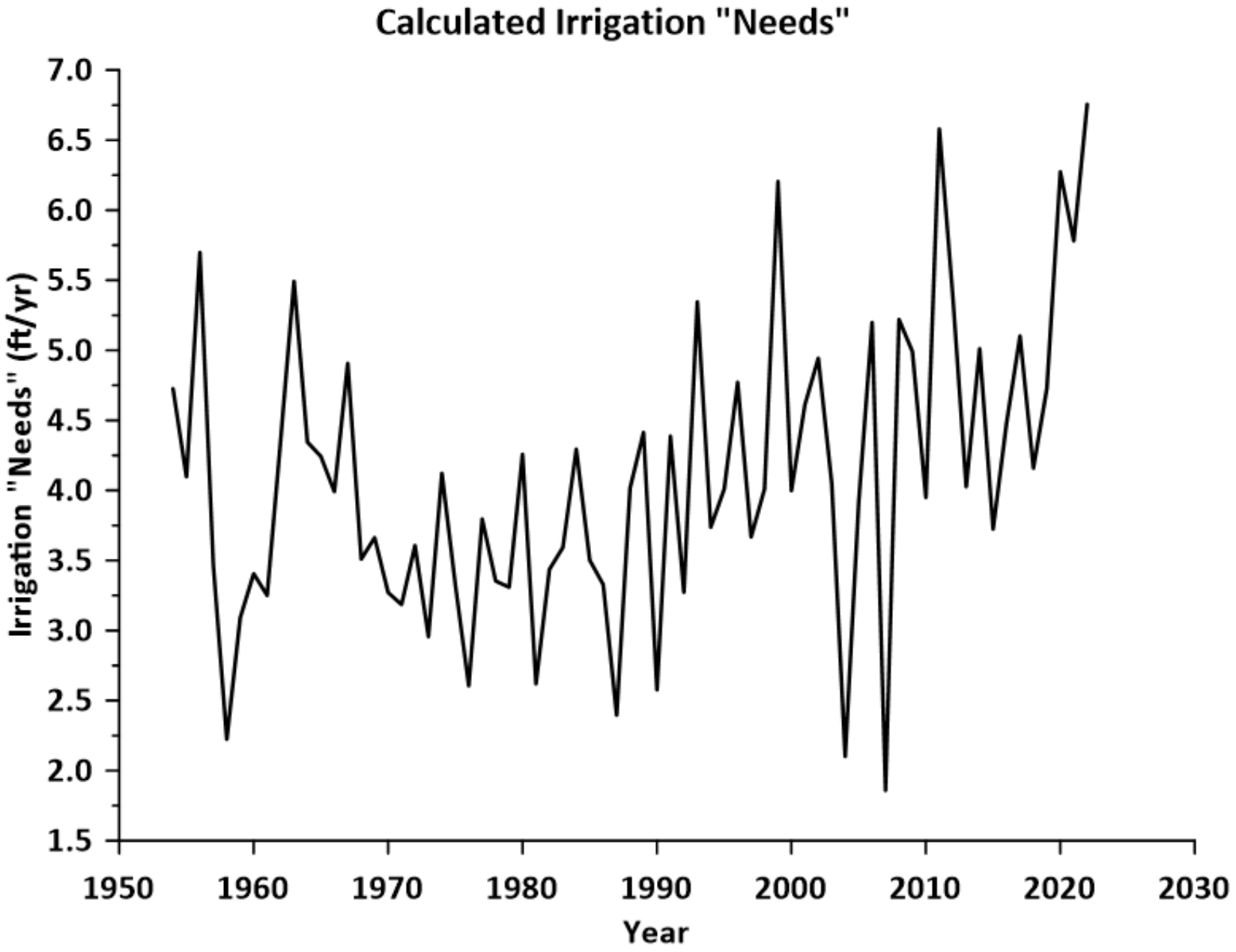

Quad 807 Precipitation
Precipitation (in/yr)
44.0
40.0
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year

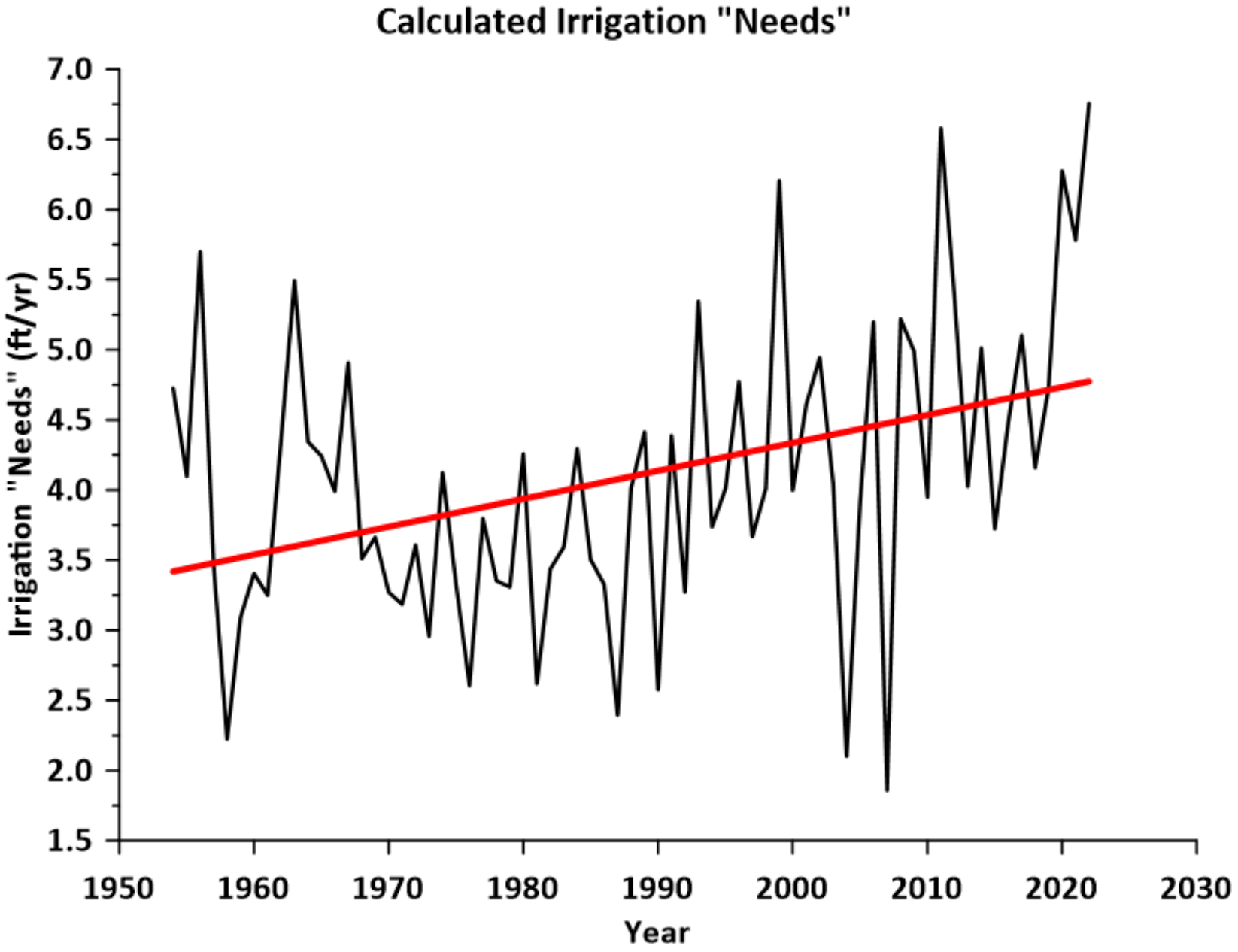

Quad 807 Precipitation
Precipitation (in/yr)
44.0
40.0
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year


Adjusted Tree Ring Data Set and TWDB Precipitation Data
10-Year Running Average
Precipitation (% of Average)
180
160
140
120
100
80
60
40
1650
1700
1750
1800
1850
1900
1950
2000
Year
Legend
Actual 10-Yr Running Average
Adjusted Cleaveland Data - 10 Yr Running Average


Quad 807 Evaporation
Evaporation (in/yr)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year

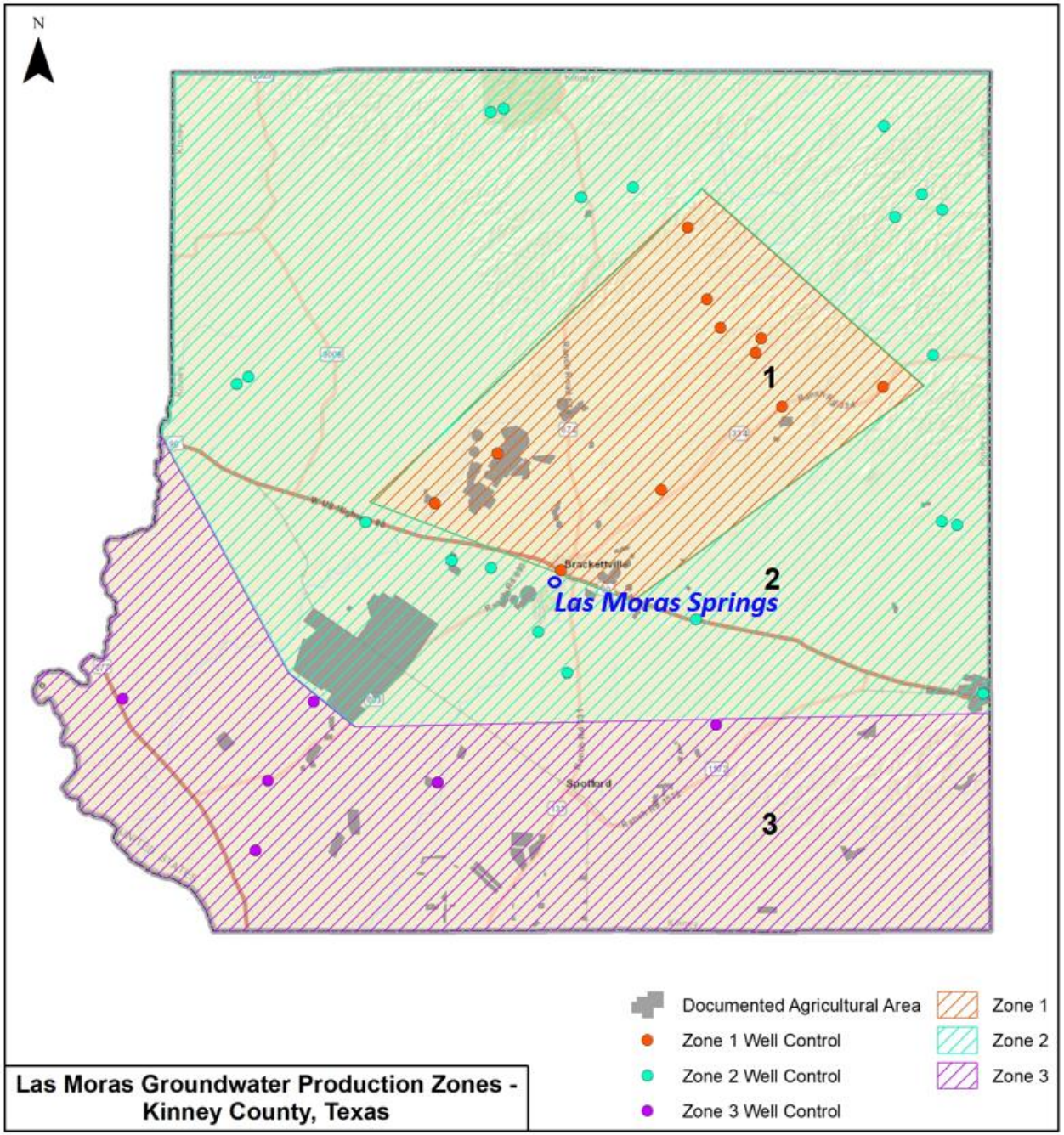

Quad 807 Evaporation
Evaporation (in/yr)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year


Calculated Irrigation "Needs"
Irrigation "Needs" (ft/yr)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year

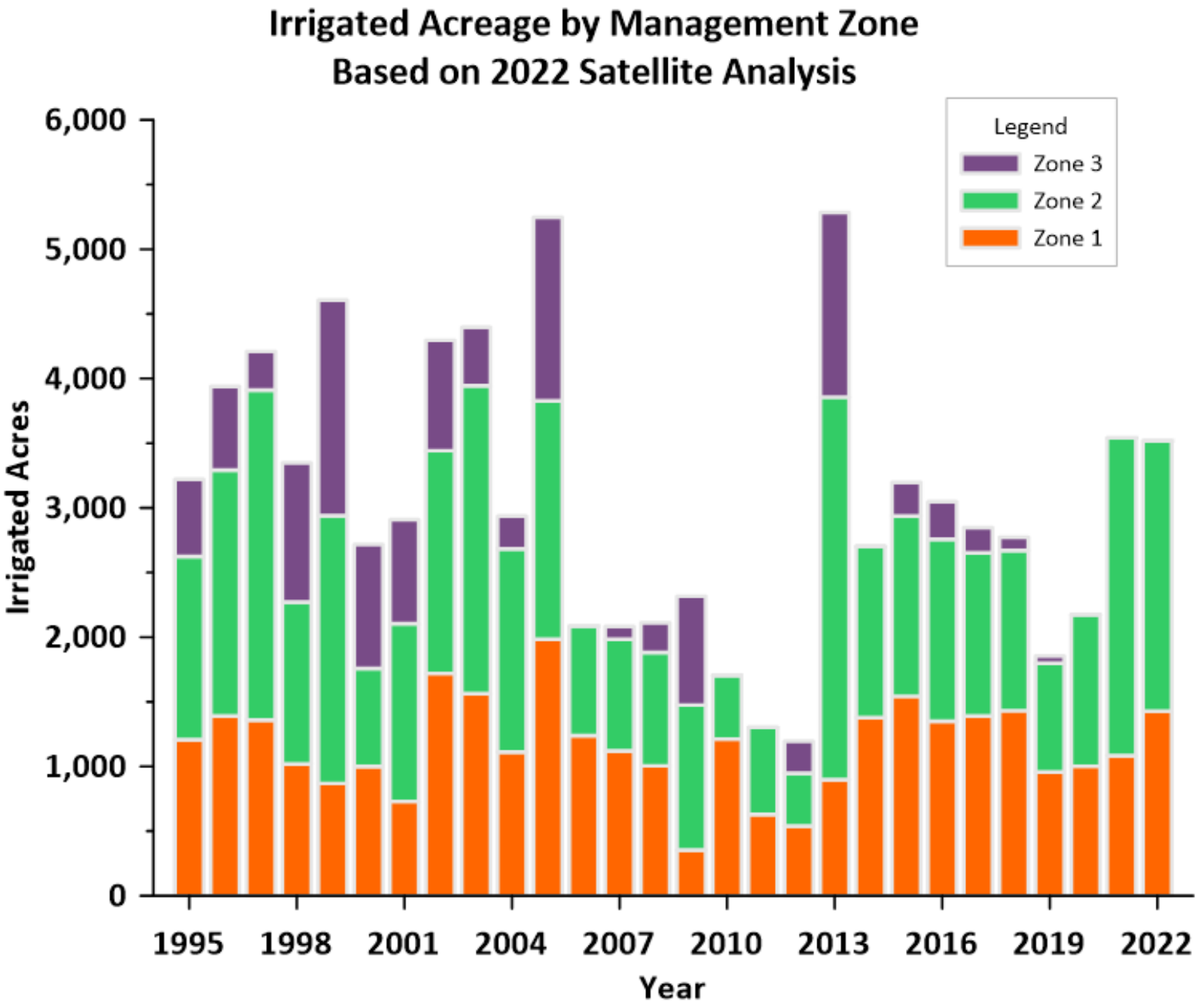

Calculated Irrigation "Needs"
Irrigation "Needs" (ft/yr)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year

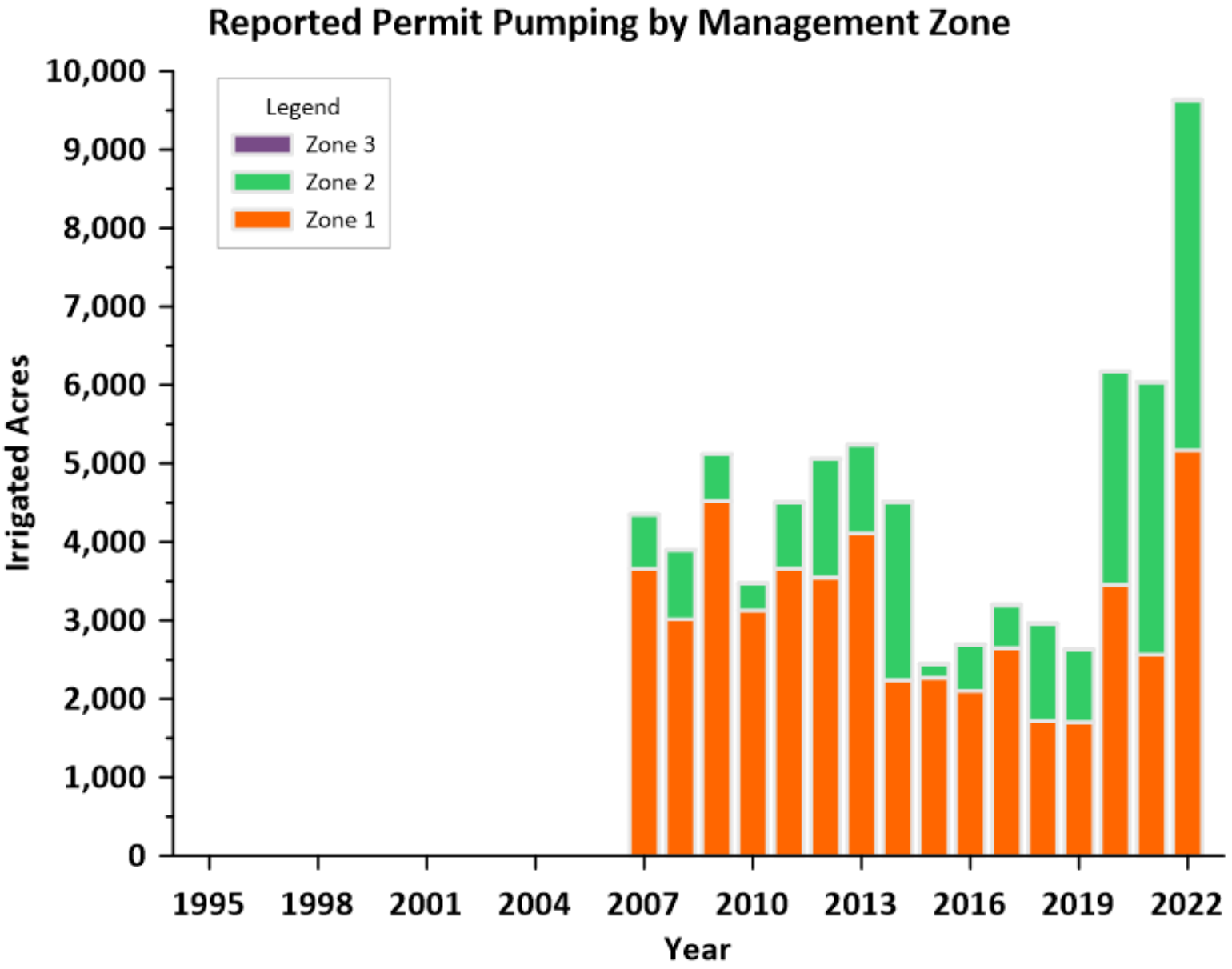
Irrigated Acres

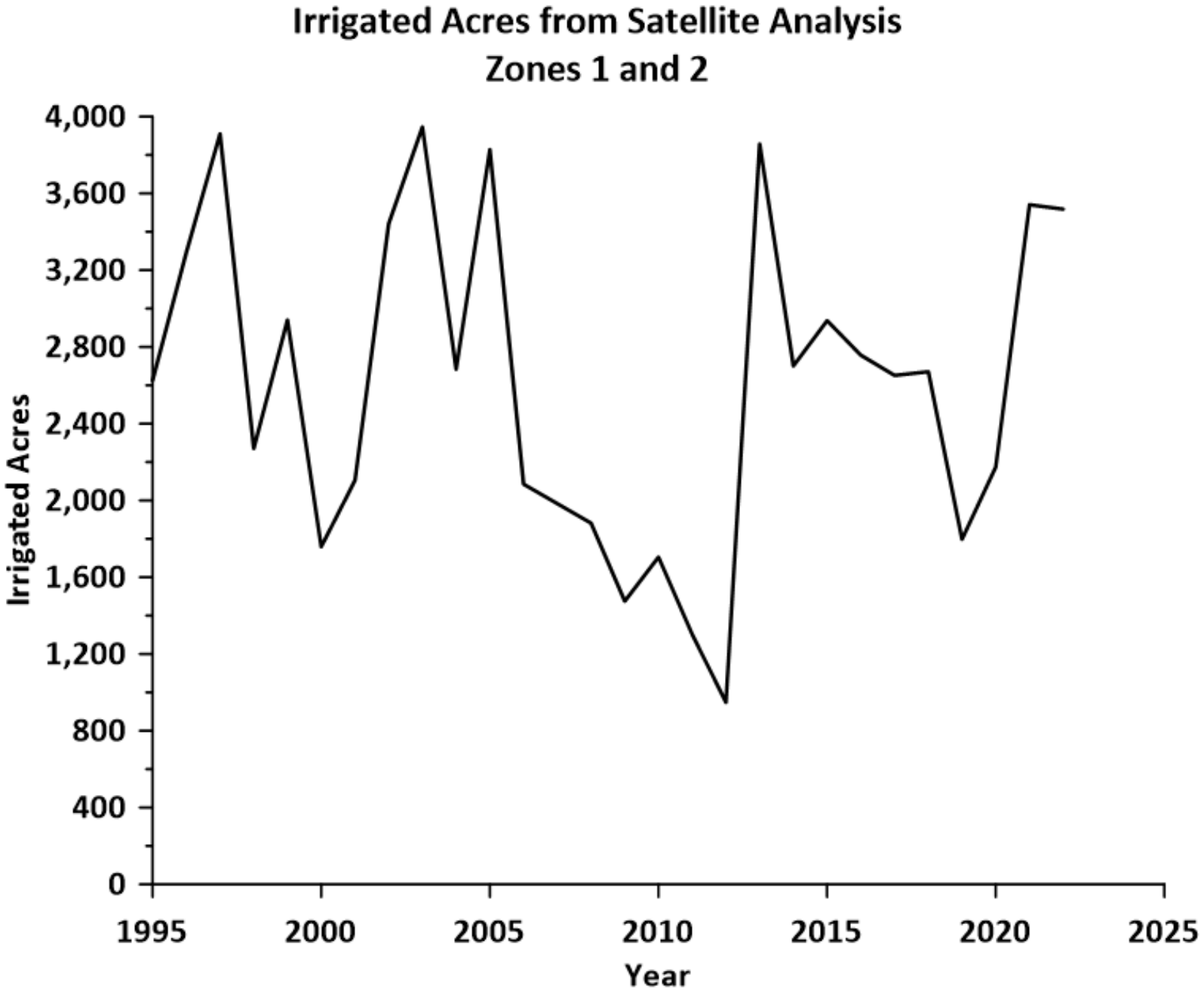
- Satellite Analysis completed in 2022
  - Reliability of permit reports has been raised as an issue in 2022
  - Satellite work provided an opportunity to compare permit reports and extend record
    - 1995 to 2022 for satellite results
    - 2007 to 2022 for metered data
  - Surprised to hear criticism related to using estimates from satellite work
- Correlation between groundwater level monitoring data and spring flow data yielded preliminary map of management zones
  - Zone 1 = strong correlation to Las Moras
  - Zone 2 = moderate correlation to Las Moras
  - Zone 3 = weak or no correlation to Las Moras
- Page 6 of management plan
  - Details and data in Appendices A-1, A-2, A-3 of management plan

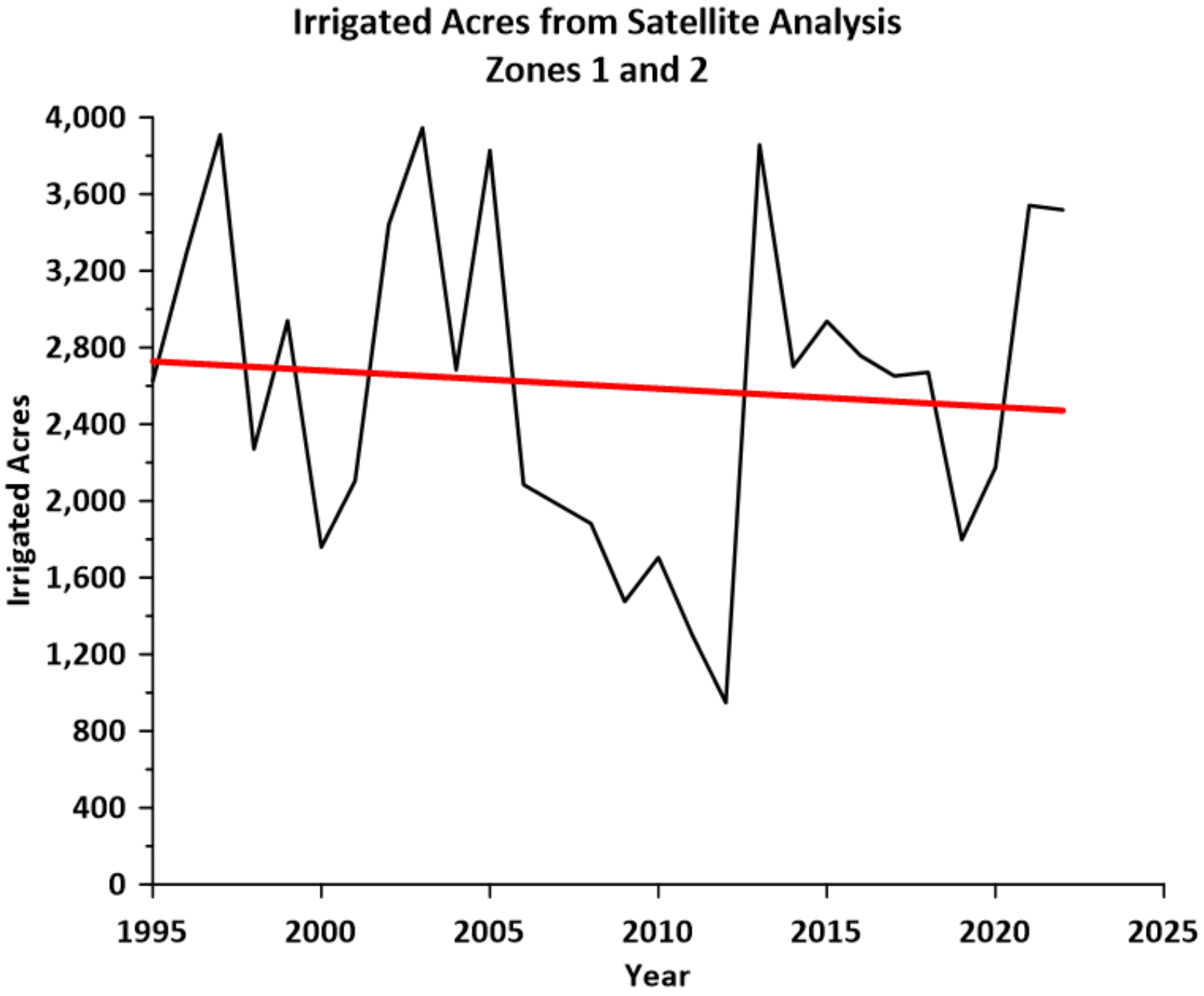


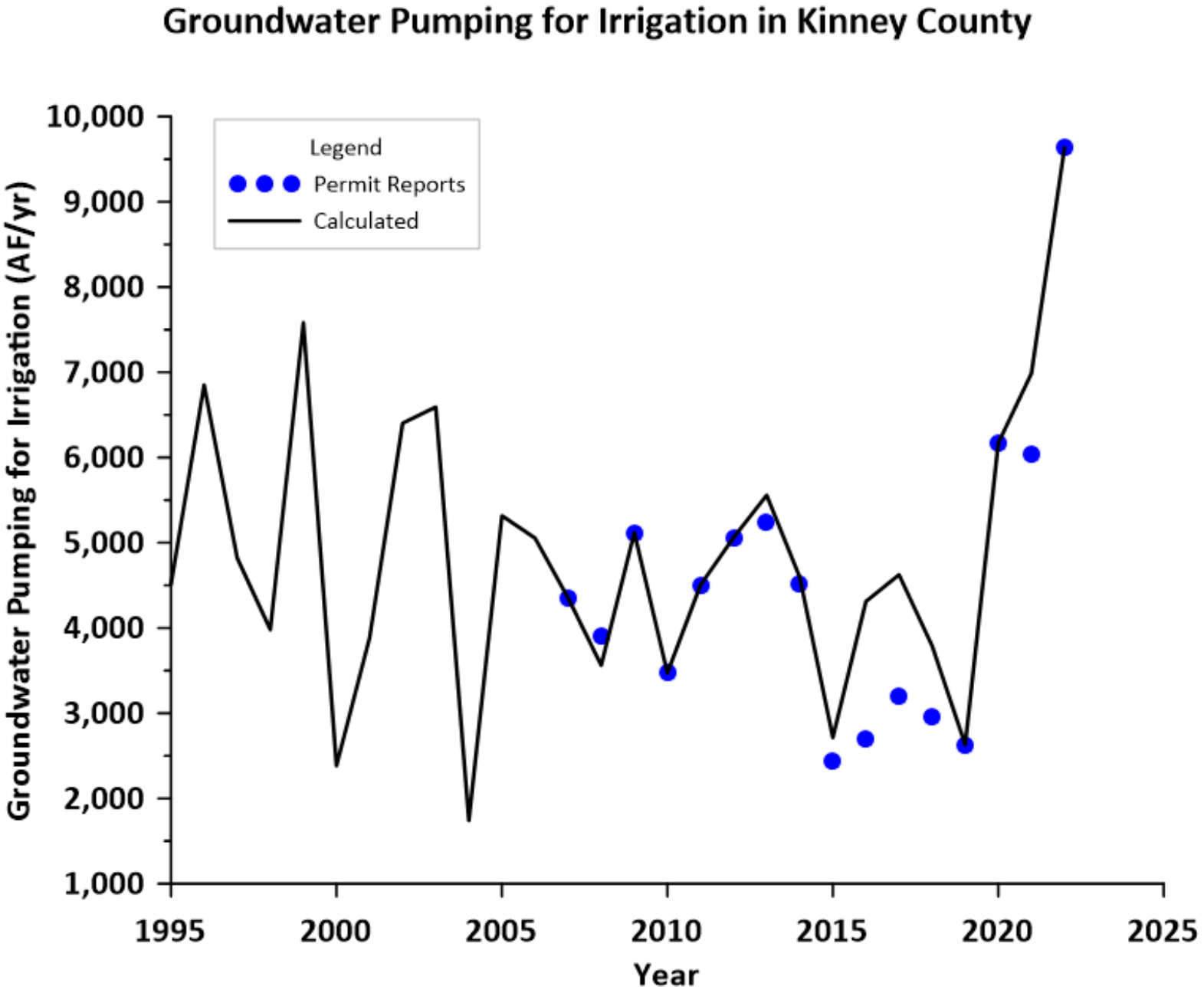
Las Moras Groundwater Production Zones - Kinney County, Texas

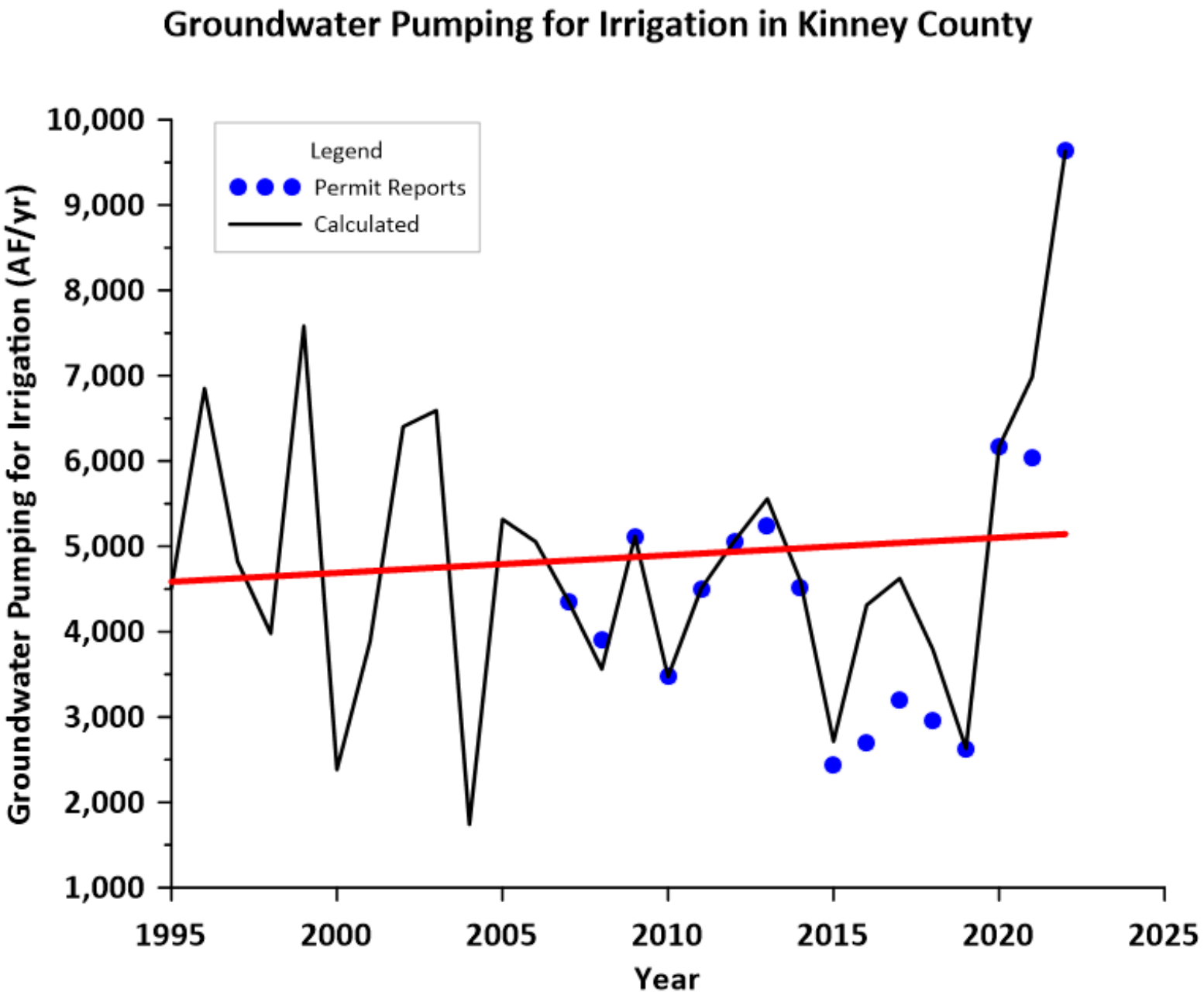

Irrigated Acreage by Management Zone
Based on 2022 Satellite Analysis
Legend
Zone 3
Zone 2
Zone 1
Irrigated Acres
6,000
5,000
4,000
3,000
2,000
1,000
0
1995
1998
2001
2004
2007
2010
2013
2016
2019
2022
Year


Reported Permit Pumping by Management Zone
Legend
Zone 3
Zone 2
Zone 1
Irrigated Acres
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1995
1998
2001
2004
2007
2010
2013
2016
2019
2022
Year


Irrigated Acres from Satellite Analysis
Zones 1 and 2
Irrigated Acres
4,000
3,600
3,200
2,800
2,400
2,000
1,600
1,200
800
400
0
1995
2000
2005
2010
2015
2020
2025
Year


Irrigated Acres from Satellite Analysis
Zones 1 and 2
Irrigated Acres
4,000
3,600
3,200
2,800
2,400
2,000
1,600
1,200
800
400
0
1995
2000
2005
2010
2015
2020
2025
Year


Groundwater Pumping for Irrigation in Kinney County
Legend
Permit Reports
Calculated
Groundwater Pumping for Irrigation (AF/yr)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
1995
2000
2005
2010
2015
2020
2025
Year


Groundwater Pumping for Irrigation in Kinney County
Legend
Permit Reports
Calculated
Groundwater Pumping for Irrigation (AF/yr)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
1995
2000
2005
2010
2015
2020
2025
Year

Conclusions from Data

- Currently in drought conditions
- Aridity in area is increasing (has been since late 1600s)
  - Precipitation is decreasing
  - Evaporation is increasing
- Irrigated acreage varies year to year
- Total groundwater pumping for irrigation is increasing slightly
  - Due to increased aridity (more than increase in irrigated acreage)
- Reports of permitted pumping are generally consistent with estimated pumping calculated from precipitation and evaporation data
  - Better during drought periods than wet periods
  - Monthly reporting with “app” will improve data reliability for future analyses

Pumping Impacts to Spring Flow

- Data analyses
  - Address concerns raised at 9/13 meeting
  - Provide foundation for evaluating model simulation results
- Compare 2022 with:
  - 2011 and 2012 (similar drought but spring flow did not cease)
  - 1950s (worse drought but spring flow did not cease)
  - 2013 and 2014 (drought not as severe but more irrigated acres)

Precipitation Comparison

1940 to 2022 Average = 24.32 in

2009 to 2012

- 2009 = 15.32 in
- 2010 = 24.38 in
- 2011 = 11.05 in
- 2012 = 17.57 in
- Sum = 68.31 in

2019 to 2022

- 2019 = 17.05 in
- 2020 = 18.82 in
- 2021 = 17.91 in
- 2022 = 18.89 in
- Sum = 72.57 in

Pumping Impact Conclusions (2011 and 2012)

2011 and 2012

- Pumping
  - 2011 = 4,504 AF/yr
  - 2012 = 5,060 AF/yr
- Summer Spring Flow
  - 2011 = 3 to 5 cfs
  - 2012 = 2 to 6 cfs
    - Limited data in 2012 due to gage issues

2021 and 2022

- Pumping
  - 2021 = 6,987 AF/yr
  - 2022 = 9,632 AF/yr
- Summer Spring Flow
  - 2021 = 4 to 10 cfs
  - 2022 = mostly 0 cfs

If pumping in 2021 and 2022 had been the same as 2011 and 2012 amounts, spring flow would have been about 2 to 6 cfs higher.

- ***Instead of no flow in 2022, flow would have been about 2 to 6 cfs***

Pumping Impact Conclusions (1950s drought)

- 1950s drought: Las Moras never went dry (daily data are not complete)
  - Summer flow
    - 6 cfs in 1951
    - 7 cfs in 1952
    - 3 cfs in 1953
    - 8 cfs in 1955
- 2021 and 2022 pumping above 1950s amount (?) resulted in about 3 to 8 cfs spring flow reduction
- Bennett and Sayre (1962, pg. 79) estimated groundwater use at about 4,000 AF/yr during in 1955-56
  - 2,000 AF/yr pumped 2,000 AF/yr flowing wells

http://www.twdb.texas.gov/publications/reports/bulletins/doc/Bull.htm/B6216.asp

Pumping Impact Conclusions (2013 and 2014)

- Rainfall
  - 2013: 21.40 in
  - 2014: 20.11 in
  - 2022: 18.89 in
- Summer LM Flow
  - 2013: 3 to 5 cfs
  - 2014: 1 to 4 cfs
  - 2022: 0 cfs
- Irrigated Acres (Z1 and Z2)
  - 2013: 3,857 acres
  - 2014: 2,701 acres
  - 2022: 3,518 acres
- Pumping ("Needs")
  - 2013: 5,558 AF/yr (4.01 ft)
  - 2014: 4,569 AF/yr (5.01 ft)
  - 2022: 9,631 AF/yr (6.75 ft)

Increased pumping in 2022 (relative to 2013 and 2014) mainly due to aridity resulted in a loss of between 1.2 and 5.2 cfs of spring flow

Spring Flow Impacts from Pumping (summary of data analyses)

- 2022 compared to 2011 and 2012
  - 2 to 6 cfs
- 2022 compared to 1950s drought
  - 3 to 8 cfs
- 2022 compared to 2013 and 2014
  - 1 to 5 cfs

Model Simulations

- Will provide more flexibility and robust analysis of the connection between pumping and spring flow
  - Can simulate repeat of 1950s drought
    - Could simulate worse droughts of 1700s suggested by tree-ring data
  - Can simulate effects of increasing aridity observed in data
  - Better understanding of both the spatial variability of rainfall and pumping

Objectives of Model Simulations

- Models are useful to quantify the impacts of pumping and estimate the increase in spring flow if pumping was reduced
  - Model results are best used to guide data collection efforts (data are always better than model results for groundwater management)
  - Model results are useful when comparing alternative management actions
- Model results should be consistent with data analysis
  - Utility of the simulations lies in the flexibility to evaluate alternatives that are not possible with data analysis

Will Conoly Email of 9/18/2023

- Requests simulation to understand “how much impact all the combined pumping has on the flow rate for Las Moras Spring”
- Specifically requested a scenario run with “all permitted wells in all zones” are shut off to see the impact to Las Moras Springs flow rate”
  - Please refer to slide 10 of 5/3/23 presentation at workshop

Item 2b from Workshop

- Simulations of Increased and Decreased Pumping
- Essentially a sensitivity analysis
  - Distinct from “management” simulations

Slide 10 from 5/3/23 presentation

2b. Simulations of Increased and Decreased Pumping

- Objective: provide stress/response data for other analyses
- Overall pumping
- Pumping by “group”
  - Agricultural
  - Municipal
  - Commercial/Industrial
  - Domestic/Livestock
- Can be extended to simulate 1950s drought conditions

Item 2d from Workshop (Management Simulations)

Slide 12 from 5/3/23 presentation

2d. Simulations of Drought Condition and Potential Management Response

- Simulations to test reducing pumping when a specified condition is "triggered"
  - Specified spring flow
  - Specified rainfall
- Specify alternative pumping reductions (simulated regulatory response)
- Evaluate results of reduced pumping
  - Increased groundwater levels
  - Increased spring flows
- Test alternative triggers/reductions

Management Simulations

- Focus is related to 2023 management plan provisions on page 3 related to “managing production of groundwater in the District”:
  1. on a sustainable basis;
  2. for beneficial use;
  3. that allows the capture of water flowing through the county;
  4. without jeopardizing the availability of water to the county during extended periods of low rainfall; and
  5. without unduly increasing the frequency of the natural cycles of springs and intermittent streams going dry.

Management Simulations

- Focus is related to 2023 management plan provisions on page 3 related to “managing production of groundwater in the District”:
  1. on a sustainable basis;
  2. for beneficial use;
  3. that allows the capture of water flowing through the county;
  4. without jeopardizing the availability of water to the county during extended periods of low rainfall; and
  5. without unduly increasing the frequency of the natural cycles of springs and intermittent streams going dry.

Same “management” elements in management plans of 2008, 2010 (amended) 2013, and 2018

Tech Memo 23-16 (6/11/23)

https://drive.google.com/drive/folders/1yXQ_WK4lZOt4891K7Oan7Ozbuamq-Jgu?usp=drive_link

- Based an analysis of historic Las Moras spring flow data, TM 23-16 outlines 9 scenarios to simulate alternative triggers and alternative management actions
  - Evaluate pumping reductions that will avoid or mitigate “low” spring flow
- Simulation thresholds:
  - 4 cfs (10th percentile of spring flow)
  - 9 cfs (33rd percentile of spring flow)
  - 15 cfs (50th percentile of spring flow)
- Alternative “Management Actions” to be simulated:
  - 25 percent reduction
  - 50 percent reduction
  - 75 percent reduction

Management Simulations

Scenario	Las Moras Spring Flow Threshold/ Trigger	Simulated Management Action
1	4 cfs	25 percent reduction in historic pumping
2	4 cfs	50 percent reduction in historic pumping
3	4 cfs	75 percent reduction in historic pumping
4	9 cfs	25 percent reduction in historic pumping
5	9 cfs	50 percent reduction in historic pumping
6	9 cfs	75 percent reduction in historic pumping
7	15 cfs	25 percent reduction in historic pumping
8	15 cfs	50 percent reduction in historic pumping
9	15 cfs	75 percent reduction in historic pumping

Potential Use of Management Simulation Results by KCGCD Board

- Drought plan could include a threshold/trigger and management action (policy choice)
  - Could adopt one of the scenarios as the basis for the plan
- Could use the results to simulate additional management actions
  - Higher, lower, or intermediate pumping reductions
- Could revise the simulation to use alternate trigger
  - Based on the depth to water of one or more monitoring wells that are correlated to Las Moras Spring flow
- Could conclude that the spring flow recovery would not be sufficient to warrant such an extreme reduction

Use of Management Simulation Results

- Management simulations provide insight related to KCGCD Board objectives to develop drought plan
  - More useful than a single simulation that just “turns off wells”
- These objectives were also raised in 9/13 public comments:
  - Trigger criteria/drought contingency plan
  - Need action to curtail pumping
  - Other groundwater districts curtail pumping
- Complexities associated with permit limits and actual pumping
  - Reducing/resetting permit amounts may not result in increased spring flow
  - Curtailing pumping based on recent production requires some understanding of the annual variation in actual pumping

Pumping Curtailment in Drought in Other GCDs

- 9/13 comments included reference to curtailment policies of “other GCDs”
- Notable Example of “Different” Drought Management Response
  - Lone Star GCD (Montgomery County, north of Houston)
    - Largely municipal/suburban water users
- Recently adopted a “Temporary Drought Buffer”
  - Initially 10%, now 15% increase in all permit limits retroactive to 1/1/2023
- Highlights a (different) policy decision in balancing production and environmental protection
  - Key “environmental factor” in Lone Star GCD = subsidence

Themes of Comments

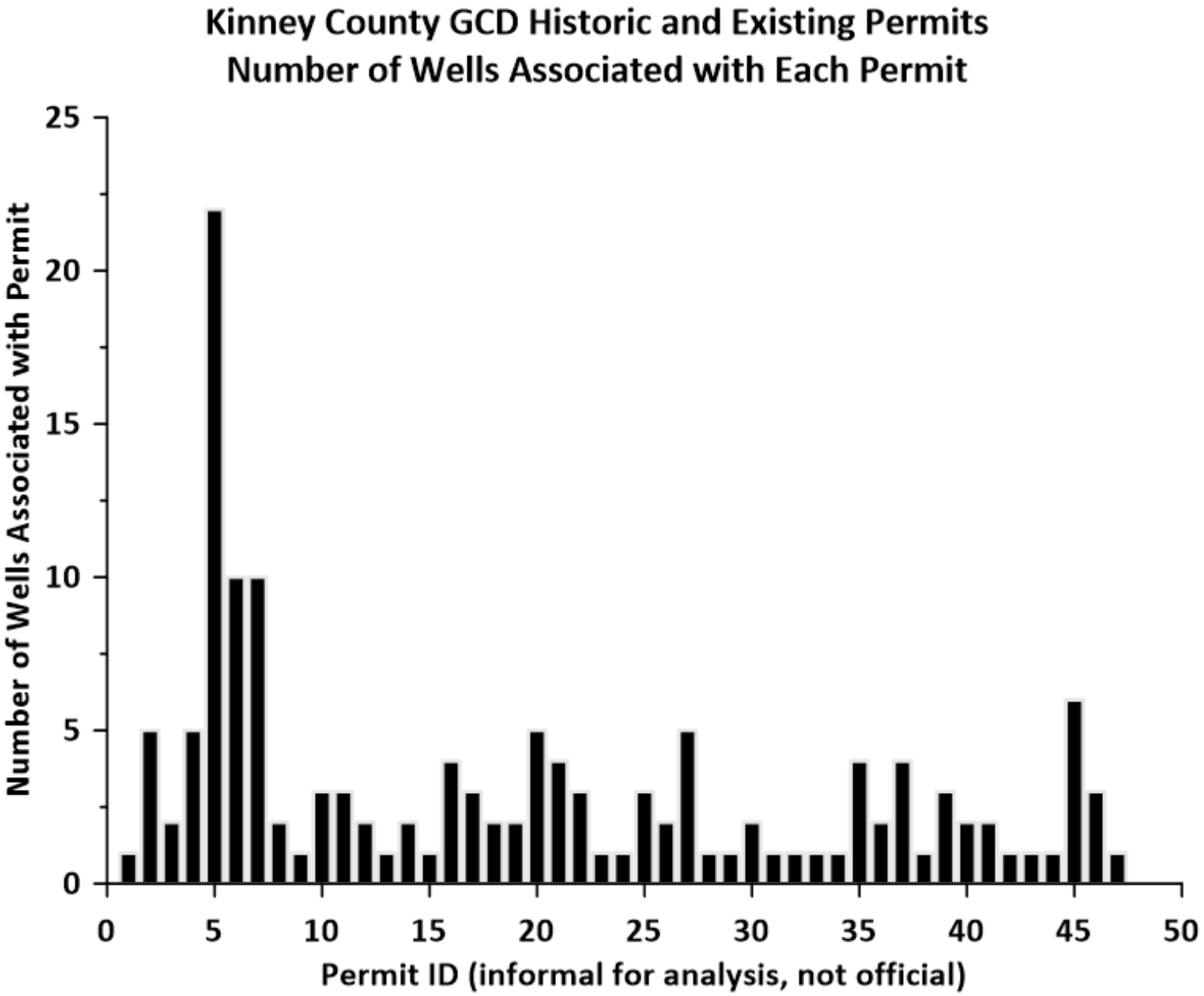
- Chapter 36 of Water Code
  - Responsibilities and Authority of KCGCD
- Desired Future Conditions
- “State of the Aquifer”
- Pumping and Permits

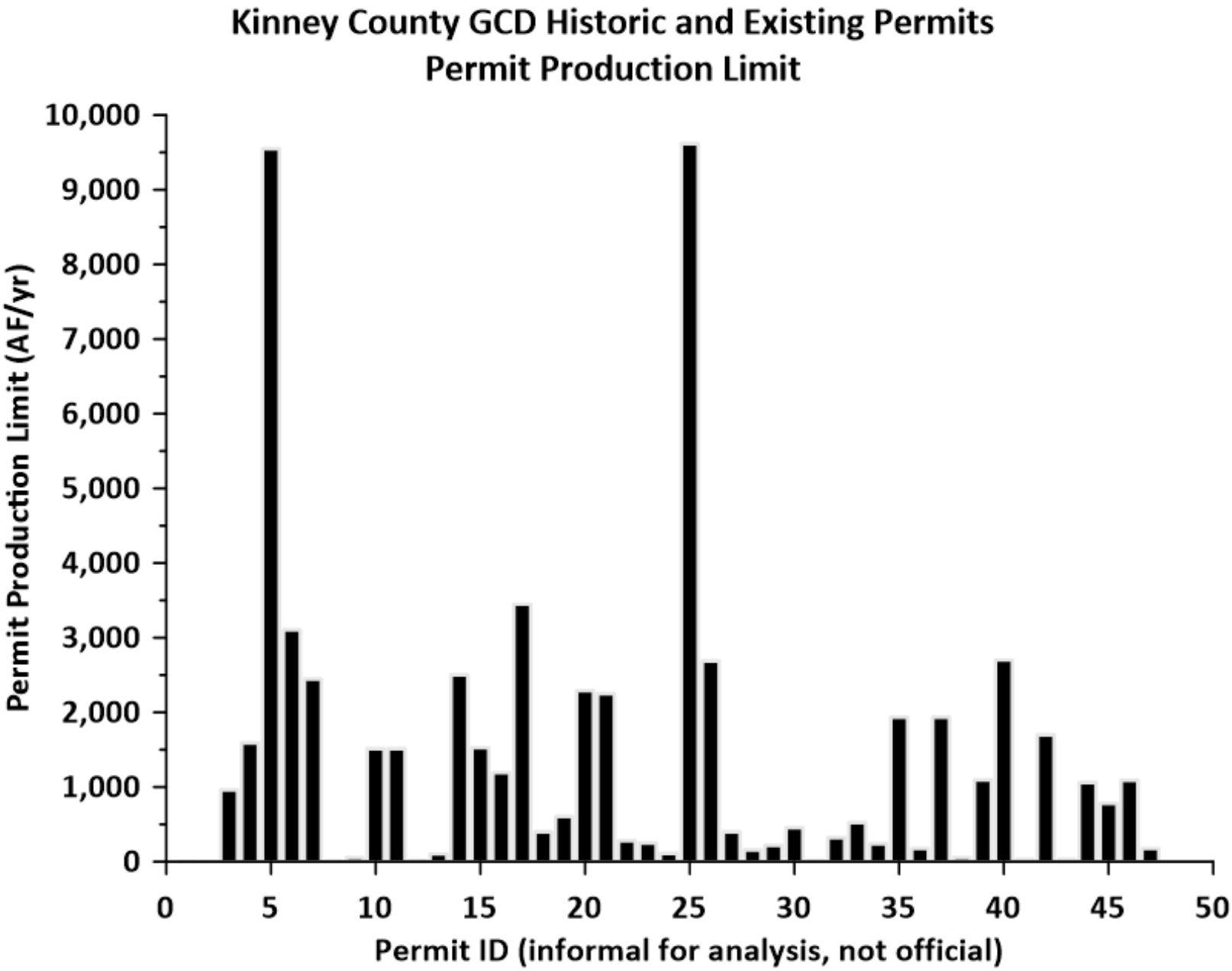
Actual Pumping vs. Permit Limits

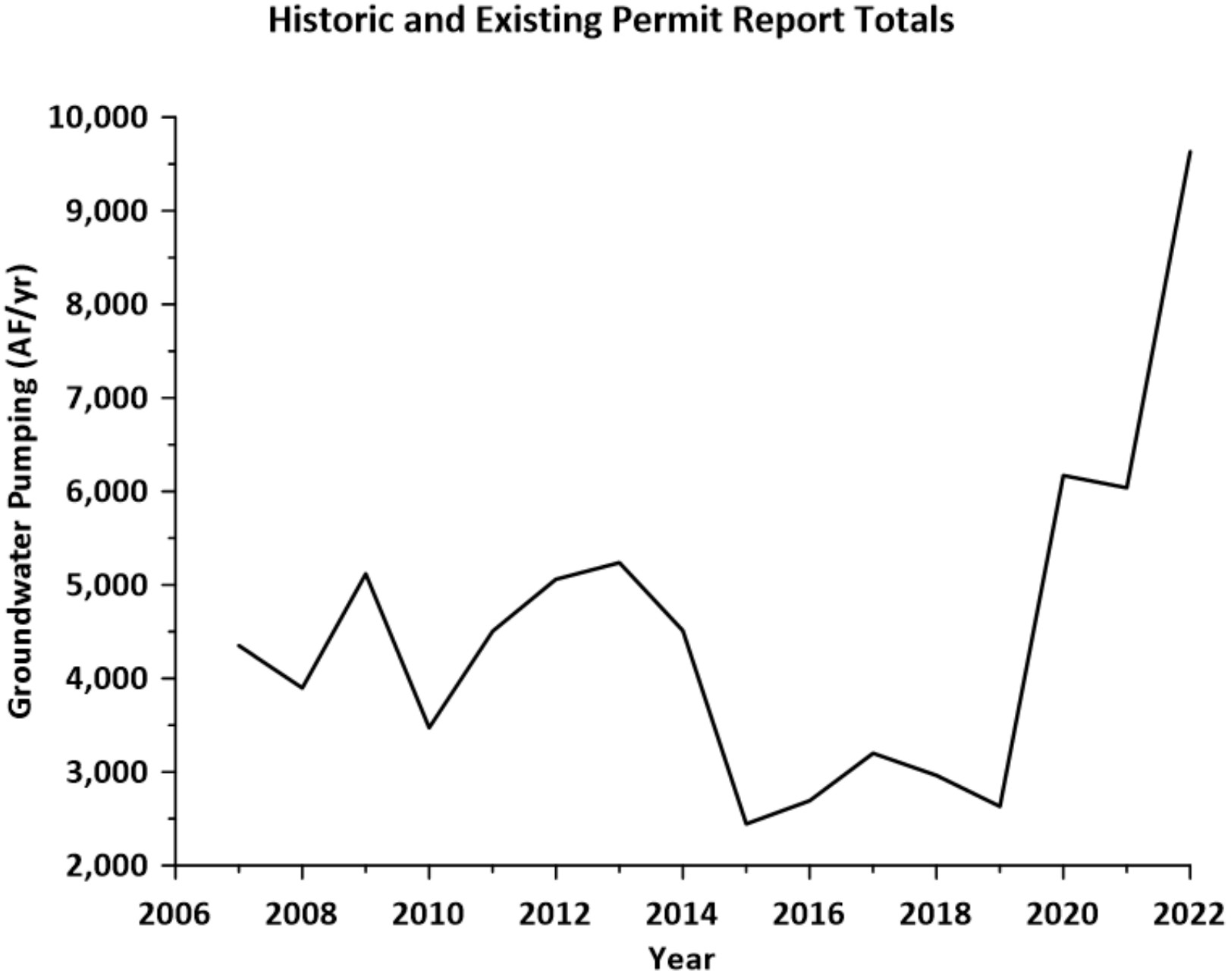
- Data evaluated from 2007 to 2022
  - 47 Historic and Existing Permits
    - Each permit has between 1 and 22 wells (total = 144 wells)
    - Permit limit ranges from 0.66 AF/yr to 9,549 AF/yr
- Many of the permits have both a historic amount and an existing amount
  - “Historic period” = 1960 to 1991
  - “Existing period” = 1992 to 2003
  - Permit limit = higher of historic and existing amounts
- Review of permit and pumping data

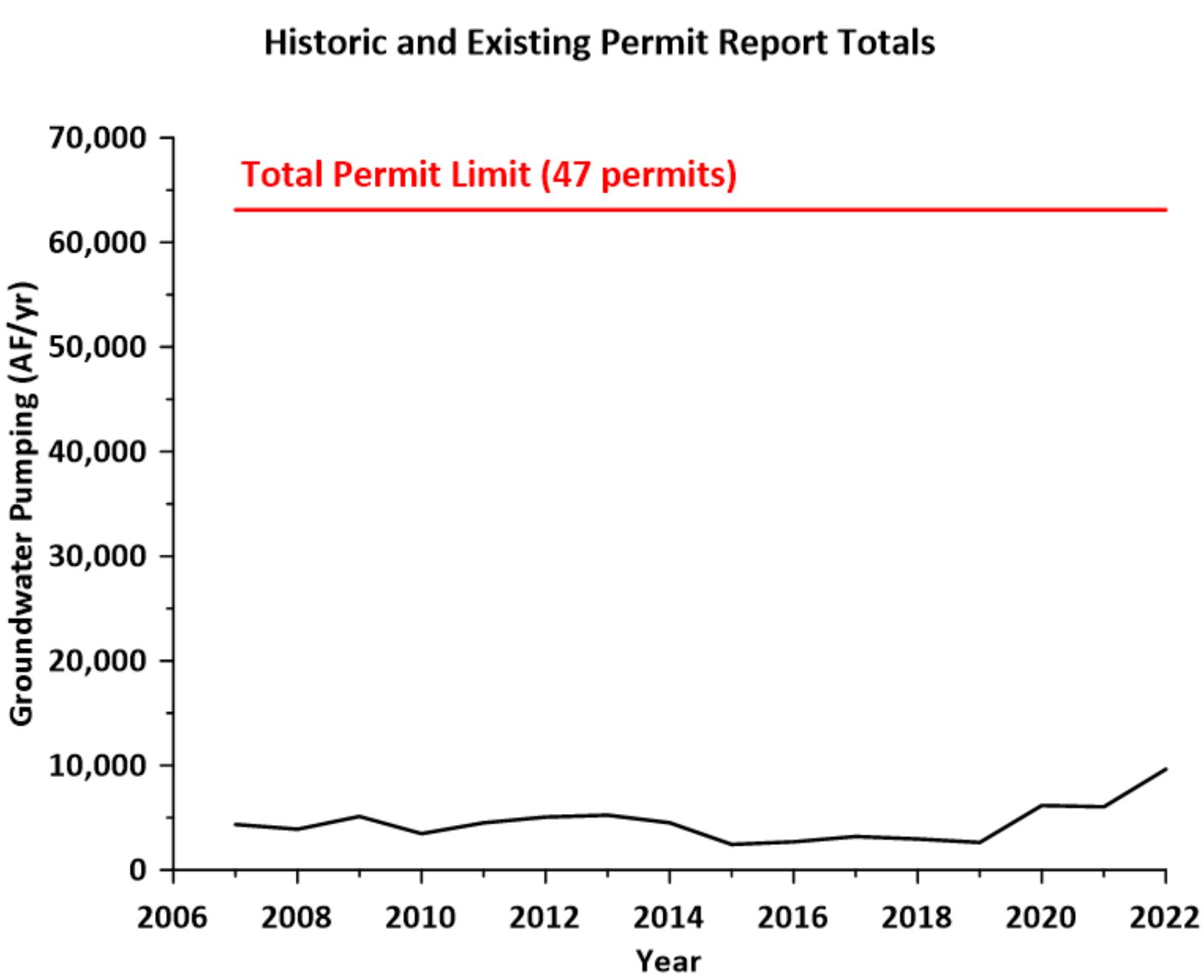
Historic and Existing Permits

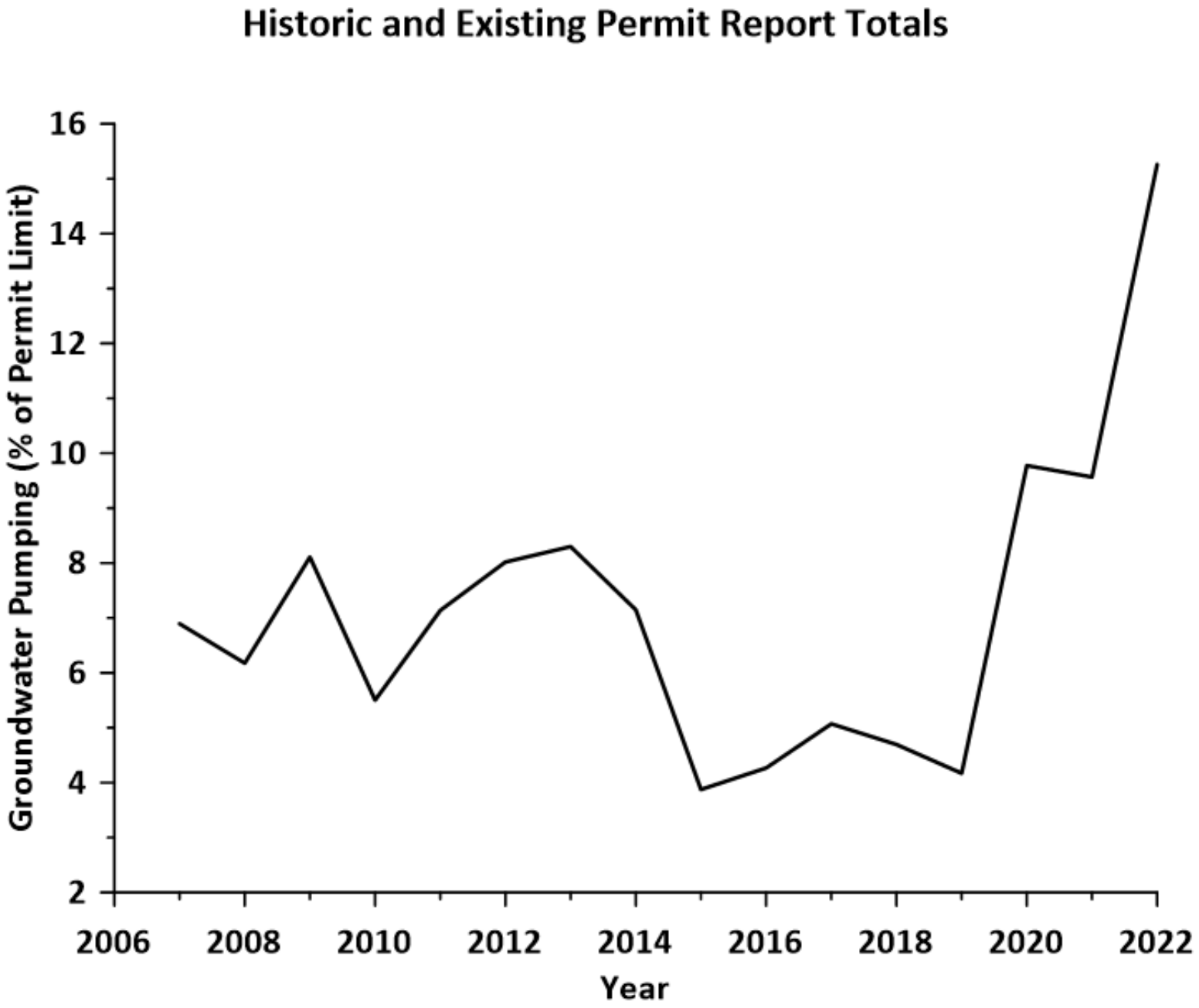
- Zone 1
  - 55 wells
  - Permit Limit = 35,380 AF/yr
  - 2022 Pumping = 2,566 AF/yr
- Zone 2
  - 88 wells
  - Permit Limit = 27,483 AF/yr
  - 2022 Pumping = 3,471 AF/yr
- Zone 3
  - 1 well
  - Permit Limit = 250 AF/yr
  - 2022 Pumping = 0 AF/yr (no pumping 2007 to 2022)

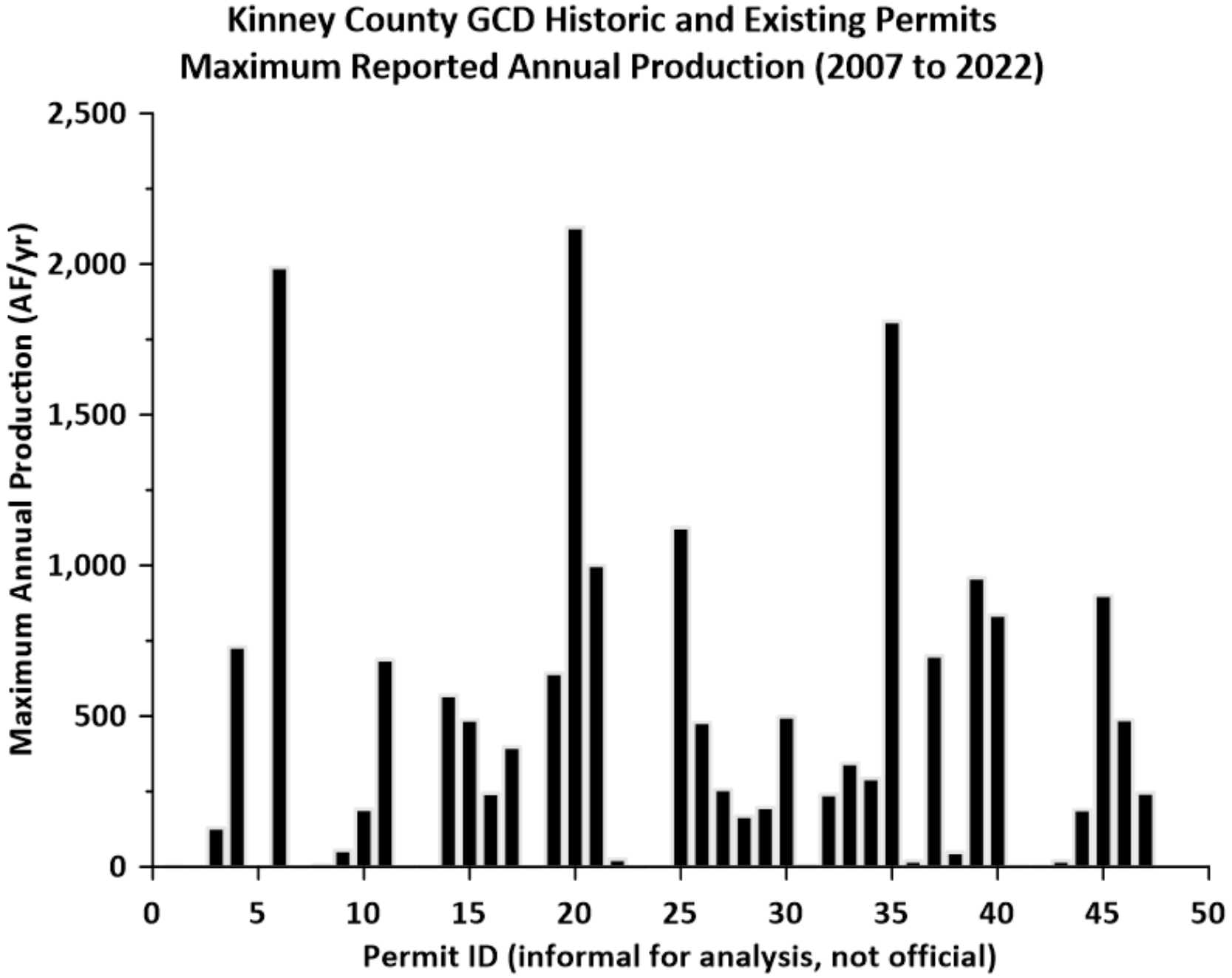

Kinney County GCD Historic and Existing Permits
Number of Wells Associated with Each Permit
Number of Wells Associated with Permit
0
5
10
15
20
25
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)

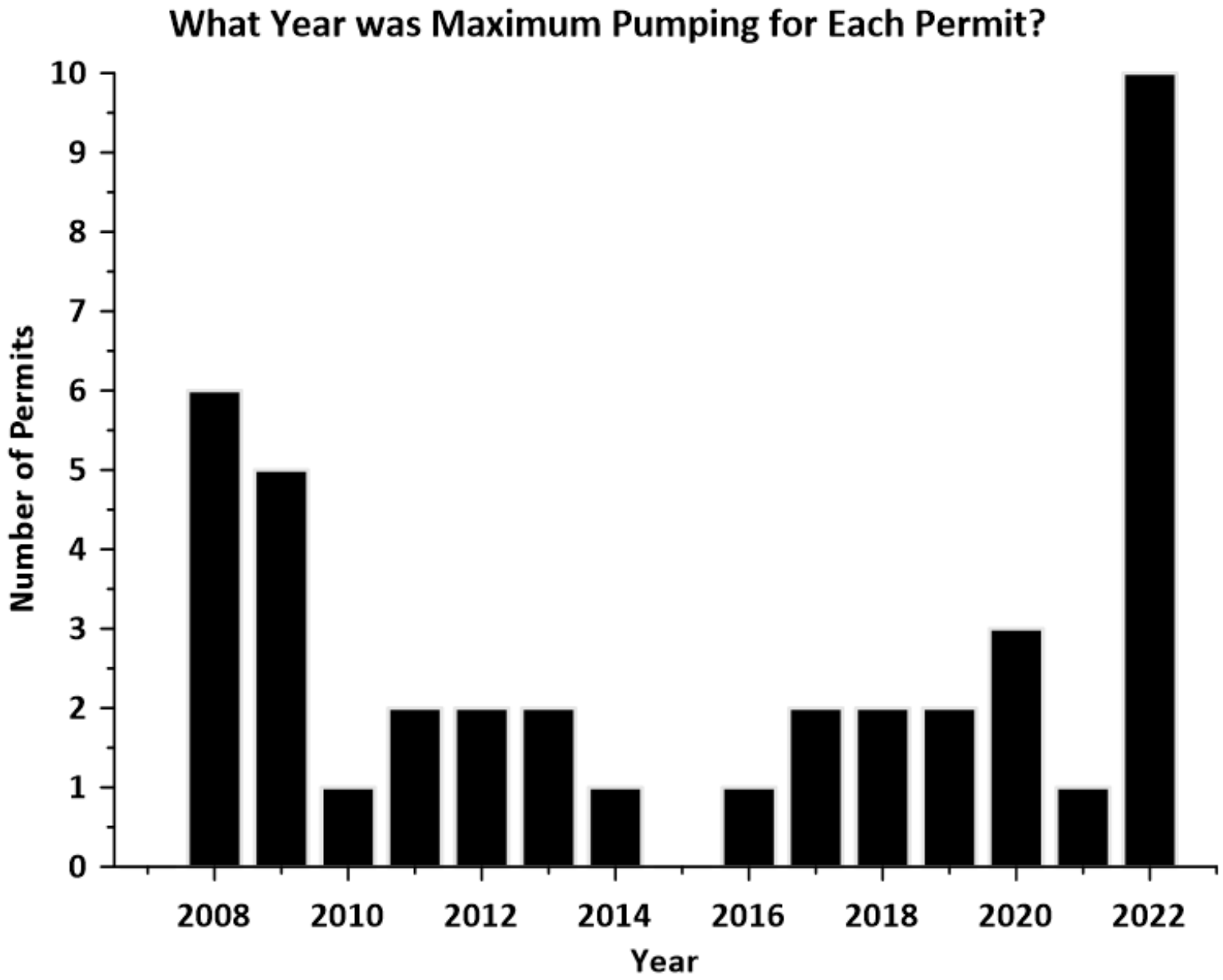

Kinney County GCD Historic and Existing Permits
Permit Production Limit
Permit Production Limit (AF/yr)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)


Historic and Existing Permit Report Totals
Groundwater Pumping (AF/yr)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year


Historic and Existing Permit Report Totals
Total Permit Limit (47 permits)
Groundwater Pumping (AF/yr)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year


Historic and Existing Permit Report Totals
Groundwater Pumping (% of Permit Limit)
16
14
12
10
8
6
4
2
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year

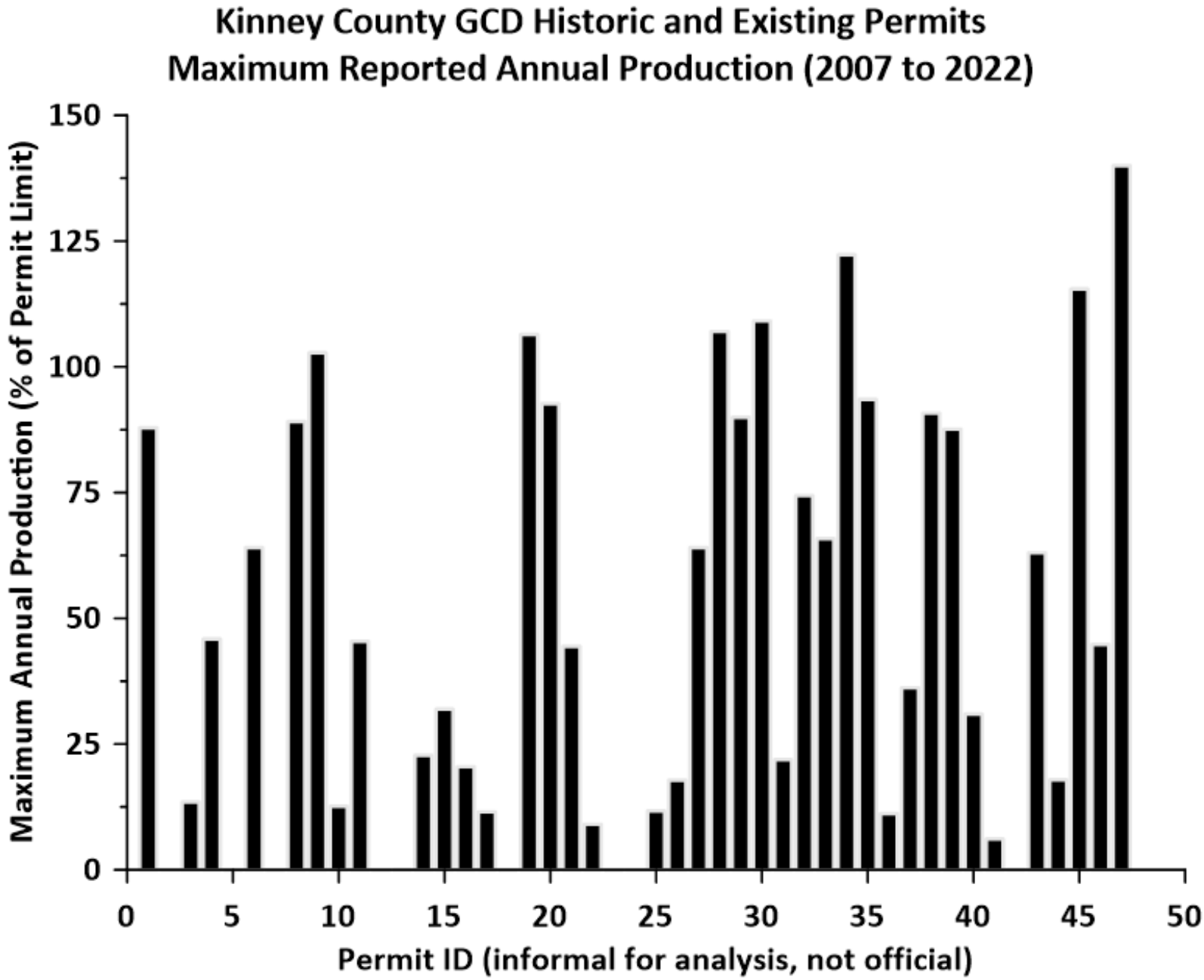

Kinney County GCD Historic and Existing Permits
Maximum Reported Annual Production (2007 to 2022)
Maximum Annual Production (AF/yr)
2,500
2,000
1,500
1,000
500
0
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)

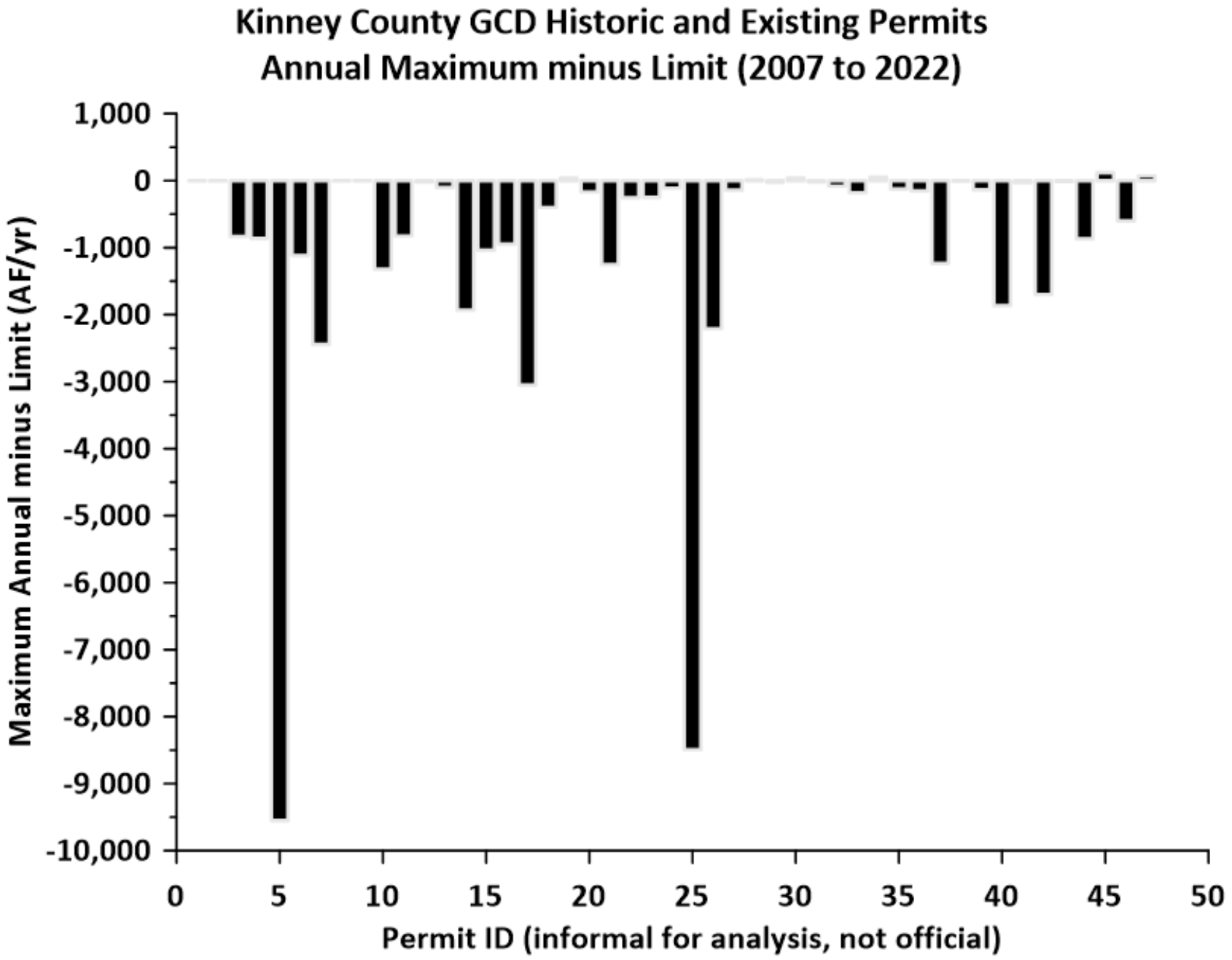

What Year was Maximum Pumping for Each Permit?
Number of Permits
0
1
2
3
4
5
6
7
8
9
10
2008
2010
2012
2014
2016
2018
2020
2022
Year

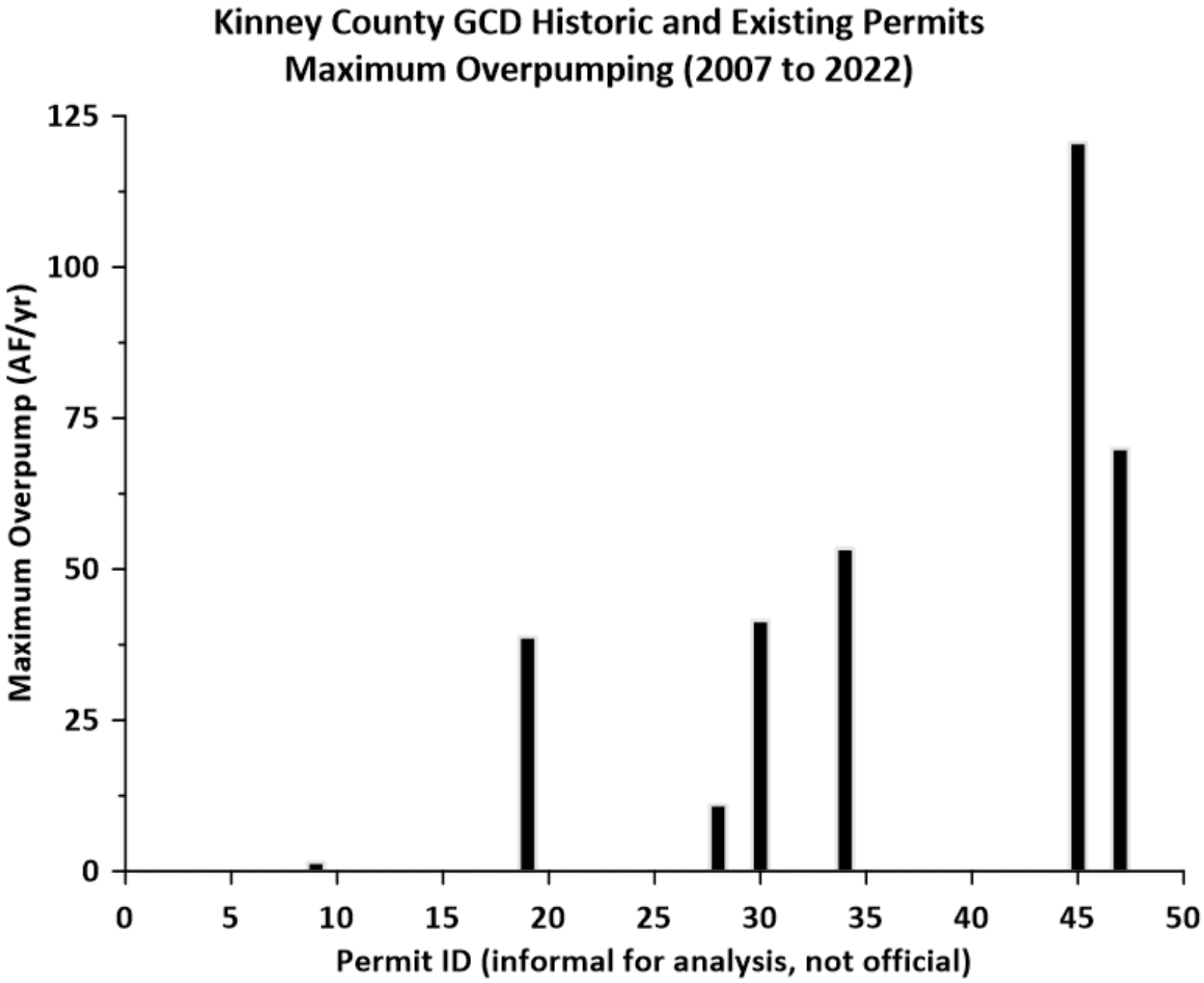
Historic and Existing Pumping (cfs)

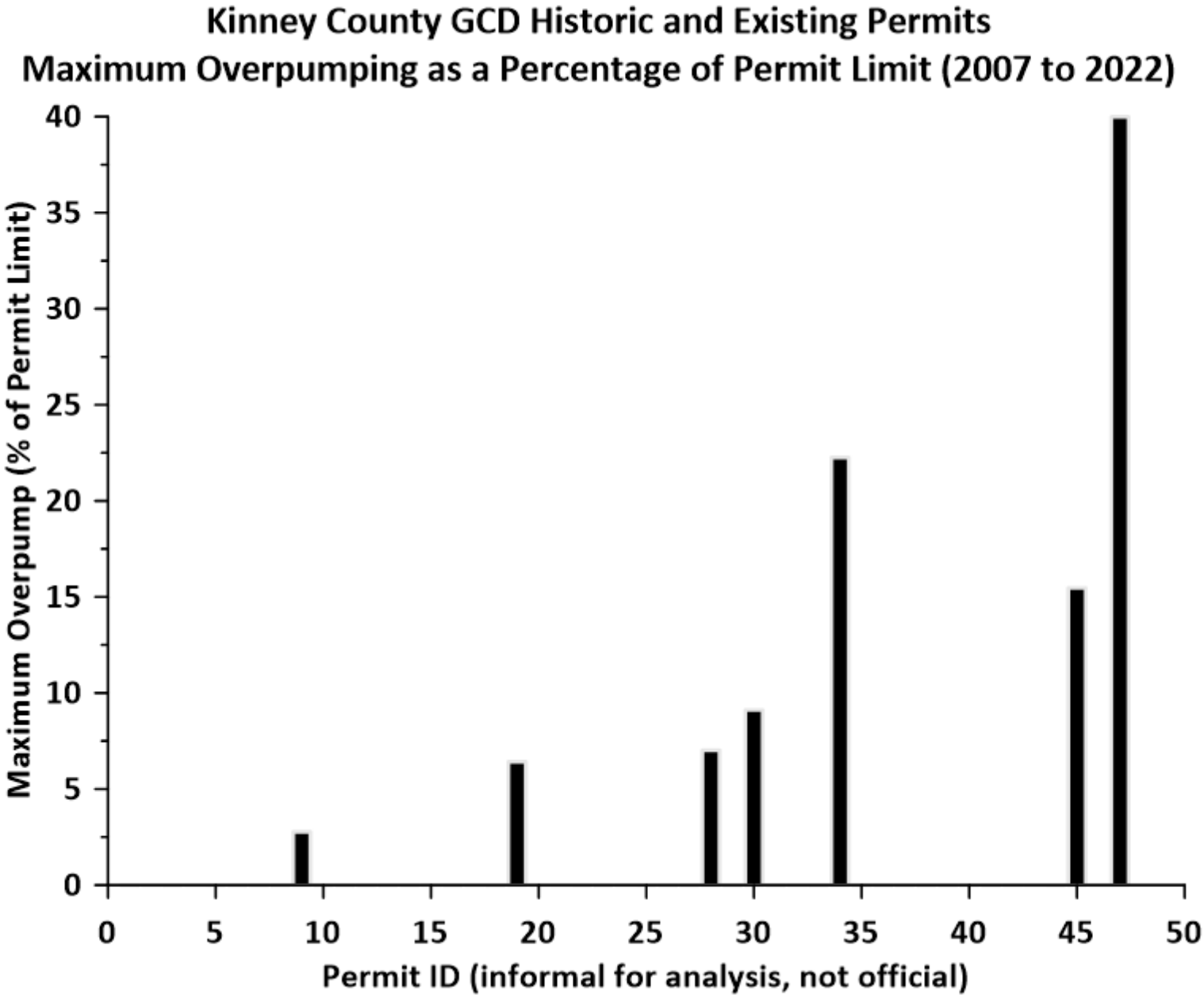
- Permit Limits Total = 87 cfs
- Sum of Individual Annual Pumping Max = 26 cfs
- 2022 Pumping = 13 cfs
- 2011 Pumping = 6 cfs

Compare to Average Spring Flow (DFC) = 24 cfs
Compare to Average Recharge = 106 cfs


Kinney County GCD Historic and Existing Permits
Maximum Reported Annual Production (2007 to 2022)
Maximum Annual Production (% of Permit Limit)
150
125
100
75
50
25
0
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)


Kinney County GCD Historic and Existing Permits
Annual Maximum minus Limit (2007 to 2022)
Maximum Annual minus Limit (AF/yr)
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
-8,000
-9,000
-10,000
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)


Kinney County GCD Historic and Existing Permits
Maximum Overpumping (2007 to 2022)
Maximum Overpump (AF/yr)
125
100
75
50
25
0
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)


Kinney County GCD Historic and Existing Permits
Maximum Overpumping as a Percentage of Permit Limit (2007 to 2022)
Maximum Overpump (% of Permit Limit)
0
5
10
15
20
25
30
35
40
0
5
10
15
20
25
30
35
40
45
50
Permit ID (informal for analysis, not official)

Characterizing Over Pumping

- 16 years (2007 to 2022)
- 47 Historic and Existing Permits
- 12 instances of over pumping (7 permits)
  - Up to 121 AF/yr over permit limit
  - Up to 40 percent over permit limit
  - Over pumping “events” = 1.6% of all reports
  - 15% of permits have had over pumping

Permit Report Observations

- Seven permit have “reported” 0 pumping in all years
  - About 15% of 47 permits
  - 43 wells in these permits (out of 144 total wells)
- Only one permit reported “round numbers”
  - Signals “estimate” and not a meter reading
- Two highest permits
  - Permit limit = 9,549 AF/yr (max pumping = 0 AF/yr)
  - Permit limit = 9,618 AF/yr (max pumping = 1,126 AF/yr)

Permits with Actual Production

- 40 (of 47 permits) have production from 2007 to 2022
- 10 had maximum pumping in 2022
  - 25% of all permits with production
- 18 had maximum pumping prior to 2014
  - 45% of all permits with production

Review and “Reset” Permit Totals

- Comments from 9/13
  - Permit production reviews
  - Need action to curtail pumping
  - Q6 of survey results distributed at 9/13 KCGCD meeting (reset permits to 150% of highest use over the past 5 years)
- Sum of maximum production = 19,097 AF/yr
  - Considers 2007 to 2022
- Alternate “reset” periods
  - 2007 to 2017 = 11,171 AF/yr
  - 2018 to 2022 = 12,715 AF/yr (5-year period from Q6 of survey results distributed at 9/13 meeting)
    - 150% = 19,072 AF/yr (the same as 100% of 2007 to 2022 period)

Survey Q6 Proposed Reset Limit is Inconsistent with Apparent Goal

- Data analysis suggests that pumping during a drought needs to be considerably less than the proposed Q6 limit if the goal is to have some minimal spring flow (1 to 8 cfs) during a drought
  - Pumping to achieve goal = 4,000 to 5,000 AF/yr
    - About 50% cut in 2022 pumping
    - About 75% cut from proposed (Q6) total permit limit
- Highlights difficulty is “curtailing” pumping
  - Curtail from what baseline?

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  - Pumping to achieve goal = 4,000 to 5,000 AF/yr
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    - About 75% cut from proposed (Q6) total permit limit
- Highlights difficulty is “curtailing” pumping
  - Curtail from what baseline?

Level of spring protection is a policy decision that requires balancing with property rights (historic and existing permits)

Preliminary Rules Update Recommendations (1)

- Recognize current MAG is not consistent with current DFC
  - Rule recognition that current MAG is not reliable and reduce potential misuse in permit hearing
    - MAG is one permitting factor
    - District manages to achieve DFC
- Need to update DFC/MAG in next round of Joint Planning (2026)
  - Not a “rule”, but needs to be completed
  - Continue to use Las Moras Spring Flow?
  - Shift to a monitoring well threshold in GMA 7?

Preliminary Rules Update Recommendations (2)

- Revise permitting process
  - Streamline process (testing period is not needed)
  - Recognize that “small” production applications will have no impact on spring flow
    - Simple approval for small permit applications
  - Revise required submittals for “large” permit applications to evaluate impacts to Las Moras Spring flow
    - Options to require applicant investigation or district review and analysis
    - Focus should be on how proposed production will impact ability to meet DFC
  - Need discussion and model results to define “small” and “large”

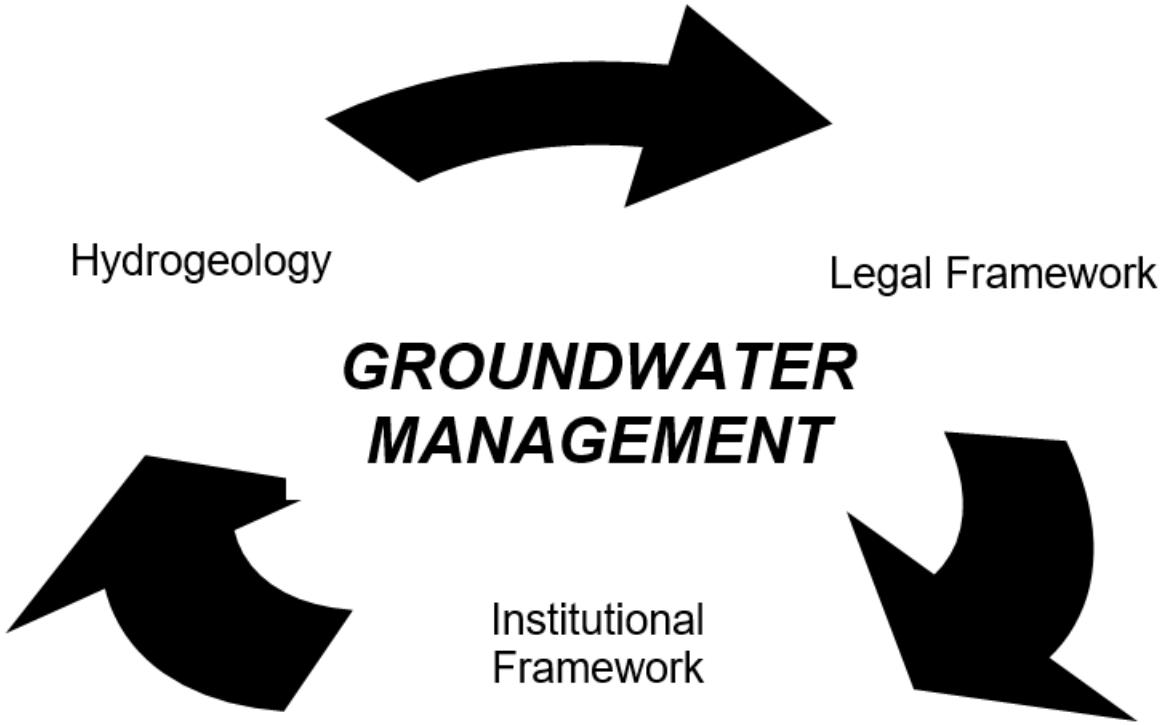
Preliminary Rules Update Recommendations (3)

- Increase permit pumping reports to monthly using app
- Add requirements related to district staff deadlines for processing and reporting data
- New field tech (agenda item 9) should develop schedule to audit meter readings
  - High priority/impact (1 to 2 times a month)
  - Medium priority/impact (3 to 5 times a year)
  - Low priority/impact (1 to 2 times a year)
- Process for new field tech to report “over pumping” to KCGCD Board for further enforcement action
- Post monthly zone total pumping data on website

Preliminary Rules Update Recommendations (4)

- Triggers/Thresholds
  - Specifics can be developed if KCGCD Board wants to move in that policy direction (needs further discussion)

Questions/Discussion



From Hutchison (2006) available at:

https://www.amazon.com/Groundwater-Management-El-Paso-Texas/dp/1581123280/ref=sr_1_1?keywords=groundwater+management+in+el+paso&qid=1695914073&sr=8-1