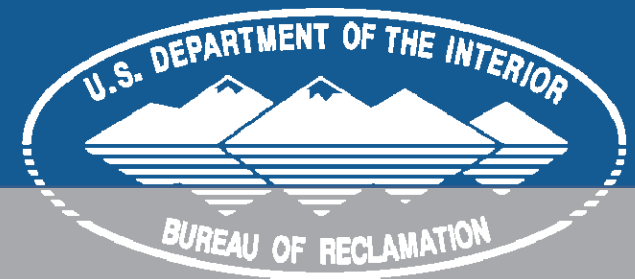
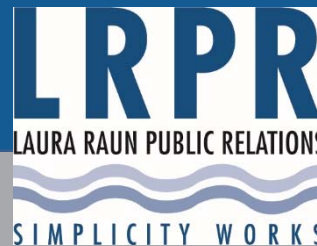




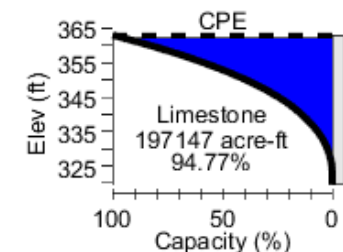
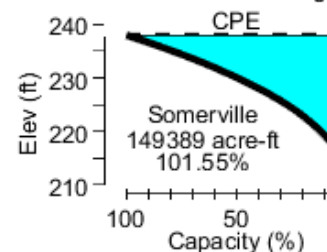
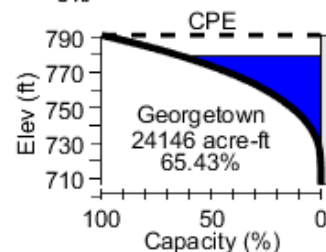
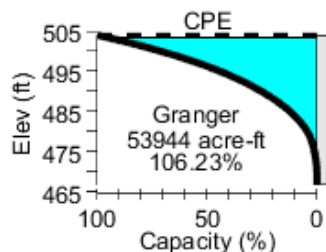
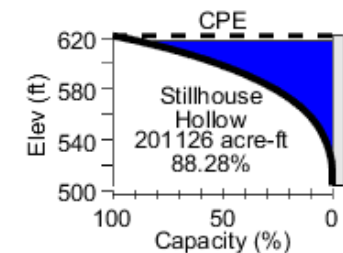
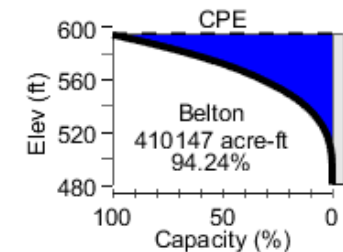
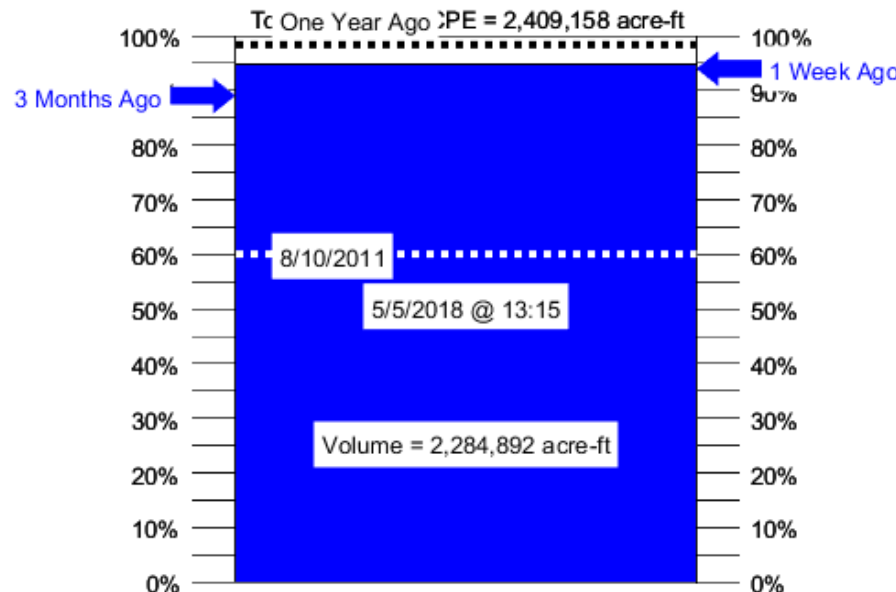
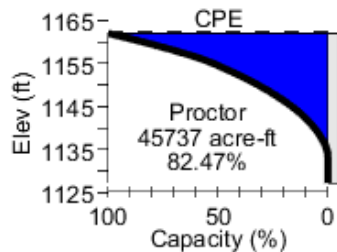
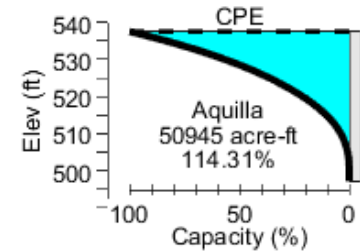
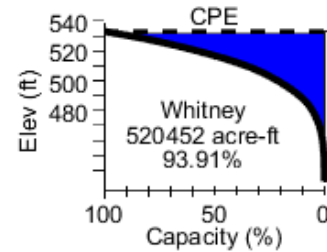
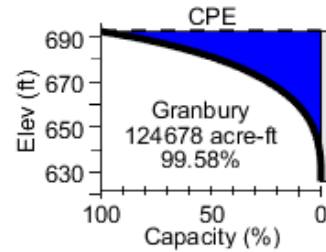
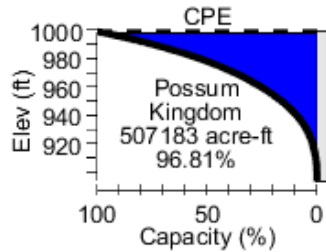
Gulf Coast Water Authority

Drought Contingency Plan Update
US BoR WaterSMART Grant
Drought Task Force Meeting #7

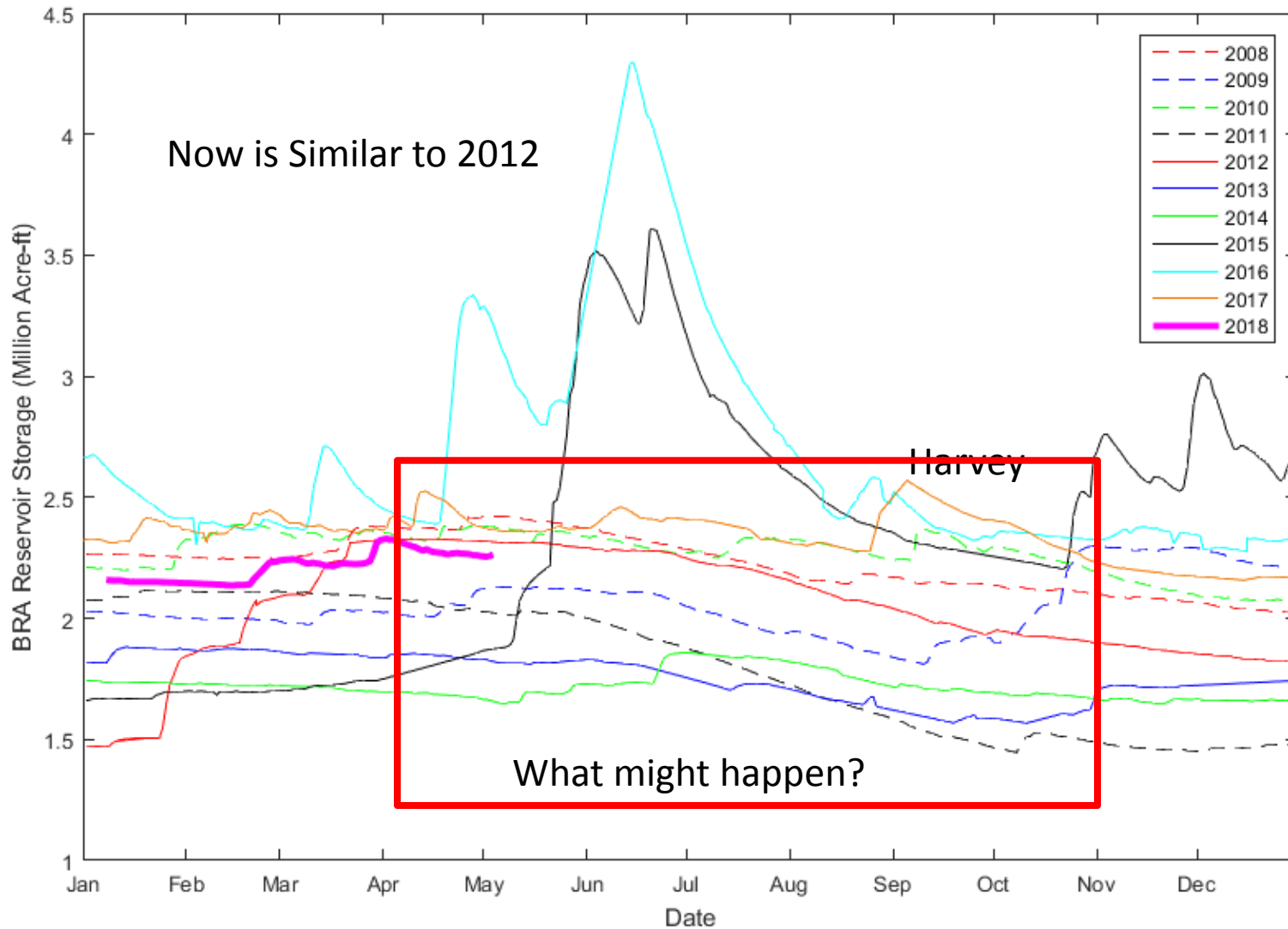
05/7/2018



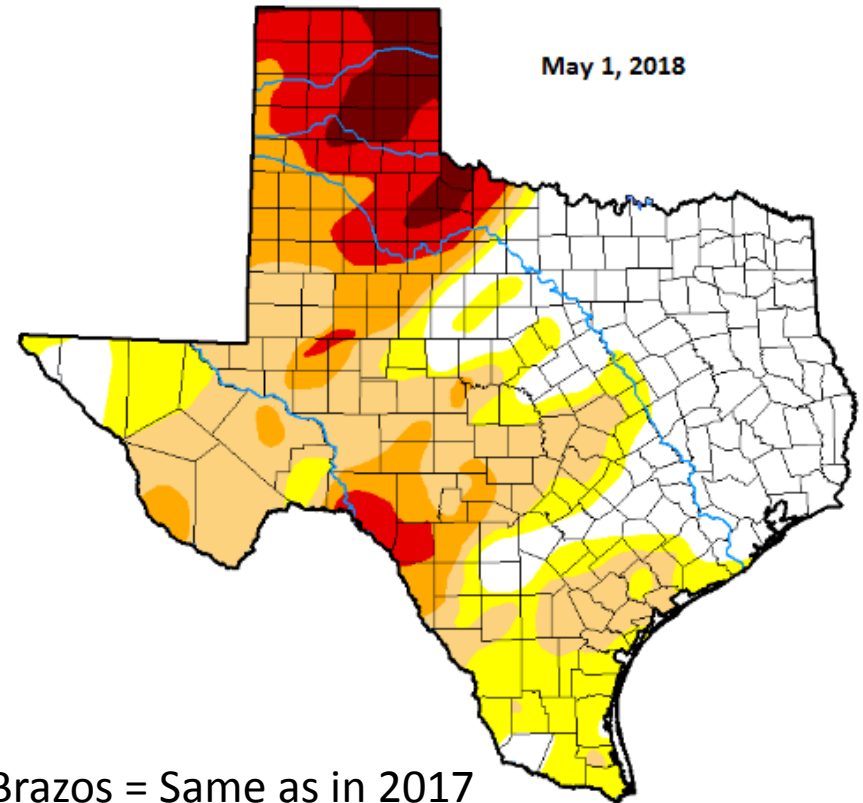
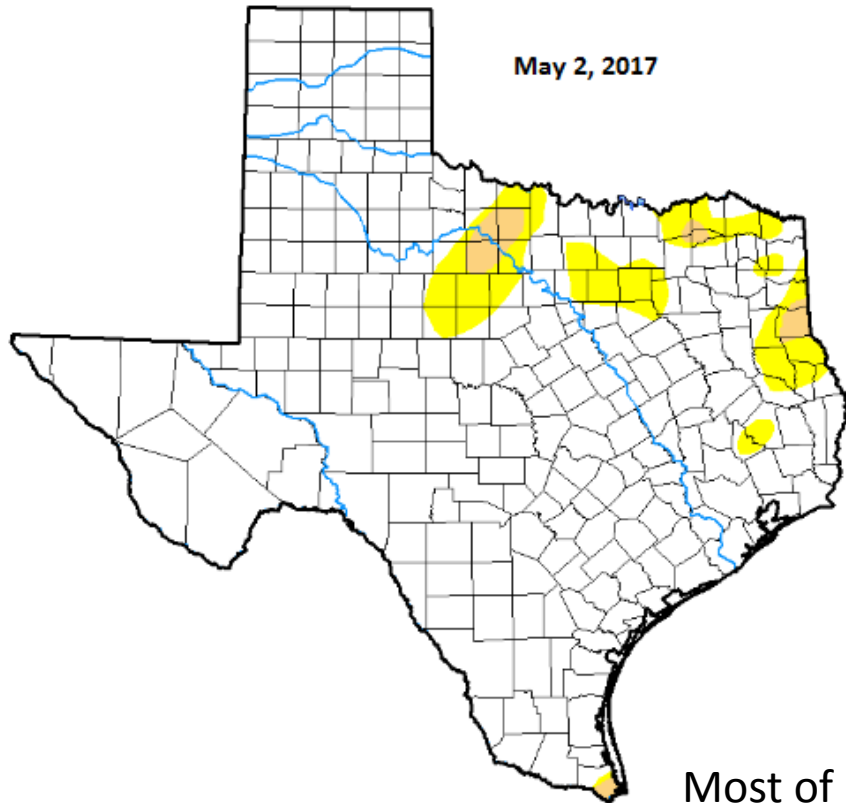
BRA System Reservoirs – Recent Status



Brazos River Authority – System Reservoirs - Historical

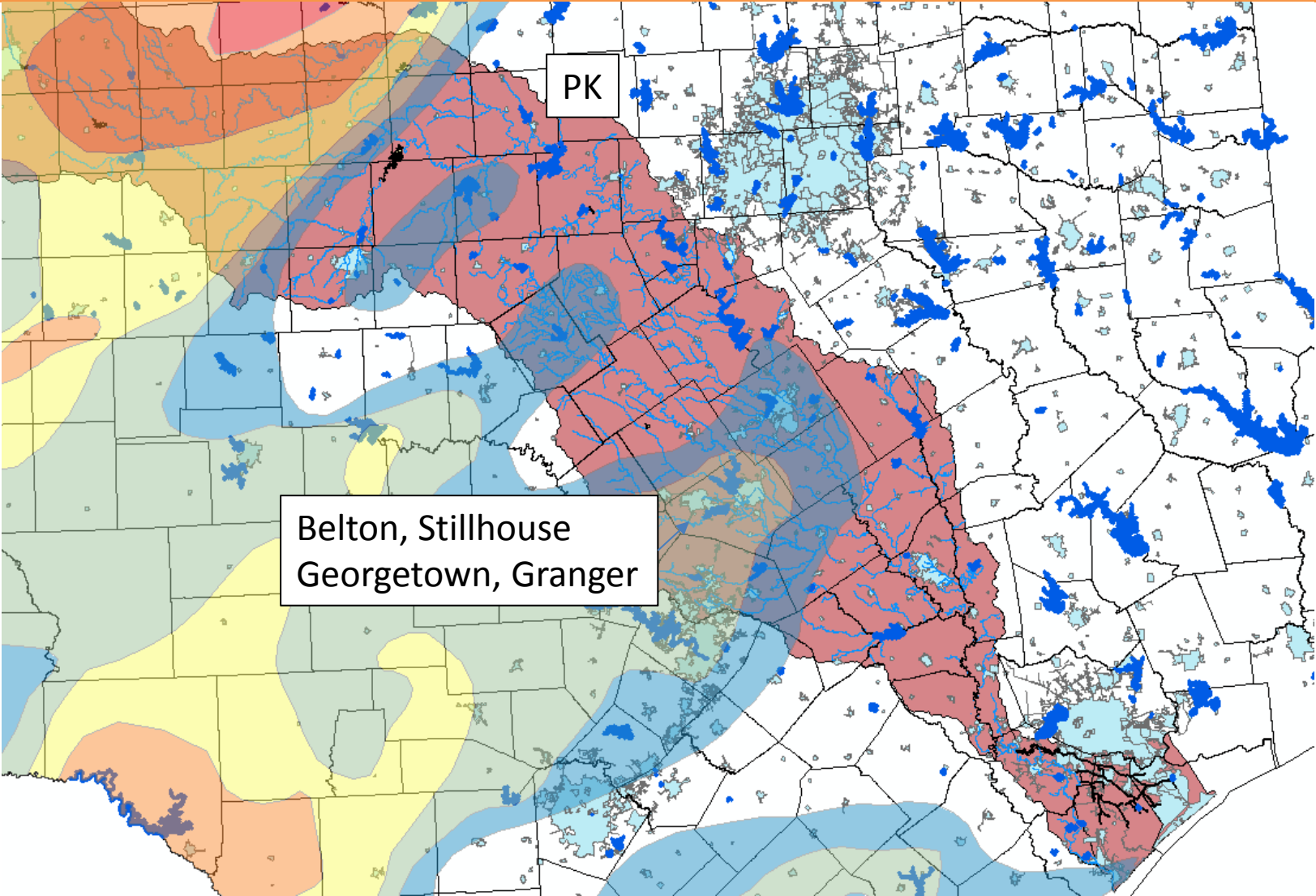


US Drought Monitor

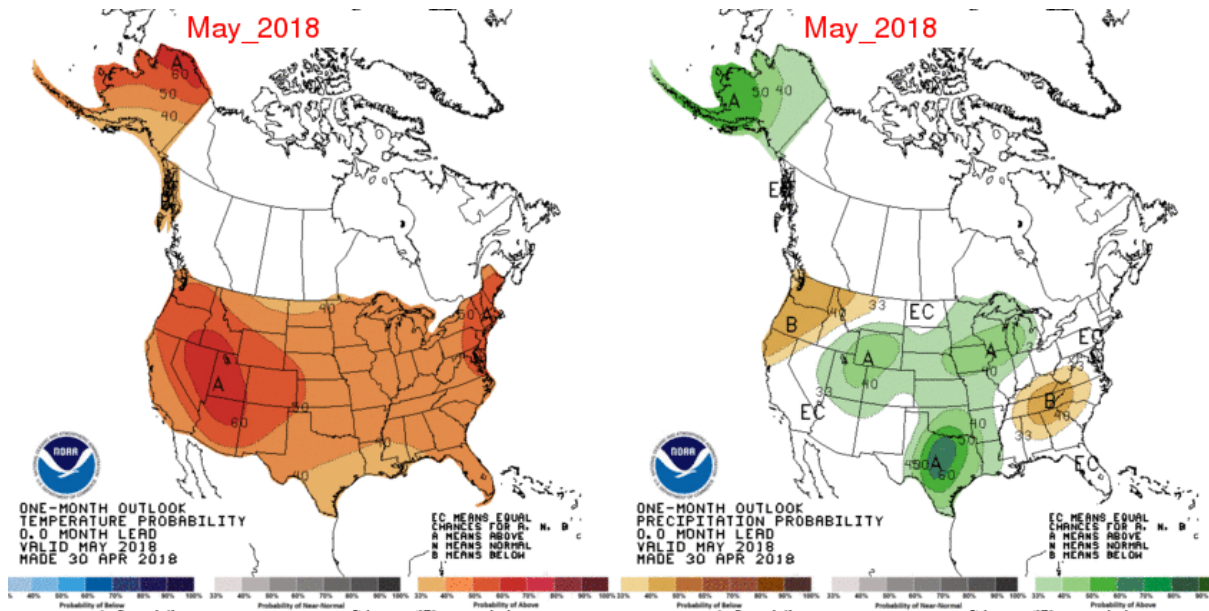


Most of Lower Brazos = Same as in 2017

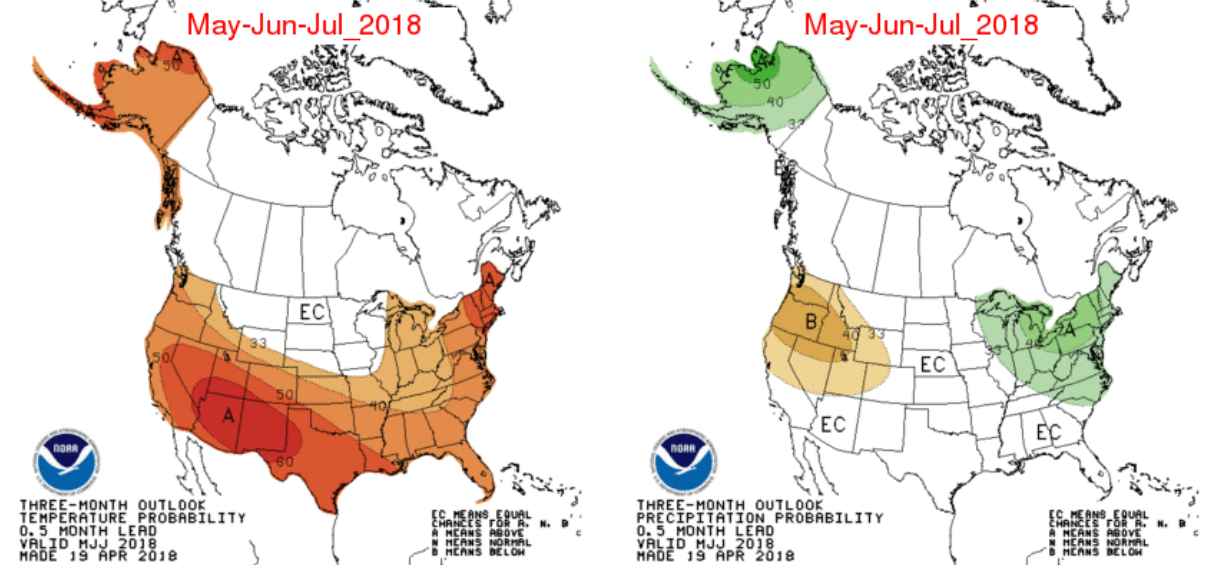
US Drought Monitor



Temperature & Precipitation Seasonal Outlook

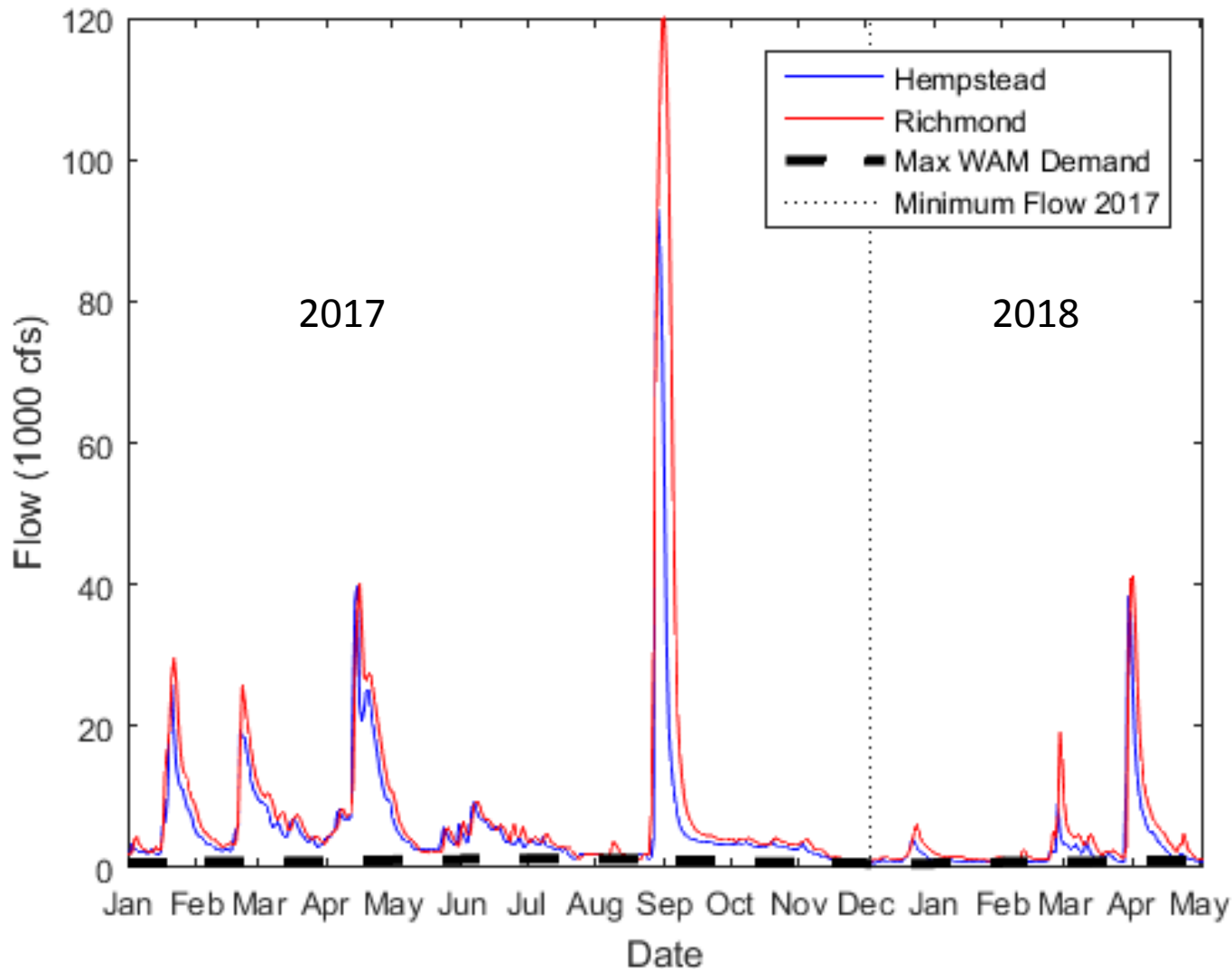


Wetter and hotter May



Hotter and Normal
June & July

2017 vs 2018 Hydrology



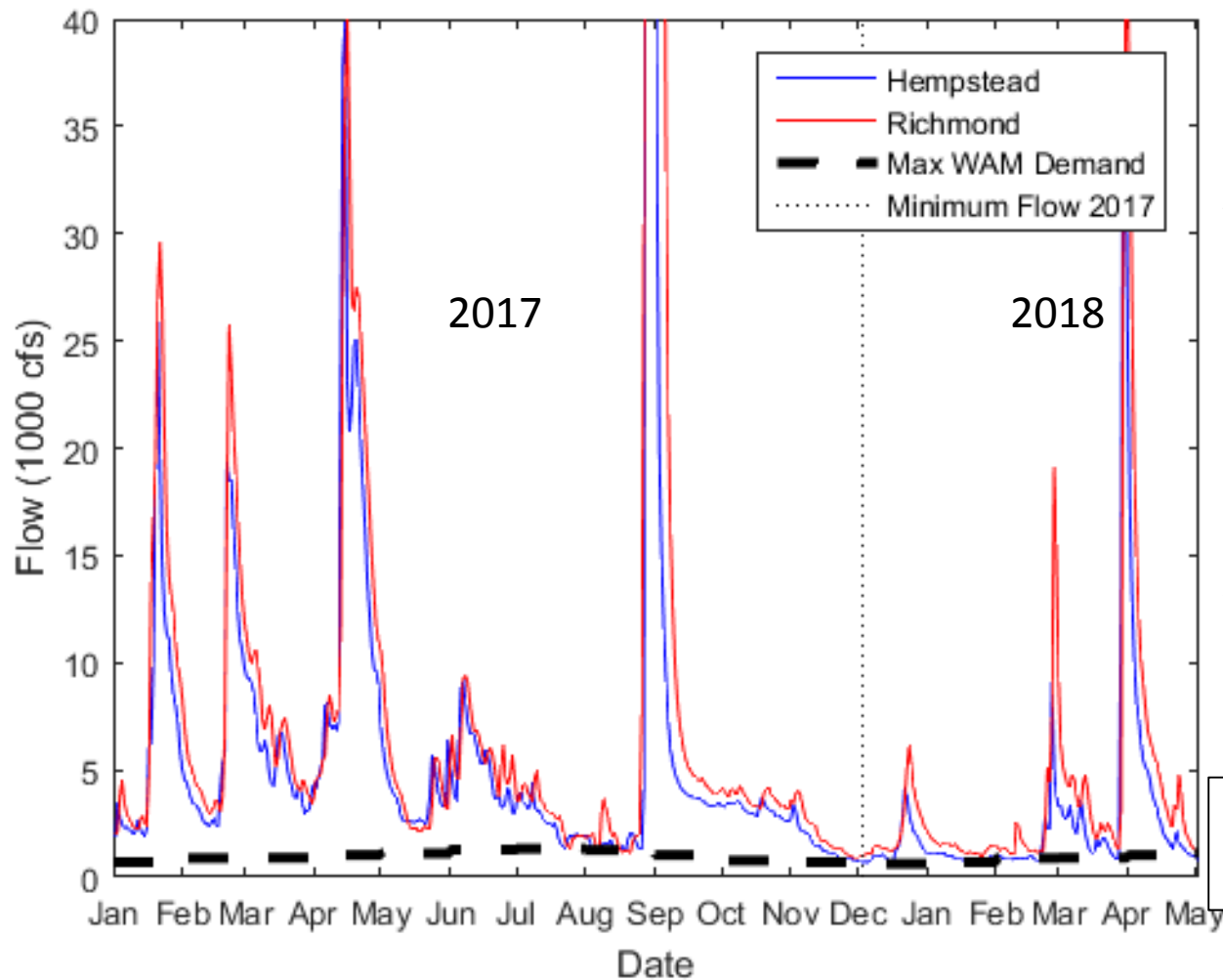
GCWA, Dow, NRG, BWA
= 703,088 acre-ft/yr
= 971 cfs – 24/7/365

Monthly WAM Demands
621-1325 cfs

Minimum 2017 Flow
occurred in December

Exceeded WAM demands

2017 vs 2018 Hydrology



Notes:

Richmond Exceeds Hempstead = watershed contribution

1-day or 2-day time lag Between Hempstead and Richmond

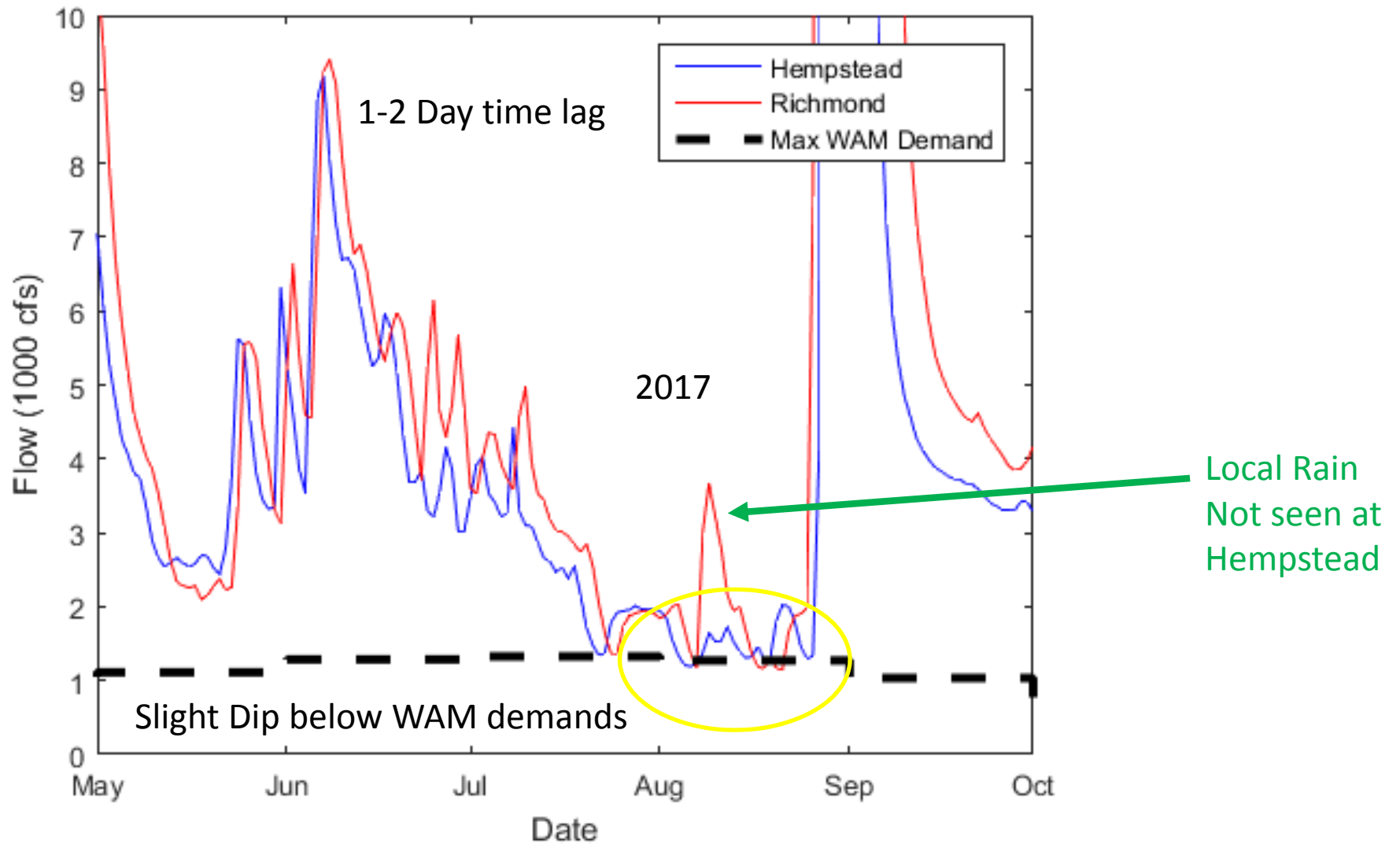
Only briefly dipped below WAM demands

Dec. 2017

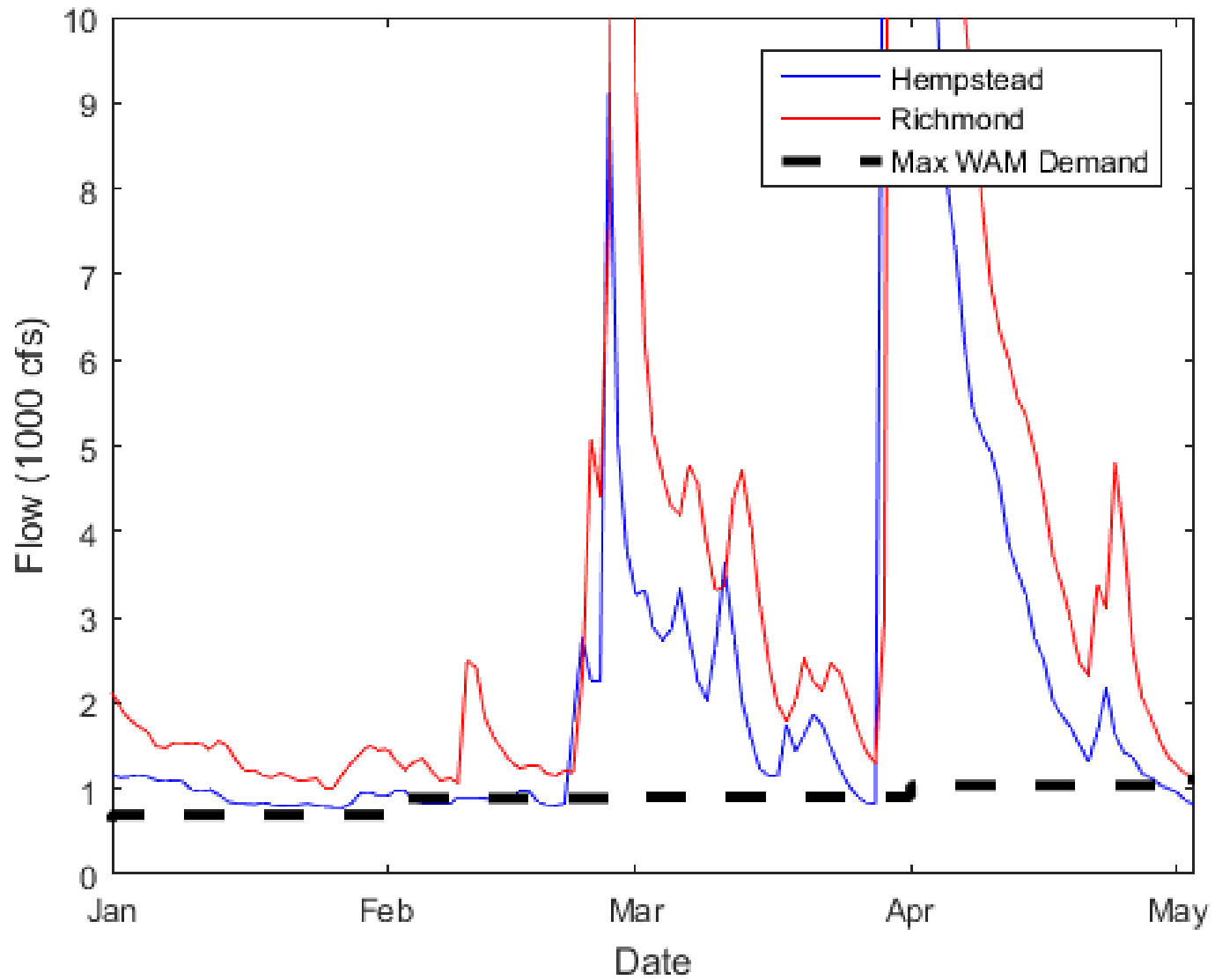
Feb. 2018 – Hempstead only

Watershed & Aquifer Providing water to Brazos

2017 vs 2018 Hydrology



2018 Hydrology – So Far



BRA System Reservoirs – WAM FY Results

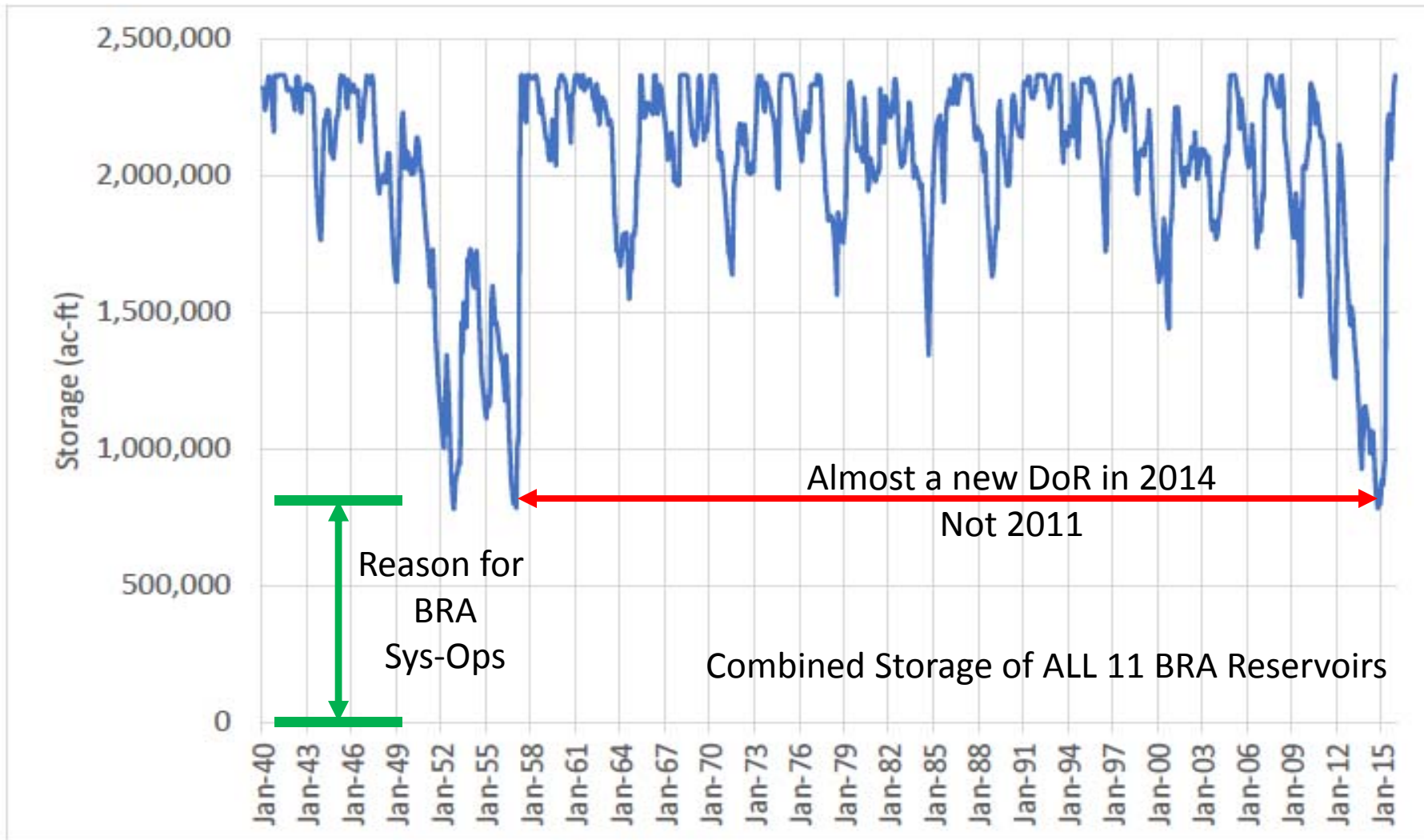


Figure 21: Total BRA System Storage Run 3

BRA System Reservoirs – WAM FY Results

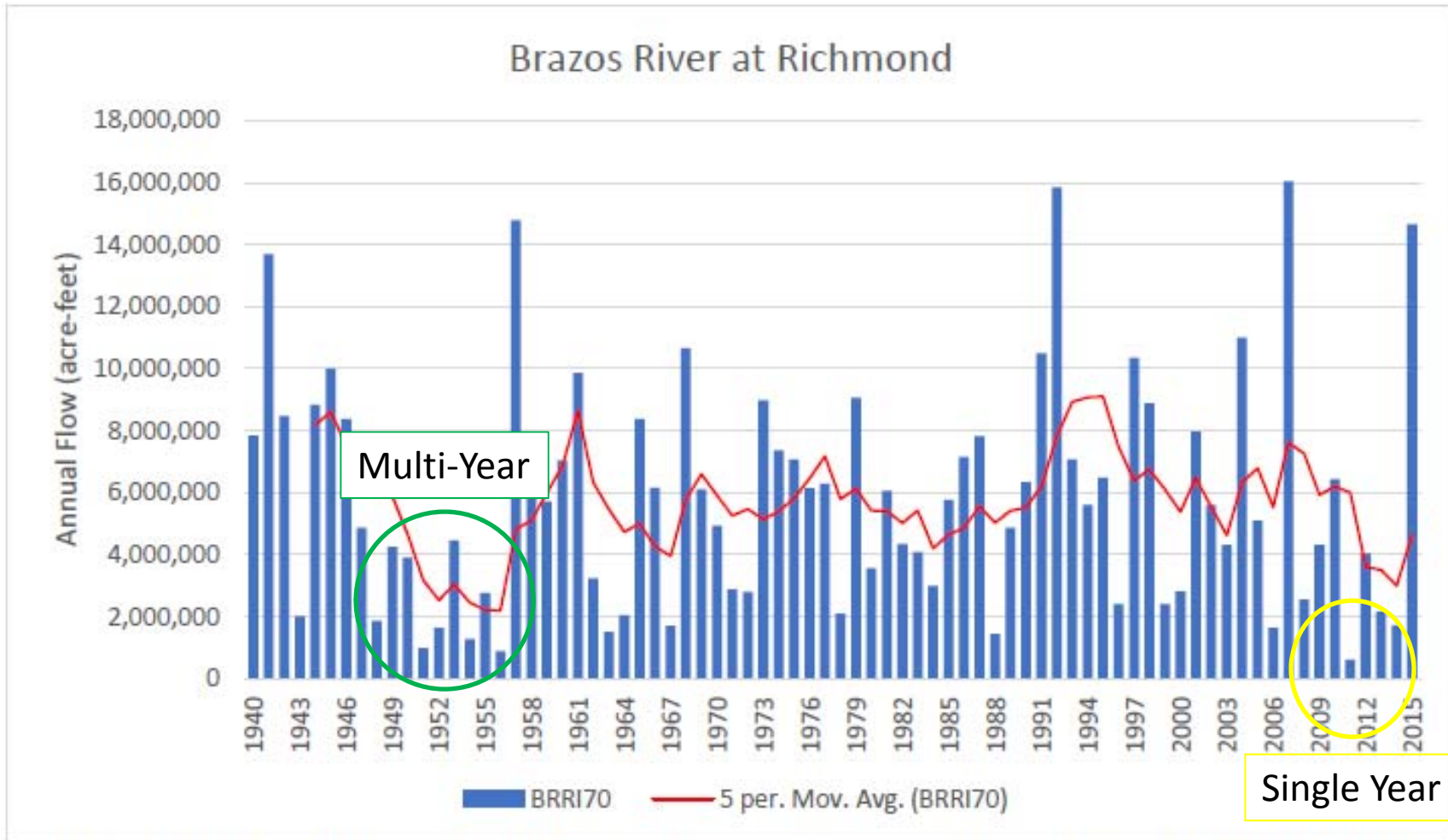
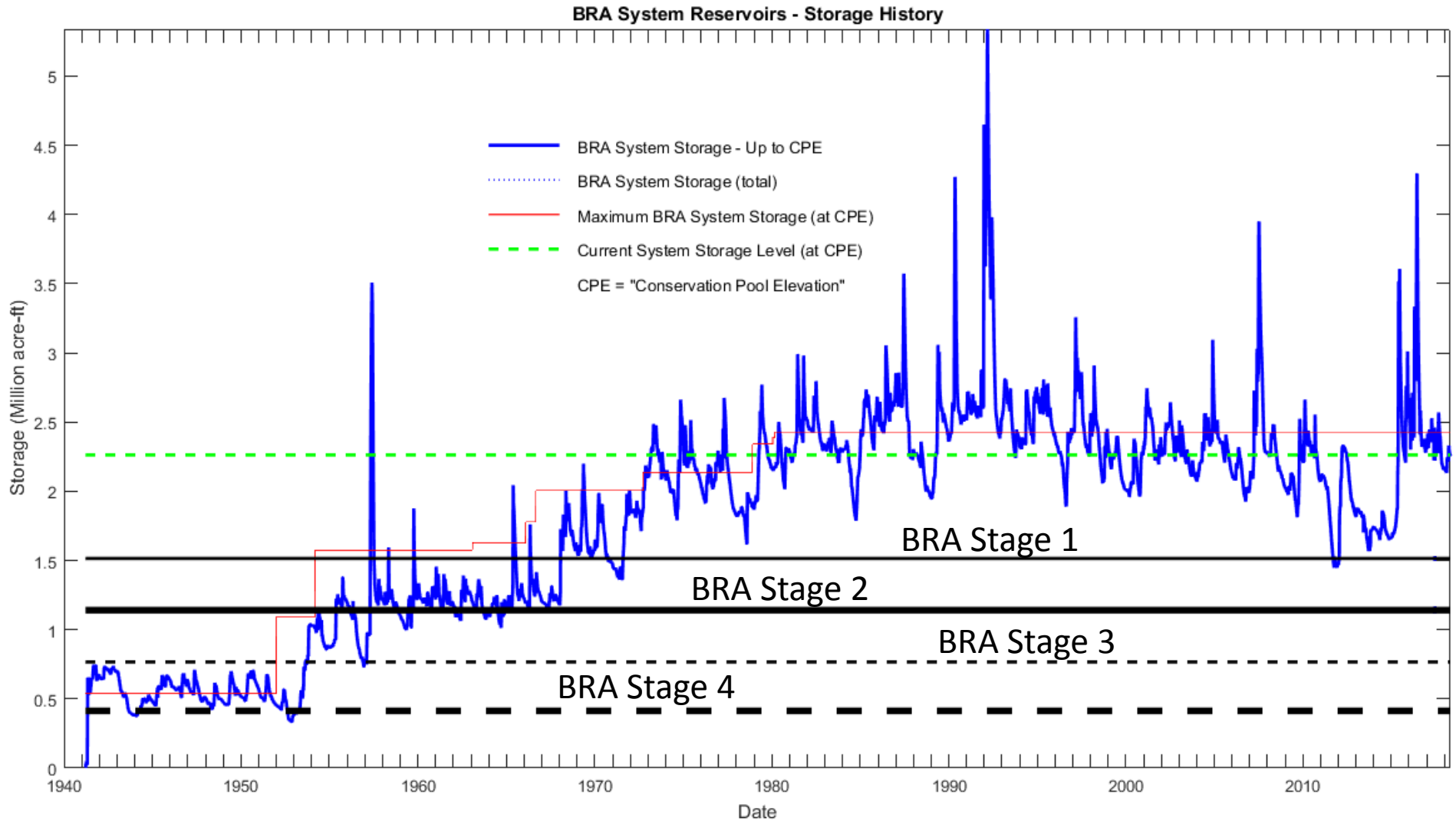


Figure A-16: Annual Naturalized flows for the Brazos River at Richmond Gage (USGS 08114000)

BRA System – Historical Storage



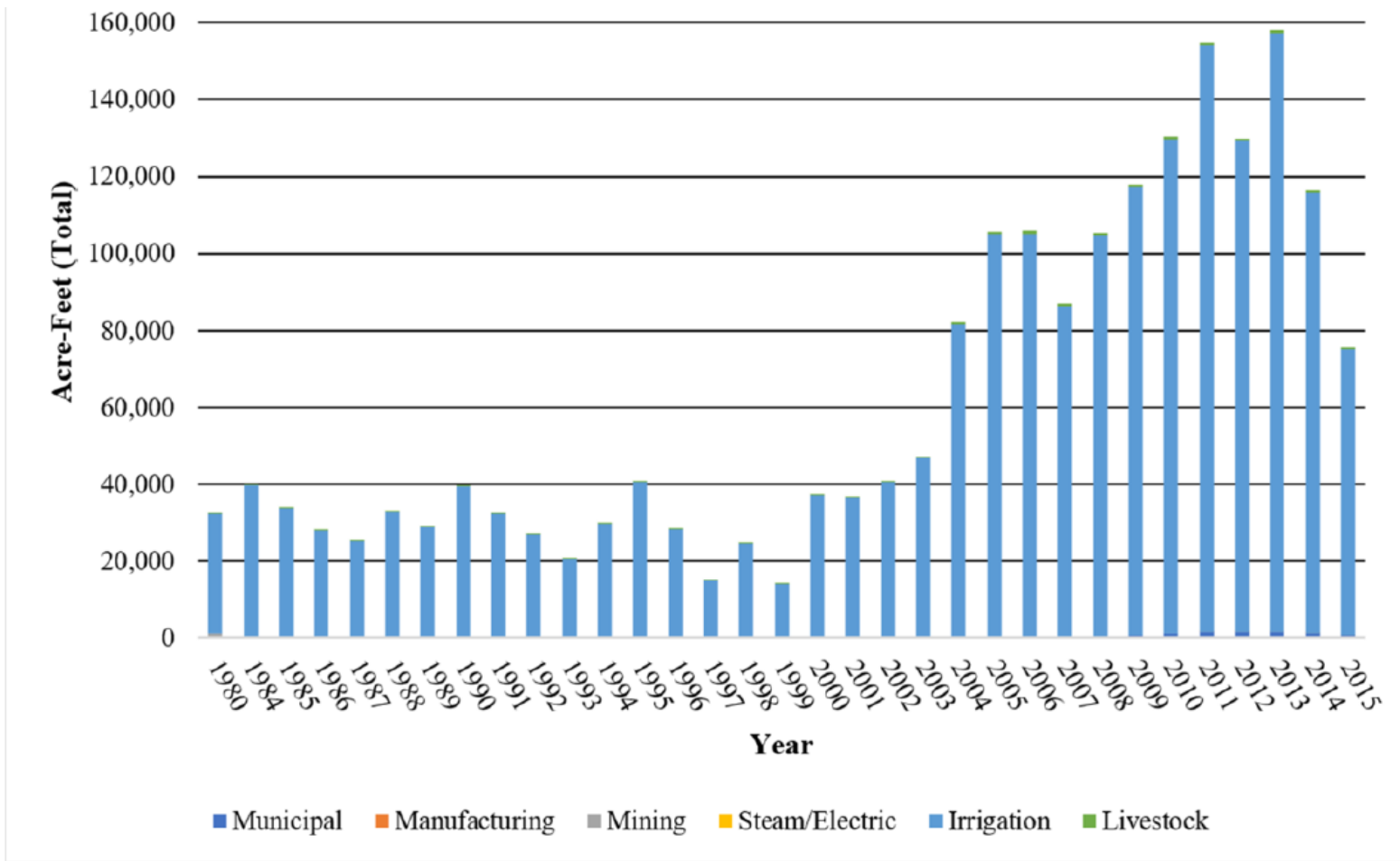


Figure 4.66. Historic pumping volumes from the Brazos River Alluvium Aquifer in the municipal, manufacturing, mining, and steam/electricity production, irrigation, and livestock sectors from 1980 to 2015 (TWDB, 2017b).

Today's Agenda

- Discuss Survey Results
- Discuss groundwater as backup water supply
- Discuss GCWA's proposed DCP Curtailments
- Set Next Meeting/Last Meeting
 - Noticed Public Meeting
 - August (?)
 - GCWA Draft DCP to be available on website at least 2-weeks prior to meeting

GCWA's Drought Contingency Planning Goal

- Ensure GCWA Customers have water needed during future droughts
- TCEQ Requires DCPs with:
 - Stated Curtailment Levels
 - Defined Triggers
- GCWA can't guarantee water supply
 - Can prepare based on past hydrology
 - Investing in means to increase water reliability in uncertain future



Survey Results

- Survey Purpose – Gauge Interest in “Cap & Trade” type system for curtailments
- Idea:
 - system-wide curtailment goals for GCWA
 - Individual customers may not have to curtail as much
 - Some customers curtail more
 - Those who curtail less compensate those who curtail more
- Survey Results: 7 responses, little commitment
 - LRE will develop spreadsheet tracking program
 - Can be implemented if GCWA & Customers Desire
 - Not part of formal DCP for TCEQ
 - US BoR is interested in idea

GCWA's Groundwater Solutions



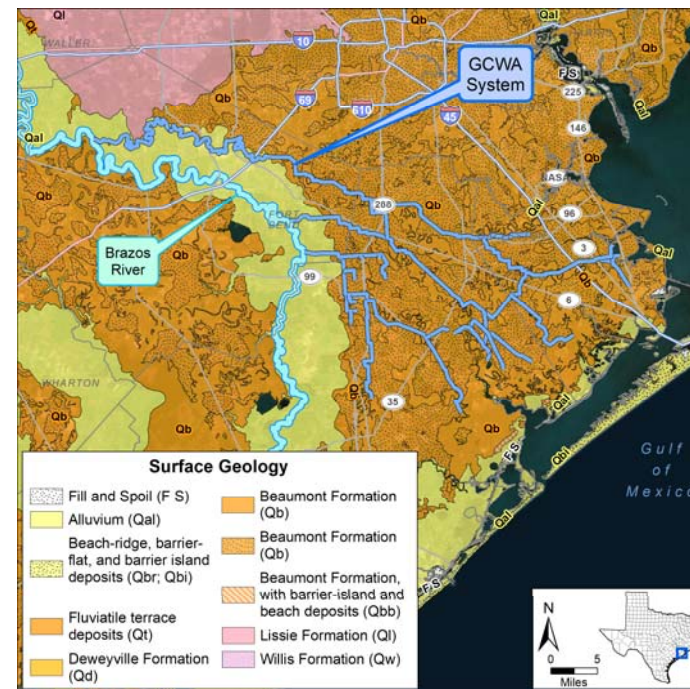
Mike Keester, PG
Senior Hydrogeologist
LRE Water, LLC

Mike.Keester@LREWater.com

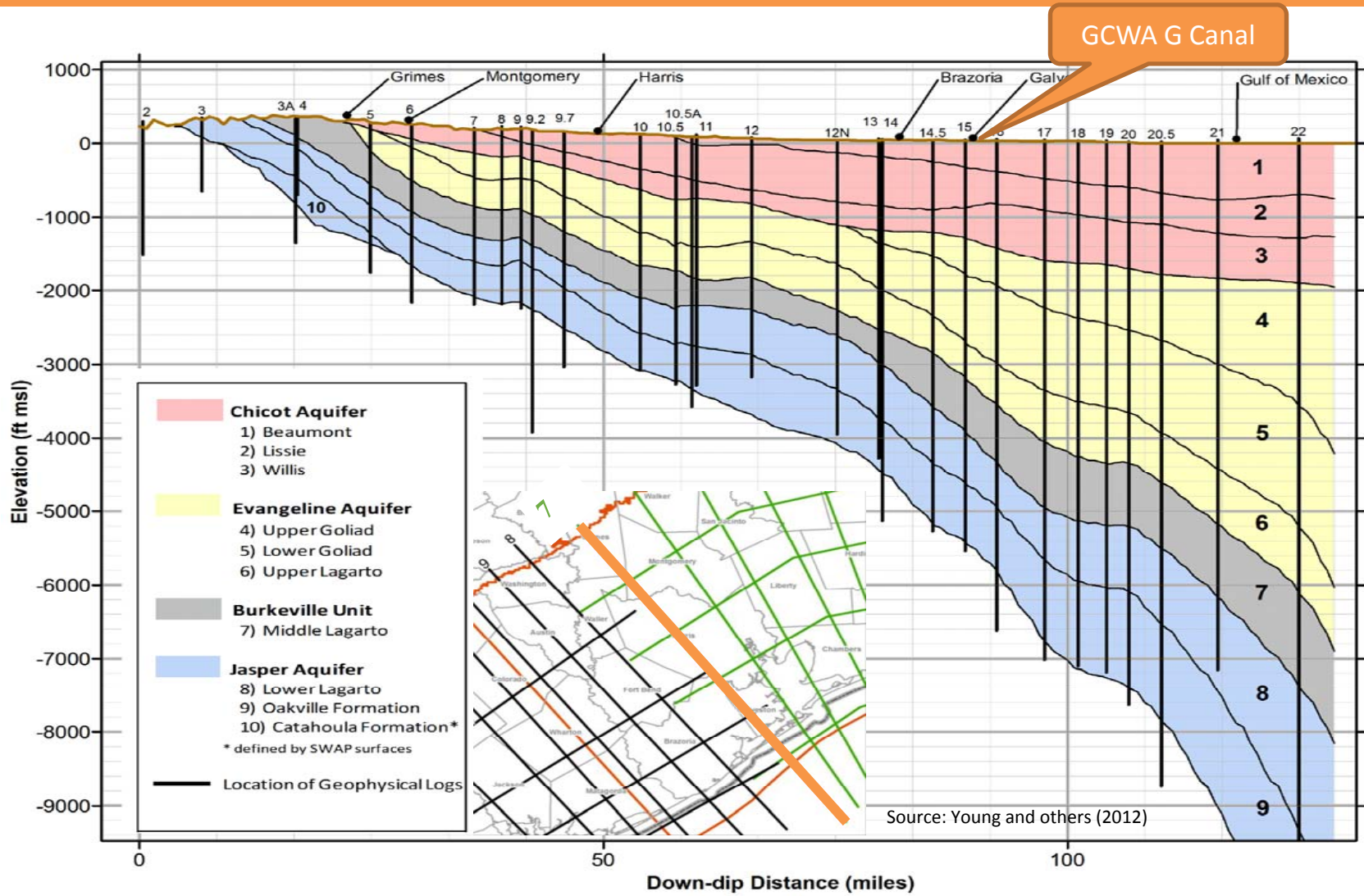
512-962-7660

Local Hydrostratigraphy

- Gulf Coast Aquifer System
 - Chicot Aquifer
 - Evangeline Aquifer
 - Burkeville Confining Unit
 - Jasper Aquifer
- Chicot Aquifer at surface
 - Dips from northwest towards Gulf
 - 500 to 1,000 feet thick
 - 40 to 60 percent sand

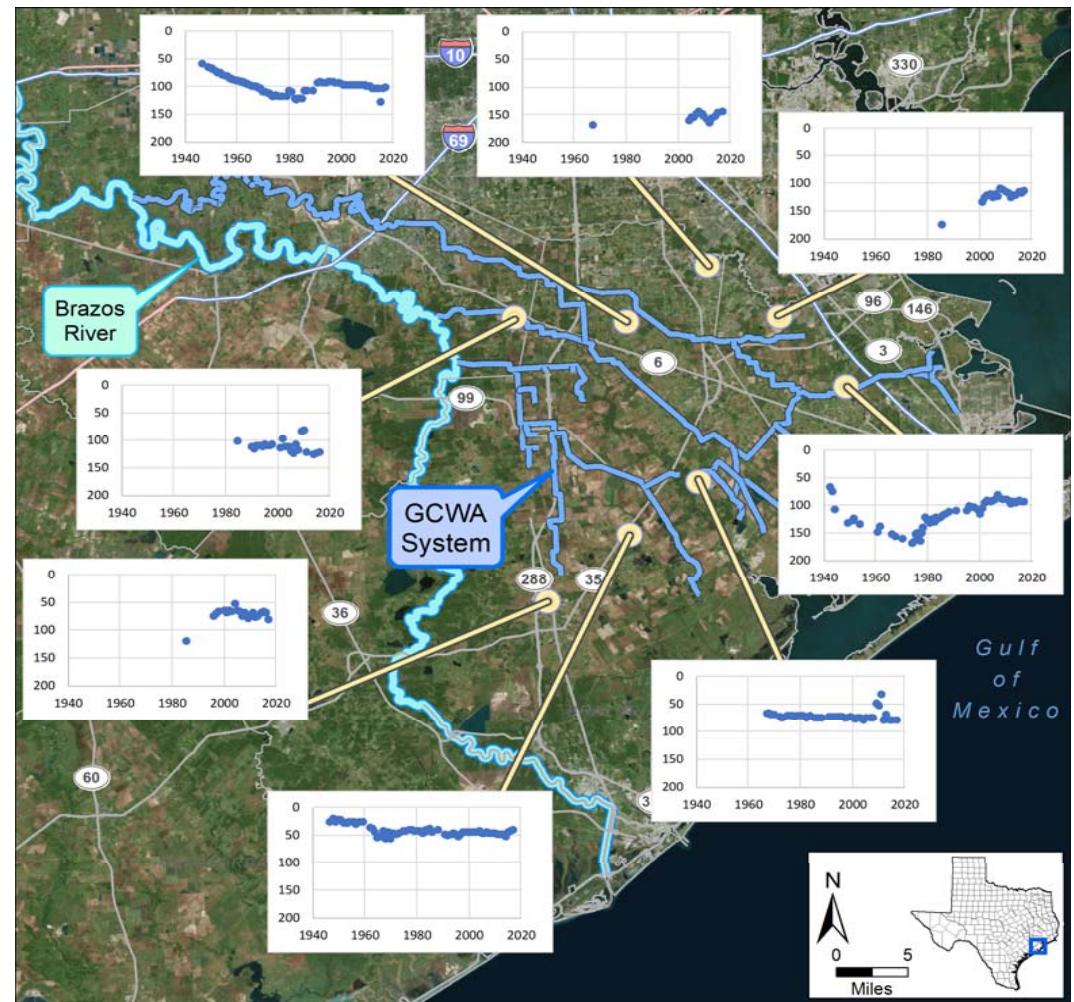


Aquifer Cross-Section



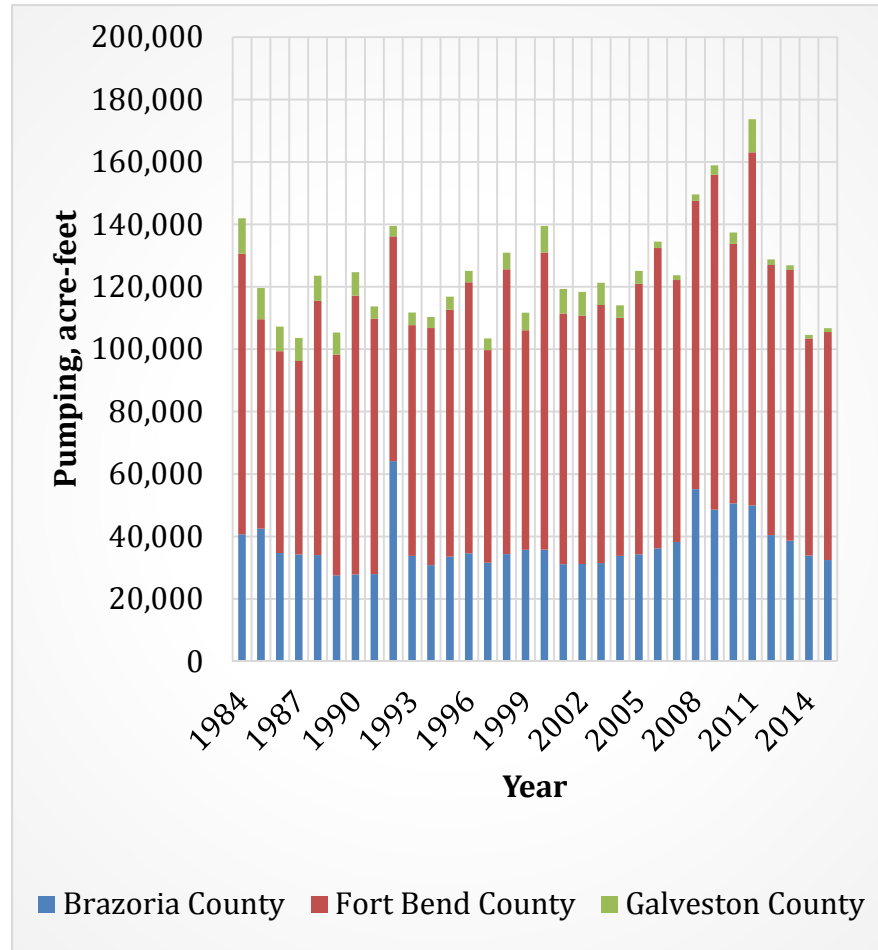
Aquifer Water Levels

- Groundwater flow
 - Before pumping – toward Gulf
 - Now – toward pumping centers
- Water levels
 - 50 to 150 feet BGL
 - Rising in some areas
 - Typically shallower in south



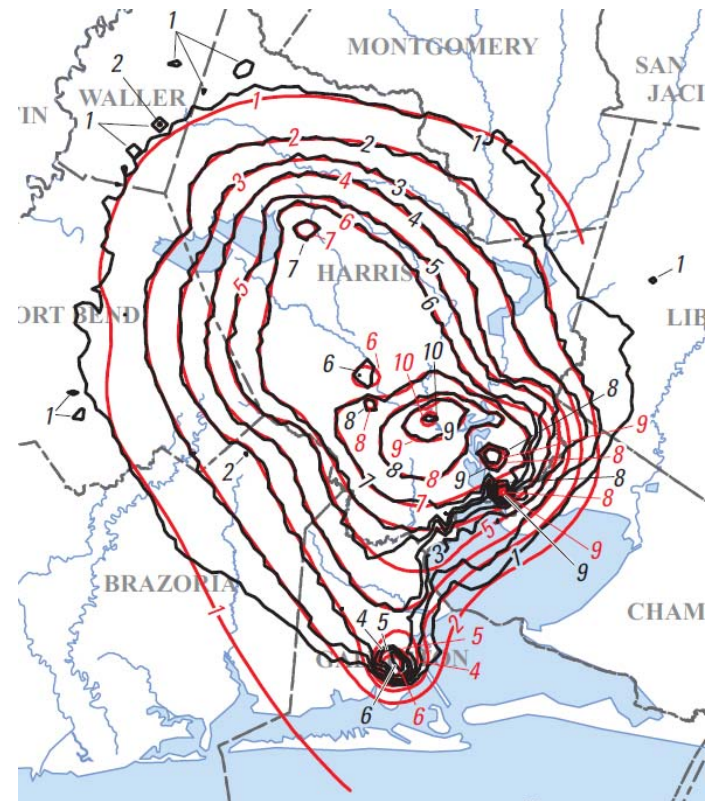
Historical Pumping

- Fairly consistent since 1984
- Typically 100,000 to 120,000 acre-feet per year
- Peak in 2011, then return to typical levels



Land Surface Subsidence

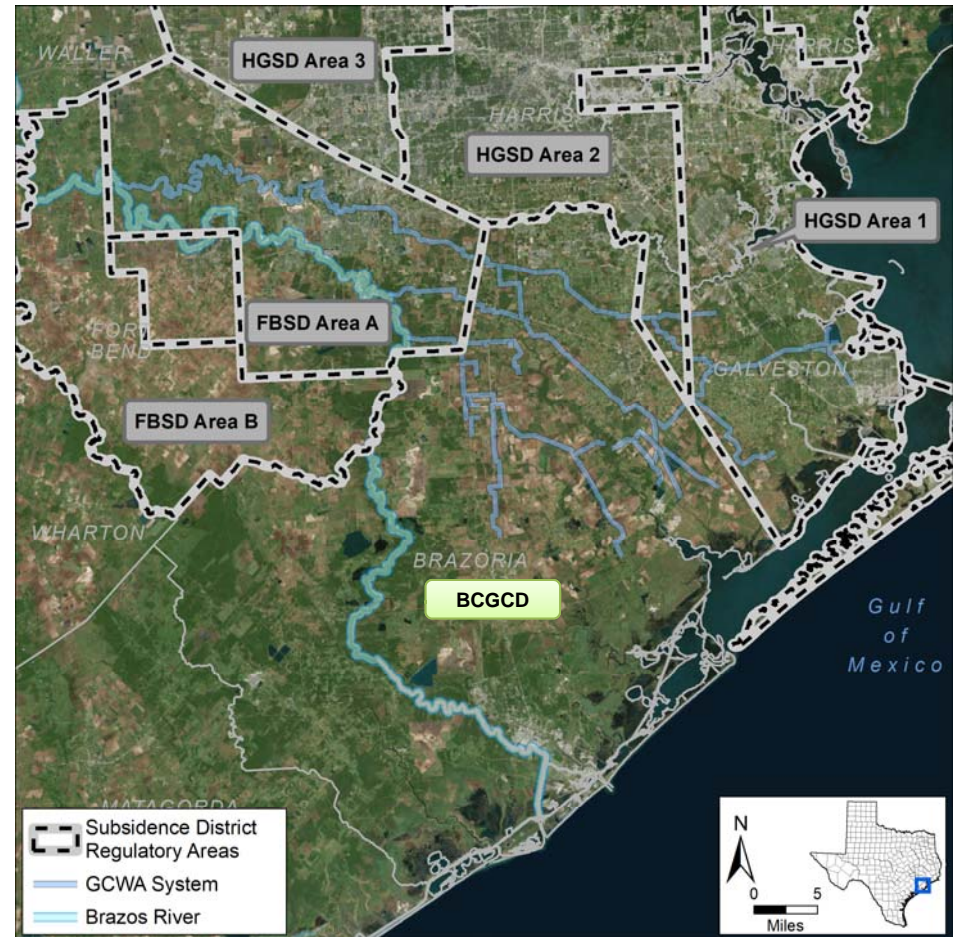
- Well documented in the Gulf Coast Aquifer System
- Compaction of clay within aquifer
- Associated with pumping and corresponding water level declines



Source: Kasmarek (2013)

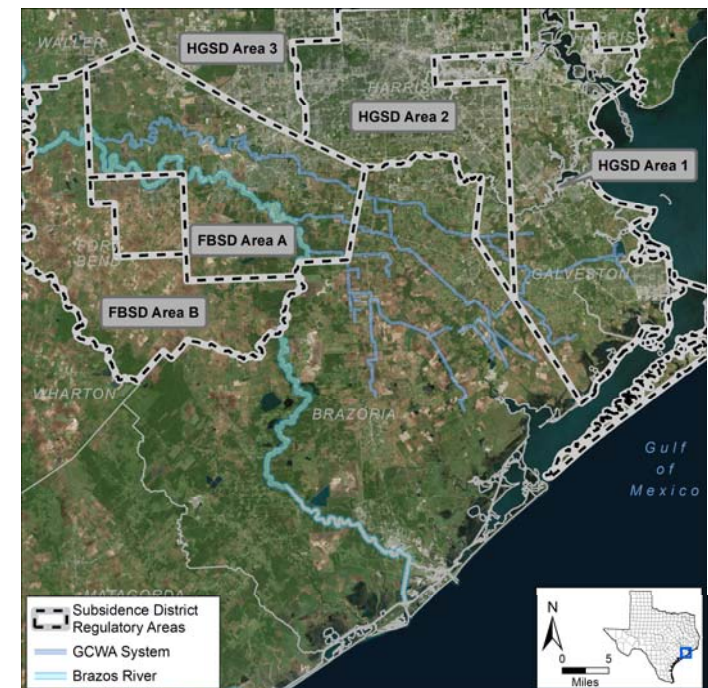
Groundwater Regulation and Management

- Harris Galveston Subsidence District (HGSD)
- Fort Bend Subsidence District (FBSD)
- Brazoria County GCD (BCGCD)



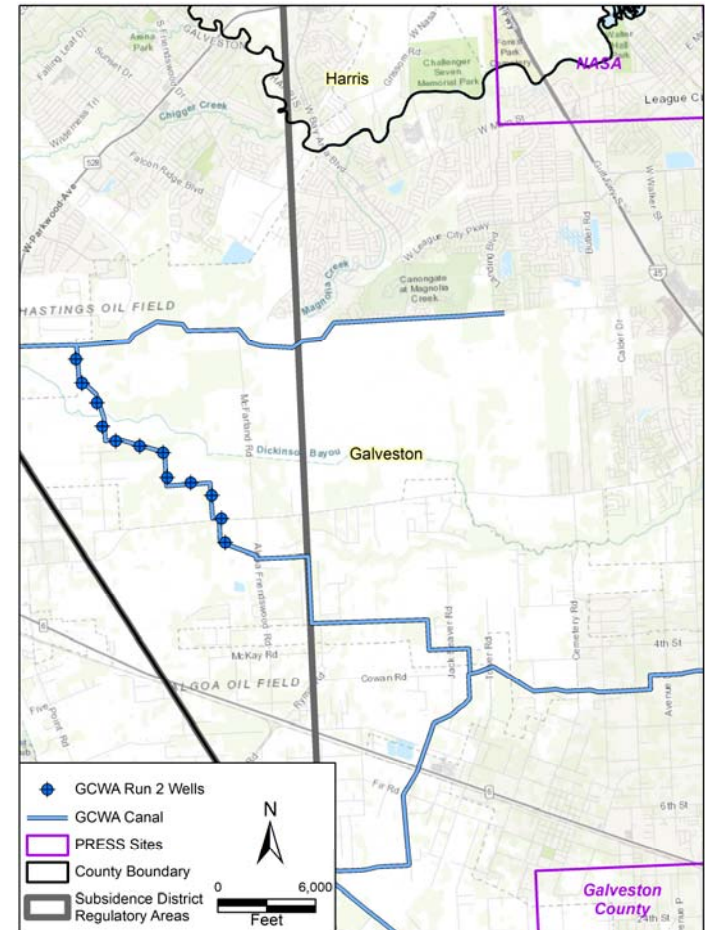
Harris-Galveston Subsidence District

- Regulatory plan to reduce groundwater to:
 - Area 1 – 10% of total water demand
 - Area 2 – 20% of total water demand
- Disincentive fee of \$7.28/1,000 gal
- Permit fee: \$22/1,000,000 gal
- Export of GW not addressed in rules



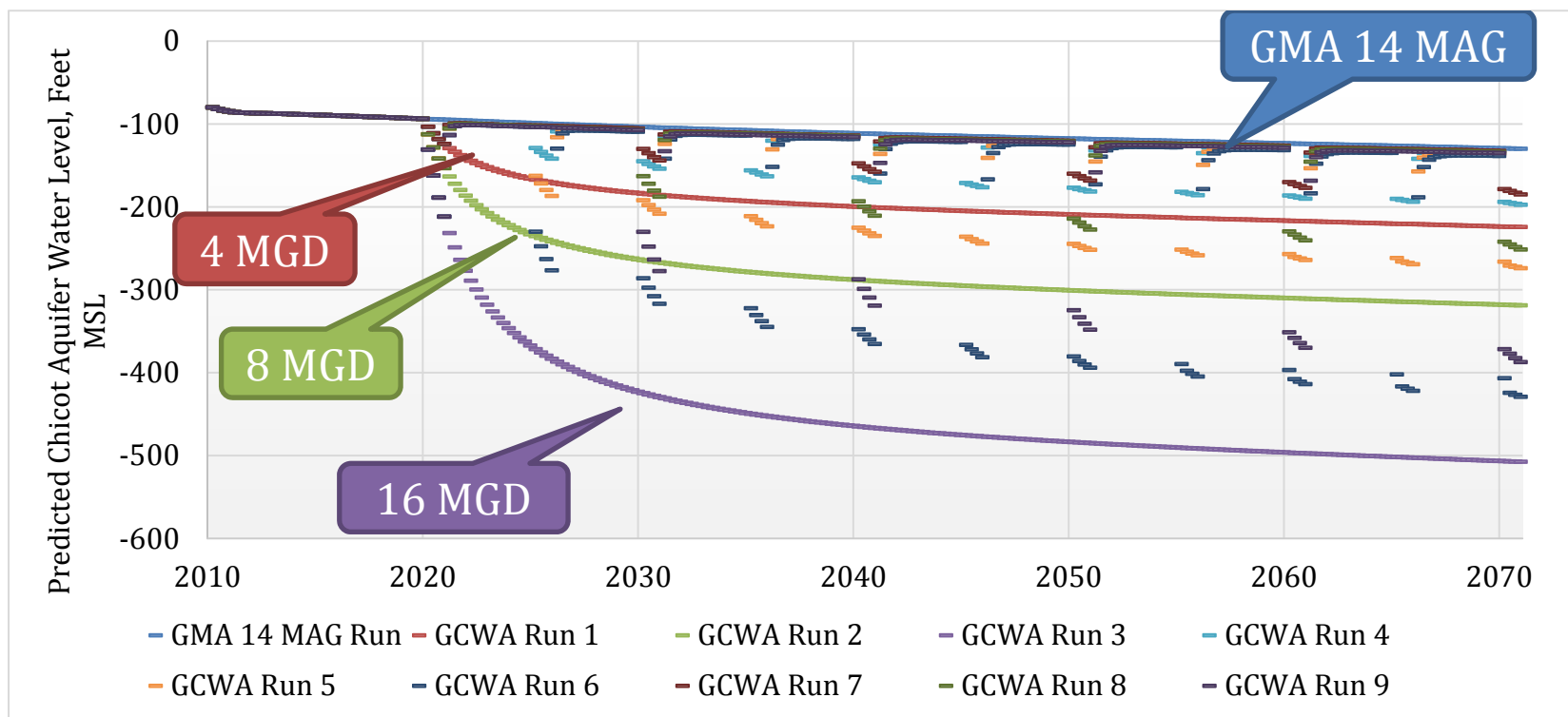
Simulation of Potential Wells

- 12 wells along upper portion of G canal in Galveston County
HGSD Area-2
- Production of 4, 8, and 16 MGD annual average
 - Every year (Runs 1 – 3)
 - Every 5 years (Runs 4 – 6)
 - Every 10 years (Runs 7 – 9)
- Used HAGM for simulation



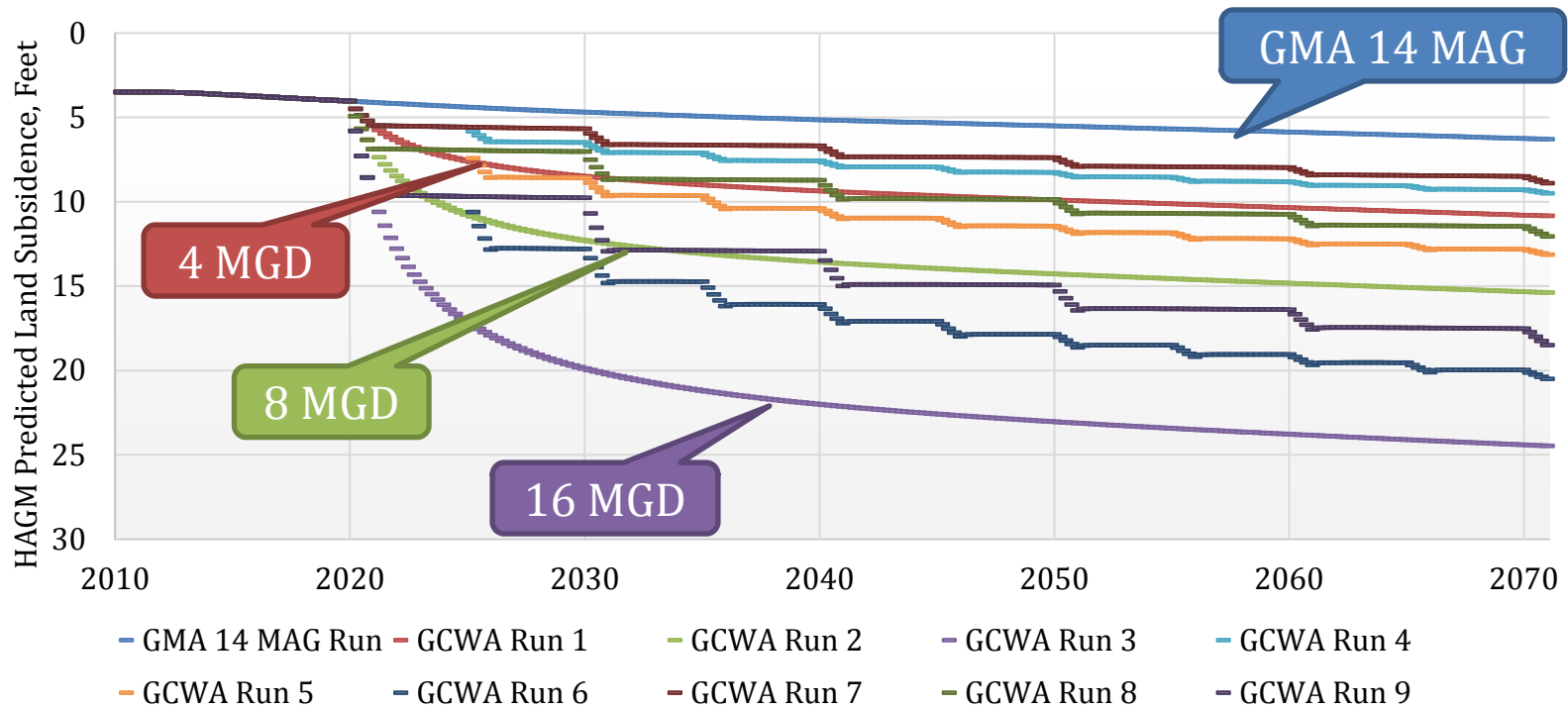
Modeled Change in Water Levels

**Assuming constant pumping 24/7/365

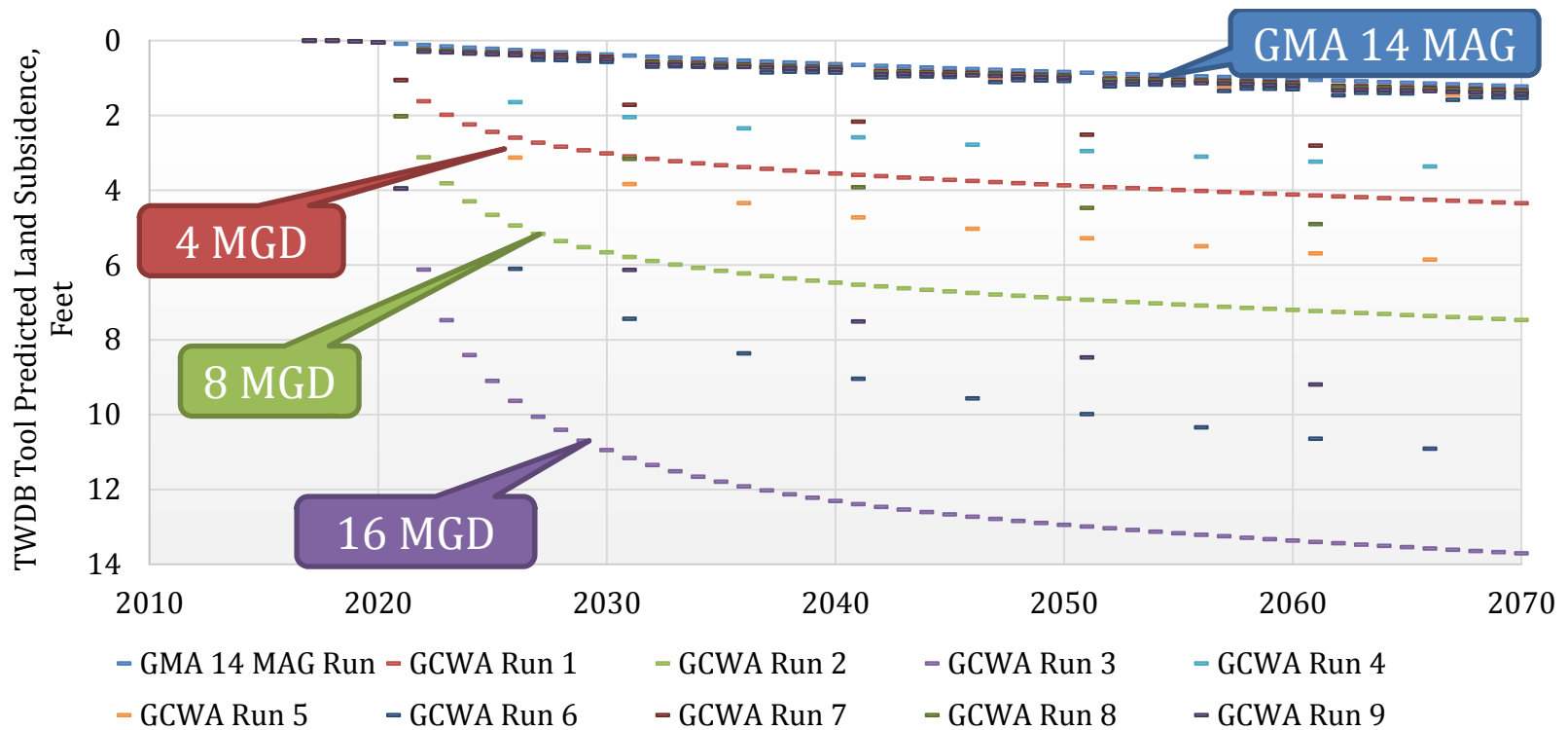


Predicted Subsidence (HAGM)

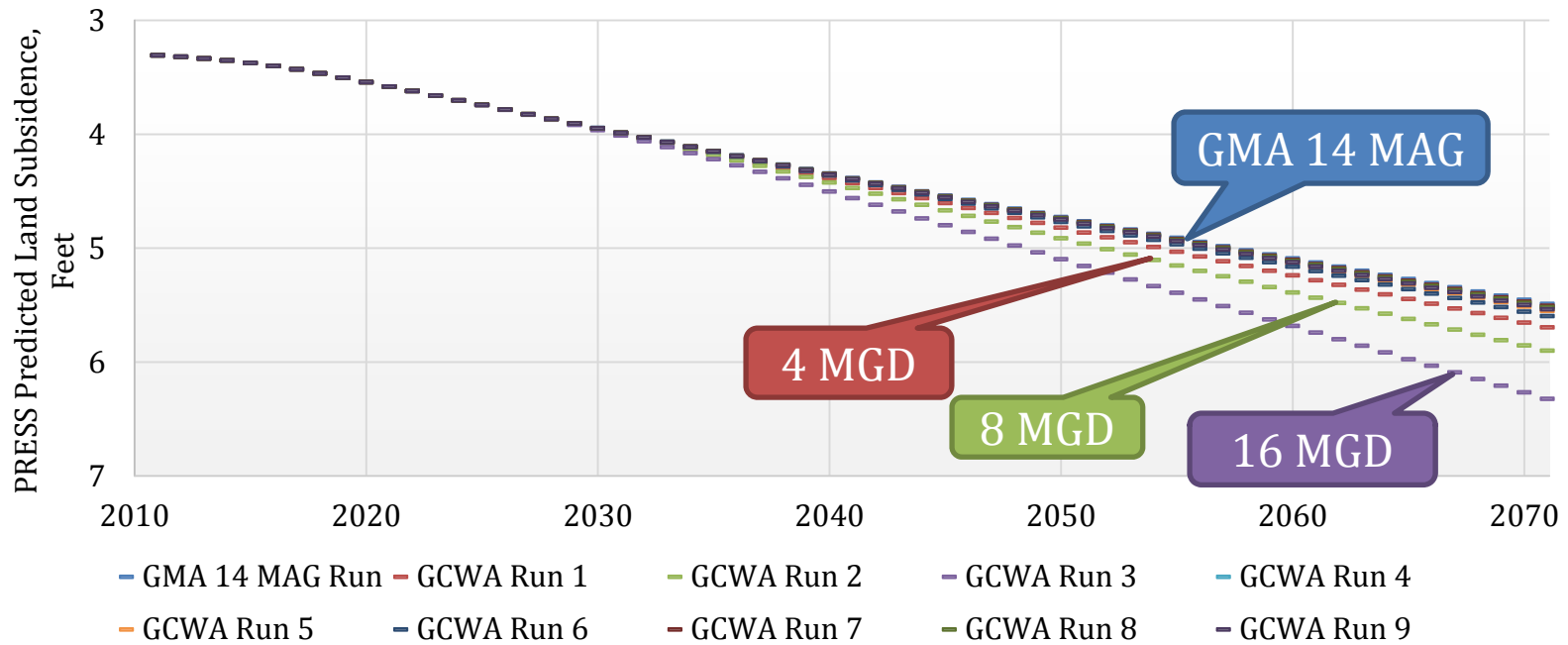
Conclusions: Large predicted subsidence with HAGM model
 Model not well suited for predicting subsidence



Predicted Subsidence (TWDB Project Tool)



Predicted Subsidence (PRESS – NASA Site)



Groundwater Modeling Summary

- Additional water level declines of 100 (4 MGD) to 400 feet (16 MGD)
- Additional subsidence highly variable
 - Less than 1 foot (PRESS model) at 16 MGD
 - More than 20 feet (HAGM) at 16 MGD
- All scenarios indicate groundwater is physically available

Cost Estimate for 12 New Wells

- 1,500 GPM per well
- 500 feet from canal
- 800 feet deep
- 12-inch discharge pipe
- Irrigation well standards
- No water treatment
- Costs based on TWDB Unified Costing Model used for Regional Water Planning
- **\$18M + \$2.7M/yr O&M**

<i>Cost Estimate Summary Water Supply Project Option November 2017 Prices</i>	
<i>GCWA - GCWA Drought Supply</i>	
<i>Cost based on ENR CCI 10870 for November 2017 and a PPI of 193 for November 2017</i>	
<i>Item</i>	<i>Estimated Costs for Facilities</i>
Well Fields (Wells, Pumps, and Piping)	\$9,515,000
TOTAL COST OF FACILITIES	\$9,515,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$3,330,000
Environmental & Archaeology Studies and Mitigation	\$28,000
Interest During Construction (4% for 1 years with a 1% ROI)	<u>\$451,000</u>
TOTAL COST OF PROJECT	\$13,324,000
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	\$1,115,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	\$95,000
Pumping Energy Costs (16901903 kW-hr @ 0.09 \$/kW-hr)	\$1,521,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$2,731,000
Available Project Yield (acft/yr), based on a Peaking Factor of 1	26,884
Annual Cost of Water (\$ per acft)	\$102
Annual Cost of Water (\$ per 1,000 gallons)	\$0.31
<i>MK</i>	
<i>01/09/2018</i>	

DCP PLAN – DRAFT CONTENTS

Curtailment Rules – Wholesale Water Providers

<u>TITLE 30</u>	ENVIRONMENTAL QUALITY
<u>PART 1</u>	TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
<u>CHAPTER 288</u>	WATER CONSERVATION PLANS, DROUGHT CONTINGENCY PLANS, GUIDELINES AND REQUIREMENTS
<u>SUBCHAPTER B</u>	DROUGHT CONTINGENCY PLANS
<u>RULE §288.22</u>	Drought Contingency Plans for Wholesale Water Suppliers

(a) A drought contingency plan for a wholesale water supplier must include the following minimum elements.

(1) Preparation of the plan shall include provisions to actively inform the public and to affirmatively provide opportunity for user input in the preparation of the plan and for informing wholesale customers about the plan. Such acts may include, but are not limited to, having a public meeting at a time and location convenient to the public and providing written notice to the public concerning the proposed plan and meeting.

(2) The drought contingency plan must document coordination with the regional water planning groups for the service area of the wholesale public water supplier to ensure consistency with the appropriate approved regional water plans.

(3) The drought contingency plan must include a description of the information to be monitored by the water supplier and specific criteria for the initiation and termination of drought response stages, accompanied by an explanation of the rationale or basis for such triggering criteria.



Streamflow
Remaining
BRA Contract
Water

Can GCWA just follow BRA's DCP, adopt their stages?

Answer: No – because GCWA depends on RoR Streamflow & BRA Supplies

Curtailment Rules – Wholesale Water Providers

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RULE §288.22	Drought Contingency Plans for Wholesale Water Suppliers

(a) A drought contingency plan for a wholesale water supplier must include the following minimum elements.

(4) The drought contingency plan must include a minimum of **three** drought or emergency response stages providing for the implementation of measures in response to water supply conditions during a repeat of the drought-of-record.

(5) The drought contingency plan must include the procedures to be followed for the initiation or termination of drought response stages, including procedures for notification of wholesale customers regarding the initiation or termination of drought response stages.

(6) The drought contingency plan must include specific, quantified targets for water use reductions to be achieved during periods of water shortage and drought. The entity preparing the plan shall establish the targets. The goals established by the entity under this paragraph are not enforceable.

****1950's
Drought**

Curtailment Rules – Wholesale Water Providers

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<u>RULE §288.22</u>	Drought Contingency Plans for Wholesale Water Suppliers

(a) A drought contingency plan for a wholesale water supplier must include the following minimum elements.

(7) The drought contingency plan must include the specific water supply or water demand management measures to be implemented during each stage of the plan, including, but not limited to, the following:

(A) pro rata curtailment of water deliveries to or diversions by wholesale water customers as provided in Texas Water Code, §11.039; and

(B) utilization of alternative water sources with the prior approval of the executive director as appropriate (e.g., interconnection with another water system, temporary use of a non-municipal water supply, use of reclaimed water for non-potable purposes, etc.).

(8) The drought contingency plan must include a provision in every wholesale water contract entered into or renewed after adoption of the plan, including contract extensions, that in case of a shortage of water resulting from drought, the water to be distributed shall be divided in accordance with Texas Water Code, §11.039.

(9) The drought contingency plan must include procedures for granting variances to the plan.

(10) The drought contingency plan must include procedures for the enforcement of any mandatory water use restrictions including specification of penalties (e.g., liquidated damages, water rate surcharges, discontinuation of service) for violations of such restrictions.

(b) The wholesale public water supplier shall notify the executive director within five business days of the implementation of any mandatory provisions of the drought contingency plan.

(c) The wholesale public water supplier shall review and update, as appropriate, the drought contingency plan, at least every five years, based on new or updated information, such as adoption or revision of the regional water plan.

??

Based on Usage or Contract

Turning On Wells

GCWA's Current DCP Language:
“reduction of the use that would have occurred in the absence of drought contingency measures”

== Based on usage

Texas Water Code §11.039

Sec. 11.039. DISTRIBUTION OF WATER DURING SHORTAGE. (a) If a shortage of water in a water supply not covered by a water conservation plan prepared in compliance with Texas Natural Resource Conservation Commission or Texas Water Development Board rules results from drought, accident, or other cause, the water to be distributed shall be divided among all customers pro rata, according to the amount each may be entitled to, so that preference is given to no one and everyone suffers alike.

(b) If a shortage of water in a water supply covered by a water conservation plan prepared in compliance with Texas Natural Resource Conservation Commission or Texas Water Development Board rules results from drought, accident, or other cause, the person, association of persons, or corporation owning or controlling the water shall divide the water to be distributed among all customers pro rata, according to:

(1) the amount of water to which each customer may be entitled; or

(2) the amount of water to which each customer may be entitled, less the amount of water the customer would have saved if the customer had operated its water system in compliance with the water conservation plan.

(c) Nothing in Subsection (a) or (b) precludes the person, association of persons, or corporation owning or controlling the water from supplying water to a person who has a prior vested right to the water under the laws of this state.

****TCEQ & TWDB Rules – Do not explicitly state**

“amount of water to which each customer may be entitled” - Contract vs. Recent Historical

But...

TCEQ Must Approve DCPs – so what have they approved?

Approved DCPs – LCRA Example

LCRA Firm Water Customer Curtailment Plan (for submittal to TCEQ)

In the event the LCRA Board orders a **pro rata curtailment**, the amount of water made available to all firm water customers will be reduced by an equal percentage from the customers' reasonable demands. The determination of a customer's available supply during a curtailment will be based on the following:

1. Actual water use from a **dry 12-month period (the "Reference Year")** will serve as the default **"Baseline Amount"** to which pro rata reductions would be applied. The Baseline Amount would not exceed customer's contracted annual quantity.
2. The Baseline Amount is **subject to adjustment** based upon conditions that caused customer's water use in the Reference Year to be reduced, including, but not limited to:
 - a. implementation of water conservation or drought contingency measures during the Reference Year which resulted in quantified and documented savings;
 - b. new growth and that will result in increases to customer's reasonable demands;
 - c. plant outages or other incidents that reduced demand; and
 - d. customer did not hold a contract for the entire Reference Year.
3. The amount of water to be made available to a customer during a curtailment (the "Annual Allotment") will be equal to the Baseline Amount, less the percentage curtailment ordered by the Board.

Approved DCPs – BRA Example

Stage 4 – Pro-rata Curtailment Condition

Under Stage 4, Pro-rata Curtailment Condition, the BRA's customers will implement a mandatory pro-rata curtailment of a minimum of 10% of water use that would have occurred in the absence of any drought curtailment or water use reduction, pursuant to *Texas Water Code* §11.039. In certain circumstances warrant, the BRA's GM/CEO or his/her designee may adjust the pro-rata curtailment percentage. All uses of water for Interruption Agreements in the affected part of the system will be terminated. The mandatory pro-rata curtailment of water use under long-term contracts will be as follows:

The general process under which the BRA will make water available during curtailment in accordance with *Texas Water Code* §11.039 is described below:

- Determine amount of water to be made available during curtailment

The amount of water made available to all affected customers with long-term contracts will be reduced by an equal percentage from the customers' reasonable demands. The determination of a customer's available supply during a curtailment will be based on the following:

- Actual water use from a dry 12-month period (the "Reference Year") will serve as the default "Baseline Amount" to which pro-rata reductions would be applied. The Baseline Amount cannot exceed a customer's

annual contracted quantity and would follow a typical pattern of water use.

- The Baseline Amount is subject to adjustment based upon conditions that caused a customer's water use in the Reference Year to be reduced, including, but not limited to:
 - implementation of water conservation or drought contingency measures during the Reference Year which resulted in quantified and documented savings;
 - new growth that has since resulted in increases to customer's reasonable demands;
 - plant outages or other incidents that reduced demand; or
 - customer did not hold a water supply contract for the entire Reference Year.

Approved DCPs – BRA Example

Stage 4 – Pro-rata Curtailment Condition

Under Stage 4, Pro-rata Curtailment Condition, the BRA's customers will implement a mandatory pro-rata curtailment of a minimum of 10% of water use that would have occurred in the absence of any drought curtailment or water use reduction, pursuant to *Texas Water Code* §11.039. In certain circumstances warrant, the BRA's GM/CEO or his/her designee may adjust the pro-rata curtailment percentage. All uses of water for Interruption Agreements in the affected part of the system will be terminated. The BRA will implement mandatory pro-rata curtailment of water use under long-term contracts.

The general process under which the BRA will make water available during curtailment in accordance with *Texas Water Code* §11.039 is described below:

- Determine amount of water to be made available during curtailment.

The amount of water made available to all affected customers with long-term contracts will be reduced by an equal percentage from the customers' reasonable demands. The determination of a customer's available supply during a curtailment will be based on the following:

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 - new growth that has since resulted in increases to customer's reasonable demands;
 - plant outages or other incidents that reduced demand; or
 - customer did not hold a water supply contract for the entire Reference Year.

Approved DCPs – LNVA Example

9 Enforcement

During periods of water shortage as defined above, the following rate adjustments shall apply:

- (a) For all water taken during a Stage II – Severe Water Shortage Condition the applicable water rate shall be increased by 25%
- (b) For all water taken during a Stage III – Extreme Water Shortage Condition the applicable water rate shall be increased by 50%
- (c) For all water taken during a Stage IV – Exceptional Water Shortage Condition or Stage V – Emergency Water Shortage Condition the applicable rate shall be increased by 100%
- (d) During times of pro-rata allocation, as prescribed by the General Manager, contracted water volumes shall be reduced to the pro-rata allotment and all water diverted in excess of the adjusted contract volume shall be charged at the uncontracted rate. For contracted municipal and industrial customers without a specified contract volume, pro-rata allocations shall be determined based on monthly average diversion for the previous calendar year.
- (e) All interruptible water supplies, including irrigation and uncontracted supplies will be restricted to any excess flows available in the Neches River and rates adjustments as defined above shall apply.

Summary:

LCRA – Baseline Dry Year
BRA – Baseline Dry Year
LNVA – Contracted or
Previous Year

All have Huge Reservoirs
with abundant storage

LCRA – Got Emergency Orders
To avoid WMP required
releases and avoid curtailment

GCWA's Proposed Curtailment Method

- Based on 3-Year Monthly Average Usage
 - Variances Allowed on Case-by-Case Basis (if requested)
 - GCWA will continuously re-compute customer monthly averages.
 - 2018 Monthly Averages – Based on 2015-2017 Usage
 - As Recorded in GCWA Master Usage Database (LRE1703)
 - If database says monthly usage = 0, month is EXCLUDED from average
 - GCWA is reviewing computed 2018 3-Year Monthly Averages
 - 150-180 cfs needed (not including canal losses or irrigation needs)

GCWA Drought Stages & Curtailment - Proposed

- Stage 0 – Normal Operations
- Stage 0.5 – Voluntary Cutbacks of up to 5%
 - » GCWA incentivizing use reductions through rate reductions
 - Trigger: **May – September**
- Stage 1 – Mandatory 5% Reduction From Baseline
 - Trigger #1: Streamflow @ Hempstead < Monthly Target cfs for 3 consecutive days, **and**
 - Trigger #2: No forecasted significant watershed rainfall for 5 days, **and**
 - Trigger #3: Predicted streamflow @ GCWA < Monthly Target cfs for 10 days into future, or
 - Trigger #4: Curtailment dictated by GCWA General Manager
 - Action: Commence release of BRA Contract Water

GCWA Drought Stages & Curtailment - Proposed

- Stage 2 – Mandatory 10% Reduction
 - Trigger #1: Predicted streamflow @ GCWA < 90% Monthly Target cfs for 10 days into future
 - Trigger #2 – Remaining GCWA BRA Contract Water Supplies plus computed GCWA streamflow won't meet monthly targets at stage 1 reductions
 - Action #1: Continue release of BRA Contract Water
 - Action #2: Utilize GCWA wells to augment supply
 - Action #3: *Interruptible use = 100% curtailment (other than BRA/Contract water)*
- Stage 3 – Mandatory 15% Reduction
 - Trigger #1: Predicted streamflow @ GCWA < 80% Monthly Target cfs for 10 days into future
 - Trigger #2 – Remaining GCWA BRA Contract Water Supplies plus computed GCWA streamflow won't meet monthly targets at Stage 2 reductions
 - Action #1: Continue release of BRA Contract Water
 - Action #2: Utilize GCWA wells to augment supply

GCWA Drought Stages & Curtailment - Proposed

- Stage 4 – Mandatory 20% (or Greater) Reduction
 - Trigger: Catastrophic Event Preventing Sufficient Water Delivery Declared by GCWA General Manager
 - Action: Alternative Supply Usage
 - Action: GCWA General Manager dictates required reduction levels
- All Stages – GCWA incentivizing Conservation
 - Exceeding Baseline Monthly Usage (w/ Reductions): **2.5x Water Rate**
 - Using less than Monthly Usage (w/Reductions): **0.75x Water Rate**
 - Rates based on Monthly Usage

Details to be worked out – Input Requested

Monthly Targets – cfs

- Monthly Target = Sum of

- Demands for Run-of-River from Dow, NRG, Brazosport (known or estimated)
- GCWA Baseline water usage with canal-loss adjustments
- Multiplied by 2 (Factor of Safety, push-water)

- Example:

- Dow: 150 cfs
- NRG: 50 cfs
- Brazosport: 15 cfs
- GCWA Firm: 200 cfs

-
- Total: 415 cfs → 830 cfs Run-of-River Flow @ Hempstead

GCWA already
coordinates with
Dow, NRG, BWA

Drought Task Force – Next & Last Meeting

- August, 2018
- Full Public Notice & Participation Requested
 - Follow rules for posting public meeting notices
- Non-GCWA venue – TDB
- Purpose – Present DCP, Obtain DTF and Public Feedback
- Mid July – Draft DCP will be available for review on GCWA DCP website



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