An Evolving Understanding of the Hosston Layer of the Trinity Aquifer

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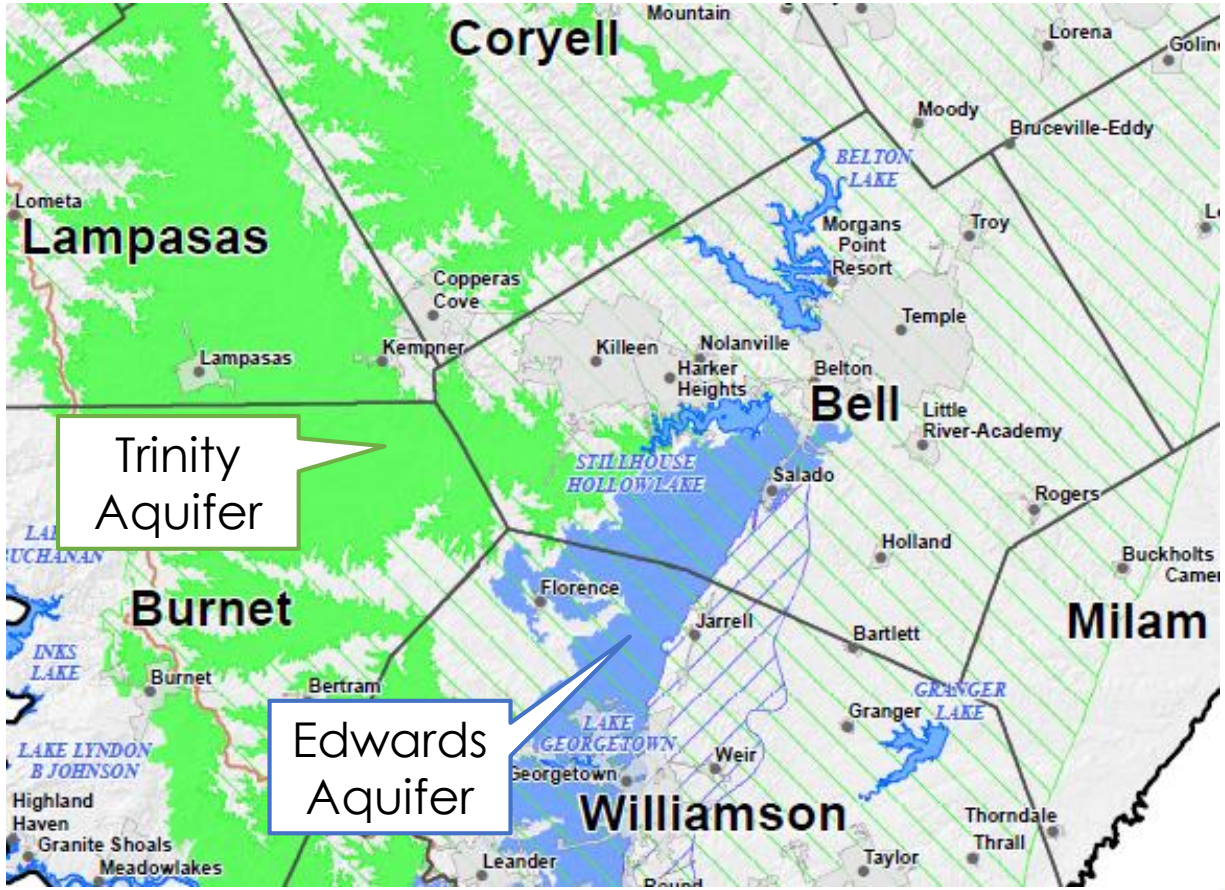
Presentation at the
Bell County Water Symposium

November 16, 2015

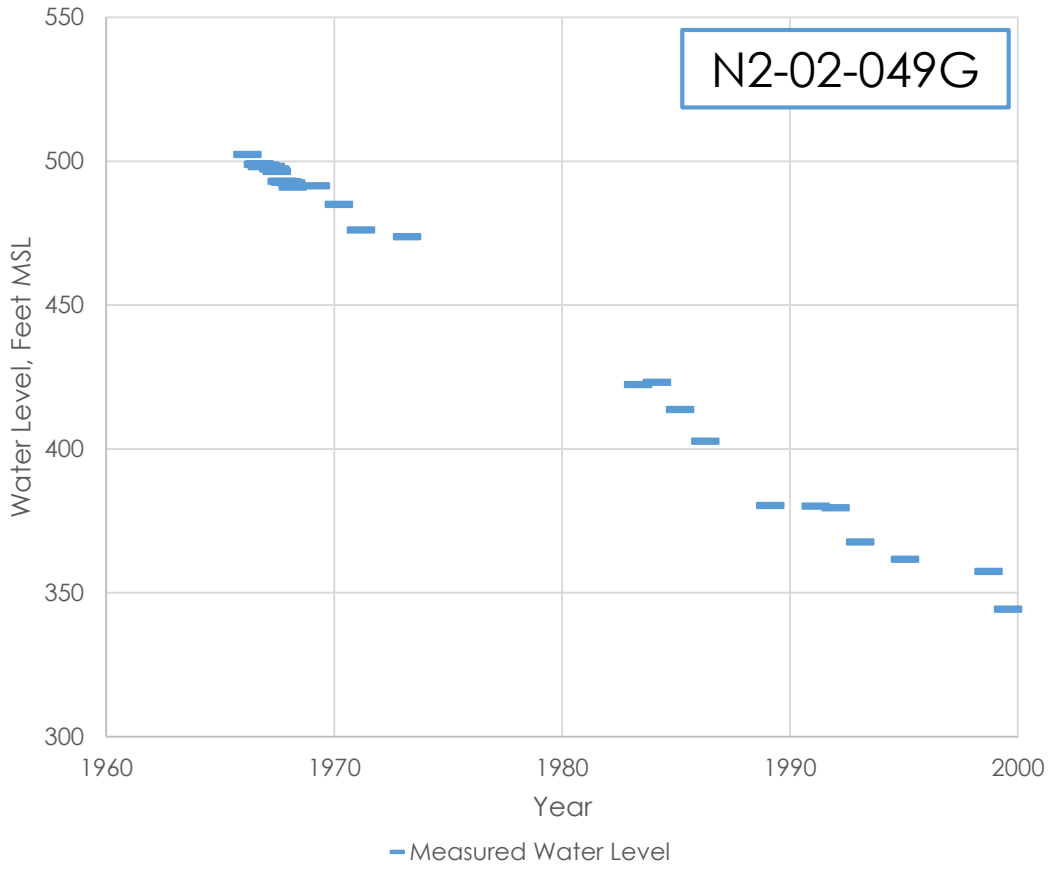
Hosston (Lower Trinity)

- What did we know
- What did we learn
- What is the difference
- What does it mean

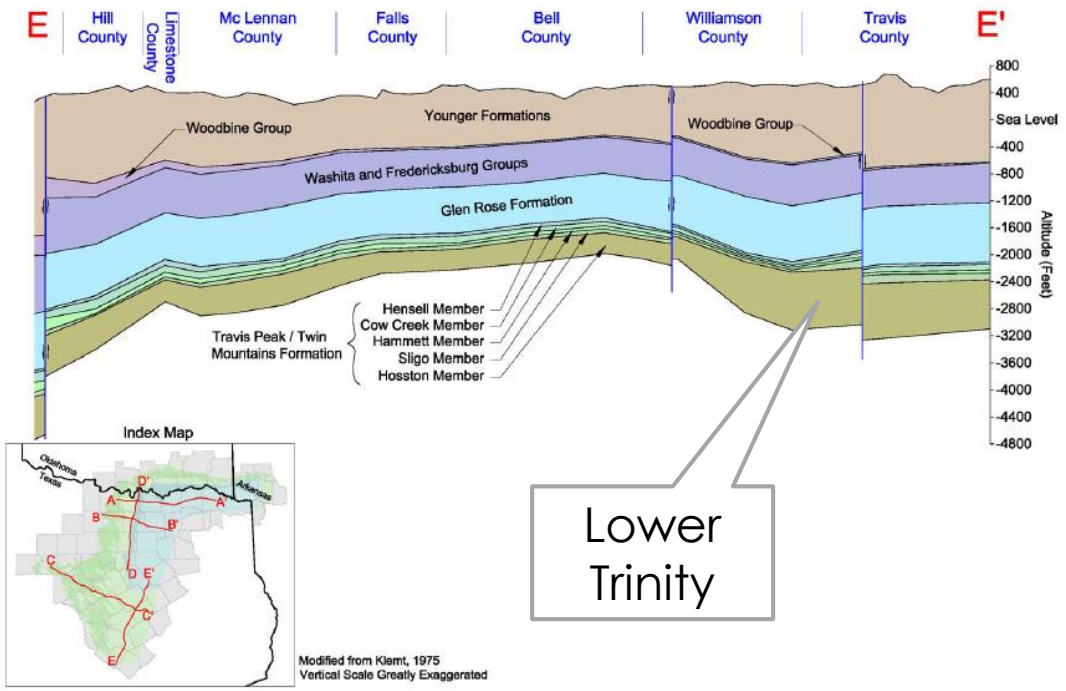


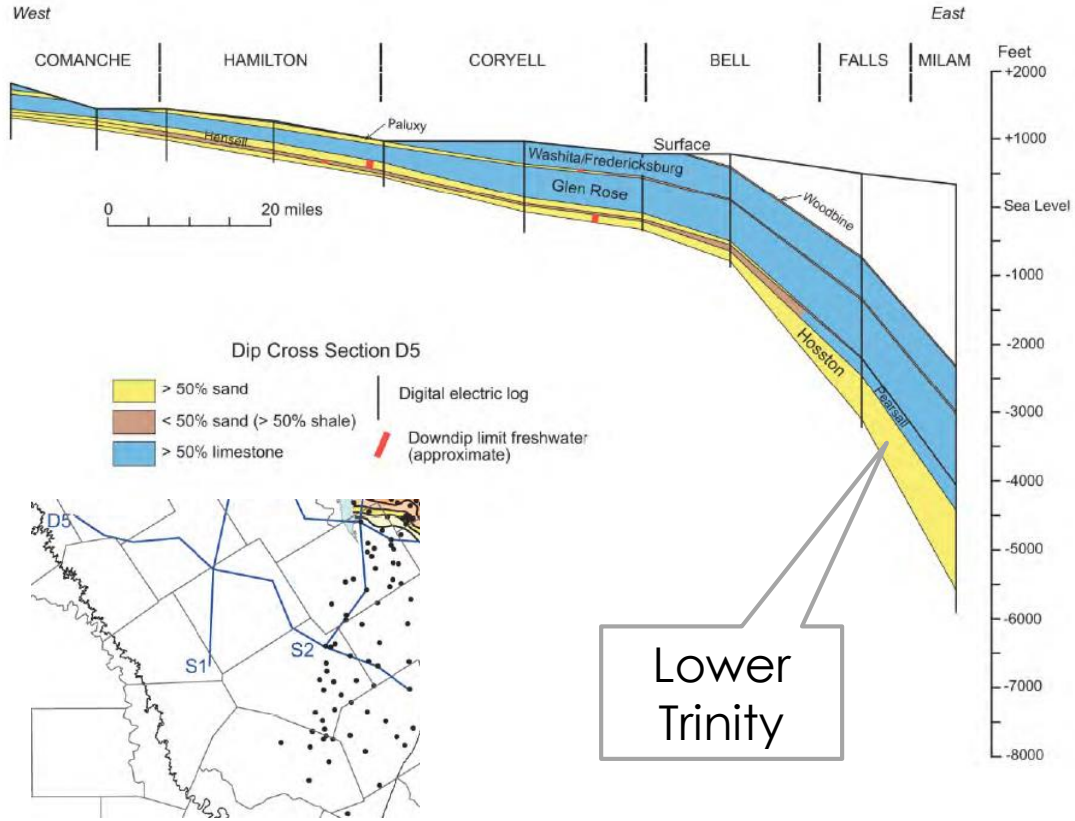
What Did We Know?

- Used for many years
- Pre-development water levels above land surface
- Water levels steadily declining
- Fresh to brackish water
- Sands typically coarser with depth
- Aquifer is deeper and thicker toward the east



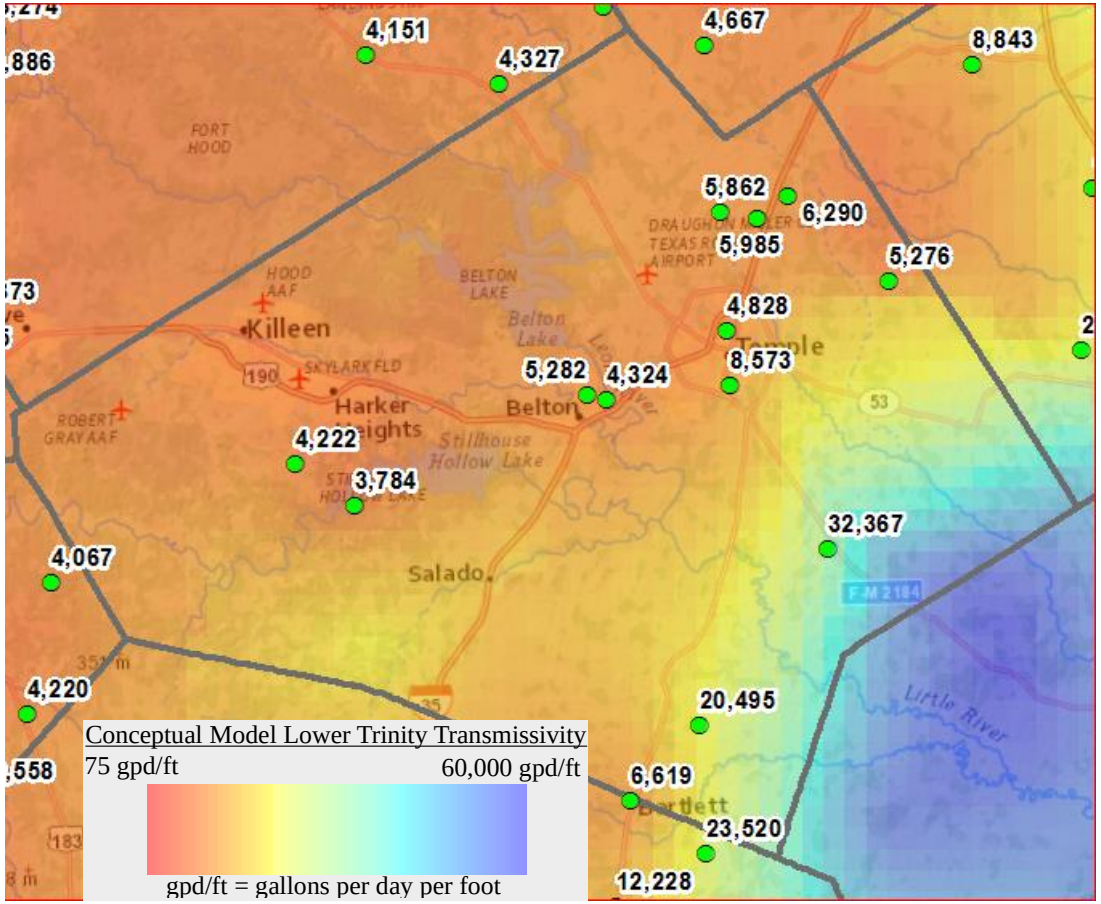
Cross-Sections





Sources: Kelley, V. A. et al., 2013, Conceptual Model Report - Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers, Austin: INTERA.
R.W. Harden & Associates, I. et al., 2004. Northern Trinity / Woodbine Aquifer Groundwater Availability Model, Austin: Texas Water Development Board.

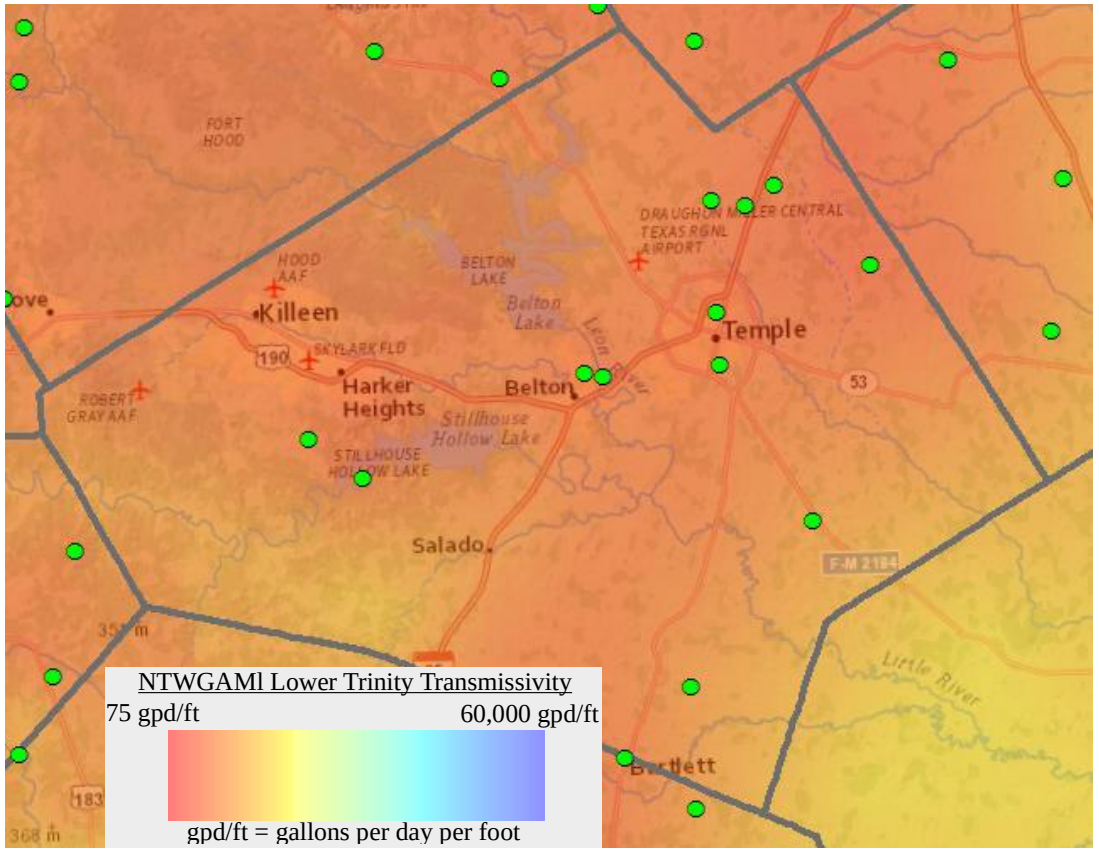
Conceptual Model Transmissivity



- Data from the NTWGAM Conceptual Model Geodatabase
- Locations are aquifer transmissivity estimates (gpd/ft)
- Generally increasing to the east

Source: Modified from Figure 4.2.31 in Kelley, V. A. et al., 2013, Conceptual Model Report - Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers, Austin: INTERA.

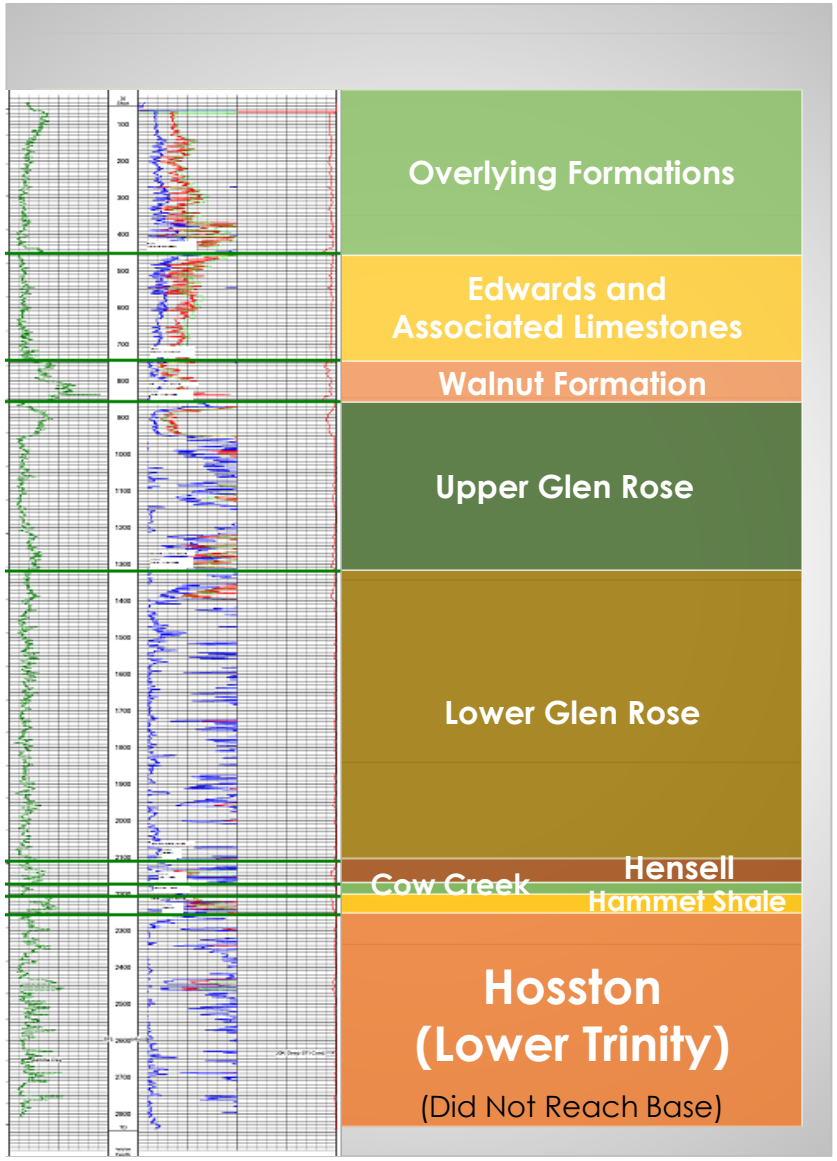
NTWGAM Calibrated Transmissivity



- Transmissivity adjusted during model calibration
- Values are typically less than the conceptual model

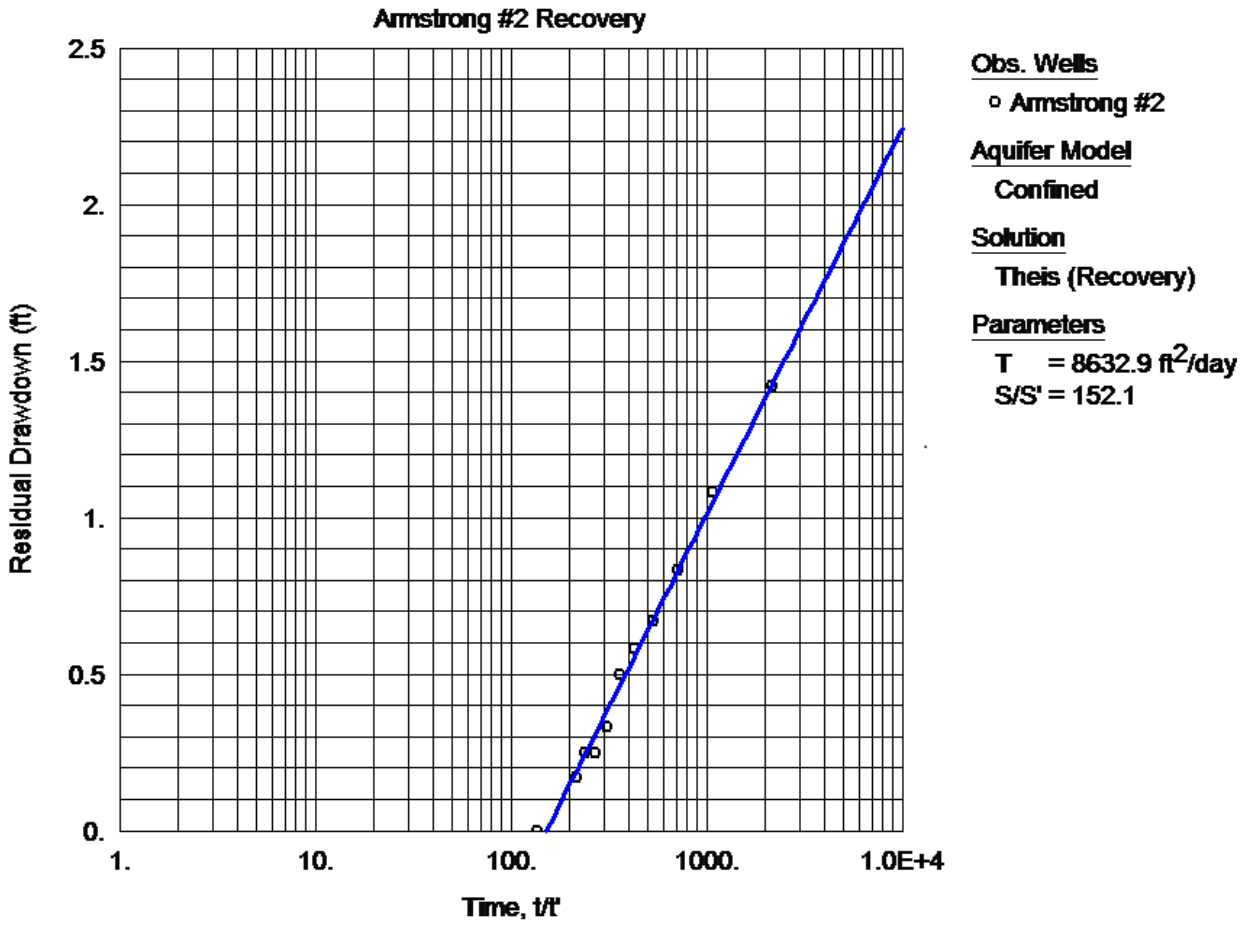
What Did We Learn?

- Relatively recent drilling and testing
- Information provided in CUWCD hydrogeologic reports
- For example:
  - District Well No. N2-13-002P
  - About 600 feet thick
  - Pea gravel at base
  - Very high transmissivity



Source: Keester, Michael R. and Ferry, Elizabeth. A Re-Evaluation of the Lower Trinity Aquifer in Central Texas. Presentation at NGWA Conference. June 2014.

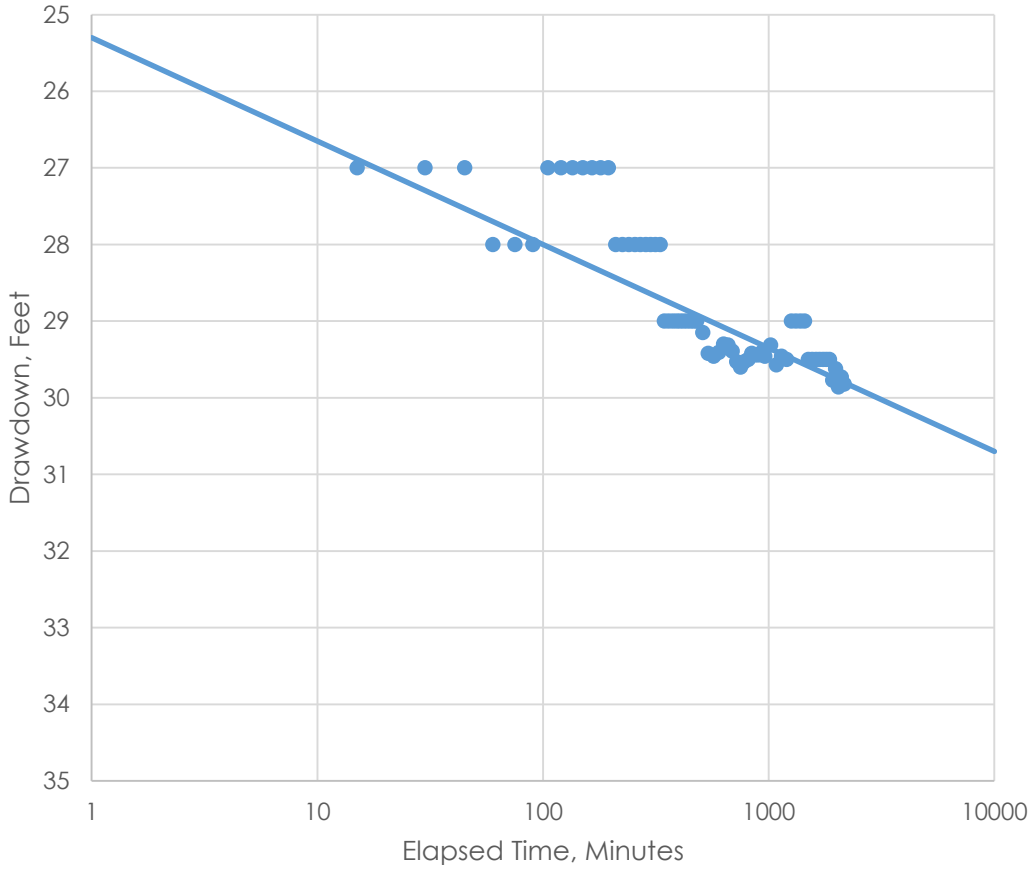
Armstrong WSC Well #2 (N2-10-001P)



- Test conducted in August 2013
- Rate = 300 GPM
- Drawdown = 15.5 ft
- Transmissivity = 65,000 gpd/ft
- TDS = 1,030 mg/L

Source: Fleishhauer, Lou and George, Peter. A Hydrologic study of Armstrong WSC Well #2. May 26, 2014.

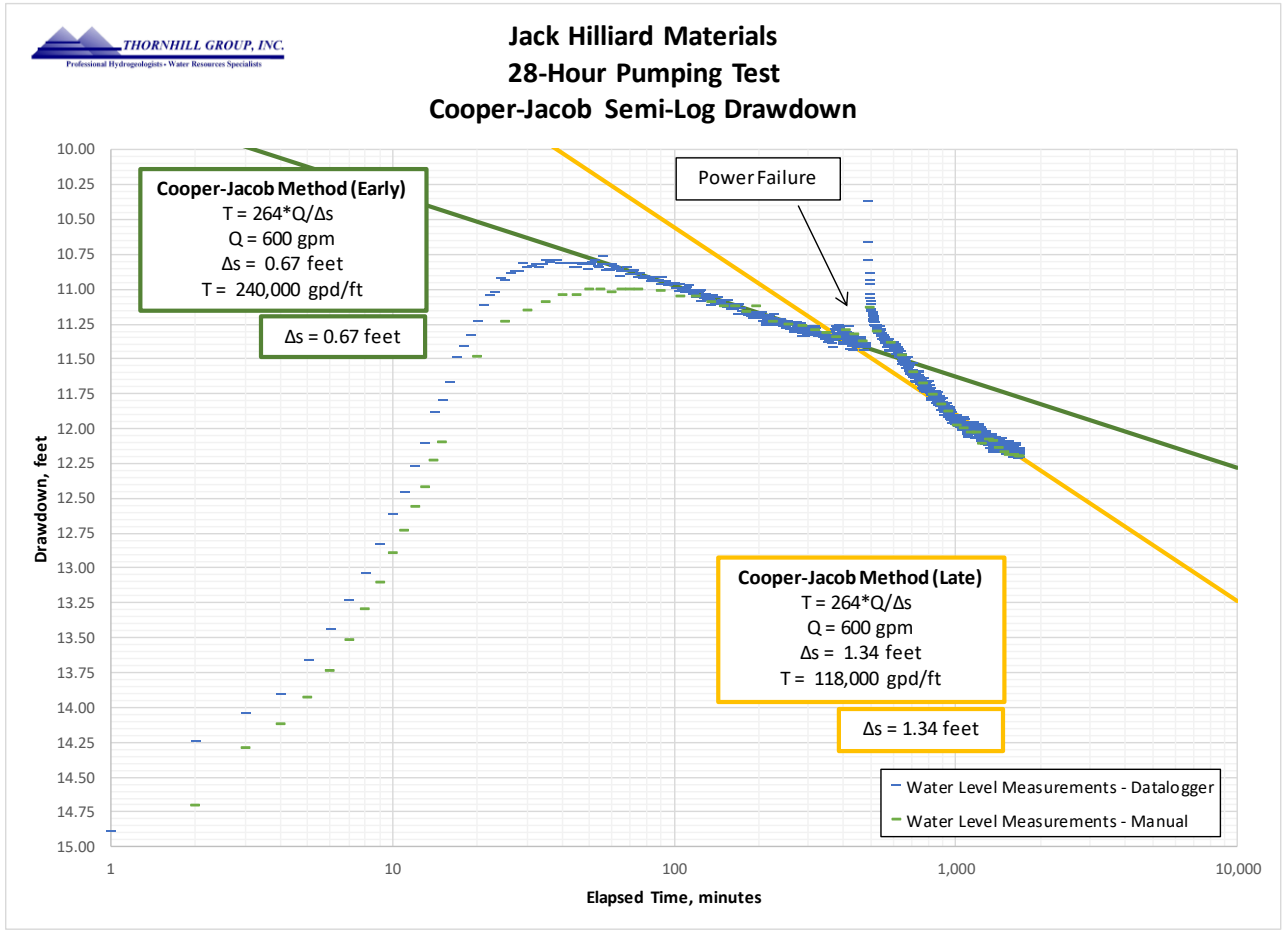
East Bell WSC #2 (N2-04-010P)



- Test conducted in July 2011
- Rate = 750 GPM
- Drawdown = 2.8 ft
- Transmissivity = 140,000 gpd/ft
- TDS = 948 mg/L

Source: East Bell Water Supply Corporation. Operating Permit Application submitted to CUWCD. September 21, 2011.

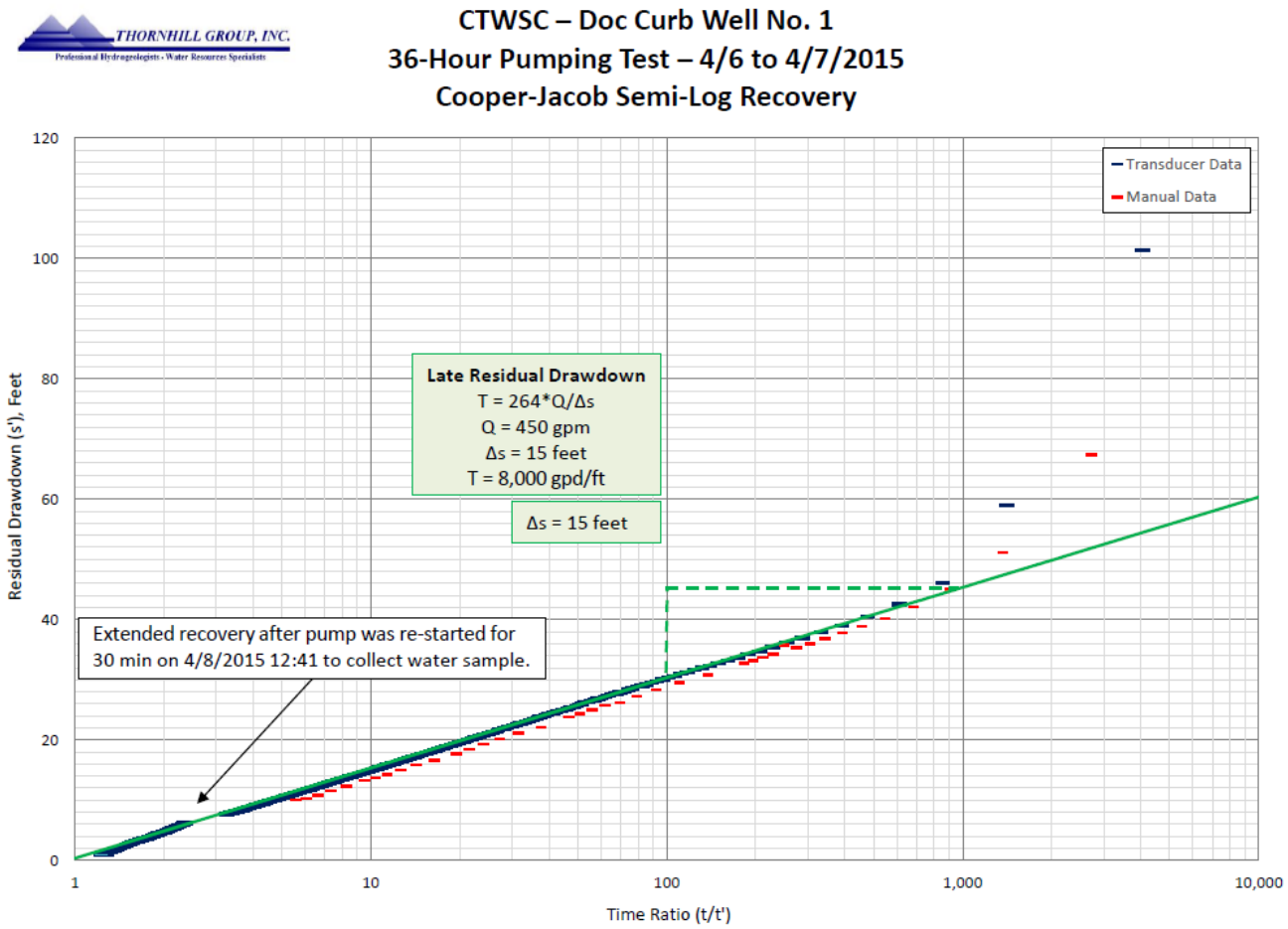
Jack Hilliard Materials (N2-13-002P)



- Test conducted in October 2013
- Rate = 600 GPM
- Drawdown = 12.2 ft
- Transmissivity
  - 240,000 gpd/ft (early)
  - 118,000 gpd/ft (late)
- TDS = 1,110 mg/L

Source: Keester, Michael R. January 21, 2014. Hydrogeologic Report – District Well No: N2-13-002P, Lower Trinity Aquifer, Bell County, Texas. Letter Report, Round Rock, TX: Thornhill Group, Inc.

Doc Curb Well No. 1 (N2-14-004P)



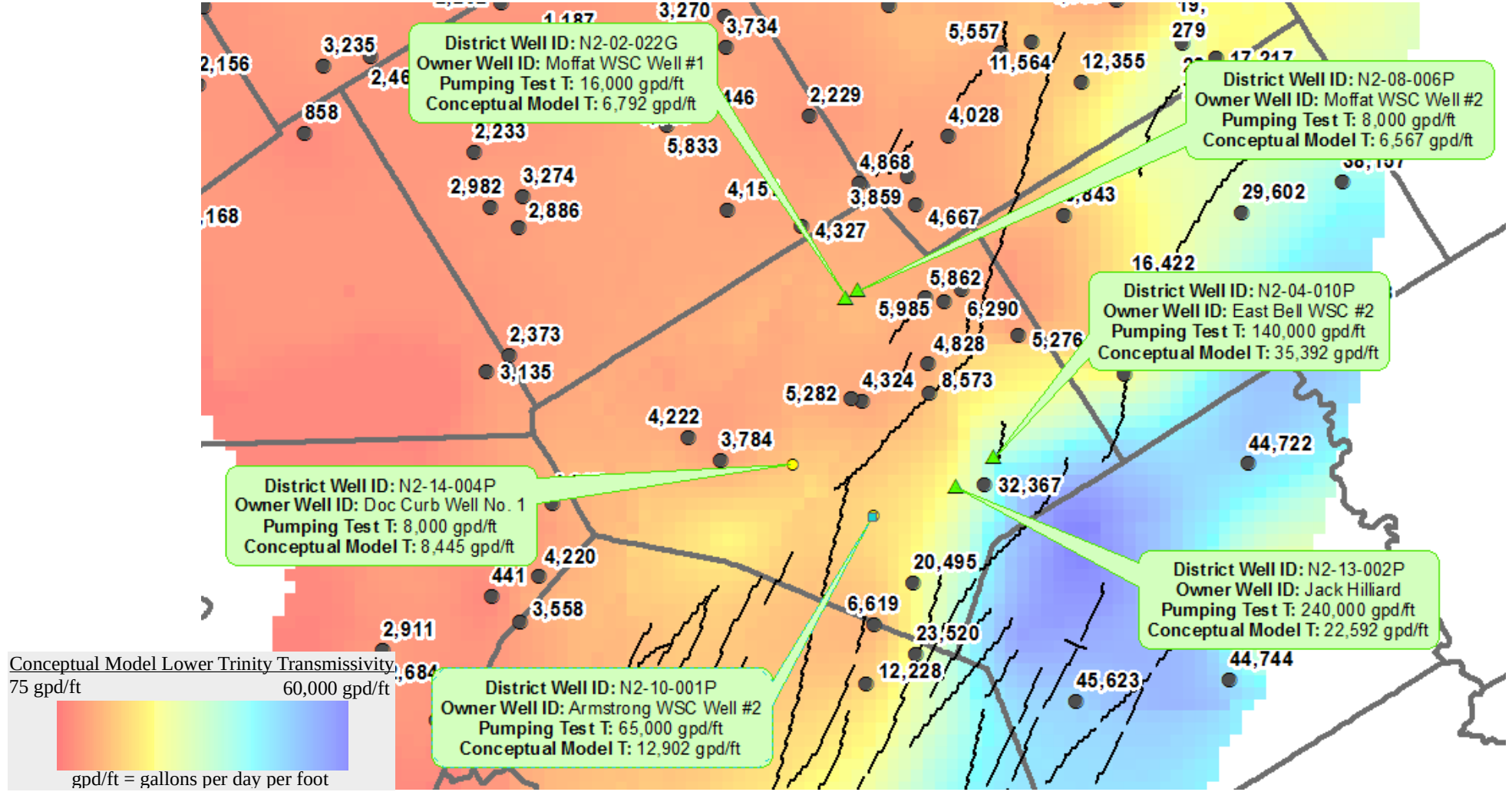
- Test conducted in April 2015
- Rate = 450 GPM
- Drawdown = 101.5 ft
- Transmissivity = 8,000 gpd/ft
- TDS = 2,420 mg/L

Source: Ferry, Elizabeth May 22, 2015. Hydrogeologic Report – Doc Curb Well No. 1 Lower Trinity Aquifer, Central Texas Water Supply Corporation, Bell County, Texas. Letter Report, Round Rock, TX: Thornhill Group, Inc.

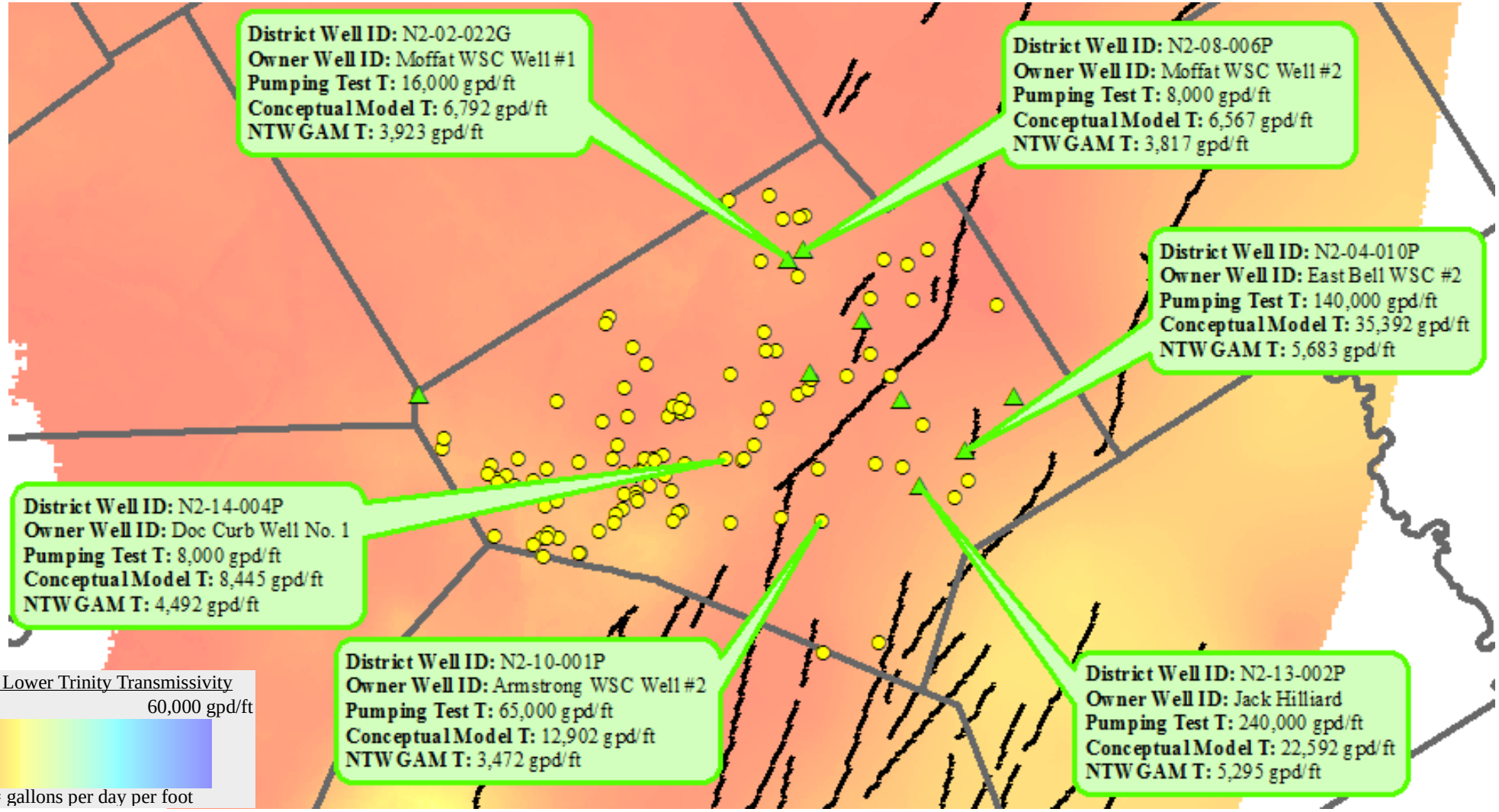
What is the Difference?

- Eastern Bell County – Transmissivity similar between tests and model
- Western Bell County - Transmissivity very different between pumping test results and model
- Apparently better quality downdip and deeper than in some updip and shallower areas

Pumping Tests Compared to Conceptual Model



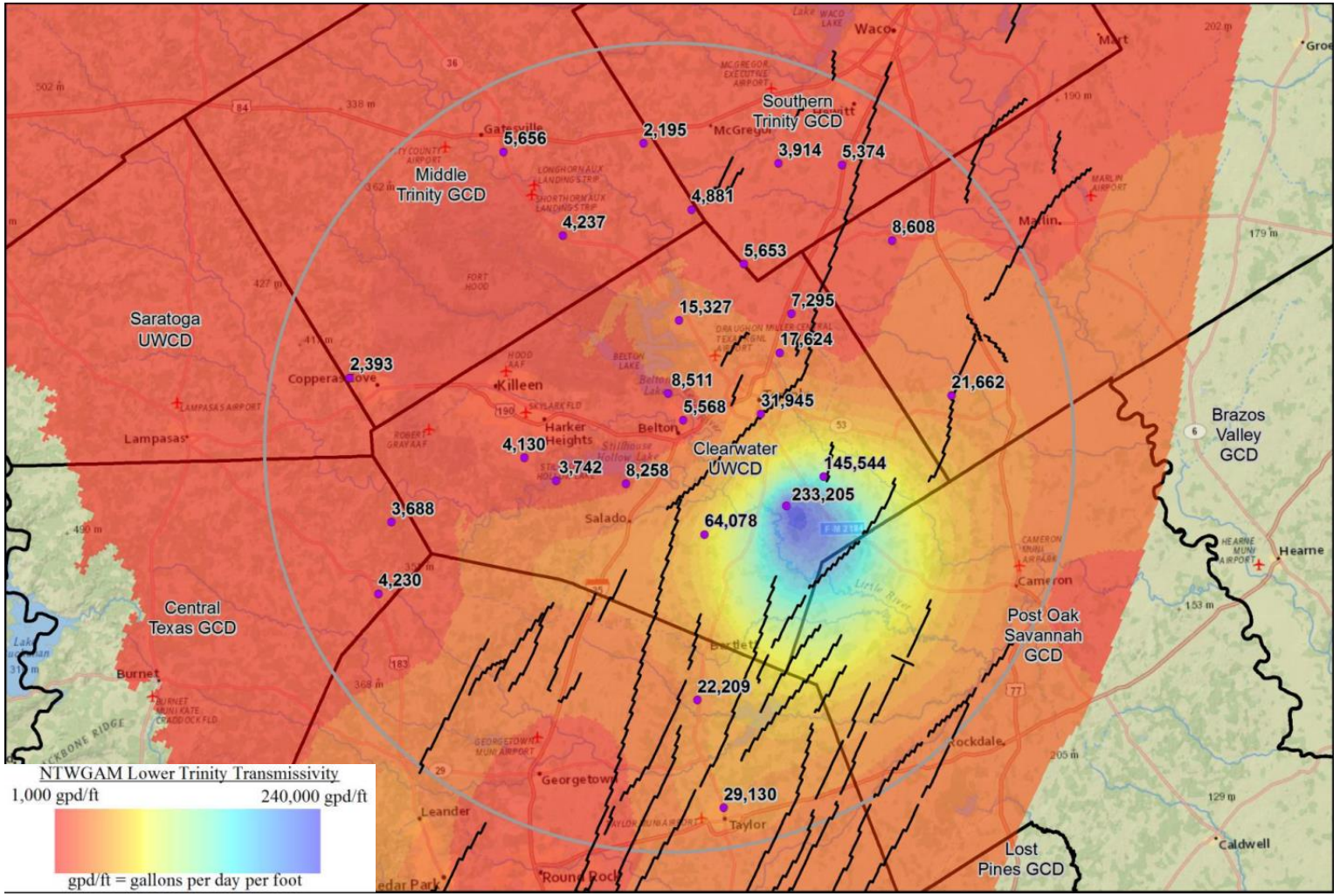
NTWGAM Calibrated Transmissivity Compared to Conceptual Model and Pumping Tests



What Do the Differences Mean?

- Models are used
  - To assess effects of production
  - To evaluate resource management options
  - To quantify groundwater availability
- Differences raise questions regarding resource management
  - How might DFCs be different with the higher transmissivity?
  - How might existing users be affected differently?
- Created a modified model to evaluate

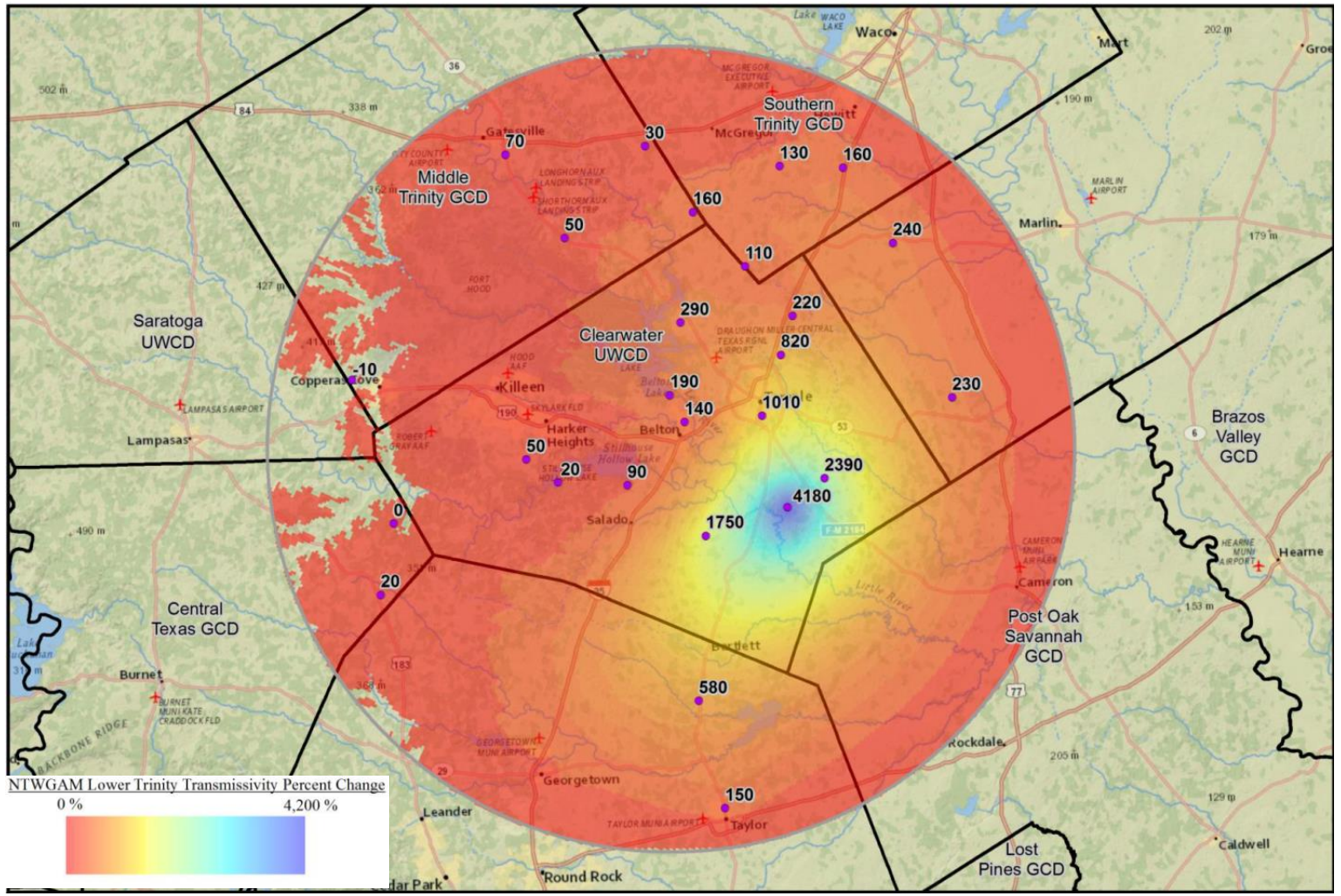
NTWGAM Modified Transmissivity Distribution Map



- Points reflect pumping test data
- Geostatistical interpolation designed to honor data point as closely as possible

Source: Keester, Michael and Konetchy. Results of Northern Trinity / Woodbine Groundwater Availability Model Simulations using a Modified Lower Trinity Transmissivity Distribution. Technical Memo to CUWCD. February 5, 2016.

Percent Change from Unmodified Values



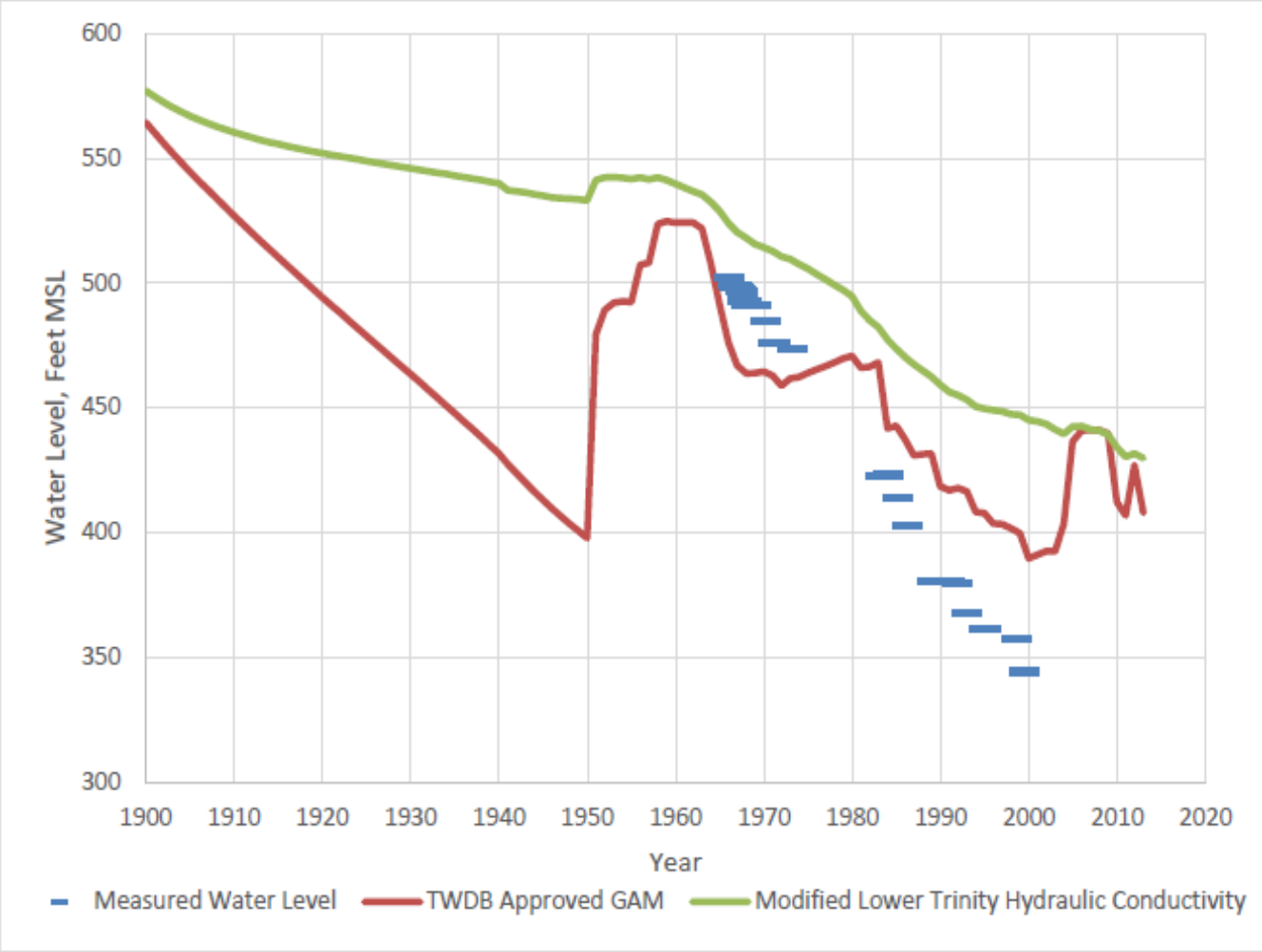
- Points reflect percent change at the location
- Calculated on a cell-by-cell basis as:

$$\frac{Modified - Original}{Original} \times 100$$

- Area outside circle is unchanged

Source: Keester, Michael and Konetchy. Results of Northern Trinity / Woodbine Groundwater Availability Model Simulations using a Modified Lower Trinity Transmissivity Distribution. Technical Memo to CUWCD. February 5, 2016.

Modeled Water Level Comparisons City of Holland Well (N2-02-049G)



- Long-term trends similar
- Unmodified GAM
  - Short-term fluctuations greater than expected
  - Suggest transmissivity is too low
- Modified GAM
  - Data suggest small short-term fluctuations
  - Later trend less than expected

Source: Keester, Michael and Konetchy. Results of Northern Trinity / Woodbine Groundwater Availability Model Simulations using a Modified Lower Trinity Transmissivity Distribution. Technical Memo to CUWCD. February 5, 2016.

Comparison Table for Bell County

Aquifer	Run 10 – Proposed DFC			Modified Run 10		
	Average Drawdown	Above Top†	Above Base‡	Average Drawdown	Above Top†	Above Base‡
Paluxy	19 ft	92%	93%	16 ft	93%	94%
Glen Rose	83 ft	87%	93%	76 ft	88%	94%
Hensell	137 ft	89%	89%	121 ft	90%	90%
Hosston	**330 ft**	**74%**	**79%**	**257 ft**	**80%**	**84%**

†Percent of January 1, 2010 Water Level Above Top of Aquifer Remaining on December 31, 2070
‡Percent of January 1, 2010 Water Level Above Bottom of Aquifer Remaining on December 31, 2070

Source: Keester, Michael and Konetchy. Results of Northern Trinity / Woodbine Groundwater Availability Model Simulations using a Modified Lower Trinity Transmissivity Distribution. Technical Memo to CUWCD. February 5, 2016.

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Potential Additional Production

- At higher transmissivity, greater production may be possible with the same DFC
- CUWCD conducted several model simulations to assess effects of higher production
  - Up to 40,000 acre-feet per year across Bell and Williamson counties
  - 6 scenarios with 4 model configurations
  - All scenarios added to GMA 8 Run 10 pumping file (that is, proposed DFC)

Source: Keester, Michael and Konetchy. Potential Effects on Lower Trinity Aquifer Water Levels due to Proposed Groundwater Production Scenarios. Technical Memo to CUWCD. July 11, 2016.

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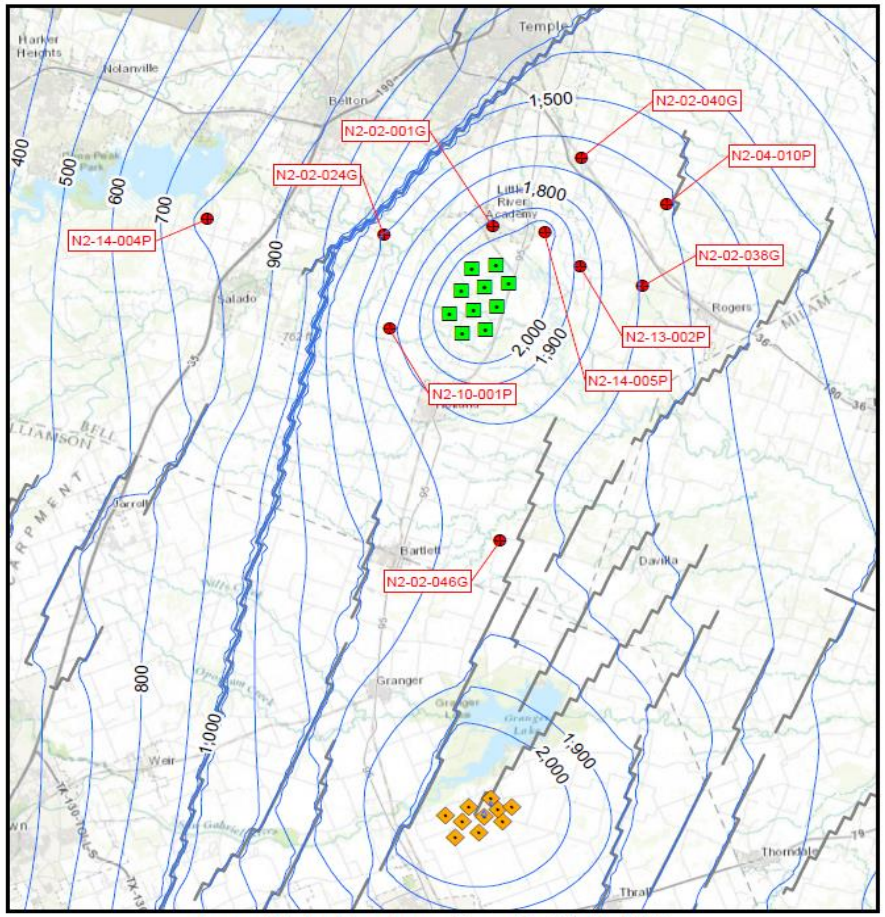
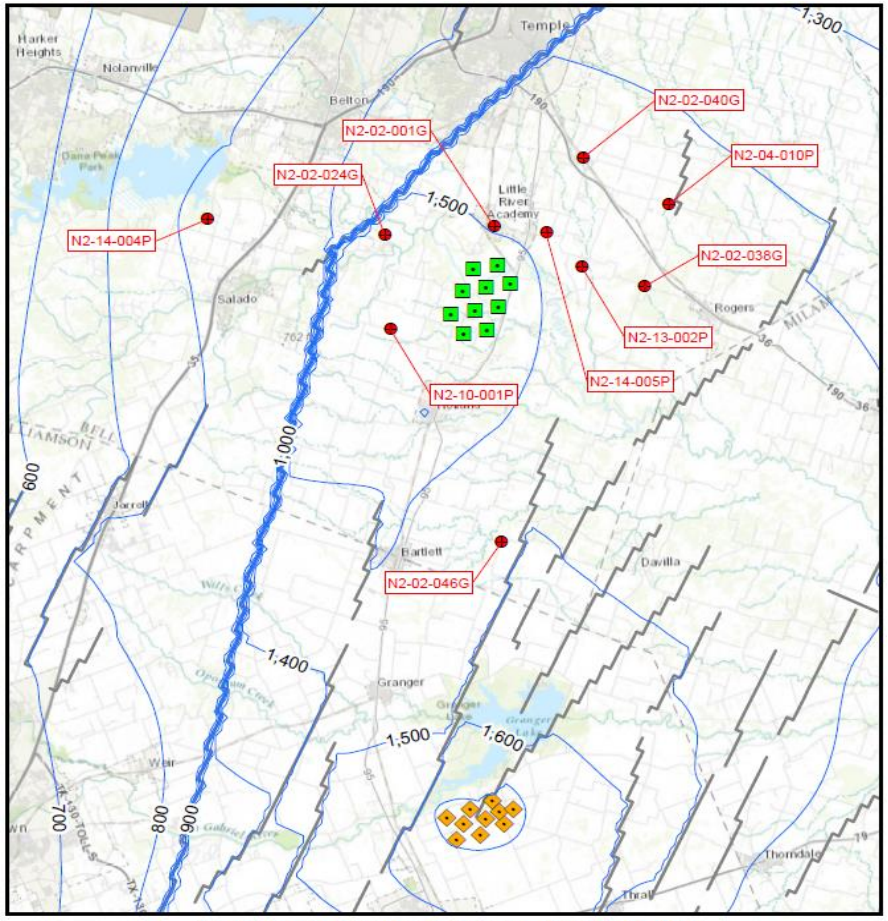
Simulated Lower Trinity Drawdown Convertible GAM – Pumping 40,000 AFY

Unmodified Transmissivity



Lower Trinity Drawdown- Scenario C-006 - 50 Years

Modified Transmissivity

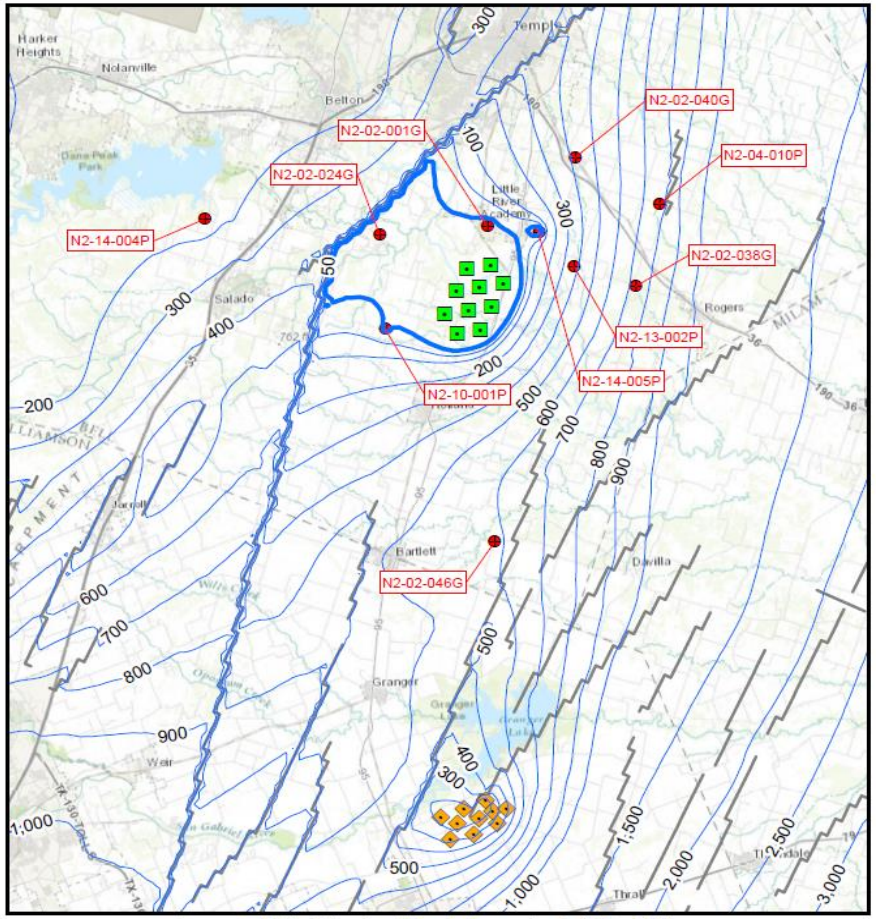


Lower Trinity Drawdown- Scenario D-006 - 50 Years

Source: Keester, Michael and Konetchy. Potential Effects on Lower Trinity Aquifer Water Levels due to Proposed Groundwater Production Scenarios. Technical Memo to CUWCD. July 11, 2016.

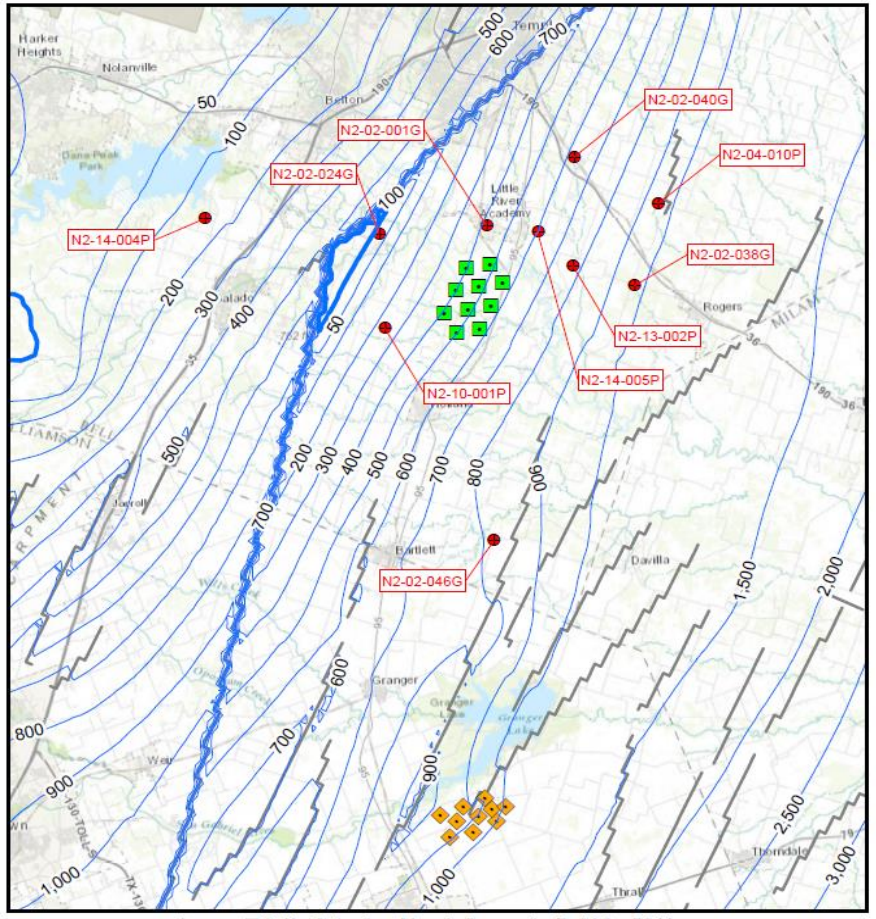
Simulated Lower Trinity Remaining Artesian Head Convertible GAM – Pumping 40,000 AFY

Unmodified Transmissivity



Lower Trinity Artesian Head- Scenario C-006 - 50 Years

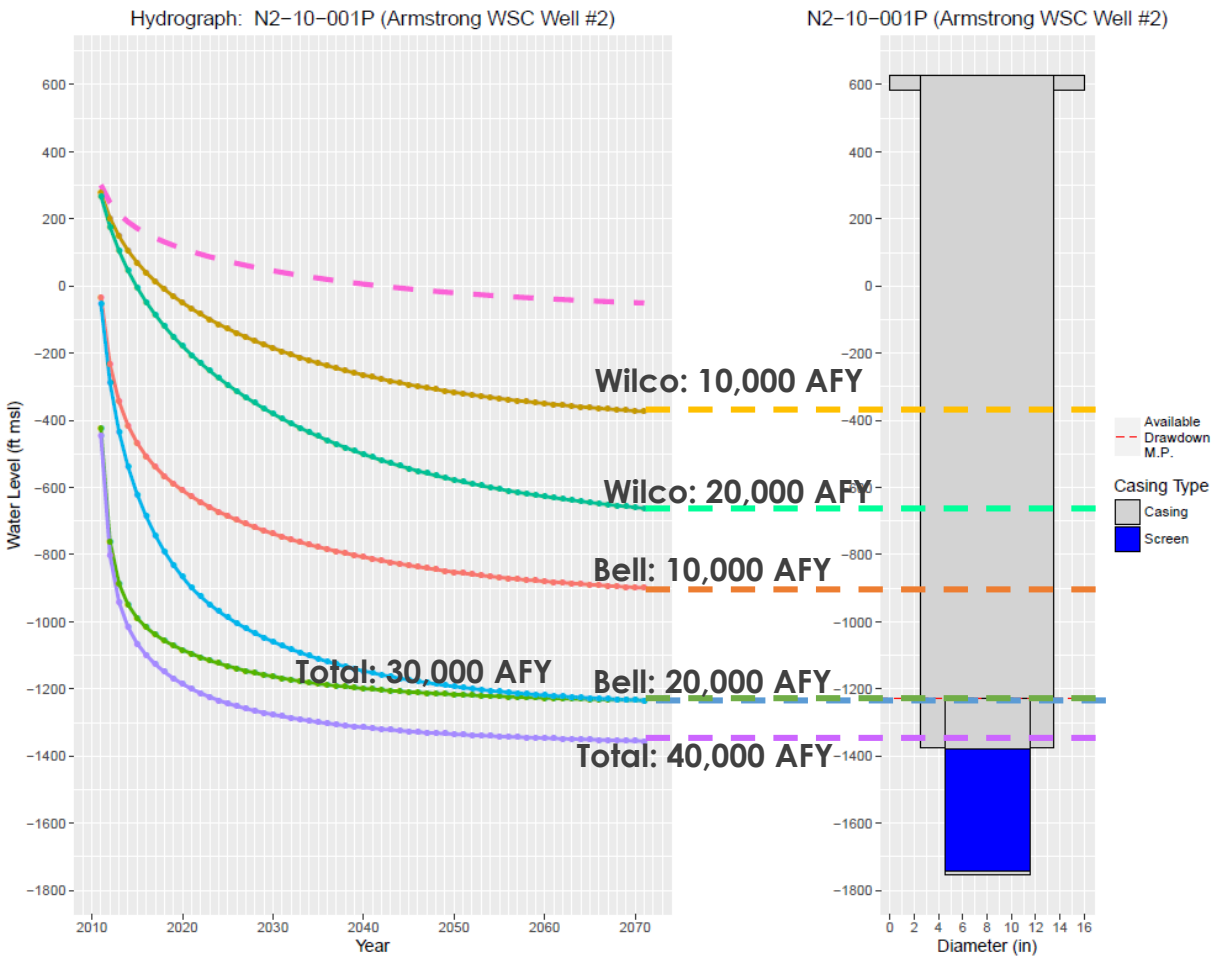
Modified Transmissivity

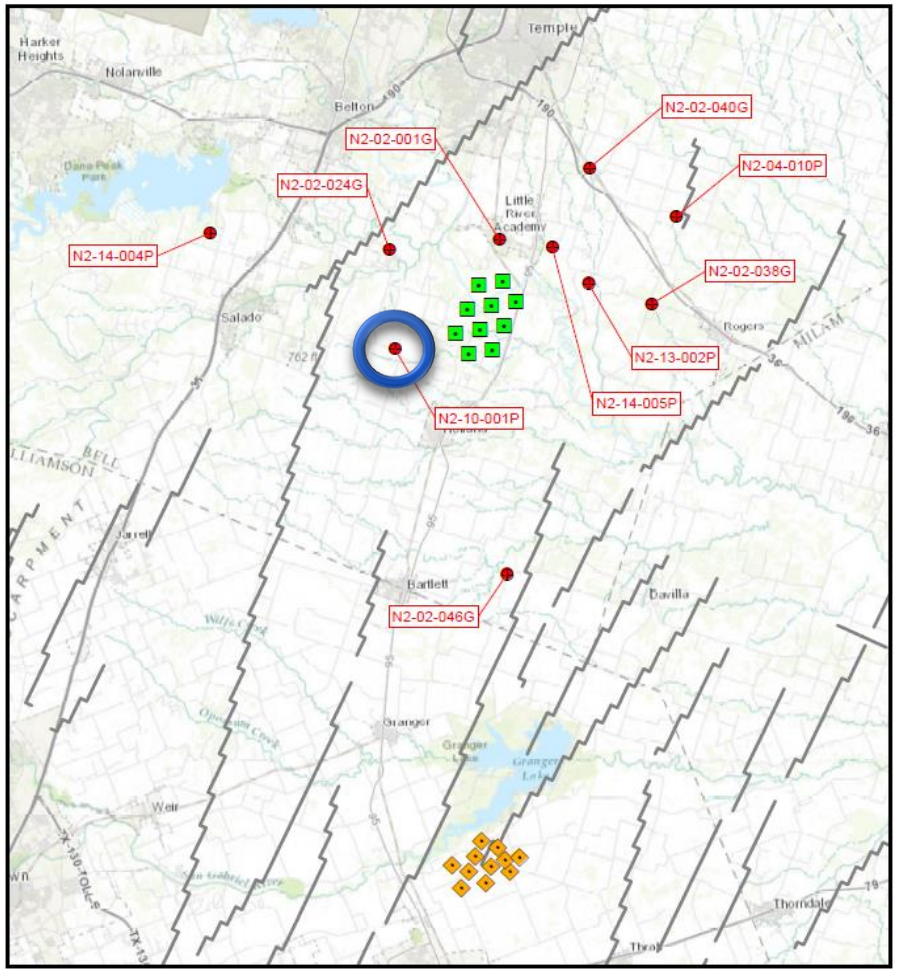


Lower Trinity Artesian Head- Scenario D-006 - 50 Years

Source: Keester, Michael and Konetchy. Potential Effects on Lower Trinity Aquifer Water Levels due to Proposed Groundwater Production Scenarios. Technical Memo to CUWCD. July 11, 2016.

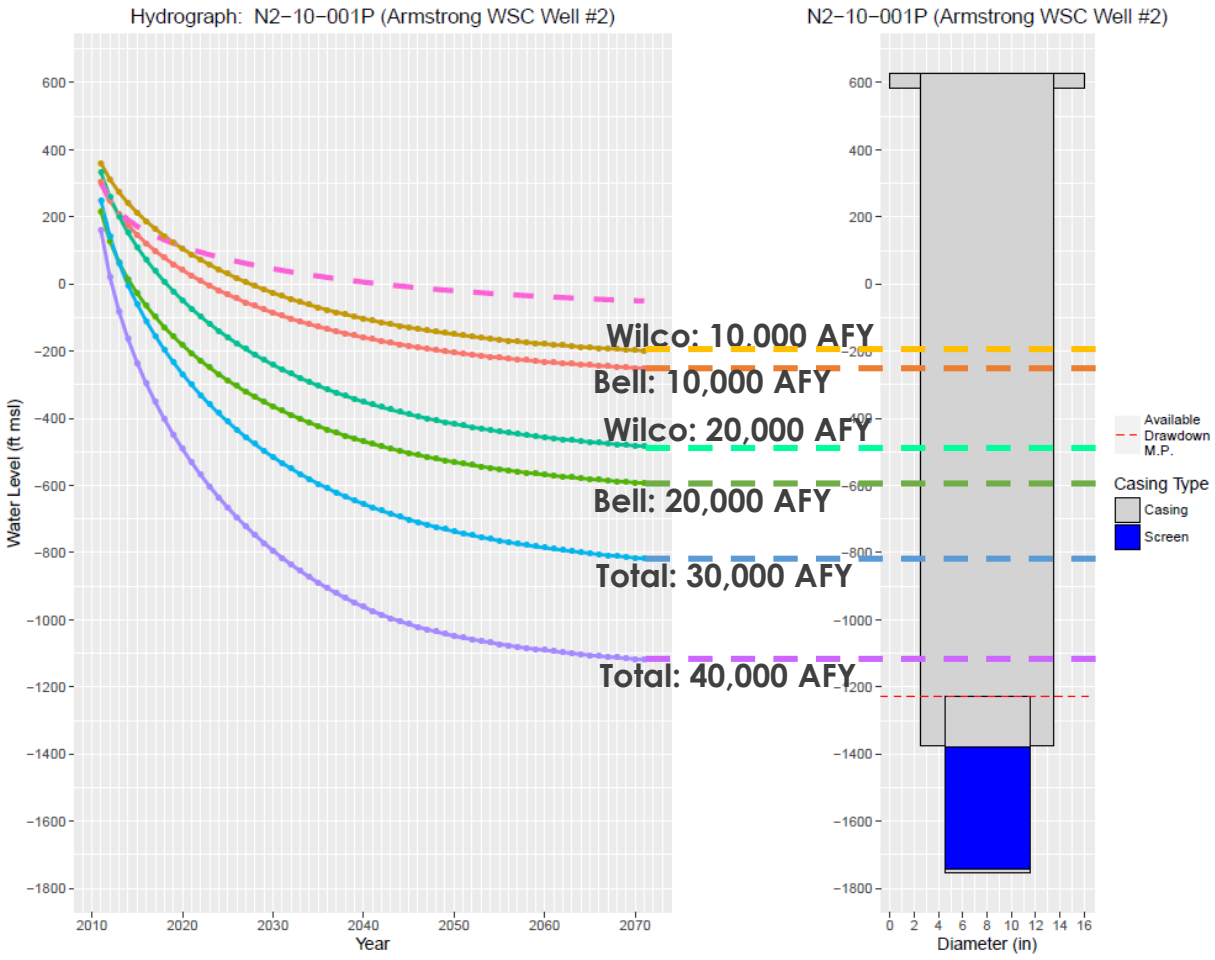
Modeled Effects on Armstrong WSC Well #2 Unmodified Transmissivity Convertible NTWGAM

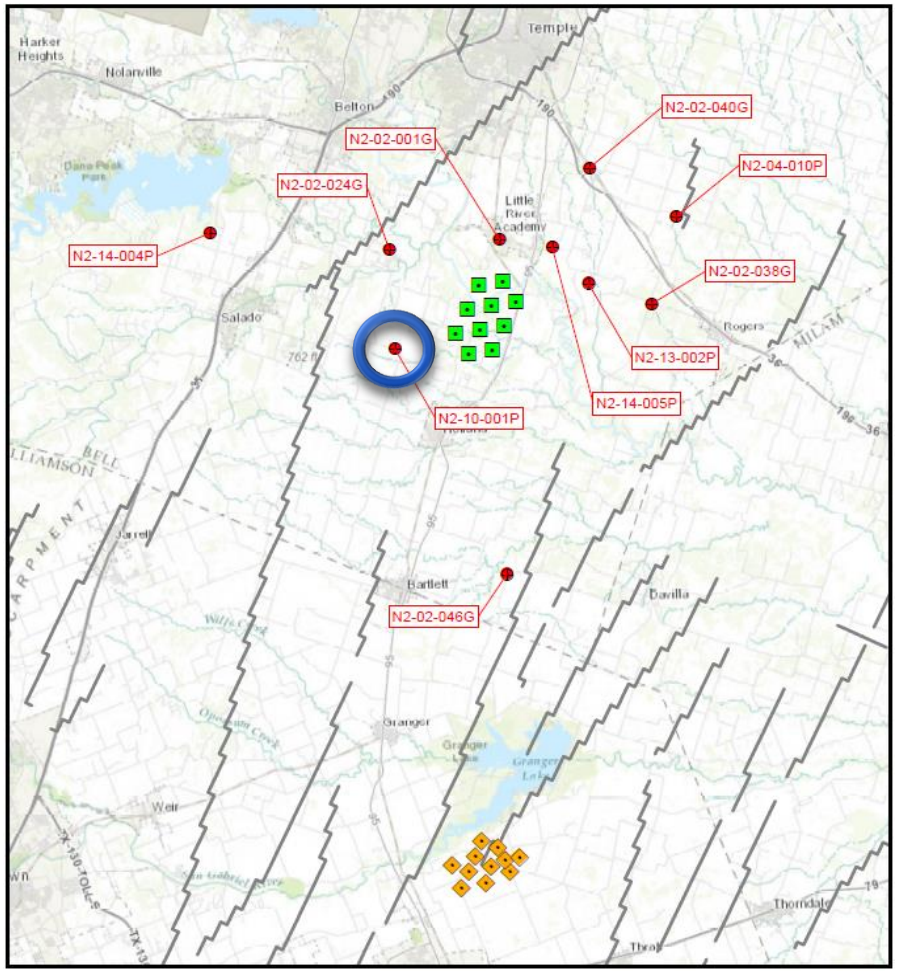




Source: Keester, Michael and Konetchy. Potential Effects on Lower Trinity Aquifer Water Levels due to Proposed Groundwater Production Scenarios. Technical Memo to CUWCD. July 11, 2016.

Modeled Effects on Armstrong WSC Well #2 Modified Transmissivity Convertible NTWGAM





Source: Keester, Michael and Konetchy. Potential Effects on Lower Trinity Aquifer Water Levels due to Proposed Groundwater Production Scenarios. Technical Memo to CUWCD. July 11, 2016.

Conclusions

- Lower Trinity transmissivity is greater than previous thought in eastern Bell County
- Modifying the existing model shows a decrease in simulated effects from production
- Similar regional effects regardless of pumping location
- Potentially higher production possible with the same DFC

BELL COUNTY WATER SYMPOSIUM

Questions

Michael Keester, P.G.