

Technical Memorandum

To: Dirk Aaron, General Manager – Clearwater Underground Water Conservation District
From: Michael Keester, PG
Date: July 2, 2020
Subject: Drawdown Analysis of the Local Middle and Lower Trinity Aquifers

This technical memorandum provides an update to the analysis of changes in water level within the Middle and Lower Trinity aquifers in southern Bell and northern Williamson counties. For this analysis we extended the collection of water-level data beyond the previous extents to begin understanding how water levels are changing regionally within the aquifers. However, while we were able to develop interpretations of water levels for the two aquifers for 2019, we were unable to extend the determination of drawdown from previous years beyond the previous extent due to limited available water level measurements from previous years in the extended area.

Methodology

Our methodology for the 2019 water level data collection remained unchanged from previous years. We began with water-level measurements from the District's database collected by District staff or from continuous monitoring wells maintained by the Texas Water Development Board (TWDB) with a measurement date as near as possible to December 31, 2019 to reflect end of year conditions. We then collected measurements from the TWDB groundwater database. Finally, we supplemented the water-level data from the databases, with records from the Submitted Driller's Report database.

We plotted the water levels at the well locations for each aquifer and prepared contour maps of the water level elevation representing the conditions at the end of 2019. Using grids generated from the water-level contours, we calculated the water-level decline (that is, drawdown) in each of the aquifers. We also used the grids to calculate the "available drawdown" remaining in each of the aquifers. As with previous evaluations, we considered available drawdown as the water level above the top of the aquifer (that is, the artesian head). For the top of the aquifer, we used the surfaces as defined by the District's 2019 update of the three-dimensional geologic model.

Middle Trinity Aquifer

For the Middle Trinity Aquifer, the pattern of the water levels has not changed significantly from previous investigations (maps included in Attachment 2). To the north of the study area, water levels are lower indicating a cone of depression extending toward McLennan County (see map titled: "[Middle Trinity Aquifer](#)")

Water Level Elevation – 2019” in Attachment 1). This pattern is expected due to the historical groundwater production from the Trinity Aquifer north of Bell County. One feature of not on the Middle Trinity Aquifer water level map is the steep gradient in water levels in the western portion of Bell and Williamson counties. This gradient is likely due to aquifer structure and may be associated with faulting in the area.

Review of the drawdown map for the Middle Trinity Aquifer indicates some recovery in water levels since 2018, but the largest recent water level declines remain located in the central and southern portions of the study area (see map titled: “Middle Trinity Aquifer Water Level Decline – 2006-2019” in Attachment 1). Since 2006, water levels in the Middle Trinity have declined by 180 feet or more toward the Sun City area in Williamson County. Near the City of Florence, the water level declines are greater than 100 feet and are more than 140 feet in much of the area. Within Bell County, the Hidden Springs area to the west of Salado appears to have recovered from declines from 2006 of more than 150 feet in 2018 to just over 120 feet in 2019.

The final Middle Trinity Aquifer map indicates that in much of the western portion of the study area the water levels are near the top of the aquifer (see map titled: “Middle Trinity Aquifer Available Drawdown – 2019” in Attachment 1). For example, near Florence water levels are less the 100 feet above the top of the aquifer and less than 50 feet above the top toward Sun City. Similar conditions are evident near the Stillman Valley area in Bell County. These low available drawdown levels mean that well owners will have increased difficulty accessing necessary quantities of groundwater.

Lower Trinity Aquifer

Like the Middle Trinity Aquifer, to the north of the study area water levels are lower indicating a cone of depression extending toward McLennan County (see map titled: “Lower Trinity Aquifer Water Level Elevation – 2019” in Attachment 1). However, for the Lower Trinity, the cone of depression is broader and better defined. This pattern is expected due to the historically high production from the Trinity Aquifer north of Bell County.

Comparison between the Lower Trinity Aquifer 2018 water level map (included in Attachment 2) and the 2019 water level map indicates a significant change in the pattern of the water level surface in northern Williamson County. The difference between the two maps is due to an increased availability of water level data and the extent of the evaluation. The change in the maps does not necessarily represent a significant change in the water levels in the Lower Trinity Aquifer.

Review of the drawdown map for the Lower Trinity Aquifer illustrates the largest recent water level declines are located in the northern portion of the study area (see map titled: “Lower Trinity Aquifer Water Level Decline – 2006-2019” in Attachment 1). The improvement in our understanding of estimated water levels across the area suggests Lower Trinity Aquifer water levels may not have declined as much as previously thought in northern Williamson County and in the northern portion of the study area in Bell County. However, as the maps illustrate there is limited availability of water level measurements for the Lower Trinity Aquifer in

southern Bell and northern Williamson counties; the estimated water levels and associated declines should be viewed with an understanding of the uncertainty

In contrast to the Middle Trinity Aquifer, the available drawdown map for the Lower Trinity Aquifer map indicates water levels are typically well above the top of the aquifer (see map titled: “Lower Trinity Aquifer Available Drawdown – 2019” in Attachment 1). The only area where water levels appear to be nearing the top of the aquifer is in the far western portion of the District. Comparison with the 2018 available drawdown map indicates the available drawdown has decreased as evidenced by the migration of the 200 foot contour line to the west near Florence and in the western portion of Bell County.

Discussion

Continued monitoring of water levels is critical for understanding the changing aquifer conditions. Understanding the aquifer conditions will allow the District to continue to proactively inform and assist constituents who rely on the local aquifers for their water needs. In several areas the water levels are nearing the top of the Middle Trinity Aquifer and groundwater users will face continued difficulties accessing the resource. Within the Hidden Springs area, the water levels remain several hundred feet above the top of the aquifer and water levels appear to have recovered a few feet since 2018. However, average declines remain near 10 feet per year and if the trend continues pumps will likely have to be lowered in wells with water levels reaching the top of the aquifer in about 30 years. These declines are illustrated in monitoring wells shown on the map prepared in 2019 and included in Attachment 3.


In northwestern Williamson County, the Middle Trinity Aquifer water levels are near the top of the aquifer. Landowners in this area have reported difficulties accessing groundwater from the Middle Trinity. It is likely that many well owners will soon, if they do not already, have pumps set near the bottom of their wells and will have to adjust to limited groundwater availability or find alternative water supplies.

Conditions in the Lower Trinity are better than in the Middle Trinity. Additional water-level data obtained for 2019 suggests recent declines may not have been as much as they were thought to be based on the available 2018 data. Nonetheless, the available drawdown does appear to be decreasing in the western part of the study area. Increasing the water level monitoring network in Williamson County would aid in understanding how water levels are changing over time in the region.

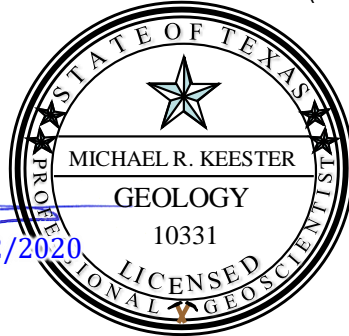
We appreciate being able to provide you with this brief assessment. If you have any questions, please contact me at (512) 962-7660.

Geoscientist Seal

This report documents the work of the following licensed professional geoscientists with LRE Water, LLC, a licensed professional geoscientist firm in the State of Texas (License No. 50516).

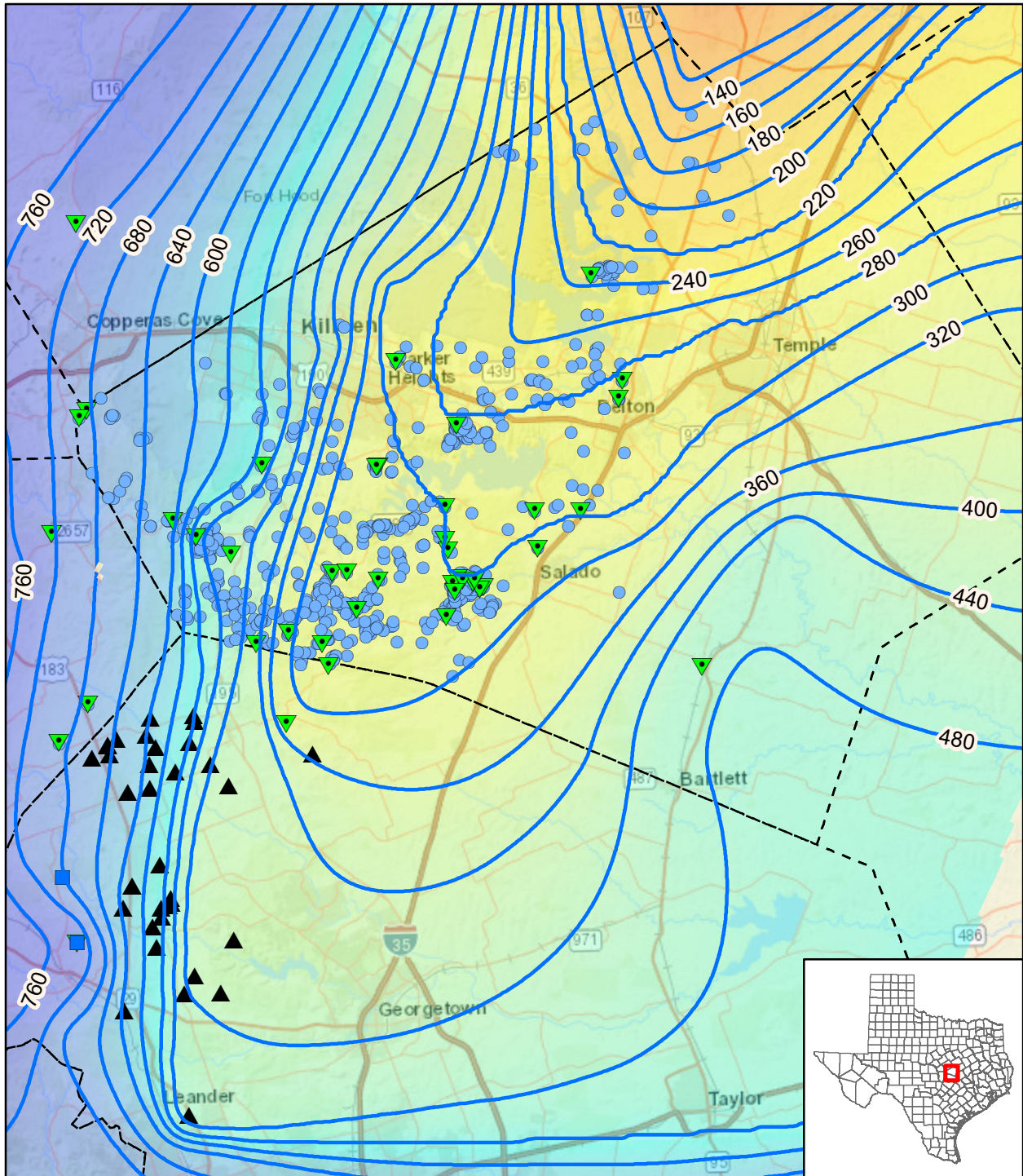







Michael R. Keester, P.G. 07/02/2020
Project Manager / Hydrogeologist

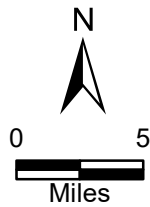


Mr. Dirk Aaron – Drawdown Analysis of the Local Middle and Lower Trinity Aquifers
July 2, 2020
Trinity Water-Level Maps

**Attachment 1 —
2019 Middle and Lower Trinity Aquifer Water Level Maps**




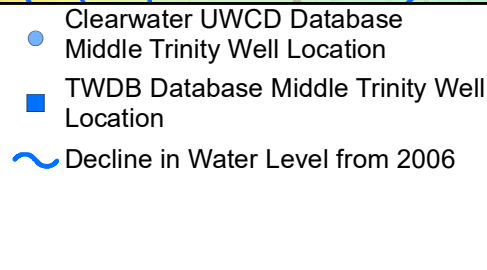
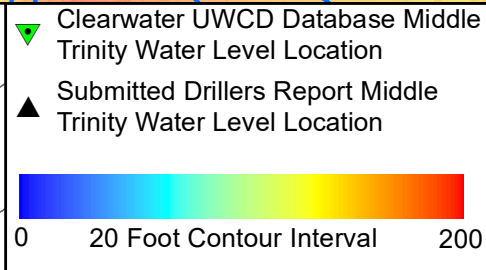
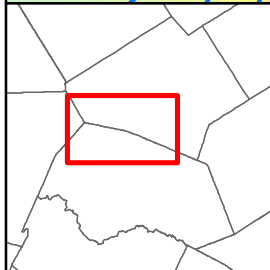
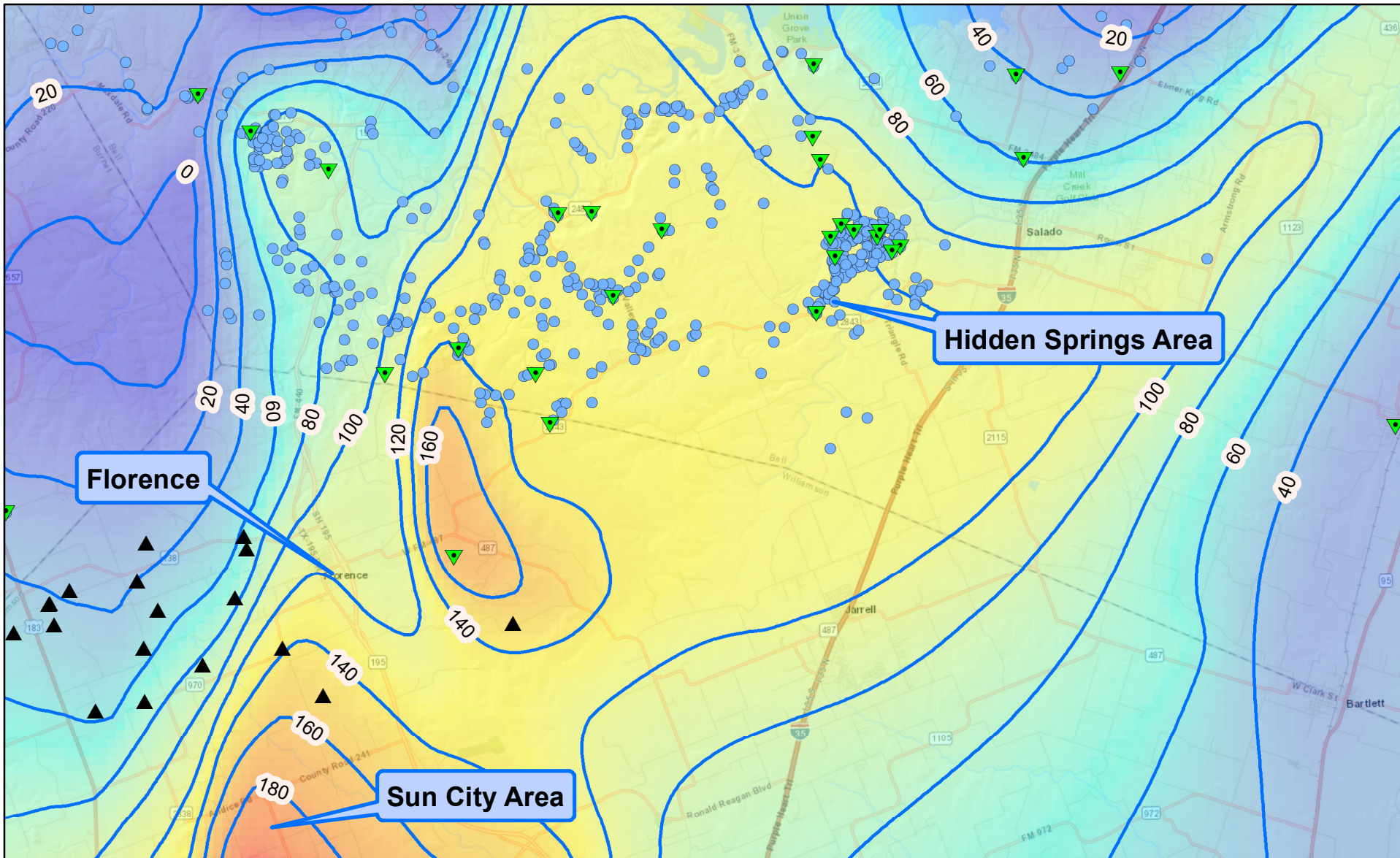
-  2019 Water Level Elevation (ft MSL)
-  Clearwater UWCD Database Middle Trinity Water Level Location
-  Submitted Drillers Report Middle Trinity Water Level Location
-  Clearwater UWCD Database Middle Trinity Well Location
-  TWDB Database Middle Trinity Well Location



Clearwater UWCD

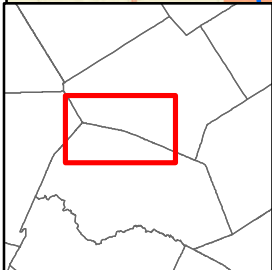
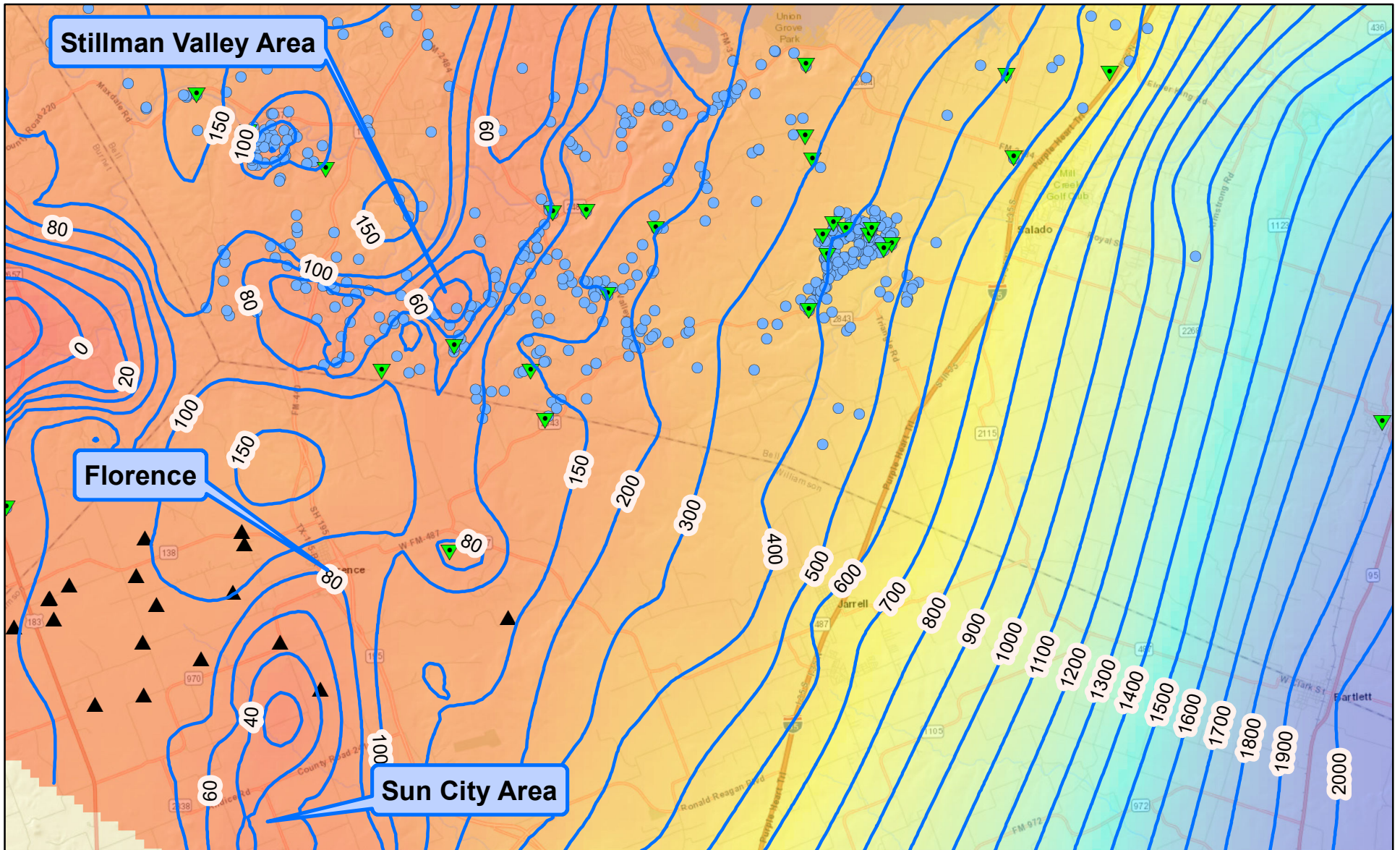
Middle Trinity Aquifer
Water Level Elevation - 2019





Clearwater UWCD

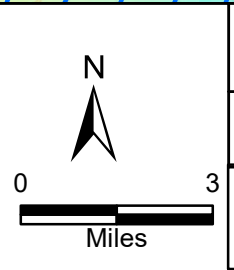
Middle Trinity Aquifer
Water Level Decline- 2006-2019



- ▼ Clearwater UWCD Database Middle Trinity Water Level Location
- Clearwater UWCD Database Middle Trinity Well Location
- ▲ Submitted Drillers Report Middle Trinity Water Level Location
- TWDB Database Middle Trinity Well Location
- ~ 2019 Available Drawdown

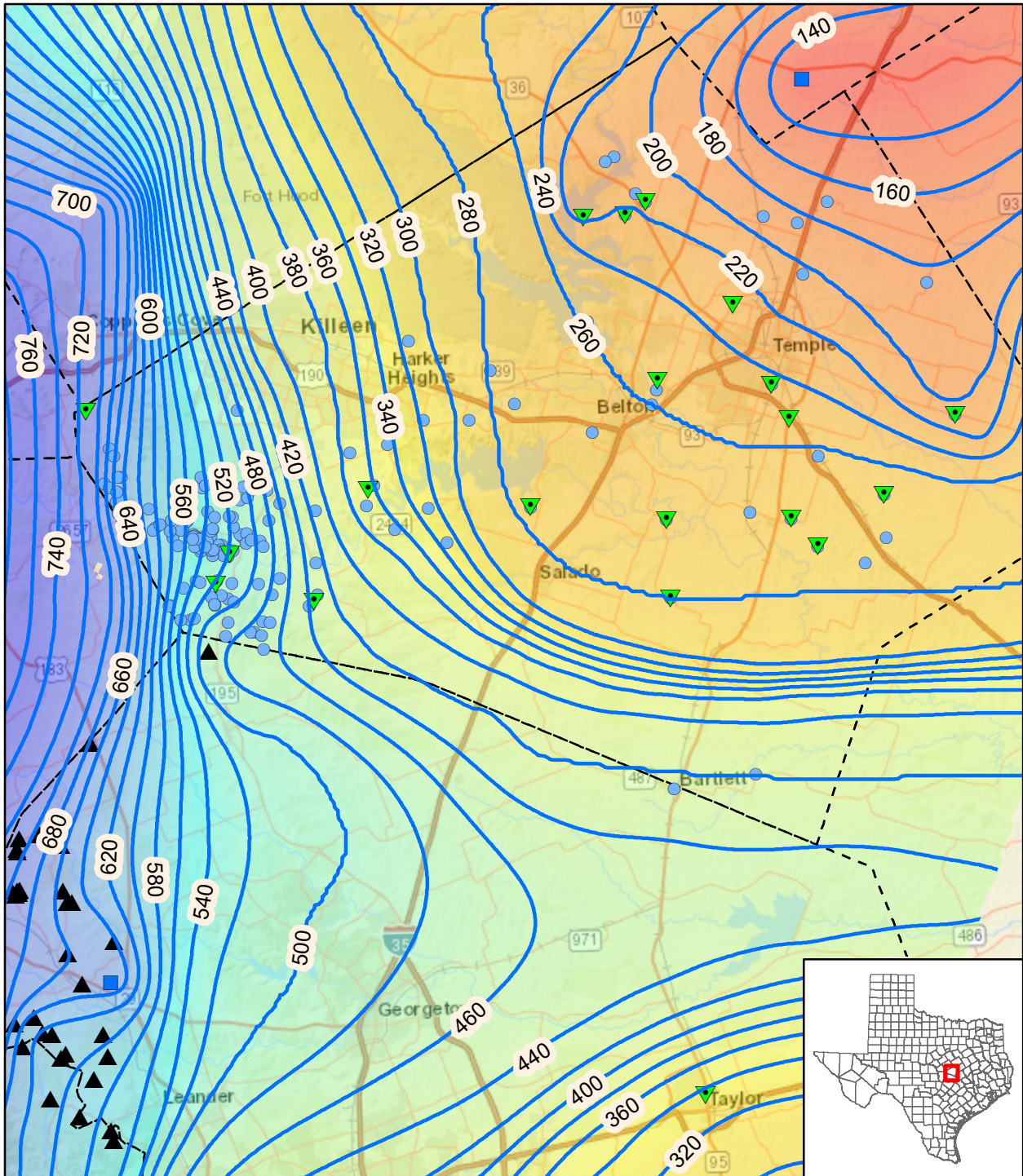
-20 Variable Contour Interval 2200

"Available Drawdown" defined as the water level above the top of the aquifer.

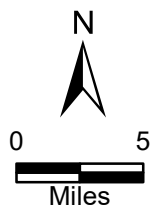


Clearwater UWCD

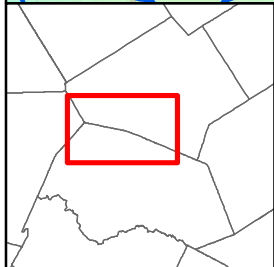
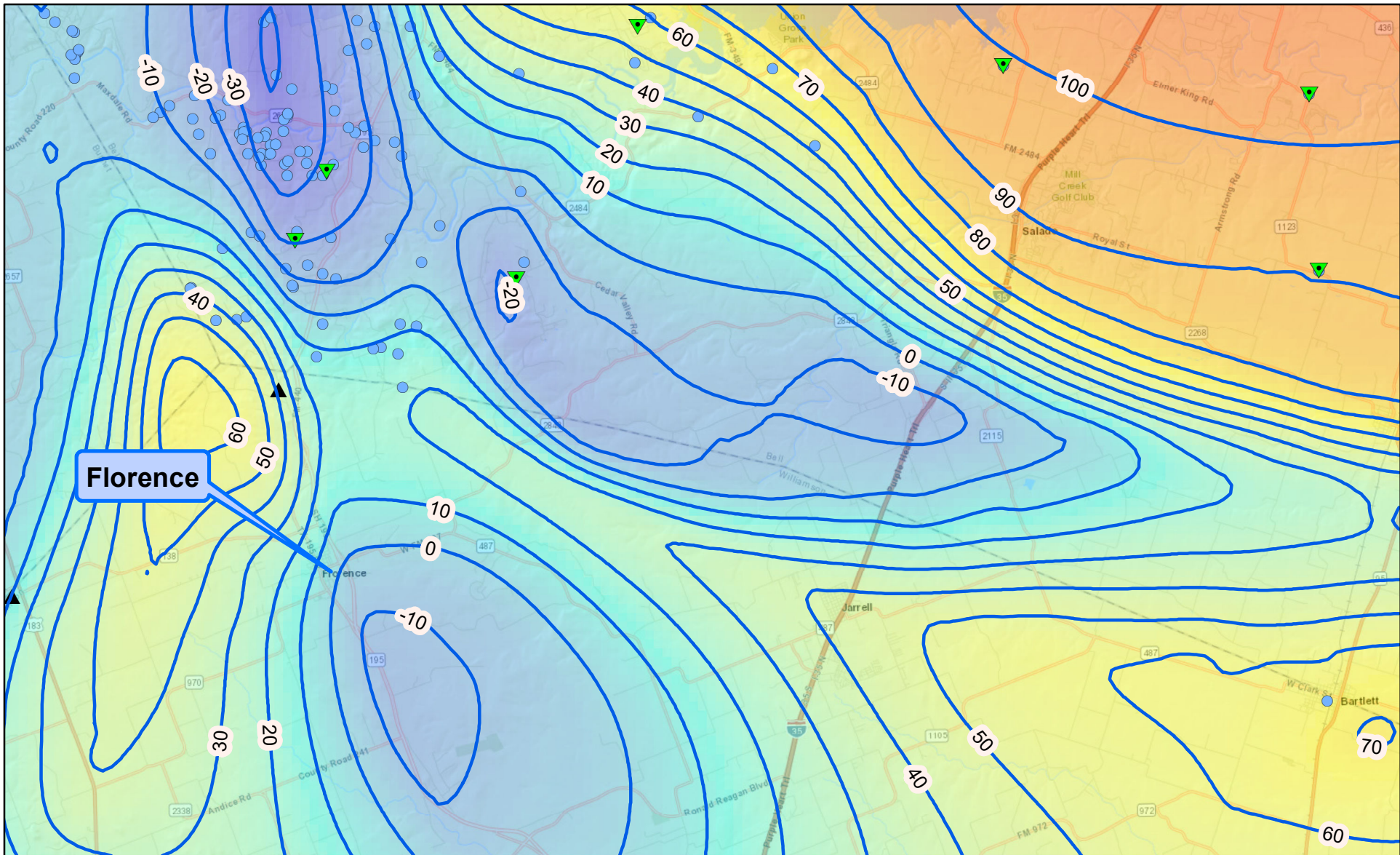
Middle Trinity Aquifer
Available Drawdown - 2019



2019 Water Elevation (ft MSL)
 Clearwater UWCD Database Lower Trinity Water Level Location
 Submitted Drillers Report Lower Trinity Water Level Location
 Clearwater UWCD Database Lower Trinity Well Location
 TWDB Database Lower Well Location



Clearwater UWCD
 Lower Trinity Aquifer
 Water Level Elevation - 2019

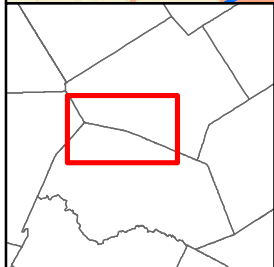
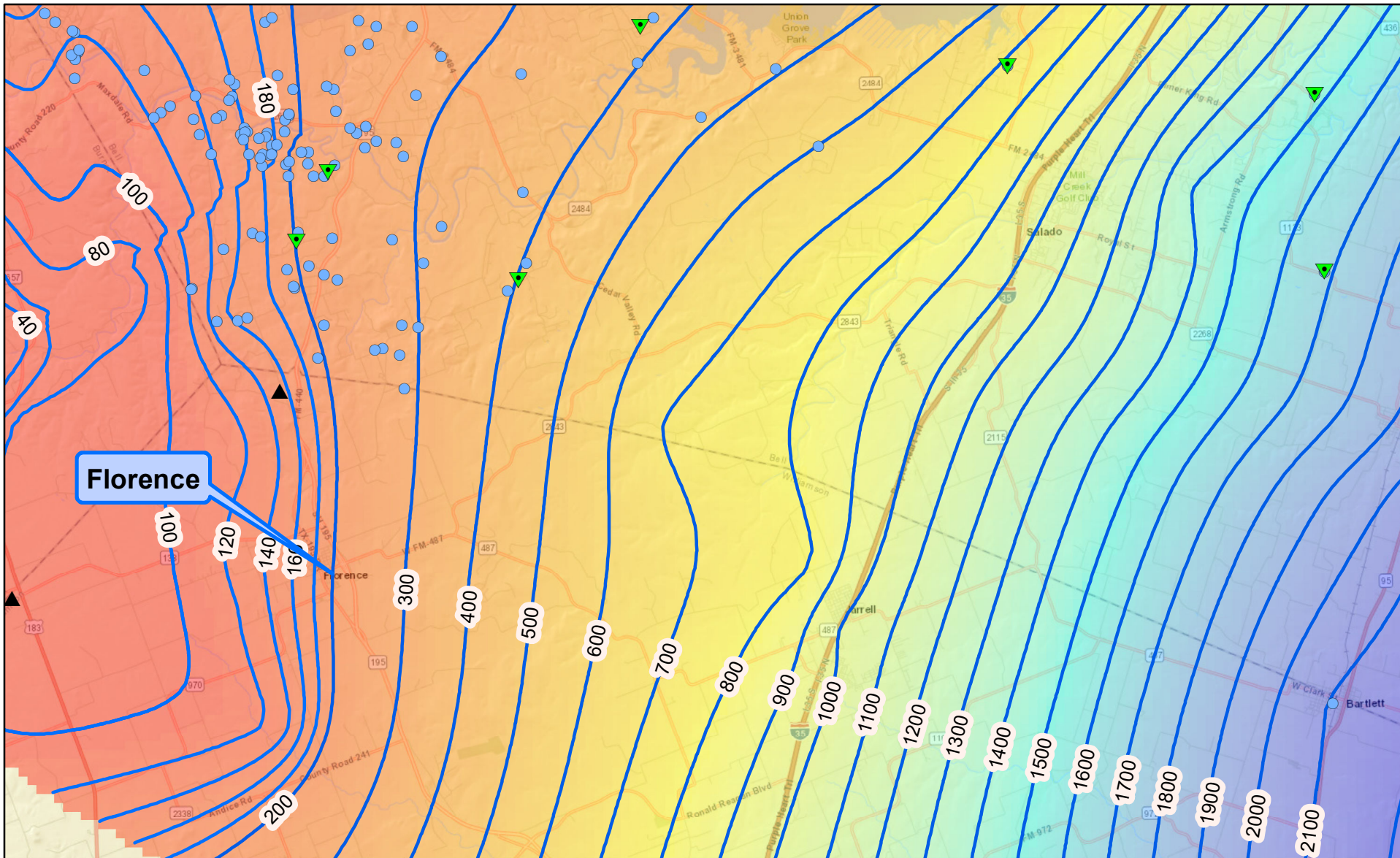


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<p>-40 10 Foot Contour Interval 120</p>	
<p>0 2.5 Miles</p>	

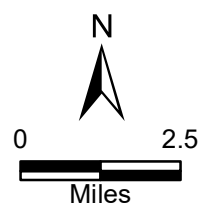
Clearwater UWCD

Lower Trinity Aquifer
Water Level Decline- 2006-2019

CONNECTING WATER TO LIFE



<ul style="list-style-type: none"> Clearwater UWCD Database Lower Trinity Water Level Location Submitted Drillers Report Lower Trinity Water Level Location 	<ul style="list-style-type: none"> Clearwater UWCD Database Lower Trinity Well Location TWDB Database Lower Trinity Well Location 2019 Available Drawdown 	<p>100 Variable Contour Interval 2200</p>	<p>"Available Drawdown" defined as the water level above the top of the aquifer.</p>
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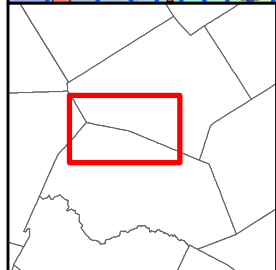
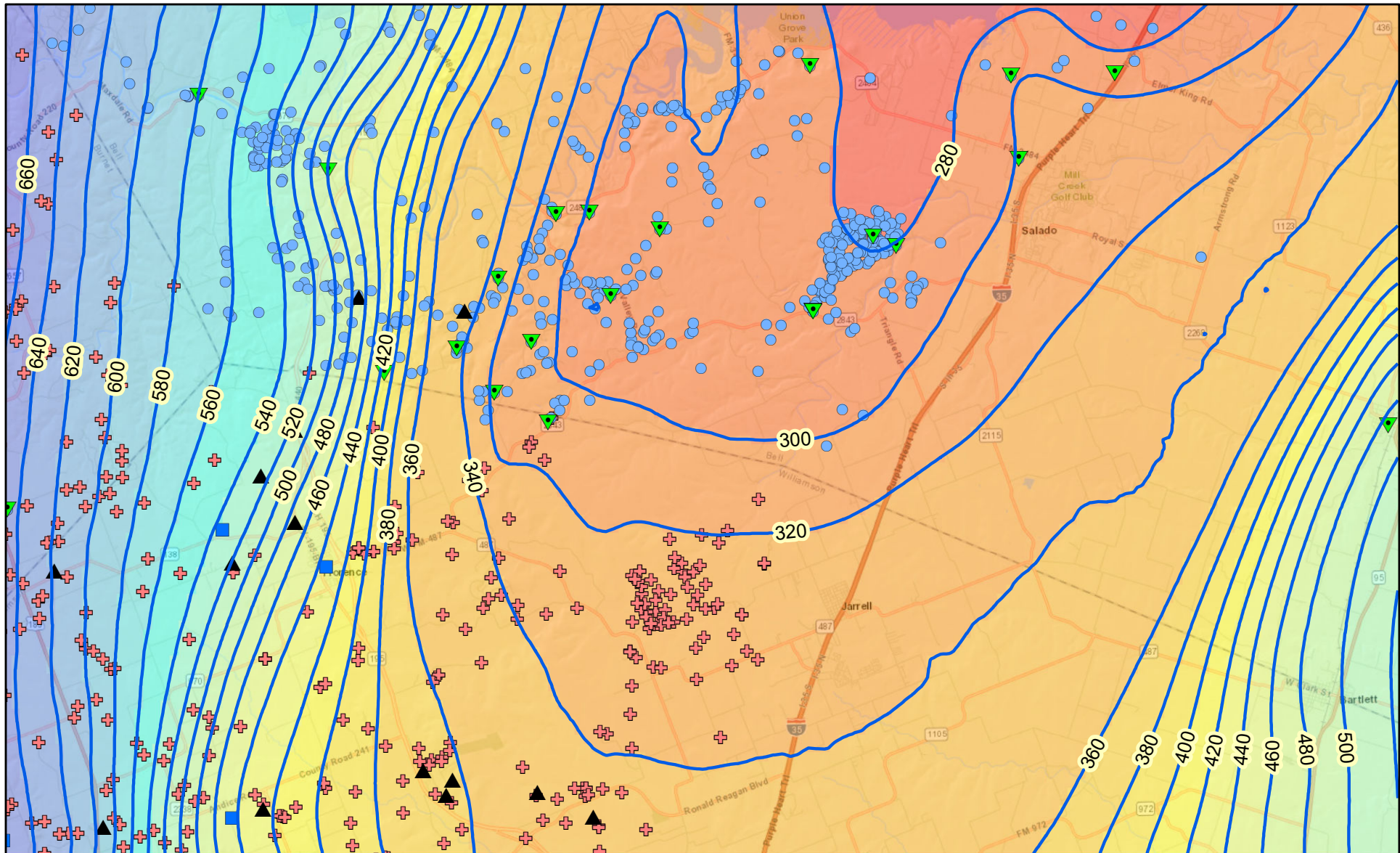
Clearwater UWCD

Lower Trinity Aquifer
Available Drawdown- 2019

CONNECTING WATER TO LIFE

Mr. Dirk Aaron – Drawdown Analysis of the Local Middle and Lower Trinity Aquifers
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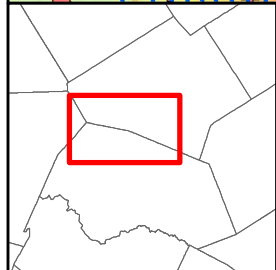
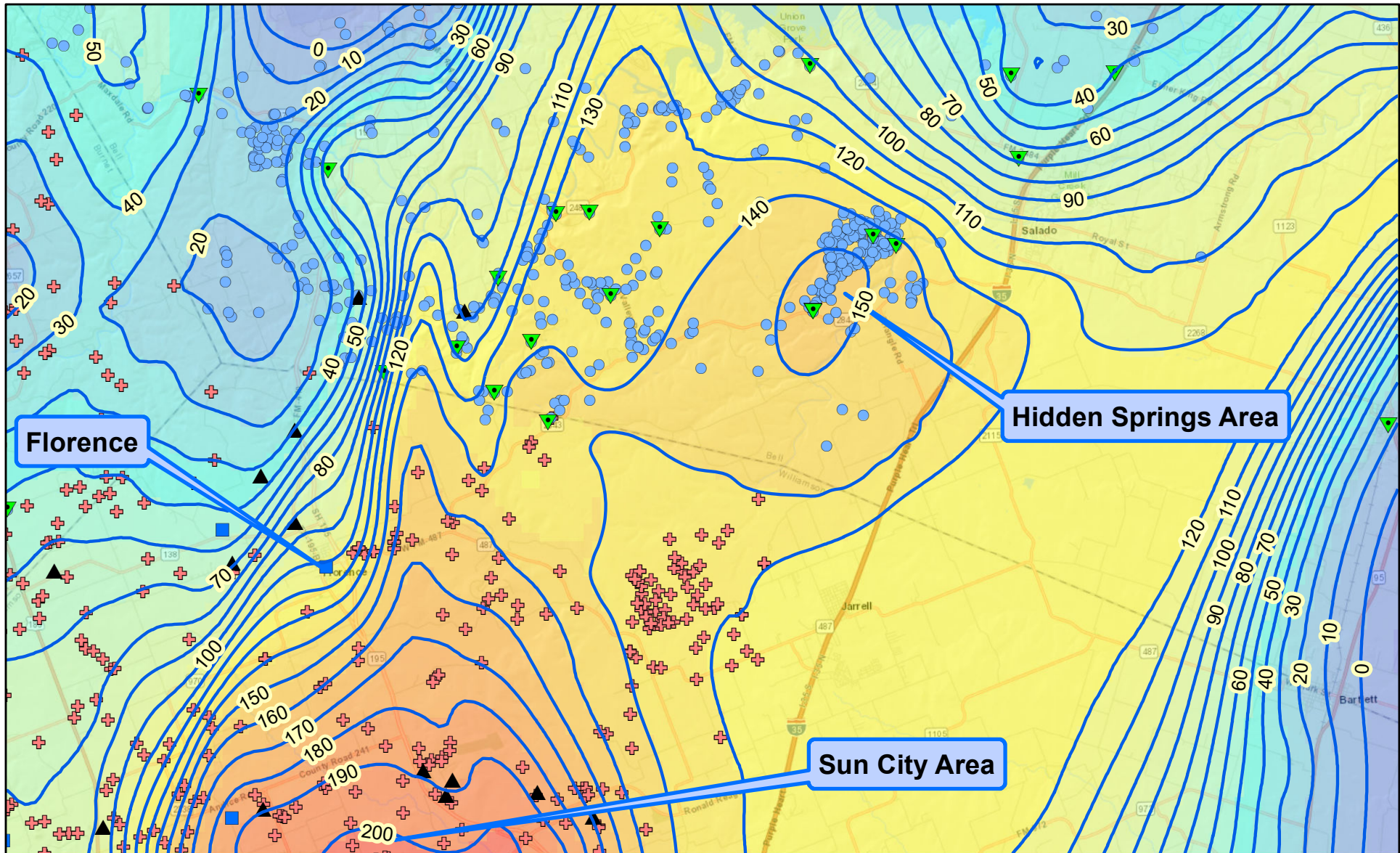
Attachment 2 — 2018 Middle and Lower Trinity Aquifer Water Level Maps



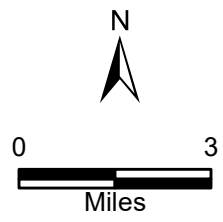
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<p>270 20 Foot Contour Interval 680</p>	
 <p>0 3 Miles</p>	

Clearwater UWCD

Middle Trinity Aquifer
Water Level Elevation - 2018



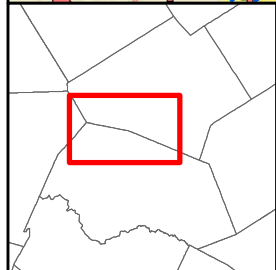
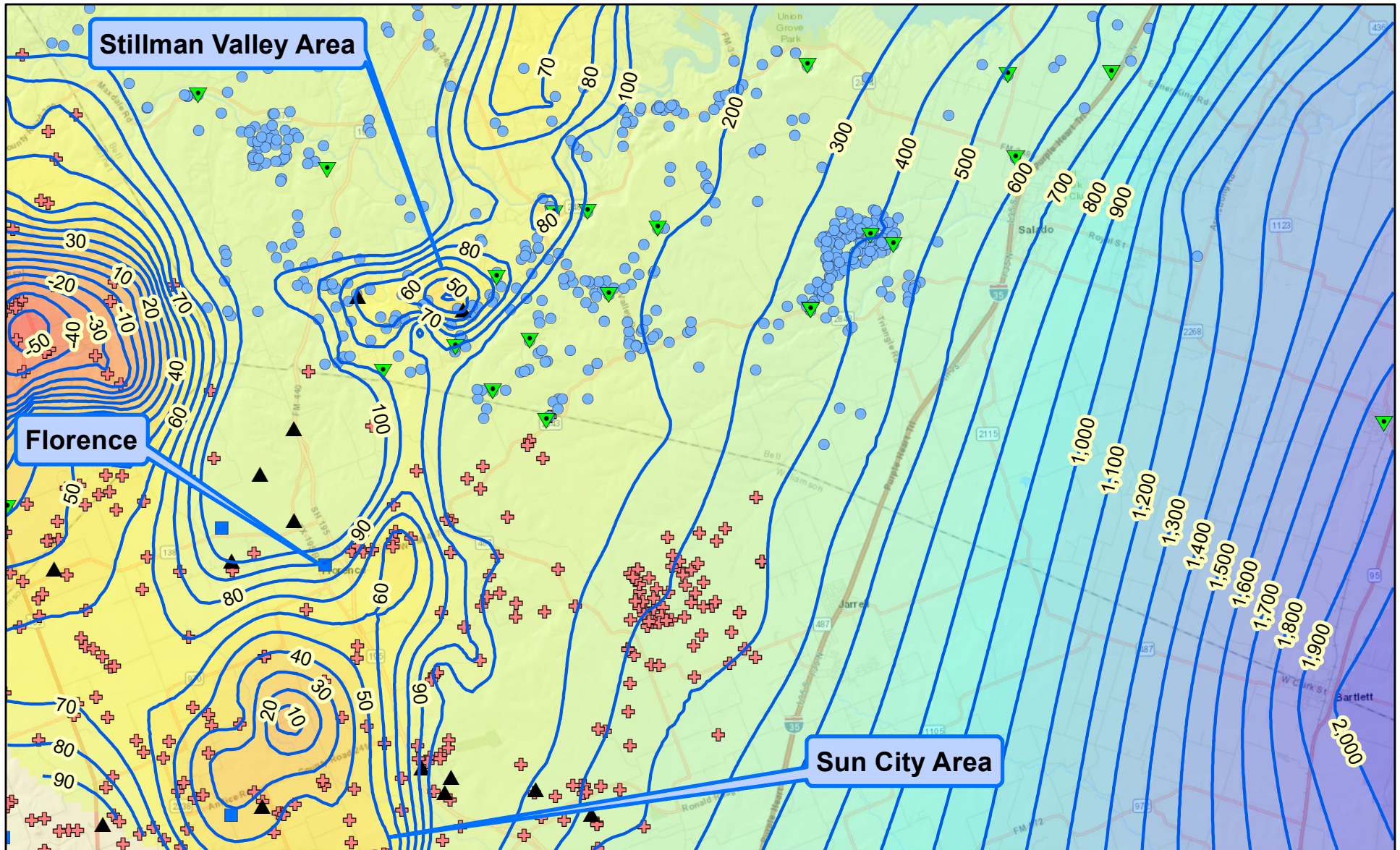
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<p>0 10 Foot Contour Interval 200</p>	



Clearwater UWCD

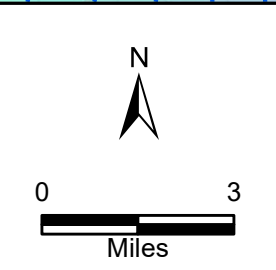
Middle Trinity Aquifer
Water Level Decline - 2006-2018

LRE Water, LLC
a Leonard Rice Engineers Company



▼ Clearwater UWCD Database Middle Trinity Water Level Location
 ▲ Submitted Drillers Report Middle Trinity Water Level Location
 ~ 2018 Available Drawdown
 -50 Variable Contour Interval 2,000

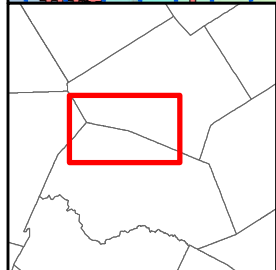
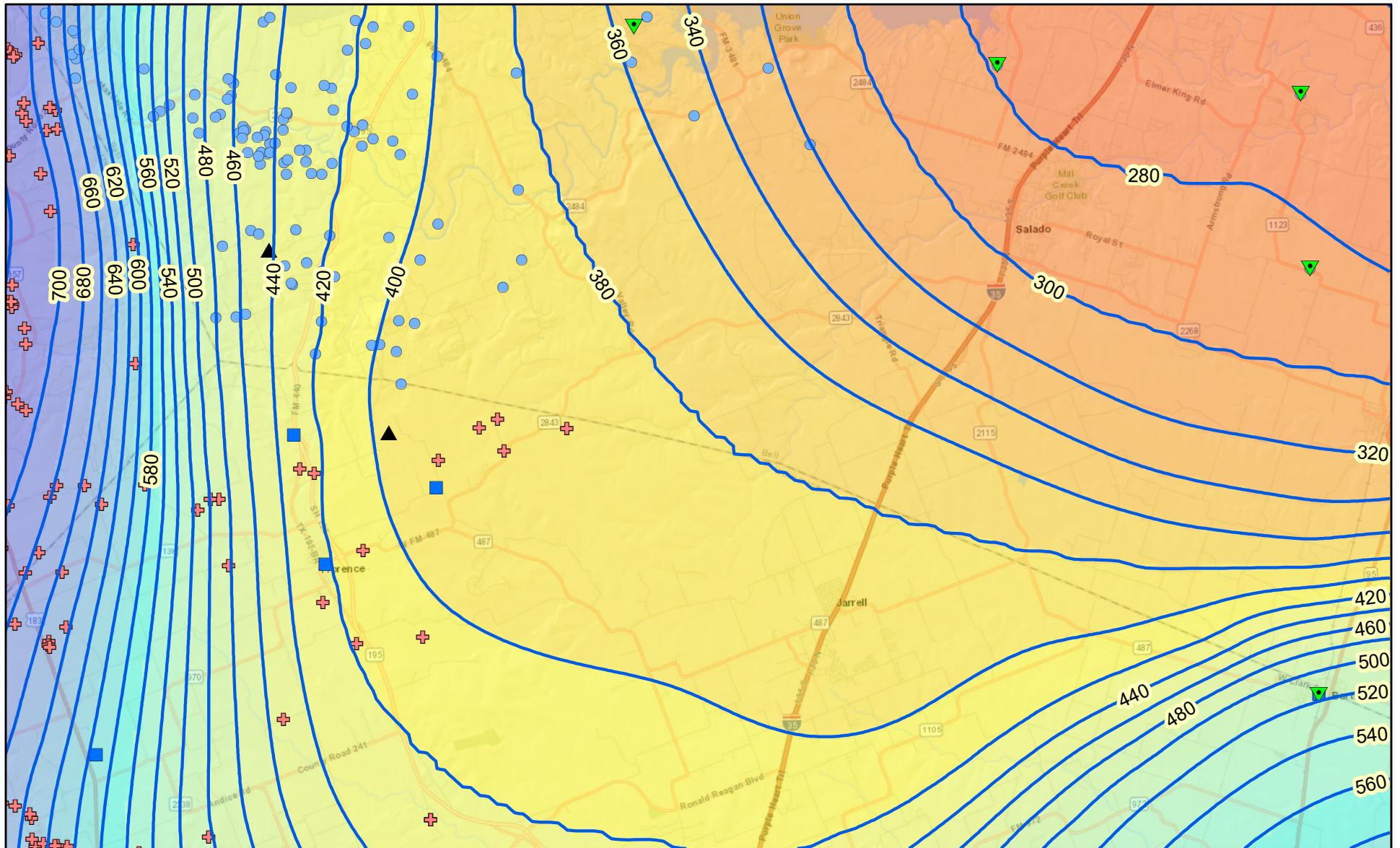
● Clearwater UWCD Database Middle Trinity Well Location
 ■ TWDB Database Middle Trinity Well Location
 + Submitted Driller's Report Database Middle Trinity Well Location
 "Available Drawdown" defined as the water level above the top of the aquifer.











Clearwater UWCD

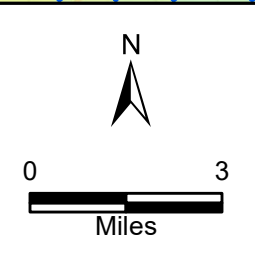
Middle Trinity Aquifer
Available Drawdown - 2018

LRE Water, LLC
a Leonard Rice Engineers Company




 Clearwater UWCD Database Lower Trinity Water Level Location
 Submitted Drillers Report Lower Trinity Water Level Location
 2018 Water Level Elevation (ft MSL)

 270 20 Foot Contour Interval 720

 Clearwater UWCD Database Lower Trinity Well Location
 TWDB Database Lower Trinity Well Location
 Submitted Driller's Report Database Lower Trinity Well Location
 Submitted Driller's Report Database Lower Trinity Well Location

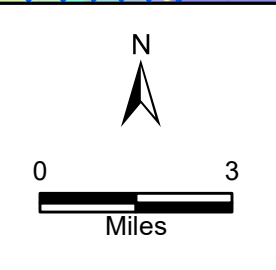
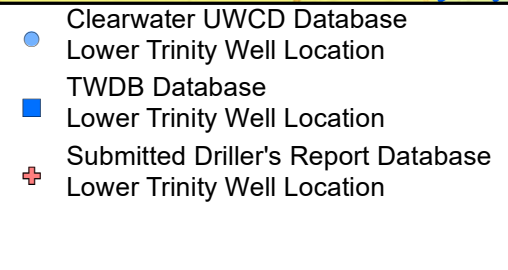
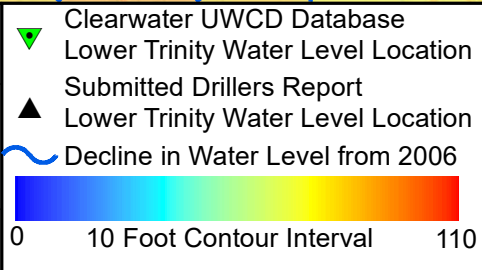
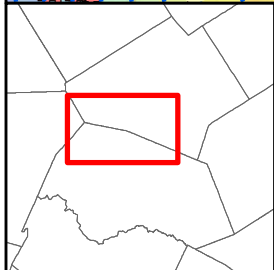
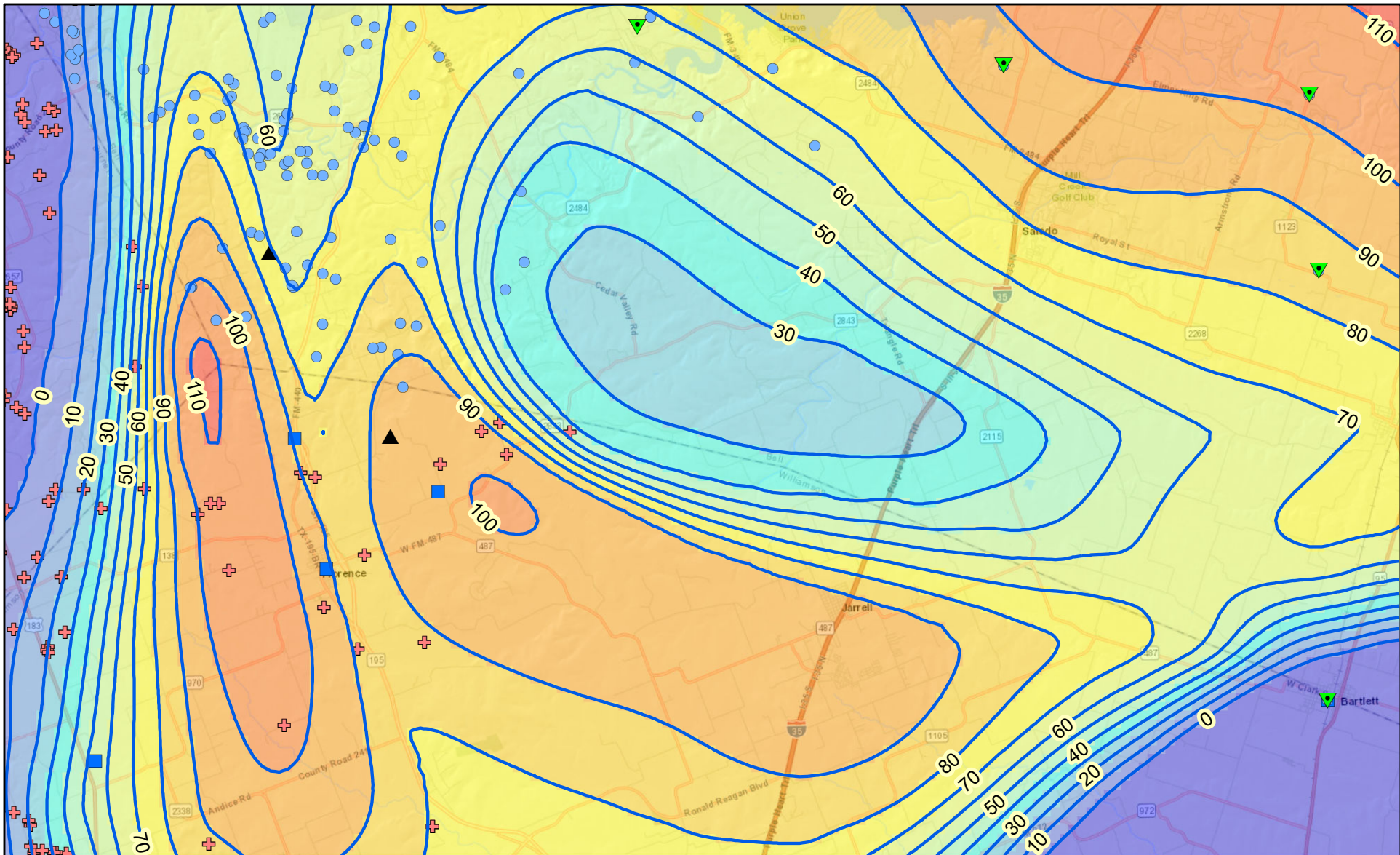


Clearwater UWCD

Lower Trinity Aquifer
Water Level Elevation - 2018



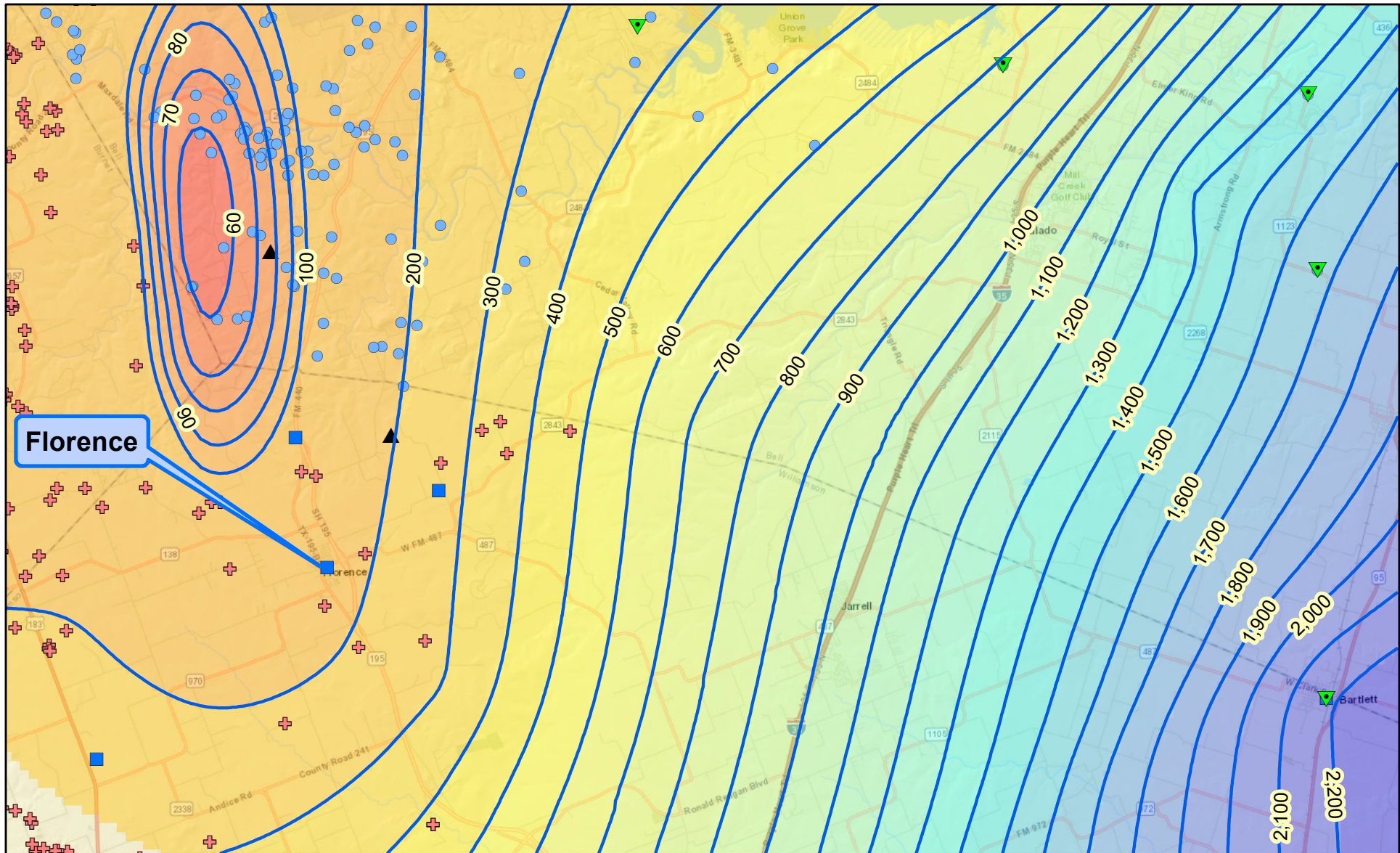
LRE Water, LLC
a Leonard Rice Engineers Company



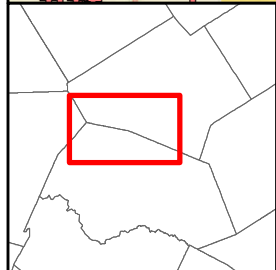
Clearwater UWCD

Lower Trinity Aquifer
 Water Level Decline - 2006-2018

LRE Water, LLC
 a Leonard Rice Engineers Company

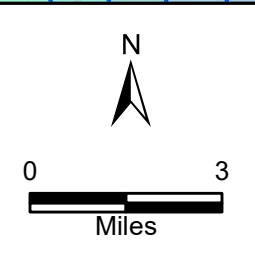



Florence



▼ Clearwater UWCD Database Lower Trinity Water Level Location
 ▲ Submitted Drillers Report Lower Trinity Water Level Location
 ~ 2018 Available Drawdown
 50 Variable Contour Interval 2,300

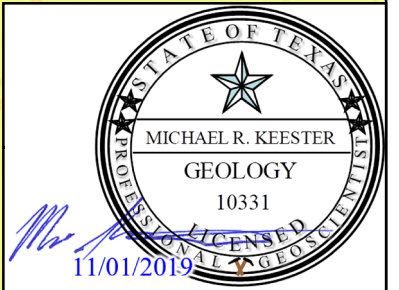
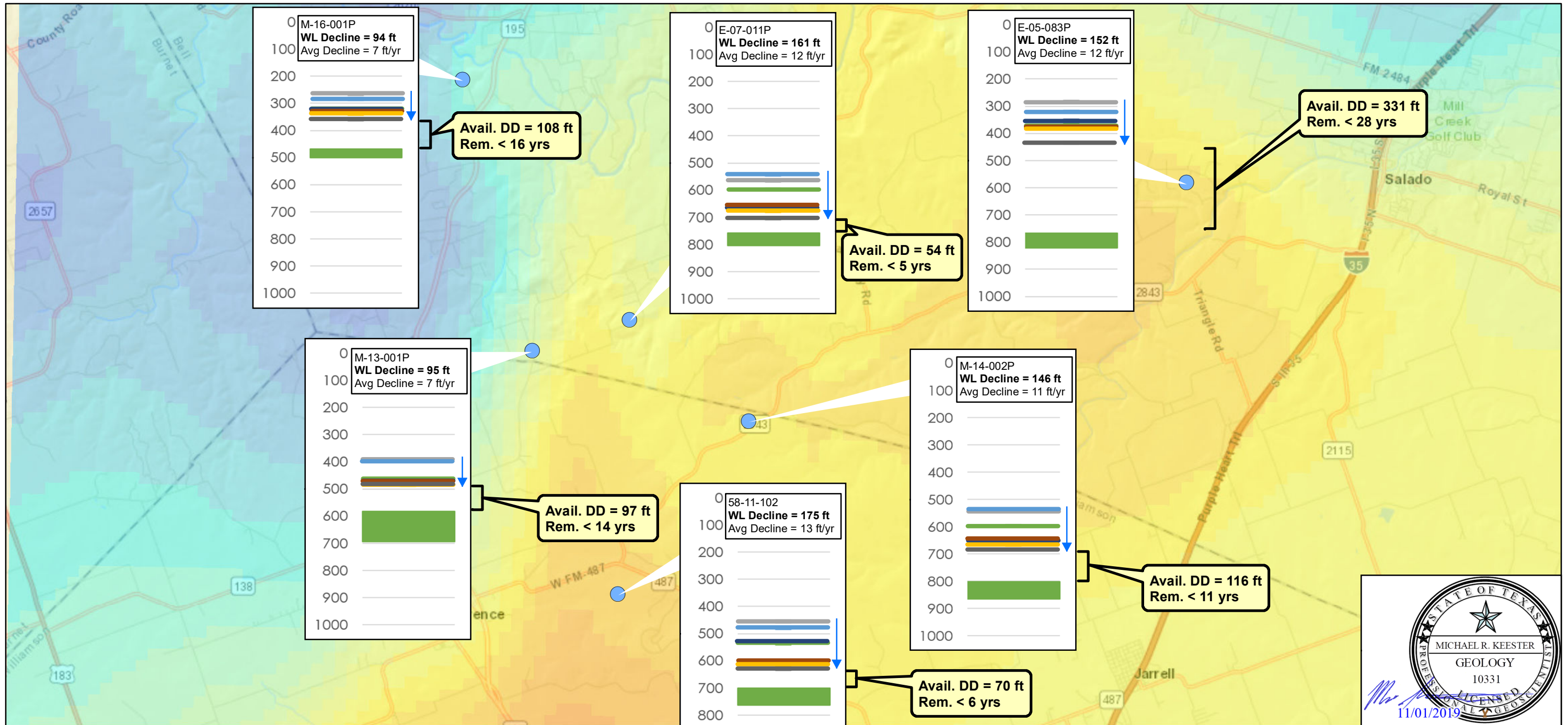
● Clearwater UWCD Database Lower Trinity Well Location
 ■ TWDB Database Lower Trinity Well Location
 + Submitted Driller's Report Database Lower Trinity Well Location
 "Available Drawdown" defined as the water level above the top of the aquifer.



Clearwater UWCD
 Lower Trinity Aquifer
 Available Drawdown - 2018

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Mr. Dirk Aaron – Drawdown Analysis of the Local Middle and Lower Trinity Aquifers
July 2, 2020
Trinity Water-Level Maps

Attachment 3 — Middle Trinity Aquifer Water Level Changes



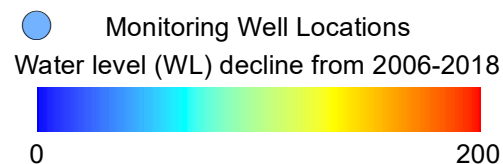
- █ Middle Trinity Aquifer
- 2006 Water Level
- 2010 Water Level
- 2013 Water Level
- 2014 Water Level
- 2015 Water Level
- 2018 Water Level
- 2019 Water Level

Water level (WL) decline represents the difference between the highest and lowest water level. For well E-07-011P and M-14-002P the value represents the decline from 2010 through current conditions. For the other four wells, the range represents the decline from 2006.

Average decline based on the decline over the last 13 years.

Available drawdown (Avail. DD) is the difference between the 2019 water level and the top of the aquifer which typically coincides with the top of the well screen. While pumps can be set deeper, water levels below the top of screen tend to coincide with a loss of well productivity.

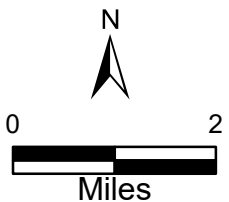
Water remaining (Rem.) is the available drawdown divided by the average rate of decline.



All values shown on the charts are in depth below ground level.

Water levels are from the CUWCD and TWDB databases. 2019 water levels reflect the most recent water level measured in September or October of 2019.

The Middle Trinity Aquifer represents the depth interval of the Hensell Formation as reflected in the CUWCD 3-D geologic model.



Clearwater Underground Water Conservation District

Middle Trinity Aquifer Water Level Change in Select Monitoring Wells

