DROUGHT TRIGGER METHODOLOGY FOR THE BARTON SPRINGS SEGMENT OF THE EDWARDS AQUIFER, TRAVIS AND HAYS COUNTIES, TEXAS

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ABSTRACT

Previous studies of the Barton Springs segment of the Edwards Aquifer have shown that at current pumping rates and a recurrence of drought-of-record conditions, flow from Barton Springs could cease for brief periods, and up to 20% of the water-supply wells could go dry. A drought trigger methodology (DTM) was devised to improve declarations of drought and to implement mandated conservation measures by ground-water users. These conservation measures are the primary means of protecting water levels and spring flow.

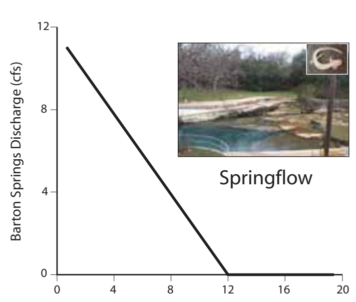
Three criteria were established as the basis for developing a DTM: 1) that a drought stage declaration be triggered in sufficient time to achieve benefits of conservation measures; 2) that it will be representative of aquifer-wide conditions; and 3) that it be simple to implement. Principal components of the hydrologic cycle (recharge, storage, and discharge) were evaluated along with historical data such as rainfall, stream flow, water levels, and spring flow.

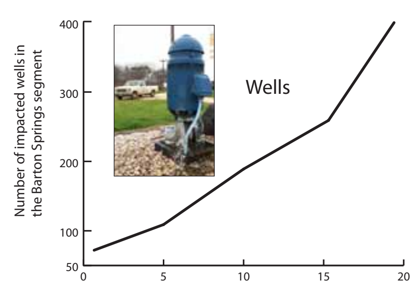
The DTM that was developed uses flow from Barton Springs and water levels in the Lovelady monitor well to determine drought status of the aquifer. Water levels in the well are indicative of the amount of water in storage. The muted response to major recharge events suggests that the well is not well connected to the conduit system. Flow from Barton Springs responds quickly to minor and major recharge events. By using both the Lovelady well and flow from Barton Springs to signal a drought, it is likely that a serious drought can be recognized early enough that conservation measures can be implemented and continue long enough to minimize the impact of low water levels in wells on water supplies and to maintain adequate flow at Barton Springs that will be protective of the endangered species at the springs.

Two stages of drought were established, Alarm and Critical. Alarm Stage drought is triggered when the 10-day running average of flow from Barton Springs drops below 38 cubic feet per second (cfs) or when the water level in the Lovelady monitor well drops below 181 ft below ground surface at the well. Critical Stage drought is triggered when the 10-day running average of flow from Barton Springs drops below 20 cubic feet per second (cfs) or when the water level in the Lovelady monitor well drops below 192 ft below ground surface at the well. To exit a drought stage, both spring flow and water level must go above their respective drought trigger value.

PROBLEM

During drought-of-record conditions, and current pumping rates, Barton Springs and many wells may go dry. Drought declarations that trigger conservation and other measures are the only non-structural means to preserve springflow and water levels.





OBJECTIVE

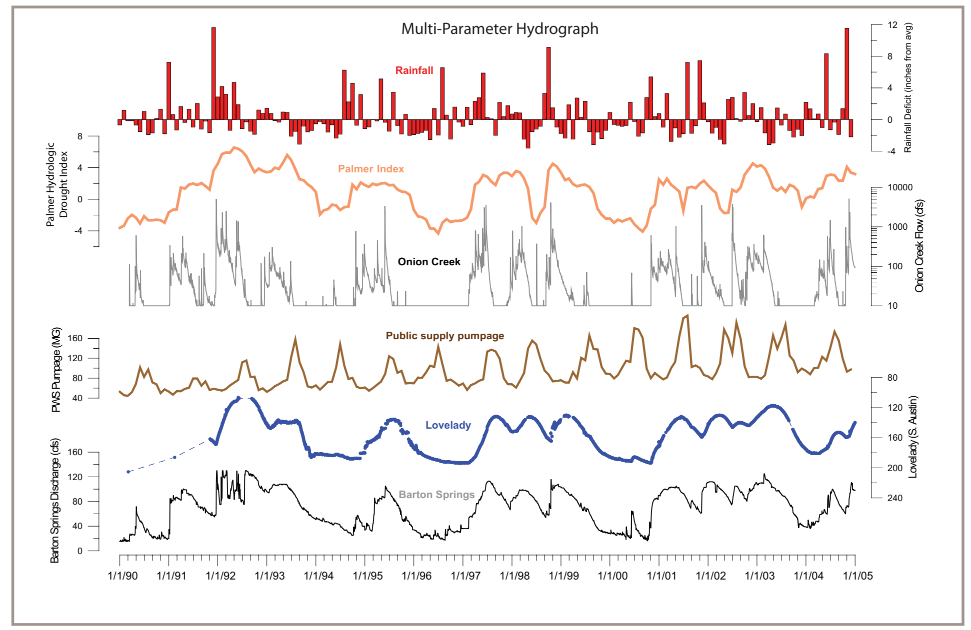
Devise a new drought trigger methodology based on three main elements:

1) Representative of the entire aquifer;
2) Simple to implement;
3) Protective of spring flow and wells.

APPROACH

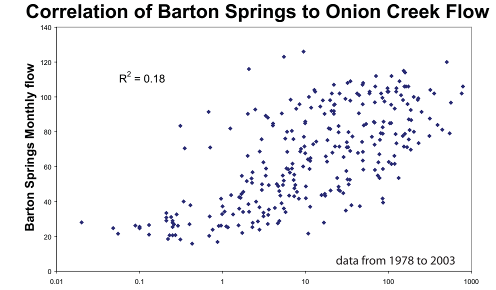
Principal components of the hydrologic cycle (rainfall, recharge, storage, and discharge) were evaluated.
- o Evaluation based primarily upon historical data;
- o Basic statistics and correlations;
- o Multivariate (Principal Components) analysis;
- o GAM model provides substantiation of drought duration and responses.

RESULTS



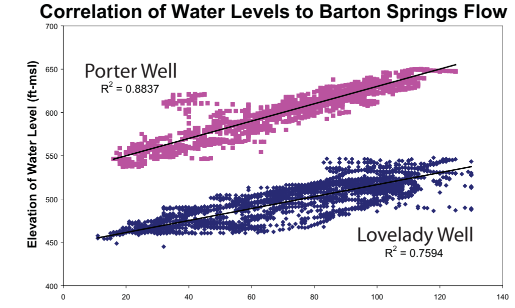
Recharge data are difficult to quantify and correlate to aquifer conditions due to the many sources and dynamic nature of recharge into a karst aquifer. Surrogate recharge data, such as rainfall or creekflow, have poor correlations to aquifer conditions.

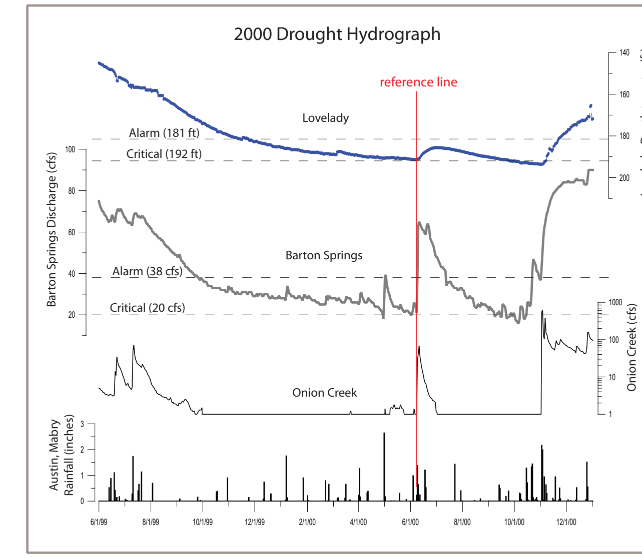
Correlation of Barton Springs to Onion Creek Flow



Many wells intersect the fracture, and conduit porosity of the aquifer and their water levels correlate very closely with Barton Springs. Wells that are less-influenced by conduit flow respond to long-term recharge events and not to ephemeral events. Therefore, they appear muted in their response to recharge when compared to other wells and Barton Springs. The Lovelady monitor well provides a good indication of aquifer storage. The Porter monitor well (like many other wells) is influenced by both conduit and matrix conditions.

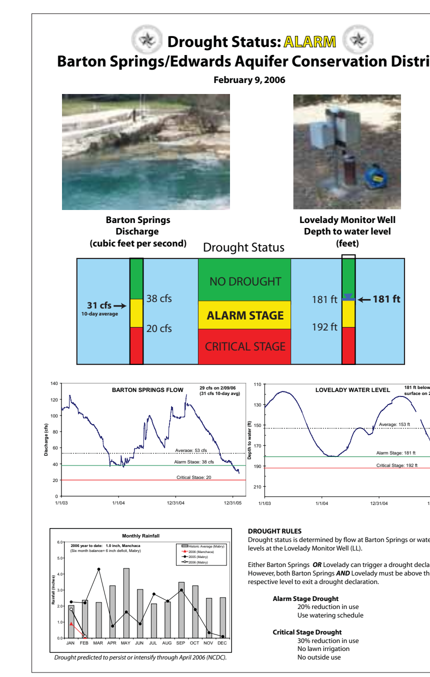
Correlation of Water Levels to Barton Springs Flow





KEY COMPONENTS OF DROUGHT TRIGGER METHODOLOGY

- Either spring flow or water levels in Lovelady can trigger a drought, but to exit a drought stage, both spring flow and water level must be above their respective drought trigger value.
- Water Conservation Period
  - May 1 through September 30
  - Voluntary reduction in usage of 10%
- Alarm Stage Drought
  - Mandatory 20% reduction in usage
- Critical Stage Drought
  - Mandatory 30% reduction in usage



CONCLUSIONS

- Recharge is difficult to quantify, therefore storage and discharge are better indicators of drought.
- There are two primary components of flow in the aquifer: conduit flow and diffuse flow or storage that are well represented by Barton Springs and Lovelady monitor well.
- The DTM that was developed uses flow from Barton Springs and water levels in the Lovelady monitor well to determine drought status of the aquifer.

ACKNOWLEDGMENTS

- o Drought Trigger Advisory Team
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- o BSEACD Board of Directors