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CE 394K.3 GIS in Water Resources
Term Project

Sufficiency of publicly-available data to monitor Central Texas groundwater salamanders

Central Texas is home to a group of endemic salamander species of the genus *Eurycea*. They are unusual in that they are fully aquatic and subterranean, dwelling in karst limestone aquifers far under the surface. Some species - like the Barton Springs Salamander *E. sosorum* - are federally endangered, while others – like the Jollyville Plateau Salamander *E. tonkawae* – are considered critically threatened by the state of Texas. What all the species have in common is that they are greatly affected by threats to groundwater quantity and quality in the rapidly developing Austin and San Antonio metro areas.

A hindrance to proper monitoring and conservation of the *Eurycea* species is a lack of information about their true ranges. They have been found to occur at springs, caves, and wells, but are generally very difficult to detect. The objective of my project is to evaluate publicly-available GIS data for its potential to supplement current monitoring efforts. I especially place emphasis on resources related to groundwater and aquifers. I relate geographic and hydrological features to current occurrence records for *Eurycea* and perform some basic analyses.

Occurrence Records and Basemap

I obtained a shapefile containing occurrence records for individual *Eurycea*. This dataset originated from the City of Austin Watershed Protection Department, but contains records from several different researchers and databases. It is the most comprehensive collection of *Eurycea* occurences available, including 331 collection events. I mapped the occurrence records, colored by species, using Texas counties as a basemap. The counties were taken from the "USA Counties" feature in the Living Atlas, and selected by location by their intersection with the occurrence shapefile (Fig. 1). Not all records had a species recorded, and species identity is not relevant to the scope of this project.

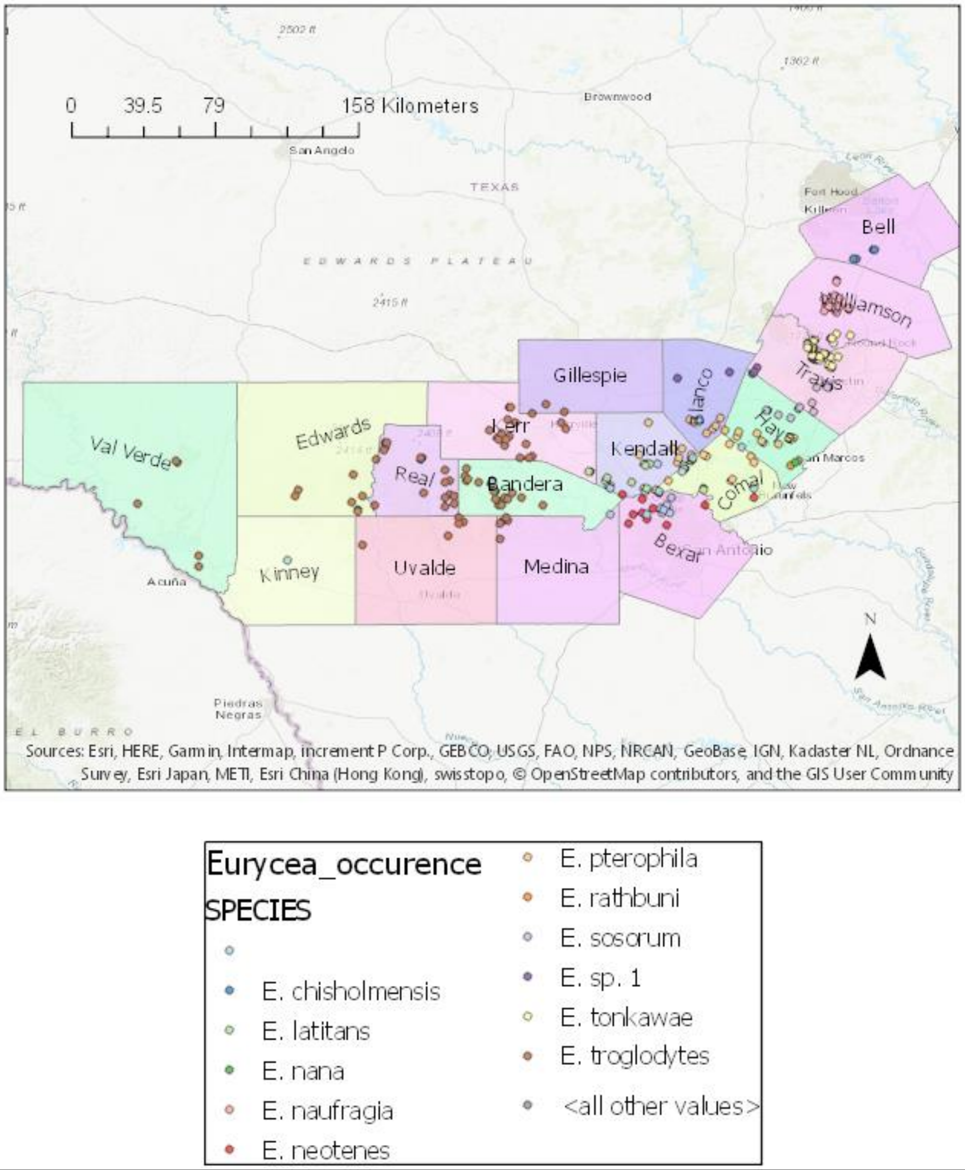


Figure 1. Occurrence of *Eurycea* in Central Texas

Watersheds and Streams

Most of the occurrence records correspond to the collection of an individual at a spring, where groundwater emerges at the surface. Because of the karst geology of Central Texas, there are many springs contributing to streamflow. My expectation is that GIS data with high enough resolution would result in a map of stream networks where the springs are located relatively close to the flowlines. This would accurately represent that the springs are directly flowing into the streams. In order to map streamflow, I first needed to find out what watersheds are represented in the occurrence data. I downloaded a HUC-8 watershed shapefile from the Texas Water Development Board, although the data comes originally from the USGS Watershed Boundary Dataset. Again selecting by location, the watersheds with *Eurycea* occurrence are mapped in Figure 2. I noted that the watersheds belong to either the Texas-Gulf or Rio Grande Region.

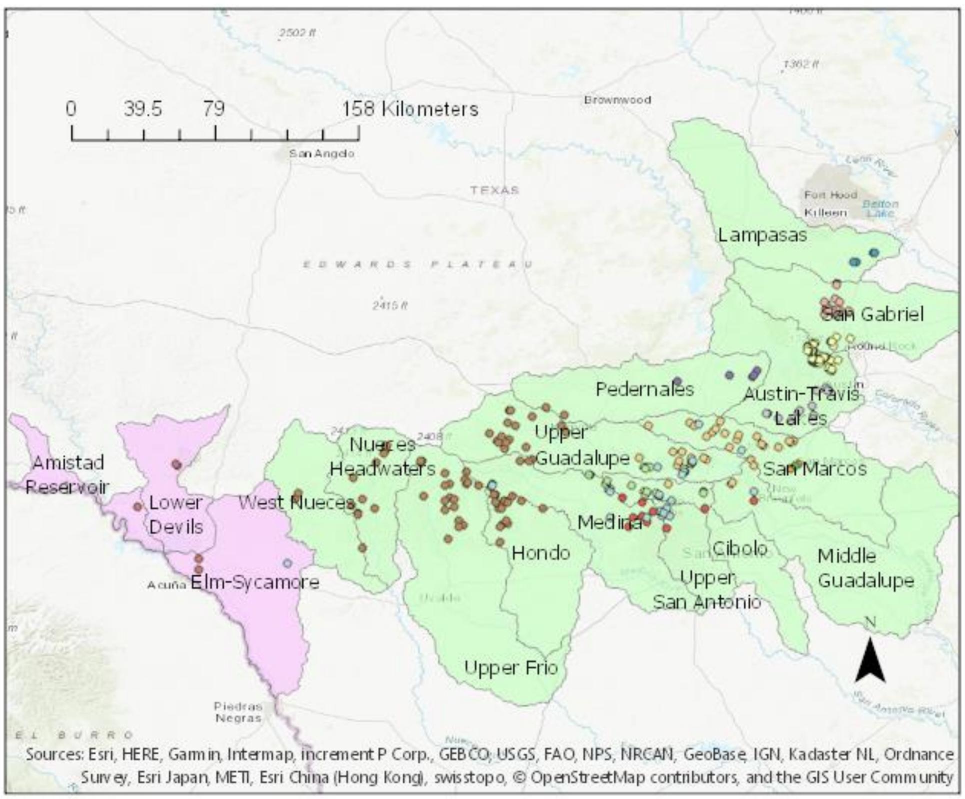


Figure 2.*Eurycea* Occurrence and Watershed. Watersheds are colored by region.

In order to obtain the highest-resolution streamflow data possible, I searched though the newer High Resolution version of the USGS National Hydrography Dataset. From the attribute table of the USGS watershed shapefile, the selected watersheds belong to the HUC-4 regions 1207, 1209, 1210, 1211, 1304, and 1308. I merged the flowline features from each region and clipped them to the watersheds with *Eurycea* occurrence (Fig. 3).

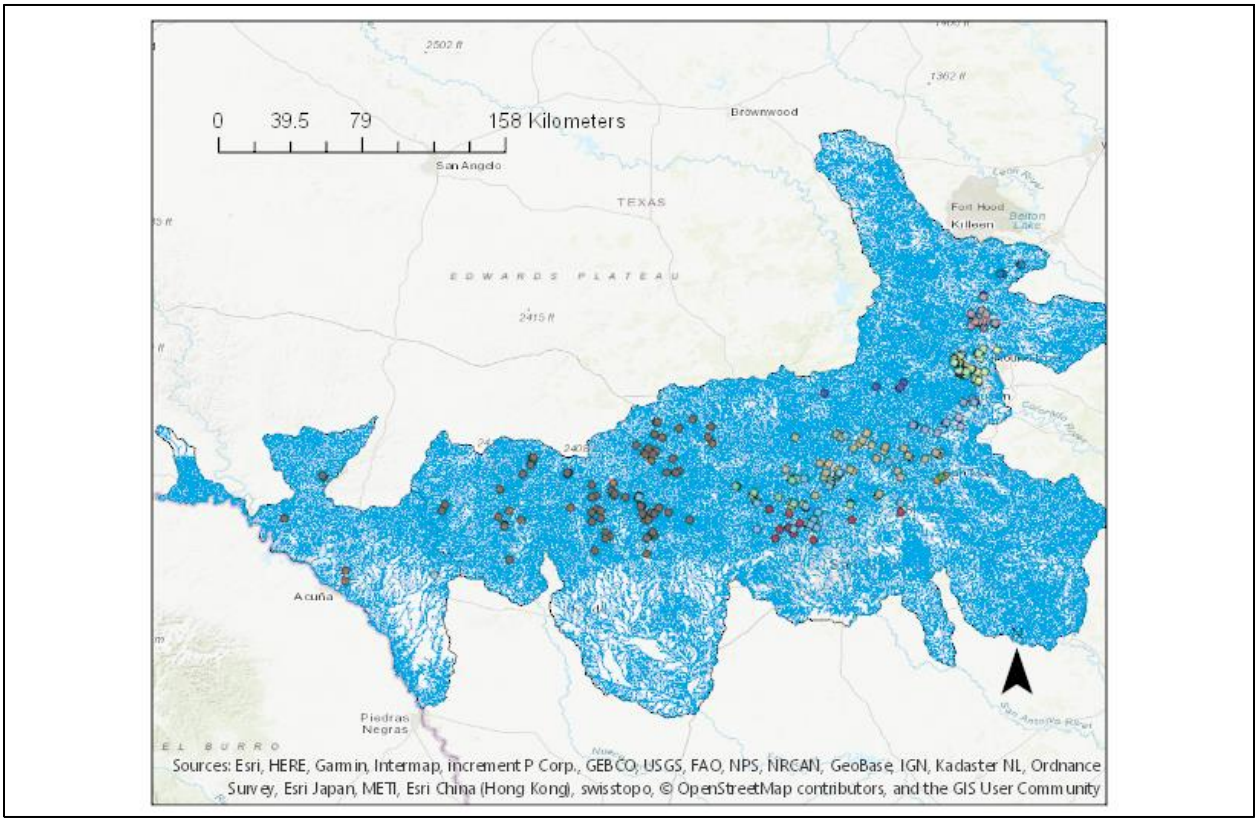
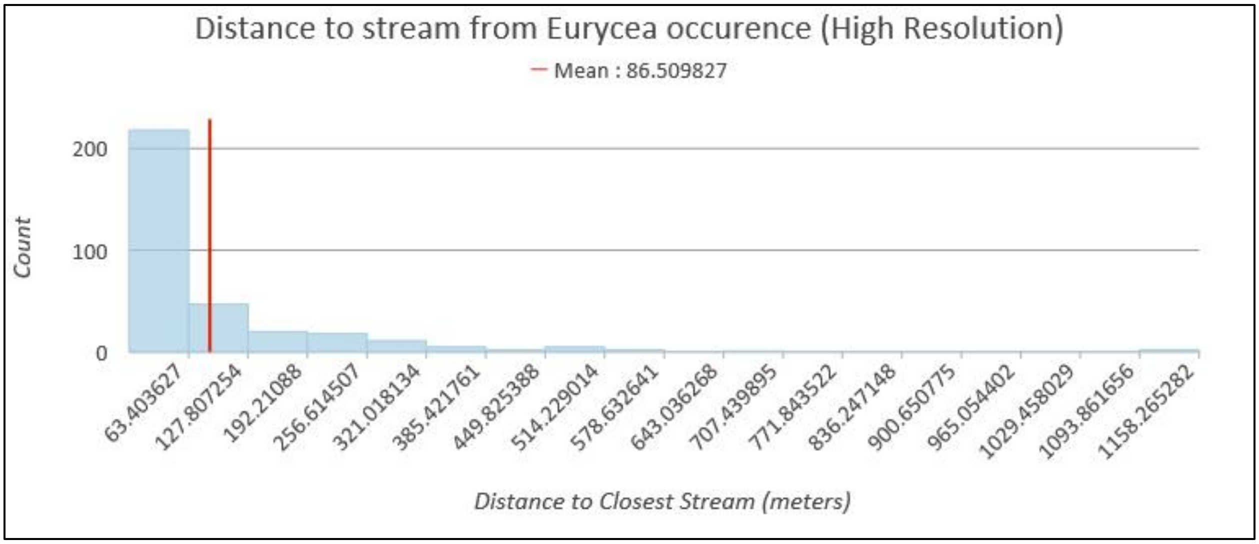


Figure 3. NHDPlus High Resolution Flowlines across Watersheds with *Eurycea* Occurrence.

The "Near" tool computes the distance from a set of points to another. I used this tool to find the distance from *Eurycea* occurrence sites to streams. The results are shown in Figure 4, along with the same calculations performed with the standard (not high-resolution) flowline data.



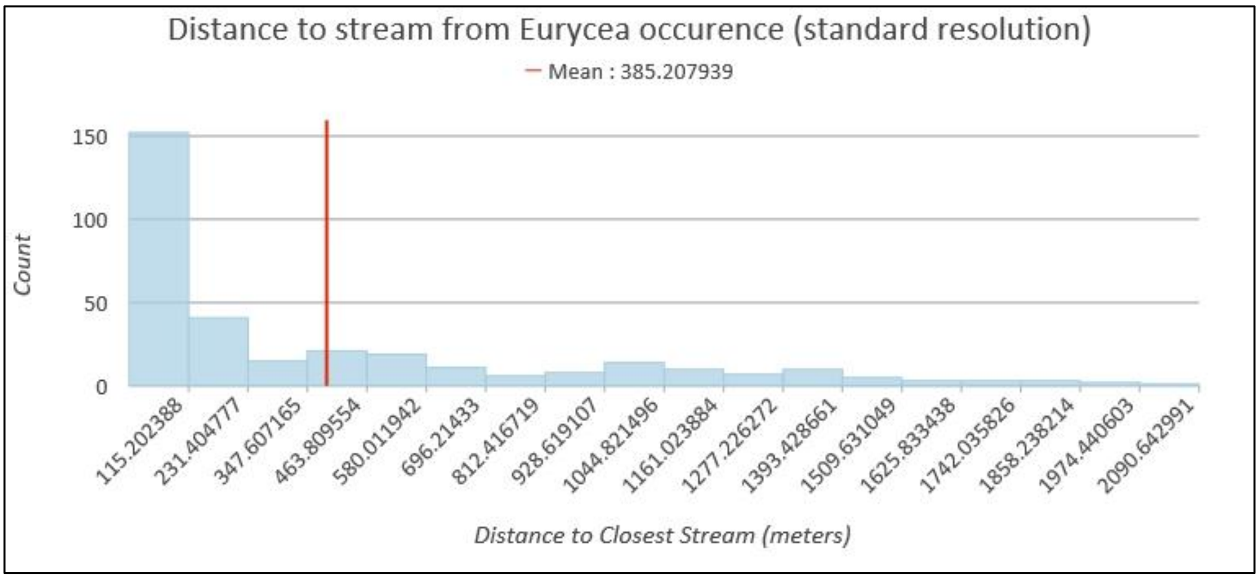


Figure 4. Distance from *Eurycea* occurrence to stream for NHD high resolution and standard datasets.

Using the high-resolution dataset results in flowlines being much closer to *Eurycea* occurrence sites. One limitation of the occurrence dataset is that springs, caves, and wells are included and not differentiated. The sites farther from streams may be from wells.

Aquifers and Wells

Texas is home to 9 major aquifers. Over 60% of water in Texas is supplied by groundwater. *Eurycea* are sensitive to changes in groundwater quality and quantity, especially as it relates to rapid development in the region. To assess the adequacy of current groundwater data as it relates to *Eurycea* occurrence, I first determined what aquifers underlied the species distribution. Using aquifer maps from the Texas Water Development Board, I selected which aquifers coincided with occurrence locations (Fig. 5).

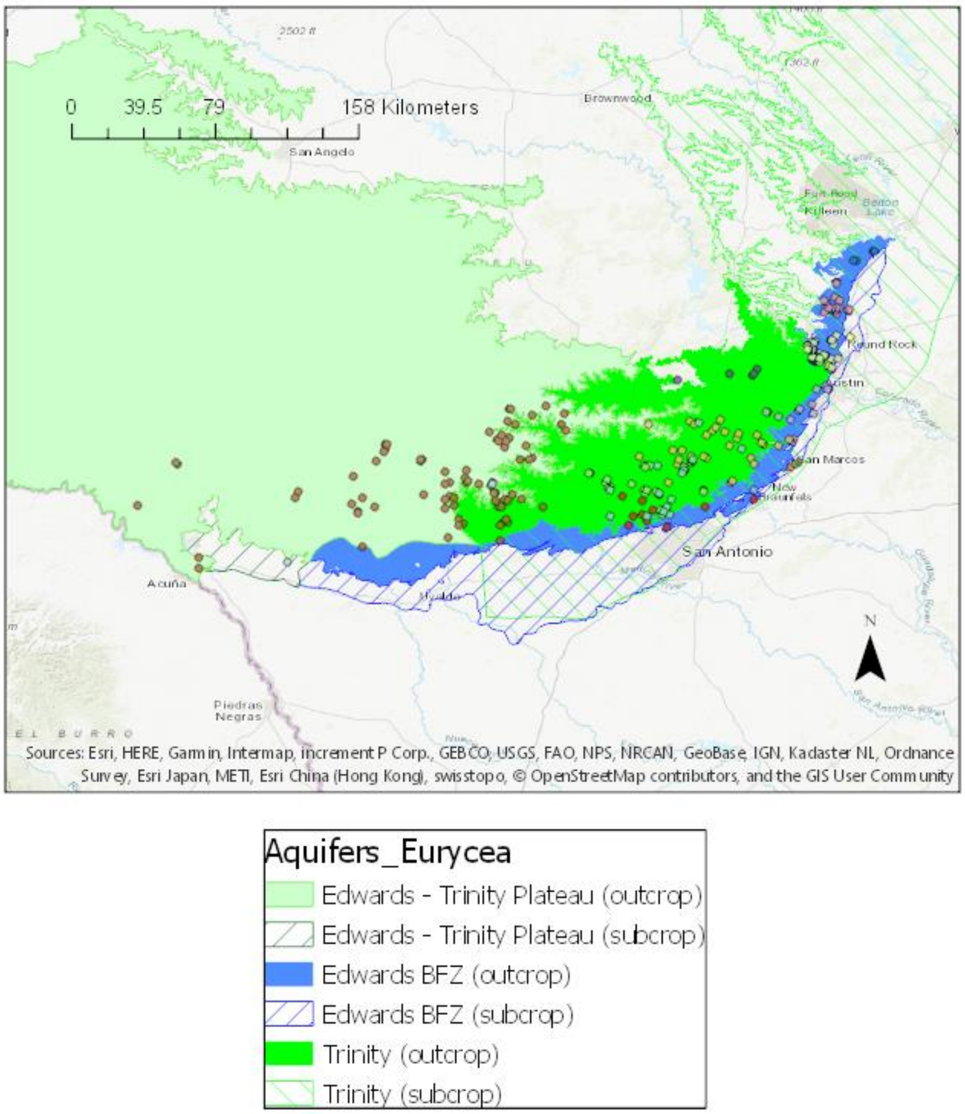
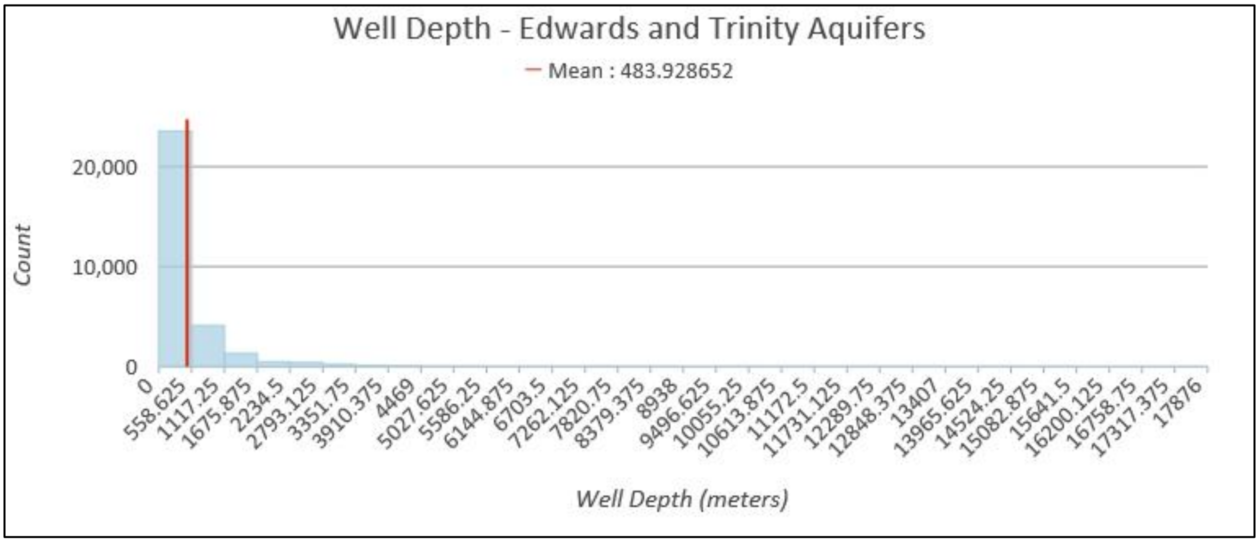


Figure 5. Edwards and Trinity aquifers.

The Texas Water Development Board monitors over 300,000 wells across the state of Texas. While other agencies like the Lower Colorado River Authority and the Edwards Aquifer Authority monitor wells, the TPWD data is the most comprehensive. I downloaded well data from the TPWD and added it to the map. Again, I used the “near” geoprocessing tool to find the individual wells closest to each location of *Eurycea* occurrence. Using a table join, I related each occurrence data point to a well water level. The results are shown in Figure 6.



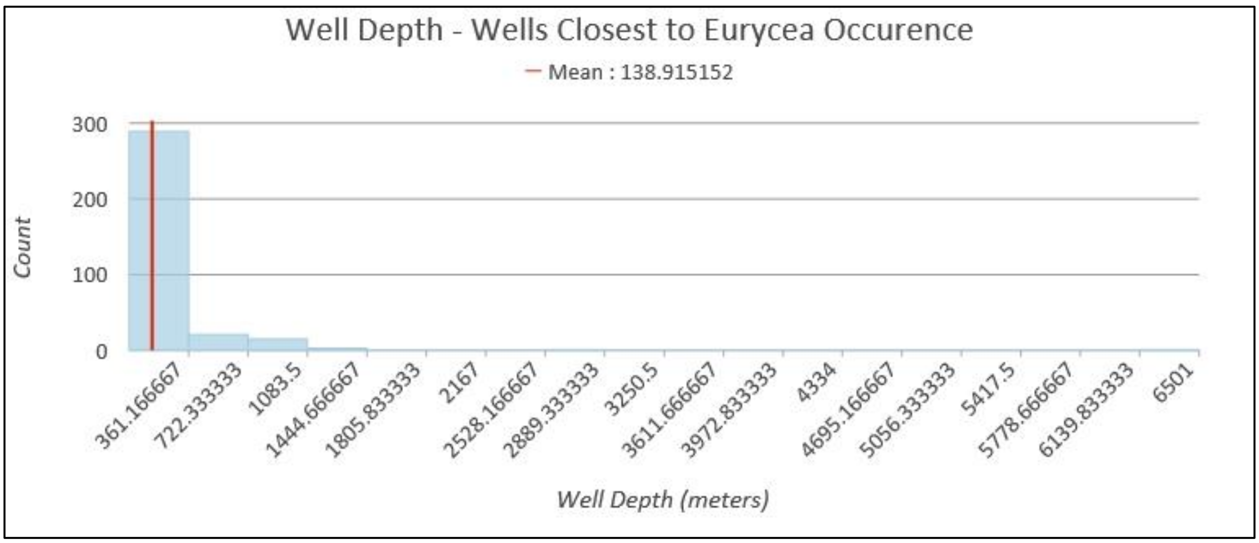


Figure 6. Well Depths of all wells on Edwards and Trinity aquifers, and wells closest to *Eurycea* occurrence.

All wells across the Edwards and Trinity aquifers had an average depth of 483.9 meters, but the wells closest to *Eurycea* sites were considerably shallower. Since springs would have a “depth” of zero, this discrepancy is a sign that the wells are relatively close to the collection sites. This is relevant because wells can also be monitored for flow and groundwater quality, characteristics that can also be important for *Eurycea* monitoring and conservation.

Limitations and Conclusions

I found that publicly available data, like the NHD high-resolution flowline dataset and TPWD well data, can supplement existing *Eurycea* occurrence data to better understand species distribution. However, several limitations are present in the data. For example, the *Eurycea* occurrence shapefile contains metadata about the collection sites, but does not differentiate between springs, wells, and caves. Calculations like distance to stream are relevant for springs, but not for wells. Collection data would need to be hand-coded for future analysis. Also, the TPWD well data included several springs, as well as wells that are not currently maintained. Not all wells are accessible. Overall, however, conservation efforts would be supplemented by additional groundwater data, and taking advantage of publicly-available resources is an important first step.