

Final report, GIS in Water resources

Water Quality in the San Marcos Basin

Objectives and location

Objectives

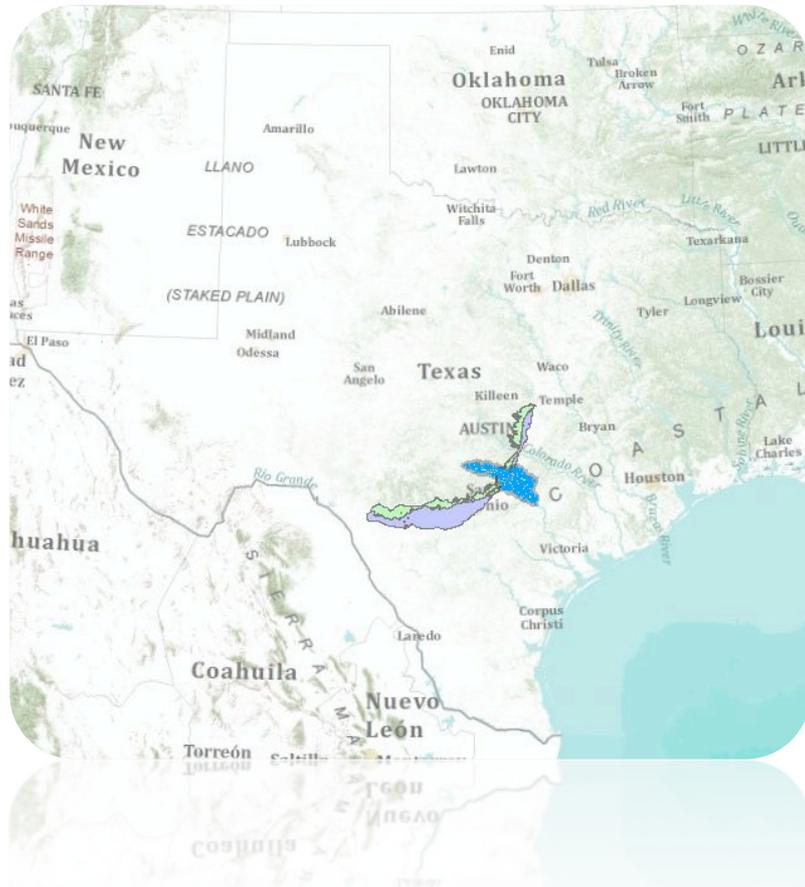
The primary idea is to compare the quality of two different types of water: groundwater and surface water.

I will focus more precisely on the bacteriological quality and the fecal coliform bacteria that are representative of pollution that can endangered human health.

Then I will compare those water qualities to drinking and recreational water requirements.

Location

The study takes place in the San Marcos Basin in Texas. Indeed, there are many rivers and especially the presence of the Edwards aquifer overlaying the basin area.



Here are two representatives pictures of our study: The first one represents a recreational area of the San Marcos river and the second shows a cave of the Edwards aquifer.



Source:

<http://blog.texasrvtravel.com/>

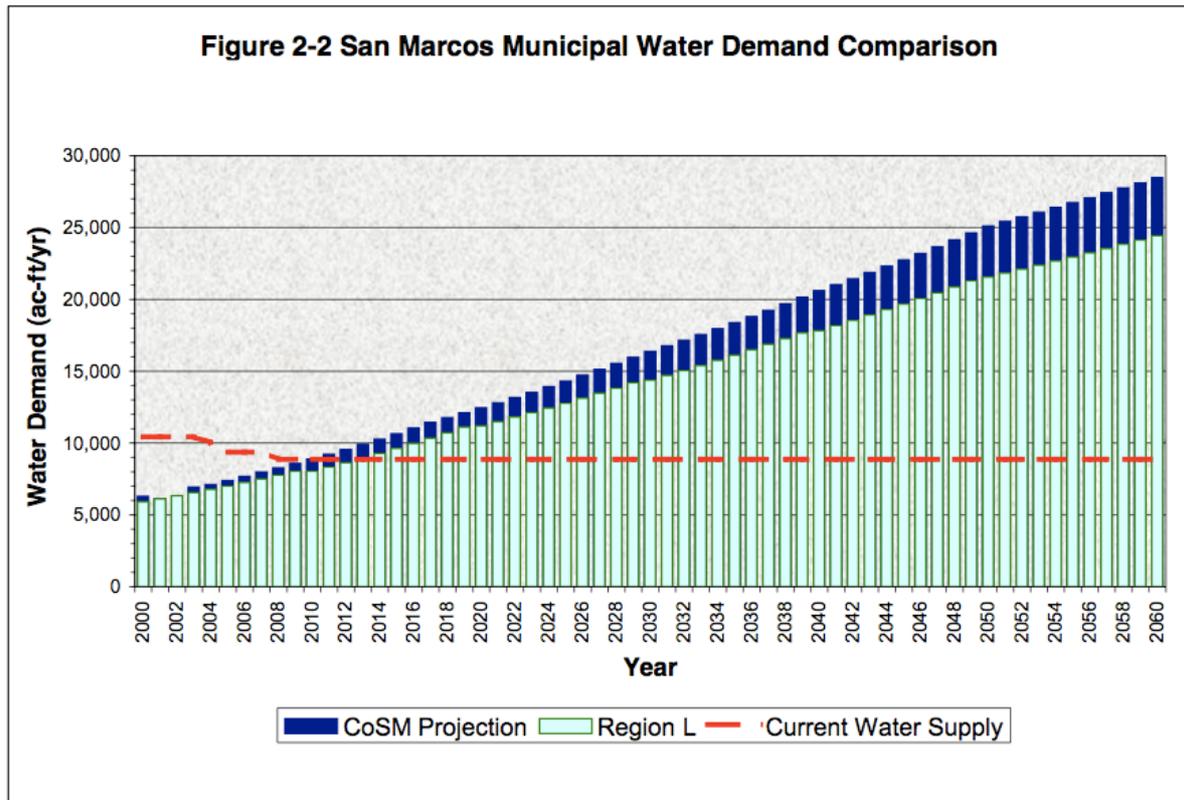
<https://www.acsm meetings.org>



Problematic

More precisely, the study will take place in the city of San Marcos. Indeed, the city has a current issue about its water supply.

Here is a graph extracted from the "Water Supply Master Plan" of the city.



Source: City Of San Marcos Water Supply Master Plan, December 2004

We can see that in the next years, the demand in water is going to increase significantly, but the water supply won't change. Thus, there is going to be a lack of water if the city doesn't find new resources.

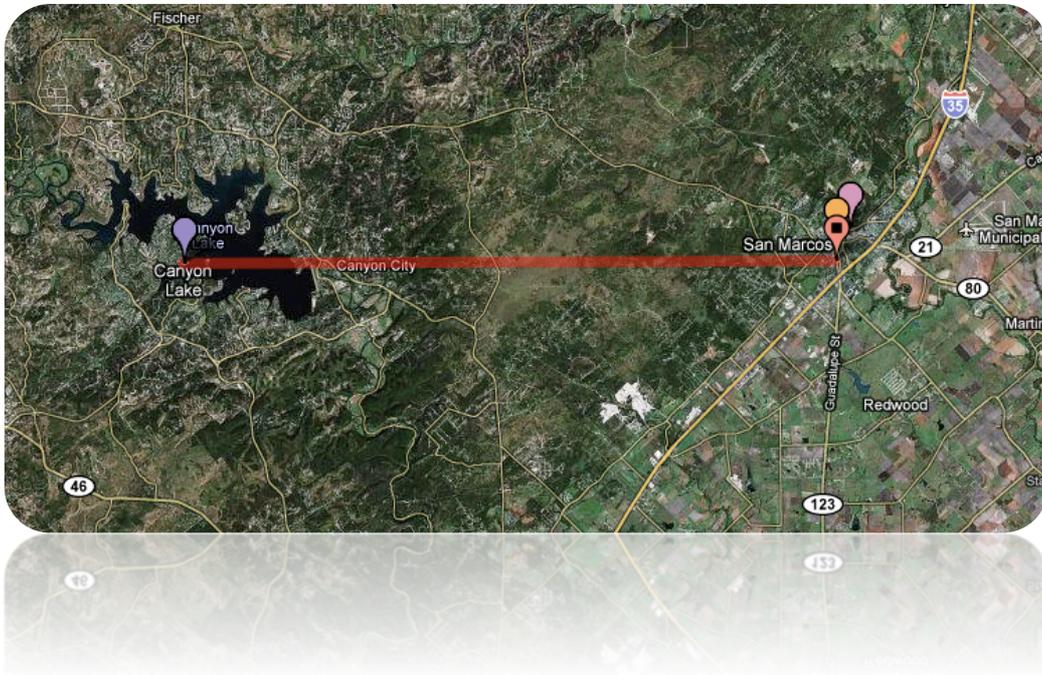
The current resource for the San Marcos city is mainly the Edwards Aquifer. Nevertheless, due to the higher demand in water, the aquifer is threatened and new regulations have been voted to reduce and limit the use of the water.

Then, the city of San Marcos has to find new alternatives.

The potential solutions are:

- Reclaimed water (wastewater reuse) : but this raises the issue of making people agree to reuse this kind of water.

- Surface water
 - Canyon Lake: more costs because the city does not own the right to exploit this water, so it will have to lease those rights and also the water has to be carried to the city which is situated approximatively at 30 km from the lake.



- San Marcos river : the city already owns the right for this water and it is situated only a few kilometers away.
- Other groundwater resources

The option that seems the easiest and the cheapest is the San Marcos River. That is the solution we will develop later in this study.

What would be the difference of quality between the groundwater and the surface water?

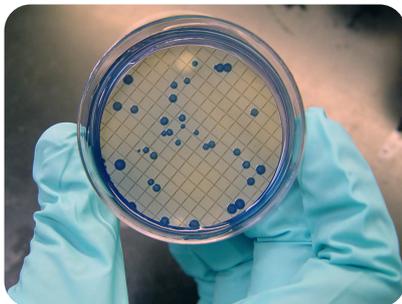
Groundwater quality : the Edwards aquifer

According to its dedicated website : the "Water quality in the Edwards is exceptionally good" (<http://www.edwardsaquifer.net/>)

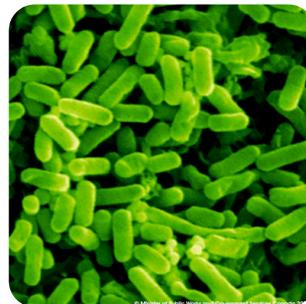
- The level of metals in the water is usually below drinking water standards
- Concerning the ions, they provide a healthy mix

• Bacteriological quality :

As explained previously, the fecal coliform bacteria are indicators of harmful bacteria presence. E.Coli is a species of those bacteria which is easily measurable and representative of pollution.



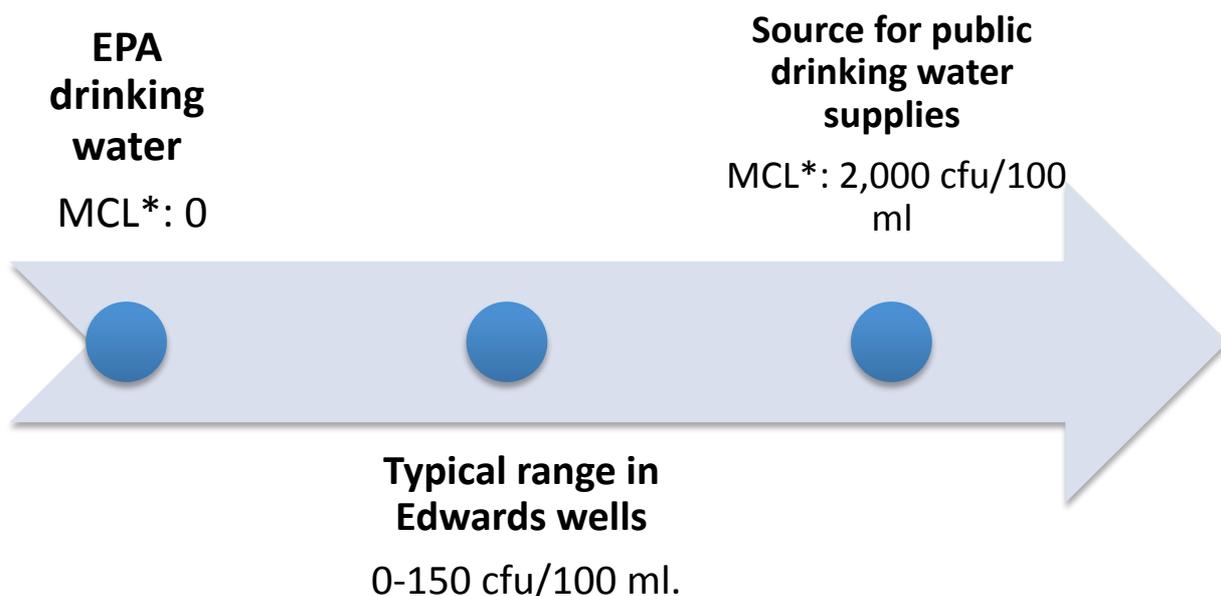
Fecal coliform bacteria



E. Coli

Source: <http://www.ars.usda.gov>

Here is a scale representing the different quality levels in terms of fecal coliform bacteria:



*MCL : Maximum contaminant level

We can see that the water of the aquifer will have to be treated before use but the aquifer is still a good resource for a drinking water plant.

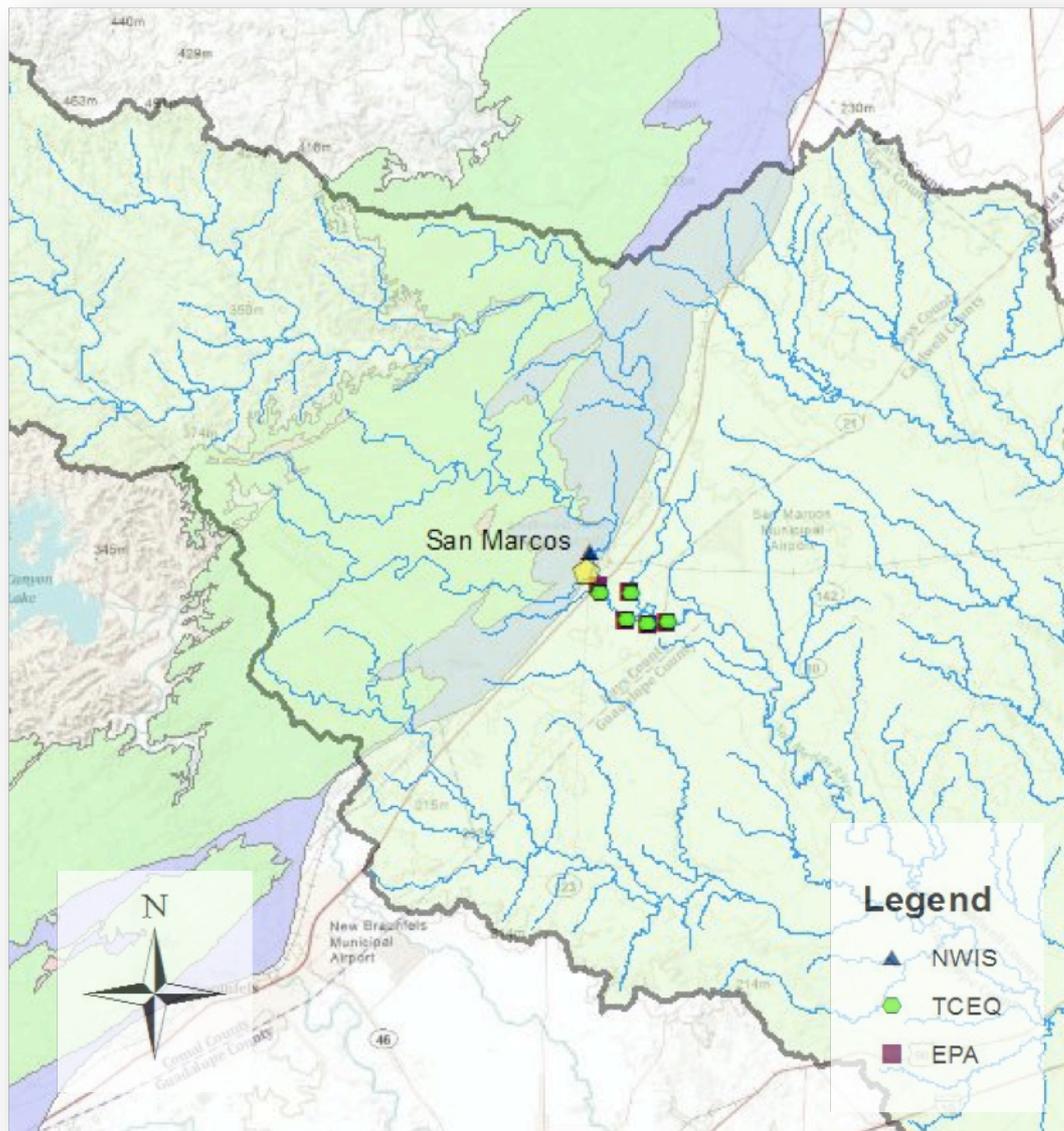
Surface water quality

Let's now analyse the bacteriological quality of the water of the San Marcos river near San Marcos.

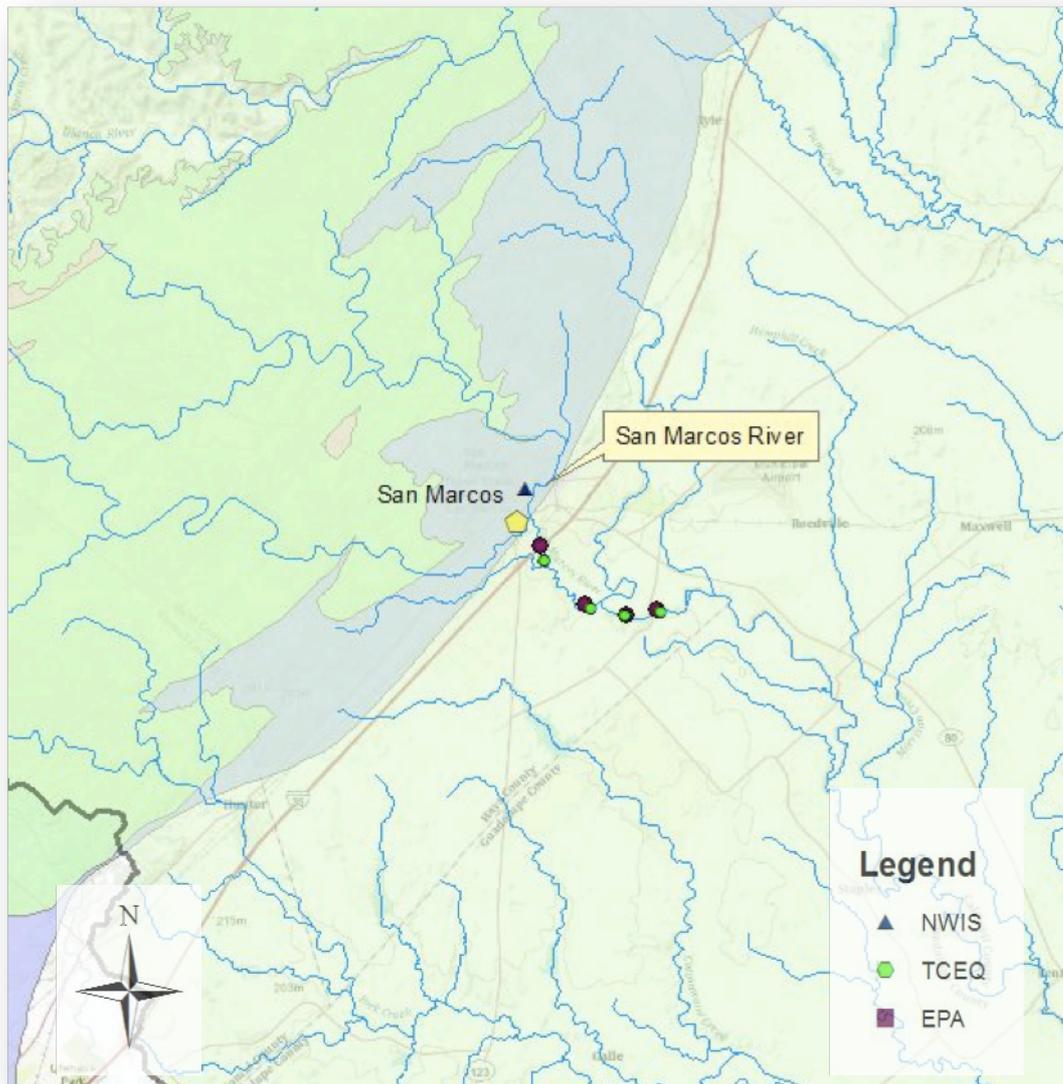
Thanks to Hydrodesktop, I have isolated the San Marcos basin and all the measurements locations that would be interesting for my study.



Then, I have exported those locations to ArcMap using their geographical coordinates and I have selected those only near the city of San Marcos (in yellow) :



Then, I have selected the locations that are only on the San Marcos River :



After this work, I have plotted with Hydrodesktop the amount of E.Coli measured in the River at the different locations for several years.

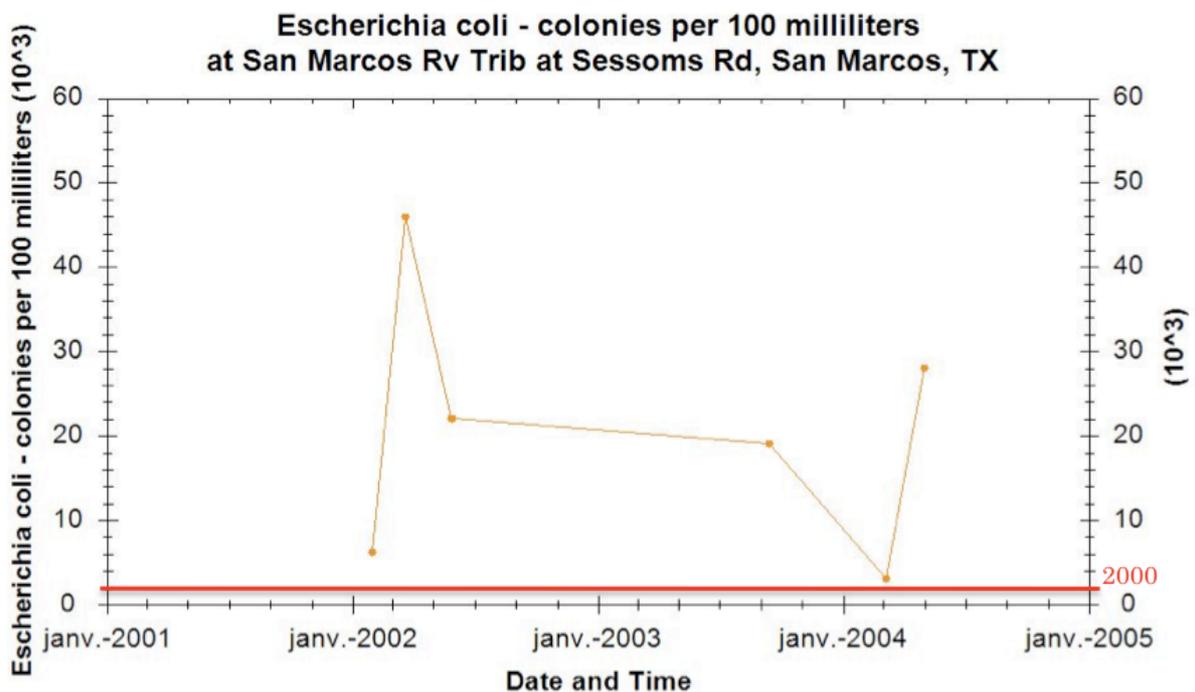
Two references are indicated :

- 126 bacteria or cfu/100 ml : which represents the requirement for recreational water
- 2000 bacteria or cfu/100ml : which represents the requirement for a source of drinking water supplies.

We can see on the two previous graph that most of the points are under the two references. Only a few spikes are in between those two values. It means that the water is a good source for drinking water supplies.

But, it also shows that sometimes the water get contaminated and it is not safe to swim in this river.

NWIS measurements



NWIS measurements show the amount of E.Coli on a shorter period of time. But this is very interesting because we can see that all the values are above the two references. Thus, the water has been polluted for this period of time.

Conclusions

We can say that the San Marcos River is prone to variations. Whereas the Edwards Aquifer has a constant quality of water. Thus, the surface water is a less reliable supply than the groundwater.

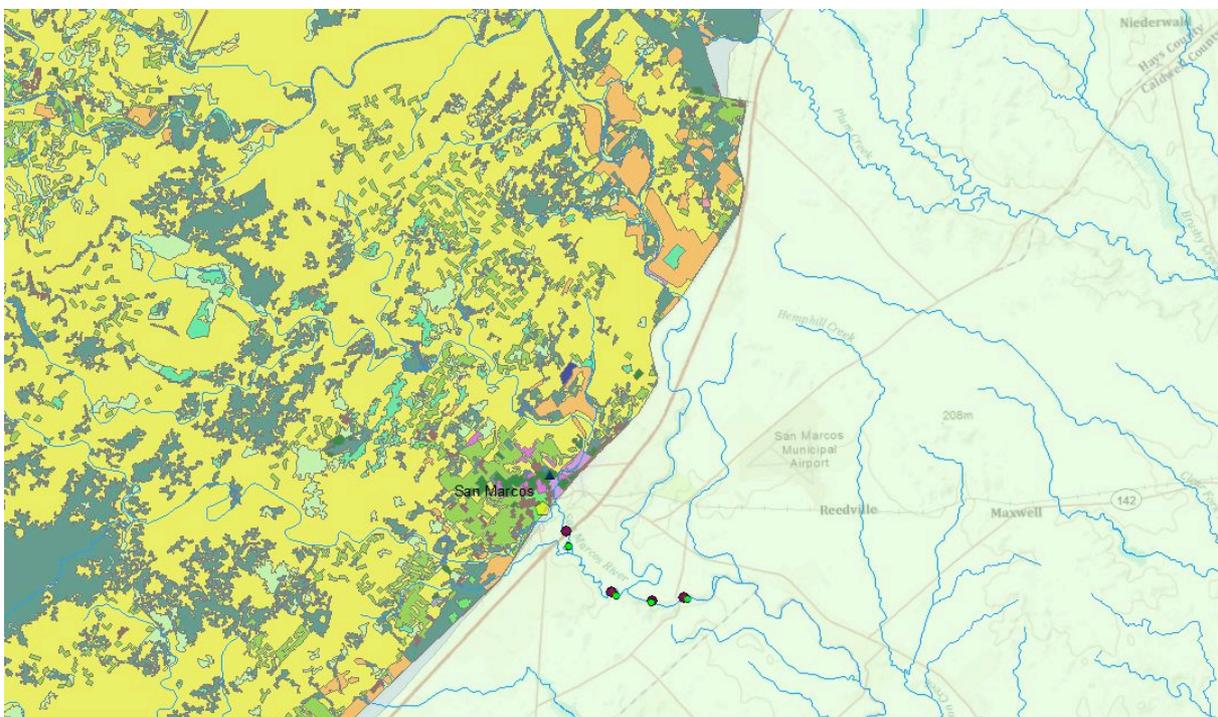
We have shown that the amount of bacteria can exceed drinking water and recreational water requirements. But generally it is still a decent source for public use.

This conclusion has two explanations :

- the Edwards Aquifer provides natural treatments to the water :
 - Dilution
 - Settling
 - Biological activity: neutralize organic material
 - Natural Degradation

- The surface water is sensitive to what happens upstream :

This is a map of the land use above the Edwards Aquifer from TCEQ.



We can see that upstream of our measurement locations there is the city of San Marcos with its industrial and urban activities. That can threaten the surface water quality and could explain some pollution episodes.