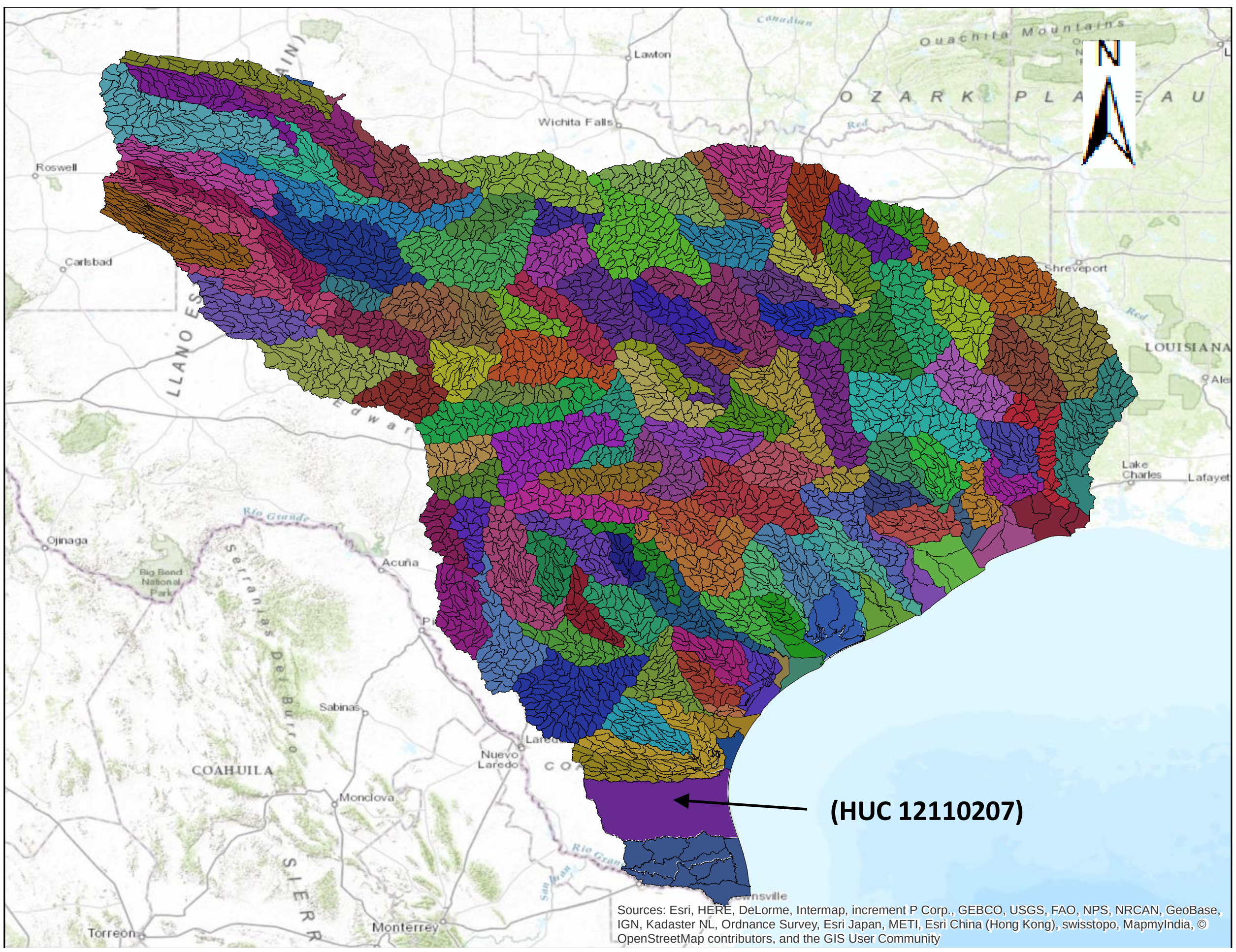
Streams in the Ranching Country of South Texas

Watershed Analysis of HUC 12110207

Sandranell Moerbe
CE GIS in Water Resources Fall 2015

INTRODUCTION

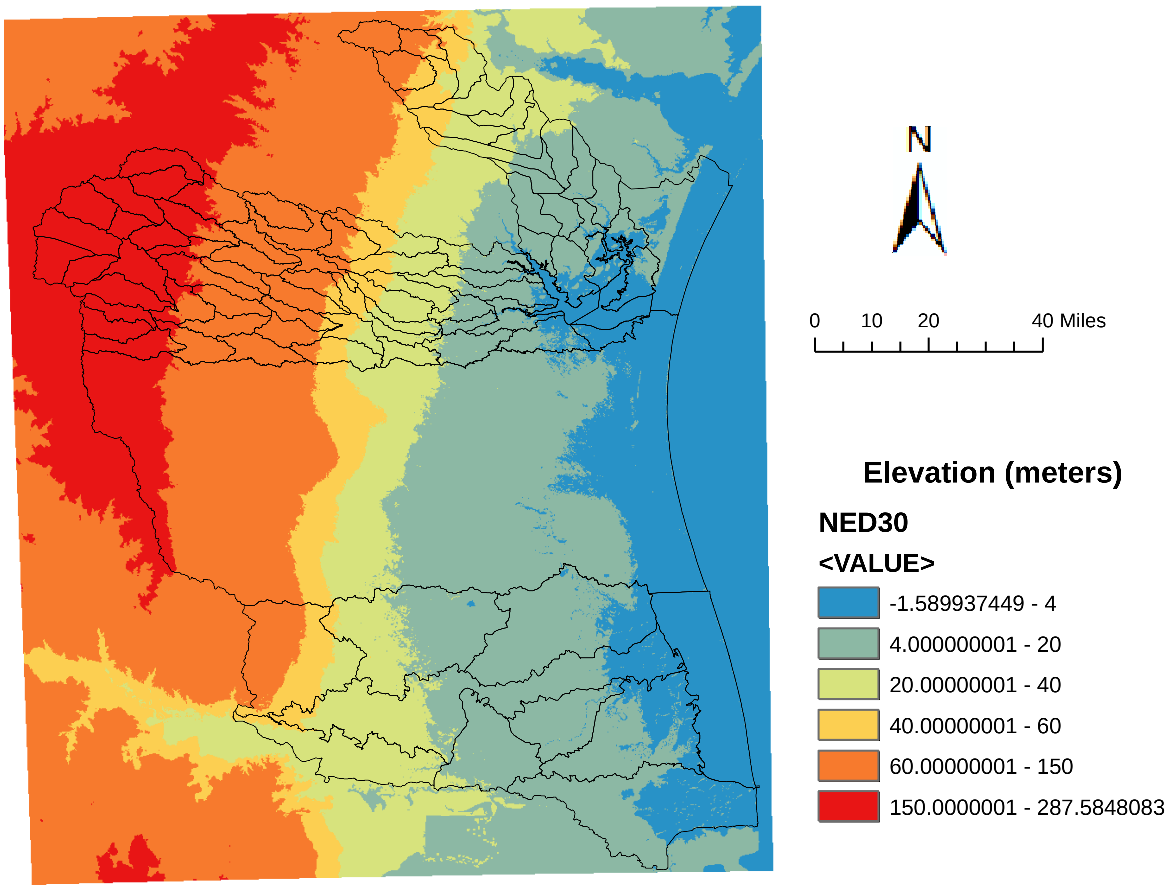
This project investigates the portion of South Texas within Hydrologic Unit Code 12110207. A location map is presented below. This sub-basin is 3567 square miles that is sparsely populated and consists primarily of large ranches. It is unique in that it does not contain any HUC10 watersheds or HUC12 sub-watersheds. The project first compares this HUC8 watershed with those to its north and south in an effort to determine if there is a geographic reason for a lack of streams. No apparent reasons were found, so three methods of watershed delineation were applied to the area to determine possible stream networks. There were some similarities in the stream networks and watershed boundaries created by each model, but there were also many differences that prohibit a conclusive answer as to where the streams actually are.



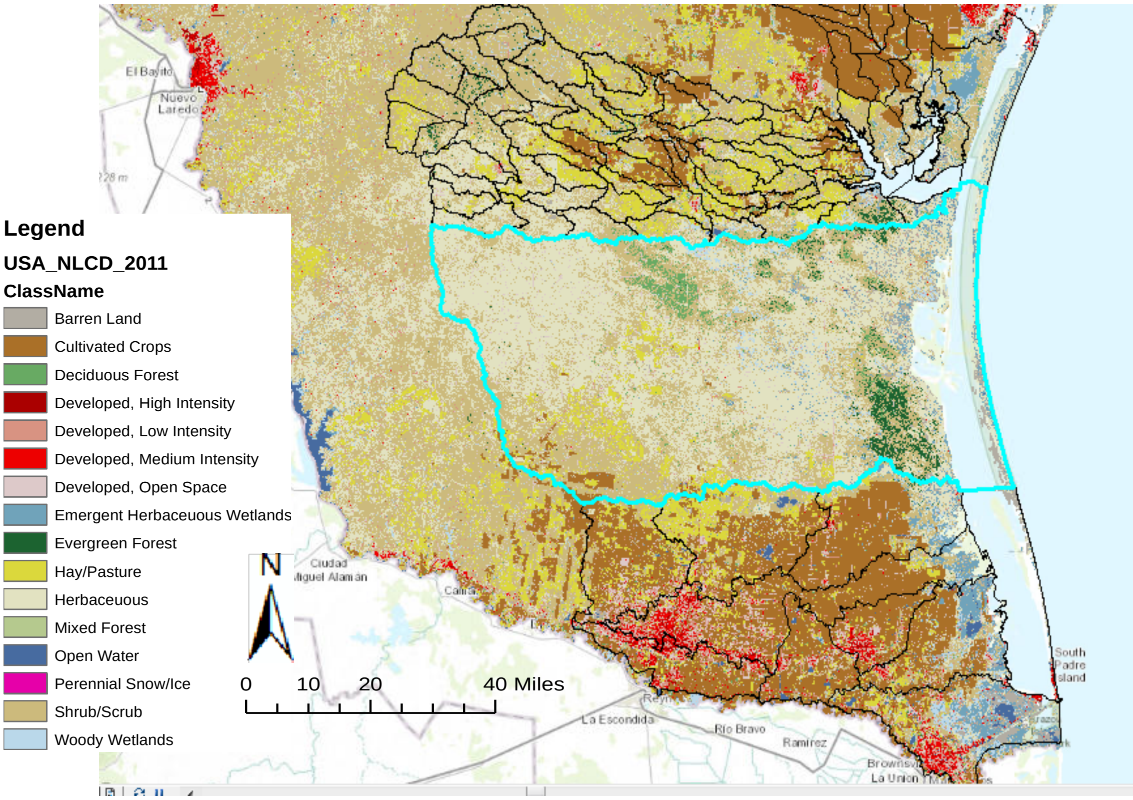
Hydrologic Region 12: Texas-Gulf. HUC 12110207 is the only sub-basin not further divided into watersheds.

PART ONE: GEOGRAPHIC COMPARISON

The National Elevation Data for HUC 12110207 and adjacent HUC 8s was downloaded at a 30 meter resolution and manipulated to show meaningful breaks in elevation. The overall slope in the sub-basin of interest is only 0.1%. Although this is a very minor slope, it is comparable to the surrounding areas. Therefore the relatively flat lay of the land does not fully explain the lack of mapped streams.



The next item analyzed was land cover. If land cover between HUC 12110207 and the surrounding regions differed significantly, it may be part of the reason or give insight into the reason that there are no mapped streams. The National Land Cover Dataset from 2011 was used to compare the regions. The primary land covers in the HUC of interest was Herbaceous at 50% and Shrub/Scrub at 30%. The surrounding areas had significantly greater land devoted to cultivated crops and less herbaceous groundcover. However, these two types of land cover are similar in how they interact with precipitation and stream flows, so land cover should not contribute significantly to the lack of mapped streams.



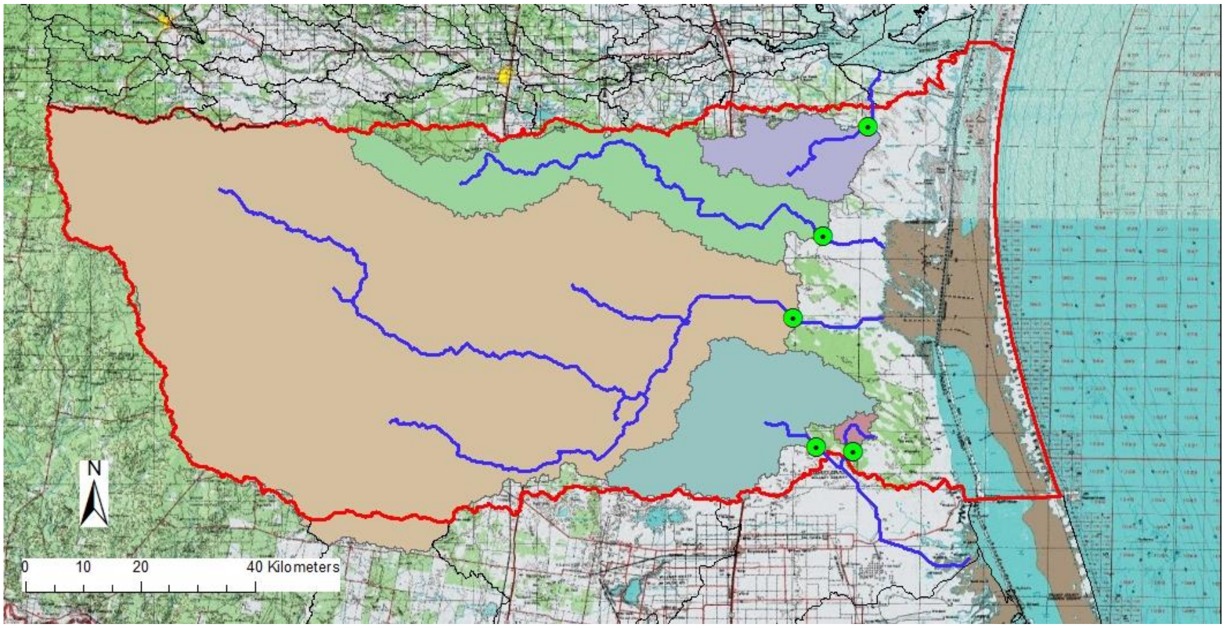
PART TWO: Watershed Delineation and Stream Mapping

With no obvious link between elevation or land use and the lack of mapped streams, I next considered the possibility that there actually are streams and they simply have not been mapped. The next step of the project was to use various methods to map the streams.

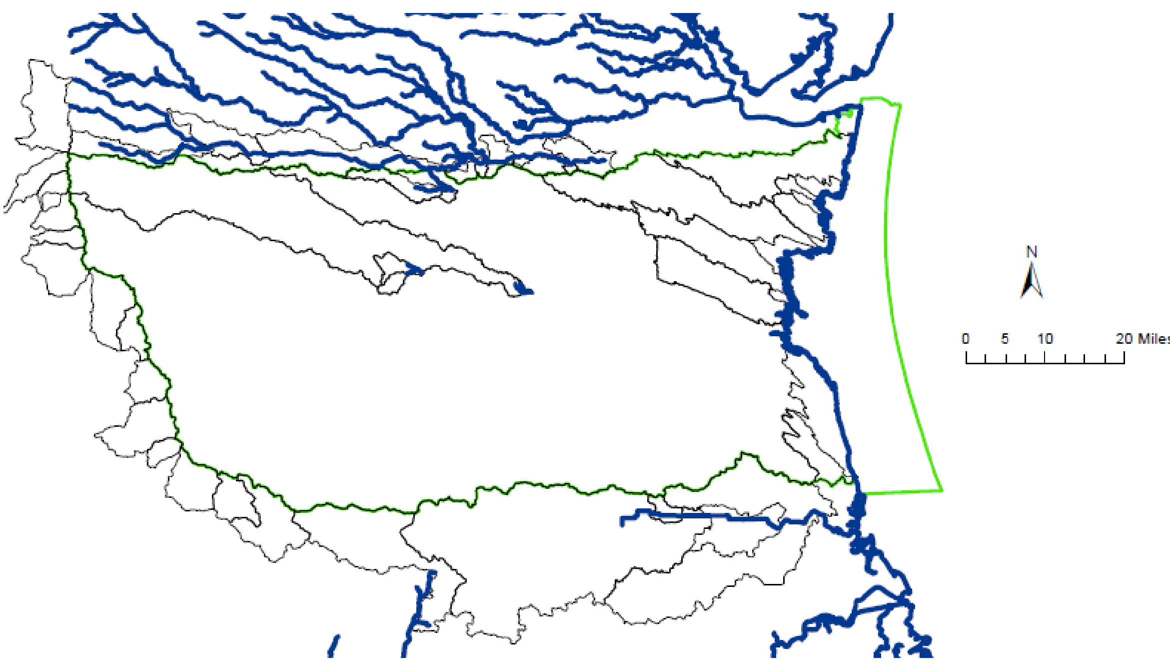
The first method I used was the ESRI ready to use services tools ‘Watershed’ and ‘Trace Downstream’. I used the USA Topo Map as a basemap because it showed small ponds scattered throughout HUC 12110207. I choose points on the west side of five randomly selected ponds, and the ‘Watershed’ tool delineated the watersheds in the map below. The borders of the watersheds were generally consistent with the overall HUC 12110207 border although there are a few areas in which the watershed delineated in this way extend well beyond the boundary of the NFIE HUC 12110207 boundary. I also did not select any points within 20 miles of the coast in order to remain in areas where I expected the streams to be converging instead of spreading out along the coastline.

My next step was to use the ‘Trace’ tool in the ESRI hydrology toolbox to gain an initial idea of the major portions of the stream network. I selected nine points, including at least one in each of the watersheds I had just delineated, as start points. The ‘Trace Downstream’ tool generated the below map of potential stream paths. The traces are not necessarily streams, because this method does not consider flow accumulation or differentiate between sheet flow and stream flow. However, it does provide a general sense for the lay of the land and the converging paths that water travels as it heads toward the coast.

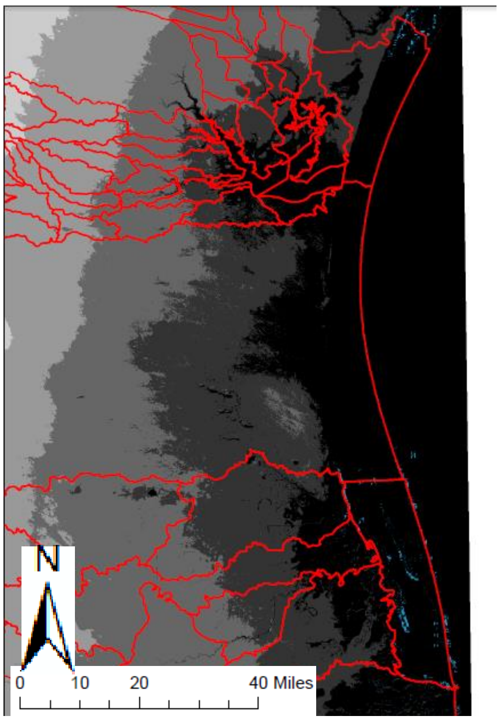
One discrepancy between these traces and the HUC boundaries is that the traces to the northeast and southeast of the basin flow out of HUC 12110207 into other basins prior to entering the coast. One or the other must be incorrect.



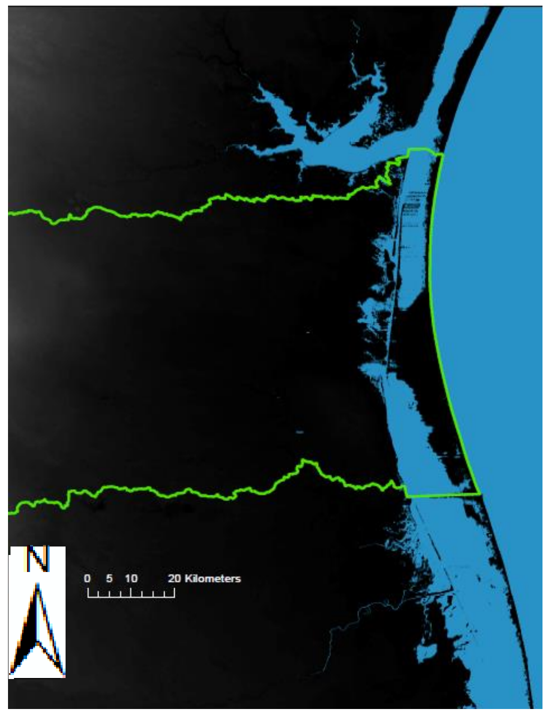
I next downloaded NHDPlusV2 data from http://landscape1.arcgis.com/arcgis to determine if it contained any streams that were not in the NFIE maps. The resulting map is shown below. There are two areas in the interior of the area of interest which have very short stream lengths. For these two areas and several more along the coast, there are watersheds within HUC 12110207. They have the same general northwest to southeast flow as the trace paths created using the previous method. The NHD information matches the NFIE boundary for HUC 12110207 almost exactly except for one area on the north of the basin where the NHD flowline crosses into a different basin.



The final method I used to determine the stream network was DEM analysis using the python code 'DEM2Watershed' written by Cyndi Castro, modified by Dr Tarboton, and used in this course. My first step was to modify the NED30 data I used in Part ONE of the project by setting all negative values of the raster to null. I did this in order to model the edge of the coast as a cliff with constant elevation instead of a sink point. When I placed the new black and white elevation map on top of the original color elevation, it became apparent that the values that were set to null were along east side of Padre Island. I then repeated the process setting all values less than 0.5 meters to null. This resulted in the desired "cliff" along the coast. Maps of both results are below.

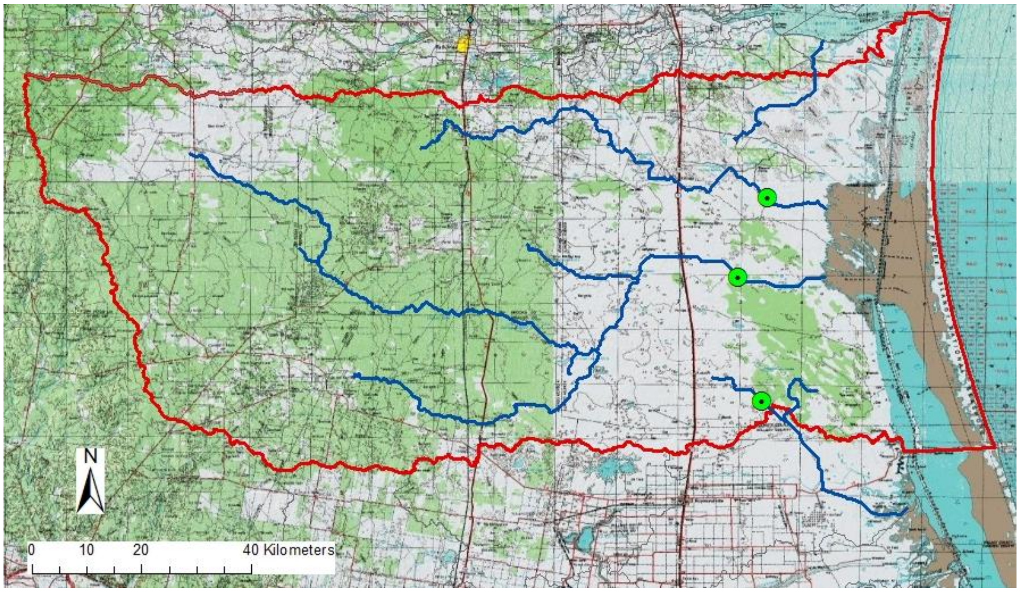


NED30 in gray scale. Values less than zero are set to null and are blue. There are very few values this low along the coast of HUC 12110207 even in the bay. Break points for color variation are the same as on page 2.

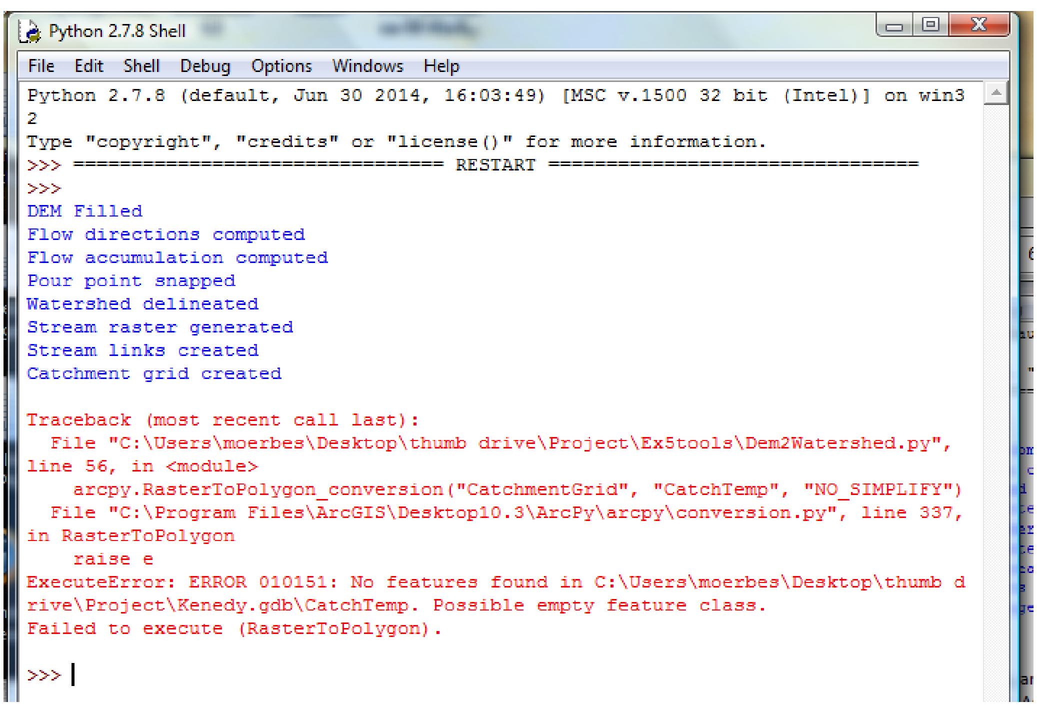


NED30 in gray scale. Values less than 0.5 meters are set to null and are blue. This produced a clear coast line.

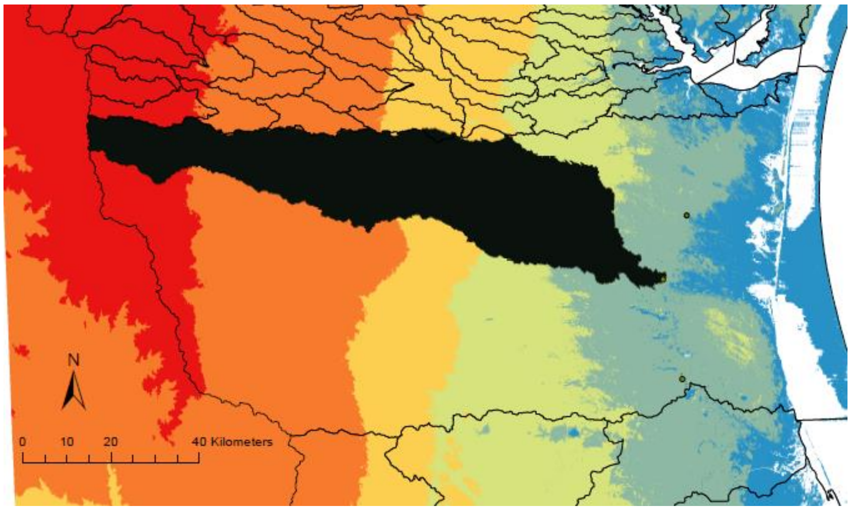
I next determined gage locations by selecting three locations on the trace lines near the coast. The locations are indicated by the green dots on the below map.

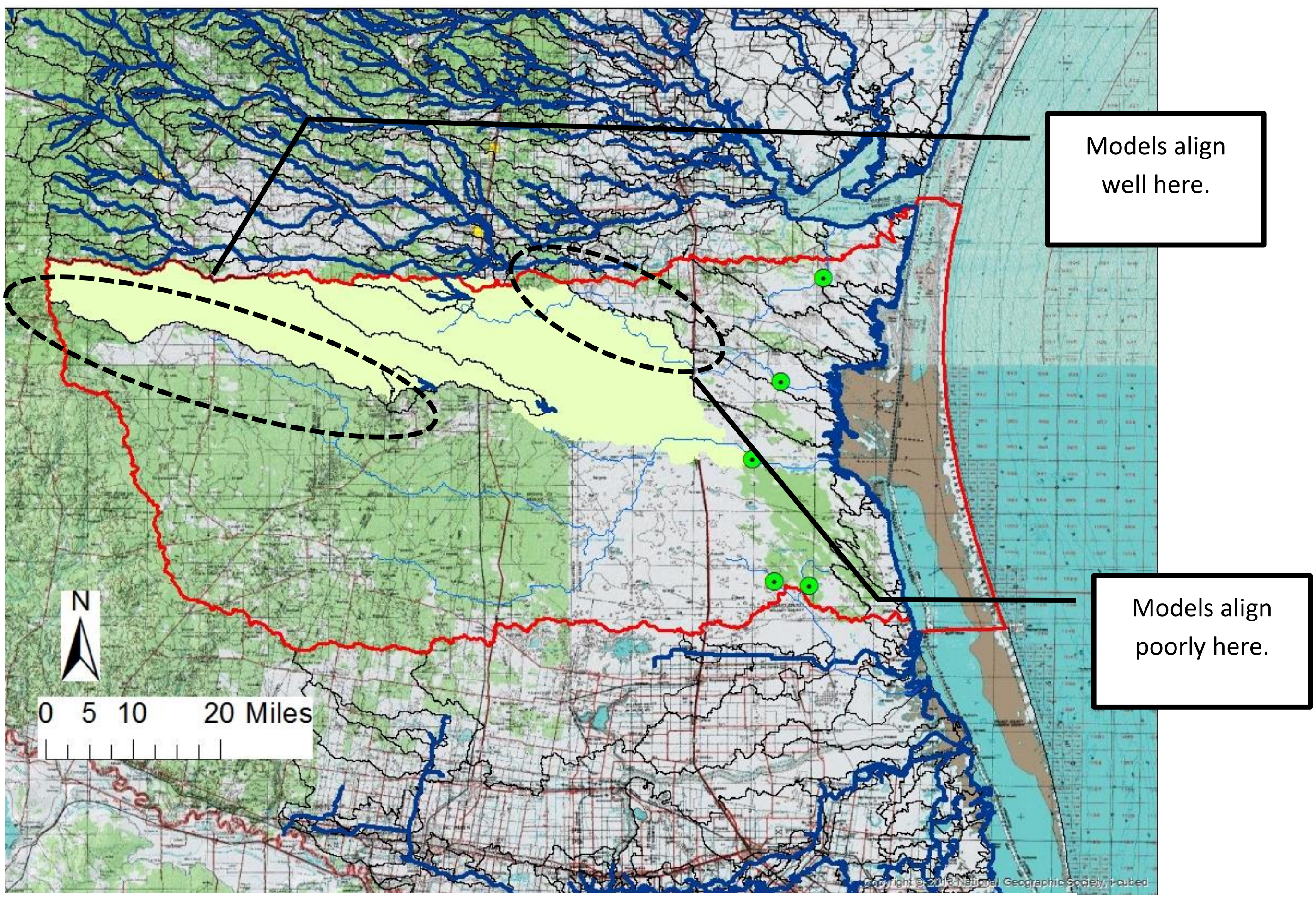


Using the DEM and gage points just described and an accumulation threshold of 10000 I ran the DEM2Watershed python script. However, I received an error which I was unable to resolve. The error detail is provided in the screenshot below. I repeated the process using an accumulation threshold of 500 and received the same error.



Despite the error, the script did produce one catchment which is also shown below. When this catchment is overlaid with that produced by the NHDPlusV2 catchment and the trace lines, it is apparent that there are many similarities and locations were boundaries align very well. However, in other locations there are large variations.



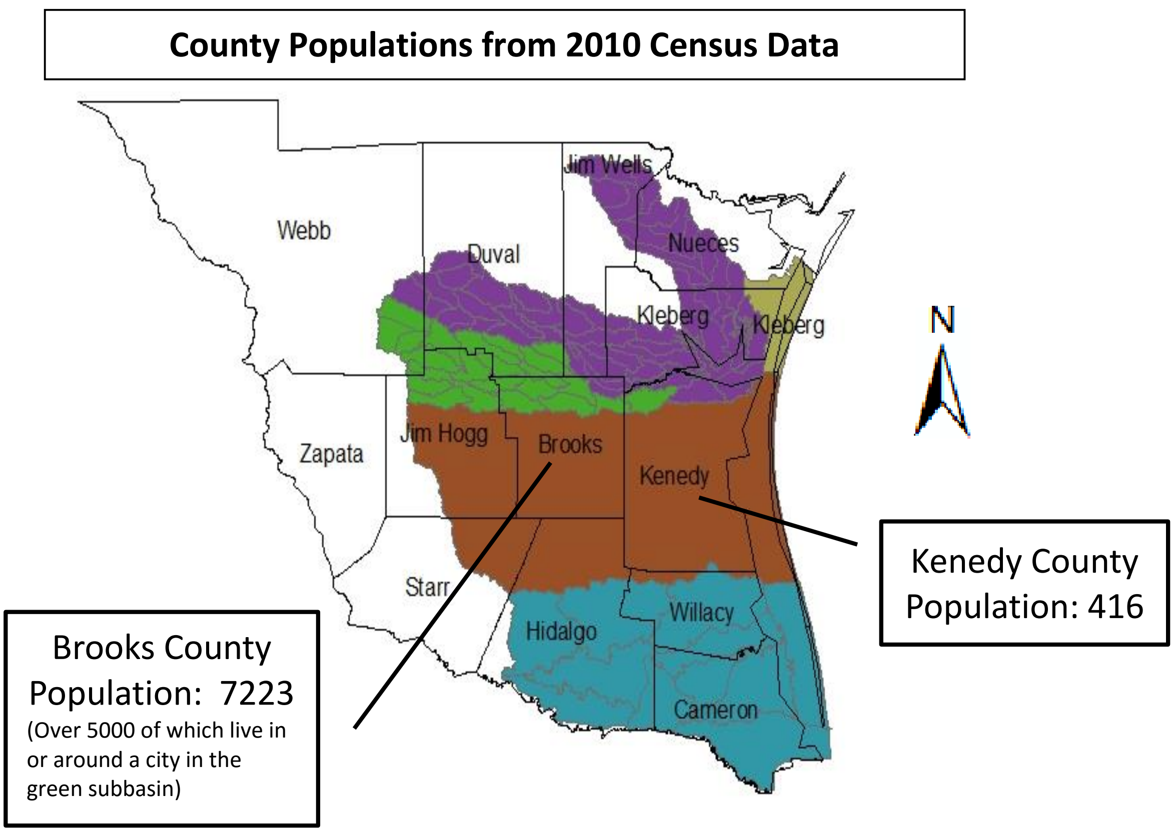


Comparison of methods. The DEM2Watershed python script produced the yellow shaded area as a watershed. The NHDPlusV2 data produced the watersheds outlined in fine blacklines and the flowlines in thick blue. The downstream trace produced the light blue traces.

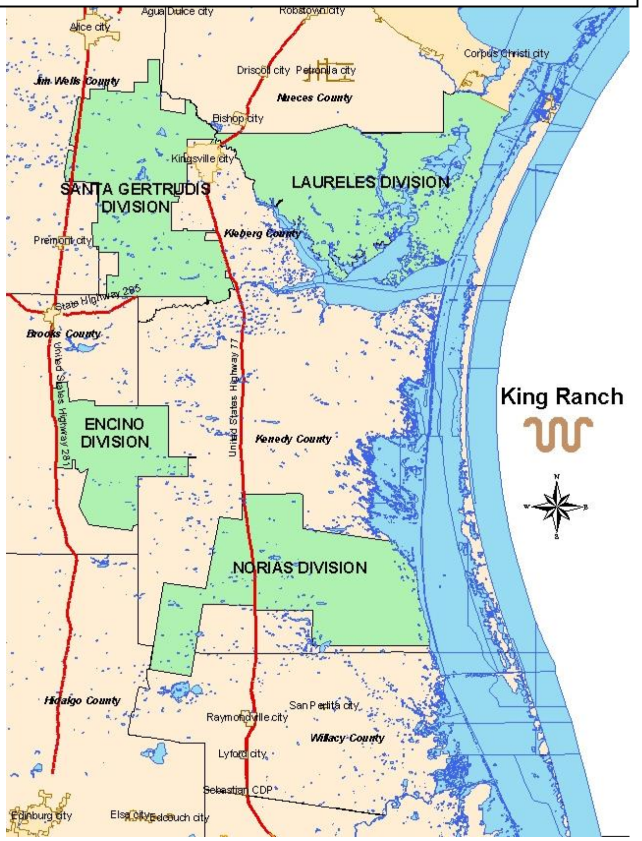
CONCLUSION:

Although none of the models produced detailed, accurate results, they collectively provide some basic information on the area. All three confirm that the HUC 12110207 boundary is fairly accurate. The slight differences in the boundary are likely due to using 30 meter elevation data. If 10 meter or LIDAR data was available, I would expect the boundaries to match more closely. The models also support the idea that there are some areas within this sub-basin that would have stream flow at least following periods of significant rainfall. The streams simply have not been mapped, and a finer resolution DEM is needed to properly model them.

An additional question that this raises is, Why? Why aren't the streams in this sub-basin mapped? One possible reason is the sparse population, and another is the private ranches that may have caused the streams to not be mapped back when USGS surveyors were manually mapping streams. One map depicting each of these conditions is presented below as final thoughts.



King Ranch Land in South Texas



This map was obtained from the King Ranch Website: http://www.king-ranch.com/visit/maps/.

Although it is only available as a pdf, a rough eyeball estimate, reveals that approximately one third of Kenedy County is owned by one ranch.