## GIS in Water Resources: Solution Exercise #2 Prepared by Gonzalo E. Espinoza

1. Make a map of the San Marcos basin with its HUC10 and HUC12 watersheds and subwatersheds. How many HUC10 and HUC12 units exist in the San Marcos Basin?

HUC10 units: 5 HUC12 units: 32



2. Make a map of the soil water storage variation over the San Marcos Basin. Discuss the spatial pattern of soil moisture storage that is shown in your map. Why is it like this? If the area of the basin is 3497.2 square kilometers, what volume of water (km3) could be stored in the top 1m of soil in the San Marcos basin and be available to vegetation?



The river valleys have greater values of water storage than its surroundings due alluvial accumulations. The area South-East has deeper soils than the North-West area; resulting in greater water storage due change in topography (flatter).

 $A = 3,497.2 \ km^2$ 

$$V_{top1m} = (3,497.2 \ km^2)(14.39 \ cm) \left(\frac{1m}{100 \ cm}\right) \left(\frac{1 \ km}{1,000 \ m}\right)$$
$$V_{top1m} = 0.50 \ \ km^3$$

3. Make a map of the five HUC-10 watersheds. Prepare a table that shows for the five watersheds, the watershed Name, the Total Drainage Area at its outlet, and the Incremental Area that results from this Watershed alone. Determine the Mean Annual Flow, Temperature and Precipitation at that location. Compute the Mean Annual Flow per unit of Total Drainage Area in units of mm, and compare that to the Precipitation. Discuss your results.



Name	Total Drainage Area (km <sup>2</sup> )	Incremental Area (km <sup>2</sup> )	Mean Annual Flow (cfs)	Temperature (°C)	Precipitation (mm)	MAF per unit of Drainage Area (mm)
Upper Blanco River	615.91	615.91	68.137	19.289	912.355	98.792
Lower Blanco River	1129.57	513.67	123.757	19.984	930.228	97.838
Upper San Marcos River	1958.83	829.26	311.907	20.121	921.958	142.193
Plum Creek	1007.48	1007.48	152.817	20.276	933.120	135.453
Lower San Marcos River	3520.00	553.70	577.063	20.419	933.361	146.397

The flow per unit area increases as we move downstream, while the precipitation remains the same. This is likely due the springs from the outcrop of the Edwards aquifer.

4. Make a map showing the labeled gages and their attribute table. Zoom into each of your gages, and compare the Drainage Area and the Mean Annual Flow from between the gage values and those given on the NHDPlus. Prepare a table for your six gages which shows these comparisons. Discuss your results. What causes the large discrepancies in flow that you observe at some sites between the gaged values and the NHDPlus values?



OBJECTID *	SiteID	SiteName	Latitude	Longitude	DASqMile	MAFlow
1	08171000	Blanco Rv at Wimberley, Tx	29.994167	-98.088611	355	142
2	08171300	Blanco Rv nr Kyle, Tx	29.979167	-97.909722	412	165
3	08172400	Plum Ck at Lockhart, Tx	29.922778	-97.678889	112	49
4	08173000	Plum Ckinr Luling, Tx	29.699444	-97.603333	309	114
5	08172000	San Marcos Rv at Luling, Tx	29.666111	-97.650556	838	408
6	08170500	San Marcos Rv at San Marcos, Tx	29.888889	-97.933889	48.9	176

SiteName	DASqMile	MAFlow	NHD Area (km2)	NHD Area (mi2)	Area (A) / (D)	NHD flow (cfs)	Flow (B) / (F)
	(A)	<b>(B)</b>	(C)	(D)	(E)	(F)	(G)
Blanco Rv at Wimberley, Tx	355	142	922.07	356.17	99.67%	166.41	85%
Blanco Rv nr Kyle, Tx	412	165	1074.31	414.97	99.28%	164.06	101%
Plum Ck at Lockhart, Tx	112	49	318.03	122.85	91.17%	56.82	86%
Plum Ck nr Luling, Tx	309	114	808.35	312.24	98.96%	139.62	82%
San Marcos Rv at Luling, Tx	838	408	2189.72	845.82	99.08%	451.87	90%
San Marcos Rv at San Marcos, Tx	48.9	176	129.09	49.86	98.07%	21.51	818%

Column E gives the percent ratio between the stations drainage area and the NHD drainage area. The latter is slightly larger because it is measured at the end of the stream and not exactly at the station location.

Column G gives the percent ratio between the stations streamflow and the NHD flow. In most of the cases, the latter is greater than former due larger contributing area, with the exception of the station at San Marcos Rv at San Marcos Tx. The excess of flow recorded is from springs which are not part of the NHD calculations.