CVEN 4333, Spring 2010, Assignment #7, Due Friday March 5 at 5:00 in Cameron Bracken's mailbox. No late papers accepted.

Please include the R script you create with this assignment.

1. Book problem 7.1
2. Book problem 7.3
3. Book problem 7.6
4. Book problem 7.11
5. Below are three figures pertaining to the hydrology of Boulder creek. First look at the overall picture of water in the west (Figure 1)
   (a) Briefly describe the state of snowpack in the west, particulalry in Colorado. What implications does this have for spring runoff and streamflow?
   (b) How many snotel sites are there across the west? Discuss the implications of this
   (c) What are snotel sites? - do a search
   (d) compare the Boulder creek map of snotel sites. How many do we rely on the assess our water supply? What are the implications of this?
   (e) Now look at the map of stream flowguages. Why are there more of these? Does it look well covered?
   (f) How big in sq kilometers is the drainage area into Boulder creek? Look it up or estimate.
6. Random numbers have important applications in hydrology. Many hydrologic parameters are typically have randomness associated with them. Assume that we know a hydrologic parameter p is distributed normally with a mean 0 and standard deviation 1 (a standard normal variate). In R we can simulate standard normal random numbers with the `rnorm()` function.
   (a) Generate a data frame with 50 columns containing 5 simulations of p. Plot each simulation as a boxplot with a horizontal line representing the population mean (at zero). Try it a few times on your own to convince yourself that the simulations will change each time.

   ```
   x <- as.data.frame(matrix(rnorm(50*5),ncol=50))
   names(x) <- 1:50
   boxplot(x,cex=.5,ylim=c(-3,3))
   ```

   Explain the high degree of variability.

(b) Repeat part (a) with 50 and with 500 samples in each column. Explain the difference between these plots.

(c) Along these same lines create histograms of sample sizes 5, 50, 500 and 5000. Plot all four in one figure using the layout command. Superimpose the theoretical normal distribution on top of these histograms. Explain what you observe. Here is an example:

```
x <- seq(-3,3,,1000)
p.theory <- dnorm(x)
p.sample <- rnorm(25)
hist(p.sample,freq=F,xlim=c(-3,3))
lines(x,p.theory)
```

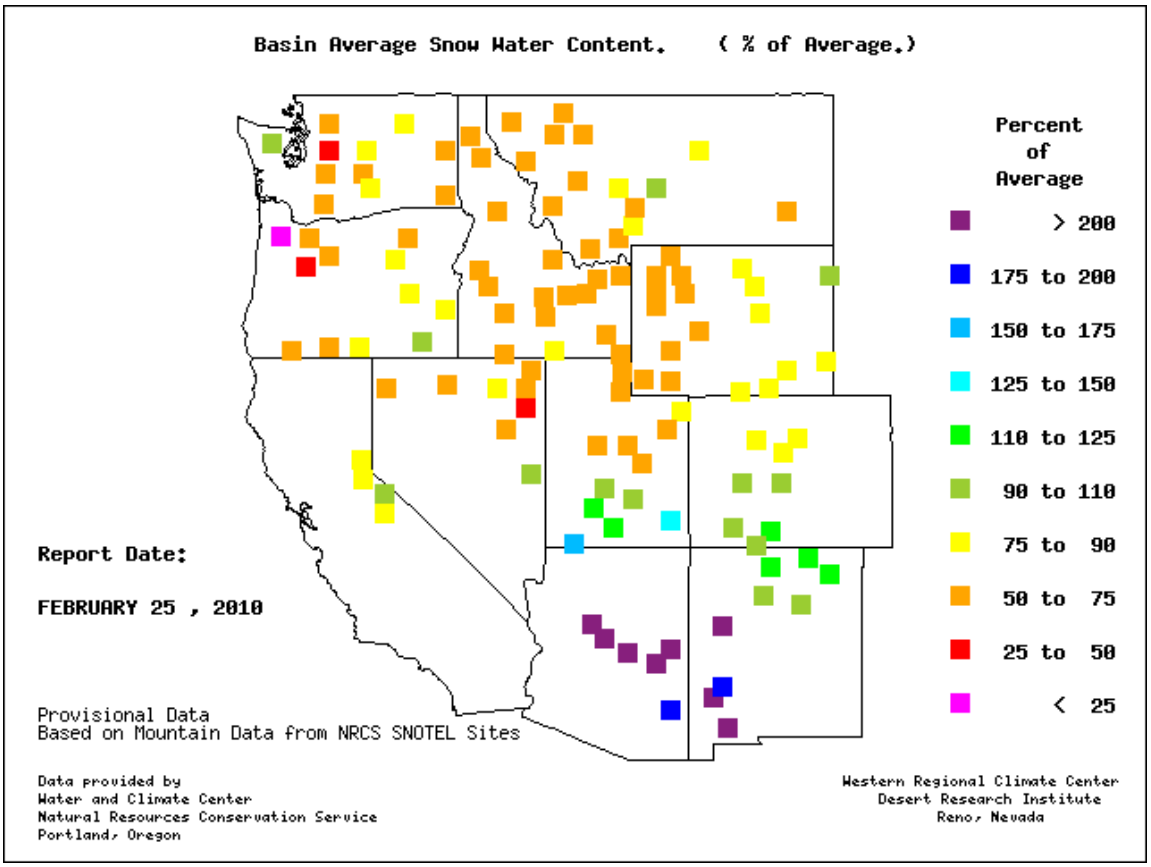

Figure 1: SNOTEL - River Basin Snow Water Content. (source: http://www.wrcc.dri.edu/snotelanom/basinswe.html)

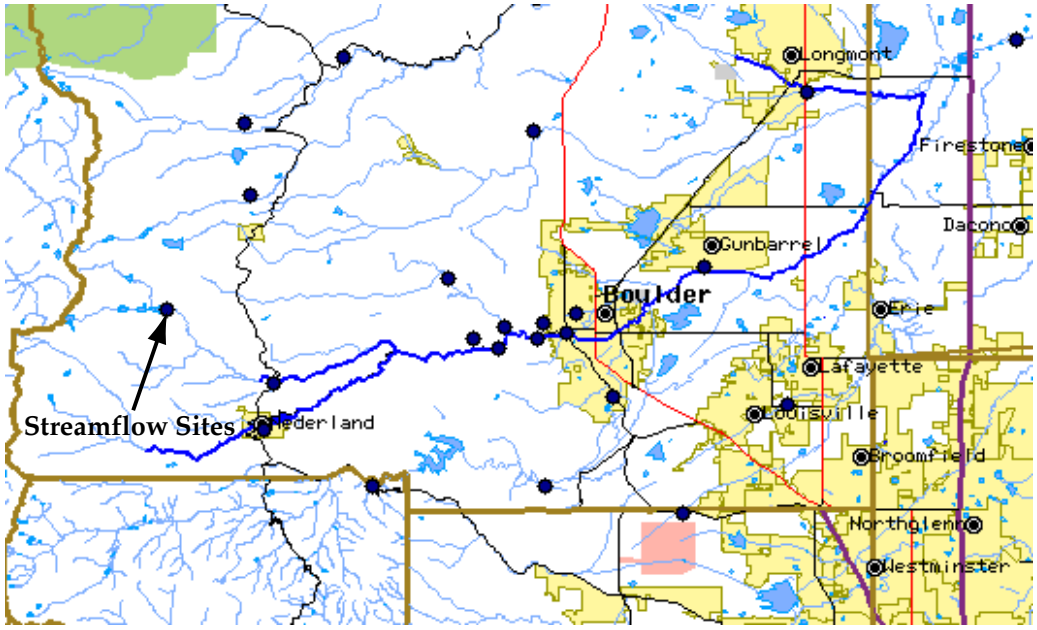

Figure 2: Boulder Creek Watershed Stream Flow Monitoring Sites (source: http://bcn.boulder.co.us/basin/data/STREAMFLOW/STREAMFLOW.html)

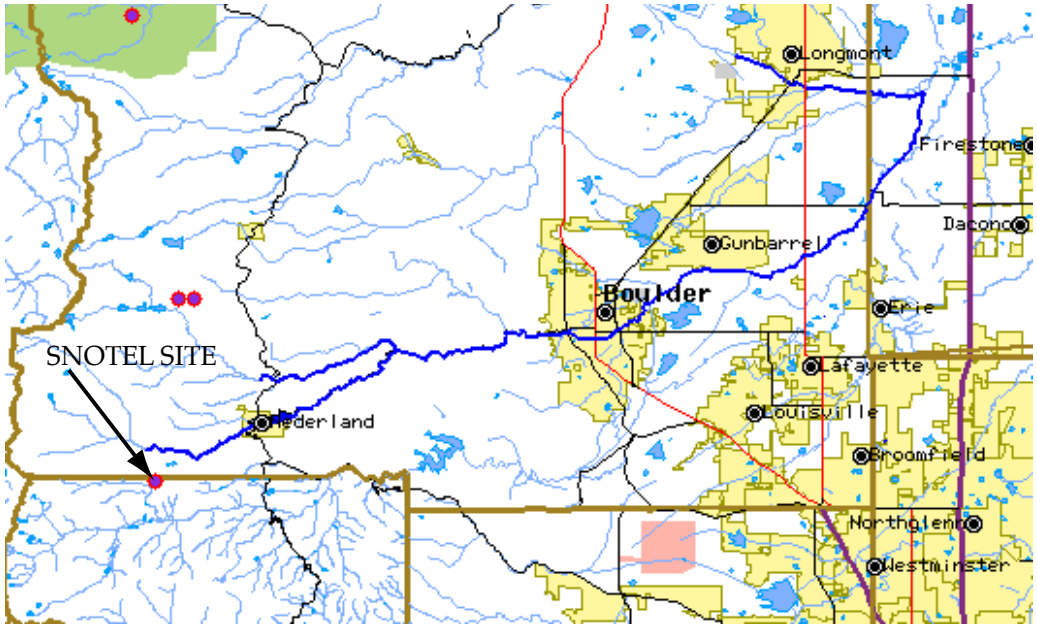

Figure 3: Boulder Creek Watershed Snowtel Snow Pack Monitoring (source: http://bcn.boulder.co.us/basin/data/SNOTEL/SNOTEL.html)