Questions about the "Approach" for the "Climate Change" portion (mostly) of CRWAS:

1) According to pages 2-20 & 2-21, CWCB directed the CRWAS technical team to coordinate its approach as much as possible with a concurrent Joint Front Range Climate Change Vulnerability Study (FRCCVS), to provide consistency between the two studies. The Front Range utilities had already selected the 2040 and 2070 time frames for the FRCCVS, with each time frame to "be characterized by average conditions over the periods 2025-2054 and 2055-2084 respectively." Why did they want those time frames? SWSI collected information for projections out to 2030, and the state's population projection goes out to 2050; wouldn't it have been more coherent all around to have used 2030 and 2050? Providing a rationale (not available yet at the CRCCVS site) for 2040 and 2070 would be helpful.
(FRCCVS website: http://cwcb.state.co.us/Home/ClimateChange/JointFRCCVulnerabilityStudy/)

2) The FRCCVS website says that study will be based on the historical period from 1950-1999. Why is the FRCCVS using 1950-1999 for its historical period while the CRWAS is using 1950-2005? That seems inconsistent with the desire for consistency between the two studies.

3) Understanding that it is necessary to distinguish between "climate" (the driver of weather) and "weather" (the local or regional consequences of climate behavior), why does CRWAS not have a section on what is likely to be happening with the climate over the Pacific Ocean, from whence almost all of the Colorado River region weather comes? Is the Southern Oscillation likely to produce more or fewer El Niños? La Niñas? What will warming in oceans and atmosphere do to the jet streams that have powerful impacts on weather in the Southern Rockies? To the atmospheric conditions that create the sub-tropical deserts?

4) Is it accurate to say that the "downscaling" discussed on pages 2-19 and 2-22 is to incorporate weather data rather than climate? How is this downscaling done? CRWAS does not tell about the process. On pg 2-19 the study talks about going from a grid of 40,000 sq. mi. to something in the range of "several hundred to a thousand" sq. mi. To accurately represent the climate/weather in just the Upper Gunnison Basin (above Blue Mesa), for example, changes from a high desert climate with less than 11 inches of precipitation to a mountain climate with precipitation water content more than twice that (24-30 inches/year) – all within a 1600 sq-mile area. How does the downscaling take that variety into account?

5) A related question: there is occasional mention of "grid cells," but there is no map showing the grid and the cells. How big are the cells? And are they just squares laid over a map, or are they conformed to altitudes demarking different precipitation zones? (E.g., the Upper Gunnison above and below ~8,000 feet)

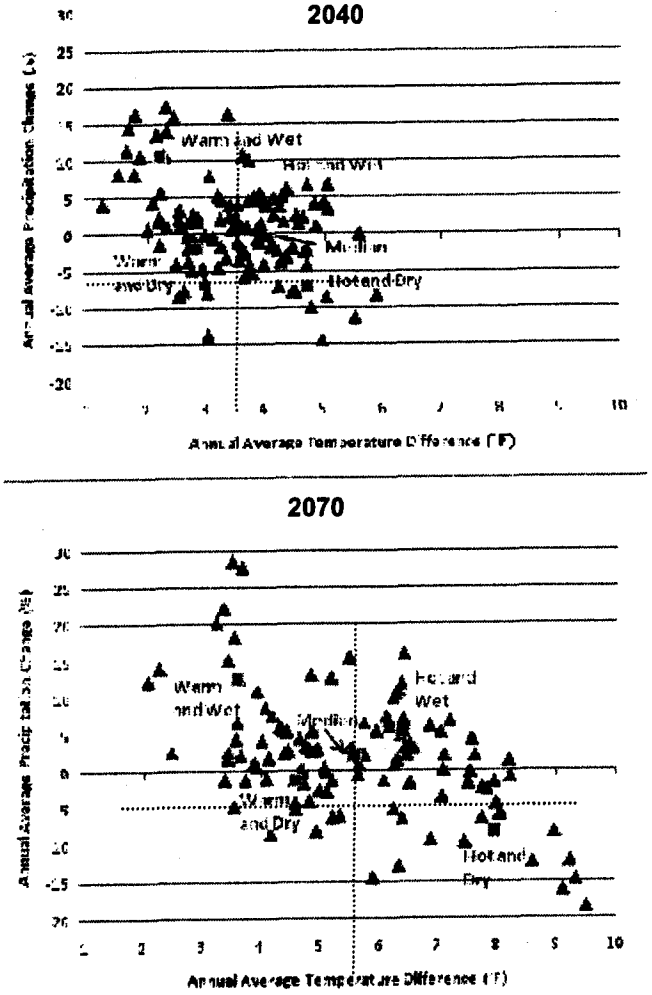
6) In the "Selection of Projections" section, do the five selected projections really cover the desired range of "Qualitative Scenarios" in Table 2-3 on page 2-23? The median is ~10 percentile above the 50th percentile desired. There is nothing below about the 20th percentile, presumably missing the "Hot and Dry" scenario entirely. The "Wet" end of the scenarios, on the other hand, seems to be well represented with two projections at the 80th percentile and above. Could this slant the study toward projections of more water availability than a more accurate set of projections would indicate?
Would the final range of estimates of potential water available for the future (0-1 maf) have been less, had the "driest" selected projection been at, say, the 8th percentile instead of the 18th (balancing the "wet" one at the 92nd percentile)? Or if the wettest and driest had both been ~20 points removed from the extremes (rather than 8 from the wettest and 18 from the driest extremes)?
Why weren't other projections picked from the scattergram (Figure 2-9) that would have given something closer to the desired "Qualitative Scenarios"?

7) On page 2-22, the selection of "Emissions Scenarios" is very briefly discussed, concluding that "only the B1, A1B (a member of the A1 family) and A2 scenarios" will be used because they "have been used as the basis for projections on many GCMs." Was the CRWAS technical team satisfied that those three scenarios "fit" the Colorado River Basin in Colorado - as satisfied, say, as the FRCCVS techs were that they fit the Front Range? Looking at the SRES Scenarios described in CRWAS as 'low' (B1), 'medium' (A1B), and 'high' (A2), what rationale was used to decide which ones to pair with the "Qualitative Scenarios" (e.g., "Warm and Wet" paired with the "A2 – High Emissions" scenario)?
("Special Report on Emissions Scenarios": http://www.grida.no/publications/other/ipcc_sr/?src=/climate/ipcc/emission/)

8) In the "Findings" section, in Tables 3-2 and 3-3, the "Average Winter and Spring-Summer Precipitation" tables, why are the "Higher" locations so relatively low in their basins?
The "Gunnison 3SW" station, for example, is only at 7640 feet, basically still in the Upper Gunnison's high desert sector. The precipitation in the Upper Gunnison mainly falls above 8,000 feet. – and there are weather stations at that altitude and higher. Only the "Grand Lake 6SSW" station in the study is above 8,000 feet – and it has the highest average projection of percentage over historical winter precipitation.

- Prepared for Gunnison Basin Roundtable, May 3, 2010

1: Figure 2-9 (p. 2-24) – Annual Temperature and Precipitation Changes for 112 individual GCMs with Idealized Qualitative Scenarios as compared to **1950-1999** annual averages (Woodbury, et al., 2010)



2: Table 2-3 (p.2-23) – Characteristic Temperature for Qualitative Future Climate Scenarios...

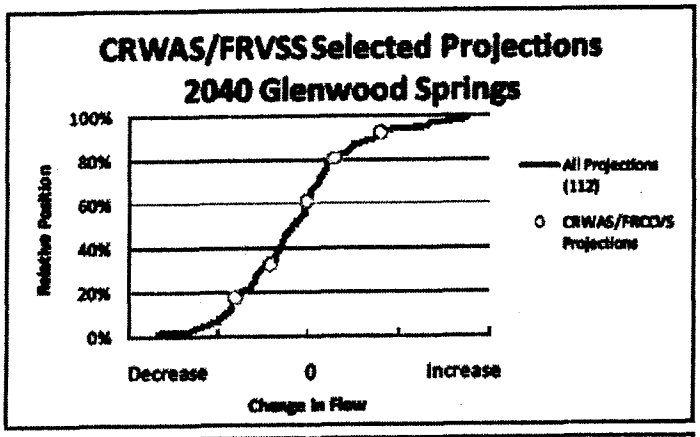
Qualitative Scenario	Characteristic Temperature	Characteristic Precipitation
Hot and Dry	90th Percentile	10th Percentile
Hot and Wet	70th Percentile	70th Percentile
Warm and Dry	30th Percentile	30th Percentile
Warm and Wet	10th Percentile	90th Percentile
Median	50th Percentile	50th Percentile

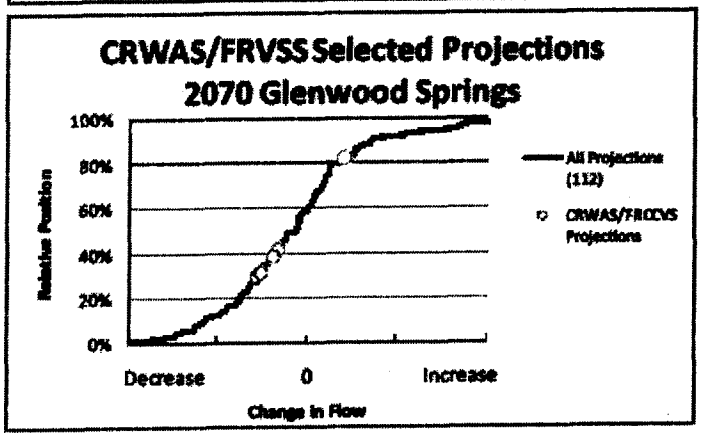
...used to come up with 5 scenarios that could be run on Global Climate Models with selected Emissions Scenarios, for the study points in the C.R. basins.

Table 2-4 – Selected Projections

Qualitative Scenario	Time Frame	SRES Scenario	Model	Version	Run
Warm & Wet	2040	A2	ncar_pcm	1	3
Warm & Dry	2040	A2	mri_cgcm	2.3.2a	1
Median	2040	B1	cccma_cgcm	3.1	2
Hot & Wet	2040	A1B	ncar_ccsm	3.0	2
Hot & Dry	2040	A2	miroc	3.2_medres	1
Warm & Wet	2070	A2	ncar_pcm	1	3
Warm & Dry	2070	A1B	mri_cgcm	2.3.2a	4
Median	2070	B1	mpi_echam	5	1
Hot & Wet	2070	A1B	ncar_ccsm	3.0	2
Hot & Dry	2070	A1B	gfdl_cm	2.0	1

3: Did they come up with a good set of projections?
In Figures 2-11 and 2-12 below (p. 2-27), the S-curve is a plot of all 112 dots on the scattergrams (Item 1) arranged in order from largest *decrease* in flow (C.R. @ Glenwood Spring) to the largest *increase* in flow as projected by the 112 runs of the GCMs. The yellow dots show the relative placement of the projections selected for the qualitiative scenarios (Item 2).





Because the 5 projections selected for 2070 were poorly distributed, the technical teams decided to use the 5 selected for 2040 for 2070 too, as shown in Fig. 2-13 (p. 2-28) below, and did the GCM runs that are portrayed in the "Findings" chapter and Appendices.