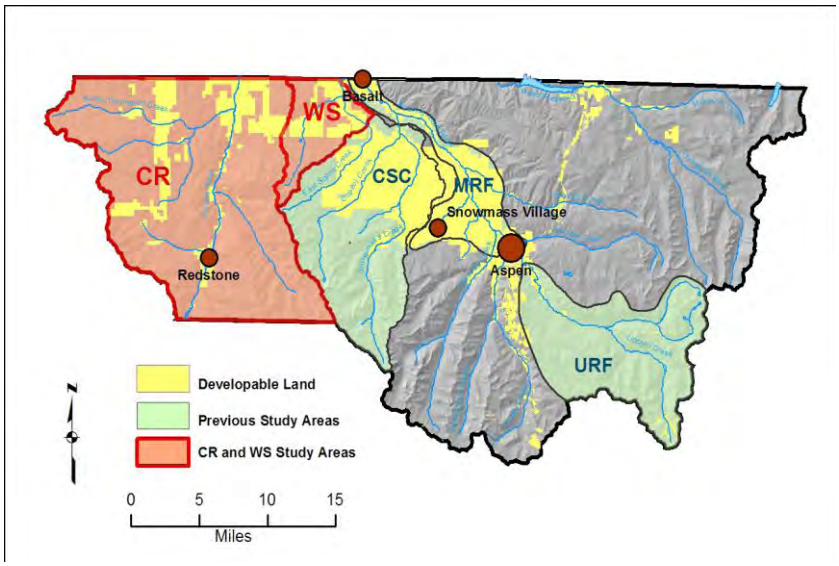
CRYSTAL RIVER & WEST SOPRIS CREEK AREAS

Background: In 2008, Hydrologic Systems Analysis, LLC completed a ground water resources evaluation of the non-Federal lands in the Crystal River and West Sopris Creek watersheds, the lower section of the East Sopris Creek watershed, and the Sopris Creek watershed below the confluence of East and West Sopris Creeks.[1] This study area is depicted below:



Location of the Crystal River (CR) and West Sopris Creek (WS) Study Areas (the "CRWS Study Area") and Other Study Areas Evaluated for Pitkin County

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The ground water resources evaluation completed for Pitkin County provides *only a general overview* of the factors influencing ground water availability, sustainability, and vulnerability to contamination in the CRWS Study Area; it does not provide site-specific evaluations for every individual parcel of land.

What Are the Key Factors Affecting the Ground Water Supply In the CRWS Study Area?

1. Hydrogeology:

- **Crystal River Area:** The hydrogeological system in the Crystal River watershed is very complex – with areas of bedrock and unconsolidated material (e.g., glacial gravel deposits, alluvial deposits). Depending upon its composition (e.g., the amount of clay present), the

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[1] The GIS-Based Ground Water Resources Evaluation of the Crystal River and West Sopris Creek (CRWS) Study Area, Pitkin County, Colorado is available online at: http://www.aspenpitkin.com/depts/12/water_res.cfm.

unconsolidated material in some localized areas may be creating aquifers. Folds, faults and fracturing may also be transmitting ground water either vertically or laterally, creating aquifers, or connecting multiple aquifers together. Some deep bedrock aquifer connections with the surface can be seen in locations such as the Penny Hot Springs.

- **West Sopris Creek Area:** The hydrogeologic framework of the West Sopris Creek portion of the study area has multiple distinct hydrogeologic areas – including bedrock (e.g., Mancos Shale) and unconsolidated material (e.g., glacial moraines, alluvial deposits). Confined and unconfined aquifers exist. Geologic folds, faults and fractures may also be transmitting ground water either vertically or laterally, creating aquifers, or connecting multiple aquifers together. In most of the West Sopris Creek study area, it is the glacial moraines, alluvial deposits, sheet wash and other unconsolidated material that are of primary importance as water sources.

2. Climate/Topography/Geomorphology: Elevation and the steepness and orientation of a slope with respect to sunshine and prevailing winds, as well as local rain and sun shadows caused by nearby ridges affect the amount of rain and snow available for ground water recharge throughout the CRWS Study Area. Typically, south and west facing hill slopes are hotter and drier and have less winter moisture and snow pack available for ground water recharge during the spring melt and will have higher evapotranspiration by plant life during the growing seasons.

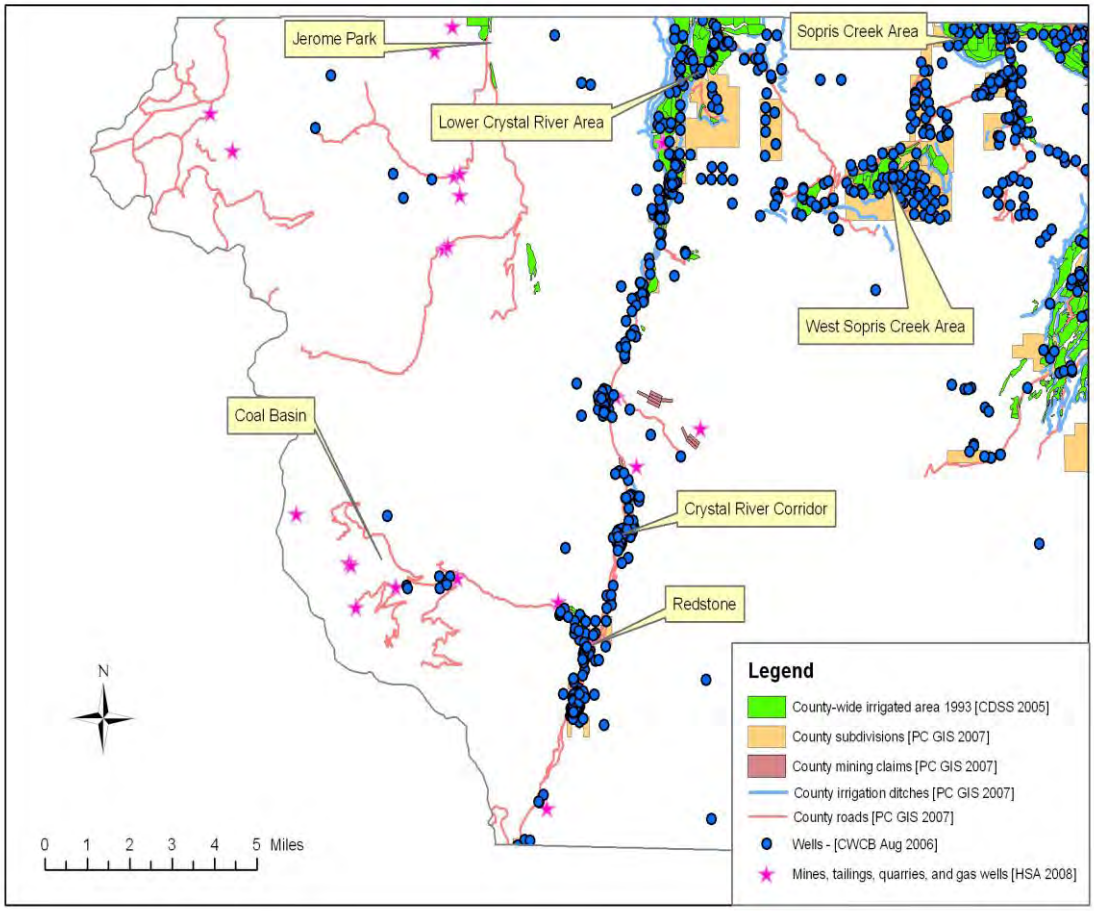
3. Surface Water: The network of streams throughout the CRWS Study Area can be either replenished by ground water or losing their water to ground water depending on local hydrology and the time of year. Springs, seeps and most wetlands indicate areas where ground water is actually being discharged to the land surface.

4. Land Use:

- **Irrigation:** A number of irrigation ditches run through the study area, especially in the Lower Crystal River and West Sopris Creek areas. Some of these ditches carry water during most of the growing season; others operate only during an actual irrigation cycle. Most of these ditches are unlined and may leak when carrying water. This ditch leakage, together with leaking irrigation ponds, may be recharging local ground water systems and may even influence ground water flow direction. Similarly, the ground water supply may be recharged by irrigation return flows in some areas. Taking irrigated land out of production may result in lowering of the water table and reduction in ground water flow velocities.

- **Onsite Wastewater Treatment Systems ("OWTSs"):** The proliferation of residences, especially along the Crystal River and on the terraces in the Lower Crystal River and West Sopris Creek areas, has resulted in an increase in the number of OWTSs. In such areas, OWTSs are also recharging the ground water system.

- **Wells:** Wells in the CRWS Study Area are clustered along the Crystal River and West Sopris Creek, and in the terraces affected by flood irrigation with water transported by leaky ditches. This is shown in the following illustration. Most of the wells are for domestic water supply and, individually, these wells do not have much impact on the ground water system. However, where wells are clustered, there may be a significant affect on the ground water supply.



Irrigated Areas, Ditches, Wells, Mines, Aggregate Quarries and Subdivisions in the CRWS Study Area

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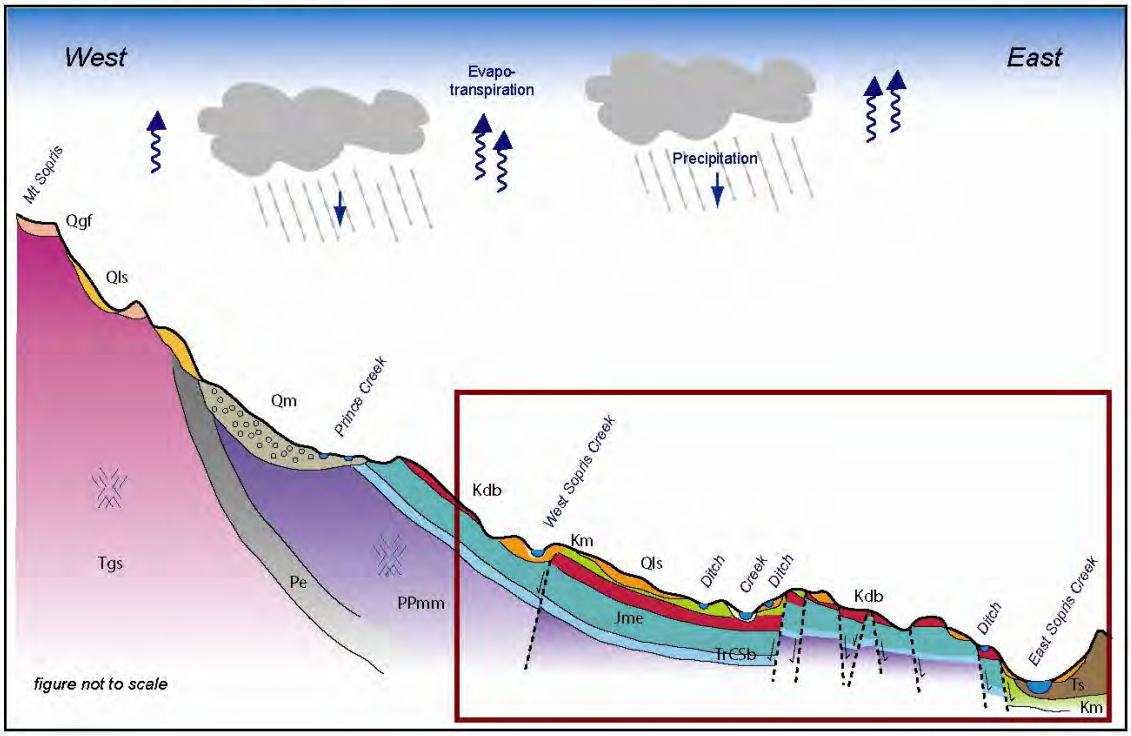
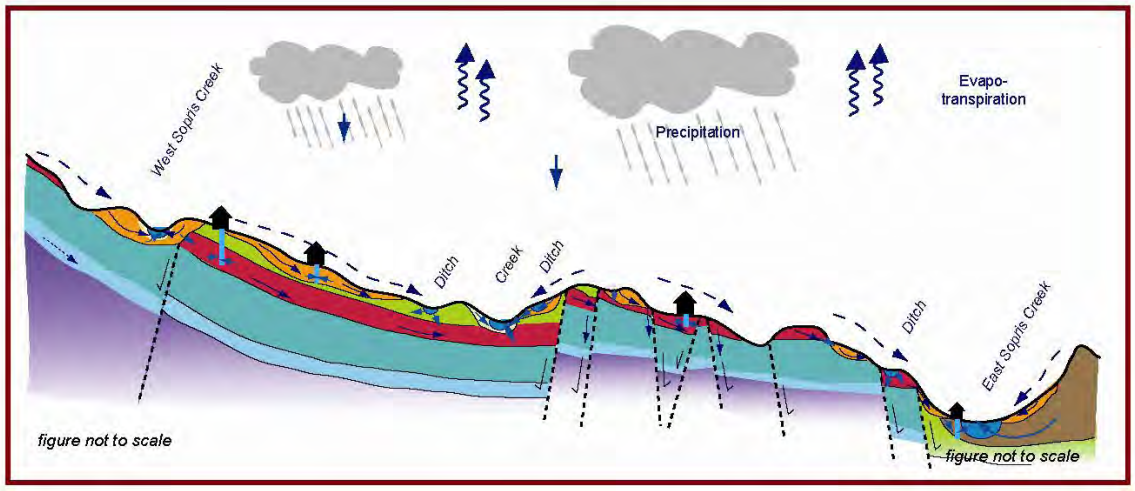
How Do You Put All Of This Information Together?

Generally, modeling a ground water system consists of identifying and quantifying all the inputs and outputs from climate (precipitation and snowmelt), stream functions (water gains/losses), vegetation (loss to evapotranspiration), topography (e.g., slope steepness and aspect), soils and geomorphology, geology, and human activity (e.g., ditches, wells, irrigation). Over time, even on a large scale, it is easy to see how difficult this process can be – as we go through periods of drought, water rights are bought and sold, and land uses change.

The study conducted for Pitkin County provides only a very “high-level” overview of a very complex system, as the following illustration shows. However, it is a good starting point for every land owner concerned about their water supply. Certainly the study demonstrates how tenuous some local water supplies may be in the CRWS Study Area.

West Sopris Creek Area





Geology

Unconsolidated Units

- Qal - alluvium
- Qgf - fans and gravels
- Qm - moraine
- Qls - landslide

Bedrock Units

- Tbaf - Basalt and Ash-flows
- Ts - Tertiary Sediments
- Tgs - Mount Sopris Granodiorite
- Tw - Wasatch
- Kmv - Mesa Verde
- Km - Mancos Shale (incl. Ft. Hays)
- Kdb - Dakota and Burro Canyon
- Jme - Morrison and Entrada
- TrCSb - Chinle and State Bridge Fm
- PPmm - Maroon and Minturn Fm
- Pe- Eagle Valley Fm and Evaporites

fault or fracture with offset

Hydrology

- groundwater flow into plane
- housing unit with well
- groundwater flow direction
- surface runoff
- locally fractured aquifer