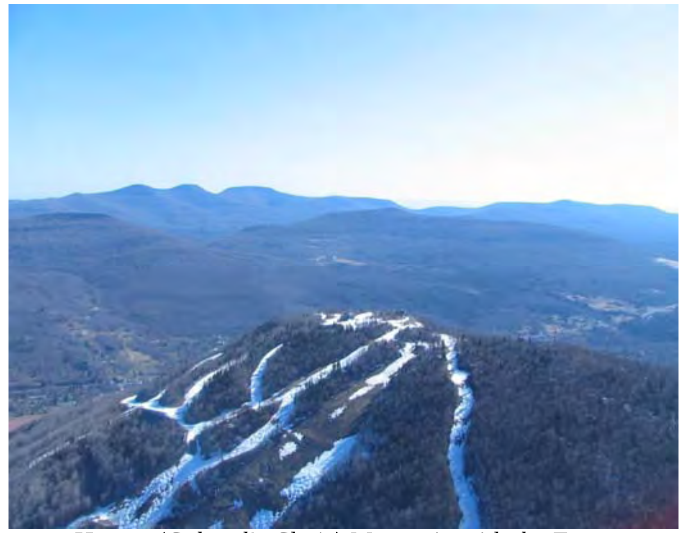
2.3 Physical Geography of the Schoharie Watershed

Physical geography encompasses the physical elements and processes that comprise the earth's surface features and associated processes. These processes include: energy, air, water, weather, climate, landforms, soils, animals, plants, and the Earth itself. The study of physical geography attempts to explain the geographic patterns of climate, vegetation, soils, hydrology, and landforms, and the physical environments that result from their interactions.



Hunter (Colonel's Chair) Mountain with the East Kill/Batavia Kill valley divide in background.

The Schoharie watershed is located in the Appalachian Plateau physiographic province (Figure 2.3.1). The erosional characteristics of the sedimentary rock formations of the Appalachian Mountains are responsible for the characteristic valley and ridge topography of the Catskills. Durable layers of sandstone and conglomerate form ridges and less resistant limestone and shale underlie the Schoharie valley as it winds its way to the Mohawk River. During the height of glaciations, the Schoharie watershed was covered by an ice sheet up to a mile thick. Upon retreat, these ice sheets left a layer of unsorted and unconsolidated glacial debris, glacial till, ranging from clay particles to huge boulders. Following the retreat of the ice sheet, the landscape was covered with glacial tills and bedrock and was wiped clean of plants and animals, leaving a clean slate for the migration and colonization of the modern plant and animal communities. Today, the Schoharie watershed lies within the Northeastern Highlands ecoregion. This ecoregion is characterized by nutrient poor soils blanketed by northern hardwood and spruce fir forests.

Figure 2.3.1. Physiographic Regions of the United States, including the Appalachian Plateau (NASA Earth Observing System (EOS) Goddard Program Office).

Elevations in the watershed vary from a high of approximately 4,040 feet above sea level in the Town of Hunter at the West Kill/Schoharie Creek watershed boundary, to a low point of 1,140 feet above sea level at the Schoharie reservoir. The average elevation of the watershed is approximately 2,590 feet above sea level. Studies indicated that the temperature drops approximately 3.0˚ F per 1000' of elevation (Thaler, 1996). The Schoharie Creek starts as a mountainous stream dropping approximately 520 feet in its first mile (Southeastern Hunter), but then reducing in slope to an average of 36 feet/mile to its approximate midway point (intersection of Route 23A and Cty Rte 17). From this midway point to the reservoir, the stream slope drops approximately 24 feet/mile. The more notable high peaks (>3,500') that form the Schoharie main stem watershed boundary are Rusk, Hunter, Plateau, Sugarloaf, Twin, Indian Head and Kaaterskill High Peak (Figure 2.3.2).

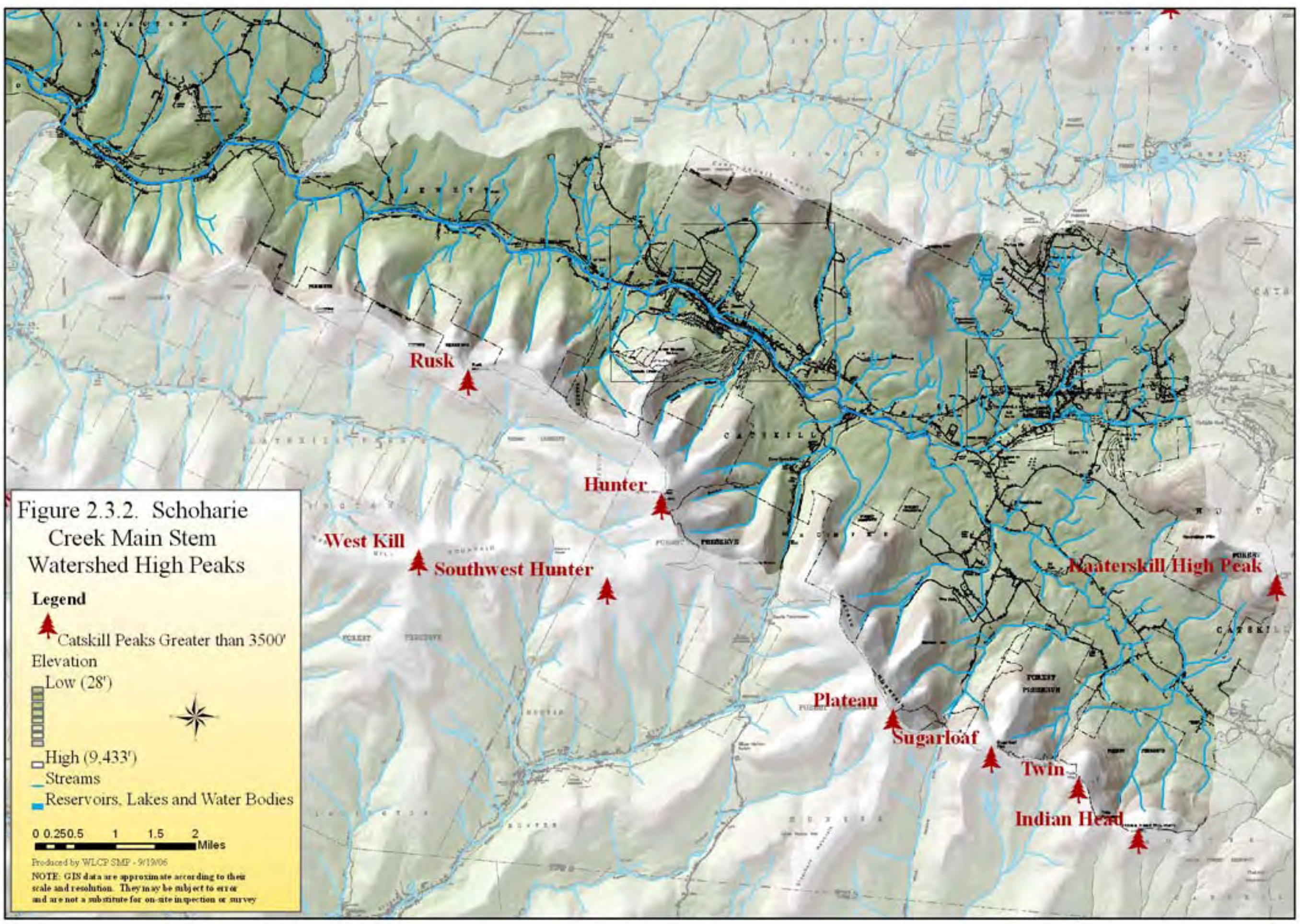


Figure 2.3.2. Schoharie Creek Main Stem Watershed High Peaks

The Schoharie Creek flows northwest through the Towns of Hunter, Jewett, Lexington and Prattsville before exiting the Schoharie reservoir where it turns north on its path to the Mohawk River. Traveling from east (Hunter) to west (Prattsville), the primary tributaries that drain into the Schoharie (and their watershed areas) are the East Kill (36.6 m^2), West Kill (31.5 m^2), Little West Kill (8.2 m^2), Batavia Kill (72.8 m^2) , Huntersfield Creek (7.9 m^2), Johnson Hollow Brook (5.2 m^2), and directly into the reservoir the Bear Kill (26.1 m^2) and Manor Kill (34.4 m^2). The watershed (including reservoir) contains approximately 706 miles of stream.

Climate

The climate of the Schoharie basin is primarily driven by the humid continental type, which dominates the northeastern United States. The average annual temperature for the area is 44.8˚ F and the area typically receives approximately 41” of rain/year (Table 2.3.1 and Figure 2.3.2). Due to up-sloping and down-sloping, the character of the mountaintop topography can affect the climate of the basin. Up-sloping occurs when air is lifted up over the mountains, the air expands, cooling and condensing into moisture, which takes the form of clouds and precipitation (Thaler, 1996). Down-sloping occurs when air sinking within a dome of high pressure or air that is forced downslope of a mountain range, warms up and loses moisture, as is shown by a drop in relative humidity (Thaler, 1996). These weather phenomena can be responsible for differences in cloud cover and precipitation between the Catskills and the surrounding area, and helps to explain the sometimes drastic variations in rainfall between Catskill basins (Figure 2.3.3).

Table 2.3.1. Average annual temperature, precipitation, snow fall and winter and summer temperatures for Windham, NY from the period 1961-1990 (Thaler, 1996).

Average Annual Precipitation	41”
Average Annual Temperature	44.8 ˚ F
Average Winter Temperature	25.6 ˚ F
Average Summer Temperature	64.7 ˚ F
Seasonal Snowfall	60”

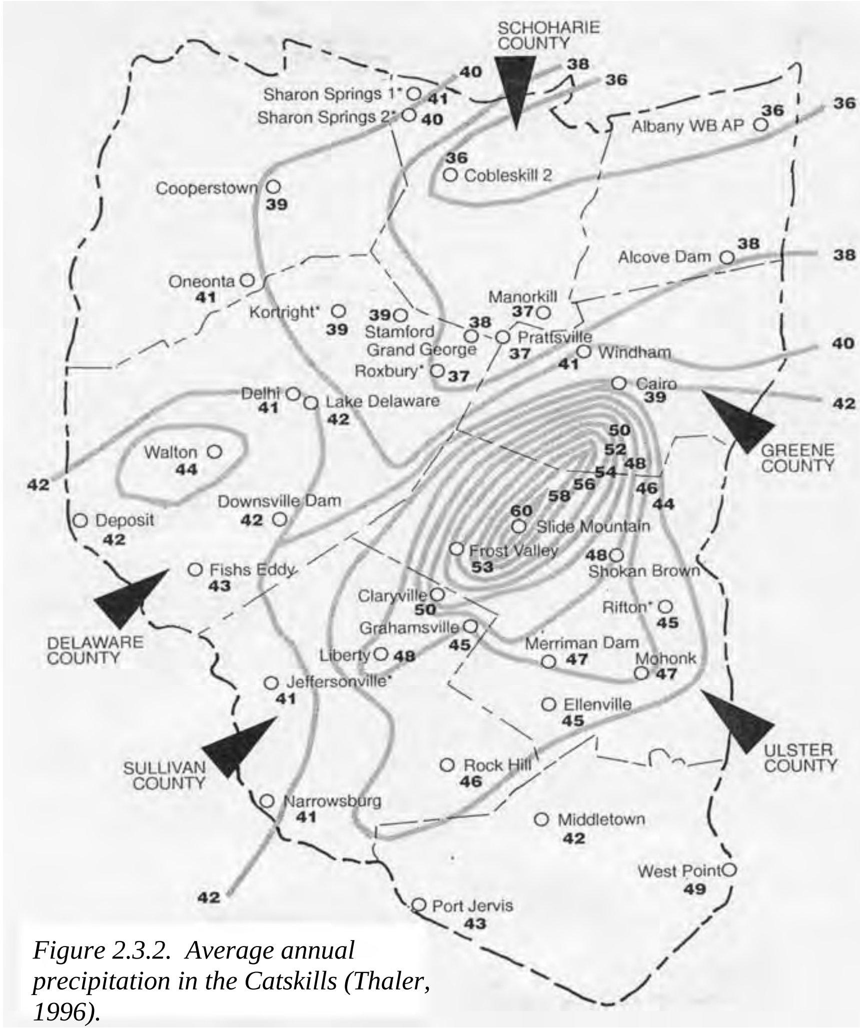
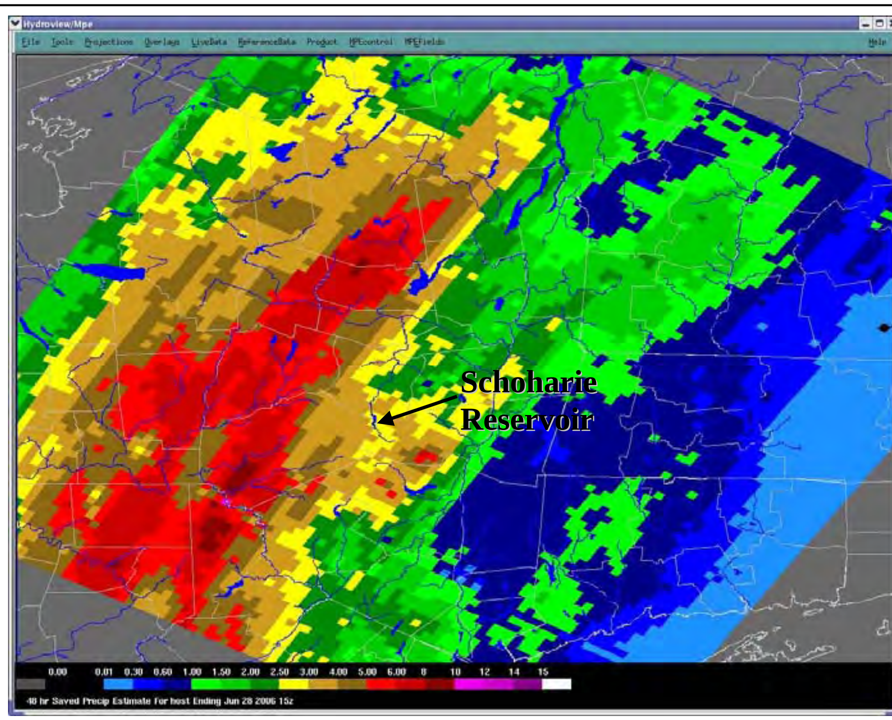


Figure 2.3.2. Average annual precipitation in the Catskills (Thaler, 1996).

Figure 2.3.3. Radar showing the rainfall intensity that caused the flooding in the Western Catskills in June 2006. The isolated pockets of heavy rain (dark red) within individual Valleys help explain why flood damages can be so dramatic from one basin to the next (National Weather Service Forecasting Office).



Global Climate Change Effects on the Watershed

Global warming will impact the Schoharie basin in coming years. Greenhouse gases are trapping energy in our atmosphere that would normally be lost to space and causing global temperatures to rise. This warming is a natural phenomenon that provides enough heat to allow humans to thrive on earth, but the burning of fossil fuels, and the atmospheric concentration of other gases such as methane, has dramatically increased the rate of warming (Figure 2.3.4). Based on local data collected between 1952 and 2005, researchers have concluded that a broad general pattern of warming air temperatures, increased precipitation, increased stream runoff and increased potential evapotranspiration has occurred in the Catskills region (Burns et al., 2007). In coming years, there is no doubt that the effects of global warming will impact management decisions in the Schoharie watershed.

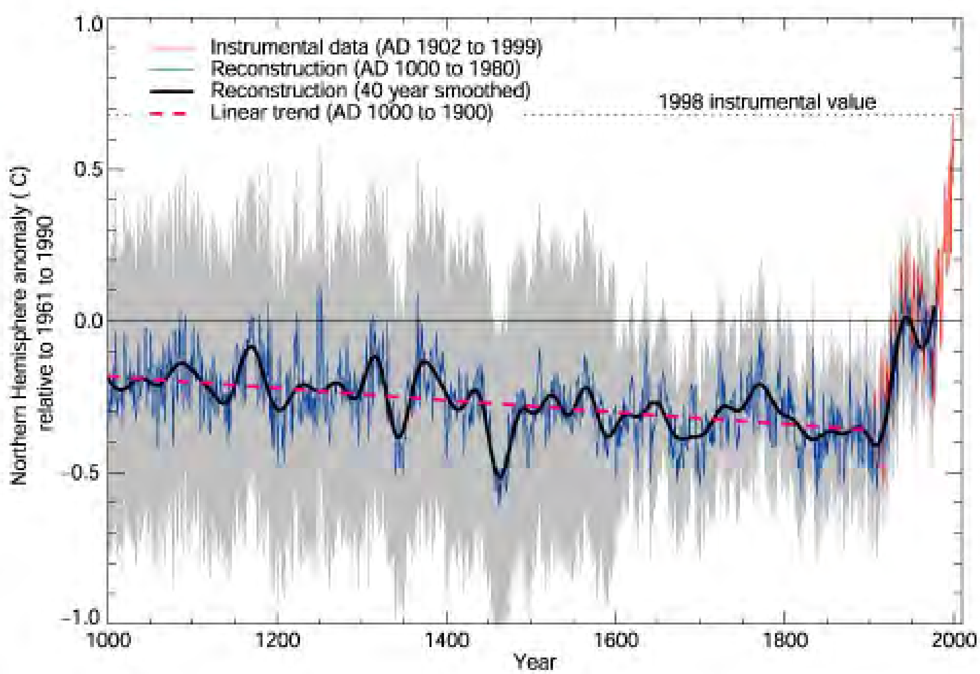


Figure 2.3.4. Millennial northern hemisphere temperature reconstruction, based upon ice core data, relative to actual temperatures recorded from 1902 through 1999. Despite large variation, the recent trend of rapid heating in the industrial era is apparent (National Climatic Data Center adapted from Mann et al., 1999).

Temperature increases will have effects on food production, plants, wildlife, invasive species, flooding, drought, snowfall and the economy. Based upon current climatic trends, our climate may migrate to the extent that by the end of the century, summers in upstate New

York may feel like Virginia (Figure 2.3.5) (Frumhoff et al., 2006). This climatic migration will have deleterious effects on plant and animal life, allowing new warmer climate species to thrive at the expense of our traditional plants and animals. The number of snow-covered days across the Northeast has already decreased, as less precipitation falls as snow and more as rain, and as warmer temperatures melt the snow more quickly. By the end of the century, the southern and western parts of the Northeast could experience as few as 5 to 10 snow-covered days in winter, compared with 10 to 45 days historically (Frumhoff et al., 2006). Decreased snowfall and increased rainfall would have negative effects on stream flows and the economy of the Catskills.

With the lack of snow fall, streams and groundwater will not receive a slow sustaining release of water through the winter and spring. Replacing the slow release will be more intense storms, which will sporadically dump large quantities of water into the system potentially causing damaging flooding (Figure 2.3.6). However, streams will return to base flow relatively quickly once the rain stops. Modeling predictions indicate that in the next century we will see more extreme stream flows that will cause streams to flow higher in winter, likely increasing flood risk, and lower in summer, exacerbating drought (Frumhoff et al., 2006). Changing the dynamic of the hydrologic cycle would also impact the NYC water supply system, forcing potential changes in operational measures.

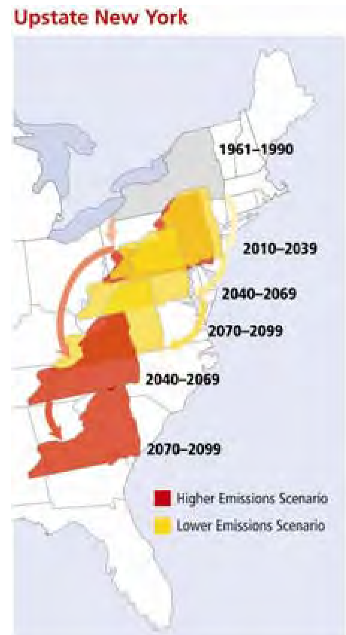


Figure 2.3.5. Projected climate "migrations" for Upstate, NY based on average summer heat index, under the lower (yellow)- and higher-emissions (rust) scenarios. Based on the average of the GFDL, HadCM3 and PCM model projections (Frumhoff et al., 2006).

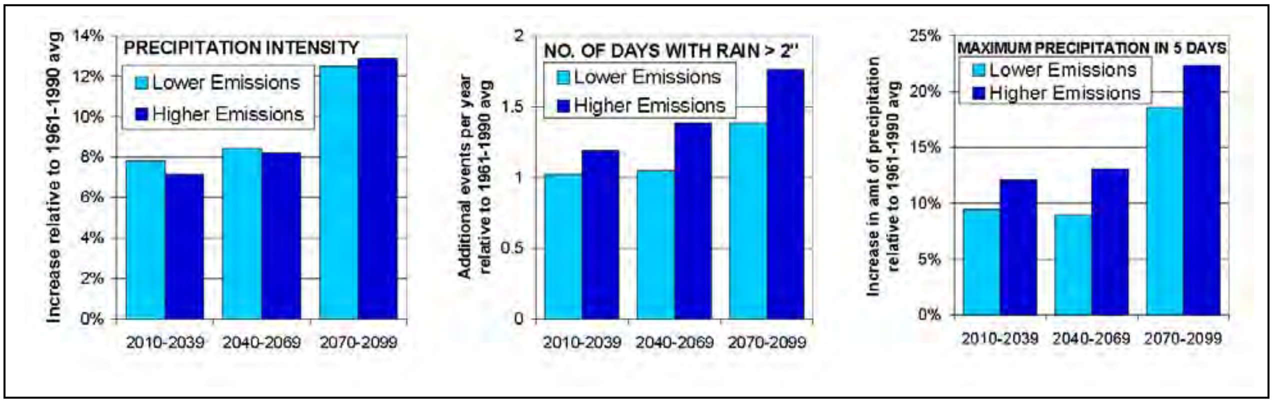


Figure 2.3.6. Projected increases in three indices of extreme precipitation: (1) precipitation intensity, (2) number of days per year with more than two inches of rain, and (3) maximum amount of precipitation to fall during a five day period each year (Frumhoff et al., 2006).

Because we don't have a clear understanding of all of the coming impacts of climate change, stream managers need to employ the "no-regrets policy" with regard to their current management actions and policies. The no-regrets policy is the recognition that lack of certainty regarding a threat or risk should not be used as an excuse for not taking action to avert that threat, that delaying action until there is compelling evidence of harm will often mean that it is then too costly or impossible to avert the threat. Stream managers –including streamside landowners-- will need a basic understanding of how streams are formed and evolve to effectively adapt to coming changes. They will need to anticipate and compare the consequences of different management options, and will need to act conservatively: oversizing culverts and bridge spans, leaving larger buffers of undisturbed streamside vegetation, and consider limiting new development of infrastructure or personal property in areas where conditions indicate a high risk of the stream channel shifting across the floodplain. The humid continental climate has been an unquestionable asset to the historical development of the Schoharie basin and its many occupants and uses. With proper planning and implementation of the no-regrets policy, undoubtedly, the climate will continue its important role in Schoharie basin life.

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