Prior landscapes preserved between eruptive cycles of the Jemez volcanic field form subsurface pathways that influence the flow of contaminants and groundwater. Knowledge of how fluids move from the surface through perched zones to the aquifer is still developing. This study looks at the prior landscape “sealed” between two major ash flows (Otori and Tshirege Members of the Bandelier Tuff at 1.6 and 1.2 Ma), within Bandelier National Monument (BNM). The ~380,000 year interval between the Bandelier eruptions, informally termed the Cerro Toledo interval, contains up to 120 m thick deposits that provide favorable settings for perched zones. Windows into this landscape are exposed in Frijoles and Alamo Canyons, two narrow, deeply incised canyons that lie within the northern section of BNM. Structure contour and isopach maps derived from field observations of exposed contacts in BNM are combined with existing geologic surface and drill-hole data for the southern part of Los Alamos National Laboratory to provide a glimpse of the topography that developed prior to eruption of the Tshirege Member. The non welded Otori Member was easily eroded, resulting in a landscape characterized by rolling hills with gentle gradients. Episodic eruptions of plinian ash and erosion of the Sierra de los Valles, accompanied by possible seismic shaking during the collapse of a portion of Rabbit Mountain, resulted in pulses of sediment that periodically overwhelmed developing drainage systems. Regional base level was controlled by the ancestral Rio Grande, whose location shifted in response to silicic volcanism from the Jemez Mountains to the west, mafic flows from the Cerros del Rio volcanic field (~3.0-1.1 Ma) to the east, as well as probable seismic activity within the rift. The mafic flows created a resistant tableland which provided local knickpoints for streams draining the Otowi headlands, allowing broad washes to form adjacent to the master stream. In addition, continuing eruptive activity, occasional landslides, earthquakes, and undercutting of the ancestral Rio canyon formed ephemeral impoundments which may have temporarily raised base level along particular reaches influencing rates of tributary drainage network development and affecting where large, episodic outflows of sediment would have been deposited.