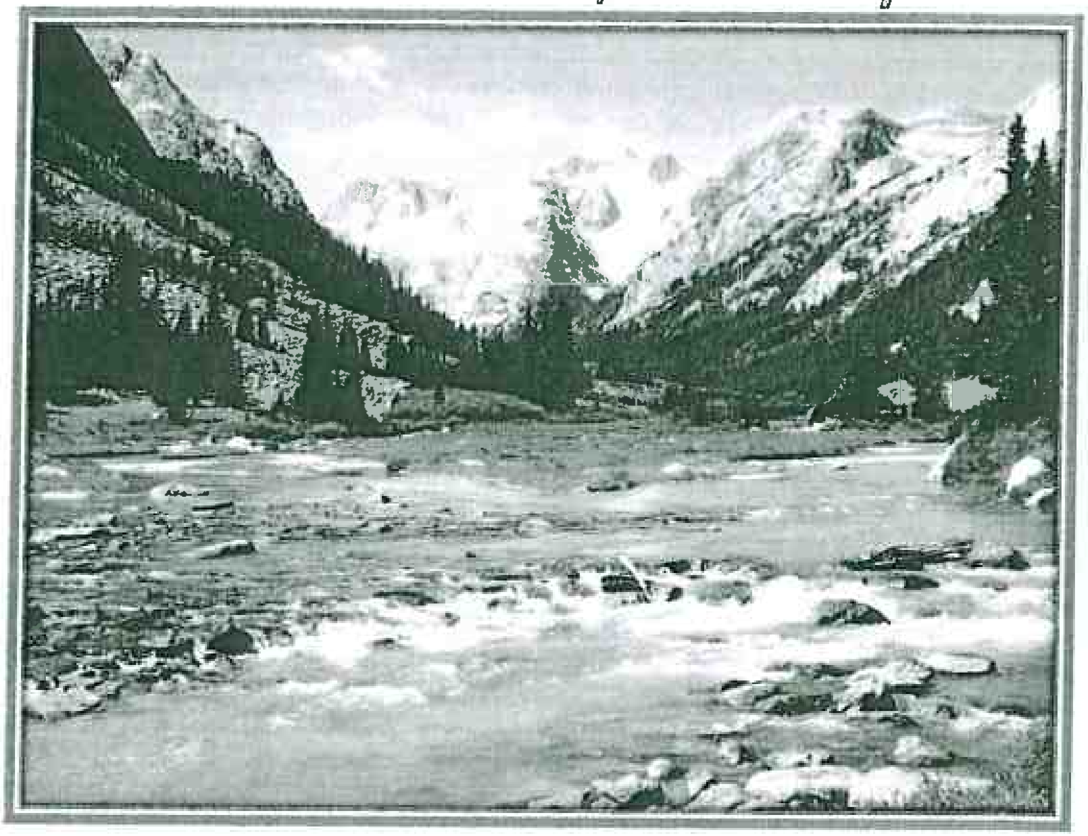
Wind River Glaciers, Level I Study



Final Report

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Abbreviated Summary

This study was requested primarily to: (1) examine climate controls on upper Green River Basin and upper Wind-Big Horn River Basin hydrology, (2) evaluate Wind River Range (WRR) glacial runoff and the contribution of glacial melt to streamflow, and (3) conduct an extensive field assessment and survey of Dinwoody Glacier.

Climate Influences: Results from this component indicate: (a) snowfall spatial and temporal variability were similar on each side of the continental divide, (b) the Pacific Decadal Oscillation (PDO) signal was not detected but a significant El Niño-Southern Oscillation (ENSO) signal was detected in streamflow and snow water equivalent, (c) the PDO Cold phase enhances La Niña in this region resulting in increased snowfall and given a PDO Cold phase began on or about 2000, the development of a La Niña could result in above average snowfall, and (d) if only the 20th century were to be considered, the descriptive statistics such as median and mean streamflows will be artificially elevated as to the same statistics of the entire reconstructed record.

Evaluation of Glacier Runoff: Glacial areas and volumes were determined from the analysis of remote imagery. Glacial volumes were also determined from glacial surface areas, with areas from remote imagery, using an area-volume scaling method. Results included: (a) the average change in surface area for the 44 primary glacial complexes (some outside the three primary watersheds) of the WRR from 1966 to 2006 was a decrease of 38%, (b) the water equivalent of the approximate 719,000 ac-ft ice lost for the 44 primary WRR glaciers from 1966 to 2006 was 647,000 ac-ft, (c) contributions of glacial melt to annual streamflow ranged from 1% to 12% in the 3 primary glaciated WRR watersheds for the period 1966-2006, (d) contributions of glacial melt to July-Sept streamflow ranged from 3% to 22% in the three primary glaciated WRR watersheds for the period 1989-2001/2006, (e) impacts of the glaciers on watershed streamflow during the months of July, August, and September were greater than that due to ice melt alone, with a glacial contribution as high as 40% of the July-Sept streamflow, and (f) during the period 1966-2006, ice melt was greater during the 89-06 portion of the period corresponding to lower streamflows and April 1st snowpacks—however, temperatures during the 89-06 portion of the study period were also generally lower than during the 66-89 portion of the study period.

Field Measurements: Field observations and measurements were taken on Dinwoody Glacier during August 6-12, 2006, yielding: (a) observations provided confirmation that glaciers delay the snowmelt runoff hydrograph as opposed to nonglaciated watersheds, (b) observation also indicated that the glacier borders are not always easily identified—the aerial photos often present the same difficulties in identifying the glacier borders as do on-ground observations, (c) GPS and ice depth measurements provide a rough verification of the remote imaging results, and (d) repeat photos clearly show Dinwoody Glacier had a net retreat during the latter two-thirds of the 20th century.

Observations: General observations include, but are not limited to: (a) the WRR glaciers were mostly in recession during the 1966-2006 period, (b) WRR glaciers have contributed to annual streamflow, especially on the east slope, and to a greater extent to late summer/early fall (July, Aug, Sept) flows during the 1966-2006 period, and (c) predicting future trends is difficult—if the WRR glaciers were to continue to retreat, the valuable source of water they provide would continue to be reduced—historically, glaciers tend to cycle between growth and retreat.

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