Hydrology and Aquatic Ecosystems

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Changes in precipitation and temperature will have implications for hydrology. Impacts will vary across BC. Pike et al. (2008a, 2008b) describe BC climate change and associated implications to hydrology. This section summarises their findings (Table 1 and below).

Table 1. Projected changes in winter weather, storm impacts and streamflow in BC (adapted from Pike et al. 2008a, b).

Winter	Summer	Storms and their impacts	Streamflow
Temp ↑	Temp ↑	Frequency & magnitude ↑	Snowmelt → hybrid rain/snow driven
Precipitation ↑	Precipitation ↓ ↑	Landslides ↑	Rain on snow events ↑
Rainfall ↑	Evaporative demand ↑	Avalanche ↑	Earlier freshet
Snowfall ↓	Plant transpiration ↑	Erosion ↑	Peak flow ↑ ↓
Snowpack ↓	Moisture deficits ↑	Sedimentation ↑	Summer low flow ↓
Snowline ↑ & north	Stream/lake temp ↑	Big log jams ↑	Low flow period ↑
Extreme weather ↑	Risk to salmon ↑	Channel stability ↓	Perennial stream → intermittent*
		Log supply (long term) ↓	

*where snowmelt not stored in ground water

Pike et al. (2008b) group implications into eight broad classes:

Increased evaporation: Increased evaporation, due in part to increased air temperature, will reduce the water available in streams, lakes and reservoirs, decrease survival and growth of existing vegetation, and likely increase the probability of fire. Modeling predicts that water deficit will increase from 20 – 60% depending on location and climate scenario (Spittlehouse 2007).

Altered vegetation composition affecting water interception: Vegetation intercepts precipitation and draws moisture from the soil through transpiration. Projected future climates will lead to changed productivity, changed dominant species, and in some cases, regime shifts (e.g. from forest to grassland). As vegetation communities shift to reflect climate, water interception, evaporation and transpiration will change.

Increased water temperature: Water temperature in streams and lakes will increase with implications to aquatic ecology. Salmonid species are tolerant to particular thermal windows. Increased water temperature has consequences for sensitive populations, including increased disease, altered growth and development, thermal barriers to migration, and altered species distribution. Small changes in water temperature will likely result in distribution shifts and loss of salmonids in areas already near their limit.

Increased frequency and magnitude of storms: Increased wind and precipitation will likely increase windthrow, flooding and landslides. Associated increases in erosion and landslide-derived log jams will destabilise channels and change the temporal input of woody structure, affecting stream ecology, hydroriparian function and fish populations.

Decreased snow accumulation and accelerated snowmelt: Less water will be stored overwinter for release in spring to groundwater or streams, changing the streamflow regime. The central and northern coasts, and high-elevation sites on the south coast, are projected to have the biggest declines.

Accelerated melting of permafrost, lake and river ice: River and lake ice will likely form later and disappear sooner than previously. In the discontinuous permafrost region, permafrost will likely disappear, with potential implications for terrain stability.

Melting glaciers: Most glaciers in BC will continue to recede. As glaciers melt, summer flows may initially increase for several years or decades, but will then decrease considerably as the glaciers shrink. This reduction in glacial melt will exacerbate summer low flows.

Altered timing and magnitude of streamflow: The impacts of climate change will vary with watershed hydrological regimes. Watersheds with **rain-dominated** regimes, with peak flows in winter and low flows in summer, will likely reflect projected changes in precipitation. For example, increased storms will lead to increased storm-related peak flows in winter, and drier summers will lead to more low-flow days. As snow decreases and rain increases in winter, **hybrid** rain and snow dominated watersheds, with peaks in winter and spring and low flows in summer, may shift to a rain-dominated regime with more frequent winter peak flows. Watersheds with **snow-dominated** regimes, with peak flows in spring and low flows from late summer to winter, will experience earlier spring freshets and longer periods of late summer and early autumn low flows, in some cases transforming streams from perennial to intermittent flow. **Glacier-fed** watersheds, with later low flows due to glacial input, will experience decreased and earlier peak flows, similar to snow-dominated systems. Over time, the loss of glacial flow will increase the low-flow periods in these systems.

Literature Cited

Pike, R.G., D.L. Spittlehouse, K.E. Bennett, V.N. Egginton, P.J. Tschaplinski, T.Q. Murdock and A.T. Werner. 2008a. Climate change and watershed hydrology: part I—recent and projected changes in British Columbia. Streamline 11: 1-7.

Pike, R.G., D.L. Spittlehouse, K.E. Bennett, V.N. Egginton, P.J. Tschaplinski, T.Q. Murdock and A.T. Werner. 2008b. Climate change and watershed hydrology: part II—hydrological implications for British Columbia. Streamline 11: 8-13.