Watershed assessment for forest management

Glynnis Horel, P. Eng., FEC
G.M. Horel Engineering Ltd.
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Reason for doing watershed assessments

➢Determine effects on values of interest from past forest development (logging, road construction)

➢Values of interest – may include

- Fish habitat
- Community water supply – water quality, quantity and infrastructure
- Development downstream in floodplains or on fans

→*Guide future forest development activities*

Purpose

- Characterize geomorphic and hydrologic processes in the watershed
- Determine present condition and factors that led to that condition
- Determine how values and elements of interest have been or could be affected by forest management activities
- Also look at how non-forest development may have affected values (e.g. fish habitat), but focus of investigation is forest management

Legal & professional

- No legal requirement on crown or private land to carry out a watershed assessment for forestry activities

- Forest managers often choose to have a watershed assessment carried out as part of their due diligence with respect to the range of values that could be affected by forestry

- On crown land, if a forest tenure holder makes a commitment in a Forest Stewardship Plan to carrying out a watershed assessment, then that becomes a legal requirement when the Forest Stewardship Plan is approved.

Legal & professional

- Professionals that carry out a watershed assessment are usually a professional engineer, a professional geoscientist, or a forest professional – and often involve other specialists such as fish biologists

- The standard of professional work does not change with the type of land tenure or ownership

- The scope of the assessment may be taylored to the specific concerns that the forest manager wants addressed; and recommendations may be specific to that land tenure.

Elements of a watershed assessment

Hydrologic Change

- The hydrologic environment – climate, streamflow and watershed characteristics
- History of development
- Potential for roads and harvesting to affect stream flows

Stream Channels

- Distribution of channel types and sensitivity
- Present condition of streams
- Impacts of past development

Riparian Condition

- Type and function of riparian vegetation along major streams
- Adequacy of existing vegetation to maintain function

Elements of a watershed assessment

Sediment Sources

- •Natural sediment sources
- •Sediment sources caused by development
- •Significance to stream conditions

Water Supply and Water Quality

- •Water supply infrastructure – vulnerability to forest management activities
- •Potential for forest development to affect water quality

Fish Habitat

- •Fish distribution
- •Present condition of habitat

Investigating the hydrologic environment of the watershed

Stream flow response is affected by:

- Vegetation (forest and nonforest)
- Topographic relief – elevation range
- Slope steepness
- Soil depth and permeability
- Bedrock permeability, especially karst
- Water storage (lakes, wetlands, icefields, late-persisting snowpacks)
- Regional climate and peak flow regime (snow melt, rain, rain-on-snow)
- Non-forest development (agriculture, urban, industrial, etc)
- Artificial flow controls or diversions
- Water extraction (wells, irrigation, other water use)
- Road networks

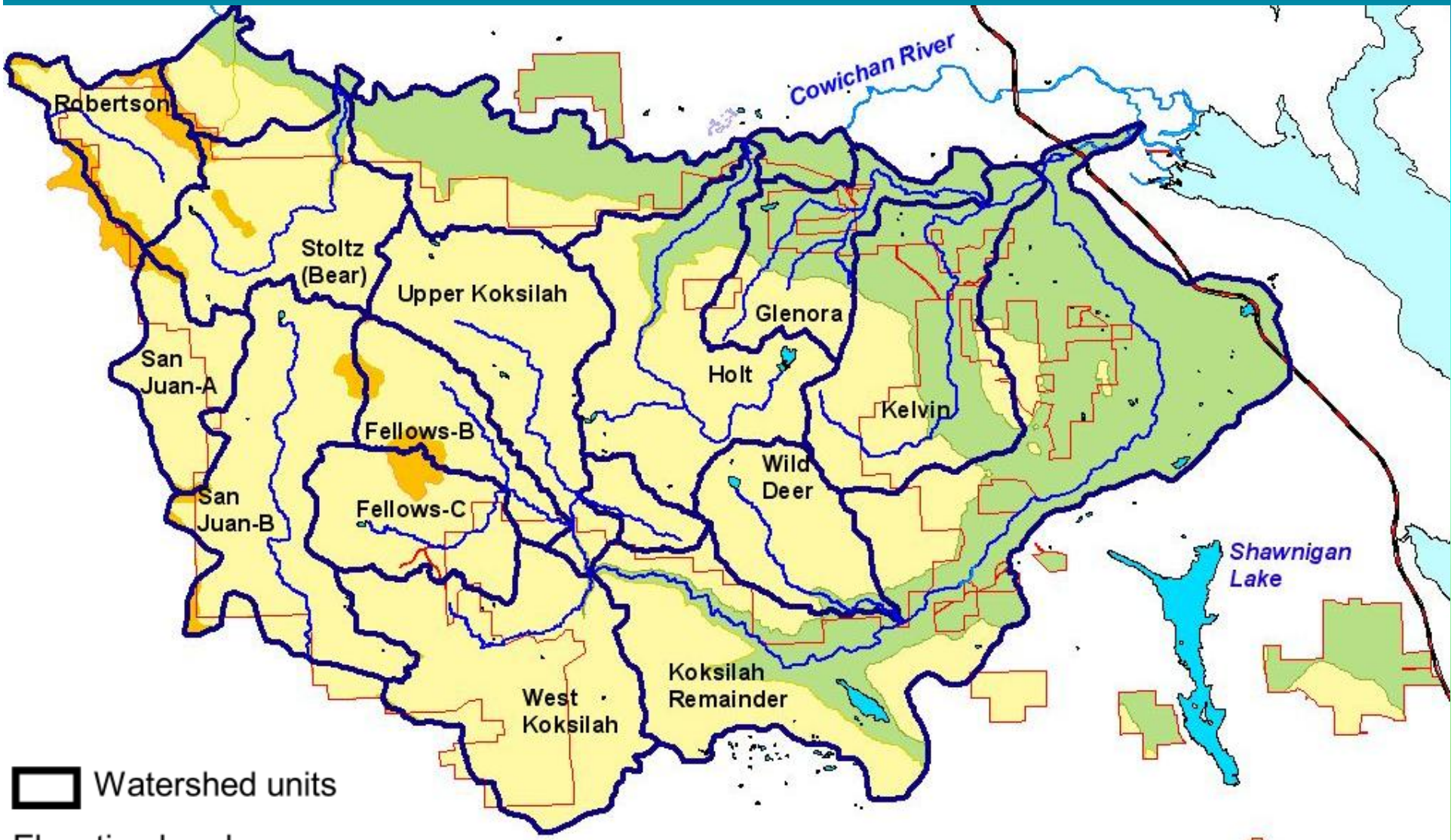
→Every watershed is unique

Streamflow responses are different in different kinds of watersheds

Must evaluate the specific characteristics of the individual watershed

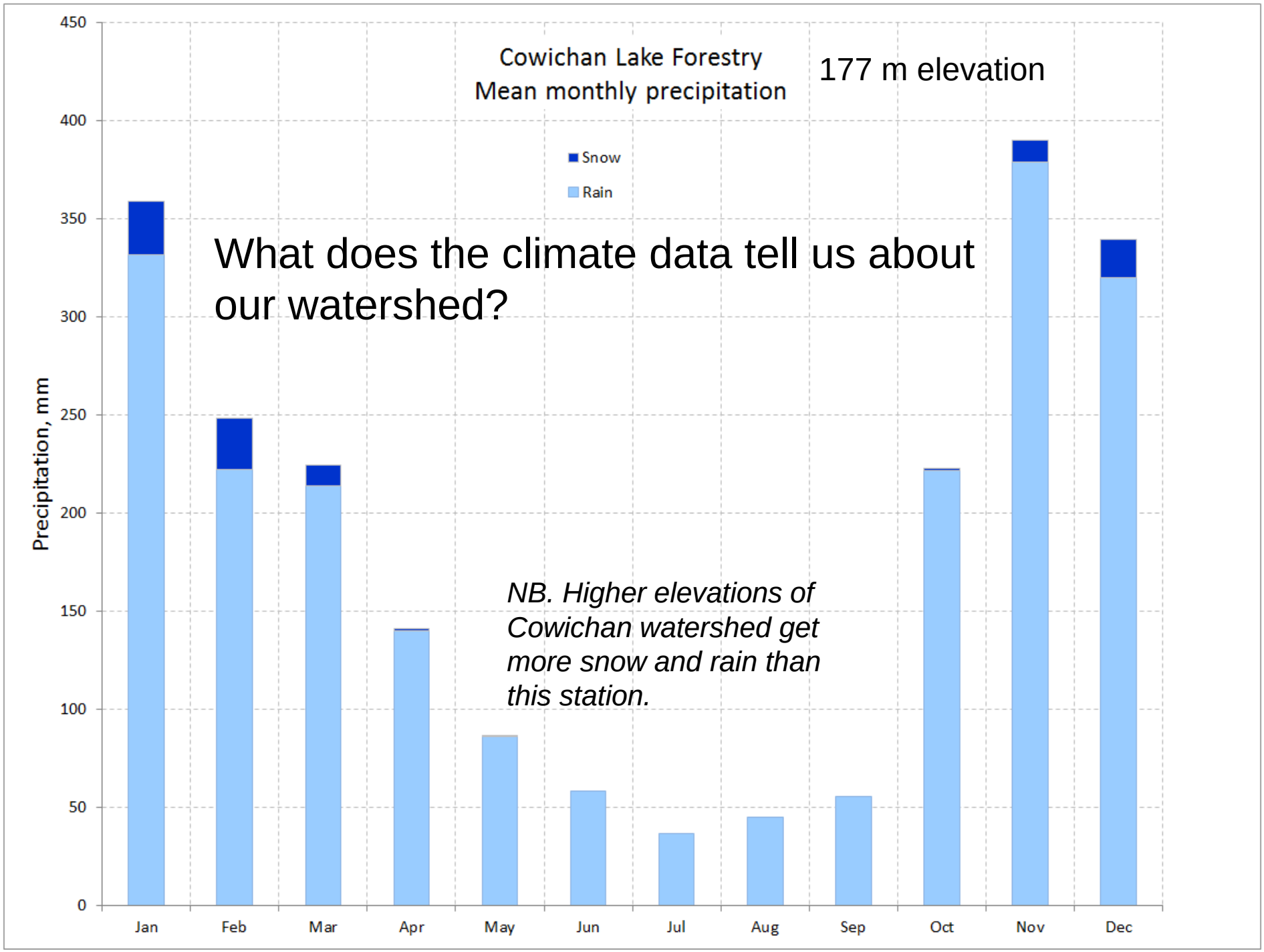
→and make judgments on how findings from scientific research relate to this watershed

Investigating the hydrologic environment of the watershed



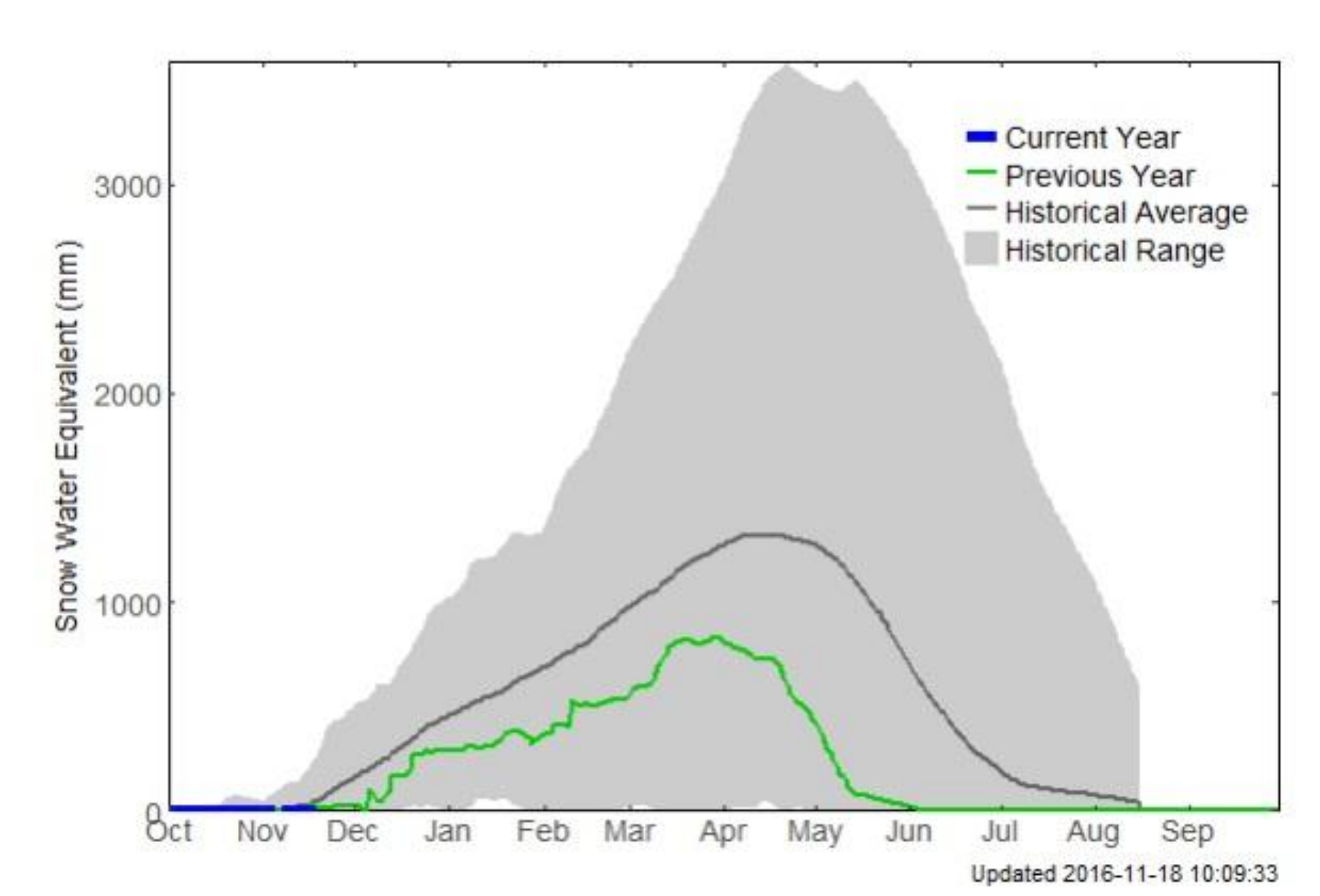
-rain zone
-transient snow (rain-on-snow)
-snow accumulation zone

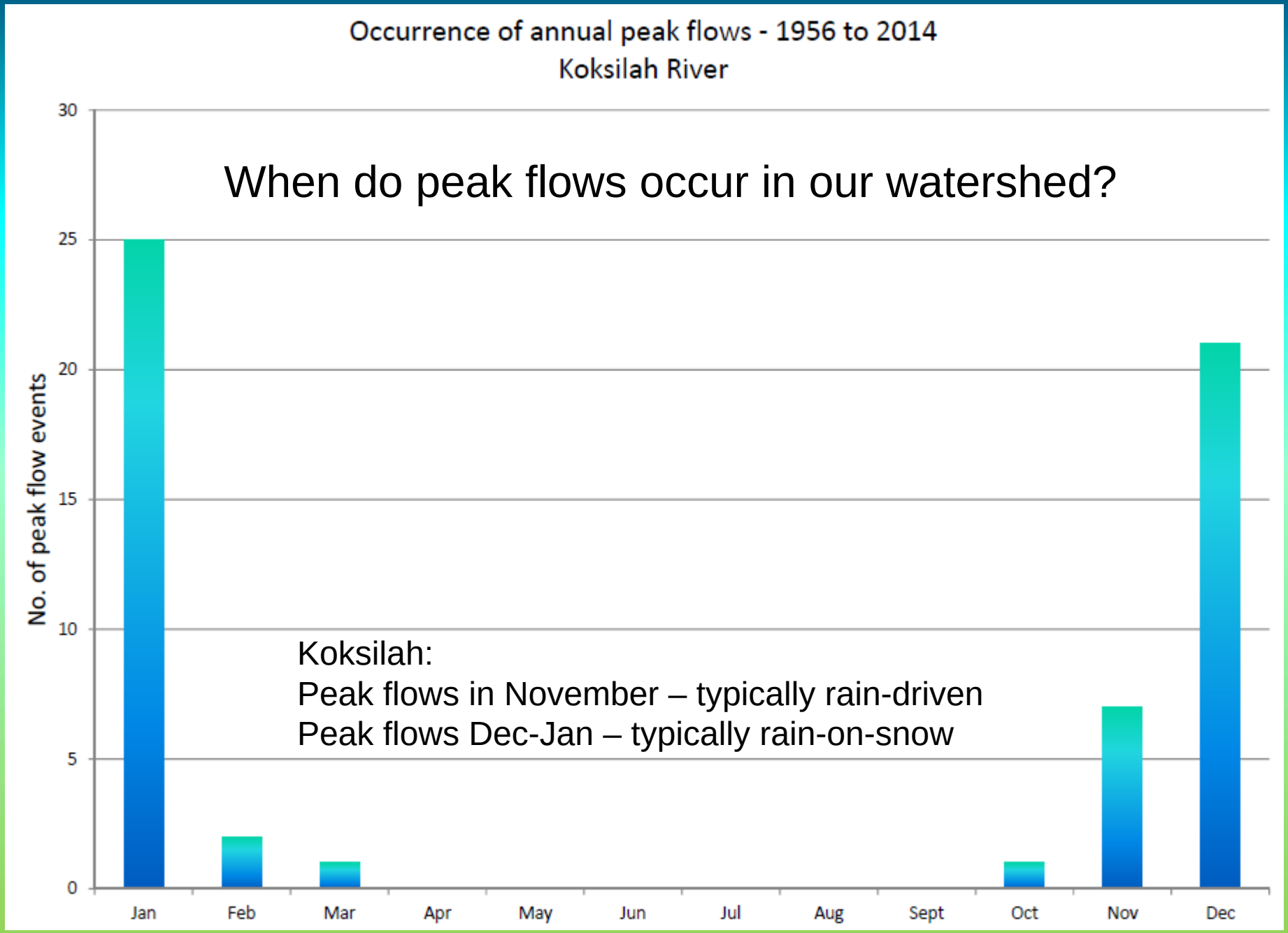
Delineate elevation zones

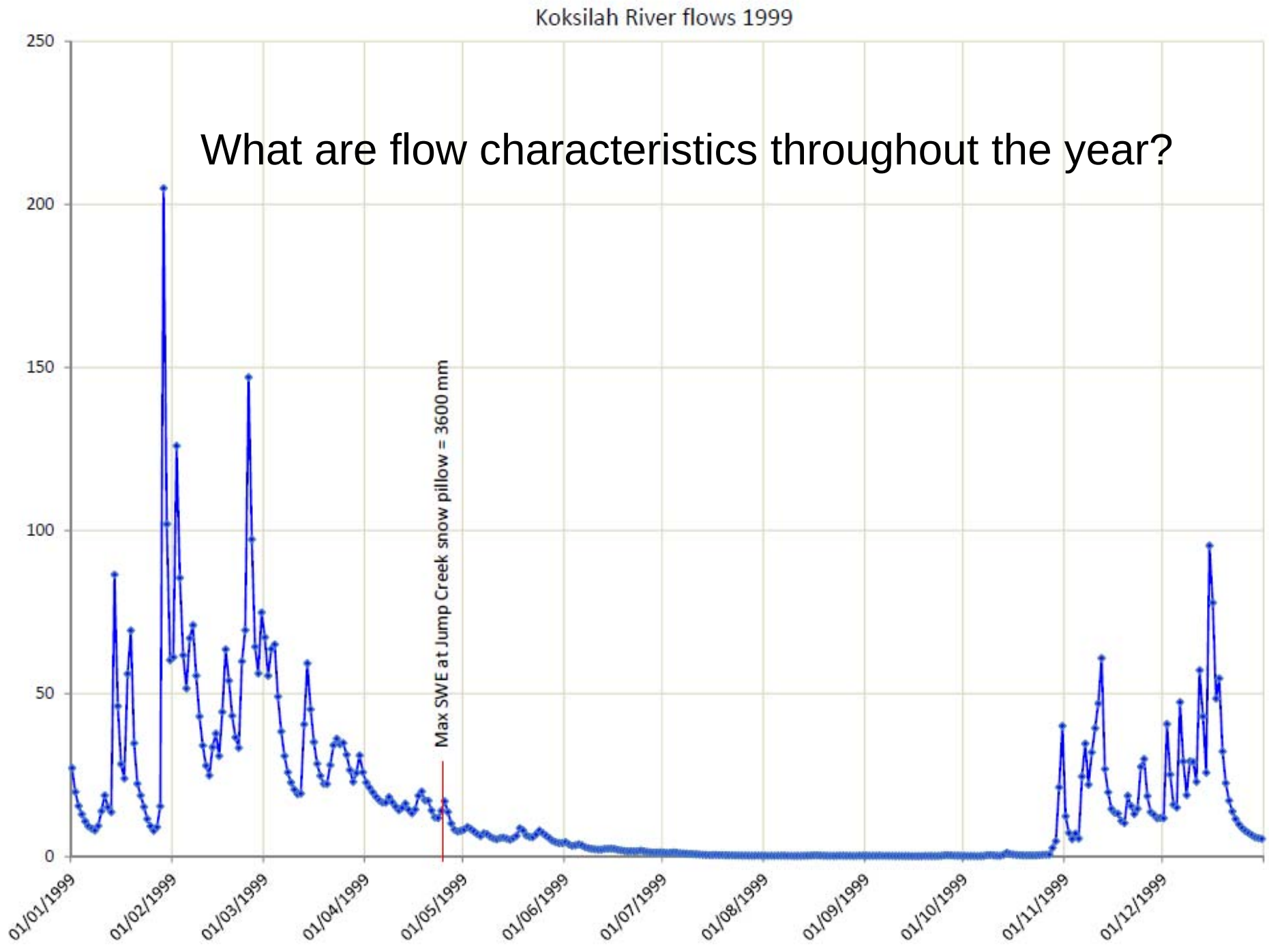

Cowichan Lake Forestry
Mean monthly precipitation
177 m elevation
Snow
Rain
What does the climate data tell us about our watershed?
NB. Higher elevations of Cowichan watershed get more snow and rain than this station.
Precipitation, mm
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Jump Creek snow course

Elevation 1134 m
Established 1995




Occurrence of annual peak flows - 1956 to 2014
Koksilah River
When do peak flows occur in our watershed?
No. of peak flow events
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Koksilah:
Peak flows in November – typically rain-driven
Peak flows Dec-Jan – typically rain-on-snow


Koksilah River flows 1999
What are flow characteristics throughout the year?
250
200
150
100
50
0
Max SWE at Jump Creek snow pillow = 3600 mm
01/01/1999
01/02/1999
01/03/1999
01/04/1999
01/05/1999
01/06/1999
01/07/1999
01/08/1999
01/09/1999
01/10/1999
01/11/1999
01/12/1999

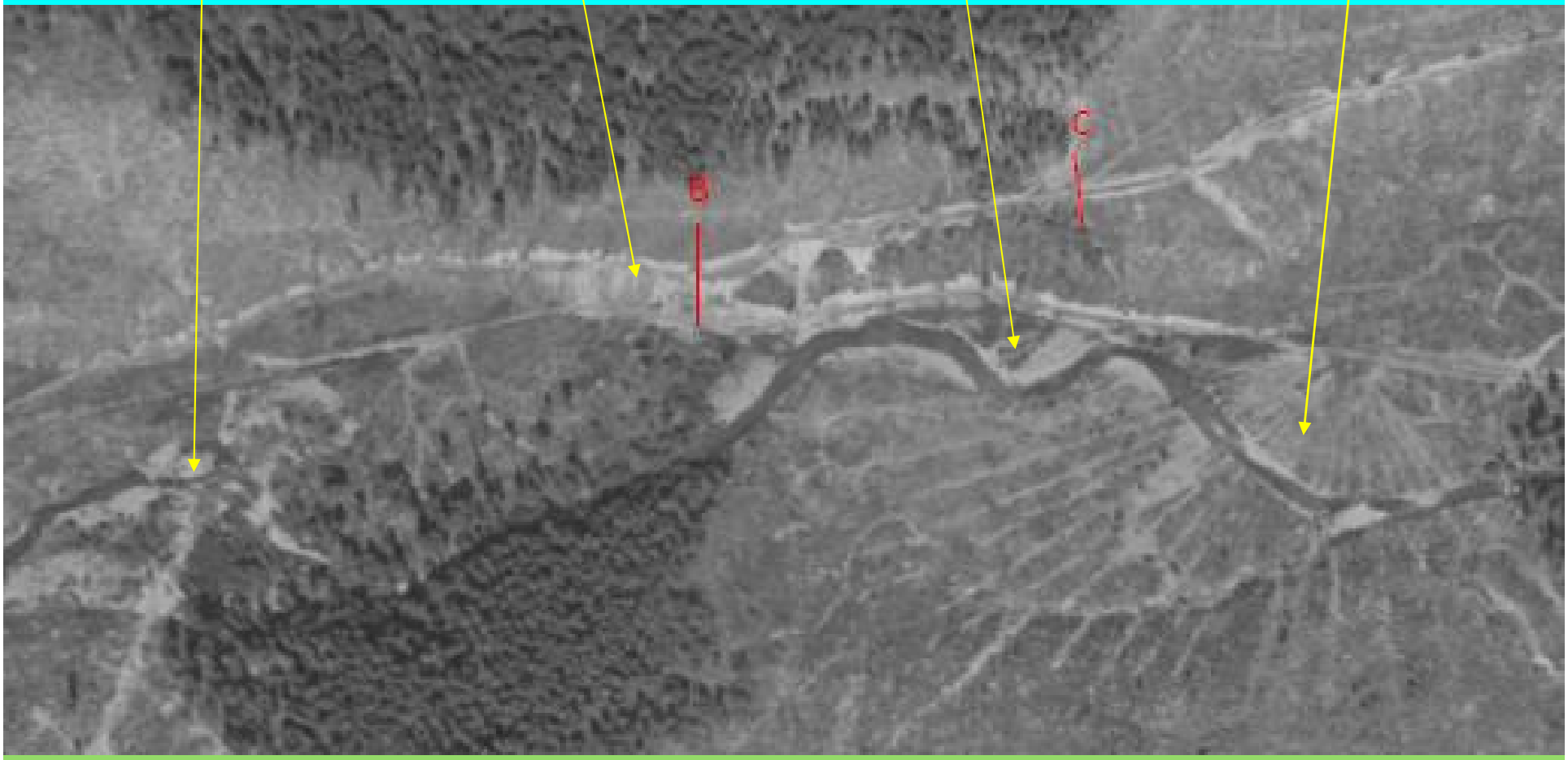
Investigating the physical condition of the watershed

Equipment travel through stream

Unstable road fills

No riparian buffers

Cross-stream yarding

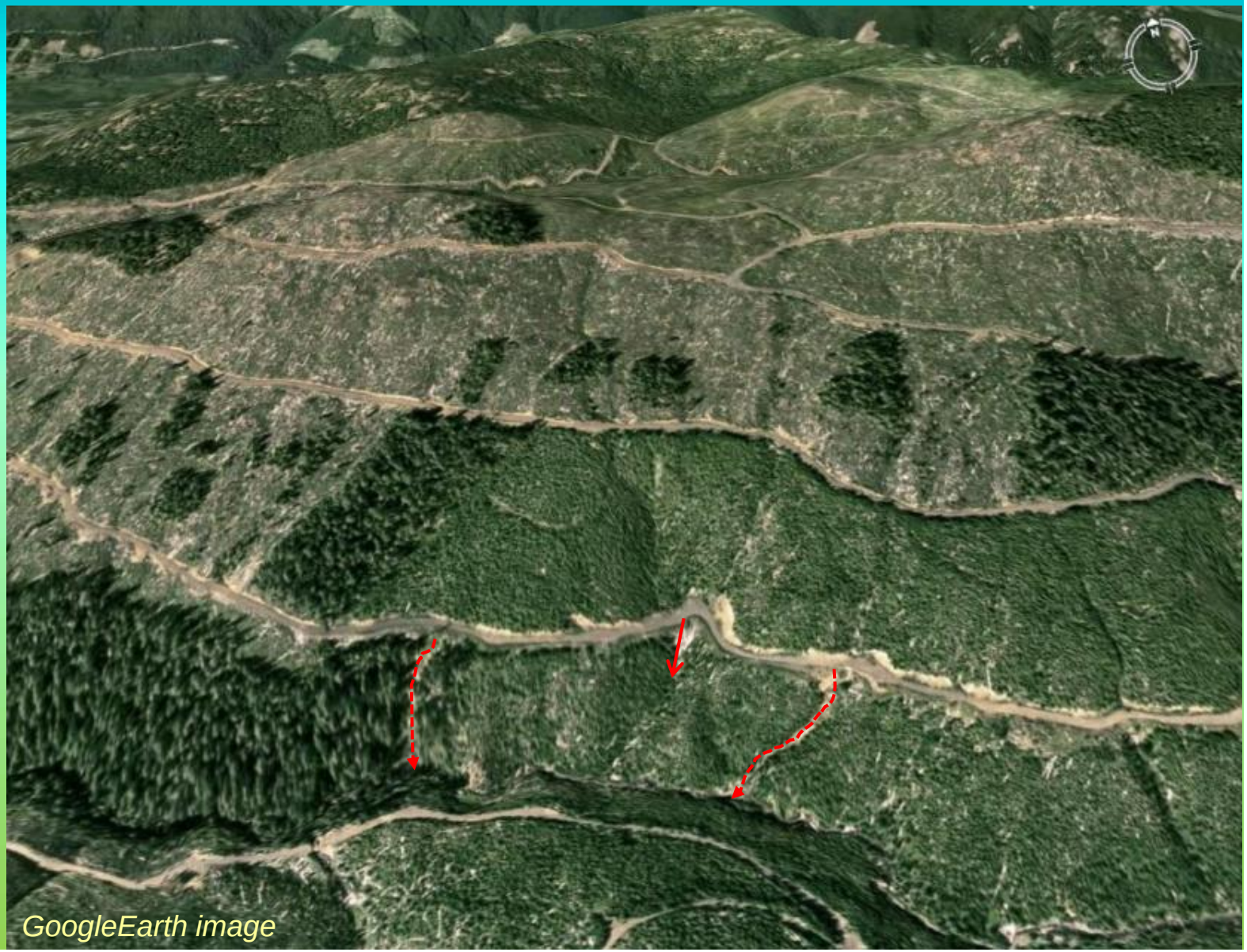


1949 airphoto

Look at legacy issues from historic practices

Sediment sources
– natural and development-related
– chronic or individual events

road systems

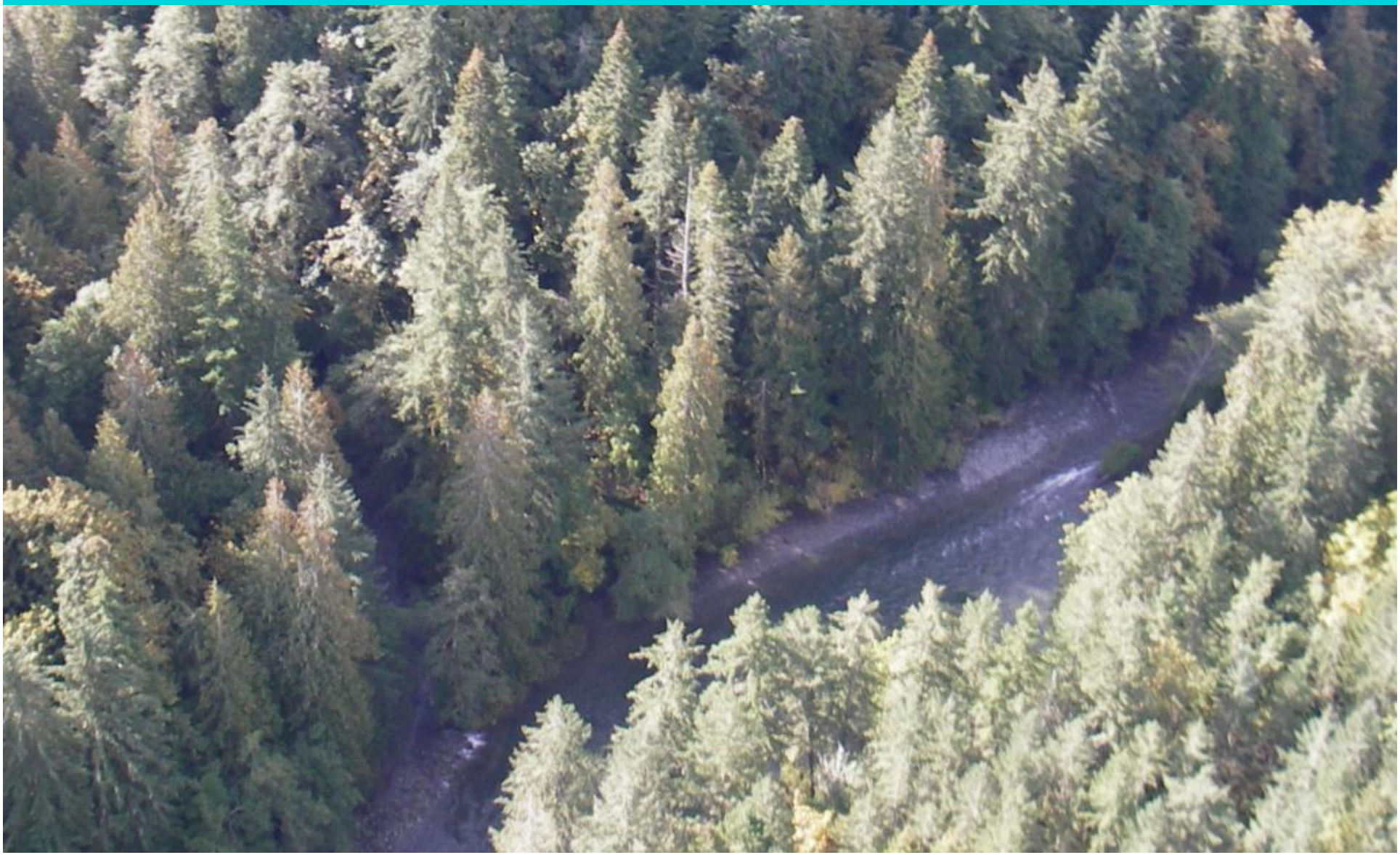


Sediment sources

Slope failures in gully sidewalls

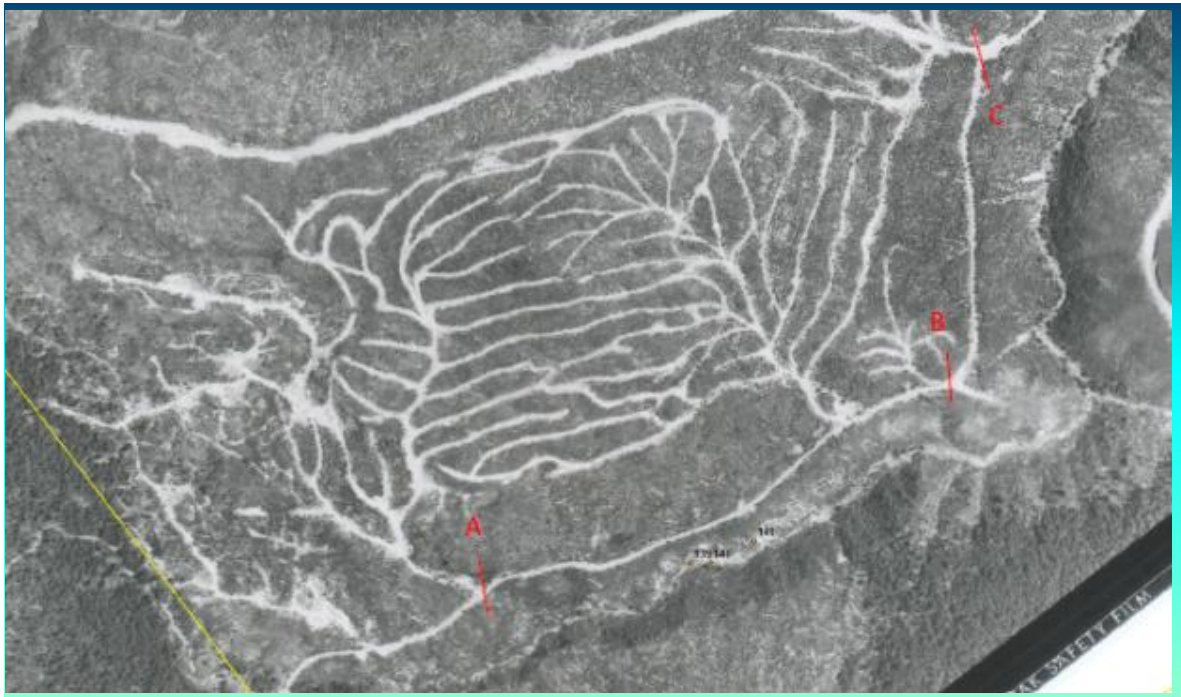
Sediment sources

Channel bank erosion and escarpments



Sediment sources

Remedial work at Stoltz Bluffs



1979

Sediment source recovery

2014

Stream channels and riparian condition

Classify stream channels as to type and sensitivity

Alluvial

Semi-alluvial

Nonalluvial

Non-alluvial reach of Koksilah River

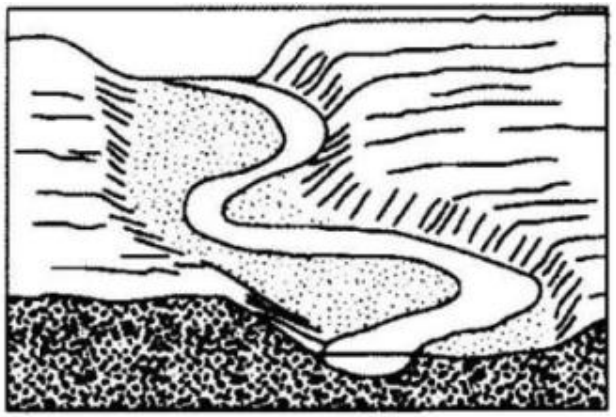
Rugged channel, not sensitive

Things that affect stream channels (channel forming events)

- Landslides, chronic sediment input – e.g., eroding escarpments
- Logging of floodplains and erodible channel banks
- Removal of large wood debris

→High-energy stream flow acting on these processes

Floodplains – highly sensitive



Alluvial streams

Cowichan River

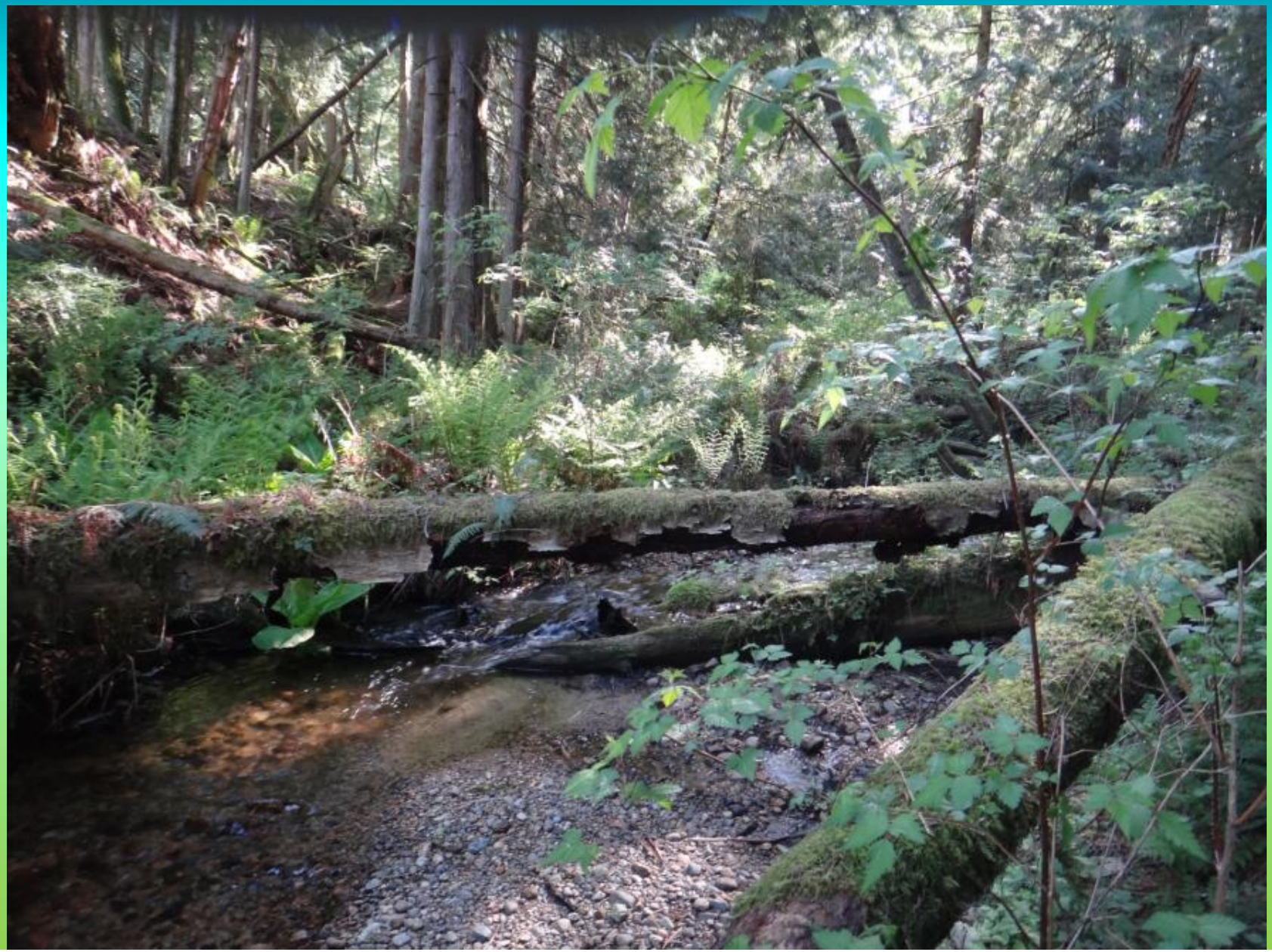
GoogleEarth image

Alluvial streams in old growth

Riparian forest – essential for channel stability

Wood very important in channel structure

Wood is good



Wood is good

Riparian forest logged, wood lost or removed
→Channel structure completely lost
→BOWLING ALLEY

Loss of LWD → planar channels, loss of pools, coarser substrate

Wrapping up our watershed assessment…..

- Synthesize all the things we have learned about the watershed through our investigation
- Current condition and trend – legacy issues that may still need to be managed to provide for recovery
- Set objectives for forest management for risks to values of concern and for the watershed condition

→Develop strategies and plans to achieve those objectives

Climate change implications to consider in watershed assessment

- More frequent intense rainstorms (*Sep – Dec?*)
  - → increase in peak stream discharge and flood elevations
  - → increased landslides and erosion
  - → increased capacity required for road ditches, culverts and stream crossing structures
- Elevation range of transient snow zone moving up
  - → adjust methods for determining hydrologic recovery
- Snowpack zone shrinking in area
  - → lower monthly discharge late spring to mid-summer
- Warmer summer temperatures
  - → more water demand by forest, higher evapotranspiration

Management strategies…..

- Plans for remediating issues found with roads, and managing road systems
- Operating procedures, e.g., to manage sediment introduction from haul roads, construction standards for new roads
- Riparian treatments for different kinds of stream channels
- Terrain stability management for landslide-prone areas
- Harvest levels consistent with hydrologic risk to downstream values

Current practices

Issues….. conflicts between what would be good for streams, and impacts to downstream human development

- Restoring channel morphology and dynamics by managing for increased large wood debris in stream system
  - →Improved quality of fish habitat
  - →Regulate sediment transport
  - →Reduce flow velocities

BUT

- →Wood debris jams increase flood levels in downstream floodplains
- →Flow diversions from wood debris jams can cause erosion of private property
- →Wood accumulating in reservoirs may be a cost for the water supplier to remove
- →Mobile large wood may impact downstream bridges

Thank you!