Bob Winship - Weyerhaeuser Pembina Timberlands

Forest Management and Watershed Values

Presentation to the

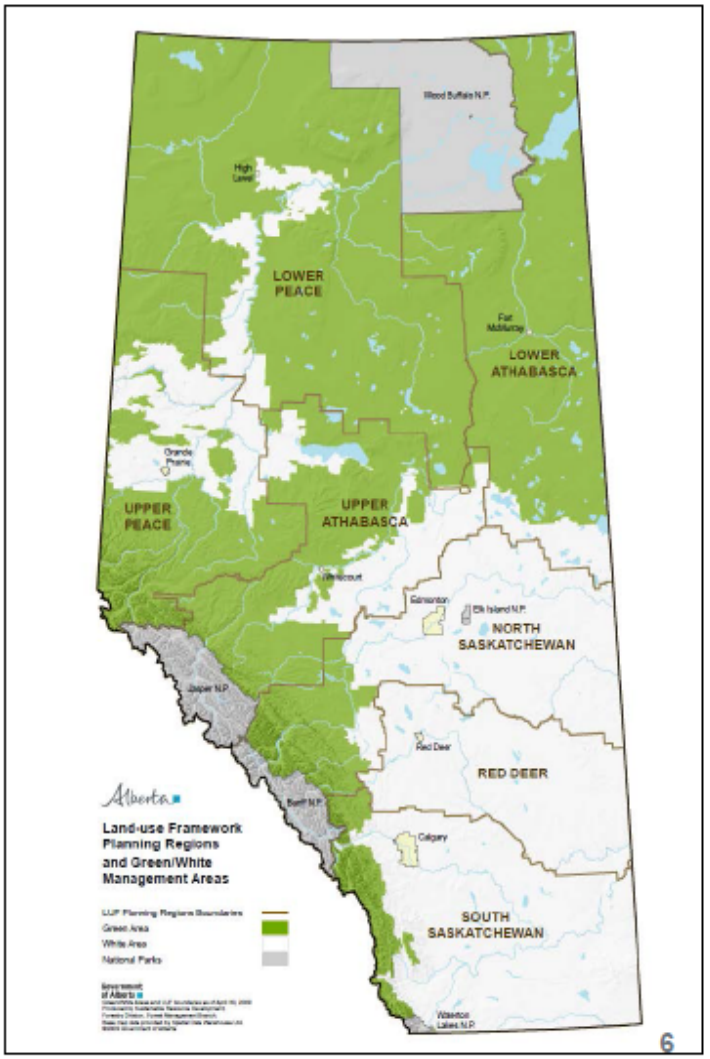
North Saskatchewan Watershed Alliance

Environmental Forum

April 6, 2017

Alberta's Green Area

- 35.1 million ha
- Shared management responsibility.
  - Land Manager (Environment and parks)
  - Forest Manager (Agriculture and Forestry)



Alberta's Foothills Forests

Late 1800's – WWII:

- Dominion Lands Act of Canada:
  - Exclude timberlands from sale or development
  - "...arrest further destruction of our remaining forests..."
- Forest Reserves established to limit settlement and protect watersheds

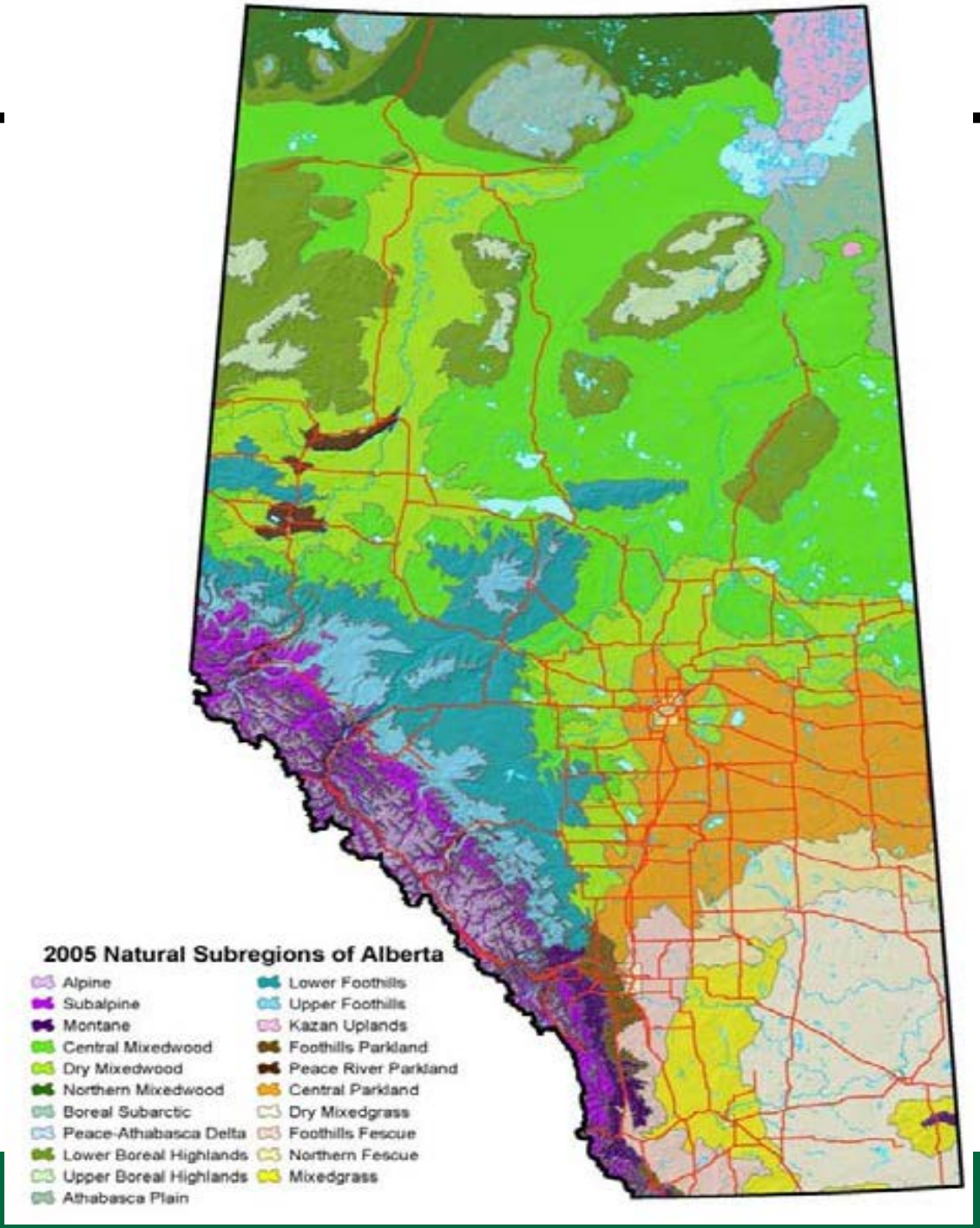
The Green Zone 1948:

- Reserve forest lands from settlement
- Modern era of forest management

25. 2001

Green Zone Activities/Events

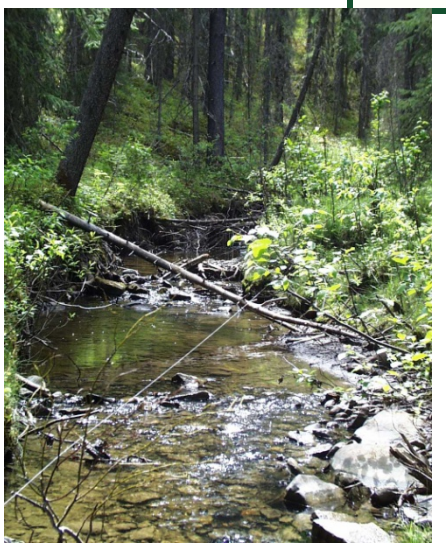
- Forest succession, natural disturbances
- Forest management – fire protection, timber harvesting, reforestation
- First Nations traditional lands
- Oil & gas
  - Well sites, pipelines, roads, facilities
- Gravel
- Grazing
- Recreation
- Community development


2005 Natural Subregions of Alberta
Alpine
Subalpine
Montane
Central Mixedwood
Dry Mixedwood
Northern Mixedwood
Boreal Subarctic
Peace-Athabasca Delta
Lower Boreal Highlands
Upper Boreal Highlands
Athabasca Plain
Lower Foothills
Upper Foothills
Kazan Uplands
Foothills Parkland
Peace River Parkland
Central Parkland
Dry Mixedgrass
Foothills Fescue
Northern Fescue
Mixedgrass

Generalities about the Foothills' forests:

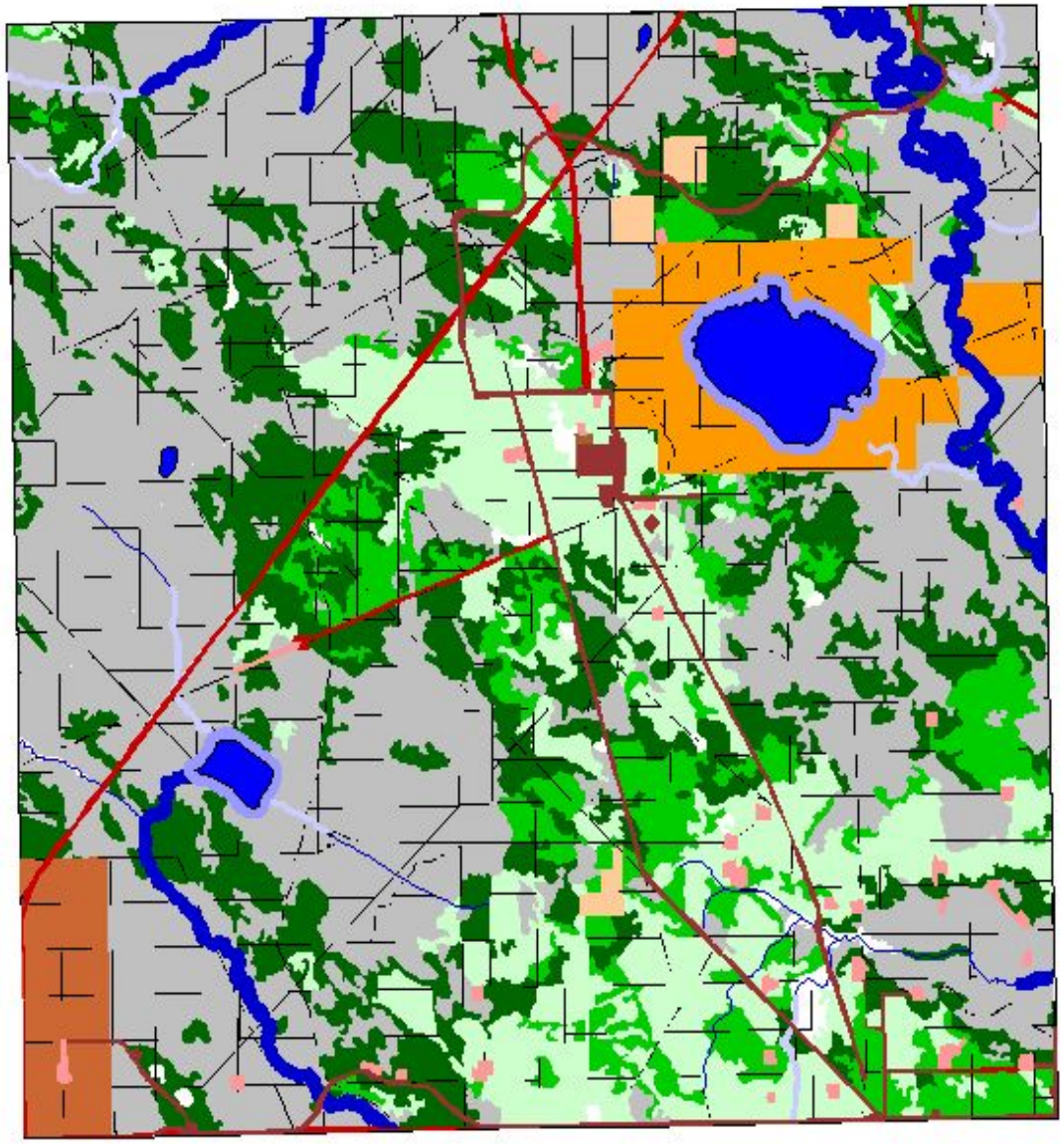
- Diverse eco-region (sub-alpine to foothills to parkland), coniferous to the west/higher and mixedwoods to the east/lower
- Fire has predominantly shaped the forest with natural fire cycles of 35 – 80+ years, but current forest is overmature (120+ years) as a result of ongoing forest protection i.e. > natural variability
- Of the total landscape in view, usually only about 50% of it is managed for timber (balance is protection, "non-productive", other land uses)
- Lots of public land grazing (MM ha. grazing dispositions)
- >000's of well sites and facilities
- Average 0.2 – 5+km. / km2 (wide range) of lineal developments
- Land withdrawals in 000's ha. per year

Forest Management 101

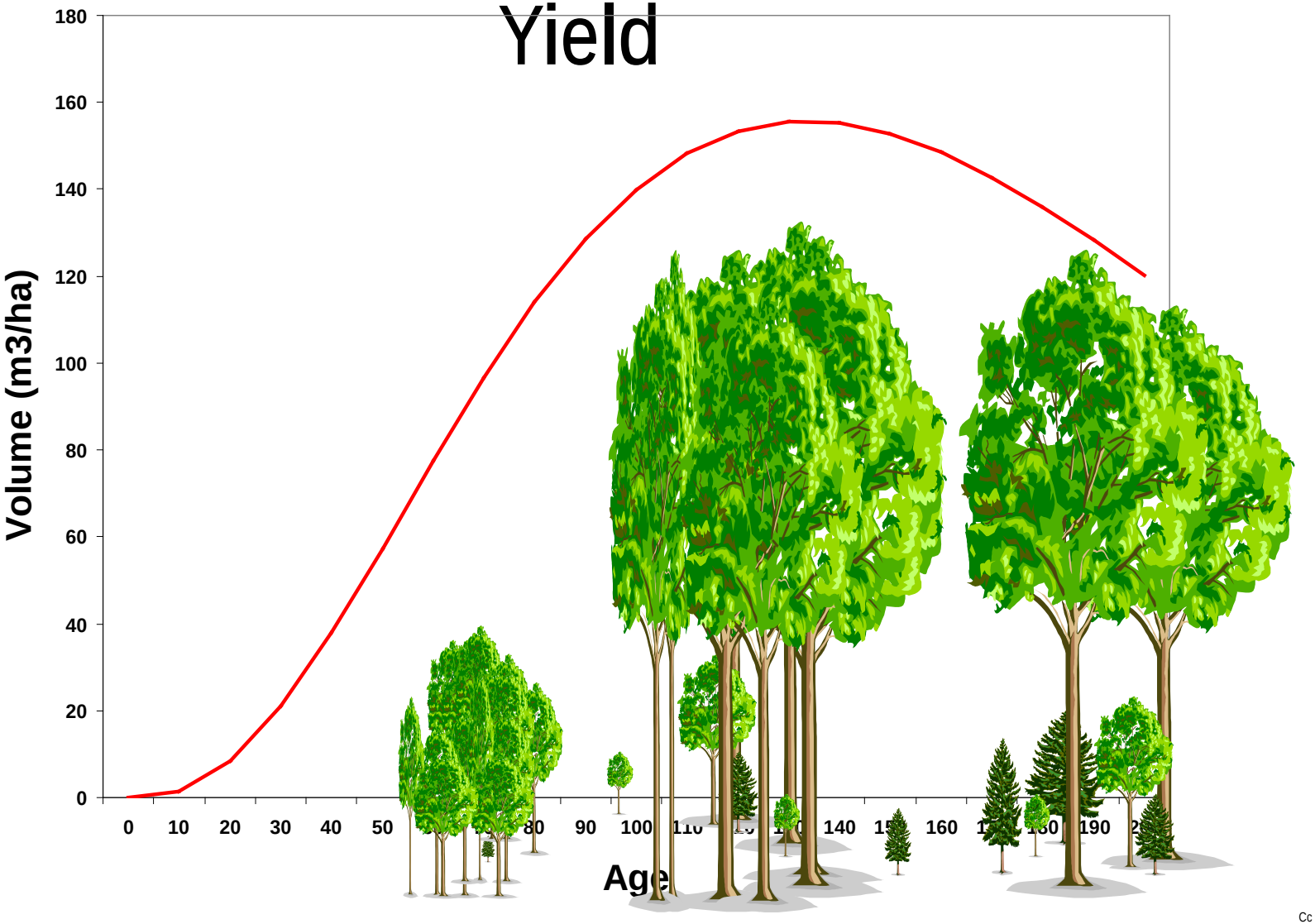


- Sustainable Forest Management
  - ✓Sustained yield of fibre - silviculture
  - ✓Watershed, ecological, biodiversity
  - ✓Conservation, protection
  - ✓Enviro certification
- Integrated Resource Management / ILM
- Detailed Forest Management Plans
  - ✓Strategic, long term (200+ year forecasts)
  - ✓Stakeholder engagement

Land & Forest Inventory



Yield

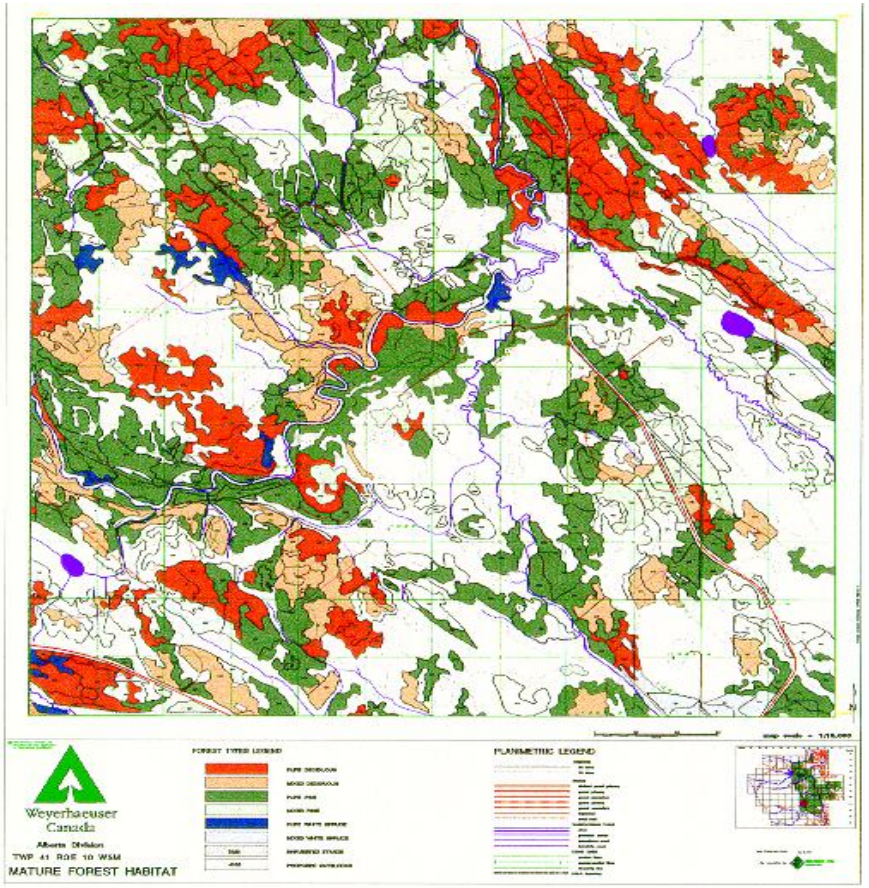

Volume (m3/ha)
180
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
80
90
100
140
160
Age

Harvest Design - Criteria

Wildlife

Watershed

Timber



Aesthetics

Logistics

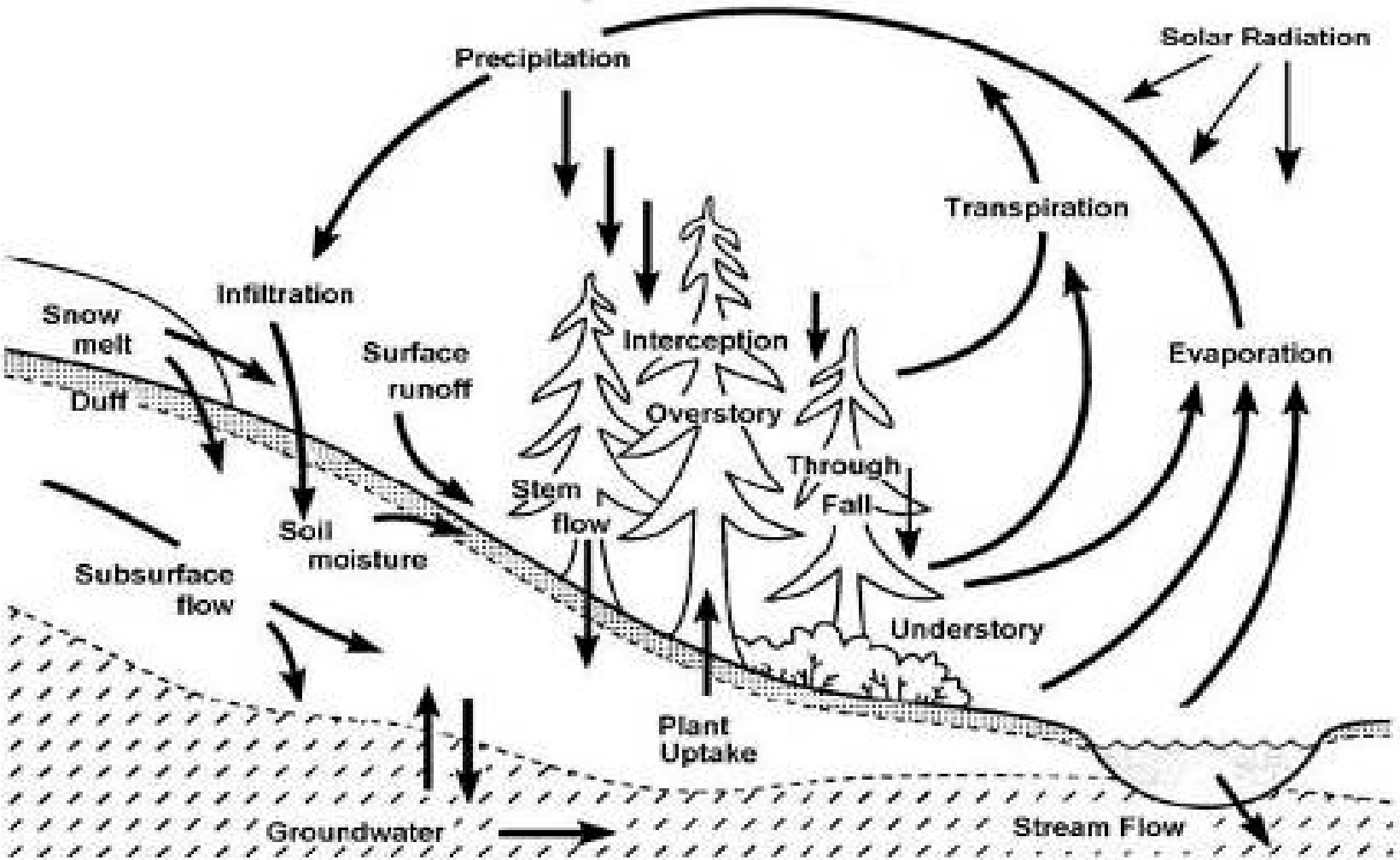
Ecological

Reforestation

Reforestation

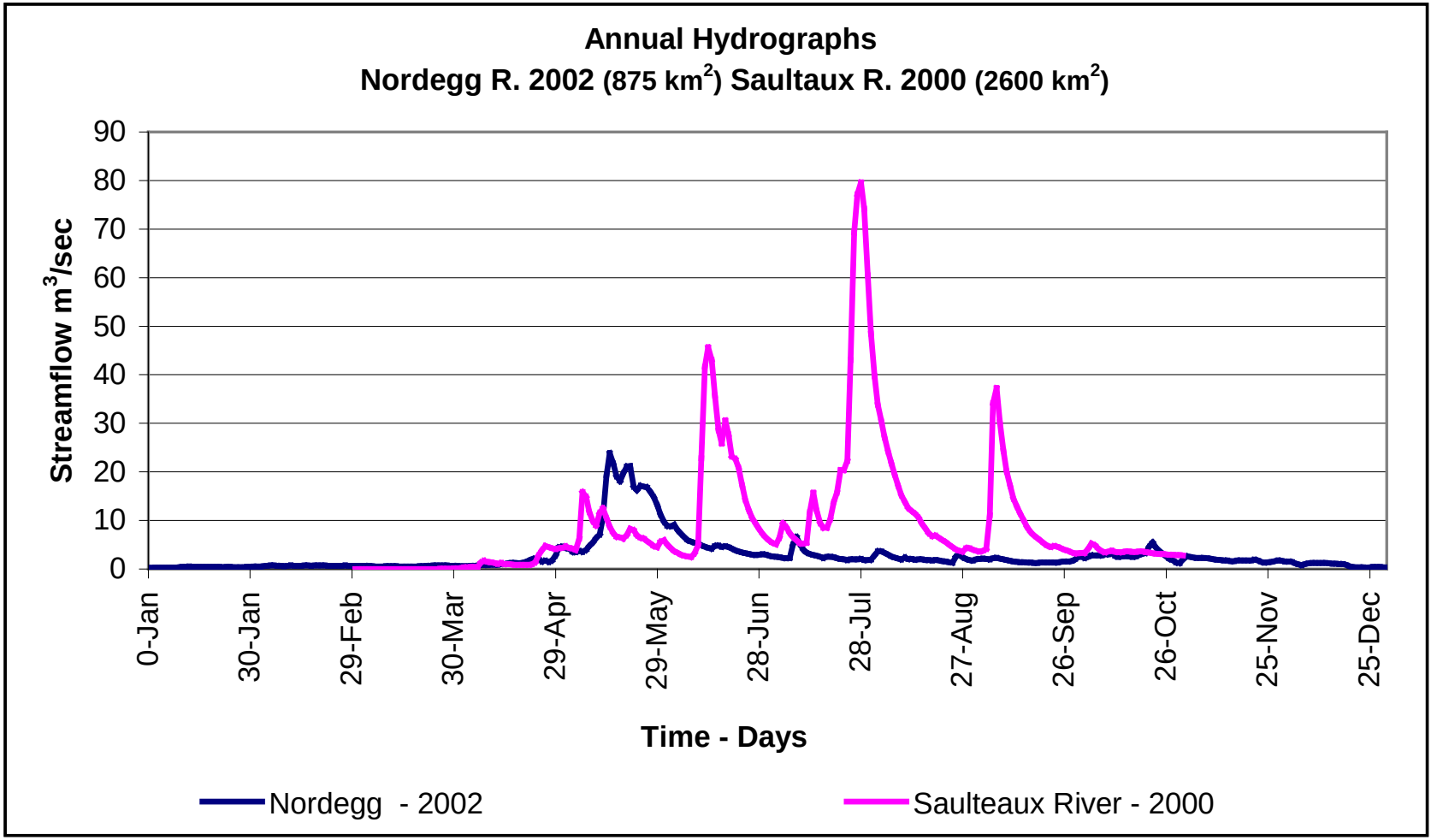
- ✓ All harvested areas are reforested to regulated standards
- ✓ We reforest to the same forest types that are there today
- ✓ Reforestation is monitored for up to 15 years to ensure success
- ✓ We plant over 4 million seedlings annually

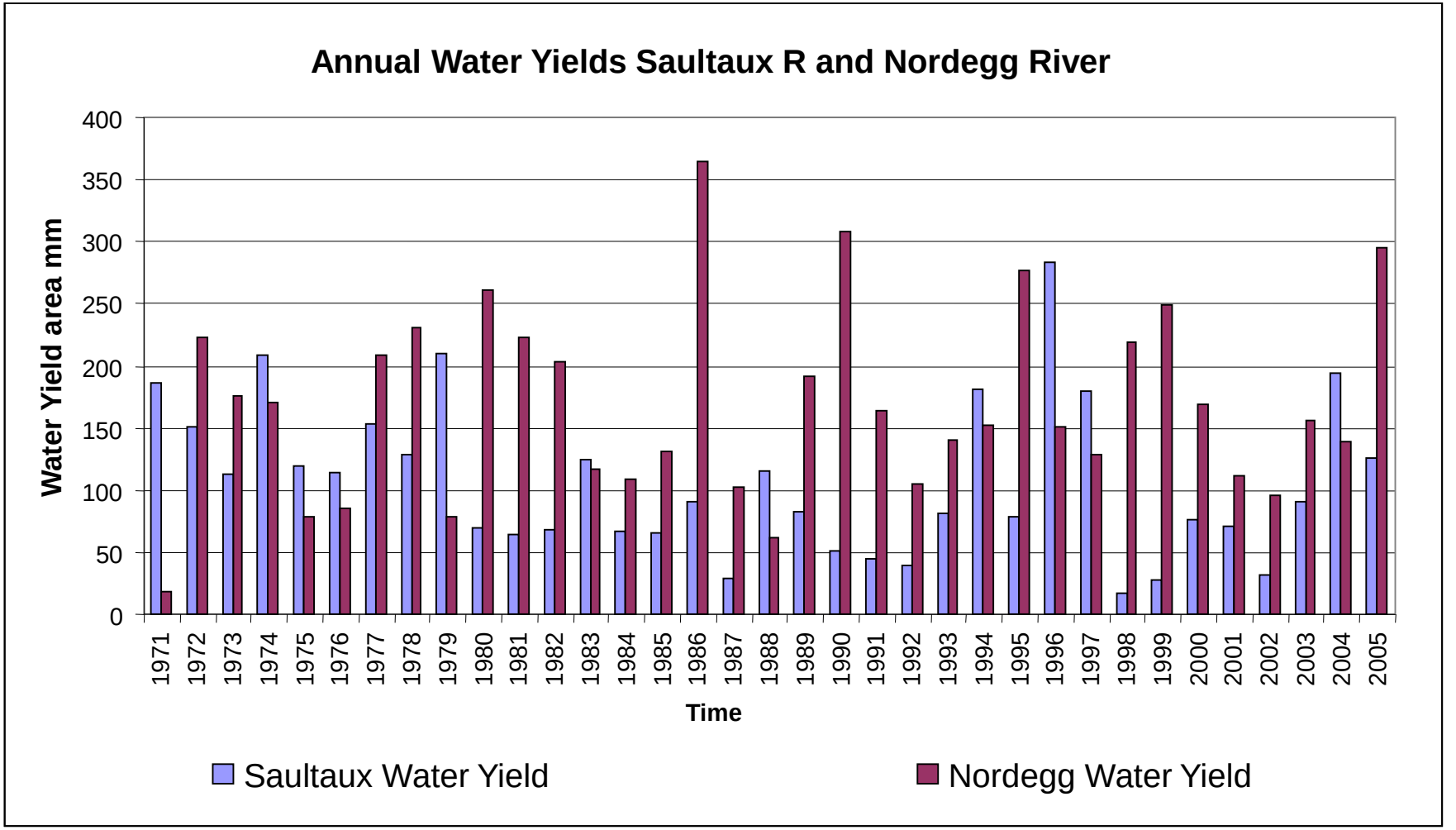
Forest Watersheds are highly variable



Forest Hydrology

- Simplified long term water balance expression $Q = P - ET$
  - Storage capacity, interception, groundwater fluxes minor
  - Not an exact science – modeling, broad assumptions, lack of baselines
- Watershed classification
  - Topographic divides (vs. phreatic or groundwater) & predictive mapping tools
  - Stream order (classification system)
- Streamflow - Foothills vs. Boreal Forest
  - Snow vs. summer rain, annual precipitation, ET potential
  - Storage capacity (landscape, soil types, wet area “sponges”)
  - Peak flows and recurrence intervals (extrapolation, deduction)
  - Effective discharge vs. storm events


Annual Hydrographs
Nordegg R. 2002 (875 km2) Saultaux R. 2000 (2600 km2)
Streamflow m3/sec
90
80
70
60
50
40
30
20
10
0
0-Jan
30-Jan
29-Feb
30-Mar
29-Apr
29-May
28-Jun
28-Jul
27-Aug
26-Sep
26-Oct
25-Nov
25-Dec
Time - Days
Nordegg - 2002
Saulteaux River - 2000


Annual Water Yields Saultaux R and Nordegg River
Water Yield area mm
400
350
300
250
200
150
100
50
0
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Time
Saultaux Water Yield
Nordegg Water Yield

Forestry Impacts on Water Yield

Timber harvesting & water yield:

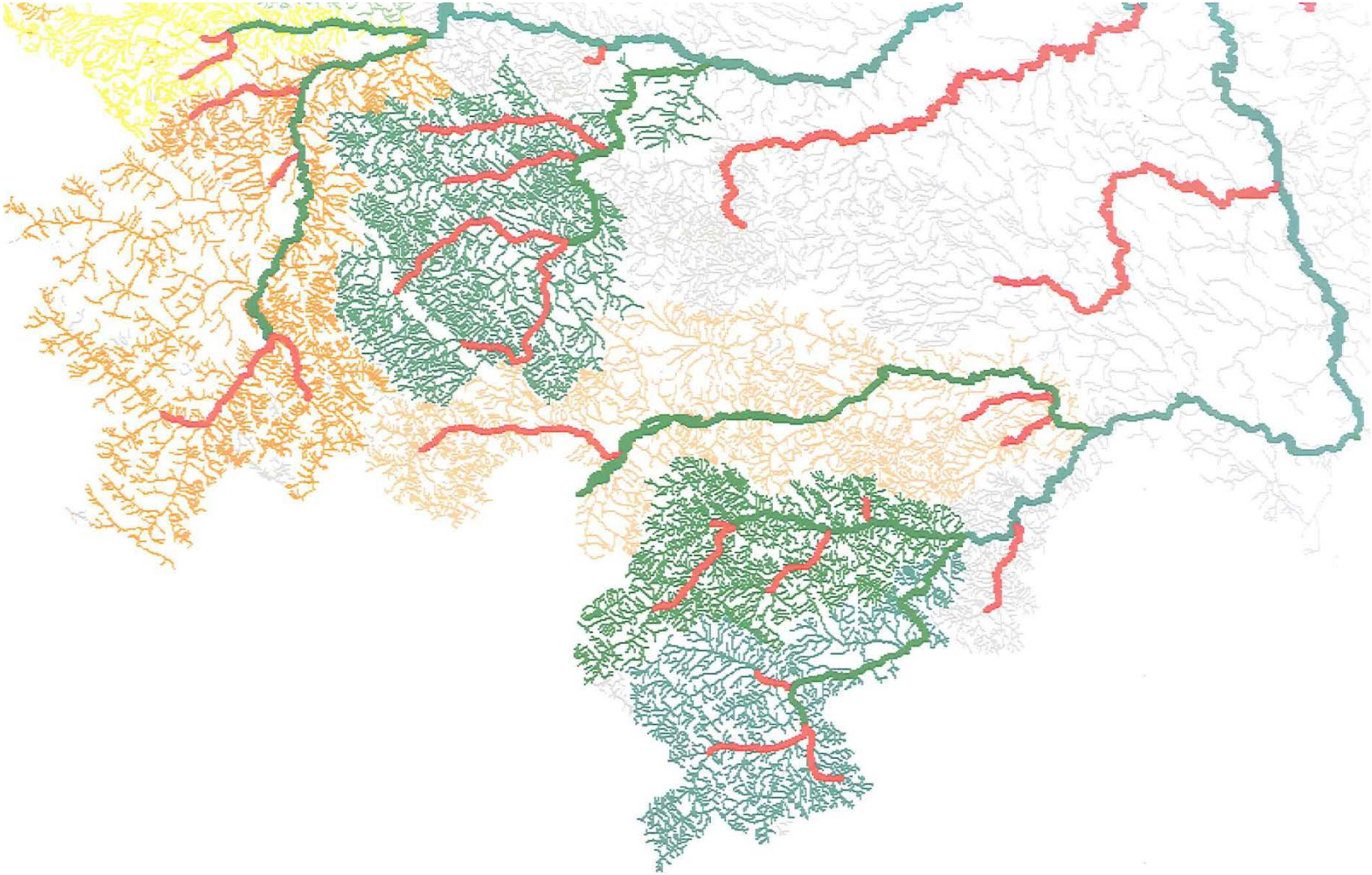
- Timber removal = reduced ET, reduced interception, increased run-off / stream flow (peak flow metric)
- Cooler, drier Alberta climate = less effect (but Chinooks, wind)
- Greatest impact is immediately after timber harvesting, *hydrologic recovery* follows forest regeneration as measured by leaf area (speculative as to when but probably early age class)
- Greatest / significant impact occurs in small watersheds where *watershed response depends on % area harvested*

Timber harvesting & water yield (cont'd):

- Watersheds recover from disturbance providing the disturbance is within thresholds and the forest grows back
- Forest harvesting and reforestation is modeled by watershed over rotation cycles to determine maximum levels of disturbance / forest harvesting temporally and spatially = Equivalent Cut Area (ECA)
  - Watershed specific qualitative factors used in step analysis e.g. slope, soil conditions, critical habitats
  - Other models can be used as needed e.g. WRENNS
  - Quantitative assessment = constraining harvesting levels / patterns
- *Generally used trigger for watershed impact is >25% ECA at any point in time*

Timber supply modeling & watershed assessment

- Long term stand harvest sequencing (SHS) is overlaid on watershed information to determine when & where disturbance (harvest) levels may exceed guidelines / thresholds
- May constrain harvested area over time:
  - Limit initial harvested area, further harvesting delayed until “recovery” is forecasted;
  - Single max entry vs. multiple small entries



Spatial Harvest Sequence

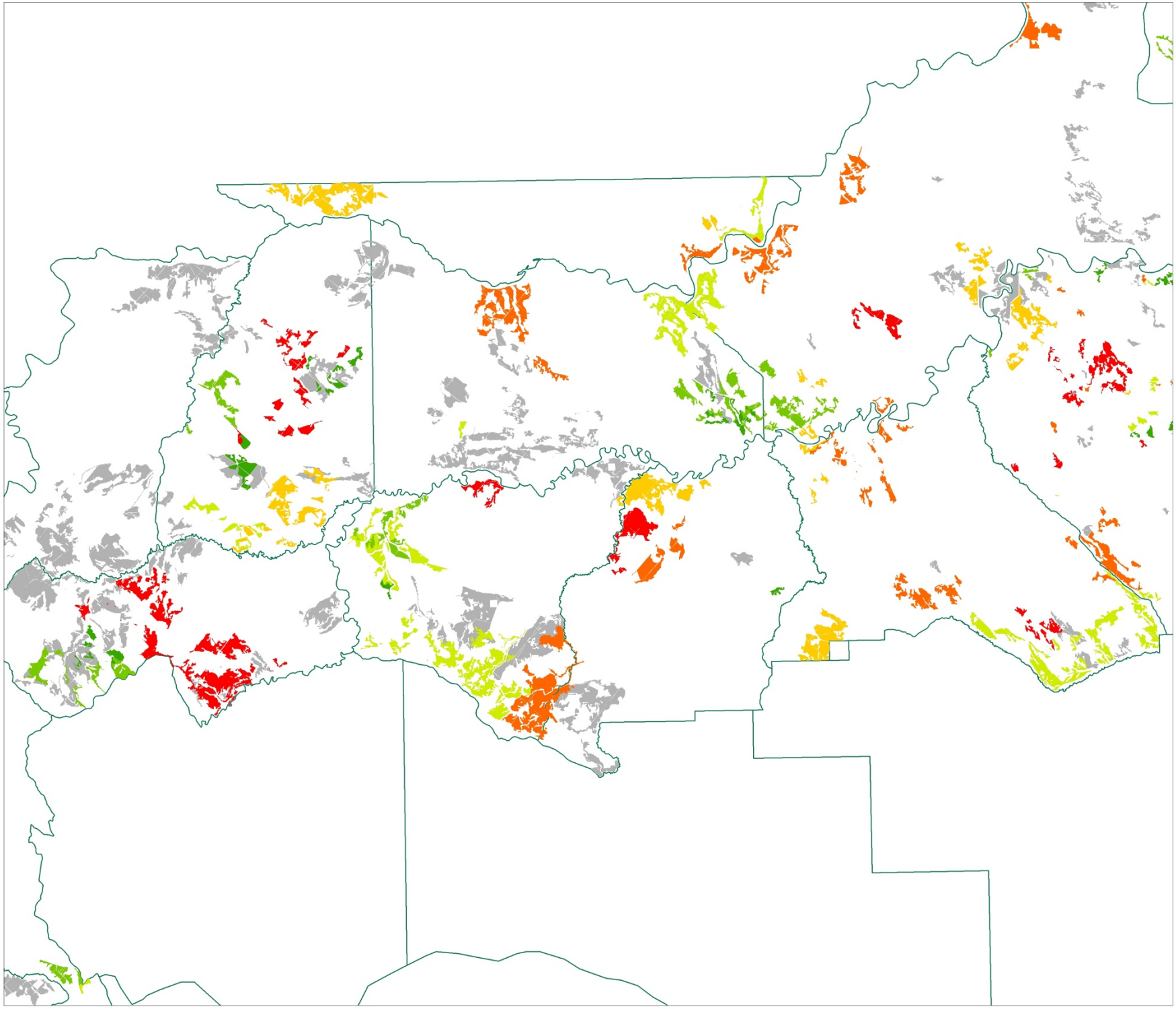
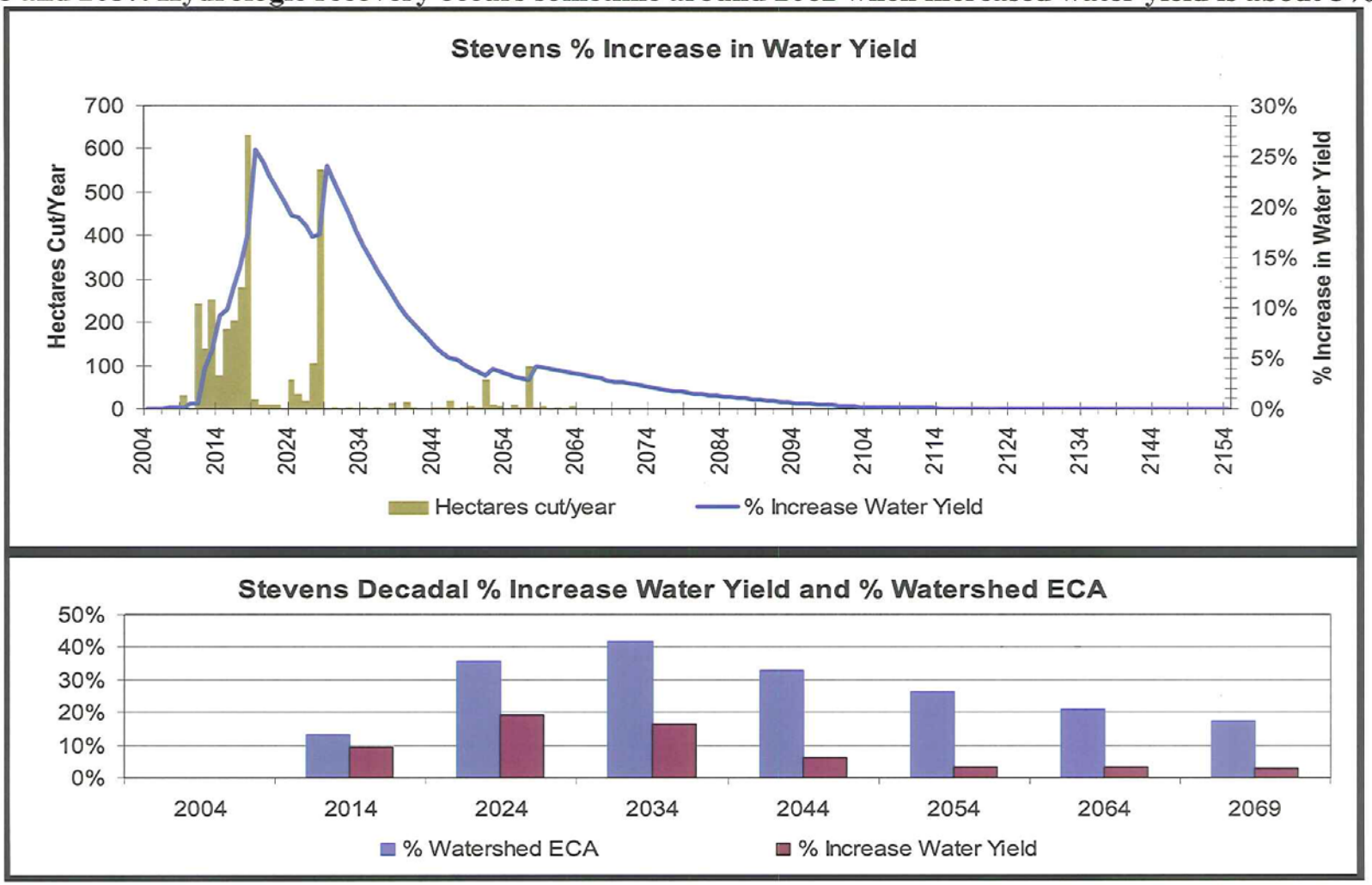


Figure 4 Simulated water yield response to forest harvesting in Stevens Creek. Maximum increase of 25% in water yield occurred in 2019, followed by a second peak in 2026. Recovery follows with two small peaks in 2048 and 2057. Hydrologic recovery occurs sometime around 2062 when increased water yield is about 5%.



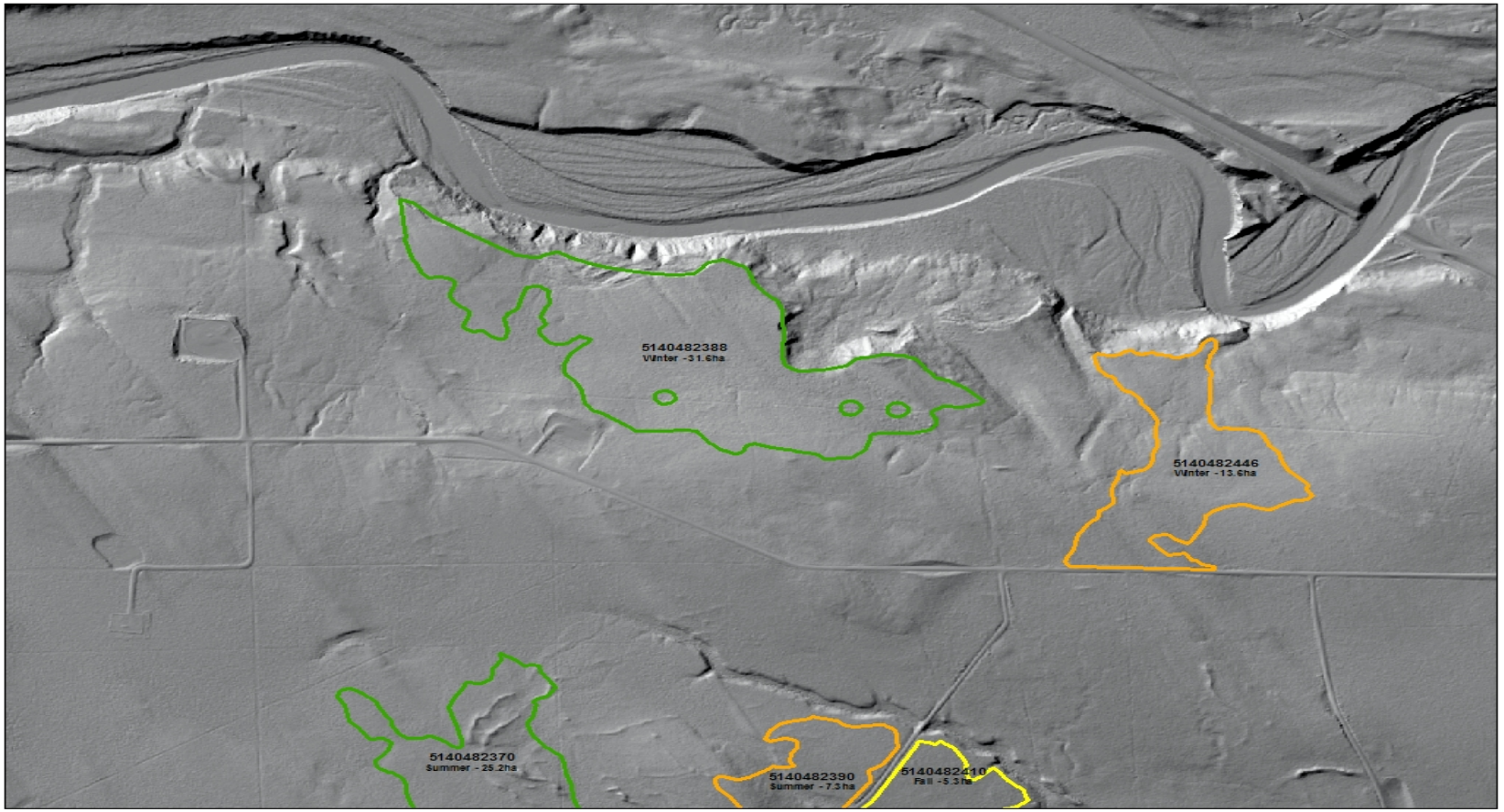
Forestry Impacts on Water Quality

- Roads and stream crossings
  - Sedimentation
  - Stream flow
  - Habitat (water temp, substrate, dissolved oxygen, nutrients, cover), fishing pressures (access control, regulations)
- Increased mineral / nutrient run-off during post-harvest early regeneration
- Non-forested area (grazing, roads, pipelines, leases, etc.) increasing
- Difficulty in monitoring non-point sources of sedimentation
  - Landscape / cumulative effects
  - Natural variance as the benchmark
  - *Chronic low level vs. acute / peak flow events*

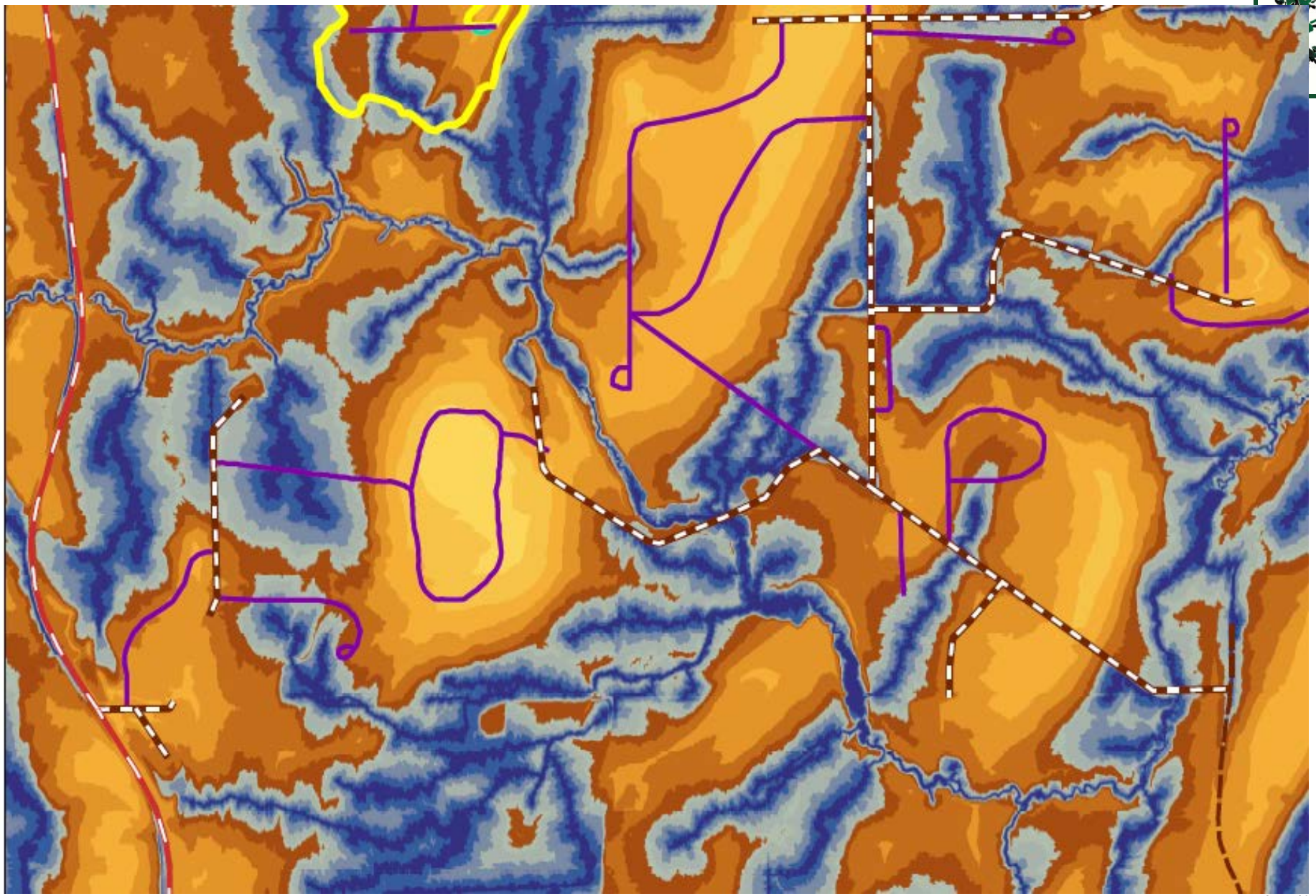
Water Quality Protection

- Reforestation – prompt, stocking, growth…
- Minimize stream crossings, minimize soil disturbance
- Crossing design & construction guidelines / standards (bridges preferred)
- Soil disturbance & erosion control standards, ongoing monitoring & inspections, maintenance plans
- Maintain undisturbed forest (“buffers”) on water source areas
- Timing restrictions i.e. frozen conditions only
- Reclamation and restoration on disturbed sites
- Detailed site planning for water source & sensitive soils (e.g. Wet Areas Mapping & LiDar)

Value of LiDar “bare earth”



Route selection using Wet Areas Mapping



Regulatory Framework

Provincial

- Presence of fish & critical habitat (or potential of) trigger
- Road & stream crossings guidelines and disposition conditions (below the Reg line)
- Wetland Policy (low impact from forestry operations)

Federal

- DFO
  - Permitted developments vs. Operating Guidelines
  - “Deposition of deleterious material”
- Nav Waters
  - Amendments to ease pressure for triggering CCEA, defining navigable

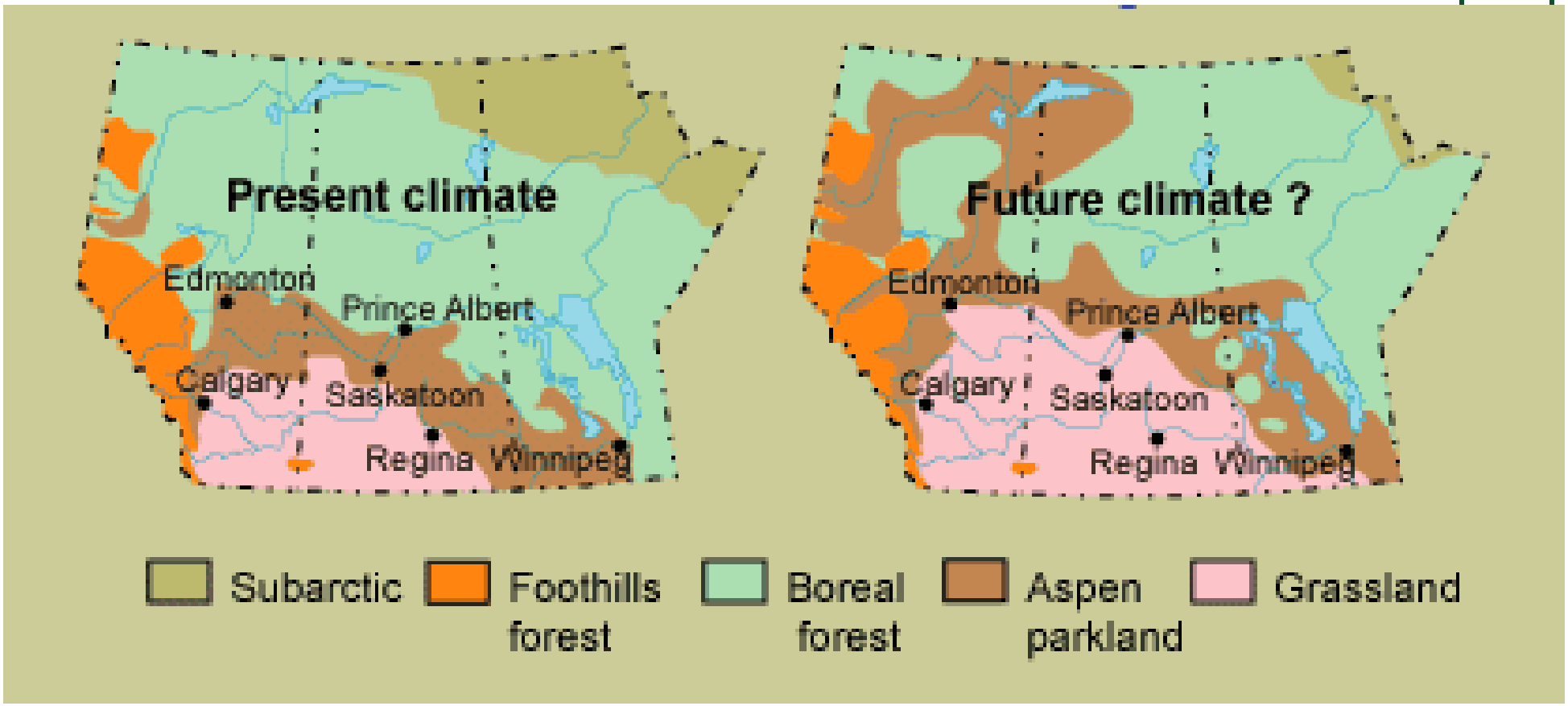
Some “best practices” are better than others...

Watershed Management (cont'd)

Future Strategic:

- Better methods to map watershed / watersource areas
- Challenges to modeling (research):
  - Anthropogenic vs. natural variability?
  - Referencing "pre/undisturbed" watersheds?
  - Stream valuations (i.e. not all the same)
- Natural disturbance events (MPB, fire, severe weather)
- Larger scale cooperative (e.g. Ducks Unlimited project, Foothills Stream Xing Assoc, FPInnovations, critical fish habitat inventories)
- Integrated Land Management to manage cumulative footprint & footstep
- Climate change and changes to forest cover (under research)

Potential Vegetation Changes



(Hogg and Hurdle 1995)

Research on Forest Disturbances and Watersheds

- Disturbances = increased precipitation run-off, increased source of sediment & nutrients, changes in snow retention, fish habitat
- Impacts are difficult to model & predict due to relationships between landform, soil, wetlands, weather variables, types of disturbances, and determining recovery (esp. time)
- Impacts are highly variable (expressed as % of change relative to undisturbed), and large range of significance
- Most important factors are size of disturbance, landform, regional climate, forest condition, associated soil disturbance
- Most important factors of mitigation are wetlands capacity, soil (groundwater) capacity, weather, retained forest cover (buffers), prompt reforestation

University of Alberta

Southern Rockies Watershed Project (fire & logging)

- Water cycling in the Headwaters
- Water quality
- Stream ecology

forWater (NSERC proposal)

- National network
- Forested drinking water source protection technologies
- Forest / land management strategies

FRI Research: Water Program

Tools and science for assessing and managing cumulative effects

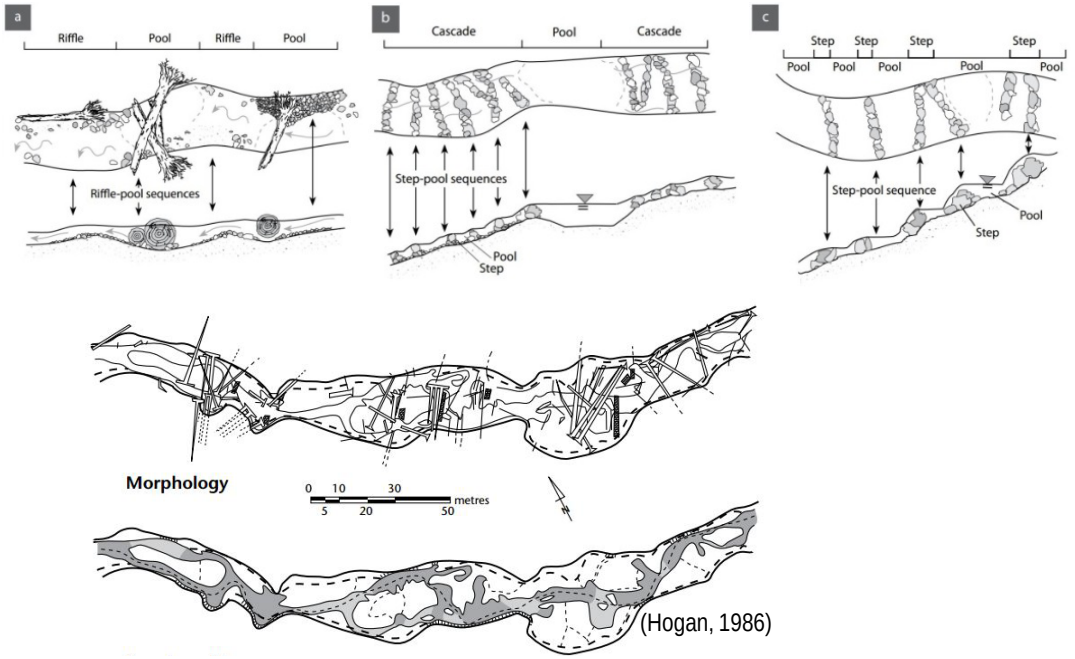
- Change to hydrology
- Riparian and Channel condition
- Sediment and Erosion.

Change to hydrology

1. Mountain Pine Beetle (Hinton area).
2. Groundwater surface water interactions in eastern slopes headwater stream (Crowsnest Pass).

Riparian Assessment

Testing the BC Forest & Range Evaluation Program (FREP) Protocol in SW Alberta

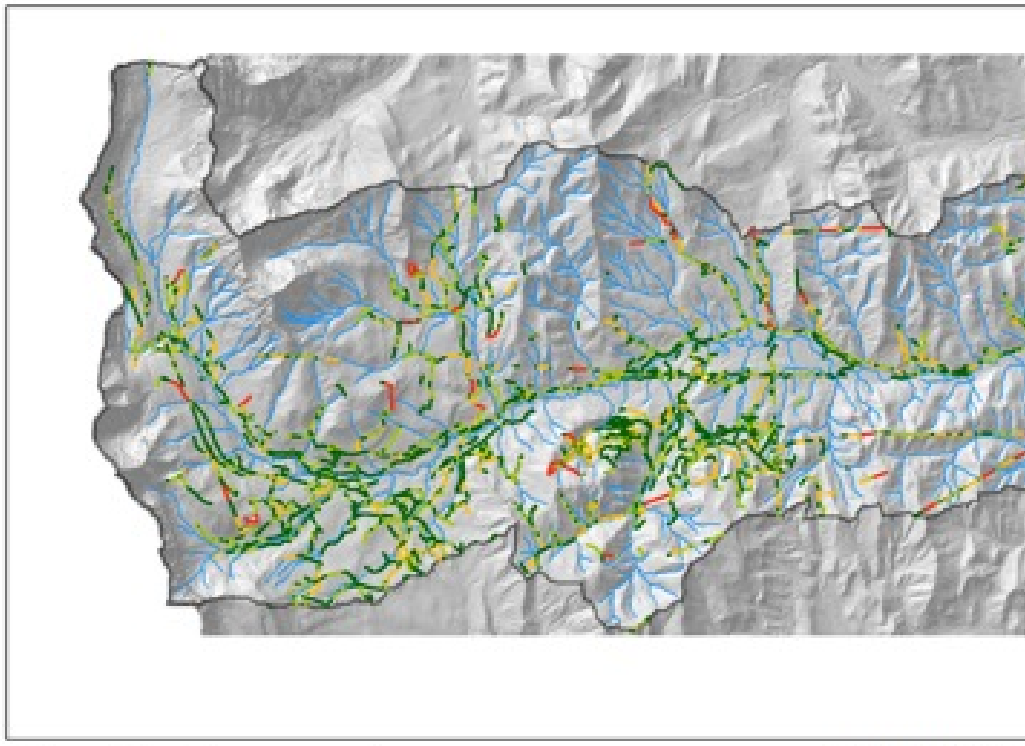


(Hogan, 1986)

Sedimentation Assessment

Testing field procedures and LiDAR and Modelling

Grande Prairie and Sundre area.



Summary:

- Watersheds recover from timber harvesting as long as the forest grows back and the disturbance is within limits
- Timber harvesting under sustainable forest management has little impact on water yield in higher order (larger) watersheds
- Natural disturbances / events / trends important looking ahead
- Roads and stream crossings!! ⇨ Integrated Land Management
- Improvement to resource assessment capacity
- Keeping the Green Zone green (with trees) is the role of forest management