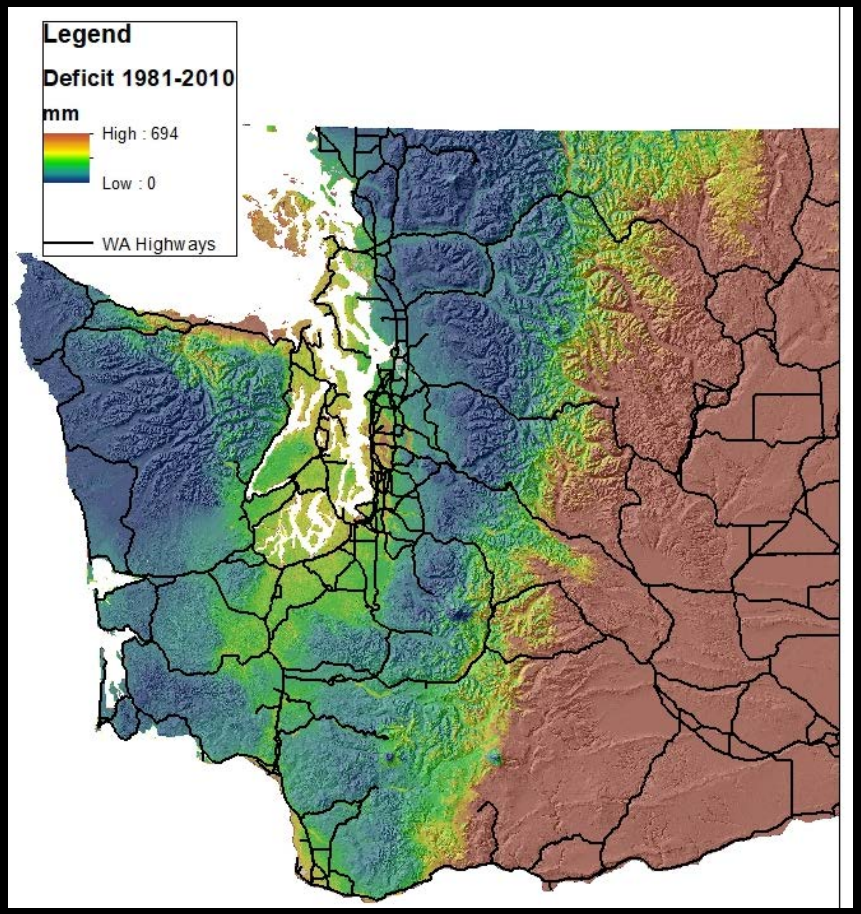
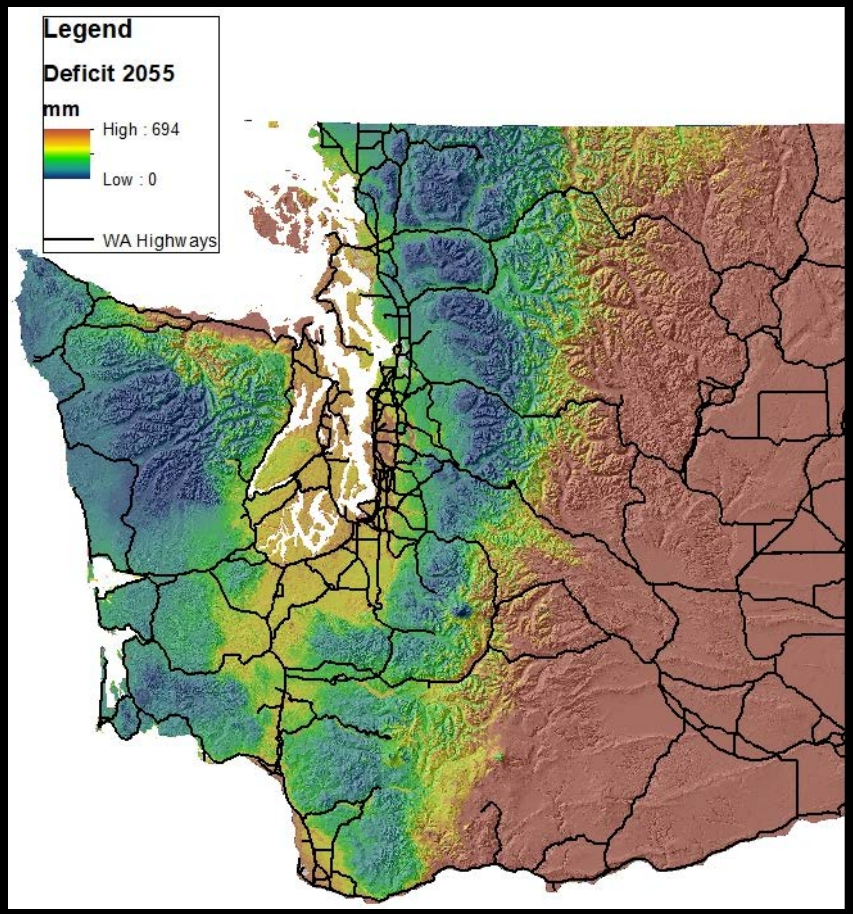
Silvicultural Strategies for Climate Change Adaption in the PNW





Derek Churchill
November 2019

Overview

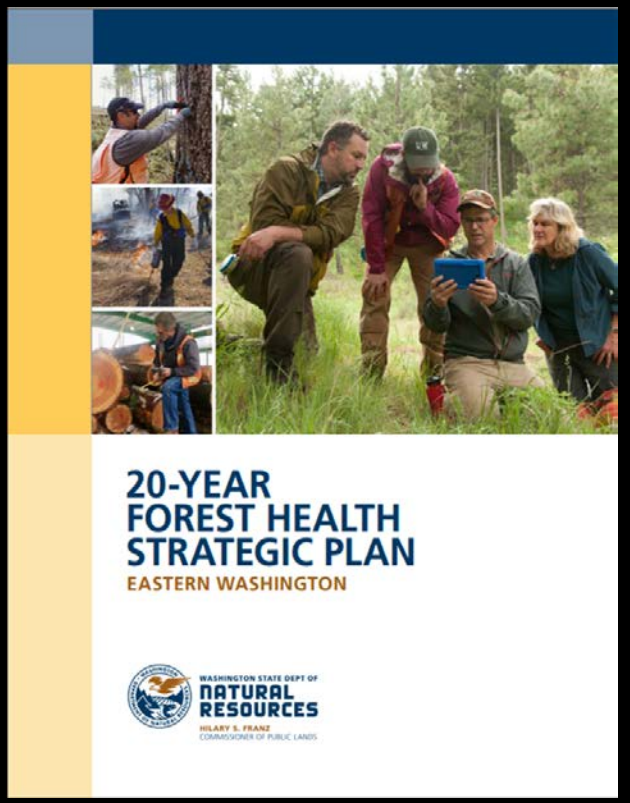
- Adaptive mindset: uncertainty, risk management, & resilience
- Strategies: what is different?
- Case studies from 3 different forest types

Adaptive Mindset

Shifting from optimizing for growth to managing for resilience.

Basic risk management to reduce exposure to higher uncertainty:

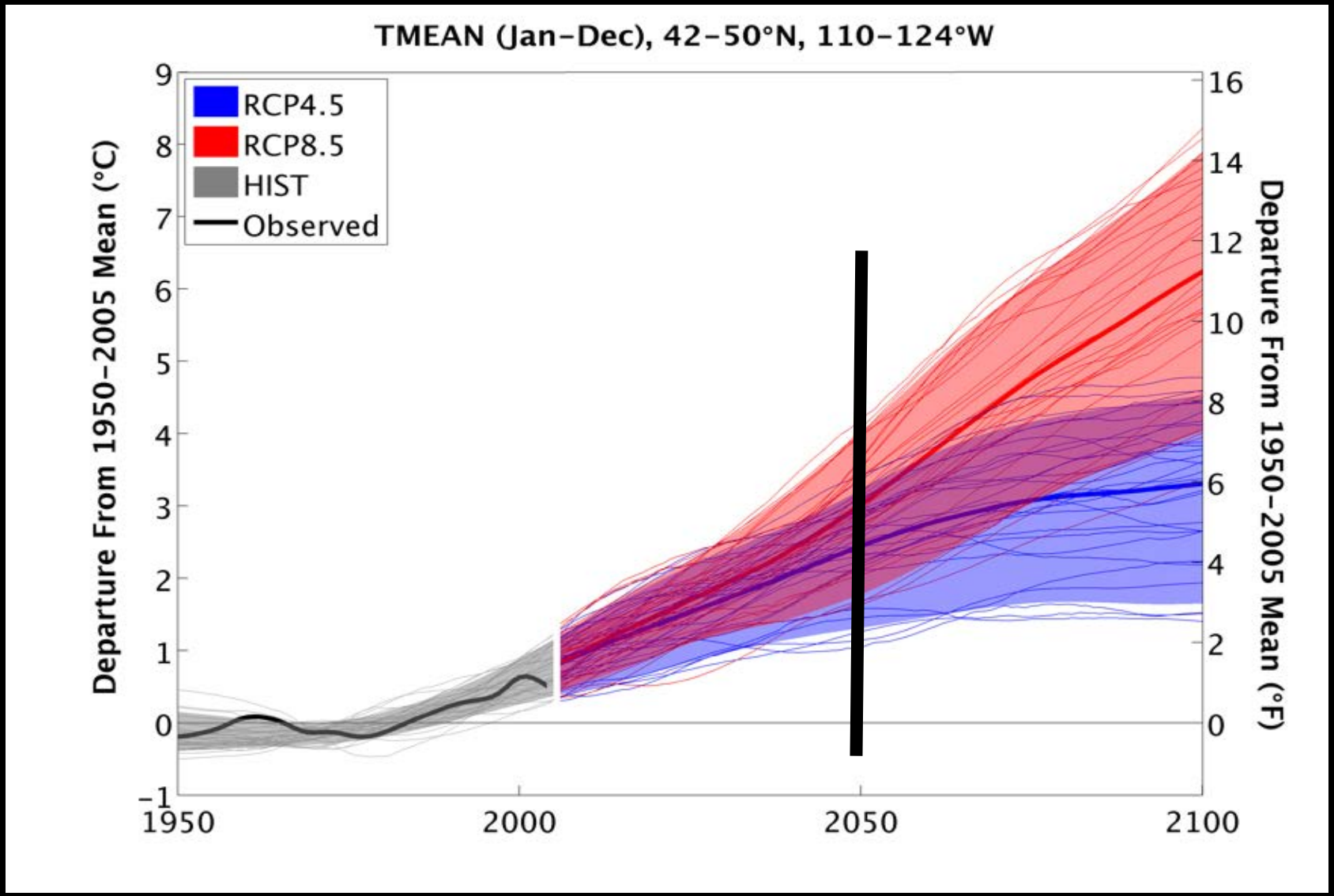
- Diversify portfolio
- Buy more insurance
- Give up higher financial returns ➔ lower risk of losses
- Increase resilience to known and unknown stressors
- Manage for systems that are less prone to big crashes
- Monitor change, adapt, and respond quickly



- Forest ecosystems in PNW are adapted to change
- Foresters are observant, creative, adaptive problem solvers.
- Silviculture has gone through lots of evolution.

Adaptive Mindset

Challenge of Time: What time period to manage for?



Overview

- Adaptive mindset: uncertainty, risk management, & resilience
- Strategies: what is different?
- Case studies from 3 different forest types

Strategies

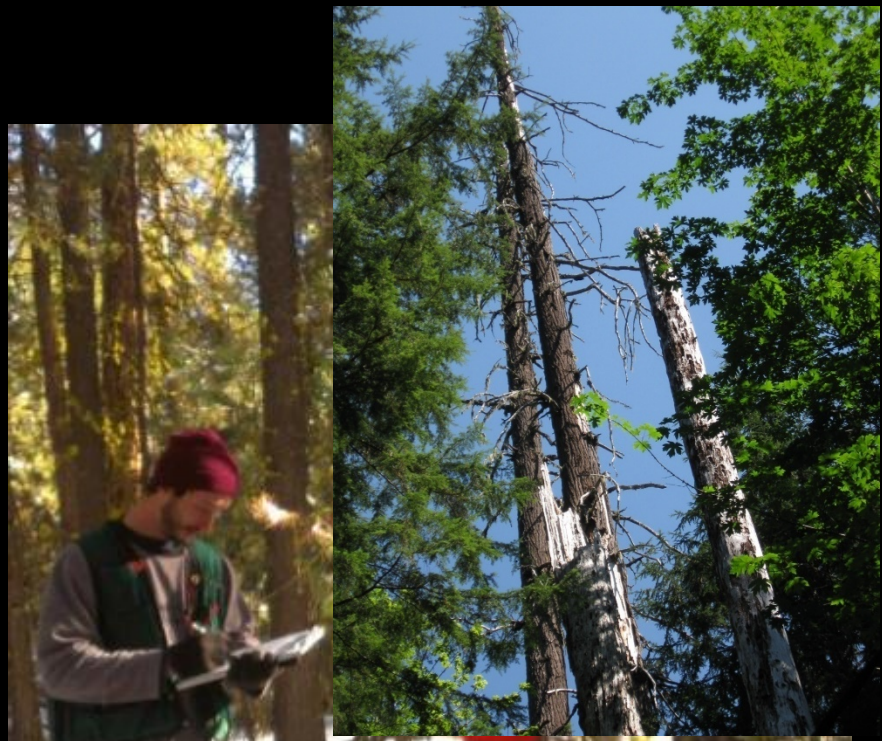
1. Increase monitoring efforts & response capability
2. Understand your site: Climate, soils, topography, and suitable vegetation types
3. Planting site adapted species & using different seed sources: shift to greater drought tolerance
4. Manage for diverse forests
5. Manage density
6. Maintain & increase soil water storage
7. Control invasive species

What is different than what I already do?

Strategies

1. Increase monitoring efforts & response capability

- Informal & formal
- Tracking seedling trials, mortality, etc.
- Share information with partners: ground data for larger scale monitoring
- Additional time & management cost



Strategies

1. Increase monitoring efforts & response capability

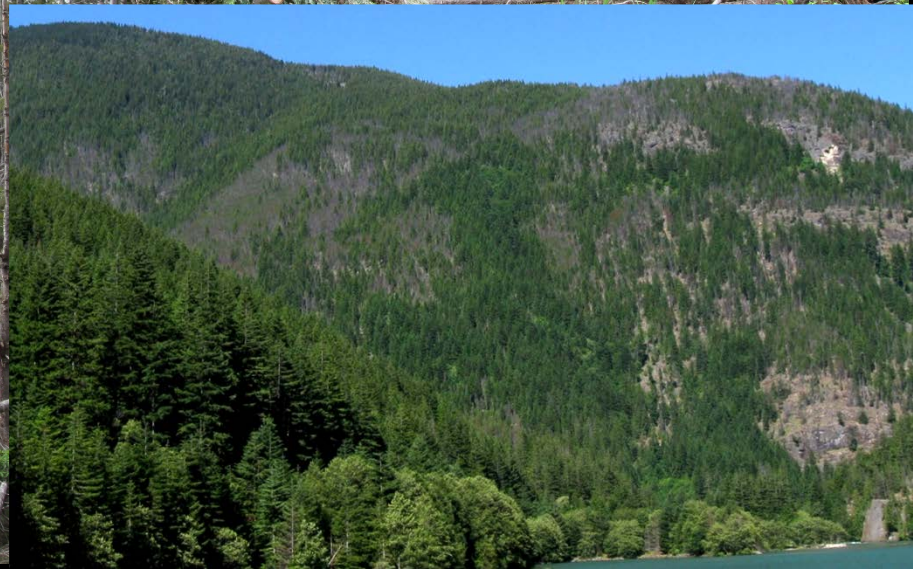
- Informal & formal
- Tracking seedling trials, mortality, etc.
- Share information with partners:
  ground data for larger scale
  monitoring
- Additional time & management cost

Phone/Tablet based monitoring
DNR protocol & public website with results

Strategies

1. Increase monitoring efforts & response capability

- Anticipate & plan for responses:
  - Mortality
  - Need to replant
  - Reframe salvage:
    green & dead tree treatments



Strategies

1. Increase monitoring efforts & response capability

- Anticipate & plan for responses:
  - Mortality
  - Need to replant
  - Reframe salvage:
    green & dead tree harvests
  - Opportunities for new planting

Strategies

2. Understand your site

- Climate
- Soils
- Topography: aspect, solar radiation
- Identify vulnerable forests on your ownership
- Determine site adapted vegetation types, current and future

Strategies

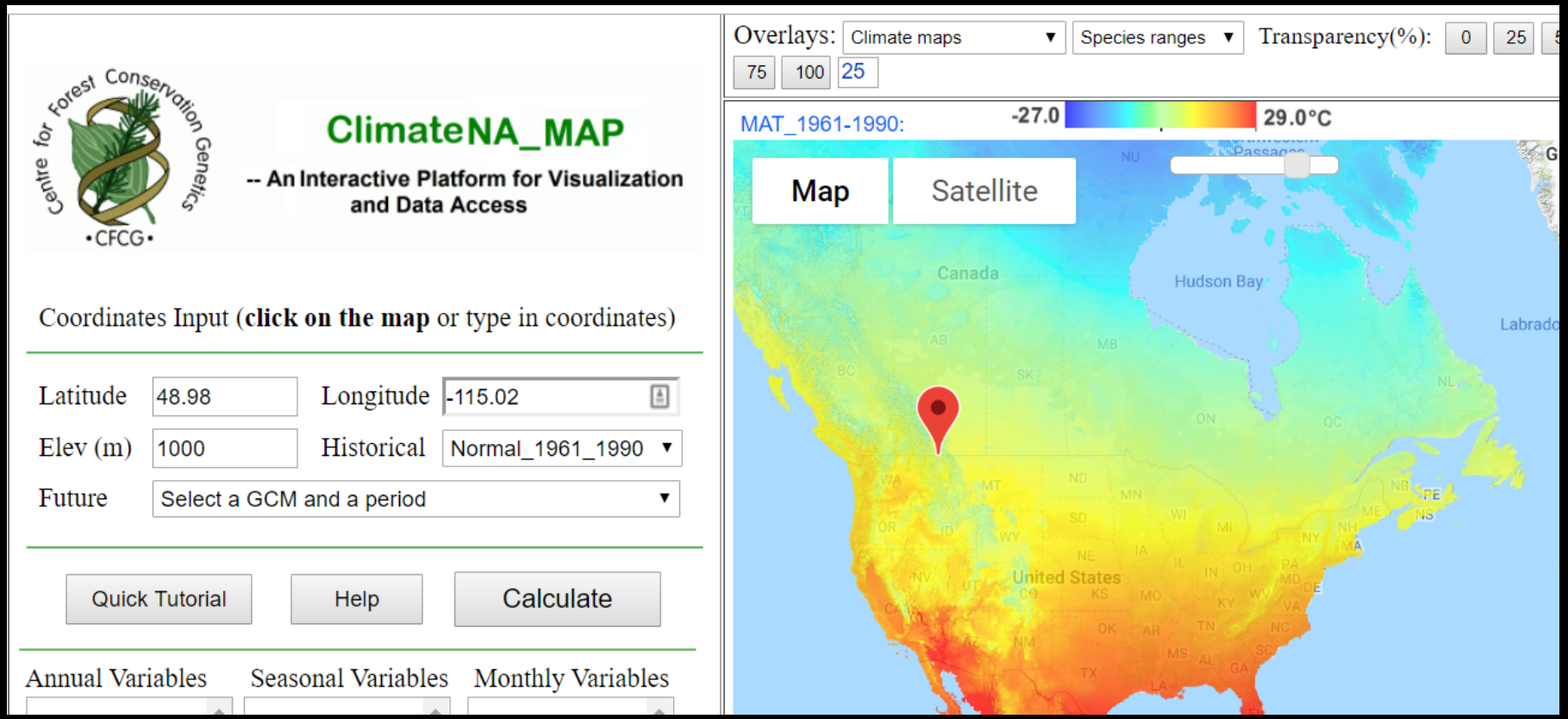
Making sense of projections for a specific place

2. Understand your site

- Climate:

- Lots of climate websites with downscaled projections
- Different degrees of change & species projections: different models & uncertainty

Filter through site factors & local knowledge: soils, microsites, etc



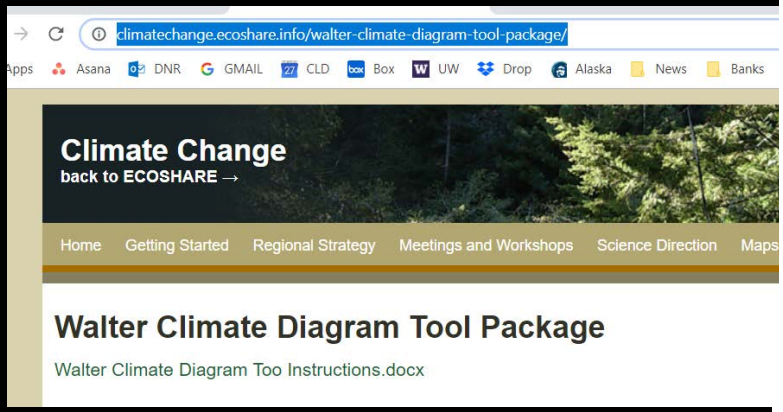
Strategies

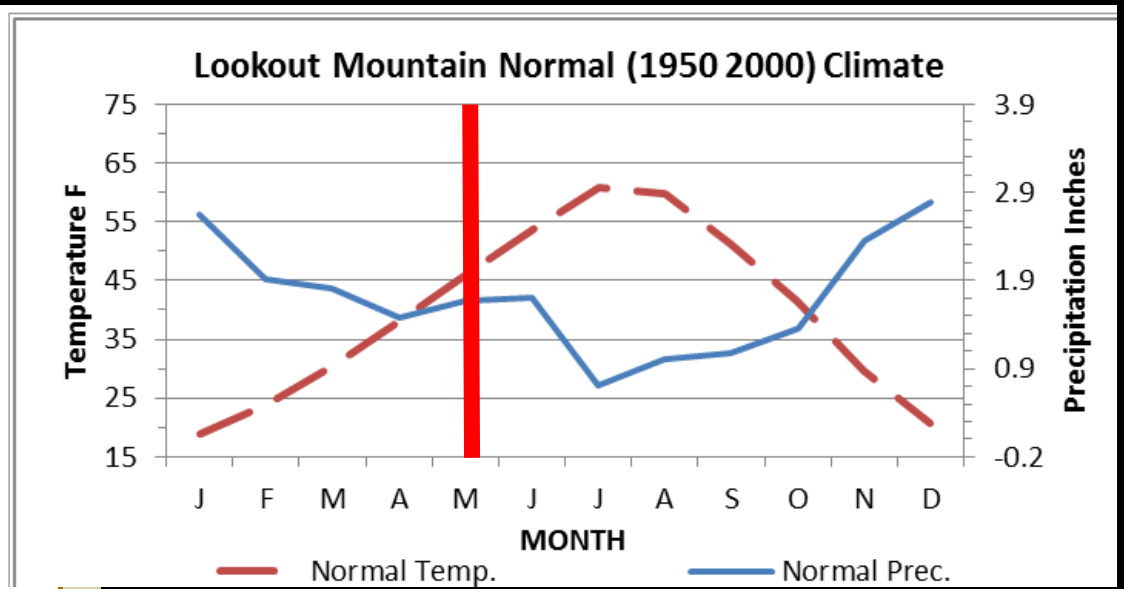
Making sense of projections for a specific place

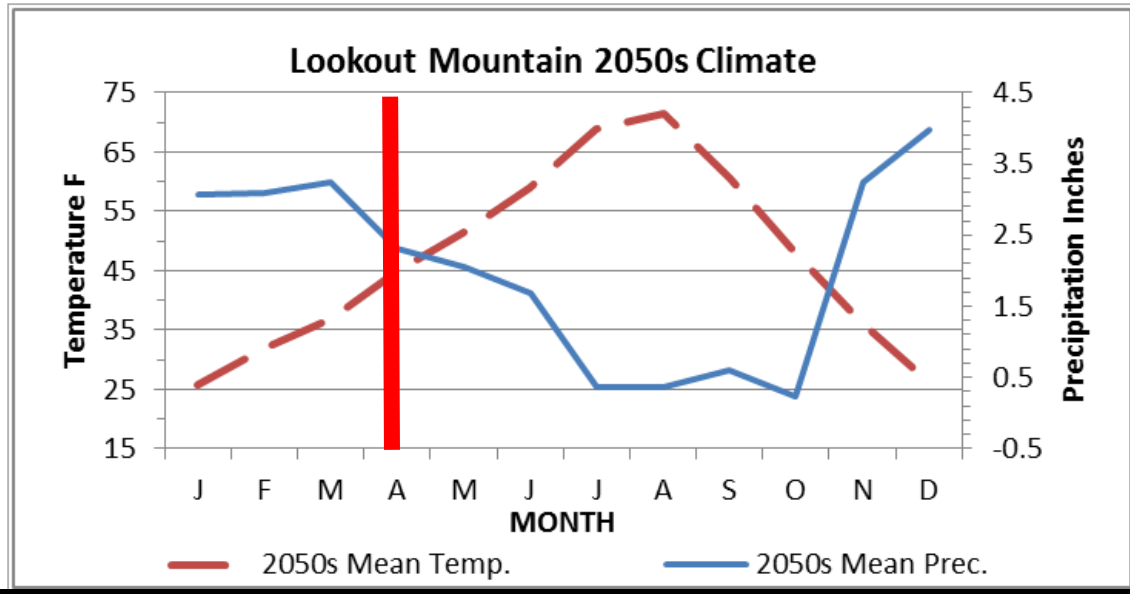
2. Understand your site

- Climate:

  - Local effects







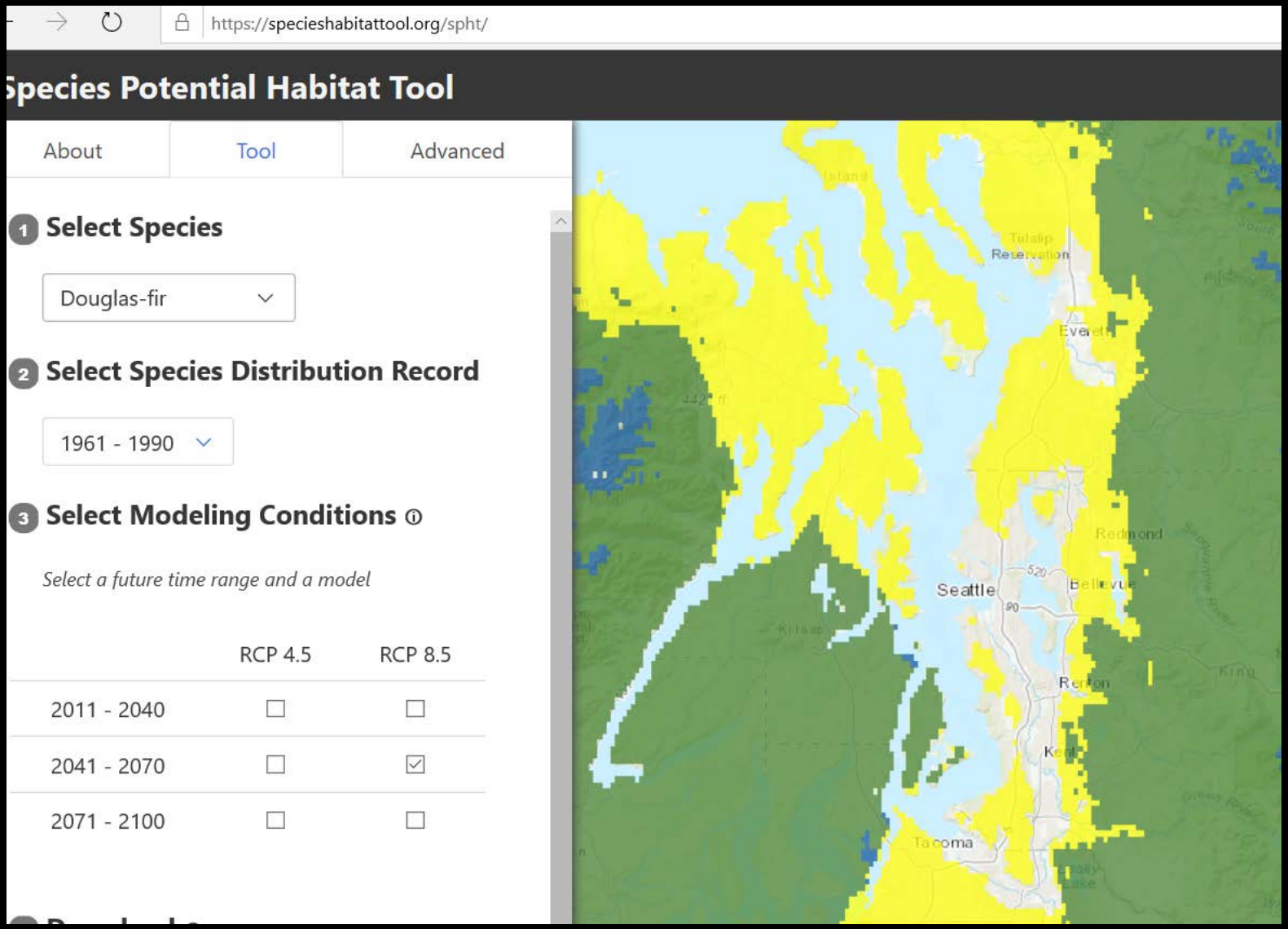
https://climatechange.ecoshare.info/walter-climate-diagram-tool-package/

Strategies

Making sense of projections for a specific place

2. Understand your site

- Climate: What does it mean for vegetation?



Strategies

2. Understand your site

- Soils: water holding capacity, nutrients, rooting depth.

Mail - Derek.Churchill@dnr.wa.g | Climate Change | Walter Climate | Web Soil Survey - Home | Web Soil Survey

websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Apps Asana DNR GMAIL CLD Box UW Drop Alaska News Banks Jack Ferry Maps NWS Spotify Scholar Rivers Forestry Other bookmarks

	70 percent slopes		
7	Bellingham silty clay loam	135.6	0.4%
8	Bellingham mucky silty clay loam	370.6	1.1%
10	Cathcart loam, 15 to 25 percent slopes	62.7	0.2%
11	Cathcart loam, 25 to 50 percent slopes	10.6	0.0%
14	Elwell silt loam, 3 to 30 percent slopes	1,848.0	5.7%
15	Elwell-Olomount complex, 15 to 30 percent slopes	2,460.9	7.6%

Map Unit Setting

National map unit symbol: 2hy1
Elevation: 330 to 1,970 feet
Mean annual precipitation: 60 to 80 inches
Mean annual air temperature: 45 degrees F
Frost-free period: 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Elwell and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elwell

Setting

Landform: Mountain slopes, ridges
Parent material: Volcanic ash over glacial till

ypical profile

H1 - 0 to 2 inches: medial silt loam
H2 - 2 to 23 inches: medial silt loam
H3 - 23 to 27 inches: gravelly medial fine sandy loam
H4 - 27 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 30 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.60 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Forage suitability group: Limited Depth Soils (G003XF303WA)
Hydric soil rating: No

Description — Map Unit Description

Web So... Vashon ... DRAFT ... Churchi... Gerson... 12.5.19 ... NCF_Ec... NCF_ti... NW_Sci... Churchi... Churchi... Vashon... Vashon ...

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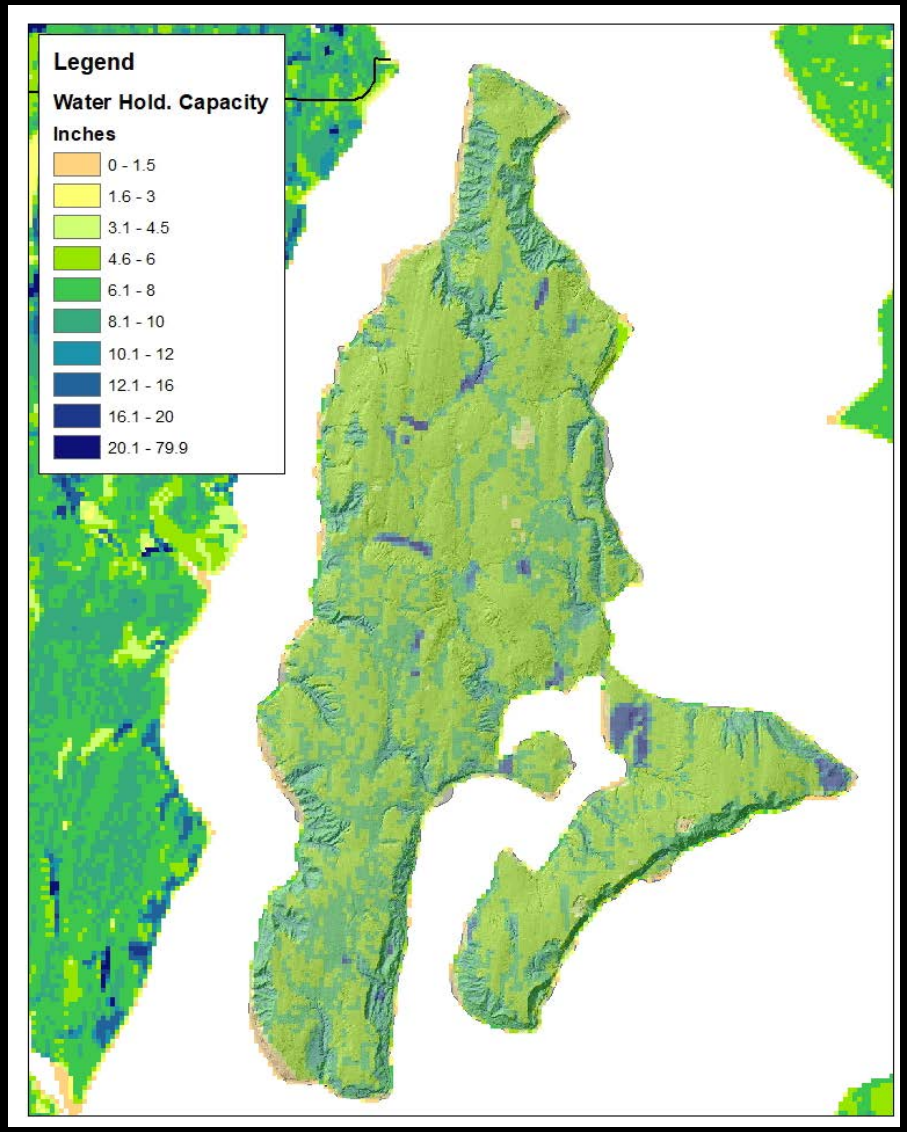
11/6/2019

Strategies

2. Understand your site

- Soils: dig some pits!! Construction, roads, etc.



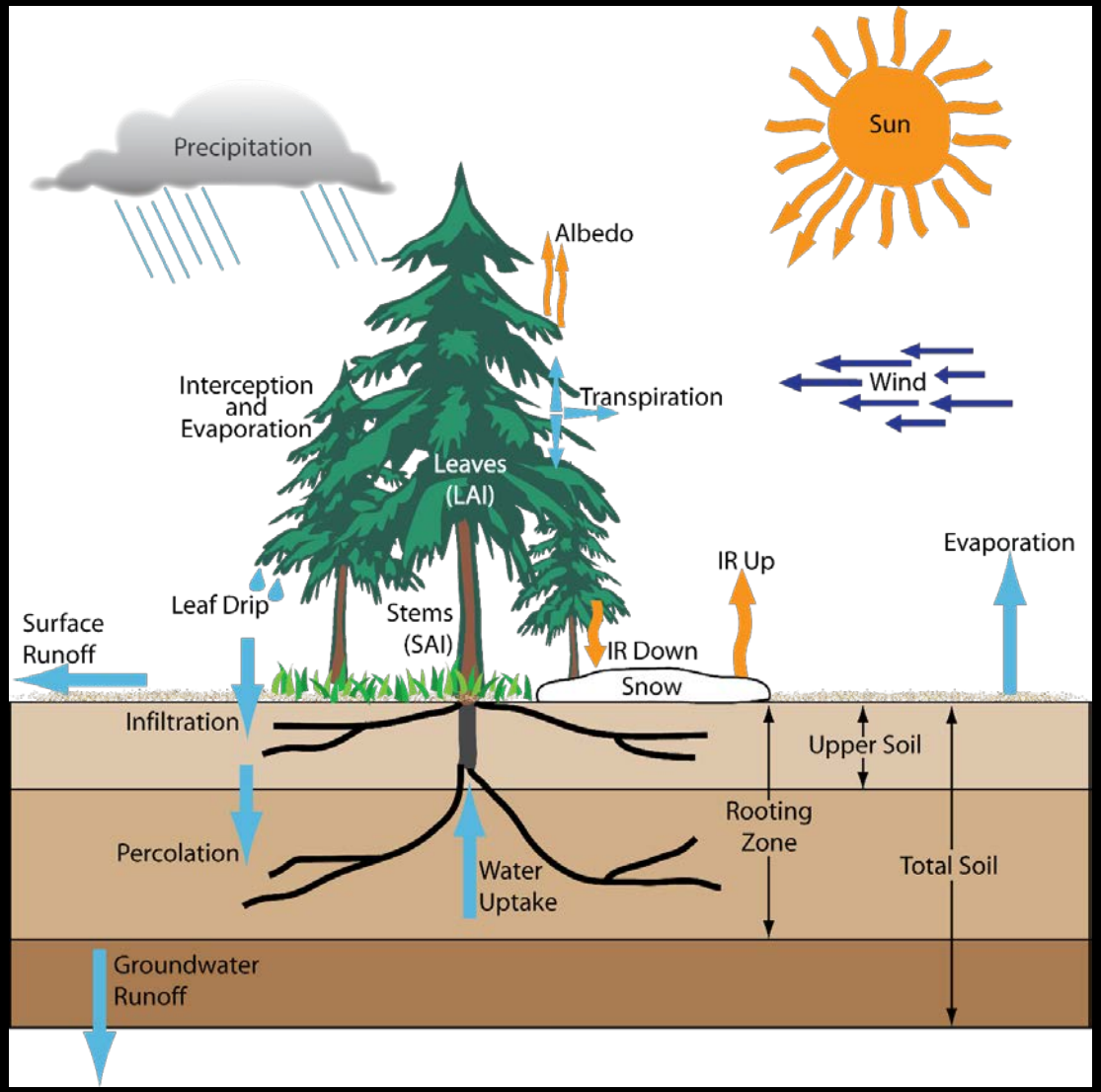
Strategies

2. Understand your site

- Integrating climate, soils, & topography/solar radiation

Deficit = amount of drought stress due to lack of water when solar radiation is high

AET: amount of water transpired ~ productivity



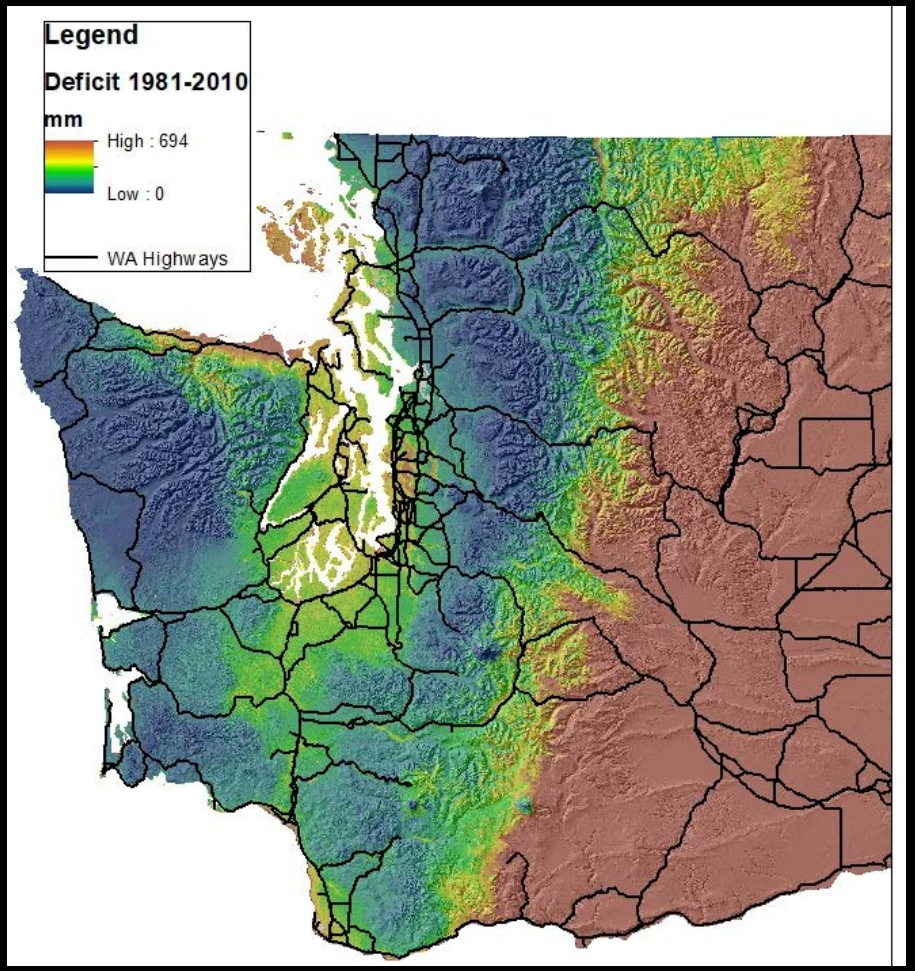
Strategies

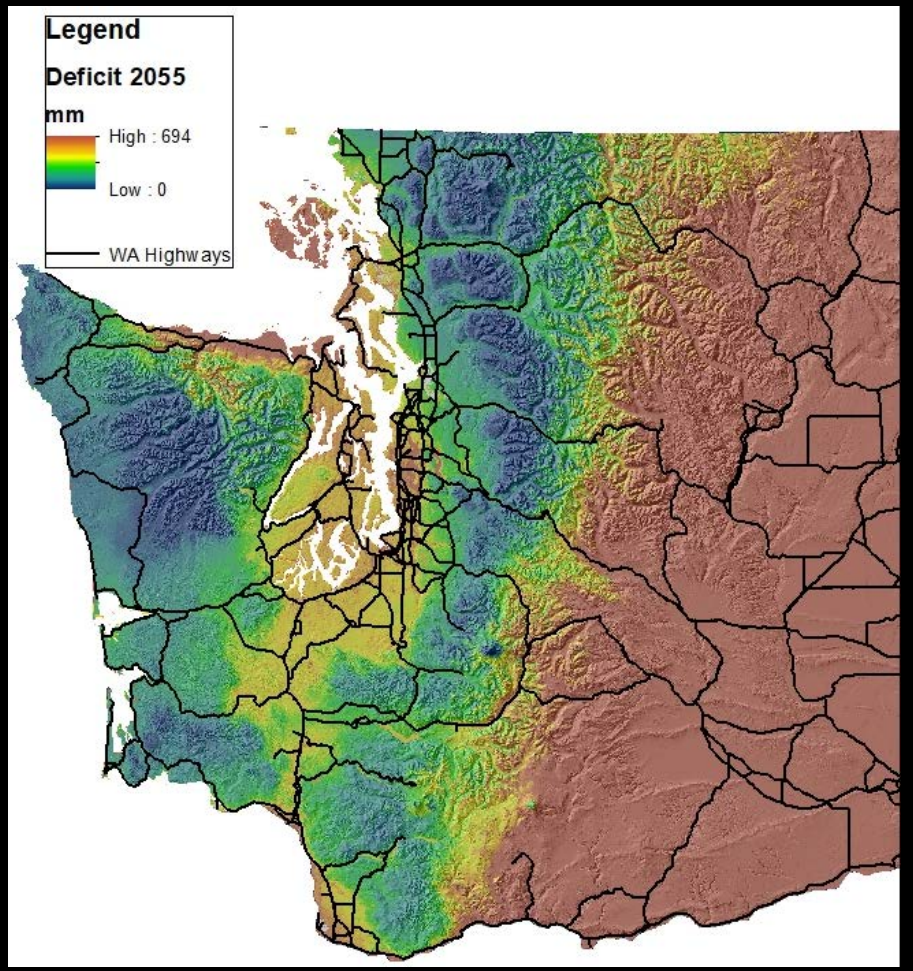
Making sense of projections for a specific place

2. Understand your site

- Deficit

https://deptofnaturalresources.box.com/s/35fo42x05zr88mr3n1rf4h3zuq9mx14j



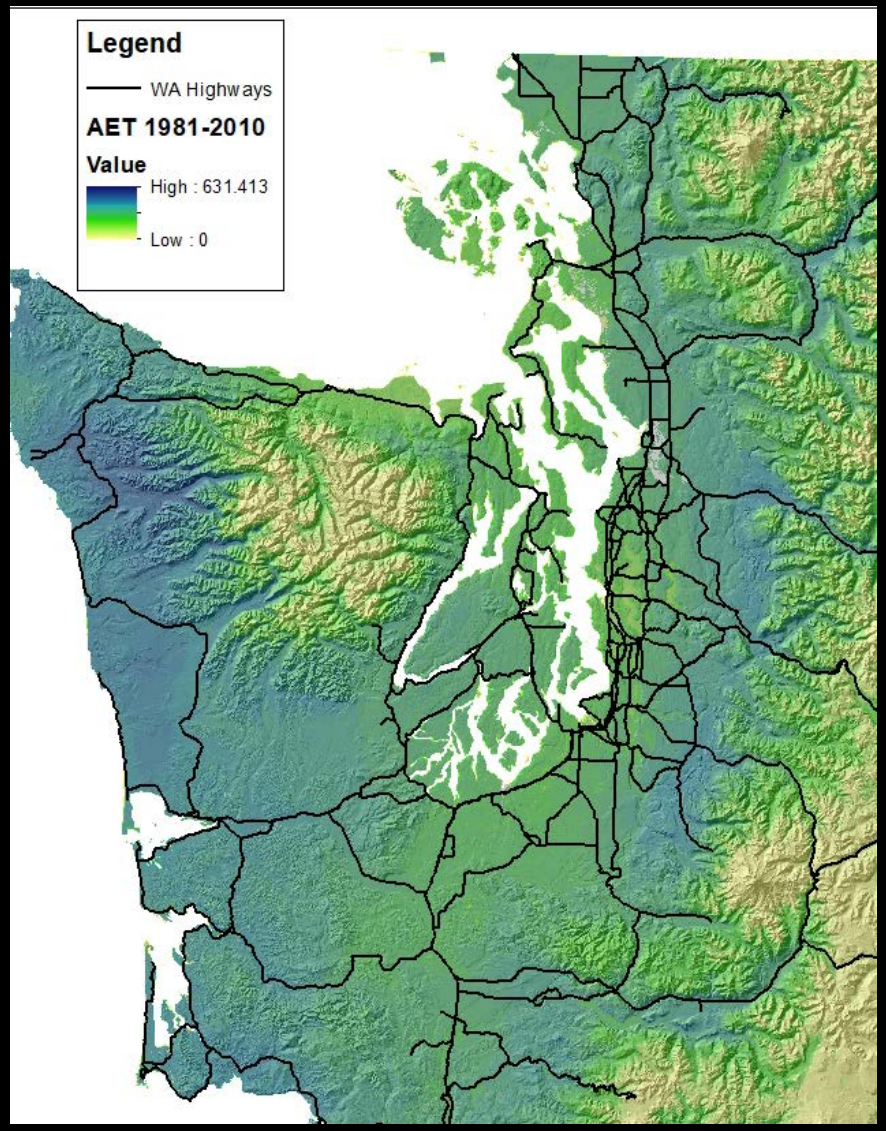


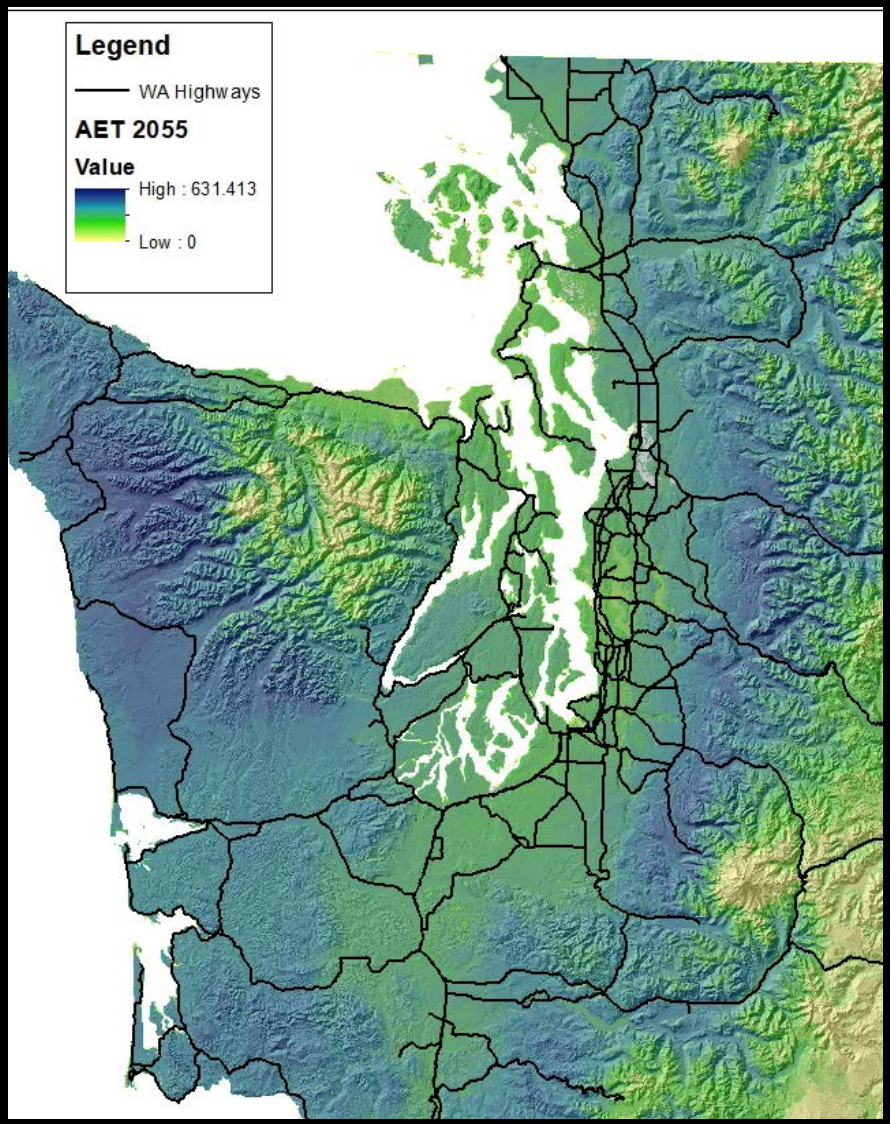
Strategies

Making sense of projections for a specific place

2. Understand your site

- AET





Strategies

2. Understand your site

- Climate: lots of climate websites
- Soils
- Topography: solar radiation
- Site adapted vegetation types, current and future

- Higher AET ~ growth?
- But higher moisture stress!

Making sense of projections for your site

Strategies

2. Understand your site

- Identify vulnerable forests on your ownership:

Climate - topography
Soils - Veg Types

Dense Hemlock ➔
Outwash Soils

Large Cedar ➔
Shallow Soils

Strategies

2. Understand your site

- Identify vulnerable forests on your ownership:

Dense Hemlock ➔
Outwash Soils

Large Cedar ➔
Shallow Soils

Moderate Density DF ➔
Deep Soils

Strategies

3. Planting site adapted species & using different seed sources: shift to greater drought tolerance

Strategies

4. Manage for diverse forests:
   - Species composition, age classes, & structural conditions

Old/large trees:
+ Fire & drought tolerance, less transpiration, genetic variability, habitat
- Windthrow potential, adaptability to new climate, large & tall crowns (water)

Young trees:
+ More plastic, adjust crowns, faster growth, shorter (wind, water), replaceable
- Higher water use, lack habitat characteristics,,

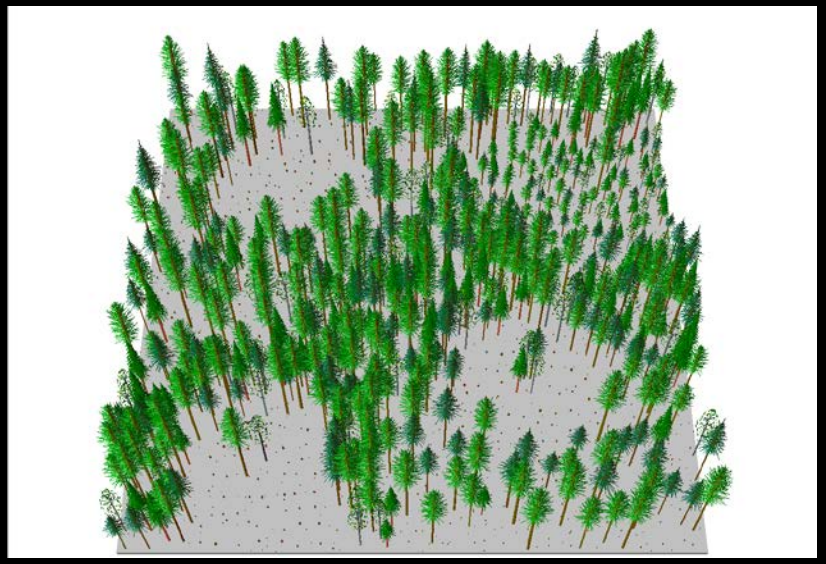
Strategies

4. Manage for diverse forests:
    - Species composition, age classes, & structural conditions:

Multi-age, multi-species, multi-cohort stands:

+ Lower insect/pathogen risk, resilient to wind, variable response to drought.
+ More options for intermediate harvests ➔ response to partial mortality
+ Higher habitat & aesthetic value

- Less fire resistant
- Require uneven-age management approaches: higher management costs



Strategies

4. Manage for diverse forests:
    - Species composition, age classes, & structural conditions

Even-age stands

+ Can be necessary for mal-adapted stands, or stand replacing disturbances

+ Shorter rotations allow for shifting seed zones & species.

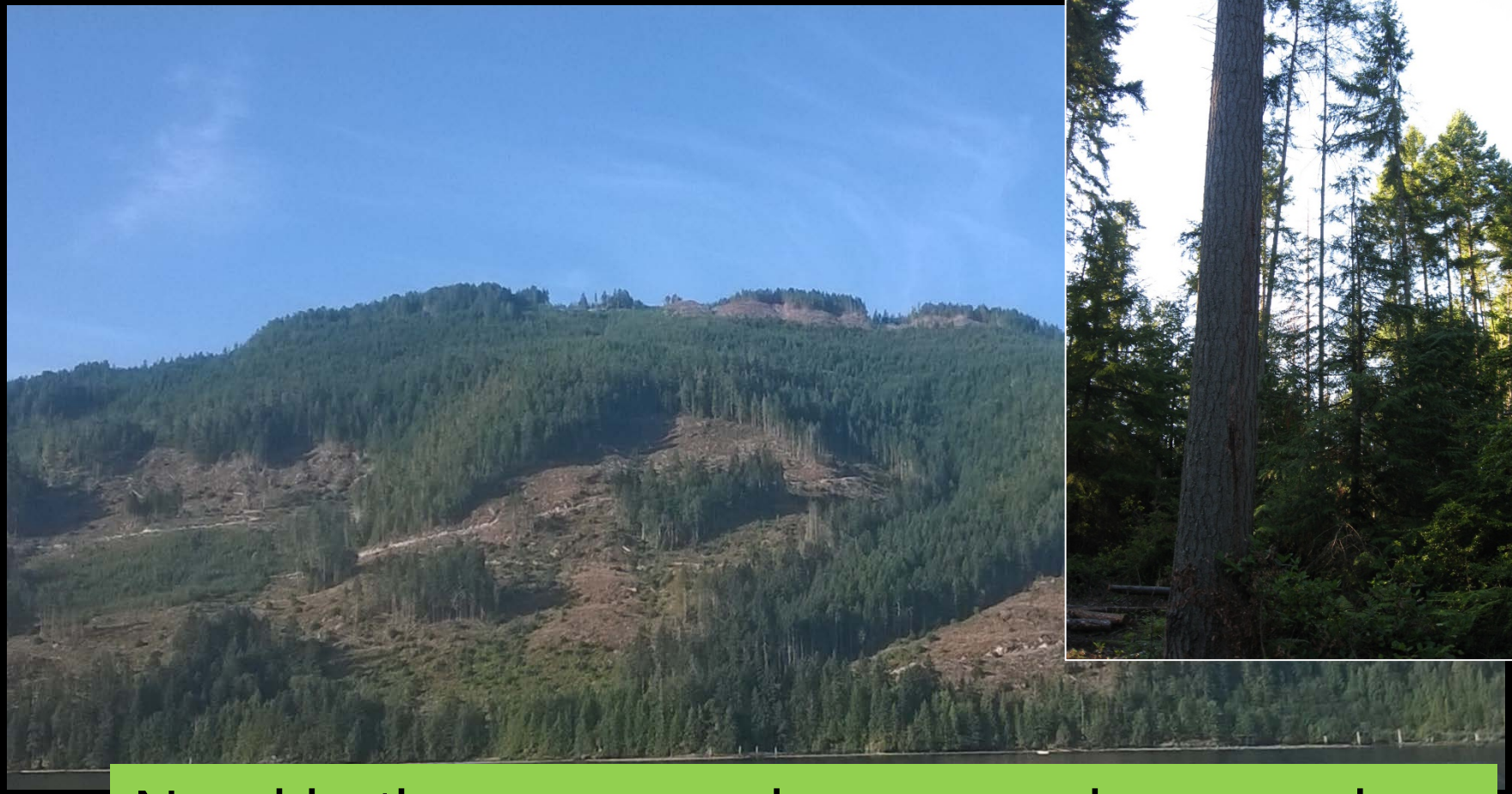
+ Simpler management & higher revenue when disturbance risk is low

+ Retention can add some benefits of multi-age stands

- Less resistant to disturbance, higher risk

Strategies

4. Manage for diverse forests:
   - Species composition, age classes, & structural

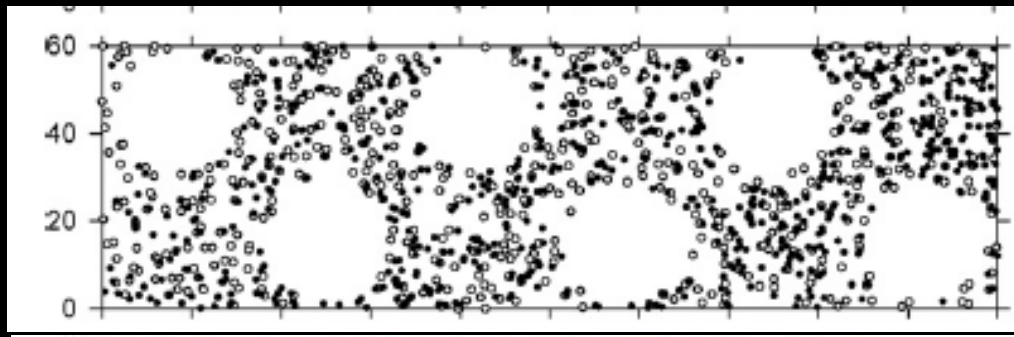


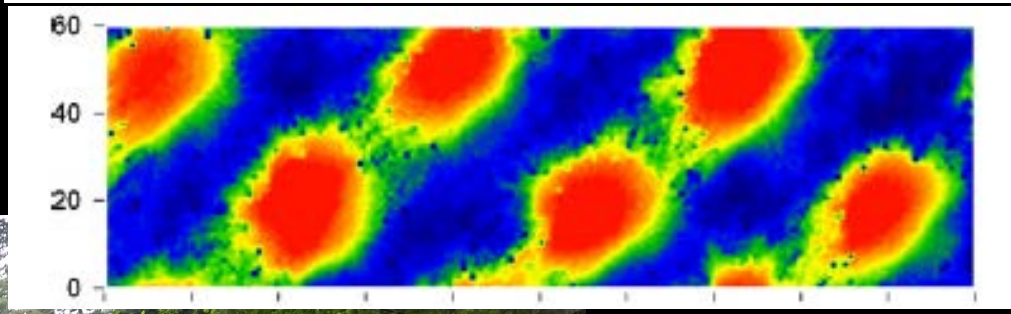
Need both uneven and even aged approaches:
Vary across ownership & landscape
Good insurance policy

Strategies

4. Manage for diverse forests:
   - Gaps

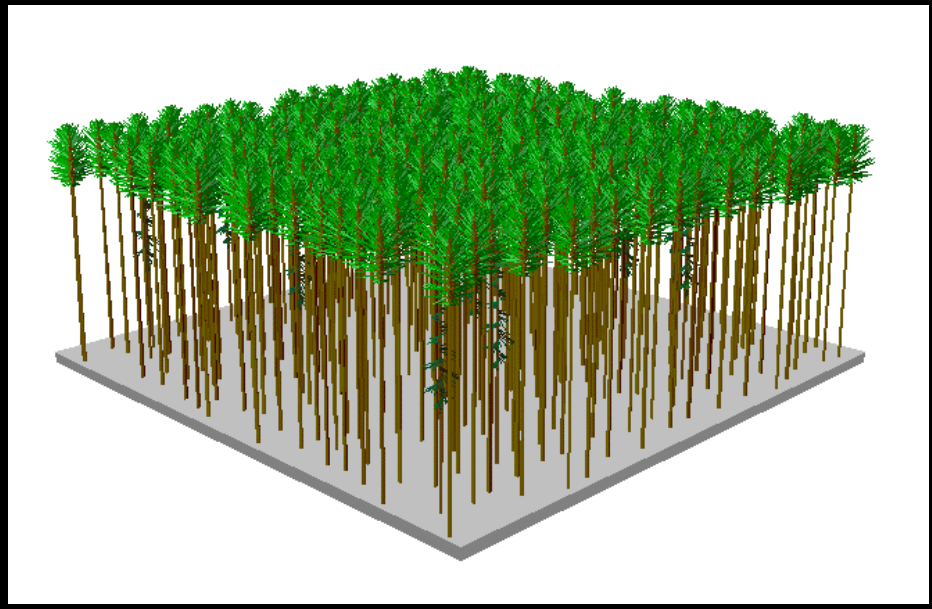
➔ Plant new species, especially shade intolerants
➔ Increased snow retention & water yield.
➔ Non-tree plant diversity





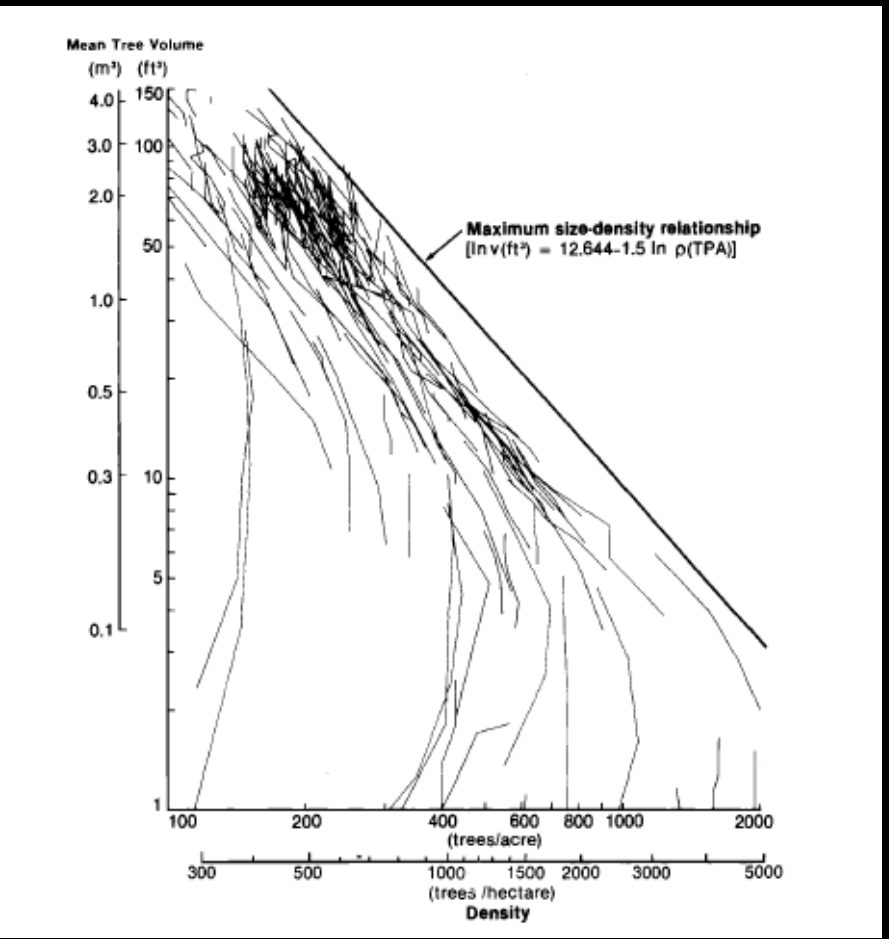
Strategies

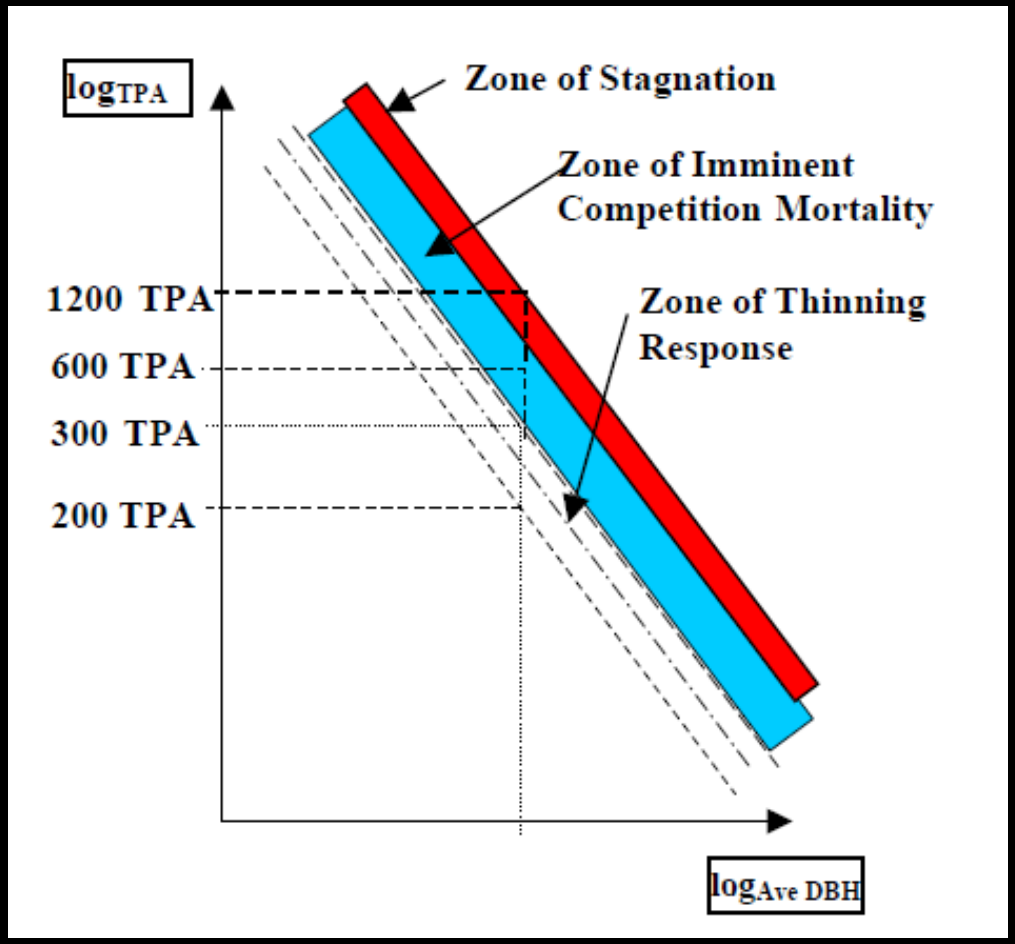
5. Manage density
    - Reduce moisture competition, increase vigor, & insect/pathogen resistance
    - Healthy crown ratios, stable height to diameter ratios.
    - Range of crown sizes. Large vs smaller crowns



Strategies

5. Manage density
   - Density levels: light limited systems





Strategies

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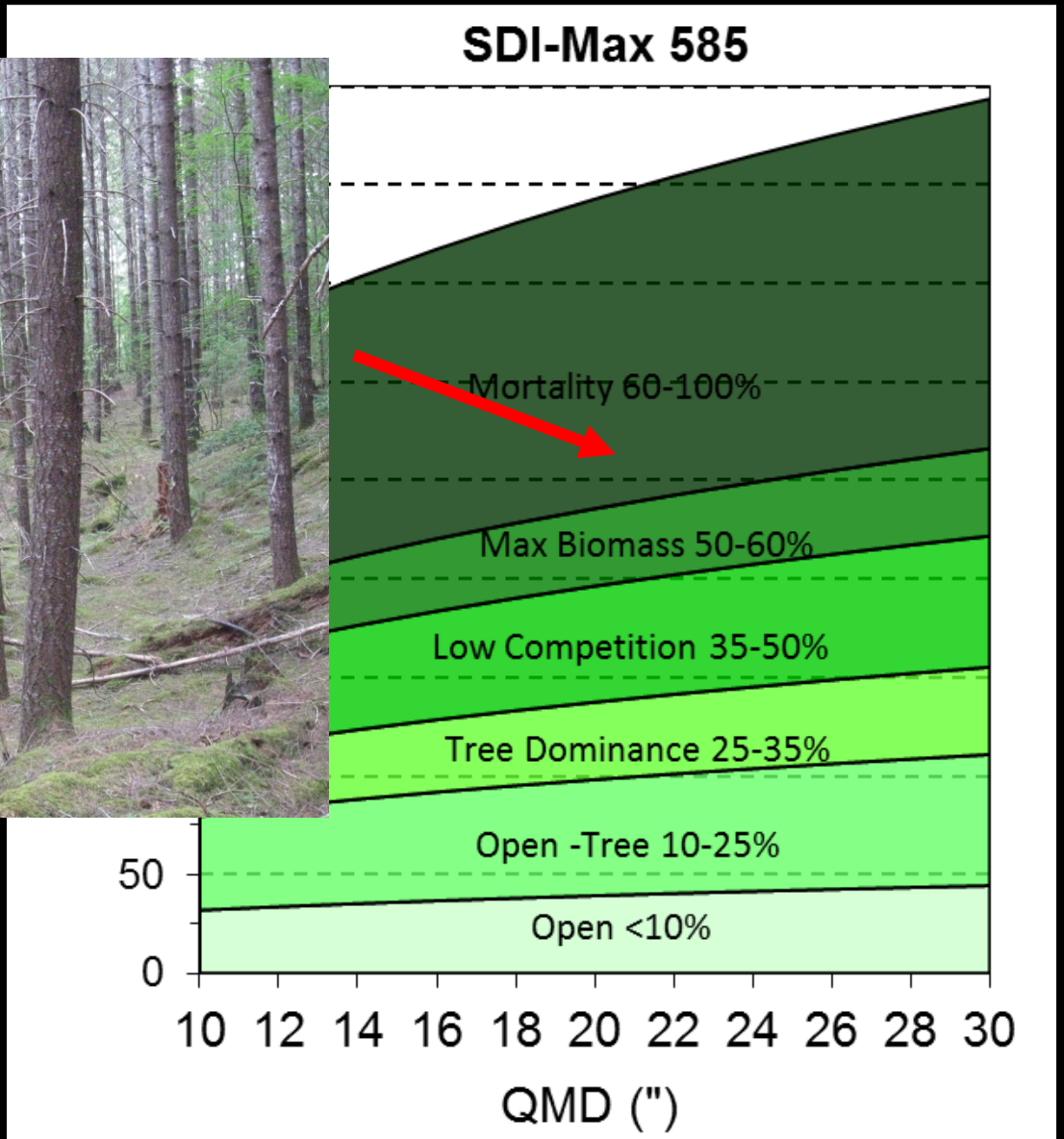
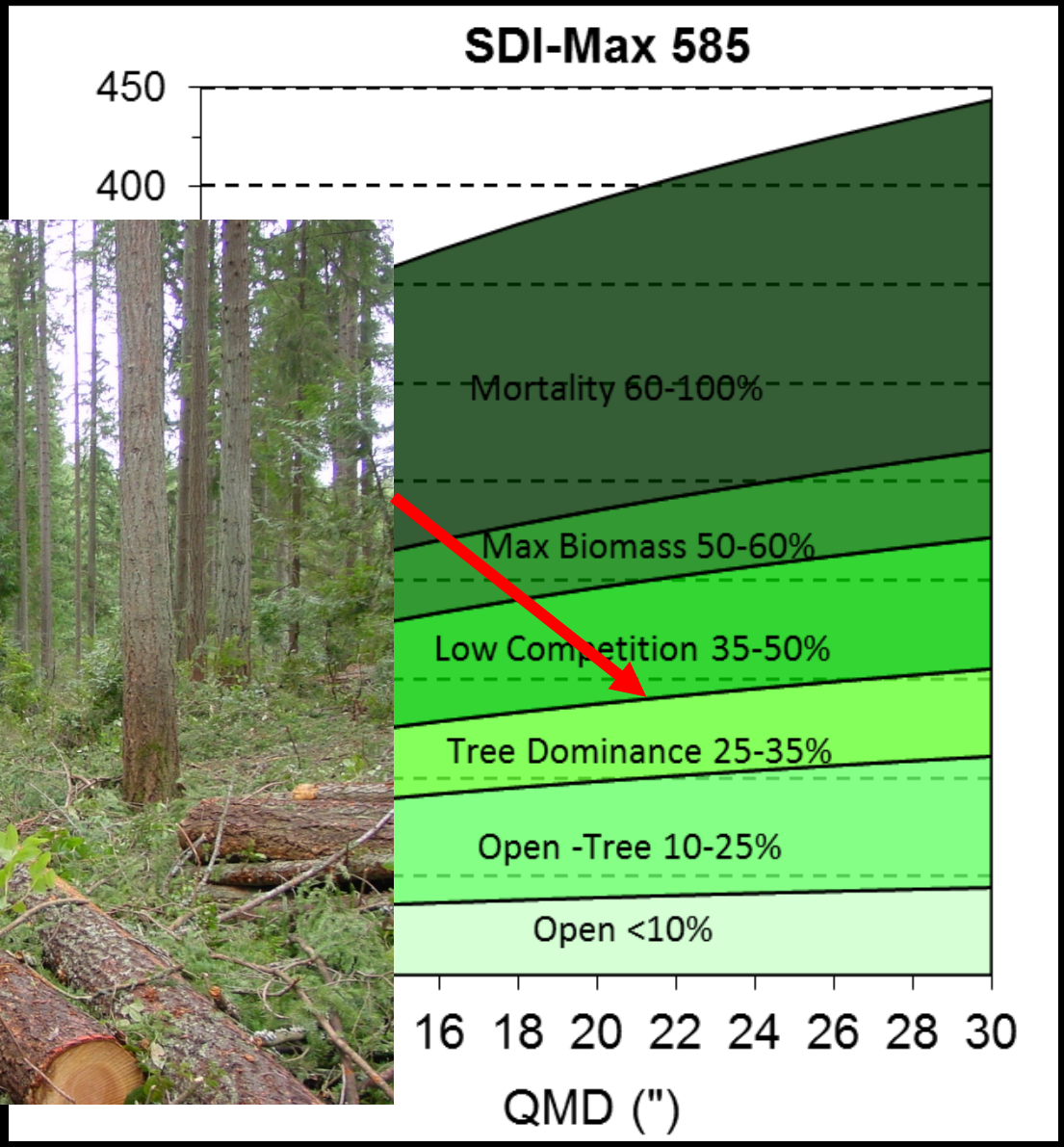


Strategies

5. Manage density
   - Density levels: light limited systems

35 Relative Density



Strategies

5. Manage density
   - Density levels: light limited systems

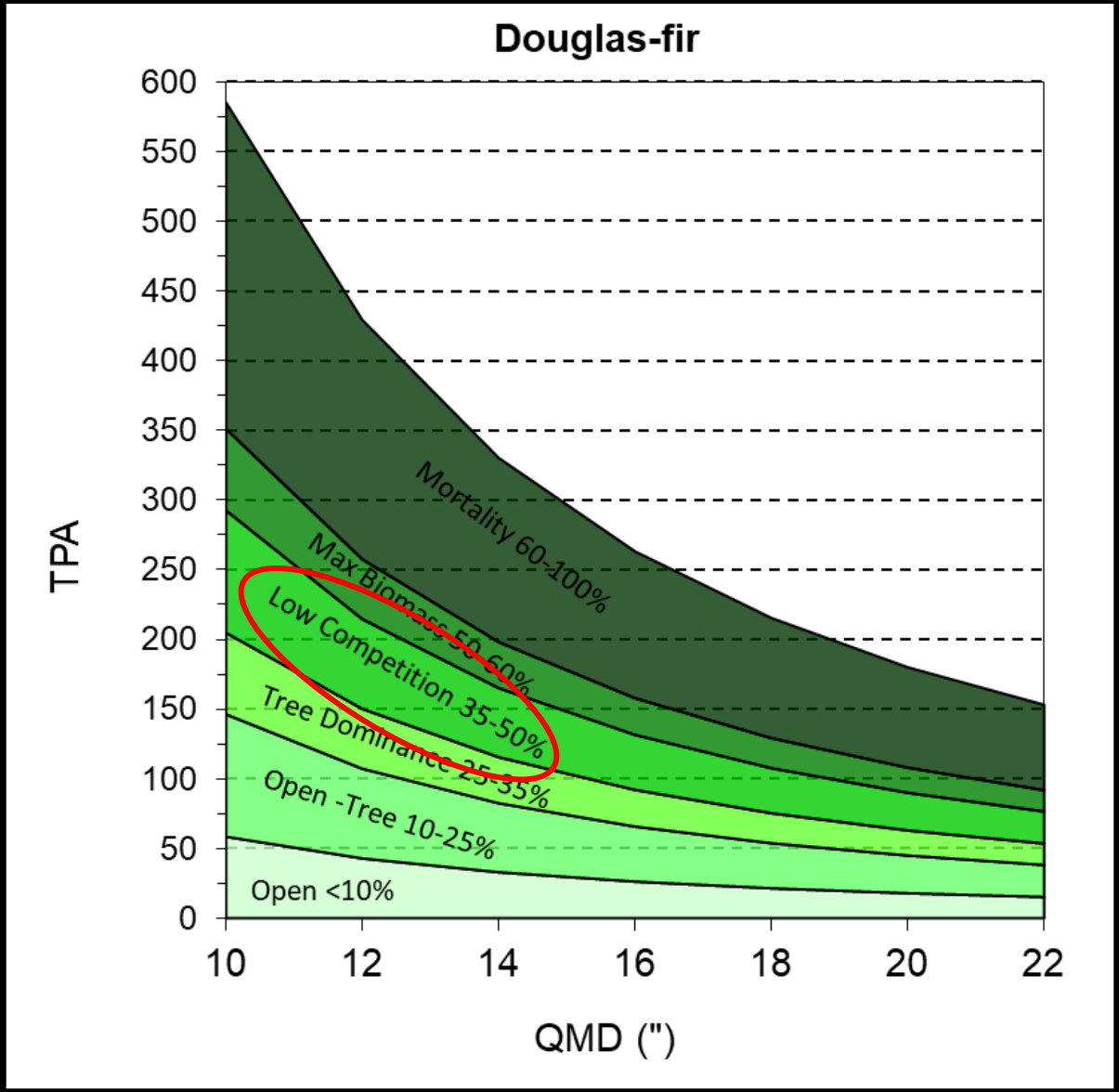
Max Stocking (SDI)

DF: 580

WH-RC: 800

RA: 350

PP: 380



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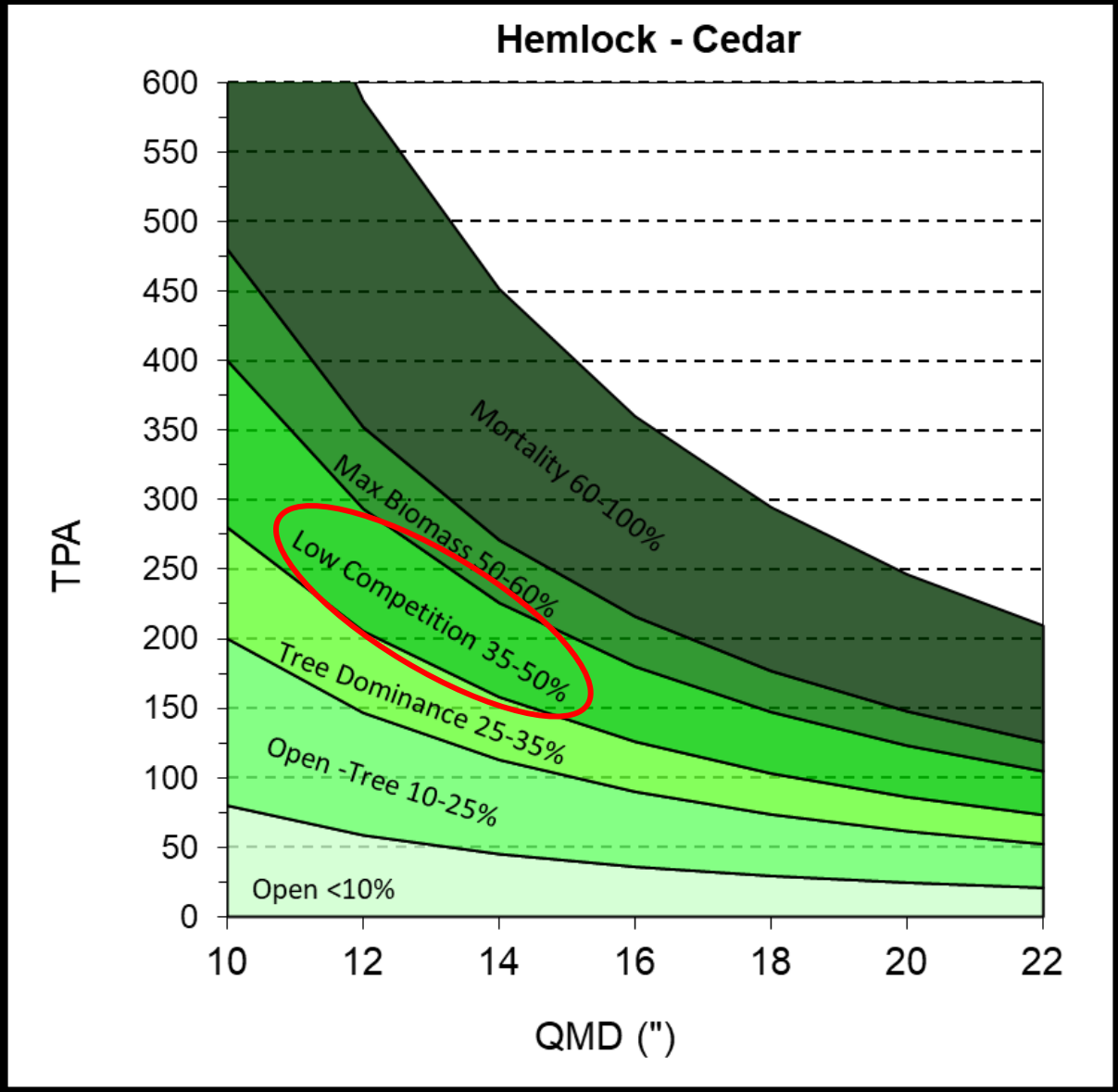

Strategies

5. Manage density
   - Density levels: light limited ➔ moisture systems

Max Stocking (SDI)

DF: 580

WH-RC: 800

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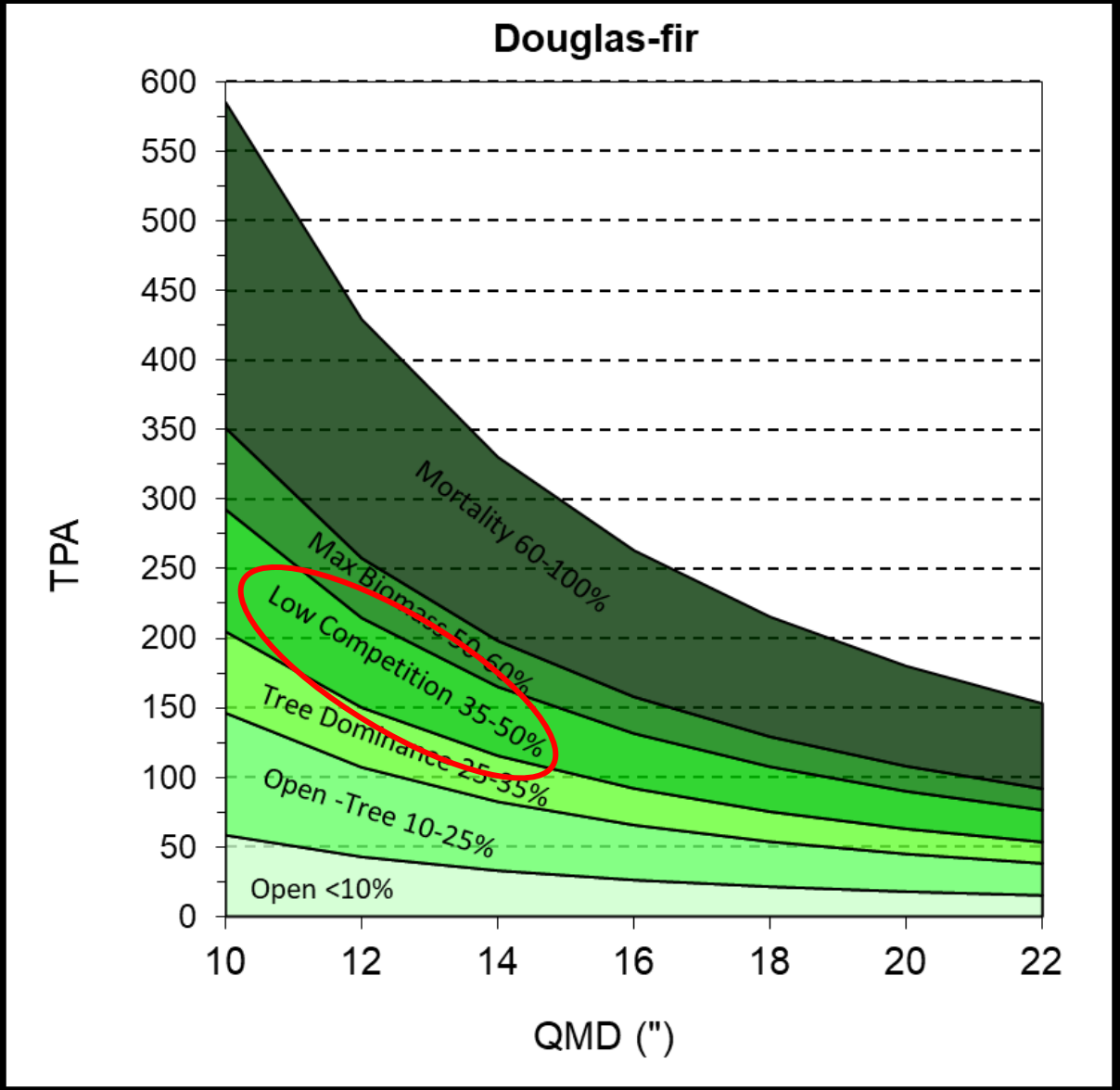


Strategies

5. Manage density
   - Density levels: light limited ➔ moisture systems

Max Stocking (SDI)

DF: 580

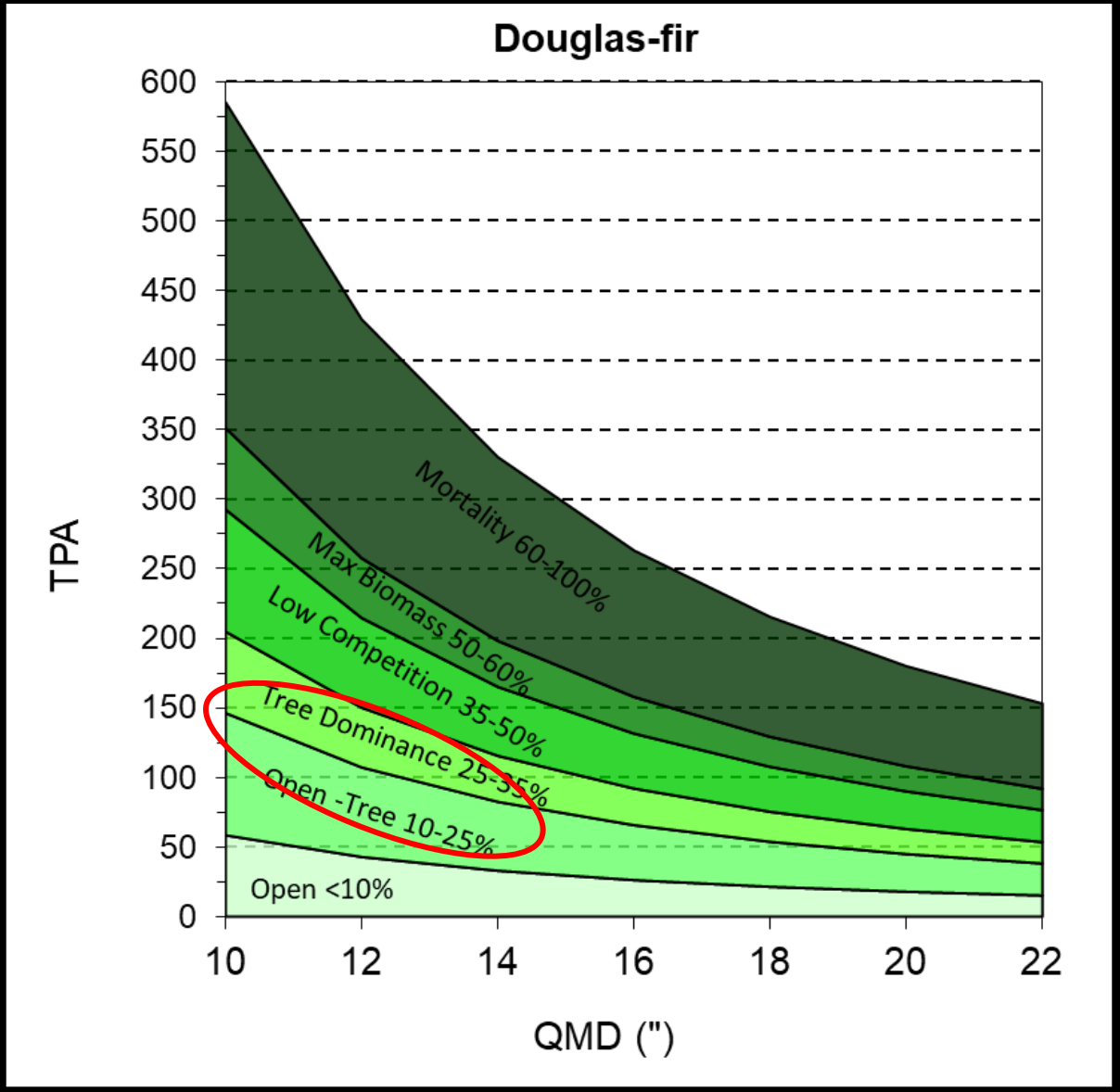
WH-RC: 800

RA: 350

PP: 380

Lower thinning levels:

35 RD ➔ 20-30



Strategies

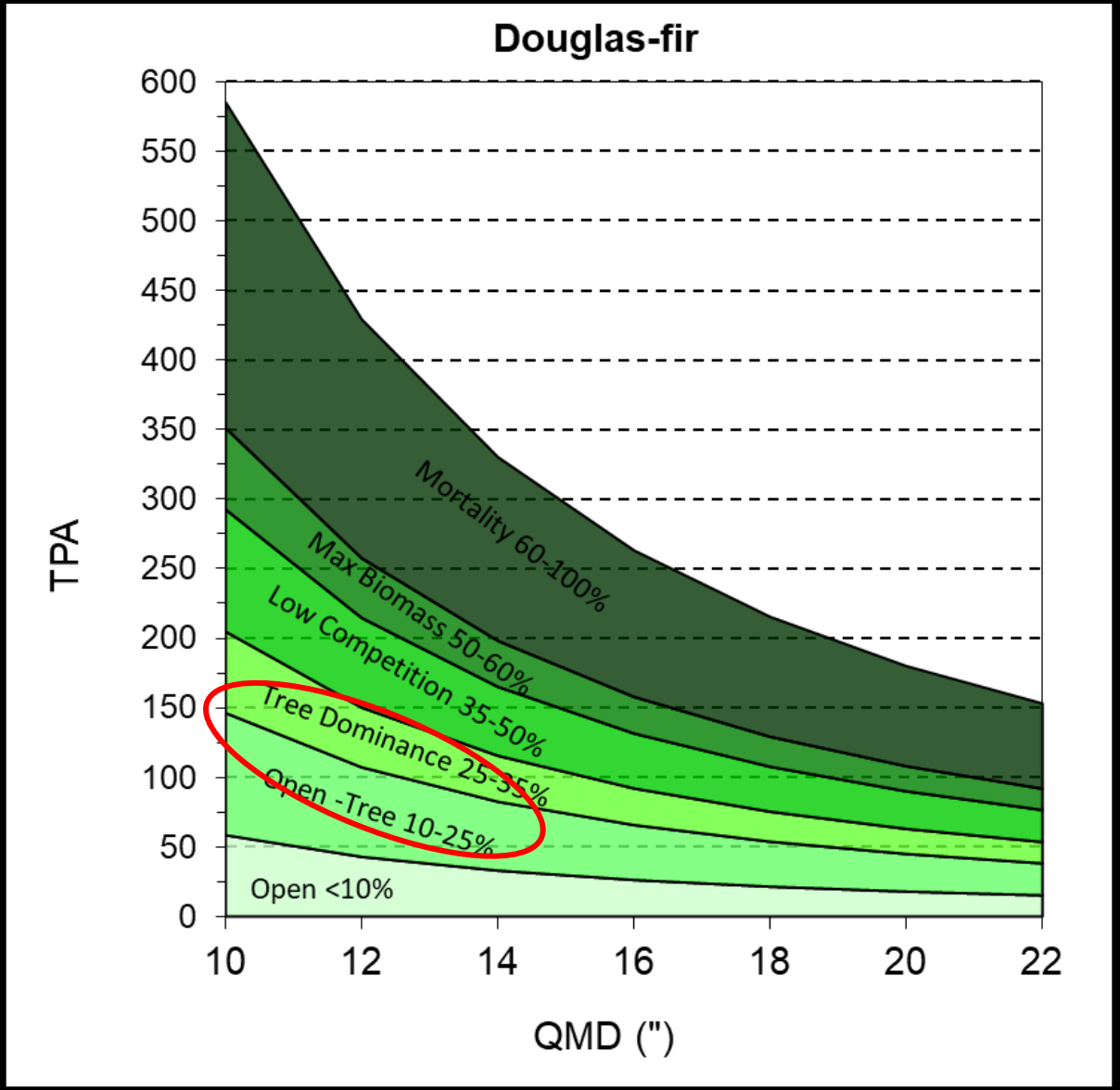
5. Manage density
   - Density levels: light limited ➔ moisture systems

<u>Lower thinning levels</u>

35 RD ➔ 20-30

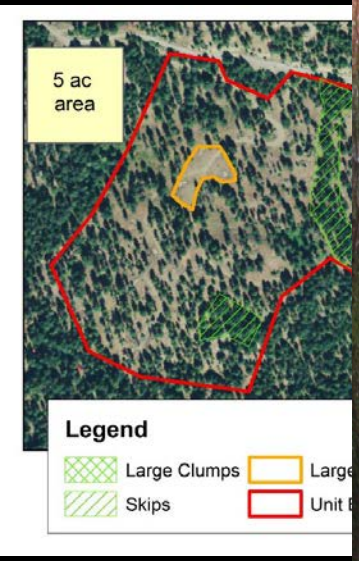
14” QMD:
- 35 RD 115 TPA
- 25 RD 85 TPA
- 20 RD 65 TPA

20” QMD:
- 35 RD 65 TPA
- 25 RD 45 TPA
- 20 RD 35 TPA



Strategies

5. Manage density
   - Density levels: varying density across stand



Strategies

6. Maintain & increase soil water storage
    - Retain downed wood, slash, non-tree vegetation, & soil organic matter
    - Gaps and moderate canopy cover ➔ soil water & snow retention
    - Minimize soil compaction during harvests

7. Control invasive species

Overview

- Adaptive mindset: uncertainty, risk management, & resilience
- Strategies: what is different?
- Case studies from 3 different forest types

Case Study 1:

High Vulnerability:

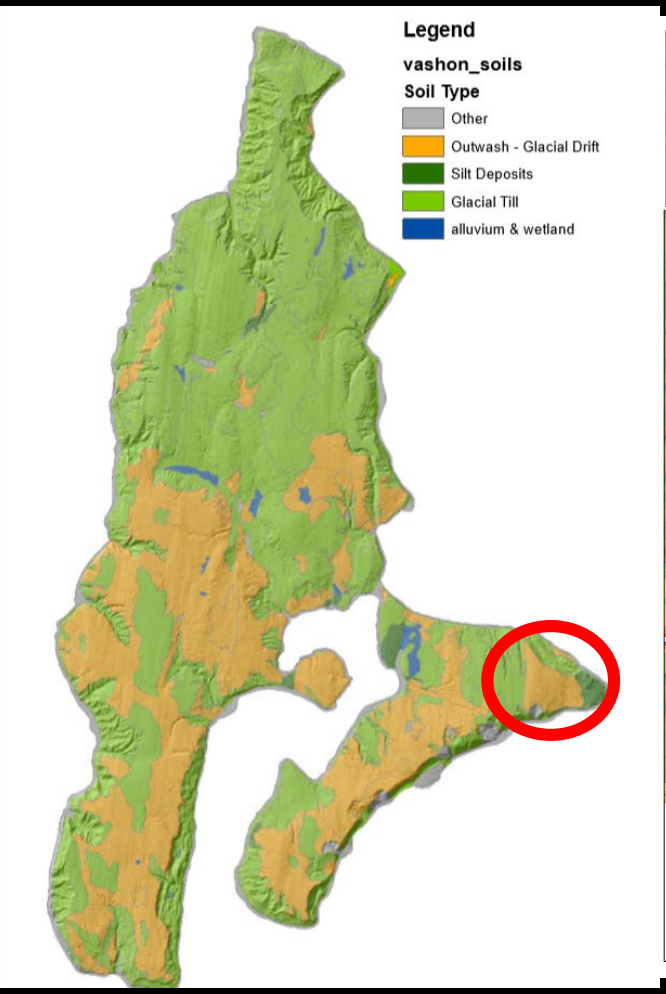
Red Alder Stand on old ag field & drier site:

Alder mortality likely soon, major die off with drought.

Case Study 1:

Red Alder Stand on old agricultural field: sandy soils, dry site

Soils



Current Deficit

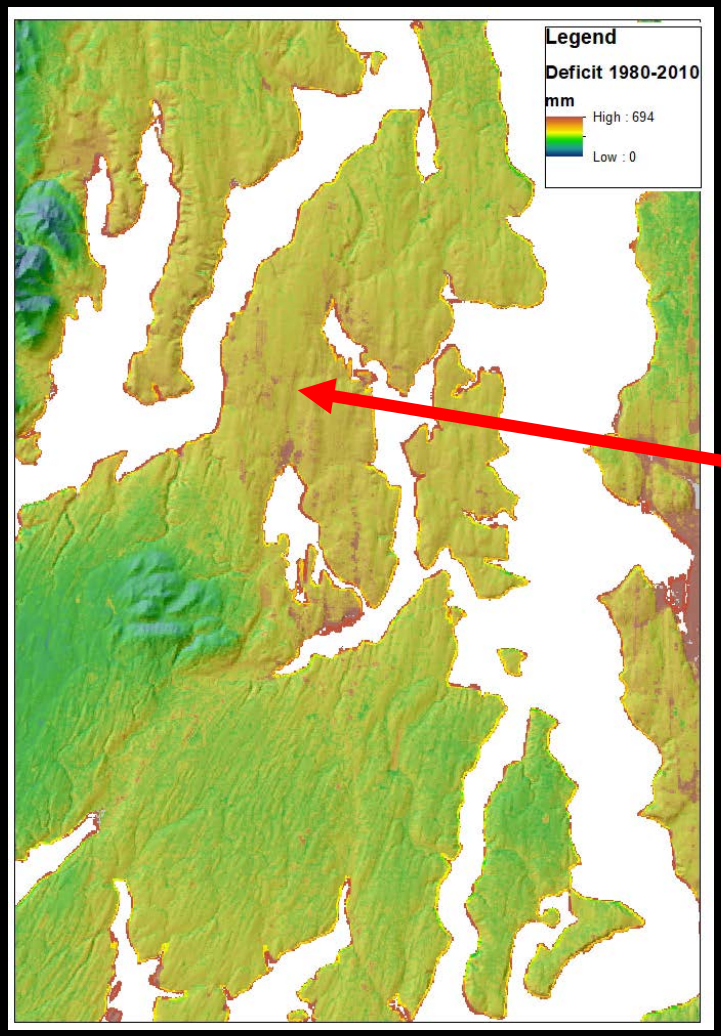
Future Deficit

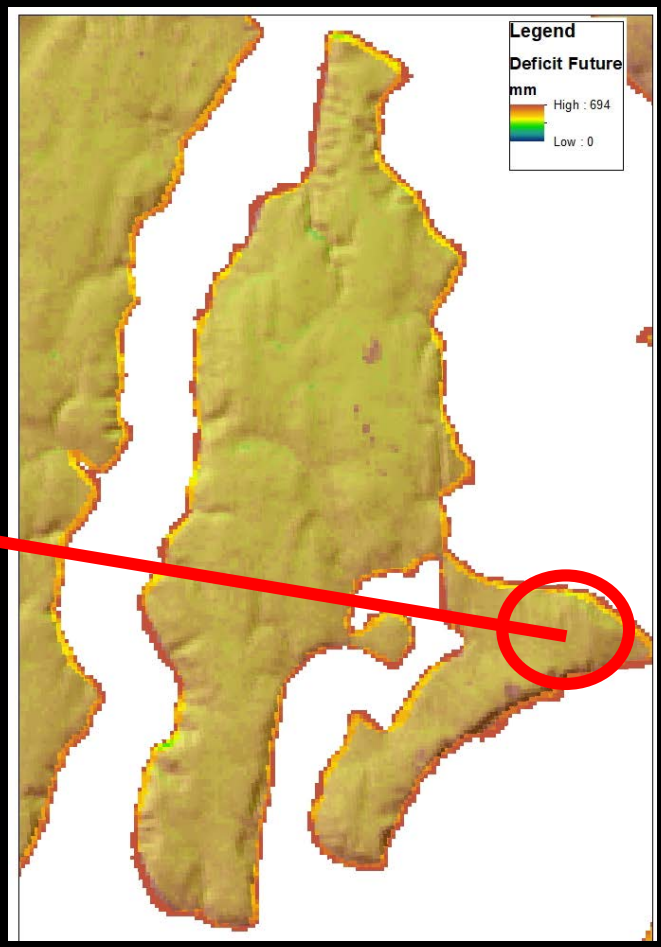
Case Study 1:

Red Alder Stand on old agricultural field: sandy soils, dry site

Current: moderate DF site. Future dry DF?

Future Deficit





Case Study 1:

Harvest now to capture revenue and have resources to replant the site

Variable retention, leave patches of alder ➔ future gaps, seed source

- Retain some/most maples, red cedar
- Retain Douglas-fir: seed sources & old cohort
- Leave tops, slash on site, plus some pulp logs (or don't sell pulp)

Case Study 1:

- Plant 20-40% of DF from different seed zones? Track during planting
- Plant white oak, ponderosa pine?
- Anticipate natural regen: Douglas-fir, madrone, red alder, maple.
- Shrub control, but not 100%.
- Planting density: higher & plan on PCT, or lower with no PCT?
- Monitor & be prepared for mortality if we have dry years.

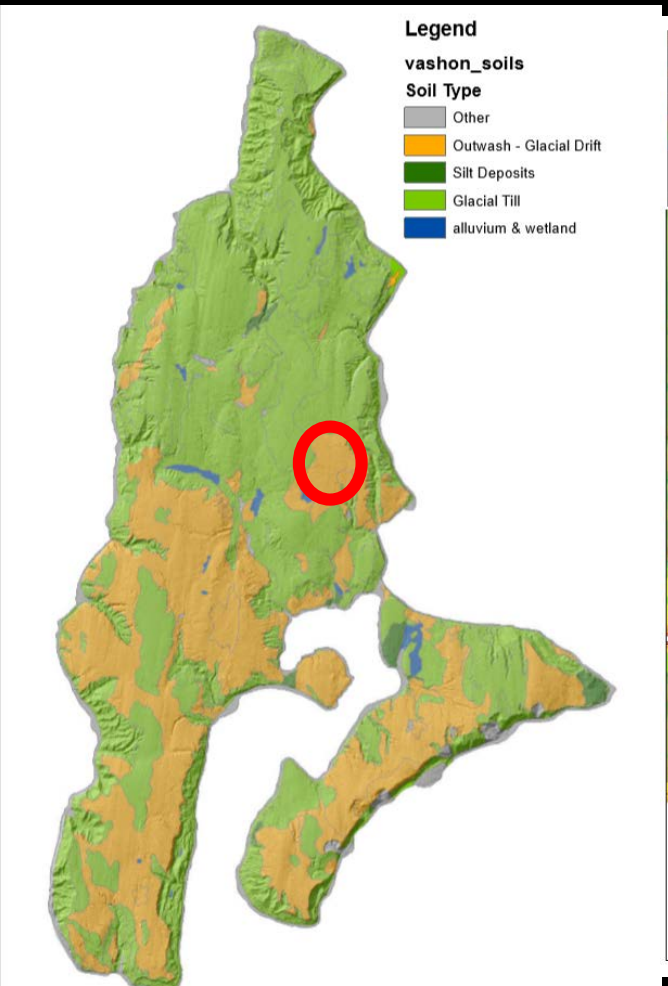
Case Study 2:

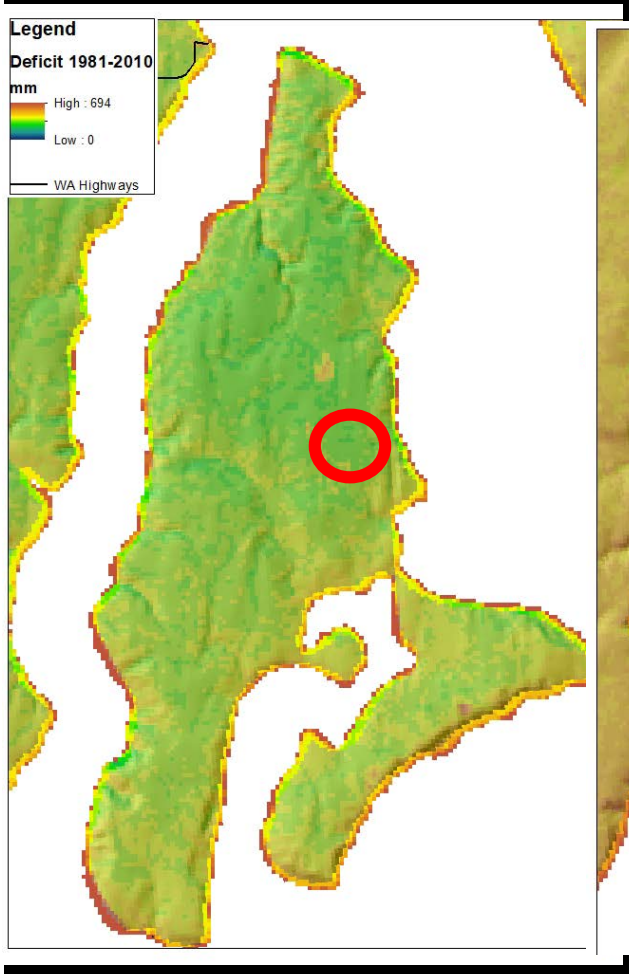
Moderate Vulnerability:

Young, dense DF plantation near homes, with infill of hemlock & hardwoods

Moderate to dry site: outwash soils, but lower deficit.

In future, may support red cedar & maple, but not hemlock





Case Study 2:

- Thinning to maintain healthy crowns and vigor
- Low thinning density: (20-25 RD)
- Remove western hemlock
- Retain RA for next entry? Retain red cedar

Case Study 2:

- Thinning to maintain healthy crowns and vigor

- Add 10-20% in ¼ - 1 acre gaps
  - Plant gaps to diversify forest.
    ~25% DF from drier seed zones
    Red cedar?
    Western white pine, lodgepole pine, grand fir
    Maple, Madrone?

- Monitor, be prepared for additional planting, salvage over time.

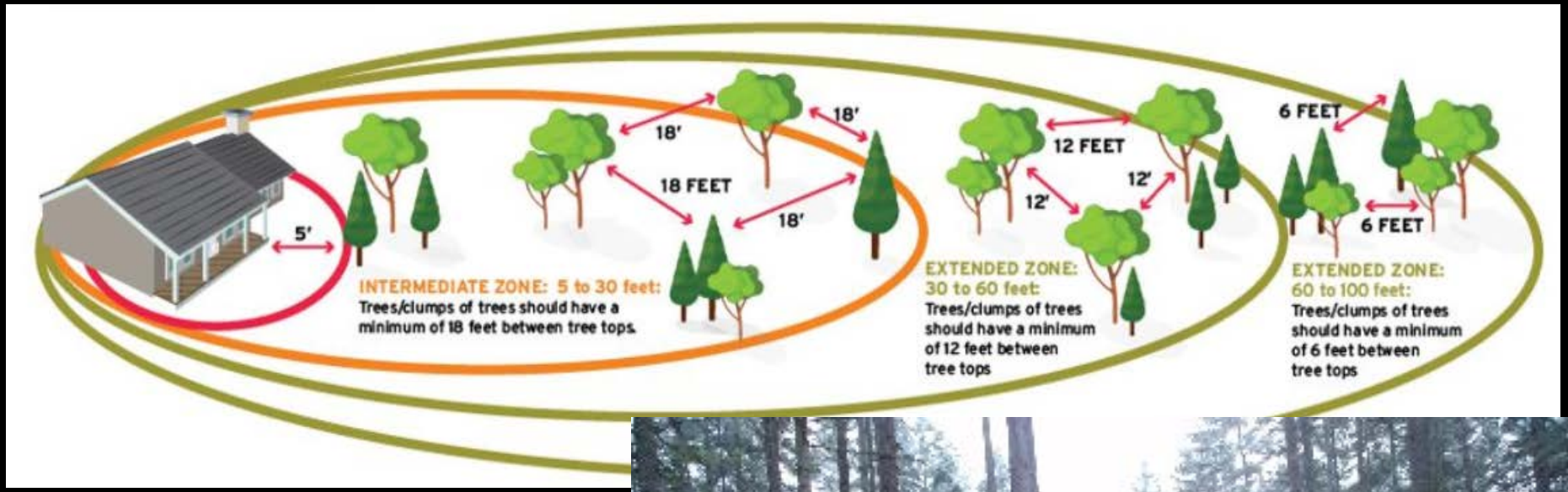
Alternatives

1. Don't thin: let grow for habitat, see what happens

2. Don't thin: grow until early retention harvest, then plant with new seed zones.

Case Study 2:

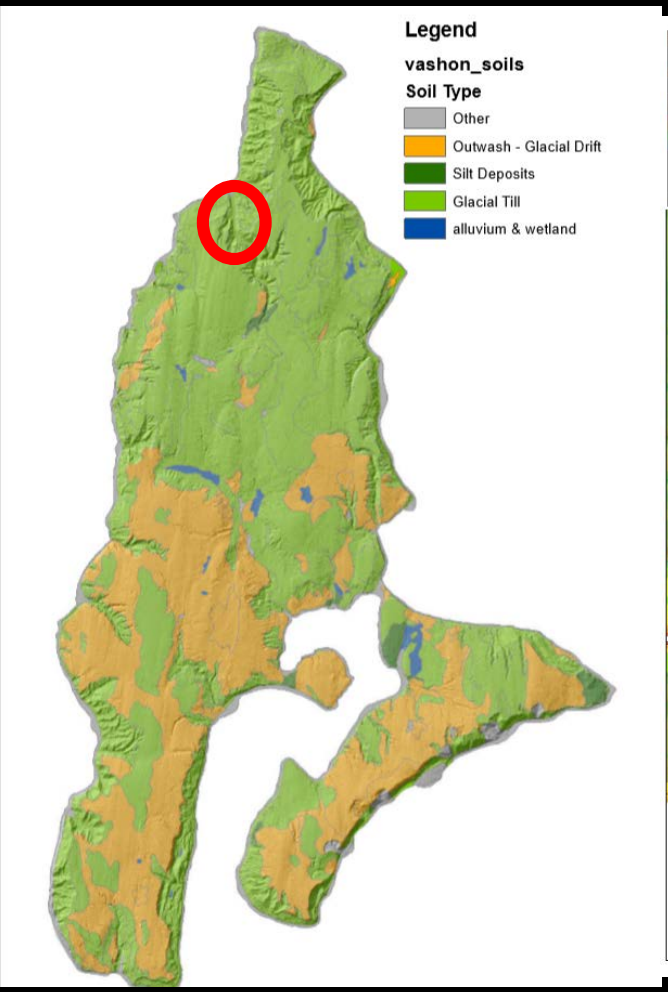
- Leave slash in majority of forest
- Within 100-200’ buffer off access roads & home:
  -Remove/reduce slash. Minimize multistory structure. Be prepared to maintain this.
  - Broadleaf species buffer?

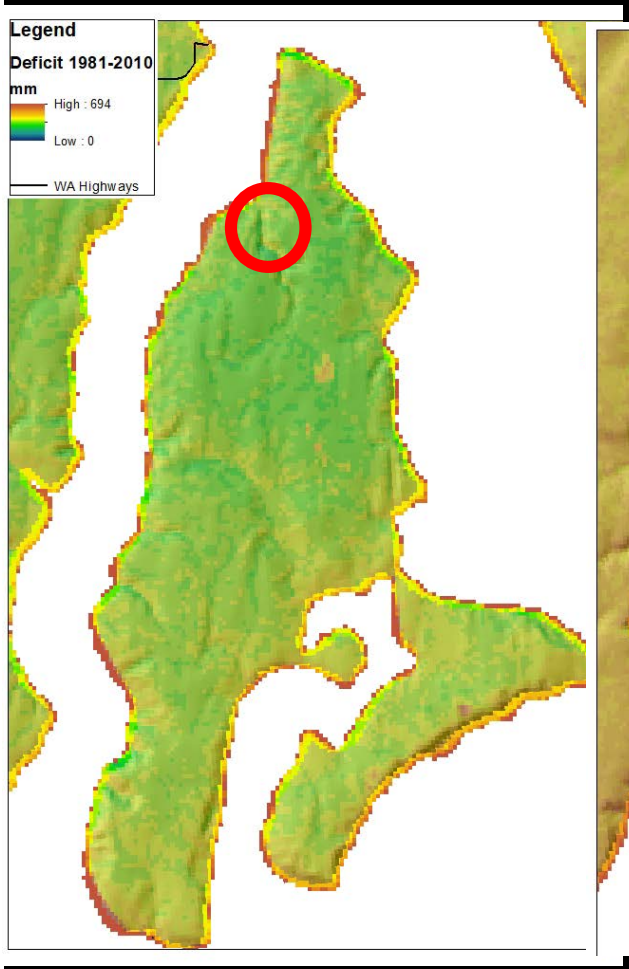


Case Study 3:

Lower Vulnerability:

Mature mixed conifer-red alder forest on north facing aspect of drainage:
Likely to support red cedar, maple, alder, may support hemlock





Case Study 3:

Uneven-age harvest: group selection
+ ITS
- Low to moderate thinning density: wind?
- Favor Douglas-fir and red cedar.
- Remove most hemlock, alder, some DF
- Retain some maple, cottonwood, alder: especially in riparian areas
- No harvest or ITS in wetter microsites

Case Study 3:

Uneven-age harvest: group selection + ITS

Gaps with range of sizes:
- Target hemlock/mature alder patches for gaps, plus some areas
- Plant new species/seed zones: DF in larger gaps, red cedar, w. pine, GF?
- Track gaps during & after harvest for planting

Case Study 3:

Monitor, be prepared for additional planting

Plan next entry in 10 – 20 years, expand gaps, new gaps, etc.

If big mortality event. salvage + green thinning

➔ Uneven-age: response potential after disturbance

Strategies

What is different than what I already do?

1. Increase monitoring efforts & response capability
2. Understand your site: Climate, soils, topography, and suitable vegetation types
3. Planting site adapted species & using different seed sources: shift to greater drought tolerance
4. Manage for diverse forests
5. Manage density
6. Maintain & increase soil water storage
7. Control invasive species

Adaptive Mindset

- Forest ecosystems in PNW adapted to change
- Foresters are observant, creative, adaptive problem solvers.
- Silviculture has gone through lots of evolution.
  ➔ Climate change presents new challenges and opportunities.