# Red Alder Growth Model & Other Management Tools

WFCA 3rd Annual PNW Forest Vegetation Management Conference, December 4-5, 2019
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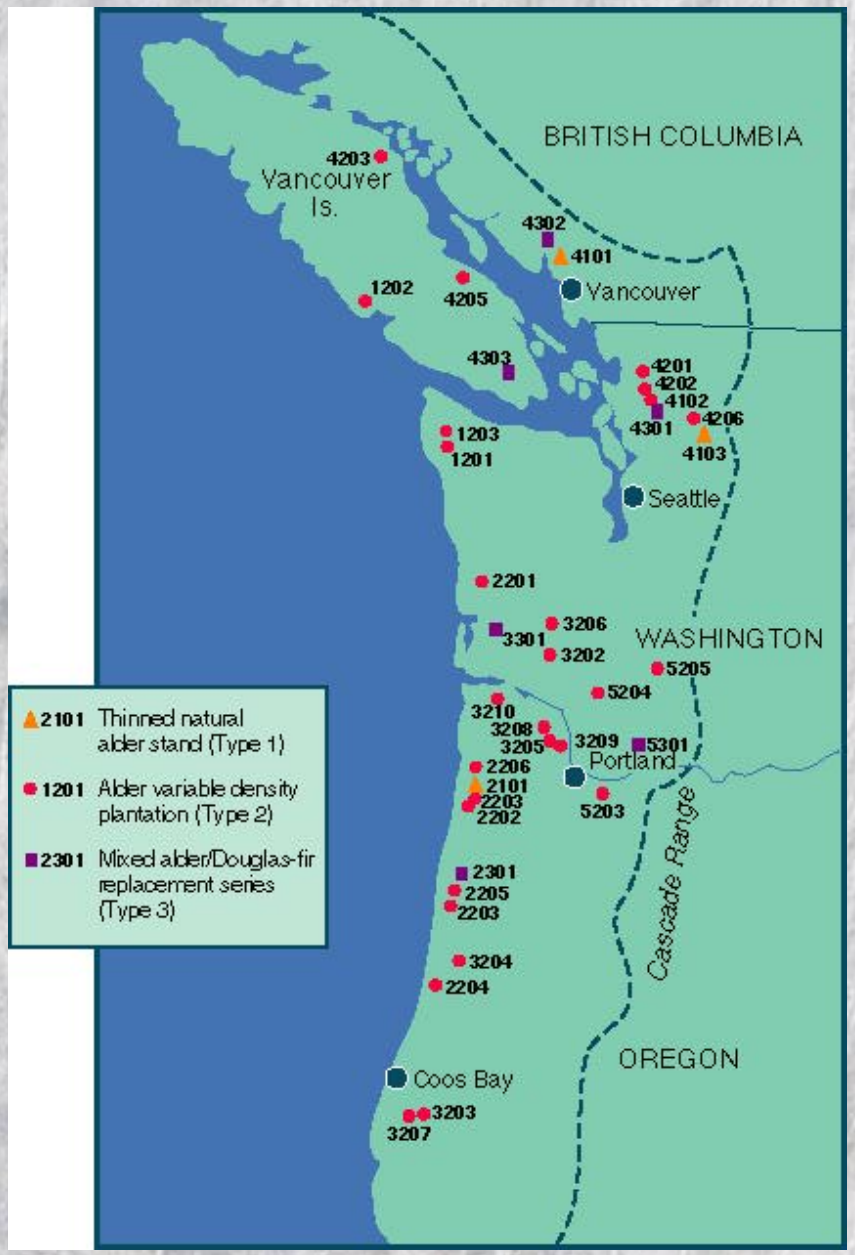
# Red Alder Growth Model & Other Management Tools

- HSC: An Overview
- Adoption of Red Alder Management
  - Issues, Obstacles, & Solutions
- Management Tools
  - Site Selection Tool
  - Site Index Equation
  - Density Management Diagram
  - Taper Equation
  - Volume Tables
  - Growth & Yield Model- RAP ORGANON
- Red Alder Growth Simulator
  - Background
  - Data
  - Inputs
  - Outputs
  - Improvements
  - Uses

# Hardwood Silviculture Cooperative (HSC)

- **The HSC is a research and education program focused on the silviculture of red alder and mixes of red alder and Douglas-fir in the PNW.**
- **Began in 1988, the HSC is a combination of industry and both federal and state agency members.**
- **The goal of the HSC is simple: to improve the understanding, management, and production of red alder.**



# Adoption of Red Alder Management- Issues/Obstacles

- Alder plantation establishment is expensive - seedling costs, high planting density (500-600 tpa) and pre-commercial thinning costs
- Lack of seedling availability - inconsistent supply of high-quality seedlings
- Landowners' and managers' bias against and unfamiliarity with red alder management
- Economics - competitive returns from alder under certain conditions…what conditions?

# Adoption of Red Alder Management- Solutions?

- Restore and support economical seedling production systems
- Genetic improvement, high-performance red alder clones
- Opportunistic management of natural regeneration
- Improved red alder management toolkit:
  - Site assessment, red alder management manual, growth & yield tables, and economic analysis tools

# Red Alder Management Tools

- Site Selection Tool
- Site Index Equation
- Density Management Diagram
- Taper Equation
- Volume Tables
- Growth & Yield Model

# Red Alder Management Tools- Site Selection

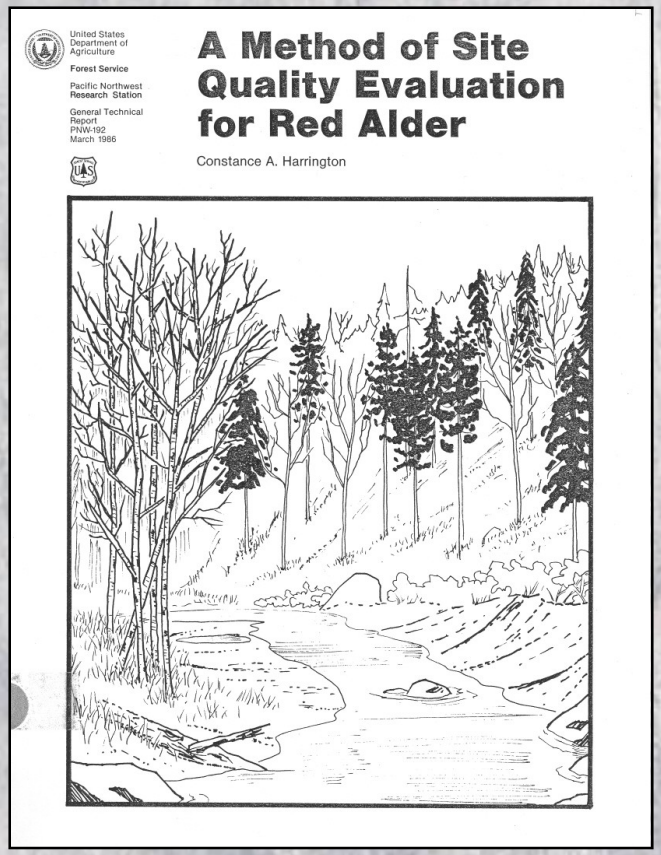
Red Alder Site Index $SI_{50}$ by Age and Height - ages 5-20 years from seed
Find SI in the table using ave. height of dominant trees in left column, age in top row

| height | age 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 59 | | | | | | | | | | | | | | | |
| 12 | 69 | 62 | | | | | | | | | | | | | | |
| 14 | 75 | 69 | 62 | | | | | | | | | | | | | |
| 16 | 82 | 72 | 66 | 62 | 59 | | | | | | | | | | | |
| 18 | 89 | 79 | 72 | 66 | 62 | 59 | | | | | | | | | | |
| 20 | 92 | 85 | 75 | 72 | 66 | 62 | 59 | | | | | | | | | |
| 22 | 98 | 89 | 82 | 75 | 72 | 66 | 62 | 62 | 59 | | | | | | | |
| 24 | 102 | 92 | 85 | 79 | 75 | 72 | 69 | 66 | 62 | 59 | | | | | | |
| 26 | 108 | 98 | 89 | 82 | 79 | 75 | 72 | 69 | 66 | 62 | 59 | | | | | |
| 28 | 112 | 102 | 92 | 89 | 82 | 79 | 75 | 72 | 69 | 66 | 62 | 62 | 59 | | | |
| 30 | 115 | 105 | 98 | 92 | 85 | 82 | 79 | 75 | 72 | 69 | 66 | 62 | 62 | 59 | | |
| 32 | 118 | 108 | 102 | 95 | 89 | 85 | 79 | 75 | 75 | 72 | 69 | 66 | 66 | 62 | 62 | 59 |
| 34 | 121 | 112 | 105 | 98 | 92 | 89 | 82 | 79 | 75 | 75 | 72 | 69 | 66 | 66 | 62 | 62 |
| 36 | 125 | 115 | 108 | 102 | 95 | 92 | 85 | 82 | 79 | 75 | 75 | 72 | 69 | 69 | 66 | 66 |
| 38 | 128 | 118 | 112 | 105 | 98 | 92 | 89 | 85 | 82 | 79 | 75 | 75 | 72 | 69 | 69 | 66 |
| 40 | | 121 | 112 | 105 | 102 | 95 | 92 | 89 | 85 | 82 | 79 | 75 | 75 | 72 | 72 | 69 |
| 42 | | 125 | 118 | 112 | 105 | 98 | 95 | 92 | 89 | 85 | 82 | 82 | 79 | 75 | 75 | 72 |
| 44 | | 128 | 121 | 112 | 108 | 102 | 98 | 95 | 92 | 89 | 85 | 82 | 82 | 79 | 75 | 75 |
| 46 | | | 121 | 115 | 112 | 105 | 102 | 98 | 92 | 92 | 89 | 85 | 82 | 82 | 79 | 75 |
| 48 | | | 125 | 118 | 112 | 108 | 102 | 98 | 95 | 92 | 89 | 89 | 85 | 82 | 82 | 79 |
| 50 | | | 128 | 121 | 115 | 108 | 105 | 102 | 98 | 95 | 92 | 89 | 89 | 85 | 82 | 82 |
| 52 | | | | 125 | 118 | 112 | 108 | 105 | 102 | 98 | 95 | 92 | 89 | 89 | 85 | 82 |
| 54 | | | | 125 | 118 | 115 | 112 | 105 | 102 | 98 | 95 | 95 | 92 | 89 | 89 | 85 |
| 56 | | | | 128 | 121 | 118 | 112 | 108 | 105 | 102 | 98 | 95 | 95 | 92 | 89 | 89 |
| 58 | | | | | 125 | 118 | 115 | 112 | 108 | 105 | 102 | 98 | 95 | 92 | 92 | 89 |
| 60 | | | | | 125 | 121 | 118 | 112 | 108 | 105 | 102 | 102 | 98 | 95 | 92 | 92 |
| 62 | | | | | 128 | 125 | 118 | 115 | 112 | 108 | 105 | 102 | 98 | 98 | 95 | 92 |
| 64 | | | | | | 125 | 121 | 118 | 112 | 108 | 108 | 105 | 102 | 98 | 98 | 95 |
| 66 | | | | | | 128 | 125 | 118 | 115 | 112 | 108 | 108 | 105 | 102 | 98 | 98 |
| 68 | | | | | | | 125 | 121 | 118 | 115 | 112 | 108 | 105 | 105 | 102 | 98 |
| 70 | | | | | | | 128 | 125 | 121 | 118 | 115 | 112 | 108 | 105 | 105 | 102 |
| 72 | | | | | | | 128 | 125 | 121 | 118 | 115 | 112 | 112 | 108 | 105 | 105 |
| 74 | | | | | | | | 128 | 125 | 121 | 118 | 115 | 112 | 108 | 108 | 105 |
| 76 | | | | | | | | 128 | 125 | 121 | 118 | 118 | 115 | 112 | 108 | 108 |
| 78 | | | | | | | | | 128 | 125 | 121 | 118 | 115 | 115 | 112 | 108 |
| 80 | | | | | | | | | 128 | 125 | 121 | 121 | 118 | 115 | 112 | 112 |
| 82 | | | | | | | | | | 128 | 125 | 121 | 118 | 118 | 115 | 112 |
| 84 | | | | | | | | | | 128 | 128 | 125 | 121 | 118 | 118 | 115 |
| 86 | | | | | | | | | | | 128 | 125 | 121 | 121 | 118 | 115 |
| 88 | | | | | | | | | | | | 128 | 125 | 121 | 121 | 118 |
| 90 | | | | | | | | | | | | 128 | 128 | 125 | 121 | 121 |

Calculated from equations of Harrington and Curtis 1986,
converted to 50-year base by Thrower and Nussbaum 1991

# Red Alder Management Tools- Site Selection

**The most common way of determining site index (base age of 50 years) uses the soil-site method developed by Harrington (1986).**



United States Department of Agriculture
Forest Service
Pacific Northwest Research Station
General Technical Report PNW-192
March 1986

## A Method of Site Quality Evaluation for Red Alder

Constance A. Harrington

Site evaluations for red alder

Site name or number: _____

Location: _____

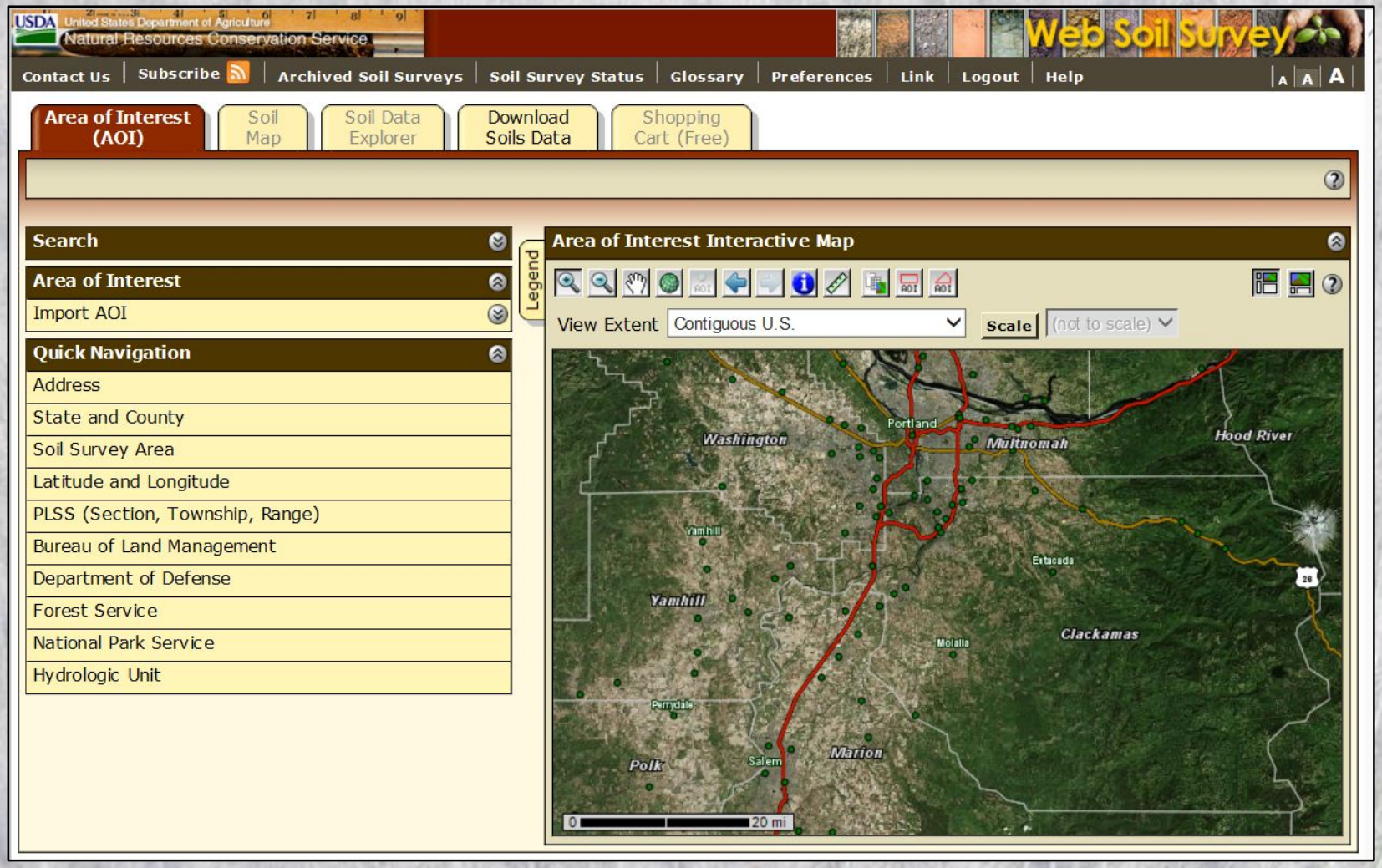
Soil-site factors

| 1 | | 2 | | 3 | |
|---|---|---|---|---|---|
| Geographic and topographic position | | Soil moisture and aeration during the growing season | | Soil fertility and physical condition | |
| Soil-site property | Score for this site | Soil-site property | Score for this site | Soil-site property | Score for this site |
| Elevation | _____ | Internal drainage | _____ | Parent material and age | _____ |
| Physiographic position | _____ | Texture | _____ | pH | _____ |
| Aspect and slope | _____ | Soil depth | _____ | Organic matter | _____ |
| Precipitation | _____ | Rock and gravel content | _____ | Bulk density | _____ |
| Special hazards | _____ | Depth to water table | _____ | | |
| Total for factor 1 = | _____ | Total for factor 2 = | _____ | Total for factor 3 = | _____ |

Total for all factors = _____ .

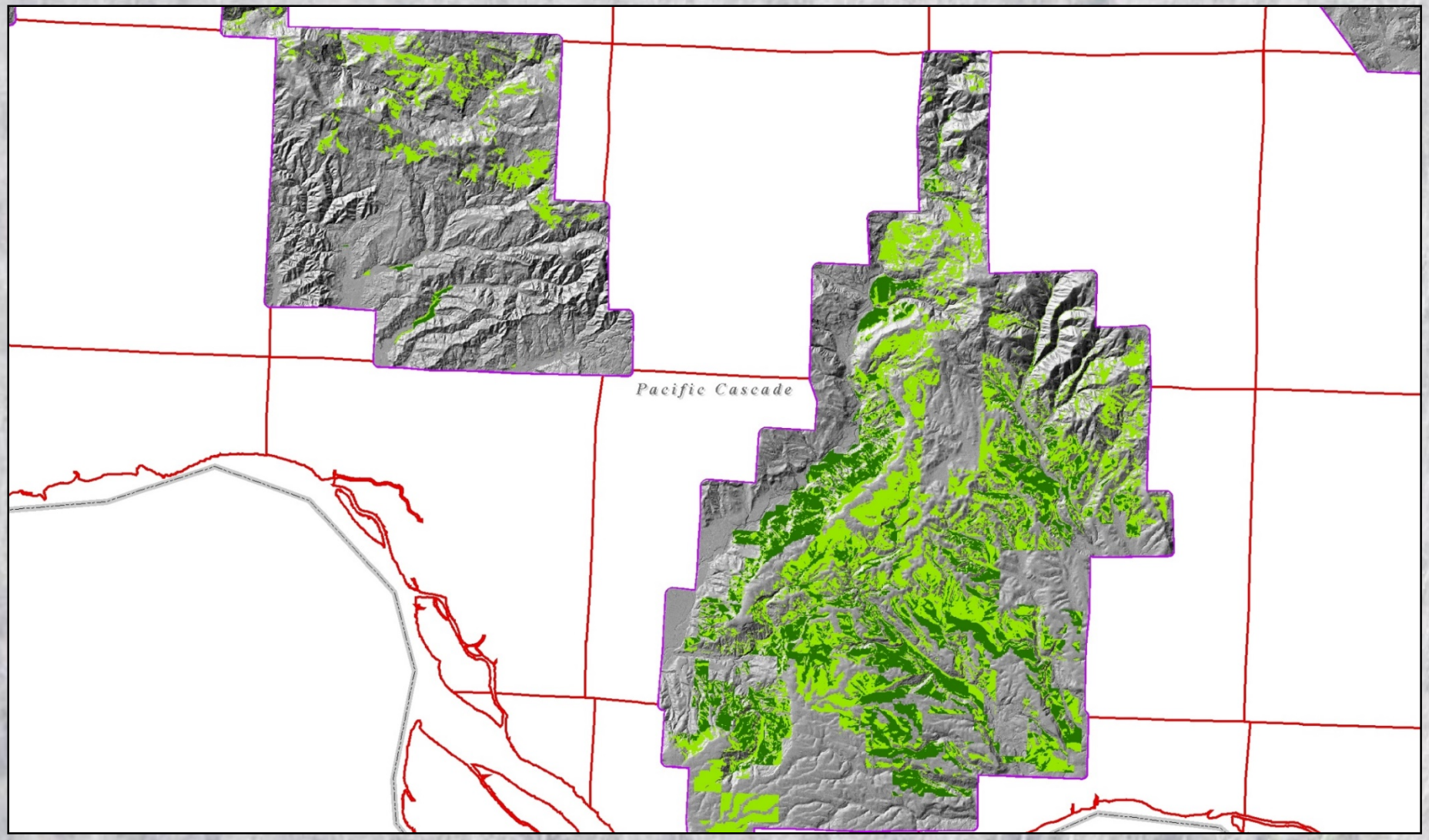
$SI_{50}$ = _____ m.

# Red Alder Management Tools- Site Selection



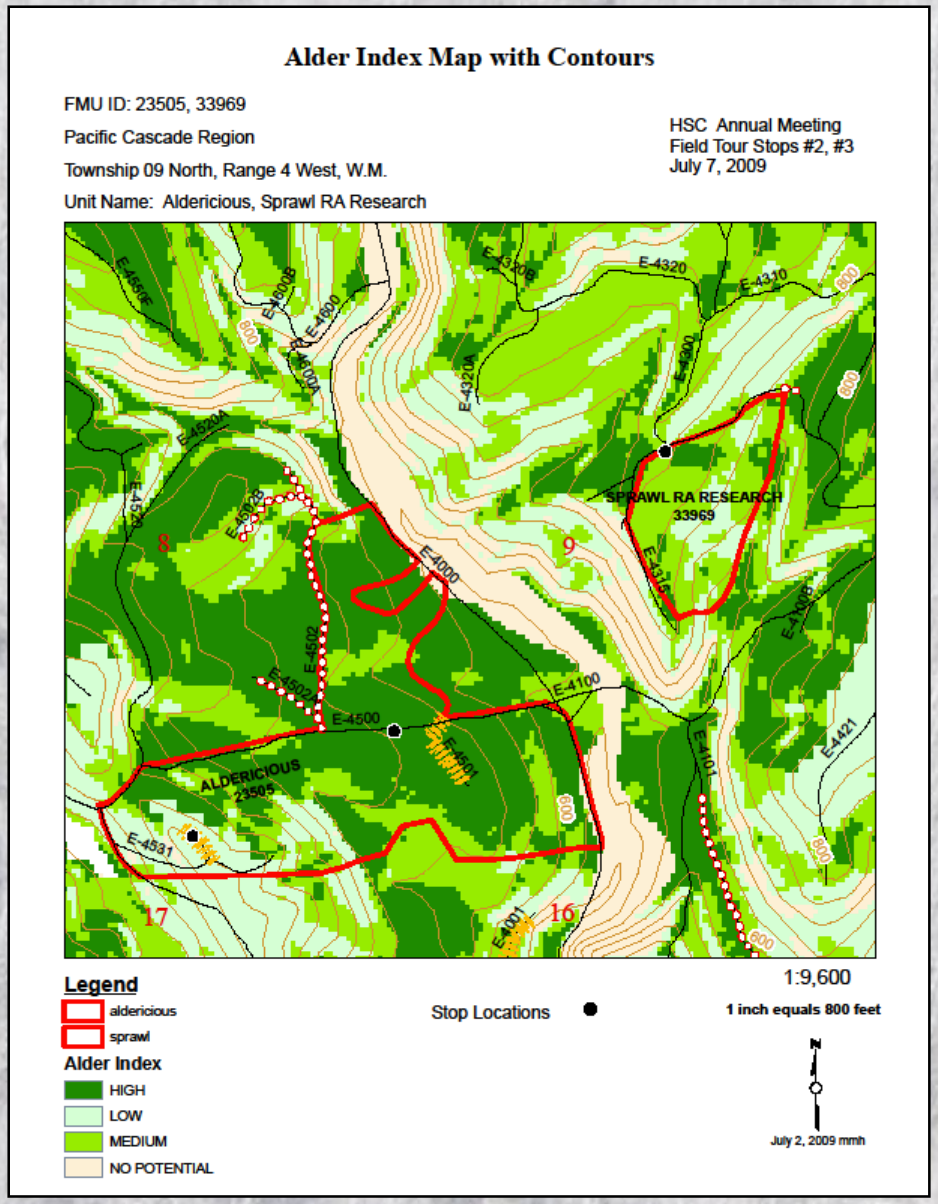

https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

# Red Alder Management Tools- Site Selection



# Red Alder Management Tools- Site Selection

- Developed by DNR
- Currently being tested on Western WA DNR lands
- Plan to have a publicly available version for all of Western WA & OR

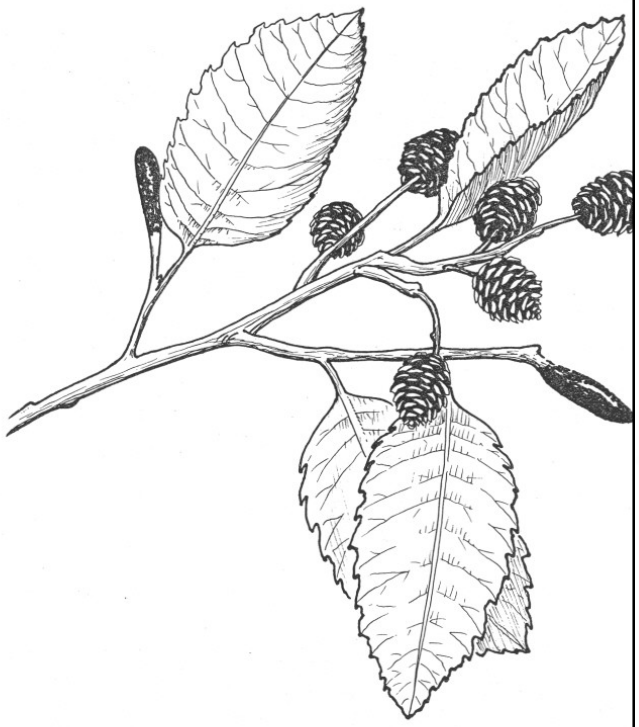


# Red Alder Management Tools- Site Index

United States Department of Agriculture
Forest Service
Pacific Northwest Research Station
Research Paper PNW-358 April 1986

## Height Growth and Site Index Curves for Red Alder

Constance A. Harrington and Robert O. Curtis



**Site index curves have been developed for natural stands of red alder using a base age of 50, 25, or 20 years.**

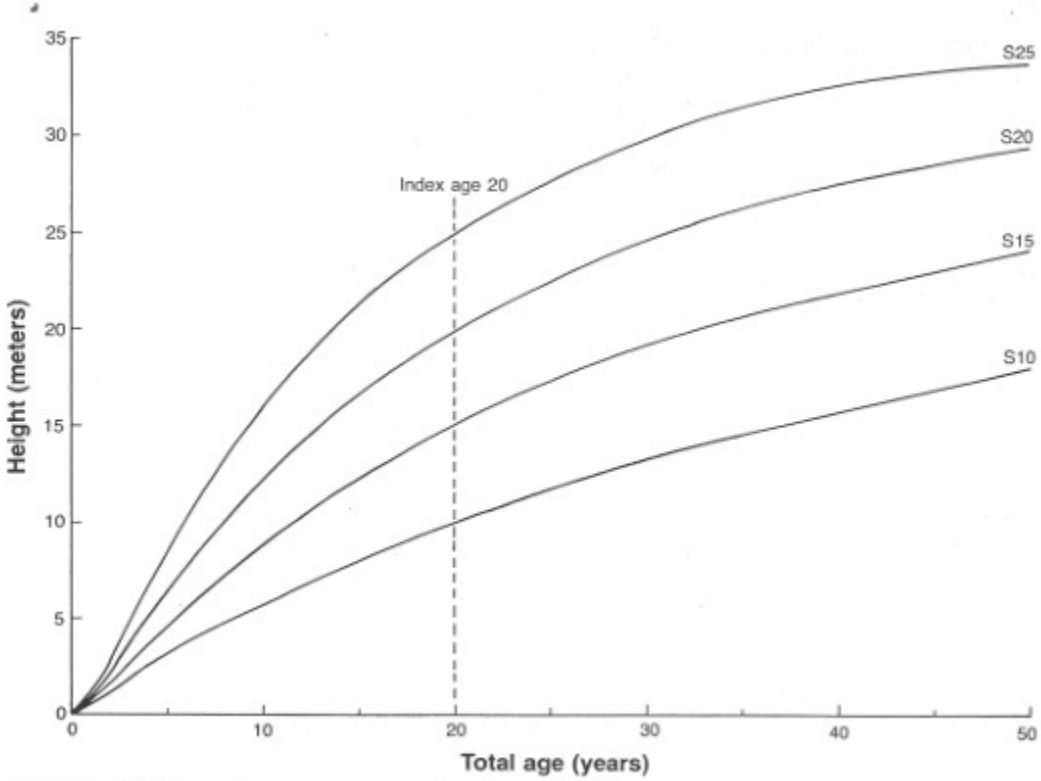
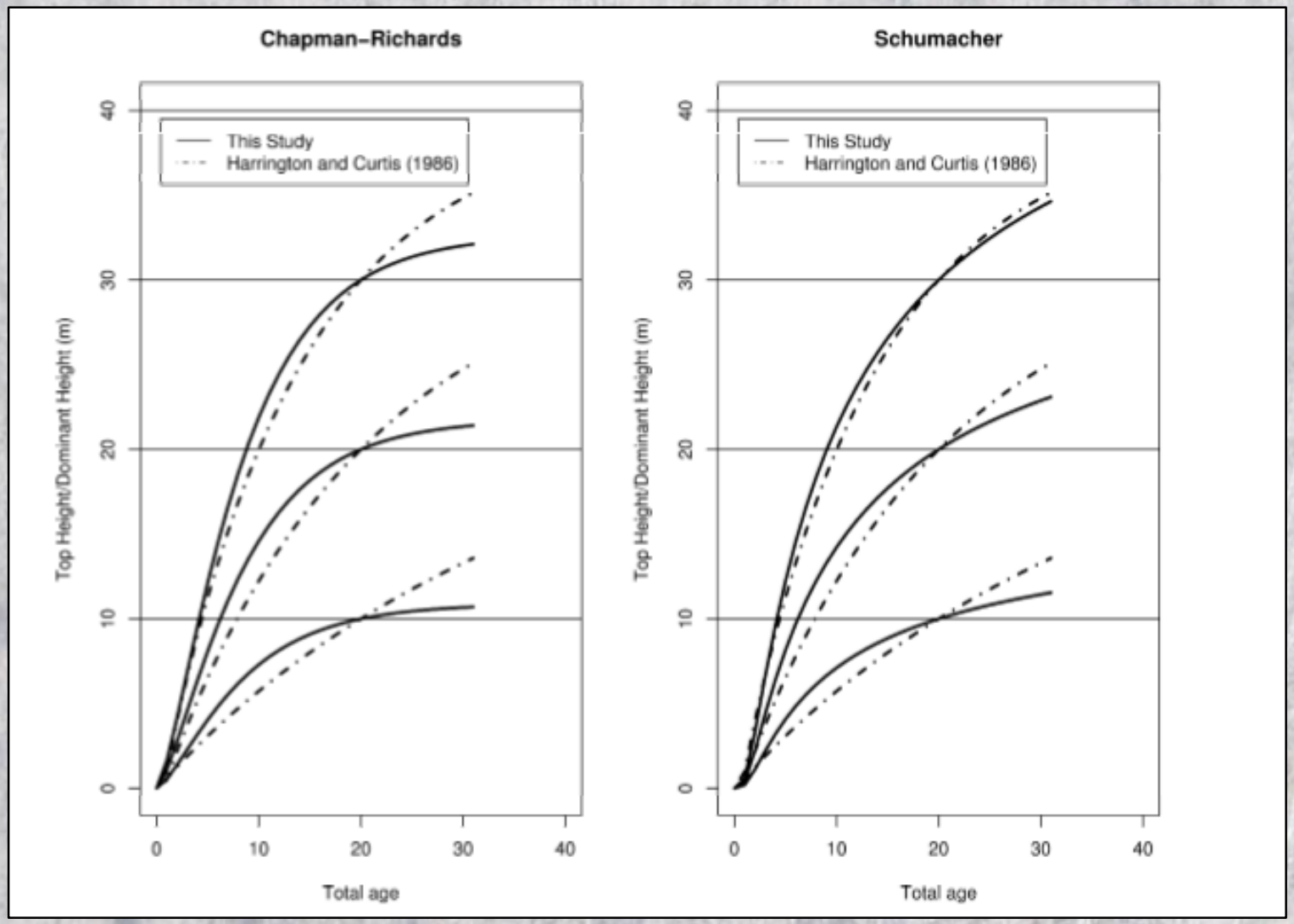



Figure 2.—Height growth curves corresponding to equation 5, combined data, in metric units.

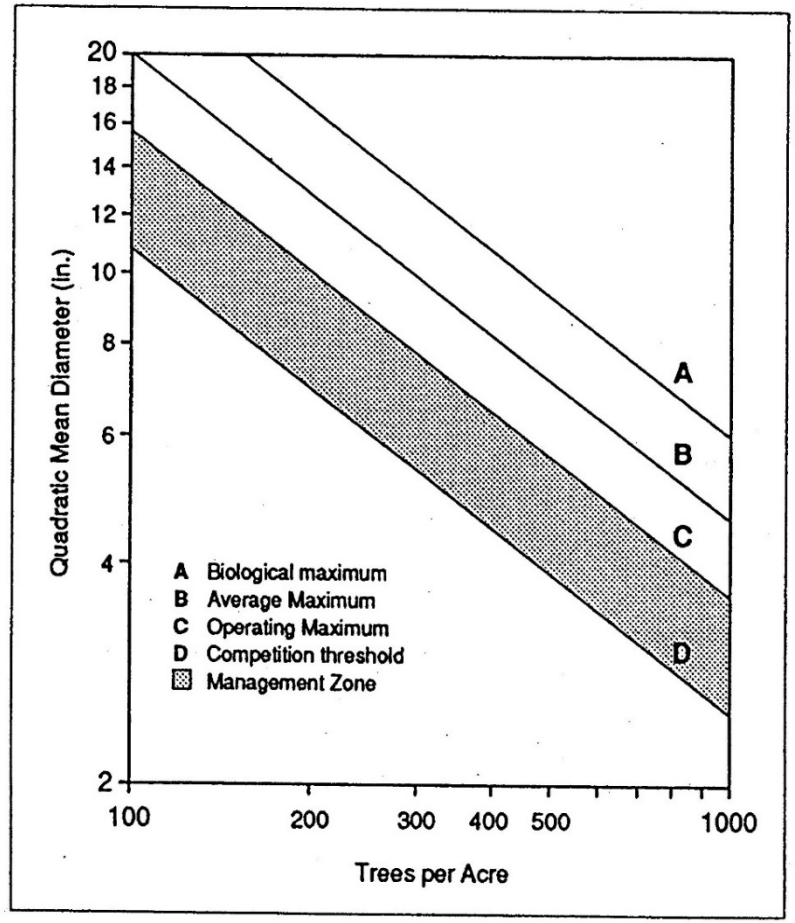
# Red Alder Management Tools- Site Index

**Site index curves have been developed for planted stands of red alder using a base age of 20 years**



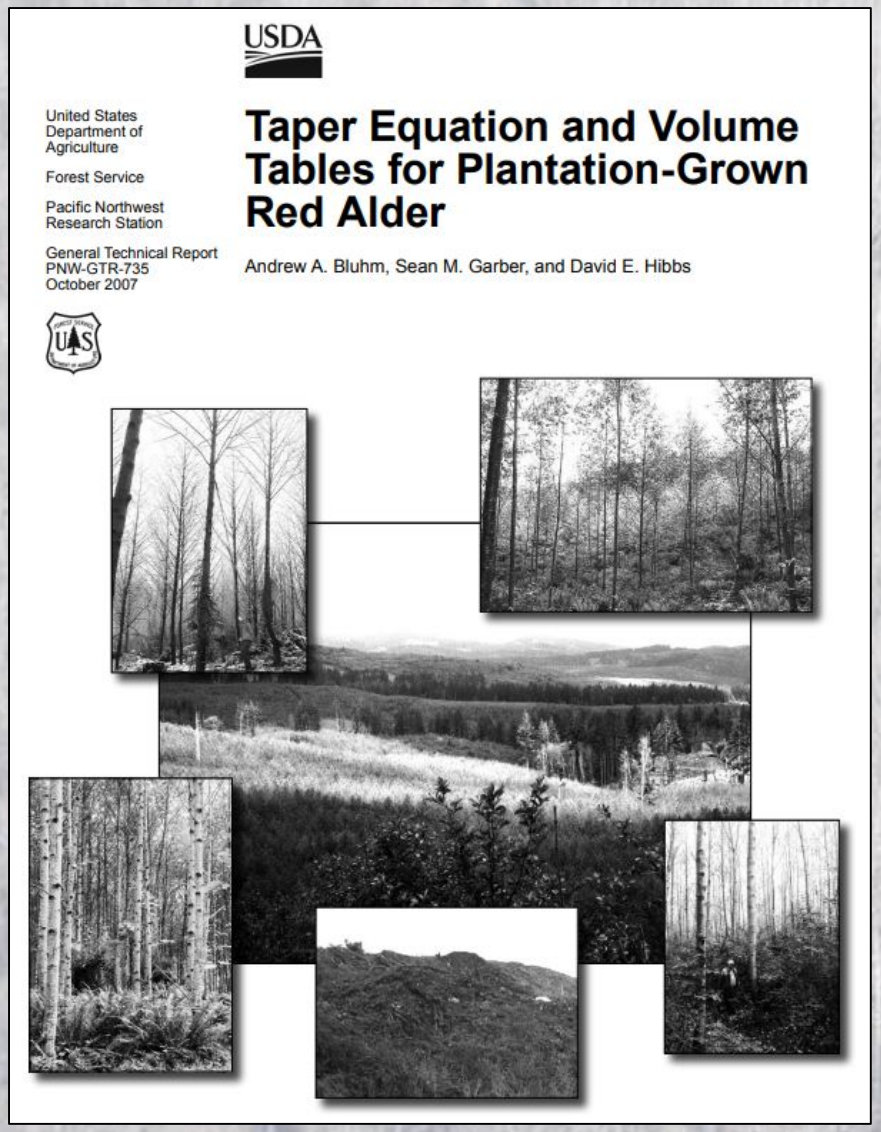
# Red Alder Mgnt Tools- Density Management Diagram

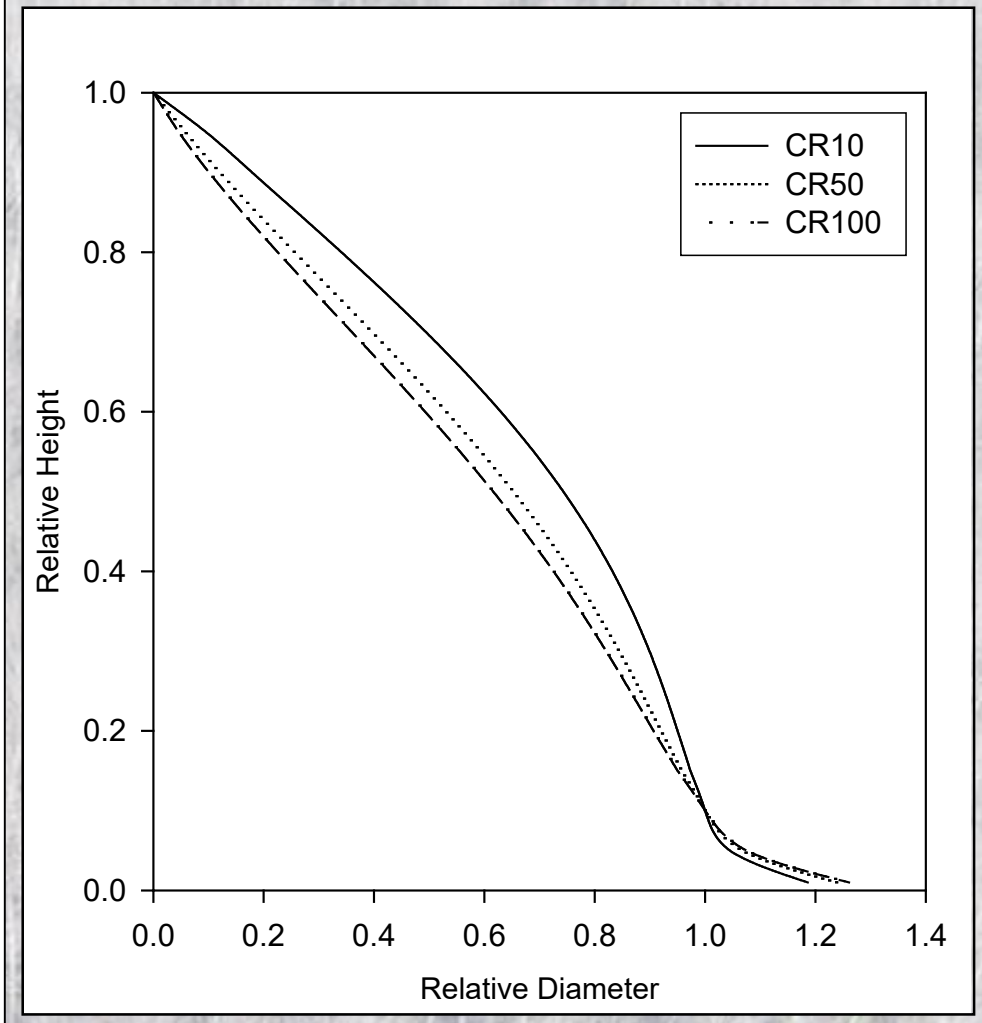
- Defines relationship between growing space and tree size
- Very useful tool for making decisions regarding stand density
  - Planting Density
  - Timing and intensity of thinning




Density Management Diagram for red alder

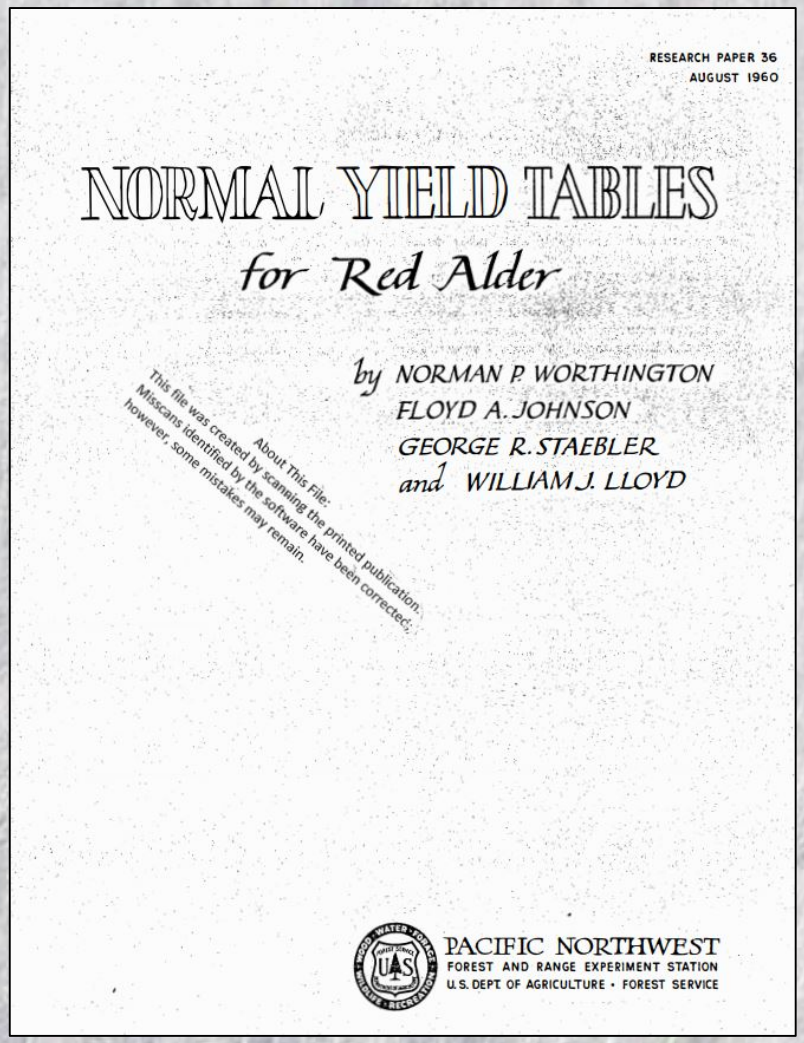
# Red Alder Management Tools- Taper Equation



# Red Alder Management Tools- Volume Tables

- **Browne. 1962**. Standard cubic-foot volume tables for the commercial species of British Columbia
- **Chambers. 1983.** Empirical yield tables for predominantly alder stands in western Washington.
- **Curtis, et al. 1968**. Volume and taper tables for red alder.
- **Johnson, et al. 1949**. Volume tables for red alder.
- **Skinner. 1959**. Cubic volume tables for red alder and Sitka spruce.
- **Worthington, et al. 1960.** Normal yield tables for red alder.



# Red Alder Mgnt Tools- Growth & Yield Model

- **RAP-ORGANON**
  - **Developed in 2010 using HSC and Weyerhaeuser data**
  - **This was the first red alder growth and yield model that specifically modelled the behavior of plantations**
  - **The oldest plantations were 18 years old**

- **Modeling Data**
  - **23 Weyerhaeuser installations containing 239 separate plots and nearly 143,000 tree measurements**
  - **25 HSC installations, containing 227 separate plots and 228,435 tree measurements**
  - **This dataset included over 70,000 more measurements than the dataset used for the original fit**
  - **Most importantly, the new dataset included 23-year-old measurements in all 25 sites, and 28-year-old measurements in 10 sites**
  - **Thinning modifiers were based on nearly 200 plots subjected to thinning, with remeasurements ensuring that more than 50 plots had at least 10 years of growth since thinning and 15 plots had 15 or more years of growth response**

# Red Alder Mgnt Tools- Growth & Yield Model

- **Red Alder Growth Simulator**
  - **Center for Intensive Plantation Silviculture (CIPS) and the HSC, developed a user-friendly interface for RAP-ORGANON using Excel**
  - **This program can simulate stand and tree growth under different treatment scenarios (i.e. thinning)**
  - **“Runs” are controlled by user-specified tree lists, stand information (site index, age and planting density), rotation length and treatment types, merchandising specifications (top diameter, log lengths, trim, etc.), and economic specifications (interest rate, incurred costs and log prices)**

# Red Alder Mgnt Tools- Growth & Yield Model

- **Features:**
  - **Tree Data: DBH, HT, CR, CFV, BFV**
  - **Stand Data: TPA, BA, QMD, HT40, RD, CFV, BFV, CFV MAI, BFV MAI, proportion of volume by log class**
  - **Stand Graphs: TPA, BA, CFV, & BFV by age**
  - **Economic Analysis: IRR & PNV**
- **Additional Features:**
  - **Site Quality Calculator: A built-in calculator for Harrington's (1986) "Method of Site Quality Evaluation for Red Alder" is included**
  - **Site Index Calculator: SI (base age 20 years) can be calculated based on height-age pairs**
  - **Site Index Converter: SI based on height age pairs (base age 20 years) can be converted to SI based on the site quality evaluation method (base age 50 years), and vice versa**

# Red Alder Growth Simulator

- **Inputs (What You Need)**

- **Computer, Microsoft Office**
- **Site Index**
- **Planting Density**
- **Tree Age**
- **Individual Tree List**
- **Management Regime**
- **Merchantability Specifications**
- **Economic Specifications**
  - **Log prices, management costs, interest rate, inflation rate, etc**

# Red Alder Growth Simulator- Inputs

- **Site Index**

| | B | C | D | E | G |
|---|---|---|---|---|---|
| 1 | Calculate Site index | | | | |
| 2 | | | | | |
| 3 | Calculate $SI_{25}$ | | | | |
| 4 | 20 yr (Wairkittel et al.) | | | | |
| 5 | Height (f | Age | Planting density (TI | $SI_{25}$ | |
| 6 | 59.7142 | 23 | 1375 | 56.5 | |
| 7 | 60.0423 | 23 | 1375 | 56.8 | |
| 8 | 58.7299 | 23 | 1375 | 55.6 | |
| 9 | 58.0737 | 23 | 1375 | 55.0 | |
| 10 | 61.3547 | 23 | 1375 | 58.1 | |
| 11 | 60.6985 | 23 | 1375 | 57.5 | |
| 12 | 55.4489 | 23 | 1375 | 52.5 | |
| 13 | 57.7456 | 23 | 1375 | 54.7 | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |
| 21 | | | | | |
| 22 | | | | | |
| 23 | | | | | |
| 24 | | | | | |
| 25 | | | | | |
| 26 | | Average (ft) | | 55.8 | |
| 27 | | | | | |
| 28 | | | | | |
| 29 | | | | | |

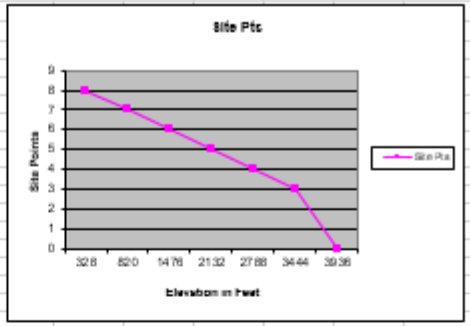
# Red Alder Growth Simulator- Inputs

- **Site Index**

| | B | C | D | E |
|---|---|---|---|---|
| 1 | | | Calculate Site index | |
| 2 | | | | |
| 3 | | | Calculate $SI_{50}$ | |
| 4 | | | 20 yr (Wairkittal et al.) | |
| 5 | | Height (f | Age | Planting density (TI | $SI_{50}$ |
| 6 | | 59.7142 | 23 | 1375 | 56 |
| 7 | | 60.0423 | 23 | 1375 | 56 |
| 8 | | 58.7299 | 23 | 1375 | 55 |
| 9 | | 58.0737 | 23 | 1375 | 55 |
| 10 | | 61.3547 | 23 | 1375 | 5 |
| 11 | | 60.6985 | 23 | 1375 | 57 |
| 12 | | 55.4489 | 23 | 1375 | 52 |
| 13 | | 57.7456 | 23 | 1375 | 54 |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |
| 21 | | | | | |
| 22 | | | | | |
| 23 | | | | | |
| 24 | | | | | |
| 25 | | | | | |
| 26 | | | Average (ft) | | 55 |
| 27 | | | | | |
| 28 | | | | | |
| 29 | | | | | |

## Red Alder - Site Quality Evaluation

| Elevation Meters | Feet | Site Ptr | Feet | Site Ptr | Select | |
|---|---|---|---|---|---|---|
| 100 | 328 | 8 | 250 | 8.1 | | 0 |
| 250 | 820 | 7 | 500 | 7.7 | | 0 |
| 450 | 1476 | 6 | 750 | 7.3 | | 0 |
| 650 | 2132 | 5 | 1000 | 6.9 | | 0 |
| 850 | 2788 | 4 | 1250 | 6.5 | | 0 |
| 1050 | 3444 | 3 | 1500 | 6.1 | 1 | 6 |
| 1200 | 3936 | 0 | 1750 | 5.7 | | 0 |
| | | | 2000 | 5.3 | | 0 |
| Don't plant RA above 3500' | | | 2250 | 4.9 | | 0 |
| | | | 2500 | 4.6 | | 0 |
| | | | 2750 | 4.2 | | 0 |
| | | | 3000 | 3.8 | | 0 |
| | | | 3250 | 3.4 | | 0 |
| | | | 3500 | 0.0 | | 0 |
| | | | 3750 | 0.0 | | 0 |
| | | | | | OK | 6.1 |




| | | |
|---|---|---|
| | -0.00158 | |
| | 328 | |
| | 7.982428 | |

| Slope Position | Site Ptr | Select | |
|---|---|---|---|
| Flood plain | 5 | | 0 |
| Bench <20% slope | 4 | | 0 |
| Lower slope >20% slope | 3 | | 0 |
| Depression/marsh | 2 | 1 | 2 |
| Upper slope | 1 | | 0 |
| Ridgetop | 0 | | 0 |
| | | OK | 2.0 |

| Slope | Aspect | Slope# | Asp# | Site Ptr | Select | |
|---|---|---|---|---|---|---|
| <5% | Any | 4 | 0 | 4 | | 0 |
| | | | | | | 0 |
| 10%-20% | E or W | 2 | 1 | 3 | | 0 |
| 10%-30% | N,NE,NW | 2 | 1 | 3 | 1 | 3 |
| | | | | | | 0 |
| 10%-20% | S,SE,SW | 2 | 0 | 2 | | 0 |
| 25%-35% | E or W | 1 | 1 | 2 | | 0 |
| 35%-45% | N,NE,NW | 1 | 1 | 2 | | 0 |
| | | | | | | 0 |
| 25%-35% | S,SE,SW | 1 | 0 | 1 | | 0 |
| 40%-50% | E or W | 0 | 1 | 1 | | 0 |
| 50%-60% | N,NE,NW | 0 | 1 | 1 | | 0 |
| 40%+ | S,SE,SW | 0 | 0 | 0 | | 0 |
| | | | | | OK | 3.0 |

| Soil | Drainage | Site Ptr | Select | |
|---|---|---|---|---|
| | Well drained | 4 | 1 | 4 |
| | Moderately well drained | 3 | | 0 |
| | Somewhat excess drained | 2 | | 0 |
| | Somewhat poorly drained | 1 | | 0 |
| | Poorly drained | 0 | | 0 |
| | | | OK | 4.0 |

| Soil | Texture | Site Ptr | Select | |
|---|---|---|---|---|
| | Silt, Silty or Loam | 3 | 1 | 3 |
| | Clay, clay loam, silty clay | 2 | | 0 |
| | Sandy.... | 0 | | 0 |
| | | | OK | 3.0 |

| Soil | Depth | Site Ptr | Select | |
|---|---|---|---|---|
| | >-30" | 2 | 1 | 2 |
| | 16"-30" | 1 | | 0 |
| | <14" | 0 | | 0 |
| | | | OK | 2.0 |

| Soil | Rock/gravel | Site Ptr | Select | |
|---|---|---|---|---|
| | 0-25% | 1 | 1 | 1 |
| | 30%-50% | 0 | | 0 |
| | >50% | -2 | | 0 |
| | | | OK | 1.0 |

| Soil | Water table | Site Ptr | Select | |
|---|---|---|---|---|
| | 6-10 feet | 2 | 1 | 2 |
| | 3-5 feet | 1 | | 0 |
| | <3 feet | 0 | | 0 |
| | | | OK | 2.0 |

| Precipitation - April thru Sept. | Site Ptr | Select | |
|---|---|---|---|
| >18" | 3 | 1 | 3 |
| 12"-16" | 2 | | 0 |
| 8"-10" | 1 | | 0 |
| <6" | 0 | | 0 |
| | | OK | 3 |

| Special Hazards | Site Ptr | Select | |
|---|---|---|---|
| None | 0 | 1 | 0 |
| Front Pocket | -2 | | 0 |
| Exposed windy site | -3 | | 0 |
| | | OK | 0 |

| Soil | Organic matter (top 4") | Site Ptr | Select | |
|---|---|---|---|---|
| | 5% to 20% | 2 | 1 | 2 |
| | <3% | 1 | | 0 |
| | >25% | 1 | | 0 |
| | | | OK | 2 |

| Soil | pH | Site Ptr | Select | |
|---|---|---|---|---|
| | 4.6 to 5.5 | 2 | 1 | 2 |
| | 3.8 to 4.3 | 1 | | 0 |
| | <3.0 | 0 | | 0 |
| | | | OK | 2 |

| Soil | Bulk density | Site Ptr | Select | |
|---|---|---|---|---|
| | <1.2 gr/cm^3 | 0 | 1 | 0 |
| | 1.4 gr/cm^3 or more | -2 | | 0 |
| | | | OK | 0 |

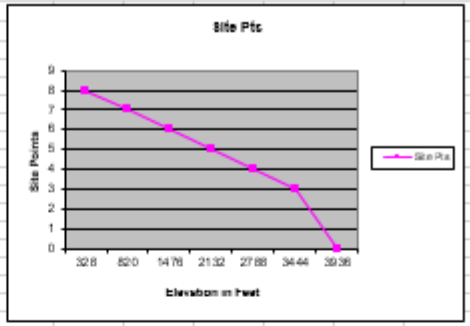
| Parent Material | Site Ptr | Select | |
|---|---|---|---|
| Young rock, water deposited | 4 | | 0 |
| Sedimentary (siltstone, sandstone | 3 | 1 | 3 |
| shale, basalt) | | | 0 |
| Coarse alluvial, glacial or volcanic | 2 | | 0 |
| Highly weathered mineral soils | 1 | | 0 |
| | | OK | 3 |

# Red Alder Growth Simulator- Inputs

- **Site Index**

## Red Alder - Site Quality Evaluation

| Elevation Meters | Feet | Site Ptr | Feet | Site Ptr | Select | |
|---|---|---|---|---|---|---|
| 100 | 328 | 8 | 250 | 8.1 | | 0 |
| 250 | 820 | 7 | 500 | 7.7 | | 0 |
| 450 | 1476 | 6 | 750 | 7.3 | | 0 |
| 650 | 2132 | 5 | 1000 | 6.9 | | 0 |
| 850 | 2788 | 4 | 1250 | 6.5 | | 0 |
| 1050 | 3444 | 3 | 1500 | 6.1 | 1 | 6 |
| 1200 | 3936 | 0 | 1750 | 5.7 | | 0 |
| | | | 2000 | 5.3 | | 0 |
| Don't plant RA above 3500' | | | 2250 | 4.9 | | 0 |
| | | | 2500 | 4.6 | | 0 |
| | | | 2750 | 4.2 | | 0 |
| | | | 3000 | 3.8 | | 0 |
| | | | 3250 | 3.4 | | 0 |
| | | | 3500 | 0.0 | | 0 |
| | | | 3750 | 0.0 | | 0 |
| | | | | | OK | 6.1 |




-0.00158
328
7.982428

| Slope Position | | Site Ptr | Select | |
|---|---|---|---|---|
| Flood plain | | 5 | | 0 |
| Bench <20% slope | | 4 | | 0 |
| Lower slope >20% slope | | 3 | | 0 |
| Depression/marsh | | 2 | 1 | 2 |
| | | | | 0 |
| 25%-35% | S,SE,SW | 1 | 0 | 1 |
| 40%-50% | E or W | 0 | 1 | 1 |
| 50%-60% | N,NE,NW | 0 | 1 | 1 |
| 40%+ | S,SE,SW | 0 | 0 | 0 |
| | | | | 0 |
| | | | OK | 3.0 |

| Precipitation - April thru Sept. | Site Ptr | Select | |
|---|---|---|---|
| >18" | 3 | 1 | 3 |
| 12"-16" | 2 | | 0 |
| 8"-10" | 1 | | 0 |
| <6" | 0 | | 0 |
| | | OK | 3 |

| Soil | Drainage | Site Ptr | Select | |
|---|---|---|---|---|
| | Well drained | 4 | 1 | 4 |
| | Moderately well drained | 3 | | 0 |
| | Somewhat excess drained | 2 | | 0 |
| | Somewhat poorly drained | 1 | | 0 |
| | Poorly drained | 0 | | 0 |
| | | | OK | 4.0 |

| Soil | Texture | Site Ptr | Select | |
|---|---|---|---|---|
| | Silt, Silty or Loam | 3 | 1 | 3 |
| | Clay, clay loam, silty clay | 2 | | 0 |
| | Sandy.... | 0 | | 0 |
| | | | OK | 3.0 |

| Soil | Depth | Site Ptr | Select | |
|---|---|---|---|---|
| | >-30" | 2 | 1 | 2 |
| | 16"-30" | 1 | | 0 |
| | <14" | 0 | | 0 |
| | | | OK | 2.0 |

| Soil | Rock/gravel | Site Ptr | Select | |
|---|---|---|---|---|
| | 0-25% | 1 | 1 | 1 |
| | 30%-50% | 0 | | 0 |
| | >50% | -2 | | 0 |
| | | | OK | 1.0 |

| Soil | Water table | Site Ptr | Select | |
|---|---|---|---|---|
| | 6-10 feet | 2 | 1 | 2 |
| | 3-5 feet | 1 | | 0 |
| | <3 feet | 0 | | 0 |
| | | | OK | 2.0 |

| Soil | Organic matter (top 4") | Site Ptr | Select | |
|---|---|---|---|---|
| | 5% to 20% | 2 | 1 | 2 |
| | <3% | 1 | | 0 |
| | >25% | 1 | | 0 |
| | | | OK | 2 |

| Soil | pH | Site Ptr | Select | |
|---|---|---|---|---|
| | 4.6 to 5.5 | 2 | 1 | 2 |
| | 3.8 to 4.3 | 1 | | 0 |
| | <3.0 | 0 | | 0 |
| | | | OK | 2 |

| Soil | Bulk density | Site Ptr | Select | |
|---|---|---|---|---|
| | <1.2 gr/cm^3 | 0 | 1 | 0 |
| | 1.4 gr/cm^3 or more | -2 | | 0 |
| | | | OK | 0 |

| Parent Material | Site Ptr | Select | |
|---|---|---|---|
| Young rock, water deposited | 4 | | 0 |
| Sedimentary (siltstone, sandstone shale, basalt) | 3 | 1 | 3 |
| | | | 0 |
| Coarse alluvial, glacial or volcanic | 2 | | 0 |
| Highly weathered mineral rock | 1 | | 0 |
| | | OK | 3 |

| | Select | |
|---|---|---|
| | 1 | 0 |
| | | 0 |
| | | 0 |
| K | | 0 |

| GRAND TOTAL SITE POINTS | Site Pts | 50yr Site Index (m) | 50yr Site Index (ft) | 20yr Site Index (m) | 20yr Site Index (ft) |
|---|---|---|---|---|---|
| | 33.1 | 33.1 | 108.7 | 23.8 | 78.2 |

## Calculate Site index

Calculate $SI_{20}$

20 yr (Wakkittal et al.)

| Height (ft) | Age | Planting density (TPA) | $SI_{20}$ |
|---|---|---|---|
| 59.7142 | 23 | 1375 | 56 |
| 60.0423 | 23 | 1375 | 56 |
| 58.7299 | | | |
| 58.0737 | | | |
| 61.3547 | | | |
| 60.6985 | | | |
| 55.4489 | | | |
| 57.7456 | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | Average (ft) | | 55 |

# Red Alder Growth Simulator- Inputs

- **Stand Info**

| | A | B | C |
|---|---|---|---|
| 1 | **Stand information input** | | |
| 2 | RA Site Index | 75.0 | |
| 3 | DF Site Index | 123 | |
| 4 | Even Aged? | 1 | |
| 5 | BH_AGE | 2 | |
| 6 | Age from seed | 4 | |
| 7 | **ORGANON input/output** | | |
| 8 | VERSION | 4 | |
| 9 | Number of plots | 1 | |
| 12 | **Merchandising Specifications** | | |
| 13 | *Cubic Foot Volume* | | |
| 14 | Stump Height (ft) | 0 | |
| 15 | Top Diameter (inches) | 0 | |
| 16 | | | |
| 17 | *Board Foot Volume* | | |
| 18 | Log length (ft) | 20 | |
| 19 | Min Log length (ft) | 10 | |
| 20 | Top Diameter (inches) | 6 | |
| 21 | Stump height (ft) | 1 | |
| 22 | Trim (inches) | 6 | |
| 23 | **Economic Specifications** | | |
| 24 | Interest rate (%) | 7.5 | |
| 25 | Inflation rate (%) | 2 | |
| 26 | Timber Prc Increase (%) | 0.5 | |
| 27 | | | |
| 28 | ***Costs*** | | |
| 29 | Logging, thin | 150.00 | |
| 30 | Logging, Final harvest | 150.00 | |
| 31 | Haul | 80.00 | |
| 32 | PCT | 125.00 | |
| 33 | Spray | 80.00 | |
| 34 | Site Prep | 200.00 | |
| 35 | Plant | 100.00 | |
| 36 | | | |
| 37 | ***Log Prices*** | | |
| 38 | 4" scaling diameter | 400.00 | |
| 39 | 5" scaling diameter | 400.00 | |
| 40 | 6" scaling diameter | 450.00 | |
| 41 | 7" scaling diameter | 450.00 | |
| 42 | 8" scaling diameter | 550.00 | |
| 43 | 9" scaling diameter | 550.00 | |
| 44 | 10" scaling diameter | 575.00 | |
| 45 | 11" scaling diameter | 600.00 | |
| 46 | 12"+ scaling diameter | 650.00 | |
| 47 | | | |
| 48 | | | |
| 49 | | | |
| 50 | | | |
| 51 | | | |

Stand info | Treatments | TreeL

# Red Alder Growth Simulator- Inputs

- **Treatments**

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Treatment (user thin, RD or TPA thinning from below, fertilization) | Total Age | Type<br>0=final harvest;<br>1=user thin;<br>2=RD thin;<br>3=TPA thin;<br>4=output stand/tree data | Treatment specifics<br>user code (if type=1);<br>Residual RD (if type=2);<br>Residual TPA (if type=3); | Thinning specifics: (% of total that should be removed proportionally) |
| 2 | 1 | 41 | 0 | 0 | 0 |
| 3 | 2 | 0 | 0 | 0 | 0 |
| 4 | 3 | 0 | 0 | 0 | 0 |
| 5 | 4 | 0 | 0 | 0 | 0 |
| 6 | 5 | 0 | 0 | 0 | 0 |
| 7 | 6 | 0 | 0 | 0 | 0 |
| 8 | 7 | 0 | 0 | 0 | 0 |
| 9 | 8 | 0 | 0 | 0 | 0 |
| 10 | Comparison to control? (1=yes, 0=no) | | | | 0 |
| 11 | | | | | |

# Red Alder Growth Simulator- Inputs

- **Treatments**

| | A | B | C | D | E |
|---|---|---|---|---|---|
| | Treatment (user thin, RD or TPA thinning from below, | Total Age | Type 0=final harvest; | Treatment specifics user code (if type=1); | Thinning specifics: (% of total that should be |

| 1 | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Treatment (user thin, RD or TPA thinning from below, fertilization) | Total Age | Type 0=final harvest; 1=user thin; 2=RD thin; 3=TPA thin; 4=output stand/tree data | Treatment specifics user code (if type=1); Residual RD (if type=2); Residual TPA (if type=3); | Thinning specifics: (% of total that should be removed proportionally) |
| 2 | 1 | 11 | 3 | 250 | 0 |
| 3 | 2 | 36 | 0 | 0 | 0 |
| 4 | 3 | 0 | 0 | 0 | 0 |
| 5 | 4 | 0 | 0 | 0 | 0 |
| 6 | 5 | 0 | 0 | 0 | 0 |
| 7 | 6 | 0 | 0 | 0 | 0 |
| 8 | 7 | 0 | 0 | 0 | 0 |
| 9 | 8 | 0 | 0 | 0 | 0 |
| 10 | Comparison to control? (1=yes, 0=no) | | | | 0 |
| 11 | | | | | |

# Red Alder Growth Simulator- Inputs

- **Tree List**

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Plot | Tree | Species | User code | DBH | Ht | CR | EXPF | | | |
| 2 | 204 | 635 | 351 | 1 | 1.1 | 11.8 | 0.86 | 3.0 | | | |
| 3 | 204 | 636 | 351 | 1 | 1.5 | 13.1 | 0.90 | 3.0 | | | |
| 4 | 204 | 637 | 351 | 1 | 1.2 | 13.1 | 0.85 | 3.0 | | | |
| 5 | 204 | 638 | 351 | 1 | 0.9 | 10.8 | 0.82 | 3.0 | | | |
| 6 | 204 | 639 | 351 | 1 | 1.5 | 15.4 | 0.96 | 3.0 | | | |
| 7 | 204 | 640 | 351 | 1 | 0.8 | | | 3.0 | | | |
| 8 | 204 | 641 | 351 | 1 | 1.3 | | | 3.0 | | | |
| 9 | 204 | 642 | 351 | 1 | 0.7 | | | 3.0 | | | |
| 10 | 204 | 643 | 351 | 1 | 1.0 | | | 3.0 | | | |
| 11 | 204 | 644 | 351 | 1 | 0.7 | 9.2 | | 3.0 | | | |
| 12 | 204 | 645 | 351 | 1 | 0.9 | 12.8 | | 3.0 | | | |
| 13 | 204 | 646 | 351 | 1 | 0.7 | 9.8 | | 3.0 | | | |
| 14 | 204 | 647 | 351 | 1 | 1.0 | 11.8 | | 3.0 | | | |
| 15 | 204 | 648 | 351 | 1 | 1.6 | | | 3.0 | | | |
| 16 | 204 | 649 | 351 | 1 | 0.8 | | | 3.0 | | | |
| 17 | 204 | 650 | 351 | 1 | 1.4 | | | 3.0 | | | |
| 18 | 204 | 651 | 351 | 1 | 1.3 | | | 3.0 | | | |
| 19 | 204 | 652 | 351 | 1 | 0.9 | 11.2 | | 3.0 | | | |
| 20 | 204 | 653 | 351 | 1 | 1.0 | 12.8 | 0.90 | 3.0 | | | |
| 21 | 204 | 654 | 351 | 1 | 1.1 | 11.8 | 0.86 | 3.0 | | | |
| 22 | 204 | 655 | 351 | 1 | 0.4 | 6.6 | 0.85 | 3.0 | | | |
| 23 | 204 | 656 | 351 | 1 | 1.1 | 12.1 | 0.86 | 3.0 | | | |
| 24 | 204 | 657 | 351 | 1 | 1.0 | 12.8 | 0.87 | 3.0 | | | |
| 25 | 204 | 658 | 351 | 1 | 1.3 | 14.1 | 0.84 | 3.0 | | | |
| 26 | 204 | 659 | 351 | 1 | 1.5 | 15.4 | 0.85 | 3.0 | | | |

Run ORGANON

# Red Alder Growth Simulator- Outputs

- **Outputs (What You Get)**

- **Tree Data: DBH, HT, CR, CFV, BFV**
- **Stand Data: TPA, BA, QMD, HT40, RD, CFV, BFV, CFV MAI, BFV MAI, proportion of volume by log class**
- **Stand Graphs: TPA, BA, CFV, & BFV by age**
- **Economic Analysis: IRR & PNV**

# Red Alder Growth Simulator- Outputs

- **Tree Data**

| | A | B | C | D | E | F | G | H | I | J | K | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AGE | Plot | Tree | Spp | DBH | HT | CR | CFVOL | BFVOL | TPA | Thin? | A |
| 7537 | 40 | 204 | 826 | 351 | 6.2 | 72.9 | 0.14 | 6.9 | 0.0 | 1.07 | 0 | |
| 7538 | 40 | 204 | 827 | 351 | 9.7 | 77.9 | 0.22 | 18.1 | 52.1 | 2.85 | 0 | |
| 7539 | 40 | 204 | 828 | 351 | 7.0 | 74.7 | 0.16 | 9.2 | 13.9 | 1.99 | 0 | |
| 7540 | 40 | 204 | 829 | 351 | 4.7 | 65.4 | 0.13 | 3.6 | 0.0 | 0.04 | 0 | |
| 7541 | 40 | 204 | 830 | 351 | 7.9 | 74.8 | 0.16 | 11.7 | 25.0 | 2.48 | 0 | |
| 7542 | 40 | 204 | 831 | 351 | 5.8 | 68.9 | 0.14 | 5.9 | 0.0 | 0.72 | 0 | |
| 7543 | 40 | 204 | 832 | 351 | 5.4 | 67.9 | 0.15 | 5.0 | 0.0 | 0.38 | 0 | |
| 7544 | 40 | 204 | 833 | 351 | 5.5 | 67.9 | 0.14 | 5.2 | 0.0 | 0.44 | 0 | |
| 7545 | 40 | 204 | 834 | 351 | 5.4 | 67.6 | 0.15 | 5.0 | 0.0 | 0.39 | 0 | |
| 7546 | 40 | 204 | 835 | 351 | 12.7 | 83.2 | 0.29 | 33.2 | 103.0 | 2.94 | 0 | |
| 7547 | 40 | 204 | 836 | 351 | 10.2 | 82.2 | 0.21 | 21.2 | 62.1 | 2.87 | 0 | |
| 7548 | 40 | 204 | 837 | 351 | 5.0 | 67.3 | 0.16 | 4.3 | 0.0 | 0.18 | 0 | |
| 7549 | 40 | 204 | 1109 | 351 | 6.9 | 69.8 | 0.18 | 8.4 | 11.6 | 2.00 | 0 | |
| 7550 | 41 | 204 | 635 | 351 | 6.5 | 71.2 | 0.15 | 7.6 | 0.0 | 1.44 | 0 | |
| 7551 | 41 | 204 | 636 | 351 | 11.0 | 79.3 | 0.25 | 23.8 | 62.1 | 2.90 | 0 | |
| 7552 | 41 | 204 | 637 | 351 | 7.2 | 74.4 | 0.15 | 9.6 | 16.2 | 2.03 | 0 | |
| 7553 | 41 | 204 | 638 | 351 | 5.7 | 68.2 | 0.14 | 5.5 | 0.0 | 0.52 | 0 | |
| 7554 | 41 | 204 | 639 | 351 | 11.5 | 87.3 | 0.24 | 28.7 | 80.4 | 2.93 | 0 | |
| 7555 | 41 | 204 | 640 | 351 | 5.2 | 67.2 | 0.14 | 4.6 | 0.0 | 0.19 | 0 | |
| 7556 | 41 | 204 | 641 | 351 | 8.7 | 81.7 | 0.18 | 15.5 | 46.1 | 2.72 | 0 | |
| 7557 | 41 | 204 | 642 | 351 | 5.1 | 66.6 | 0.15 | 4.4 | 0.0 | 0.18 | 0 | |
| 7558 | 41 | 204 | 643 | 351 | 6.2 | 71.1 | 0.15 | 6.8 | 0.0 | 1.06 | 0 | |
| 7559 | 41 | 204 | 644 | 351 | 5.3 | 66.8 | 0.15 | 4.7 | 0.0 | 0.26 | 0 | |
| 7560 | 41 | 204 | 645 | 351 | 5.8 | 72.2 | 0.14 | 6.1 | 0.0 | 0.61 | 0 | |
| 7561 | 41 | 204 | 646 | 351 | 5.2 | 67.1 | 0.14 | 4.5 | 0.0 | 0.18 | 0 | |
| 7562 | 41 | 204 | 647 | 351 | 6.7 | 72.1 | 0.16 | 8.0 | 0.0 | 1.61 | 0 | |
| 7563 | 41 | 204 | 648 | 351 | 12.5 | 85.8 | 0.27 | 33.0 | 114.6 | 2.93 | 0 | |
| 7564 | 41 | 204 | 649 | 351 | 5.1 | 68.0 | 0.13 | 4.3 | 0.0 | 0.11 | 0 | |
| 7565 | 41 | 204 | 650 | 351 | 11.7 | 76.8 | 0.29 | 26.1 | 73.2 | 2.92 | 0 | |
| 7566 | 41 | 204 | 651 | 351 | 9.4 | 78.1 | 0.21 | 17.2 | 49.6 | 2.83 | 0 | |

# Red Alder Growth Simulator- Outputs

- **Stand Data**

| 1 | Cycle | Age | TPA | BA | QMD | HT40 | CFV | BFV | CFV MAI | BFV MAI | RD | IRR | PNW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 15 | 19 | 519.1 | 138.9 | 7.0 | 69.7 | 4006 | 5960 | 210.8 | 313.7 | 97.9 | 9.7% | $231.82 |
| 18 | 16 | 20 | 511.2 | 142.9 | 7.2 | 71.3 | 4209 | 6670 | 210.5 | 333.5 | 99.8 | 10.3% | $296.09 |
| 19 | 17 | 21 | 503.3 | 146.6 | 7.3 | 72.3 | 4404 | 7456 | 209.7 | 355.0 | 101.6 | 10.7% | $354.80 |
| 20 | 18 | 22 | 495.5 | 150.1 | 7.5 | 73.7 | 4591 | 8014 | 208.7 | 364.3 | 103.2 | 10.8% | $390.00 |
| 21 | 19 | 23 | 487.9 | 153.4 | 7.6 | 74.9 | 4772 | 8776 | 207.5 | 381.6 | 104.7 | 11.1% | $454.20 |
| 22 | 20 | 24 | 480.4 | 156.5 | 7.7 | 76.1 | 4946 | 9377 | 206.1 | 390.7 | 106.0 | 11.1% | $475.22 |
| 23 | 21 | 25 | 473.1 | 159.4 | 7.9 | 77.2 | 5113 | 9939 | 204.5 | 397.6 | 107.3 | 11.1% | $500.00 |
| 24 | 22 | 26 | 466.0 | 162.2 | 8.0 | 78.2 | 5276 | 10650 | 202.9 | 409.6 | 108.4 | 11.2% | $543.41 |
| 25 | 23 | 27 | 459.2 | 164.8 | 8.1 | 79.2 | 5433 | 11115 | 201.2 | 411.7 | 109.5 | 11.1% | $552.43 |
| 26 | 24 | 28 | 452.5 | 167.3 | 8.2 | 80.2 | 5586 | 11673 | 199.5 | 416.9 | 110.5 | 11.1% | $575.90 |
| 27 | 25 | 29 | 446.1 | 169.8 | 8.4 | 81.1 | 5734 | 12251 | 197.7 | 422.5 | 111.5 | 11.0% | $596.18 |
| 28 | 26 | 30 | 439.9 | 172.1 | 8.5 | 81.9 | 5879 | 12719 | 196.0 | 424.0 | 112.4 | 10.9% | $598.63 |
| 29 | 27 | 31 | 433.9 | 174.3 | 8.6 | 82.8 | 6020 | 13345 | 194.2 | 430.5 | 113.3 | 10.8% | $613.59 |
| 30 | 28 | 32 | 428.2 | 176.5 | 8.7 | 83.6 | 6157 | 14129 | 192.4 | 441.5 | 114.1 | 10.8% | $636.60 |
| 31 | 29 | 33 | 422.7 | 178.6 | 8.8 | 84.3 | 6291 | 14923 | 190.6 | 452.2 | 114.9 | 10.8% | $663.63 |
| 32 | 30 | 34 | 417.4 | 180.6 | 8.9 | 85.1 | 6423 | 15236 | 188.9 | 448.1 | 115.6 | 10.7% | $653.09 |
| 33 | 31 | 35 | 412.2 | 182.6 | 9.0 | 85.8 | 6551 | 16044 | 187.2 | 458.4 | 116.3 | 10.6% | $674.19 |
| 34 | 32 | 36 | 407.3 | 184.5 | 9.1 | 86.4 | 6677 | 16425 | 185.5 | 456.3 | 117.0 | 10.5% | $662.84 |
| 35 | 33 | 37 | 402.6 | 186.4 | 9.2 | 87.1 | 6800 | 17076 | 183.8 | 461.5 | 117.7 | 10.4% | $664.25 |
| 36 | 34 | 38 | 398.1 | 188.2 | 9.3 | 87.7 | 6921 | 17400 | 182.1 | 457.9 | 118.3 | 10.3% | $651.51 |
| 37 | 35 | 39 | 393.7 | 190.0 | 9.4 | 88.3 | 7039 | 18234 | 180.5 | 467.5 | 119.0 | 10.3% | $665.76 |
| 38 | 36 | 40 | 389.5 | 191.7 | 9.5 | 88.9 | 7155 | 18583 | 178.9 | 464.6 | 119.6 | 10.2% | $652.07 |
| 39 | 37 | 41 | 385.4 | 193.4 | 9.6 | 89.5 | 7270 | 19130 | 177.3 | 466.6 | 120.2 | 10.1% | $651.04 |
| 40 | | | | | | | | | | | | | |

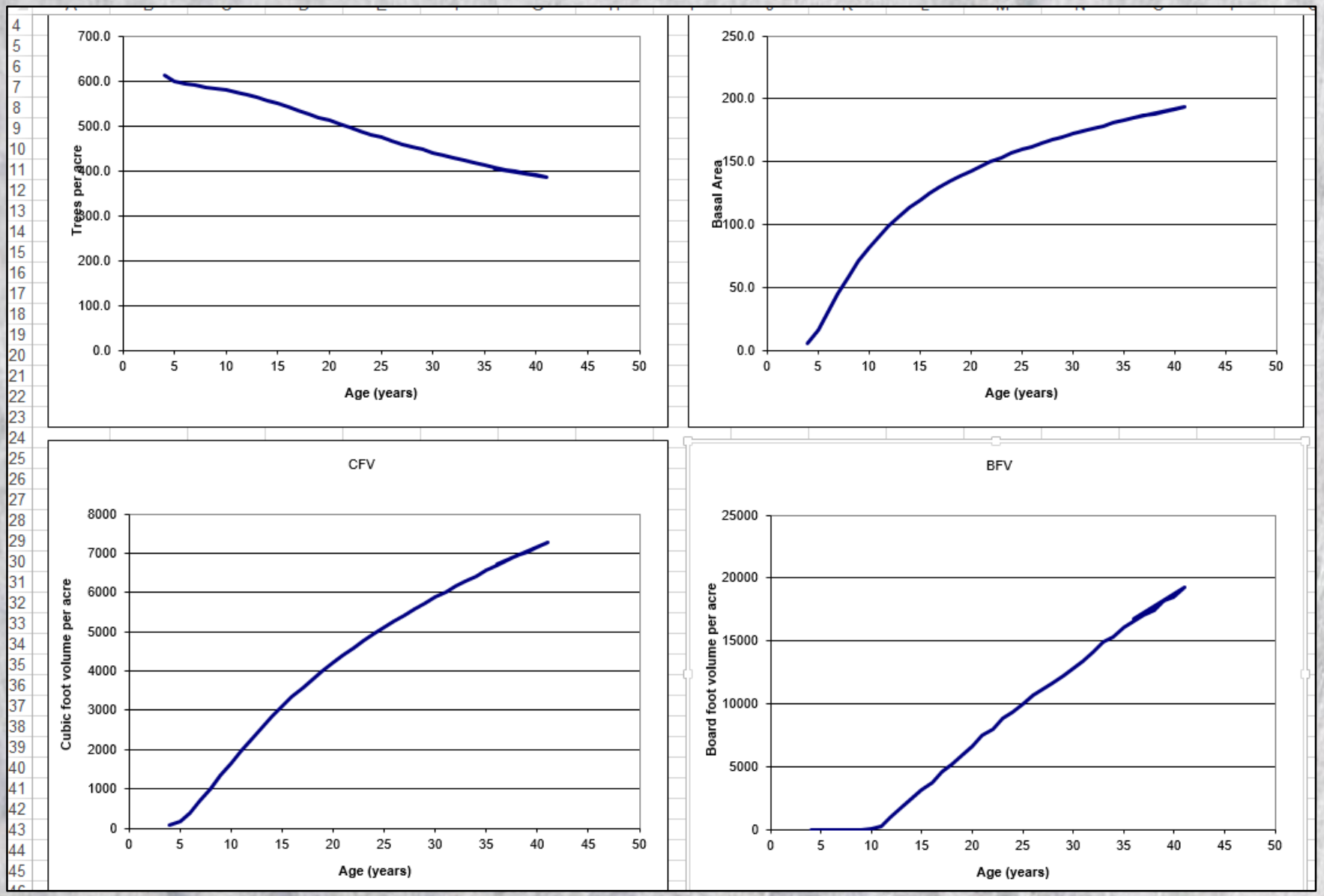
# Red Alder Growth Simulator- Outputs

- **Stand Data**

| Age | Thin | prop_4" | prop_5" | prop_6" | prop_7" | prop_8" | prop_9" | prop_10" | prop_11" | prop_12"+ |
|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 0.00 | 0.12 | 0.24 | 0.22 | 0.23 | 0.18 | 0.02 | 0.00 | 0.00 | 0.00 |
| 23 | 0.00 | 0.11 | 0.23 | 0.17 | 0.20 | 0.23 | 0.06 | 0.00 | 0.00 | 0.00 |
| 24 | 0.00 | 0.10 | 0.24 | 0.16 | 0.20 | 0.20 | 0.10 | 0.00 | 0.00 | 0.00 |
| 25 | 0.00 | 0.09 | 0.21 | 0.18 | 0.20 | 0.21 | 0.11 | 0.00 | 0.00 | 0.00 |
| 26 | 0.00 | 0.08 | 0.20 | 0.17 | 0.17 | 0.20 | 0.16 | 0.02 | 0.00 | 0.00 |
| 27 | 0.00 | 0.06 | 0.19 | 0.16 | 0.19 | 0.20 | 0.15 | 0.04 | 0.00 | 0.00 |
| 28 | 0.00 | 0.05 | 0.19 | 0.13 | 0.19 | 0.15 | 0.22 | 0.07 | 0.00 | 0.00 |
| 29 | 0.00 | 0.05 | 0.17 | 0.13 | 0.17 | 0.18 | 0.18 | 0.12 | 0.00 | 0.00 |
| 30 | 0.00 | 0.05 | 0.15 | 0.14 | 0.18 | 0.18 | 0.18 | 0.13 | 0.00 | 0.00 |
| 31 | 0.00 | 0.04 | 0.13 | 0.14 | 0.19 | 0.17 | 0.18 | 0.13 | 0.02 | 0.00 |
| 32 | 0.00 | 0.03 | 0.13 | 0.12 | 0.18 | 0.18 | 0.16 | 0.17 | 0.02 | 0.00 |
| 33 | 0.00 | 0.03 | 0.13 | 0.13 | 0.16 | 0.17 | 0.16 | 0.17 | 0.05 | 0.00 |
| 34 | 0.00 | 0.02 | 0.12 | 0.13 | 0.14 | 0.16 | 0.18 | 0.15 | 0.09 | 0.00 |
| 35 | 0.00 | 0.02 | 0.11 | 0.12 | 0.14 | 0.15 | 0.15 | 0.21 | 0.10 | 0.00 |
| 36 | 0.00 | 0.02 | 0.10 | 0.12 | 0.15 | 0.15 | 0.13 | 0.22 | 0.12 | 0.00 |
| 37 | 0.00 | 0.01 | 0.09 | 0.12 | 0.15 | 0.15 | 0.14 | 0.20 | 0.13 | 0.00 |
| 38 | 0.00 | 0.01 | 0.09 | 0.12 | 0.14 | 0.14 | 0.15 | 0.18 | 0.15 | 0.02 |
| 39 | 0.00 | 0.01 | 0.08 | 0.10 | 0.15 | 0.14 | 0.17 | 0.18 | 0.14 | 0.04 |
| 40 | 0.00 | 0.01 | 0.08 | 0.10 | 0.13 | 0.16 | 0.16 | 0.16 | 0.14 | 0.06 |
| 41 | 0.00 | 0.01 | 0.07 | 0.10 | 0.13 | 0.15 | 0.14 | 0.19 | 0.12 | 0.10 |

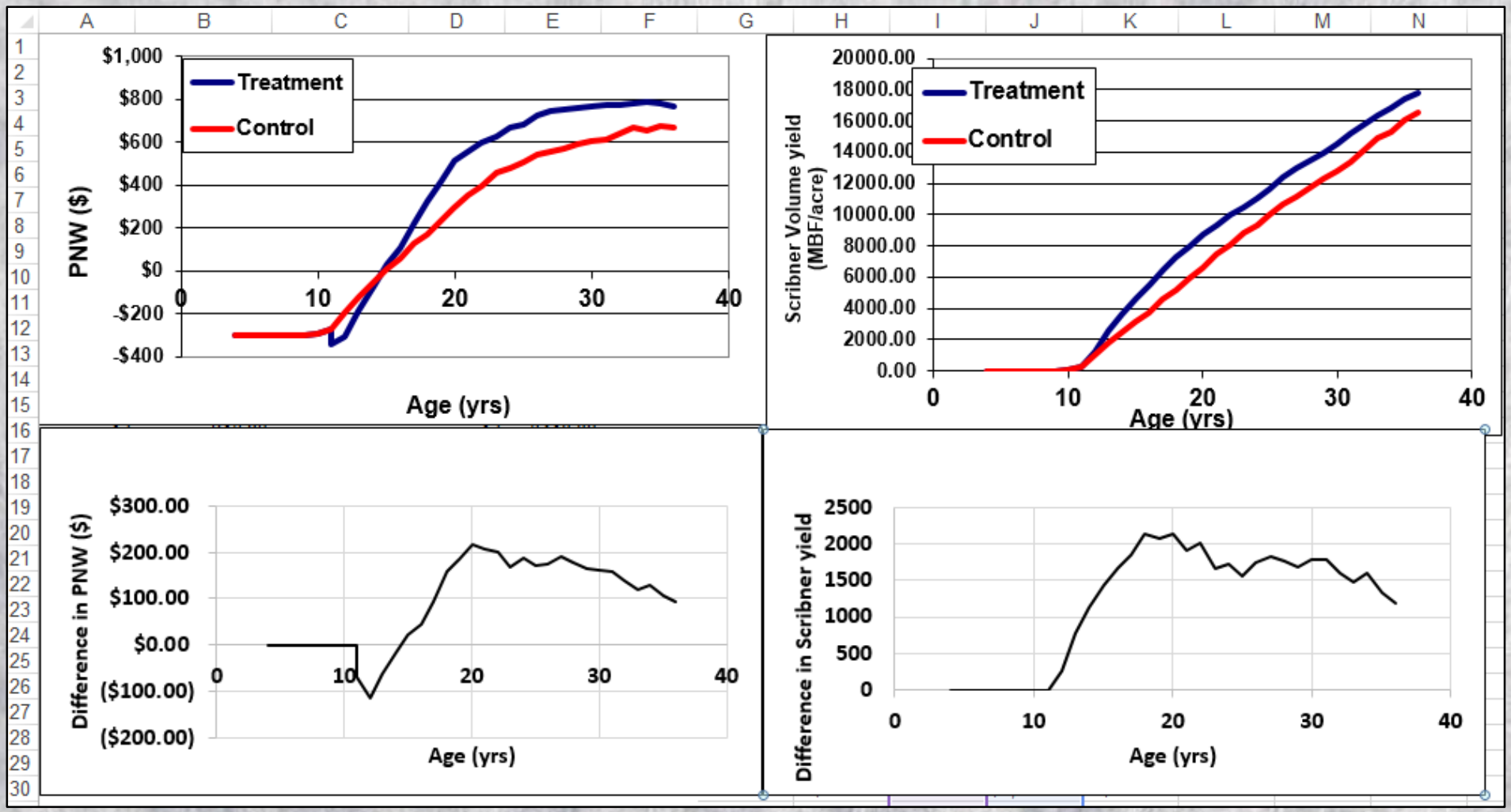
# Red Alder Growth Simulator- Outputs

- **Stand Graphs**



# Red Alder Growth Simulator- Outputs

- **Stand Graphs**



# Red Alder Growth Simulator- Improvements

- Updated/2019 Version
- R code
- Treelist Generator
- Genetic Gain Multiplier?

# Red Alder Growth Simulator- Uses

- Stand Projection
- Inventory Projection
- Testing Management Scenarios (i.e. Pre-commercial Thinning)
  - Should we do it?
  - When?
  - Does the initial TPA make a difference?
  - How much to leave?
  - Differences by site index?
- Testing Species Choice
  - Douglas-fir vs red alder

# Red Alder Growth Simulator- Testing PCT

| | Medium Site (SI20=65ft), Planting Density=600tpa | | | | |
|---|---|---|---|---|---|
| Scenario | Unthinned | PCT RD25, 150tpa | PCT RD25, 250tpa | PCT RD45, 150tpa | PCT RD45, 250tpa |
| PCT Age | NA | 10 | 10 | 13 | 13 |
| Harvest Yield (MBF) | 9.2 | 9.1 | 9.9 | 9.1 | 9.9 |
| Rotation Age (YRS) | 29 | 27 | 27 | 29 | 28 |
| Log Value | 726 | 825 | 755 | 827 | 754 |
| NPV ($) | -$61 | $168 | $109 | $63 | $59 |
| IRR (%) | 5.3% | 6.1% | 5.9% | 5.7% | 5.7% |
| BLV/SEV ($) | -$78 | $220 | $142 | $80 | $75 |

| | High Site (SI20=75ft), Planting Density=600tpa | | | | |
|---|---|---|---|---|---|
| Scenario | Unthinned | PCT RD25, 150tpa | PCT RD25, 250tpa | PCT RD45, 150tpa | PCT RD45, 250tpa |
| PCT Age | NA | 6 | 6 | 10 | 10 |
| Harvest Yield (MBF) | 12.3 | 11.6 | 14.3 | 10.5 | 12.9 |
| Rotation Age (YRS) | 28 | 23 | 26 | 24 | 26 |
| Log Value | 761 | 843 | 807 | 841 | 796 |
| NPV ($) | $395 | $895 | $863 | $633 | $660 |
| IRR (%) | 6.8% | 8.4% | 8.0% | 7.7% | 7.6% |
| BLV/SEV ($) | $509 | $1,264 | $1,148 | $875 | $878 |

# Red Alder Growth Simulator- Testing PCT

| | Medium Site (SI20=65ft), Planting Density=600tpa | | | | |
|---|---|---|---|---|---|
| Scenario | Unthinned | PCT RD25, 150tpa | PCT RD25, 250tpa | PCT RD45, 150tpa | PCT RD45, 250tpa |
| PCT Age | NA | 10 | 10 | 13 | 13 |
| Harvest Yield (MBF) | 9.2 | 9.1 | 9.9 | 9.1 | 9.9 |
| Rotation Age (YRS) | 29 | 27 | 27 | 29 | 28 |
| Log Value | 726 | 825 | 755 | 827 | 754 |
| NPV ($) | -$61 | $168 | $109 | $63 | $59 |
| IRR (%) | 5.3% | 6.1% | 5.9% | 5.7% | 5.7% |
| BLV/SEV ($) | -$78 | $220 | $142 | $80 | $75 |

| | High Site (SI20=75ft), Planting Density=600tpa | | | | |
|---|---|---|---|---|---|
| Scenario | Unthinned | PCT RD25, 150tpa | PCT RD25, 250tpa | PCT RD45, 150tpa | PCT RD45, 250tpa |
| PCT Age | NA | 6 | 6 | 10 | 10 |
| Harvest Yield (MBF) | 12.3 | 11.6 | 14.3 | 10.5 | 12.9 |
| Rotation Age (YRS) | 28 | 23 | 26 | 24 | 26 |
| Log Value | 761 | 843 | 807 | 841 | 796 |
| NPV ($) | $395 | $895 | $863 | $633 | $660 |
| IRR (%) | 6.8% | 8.4% | 8.0% | 7.7% | 7.6% |
| BLV/SEV ($) | $509 | $1,264 | $1,148 | $875 | $878 |

# Red Alder Growth Simulator- Testing Species

| | Red Alder | | | | | Douglas-fir |
|---|---|---|---|---|---|---|
| Scenario | 400tpa | 600tpa | 600Pct | 1000tpa | 1000Pct | 400tpa |
| PCT Age | NA | NA | 10 | NA | 10 | NA |
| Harvest Yield (MBF) | 10.6 | 12.3 | 12.9 | 11.9 | 11.8 | 35 |
| Rotation Age (YRS) | 23 | 28 | 26 | 29 | 25 | 55 |
| Log Value | 682 | 682 | 682 | 682 | 682 | 708 |
| NPV ($) | $494 | $178 | $294 | $547 | $705 | $289 |
| IRR (%) | 7.8% | 6.2% | 6.5% | 8.3% | 9.0% | 6.3% |
| BLV/SEV ($) | $697 | $230 | $391 | $694 | $956 | $305 |

Source: 2018. Andrew Bluhm, HSC 2018 Annual Meeting Tour

# Red Alder Growth Simulator- Testing Species

| | Red Alder | | | | | Douglas-fir |
|---|---|---|---|---|---|---|
| Scenario | 400tpa | 600tpa | 600Pct | 1000tpa | 1000Pct | 400tpa |
| PCT Age | NA | NA | 10 | NA | 10 | NA |
| Harvest Yield (MBF) | 10.6 | 12.3 | 12.9 | 11.9 | 11.8 | 35 |
| Rotation Age (YRS) | 23 | 28 | 26 | 29 | 25 | 55 |
| Log Value | 682 | 682 | 682 | 682 | 682 | 708 |
| NPV ($) | $494 | $178 | $294 | $547 | $705 | $289 |
| IRR (%) | 7.8% | 6.2% | 6.5% | 8.3% | 9.0% | 6.3% |
| BLV/SEV ($) | $697 | $230 | $391 | $694 | $956 | $305 |

Source: 2018. Andrew Bluhm, HSC 2018 Annual Meeting Tour

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**HSC:** http://hsc.forestry.oregonstate.edu/

**CIPS:** http://cips.forestry.oregonstate.edu/background

**WHC:** http://wahardwoodscomm.com/index.htm

Hardwood Silviculture Cooperative