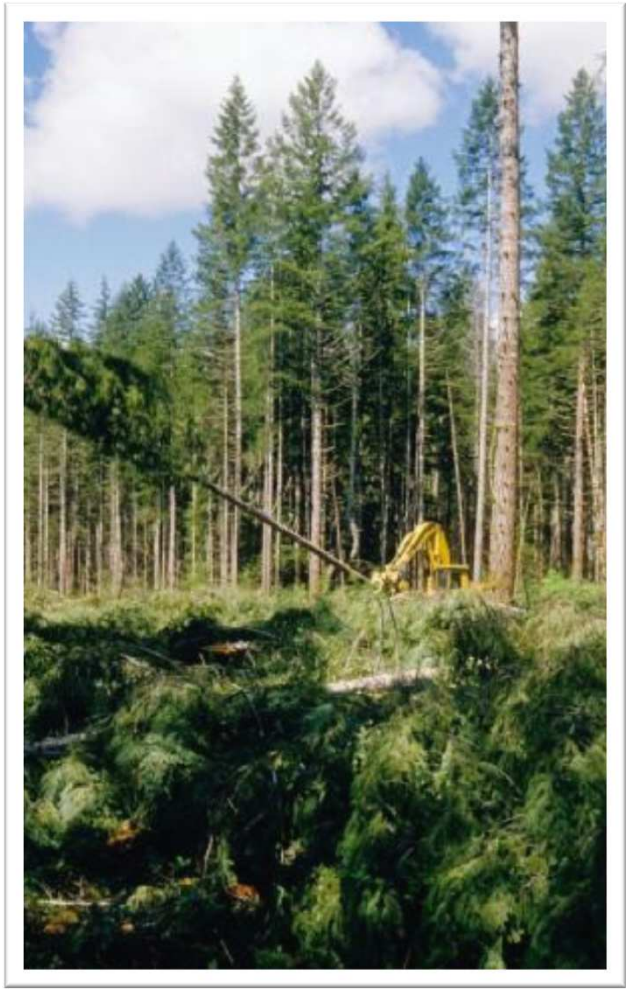


Photo Credit: Logging of Douglas fir trees in Washington state. (iStockphoto/Phil Augustavo)

State of Washington Forest Biomass Supply Assessment Project Overview:

data sources, analytical techniques, and biomass calculation sensitivity

8th Annual Sustainable Energy Conference
April 26th, 2011

Dr. James B. McCarter
North Carolina State University and
University of Washington

Presentation Outline

- Background
- Information Sources
- Analytical Techniques
  - Spatial analysis
  - Forest inventory
  - Biomass estimation
- Preliminary Results
- Next Steps

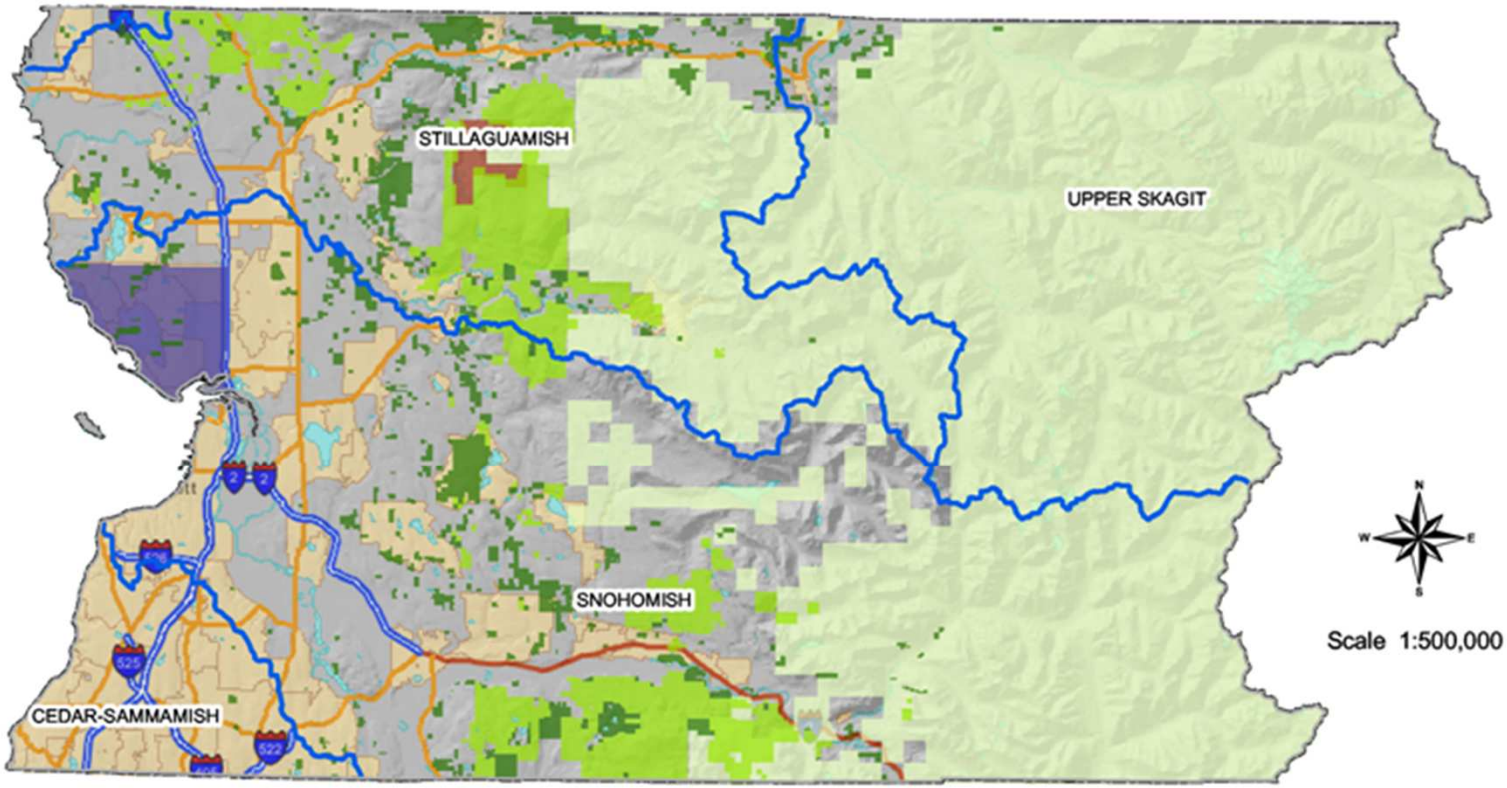
Background

- WA Department of Natural Resources RFP
- UW/TSS Awarded Contract
- Negotiation of timelines and deliverables
- Project Starts
  - Spatial Analysis and Inventory done by UW
  - Surveys done by TSS

Information Sources

- Spatial Information
  - GNN (vegetation map, non-forest mask)
  - WA DNR (operations layers, transportation layers, hydrology, etc.)
  - UW RTI (Landowner Database, Statewide DEM, …)
  - USGS (elevation data, land cover types, etc.)
  - Other or derived (satellite imagery, fuelsheds, …)
- Inventory Information
  - GNN (30m pixel resolution with tree list inventory associated)
  - FIA (validation and check dataset)
  - WA DNR (validation and check dataset)
- Survey Information
  - TSS Generated

Snohomish County Forestland - 2002



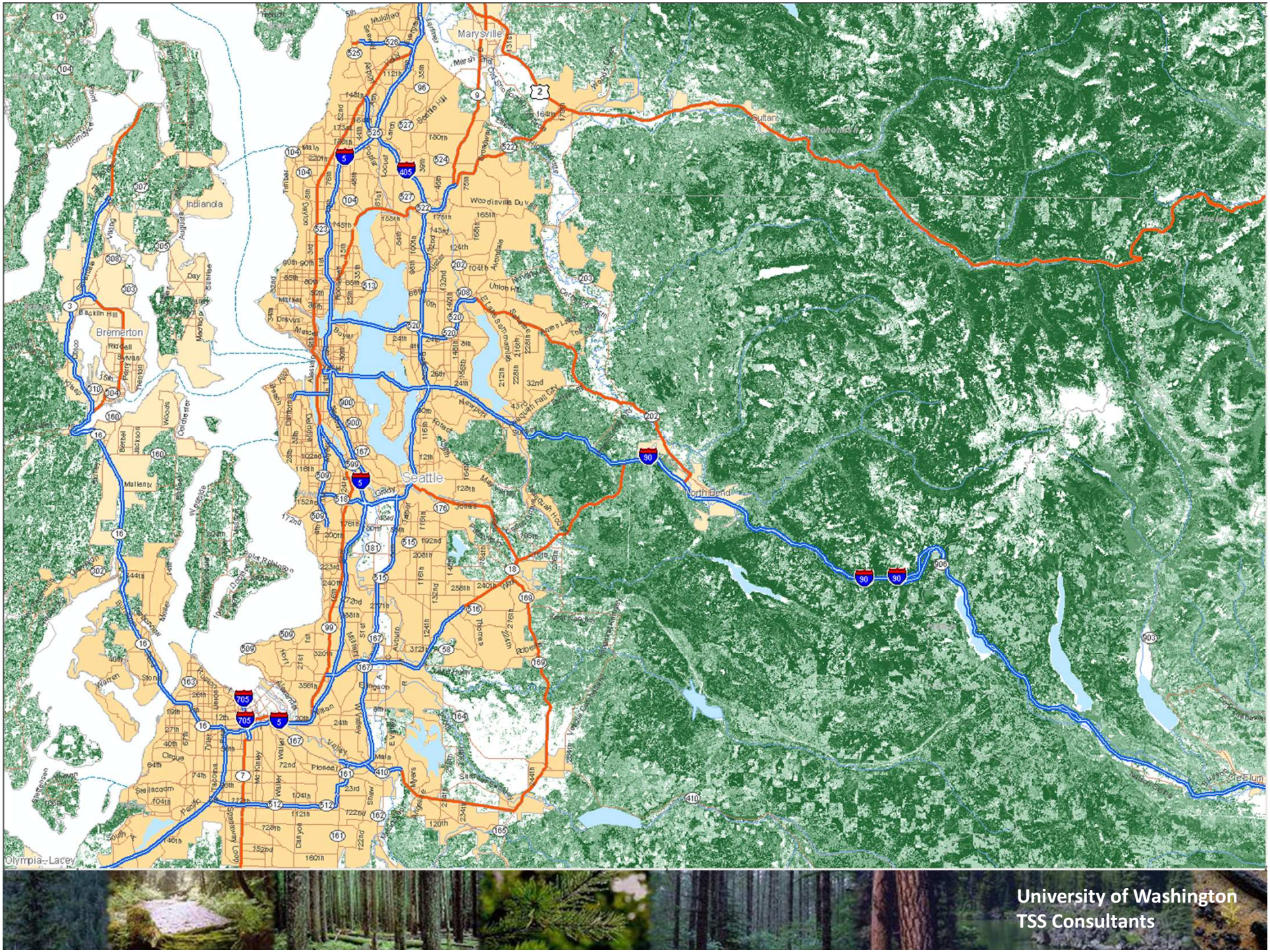
Land Cover Types and Geographic Features

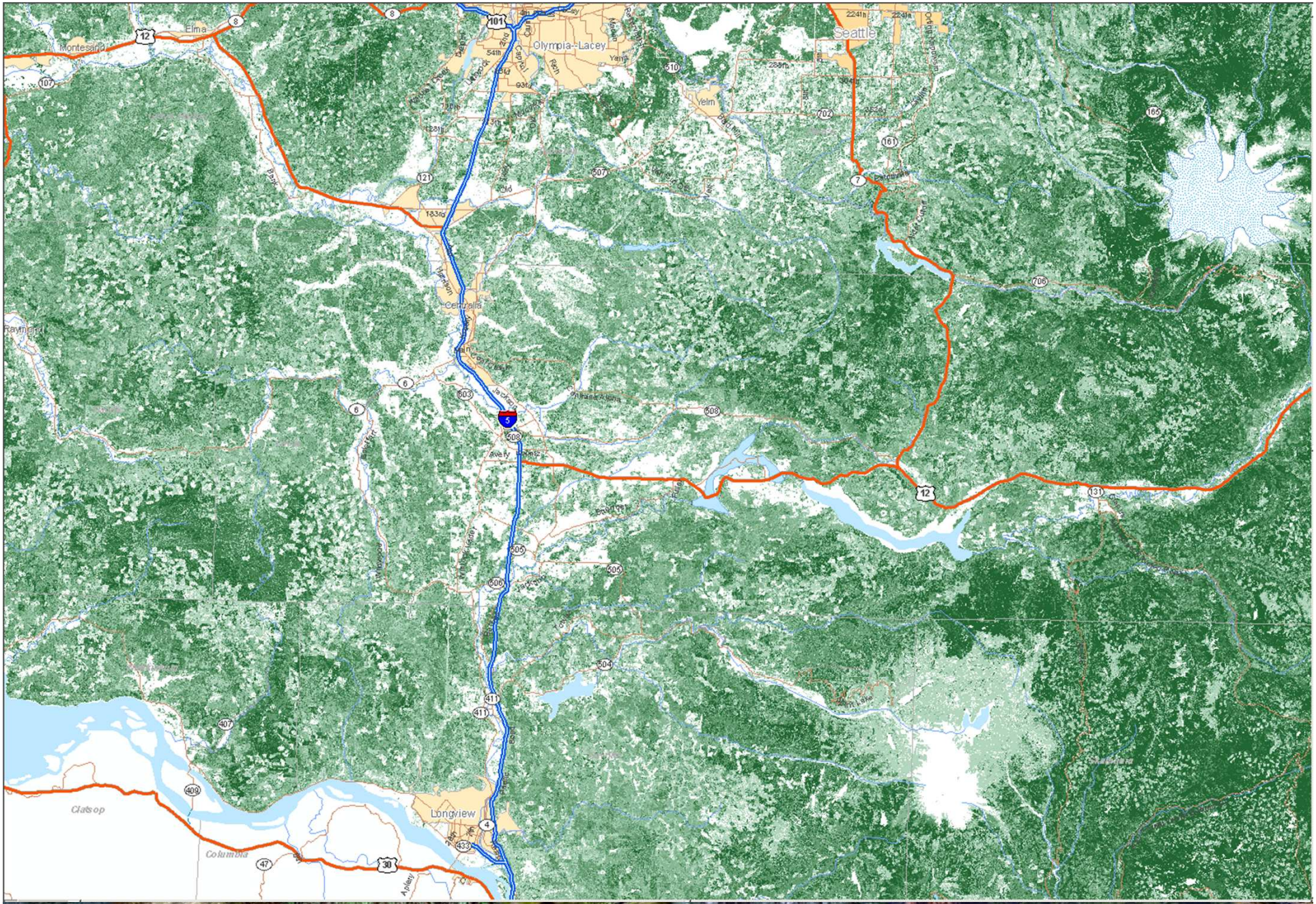
- Industrial Forestland
- NIPF Lands
- Indian Reservations BIA
- National Forest FS
- Navy DOD
- Urban Areas
- Water Bodies
- WRIA
- Interstate
- State Highway
- U.S. Highway
- County Highway

Data vary in scale and source. Industrial and NIPF Forestland from the 2001 Department of Natural Resources Small Forest Landowner Office Non-Industrial Forestland Owner database and Snohomish County GIS. Federal Land data from the National Atlas. Roads, streams and urban areas from the US Cenus Tiger 2000 Geography Network ArcIMS Image Service. Not all potential NIPF land is shown on this map. Undeveloped, cleared land and agricultural areas that may include NIPF land are absent in the DNR SFLO Dataset from Snohomish County.

WASHINGTON STATE DEPARTMENT OF Natural Resources

July 23, 2002, Luke Rogers - Rural Technology Initiative

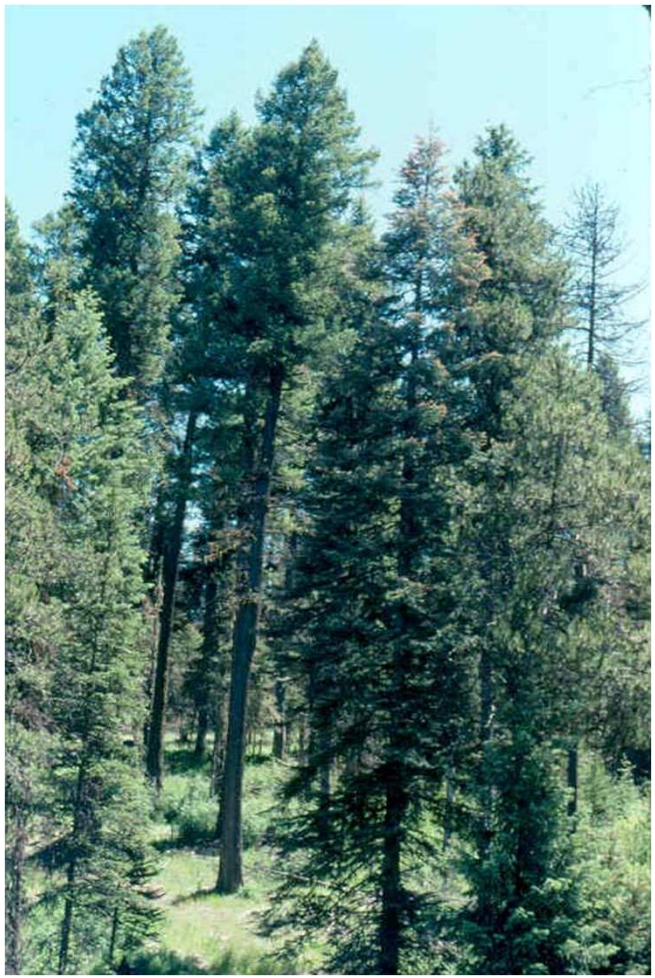

Marysville
Indianola
Bremerton
Seattle
Olympia--Lacey
University of Washington
TSS Consultants



University of Washington
TSS Consultants

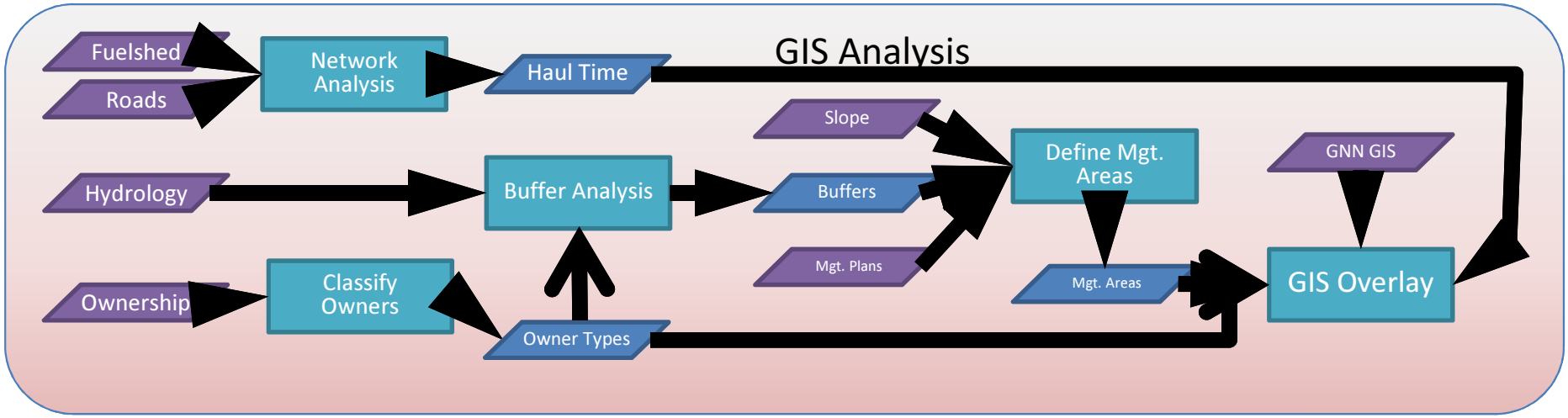
Analytical Techniques

- Spatial Analysis
- Inventory Assessment
- Biomass Assessment
- Forest Operations Surveys
- Combine spatial and inventory information for fuelshed, county, and statewide estimates



Spatial Analysis

- Spatial analysis combines legal, transportation, hydrology, ownership, slope, forest type, buffers

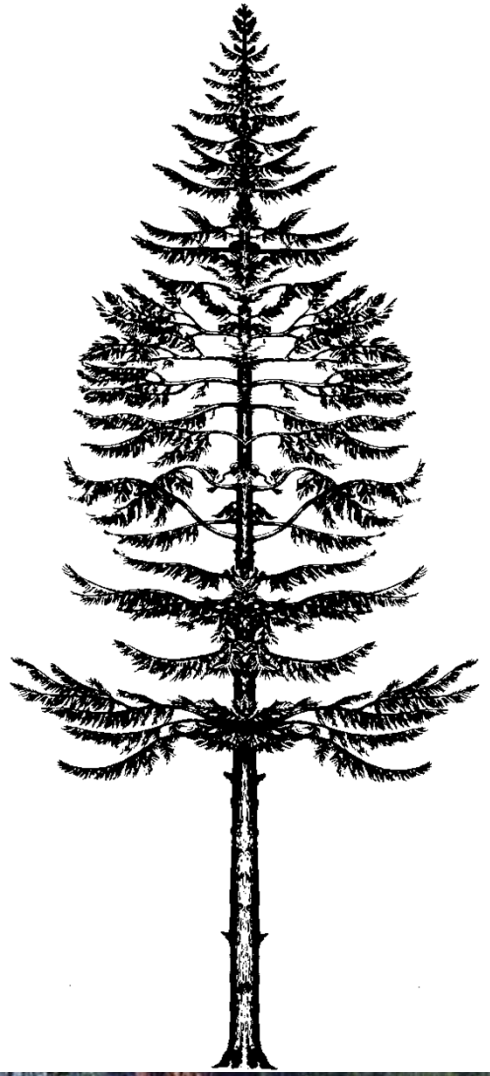


Inventory Assessment

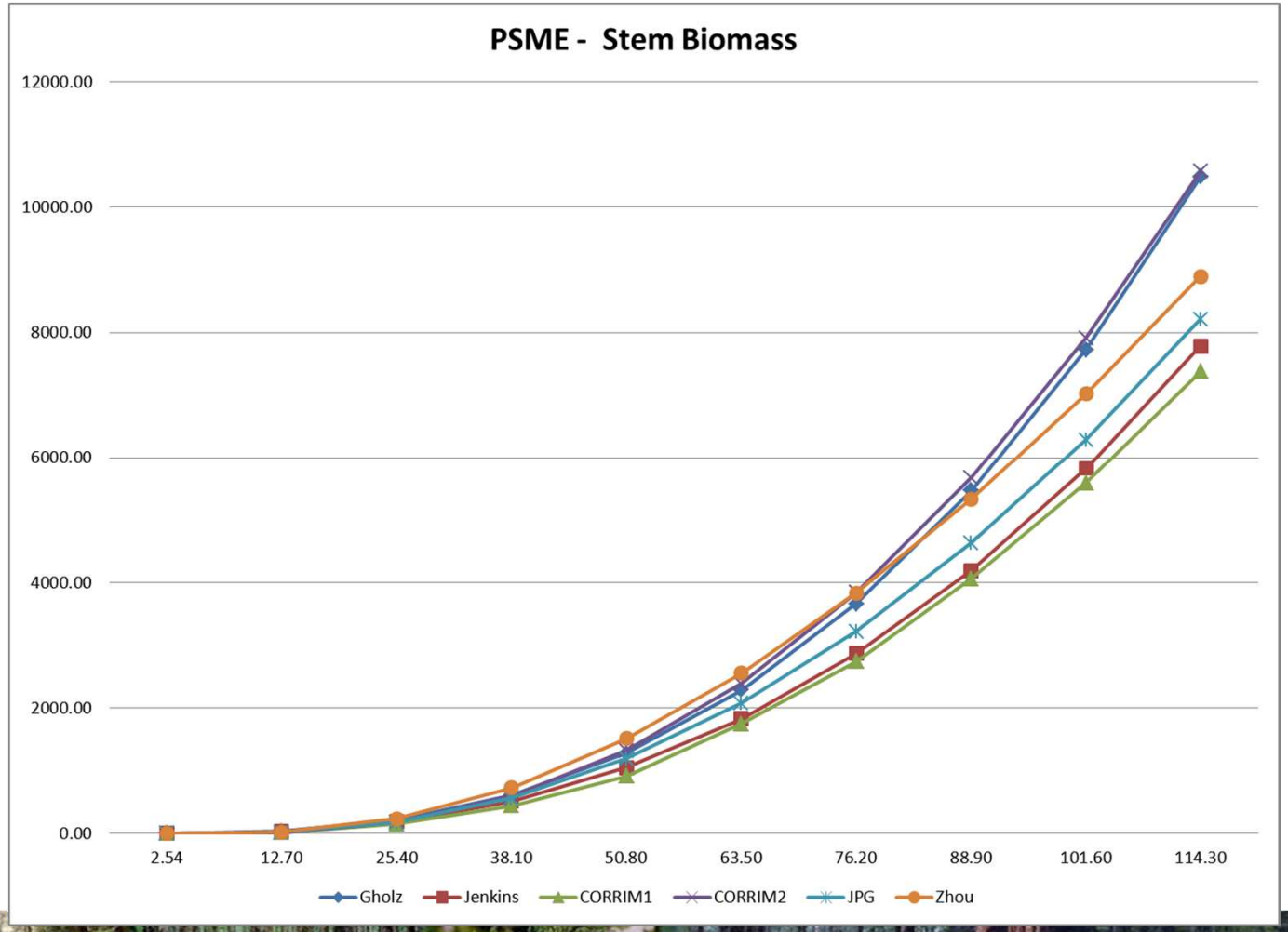
- Start with initial GNN inventory (2000 eastside, 2006 westside).
- Update with harvest information 2000-2009 and apply growth and regeneration resulting in 2010 inventory.
- 2010 Inventory used as base for projecting management scenarios by ownership class to arrive at current and future estimates of biomass.

Biomass Estimation

- Populate state with appropriate inventory information across state
- Estimate biomass based on existing inventory and management activities



Utilizing Stem Biomass Equations Found in Literature



Biomass Estimation

- Determine Biomass:
  - merchantable

$$CuFt = 10^{(-2.658025 + 1.739925 * LOG(DBH) + 1.133187 * LOG(Height))}$$

Biomass Estimation

- Determine Biomass:
  - Residuals

Douglas-fir:

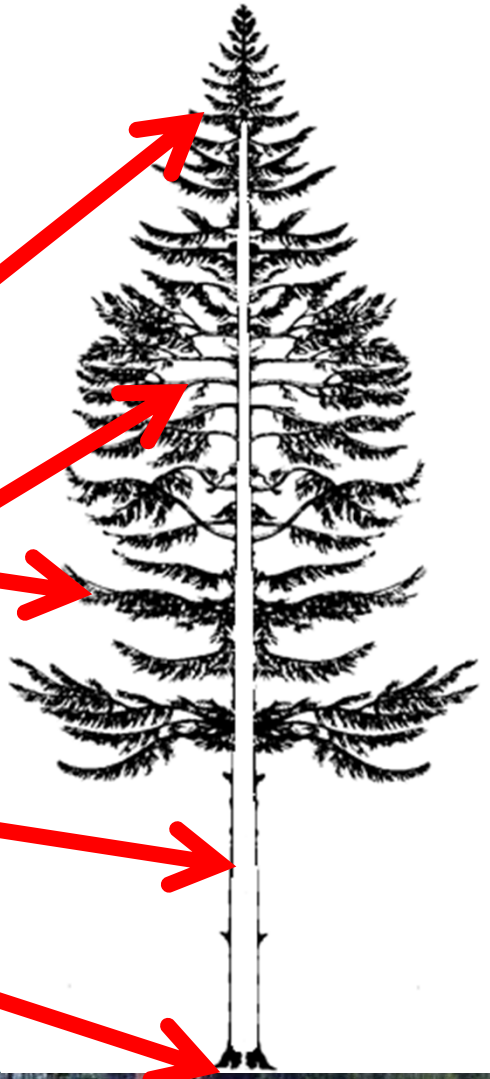
Foliage=EXP(-2.8462+1.7009*LN(DBH))

LiveBranch=EXP(-3.6941+2.1382*LN(DBH))

Bark=EXP(-4.3103+2.400*LN(DBH))

Root=EXP(-4.6961+2.6929*LN(DBH))

Note DBH in cm used in above equations

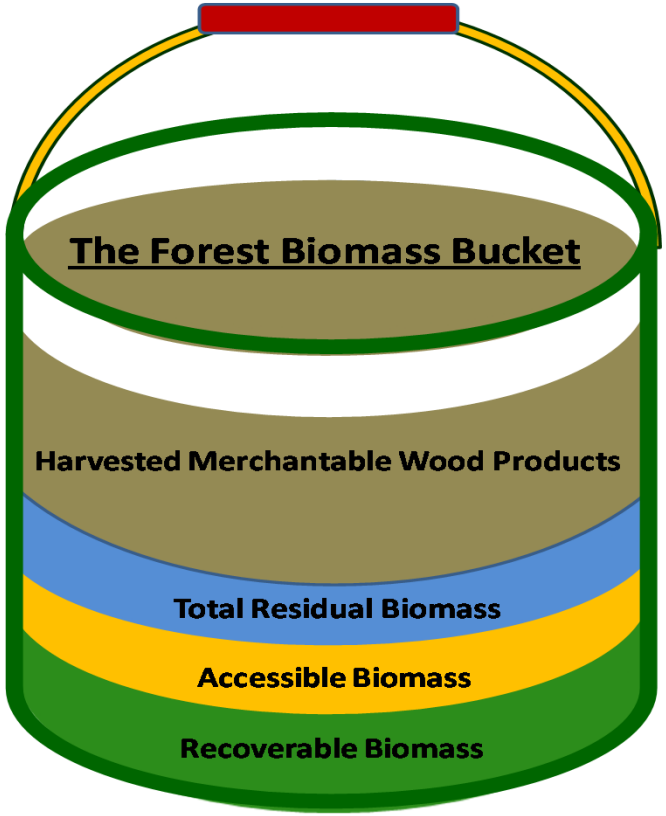


Merchantable volume

Residual biomass volume

Sustainable Recovery of Forest Residuals – NE WA study

- ~ 50% is already removed from the woods, leaving 50% as residual biomass (tops, limbs, broken material) (Oneil and Lippke 2009)
- Of the residual biomass, 70% is accessible (meaning available for removal as the rest is left for soil building, wildlife, and habitat purposes) (35% of total harvested)
- Of the residual biomass, 42% is recoverable (21% of the total)



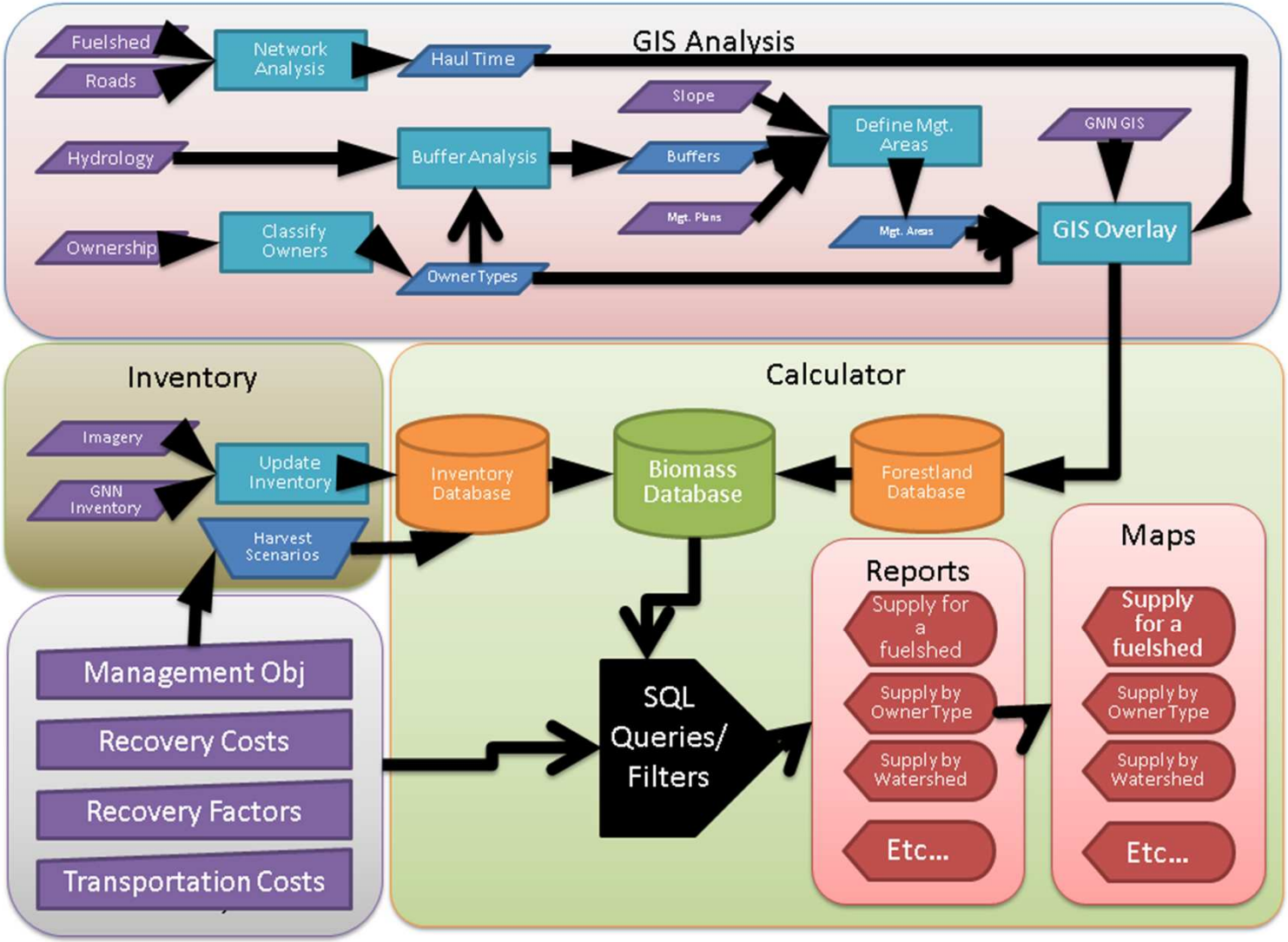
Forest Operations Survey

FOREST ECOSYSTEM	OWNER CLASS	WESTSIDE OR EASTSIDE	HARVEST OR FOREST OPERATIONS SCENARIO	ESTIMATED PERCENT OF ACTIVITY
Douglas-fir	Industrial	West	RH remnant stands>50 years	5% of stands
		West	No PCT, RH at 45 years	70% of stands
		West	PCT @ 15 years, RH at 45 years	20% plantations require PCT
		West	No PCT, CT @ 25 years, RH @ 45 years	5% of stands
	Federal	West	PC - thinning from above and below w/RH @ 65 years	95% (90% PC/10% RH)
			or PC @ 55 years	5%
			@ 15 years, CT @ 45 years, RH at 65 years	10% plantations require PCT
			PCT, CT @ 45 years, RH at 65 years	90% of stands
			- from above and below	<10%
			remnant stands>50 years	5%
			PCT, RH at 45 years	45%
			@ 15 years, RH at 45 years	45%
			PCT, CT @ 25 years, RH @ 45 years	5%

Determine volume removed from site

Determine volume left on site

Putting it Together

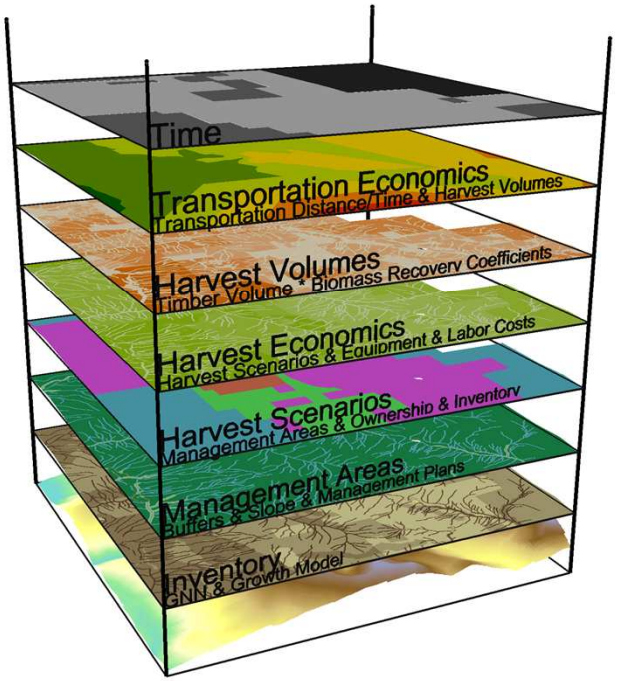


Preliminary Results

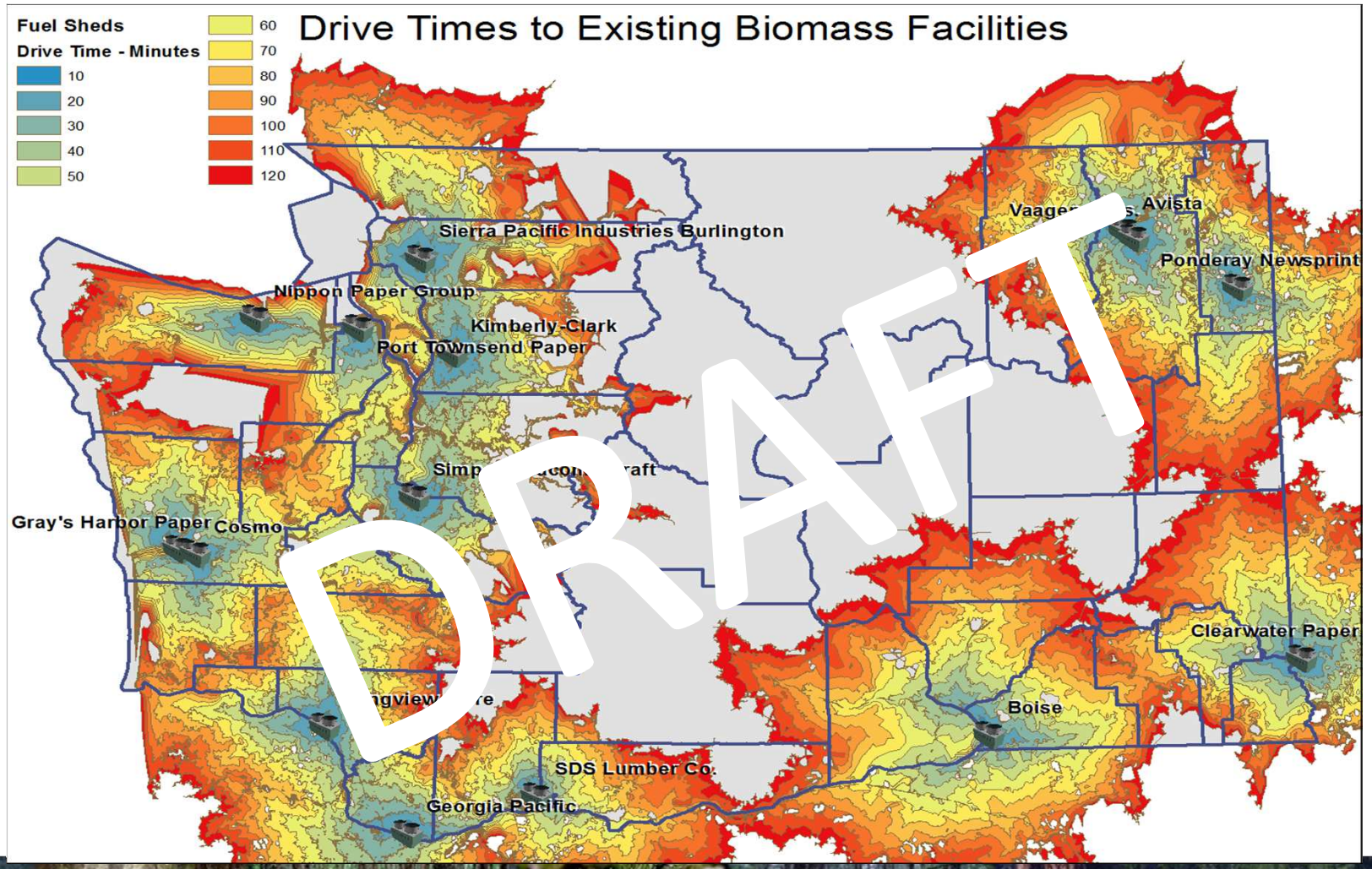
- Spatial information acquired
- Spatial information validated and spatial joins created for pre-processing
- Inventory information acquired
- Initial inventory assessment completed
  - Update initial inventory to 2010 with regeneration, growth and harvest information
- Spatial database created and populated with spatial information and initial inventory
- Harvest scenario matrix developed

Stratify Results by Supply Tributary & Produce Projections

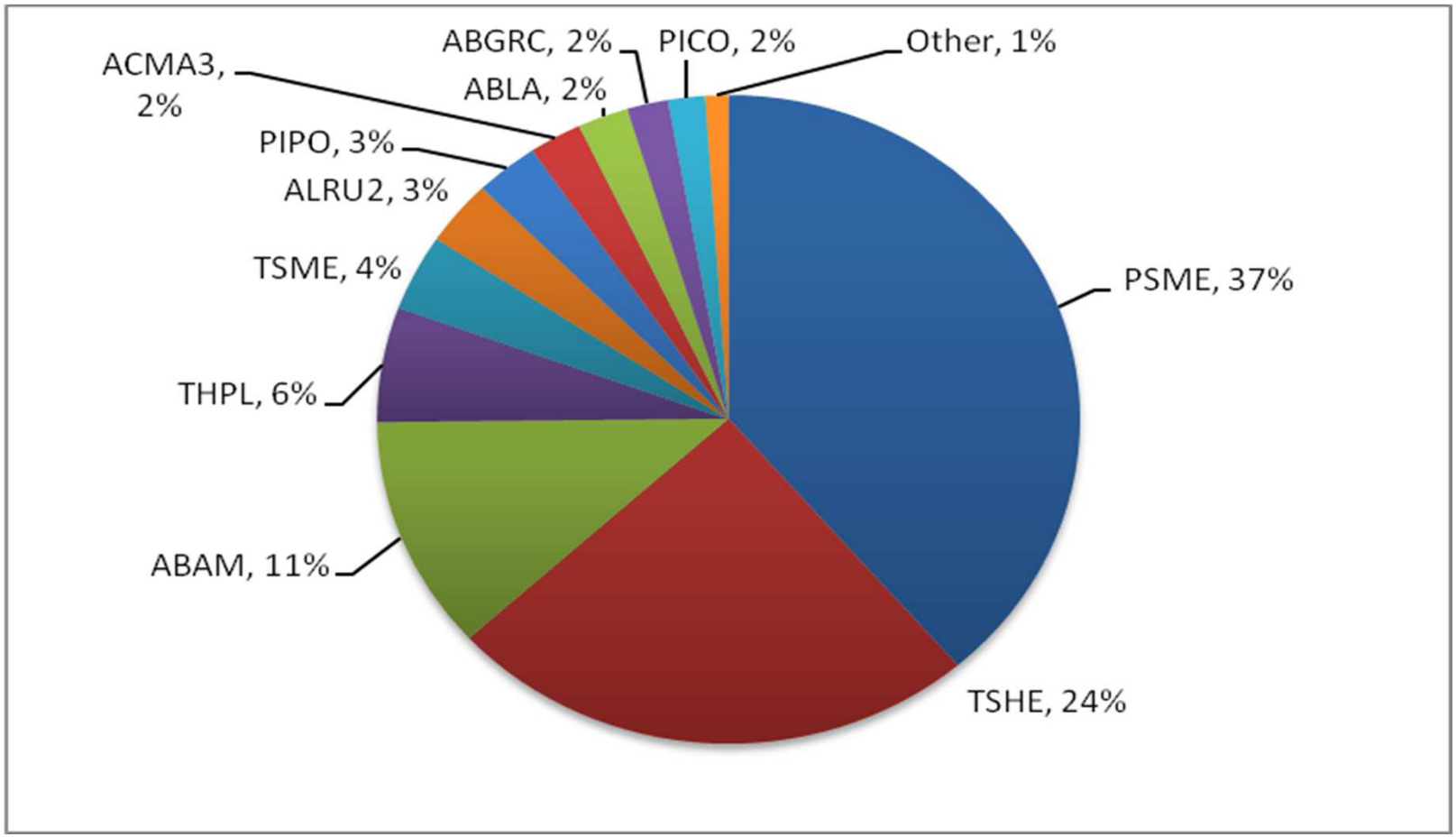
- GIS analysis
  - Forestland Database
  - Inventory Database
  - Harvest Scenarios



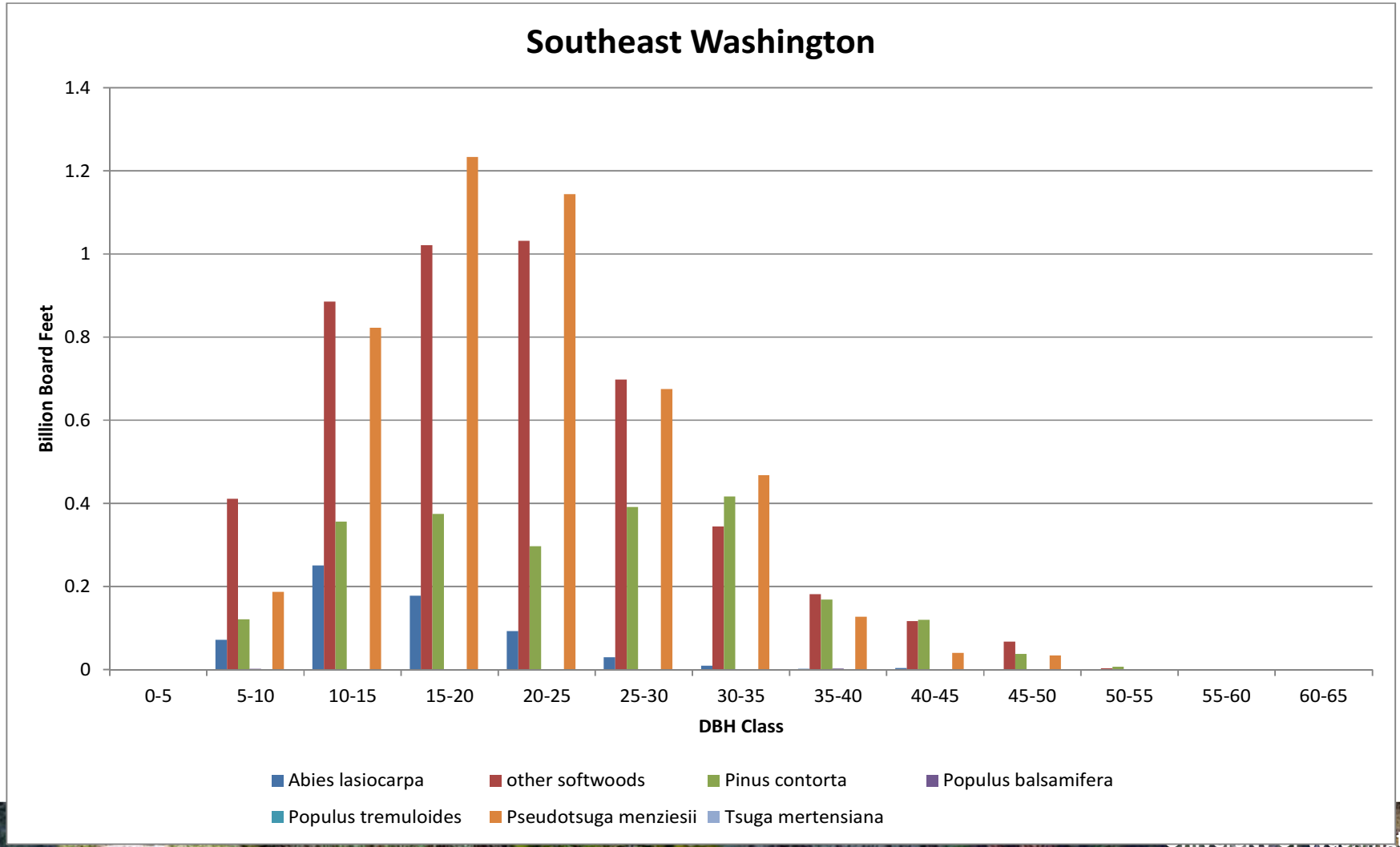
Conduct Transportation Assessment: Competition Analysis



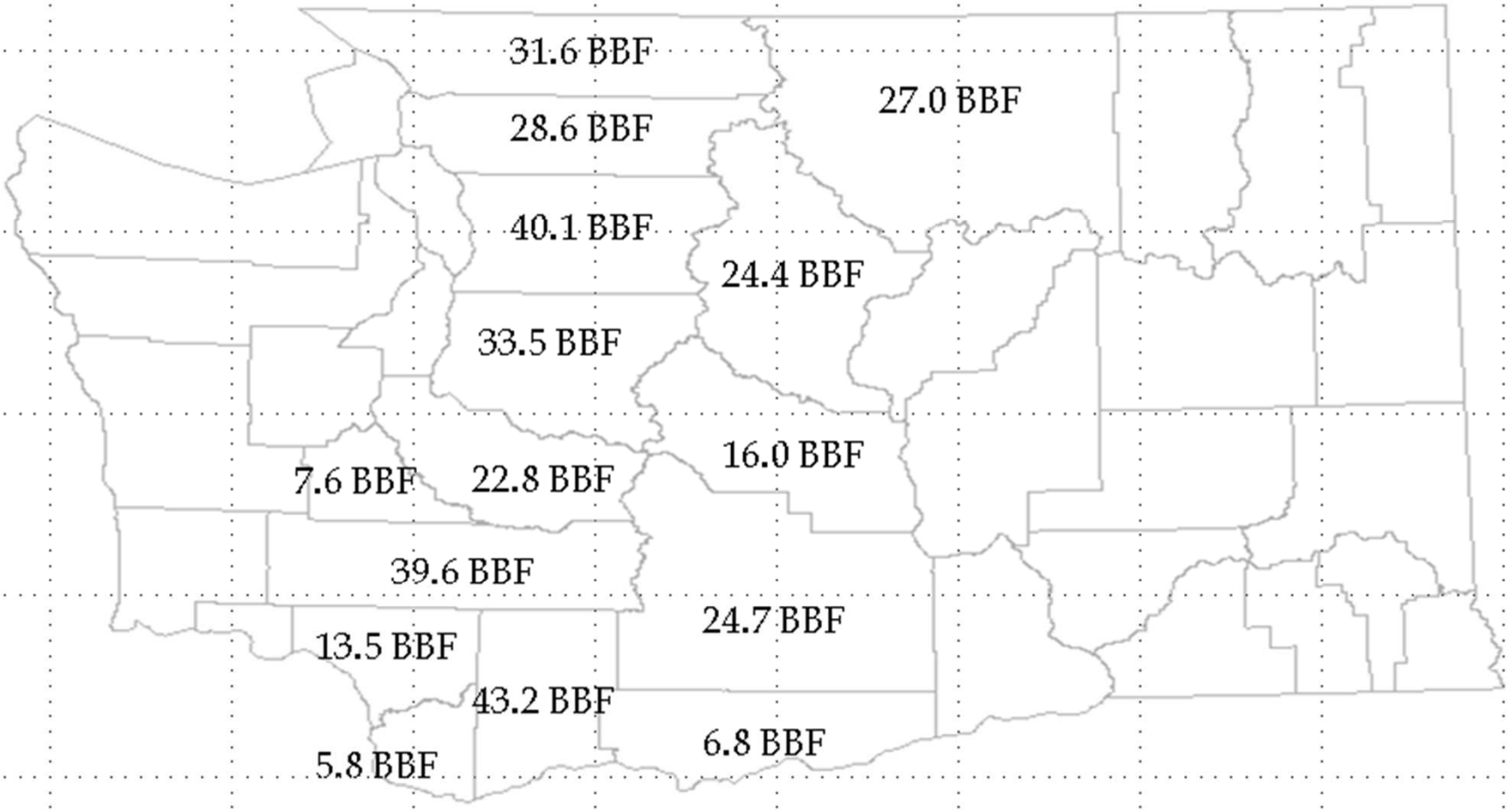
Distribution of Inventory by Dominant Species



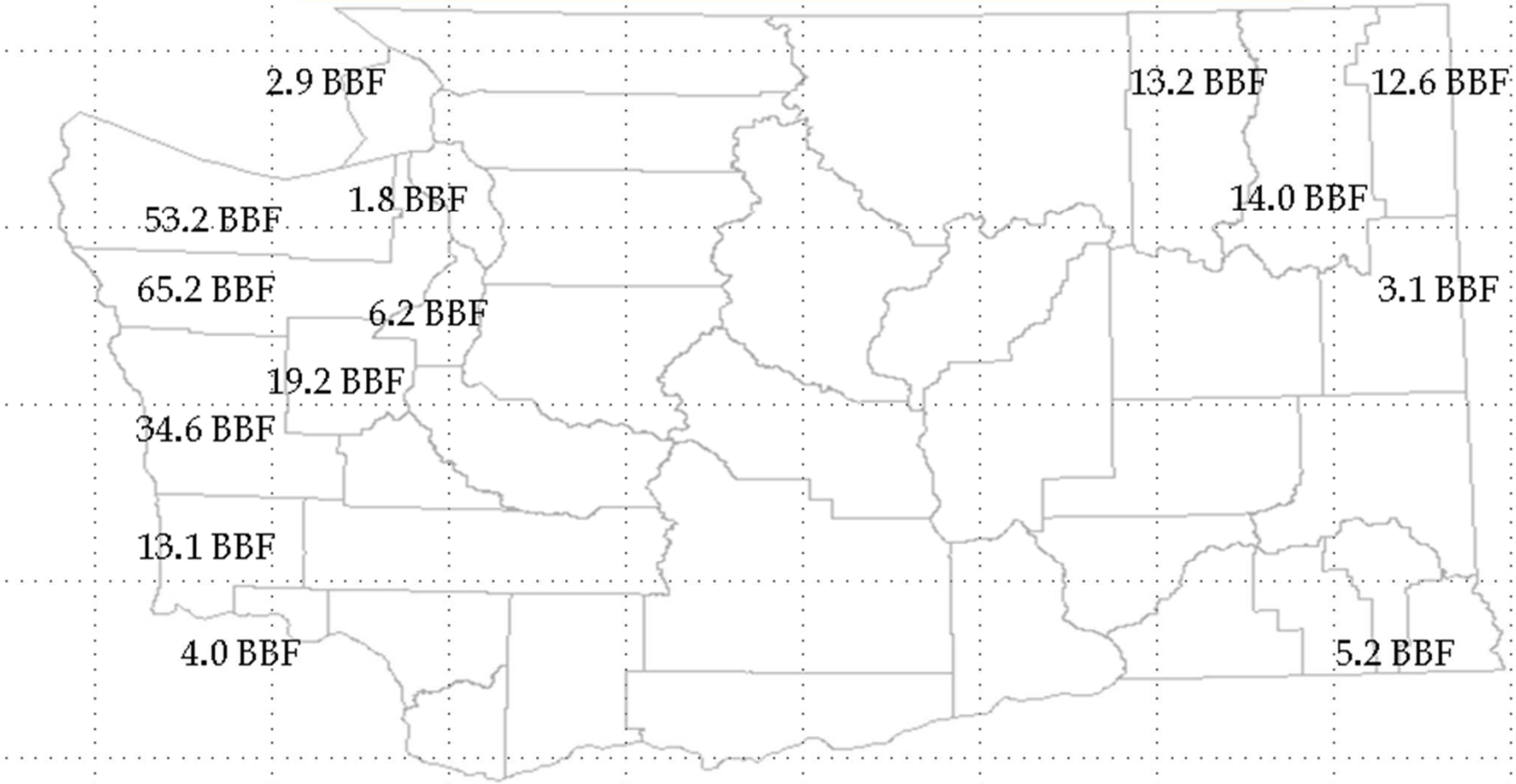
Volume by Species & DBH Class



Merchantable Volumes of Standing Trees



Merchantable Volumes of Standing Trees



Next Steps

- Estimate biomass associated with inventory
- Determine biomass recovery volume and volume retained on site
- Calculate economically recoverable volume
- Stratify results by supply tributary and produce projections to 2020 and 2030
- Conduct transportation assessment
- Conduct cost and price assessments