Characterizing Fuels in the 21st Century How are we doing?

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Fuel Recommendation--1999

A more integrative and systematic national approach to fuel mapping and modeling across multiple spatial and temporal scales to provide accurate model input is needed.

Why is fuel characterization, mapping and modeling so important?

- Key requirement for operation of decision support systems such as:
  - Fire and fuels management
  - Ecology
  - Wildlife
  - Smoke management
  - Carbon accounting
- Impossible to measure all components important to these systems
- More than just loading needed

To whom is it important?

- Fire & Smoke Modelers
- Scientists
- Fuels & Fire Planners
- Firefighters
- Fire Ecologists
- Wildlife Managers
- Smoke and Carbon Regulators

State of Knowledge --1999

Collection

Measuring

- line intersect
- clip/weighing
- biometric equations

Photo series

Expert opinion

Modeling

Fire and Fuels Extension

FVS

Mapping

Assignment of Fire Behavior Fuel Model

Assignment of FOFEM fuelbeds

Assignment of Fuel Characteristic Classes (FCC)

State of Knowledge--Current

- Collection
  - line intersect
  - clip/weighing
  - measuring/biometric equations
  - FIREMON
  - Photo series (15 new volumes)
  - Digital photo series
  - Pile load (machine/hand)
  - Photoload
  - Ground/aerial/satellite LiDAR
  - Expert Opinion
- Model
  - FCCS
  - FLM
  - FireBCG, FFE, FVS, Fuel3D
- Mapping
  - LANDFIRE
  - FCCS

Let's revisit the 1999 recommendation

A more integrative and systematic national approach to fuel mapping and modeling across multiple spatial and temporal scales to provide accurate model input is needed.

How have we done?

Example: Fuel Characteristic Classification System (FCCS)

Simple

Variability

Complex

Seasonality

Natural Change Agents

Human Change Agents

Treatment Effectiveness

Increased fuel data requirements by fire decision support systems

Fuel Characteristic Classification System (FCCS)

A nationally consistent, durable system to build and characterize all components of a fuelbed and to classify the fuelbed for its potential flammability and fire hazard.

What are the specifics of the FCCS?

Composed of 3 elements:

- **Fuel beds**
  - FCCS fuelbeds
  - Customized fuelbeds
- **Calculation of physical characteristics**
- **Calculation of:**
  - FCCS fire potentials
  - Fire behavior prediction
  - Fuel model crosswalk

What is a FCCS Fuelbed?

- Measured or averaged physical characteristics of a relatively uniform unit on the landscape that represent a distinct fire environment
- At any scale and precision of interest

Fuelbed Organization

6 strata divided into categories and subcategories:

Canopy

Trees

Snags

Ladder fuels

Shrub

Primary

Secondary

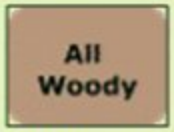
The fuelbed was designed to include all fuelbed components that could burn. It allows users to include, combine or exclude as much detail as needed for an application

Nonwoody

Primary

Secondary

Woody



All Woody

Sound

Rotten

Stumps

Woody fuel accumulations

Litter-lichen-moss

Litter-lichen-moss

Ground fuels

Duff

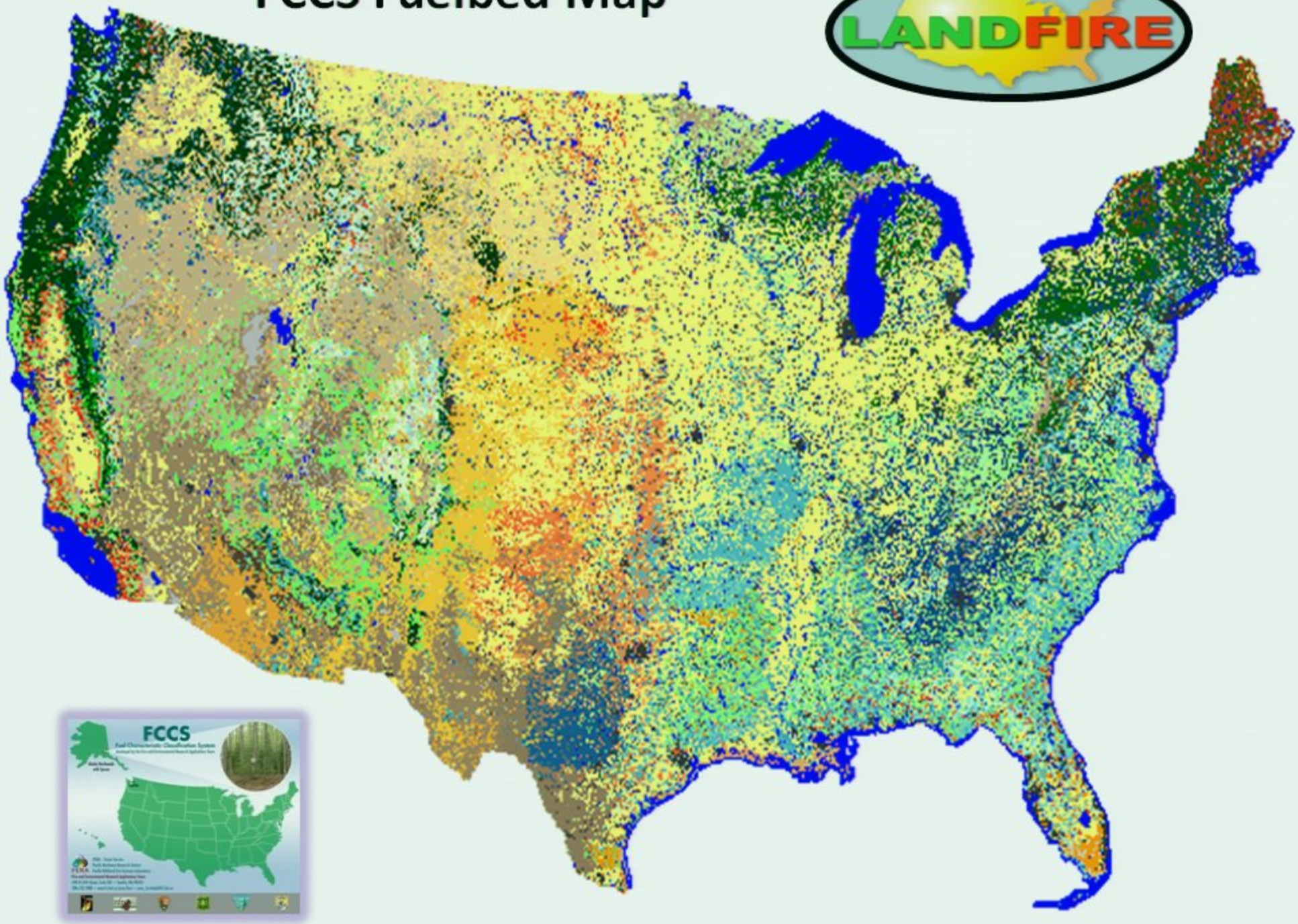
Squirrel midden

Basal accumulations

FCCS Fuelbeds

- FCCS data base contains approximately 500 fuelbeds
  - Represent a broad variety of common vegetation types (for mapping)
  - Associated change agents (e.g. fire, disease, insects, harvest, etc.)
- 500 additional FCCS fuelbeds can be downloaded

FCCS Fuelbed Map



FCCS Fuelbed Translation to Fire Behavior and Fire Effects?

1) Fire Potentials

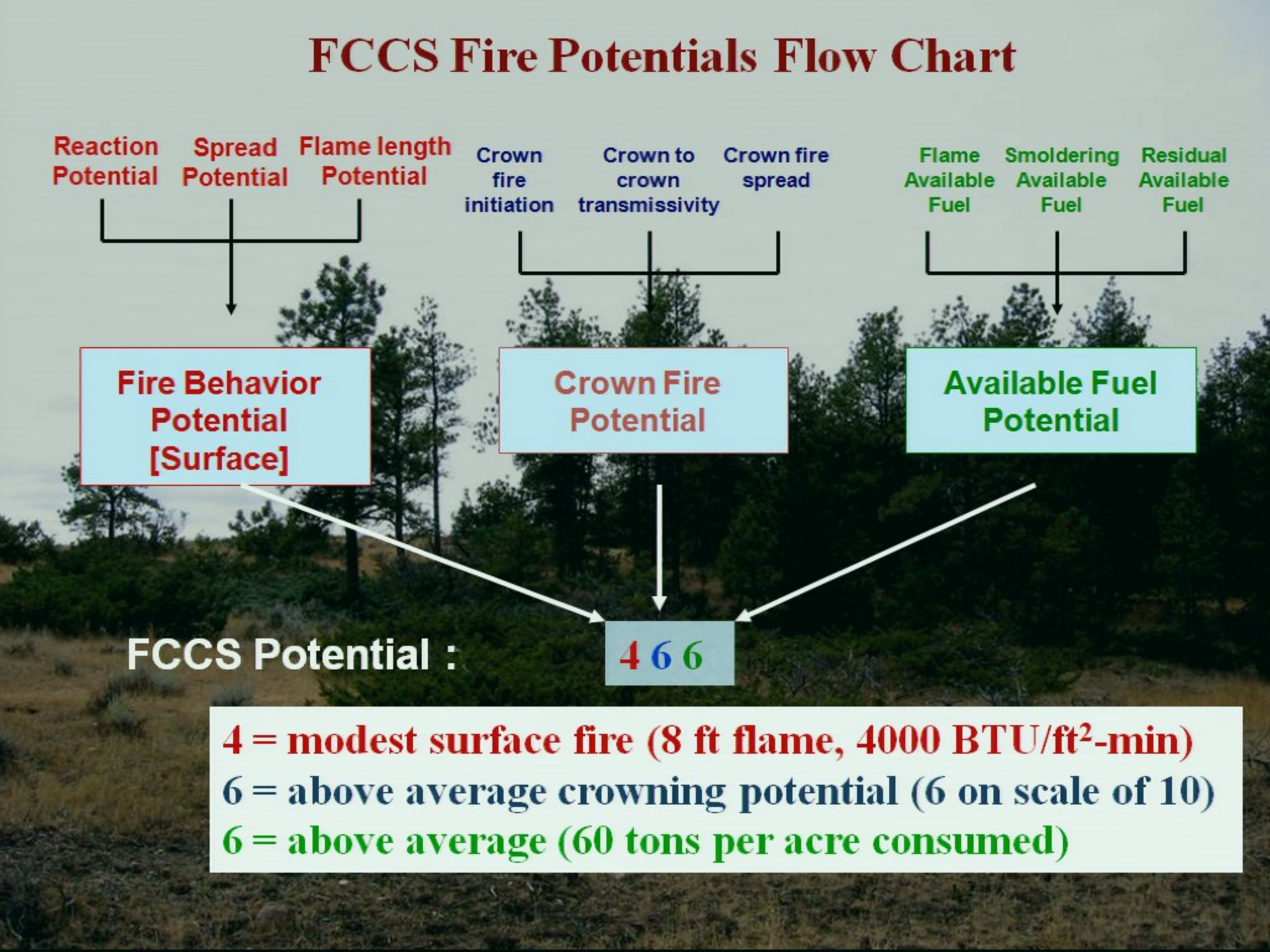
2) Fire Behavior Prediction

3) FCCS Fuelbed/Fuel Model Crosswalk

FCCS Fire Potentials

Intrinsic capability for a fuelbed to support a surface fire and crown fire and to consume and smolder fuels

FCCS Fire Potentials Flow Chart



4 = modest surface fire (8 ft flame, 4000 BTU/ft^2-min)

6 = above average crowning potential (6 on scale of 10)

6 = above average (60 tons per acre consumed)

Ponderosa Pine

4 3 5

Long Leaf Pine

4 3 5

Signal Thin DFPZ Timber Sale (HFQLG)
1,189 ac.

Eastside Pine prior to harvesting (2002) Strata - E2G (approx. 300+ Trees Per Ac.)

FCCS Fire Potential:

657

Eastside Pine after harvesting (2002) Strata - E3N (approx. 90-110 Trees Per Ac.)

FCCS Fire Potential:

213

- Removed 28.5 green tons/ac., which was 40% sawlogs and 60% chips and biomass
- Generated $74,183.00 or $124.67/ac. in revenues for the portion of the sale which is harvested
- The objectives were to develope a DFPZ and improve stand health and vigor.
- CASPO Prescription

Reformulated surface fire behavior equations calculates heat sink and source by shrub, grass, small woody, and litter components allowing the use of measured fuels!!

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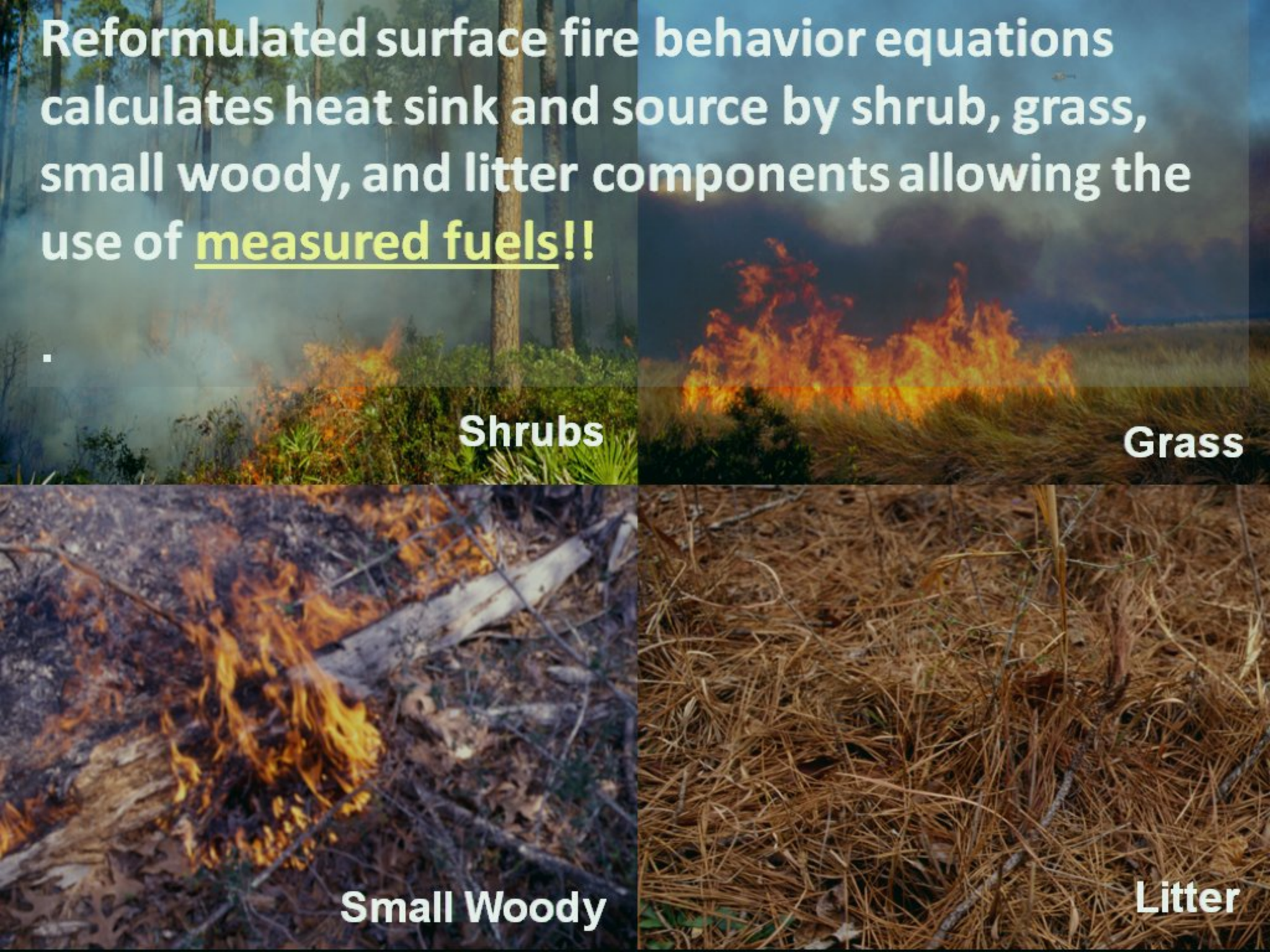


Information Flow in FCCS

Select FCCS Fuelbed

Ecoregion
Veg. form
Structure
Cover type
Change agent
Fire regime
Condition class

Review assigned variables of selected fuelbed in FCCS editor

Customize fuelbed

Calculate fuelbed properties

Generate output reports

Characteristics by fuelbed strata and category

FCCS fire potentials

Surface fire behavior

Fuel model crosswalk

Carbon

FCCS Fuelbed Project—Predictive Services E-4 Region of Oregon & Washington

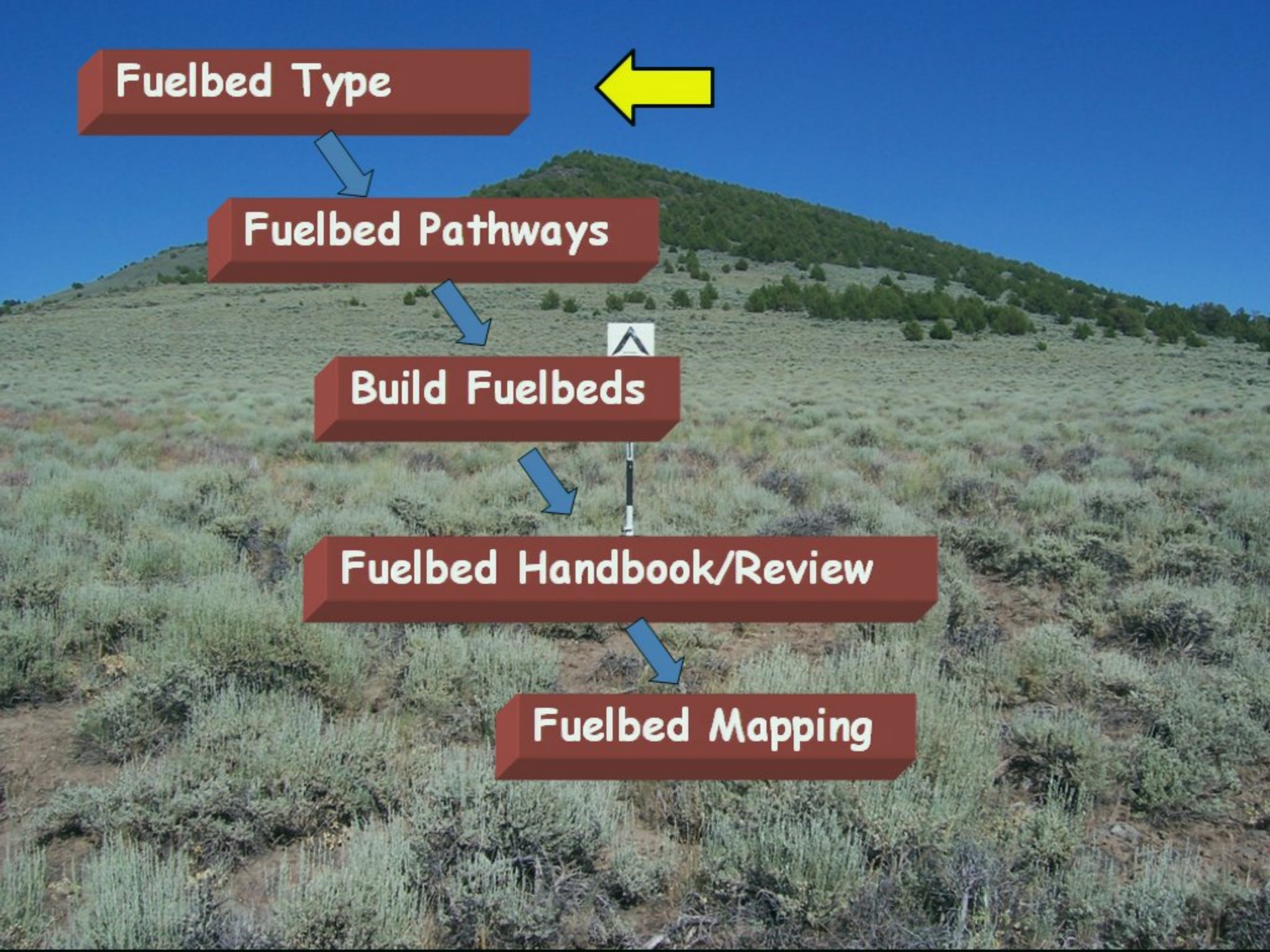
Objective: Identify, build and map FCCS fuelbeds for the Predictive Services E-4 region of Oregon & Washington

FERA
Fire and Environmental Research Applications

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

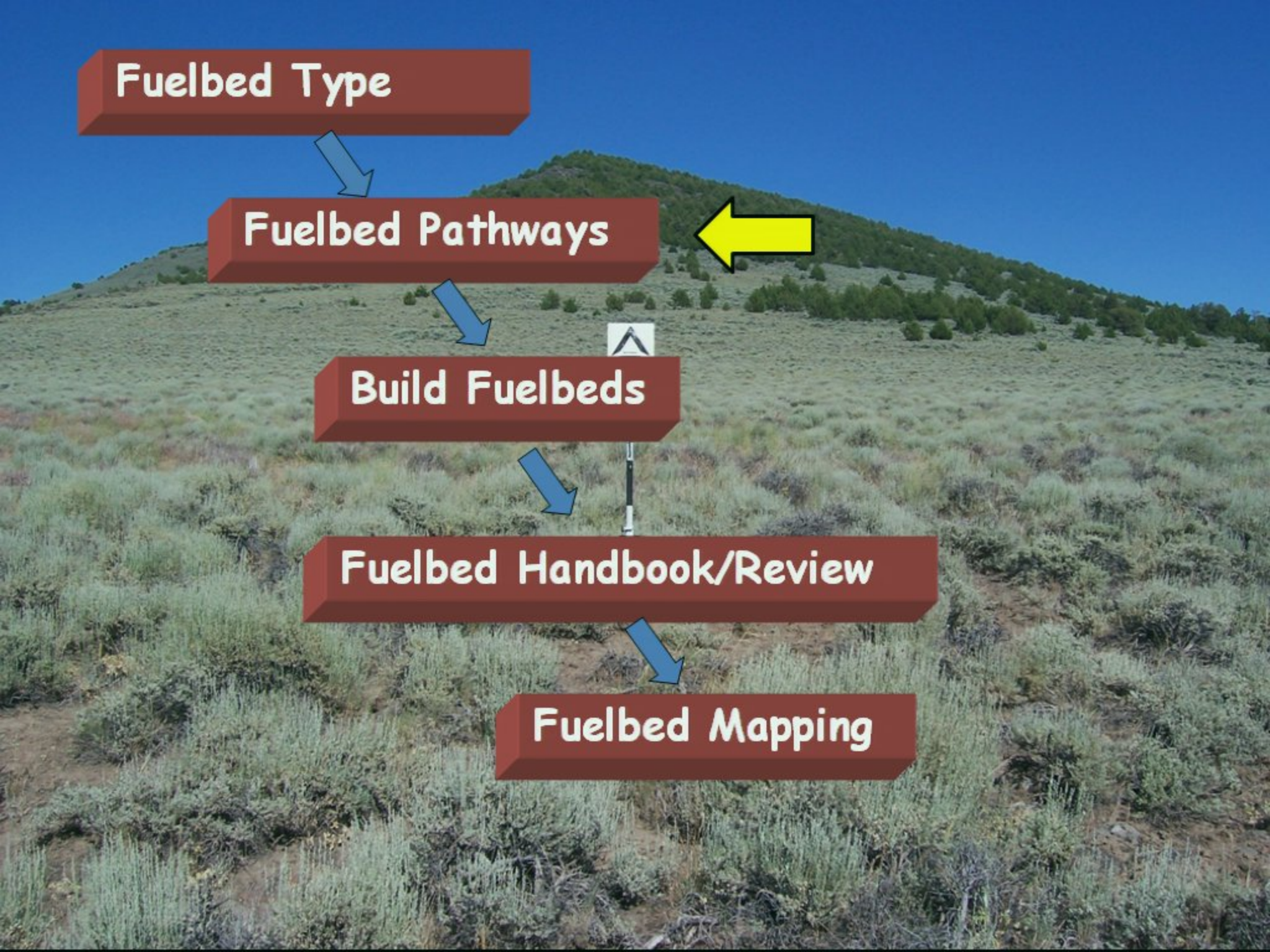
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

SORO


Fuelbed Type
Fuelbed Pathways
Build Fuelbeds
Fuelbed Handbook/Review
Fuelbed Mapping

E-4 Oregon Fuelbed types

- Warm, dry Douglas-fir, ponderosa pine, grand fire
- Cool, moist grand fir
- Cold, dry subalpine forest
- Cool, moist lodgepole pine, western larch
- Cold, dry lodgepole pine, western larch
- Warm, dry Douglas-fir/noiebark
- Hot, dry ponderosa pine
- Warm, dry ponderosa pine
- Western juniper, bitterbrush/grass
- Mountain big sage/grass
- Wyoming big sagebrush/grass
- Additional fuelbeds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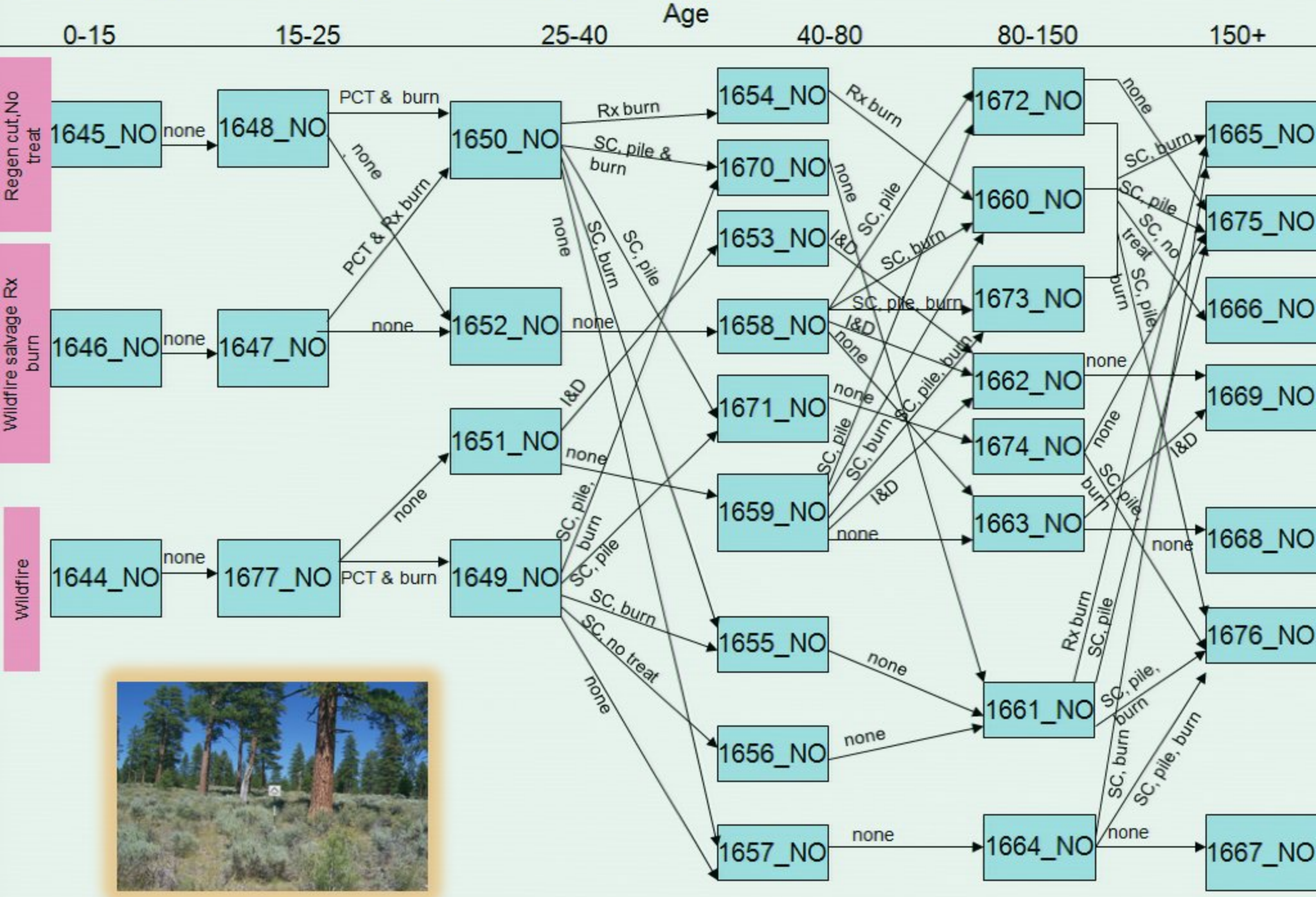
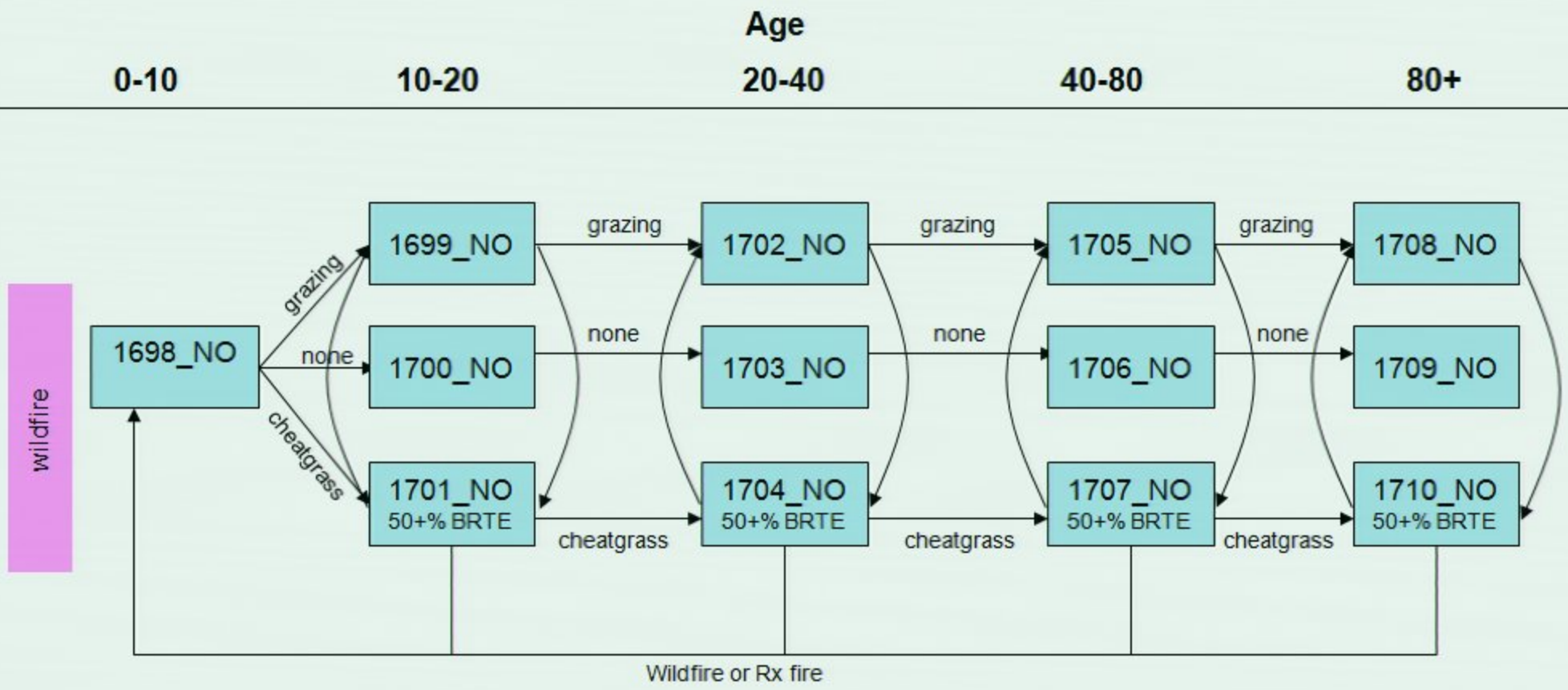
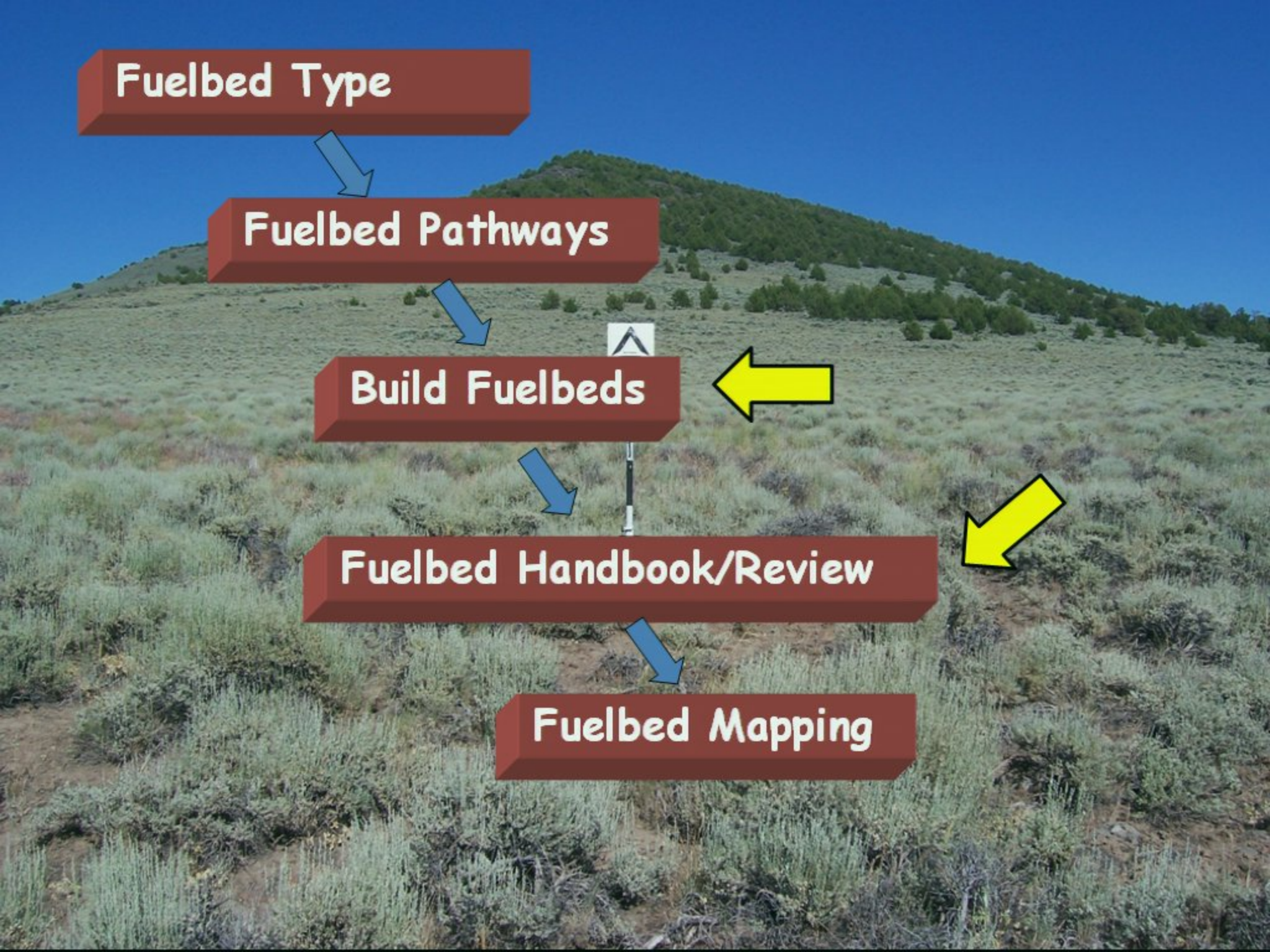
Warm, dry ponderosa pine pathways



Wyoming sagebrush / grass pathways




Fuelbed Type
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Fuelbed Pathways Handbook

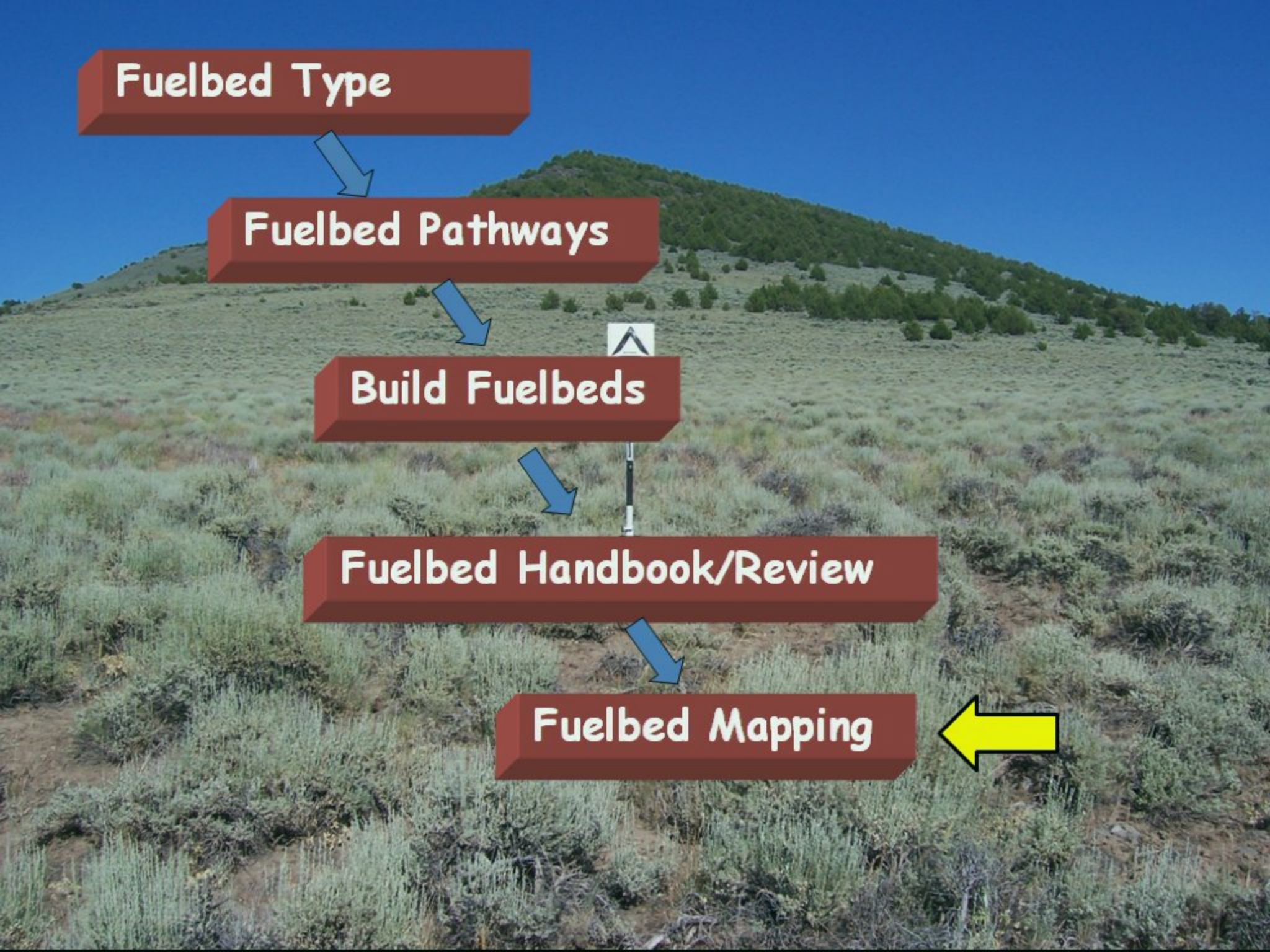
Northeast Oregon

FCCS Fuelbeds—July, 2012

Fuelbed Handbook

- Fuelbed Pathways
- Fuelbed Descriptions
- FCCS Fire Potential and Fire behavior Outputs (L,M,H)
  - Fire potentials
  - Reaction Intensity
  - Flame length
  - Rate of Spread

Wet, moist, dry
Wind: 0, 3, 7 mph mid-flame
Slope: 0, 30, 70 percent

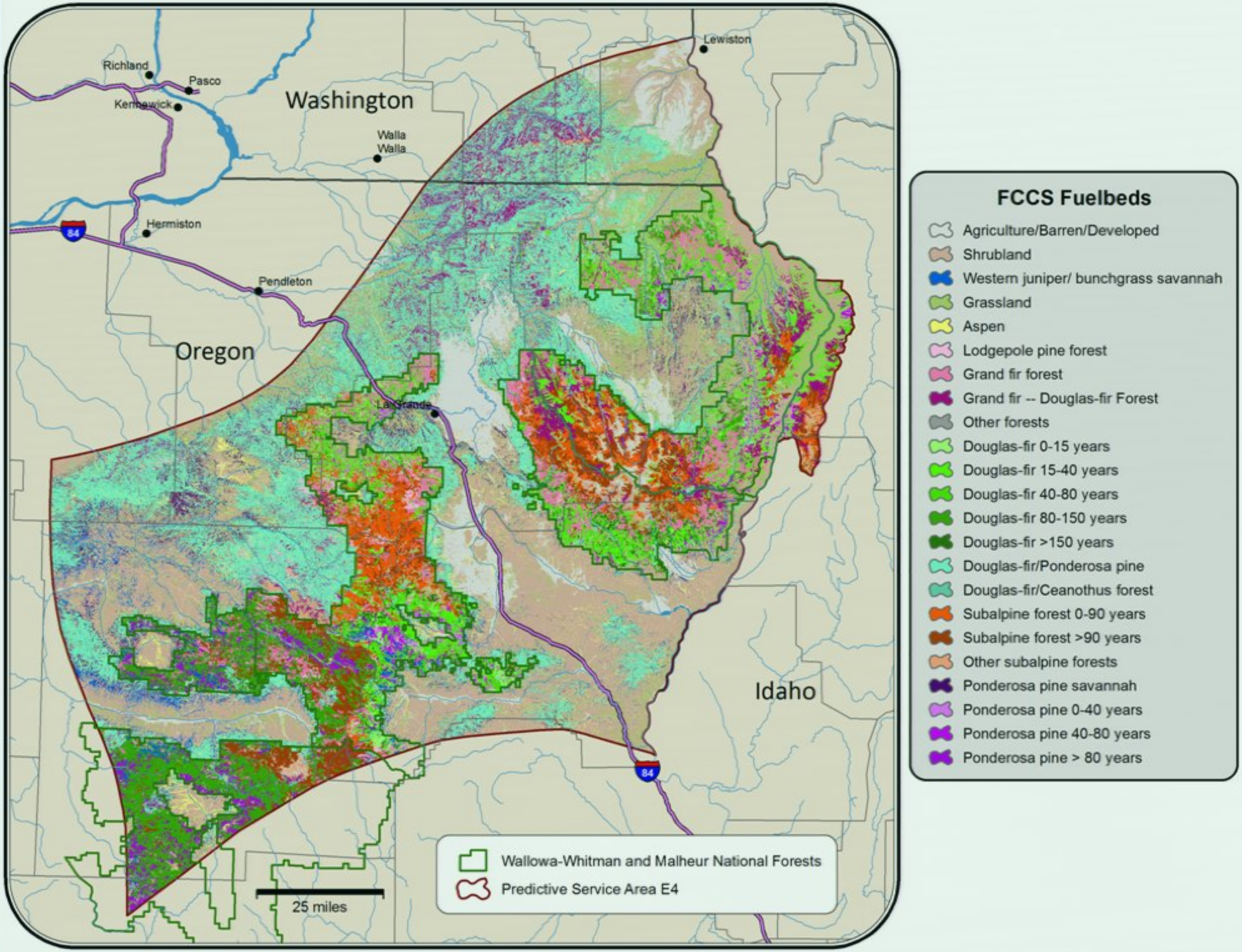

Fuelbed Type
Fuelbed Pathways
Build Fuelbeds
Fuelbed Handbook/Review
Fuelbed Mapping

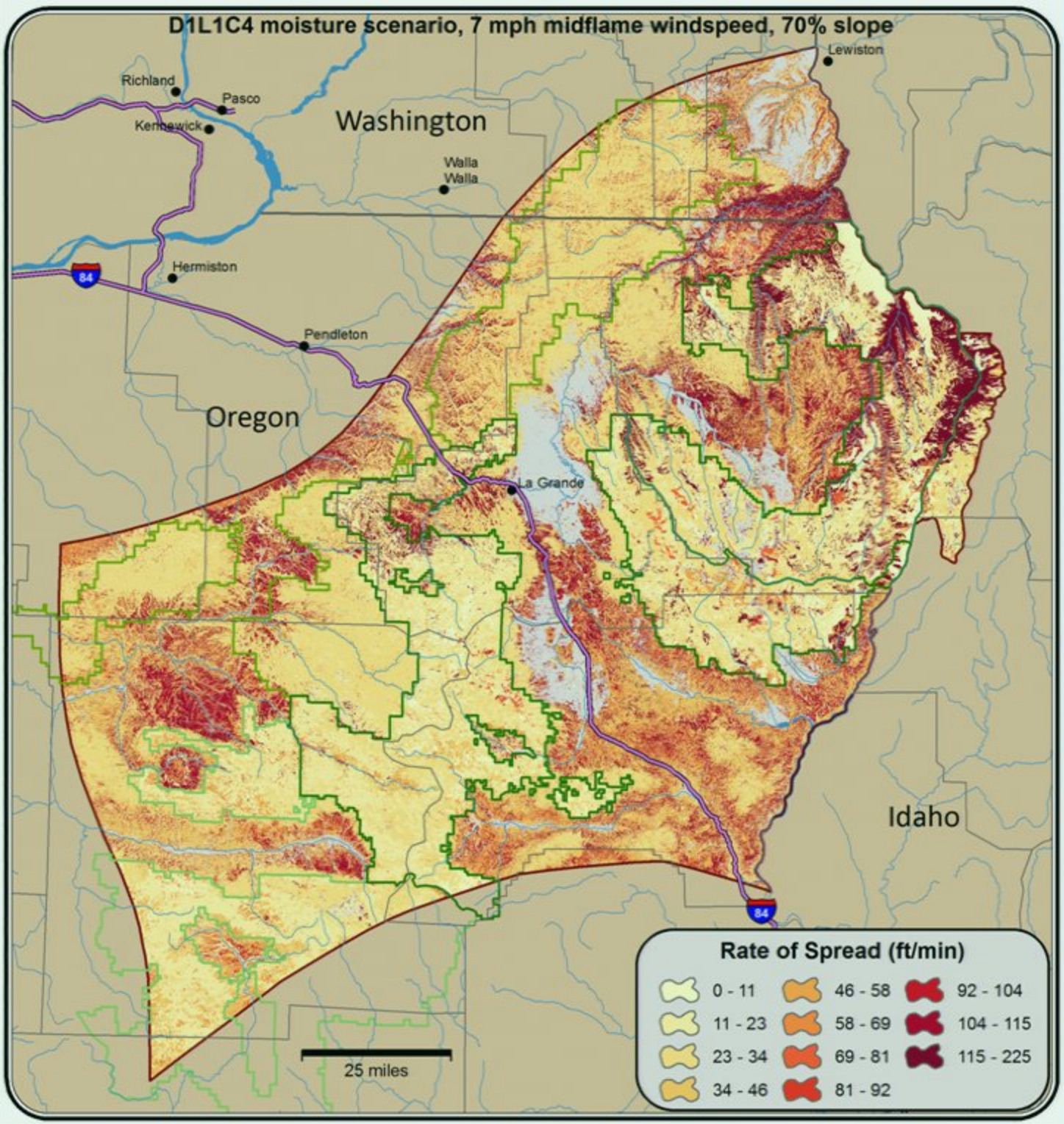
Fuelbed Mapping

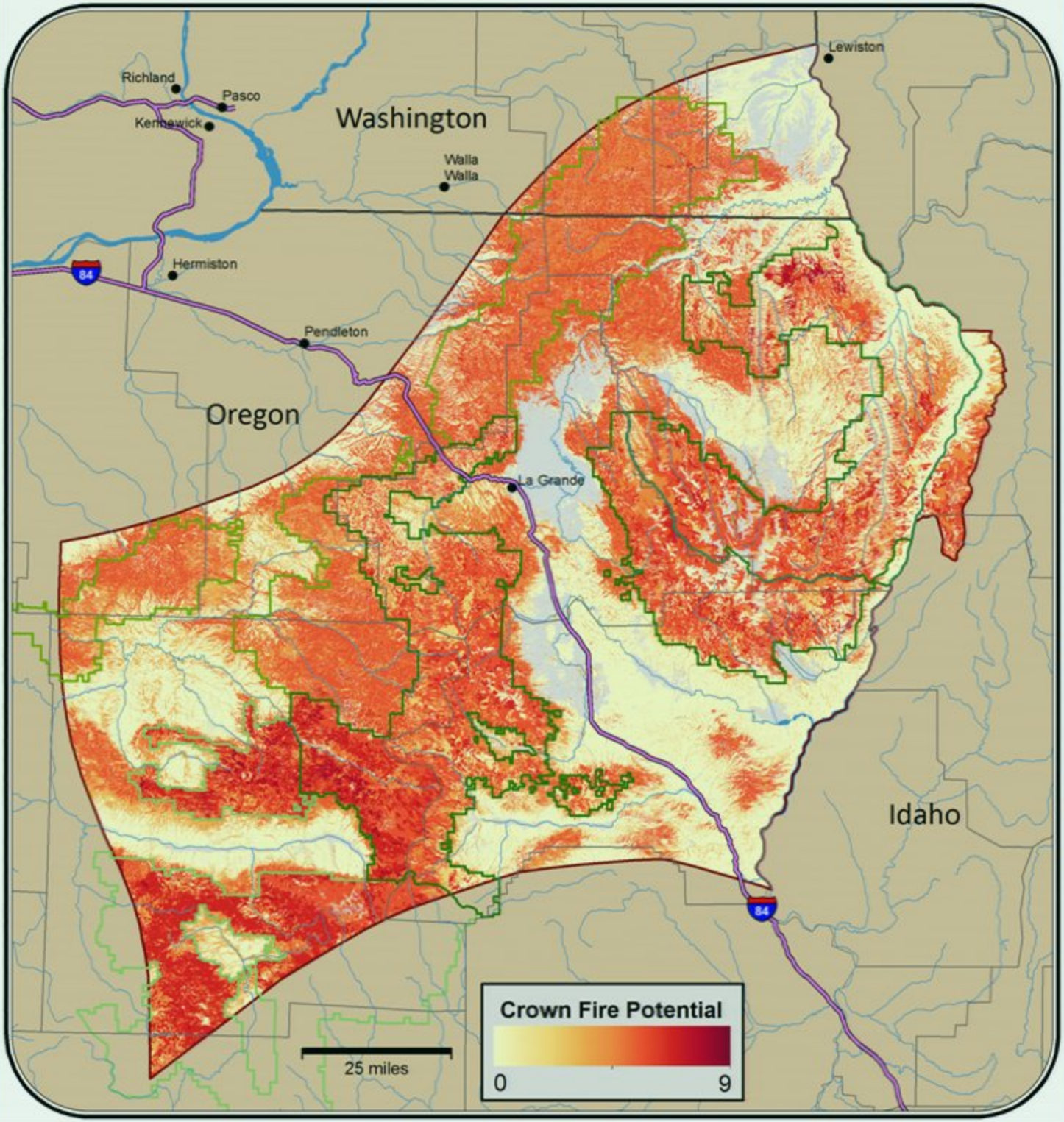
- FCCS fuelbeds cross-walked to best available vegetation map based on vegetation classifications and quantitative vegetation data such as vegetation form, canopy cover and structural stage.

- Used LANDFIRE FCCS fuelbed map when applicable veg map was not available.

- Mapped fire potentials and fire behavior outputs.


Richland
Pasco
Kennewick
Washington
Walla Walla
Lewiston
Hermiston
84
Pendleton
Oregon
La Grande
Idaho
84
25 miles
Wallowa-Whitman and Malheur National Forests
Predictive Service Area E4
FCCS Fuelbeds
Agriculture/Barren/Developed
Shrubland
Western juniper/ bunchgrass savannah
Grassland
Aspen
Lodgepole pine forest
Grand fir forest
Grand fir -- Douglas-fir Forest
Other forests
Douglas-fir 0-15 years
Douglas-fir 15-40 years
Douglas-fir 40-80 years
Douglas-fir 80-150 years
Douglas-fir >150 years
Douglas-fir/Ponderosa pine
Douglas-fir/Ceanothus forest
Subalpine forest 0-90 years
Subalpine forest >90 years
Other subalpine forests
Ponderosa pine savannah
Ponderosa pine 0-40 years
Ponderosa pine 40-80 years
Ponderosa pine > 80 years


D1L1C4 moisture scenario, 7 mph midflame windspeed, 70% slope
Richland
Pasco
Kennewick
Washington
Walla Walla
Lewiston
Hermiston
84
Pendleton
Oregon
La Grande
Idaho
84
25 miles
Rate of Spread (ft/min)
0 - 11
11 - 23
23 - 34
34 - 46
46 - 58
58 - 69
69 - 81
81 - 92
92 - 104
104 - 115
115 - 225


Richland
Pasco
Kennewick
Washington
Walla Walla
Lewiston
Hermiston
84
Pendleton
Oregon
La Grande
Idaho
84
25 miles
Crown Fire Potential
0
9

What is left to do?

- Validation
- Continue to adapt to new fire model requirements (e.g. fine scale bulk densities)
- Cover all fuelbed components
- New and efficient measuring protocols
- Account for spatial variability of fuel properties
- Improved characterization of change agents