# NARA Long-term Soil Productivity (LTSP) Project – 2015 Update

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Sustainable Feedstock Production

## Objective

Assess the impact of residual biomass harvesting in Douglas-fir forests by establishing the fourth in a series of Long-Term Soil Productivity (LTSP), slash removal and compaction studies in Western Oregon and Washington.

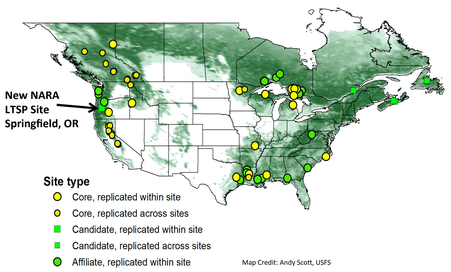
## Introduction

Understanding the effects of woody biomass removals and any associated soil compaction is necessary to assess the sustainability (in an environmental and productivity sense) of harvesting woody biomass forest residuals as a source of biomass for bioenergy feedstock. Demonstrating the on-site environmental sustainability of collecting and utilizing forest harvest residuals from Pacific Northwest Douglas-fir forests for the production of biofuels is a key to the viability of the venture. The long-term goal of the study is to contribute to our understanding of the amount of residual woody Douglas-fir biomass that can be removed during timber harvest without detrimental effects on soil quality, water quality, and wildlife. We will address these issues by installing an additional Long-Term Soil Productivity (LTSP) site in the southern Willamette Valley of Oregon on Weyerhaeuser ownership to round out the existing regional studies, to extend into warmer and drier parts of the Douglas-fir range, and to contribute to the broader LTSP network.

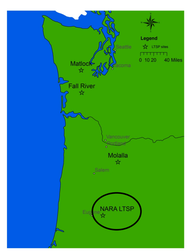
## Background

Launched in 1989, the North American LTSP study was founded as a continuing cooperative effort whose goal was to address the ultimate consequences of organic matter/woody biomass removals and soil compaction on fundamental forest productivity (see Powers, et al. 2005.) Today, those initial collaborations have grown into a network of core and affiliate sites across the US and Canada.

Map of Current LTSP Locations




These sites include three affiliate LTSP locations in the Pacific Northwest that have been installed over the past 12 years. These sites, Fall River (Washington State), Matlock (Washington State), and Molalla (NW Oregon), have focused on the effects of manipulating woody biomass harvest residuals remaining on site after a clear-cut harvest, but are limited in geographic scope, so additional sites are warranted to span the range of soil and climatic conditions of the region.




## Methods

### Organic Matter and Compaction Treatments:

| *Compaction* / *Harvest* | C0 No compaction | C1 Moderate compaction |
|---|---|---|
| OM0 – Bole only | OM0 C0 **A** Boles removed No compaction | OM0 C1 **C** Boles removed Moderate compaction |
| OM1 - Boles and crowns removed - "Total Tree" | OM1 C0 **B** Boles and crowns removed / No compaction | OM1 C1 **D/F*** Boles and crowns removed / Moderate compaction |
| OM2 - Boles, crowns, forest floor removed | | OM2 C1 **E/G*** Boles, crowns, forest floor removed / Moderate compaction |

* In addition to the set of non-fertilized plots, these treatments will also have a second set of plots that receive fertilizer mid-rotation to test amelioration effectiveness.

## Experimental Design

- Randomized complete block design with 4 complete replicates of the treatments totaling 28 plots.
- Blocks based on pre-harvest soil analysis, pre-harvest tree measurements, and spatial layout.
- 1.0 acre treatment area per plot - ½ acre internal measurement plot.

- Response variables: Planted-seedling growth, soil carbon and nutrients including leaching losses (Harrison, UW), soil moisture, soil temperature. Potential for wildlife (small verts/inverts) responses and hydrology responses.

## Aerial Photos

Pre-harvest (2010) — Post-treatment (2015 June)

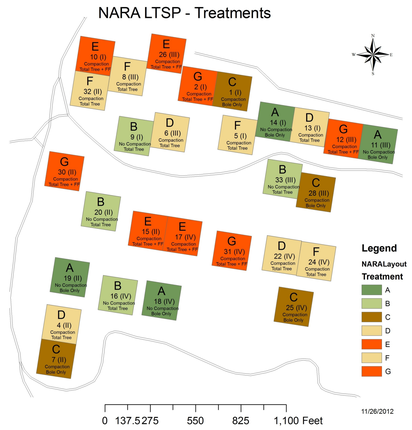
1 acre treatment plots

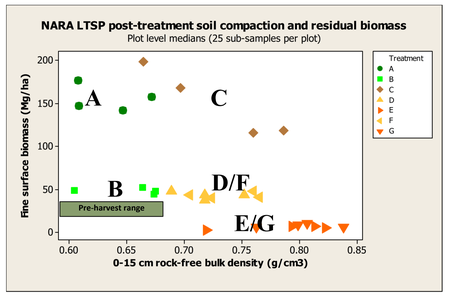
## Pre-Harvest Site Characterization

The plots were assessed for pre-harvest condition both to establish a baseline and were used in the statistical blocking of the treatments across plots. We assessed soil, trees, understory shrubs and vegetation, and dead organic material creating a carbon/biomass budget by plot for the site. Soil samples were collected from 25 points in each plot on a 5 point by 5 point grid on the interior ½ acre plot. A total of 30 plots were examined pre-harvest and 28 were ultimately used in the final study after dropping two outliers.

## Post-Treatment Characterization

Following treatment implementation soil bulk density and fine biomass retention was evaluated at 25 points per plot in a similar manner to the pre-harvest assessment to verify treatment effects.




**Post-treatment plot conditions** – good separation. Pre-harvest range also shown in the green box

## Timeline

**2011 –**
- ✓ Finalize work plan, define treatments to be applied, begin scouting sites, place seedling order.

**2012 –**
- ✓ Sites indentified/plotted and initial pre-harvest measurements taken (soil nutrients (June/July). Pre-harvest tree/downed-wood measurements (Sept/Oct).

**2013 –**
- ✓ Harvest (March-May) and apply biomass removal and compaction treatments (May-July).
- ✓ Site instrumented for weather data and soil water collection (Aug-Nov). Install fence (Nov).

**2014 –**
- ✓ Plant seedlings, initial tree measurements (March/April).
- ✓ First growing season tree measurements (Oct). Continue monitoring site conditions.
- ✓ Measure seedlings at an established LTSP site: Fall River, Washington. Age 15.

**End 2015 –**
- ☐ Second-year tree measurements taken. Report drafted by mid-2016.

Douglas-fir seedling

September 15-17, 2015

NARA
Northwest Advanced Renewables Alliance

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