

**“The Priority of Hazardous Fuels Treatments
For Eight Stands of the Rush 2 Vegetation Treatment Area
On the Modoc National Forest”**

Project Background

The Rush 2 Vegetation Treatment area consists of approximately 3,600 acres of mixed conifer forested lands in the upper portion of the Cottonwood Creek watershed. The area is part of the Modoc National Forest near the small logging town of Adin in Northeastern California. Past activities such as logging and fire suppression in addition to slight changes in climate have resulted in a shift in species composition, structure and density. Shade tolerant and fire susceptible species such as white fir have been allowed to become thick and overgrown with dead and downed material accumulating over time and creating hazardous fuels conditions should a wildfire occur. High intensity, destructive wildfires that may occur in these kinds of conditions intensely impact the ecosystem. A large wildfire could consume important vegetative cover across the landscape and have a severe impact on water quality within the sub-watersheds in the area as well as causing hill slope instability and degraded habitat for wildlife (Landoski, 2005.)

In response, the US Forest Service has proposed to reduce hazardous fuels in the project area by thinning, masticating, burning piles, pruning, and under burning. The project area is divided up into compartments for organizational purposes. These are then divided into individual timber stands based on similar stand characteristics, species composition, and natural boundaries. Activities such as fuels treatments or timber harvests are usually restricted to the stand boundaries. In addition, areas such as Stream Management Zones (SMZs) which include wet areas with various buffers surrounding them, and sensitive species habitat can be excluded from treatment. It was determined by silviculture professionals that a 50ft stream zone buffer would be put in place around all wet areas and seeps to preclude mechanical piling (Landoski.) With a restricted fiscal budget and many other high priorities on the forest, it must be determined which stands exhibit the most pronounced characteristics of hazardous fuels conditions and what parts of these areas are available for treatment.

First, GIS layers of known stream locations and stand boundaries within the project were used to determine the areas available for fuels treatments. Then, with the assistance of the Modoc National Forest “Fuels Monitoring Crew,” data was collected in the project area in order to determine the present condition of fuels. Using a systematic sampling technique and installing permanent plots prior treatment, the condition of each of the individual plots in eight stands within the project area was recorded.

With this data, a spatial analysis was performed to predict the general fuels conditions of each timber stand in which these plots exist, the relative priority of each stand for receiving treatment, and the areas that would be excluded from treatment.

Purpose and Need

The purpose of this spatial analysis was to identify the stand with the most hazardous fuel conditions using field sampled data including tree density and ground fuel depth from sampled plots. Base data of stand boundaries and stream locations were used to exclude unavailable areas from the study. Higher counts of trees per acre and deeper fuel depths indicate more hazardous conditions. The need for this analysis arose from the mandate from the National Fire Plan (2002) and the Healthy Forest Restoration Act (2004) to “provide direction to reduce fuels loadings in fire-prone forests to protect people and sustain resources” (Landoski, 2005.) By determining the relative priority and treatment area of each stand, managers can effectively allocate time and resources to projects that need it most.

Collecting Field Sampled Data

Data used in this analysis were gathered in the project area during July and August of 2005. Plot locations were determined using diagonal transects across each stand and placing the plots approximately equi-distance along the transect. At least one plot per fifty acres of the stand area was installed. Data was recorded using the “Common Stand Exam” (CSE) program and uploaded into the Forest Service database management system “Field Sampled Vegetation” (FSVeg.) A Trimble GeoExplorer 3 GPS data file was created at each plot center, collecting at least 180 points for each file, as per US Forest Service GIS guidelines. A data dictionary was created in Trimble’s “Pathfinder Office” program and maintained on the handheld GPS unit to record “Plot name” and “Stand number” with each GPS file. Protocol followed to sample the data used in this analysis was based on the CSE program and field guide and are as follows:

- 1) “Trees per acre” was determined for each plot by using a 37.5 ft radius creating a circle around plot center. The number of trees greater than 1 in diameter and taller than 4.5ft that lie within the circumference of the circle were counted (additionally diameter at breast height, total height, height to first live crown, and damage was recorded.) This area represents 1/10th on an acre. The value is then multiplied by 10 to get the final value, trees per acre.
- 2) “Fuel depth” was determined using the “Brown’s Planar Intercept” method. This method uses a transect along the ground at a random azimuth, starting at plot center. Maximum fuel depth measurements are measured to the nearest 1/10th inch between 0ft and 1ft from plot center, 1ft and 2ft, and 2ft and 3ft. The values are averaged and recorded. “Fuel” is defined as any dead, down, woody material not connected to the ground and up to 6ft from the surface (“Common Stand Exam Field Guide”, USFS, 2005.)

Table 1: “Average Tree and Fuel Values and Priorities in Each Stand”

STAND	Avg. Number of Trees per Stand	Tree Priority	Avg. Fuel Depth per Stand (inches)	Fuel Priority
1300	33	MED	1.75	LOW
200	56	HIGH	3.1	HIGH
2500	13	LOW	2.7	MED
300	60	HIGH	2.2	LOW
400	14	LOW	2.1	LOW
500	14	LOW	1.7	LOW
600	14	LOW	2.4	MED
800	50	HIGH	3.5	HIGH

The Analysis

Goal: To determine the relative fuel conditions and treatment priority of eight stands within a 3,600 acre project area using field sampled plot data from each of the stands and base data of stream locations to exclude non-treatment areas.

Variables: “Trees per Acre” and “Average Fuel Depth” are the conditions that will be compared in each stand to determine the highest treatment priorities. Stream locations will be buffered to exclude non-treatment areas.

Outcomes:

- Stands with 13 to 28 trees per acre and an average of 1.7 to 2.3 inches of fuel depth will be considered a **low priority** for treatment.
- Stands with 29 to 44 trees per acre and an average of 2.4 to 2.9 inches of fuel depth will be considered a **medium priority**.
- Stands with 45 to 60 trees per acre and an average of 3.0 to 3.5 inches of fuel depth will be considered a **high priority**.
- Identified streams will be buffered with a 50ft strip on each side to maintain the SMZs. These areas will be excluded from the stands’ area available for treatment.

Data Files

Shapefiles:

- “Rush2_plots” (renamed “study_area”) (source: Fuels Monitoring Crew)
- “Rush2_stands” (source: Modoc National Forest)

Coverages: “Allstreams” (renamed "streams") (source: Modoc National Forest)

Image files: pbs085, pbs072 (source: Modoc National Forest)

The Process

Step 1: Determine “Trees Per Acre” and “Average Fuel Depth” for each stand by averaging the individual plot data

- 1) Populate “Study_area” attribute table with “Trees Per Acre” and “Average Fuel Depth”
- 2) Use “Select by Attribute” option in the “Study_area” attribute table to create a selection of each stand
- 3) Show selection and activate “Selection statistics –Mean Value” on each field “Trees Per Acre” and “Fuel Depth”
- 4) Record the mean value for each field in each stand in the “Study_area” attribute table by creating new fields “Avg Trees” and “Avg Fuel”

Step 2: Display one map showing “Trees per Acre” priorities and display one map showing “Average Fuel Depth” priorities

- 1) Categorize values in each field into three groups, “High,” “Med,” and “Low” priority using the Equal Interval method with three classes
- 2) Edit the “Study_area” attribute table with new fields “Tree Priority” and “Fuel Priority”
- 3) Create new data frames for each map and copy and paste “Study_area” to each frame
- 4) Display “Study_area” using “graduated colors” and the Equal Interval method with three classes (High, Med, and Low) for the “Tree Priority” field, **Map 1**
- 5) Display “Study_area” using “graduated colors” and the Equal Interval method with three classes (High, Med, and Low) for the “Fuel Priority” field, **Map 2**

Step 3: Display a map showing areas with “High” values in both the “Tree Priority” field and “Fuel Priority” field and label with total area for each stand

- 1) Use “Select by Attribute” to create a selection of Tree Priority = High And Fuel Priority = High
- 2) Go to the table of contents, right click on “Study_area” go to Selection and “Create New Layer from Selection” (“Study_area_selection”)
- 3) Create new data frame and copy and paste “Study_area_selection”
- 4) Label stands with “Area”, **Map 3**

Step 4: Create stream buffers, determine adjusted areas for each stand, and label with new area value

- 1) In ArcCatalog, navigate to “streams” coverage, right-click and select “Create New Layer”
- 2) Create new data frame and copy and paste the “Study_area_selection” and “streams” layer

- 3) Select “Clip” from ArcTool box and clip the “streams” layer to the “Study_area_selection” layer
- 4) Select “Buffer” from ArcTool box and buffer the “streams” layer to 50ft
- 5) Select “Union” from ArcTool box and union the “streams_buff” and “Study_area_selection”
- 6) In the table of contents, right-click “study_area_union,” go to Properties and Definition Query tab
- 7) Type in “FID_stream_buffer” = -1 to find areas that are not available for fuels treatments in the selected stands
- 8) Show selection and use “Calculate Values” on the “Area” field (from the study_area attributes) to subtract the “Shape_area” value (from the streams_buffer attributes) to determine the adjusted area on each stand available for fuels treatments.
- 9) Label each stand with the new “Area” value, **Map 4**

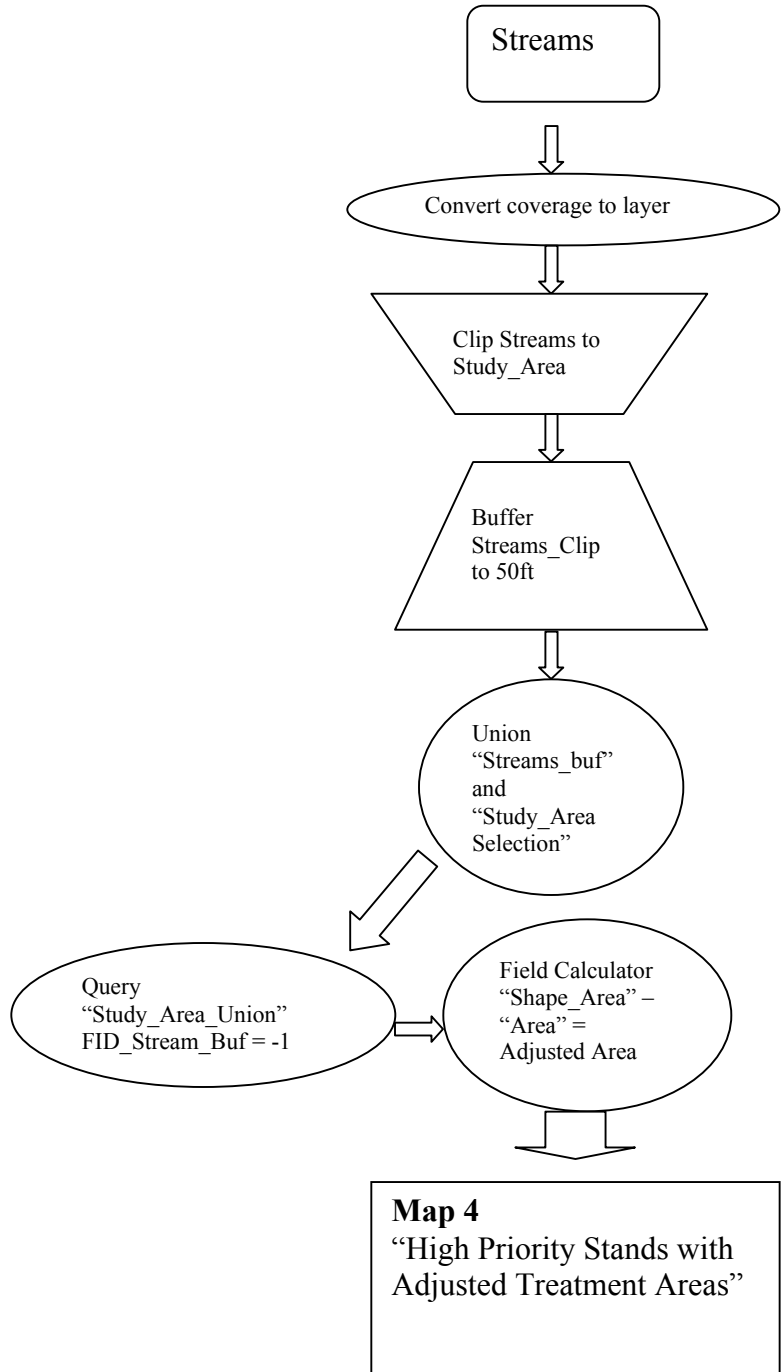
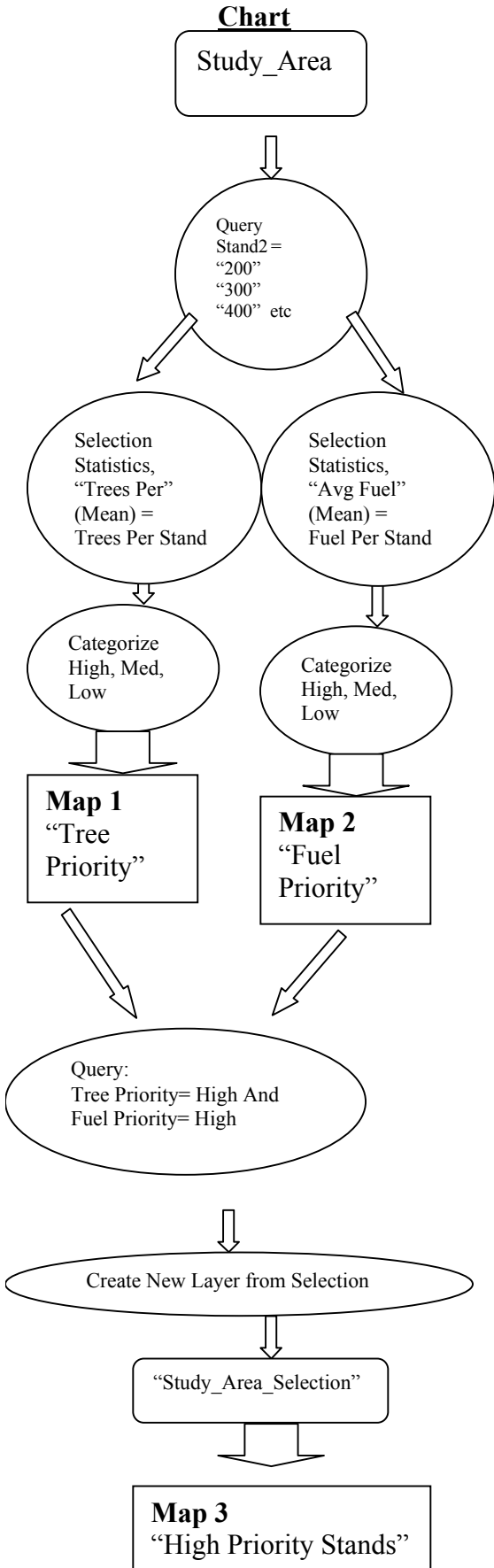
Results and Recommendations

The final map (**Map 4**) in the spatial analysis suggested stands 200 and 800 to exhibit the highest density of trees and deepest average fuel depths. Therefore, it is recommended that these stands be given the funding and resources for hazardous fuels reduction and be considered the highest priority for treatment. **Map 4** also displays the final area, in square feet, of the suggested treatment stands, adjusted to exclude the SMZs in the stands. The values changed from 6,274,470 sq ft to 5,695,230 sq ft in Stand 200 and from 12,946,400 sq ft to 11,807,035 sq ft in Stand 800. This value can help to determine the fiscal commitment and timeframe needed for treatment completion based on cost per area.

Data Quality, Accuracy, and Error

In general, this spatial analysis can be helpful in making decisions about forest management, planning, and project implementation. But, the results should not be considered infallible due to several issues surrounding the analysis. First, the number of plots per acre in the project area was not sufficient to provide the statistical validity needed to accurately extrapolate the data to the whole project area. The CSE protocol suggests one plot per ten acres in a homogeneous study area. Due to constraints in funding and the large expanse of areas to cover, the decision was made by forest managers to limit the number of plots installed to at least one plot per fifty acres. Some stands in the project area contain as many as one plot per twenty five acres. Next, there are several ecological variables such as the extent of sensitive wildlife habitat, wildland urban interface boundaries, and locations of existing fire breaks that could have greatly expanded the scope of the study. These data were not available in a compatible format in at the time of analysis. Additionally, the original data could have been entered directly into the data dictionaries of the GPS units at the time of sampling. This may have reduced errors made while doing math equations and hand-entering raw data for the analysis.

Flow



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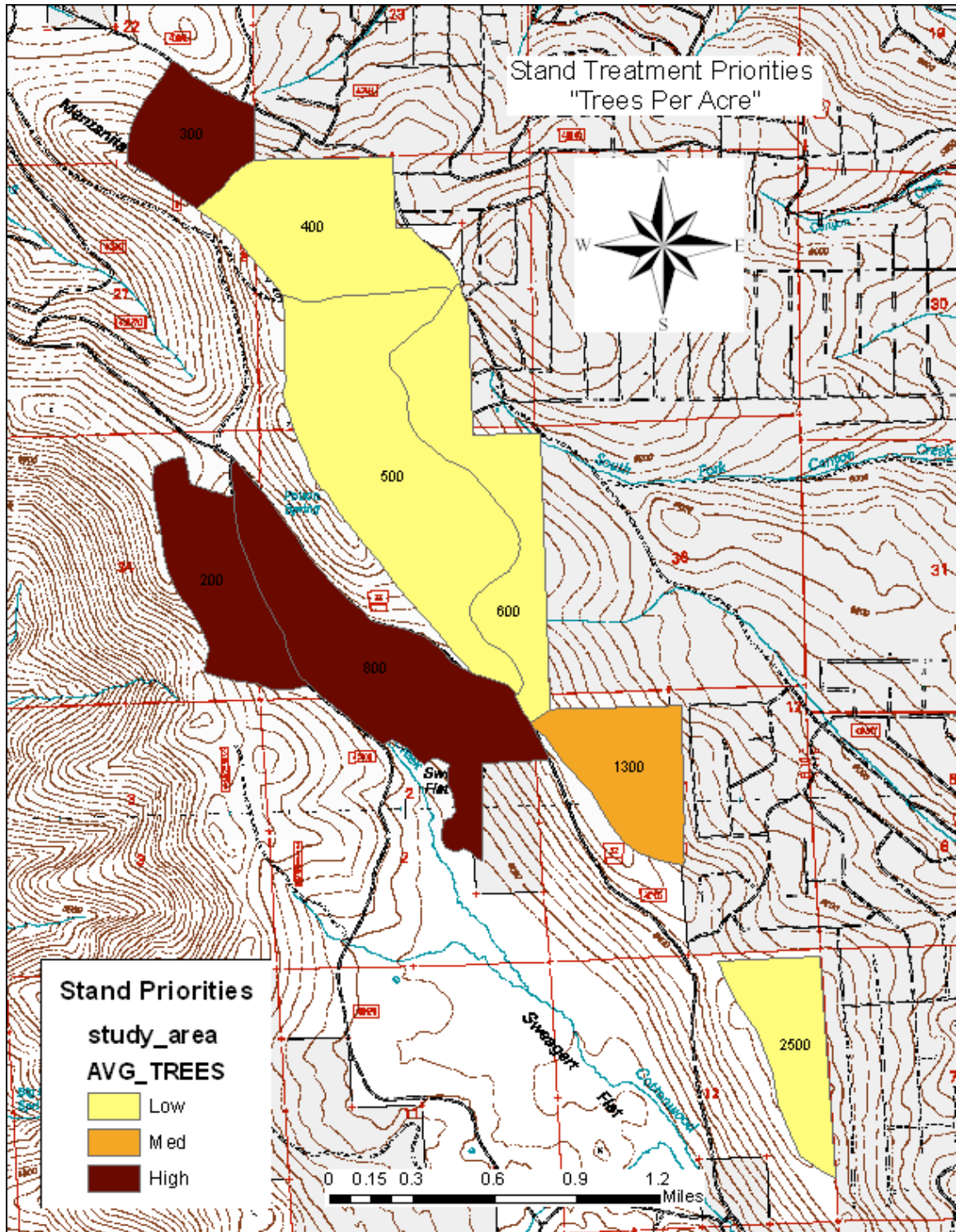
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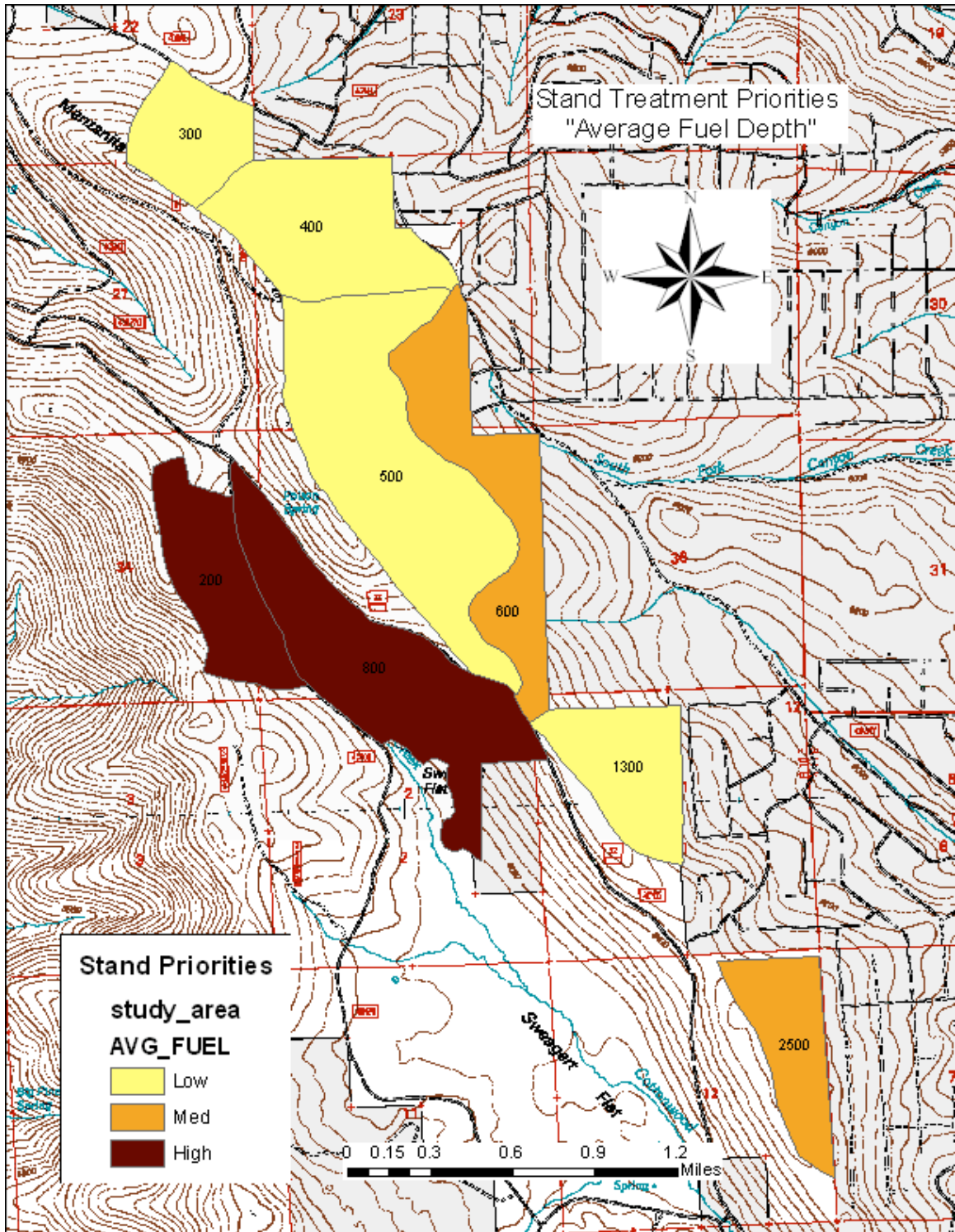
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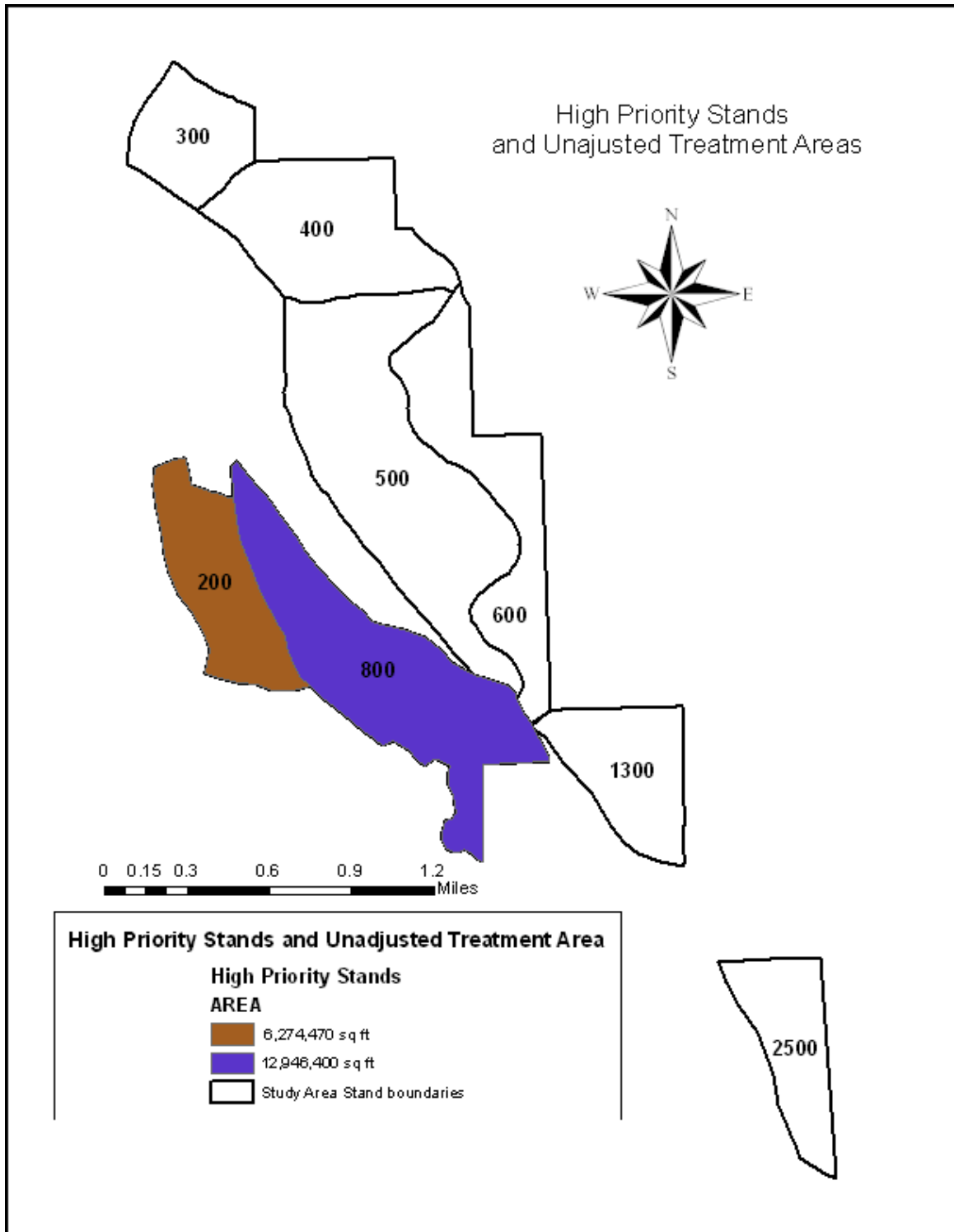
Map 1



Map 2



Map 3



Map 4

