# Fuels Mapping Scope of Work – San Mateo County

Tukman Geospatial

## Project Description

The Golden Gate National Parks Conservancy (GGNPC) and its partners plan to develop a fine-scale vegetation map of San Mateo County (and Federal lands in San Francisco County) to support various planning, monitoring, and land management efforts. In 2017, San Mateo County acquired high density LiDAR data and created derivatives layers such as contours and building footprints. In 2018, a consortium of land managing agencies in San Mateo County partnered to fund the collection of high resolution 4-band imagery.

The fine scale vegetation map provides the opportunity for the creation of a derivative fine scale fuels map that would be superior to the regional fuel models and data products now available for the County, such as the 30-meter resolution Landfire data products.

This scope of work describes the creation of a fuel model and associated data products for San Mateo County. The scope assumes as its prerequisites that San Mateo County develop a fine scale vegetation map and a high-density LiDAR point cloud.

Joining the Tukman Geospatial team for this project is subcontractor Esther Mandeno. Esther's firm, Digital Mapping Solutions, has over 20 years of experience mapping fuels, modeling fire behavior, assessing fire risk, and developing community wildfire preparedness plans (CWPPS).

## Fuel Mapping Overview

Existing fuel models for San Mateo County, such as Landfire, are medium resolution datasets designed for use at regional scales. The upcoming fine scale vegetation map for San Mateo County, coupled with the recent availability of high density LiDAR data and high resolution 4-band aerial photography, provide the needed foundational datasets for a high-resolution fuel model, which can be primarily used to inform fuel management decisions at a finer scale than existing datasets, and may also help fire behavior models..

In addition to providing the fuel model and associated data products, Tukman Geospatial will optionally derive - from the 2017 LiDAR point cloud - a 30-meter raster that represents the percent of all returns between 1 and 8 meters above the ground. Studies in the Sierra Nevada and the Klamath Basin have found this LiDAR derived metric to be a useful for identifying areas of high ladder fuels[1,2].

## Fuel Mapping Deliverables

The end products of this work will result in the following deliverables:

- **5-meter Fuel Model** – Tukman Geospatial will work with San Mateo County to understand their specific fuel model needs and any required customizations. Tukman Geospatial and team member Esther Mandeno will work with local and state fire experts to create a modified version of the Scott and Burgan fire behavior fuel model[3] that is tailored to San Mateo County - this will be a crosswalk from San Mateo's fine scale vegetation classes, aspect, vegetation height, and vegetation cover. Tukman Geospatial will deliver the fuel model as a 5-meter raster.
- **Landscape (.lcp) file for modeling** – Landscape files are a required input to fire behavior and fire spread models such as FlamMap and FARSITE. Landscape files consist of the following components, which will be delivered as a stack of 5-meter rasters:
    - **Elevation** (derived from '17 LiDAR)
    - **Slope** (derived from '17 LiDAR)
    - **Aspect** (derived from '17 LiDAR)
    - **5-meter Fuel Model** - FBFM40 (LANDFIRE version 1.40). A refined, accurate and up-to-date representation of typical surface fuel arrangements or "collections of fuel properties" described to serve as input for mathematical surface fire behavior and spread models (Scott & Burgan, 2005).

[1] Kramer, Heather A., et al. "Estimating ladder fuels: a new approach combining field photography with LiDAR." Remote Sensing 8.9 (2016): 766.
[2] Kramer, Heather A., et al. "Quantifying ladder fuels: A new approach using LiDAR." Forests 5.6 (2014): 1432-1453.
[3] Scott, Joe H.; Burgan, Robert E. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

- **Canopy Cover** - Described by percent cover of tree canopy in a stand (derived from ’17 LiDAR).
- **Canopy Height** - Described as the average height of the top of the canopy for a stand (derived from ’17 LiDAR).
- **Canopy Base Height** - Described by the lowest point in a stand where there is sufficient available fuel (0.25 in dia.) to propagate fire vertically through the canopy, reported in meters * 10 (estimated based on local knowledge)
- **Canopy Bulk Density** - Defined as the mass of available canopy fuel per unit canopy volume that would burn in a crown fire, reported in kg/m3*100 (will be estimated from the literature for each fuel model / canopy cover combination).

- **Ladder Fuel Proxy** – LiDAR derived proxy for ladder fuels delivered as a 30 meter raster.
- **Report** – 5-10 page report outlining methods.

## Fuel Mapping Tasks and Costs

Table 1 shows the tasks and the costs for each task for developing a fuel model for San Mateo County and creating the deliverables described above.

Table 1. San Mateo fuel model tasks and costs

| Task | Description | Costs |
|---|---|---|
| 1.1. Meetings with stakeholders & product specification development | Meetings with San Mateo County stakeholders to discuss the specific needs and product specifications of the fuel model and related data products. | **$3,500** |
| 1.2. Develop fuel model crosswalk | Work with CAL FIRE, stakeholders, and local fire experts and first responders to finalize the crosswalk between fine scale veg / topography/ forest structure and fuel model class. | **$6,000** |
| 1.3. Process imagery, LiDAR, and ancillary data for fuels mapping | Image processing to prepare LiDAR, imagery, and vegetation data for fuels mapping. | **$7,500** |
| 1.4. Create fuel model and landscape files | Create the fuel model and make geography-specific modifications. Develop landscape files for modeling fire spread and fire behavior. | **$7,500** |
| 1.5 Ladder fuel proxy (Optional) | Create a 30-meter raster with pixel values that represent the percent of all returns between 1 and 8 meters above the ground. | **$5,000** |
| | Total | **$29,500** |