LANDFIRE 2001 and 2008 Refresh

Geographic Area Report

Alaska

December 2011

Executive Summary

The LANDFIRE National Project (LF_1.0.0) was successfully completed in 2009. The goal of LANDFIRE National was to generate consistent 2001 vintage 30 meter spatial data sets for all 50 States for fire and other natural resource applications. This report highlights results from the continuation of LANDFIRE as a program to update the spatial data layers through 2008. The focus of this phase of the program was to improve the data products and account for vegetation change across the landscape caused by wildland fire, fuel and vegetation treatments, and management. In addition, changes caused by insects and disease, storms, invasive plants, and other natural or anthropogenic events were incorporated when data were available. This report describes the LANDFIRE 2001/2008 Refresh effort to update existing map layers to reflect more current conditions, focusing primarily on vegetation changes. The effort incorporated user feedback and new data, producing two comprehensive Refresh data product sets:

1. LANDFIRE 2001 Refresh (LF_1.0.5) enhanced LANDFIRE map layers by incorporating user feedback and additional data to provide a foundation to update data to 2008. It was also designed to provide users with a data set to help facilitate comparisons between 2001 and 2008 (i.e. Refresh LF_1.1.0) data sets.

2. LANDFIRE 2008 Refresh (LF_1.1.0) updated map layers to reflect vegetation changes and disturbances that occurred between 1999 and 2008.

In this report, we (1) address the background and provide details pertaining to why there are two Refresh data sets, (2) explain the requirements, planning, and procedures behind the completion and delivery of the updated products for each of the data product sets, (3) show and describe results, and (4) provide case studies illustrating the performance of LANDFIRE National, LANDFIRE 2001 Refresh and LANDFIRE 2008 Refresh (LF_1.1.0) data products on some example wildland fires.

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1.0 Introduction

1.1 LANDFIRE Program

LANDFIRE (LF), also known as Landscape Fire and Resource Management Planning Tools, is a joint program between the wildland fire management programs of the United States Department of Agriculture (USDA) Forest Service (USFS) and the United States Department of the Interior (DOI), including the following bureaus: the U.S. Geological Survey (USGS), the Bureau of Indian Affairs (BIA), the Bureau of Land Management (BLM), the Fish and Wildlife Service (FWS), and the National Park Service (NPS). The Nature Conservancy (TNC) serves as a cooperating partner. LF applies consistent methodologies and processes to create comprehensive spatial data and models describing vegetation and wildland fire/fuel characteristics across the United States. Mapped data products are based on Landsat satellite imagery and an extensive database of field-reference data (including USFS Forest Inventory Analysis (FIA) data).

LF provides the first implementation of methodologies and processes to develop and combine intermediate scale (30 m) spatial vegetation and fire information consistently across the entire United States. Such a suite of integrated vegetation, fuel, and fire regime data sets has not previously been created by the public or private sectors. LF data products facilitate national and regional (large landscape level) fire planning activities and the reporting of wildland fire management activities. LF products provide managers with the data needed for collaborative, landscape-scale, cross-boundary, interagency planning and implementation. LF data support land management to 1) identify fuel where fire hazards and fire risks to local communities may be located, 2) identify vegetation and fuel conditions where rehabilitation may benefit fire-dependent landscapes, 3) prioritize resources for national budget formulation and allocation, and 4) enhance management knowledge of fire behavior to improve firefighting safety. Programs within the wildland fire community that use LF data include the National Cohesive Wildland Fire Management Strategy, the Wildland Fire Decision Support System, Fire Program Analysis, and the Hazardous Fuel Prioritization and Allocation System.

While LF has proven highly valuable for the wildland fire community, it also provides value for other land management disciplines. LF data products provide an informational foundation that supports many diverse applications, including land management planning, environmental analyses, biological evaluations, monitoring, and resource assessments. Moreover, LF data are being considered as a key information input to a range of Federal interagency carbon sequestration and climate research initiatives. LF products are used in the land and resource management domains for setting strategic direction, supporting resource and staffing determinations, designing conservation management activities, and assessing risks to the environment and communities.

1.2 LANDFIRE Versions

In an effort to address user feedback and leadership direction, the LF team started from the base collection of data products developed during the LF National Project (circa 2001) to provide an updated collection of LF products. As such, different versions of LF data products were developed, requiring the creation of a data versioning specification. The data versioning table, available on the LF website (http://www.landfire.gov/version_comparison.php), assists users in understanding the differences among the various versions of LF data available on the LF Data Distribution Site (DDS). When LF data products are updated in the future, most of the versions currently available will be removed from the DDS and archived. Previous versions will be made available upon request. At any given point in time, there will be at most three versions of the data products available from the DDS. These will remain available for download on the DDS until the next product update has been completed.

1.2.1 LANDFIRE National (LF_1.0.0) circa 2001

LF National (LF_1.0.0) constitutes the first complete LF mapping of all geospatial data products for the Nation. LF National was a five-year project that incorporated Landsat imagery from 1999 through 2003 (circa 2001) and delivered data on vegetation characteristics and condition, fire behavior and effects, fuel models, historical fire regimes, and fire regime conditions class for the United States in 2009. In this report, we refer to this data set simply as “LANDFIRE National” or “LF National.” The final deliverables for LF National included all of the layers required to run fire behavior models, such as the Fire Area Simulator (FARSITE; Finney, 2004). Methods used were consistent and repeatable across all ownerships nationwide. The consistent and comprehensive nature of LF National methods ensured that data were nationally relevant, while the 30-meter grid resolution assured that data had local application. A modified suite of the LF National data products was delivered for Alaska and Hawaii.

1.2.2 LANDFIRE 2001 (LF_1.0.5) and 2008 (LF_1.1.0) Refresh

The LF 2001/2008 Refresh represents the initial effort to enhance and update LF layers to maintain the currency of the data sets across all 50 States. These versions were produced in tandem, starting in fall 2009 with the LF 2001 Refresh (LF_1.0.5), and finishing in calendar year 2011 with the LF 2008 Refresh (LF_1.1.0). LF 2001/2008 enhancements and updates were developed to facilitate comparative analyses, evaluate trends, and potentially monitor changes over time. In this report, we use the following simplified terminology.

When the enhancement and update segments are referred to individually, we use:

- (enhancements) “LANDFIRE 2001” or “LF 2001” for LANDFIRE 2001 Refresh (LF_1.0.5)
- (updates) “LANDFIRE 2008” or “LF 2008” for LANDFIRE 2008 Refresh (LF_1.1.0)

When we refer to both of these segments together in a generic fashion, we use:

- “LANDFIRE 2001 and 2008” or “LANDFIRE 2001/2008”
- “LF 2001 and LF 2008” or “LF 2001/2008”

The LF 2001 version was implemented to enhance the LF National data set and provide a foundation upon which to build the updated geospatial data set.

The LF 2008 version was implemented to update the LF National data set to reflect changes from recent (1999-2008) natural disturbances (such as wildland fires) and management activities using Landsat imagery.

1.3 LANDFIRE 2001/2008

The LF 2001 and LF 2008 components of the LF Program sustain and extend the investment value of the original LF National data products with enhancements and updates to the LF spatial data suite. LF 2001 addressed vegetation discrepancies and areas of concern detected after the initial mapping effort. Problems with LF National products identified by users included discrepancies in vegetated versus non-vegetated lands, vegetation/land use categories, vegetation structure, and water/riparian attribution. Enhancements to address these discrepancies were requested by stakeholders that use LF data. The map layers were enhanced in LF 2001 by leveraging additional data sources, such as Soil Survey Geographic (SSURGO) data.

LF 2008 focused on updates to the suite of LF data products to reflect 2008 conditions. This focus was on updating landscape-level vegetation changes, such as those resulting from wildland fire, fuel and vegetation / silvicultural treatments, mortality from insects and disease, storm damage, invasive plants, and other natural or anthropogenic events where relevant data were available that occurred in the years from 1999 - 2008. To create LF 2008 products, Landsat imagery was used to detect vegetation change and landscape disturbance. A collection of recent natural disturbance and land management activities was compiled and stored in a spatial database. These products were combined along with other data sets to update existing vegetation and fuel layers. These updated vegetation and fuel layers were then used to update other LF data products. LF 2008 did not use new imagery to remap the entire landscape only to identify vegetation change or disturbance. To update products, LF 2001/2008 leveraged information and comments received through various sources, such as the LF help desk (http://www.landfire.gov/contactus.php), after action reviews, fuel calibration workshops, and lessons learned examples. LF 2001/2008 products have been used as inputs to strategic wildland fire management decision support systems and are expected to improve the relevance and reliability of the outcomes generated by these systems.

Nine geographic areas (GeoAreas; Figure 1) were defined to include all of the original mapping zones used from the National Land Cover Database (NLCD; based loosely on Omernik, 1987) for use in the LF National effort. The application of mapping zones as a pre-classification stratification method has been used in many mapping approaches (Homer et al. 1997; Homer et al. 2004). Research has shown that carefully defined mapping zones maximize spectral differentiation, provide a means to facilitate partitioning the workload into logical units, simplify post-classification modeling and improve classification accuracy (Homer et al. 2004). The GeoAreas were not intended to represent standardized analysis units or reporting extents. The primary purpose of the GeoAreas and mapping zones was to define ecologically relevant divisions for data acquisition and production planning.

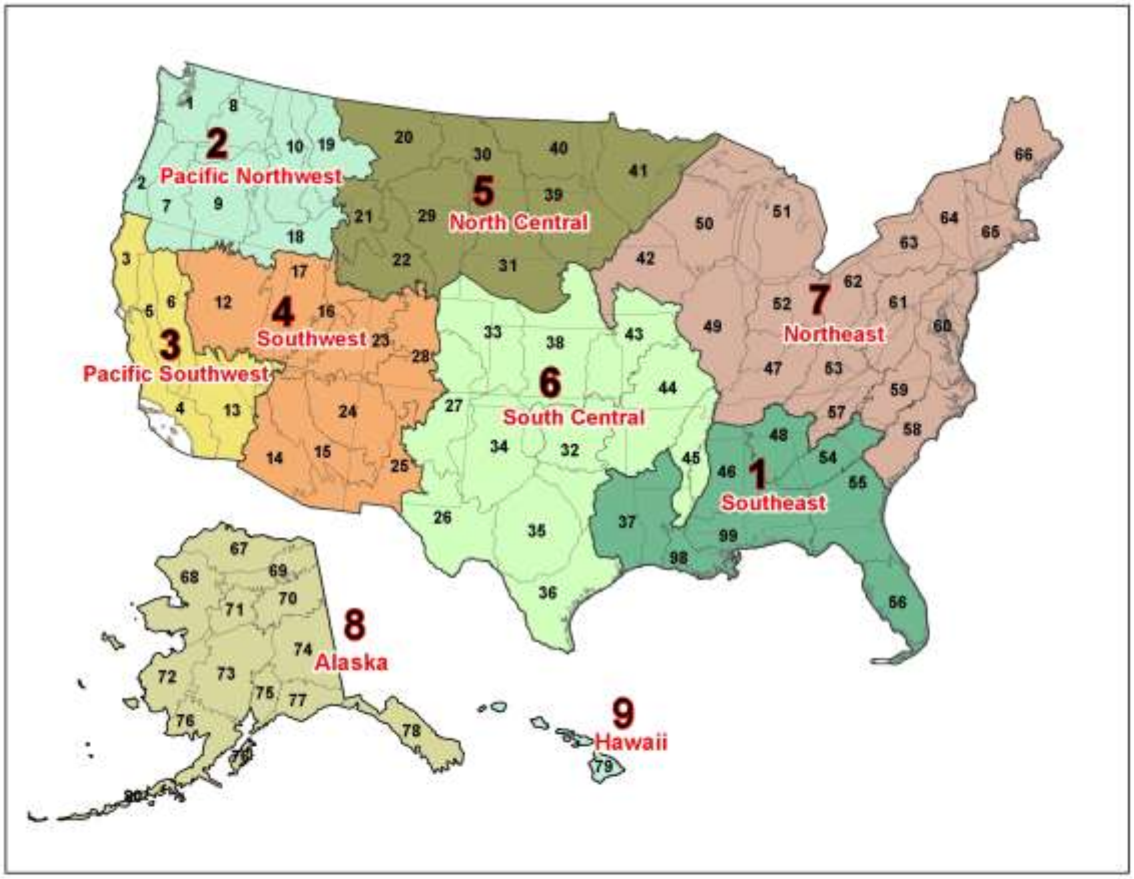

Figure 1 – Map of LF 2001/2008 GeoAreas according to the schedule. This image shows the nine GeoArea boundaries, which are composed of National Land Cover Database 2001 mapping zones (numbered units); state boundaries are included for reference. GeoArea numbers and corresponding colors relate to the schedule in Table 1 below.

1.4 LANDFIRE 2001/2008 Statement of Work and Work Breakdown Structure

LF 2001/2008 used conventional best practices in project and program management to address the organizational structure, scheduling, and implementation procedures. The effort was faced with uncertainties common to many initiatives in the public and private sectors with regard to funding availability for elements within and outside of the scope of the program, contract acquisition, and prioritization of requirements that would shape the final suite of deliverables.

A statement of work (SOW) approach was used to define the scope of LF 2001/2008 and the data products to be delivered. In essence, the SOW included the development of comprehensive documentation describing the general methodological approach required to develop the suite of LF 2001/2008 intermediate and final products (deliverables). The SOW also included guidelines for quality assurance and quality control procedures, program management and program performance standards, estimates of overall duration, and an independent estimate of cost to the government for the defined scope of work.

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A primary element of the SOW was a structured index and definition of work segments and deliverable-scheduled milestones. This structure is referred to as a Work Breakdown Structure (WBS) – also a standard best practice in program planning and management – and is used for effective organization and management of work activities. The SOW document and WBS organization drew upon lessons learned and program management artifacts developed during the completion of the LF National project and the LF 2007 Rapid Refresh project. A summary display of the actual project results in terms of scheduled initiation and completion of project milestones is provided in Figure 2 below. A description of the project milestones (such as GeoAreas and Group A and Group B product segments as outlined in Table 2) is provided in detail in section 1.5 of this report.

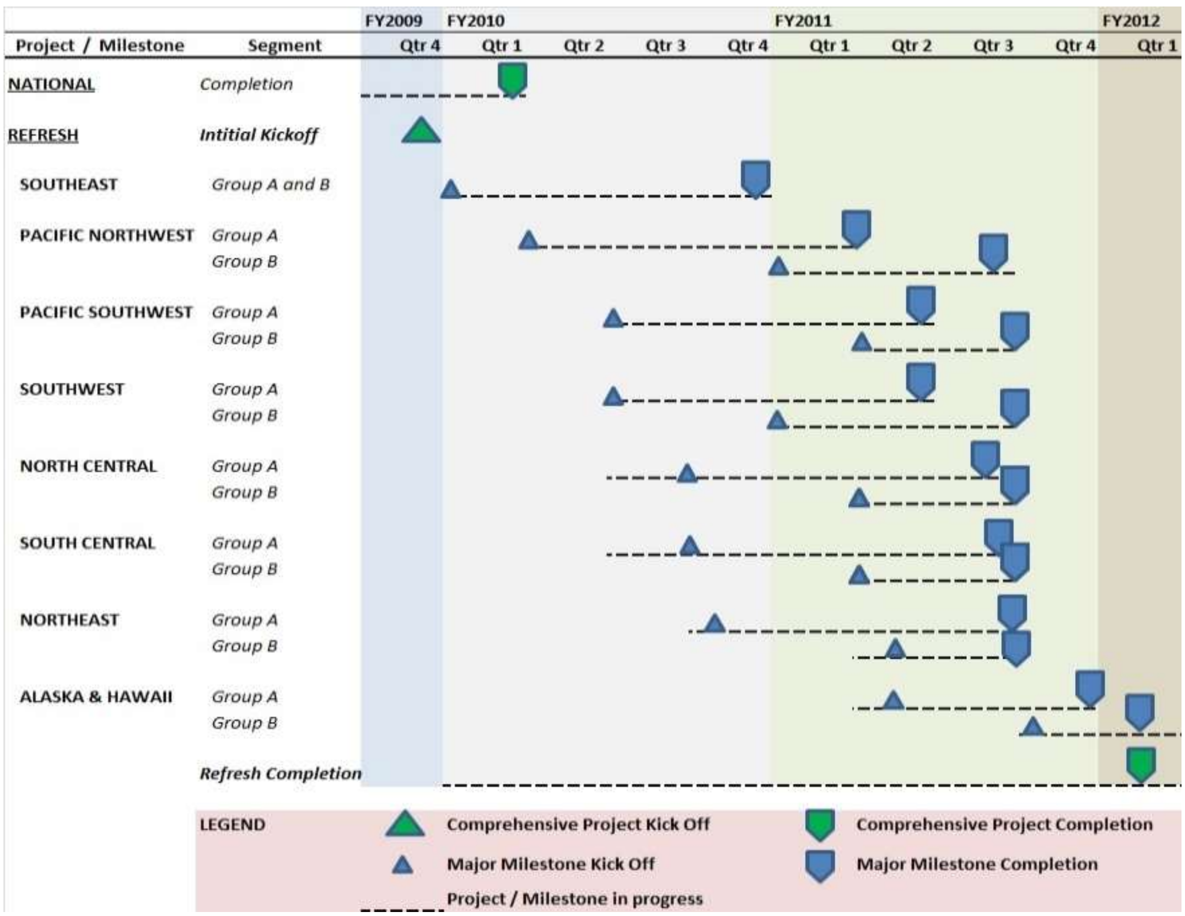

Figure 2 – LF 2001/2008 Gantt chart. This is a summary display of the actual results of the start and finish dates of the milestones and segments [such as GeoArea and Group A and Group B products]. These milestones and segments compose the WBS discussed in Section 1.4.

The LF 2001/2008 effort was challenged by external factors such as mandatory work stoppages related to contractual reviews at the USFS and access to a range of qualified vendors through contract vehicles at both DOI component agencies and the USFS. Moreover, evolving management requirements resulted in longer periods of time required to complete processes for conducting full and open competitive bidding and finalizing vendor selection and formal work kickoff. Nonetheless, the use of comprehensive SOW documentation and WBS organization permitted the LF Program to segment certain elements of development work and allocate these elements to vendor organizations that were best qualified and able to complete the LF 2001/2008 work at an optimal combination of cost, quality, and schedule performance.

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At the inception of the LF 2001/2008 effort, there was a tight interdependency in scheduling between LF 2001/2008 and the Monitoring Trends in Burn Severity (MTBS) project. As noted in detail throughout this GeoArea report, LF 2001/2008 used data such as the MTBS mapping products to characterize the landscape changes reflected in LF 2001/2008 data layers. Thus, the structure of LF 2001/2008 production activities as well as product releases were linked to the organization of the original MTBS production schedule, which was segmented by geographic regions across the conterminous United States (CONUS).

1.5 LANDFIRE 2001/2008 Spatial Products

LF 2001/2008 was originally estimated to span 24 months and involve over 500 unique tasks to deliver updated LF data layers. The update was highly dependent upon field data in the form of landscape change polygons and other information regarding landscape conditions. LF partitioned the delivery of the updated LF 2001/2008 products into two segments, "Group A" and "Group B," to facilitate management direction and the fulfillment of user needs. The staggered release of products by GeoArea (Table 1) and grouping of data products (Table 2) was determined to be the most practical approach with respect to scope limitations, cost considerations, and contractual circumstances.

Table 1 – LF 2001/2008 product delivery schedule listing the nine GeoAreas as represented above in Figure 1 and delineating delivery of "Group A" and Group "B" data sets.

Table 1 LF 2001/2008 Schedule		
Geographic Area	**Group A**	**Group B**
Southeast	4th Qtr. 2010	4th Qtr. 2010
Pacific Northwest	1st Qtr. 2011	3rd Qtr. 2011
Pacific Southwest	2nd Qtr. 2011	3rd Qtr. 2011
Southwest	2nd Qtr. 2011	3rd Qtr. 2011
North Central	2nd Qtr. 2011	3rd Qtr. 2011
South Central	3rd Qtr. 2011	3rd Qtr. 2011
Northeast	3rd Qtr. 2011	3rd Qtr. 2011
Alaska	3rd Qtr. 2011	4th Qtr. 2011
Hawaii	3rd Qtr. 2011	4th Qtr. 2011

Table 2 - LF 2001/2008 list of data products and how they were grouped (Group A and Group B) to facilitate management direction and user needs.

Table 2. LF 2001/2008 Products and Groupings	
Group A	**Group B**
Fire Behavior Fuel Model 13 (FBFM13) Fire Behavior Fuel Model 40 (FBFM 40) Canadian Forest Fire Danger Rating System (CFFDRS) (Alaska Only) Forest Canopy Bulk Density (CBD) Forest Canopy Base Height (CBH) Forest Canopy Cover (CC) Forest Canopy Height (CH) Fuel Characteristic Classification System Fuelbeds (FCCS) Existing Vegetation Type (EVT) Existing Vegetation Cover (EVC) Existing Vegetation Height (EVH)	Biophysical Settings (BpS) Vegetation Condition Class (VCC) Vegetation Departure Index (VDEP) Fire Regime Groups (FRG) Mean Fire Return Interval (MFRI) Percent Low Severity Fire (PLS) Percent Mixed Severity Fire (PMS) Percent Replacement Severity Fire (PRS) Fuel Loading Models (FLM) Succession Classes (SCLASS)

2.0 LANDFIRE 2001 and 2008 Methods and Results

2.1 Geographic Area Description

The Alaska (AK) GeoArea consists of 12 mapping zones encompassing the entire State of Alaska, approximately 375 million acres.

Within a given GeoArea, land ownership is important because the condition of the landscape, including disturbances, may be a direct result of ownership mission and management activities. A summary of land ownership segmentation across the AK GeoArea is provided in Table 3 and in Figure 3.

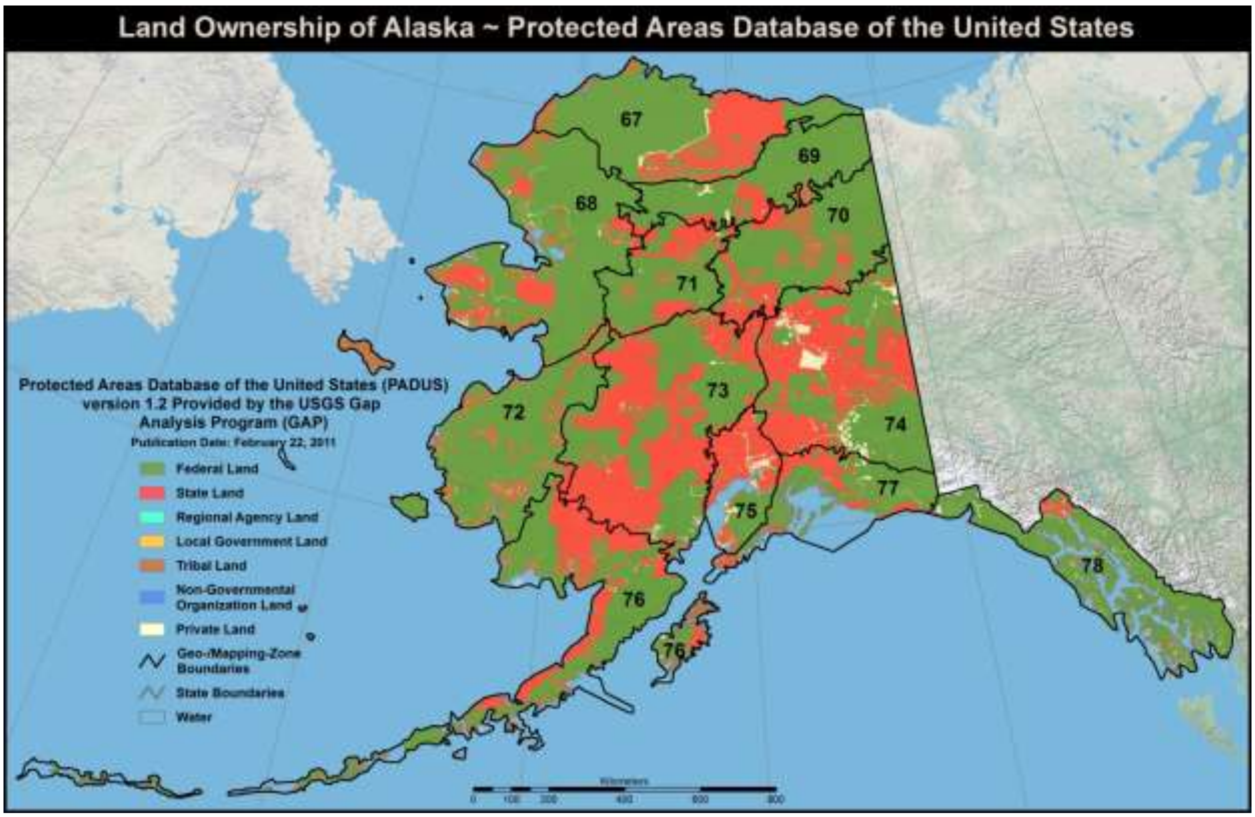


Figure 3 – Land ownership categories for the AK GeoArea.

Table 3 – Categories of land ownership, number of acres, and percentages of total GeoArea by category for the LF AK GeoArea.

Table 3. Acreage of Land Ownership Categories for the AK GeoArea.		
Land Ownership	**Acres**	**Percent of**
Federal Government	240,877,772	64.3
Jointly Owned	340,037	0.1
Tribal	37,182,086	9.9
Private	2,786,059	0.7
State	93,408,053	24.9
Total	374,594,007	100.00

2.2 LANDFIRE Reference Database

2.2.1 Product Description

LF 2008 mapping was supported by a large database of field-referenced data. The LANDFIRE Reference Database (LFRDB) includes vegetation and fuel data from over 800,000 geo-referenced sampling units located throughout the United States. These data were amassed from numerous sources, and, in large part, from existing information resources of outside entities, such as the USFS FIA Program, the USGS National Gap Analysis Program (GAP), and state natural heritage programs. Vegetation data drawn from these sources and used by LF include natural community occurrence records, estimates of canopy cover and height per plant taxon, and measurements (such as diameter, height, crown ratio, crown class, and density) of individual trees. Fuel data included biomass estimates of Downed Woody Material (DWM), percent cover and height of shrub and herb layers, and canopy base height estimates. Digital photos of the sampled units, when available, were archived.

A subset of the full suite of field-sampled data used in the production of LF deliverables is available for public access, as stipulated in the 2004 LF Executive Charter. In accordance with agreements between LF and its data contributors, certain proprietary or otherwise sensitive data were removed to create this publically available version of the LFRDB. There are over 275,000 sampling units from 260 different sources located throughout the United States available for public use.

2.2.2 LANDFIRE Reference Database Update Process

The following is a summary of key steps the LF production team conducted to complete the LFRDB component of LF 2001/2008. These methods were subject to revision and update upon the completion of all LF 2001/2008 GeoArea processing.

- acquired geo-referenced, field-sampled vegetation and fuel data from existing national and local programs - this work required extensive communication with representatives of governmental and non-governmental entities throughout the U.S. and work with FIA staff to draw all relevant data
- maintained a catalog and archive of all acquired data and metadata in their original formats using the existing LF data-catalog template and file structure
- assessed and prepared acquired data for LF processing - this work required thorough inventorying of acquired geospatial data (in tabular format or as shapefiles, coverages, geodatabases, etc.) with regard to distribution and information content and removal of records with irreconcilable geospatial or information errors/omissions
- converted relevant/viable data into LF format such that they conformed to standards defined in the data dictionaries for the AutoKey Database to accurately assign Existing Vegetation Type (EVT) to plots that have species composition (species and cover) attributes and LFRDB - this required using intermediate to advanced techniques for relational database management, manipulation and management of point and vector geospatial data, and regular documentation of data-conversion processes and quality-control measures
- acquired and incorporated into the LFRDB all ancillary spatial data needed for LF production (such as data extracted from LF base and product layers) - this required support from FIA staff and representatives of other entities that provide data with plot locations that must remain confidential

- derived and incorporated into the LFRDB any attributes necessary for LF production but not acquired as part of the original data sets - this included the derivation of canopy cover and height estimates from FIA tree records, fuel loading estimates from DWM records, un-compacted crown ratios from compacted crown ratios, vegetation map-unit assignments from the Ecological Systems AutoKey, canopy fuel attributes from FuelCalc (Reinhardt, 2006) (a tool to compute surface and canopy fuel loads and characteristics from inventory data), and various attributes from the Forest Vegetation Simulator (FVS; Dixon 2002) and its Fire and Fuels Extension (FFE; Reinhardt and Crookston 2003).
- checked for information and spatial errors as detailed in the LFRDB Quality Assurance (QA) checklist, and, once removed or appropriately identified, distributed the inaugural LFRDB for LF production
- maintained and updated the LFRDB after the inaugural posting by archiving relevant LF production information, including results of Quality Assurance / Quality Control (QA/QC) on LFRDB records performed by mapping teams and additional data as requested/permitted by LF mapping teams and leadership

2.2.3 LANDFIRE Reference Database Update Results

Final deliverables for the AK GeoArea consisted of a catalog (spreadsheet) and archive (file system) of all acquired data, an AutoKey Database (Microsoft Access© database), which was developed to quickly and accurately assign EVT to plots that have species composition (species and cover) attributes for the AK GeoArea, a LFRDB (Microsoft Access© database) for the AK GeoArea, and documentation of data conversion processes and QC measures taken during the data-loading stages.

The final LFRDB product for the AK GeoArea resulted in a large number of sampling events derived from various data sources, including the following:

- 81,048 geo-referenced sampling events were contained within the AK LFRDB.
- 102 different sources of data were contributed by Federal, State, and private entities.
- 93% of data were submitted in response to the LF data call (http://www.landfire.gov/participate_refdata.php) 56 and 7% of data were acquired by LF personnel through direct data sharing agreements (USFS FIA), websites such as the NPS Data Store and Northwest and Alaska Fire Research Clearinghouse or agency database systems (USFS-Natural Resource Information System and Field Sampled Vegetation
- There were no Forest Inventory and Analysis (FIA) sampling events that were added to the LFRDB for LF 2001/2008.

A substantial amount of vegetation and fuel data were acquired and compiled from many different sources for LF National and LF 2001/2008. The LFRDB team was able to acquire nearly half of the data archived in the AK LFRDB from data sharing agreements, websites, and/or agency databases. Data contributions submitted in response to the data call comprised nearly 93% of the sampling events. Major data contributions can be accredited to the National Park Service, Natural Resources Conservation Service and USFS. Data compiled from multi-agency data sources accounted for over half the data that were archived in the Alaska LFRDB. Table 4 shows a breakdown of the data contribution profile for the AK LFRDB.

Table 4 – Data contribution profile for the AK LFRDB.

Table 4 AK LANDFIRE Reference Database Data Contributions		
Data Contribution Profile	**Samples**	**Percent**
Multi Agency	43,721	53.9
NPS	12,656	15.6
NRCS	6,478	8.0
Non-Governmental Organizations/Private	5,754	7.1
BIA/Tribal	4,978	6.1
USFS	4,645	5.7
FWS	2,056	2.5
State	713	0.9
BLM	47	0.1
Total	81,048	100.0

For LF 2001/2008, the LFRDB team acquired and incorporated additional data into the existing LFRDB to facilitate the improvement and updating of several LF data products. Data provided by FIA contain a complete set of attributes necessary for updating LF products, so efforts were focused on converting and adding these data. During LF 2001/2008, several improvements were made to FIA data processing procedures, including updates to the way forest canopy cover and height metrics were derived and improvements to the LFRDB database schema that allowed for the archiving of repeat measures. There were 15,061 new FIA sampling events added to the AK LFRDB for LF 2001/2008. The AK LFRDB also contains a substantial amount of vegetation data, including information on community occurrence, species composition, vegetation structure, exotic plants, and fuel. Table 5 provides a summary of data types by percent distribution for the AK GeoArea. Community occurrence data include natural community or cover type classifications; species composition data include canopy cover estimates per plant taxon; vegetation structure data include height measurements per life form or plant taxon; exotic plant data include occurrence or cover estimates of exotic plants; and fuel data include composition and characteristics of surface and/or canopy fuel.

Table 5– Percent distribution of data types for AK LFRDB.

Table 5. AK LANDFIRE Reference Database Plot Summary		
Data Type	**Samples**	**Percent***
Community Occurrence Records	43,520	53.7
Species Composition	37,528	46.3
Vegetation Structure	19,499	24.1
Exotics	-	-
Fuels	2,834	3.5

**Percent occurrence of the listed data types within the LFRDB. The percentages do not total to 100% because a plot may have more than one data type. For example, a plot may have both species composition and fuel data whereas another plot may only have community occurrence records.*

2.3 Biophysical Settings

2.3.1 Product Description

The Biophysical Settings (BpS) layer represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the biophysical environment and an approximation of the historical disturbance regime. BpS is a refinement of the Environmental Site Potential (ESP), it includes disturbance. In this update, we attempted to incorporate current scientific knowledge regarding the functioning of ecological processes – such as fire – in the centuries preceding non-indigenous human influence. Map units were based on NatureServe's (NS) Ecological Systems classification; a nationally consistent set of mid-scale ecological units (Comer et al. 2003).

LF used these classification units to describe BpS, which differed from their intended use as units of existing vegetation. As used in LF, map unit names represent the natural plant communities that may have been present during the reference period. Each BpS map unit was matched with a model of vegetation succession defined during LANDFIRE National. The LF BpS concept is similar to the concept of potential natural vegetation groups used in mapping and modeling efforts related to Fire Regime Condition Class (FRCC; Schmidt et al. 2002; www.frcc.gov).

2.3.2 Biophysical Settings Layer Enhancements

One objective for LF 2001/2008 was to simplify the BpS map layer by reclassifying similar ecological systems into BpS Groups. New names were assigned to better reflect the floristic make-up of the grouped systems and to include the appropriate fire regime (I thru V), and a vegetation model was chosen that best represented the grouped systems (Barrett et al. 2010).

This task included a review of all BpS model descriptions and the Model Tracker Database (MTDB) for each mapping zone. MTDB is an Access database application developed by TNC specifically for the LF Program. MTDB contains a very detailed description of every Ecological System mapped by LF, including physiographic characteristics, biological characteristics, and disturbance regime of each system and the individual succession classes within that system, as defined by local experts. In addition, all review comments are contained within MTDB to allow readers to understand the evolution of the models through the development and review processes. LF team members assessed all model transition states, reference conditions, fire-regime groups, and ancillary information to determine similarities between BpS. At the end of this process a grouping strategy was proposed and implemented. The final step was the development of a lookup table relating LF National BpS map units and LF 2001/2008 Grouped BpS map units. Redundant and/or similar BpS models were collapsed into one group, and the original LF National BpS codes have corresponding LF 2001/2008 grouped BpS codes.

2.3.3 Fire Regime Products

Five layers [Mean Return Interval (MFRI), Percent of Low Severity (PLS) fire, Percent of Mixed Severity (PMS) fire, Percent Replacement Severity (PRS) fire, and Fire Regime Groups (FRG)] characterizing modeled historical fire regimes were produced based on the BpS and linkage with the Refresh Model Tracker (RMT). This linkage provides the probability of replacement, mixed, and surface fires. MFRI was calculated as the reciprocal of the sum of these probabilities (which is the probability of fire of any severity), grouped into classes and then combined with the non-vegetated types from the Succession Classes (SCLASS) layer. The PLS, PMS, and PRS layers were calculated respectively as the ratio of the probability of surface, mixed, and replacement fires to the probability of any fire. The FRG was based on a combination of the MFRI and average fire severity from the FRCC Guidebook (FRCC, 2010), as displayed in Table 6 and Table 7 showing the comparisons between LF National and LF 2001. The FRG's for Alaska are depicted in a map graphic in Figure 4.

Table 6– The Fire Regime Groups by frequency and PRS for vegetation types within each regime as described in the FRCC Guidebook.

Table 6. Fire Regime Groups, Frequency, and Severity

Fire Regime Group Name	Frequency (years)	Severity Percent
FRG I	0-35	PRS < 75
FRG II	0-35	PRS >= 75
FRG III	35-200	PRS < 75
FRG IV	35-200	PRS >= 75
FRG V	200+	all

Figure 4 – Map of the AK GeoArea depicting LF Fire Regime Groups in the absence of modern human intervention with possible aboriginal fire use.

Table 7 – Comparison of acreage mapped and percent change by Fire Regime Groups in LF National and LF 2001 versions of LF data.

Table 7. Fire Regime Group Comparison			
Fire Regime Group Name	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
FRG I	1,425		-100.0
FRG II	18,141,540	17,866,259	-1.5
FRG III	102,925,990	94,011,029	-8.7
FRG IV	74,183,970	81,764,561	10.2
Water	43,303,415	43,027,808	-0.6
Snow / Ice	18,088,424	18,084,283	0.0
Barren	33,969,954	30,013,317	-11.7
Sparsely Vegetated	1,124,969	4,300,436	282.3
Indeterminate Fire Regime Characteristics	110,520,084	113,192,078	2.4

2.4 Disturbance Mapping

2.4.1 Product Description

LF disturbance data were developed to provide temporal and spatial information related to landscape change for determining vegetation transitions over time and making subsequent updates to LF vegetation, fuel, and other data. Disturbance data include attributes associated with disturbance year, type, and severity.

2.4.2 Disturbance Mapping Objectives

Changes in the landscape are pervasive and occur continually. For LF data to remain current, a process was needed to integrate spatial temporal landscape changes into the suite of LF products. The objective of this process was to map the location, extent, type, and severity of major disturbances for the entire United States. To achieve this objective, data sets needed to be integrated into one product. Not all types of data were available in all areas. The disturbance mapping process was performed at the LF mapping zone scale.

2.4.3 Disturbance Mapping Process

Disturbance mapping in Alaska was limited to combining MTBS and locally-contributed fire perimeter polygons. Burn severity was determined from MTBS or from local knowledge of the individual fires (Eidenshink et al, 2007). Time since disturbance was categorized into three time steps:

- 1 year post disturbance
- 2-5 years post disturbance
- 6-10 years post disturbance

Three attributes, including disturbance type, severity, and time since disturbance, were combined to create the vegetation disturbance (VDist2008) and fuel disturbance (FDist2008) layers. Additionally, exotic herbaceous height estimates were included in the FDist2008 layer to facilitate surface fuel model assignments where exotic grasses were present and substantially affected surface fire behavior.

2.4.4 Disturbance Mapping Results

Disturbance categories were mapped and tabulated for the entire AK GeoArea (Table 8). Across all lands, 6 percent of the GeoArea was mapped as disturbed from 1999 to 2008. On Federal lands, 5 percent of the GeoArea was mapped as disturbed. The disturbances for Alaska are depicted in a map graphic in Figure 5. Table 9 through Table 13 provide a detailed listing of mapped disturbance by type on all lands and Federal lands.

Table 8 –Total mapped disturbances area and percent by land ownership category for the AK GeoArea.

Table 8. Disturbance Acreage by Land Ownership			
Land Ownership	**Category**	**Acres**	**Percent Ownership**
All Lands	No Disturbance	350,979,290	94
All Lands	All Disturbances	23,614,716	6
Federal Lands	No Disturbance	156,235,152	95
Federal Lands	All Disturbances	16,737,216	5

Figure 5 – Map of vegetation disturbance types (fire, mechanical, etc.) mapped for the AK GeoArea from 1999 to 2008.

Table 9 – Number of acres mapped as affected by fire disturbance for severity classes of low, moderate, and high with the period of years since disturbance between All Lands and Federal Land ownership for the AK GeoArea.

Table 9. Area Affected by Fire Disturbance				
Land Ownership	**Category**	**Severity**	**Time Since Disturbance**	**Acres**
All Lands	Fire	Low	One Year	520,756
All Lands	Fire	Low	Two to Five Years	4,938,388
All Lands	Fire	Low	Six to Ten Years	5,690,095
All Lands	Fire	Moderate	One Year	146,173
All Lands	Fire	Moderate	Two to Five Years	1,813,920
All Lands	Fire	Moderate	Six to Ten Years	1,536,782
All Lands	Fire	High	One Year	64,113
All Lands	Fire	High	Two to Five Years	1,081,835
All Lands	Fire	High	Six to Ten Years	1,024,026
Federal Lands	Fire	Low	One Year	335,161
Federal Lands	Fire	Low	Two to Five Years	3,940,372
Federal Lands	Fire	Low	Six to Ten Years	4,497,048
Federal Lands	Fire	Moderate	One Year	86,391
Federal Lands	Fire	Moderate	Two to Five Years	1,420,922
Federal Lands	Fire	Moderate	Six to Ten Years	1,219,521
Federal Lands	Fire	High	One Year	52,161
Federal Lands	Fire	High	Two to Five Years	924,889
Federal Lands	Fire	High	Six to Ten Years	896,367

Table 10 – Number of acres mapped as affected by the Mechanical Add disturbance by severity classes of low, moderate, and high with the period of years since disturbance between All Lands and Federal Land ownership for the AK GeoArea.

Table 10. Area Affected by Mechanical Add Disturbance				
Land Ownership	**Category**	**Severity**	**Time Since Disturbance**	**Acres**
All Lands	Mechanical Add	Low	One Year	65,673
All Lands	Mechanical Add	Low	Two to Five Years	426,818
All Lands	Mechanical Add	Low	Six to Ten Years	369,015
All Lands	Mechanical Add	Moderate	One Year	11,855
All Lands	Mechanical Add	Moderate	Two to Five Years	51,409
All Lands	Mechanical Add	Moderate	Six to Ten Years	42,487
All Lands	Mechanical Add	High	One Year	6,300
All Lands	Mechanical Add	High	Two to Five Years	25,716
All Lands	Mechanical Add	High	Six to Ten Years	22,138
Federal Lands	Mechanical Add	Low	One Year	54,184
Federal Lands	Mechanical Add	Low	Two to Five Years	369,275
Federal Lands	Mechanical Add	Low	Six to Ten Years	315,186
Federal Lands	Mechanical Add	Moderate	One Year	9,034
Federal Lands	Mechanical Add	Moderate	Two to Five Years	37,540
Federal Lands	Mechanical Add	Moderate	Six to Ten Years	26,443
Federal Lands	Mechanical Add	High	One Year	4,538
Federal Lands	Mechanical Add	High	Two to Five Years	14,830
Federal Lands	Mechanical Add	High	Six to Ten Years	6,309

Table 11 – Number of acres mapped as affected by the Mechanical Remove disturbance by severity of classes of low, moderate, and high with the period of years since disturbance between All Lands and Federal Land ownership for the AK GeoArea.

Table 11. Area Affected by Mechanical Remove Disturbance				
Land Ownership	**Category**	**Severity**	**Time Since Disturbance**	**Acres**
All Lands	Mechanical Remove	Low	One Year	219,078
All Lands	Mechanical Remove	Low	Two to Five Years	876,692
All Lands	Mechanical Remove	Low	Six to Ten Years	846,468
All Lands	Mechanical Remove	Moderate	One Year	123,187
All Lands	Mechanical Remove	Moderate	Two to Five Years	456,618
All Lands	Mechanical Remove	Moderate	Six to Ten Years	504,236
All Lands	Mechanical Remove	High	One Year	100,247
All Lands	Mechanical Remove	High	Two to Five Years	448,789
All Lands	Mechanical Remove	High	Six to Ten Years	499,690
Federal Lands	Mechanical Remove	Low	One Year	60,964
Federal Lands	Mechanical Remove	Low	Two to Five Years	263,008
Federal Lands	Mechanical Remove	Low	Six to Ten Years	257,096
Federal Lands	Mechanical Remove	Moderate	One Year	29,369
Federal Lands	Mechanical Remove	Moderate	Two to Five Years	106,698
Federal Lands	Mechanical Remove	Moderate	Six to Ten Years	111,308
Federal Lands	Mechanical Remove	High	One Year	17,361
Federal Lands	Mechanical Remove	High	Two to Five Years	57,676
Federal Lands	Mechanical Remove	High	Six to Ten Years	60,205

Table 12 – Number of acres mapped as affected by Windthrow and Insects and Disease disturbance by severity classes of low, moderate, and high with the period of years since disturbance between All Lands and Federal Land ownership for the AK GeoArea.

Table 12. Area Affected by Windthrow and Insect/Disease Disturbances				
Land Ownership	**Category**	**Severity**	**Time Since Disturbance**	**Acres**
All Lands	Insects-Disease	Low	One Year	344,940
All Lands	Insects-Disease	Low	Two to Five Years	460,633
All Lands	Insects-Disease	Low	Six to Ten Years	225,209
All Lands	Insects-Disease	Moderate	Two to Five Years	155
All Lands	Insects-Disease	High	Two to Five Years	31
Federal Lands	Insects-Disease	Low	One Year	344,044
Federal Lands	Insects-Disease	Low	Two to Five Years	457,823
Federal Lands	Insects-Disease	Low	Six to Ten Years	220,517
Federal Lands	Insects-Disease	Moderate	Two to Five Years	154
Federal Lands	Insects-Disease	High	Two to Five Years	31

Table 13 – Number of acres mapped as affected by Chemical, Biological, and Development disturbances by severity classes of low, moderate, and high with the period of years since disturbance between All Lands and Federal Land ownership for the AK GeoArea.

Table 13. Area Affected by Chemical, Biological, or Development Disturbances				
Land Ownership	**Category**	**Severity**	**Time Since Disturbance**	**Acres**
All Lands	Chemical	Low	One Year	36,884
All Lands	Development	Low	One Year	37
All Lands	Chemical	Low	Two to Five Years	532,175
All Lands	Development	Low	Two to Five Years	339
All Lands	Chemical	Low	Six to Ten Years	96,636
All Lands	Development	Low	Six to Ten Years	85
All Lands	Development	Moderate	One Year	18
All Lands	Development	Moderate	Two to Five Years	78
All Lands	Development	Moderate	Six to Ten Years	38
All Lands	Development	High	One Year	2
All Lands	Development	High	Two to Five Years	50
All Lands	Development	High	Six to Ten Years	12
Federal Lands	Chemical	Low	One Year	34,851
Federal Lands	Development	Low	One Year	37
Federal Lands	Chemical	Low	Two to Five Years	407,695
Federal Lands	Development	Low	Two to Five Years	332
Federal Lands	Chemical	Low	Six to Ten Years	93,947
Federal Lands	Development	Low	Six to Ten Years	85
Federal Lands	Development	Moderate	One Year	18
Federal Lands	Development	Moderate	Two to Five Years	75
Federal Lands	Development	Moderate	Six to Ten Years	38
Federal Lands	Development	High	One Year	2
Federal Lands	Development	High	Two to Five Years	46
Federal Lands	Development	High	Six to Ten Years	12

2.5 Existing Vegetation

2.5.1 Product Description

The existing vegetation layers for each LF mapping zone include: EVT, Existing Vegetation Cover (EVC), and Existing Vegetation Height (EVH). All three layers were originally mapped using predictive landscape models based on extensive field-referenced data, satellite imagery, and classification and regression trees. Various parts of these existing vegetation layers were edited and refined as part of LF 2001/2008. The EVT layer represents the current dominant vegetation using map units derived from NS's Ecological Systems vegetation classification. The EVC layer represents the average percent cover of existing vegetation for a 30 meter grid cell. The EVH layer represents the average height of the dominant/co-dominant vegetation for a 30 meter grid cell.

2.5.2 LF 2001: Enhancements to Existing Vegetation Products

To improve their representation, the existing vegetation type and structure products were modified based on local expert opinion. In Table 14 through Table 26 of this report, comparisons are made between the LF 2001 and LF National data product and the LF 2001 and the LF 2008 updated products.

The EVT's are grouped by National Vegetation Classification Standard (NVCS) Subclass to assist with interpretation. It is important to note that in the majority of cases, the percent changes between the National and LF 2001 / 2008 are a result of classification and product differences and not actual changes on the ground.

2.5.2a Enhancements to Existing Vegetation Type

There were several issues with the LF National EVT. First, was the existence of swamp and marsh EVT's and water in areas that were not logical, barren and sparse EVT's were over mapped, and the EVT consisted of too many classes to accurately represent the vegetation types.

A number of logical inconsistencies in land cover types and systematic improvements were made to the LF National EVT layer. First, natural land cover classes were reclassified to anthropogenic land cover classes based on the NLCD2001 land cover product. Where NLCD2001 was classified as an anthropogenic land cover and LF layers were classed as natural land cover class, LF data were updated with the NLCD2001.

In the LF National EVT, swamp and marsh EVT's existed in areas that were not logical. In order to address this issue, pixels that were mapped to swamp and marsh EVT's that existed in areas with a slope greater than 10 degrees and had an elevation 3 m greater than adjacent valley bottoms were removed using a nearest neighbor nibble of the combined EVT/EVC/EVH.

Also in LF National EVT, water was mapped in areas that were not logical. A process similar to identifying swamp and marsh pixels was used to identify water pixels. Water pixels that existed in areas with a slope greater than 10 degrees and had an elevation 3 m greater than adjacent valley bottoms were removed using a nearest neighbor nibble of the combined EVT/EVC/EVH.

The EVT for LF National also required improved mapping of barren and sparse EVT's. Barren was over mapped in LF National. To address this issue, summer season composites of Web-enabled Landsat data (WELD) (Roy et al. 2010) imagery was utilized to create Normalized Difference Vegetation Index and Normalized Difference Water Index (Gao, 1996) was created and used in conjunction with NLCD2001 to refine assignment of barren and sparse EVT's.

In another revision to the LF 2001/ LF 2008 data sets, the EVT legend was simplified. The original EVT legend development effort in Alaska for LF National yielded approximately 140 EVT's, many of which described a wide mix of sparsely vegetated and riparian-wetland conditions. Unlike the EVT development process for LF National in CONUS, which aggregated these type of EVT's into broader, more map-able types, the EVT legend for Alaska retained these types resulting in a less accurate EVT map. As part of the LF Refresh Alaska EVT map refinements, an effort was made to aggregate these type of EVT's into classes more analagous to the CONUS EVT legend. Table 14 shows the aggregations created for this effort, along with the new EVT ID's and names, along with the original EVT ID's and names that were aggregated (Figure 6).

Table 14 –Detailed comparison of 73 LF National that we aggregated to 36 LF 2001 Existing Vegetation Types.

Table 14. Aggregated Existing Vegetation Types

LF 2001 EVT	LF 2001 EVT Name	LF National EVT	LF National EVT Name
2740	Boreal Aquatic Beds	2627	Western North American Boreal Freshwater Aquatic Bed
2741	Polar Tidal Marshes and Aquatic Beds	2696	Alaska Arctic Freshwater Aquatic Bed
2741	Polar Tidal Marshes and Aquatic Beds	2711	Alaska Arctic Tidal Marsh
2741	Polar Tidal Marshes and Aquatic Beds	2721	Aleutian Freshwater Aquatic Bed
2741	Polar Tidal Marshes and Aquatic Beds	2726	Aleutian Tidal Marsh
2742	Temperate Pacific Tidal Marshes, Aquatic Beds, and Intertidal Flats	2664	Temperate Pacific Freshwater Aquatic Bed
2742	Temperate Pacific Tidal Marshes, Aquatic Beds, and Intertidal Flats	2668	Temperate Pacific Tidal Salt and Brackish Marsh
2742	Temperate Pacific Tidal Marshes, Aquatic Beds, and Intertidal Flats	2669	Temperate Pacific Intertidal Flat
2743	Aleutian Herbaceous Wetlands	2722	Aleutian Freshwater Marsh
2743	Aleutian Herbaceous Wetlands	2729	Aleutian Floodplain Wetland
2744	Arctic Herbaceous Wetlands	2697	Alaska Arctic Pendant grass Freshwater Marsh
2744	Arctic Herbaceous Wetlands	2705	Alaska Arctic Sedge Freshwater Marsh
2744	Arctic Herbaceous Wetlands	2712	Alaska Arctic Coastal Brackish Meadow
2745	Boreal Herbaceous Wetlands	2618	Western North American Boreal Herbaceous Fen
2745	Boreal Herbaceous Wetlands	2625	Western North American Boreal Freshwater Emergent Marsh
2745	Boreal Herbaceous Wetlands	2626	Western North American Boreal Wet Meadow
2746	Pacific Maritime Herbaceous Wetlands	2661	Alaskan Pacific Maritime Fen and Wet Meadow
2746	Pacific Maritime Herbaceous Wetlands	2662	Temperate Pacific Freshwater Emergent Marsh
2746	Pacific Maritime Herbaceous Wetlands	2670	North Pacific Maritime Eelgrass Bed
2746	Pacific Maritime Herbaceous Wetlands	2673	Alaskan Pacific Maritime Alpine Wet Meadow
2747	Arctic Sedge Meadows	2698	Alaska Arctic Wet Sedge Meadow
2749	Pacific Maritime Coastal Meadows and Slough-Levee	2665	Alaskan Pacific Maritime Coastal Meadow and Slough-Levee
2751	Boreal Coniferous Woody Wetland	2621	Western North American Boreal Black Spruce Dwarf-Tree Peatland

Table 15 (cont.) –Detailed comparison of 73 LF National that we aggregated to 36 LF 2001 Existing Vegetation Types.

Table 14. Aggregated Existing Vegetation Types

LF 2001 EVT	LF 2001 EVT Name	LF National EVT	LF National EVT Name
2751	Boreal Coniferous Woody Wetland	2622	Western North American Boreal Black Spruce Wet-Mesic Slope Woodland
2752	Pacific Maritime Coniferous Woody Wetland	2681	Alaskan Pacific Maritime Poorly Drained Conifer Woodland
2753	Boreal Coniferous-Deciduous Woody Wetland	2623	Western North American Boreal Black Spruce-Tamarack Fen
2756	Arctic Dwarf Shrub Wetland	2701	Alaska Arctic Coastal Sedge-Dwarf-Shrubland
2757	Boreal Dwarf Shrub Wetland	2619	Western North American Boreal Sedge-Dwarf-Shrub Bog
2758	Pacific Maritime Dwarf Shrub Wetland	2660	Alaskan Pacific Maritime Wet Low Shrubland
2761	Aleutian Floodplains	2727	Aleutian Shrub and Herbaceous Meadow Floodplain
2761	Aleutian Floodplains	2728	Aleutian Floodplain Forest and Shrubland
2762	Arctic Floodplains	2714	Alaska Arctic Large River Floodplain
2762	Arctic Floodplains	2715	Alaska Arctic Floodplain
2763	Boreal Floodplains	2614	Western North American Boreal Montane Floodplain Forest and Shrubland
2763	Boreal Floodplains	2615	Western North American Boreal Lowland Large River Floodplain Forest and Shrubland
2763	Boreal Floodplains	2617	Western North American Boreal Shrub and Herbaceous Floodplain Wetland
2763	Boreal Floodplains	2637	Western North American Boreal Alpine Floodplain
2764	Pacific Maritime Floodplains	2655	Alaskan Pacific Maritime Floodplain Forest and Shrubland
2764	Pacific Maritime Floodplains	2656	Alaskan Pacific Maritime Shrub and Herbaceous Floodplain Wetland
2764	Pacific Maritime Floodplains	2676	Alaskan Pacific Maritime Alpine Floodplain
2771	Aleutian Peatlands	2647	Aleutian Shrub-Sedge Peatland
2771	Aleutian Peatlands	2723	Aleutian Wet Meadow and Herbaceous Peatland
2771	Aleutian Peatlands	2724	Aleutian Nonvascular Peatland
2772	Arctic Peatlands	2702	Alaska Arctic Wet Sedge-Sphagnum Peatland

Table 16 (cont.) –Detailed comparison of 73 LF National that we aggregated to 36 LF 2001 Existing Vegetation Types.

LF 2001 EVT	LF 2001 EVT Name	LF National EVT	LF National EVT Name
2772	Arctic Peatlands	2703	Alaska Arctic Dwarf-Shrub-Sphagnum Peatland
2773	Boreal Peatlands	2620	Western North American Boreal Low Shrub Peatland
2774	Pacific Maritime Peatlands	2657	Alaskan Pacific Maritime Shore Pine Peatland
2774	Pacific Maritime Peatlands	2658	Alaskan Pacific Maritime Dwarf-shrub-Sphagnum Peatland
2774	Pacific Maritime Peatlands	2659	Alaskan Pacific Maritime Mountain Hemlock Peatland
2776	Boreal Riparian Stringer Forest and Shrubland	2616	Western North American Boreal Riparian Stringer Forest and Shrubland
2777	Boreal Shrub Swamp	2624	Western North American Boreal Deciduous Shrub Swamp
2778	Pacific Maritime Shrub Swamp	2663	North Pacific Shrub Swamp
2781	Arctic Sedge-Tussock-Lichen Tundra	2695	Alaska Arctic Tussock-Lichen Tundra
2781	Arctic Sedge-Tussock-Lichen Tundra	2706	Alaska Arctic Polygonal Ground Wet Sedge Tundra
2781	Arctic Sedge-Tussock-Lichen Tundra	2707	Alaska Arctic Polygonal Ground Tussock Tundra
2782	Boreal Tussock Tundra	2629	Western North American Boreal Tussock Tundra
2783	Arctic Tussock Tundra	2694	Alaska Arctic Tussock Tundra
2784	Arctic Shrub-Tussock Tundra	2693	Alaska Arctic Shrub-Tussock Tundra
2784	Arctic Shrub-Tussock Tundra	2708	Alaska Arctic Polygonal Ground Shrub-Tussock Tundra
2785	Arctic Shrub Tundra	2700	Alaska Arctic Polygonal Ground Mesic Shrub Tundra
2785	Arctic Shrub Tundra	2704	Alaska Arctic Permafrost Plateau Dwarf-Shrub Lichen Tundra
2786	Boreal Shrub-Tussock Tundra	2628	Western North American Boreal Low Shrub-Tussock Tundra
2786	Boreal Shrub-Tussock Tundra	2630	Western North American Boreal Wet Black Spruce-Tussock Woodland
2791	Aleutian Sparsely Vegetated	2716	Aleutian Rocky Headland and Sea Cliff
2791	Aleutian Sparsely Vegetated	2732	Aleutian Volcanic Rock and Talus
2792	Arctic Sparsely Vegetated	2710	Alaska Arctic Tidal Flat
2792	Arctic Sparsely Vegetated	2713	Alaska Arctic Active Inland Dune
2792	Arctic Sparsely Vegetated	2717	Alaska Arctic Bedrock and Talus

Table 17 (cont.) –Detailed comparison of 73 LF National that we aggregated to 36 LF 2001 Existing Vegetation Types.

LF 2001 EVT	LF 2001 EVT Name	LF National EVT	LF National EVT Name
2793	Boreal Sparsely Vegetated	2613	Western North American Boreal Active Inland Dune
2793	Boreal Sparsely Vegetated	2632	Western North American Boreal Alpine Talus and Bedrock
2794	Pacific Maritime Sparsely Vegetated	2667	Alaskan Pacific Maritime Rocky Coastline
2794	Pacific Maritime Sparsely Vegetated	2733	North Pacific Montane Massive Bedrock, Cliff and Talus
2794	Pacific Maritime Sparsely Vegetated	2734	North Pacific Alpine and Subalpine Bedrock and Scree

Figure 6 – Map of Existing Vegetation Type layer that was enhanced as part of the LF 2001 updates by incorporating user feedback and additional data.

Table 18 – Acreage of LF agricultural Existing Vegetation Type Groups and percent change on All Land ownerships in the AK GeoArea between LF National and LF 2001.

Table 18. Agricultural Type Comparisons across All Lands			
Existing Vegetation Type Groups	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
Agriculture-Cultivated Crops and Irrigated Agriculture	53,519	71,441	33.5
Agriculture-Pasture and Hay*	3,491	11,635	233.3

** Denotes burnable vegetation type in LF 2001*

Table 19 – Acreage of LF agricultural Existing Vegetation Type Groups and percent change on Federal Land ownership in the AK GeoArea between LF National and LF 2001

Table 19. Agricultural Type Comparisons across Federal Lands			
Existing Vegetation Type Groups	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
Agriculture-Cultivated Crops and Irrigated Agriculture	101	848	739.6
Agriculture-Pasture and Hay*	4	352	8,700.0

** Denotes burnable vegetation type in LF 2001*

Table 20 – Acreage of LF urban (developed) Existing Vegetation Type Groups and percent change on All Lands in the AK GeoArea between LF National and LF 2001.

Table 20. Developed Lands Comparisons across All Lands			
Existing Vegetation Type Groups	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
Developed-High Intensity	11,216	11,239	0.2
Developed-Low Intensity	219,929	233,639	6.2
Developed-Medium Intensity	29,753	30,147	1.3
Developed-Open Space	85,181	85,585	0.5

Table 21 – Acreage of LF urban (developed) Existing Vegetation Type Groups and percent change on Federal Lands in the AK GeoArea between LF National and LF 2001.

Table 21. Developed Lands Comparisons across Federal Lands			
Existing Vegetation Type Groups	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
Developed-High Intensity	2,278	2,279	0.0
Developed-Low Intensity	34,209	34,807	1.8
Developed-Medium Intensity	2,970	2,980	0.3
Developed-Open Space	10,183	10,232	0.5

Table 22– Acreage of LF riparian and wetland Existing Vegetation Type Groups and percent change in the AK GeoArea between LF National and LF 2001.

Table 22. Riparian/Wetland Comparisons				
Land Ownership	**Existing Vegetation Type Groups**	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
All Lands	Freshwater Aquatic Bed	242,623	108,126	-55.4
All Lands	Freshwater Marsh	7,299,381	6,154,400	-15.7
All Lands	Riparian Stringer Forest and Shrubland	147,444	147,635	0.1
All Lands	Shrub and Herbaceous Floodplain Wetland	2,271,076	180,695	-92.0
All Lands	Shrub and Herbaceous Peatlands	14,759,423	14,806,117	0.3
All Lands	Tidal Flat	17,150	29,975	74.8
All Lands	Tidal Marsh	676,671	777,640	14.9
All Lands	Wet Meadow	13,943,578	15,107,210	8.4
Federal Lands	Freshwater Aquatic Bed	154,018	66,384	-56.9
Federal Lands	Freshwater Marsh	4,992,197	4,333,921	-13.2
Federal Lands	Riparian Stringer Forest and Shrubland	47,695	47,774	0.2
Federal Lands	Shrub and Herbaceous Floodplain Wetland	1,269,172	108,439	-91.5
Federal Lands	Shrub and Herbaceous Peatlands	9,099,999	9,118,835	0.2
Federal Lands	Tidal Flat	12,906	14,620	13.3
Federal Lands	Tidal Marsh	360,117	439,533	22.1
Federal Lands	Wet Meadow	8,243,091	8,832,969	7.2

Table 23 – Acreage of LF barren Existing Vegetation Type Groups and percent change in the AK GeoArea between LF National and LF 2001.

Table 23. Barren Comparison				
Land Ownership	**Existing Vegetation Type Groups**	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
All Lands	Barren	33,969,954	30,013,317	-11.7
All Lands	Bedrock, Scree, and Talus	1,124,131	-	-100.0
Federal Lands	Barren	23,963,624	21,473,059	-10.4
Federal Lands	Bedrock, Scree, and Talus	581,076	-	-100.0

Table 24 – Acreage of LF water Existing Vegetation Type Groups and percent change in the AK GeoArea between LF National and LF 2001.

Table 24. Water Comparison				
Land Ownership	**Existing Vegetation Type Groups**	**LF National (acres)**	**LF 2001 (acres)**	**Percent Change**
All Lands	Open Water	43,303,415	43,027,808	-0.6
Federal Lands	Open Water	14,215,416	14,036,539	-1.3

No adjustments were made to EVC or EVH in Alaska LF 2001/ LF 2008 data sets, consequently, minimal changes were experienced in height or cover estimates as are depicted in Table 25 and Table 26. EVC is represented in Figure 7 and EVH is depicted in Figure 8.

Figure 7 – Map of Existing Vegetation Cover layer that was enhanced as part of the LF 2001 update by incorporating user feedback and additional data.

Table 25 – Existing Vegetation Cover: Forest Canopy Cover – Comparison between LF National and Refresh 2001 tree cover classes and percent change in the AK GeoArea by ownership categories.

Table 25. Tree Cover Comparison

Land Ownership	Percent Tree Cover	LF National (acres)	LF 2001 (acres)	Percent Change
All Lands	>= 10 and < 25	42,871,580	43,048,627	0.4
All Lands	>= 25 and < 60	61,070,913	61,366,938	0.5
All Lands	>= 60 and <= 100	22,262,056	22,430,272	0.8
Federal Lands	>= 10 and < 25	25,579,165	25,691,609	0.4
Federal Lands	>= 25 and < 60	32,786,375	32,964,772	0.5
Federal Lands	>= 60 and <= 100	13,577,493	13,687,052	0.8

Figure 8 – Map of Existing Vegetation Height layer that was enhanced as part of the LF 2001 update by incorporating user feedback and additional data.

Table 26 – Existing Vegetation Height: Forest Canopy Height – Comparison between LF National and Refresh 2001 tree height classes and percent change in the AK GeoArea by ownership categories.

Table 26. Tree Height Comparison

Land Ownership	Height (m)	LF National (acres)	LF 2001 (acres)	Percent Change
All Lands	0 to 5	83,723,836	84,058,609	0.4
All Lands	5 to 10	42,480,712	42,787,228	0.7
Federal Lands	0 to 5	48,358,503	48,555,023	0.4
Federal Lands	5 to 10	23,584,530	23,788,410	0.9

2.5.3 LANDFIRE 2008: Updates to Existing Vegetation Products

The primary focus for updating the LF existing vegetation layers was to characterize disturbance activities from 1999 - 2008. Additionally, the update included changes within these disturbance areas due to tree growth and regeneration.

As discussed in section 2.4, disturbance mapping for LF 2008 included data derived in part from MTBS and the LF 2001/2008 events data contribution. These data were used to produce disturbance maps identifying type, location, and severity.

The disturbance mapping identified areas where EVT, EVC, and EVH needed to be transitioned (updated) into new vegetation classes. Vegetation transitions were determined through literature sources and expert opinion for each EVT, EVH, and EVC combination based on the severity and time since each fire disturbance. These transitions were applied to the LF2001 layers to produce the LF2008 existing vegetation data.

Information from a variety of sources was used to inform vegetation transition assignments. Low severity fire did not affect EVT for any vegetation types. Moderate severity fire was considered stand replacing in exotic deciduous shrublands, causing a transition to an exotic herbaceous class. All other moderate severity fires were considered non-stand replacing and did not affect EVT. High severity fires were considered stand replacing for all vegetation types. For all fires occurring between 0-5 years, EVT was transitioned to an herbaceous class. For fires older than 5 years, EVT was transitioned to a shrubland type. EVC and EVH were updated based on the time since disturbance for those areas where the EVT lifeform was modified.

2.5.3a Updates to Existing Vegetation Type

Information from a variety of sources was used to inform vegetation transition assignments. A series of tables created in a Vegetation Transition Data Base (VTDB) were used to update attribute tables for the LF 2008 EVT layer.

In forested EVTs, low and moderate severity disturbance did not change EVT. Stand-replacing events such as high severity fire and timber harvests in forested EVTs were transitioned to an herbaceous or shrubland EVT with a cover and height appropriate for an early seral expression of that EVT and for that geographic location. It was assumed that some herbaceous and shrub communities would transition to forested communities. These sites were typically within formerly forested communities where non-forested EVTs occurred in areas of older, not recent disturbance. In these situations, shrub and herbaceous communities were transitioned to an appropriate forested EVT. Relationships between ESP and these shrub and herbaceous communities were used to predict the new forested EVT at a particular site. Successional class A in the Vegetation Dynamics Development Tool (VDDT) models (ESSA Technologies, Ltd., 2007) informed cover and height estimations for 2008 EVT assignments and 2008 cover and height transitions.

In shrub EVTs , all fire severities were considered stand-replacing, so all burned non-forested polygons were replaced by an herbaceous EVT that would be found in that area. Chemical treatments were assumed to be performed on exotic species, so a native herbaceous community for that local or regional area replaced the introduced EVT. Mechanical treatments were treated similarly to fire disturbances and transitioned to an herbaceous community. Introduced annual grasses replaced some shrub-dominated EVTs in lowland areas (for example, Western US Great Basin and Columbia Plateau shrubland EVTs). In herbaceous EVTs, disturbed areas were not transitioned to different EVTs due to the fact that these communities rapidly reestablish themselves after disturbance. Depicted in Figure 9 is a map graphic of LF 2008 EVT. Table 27 through Table 30 depict the changes in acreage of Existing Vegetation Type Groups between the LF 2001 and LF 2008 versions.

Figure 9 – Map of Existing Vegetation Type layer for the AK GeoArea depicting vegetation changes with disturbances for 1999 - 2008.

Table 27 – Comparison of acreage of forested Existing Vegetation Type Groups between LF 2001 and LF 2008 on All Lands in the AK GeoArea.

Table 27. Forested Existing Vegetation Type Groups Comparison: All Lands			
Existing Vegetation Type Groups	**LF 2001 (acres)**	**LF 2008 (acres)**	**Percent Change**
Balsam Poplar-Aspen Woodland	122,975	122,549	-0.4
Birch-Aspen Forest	13,846,611	13,666,980	-1.3
Birch-Cottonwood-Poplar Forest	280,416	280,416	0.0
Black Spruce Forest and Woodland	15,899,023	15,577,391	-2.0
Dry Aspen-Steppe Bluff	190,140	188,561	-0.8
Floodplain Forest and Shrubland	11,529,455	10,584,989	-8.2
Mountain Hemlock Forest and Woodland	2,917,779	2,917,720	0.0
Peatland Forests	23,541,486	23,208,538	-1.4
Periglacial Woodland and Shrubland	513,431	513,431	0.0
Riparian Stringer Forest and Shrubland	147,635	147,213	-0.3
Sitka Spruce Forest	2,877,607	2,877,607	0.0
Spruce-Lichen Woodland	2,238,872	2,194,989	-2.0
Transitional Forest Vegetation	295,015	14,650	-95.0
Western Hemlock-Yellow-Cedar Forest	7,559,955	7,559,953	0.0
Western Red-Cedar-Western Hemlock Forest	715,652	715,652	0.0
White Spruce Forest and Woodland	25,301,502	25,118,561	-0.7
White Spruce-Hardwood Forest and Woodland	15,975,037	15,803,390	-1.1

Table 28 – Comparison of acreage of forested EVT Groups between LF 2001 and LF 2008 on Federal Lands in the AK GeoArea.

Table 28. Forested Existing Vegetation Type Groups Comparison: Federal Lands			
Existing Vegetation Type Groups	**LF 2001 (acres)**	**LF 2008 (acres)**	**Percent Change**
Balsam Poplar-Aspen Woodland	46,446	46,216	-0.5
Birch-Aspen Forest	7,461,973	7,345,065	-1.6
Birch-Cottonwood-Poplar Forest	158,544	158,544	0.0
Black Spruce Forest and Woodland	8,397,518	8,164,778	-2.8
Dry Aspen-Steppe Bluff	86,066	85,628	-0.5
Floodplain Forest and Shrubland	5,513,423	4,957,625	-10.1
Mountain Hemlock Forest and Woodland	2,591,946	2,591,886	0.0
Peatland Forests	13,851,991	13,621,817	-1.7
Periglacial Woodland and Shrubland	400,611	400,611	0.0
Riparian Stringer Forest and Shrubland	47,774	47,509	-0.6
Sitka Spruce Forest	1,556,849	1,556,849	0.0
Spruce-Lichen Woodland	1,227,489	1,201,141	-2.2
Transitional Forest Vegetation	235,261	12,636	-94.6
Western Hemlock-Yellow-cedar Forest	6,612,263	6,612,261	0.0
Western Red-cedar-Western Hemlock Forest	622,959	622,959	0.0
White Spruce Forest and Woodland	15,046,599	14,970,908	-0.5
White Spruce-Hardwood Forest and Woodland	7,295,598	7,205,094	-1.2

Table 29 – Comparison of acreage of shrubland Existing Vegetation Type Groups between LF 2001 and LF 2008 across land ownerships in the AK GeoArea.

Table 29. Shrubland Existing Vegetation Type Groups Comparison				
Land Ownership	Existing Vegetation Type Groups	LF 2001 (acres)	LF 2008 (acres)	Percent Change
All Lands	Alder Shrubland	14,709,586	14,594,326	-0.8
All Lands	Avalanche Slope Shrubland	676,155	666,535	-1.4
All Lands	Dwarf Shrubland	45,906,181	45,480,527	-0.9
All Lands	Floodplain Forest and Shrubland	2,054,486	2,046,999	-0.4
All Lands	Shrub and Herbaceous Floodplain Wetland	180,695	180,636	0.0
All Lands	Shrub and Herbaceous Peatlands	14,806,117	14,434,102	-2.5
All Lands	Shrub Swamp	553,965	540,824	-2.4
All Lands	Shrub Tundra	11,127,575	11,044,297	-0.8
All Lands	Sparse Shrub and Fell-field	953,040	952,984	0.0
All Lands	Sparse Tundra	1,591,916	1,591,067	-0.1
All Lands	Tussock Tundra	31,042,562	29,212,763	-5.9
All Lands	Willow Shrubland	24,819,872	23,468,827	-5.4
Federal Lands	Alder Shrubland	8,960,903	8,875,428	-1.0
Federal Lands	Avalanche Slope Shrubland	484,927	481,550	-0.7
Federal Lands	Dwarf Shrubland	30,884,600	30,585,961	-1.0
Federal Lands	Floodplain Forest and Shrubland	1,266,145	1,260,765	-0.4
Federal Lands	Shrub and Herbaceous Floodplain Wetland	108,439	108,439	0.0
Federal Lands	Shrub and Herbaceous Peatlands	9,118,835	8,870,134	-2.7
Federal Lands	Shrub Swamp	333,302	318,679	-4.4
Federal Lands	Shrub Tundra	7,320,600	7,288,416	-0.4
Federal Lands	Sparse Shrub and Fell-field	788,747	788,718	0.0
Federal Lands	Sparse Tundra	1,207,384	1,206,706	-0.1
Federal Lands	Tussock Tundra	20,326,191	19,185,392	-5.6
Federal Lands	Willow Shrubland	13,838,983	13,004,487	-6.0

Table 30 – Comparison of acreage of herbaceous Existing Vegetation Type Groups between LF 2001 and LF 2008 across land ownerships in the AK GeoArea.

Table 29. Shrubland Existing Vegetation Type Groups Comparison

Land Ownership	Existing Vegetation Type Groups	LF 2001 (acres)	LF 2008 (acres)	Percent Change
All Lands	Alder Shrubland	14,709,586	14,594,326	0.8
All Lands	Avalanche Slope Shrubland	676,155	666,535	1.4
All Lands	Dwarf Shrubland	45,906,181	45,480,527	0.9
All Lands	Floodplain Forest and Shrubland	2,054,486	2,046,999	0.4
All Lands	Shrub and Herbaceous Floodplain Wetland	180,695	180,636	0.0
All Lands	Shrub and Herbaceous Peatlands	14,806,117	14,434,102	2.5
All Lands	Shrub Swamp	553,965	540,824	2.4
All Lands	Shrub Tundra	11,127,575	11,044,297	0.8
All Lands	Sparse Shrub and Fell field	953,040	952,984	0.0
All Lands	Sparse Tundra	1,591,916	1,591,067	0.1
All Lands	Tussock Tundra	31,042,562	29,212,763	5.9
All Lands	Willow Shrubland	24,819,872	23,468,827	5.4
Federal Lands	Alder Shrubland	8,960,903	8,875,428	1.0
Federal Lands	Avalanche Slope Shrubland	484,927	481,550	0.7
Federal Lands	Dwarf Shrubland	30,884,600	30,585,961	1.0
Federal Lands	Floodplain Forest and Shrubland	1,266,145	1,260,765	0.4
Federal Lands	Shrub and Herbaceous Floodplain Wetland	108,439	108,439	0.0
Federal Lands	Shrub and Herbaceous Peatlands	9,118,835	8,870,134	2.7
Federal Lands	Shrub Swamp	333,302	318,679	4.4
Federal Lands	Shrub Tundra	7,320,600	7,288,416	0.4
Federal Lands	Sparse Shrub and Fell field	788,747	788,718	0.0
Federal Lands	Sparse Tundra	1,207,384	1,206,706	0.1
Federal Lands	Tussock Tundra	20,326,191	19,185,392	5.6
Federal Lands	Willow Shrubland	13,838,983	13,004,487	6.0

Table 30. Herbaceous Existing Vegetation Type Group Comparison

Land Ownership	Existing Vegetation Type Groups	LF 2001 (acres)	LF 2008 (acres)	Percent Change
All Lands	Beach Meadow	96,265	96,265	0.0
All Lands	Boreal Grassland	488,027	823,562	68.8
All Lands	Dune Grassland	19,557	19,557	0.0
All Lands	Freshwater Aquatic Bed	108,126	108,126	0.0
All Lands	Freshwater Marsh	6,154,400	6,244,940	1.5
All Lands	Herbaceous Meadow	2,762,643	2,895,092	4.8

All Lands	Shrub and Herbaceous Peatlands	-	-	
All Lands	Shrub Tundra	174,065	179,886	3.3
All Lands	Sparse Tundra	2,957,806	2,959,491	0.1
All Lands	Tidal Marsh	777,640	777,640	0.0
All Lands	Tussock Tundra	5,253,304	5,619,344	7.0
All Lands	Wet Meadow	15,107,210	20,843,400	38.0
Federal Lands	Beach Meadow	53,181	53,181	0.0
Federal Lands	Boreal Grassland	253,619	407,536	60.7
Federal Lands	Dune Grassland	12,190	12,190	0.0
Federal Lands	Freshwater Aquatic Bed	66,384	66,384	0.0
Federal Lands	Freshwater Marsh	4,333,921	4,416,596	1.9
Federal Lands	Herbaceous Meadow	1,754,574	1,860,626	6.0
Federal Lands	Shrub and Herbaceous Peatlands	-	-	
Federal Lands	Shrub Tundra	154,681	159,438	3.1
Federal Lands	Sparse Tundra	1,918,384	1,918,651	0.0
Federal Lands	Tidal Marsh	439,533	439,534	0.0
Federal Lands	Tussock Tundra	3,512,126	3,791,296	8.0
Federal Lands	Wet Meadow	8,832,969	12,422,293	40.6

2.5.3b Updates to Existing Vegetation Cover

Transitions in the forested component of EVC due to disturbance and succession were modeled using the FVS and FFE. These transitions were applied to the LF 2001 Forest Canopy Cover (CC) layer to create the LF 2008 CC layer (Figure 10). Changes in area mapped in the cover categories are reported in Table 31.

Figure 10 – Map of Existing Vegetation Cover for the AK accounting for vegetation changes with disturbances for 1999 - 2008.

Table 31 – Existing Vegetation Cover: Tree Cover – Comparison between LF 2001 and 2008 Refresh.

Table 31. Tree Cover Comparison				
Land Ownership	**Percent Tree Cover**	**LF 2001 (acres)**	**LF 2008 (acres)**	**Percent Change**
All Lands	>= 10 and < 25	43,048,627	41,769,774	-3.0
All Lands	>= 25 and < 60	61,366,938	57,513,687	-6.3
All Lands	>= 60 and <= 100	22,430,272	24,451,469	9.0
Federal Lands	>= 10 and < 25	25,691,609	24,771,375	-3.6
Federal Lands	>= 25 and < 60	32,964,772	30,971,106	-6.1
Federal Lands	>= 60 and <= 100	13,687,052	14,663,834	7.1

2.5.3c Updates to Existing Vegetation Height

Transitions in the forested component of EVH due to disturbance and succession were modeled using FVS/FFE. These transitions were applied to the LF 2001 Forest Canopy Height (CH) layer to create the LF 2008 CH layer. Using FIA plot data for forested vegetation types, the model was calibrated to disturb the sites with a variety of disturbance types and severities. Depicted in Figure 11 is a map graphic of LF 2008 EVT. Table 32 shows the changes in EVH between LF 2001 and LF 2008 for both Federal and all lands.

Figure 11 – Map of Existing Vegetation Height for the AK GeoArea accounting for vegetation changes from disturbances for 1999 - 2008.

Table 32 – Existing Vegetation Height: Tree Height – Comparison between LF 2001 and 2008 Refresh.

Table 32. Tree Height Comparison				
Land Ownership	**Height (m)**	**LF 2001 (acres)**	**LF 2008 (acres)**	**Percent Change**
All Lands	> 0 and < 10	84,058,609	53,499,417	-36.4
All Lands	>= 10	42,787,228	70,235,513	64.2
Federal Lands	> 0 and < 10	48,555,023	30,372,151	-37.5
Federal Lands	>= 10	23,788,410	40,034,163	68.3

2.6 Fire Behavior

2.6.1 Product Description

The LF fuels data describe the composition and characteristics of both surface and canopy fuel. Geospatial products include fire behavior fuel models (FBFM13 [Anderson 1982], FBFM40 [Scott and Burgan 2005], Forest Canopy Bulk Density (CBD), Forest Canopy Base Height (CBH), CC, and CH. The landscape file (LCP) is the data format required for many fire behavior and effects models and was provided as well. These data can be implemented within models to forecast wildland fire behavior and effects that are useful for strategic fuel treatment prioritization and for tactical assessments during firefighting operations.

2.6.2 LF 2001 Enhancements to Fire Behavior Products

LF FBFM layers were calibrated as part of the LF 2001 Refresh effort. FBFM assignment rules were evaluated and modified based on local expert input and experience.

2.6.2a Enhancements to Surface Fuel

The FBFM40/13 fuel model grids for LF National were based on input provided by regional fuel specialists and the LF fuel team. Surface fuel models were dependent upon the type of vegetation described in the EVT layer, the amount of cover in the overstory of the vegetation from EVC, and the height of the vegetation expressed by EVH. Fuel model assignments were given break points of EVC and EVH for each EVT to determine the fuel model. For instance, in a forested EVT in an open condition, a grass or shrub model would be used in the low cover rule set to describe the surface fuel. As the stand closed in the higher EVC classes, a timber understory or timber litter model would often be used in a subsequent rule set. The newly calibrated surface fuel rule set was applied to the LF2001 EVT, EVC, and EVH data to derive the LF2001 FBFM products. The results are fire behavior models such as the graphic of LF 2001 FBFM40 depicted in Figure 12.

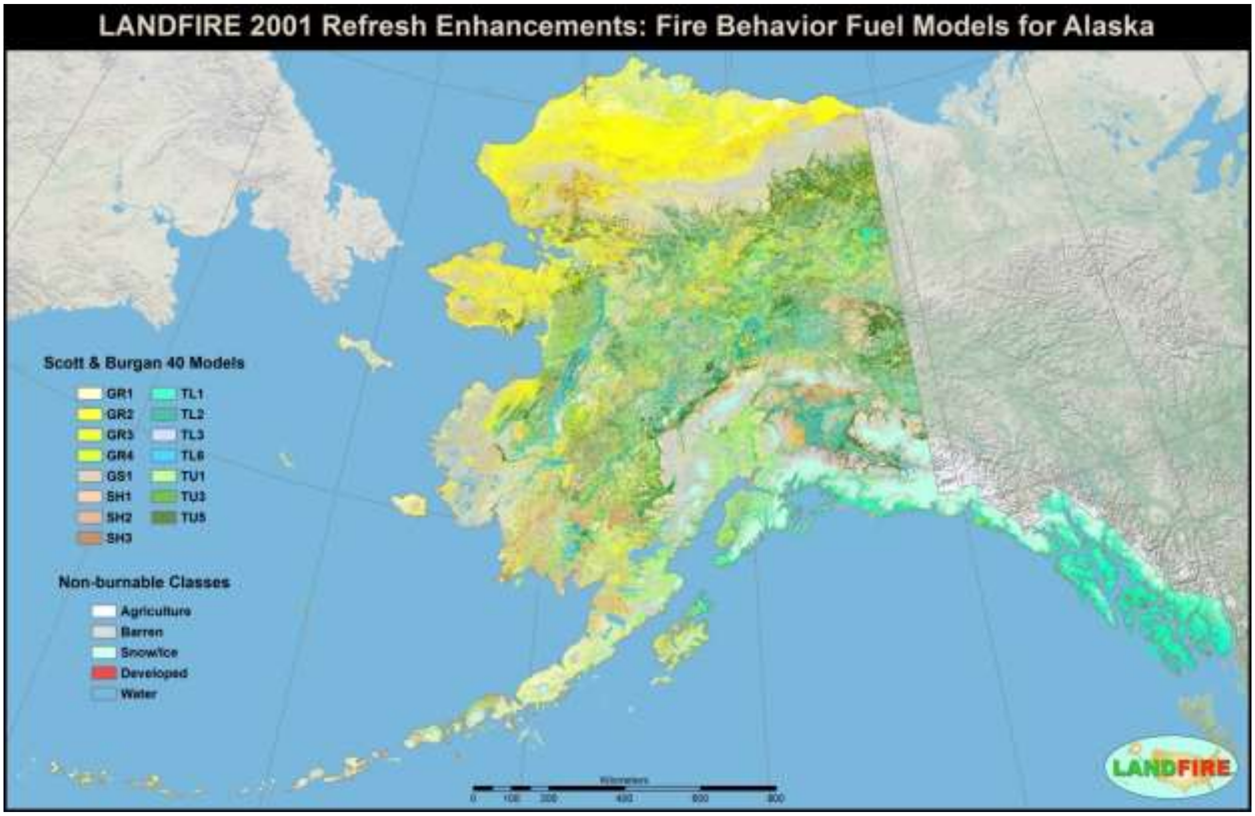


Figure 12 – LF 2001 Fire Behavior Fuel Model 40 for the AK GeoArea

2.6.2b Enhancements to Canopy Fuel

The CC and CH layers were directly affected by the changes in EVC and EVH, and the grids for CBH and CBD were calculated from the new values in CC and CH. The CBH data layer was developed through exploratory analysis of the LF plot data and statistically analyzed to search for relationships between the plot level variables and CBH. Unfortunately, no such relationship could be gleaned between these variables. It was determined that CBH would be represented through an averaging method based on combinations of EVT and coarser groupings of EVT with EVH and EVC categories.

The CBD data layer was also developed through exploratory analysis of the LF plot data. The entire LF plot data compiled for the western United States were statistically analyzed to search for relationships between the plot level variables and CBD. A General Linear Model (GLM) was developed that expresses the relationship between CBD and CC, CH, and EVT (Reeves et al. 2009).

2.6.3 LF 2008 Updates to Fire Behavior Products

The LF 2008 update process attempted to model the vegetation and fuel characteristics depicted in the circa 2001 imagery (LF National) to the more current period of 2008. The focus of this process was to incorporate vegetation growth and disturbance over the time period. Regarding fuel characteristics, the changes in surface fuel models (FBFM40, FBFM13, and FCCS) and canopy characteristics in the disturbed areas were incorporated according to expert opinion.

2.6.3a Updates to Surface Fuel

The FBFM40 and FBFM13, canopy fuels were transitioned from their original assignment in LF 2001 based on type, intensity, and the time since disturbance. Vegetation outside of disturbed areas maintained the same surface fuel model unless there was some change in the EVT. Vegetation was transitioned using the process explained in Section 2.5.3.

Time since disturbance was separated into two categories (i.e. time steps) for surface fuel: 0-3 years post disturbance and 4-10 years. For each time step, one FBFM 40/13 and FCCS was assigned to represent the surface fuel characteristic for the period. Generally, the first step was visualized as a full growing season and the second step was 7 years post disturbance. The transitions of surface fuel models in disturbed areas were assigned by the LF fuel team and then sent to regional experts for review and editing. The resulting FBFM40 fuel models are represented in Figure 13.

Figure 13 – LF 2008 Fire Behavior Fuel Model 40 for the AK GeoArea.

2.6.3b Updates to Canopy Fuel

The changes in canopy attributes and the growth in non-disturbed areas were modified according to local expert opinion. Values for CC, CH, and CBD were recalculated using the 2008 EVC, EVH and EVT. The coefficients of change in the CBH attributes were applied to the usual calculation of CBH based on the type, severity, and time since disturbance. Time since disturbance was implemented in three time steps for canopy fuel; 1) immediately after the disturbance, 2) 3-5 years post disturbance and 3) 7-10 years post disturbance. For each time step, a CBD value was calculated using the GLM and the updated LF 2008 EVT, EVC and EVH data layers.

2.6.3c Modeled Fire Behavior Using LF 2008 Updated Products

The WFAT was used to estimate potential fire behavior using fuel data from LF 2001 and LF 2008. Three fire behavior outputs from these simulations were then compared to quantify changes in LF fuel mapping improvements (Table 33). The WFAT runs used a simulation landscape and a representative RAWS for each analysis. Fire weather data were generated from the RAWS data for the selected station. The 98th percentile fire weather was used as an input to WFAT to ensure that the conditions were adequate and that WFAT would simulate the burning of the vast majority of pixels in FRG 1-4.

Table 33 – Comparison of fire behavior characteristics derived from LF 2001 and LF 2008 for Federal Lands in the AK GeoArea.

Table 33. Fire Behavior Comparison LF 2001 and LF 2008			
Fire Behavior Characteristic	**LF 2001 (acres)**	**LF 2008 (acres)**	**Percent Change**
Flame Length (feet)			
No Fire	68,817,881	68,752,655	-0.1
Low(>0 and <=4)	102,183,474	104,179,587	2
Moderate (>4 and <=11)	36,496,241	35,910,039	-1.6
High (> 11)	32,393,940	31,049,255	-4.2
Spread Rate (chains/hour)			
No Fire	68,817,909	68,752,678	-0.1
Low (>0 and <=5)	56,914,171	56,623,396	-0.5
Moderate (>5 and <=50)	81,349,162	81,489,222	0.2
High (>50)	32,810,295	33,026,240	0.7
Crown Fire			
No Fire	68,817,873	68,752,651	-0.1
Surface Fire	128,459,466	130,363,919	1.5
Passive Crown Fire	36,468,377	33,835,587	-7.2
Active Crown Fire	6,145,819	6,939,380	12.9

2.7 Fire Effects

2.7.1 Product Description

The LF fire effects data layers describe the composition and characteristics of both surface fuel loadings and canopy fuel loadings, which are represented in Alaska by the Fuel Characterization Classification System (FCCS) fuelbed models (Ottmar et al. 2007). FCCS data may be used within fire behavior models to forecast the effects of wildland fire for strategic fuel treatment prioritization and tactical assessment of fire behavior.

FCCS fuelbeds were developed by the Fire and Environmental Applications Team (FERA) at the USFS Pacific Wildland Fire Sciences Laboratory using data from the following sources: regional workshops, published literature, USFS photo series, general technical reports, research papers, other government literature, large databases, masters and doctoral theses, white papers, field data, and other unpublished data, and expert opinion. FCCS defines a fuelbed as the inherent physical characteristics of fuel that contribute to fire behavior and effects (Riccardi et al. 2007). FCCS is a set of measured or averaged physical fuel characteristics of a relatively uniform unit on the landscape that represents a distinct fire environment. An FCCS fuelbed can represent any scale or precision of interest. In FCCS, fuelbeds represent realistic fuel conditions and can accommodate a wide range of fuel characteristics in six horizontal fuel layers including include canopy, shrub, non-woody vegetation, woody fuel, litter/lichen/moss, and ground fuel strata (Ottmar et al. 2007). Each stratum was further divided into 16 categories and 20 subcategories to represent the complexity of wildland and managed fuel types in the United States.

2.7.2 LF 2001 Enhancements to Fire Effects Products

2.7.2a Enhancements to the Fuel Characterization Classification System fuelbeds

The FCCS fuelbeds mapping relied almost entirely on the LF EVT layer. A crosswalk was constructed between LF EVT and FCCS fuelbed classes. Where multiple FCCS fuelbeds could exist within a single EVT class, EVC and EVH were used to further refine the crosswalk. The final crosswalk was converted into a rule set and applied to the EVT, EVC, and EVH data to produce the final FCCS layer.

2.7.2b Enhancements to the Fuel Loading Models

For the AK GeoArea, due to the lack of LFRDB plot data, we first evaluated surface fuel loadings using a pseudo-plot process. We selected plots from the AK LFRDB that contained photos. From these we selected plots with photos that were of sufficient resolution to rate classes of surface fuel loading following a modified process of the photo evaluation techniques of Keane et al. (2007). We then associated these data with the AK FCCS classification through review of the FCCS types.

Following the methods outlined by Lutes et al. (2009) and Sikkink et al. (2009), we conducted fire effects modeling on the AK FCCS types and pseudo-plot data using the First Order Fire Effects Model (FOFEM) version 5.9 to simulate Particulate Matter (PM) 2.5 smoke emissions, soil heating, and fuel consumption. The NLCD types with loading attributes were also included in these data. A series of iterative cluster analyses of fire effects, fuel loading, and data subsets were then performed to cluster the data, identify potential FLM types, and evaluate whether potential classifications would achieve objectives. The results indicated that 31 FLMs would account for most variation in fuel class loading and fire effects, and that these would achieve objectives for AK as depicted in Figure 14.

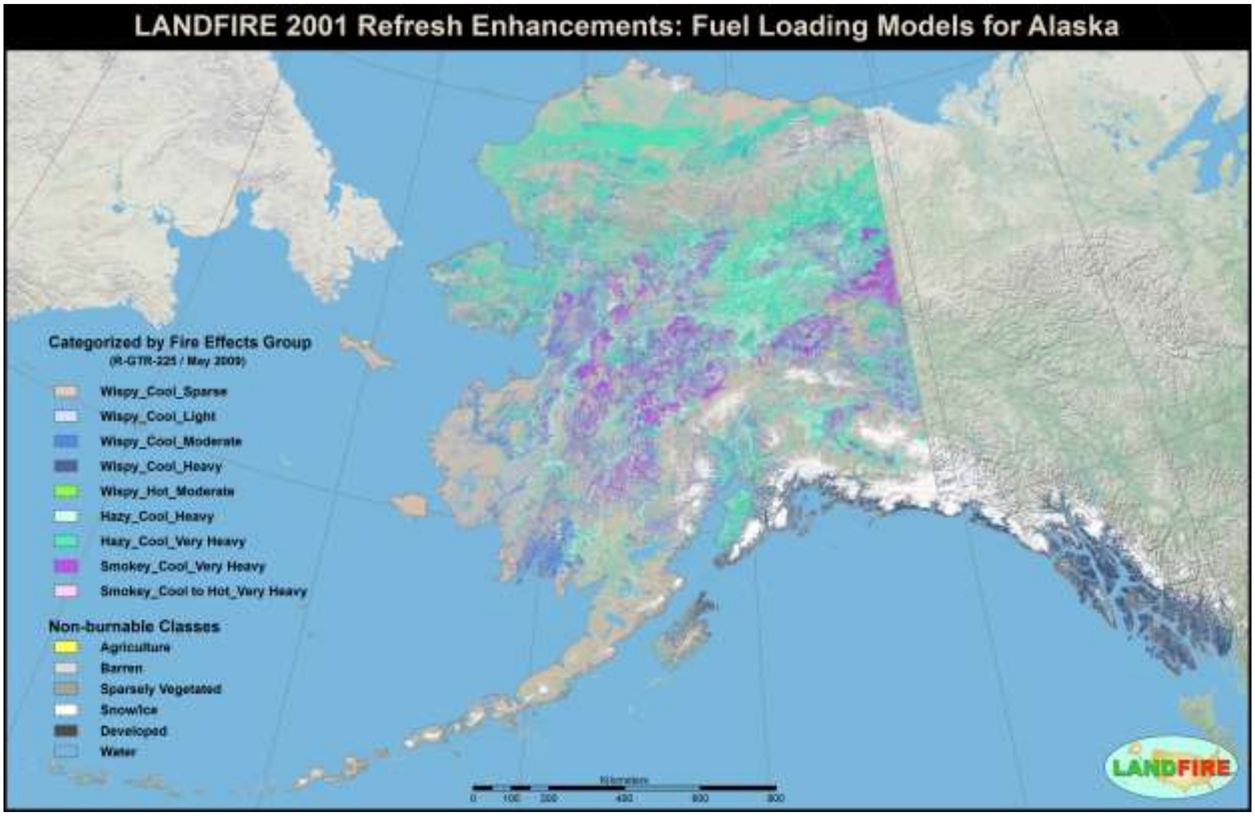


Figure 14 – LF 2001 Fuel Loading Models for the AK GeoArea. FLM categories are from Rocky Mountain Research Station General Technical Report 225.

2.7.2c Modeled Fire Effects Using LF 2001 Enhanced Products

The Wildland Fire Assessment Tool (WFAT) can also be used to spatially model fire effects using a FOFEM, and was used to estimate potential fire effects using fuel loading data from LF National and LF 2001. Three fire effects outputs from these simulations were then compared to quantify changes in LF FLM mapping improvements (Table 34). The WFAT runs used a simulation landscape and a representative Remote Automated Weather Station (RAWS) for each area. Fire weather data were generated from the RAWS data for the selected station. The 98th percentile fire weather was used as an input to WFAT. The FLM grids provided the loadings data for these simulations.

Table 34 –Comparison of fire effect characteristics derived from LF National and LF 2001 for Federal Lands in the AK GeoArea.

Table 34. Fire Effect Characteristics Comparison LF National to 2001			
Fire Effect Characteristics	National (acres)	LF 2001 (acres)	Percent Change
Particulate Production:			
No Burnable Fuels	1,408,188	1,200,335	-14.8
No Burn In Fuels	2,822,947	2,600,067	-7.9
No Effect	87,334,679	78,639,709	-10
Low (>0 and <=250 lbs/ac)	82,414,886	67,342,602	-18.3
Moderate (>250 and <=1000 lbs/ac)	18,123,412	23,845,090	31.6
High(>1000 lbs/ac)	47,787,424	66,263,734	38.7
Soil Heating:			
No Burnable Fuels	1,408,188	1,200,335	-14.8
No Burn in Fuels	2,822,947	2,600,067	-7.9
No Effect	184,473,785	175,432,504	-4.9
Low (>0 and <=3 cm)	27,593,384	31,492,688	14.1
Moderate (>3 and <=8 cm)	23,582,920	29,155,551	23.6
High(>8 cm)	10,311	10,391	0.8
Fuel Consumption:			
No Burnable Fuels	1,408,188	1,200,335	-14.8
No Burn in Fuels	2,822,947	2,600,067	-7.9
No Effect	87,334,679	78,639,709	-10.0
Low (>0 and <=33 %)	684,153	453	-99.9
Moderate (>33 and <= 66 %)	6,148,225	7,439,365	21
High (>66 %)	141,493,344	150,011,607	6.0

2.7.3 LF 2008 Updates to Fire Effects Products

2.7.3a Updates to Fuel Characterization Classification System Fuelbeds

The same crosswalk and mapping rules that were used for LF 2001 were used for LF 2008, which included rules for disturbed pixels that took into account disturbance type, severity, and time since disturbance described in Section 2.4.3.

2.7.3b Updates to Fuel Loading Models

The same mapping rules (see Section 2.7.2) that were used for LF 2001 were used for LF 2008 in areas not disturbed by either fire, mechanical removal of surface fuel, or mechanical or wind addition of surface fuel. However, pixels that were affected by disturbances prior to 2008 were adjusted using a simple rule set that modified the original FLM assignment based on disturbance type, severity, and time since disturbance (Figure 15).

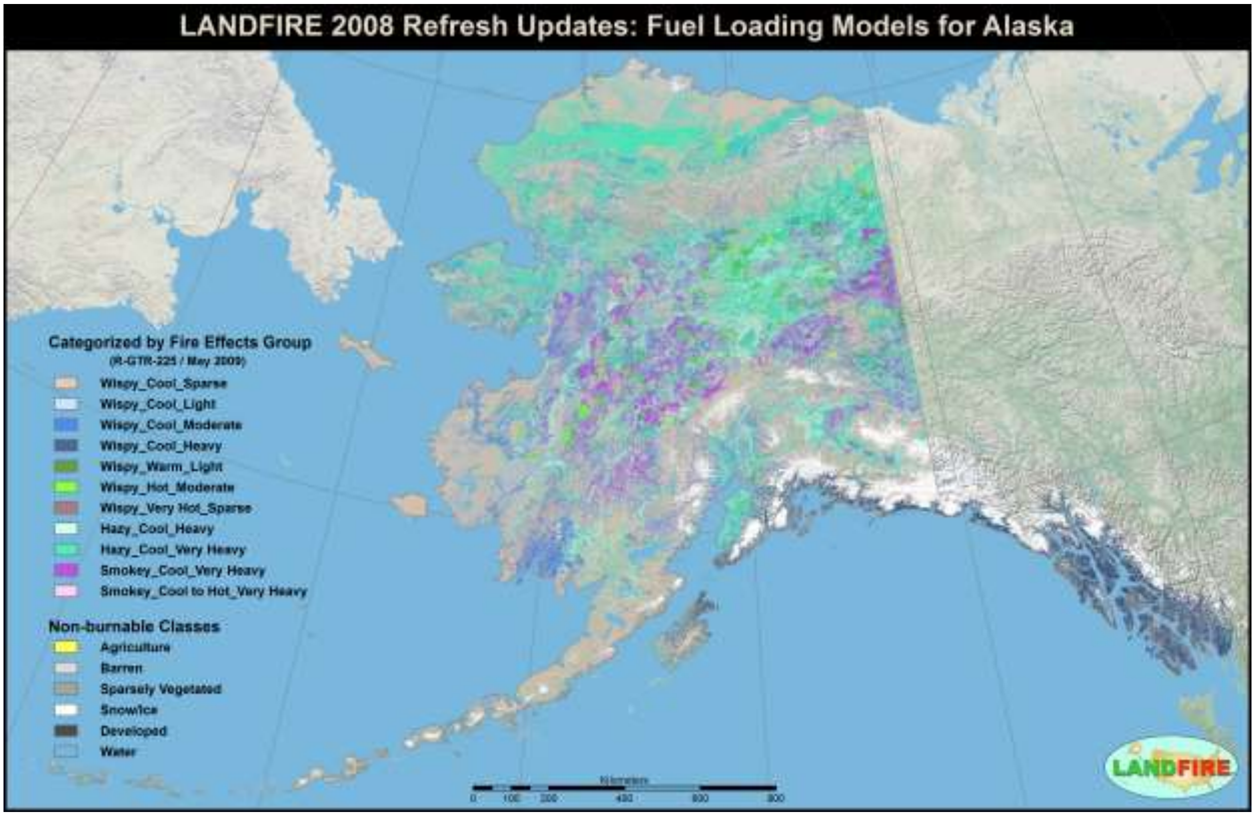


Figure 15 – LF 2008 Fuel Loading Models for the AK GeoArea. Categories are from the Rocky Mountain Research Station General Technical Report 225.

2.7.3c Modeled Fire Effects Using LF 2008 Updated Products

WFAT was used to estimate potential fire effects using fuel loading data from LF 2001 and LF 2008. Three fire effects outputs from these simulations were then compared to quantify changes in LF fuel loading mapping improvements (Table 35). The WFAT runs used a simulation landscape and a representative RAWS for each area. Fire weather data were generated from the RAWS data for the selected station. The 98th percentile fire weather was used as an input to WFAT. The FLM grids provided the loadings data for these simulations.

Table 35 – Comparison of fire effect characteristics derived from LF 2001 and LF 2008 for Federal Lands in the AK GeoArea.

Table 35. Fire Effect Characteristics Comparison LF 2001 to LF 2008

Ownership	Fire Effect Characteristics	LF 2001 (acres)	LF 2008 (acres)	Percent Change
Particulate Production:				
Federal Lands	No Burnable Fuels	1,200,335	1,198,722	-0.1
Federal Lands	No Burn In Fuels	2,600,067	2,536,457	-2.5
Federal Lands	No Effect	78,639,709	77,945,044	-0.9
Federal Lands	Low (>0 and <=250 lbs/ac)	67,342,602	69,693,399	3.5
Federal Lands	Moderate (>250 and <=1000 lbs/ac)	23,845,090	25,325,552	6.2
Federal Lands	High(>1000 lbs/ac)	66,263,734	63,192,361	-4.6
Soil Heating:				
Federal Lands	No Burnable Fuels	1,200,335	1,198,722	-0.1
Federal Lands	No Burn in Fuels	2,600,067	2,536,457	-2.5
Federal Lands	No Effect	175,432,504	175,172,424	-0.2
Federal Lands	Low (>0 and <=3 cm)	31,492,688	30,933,030	-1.8
Federal Lands	Moderate (>3 and <=8 cm)	29,155,551	29,117,567	-0.1
Federal Lands	High(>8 cm)	10,391	933,336	8,882.2
Fuel Consumption:				
Federal Lands	No Burnable Fuels	1,200,335	1,198,722	-0.1
Federal Lands	No Burn in Fuels	2,600,067	2,536,457	-2.5
Federal Lands	No Effect	78,639,709	77,945,044	-0.9
Federal Lands	Low (>0 and <=33 %)	453	47,470	10,379.0
Federal Lands	Moderate (>33 and <= 66 %)	7,439,365	7,755,456	4.3
Federal Lands	High (>66 %)	150,011,607	150,408,387	0.3

2.8 Fire Regime Products

2.8.1 Product Description

Broad-scale alterations of historical fire regimes and vegetation conditions have occurred in many landscapes in the U.S. through the combined influence of land management practices, fire exclusion, ungulate herbivory, insect and disease outbreaks, climate change, and invasion of non-native plant species. The LF Program produced maps of historical fire regimes and historical vegetation conditions using a state and transition model, VDDT. The LF Program also produced maps of current vegetation and measurements of current vegetation departure from simulated historical reference conditions. The LF 2001/2008 update was accomplished by using the FRCC Mapping Tool (FRCCMT; Jones and Tirmenstein, 2012) to perform the FRCC calculations as defined in the Interagency Fire Regime Condition Class Guidebook (Interagency Fire Regime Condition Class Guidebook, 2010). FRCCMT relied on the use of a variety of spatial inputs, including the BpS and SCLASS layers and LF 2001 Fire Regime Landscape layers.

SCLASS categorizes current vegetation composition and structure in up to five successional states defined for each LF BpS model. Two additional categories define uncharacteristic native and exotic vegetation components that were not found within the compositional or structural variability of successional states defined for each BpS model, such as exotic species. These succession classes were similar in concept to those defined in the FRCC Guidebook. The FRCC data layer categorizes departure between current vegetation conditions and reference vegetation conditions according to the methods outlined in the FRCC Guidebook. This departure index is represented using a 0 to 100 percent scale, with 100 representing maximum departure. The departure index was then classified into three condition classes. It is important to note that the LF FRCC approach differs from that outlined in the FRCC Guidebook as follows: LF FRCC was based on departure of current vegetation conditions from reference vegetation conditions only, whereas the Guidebook approach also includes departure of current fire regimes from those of the reference period. As such, LF has made a transition from calling these products FRCC data products to Vegetation Condition Class (VCC). Similarly, the FRCC departure has been changed to Vegetation Departure Index (VDEP).

2.8.2 LF 2001 Enhancements to Fire Regime Products

2.8.2a Enhancements to Summary Units

The LF 2001 fire regime product was developed to provide a spatial summary unit for processing within each GeoArea using the FRCCMT. The layer was developed by combining the Hydrologic Unit Code (HUC) and the FRCC layer and clipping this combined raster to each GeoArea boundary. The FRCC layer was then summarized by HUC codes 8, 10, and 12. The fire regime product is one of five inputs used in analyzing departure with FRCCMT, allowing for scale-appropriate analyses for each stratum according to its associated FRG (FRCC, 2010). The outputs from FRCCMT differ as the landscape used to report those results changes in size and/or shape. It is therefore important to select appropriately sized landscapes when using FRCCMT. In addition to the fire regime product, FRCCMT assesses the FRCC metrics by BpS within the landscape watersheds, using the smaller sub-watersheds denoted by the HUC 12 code to calculate FRCC for BpS in FRG 1 and 2, the watersheds denoted by the HUC 10 code to calculate FRCC for BpS in FRG 3, and the larger sub-basins denoted by the HUC 8 code to calculate FRCC for BpS in FRG 4 and 5.

2.8.2b Enhancements to Succession Classes

The SCLASS layer was created by linking the BpS Group attribute in the BpS layer with the RMT data and assigning the SCLASS attribute. This geospatial product displays a reasonable approximation of SCLASS, documented in the RMT. The current successional classes and their historical reference conditions were compared to assess departure of vegetation characteristics; this departure can be quantified using methods such as FRCC. SCLASS rules for each BpS were designed to meet the following criteria: 1) represent the existing locations of a BpS SCLASS on the landscape and 2) meet the input requirements for the FRCCMT. User feedback had identified two primary issues with the LF National BpS SCLASS rules.

1. Many of the rules in the RMT database conflicted due to overlapping cover and height ranges.
2. Some life-forms that were mapped within a given BpS should not have been included based on the BpS model description for the SCLASS. These cases are referred to as “life-form mismatches.”

BpS models and SCLASS rules were evaluated against the BpS model descriptions and adjusted to accurately reflect the intent of the model. In some cases the cover and height values either matched or remained similar to the original model. In other cases the cover and height values were adjusted considerably. The SCLASS rule revision process eliminated overlap between cover and height ranges of the SCLASS rules for a given BpS. Overlapping rules were edited so that only one rule applied to each pixel. In some cases correcting the overlapping values resulted in cover or height values that were one or more categories above or below the original model.

In the case of life-form mismatches, the life-forms that were mapped as part of the BpS but not allowed by the SCLASS rules were reviewed and reassigned to an uncharacteristic class and the probable source of the error was documented. The resulting updates to SCLASS are presented in Figure 16.

Figure 16 – Map of LF 2001 enhancements of the Succession Classes layer for the AK GeoArea.

2.8.2c Enhancements to Vegetation Departure

Unlike previous versions of LF data, reference conditions of percent composition for each of the characteristic SCLASS were derived from modeling workshops with the intent to approximate the definitions outlined in the FRCC Guidebook. Modelers used the VDDT, which uses state and transition landscape modeling to simulate the effect that disturbance and management actions have on a landscape over time. The results of this modeling are stored in the LF RMT.

The current conditions were derived from the corresponding version of the LF SCLASS data layer. The areas currently mapped to agriculture, urban, water, barren, or sparsely vegetated BpS units were not included in the FRCC calculation; thus, FRCC is based entirely on the remaining area of each BpS unit that is occupied by valid SCLASS. To calculate the Stratum Vegetation Departure, FRCCMT used the BpS layer along with a HUC within the layer to stratify the SCLASS layer. Once the SCLASS layer was stratified by a HUC and BpS, FRCCMT was able to calculate the Current Percent Composition for each SCLASS within each BpS at the appropriate HUC level.

FRCCMT then used the Current Percent Composition for each of the SCLASS within a BpS/HUC along with the corresponding Reference Percent Compositions for that BpS from the Reference Condition Table to calculate the Stratum Vegetation Departure, which is described above. The Stratum Vegetation Departure grid was calculated by comparing the Reference Percent Composition of each SCLASS to the Current Percent Composition, summing the smaller of the two for each of the SCLASS to determine the Stratum Similarity. This value was then subtracted from 100 to determine the Stratum Vegetation Departure. The VCC grid (Figure 17) is a 3-category classification of the Stratum Vegetation Departure based on the following thresholds:

1. VCC I: Stratum Vegetation Departure of 0 to 33
2. VCC II: Stratum Vegetation Departure of 34 to 66
3. VCC III: Stratum Vegetation Departure of 67 to 100

Figure 17 – Map of Vegetation Condition Class for the AK GeoArea from LF 2001 enhancements.

2.8.3 LF 2008 Updates to Fire Regime Products

2.8.3a Updates to Succession Classes

The same SCLASS mapping rules (see Section 2.8.2) that were used for LF 2001 were used for LF 2008 (Figure 18). Mapping rules were applied to LF 2008 EVT, EVC, and EVH layers to map the LF 2008 SCLASS layer.

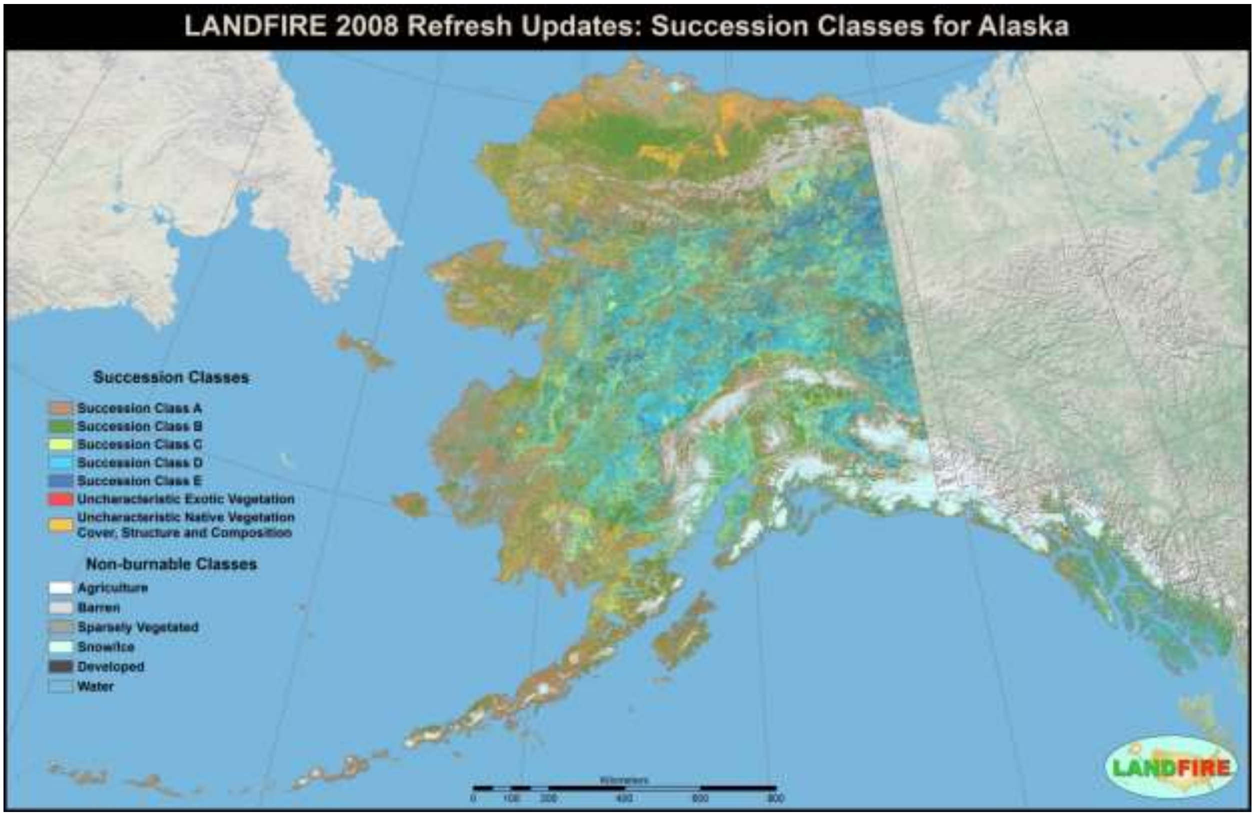


Figure 18 – Map of LF 2008 updates of the Succession Classes layer for the AK GeoArea.

2.8.3b Updates to Vegetation Departure

FRCCMT was used to calculate the current percent composition for each of the LF 2008 SCLASS within a BpS/HUC along with the corresponding reference percent compositions for that BpS from a reference condition table to calculate the LF 2008 stratum vegetation departure. The LF 2008 VCC grid (Figure 19) was derived from a 3-category classification of the stratum vegetation departure as defined in Section 2.8.2c.

Figure 19 – Map of Vegetation Condition Class for the AK GeoArea from LF 2008 updates.

3.0 ARSITE Comparison of LANDFIRE uel

This section evaluates one or more of the LF fuel data sets against known wildland fire perimeters, spread distances, and environmental conditions to determine the efficacy of the data for fire analyses. Testing was done using the FARSITE program to perform comparisons between LF data sets with the final perimeters of an actual wildland fire as well as use of the FlamMap software for additional fuels and environmental characteristics. Fires were selected from one of several sources such as, MTBS, Fire Occurrence Database for each of the representative geographic areas, National Interagency Fire Center, or from personal contact with fire personnel related to the fire. The LF data sets that were used throughout this process were FBFM13 and FBFM40, CC, CH, CBH, and CBD from LF National, LF 2001, and LF 2008. Slope, elevation, and aspect were also included as inputs. Below is an example of a comparison between LF data sets with the final perimeters of an actual wildland fire.

3.1 Turquoise Lake Fire, 2010

The Turquoise Lake Fire occurred in south central Alaska (map zone 73) from May 22, 2010, through June 2, 2010. The fire burned to its final size of 99,246 acres by the night of June 1, 2010. Suppression actions on this fire are unknown, but it is assumed they were limited based on the shape and extent of the final perimeter. The year 2010 was very dry and drought conditions occurred in the spring due to low winter moisture throughout central Alaska. Energy Release Component figures from Farewell RAWS indicated the 90th percentile in fuel dryness over a 10-year average for the period being analyzed. Wildland fire torching and runs of active crowning were suspected in the fire activity.

The vegetation of the site in LF 2008 data is characterized as a mixture of numerous EVT's and barren areas. Western North American Boreal Mesic Scrub Birch (2610) represents the largest portion of the burned area with White Spruce (2600, 2603), Black Spruce (2604, 2751), Birch-Aspen (2605), and Alder Shrubland (2609) all being well represented.

The final fire extent used for this comparison was the infrared (IR) map acquired June 1st at 2200 hours. The fire progression maps are used for approximate ignition locations for this report.

LF 2001 and LF 2008 data sets were identical in portions of the fire that burned in the simulations. There were some previous disturbances due to fires that had occurred on the landscape that were included in the LF 2008 data, but they were not involved in the simulation, so LF 2008 will be displayed in this report with LF National and not LF 2001 since it would be essentially the same as LF 2008.

3.1.1 Inputs

Weather, wind, and fuel moisture data supplied to the fire simulation was from Farewell RAWS located 8 miles to the northwest of the fire area. Values from the RAWS were used for fuel moisture, temperature, and relative humidity. The median value for 10-minute average and maximum gust wind speed was found for each hour and each burn period. These data were used as indicators for input into the model for projections across all the versions of LF fuel data used in the analysis. Wind direction had some minor adjustments to ensure fire spread was in the direction of the final perimeter. These median wind speeds did not allow for crowning in either the LF National or LF 2008.

FARSITE Comparison of LANDFIRE Fuel Characteristics Versions

Surface fuel models (FBFM40) for LF National and LF 2008 are displayed in Table 33 by EVT. The main differences between the two versions of LF are the way FBFM40 pixels are distributed across the landscape due to the change in cover and height in the two versions.

Table 36 - FBFM40 by EVT within the extent of the Turquoise Lake Fire.

Table 36 FBFM40 by EVT within the extent of the Turquoise Lake Fire..	
EVT	**FBFM40**
Boreal Mesic Scrub Birch (2610)	142, very little 143
White Spruce (2600, 2603)	165, some 161
Black Spruce (2604, 2751)	164,
Birch-Aspen (2605)	161
Alder Shrubland (2609)	161

The canopy base heights were generally similar in both versions of LF in the Spruce EVT's. Two separate simulations were produced for this fire; the first from the perimeter of May 26, 2010 with fire spreading on May 27, 2010, and May 28, 2010; the second from the progression perimeter of May 28, 2010, and fire spreading on May 29, 2010, and May 30, 2010. The Northern fire spread was the only part of the fire perimeter simulated. A 5-hour maximum burn period was initiated in the model with crown fire activity set to the Scott and Reinhardt method and spotting was enabled at 2.0% (Scott and Reinhardt 2001). A fuel moisture and environmental conditioning period was used from May 26, 2010, in the first simulation and May 26, 2010, through May 28, 2010 in the second. There was precipitation in the weather stream data inputs prior to May 26, 2010, and after May 30, 2010.

Figure 20 is the site for the Turquoise Lake Fire with the progression of May 22, 2010, through May 28, 2010. The first simulation depicts the daily fire spread from the fire extent on May 26, 2010, through May 28, 2010.

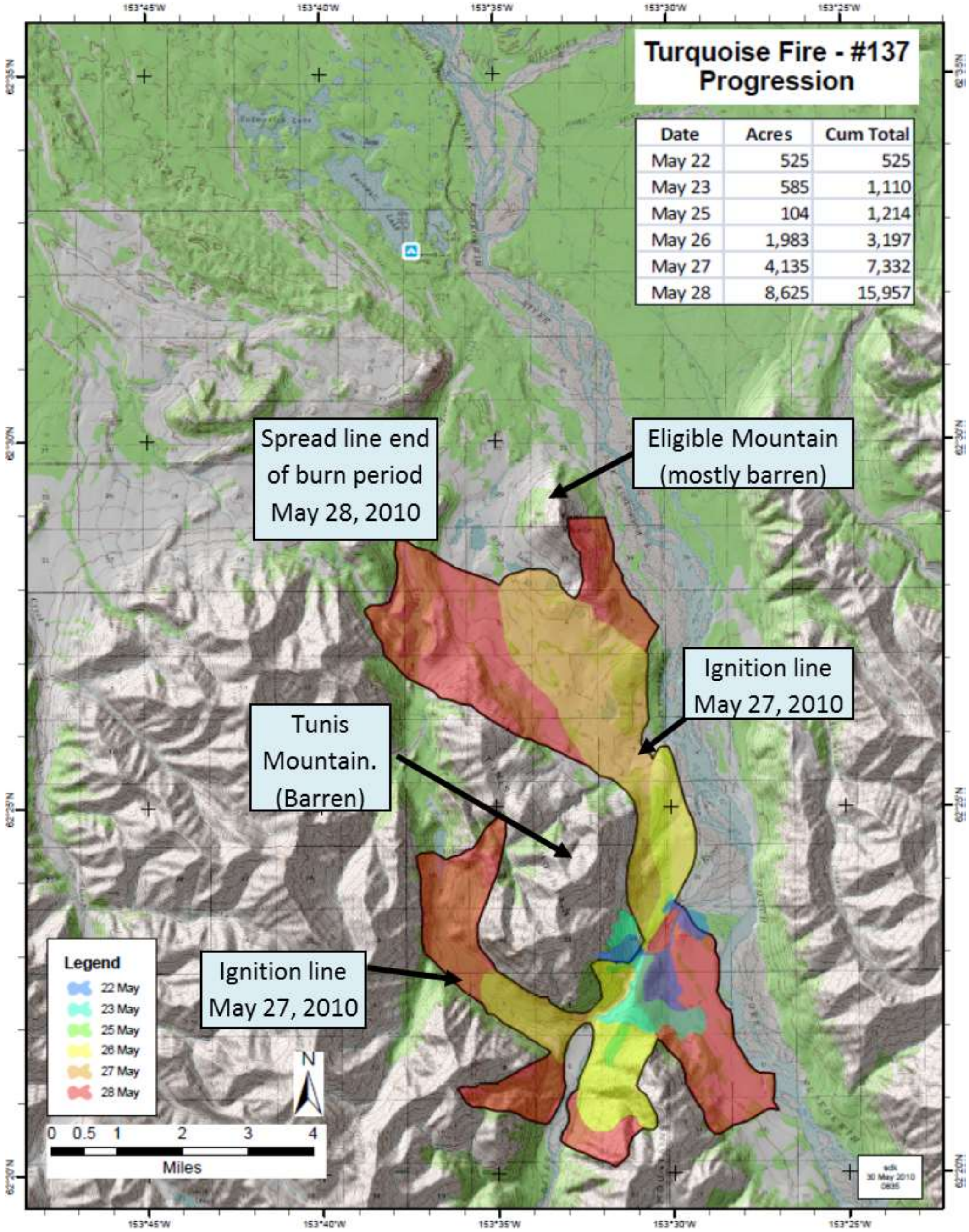


Figure 20- Turquoise Lake Fire Alaska May 22, 2010, through May 28, 2010. The fire extended nearly 33 miles from north to south.

3.1.2 Results

LF 2008 data closely predicted the fire spread (Figure 21) compared to the actual fire progression perimeter on the northern side of Tunis Mountain, however, somewhat under predicted the fire spread on the east side. In order to achieve this replication in the simulation, wind speeds were increased from the median 10-minute average and maximum gust wind speeds to maximum gust values.

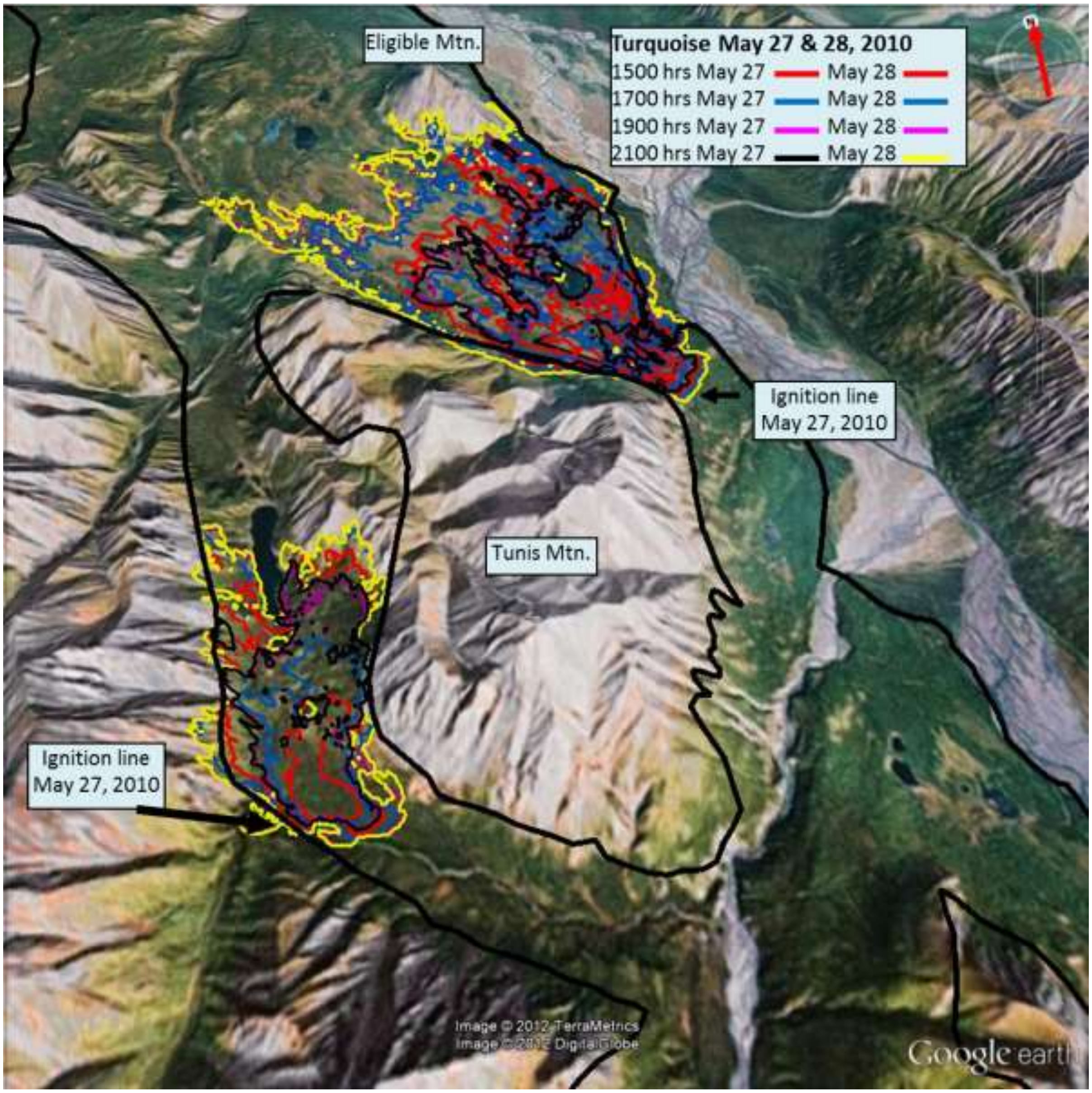


Figure 21– Turquoise Lake Fire simulations LF 2008 May 27, 2010, and May 28, 2010. The fire extended nearly 33 miles from north to south.

As discussed earlier, the wind speeds were increased (20-foot (ft) winds to 25 miles per hour (mph)) to insure fire crowning in the Spruce types to mimic suspected fire activity spread. The differences noted above about modeled fire spread differences between the northern and eastern sides of Tunis Mountain were evaluated and what seemed to keep the fire from spreading were the pixels of Timber Understory (TU) 1 (161) and Shrub (SH) 2 (142) that are interspersed throughout the landscape from EVT's 2605, 2609, 2600, and 2610. Figure 22 is a FlamMap depiction of the wind speed values (mid-flame) using the 25 mph 20-ft winds. The surface or mid-flame winds appeared reasonable for this evaluation given that a common median wind speed between the 10-minute average and the maximum gust wind speeds from Farewell during the burn period was 12 mph at 20-ft. For the crown fire rate of spread a reduction factor of 0.4 for the 20-ft wind per Rothermel was used (Rothermel, 1991).

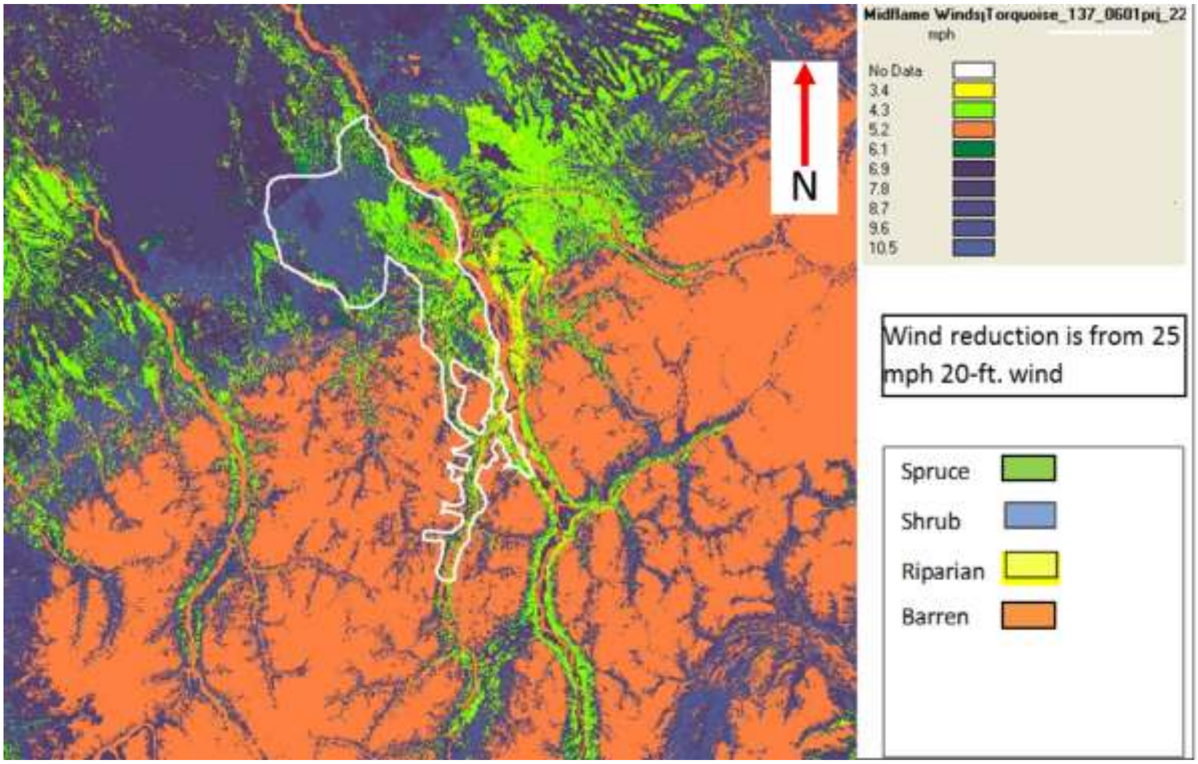
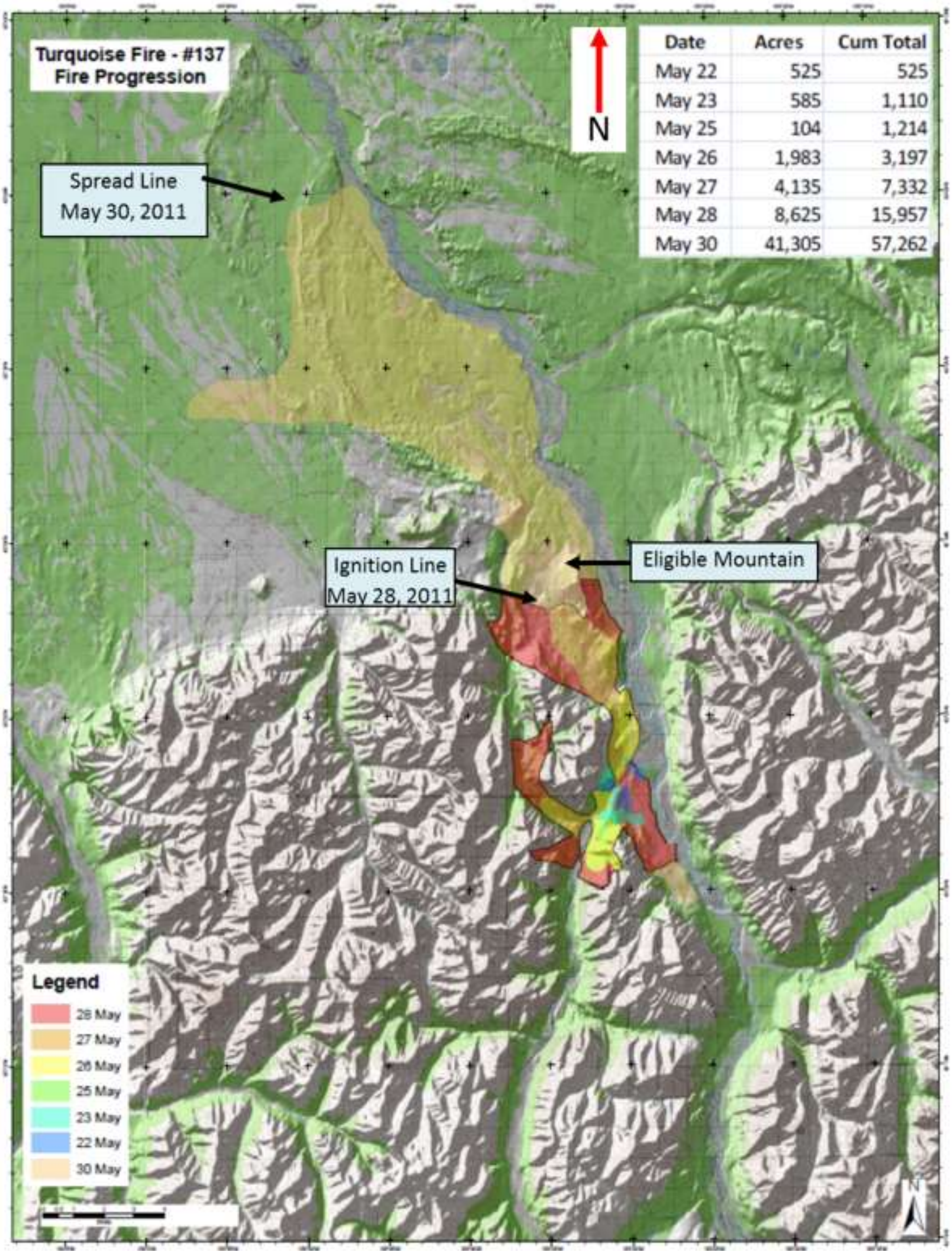


Figure 22– FlamMap Wind Reduction to Mid-Flame Wind Speed on Turquoise Lake Site. The fire extended nearly 33 miles from north to south.

The mid-flame winds in the model ranged between 3 and 5 mph to ensure active crown fire in the Spruce and the median wind speeds from Farewell RAWS multiplied by the 0.4 reduction value produced mid-flame wind speeds in that range across the site.

The progression maps only show a perimeter for May 30, 2010 (Figure 23); it is unknown whether the fire did not spread on May 29, 2010, or if it was just not mapped. Due to the burn period window of the simulation, the model spread the fire for 5 hours each of those two days to simulate the spread line of May 30, 2010. The ignition line for this simulation approximates the spread line from May 28, 2010, on the progression map.

The fuel moistures for May 29, 2010, and May 30, 2010, were reduced due to drying conditions on the site as indicated by the Farewell weather station as follows; 1 hour fuels to 4%, 10 hour to 7%, and 100 hour to 9%, with live herbaceous at 45%, and live woody at 85%. The simulation for May 29, 2010, and May 30, 2010, was performed using LF National and LF 2008 landscapes for comparison against the actual wildland fire progression.



Date	Acres	Cum Total
May 22	525	525
May 23	585	1,110
May 25	104	1,214
May 26	1,983	3,197
May 27	4,135	7,332
May 28	8,625	15,957
May 30	41,305	57,262

Figure 23 - Turquoise Fire Progression through May 30, 2010. The fire extended nearly 33 miles from north to south.

The LF National landscape differed from LF 2008 in surface fuel models primarily by the change in CC and CH between the two versions (Figure 23). The fuel model rule sets are based on CC and CH in each EVT, so changes in CC and CH resulted in a shifting of pixels in the fuel models.

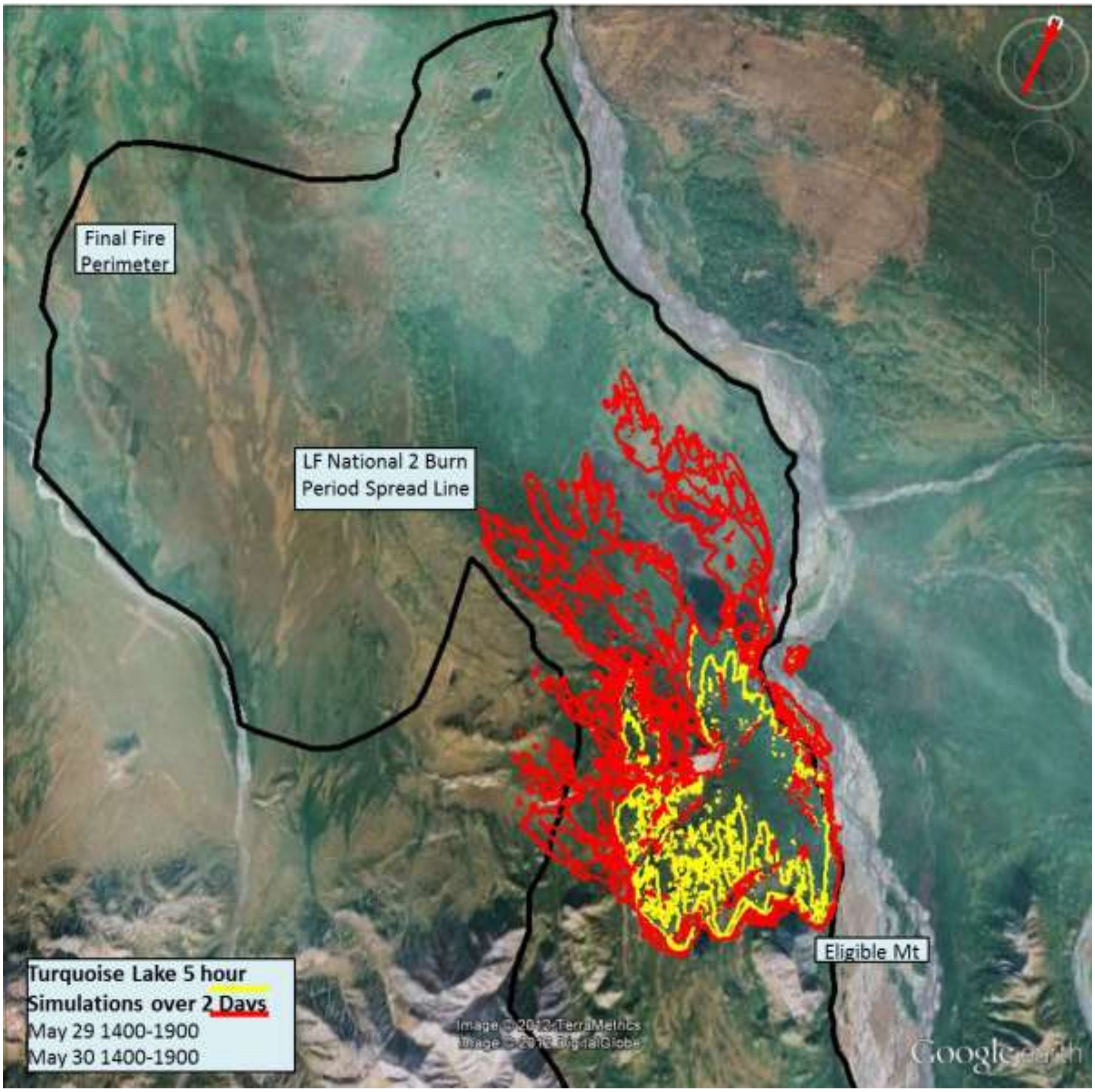


Figure 24– Turquoise Lake Simulated Fire Spread May 29, 2010, and May 30, 2010, using LF National data. The fire extended nearly 33 miles from north to south.

The same model inputs were used on the LF 2008 landscape file (Figure 24). Neither LF National nor LF 2008 landscapes produced the extent of the actual fire. There are several reasons why this may have occurred:

- Burn period of simulation needs to be increased.
- Wind speeds do not represent actual conditions on the fire site
- Turquoise Lake Fire burned under more extreme environmental conditions (drought) than the LF fuels layers were built to represent. FBFM40 TU1 (161) and SH2 (142) do not display extreme fire behavior characteristics without more extreme environmental conditions.
- Although, LANDFIRE and other mapping efforts have mapped Alaska, the lack of data and difficulties with existing Alaska data make mapping the State difficult at this time.

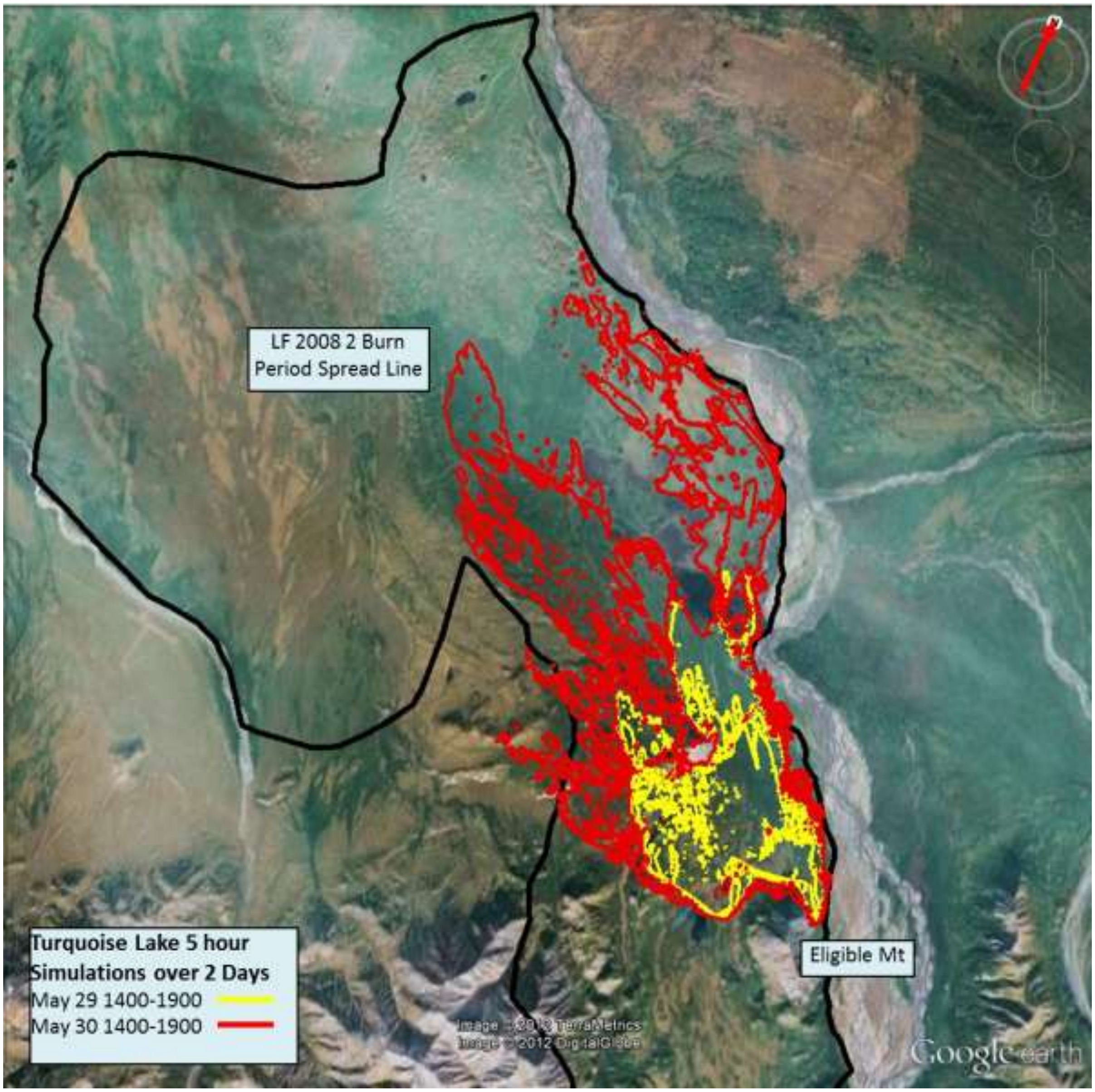


Figure 25 – Turquoise Lake Simulated Fire Spread May 29, 2010, and May 30, 2010, LF 2008. The fire extended nearly 33 miles from north to south.

The LF 2008 landscape burned to the top of the Spruce area in the projection before the end of the burn period and the area above the simulated fire extent is shrub FBFM SH2 (142). It is unlikely that the fire would have spread through the shrub area with much speed had it gotten there within the burn period. In comparison to the progression for May 30, 2010, the shrubland to the west of the simulated fire front should have been involved as well, but it was not in the model. It is important to note that this is just one fire, so further analyses are needed on other fires and in other locations throughout the State as well as future improvements in data.

4.0 LF 2001/2008 Organization

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5.0 Disclaimers

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These data and related graphics (such as ".gif" or ".jpg" file formats) are not legal documents and are not intended to be used as such. Users take full responsibility for their applications of these data. It is the sole responsibility and obligation of the user to determine whether the data are suitable for the intended purpose and apply those data in an appropriate and conscientious manner.

LF is not obligated to provide updates to the data herein, as they are and shall remain consistent with those used to develop the LF Program products. However, the LF Program will, at its discretion, continue using these and previously supplied and sampled data to update and improve future versions of LF products. Users of these data are requested to inform the LF Program of significant errors to assist with product maintenance activities. Please send your feedback to helpdesk@landfire.gov.

6.0 Additional Information

This section lists some, but not all, partners that the LF Program works with and relies on for information and data.

6.1 Landsat

The Landsat program within USGS is a critical partner in the development of LF data products. The 30-meter Landsat imagery constitutes the foundation upon which all data layers were mapped as well as updated. When LF began in 2004, the cost of Landsat data greatly increased costs associated with the development of LF data products. Now that these data are free, costs have decreased and data improvement opportunities similar to the LF 2008 update process are expanding.

6.2 Forest Inventory Analysis

USDA

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

The FIA Program of the USFS provides key information to LF about America's forests. FIA provides a continuous forest census and reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. Given the confidentiality of the FIA data, LF has a memorandum of understanding and supports an FIA employee who works with the FIA data, enabling LF to use this key resource. FIA has changed processes and procedures from a periodic survey to an annual survey and by expanding the scope of data collection to include soil, under story vegetation, tree crown conditions, coarse woody debris, and lichen community composition on a subsample of plots. LF will evaluate these data sets in the continual process to improve and update the LF data products.

6.3 National Agricultural Statistics Service

NASS provides valuable agriculture data for the entire United States. These data were extremely useful in assisting to delineate burnable and non-burnable agricultural lands. LF 2001/2008 used NASS data to refine the burnable/non-burnable lands data. LF and NASS will continue to work together in the future on additional LF data product improvements.

6.4 Multi-Resolution Land Characteristics Consortium National Land Cover Database

The Multi-Resolution Land Characteristics Consortium (MRLC) is a group of Federal agencies that coordinates and generates consistent and relevant land cover information at the national scale for a wide variety of environmental, land management, and modeling applications. The creation of this consortium (the LF Program is a member) has resulted in the mapping of a comprehensive land cover product, termed the NLCD, which is based upon a decadal composite of Landsat satellite imagery and other supplementary data sets.

LF has leveraged the MRLC NLCD2001 land cover product with the development of LF National (circa 2001) data and works to promote nationally complete, current, and consistent data across the Nation.

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7.0 Glossary

FARSITE—Fire Area Simulator, a fire behavior and growth simulator

Fire Effects—The physical, biological, and ecological impacts of fire on the environment (NWCG 2005).

Fire Occurrence Database—A collection of information about fires including elements such as, date, location, acres, cause, etc.

Landsat Imagery—Thematic Mapper and Enhanced Thematic Mapper Plus image data from the Landsat 5 and Landsat 7 satellites, respectively. Image scenes have a footprint area of approximately 34,000 square kilometers and a pixel resolution of 30 meters.

Monitoring Trends in Burn Severity—Relevant spatial and non-spatial fire data are mapped by the MTBS project. Data elements include the latitude/longitude of the centroid of the MTBS burn scar perimeter.

Normalized Burn Ratio—an index similar to the Normalized Difference Vegetation Index. The primary difference is that NBR integrates the two Landsat bands that respond most, but in opposite ways to burning. The Landsat Thematic Mapper/Enhanced Thematic Mapper Plus bands used to calculate NBR are Band 4 and Band 7. The NBR is calculated as follows: NBR = (4 - 7) / (4 + 7).

Prescribed Fire—Any fire ignited by management actions to meet specific objectives (NWCG 2005).

Remote Sensing Landscape Change— A process composed of four main elements. These are: 1) acquisition and compilation of field data; 2) wildfire burn mapping, as being conducted by the MTBS project; 3) updating and analysis using the VCT; and 4) mapping and incorporation of subtle intra-state changes, such as those related to insects and disease.

Spatial Resolution—The areal extent of the smallest unit, pixel, or feature that can be resolved on an image, map, or surface. Typically expressed as a measure of distance – for example, a 30-meter pixel – but can also be expressed as a unit of area.

Vegetation Change Tracker— The VCT is an automated and highly efficient algorithm for mapping changes in forest cover. The algorithm uses Landsat time series stacks, which are defined as sequences of Landsat images with a nominal temporal interval (for example, one image every year or every two years) for a particular location.

Wildfire—An unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out (NWCG 2005).

Wildland Fire—Any non-structure fire that occurs in the wildland. Three distinct types of wildland fire have been defined and include wildfire, wildland fire use, and prescribed fire (NWCG 2005).

8.0 Acronyms

8.1 Acronyms for Agencies and Organizations

Agencies and Organizations	
BIA – Bureau of Indian Affairs	BLM – Bureau of Land Management
DOI – Department of the Interior	FWS – U. S. Fish and Wildlife Service
NASS – National Agricultural Statistics Service	NPS – National Park Service
NS – NatureServe	TNC – The Nature Conservancy
USDA – United States Department of Agriculture	USFS – U. S. Forest Service
USGS – U.S. Geological Survey	

8.2 Acronyms for Terms, Information, and Systems

Terms, Information, and Systems	
AK – Alaska	BARC – Burned Area Reflectance Classification
BpS – Biophysical Settings	CBD – Canopy Bulk Density
CBH – Canopy Base Height	CC – Canopy Cover
CFA – Crown Fire Activity	CFFDRS – Canadian Forest Fire Danger Rating System
CH – Canopy Height	CONUS – Conterminous United States
CWD – Coarse Woody Debris	DDS – LANDFIRE Data Distribution Site
DWM – Downed Woody Material	EDNA – Elevation Derivatives for National Applications
ERC – Energy Release Component	ESP – Environmental Site Potential

Acronyms

EVC – Existing Vegetation Cover	EVH – Existing Vegetation Height
EVT – Existing Vegetation Type	FBFM13 – Fire Behavior Fuel Model 13, Anderson
FBFM40 – Fire Behavior Fuel Models 40, Scott and Burgan	FCCS – Fuel Characteristic Classification System
FERA – Fire and Environmental Research Applications Team – USFS	FFE – Fire and Fuels Extension
FIA – Forest Inventory and Analysis – USFS	FLM – Fuel Loading Models
FOFEM – First Order Fire Effects Model	FRCC – Fire Regime Condition Class (also known as LF Vegetation Condition Classes [VCC])
FRCCMT – FRCC Mapping Tool	FRG – Fire Regime Group
FVS – Forest Vegetation Simulator	GAP – Gap Analysis Program
GAP – Gap Analysis Program – USGS	GLM – General Linear Model
GR – Grass	GS – Grass-shrub
HI – Hawaii	hrs. – hours
HUC – Hydrologic Unit Code	IR – Infrared
LCP – FARSITE landscape file	LF – LANDFIRE
LFRDB – LANDFIRE Reference Database	LTSS – Landsat Time Series Stacks
MFRI – Mean Fire Return Interval	MRLC – Multi-Resolution Land Characteristics Consortium
MTBS – Monitoring Trends in Burn Severity	MTDB – Model Tracker Database
NBR – Normalized Burn Ratio	NC – North Central
NE – Northeast	NFDRS – National Fire Danger Rating System
NLCD – National Land Cover Database	PAD-US – Protected Area Database of the United States

PLS – Percent of Low-Severity fire	PM2.5 – total fine particulate matter emissions less than 2.5 micrometers in diameter
PMS – Percent of Mixed-Severity fire	PNW – Pacific Northwest
PRS – Percent Replacement-Severity fire	PSW – Pacific Southwest
QA/QC – Quality Assurance / Quality Control	RAVG – Rapid Assessment of Vegetation Condition after Wildfire
RAWS – Remote Automated Weather Station	RMT – Refresh Model Tracker (LF 2001/2008)
RSLC – Remote Sensing of Landscape Change	SC – South Central
SCLASS – Succession Class	SE – Southeast
SH – Shrub	SOW – Statement of Work
SSURGO – Soil Survey Geographic Database	SW – Southwest
TL – Timber litter	TU – Timber-understory
VCC – Vegetation Condition Class formerly known as LF FRCC	VCT – Vegetation Change Tracker
VDDT – Vegetation Dynamics Development Tool	VDEP – Vegetation Departure Index formerly known as LF FRCC Departure Index
VTDB – Vegetation Transition Data Base	WBS – Work Breakdown Structure
WFAT – Wildland Fire Assessment Tool	

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