



LANDFIRE Updates – LF 2019 Limited

Informational White Paper on LF 2019L and Transition to Annual Updates

Introduction

The purpose of this white paper is to provide Landscape Fire and Resource Management Planning Tools Program (LANDFIRE) product users with summary information about plans to transition the LANDFIRE (LF) program from LF 2016 Remap work to producing an annually updated product suite with reduced latency, starting with a transition project called LF 2019 Limited (LF 2019L).

The LF Program has produced comprehensive, consistent, and scientifically based products and associated databases for the United States and territories since 2004. These products provide data about the nation's major ecosystems, wildlife habitats, wildland fire regimes, fuels, and fire behavior. Since the development of the first LF base map, LF 2001 National (circa 2001), and the creation of a new base product, LF 2016 Remap (circa 2016), the products have been maintained with disturbance/change updates in order to be timely and relevant.

This document is presented in a question and answer format with questions about this transition and the LF 2019L project. The questions are presented in the Table of Contents (below) with bookmarks/hyperlinks so readers can easily navigate to information of interest. Although there are several questions covered in this document, LF product users may still have questions. As such, we encourage you to follow up with the LF helpdesk at helpdesk@landfire.gov.

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1. What is LANDFIRE?

LANDFIRE is a vegetation, fire, and fuel characteristic data creation program managed by both the U.S. Department of Agriculture (USDA) Forest Service (FS) and the U.S. Department of the Interior (DOI) with involvement from The Nature Conservancy (TNC). LF represents the first and only complete, nationally consistent collection of over 20 geo-spatial layers (e.g. vegetation, fuel, disturbance, events geodatabase, reference plot database, etc.), databases, and ecological models that can be used across multiple disciplines to support cross-boundary planning, management, and operations for all lands of the U.S. and insular areas at a 30m pixel resolution (Figure 1). LF products are designed to be used at the large landscape-scale in support of strategic vegetation, fire, and fuels management planning and to evaluate management alternatives across boundaries. LF products facilitate national, regional, and large landscape-level strategic planning and reporting of wildland fire and natural resource activities.

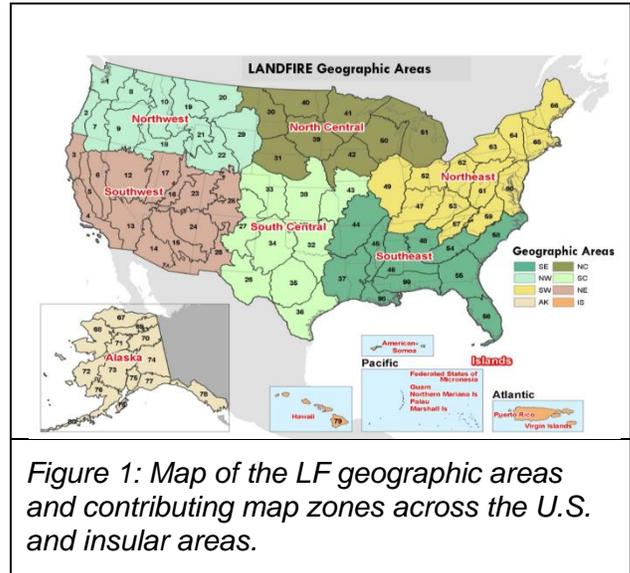


Figure 1: Map of the LF geographic areas and contributing map zones across the U.S. and insular areas.

2. Why was LANDFIRE developed?

In 2000 the Government Accountability Office (GAO) stated that "Federal land management agencies do not have adequate data for making informed decisions and measuring the agencies' progress in reducing fuels." In 2002, GAO reported (GAO-02-259) that "Data are not available to better prioritize communities and projects for funding," and concluded that "On the basis of our review, LF is the only proposed research project so far that appears capable of producing consistent national inventory data for improving the prioritization of fuel projects and communities." Beginning as a prototype in 2002, LF was chartered in 2004 by the Wildland Fire Leadership Council based on the need of accurate, complete, and comparable data for all lands.

3. Why is LANDFIRE transitioning to an annual update strategy?

Based on user feedback, the LF program is attempting to increase the frequency of releases and to reduce the latency of products. Our primary goal is to produce annual products that represent and reflect data conditions less than one year behind current conditions for disturbances. Our secondary goal is to produce products that represent data conditions reflecting growth that one would expect in areas of change/disturbances up to the year the product is delivered. This next version release of LF products is a key step toward an annual update strategy. The first few product releases will not just be an annual product set, but the data will comprise several years given that the last LF product was LF 2016. This next version will not update all the LF product components but is an important transition step for future annual releases. More information is provided in other questions within this document to help users understand the nature of these product sets and better decide if these updated products are suitable to meet their needs.



4. Why are LANDFIRE products named or titled the way they are? Why is this product called LF 2019L?

LF products are generally named or titled based on the year (or years) of data/disturbances represented for vegetation/fuel conditions of the time-period. For example, the LF 2014 biennial update was titled as LF 2014 because it incorporated disturbances, or changes, from 2013 and 2014. Based on new Landsat satellite imagery, LF 2016 Remap was called circa 2016 to indicate the best available imagery closest to that year and disturbances up through 2016. LF 2019L is titled as such because it includes changes/disturbances since the completion of LF 2016, for the years of 2017, 2018, and 2019. The “L” indicates that this version is a “Limited” data set because LF 2019L only focuses on updating areas of disturbance for the listed years from submitted or collected data providers, covers only CONUS, and produces a subset of products. Note: The non-disturbed vegetation is identical to LF 2016.

The LF 2019L updates were based on collected or submitted disturbances over the three-year time period of 2017-2019 (https://www.landfire.gov/participate_contribute.php) and national remotely sensed fire products, e.g., Monitoring Trends in Burn Severity (MTBS), Burned Area Reflectance Classification (BARC), Rapid Assessment of Vegetation Condition after Wildfire (RAVG). No other remote sensing change detection data (that had been included in previous LF updates) were included in LF 2019L. Data in these disturbed areas include “capable fuels*” bringing the data to a 2021 effective condition.

5. What is and is not included in the LF 2019L update?

This section is broken into three parts; disturbance, vegetation, and fuels to better help answer this question.

DISTURBANCE: LF 2019L only includes 2017, 2018, and 2019 disturbances submitted directly to LF or to national data bases (FACTS, NFORS) by December 31, 2019. It also includes all available fire program data (MTBS, RAVG and BARC) from those years and accessible during the production window. Although this document is being provided in 2021, it is important to note that disturbances from 2020 and 2021 are not included in LF 2019L. There are also no remote sensing change detection methods employed as part of this update to locate disturbances beyond those included in the sources listed above.

VEGETATION: Vegetation for LF 2019L pixels not mapped as disturbed by LF from 2017–2019 are identical to LF 2016 Remap. There is NO CHANGE to these LF 2016 vegetation products (Existing Vegetation Type, Cover, and Height – EVT, EVC, & EVH). The EVT for LF 2019L pixels mapped as disturbed by LF from 2017–2019, are transitioned to estimate conditions of EVC and EVH up to a 2021 growth state (capable fuels*) representative of the amount of successional change since the disturbance occurred. In LF 2016, some disturbed pixels were labeled as “Recently Disturbed” that included disturbance type, severity, and the time since the disturbance occurred. This distinction is important in that these recently disturbed classes show no change or growth that would contribute to a 2019 update condition in EVT, EVC, or EVH. Some of the pixels labeled “Recently Disturbed” could come from disturbances up to 10 years prior to LF 2016, i.e., as old as 2006 for high severity forest disturbances. As a result, if an area



labeled as a recently disturbed type in LF 2016 experienced another disturbance in 2017, 2018, or 2019, it is not represented or accounted for in LF 2019L. It is important to also note, as covered above, that disturbances from 2020-2021 are not included in LF 2019L.

FUEL: Fuels in LF 2019L pixels not mapped as disturbed by LF from 2012–2019, is identical to LF 2016 Remap; there is NO CHANGE to these fuel products. Fuels in LF 2019L pixels mapped as disturbed by LF from 2012–2019 are transitioned to estimate conditions to a 2021 capable fuel product. This “Year Capable*” product reflects regrowth of vegetation and fuels for areas identified as disturbed for the 10-year period prior to 2021. Note that disturbances from 2020 and 2021 are not included in LF 2019L.

6. What is the extent or coverage of LF 2019L?

The LF 2019L products only cover the Conterminous United States (CONUS); there are NO LF 2019L products produced for Alaska, Hawaii, or Insular Areas (OCONUS) because the LF 2016 OCONUS data were not complete when work on LF 2019L began.

7. Why are Alaska, Hawaii, and Insular areas not included in the LF 2019L update?

Data for the LF 2016 Remap were not fully complete for Alaska, Hawaii, and Insular Areas (OCONUS) when the work for LF 2019L began. Since the LF 2016 data serve as the base data upon which the updates were incorporated, work in these areas could not proceed concurrently. These areas will be incorporated in future updates once the complete base map of LF 2016 is available. Production work on the OCONUS regions to produce updated products is still in process and updates to these areas will come later.

8. What is the planned delivery date of the LF 2019L products?

The plan was to deliver LF 2019L Fuels products on or before June 1, 2021. The Fuels products were successfully delivered before this target date, with the LF 2019L Vegetation products delivered shortly thereafter, in mid-June 2021. This type of delivery follows what the LF program has done in the past with incremental delivery for geographic areas.

9. What products are produced as part of the LF 2019L update?

Table 1 provides the list of products that the LF program has produced, or explored producing, in the past. The table has been marked indicating what products were produced as part of the LF 2019L project.



Table 1: LF 2019 Limited Products list with LF 2019L Update Deliverables marked

Theme	Product Name	Abbreviation as applicable	CONUS	AK	HI	IA
Reference	LF Reference Database	LFRDB				
	Public Events Geodatabase - 17, 18, 19		Internal			
	Forest Vegetation Simulator Disturbance Database	FVSDDB				
Disturbance / Transition	Annual Disturbance (YEAR) - 17, 18, 19	DISTYEAR	Internal			
	Vegetation Disturbance	VDist				
	Fuel Disturbance (2021 Capable)	FDist	x			
	Historical Disturbance	HDist				
	Vegetation Transition Magnitude	VTMYEAR				
	Forest Vegetation Transitions Database	FVTDB				
	Non-Forest Vegetation Transitions Database	NFVTDB				
Vegetation	Existing Vegetation Cover	EVC	x			
	Existing Vegetation Height	EVH	x			
	Existing Vegetation Type – Ecological Systems	EVT-ES	x			
	Existing Vegetation Type – Natl. Veg. Classification	EVT-NVC				
	Dominant Cover Type	DCT				
	Attributed data – Crosswalks to Society of American Foresters/Society for Range Management/NVCS > for EVC, EVH, EVT, DCT					
Potential Vegetation	Biophysical Settings	BPS				
	Environmental Site Potential	ESP				
	Biophysical Settings Models and Descriptions					
Fuel and Seasonal	13 Anderson Fire Behavior Fuel Models	FBFM13	x			
	40 Scott and Burgan Fire Behavior Fuel Models	FBFM40	x			
	Landscape File	LCP/GeoTIFF	x			
	Canadian Forest Fire Danger Rating System	CFFDRS				
	Forest Canopy Bulk Density	CBD	x			
	Forest Canopy Base Height	CBH	x			
	Forest Canopy Cover	CC	x			
	Forest Canopy Height	CH	x			
	Fuel Vegetation Type	FVT	x			
	Fuel Vegetation Cover	FVC	x			
	Fuel Vegetation Height	FVH	x			
	Fuel Characteristic Classification System Fuelbeds	FCCS				
	Modeling Dynamic Fuels with an Index System	MoD-FIS				
Fuel Rulesets Database						
Fire Regime and Vegetation Departure	Fire Regime Groups	FRG				
	Mean Fire Return Interval	MFRI				
	Percent Low-Severity Fire	PLS				
	Percent Mixed-Severity Fire	PMS				
	Percent Replacement-Severity Fire	PRS				
	Succession Classes	SClass				
	Vegetation Condition Class	VCC				



	Vegetation Departure Index	VDep				
Topographic	Aspect	ASP	x*			
	Elevation	DEM	x*			
	Slope	SLP	x*			

CONUS = Continental United States

AK = Alaska

HI = Hawaii

IA = Insular areas of the United States

x = Products produced/delivered

x* = Products as part of the LCP/GeoTIFF

More information on each of the LANDFIRE products can be found at: http://www.landfire.gov/data_overviews.php.

10. How are the LF 2019L products developed?

The LF 2019L products were developed through two principal pathways, both using disturbances from 2017, 2018, and 2019 for fuels and vegetation. These two sections are broken out below.

As part of both pathways, the LF program has several rulesets, or tables, that have been developed over the years. Some of these are not available in a public form; however, those that are available have been posted on the LF website. The LF2019L rulesets were derived from these rulesets but updated to apply to LF 2016 Remap codes for EVT, EVC, and EVH. Relative to LF 2019L rules, these are not being made available due to the on-going transition work from the LF 2016 effort to that of producing annual updates as described in question #3. As this work progresses, these rules, or a refined set, may be made publicly available in the future.

Two examples of the publicly available rulesets on the LF website are the Forest Vegetation Transitions Database (FVTDB), which describes post-disturbance vegetation changes through 2014 for EVT, EVC, and EVH (https://www.landfire.gov/lf_transitiontbls.php) and the Fuel Rulesets Database, which is part of the LF Total Fuel Change (LFTFC) tool. This database has rules structured around EVT, disturbances, and map zones (Figure 1) with combinations of cover, height, and Biophysical Settings (BpS). The latest fuel rulesets database that includes updates based on LF 2019L are available at https://www.landfire.gov/fuel_rulesets_db.php.

FUEL: Changes to fuels layers brought on by disturbance and succession for LF 2019L are similar to methods used in LF 2016 Remap. Adjustments to fuels due to disturbance are based solely on the originally designated vegetation (pre-disturbance) that existed on site before the change occurred. The pre-disturbance vegetation is important and needed to establish and track fuel characteristics over time. This method of accounting (foundation for LF 2016 and building blocks for LF 2019L) for change, canopy cover, and height was produced from linear models derived from outputs of the Forest Vegetation Simulator using pre-disturbance Fuel Vegetation Cover (FVC) and Fuel Vegetation Height (FVH) for forested vegetation. For non-forested areas, user-defined surface fuel transitions were assigned.

Using the Fuel Disturbance (FDist) layer, a 10-year window is established to track the type and severity of the disturbance for the fuel vegetation. For 2019L, the 10-year window is 2011-2021. This indicates that the time since disturbance attribute is calculated from the 2021 capable*



year. The disturbances represented in FDist are only available for 2011-2019. In the case of a 2019 disturbance, the time since disturbance would be represented in the FDist layer as two years. More information about these processes are available in documentation on the LF website (<https://www.landfire.gov>). To learn more about “Capable” fuels (*), please access links provided at the end of this document.

VEGETATION: At the core of the LF 2019L products are rulesets, or tables, that inform the vegetation transitions from a disturbance or change. These rules incorporate disturbance type, severity, and time relationships in order to populate vegetation changes for disturbed areas producing updates to vegetation products. These rulesets account for transitions between pre-disturbance/treatment EVT, EVC, EVH and post-disturbance/treatment EVT, EVC, EVH. Rules have been developed through a hierarchical process in order to leverage disturbance or change outcomes nationally, regionally, and sub-regionally so all possible outcomes are accounted for to the extent possible. The vegetation rulesets are processed through a software-based ecological simulation tool called ST-Sim, short for “state-and-transition simulation model.” This work has been performed in partnership with a company called Apex Resource Management Solutions (commonly known as “Apex”). ST-Sim can be downloaded from the Apex website (<https://apexrms.com/landscape-change/>), along with tutorials and a host of other resources.

11. How are LANDFIRE products generally made and how are they being used?

There are several documents that detail how LF products are made and used. They are available on the LF website at https://www.landfire.gov/lf_methods.php and https://www.landfire.gov/lf_applications.php. In a lot of planning and applications of the products (how are they used), the EVT, EVC, EVH, lifeform (with its cover and height aspects), disturbance, fuel models, etc. are very important for natural resource and wildland fire management activities ranging from vegetation/fuel, habitat, modeling, assessments, analyses, etc.

12. What is the difference between updating vs. remapping?

Update: An update is a short-term improvement to the data focusing on areas of change/disturbances and successional vegetation growth. In the past, LF produced updated products approximately every two years (Biennial updates: LF 2008, LF 2010, LF 2012, and LF 2014). With the completion of LF 2016 Remap, the LF program is shifting to an annual update to address user feedback on the frequency and latency of the LF products.

Remap: A remap is a longer-term and more comprehensive product that incorporates improvements, innovations, and advancements in data and science, as well as new base imagery to provide for national currency of the products across all lands/pixels. A three-year (or longer) period has historically been necessary in order to piece together a wall-to-wall image across the nation to reduce data anomalies, such as clouds or cloud shadows, and to build the composite image that serves as the base for mapping work. LF 2016 Remap was the first remap for the LF program. The interval between the original base map, LF 2001 National, and LF 2016 Remap was approximately 15 years.



13. What is the target delivery date for future LANDFIRE annual update products?

The LF program is targeting delivery of annual update products on or before June 1st of each year, depending on the products. Although fires do occur year-round in the U.S., the largest portion of wildland fires occur during the summer months, so having updated data available for use before this time period is critical.

14. How is the LANDFIRE program transitioning to this annual update strategy?

At the time of this writing we are in calendar year 2021 and the LF 2016 products represent 2016 conditions. This means that LF products do not account for four years of disturbances or landscape changes. As such, the LF program is transitioning production work to be in a position where annual updates can be accomplished. Also factoring into this is that LF 2016 Remap for Alaska has not been fully completed. The transition includes these broad general elements:

- Moved the LF data call date for vegetation/fuel disturbances/changes from March of each year to November. Data being submitted by November 30th of each year will encompass fiscal year data. This earlier submission is critical to allow for processing and production time for a new annual national product suite by June 1st of each year.
- Partitioned work into two segments during the transition period – limited and full updates.
 - The first segment is being called limited because it focuses on disturbed areas only, or areas of change for the years 2017, 2018, and 2019, based on user/partner submitted data, as well as available MTBS, BARC and RAVG data at the time of production. Availability of these national fire program datasets could vary by GeoArea. This limited update will not incorporate LF's comprehensive Remote Sensing of Landscape Change (RSLC) methodology and no aging or successional growth to undisturbed areas; however, the LF 2019L products are produced with a 2021 "capable*" status. As noted in the questions/answers above, the LF 2019L product set is limited in several important ways. Understanding the nature of these limitations helps product users decide if LF 2019L is suitable for their analysis and project needs. Knowing the limitations also helps users interpret any results from modeling or other analytical uses of the data.
 - The second segment will be a full update similar to what LF has produced in past updates. These updates incorporate both user/partners submitted disturbances/changes, all available MTBS, BARC and RAVG data, as well as LF's comprehensive remote sensing of landscape change (RSLC) outputs for all years since LF 2016 Remap.

Depending on development progress during this transition to annual update approach, the LF program may produce a limited product followed by a full product. This pattern may enable the program to be able to transition to an annual schedule that accommodates all program aspects annually.

It is not clear if the program will be able to fully process a year's worth of data and deliver products within a one-year time frame. Assuming both user/partners submitted polygons, as well as remote sensing work, can be processed in the time frame required, LF will be producing



annual updates. As technology improves and data become more available, the need to differentiate between short-term updates versus long-term remaps may also no longer exist. A goal of the LF program is to use the best technology and data more quickly, so in the future, map products may be able to reflect national currency of the products faster.

* To learn more about “Capable” fuels, please see
https://www.landfire.gov/documents/Summary_LF_capable_fuels.pdf
https://www.landfire.gov/documents/Capable_Fuels_TD.pdf