



Operations and Maintenance Technical Plan

February 26, 2008



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REVISION AND HISTORY PAGE

Document Version #	Revision Date	Description of Change	Section #/ Paragraph #	Name
1.0	5-25-07	Consistency edits, formatting,	Throughout	Crittenden
1.1	6-8-07	EOC initial comments		Crittenden / Bastian
1.2	6-25-07	Technical Team revisions	Throughout	Crittenden/ Bastian /Rollins
1.3	10-31-07	NIFC Scoping meeting, NFAEB, and EOC comments	Throughout	Bastian
1.4	11-28-07	Consistency edits - formatting	Throughout	Bastian / Crittenden / Jeske
1.5	1-7-08	Final Team and EOC review	Throughout	Bastian

CURRENCY OF PLAN

This Operations and Maintenance Technical Plan was written with the best available information at the time. This plan and associated information contain dates that may need to be adjusted dependant on plan approvals and LANDFIRE governance decisions. The simple act of putting thoughts to paper will at some time in the future cause the information and materials documented and referenced in this plan (as well as the business case) to become outdated, obsolete, or over taken by management events. The program sponsors along with agency and departmental leadership will provide program oversight and direction.



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1. Scope

This document outlines the technical development and production tasks necessary for the operations, maintenance, improvement, innovation, and governance of the LANDFIRE program. It is a companion document to the Operations and Maintenance (O&M) Business case and the O&M budget outline.

In the context of this technical plan:

- 1) 'Operations' refer to the continued archiving, documentation, technical transfer, user-support, communications/outreach, and distribution of data products. This includes providing and managing the computer infrastructure to support these services. Operation service providers are responsible for archiving data products from the initial cycle of LANDFIRE including the LANDFIRE reference database.
- 2) 'Maintenance' refers to the actual updating of LANDFIRE data products. LANDFIRE maintenance will be implemented to capture landscape changes that alter vegetation using three approaches. The three approaches are Refresh, Biennial, and Decadal; listed in the following sections: 5.1 Refresh, 5.2 Biennial, and 5.3 Decadal comprehensive re-mapping.
- 3) 'Improvement' refers to developments (technological and scientific advancements) approved through the governance process, that maximize maintenance efficiencies, product quality, timeliness, and ensure that defensible science is brought to bear on data products.
- 4) 'Innovation' refers to the development of new data products or changing existing products for applications outside of the scope of the existing LANDFIRE executive charter or approved program. Innovations are outside the scope of this technical plan; however the process to review innovations is addressed in the business case.
- 5) 'Governance' refers to oversight, roles and responsibilities, and a standard business process for implementing the elements listed above. Governance is addressed in more detail in the business case. The "Governance" process of the LF program may change or modify business or technical elements prescribed in this Technical Plan or in the Business Case as agreed upon by this governing body to achieve departmental or agency needs or objectives.

2. Justification

The LANDFIRE program data products are designed primarily to support 1) national strategic planning, 2) regional (single large states or groups of smaller states), and 3) strategic/tactical planning for large sub-regional landscapes (for example, significant portions of states, multiple federal administrative entities). These, respectively, are the primary, secondary, and tertiary uses and user groups of LANDFIRE data products and reflect the appropriate scale and uses of the data. The Fire Program Analysis (FPA) system is an example of a primary intended use of LANDFIRE data products. This O&M technical plan describes the development of up-to-date products



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to run systems such as FPA and ensure that management planning and budgeting are based on the best and most current data available. The LF data products will facilitate analyses that evaluate the effectiveness of fire management strategies through time to meet land management goals and objectives. As required by the LANDFIRE Executive Charter, recent Government Accountability Office reports, and federal wildland fire policy, the justification for LANDFIRE O&M rests in the need for managers to have consistent up-to-date, reliable data to support natural resource and fire management activities. The focus of LANDFIRE O&M is on consistency, currency and reliability. The initial cycle of LANDFIRE data products represents a baseline. Without an O&M program, LANDFIRE data will not be updated. The \$40M investment in the baseline data will have been made to produce data that is useful only for a brief period of time as the data becomes outdated. The goal of this plan is to protect the investment in LANDFIRE and to ensure that data products remain effective, useful and accessible for a broad range of user communities through 2025. Near this time, a new update plan for O&M will be needed.

3. Timeline and Organization

This plan presumes that the O&M program initiation will begin in FY2008. The timeline diagram in Figure 1 depicts each of the program aspects as they are implemented over time.

- 1) An O&M independent improvement staff, dedicated to develop and provide updated conditions will be assembled. When the improvement staff has been assembled, the LANDFIRE vegetation and wildland fuel products will be refreshed from the original base National Land Cover Database (NLCD 2001) data used for the initial cycle of LANDFIRE to the year 2009. The work is respectively portioned between a "Rapid Refresh" and a "Refresh." This work is a one time improvement that will be replaced by the Biennial update. The rationale for the independent approach (either through other government support or contracting) is to keep research, development, and production focused on meeting the criteria for the biennial and decadal processes.

The "Rapid Refresh" will incorporate major, detectable, large scale disturbances that occurred between 1999 and 2007 with updated fire behavior products delivered in June 2008. This will include available data from the Monitoring Trends in Burn Severity (MTBS) project which currently includes fire disturbances of at least 1000 acres in the western U.S. and 500 acres in the east (standards for fire management spatial data will be coordinated through the governance organization).

The "Refresh" will incorporate landscape scale changes to vegetation, fire behavior fuels, SClass, and potentially fire effects data products refreshing the data products from the initial LF 2001 (1999-2002) data up through CY2009. This approach will include MTBS data or other major, detectable, large scale changes



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and disturbances to vegetation caused by such events as hurricanes, tornadoes, and insects/disease.

- 2) In FY2009 a maintenance staff will be assembled that will be tasked with the Biennial maintenance of LANDFIRE products. This is the beginning of the long-term maintenance of the LF products vs. the short-term improvements accomplished by the Rapid Refresh and Refresh. There will be a two year period of overlap between the maintenance and improvement staffs. The Biennial maintenance staff is tasked with reviewing the updating approaches developed by the improvement staff, refining the national biennial Research & Development (R&D) methodologies, and developing a process and delivering data products biennially for landscape scale changes. This maintenance staff will complete the R&D tasks needed to implement the biennial update process with the first biennial products for the nation completed in 2011. Depending on the scope of the R&D elements, some of these elements may be processed through the innovation approach described in section 6. Biennial maintenance will be structured to be conducted by either government employees or contractors. The Biennial maintenance team will work closely with, but be distinct from the operations and improvement teams.
- 3) To prepare for and in connection with the first decadal re-mapping effort in FY2015, a reference database staff will be established to begin the compilation of recently collected field data for the nation. Data sources will include FIA and contacting any previous data contributors or potential new sources of data.
- 4) A decadal maintenance re-mapping staff to implement the second comprehensive remap of all lands in the United States will be put into operation by FY2017, with a complete remap of the United States completed in FY2020. This decadal update will be based on the NLCD remapping work. In conjunction with the remapping staff, the biennial maintenance will continue to work on updates.

4. Operations

Operations are composed primarily of two components; data distribution and technology transfer. This includes the continued archiving, documentation, technical transfer, user-support, communications/outreach, and distribution of data products.

Data distribution — provides and manages the computer infrastructure to support LANDFIRE data archiving, access, and distribution capability for a period up to 2025 (LF Data Distributions operations are funded by the current project through the end of FY2009). At this time the distribution strategy will need to be re-evaluated and updated. LANDFIRE operations will be the responsibility of the USGS. The system will be automated with a minimum of human interactions where data access and distribution occurs without the need for in-depth interface with the user, except for basic customer support. The operational paradigm also includes equipment and services to provide continuity of operations for uninterrupted data distribution services and data backup. Operation service providers are responsible for archiving



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data products from the initial cycle of LANDFIRE including the LANDFIRE reference database. The operations paradigm includes addition of new data as LANDFIRE data products are updated and remapped and the addition of LANDFIRE updates yet maintaining a separate database of the initial cycle of LANDFIRE products as a baseline. The biennial updates will be maintained on the distribution site for input into the decadal remapping effort. Once the decadal remapping is completed these updates will be removed and replaced by the next generation of biennial updates. As was provided for in the initial cycle, products will be available on an as needed basis via digital versatile disc (DVD) for those customers with limited network access.

Technology transfer — under LANDFIRE O&M consists of maintaining the curriculum for two training courses: on-line course(s) similar to the current FOR-437 (narrated tutorial and self-study course); and a face-to-face workshop or integrated into another course or curriculum as part of other structured training similar to the current FOR-438, “Fuel Assessment Techniques using LANDFIRE data”. Collectively, the curricula and content of these courses will be adjusted to meet changing user-support needs and changes in application technology. It is expected that user needs will sharply increase as the utility of LANDFIRE data products evolves. The goal for the future of LANDFIRE technology transfer is to look for opportunities to transfer this responsibility from the current Interagency Fuel Group sponsored National Interagency Fuels Technology Team to more established training programs and curricula (for example, the National Advanced Fire and Resource Institute, Fire Modeling Institute or through the NWCG curriculum). Technology transfer will also support and provide for communications and outreach needs of the program.

5. Improvements and Maintenance

Maintenance efforts will be implemented and informed from the improvements of the Rapid Refresh and Refreshed data update processes (characterizing changes that have occurred between 1999 and 2009). Timeline and Organizations are addressed in section 3. The Department of the Interior (DOI) U.S. Geological Survey (USGS) is the likely lead agency of this national maintenance team for the duration of the maintenance period. DOI would serve as the lead agency because of the connections with Landsat, NLCD, and National Map systems through EROS (USGS – Earth Resources Observation Systems) focusing on the maintenance needs to identify and characterize vegetation changes. LANDFIRE will update vegetation and wildland fuel data products.

The improvement and maintenance portions of the program will leverage existing federal programs such as MTBS, Forest Health, and Burned Area Reflectance Classification (BARC). Depending on the development and improvement processes, some other elements may be incorporated such as, National Fire Plan Operations Reporting System (NFPORS), USFS FACTS, or other programs that track landscape changes.

A key component of the maintenance and improvement part of LF O&M is to build upon the lessons learned from the initial mapping effort. Information collected as part



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of the LF After Action Review (AAR) Workshops as well as comments received through the LF helpdesk will be analyzed and evaluated for incorporation during the maintenance updates.

As science evolves and new technologies are implemented (for example, LIDAR data for characterizing canopy fuel) over the 10 year updating time frame of LANDFIRE, the program will evaluate and potentially incorporate these new up-to-date science and standards as improvements to the data products. These new improvements would be addressed by a change management board or technical advisory group through LANDFIRE governance. If science and technological advances would change the scope of the production processes they will be evaluated as an innovation through the governance process described in the O&M business case.

Improvement updates are proposed in these staged phases:

Refresh

Refresh is intended to be a one time improvement that will be replaced by the Biennial update. The approach may include a combination of the below or be modified based on LF governance.

1A) - The "Rapid Refresh" will incorporate major and detectable large scale disturbances that occurred between 1999 and 2007 with products delivered in June 2008. This process will refresh Fire Behavior Fuel Models (FBFM) layers principally focused on landscape areas that have been affected by wildland fires.

1B) – The "Refresh" will incorporate landscape scale changes to update Existing Vegetation Type (EVT), fire behavior fuels, SClass, and potentially fire effects data products for landscape changes that occurred between 1999 and 2009.

Maintenance updates are proposed in these staged phases:

Biennial

2) Biennial updating of LANDFIRE products using change detection procedures will be conducted from FY2011 through FY2025.

Decadal

3) Decadal remapping of LANDFIRE products using the refreshed, biennial, and change detection processes will be conducted from 2017 through 2025.

Improvement and Maintenance Program Product Review

The development of a national survey of uses of LANDFIRE data will be a critical task of LANDFIRE operations (for example, LANDFIRE questionnaire and after action review meetings). The results of these survey/meetings will be used to



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develop a standardized review process with a focus on which products need to be evaluated, how comments should be submitted, and how comments will be incorporated in updated LANDFIRE data products. The survey will be used as the indicator of the overall LANDFIRE product quality, hence addressing current limitations in comprehensively assessing individual data layers and the integration of data layers. The survey will incorporate a rigorous statistical sampling design and be completed by the maintenance staff.

5.1 Refresh

The focus of the Refresh is to identify areas that have experienced landscape changes due to disturbance or land management activities since the initial suite of LANDFIRE products were completed. The national improvement team will work closely with, but be distinct from, the operations and maintenance teams. This independent improvement team(s) will work at the national level to provide refreshed products for those areas where LF products have been produced and where other national products are available (Forest Health, BARC, etc.) that can help support this update work. Product updates will refresh vegetation and wildland fuel products (9 of the original 21 mapped deliverables). This subset of the LANDFIRE data products is the focus of the refresh and biennial updates as these are the core data needed to characterize current vegetation conditions and associated fire behavior characteristics. The refresh improvement team(s) may also work with interagency Geographic Area (GA) or Fire Planning Unit (FPU) personnel to work through a structured systematic process updating vegetation, fire behavior fuels, SClass, and fire effects data. The basic premise of this option is two fold; one - provide rapidly updated products based on nationally available data and two – through an interagency GA or FPU approach to work through a structured critique process involving the review and update of areas (perimeters/polygons) that have experienced a disturbance creating a changed updated polygon and finalize updated data (This approach would provide a systematic methodology outlining specific standards and criteria that would need to be completed for the data to be certifiable). The approach may also use a local review. The updated data would then be reviewed and certified at a regional- to national- level (GA or FPU). When the updated data meets interagency standards (Federal Geographic Data Committee - FGDC, Geospatial, etc.), the data would then be submitted to the LANDFIRE program for quality assurance, quality control review, and assessment.

Deliverables are identified under each option but may be modified based on LF governance.

1A) – Rapid Refresh

LANDFIRE cycle one deliverables to be refreshed include the following:

1. **Fire Behavior Layers**

- 13 Anderson (1982) Fire Behavior Fuel Models
- 40 Scott/Burgan (2005) Fire Behavior Fuel Models
- Forest Canopy Bulk Density



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- Forest Canopy Base Height
- Forest Vegetation (stand) Height
- Forest Canopy Cover

1B) – Refresh

- May use where available Monitoring Trends in Burn Severity (MTBS) data, accomplished fuel and vegetation treatments, and possibly other disturbances.

LANDFIRE cycle one deliverables to be refreshed include the following:

1. **Fire Behavior Layers**

- 13 Anderson (1982) Fire Behavior Fuel Models
- 40 Scott/Burgan (2005) Fire Behavior Fuel Models
- Forest Canopy Bulk Density
- Forest Canopy Base Height
- Forest Vegetation (stand) Height
- Forest Canopy Cover

2. **Vegetation Layers**

- Existing Vegetation
- Existing vegetation height
- Existing vegetation cover

3. **Fire Regime**

- Succession Class

4. **Fire Effects** (May include these layers)

- Fuel Loading Models
- Fuels Characteristics Classification System

5.2 Biennial

The 'Biennial' update approach will capture major detectable landscape disturbances (for example, wildland fires, storm damage, insects and disease). This maintenance process will use research and development to create a change detection approach and to develop the vegetation and canopy/surface fuel modeling framework for the national approach.

The national maintenance team will be tasked with developing but 'not limited to': 1) methodologies for identifying areas of landscape change; 2) a transition database with algorithms that predict the vegetation that would be present in these changed areas based on the type and extent of change; 3) a system that updates wildland fuel (surface and canopy) based on the post-change vegetation; and 4) a process to evaluate structured/organized Geographic Area (GA) or Fire Planning Unit (FPU) updates that may help inform the update of products under the auspice of the national governance strategy. These structured/organized GA or FPU updates will include interagency coordination and collaboration to provide unified organized data in a structured form that meets agency standards (FGDC, Geospatial Task Group – GTG, Fire Environment Working Team – FEWT, etc.). These data sets, if broad enough in extent and coverage, may prove to be critical components to maintain the currency of LANDFIRE data products as deemed appropriate through the



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governance process. Research and development conducted during the initial years of this maintenance period is critical for the successful implementation of the update work conducted as part of the national biennial process for the duration of the LANDFIRE program

Every two years a new map updating these areas will be produced. These updates will feed into the decadal remapping. Biennial updates will focus on the same 9 vegetation and wildland fuel deliverables.

Biennial updates occur in a two stage approach:

- 1) Identification of areas that have experienced major changes due to disturbance or land management activities since the previous LANDFIRE mapping.
 - Improvement process – An approach will be developed to identify areas of change and set priorities for updating. We will leverage existing federal programs such as MTBS and investigate using data describing insect and disease outbreaks from the USFS Forest Health Monitoring program. Vegetation successional models will be updated during these biennial updates across super map zones to incorporate new information and provide improved detail for major disturbance processes. Other possible sources of disturbance information data include the National Fire Plan Operations Reporting System (NFPORS), USFS FACTS, or other programs that track major landscape changes.
- 2) Spatial updating LANDFIRE data products for these changed areas using satellite imagery and a disturbance transition vegetation database.
 - Improvement process – Vegetation dynamics models and related vegetation ecology databases developed during the initial cycle of LANDFIRE will be used to develop a database of transition algorithms that will predict vegetation composition and structure in the disturbed areas identified using the approach described above. Information from this database will be used to update existing vegetation type, vegetation cover, and vegetation height. This 'predicted' vegetation will be used to update LANDFIRE wildland fuel products.

Updated data products will be posted for dissemination early (no later than May 1) in the calendar year to ensure timely access for agency planning cycles and management operations.

LANDFIRE cycle one deliverables to be updated biennially include the following:

1. Fire Behavior Layers

- 13 Anderson (1982) Fire Behavior Fuel Models
- 40 Scott/Burgan (2005) Fire Behavior Fuel Models
- Forest Canopy Bulk Density
- Forest Canopy Base Height
- Forest Vegetation (stand) Height
- Forest Canopy Cover



2. Vegetation Layers

- Existing Vegetation
- Existing vegetation height
- Existing vegetation cover

5.3 Decadal Comprehensive Remapping

Comprehensive decadal remapping will capture gradual, cumulative, and broad-scale changes (for example, drought, invasive species, vegetation succession, loss of open space). Decadal re-mapping of applicable approved data layers will be updated or added for the decadal update. This may or may not include all of the original mapped deliverables during the initial LF initiative.

Decadal updates occur in a simplistic three stage approach:

- 1) Acquisition and processing of national satellite imagery catalog completed by EROS.
- 2) Compilation of recently collected field data for the nation. This may be conducted at Missoula Fire Sciences Lab (MFSL) similar to the initial LF mapping effort. This would include a staff person(s) to conduct work on the Forest Inventory Analysis (FIA) data to up date the LANDFIRE Reference Data Base (LFRDB).
- 3) Vegetation map unit refinement, remapping existing vegetation, refinement of environmental site potential and biophysical settings maps, and remapping vegetation dynamics models, wildland fuel, and fire regime data products using the consistent, comprehensive approaches developed during the first cycle of LANDFIRE.

LANDFIRE deliverables to be updated periodically (decadal) include the following:

1. Fire Behavior Layers

- 13 Anderson (1982) Fire Behavior Fuel Models
- 40 Scott/Burgan (2005) Fire Behavior Fuel Models
- Forest Canopy Bulk Density
- Forest Canopy Base Height
- Forest Vegetation (stand) Height
- Forest Canopy Cover

2. Vegetation Layers

- Environmental Site Potential
- Biophysical Settings
- Existing Vegetation
- Existing vegetation height
- Existing vegetation cover

3. Fire Regime Layers

- Successional class
- Fire Regime Condition Class (FRCC)
- FRCC Departure



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- Fire Regime Groups
- Simulated Historical Fire Return Interval
- Percent of non-lethal fire
- Percent of mixed-severity fire
- Percent of stand-replacement fire
- Succession Classes

Fire Effects Layers

- Fuels Characteristics Classification System (FCCS)
- Fuel Loading Models (FLM)

6. Innovation

Providing for new innovations in data products or changing existing products is outside the scope of this technical plan; however the process to review innovations is addressed in the business case under the governance process.

7. Governance

A governance board will be established to develop and monitor the long-term strategy and direction of the LANDFIRE program. See O&M Business Case plan for the overall details on the governance of LANDFIRE which addresses the Executive Oversight Governance Group (EOGG), Change Management Board (CMB), and the Technical Advisory Group (TAG).

8. LANDFIRE O&M Program

In this section a series of process and timeline diagrams are provided to illustrate the operational relationships within the program plan.

The timeline diagram in Figure 1 depicts each of the program aspects as they are implemented over time



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LANDFIRE Operations and Maintenance Program - Timeline

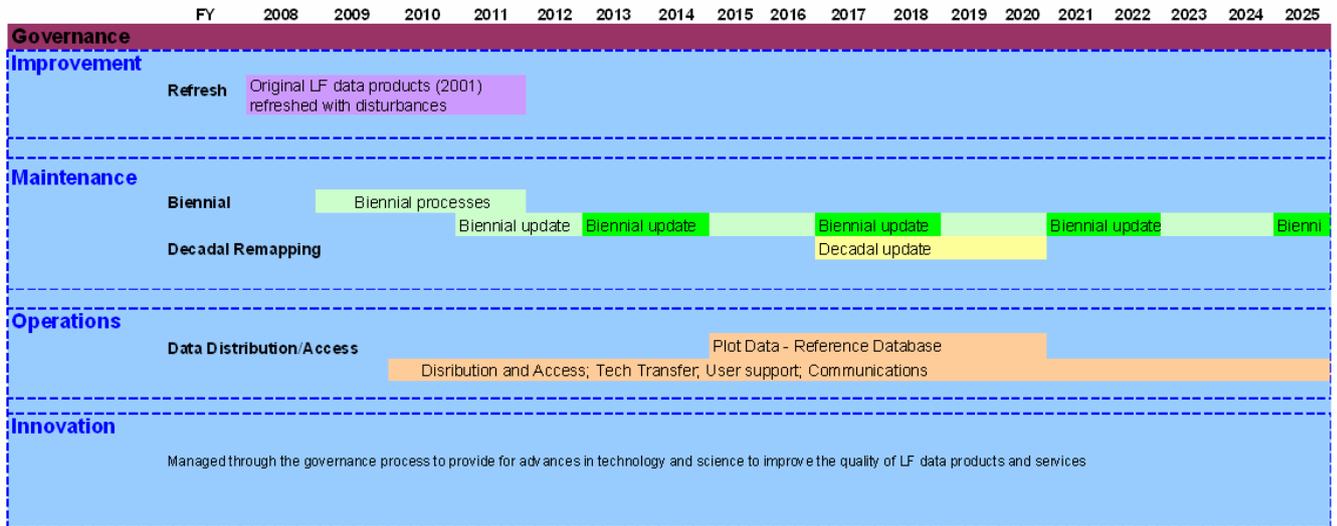


Figure 1. LF O&M Timeline

The swim lane diagram in Figure 2 depicts the transition from the initial LF investment to the integrated components of the program.



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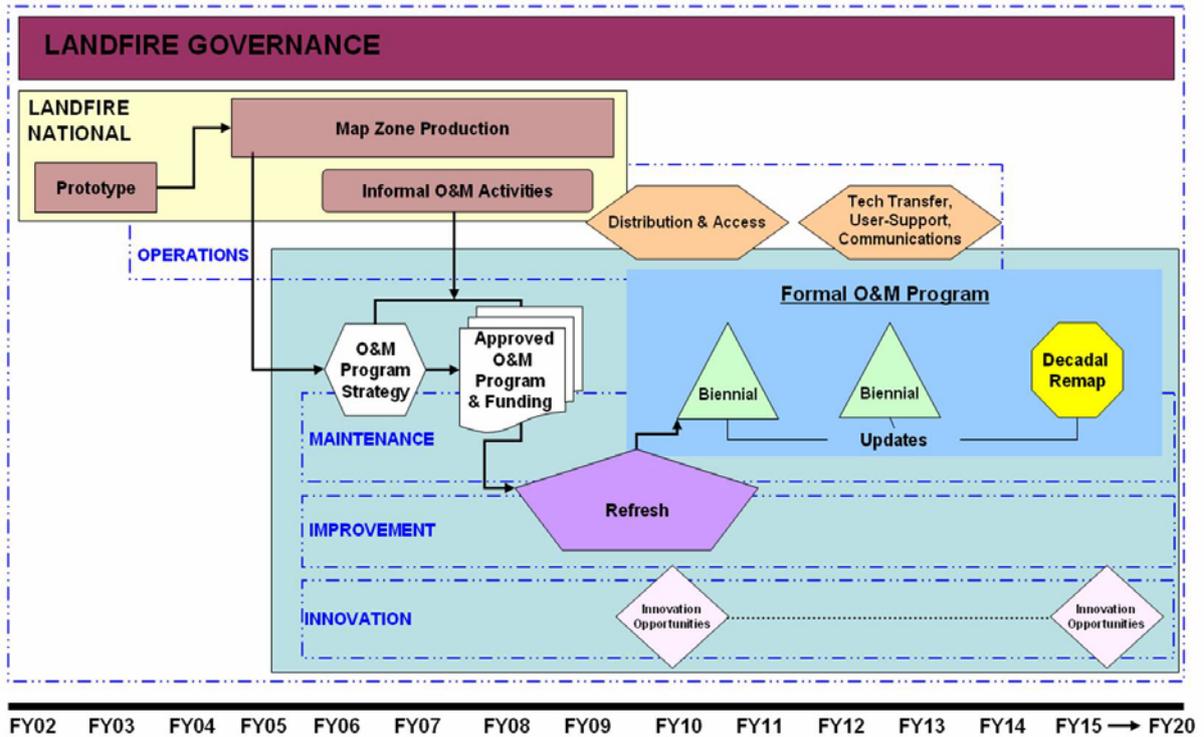


Figure 2. LF O&M Transition and Integration

The cycle diagram in Figure 3 depicts the adaptive management cycle of integrating the operations, maintenance, improvement, and innovation aspects of the program.



LANDFIRE Program Cycle

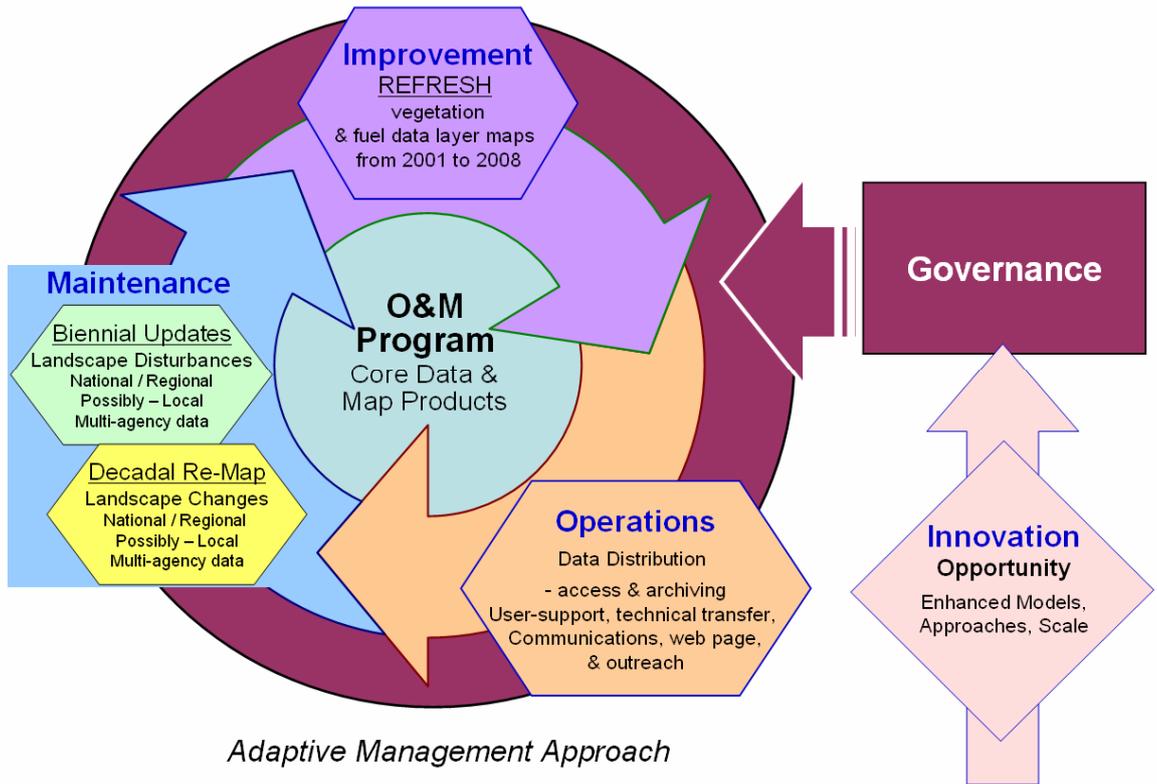


Figure 3. LF Program Cycle