West Wide Wildfire Risk Assessment Using WWA Data

The Council of Western State Foresters (CWSF) and the Western Forestry Leadership Coalition (WFLC) embarked on a wildfire risk assessment of all lands for the 17 western states and selected Pacific islands. This assessment is known as the "West Wide Wildfire Risk Assessment", or "WWA".

This document is intended to guide and describe potential uses for the WWA data.

How can I use WWA data?

- Do you need to prioritize where to commit limited wildfire mitigation resources?
- Are you curious about which counties in the West or your state have the highest wildfire risk, threat, fire effect or population living in wildland vegetation?
- Do you need to engage partners in discussions wildlife risk?
- Do you need spatial wildfire risk data to support development of Community Wildfire Protection Plans, County Natural Hazard Mitigation Plans, or other planning needs?
- Do you need consistent spatial wildfire risk data for across ownerships, county and state boundaries implement a landscape level National Wildfire Cohesive Strategy project?
- Is your state updating a State Forest Resource Assessment and Forest Action Plans and need spatial data that are consistent across ownerships and state boundaries to evaluate wildfire threat to homes, infrastructure, forests, drinking water, or riparian areas?
- Do you need update your Communities At Risk assessment?
- Do you need spatial data to help plan prevention, dispatch, response, or fuels activities?
- Would you like to see maps of fire behavior (rate of spread, flame length, canopy fire) at low to extreme conditions for your state?

Scale and intended use matters.

The WWA was conducted to support strategic planning at regional, state, and landscape scale. It was conducted at the regional level. It represents findings as of 2008, however key data used in the assessment varies with respect to accuracy and date of compilation.

Although products are delivered as 30-meter pixels, they should not be used at the individual pixel level or on small groups of pixels. Managers and planners must evaluate WWA data according to the scale and requirements specific to their needs, especially for smaller areas. It is important that the user to be familiar with the value, assumptions, and limitations of WWA products. Refer to the Final Report.

WWA Published Results may not match other assessments conducted that use different data, technical methods, or scale of analysis. Having two assessments that do not match does not mean that either one of them is incorrect. The use of different data sources, often from different collection dates and with spatial accuracy and resolutions, combined with different modeling assumptions or definitions will result in different results and can have different interpretations and uses. The WWA results are not intended to replace local and state products as a decision-making tool.

There are no use limitations. Users should acknowledge the US Forest Service for funding and credit the Oregon Department of Forestry and the Council of Western State Foresters.

What did WWA produce?

This diagram represents a general flow for the WWA process identifying the key inputs and outputs utilized in the assessment. These outputs can be used individually or in combination to characterize wildfire risk.

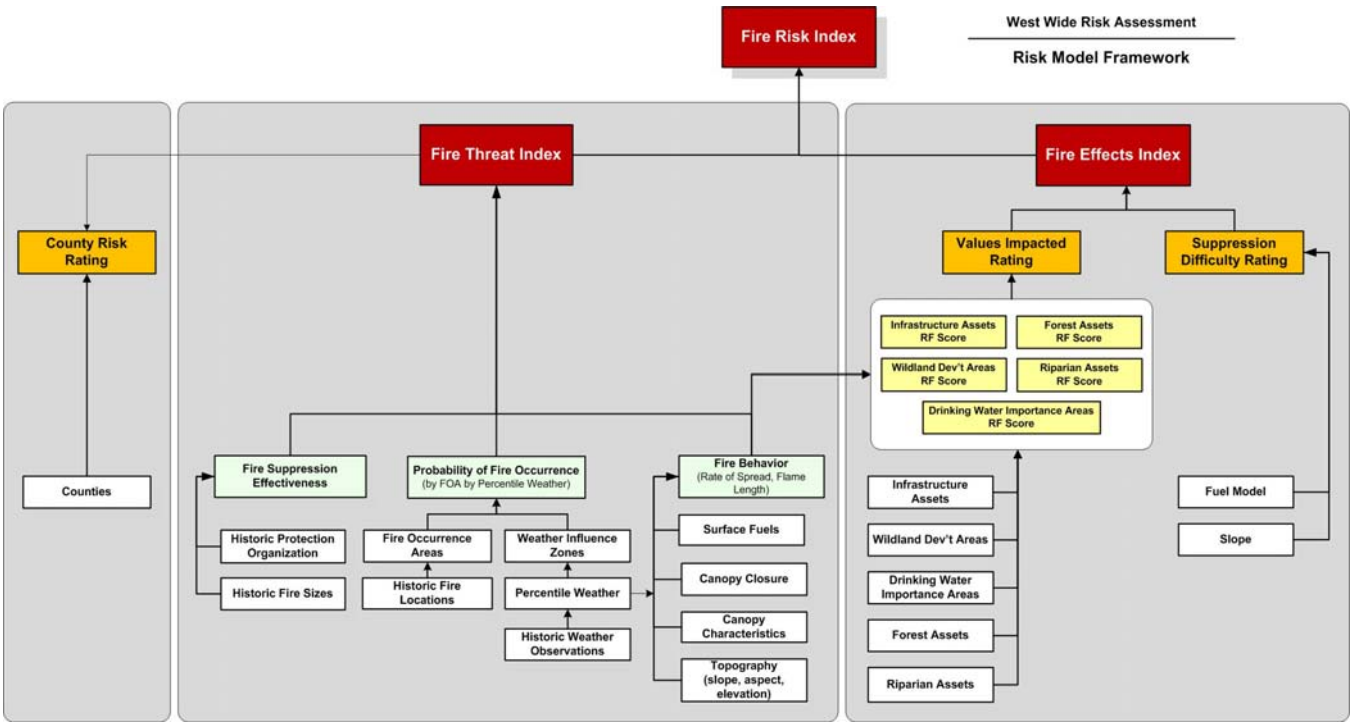

Figure 1: Risk model framework

Table 1: Datasets associated with the West Wide Wildfire Risk Assessment

Dataset	Description	Feature Type
Indices		
Fire Risk Index (FRI)	Measure of overall wildfire risk. It is an index of **expected** loss based upon the likelihood of an acre burning (Fire Threat Index) and the potential effect on important values and suppression cost (Fire Effects Index).	30-meter Raster
Fire Effects Index (FEI)	Identifies areas with important values affected by wildland fire and/or that are costly to suppress. It is an index of **conditional** loss - the potential effect on important values and suppression cost if a fire occurs. FEI is a weighted combination of the Values Impacted Rating (VIR) and Suppression Difficulty Rating (SDR) layers described below.	30-meter Raster
Fire Threat Index (FTI)	Wildfire threat is an index related to the likelihood of an acre burning. The FTI integrates the probability of an acre igniting and the expected final fire size, based on the rate of spread in four weather percentile categories, into a single measure of wildfire threat.	30-meter Raster
Ratings		
Values Impacted Rating (VIR)	Reflects areas that have important values affected by wildland fire. This combines all Values Impacted being assessed based on a composite of weights provided by the states. Fire Threat Index is not a component of VIR, so values are conditional, assuming that the probability of being impacted by fire is equal	30-meter Raster
Suppression Difficulty Rating (SDR)	Reflects areas with increased difficulty for fire suppression. It is based on fireline production rates and slope and a composite of the scores and weights provided by the states.	30-meter Raster
Scores		
Response Function Scores (RFS)	For each individual Value dataset, identifies areas for those values impacted that are at risk to wildland fire. This is based on the scores and weights provided by the states.	30-meter Raster

Dataset	Description	Feature Type
Key Inputs		
Wildland Development Areas (WDA)	Describes where people are living in wildland areas (i.e. urban areas masked out).. This dataset is derived from the LandScan population count data and represents the number of housing units per acre.	30-meter Raster
Drinking Water Importance Areas (DWIA)	An index that identifies areas that are most crucial to sustaining the quality of drinking water by incorporating data on water supply, surface drinking water consumers at the point of intake, and the flow patterns to the surface water intakes. The U.S. Forest Service's Forests to Faucets (F2F) project is the primary source of this dataset, however, F2F does not exist for Alaska and Hawaii so alternative datasets were used for these two states.	30-meter Raster
Forest Assets (FA)	Forested lands categorized by height, cover and susceptibility (response to wildland fire). The LANDFIRE vegetation datasets (existing vegetation type, cover, and height) were the primary inputs to this dataset along with a crosswalk of the existing Vegetation Type dataset to a susceptibility class.	30-meter Raster
Riparian Assets (RA)	Riparian areas that are important as a suite of ecosystem services, including both terrestrial and aquatic habitat, water quality and quantity, and other ecological functions. The National Hydrography Dataset (NHD), the National Wetlands Inventory (NWI) and LANDFIRE's Existing Vegetation Dataset (EVT) were the primary inputs to this dataset.	30-meter Raster
Infrastructure Assets (IA)	Key infrastructure assets that are susceptible to adverse effects from wildfires. Includes Roads (Levels 1-3), Railroads, Airports, Schools and Hospitals (roads and railroads are buffered by 300m and airports, schools and hospitals are buffered by 500m).	30-meter Raster
Fire Occurrence Areas (FOA)	Areas within which the probability of each acre igniting is the same. (Based on historical fire occurrence data).	30-meter Raster
Fire Behavior Outputs	Rate of Spread, Flame Length, Fire Type (canopy fire potential) by Low, Moderate, High and Extreme percentile weather. Also provided is the Expected Rate of Spread and Flame Length which is the weighted average of using probability of a fire occurring by percentile weather times the output at that percentile weather. The probability of a surface or canopy fire type occurring is also provided.	30-meter Raster
Weather Influence Zones (WIZ)	Areas where, for analysis purposes, the weather on any given day is uniform.	Polygon
Where People Live (WPL)	Describes where people are living and includes both urban and rural areas. This dataset is derived from the LandScan population count data and is based on the number of housing units per acre. The WDA dataset (above) is a subset of the WPL dataset.	30-meter Raster
Final Report and Summary Statistics		
Final Report	The Final Report serves as the primary documentation for the project and includes background, project overview, description of methods and data development, description of final deliverables, assessment results and findings, and supporting information (i.e. references, glossary of terms, project team, etc).	PDF
Addendum I – Technical Methods	The Technical Methods addendum provides a detailed description of the methods. The assumption of this addendum is that the reader has read the final report and is interested in understanding the specifics of the data development process. The risk assessment process itself is not restated in this document.	PDF
Addendum II – Fire Effects Calculations	This spreadsheet provides data and state provided weights and response values and formulas used to generate the response function scores for the 5 values impacted layers, as well as weights used to generate the Values Impacted Rating, Suppression Difficulty Rating, and Fire Effects Index.	PDF

Dataset	Description	Feature Type
Final Report and Summary Statistics		
Addendum III - Pacific Islands	The Pacific Islands lack some of the basic datasets required to complete a quantitative wildfire risk assessment. This addendum provides a qualitative assessment by summarizing the Pacific Islands State Forest Resource Assessment documents and identified several key factors relating to wildfire risk. This report summarizes these key factors with respect to wildfire risk.	XLS
Addendum IV – Regional Stat Summary	The Regional Statistical Summary summarizes the primary outputs of the assessment for the region.	PDF
Addendum V – State Stat Summaries	The State Statistical Summaries summarizes the primary outputs of the assessment for each state.	PDF XLS charts
Addendum IV – County Risk Summaries	The County Risk Summaries summarizes the primary outputs of the assessment for each county in the west. For each county, it summarizes total acres, burnable acres, acres by class (1-9), and an rating for burnable acres.	PDF XLS
Addendum VII – Data Structure	The purpose of this document is to provide GIS users a reference guide to the data and data structure. It was included as a readme file with the state data hard drives.	PDF
Addendum VIII – State Specific Data	The purpose of this document is to document the process used to create the State Specific data set for each state.	PDF

How were the results categorized?

Several output data layers, specifically the indices, ratings and scores data layers, as well as the Fire Occurrence Area (FOA) data layer, are comprised of continuous floating point data values. It was necessary to group these values into classes or categories. For consistency, for the output data layers nine categories were used. The breakpoints between these categories are based on a consistent target cumulative (Table 2). By design, the categories were developed to display the highest rated 14.5% of the cells in categories 6-9. The highest rated 22.5% of the cells are in categories 5-9. This places the highest rated cells (areas) into just about half of the categories (5-9) which allows the user to truly locate and distinguish the differences within these highly rated cells (areas).

Table 2: Cumulative percent breaks used for class breaks in the WWA

Category	% Range	Cumulative%	Categorical%
1	0 – 32.9%	32.9%	32.9%
2	33.0 - 63.5%	63.5%	30.5%
3	63.5 -70.0%	70.0%	6.5%
4	70.0 - 77.5%	77.5%	7.5%
5	77.5 - 85.5%	85.5%	8.0%
6	85.5 - 92.5%	92.5%	7.0%
7	92.5 - 96.5%	96.5%	4.0%
8	96.5 - 98.5%	98.5%	2.0%
9	98.5 - 100.0%	100.0%	1.5%

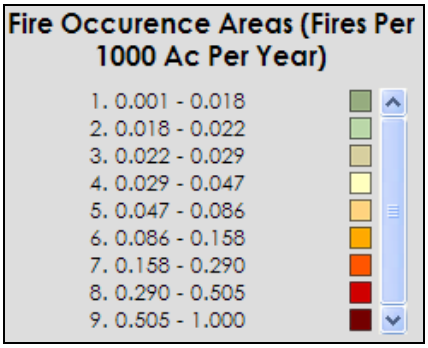

Figure 2: Color ramp used for WWA classes. Value breaks shown here are for the FOA Regional dataset, specifically.

Why are there two complete data sets – *Regional* and *State Specific*?

The original project scope focused on developing a west wide regional assessment. The class breaks for the primary indices, ratings and scores were developed (normalized) for the entire West. While the regional outputs allow comparing and quantifying a suite of risk components across the West, the State Specific data allow states to compare and quantify the results for an individual state.

How do I acquire WWA data?

TBD

How can WWA data support my planning needs?

WWA products are not fire planning. However, WWA products can be valuable to support a range of planning needs of agencies and stakeholders. They provide a suite of data for characterizing the potential impact of wildfire. The utility various data sets will vary depending upon the specific need and question to be answered. As stated earlier, managers and planners must evaluate WWA data according to the scale and requirements specific to their needs, especially for smaller areas. Below are some suggested potential uses. It is not intended to be a complete list.

Need	Product/Data	Considerations
▪ Serve as a regional policy analysis tool that provides results comparable across geographic areas in the West ▪ Highlight wildfire risk by quantifying magnitude of the fire problem for public and stakeholder awareness ▪ Support National Cohesive Wildfire Strategy and Western Regional Strategy ▪ Engage national, regional and state stakeholders	Regional and State Specific Data ▪ Regional and State Statistical Summaries ▪ County Risk Summary ▪ Fire in the West (to be developed)	Scale: region, state The WWA statistical summaries and county risk summary are the first applied use of WWA Regional data. Use of summarized results to quantify aggregated the results into states and counties. The data can be easily summarized by additional geographic areas, such as national forests, protection, districts, congressional districts, watersheds, etc. Fire Risk Index and Fire Threat Index are especially useful at this scale to account for differences in the likelihood of fire effect due to climate and past acres burned. Fire Effects Index, ratings and scores can communicate the conditional fire effect IF a fire occurs Note: Summarizing data by polygon can produce significantly different results depending upon whether the data is summed or averaged, or includes all acres or burnable acres. Use caution when averaging results, especial where there is a bimodal distribution of risk. Note: These reports were generated using the regional data.
▪ Development of Communities At Risk as a GIS layer and assess risk ▪ State Natural Hazard Mitigation Plans	State Specific Data ▪ Wildland Development Areas ▪ Where People Live ▪ Wildland Development Areas RFS ▪ Wildfire Threat, Fire Effect, and Risk Indices ▪ Fire behavior outputs ▪ Updated State Statistical Summaries and County Risk Summary using State Specific data	Scale: state, local There is national direction for states to establish a spatial Communities At Risk (CAR) layer. Wildland Development Areas data provides a consistent footprint of homes in wildland fuels in categories to allow states to set a threshold density to establish Communities At Risk or other needs. Fire Threat Index can be used to assign a threat values to these communities. Fire behavior outputs could be of value for establishing CAR boundaries or community planning zones beyond the homes. Note: While WDA does a much job than previous WUI layers, the source Landscan data does miss some areas of second homes and remote areas. Note: An effort was made in the WWA project to exclude non-wildland areas from WDA. Homes adjacent to the wildland may be at risk from embers and burning of urban fuels. Users may desire to buffer the WDA into urban areas and designate them as at risk from embers.

Need	Product/Data	Considerations
▪ Support Community Wildfire Protection Plans and County Natural Hazard Mitigation Plans ▪ Support local implementation of the National Cohesive Wildfire Strategy and Western Regional Strategy locally	State Specific and Regional Data ▪ Wildland Development Areas ▪ Where People Live ▪ Wildland Development Areas RFS ▪ Resource RFS such as Drinking Water, Forest, Riparian ▪ Fire behavior outputs ▪ Fire Occurrence Areas ▪ Fire occurrence layer and data ▪ Wildfire Threat, Fire Effect, and Risk Indices	Scale: local WWA provides a suite of products that can be helpful for characterizing risk, threat and fire effects, establishing a WUI boundary, understanding fire ignition locations and causes, and prioritizing neighborhoods and landscapes within the planning area. The data is consistent across ownership and jurisdiction. Reports can be generated that summarize the individual layers to understand the nature of the problem. For example, Wildland Development Area RFS characterizes relative conditional loss to homes based upon home density and fire intensity. Flame length can help the community understand adjacent fire intensity that may influence control issues and ember intensity. Fire behavior outputs can help establish a community's WUI boundary. The regional data will be especial useful for assessing state boundary issues, since it's consistent across state lines.
▪ Support State Forest Resource Assessment and Forest Action Plans	State Specific and Regional Data ▪ All WWA data	Scale: state Each state has very unique issues and needs. There are normally resources available to customize WWA data to meet the planning needs (i.e. adjust response function inputs and weights). The WWA provides some data not available elsewhere (i.e. Riparian Assets) that may fulfill a need. The Values Impacted RFS data can be valuable to understand not only where the values exist, but there potential response to fire. The regional data will be especial useful for assessing state boundary issues, since it's consistent across state lines. Note: The Forest Asset RFS was generated based largely upon a forest type's anticipated response to fire (adapted, resilient, and sensitive). Additional work will likely be needed to refine this for a state. For example, there may be forest types that are sensitive to fire that where stakeholders may want a fire to replace the type.

Need	Product/Data	Considerations
▪ County/forest/district planning – prevention, dispatch, response, fuels	State Specific Data ▪ All WWA data	Scale: local Fire Occurrence Area and the interagency fire occurrence layer and database (includes general cause) can help prevention planning efforts. The Fire Threat and Risk Indices can help understand and prioritize where fire can be expected based upon past fire occurrence history (location and size). The fire behavior outputs, Fire Effects Index and related suppression difficulty rating and values impacted RFS are conditional upon a fire occurring. These data may be especially useful where the question is "if a fire occur" what response strategy may be appropriate? Fire behavior layers are provided for low, moderate, high, and extreme and expected (weighted average), which may aid in dispatch planning. Note: NFIRS is included, however lacks specific location or fire size. How the data was utilized in WWA is described in the Final Report.

Are there tools to utilize WWA data to meet my planning needs?

Each state will have a Fire Effects Adjustment ArcGIS extension that can used to edit weights and response inputs and generate new values impacted response function scores, Values Impacted Rating, Fire Effects Index and Fire Risk Index. The WWA delivered to states used a regional average based upon expert option from each state. This tool will allow states and customize the WWA data for their uses.

The Council of Western State Foresters will hold a single license to a tool that can be used to update fire occurrence, weather, and fuels and generate a new Fire Threat Index.

Some stated are moving forward with web portals to help deliver assessment data to the end users. Below are links to Colorado and Texas:

www.ColoradoWildfireRisk.com

www.texaswildfirerisk.com

There are tools developed by the federal agencies and private companies to assist in fire planning. One tool in particular, *Landscape Treatment Designer (LTD) for Fuel Treatment Planning*, can be used with WWA data that has been summarized by a polygon layer (stand, watershed, community, etc).

http://www.fs.fed.us/wwetac/tools.html