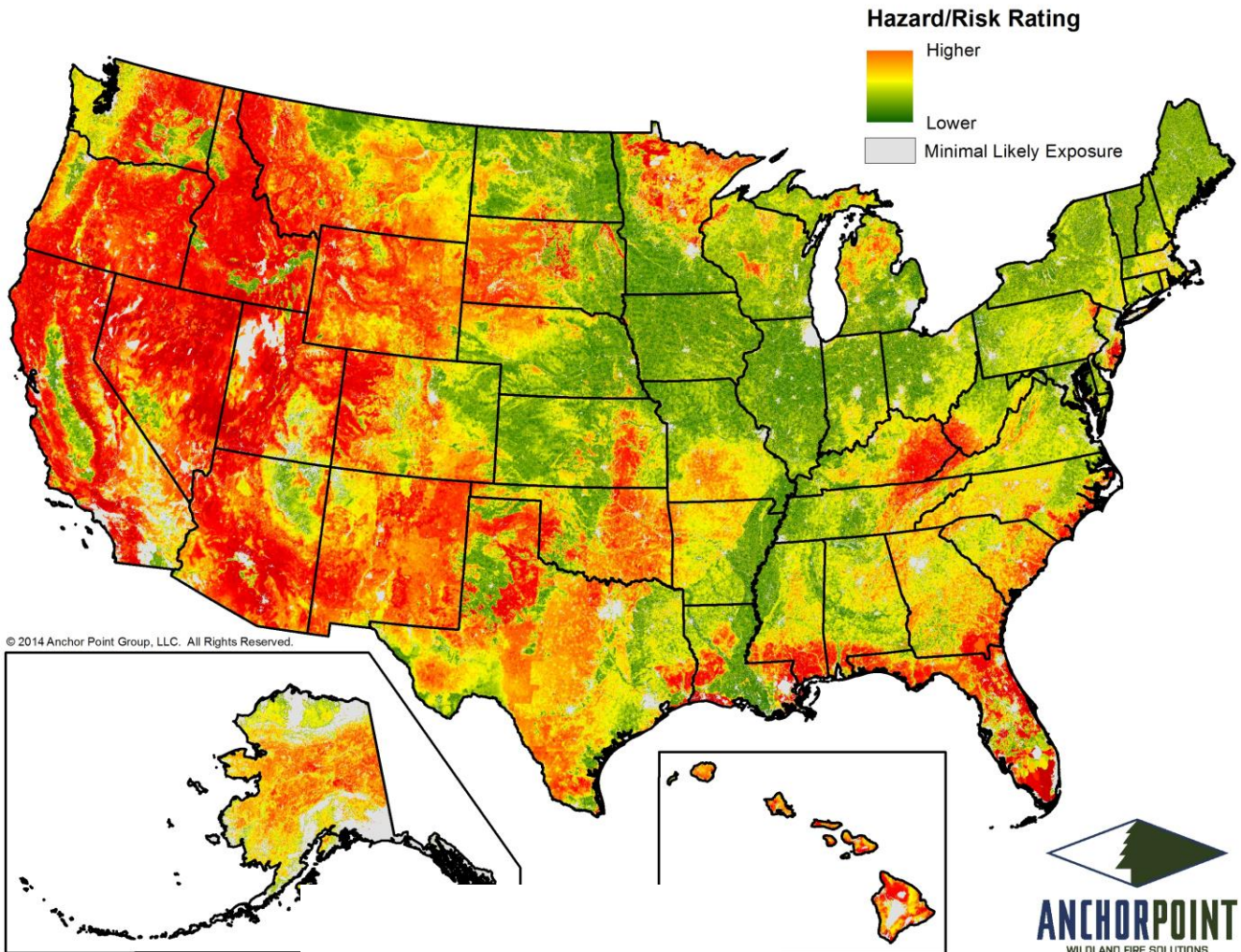


National Hazard and Risk Model (No-HARM)

Wildfire

A Briefing Paper



Anchor Point Group LLC
2131 Upland Ave. Boulder, CO 80304
(303) 665-3473
www.AnchorPointGroup.com

Summary

The potential for wildfire-caused damage to structures is a growing problem as wildland fuels accumulate and greater numbers of people choose to build structures in areas with the potential for wildfires. Anchor Point's (AP) National Hazard and Risk Model (No-HARM) was created in response to the growing need for a scientific, accurate, consistent, and up-to-date Wildland Urban Interface hazard and risk assessment throughout the United States.

No-HARM Components

Wildland Model

- Fire behavior modeling
- Probability of wildfire occurrence
- Built environment factors

Urban Interface Model

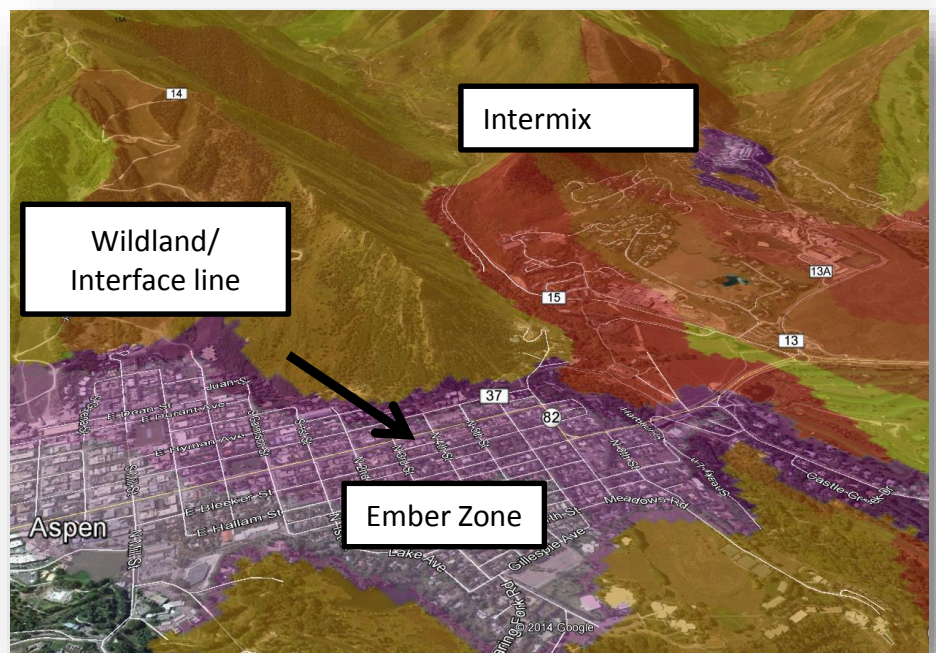
- Urban interface designation
 - Intermix and interface designation
 - Fuel islands

Ember Zone Modeling

- Three-tiered system

Final Model Integration

- FireSheds™



Wildland Model

Fire Behavior Modeling – Hazard

Fire behavior modeling is one of the best predictive tools available to determine an objective hazard from wildfire. It incorporates elements of the physical landscape (slope, aspect, elevation) along with specific fuel types (Scott and Burgan 40 Standard Fuel Models) and climatological information, such as fuel moisture and historic weather conditions.

The No-HARM fire behavior model takes state-of-the-art model inputs and, informed by Anchor Point’s decades of wildfire suppression and fire modeling experience, creates predictions of potential fire behavior, including fireline intensity. Fireline intensity can be thought of as a combination of flame length and rate of spread and is considered the best overall predictor of potential fire behavior. Fireline intensity indicates the severity of fire effects and determines the potential impact to structures. For instance, chaparral in southern California or saw palmetto in Florida has higher fireline intensities than sage brush in southern New Mexico. This factor is then weighted, in relation to structure ignition within the model. This information is vital in assessing the hazard or susceptibility to structures due to wildfire.

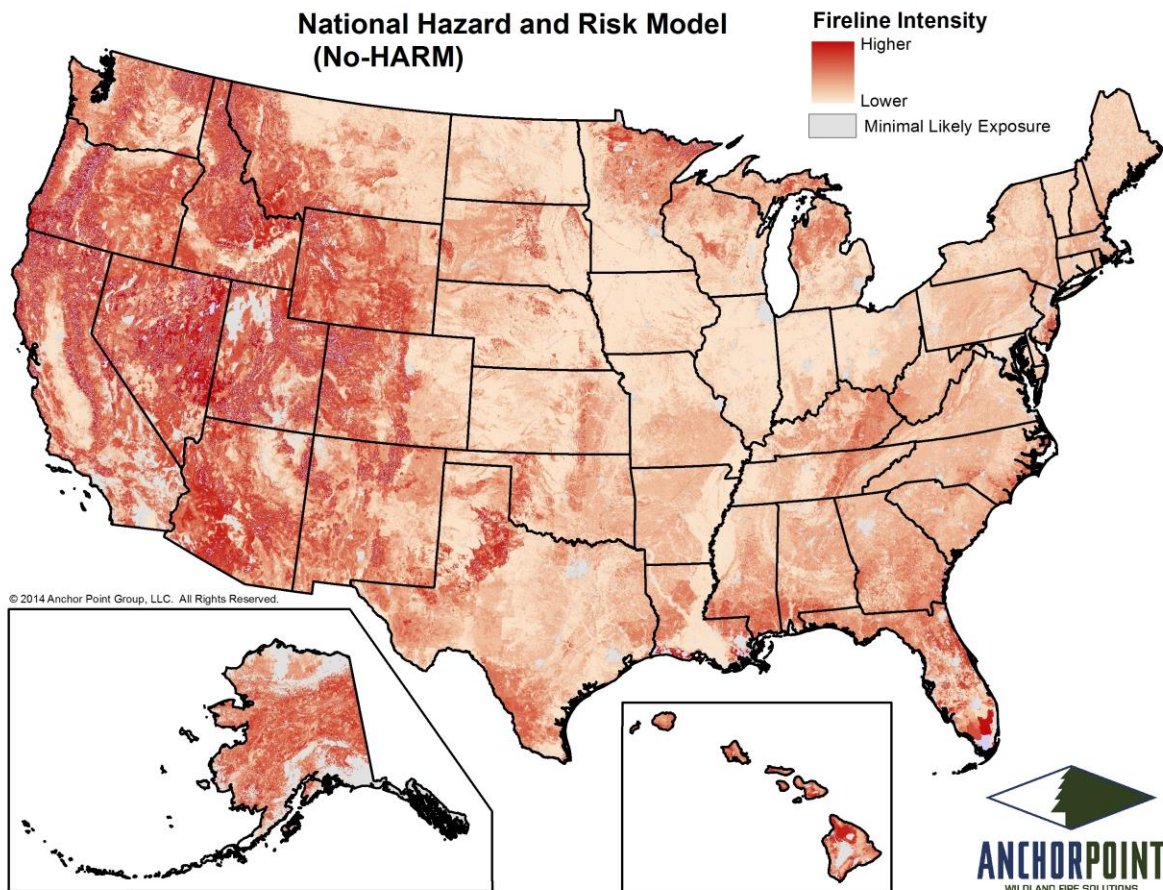


Figure 1: National Fire Line Intensity map.

Probability of Wildfire Occurrence – Risk

The best way to predict the future is to look at the past. Historic risk of wildfire occurrence can be useful when determining the potential for wildfire activity in the future. Historic information about how often fires occur and how large wildfires have been in the past can help predict the threat to structures during current conditions. By examining historic ignition points and fire perimeters, the model provides the probability that an area will burn in any given year. Using spatially-explicit climate and fuel data as a starting point, No-HARM utilizes data that is derived by calculating numerous simulated fire perimeters to provide a long-term profile of wildfire frequency and size for the U.S.

No-HARM considers and weights the duration, rate of spread, type of fuel, and final size of multiple fires to estimate the probability of wildfire occurrence. This is done to define areas where it is more or less likely for a new fire to occur.

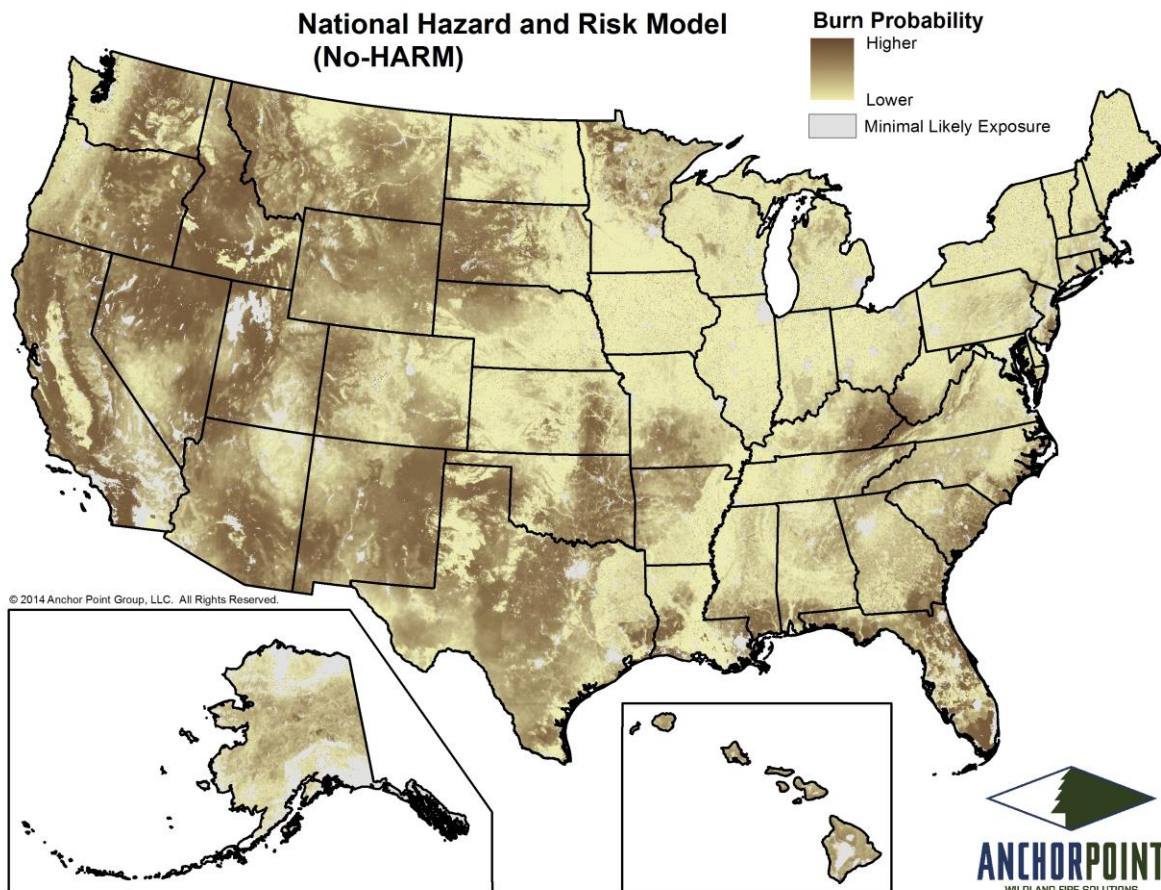


Figure 2: The probability of wildfire occurrence in the continental U.S.

It takes both hazard AND risk to create an area of concern.

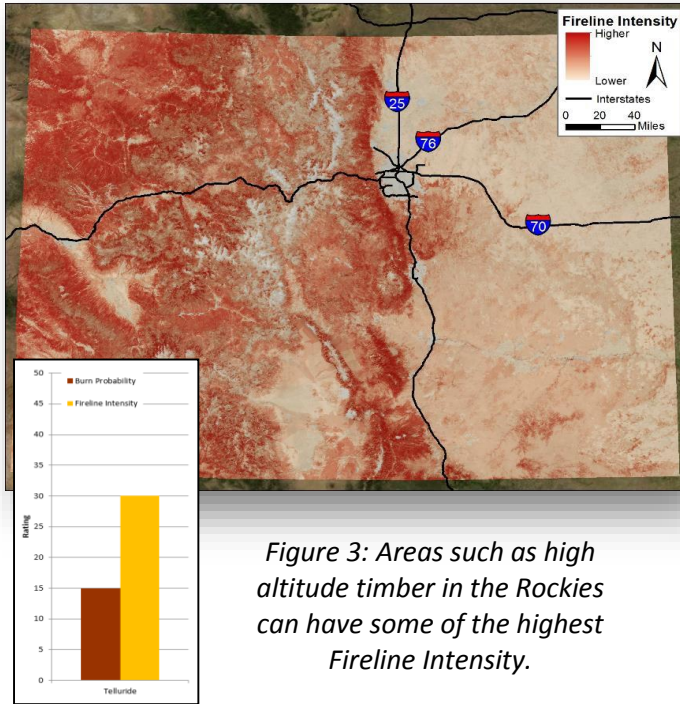


Figure 3: Areas such as high altitude timber in the Rockies can have some of the highest Fireline Intensity.

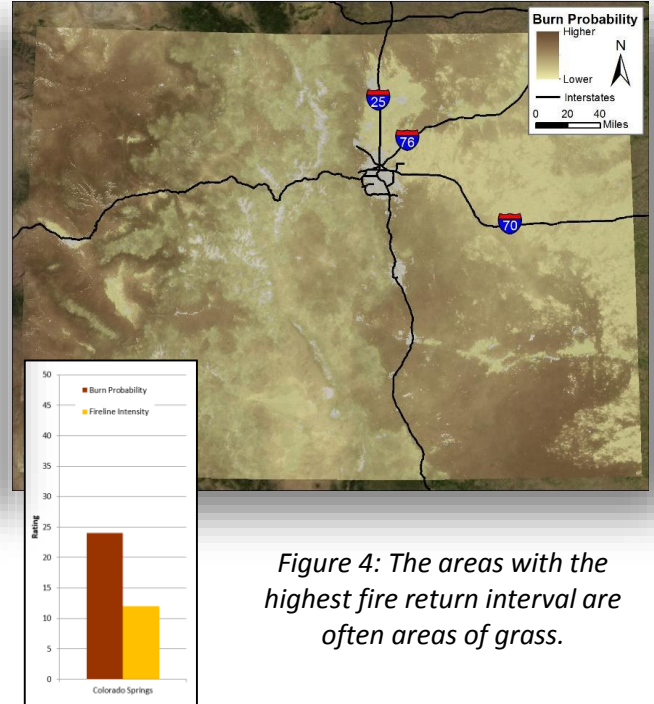


Figure 4: The areas with the highest fire return interval are often areas of grass.

It takes both hazard and risk to constitute an area of concern. Some wildland fuel burns intensely but only burns very infrequently. Many areas of the U.S., such as the coastal forest in the North West and high altitude timber in the Rockies, exhibit very intense fire behavior when they burn; however they burn very rarely since weather conditions that favor large fire occur infrequently. Conversely, grassland prairies burn frequently but burn very quickly and with intensities that are far below timber fires.

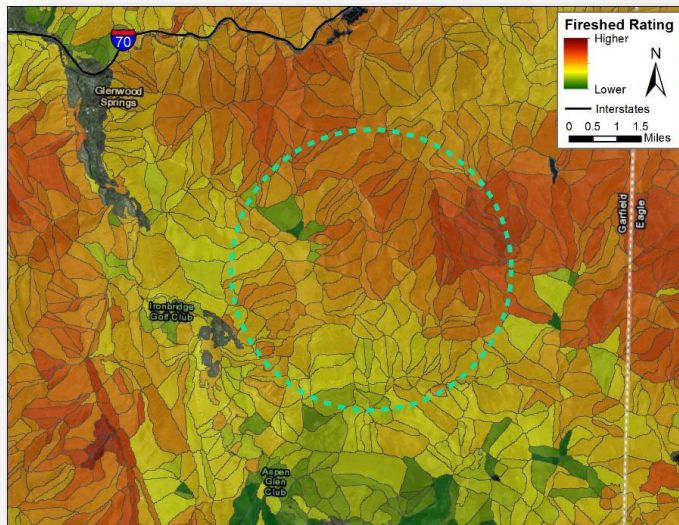
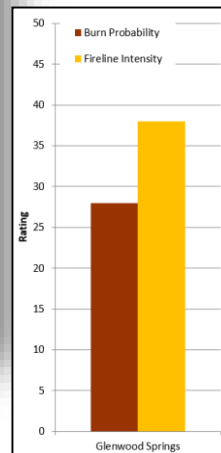


Figure 5: There are areas in the U.S. that exhibit both high Fireline intensity and burn probability (see graphic at left). It is these areas that No-HARM considers as the most significant.



BUILT ENVIRONMENT FACTORS

Fire Station Proximity

When a fire starts, large distances between a structure and the nearest fire station may reduce the survivability of a structure in the event of a wildland fire.

If a structure is farther away from a fire station, it can mean that it takes longer for a response to an initial wildfire event. Conversely, short time periods may increase the probability that a structure will be defended. Combined together, the degree of fire containment and distance to fire station provides a suppression factor that is weighted in the model.

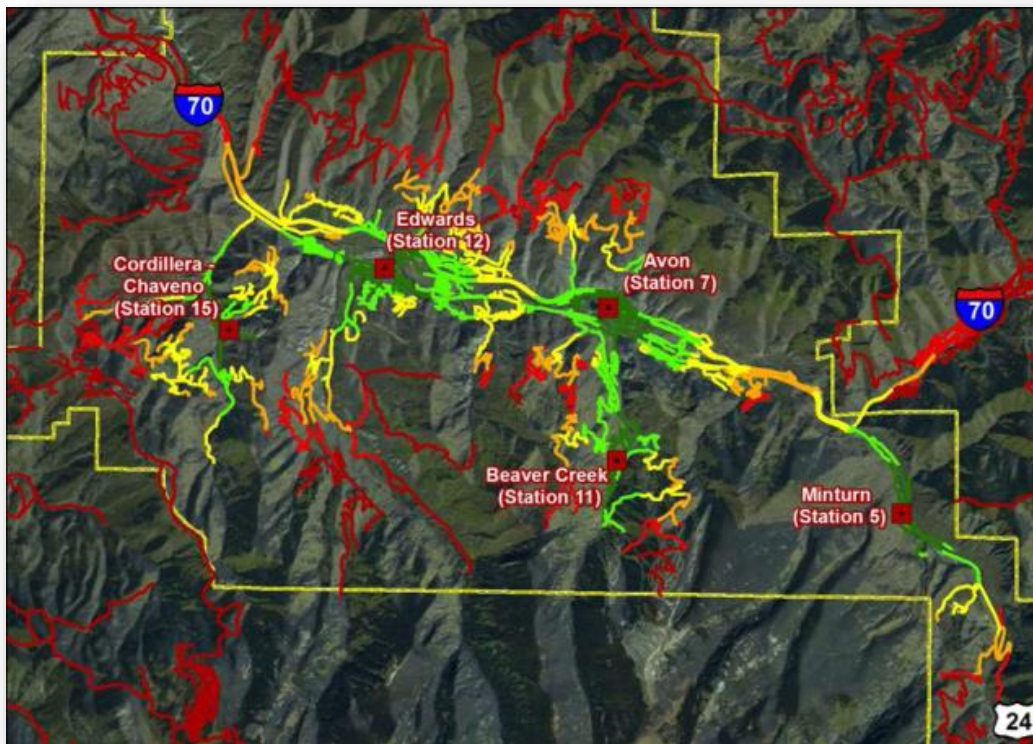


Figure 6: Distribution of fire station locations in a portion of the state of Colorado

The fire environment becomes more complex closer to the built environment. As fires move into areas of dense structures and complex road systems, it becomes increasingly difficult for firefighting resources to control the fire. Evacuating citizens and difficult access to the fire are two factors that hamper suppression effectiveness. To define this effect, the model incorporates parcel size and density as well as a road complexity factor.

Additionally, these data are proxies for an increased probability of fire occurrence. Greater densities of parcels and roads indicate a higher number of people frequenting those locations. Larger numbers of

people can mean more complex fires and higher likelihood of human-caused ignitions. Anthropogenic ignitions, accidental or intentional, are one of the most frequent causes of wildland fires.

This component is used as a fire complexity rating as well as an additional factor to the probability of wildfire occurrence described above. Through this process, No-HARM identifies communities and the edges of towns and cities. This is important as fire behavior changes radically in these areas.

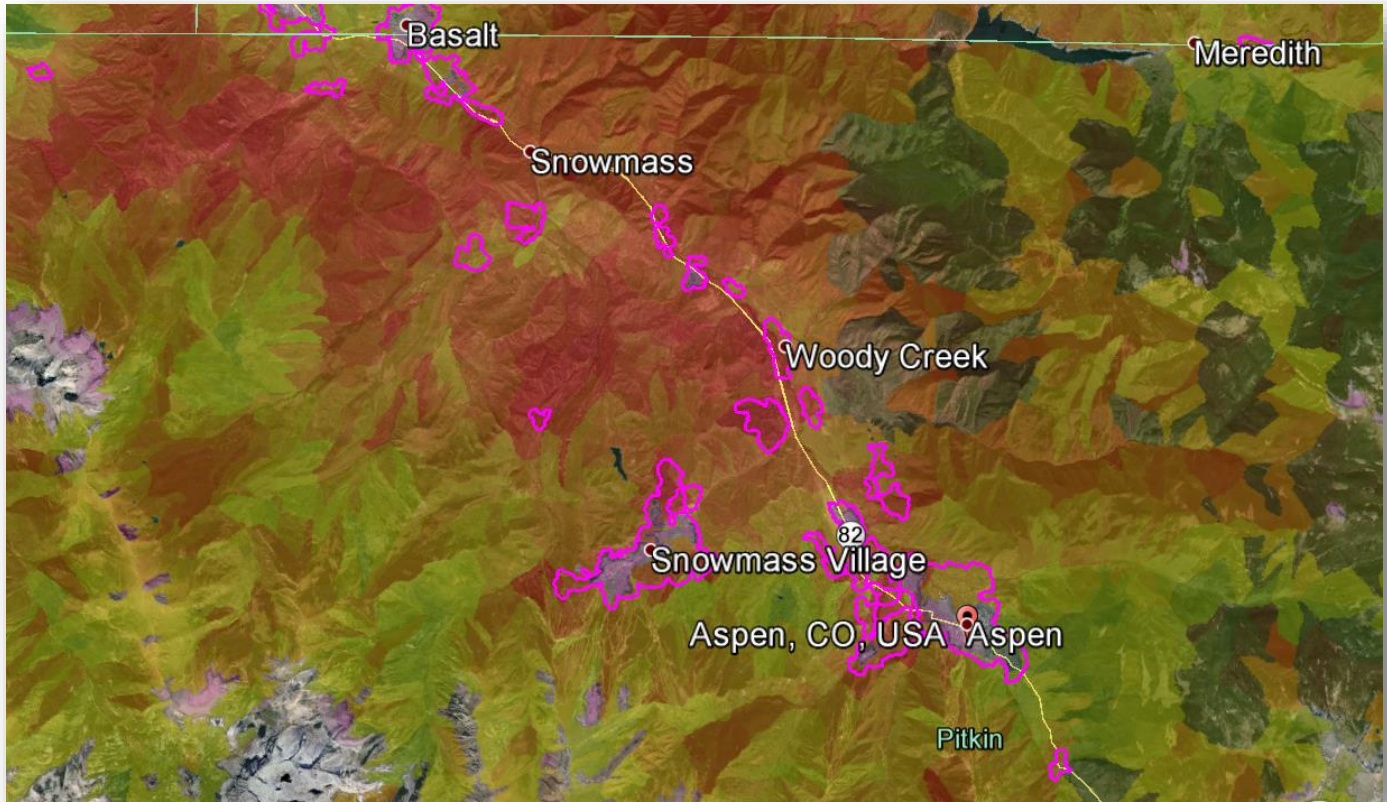


Figure 7: Areas of significant road and parcel complexity.

FireSheds™

A structure's threat from wildland fire is based not only on immediate proximity to hazardous fuels — neighboring fuels can influence and compound the impacts to a structure as well.

No-HARM divides up the landscape based on the topography of an area. This is optimal because it groups areas together that are most likely to be similar in terms of climate, vegetation, slope, and aspect. The model divides these similar areas into FireSheds. These can be thought of as areas that “collect” fire, similar to how watersheds collect water. Unlike watersheds however, FireSheds are determined more by fuels and aspect.

At a broader scale, the model incorporates the hazard/risk of neighboring FireSheds. Using this technique, a structure is more likely to fall into a model rating that properly reflects the wildfire context relevant to that structure and its overall location. This technique also reduces the impact of inconsistencies (high or low) in the underlying data. By addressing wildfire threat at multiple scales, different types of impacts can be considered simultaneously.

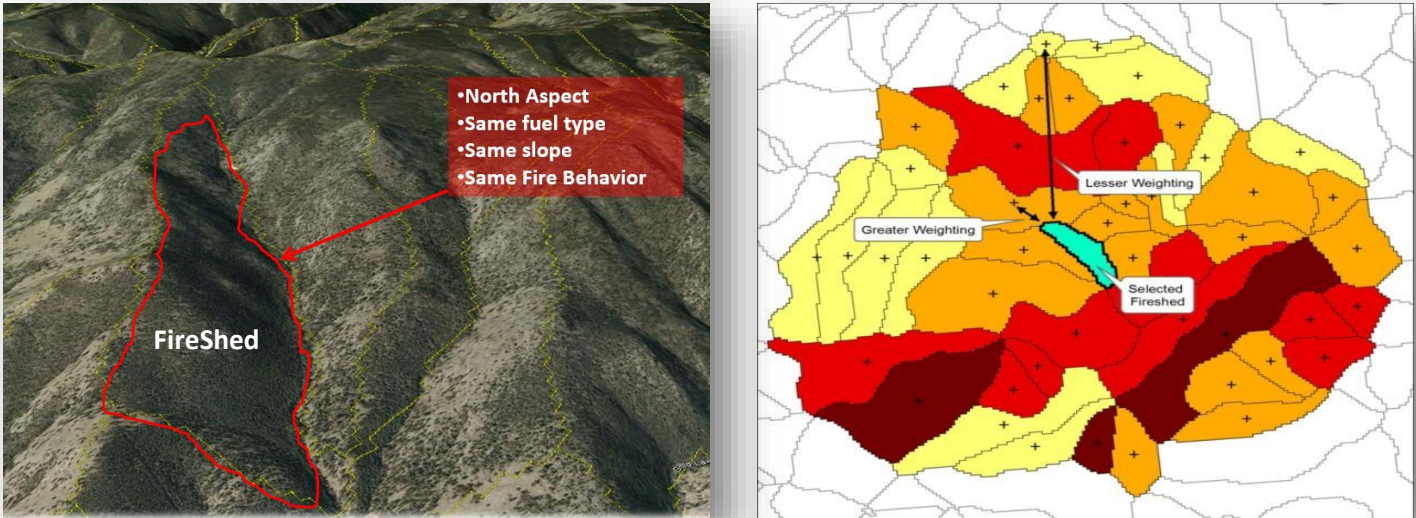


Figure 8: FireSheds are areas of similar fire behavior. Each FireShed rating is derived by allowing it to be influenced by the adjacent FireSheds. This ensures a more realistic calculation of the fire environment and consequently a more realistic assessment of structure vulnerability.

Urban Interface Model

Urban Interface Designation

Hazard/risk is calculated differently in urban areas than it is in wildland areas. Exposure to fuel and resulting fire effects is different in areas where the built environment composes a larger part of the landscape. This difference is reflected in the Urban Interface Designation model.

While it is unsuitable to treat large, densely-built areas with the same methodology as areas with sparse housing surrounded by fuel, it is also inappropriate to assume that structures in urban areas cannot burn. A separate technique was developed to address this situation. The wildland fire threat in urban areas can take the form of immediate fire effects (flame impingement, radiant heat, etc.) to structures in close proximity to wildland fuel. Additionally, the threat can come from embers cast toward structures not located directly adjacent to fuel, but that are close enough to experience a rain of embers from a more-distant wildfire. The first step is to designate the line where model transition occurs.

The purple buffer in this picture depicts the transition zone between the two models. In common terms, this area designates the wildland urban interface (WUI) for the country. Areas within the purple buffer are not considered to have enough natural fuel to carry a wildfire. Hazard/risk due to proximity to neighboring wildland fuel and/or fuel islands is assigned to urban/suburban parcels. This methodology allows wildfire hazard/risk to be assigned in a way that better captures the possibility that structures in urban areas will be damaged by wildfire.

Ember Factor

Embers are considered the primary cause for structure damage and loss adjacent to FireSheds and fuel islands. In the Ember Zone, hazard ratings are derived from proximity to hazardous FireSheds or fuel islands. The ember factor diminishes with increased distance from FireSheds or fuel islands.

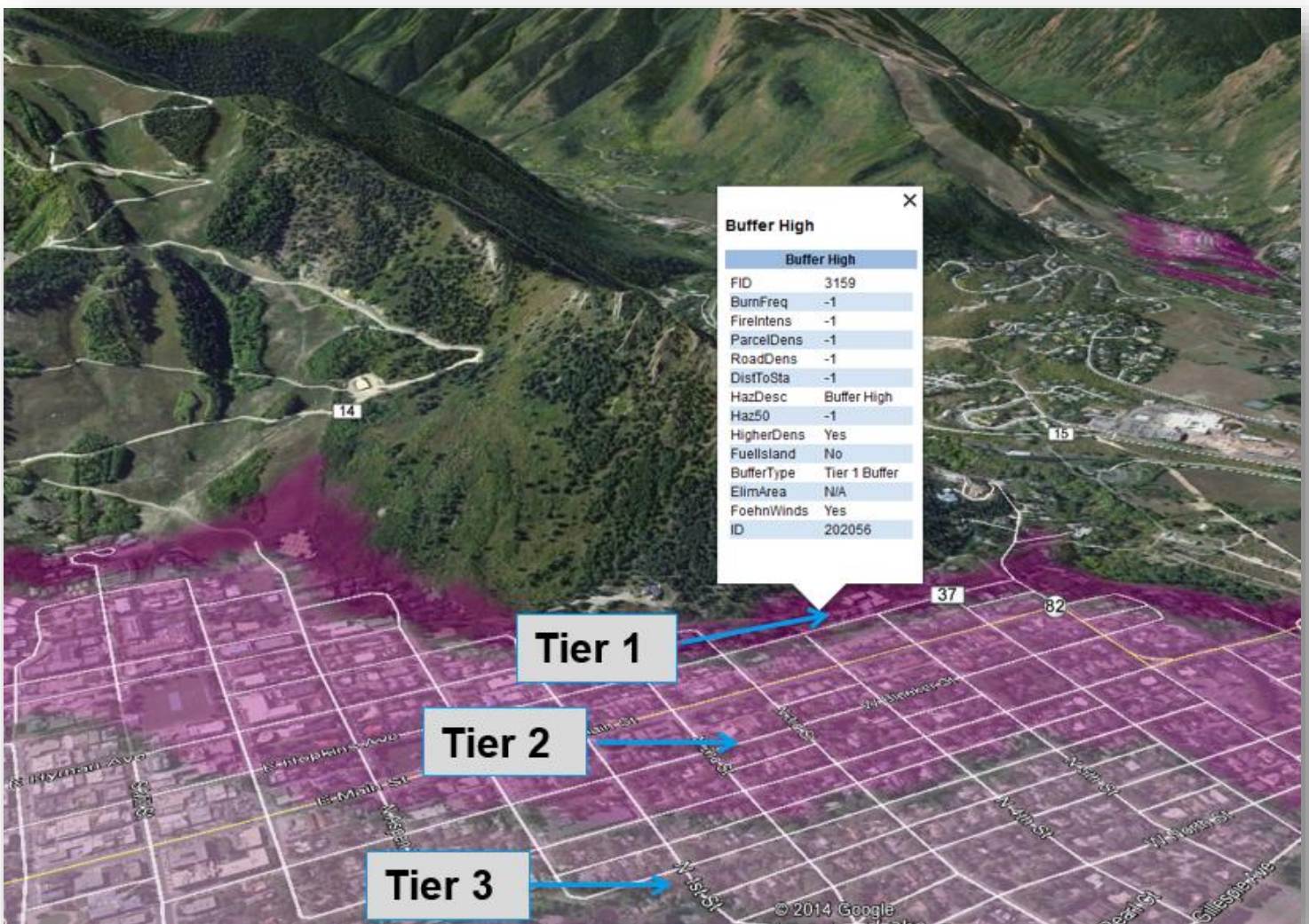


Figure 9: The ember zone represents areas where structures are susceptible to direct flame impingement in Tier 1, embers in Tier 2, and smoke in Tier 3.

Fuel Islands

The second step in the Urban Interface Designation is determining fuel islands, or undeveloped areas with native vegetation, parks or other open space areas within urban centers.

These graphics show fuel islands within an urban designated area. These areas are of concern as fire can ignite and burn, potentially resulting in structure damage. This fuel island in Poway, CA is immediately adjacent to a major hospital and thousands of homes, and must be considered a threat.

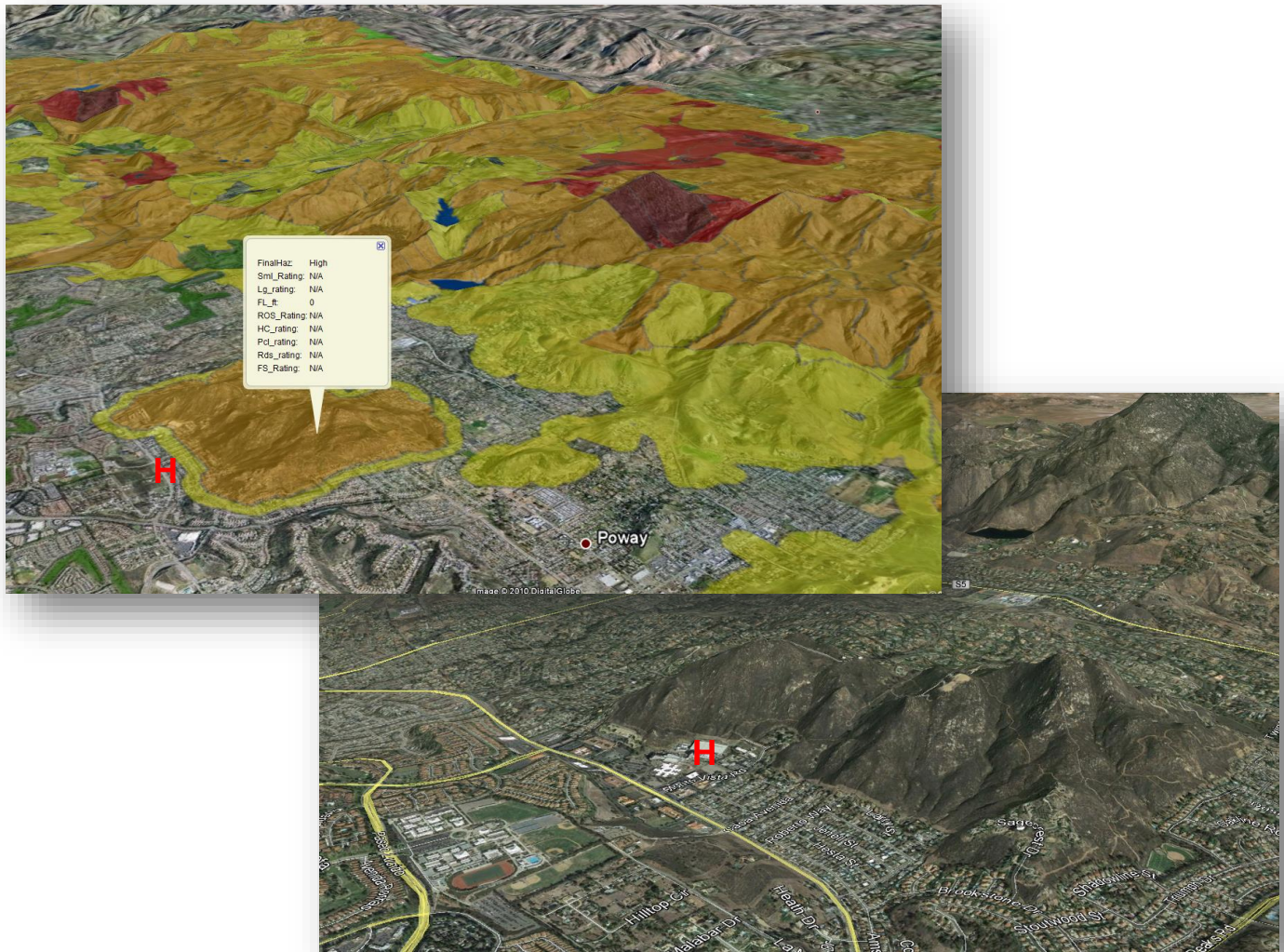


Figure 10: Fuel islands are critical to identify and rate as homes and infrastructure are often very dense in these areas.

Final Model Integration

The outputs from the multiple models are integrated into a single, seamless, 50-state wildfire hazard and risk assessment. Model data can be used with any geospatial software that accepts shape files. Many of the input datasets listed above are present in tabular format in the final dataset and can be queried for use in business and programmatic analytics.

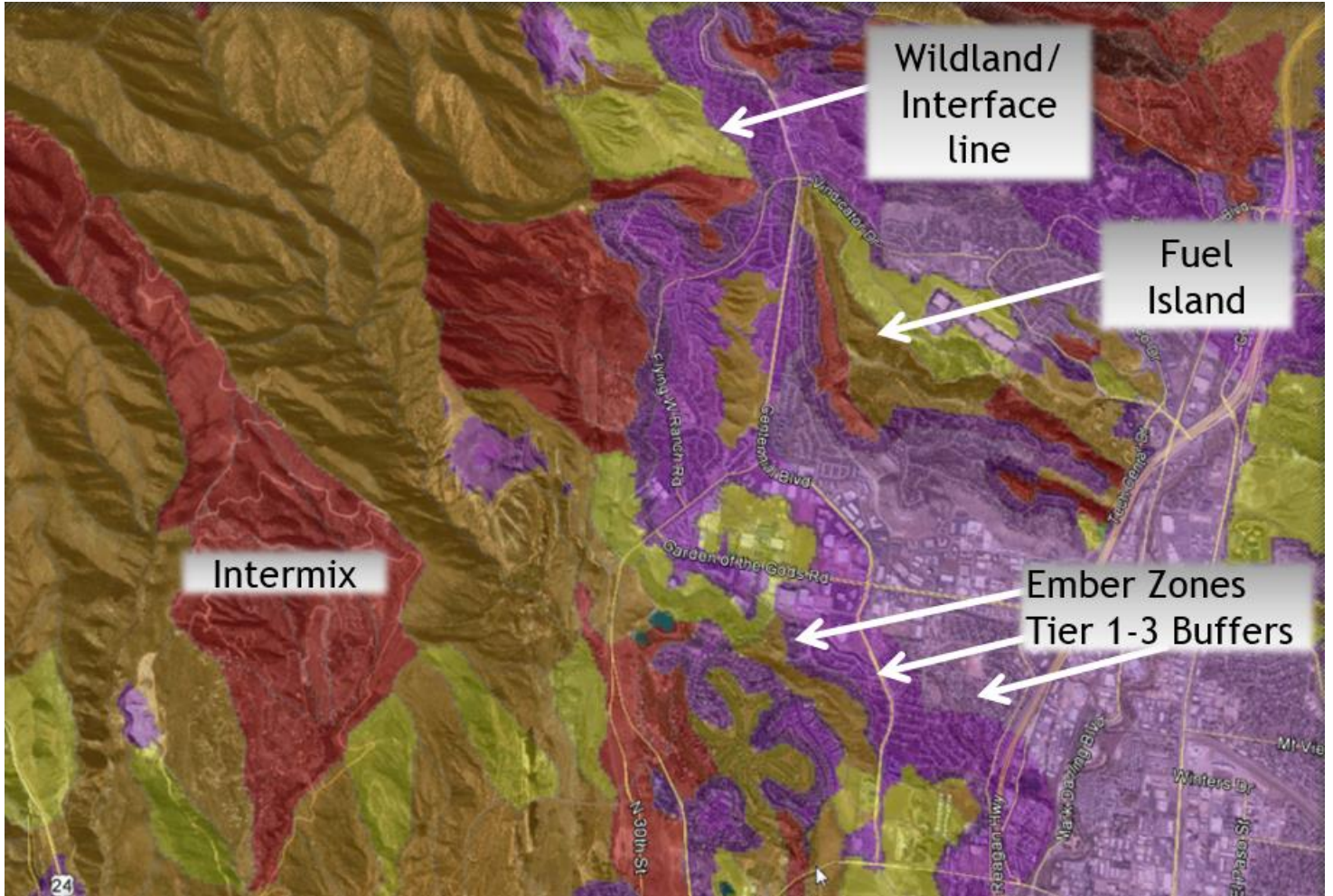


Figure 11: Overview of final hazard and risk graphical layer.



For more information, please contact Chris White of Anchor Point:

Telephone: (303) 665-FIRE (3473)

Email: CWhite@AnchorPointGroup.com