Tutorial E - Creating a Risk Assessment Using the Flame Length Probabilities Approach: Assessing Potential Risks Across a Landscape

Overview

Fire risk can be addressed in multiple ways. This tutorial uses one possible set of criteria for assessing fire risk across a landscape. In the process, this tutorial introduces some IFTDSS functionality.

In this risk assessment tutorial, you will:

- Learn the background behind the two risk assessment approaches within IFTDSS
- Set up a project in IFTDSS (step by step walkthrough)
- Acquire LANDFIRE data (step by step walkthrough)
- Create a run focusing on risk assessment using the Flame Length Probabilities approach (step by step walkthrough)
- Read a discussion of the risk assessment caveats specific to IFTDSS

To create a risk assessment run using the Flame Length Probabilities approach you will:

- Develop a values-at-risk map
    - Define values at risk and assign response functions
- Establish environmental and simulation parameters
    - IFT-FlamMap Inputs
    - IFT-RANDIG (a random ignition module) inputs
- Review/edit spatial landscape input data
- Analyze potential burn probability output data
- Use relative net value change data
- Export data to Google Earth
- Identify potential fire risks across a landscape

To download a PDF version of this tutorial click Here.

Note: All references cited in this tutorial are in the IFTDSS online help bibliography; access it by navigating to **Reference Material > Bilbiography.**

Introduction & Background

IFTDSS provides two approaches for assessing fire hazard and risk across the landscape based on the methods described in RMRS-GTR-235 Wildfire Risk and Hazard: Procedures for the First Approximation (Calkin et al. 2010a):

1. Worst-Case Flame Lengths Approach (see **Tutorial D**)

   - This approach is useful when the user is interested in identifying high fire hazard situations during **wind-driven wildfires.** In the future, this tool will be useful for assessing the effectiveness of a fuel treatment at reducing the hazard of a fire burning as a head fire.

2. Flame Length Probabilities Approach

   - This approach differs from the worst-case flame length approach in that it considers the likelihood of a fire burning as a backing fire, a flanking fire, or a head fire given a random ignition in the landscape when determining the potential losses or benefits for an area represented by a pixel burning. This approach is useful when the user is interested in identifying the potential consequences of an area represented by a pixel burning **under variable fire conditions** and/or assessing the potential ecological benefits of using fire as a management tool.

The processes employed in IFTDSS uses a quantitative risk framework to approximate the expected loss and/or potential ecological benefits to valued resources (values at risk) from wildfire. In the risk assessment, burn probabilities and fire behavior potentials are estimated using the fire simulation modules **IFT-FlamMap** and **IFT-RANDIG)**. The modeled output is coupled with data on human and ecological values at risk using a set of fire-effects response functions, with the goal of estimating the expected loss or potential benefit resulting from fire.

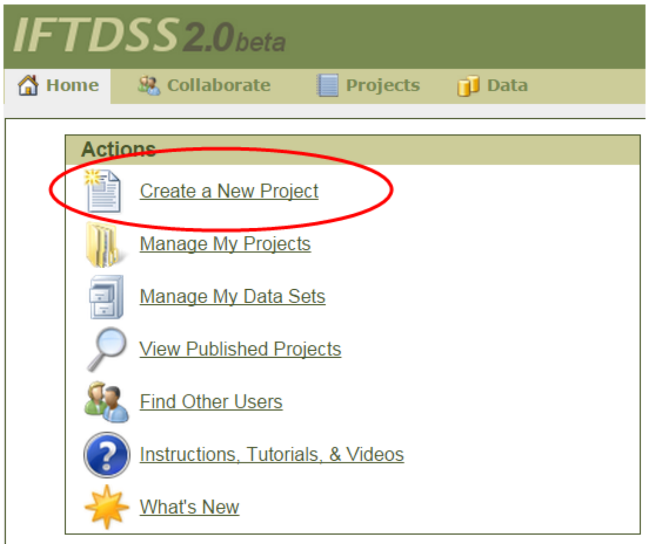
In this tutorial, we focus on the **flame length probabilities approach**. This method uses the response functions developed by Calkin et al. (2010a) and modeled flame length burn probabilities from the IFT-RANDIG burn probability simulator to estimate the likelihood of the area represented by the pixel burning, and the potential consequences if the area represented by the pixel is burned by a backing fire, a flanking fire, or a head fire. We'll spatially identify areas surrounding the Olompali State Historic Park (located near Novato, California) where fire is likely to occur, and view potential losses/benefits from a burn based on set environmental conditions.

This type of risk assessment should be used as a first approximation of how fire likelihood and fire behavior potentials across landscapes influence fire hazard and risk to social, economic, and ecological values within an area of interest.

The results can provide information useful for evaluating and prioritizing where to place treatments to reduce fire hazard and risk to valued resources.

Setting up the project

To begin, click **Create a New Project** under the Home tab.



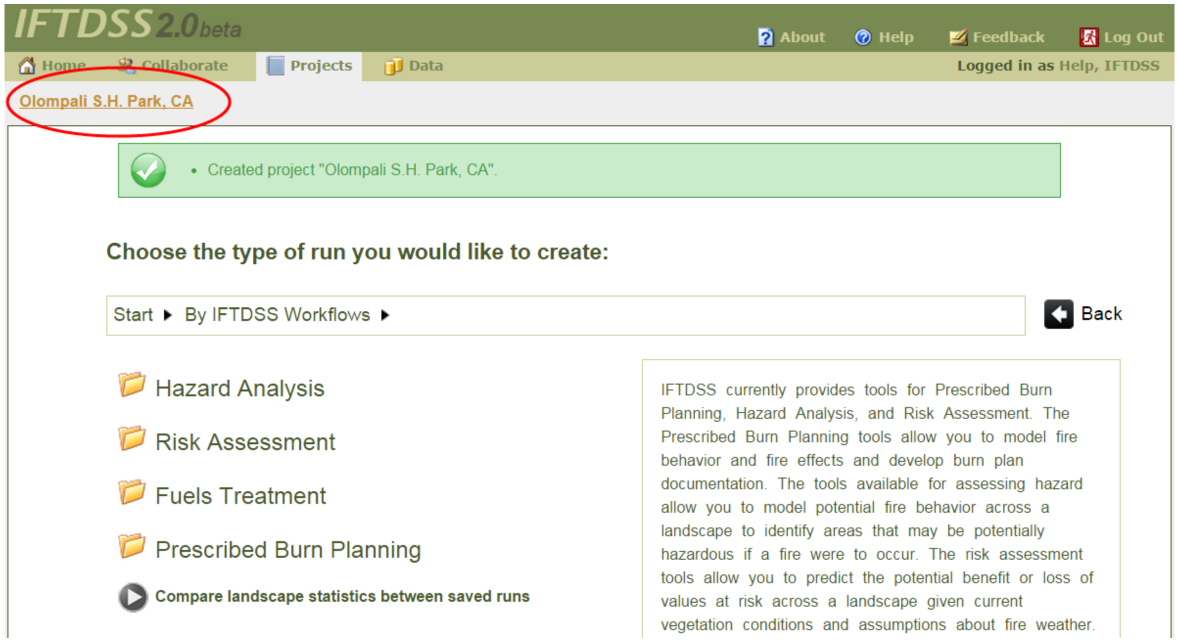
Choose a descriptive project name.

If desired, fill in the optional information.

Choose **Next**.

After creating a new project, you will see the page for **creating a new run**.

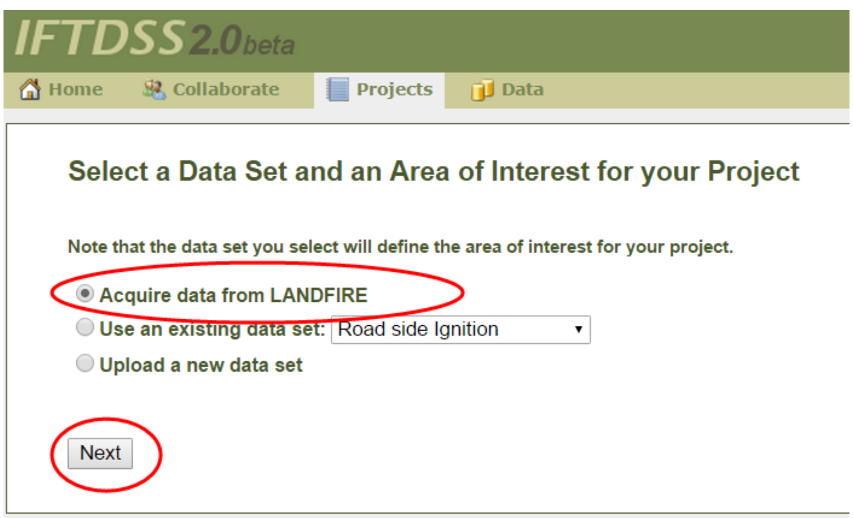
For the next steps, setting up an area of interest and acquiring LANDFIRE data, we are going to navigate to the project summary page by clicking on our project name (circled in red).


IFTDSS 2.0 beta
About
Help
Feedback
Log Out
Home
Collaborate
Projects
Data
Logged in as Help, IFTDSS
Olompali S.H. Park, CA
Created project "Olompali S.H. Park, CA".
Choose the type of run you would like to create:
Start
By IFTDSS Workflows
Back
Hazard Analysis
Risk Assessment
Fuels Treatment
Prescribed Burn Planning
Compare landscape statistics between saved runs
IFTDSS currently provides tools for Prescribed Burn Planning, Hazard Analysis, and Risk Assessment. The Prescribed Burn Planning tools allow you to model fire behavior and fire effects and develop burn plan documentation. The tools available for assessing hazard allow you to model potential fire behavior across a landscape to identify areas that may be potentially hazardous if a fire were to occur. The risk assessment tools allow you to predict the potential benefit or loss of values at risk across a landscape given current vegetation conditions and assumptions about fire weather.

Acquiring LANDFIRE Data

From the project summary page, click **Acquiring data from LANDFIRE** in the area of interest box

Make sure the **Acquire data from LANDFIRE** option is selected and click **Next**.



Navigate to your desired location using one of these methods:

- Use the navigation tools located in the top left portion of the map. Use the mouse. Click and drag to move; double-click to zoom in.**Enter coordinates**.

For this example, you may enter the following coordinates:

- **North:** 38.164505878997
- **East:** -122.54560796614
- **South:** 38.111039352952
- **West:** -122.62800542709

Name the data set

Select a LANDFIRE data layer, in this example, we'll choose LANDFIRE 2010 (V 1.20)

Select a fuel model type (Scott and Burgan 40 or Anderson 13). In this example we use Anderson 13.

Note: Once you select your dataset, the project area **cannot** be changed. To change a project area, you must create a new project.

Note: Currently, acquisition of LANDFIRE data is limited to 400,000 acres.

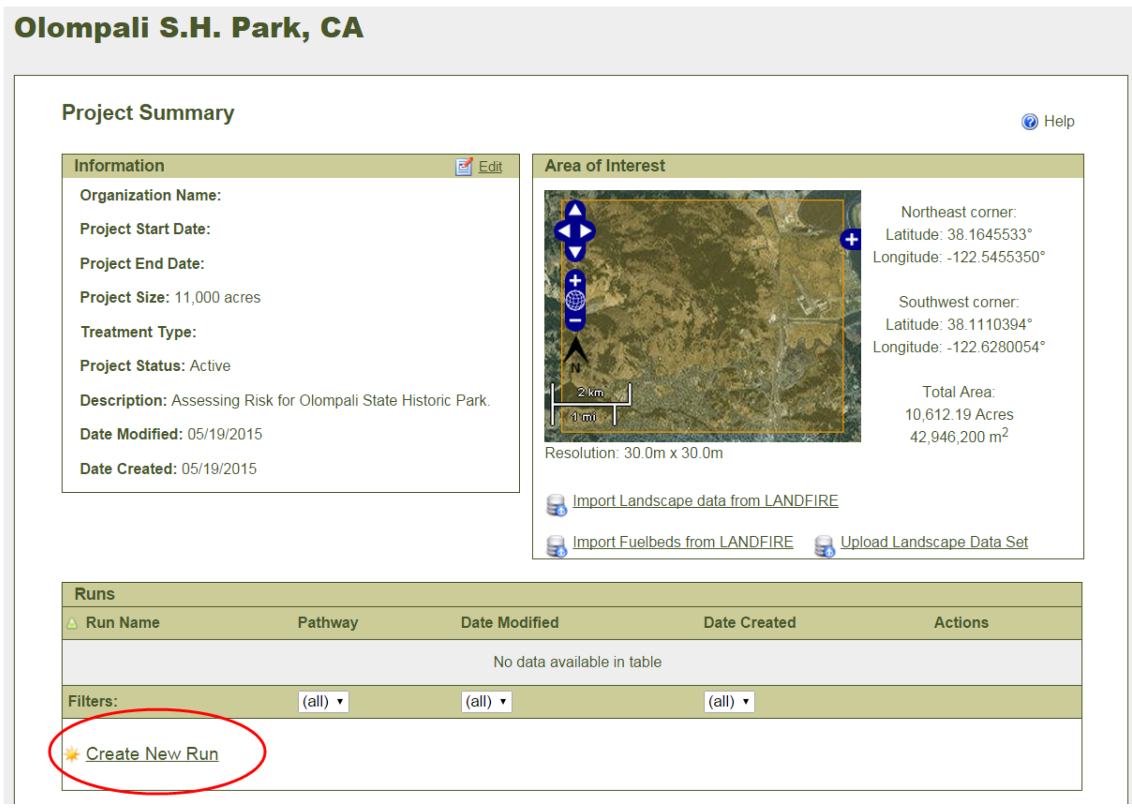
After acquiring the LANDFIRE data, you are returned to the **Project Summary** page. Stay on this page for the next section.

For use in spatial modules, you now have

- a Project Area of Interest and
- a Project Data Set.

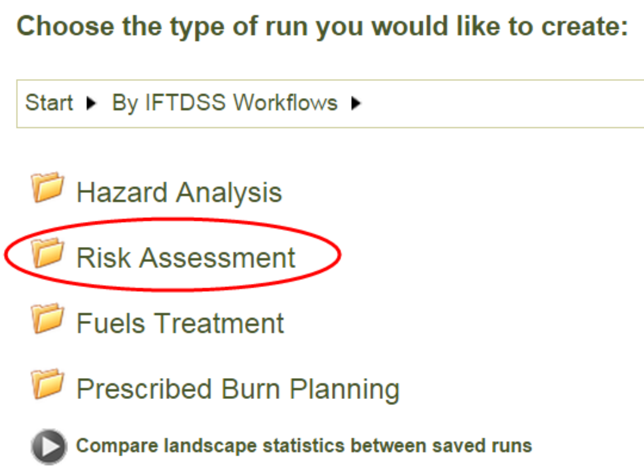
Flame Length Probabilities Risk Assessment: Creating a New Run

To create a new run from the Project Summary page select Create New Run.

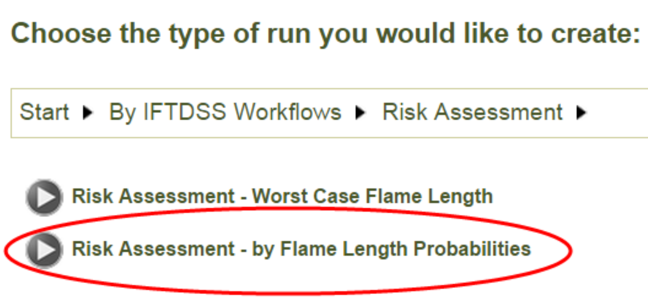


Flame Alternatively, you can navigate to your project from the **Projects** tab along the top Navigation bar.

Select the **Risk Assessment** workflow



Choose **Risk Assessment – by Flame Length Probabilities**



Length Probabilities Risk Assessment: Define Area of Interest

Name your run.

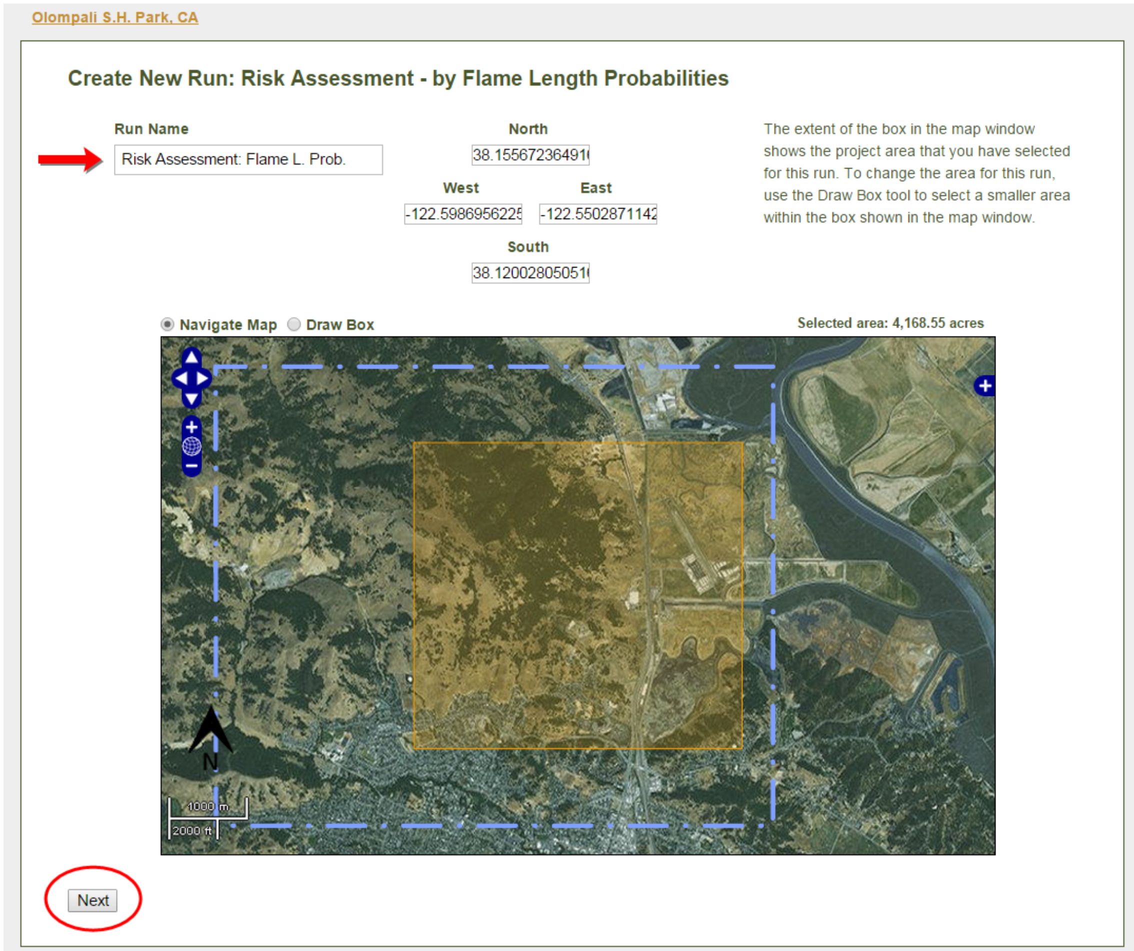
Tip: For future reference, give your run a descriptive name.

In this step, select an area of interest within the project boundary. For this example, we selected a smaller area within the project boundary.

Tip: For this example, **enter the following coordinates:**

- **North:** 38.155672364916
- **East:** -122.5502871142
- **South:** 38.120028050516
- **West:** -122.5986956225

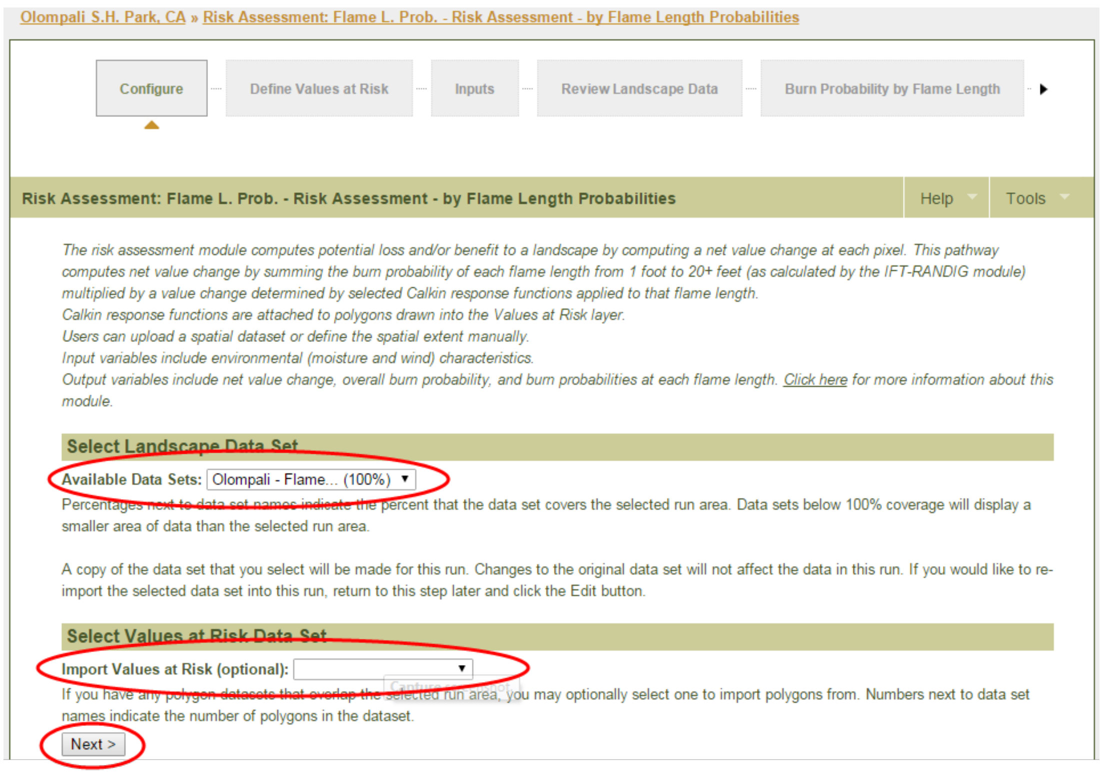
After selecting an area of interest, choose **Next.**


Olompali S.H. Park, CA
Create New Run: Risk Assessment - by Flame Length Probabilities
Run Name
Risk Assessment: Flame L. Prob.
North
38.15567236491
West
-122.598695622
East
-122.550287114
South
38.12002805051
The extent of the box in the map window shows the project area that you have selected for this run. To change the area for this run, use the Draw Box tool to select a smaller area within the box shown in the map window.
Navigate Map
Draw Box
Selected area: 4,168.55 acres
N
1000 m
2000 ft
Next

Flame Length Probabilities Risk Assessment: Selecting a Dataset

You are now on the **Configure** step.

Under **Select Landscape Data**, select the “Olompali State Historic Park (100%)” data set and choose **Next** to proceed to the **Define Values at Risk** step.

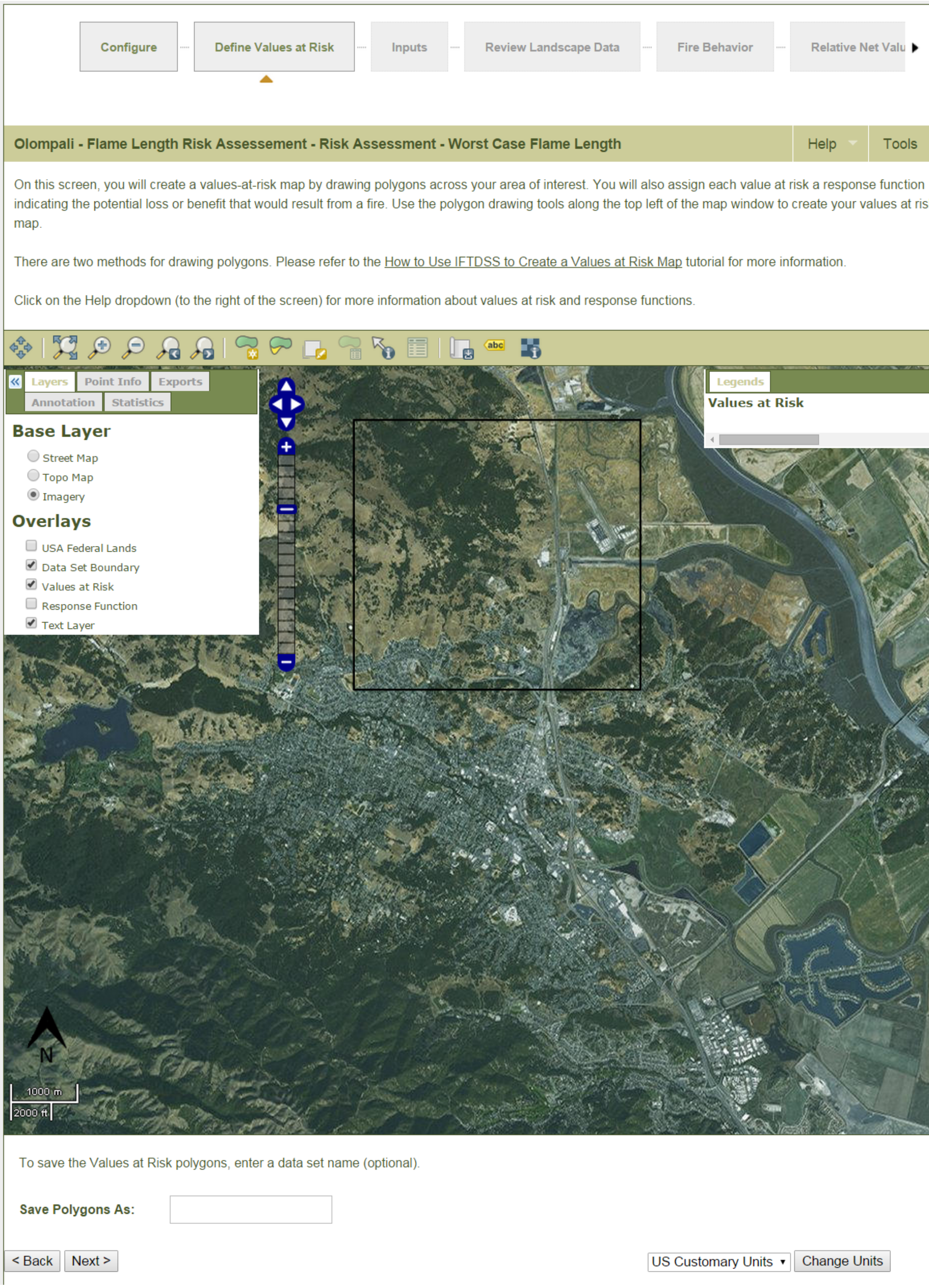


Flame Length Probabilities Risk Assessment: Defining Values at Risk

You are now at the **Define Values at Risk** step. In this step, you will define your values at risk (using the **Draw Polygon** tool) across your entire area of interest. In this step you will cover:

- Values at Risk
- Response Functions (Definitions)
- Introduction the Map Toolbar
- Defining Values at Risk: Methods
- Defining Values at Risk: Using the Free-form Drawing Method to create polygons
- Defining Values at Risk: Using the Edit Feature Panel to Specify Values at Risk Response function
- Defining Values at Risk: Using the Point and Click Method to create polygons
- Defining Larger Values at Risk
- Defining Smaller Values at Risk
- Editing Values at Risk
- Defining Values at Risk: Assigning a Background

- Reviewing and Saving Your Values-at-Risk Map



Values-at-risk

Values at risk, also known as highly valued resources, (HVR) are features on the landscape that are influenced positively and/or negatively by fire. A value at risk can have ecological, economic, or social importance.

Some examples of values at risk include:

- Airports
- Archeological sites
- Conifer forests
- Highway buffers
- Historic buildings
- Wildland-urban interface

Response Functions (Definitions)

Response functions describe the effect of fire on the values at risk.

Response functions are mathematical relationships between fire characteristic (e.g., flame length) and fire outcome (see the table above; this table is also available in the online help). There are 14 pre-defined response functions.

RESPONSE FUNCTION	DESCRIPTION	NET VALUE CHANGE MULTIPLIER BASED ON USER-DEFINED FLAME LENGTH CLASSES			
		LOW	MODERATE	HIGH	VERY HIGH
1	All fire is beneficial; strong benefit at low and moderate fire intensities and moderate benefit at high and very high intensity.	+80	+80	+40	+40
2	All fire is beneficial; moderate benefit at low fire intensity and mild benefit at higher intensity.	+50	+20	+20	+20
3	Strong benefit at low fire intensity, decreasing to a strong loss at very high intensity.	+60	+20	-20	-60
4	Moderate benefit at low fire intensity, decreasing to a moderate loss at very high fire intensity	+30	+10	-10	-30
5	Slight benefit or loss at all fire intensities	0	0	0	0
6	Mild increasing loss from slight benefit or loss at low intensity to a moderate loss at very high intensity.	0	-10	-20	-30
7	Moderate increasing loss from mild loss at low intensity to a strong loss at very high intensity.	-10	-30	-50	-80
8	Slight benefit or loss at all fire intensities, except a moderate loss at very high intensity.	0	0	0	-50
9	Slight benefit or loss at low and moderate fire intensities and a mild loss at high and very high intensities.	0	0	-20	-20

10	Mild loss at all fire intensities	-20	-20	-20	-20
11	Moderate loss from fire at all fire intensities	-50	-50	-50	-50
12	Strong loss from fire at all fire intensities.	-80	-80	-80	-80
13	Loss increases from slight loss at low intensity to strong loss at very high intensity.	-10	-60	-70	-80
14	Slight benefit or loss from fire at low and moderate intensities and a strong loss from fire at high and very high intensities.	0	0	-80	-80

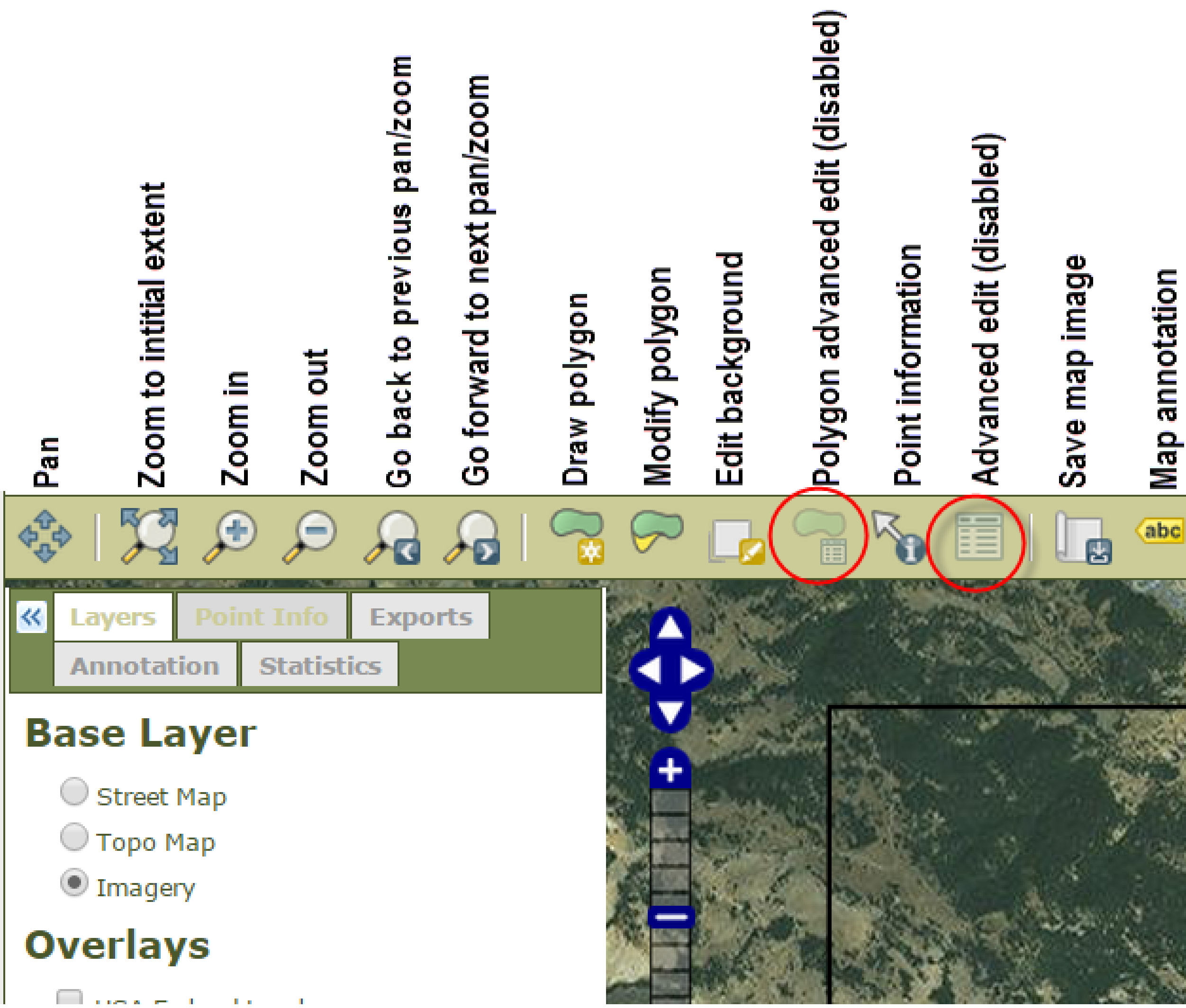
(Table modified from Calkin et al., 2010a)

Introduction to the Map Toolbar

To create the values at risk polygons, we'll use the map toolbar located at the top of the map; the toolbar provides tools for drawing your values at risk.

Hover your cursor over each tool for a brief description of that tool.

Tools that **Advanced** are disabled are faded out (for example, the **Polygon Edit** and **Advanced Edit** tools, circled here in red).



Defining Values at Risk: Methods

To create a values-at-risk map, you will draw polygons across the landscape and assign each one a response function.

There are two methods for using the map tools to draw polygons:

1. The **free-form drawing method** is useful when
   - You want to quickly and easily draw polygons.
   - You have a small area of interest.
   - You can see the entire area your polygon will encompass without moving the map.
2. The **point and click method** is useful when
   - You want to zoom in to make a detailed polygon.
   - You need to move the map (using the **pan tool**) while you are drawing a polygon.

These polygon drawing methods are discussed in the next four sections.

Defining Values at Risk: Using the Free-form Drawing Method to create polygons

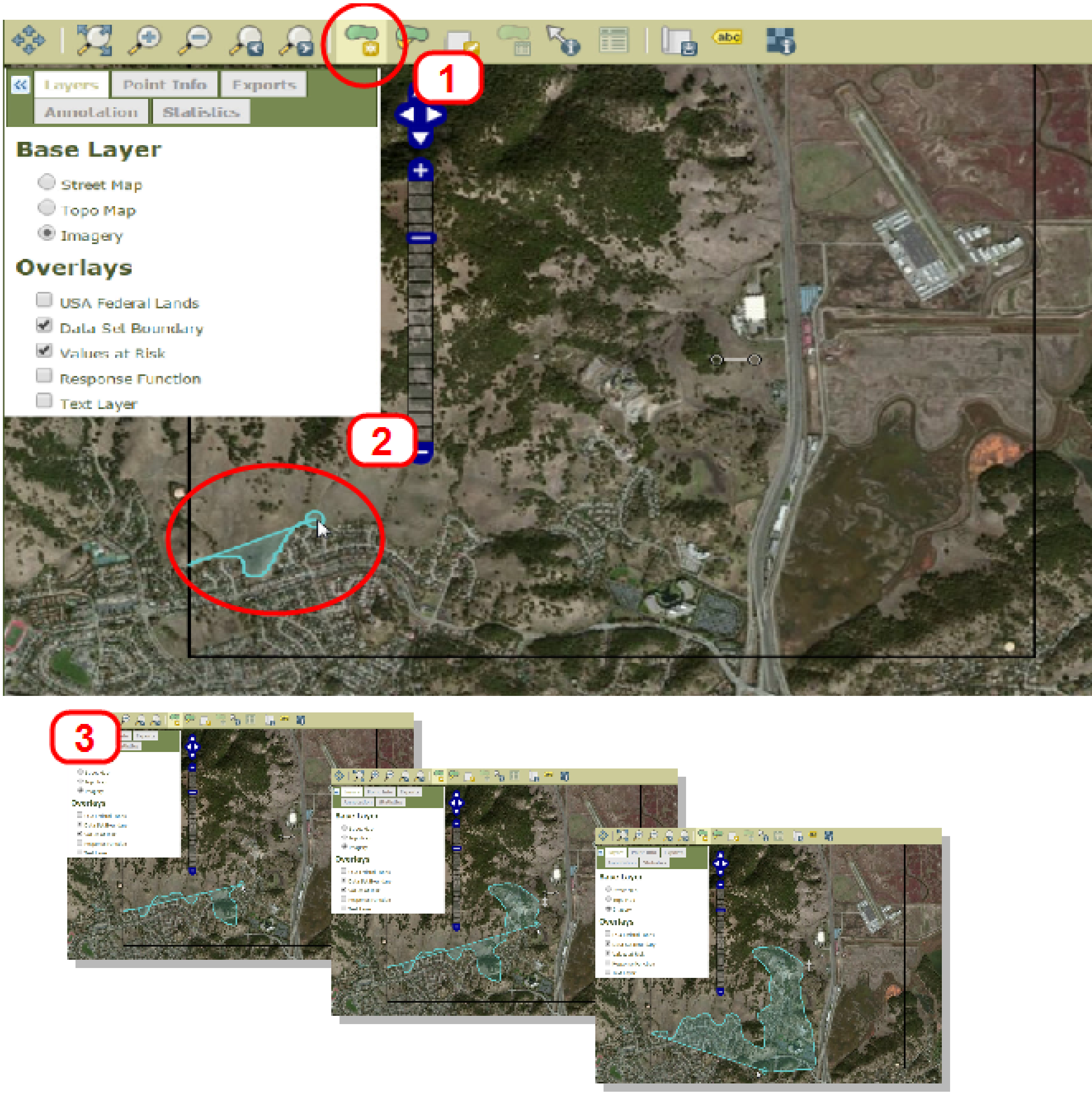
In this step, you use the free-form drawing method to **define values at risk** and assign each value at risk a response function.

In this example, you draw a polygon over the wildland-urban interface.

1. Select the **Draw Polygon** tool.
2. Hold down the **shift** key and the **left mouse button** at the map location where you want to start drawing your first polygon.
3. Continue to hold down the **shift** key and **left mouse button**. Moving the mouse as if it were a pencil, draw your polygon (outlining the wild-land-urban interface).

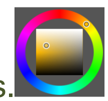
Let go of the left mouse button and shift key when you are done drawing the polygon. This creates the polygon and opens the **Edit Feature** panel (shown in the next step).

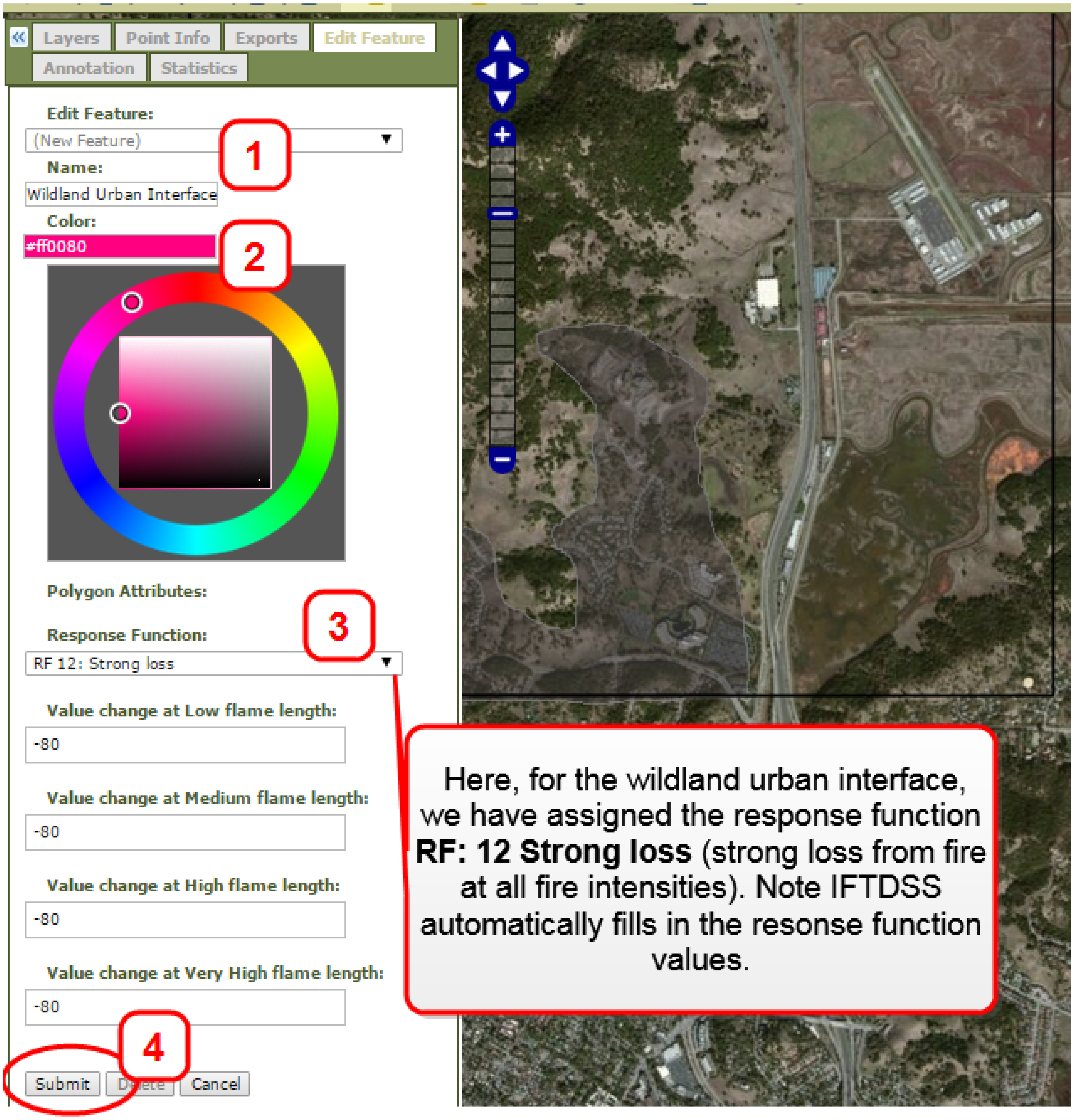
Tip: Define your largest values at risk first (e.g., wildland-urban interface, oak woodlands).


1
2
3
abc
Layers
Point Info
Exports
Annotation
Statistics
Base Layer
Street Map
Topo Map
Imagery
Overlays
USA Federal Lands
Data Set Boundary
Values at Risk
Response Function
Text Layer

Defining Values at Risk: Using the Edit Feature Panel to Specify Values at Risk Response function

After you create the polygon, the **Edit Feature** panel appears. To edit the polygon,

1. Name the polygon.
2. Give the polygon a color.
    - Click on the **Color** text box. A color wheel appears.
    - Use the color wheel to choose a color.
    - Use the inner box to choose the shade of the color selected.
3. Assign a response function to the polygon
4. Choose **Submit** to save the polygon data.



Tip: Click on **Response Functions** under the **Help** dropdown menu to read a description of each response function and to find additional resources.

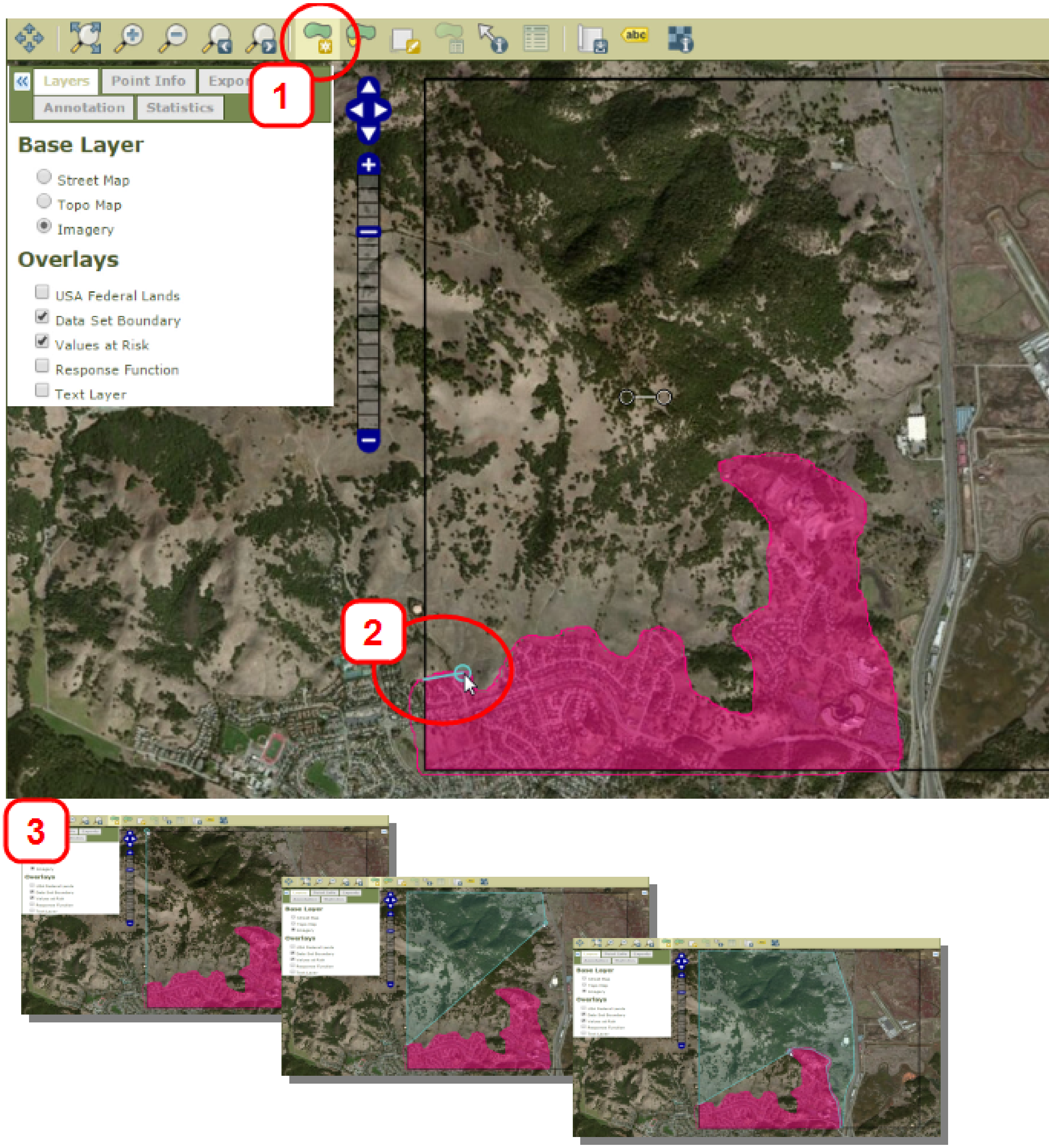
Defining Values at Risk: Using the Point and Click Method to create polygons

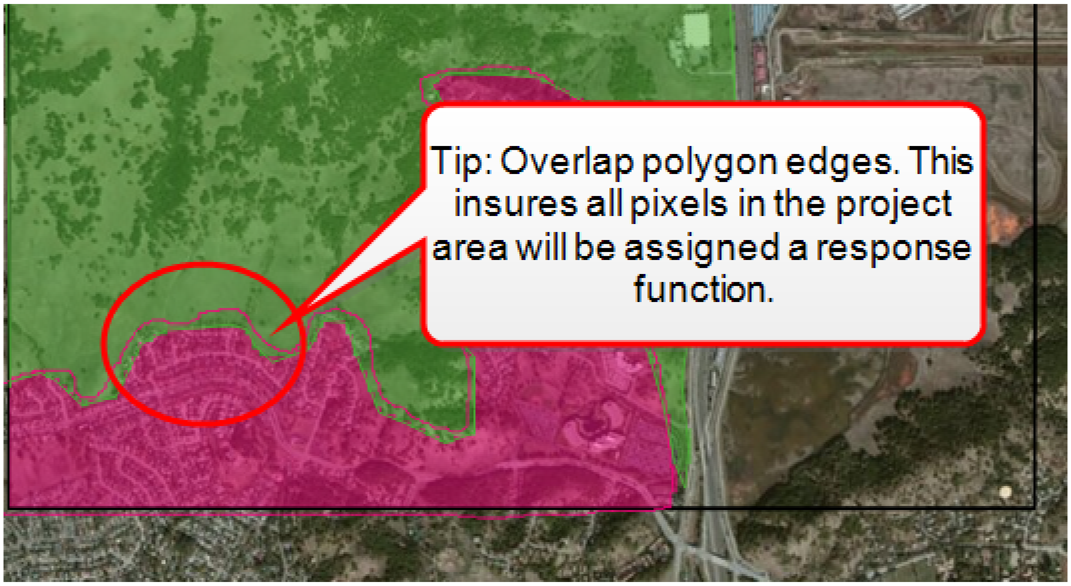
Next, define another value at risk.

In this example, use the **point and click method** to draw a polygon over the private land (oak woodlands).

1. Select the **Draw Polygon** tool.
2. Click on the map and release to start drawing your first polygon.
3. Move the mouse to a new point and click to add another point. Before moving on, make sure the point is established (by moving the mouse away from the point). Continue this process until you are done drawing your polygon.

Double-click when you are done drawing the polygon to create the polygon and to open the **Edit Feature** panel (shown on the next page).

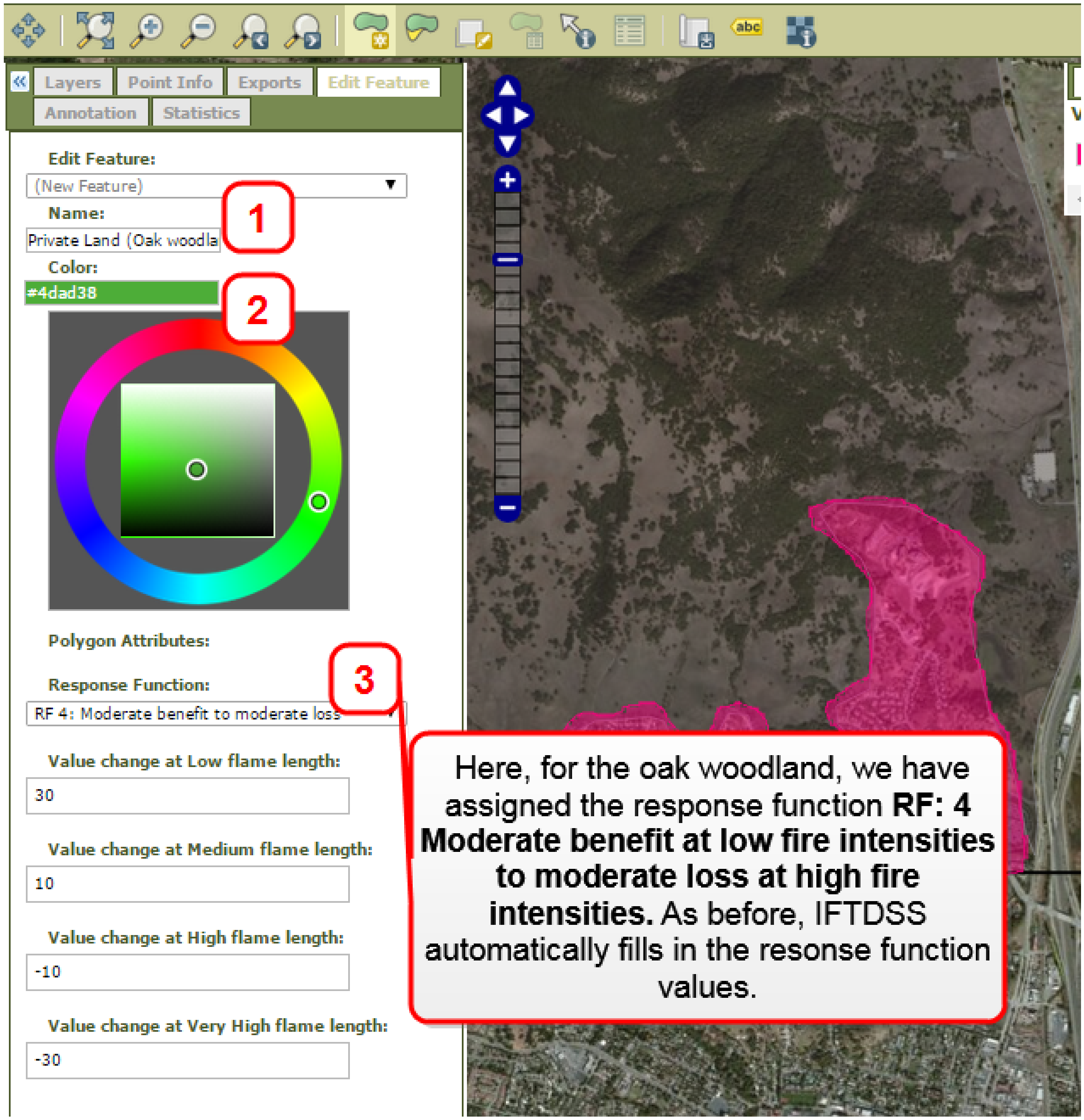

Layers
Point Info
Expor
Annotation
Statistics
1
Base Layer
Street Map
Topo Map
Imagery
Overlays
USA Federal Lands
Data Set Boundary
Values at Risk
Response Function
Text Layer
abc
2
3



After double-clicking to create the polygon, the **Edit Feature** panel appears. To edit the polygon:

1. Name the polygon.
2. Give the polygon a color.
   - Click on the **Color** text box. A color wheel appears.
   - Use the color wheel to choose a color.
   - Use the inner box to choose the shade of the color selected.
3. Assign a response function to the polygon (see page 19 and the box to the lower right on this page). Here we have assigned to the oak woodland the response function RF 4: Moderate benefit at low fire intensities to moderate loss at high fire intensities. As before, IFTDSS automatically fills in the response function values.

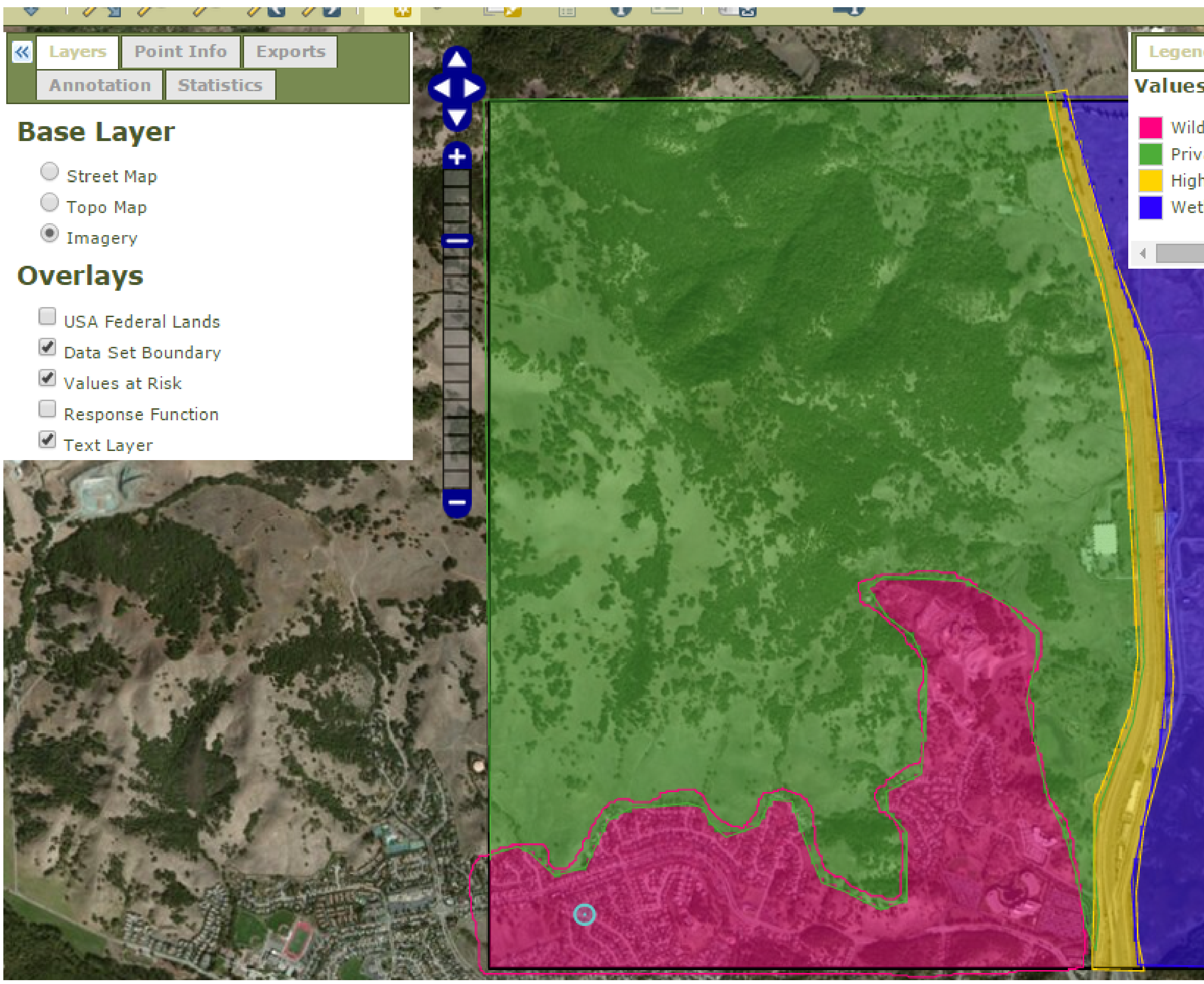
Choose **Submit** to save the polygon data.


Layers
Point Info
Exports
Edit Feature
Annotation
Statistics
Edit Feature:
(New Feature)
Name:
Private Land (Oak woodla
1
Color:
#4dad38
2
Polygon Attributes:
Response Function:
RF 4: Moderate benefit to moderate loss
3
Value change at Low flame length:
30
Value change at Medium flame length:
10
Value change at High flame length:
-10
Value change at Very High flame length:
-30
Here, for the oak woodland, we have assigned the response function **RF: 4 Moderate benefit at low fire intensities to moderate loss at high fire intensities.** As before, IFTDSS automatically fills in the resonse function values.

Defining Larger Values at Risk

Continue to fill your entire area of interest with polygons representing the larger values at risk. **Define your largest values at risk** first (e.g., wildland-urban interface, oak woodlands).

Try it out: Define your own large values at risk, using both of the polygon drawing methods, and assign those values at risk a variety of response functions.

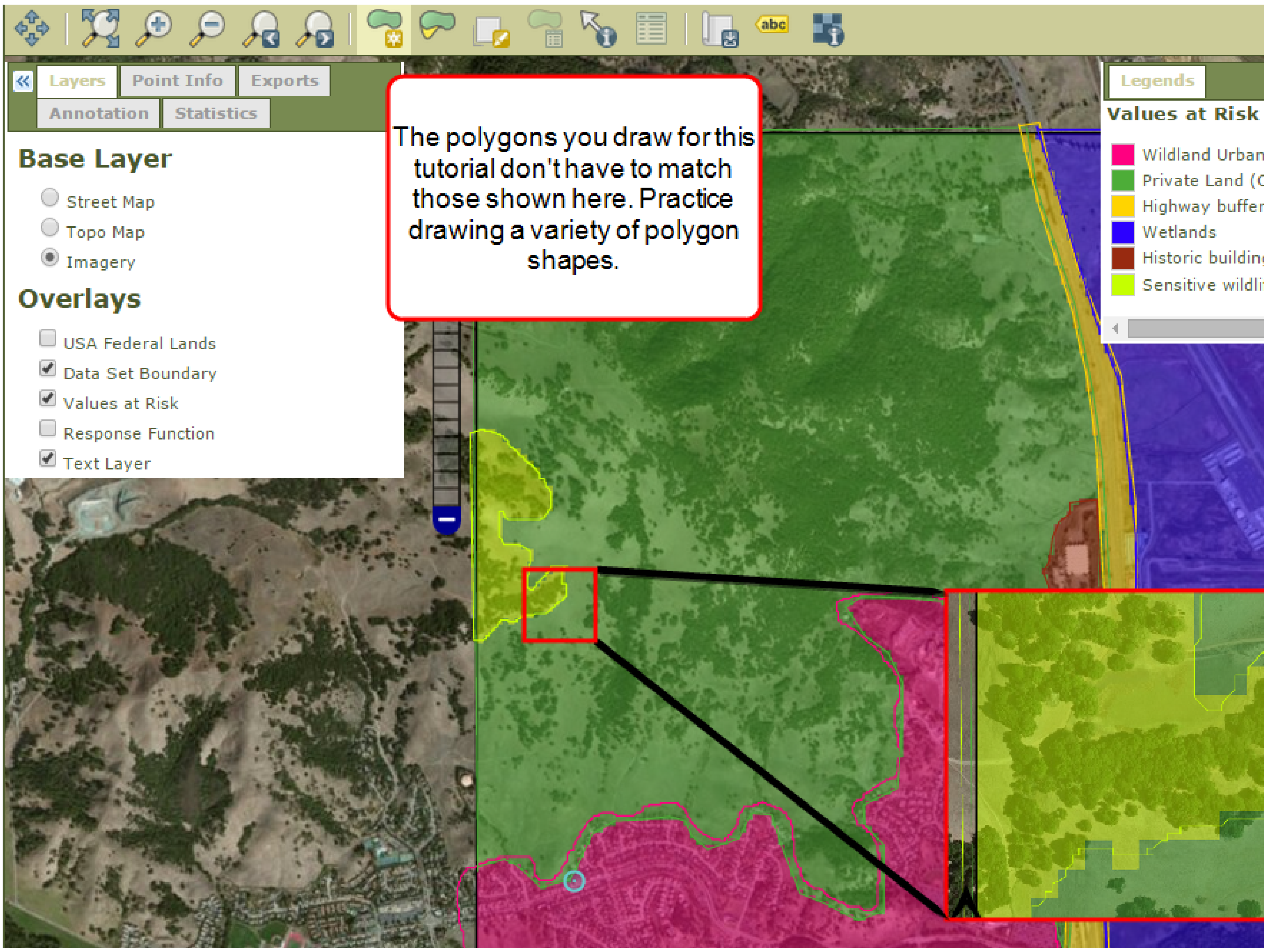


Defining Smaller Values at Risk

After defining your larger values at risk, draw smaller values of risk (e.g., archeological sites, endangered species habitat, structures) on top of the larger values at risk.

The smaller polygons replace the larger polygons beneath.

Tip: Creating a detailed values-at-risk map (with multiple response functions) produces better outputs.



Once you create a polygon, the data area is rasterized. If your polygon line encompasses less than half of a pixel, that pixel will not be included in your polygon. If your polygon line encompasses more than half of a pixel, that pixel will be included in your polygon.

Editing Values at Risk

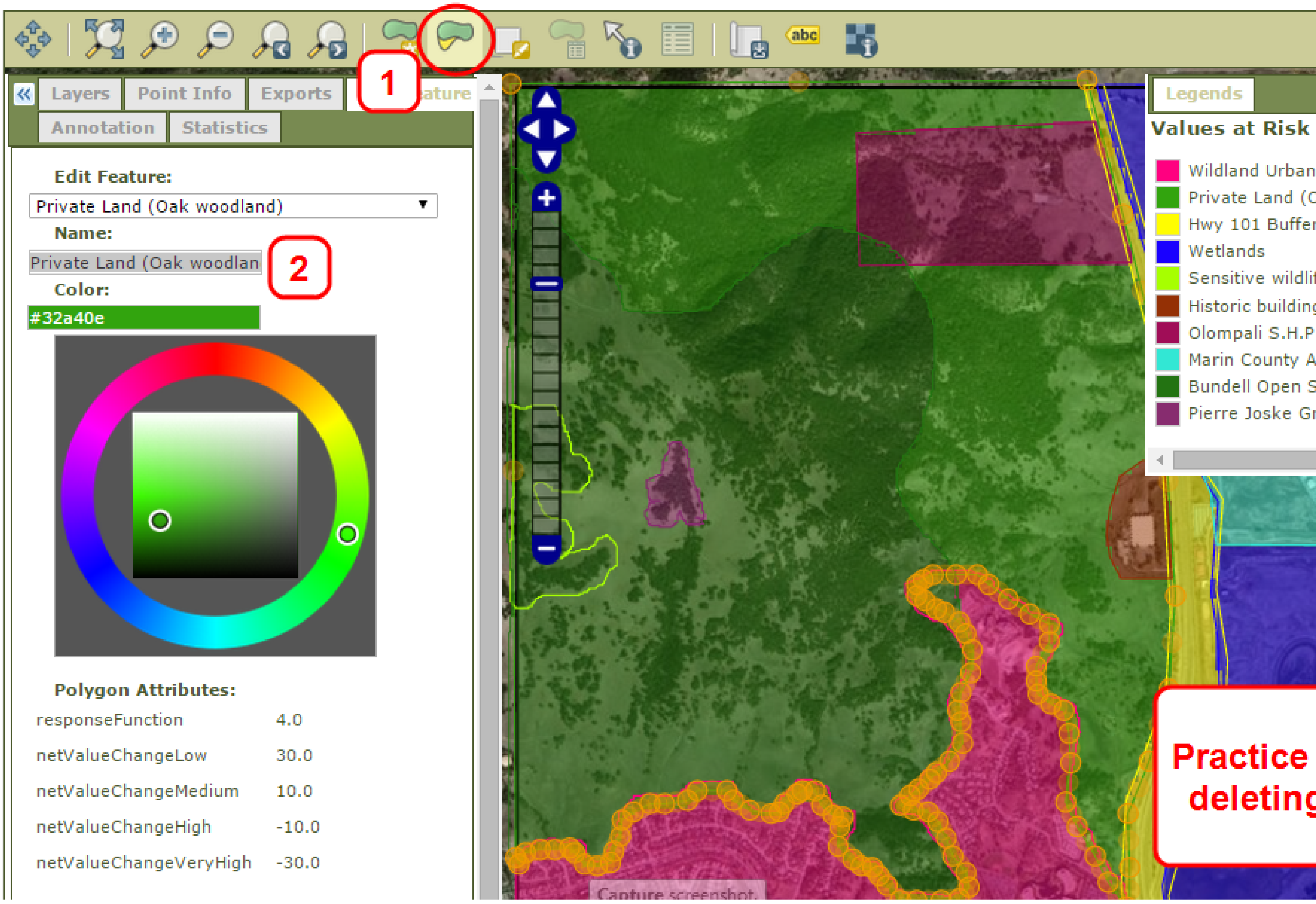
You can also edit your polygons using the **Modify Polygon** tool.

1. Select the **Modify Polygon** tool.
2. Select the feature (value at risk) you would like to edit using the **Edit Feature** drop-down list.

In the **Edit Feature** panel, you can edit the polygon's name, color, or response function.

You can also delete a polygon using the **Delete** button at the bottom of the panel.

If you delete a polygon, the assigned background will replace the deleted polygon.

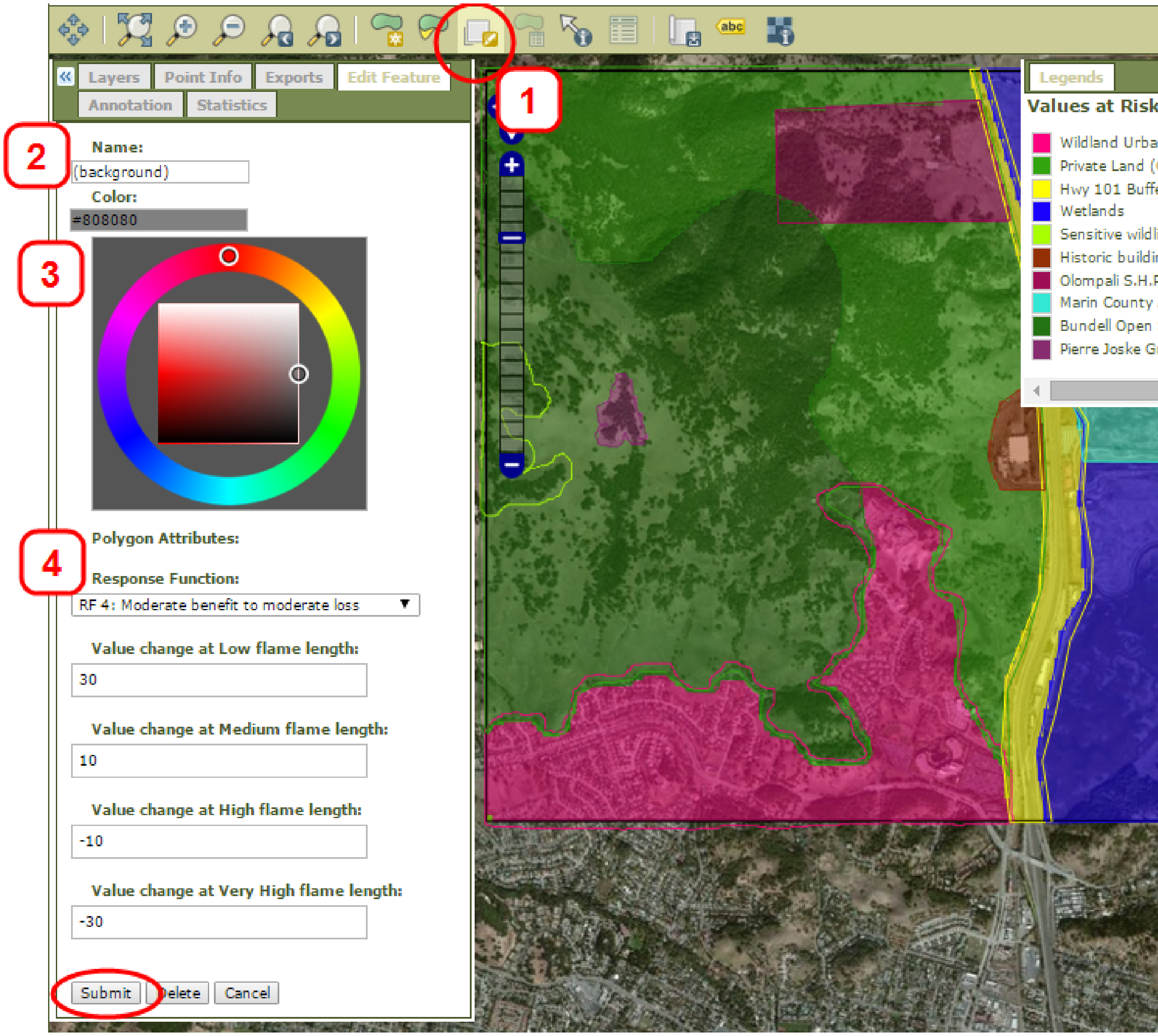


Defining Values at Risk: Assigning a Background

In order for IFTDSS to calculate an output in the risk pathways, **every grid cell within the area of interest needs a response function**. To fill this requirement without having to define values at risk for every pixel, you can assign a background to your values-at-risk map. To ensure every grid cell is assigned a response function, assign a response function to the background using the following steps:

1. Select the **Edit Background** tool.
2. The **Edit Feature** panel will appear. If you prefer, you can change the background's name from background).
3. Assign the background a color.
4. Assign the background a response function.

Assigning the background a response function of 4 tells IFTDSS to assume that the areas without a polygon will burn with a moderate benefit under low flame lengths to a moderate loss under very high flame lengths.

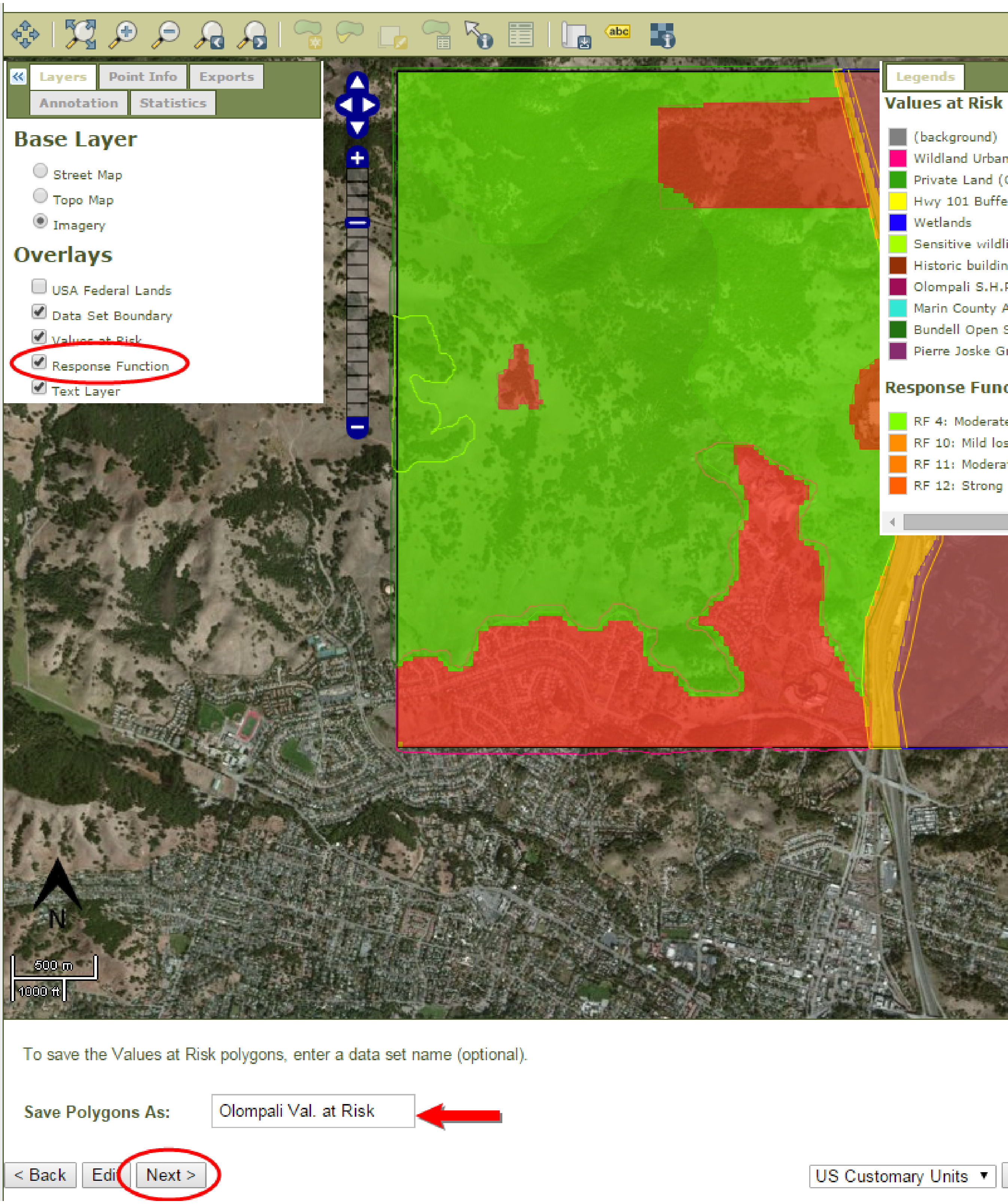

1
Layers
Point Info
Exports
Edit Feature
Annotation
Statistics
2
Name:
(background)
Color:
#808080
3
4
Polygon Attributes:
Response Function:
RF 4: Moderate benefit to moderate loss
Value change at Low flame length:
30
Value change at Medium flame length:
10
Value change at High flame length:
-10
Value change at Very High flame length:
-30
Submit
Delete
Cancel
Legends
Values at Risk
Wildland Urba
Private Land (
Hwy 101 Buffe
Wetlands
Sensitive wildl
Historic buildi
Olompali S.H.P
Marin County
Bundell Open
Pierre Joske G

Reviewing and Saving Your Values-at-Risk Map

You can use the **Layers** panel to view your values at risk or the response functions that you assigned to your values at risk.

To save your values-at-risk map for use in future runs, type a descriptive name into the “**Save Polygons As**” text box.

To continue the risk assessment pathway, when your values-at-risk map is complete, choose **Next.**

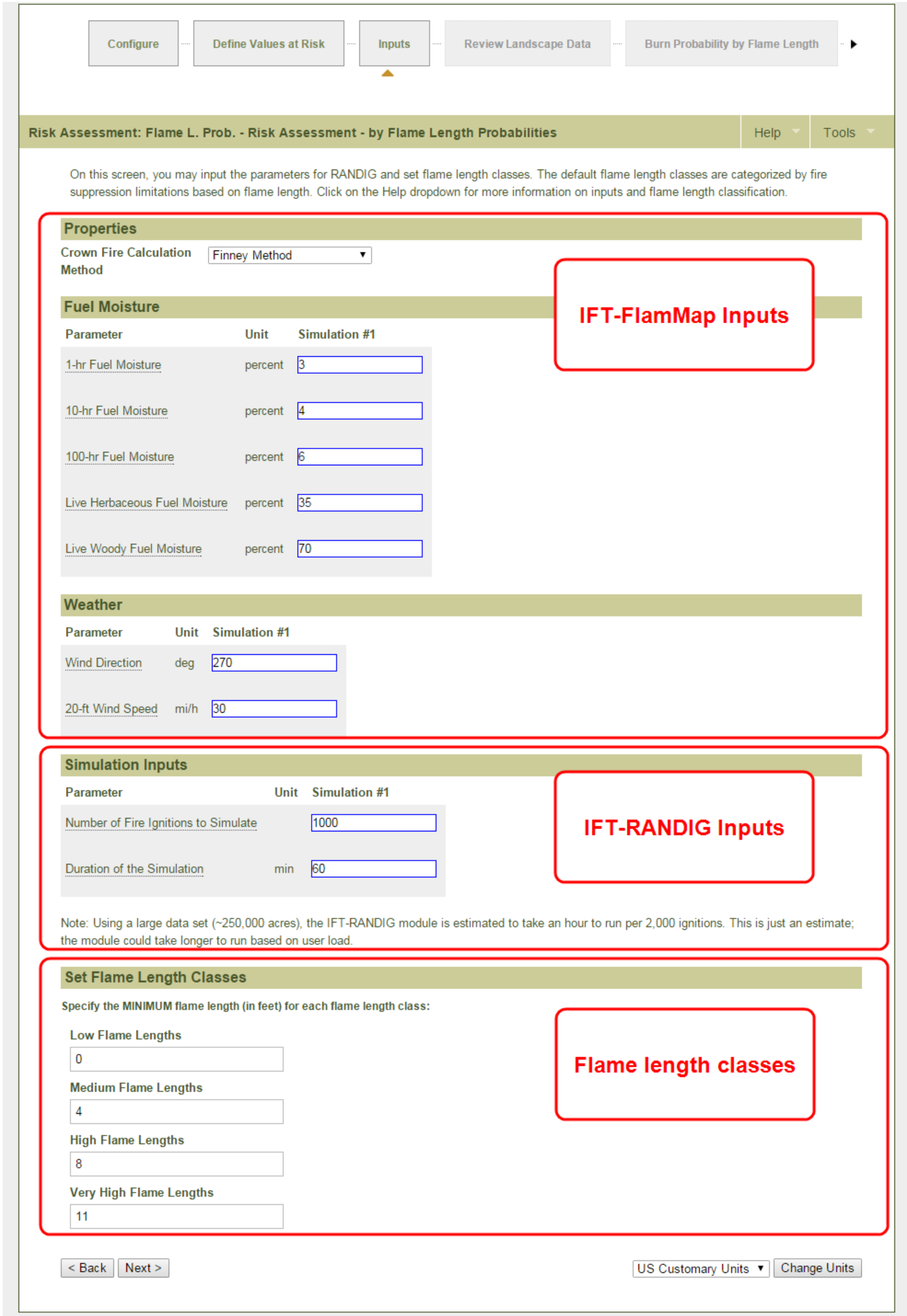

Layers
Point Info
Exports
Annotation
Statistics
Base Layer
Street Map
Topo Map
Imagery
Overlays
USA Federal Lands
Data Set Boundary
Values at Risk
Response Function
Text Layer
Legends
Values at Risk
(background)
Wildland Urban
Private Land (
Hwy 101 Buffe
Wetlands
Sensitive wildli
Historic buildin
Olompali S.H.P
Marin County A
Bundell Open S
Pierre Joske Gr
Response Func
RF 4: Moderate
RF 10: Mild los
RF 11: Modera
RF 12: Strong
N
500 m
1000 ft
To save the Values at Risk polygons, enter a data set name (optional).
Save Polygons As:
Olompali Val. at Risk
< Back
Edi
Next >
US Customary Units

Inputting Environmental and Simulation Parameters

Now that you have created a values-at-risk map, the next steps will involve inputting the environmental and simulation parameters needed to run the model.

In the following steps we will cover:

- IFT-FlamMap Inputs: Crown Fire Calculation, Fuel Moisture, & Weather)
- IFT-RANDIG Inputs: Simulation Inputs
- Setting Flame Length Classes



Configure
Define Values at Risk
Inputs
Review Landscape Data
Burn Probability by Flame Length
Risk Assessment: Flame L. Prob. - Risk Assessment - by Flame Length Probabilities
Help
Tools
On this screen, you may input the parameters for RANDIG and set flame length classes. The default flame length classes are categorized by fire suppression limitations based on flame length. Click on the Help dropdown for more information on inputs and flame length classification.
Properties
Crown Fire Calculation Method
Finney Method
IFT-FlamMap Inputs
Fuel Moisture
Parameter
Unit
Simulation #1
1-hr Fuel Moisture
percent
3
10-hr Fuel Moisture
percent
4
100-hr Fuel Moisture
percent
6
Live Herbaceous Fuel Moisture
percent
35
Live Woody Fuel Moisture
percent
70
Weather
Parameter
Unit
Simulation #1
Wind Direction
deg
270
20-ft Wind Speed
mi/h
30
Simulation Inputs
Parameter
Unit
Simulation #1
Number of Fire Ignitions to Simulate
1000
Duration of the Simulation
min
60
IFT-RANDIG Inputs
Note: Using a large data set (~250,000 acres), the IFT-RANDIG module is estimated to take an hour to run per 2,000 ignitions. This is just an estimate; the module could take longer to run based on user load.
Set Flame Length Classes
Specify the MINIMUM flame length (in feet) for each flame length class:
Low Flame Lengths
0
Medium Flame Lengths
4
High Flame Lengths
8
Very High Flame Lengths
11
Flame length classes
< Back
Next >
US Customary Units
Change Units

NOTE: The input fields are pre-populated with default values.

NOTE: You should perform multiple runs with each crown fire initiation method to determine which method works best for your local vegetation. The Scott-Reinhardt method will generally result in more crown fire being modeled across the landscape.

Tip: You can use the **Tab** key on your keyboard to navigate to the next input field.

IFT-FlamMap Inputs: Crown Fire Calculation, Fuel Moisture, & Weather

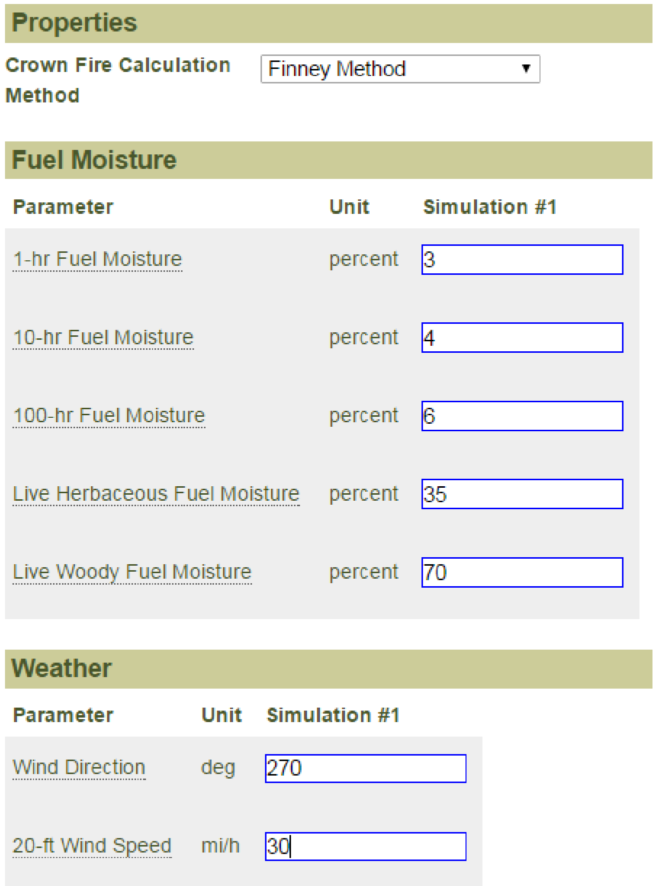
There are two choices for the crown fire calculation method, Finney, and Scott and Reinhardt. We will select Finney for this example, you can read more about the differences between the two choices on the Crown Fire Calculation Options help page.

Fuel moisture and weather inputs should be based on dry, hot summer conditions that could potentially produce the worst-case flame length outcomes.

Tip: When assessing fire risk across large landscapes, especially in mountainous terrain, be aware that weather conditions can vary across diverse topographic settings. Create multiple runs to test different weather scenarios that can produce low, high, and extreme fire behaviors

Tip: Definitions and possible value ranges will display when a mouse cursor is hovered over the underlined parameters.

For this example, we input “red-flag warning” weather conditions that occur in this region (see the inputs in the figure below). Red-flag warning conditions often include low fuel moisture and low relative humidity, high/erratic winds, and lightning activity.



Tip: Create multiple runs to model burn probability using low, medium, and high numbers of fire ignitions, and short and long durations.

The results will help you understand how these inputs are affecting your specific area of interest.

IFT-RANDIG Inputs: Simulation Inputs

Next, define the IFT-RANDIG simulation inputs.

- Specify the **Number of fire ignitions to simulate**. This value refers to the number of randomly located ignition points across your run area.

The literature states that every pixel should have a chance of igniting; therefore, the larger the run area, the more random ignitions you will want to simulate. Start with 500 ignitions in small areas and 1000 ignitions in larger areas, add ignitions until most of the area experiences at least one fire.

- Specify the **Duration of the simulation** in minutes. This value refers to the duration of the fire growth calculations for the set of constant fuel moisture and weather conditions.

In this example, we chose to run the simulation for 60 minutes, which is the estimated response time for fire resources to be on scene at the Olompali State Historic Park. You can use shorter and longer duration times to answer a variety of questions.

Simulation Inputs

Parameter	Unit	Simulation #1
Number of Fire Ignitions to Simulate		1000
Duration of the Simulation	min	60

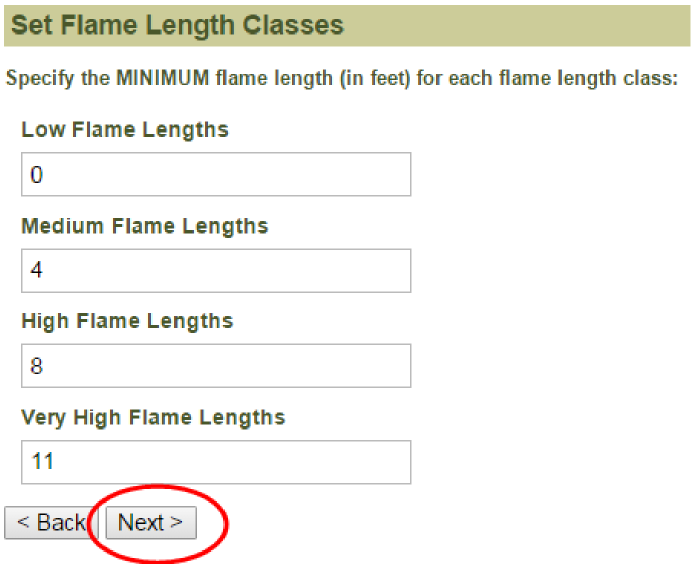
Tip: Create multiple runs to model burn probability using (a) Low, medium, and high numbers of fire ignitions, and (b) short and long simulation durations. The results will help you understand how these inputs are affecting your specific area of interest.

Setting Flame Length Classes

Now **enter flame lengths for your flame length classes, or accept the default values**. The default flame length classes are categorized by fire suppression limitations based on flame length (see table below).

The low flame lengths parameter is not directly editable. The minimum flame length for the low flame length class will always be zero. The upper limit for low flame lengths is determined by the value you enter for medium flame lengths.

For example, if you enter 4 for medium flame lengths, the range for low flame lengths becomes 0 to 4 feet.



FLAME LENGTH CLASS	FLAME LENGTH	FIRE SUPPRESSION INTERPRETATIONS
Low	<4	Fires can generally be attacked at the head or flanks by persons using hand tools. Handline should hold fire.
Medium	4 to 8 feet	Fires are too intense for direct attack on the head by persons using hand tools. Handline cannot be relied on to hold the fire. Bulldozers, engines, and retardant drops can be effective.
High	8 to 11 feet	Fires may present serious control problems: torching, crowning, and spotting. Control efforts at the head will probably be ineffective.
Very High	> 11 feet	Crowning, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

(Table modified from the National Wildfire Coordinating Group, 2004)

Choose **Next** to submit the inputs. You are taken to the **Review Landscape Data** step.

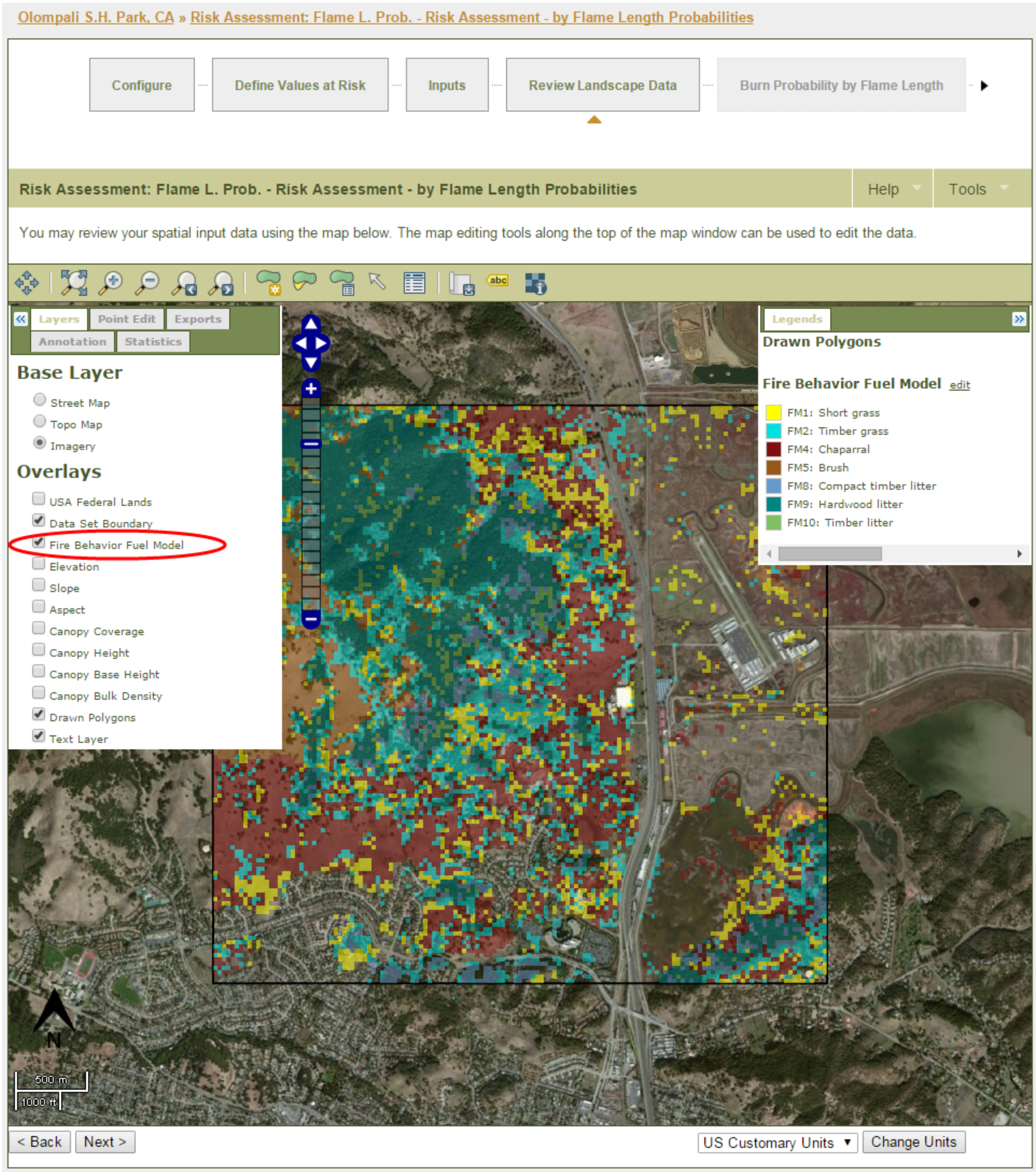
Reviewing Spatial Landscape Data

Now you can review your spatial landscape data using the map.

You can view the project area using imagery, topography, or street maps within IFTDSS. Toggle between these layers under the Base Layer section on the Layers tab.

You can also choose to display one or more overlays provide visual representations of different types of data.

In this example, you can see the area of interest with data from the **Fire Behavior Fuel Model**.

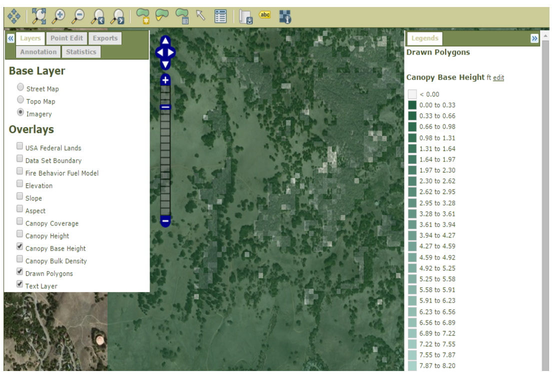


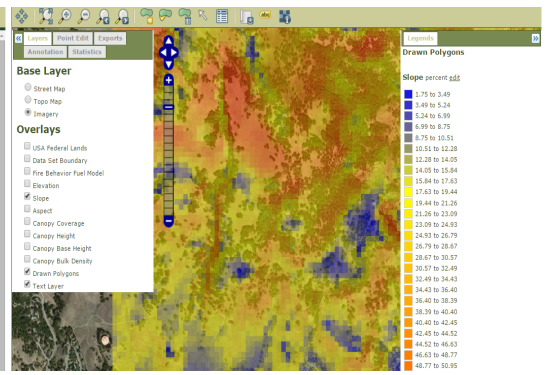
You can view the area of interest by the following LANDFIRE data layers:

- Fuel Model
- Elevation

- Slope
- Aspect
- Canopy Coverage
- Canopy Height
- Canopy Base Height
- Canopy Bulk Density

You can also view the project area using imagery, topography, or street maps within IFTDSS. Toggle between these layers under the Base Layer section on the Layers tab.





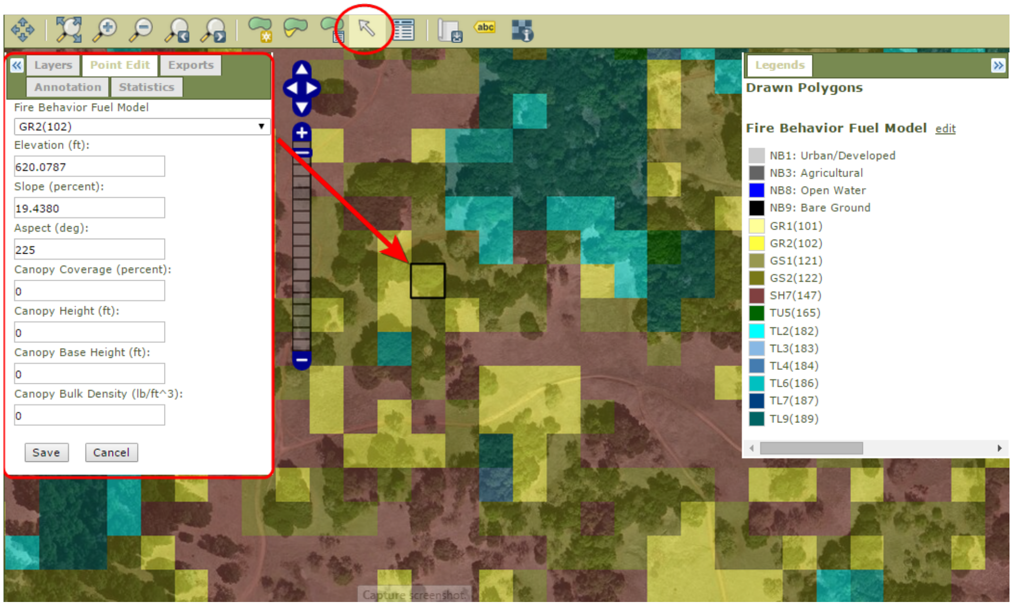
Editing Spatial Landscape Data (One Grid Cell at a Time)

If there are land use changes or if fires have occurred since the data layer was developed, you may need to edit the spatial landscape data, select the **Point Edit** tool. Using this tool, you can edit one grid cell at a time. (Or, you can edit multiple grid cells at a time using the **Advanced Edit** tool, as shown on the next page.)

Click on the grid cell you would like to edit, and the **Point Edit** panel appears.

Edit the grid cell data and choose **Save**.

The next page shows how to edit the spatial landscape data using the **Advanced Edit** tool.



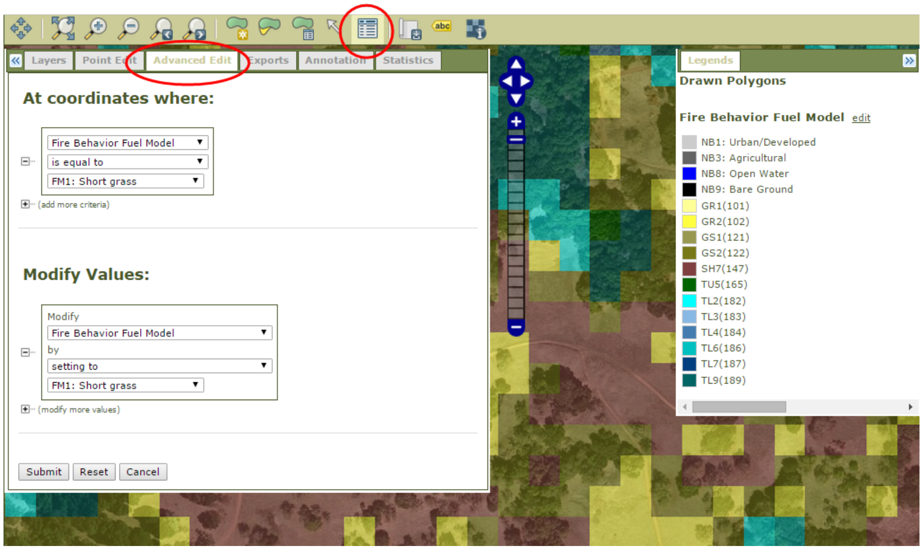
Editing Spatial Landscape Data (Multiple Grid Cells at a Time)

In the previous example, we showed how to edit grid cells one at a time. You can also use the **Advanced Edit** tool to edit multiple cells at once.

To get started, select the Advanced Edit tool. The **Advanced Edit** panel appears.

In this panel, you can modify any of the spatial data in query format so that multiple cells can be changed at once.

After you are done reviewing and editing your spatial data, choose **Next** to run the IFT-FlamMap and IFT-RANDIG modules.



Both the IFT-FlamMap and IFT-RANDIG modules are now running. The more random ignitions you place across a landscape, the longer this step takes to complete.

Note: For the example data used in this tutorial, the IFT-RANDIG module takes approximately 30 minutes to run.

Analyzing Burn Probability Output Data

After the IFT-RANDIG module finishes running, you can review your fire behavior output variables using the map.

The fire behavior output variables include:

Overall Burn Probability: An estimate (produced by IFT-RANDIG) for a given 30 x 30 m pixel of the likelihood that the area represented by a pixel will burn given a random ignition within the area of interest (for a specific set of environmental conditions). The formula is:

$$BP = \frac{F}{n}$$

where:

BP = burn probability

F = number of times a pixel burns

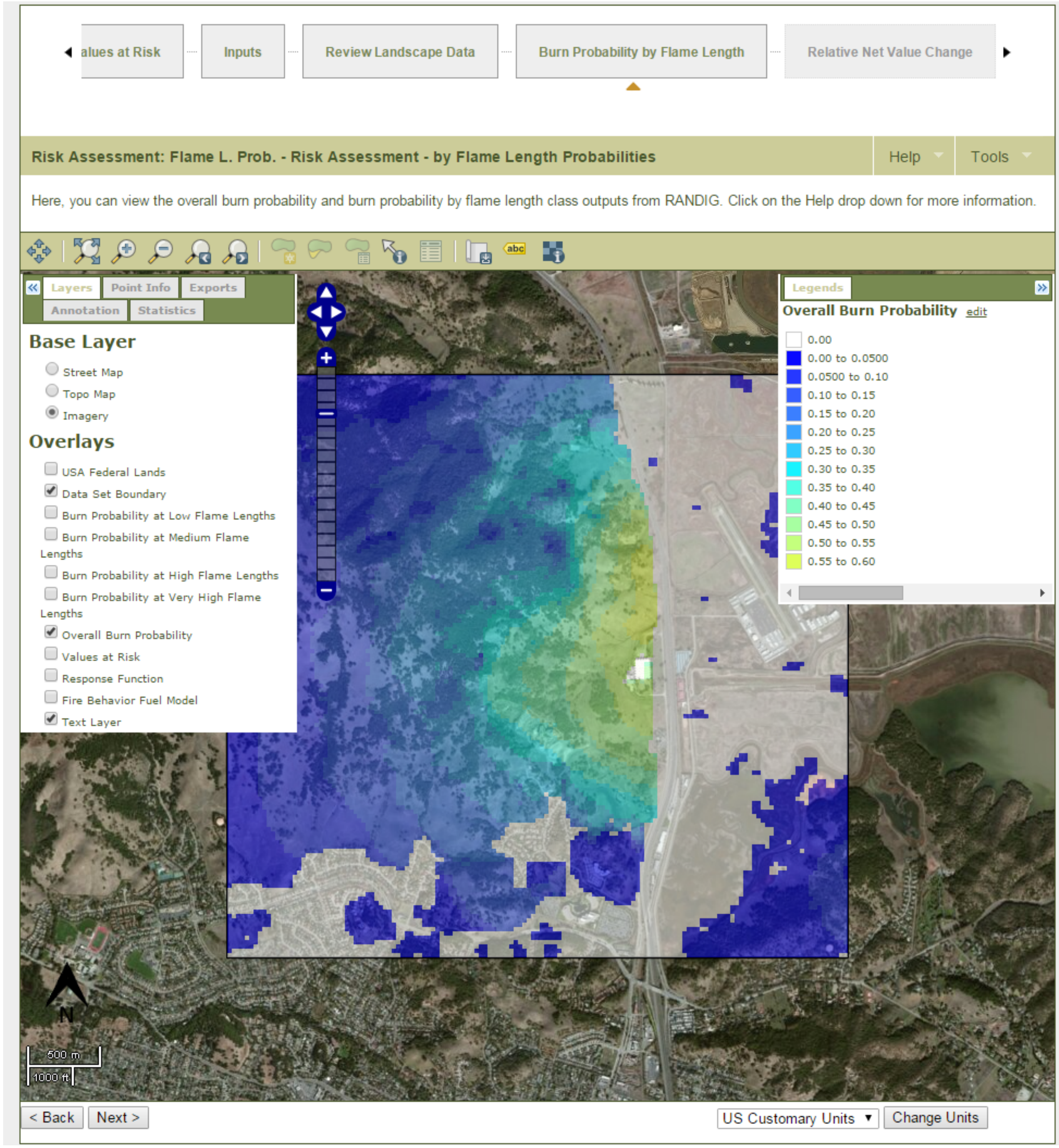
n = number of simulated fires

Burn probability is **not** an estimate of the potential for wildfires to occur and should not be confused with empirical wildfire occurrence probabilities.

Burn probability at defined flame lengths: is the likelihood that if the area represented by a pixel burns, it will burn within the flame length classes for which you will have defined the values for low, medium, high, or very high flame lengths.

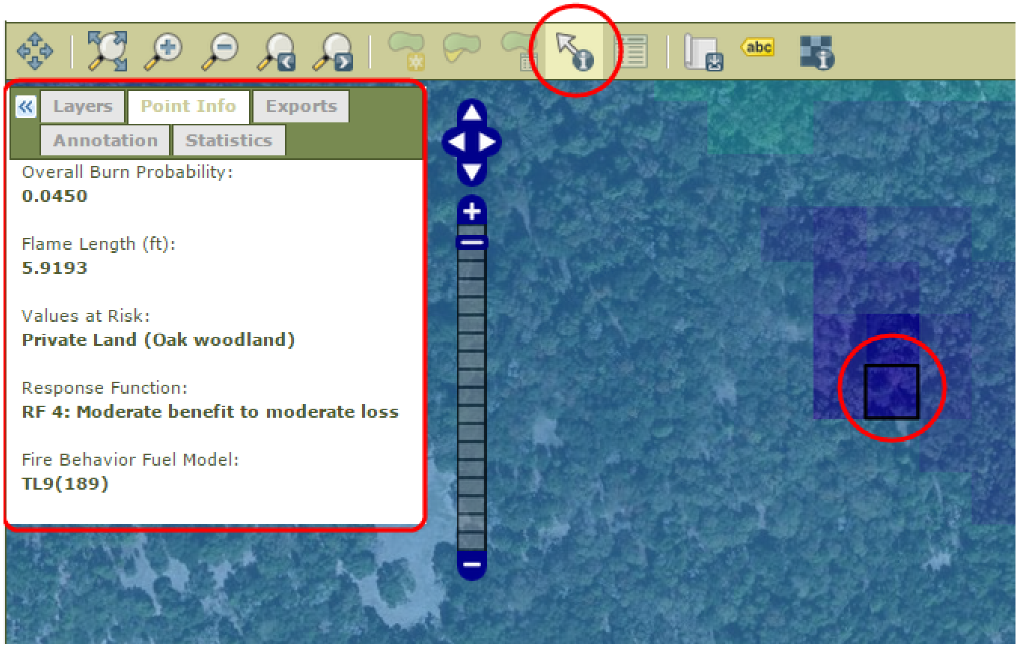
You can also review the values at risk, response function, and fire behavior fuel model layers.

Note: Due to random ignitions, your burn probability output will look different than this example's output

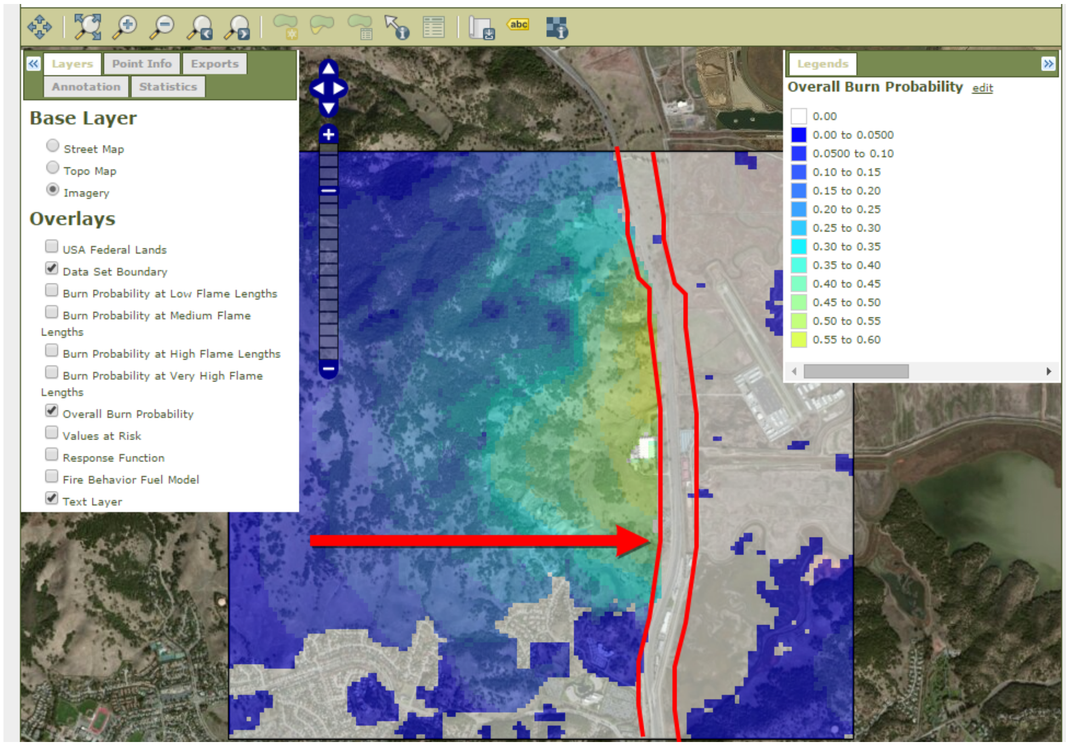


You can review the fire behavior data at a specific grid cell by selecting the **Point Info** tool.

Click on the grid cell you would like to review, and the **Point Info** panel appears.



Taking a simple first look at the **Overall Burn Probability** output, it is clear that the westerly wind (blowing from the west to the east) is pushing the fire to the east (indicated by the red arrow). Highway 101 (outlined in red) would potentially stop a majority of the fire spread.

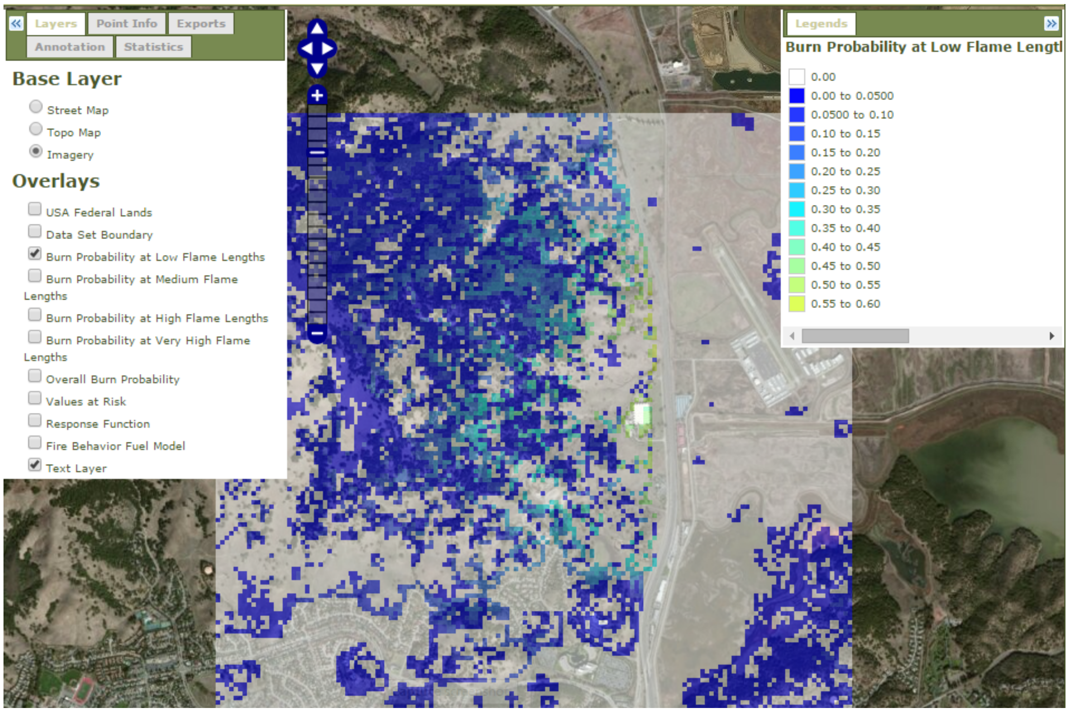


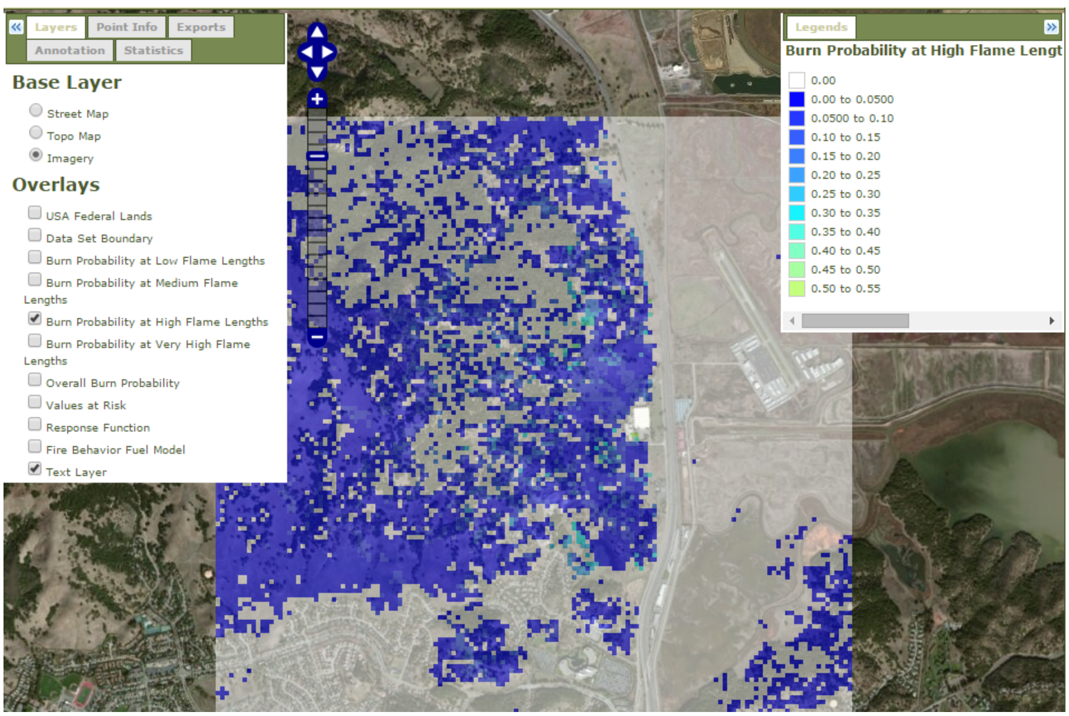
Note: In a risk assessment, you will need to perform a more detailed interpretation of the burn probability results.

Next, we will review the burn probabilities at low and high flame lengths.

Taking a simple first look at the Burn Probability by Low Flame Lengths (0 to 4 ft) and Burn Probability by High Flame Lengths (8 to 11 ft) outputs, it is clear that the red flag warning environmental conditions predicted that if the area represented by a pixel were to burn under these conditions, that area is more likely to burn with low flame lengths than high flame lengths.

Use the **Values at Risk** overlay and the **Point Info** tool to determine potential burn probability variability across the landscape.





Click **next** at the bottom of the page to run the risk model and view the Relative Net Value Change.

In the next sections we'll use a real example to show how net value change is calculated. We will:

- Examine Relative Net Value Change
- Classify Relative Net Value Change Data
- Review Relative Net Value Change Data
- Export Map Summary Data
- Evaluate Results in Google Earth
- Add Map Details in Google Earth
- Identify Potential Fire Hazards and Risk
- Assess further needs
- Review some helpful analysis considerations

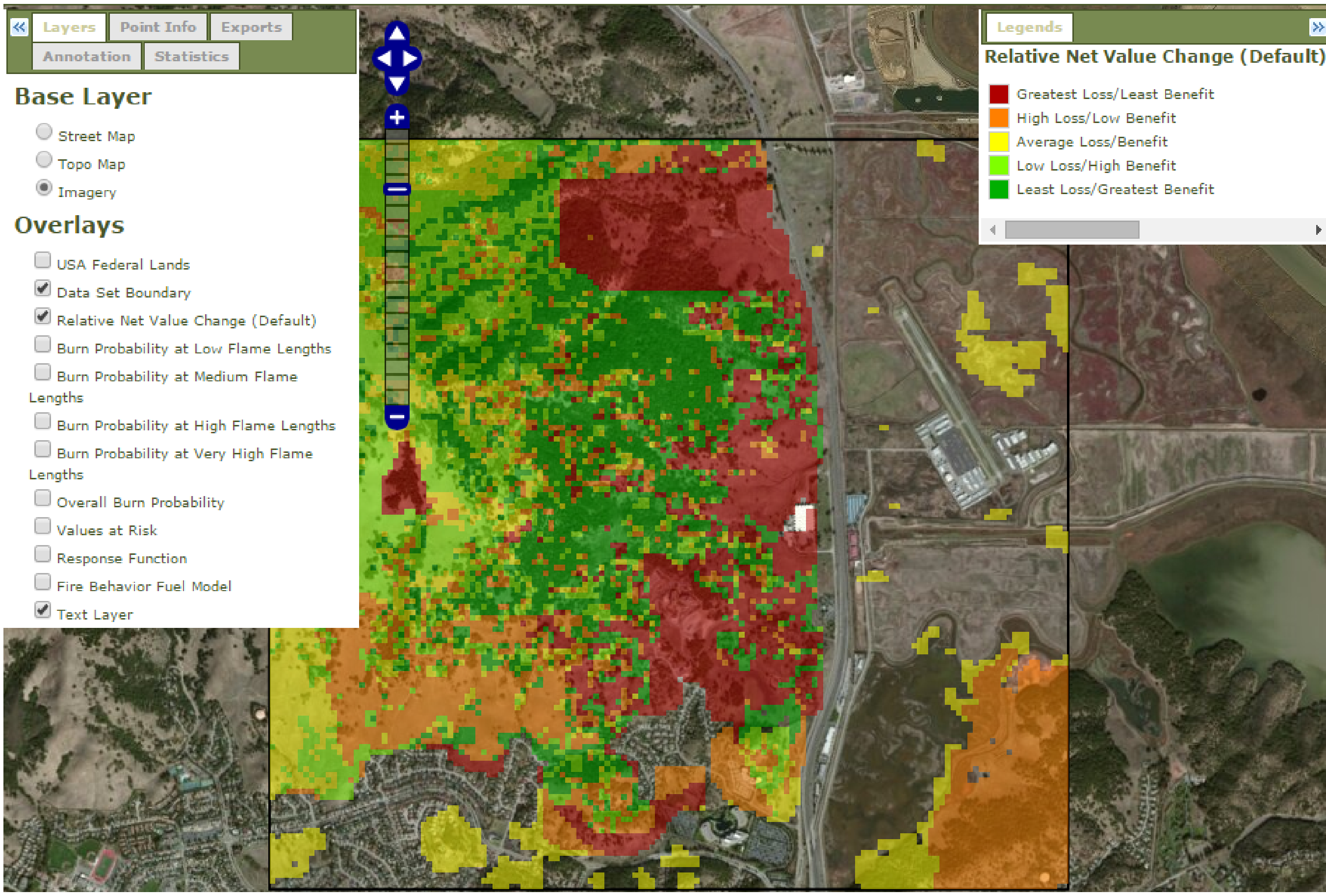
About Relative Net Value Change

Risk is defined as the expected net value change per pixel calculated as the product of:

1. The probability that the area represented by the pixel burns given a random ignition within the project area, and

2. The resulting change in financial or ecological value (response function) if the area represented by the pixel burns with a specific flame length for a single static IFT-FlamMap run.

After the risk model runs, you can view the **Relative Net Value Change**.



Note: Your output will look different than this example's output due to differences in values at risk, as well as random ignitions across the landscape.

Next, we discuss how the default relative net value change is binned into the five data subsets (listed in the Relative Net Value Change legend).

Classifying Relative Net Value Change Data

The relative net value change parameter is classified into five data subsets.

Greatest Loss/Least Benefit

High Loss/Low Benefit

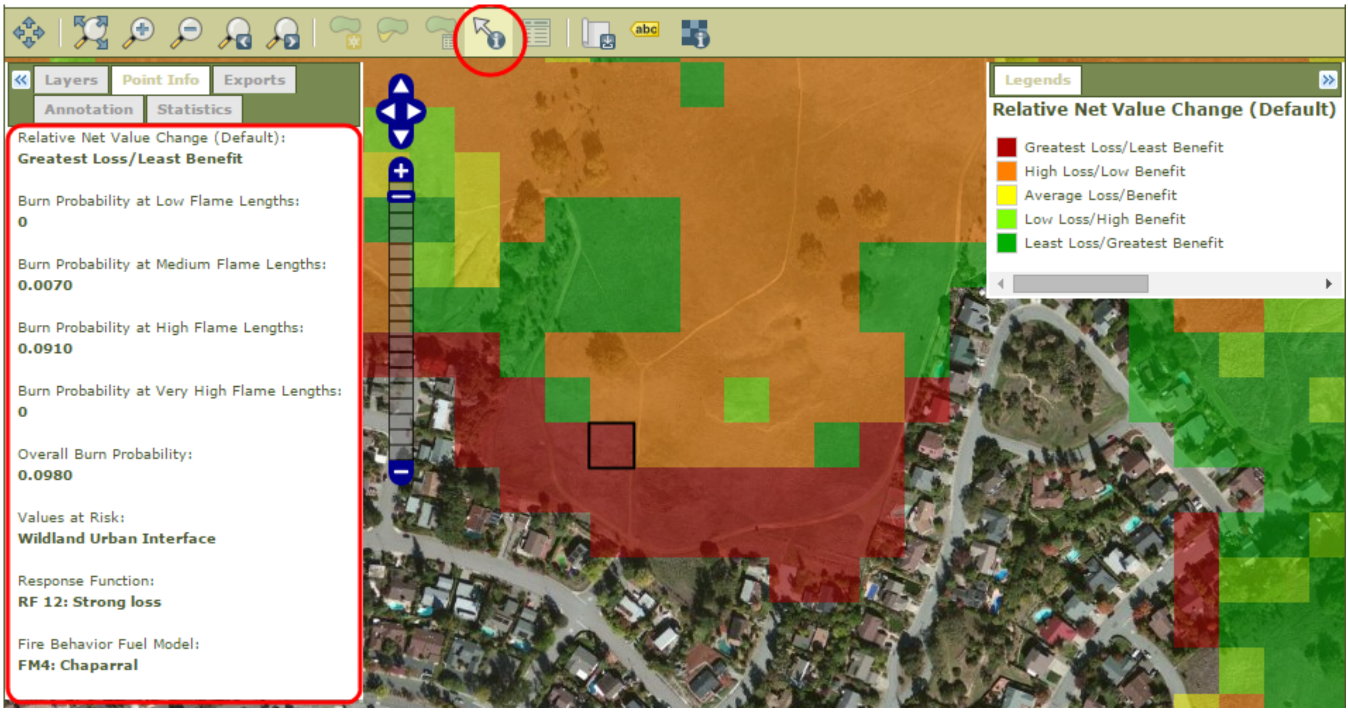
Average Loss/Benefit

Low Loss/High Benefit

Least Loss/Greatest Benefit

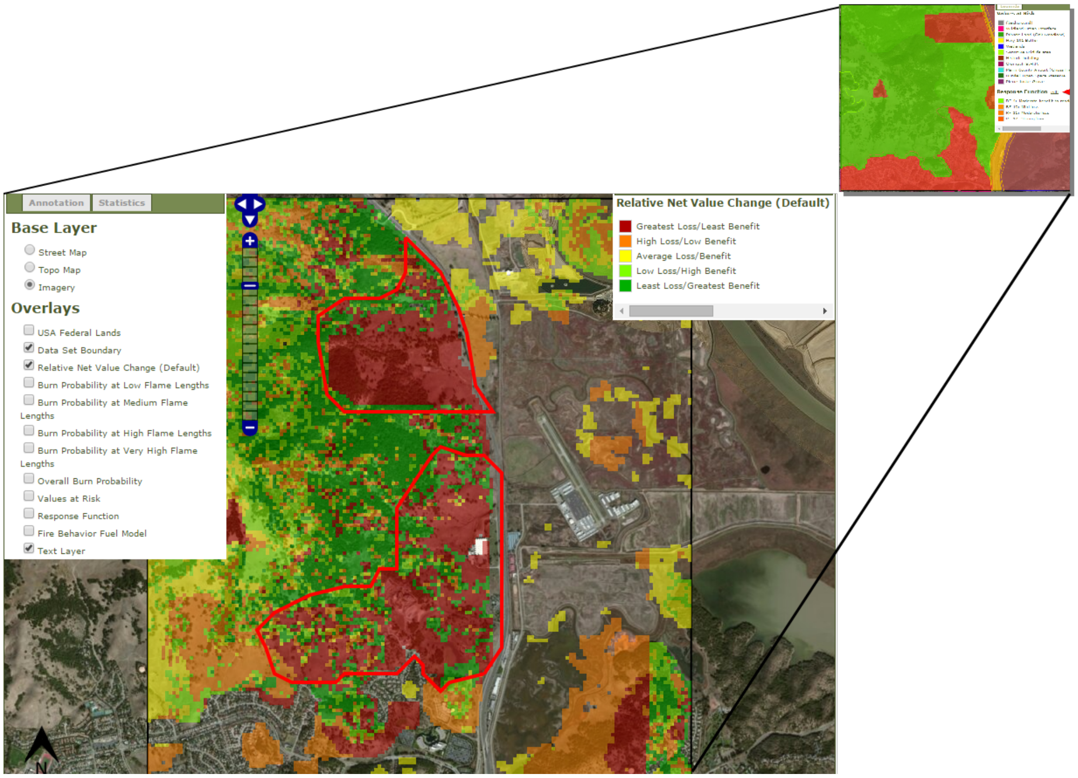
For the default relative net value change parameter, **the output value range is binned by 20%** for all of the categories.

For example, if your data ranges from a numerical value of -20 to +40, the data subsets will be binned into the following data ranges: -20 to -8, -8 to 4, 4 to 16, 16 to 28, and 28 to 40.



Reviewing Relative Net Value Change Data

Taking a simple first look at the default relative net value change parameter, we can see that many of the pixels classified in the "Greatest Loss/Least Benefit" category (pixels representing areas with the highest risk of loss based on the values at risk and the overall burn probability) are surrounding the wildland-urban interface and the Olompali State Historic Park (areas outlined in red).



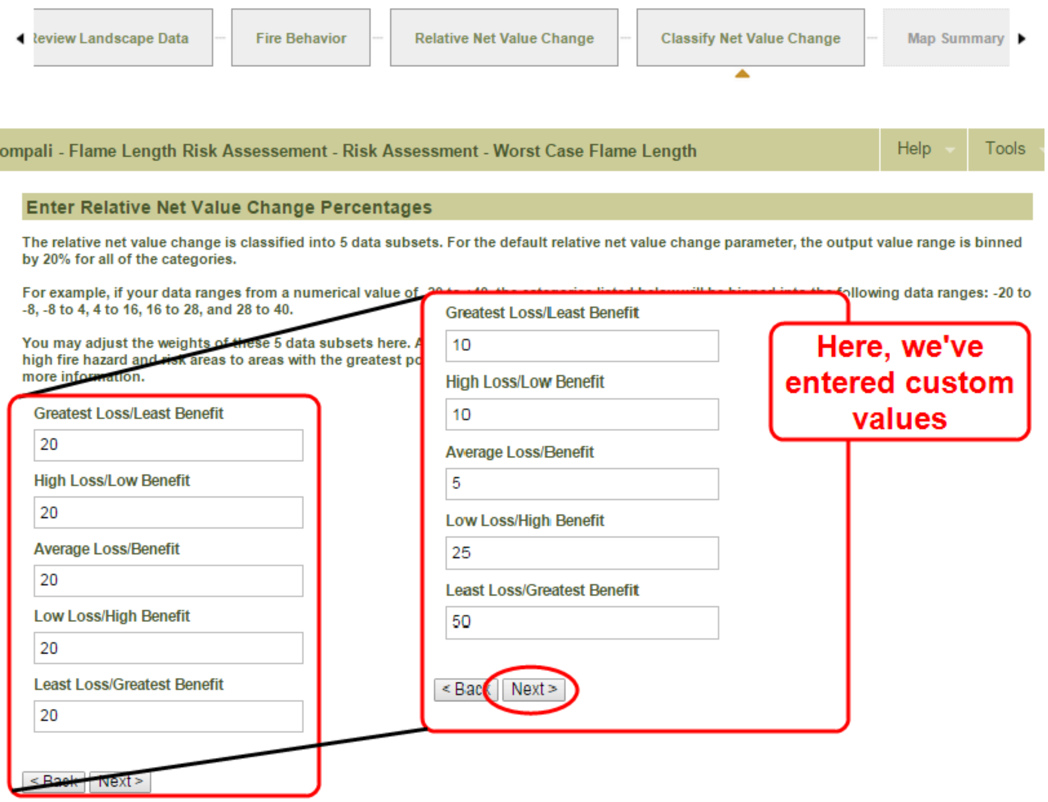
In this example, we would like to refine the area of interest to find the areas within the wildland-urban interface and Olompali State Historic that have the greatest potential loss.

To classify these categories into different data ranges, choose **Next**.

Classifying Relative Net Value Change Data

In classifying relative net value change, you can adjust the weights of the five data subsets. Using this functionality, you can narrow your search of high fire hazard and risk areas to areas with the greatest potential loss.

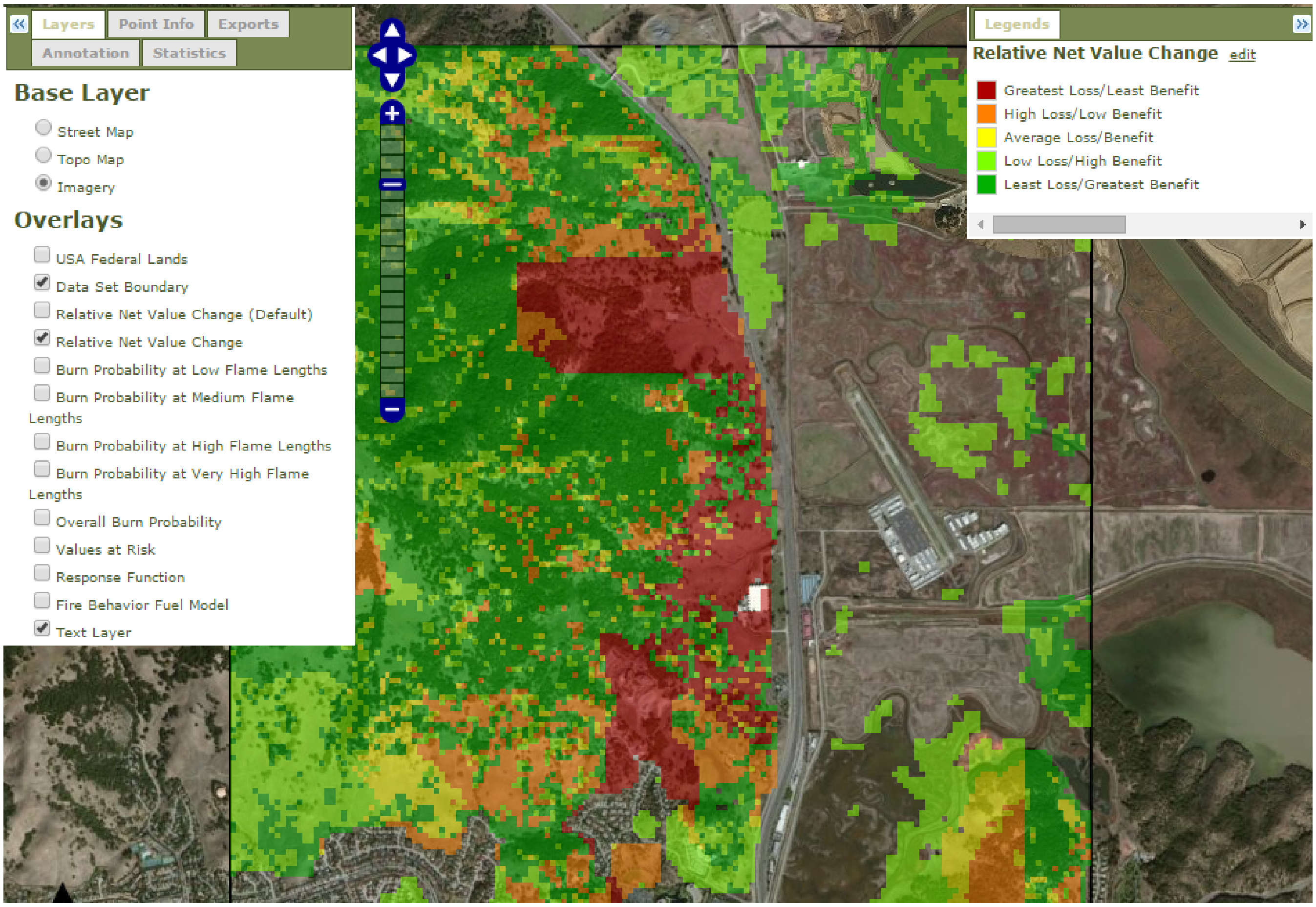
In this example, we will reduce the output range for the Greatest Loss/Least Benefit category from 20% to 10%. We will change the remaining output ranges as shown.



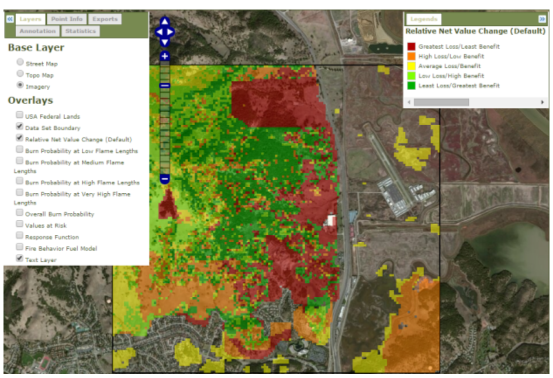
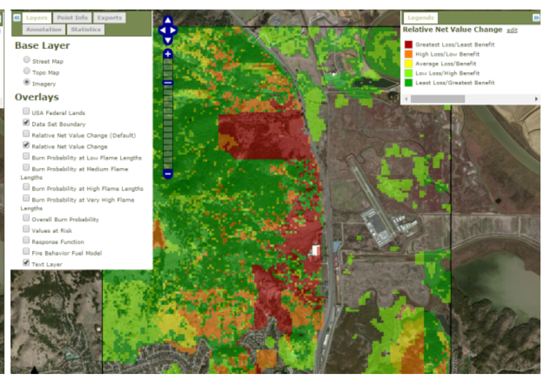
Note: The sum of all five weights **must** be 100%.

To view the user-binned relative net value change, choose **Next**.

You are now on the Map Summary step, and your custom relative net value change distribution is the active layer.

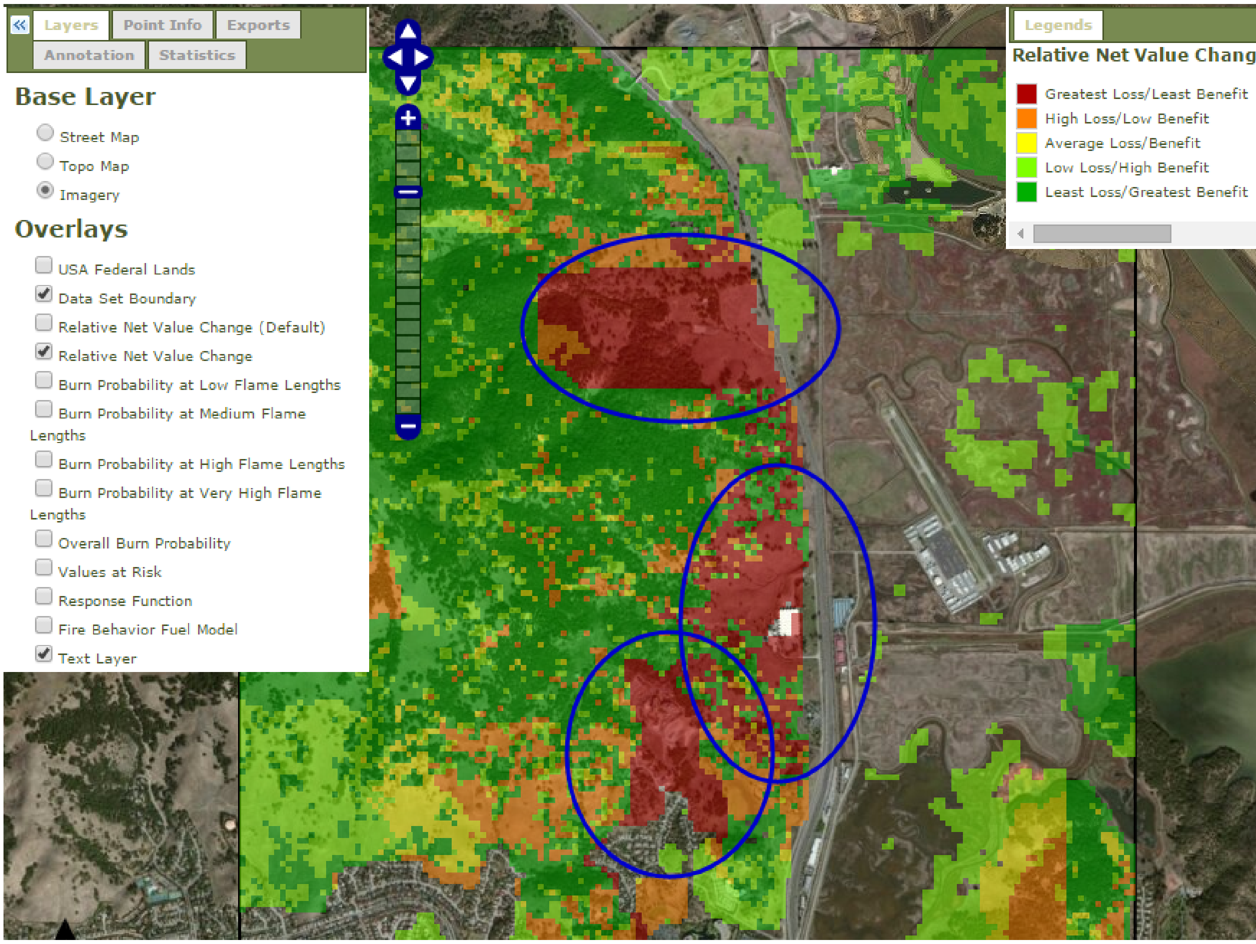


You can compare your relative net value change distribution to the default relative net value change distribution.

In this example, you can see that the custom relative net value change reduced the amount of pixels in the Greatest Loss/Least Benefits category.

Now we can focus our attention on the highest risk areas across our area of interest (outlined in blue).



Find areas across your landscape that are predicted to have the greatest loss/least benefit due to fire.

You can export IFTDSS inputs and outputs to Google Earth to further analyze potential fire hazard and risk.

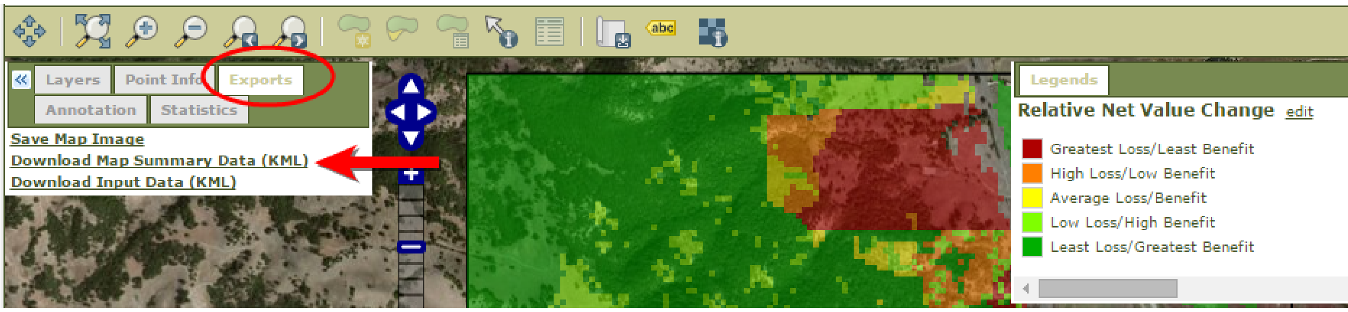
In the next steps, we will export our map summary data and review this data using Google Earth.

Exporting Map Summary Data

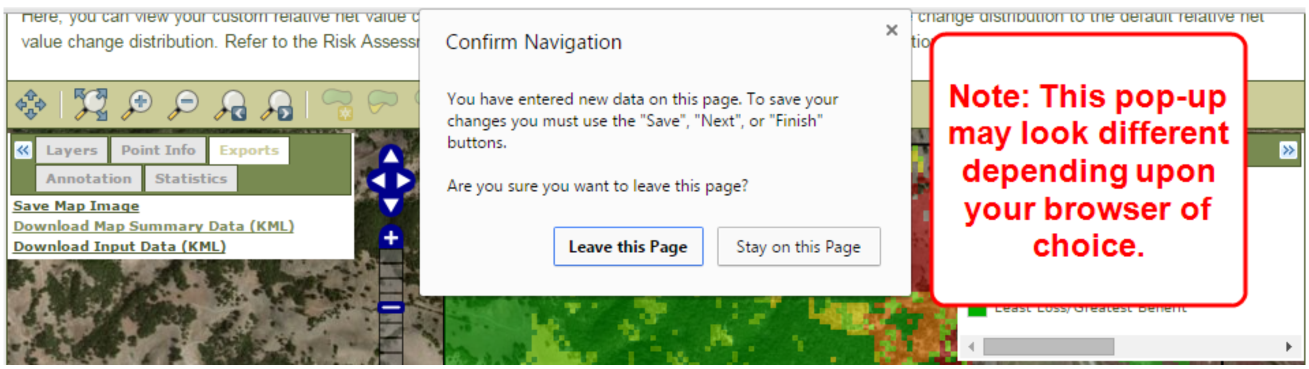
IFTDSS can save your map image, or export the map summary and input data as a KML file, which can be opened and viewed in Google Earth. To export the map summary and input data as KML files:

Access the **Exports** tab (located in the upper left panel).

Select **Download Map Summary Data (KML).**



Select **Open with Google Earth** in the pop-up window.



Repeat these steps to **Download Input Data (KML).**

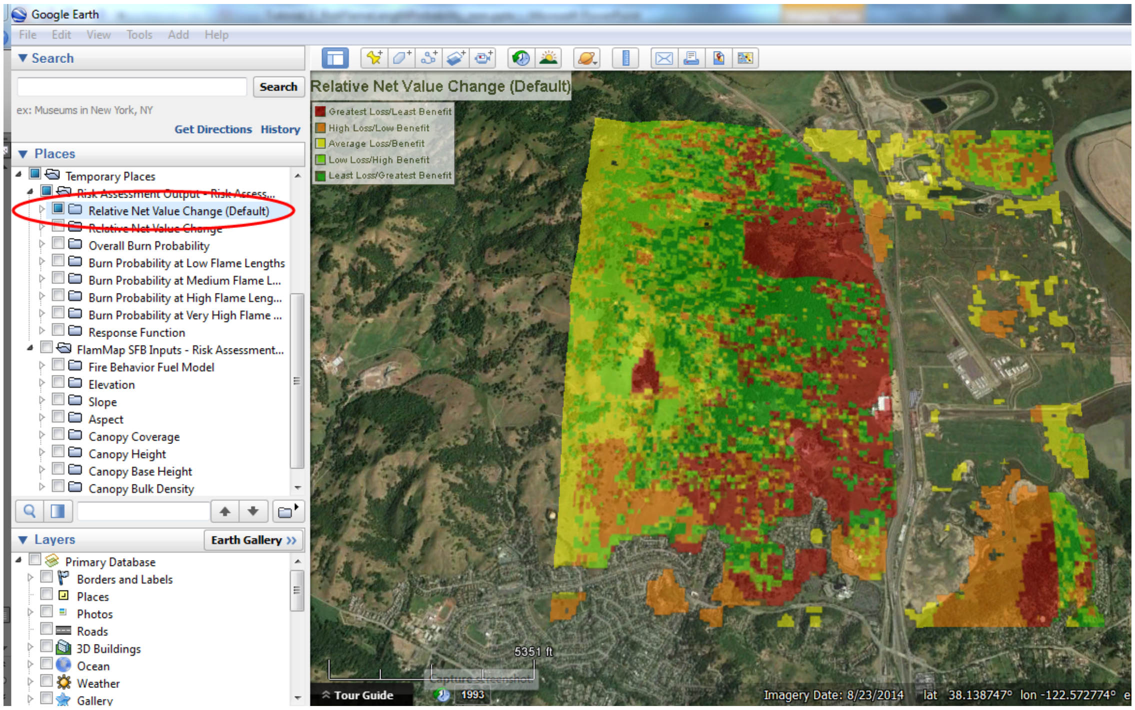
For the next several steps, we will evaluate the output data in Google Earth. Minimize your IFTDSS workspace, we will return to it to wrap-up the tutorial in a few steps.

Note: Depending on your browser setting you may be prompted to ‘Confirm Navigation’, or choose a location to save to. Follow the prompts in your specific browser. Your data will automatically be displayed in Google Earth

Note: If you do not currently have Google Earth on your computer, it may be downloaded here: https://www.google.com/earth/

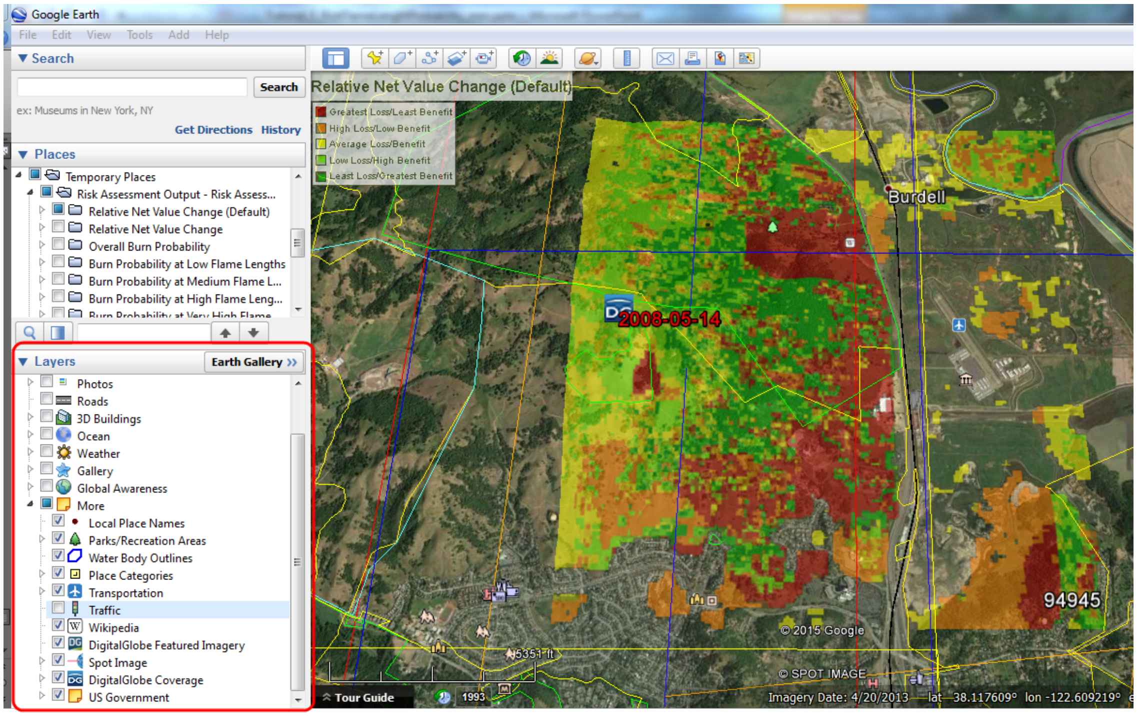
Evaluating Results in Google Earth

The map summary parameters are now stored as layers in the **Temporary Places** folder within Google Earth. Unselect the **Fire Behavior Fuel Model** layer. The default relative net value change parameter is the active layer.



Adding Map Details in Google Earth

Using the **Layers** tab in Google Earth, you can add such things as park and recreation areas, water body outlines, schools, airports, and roads to your map(s).

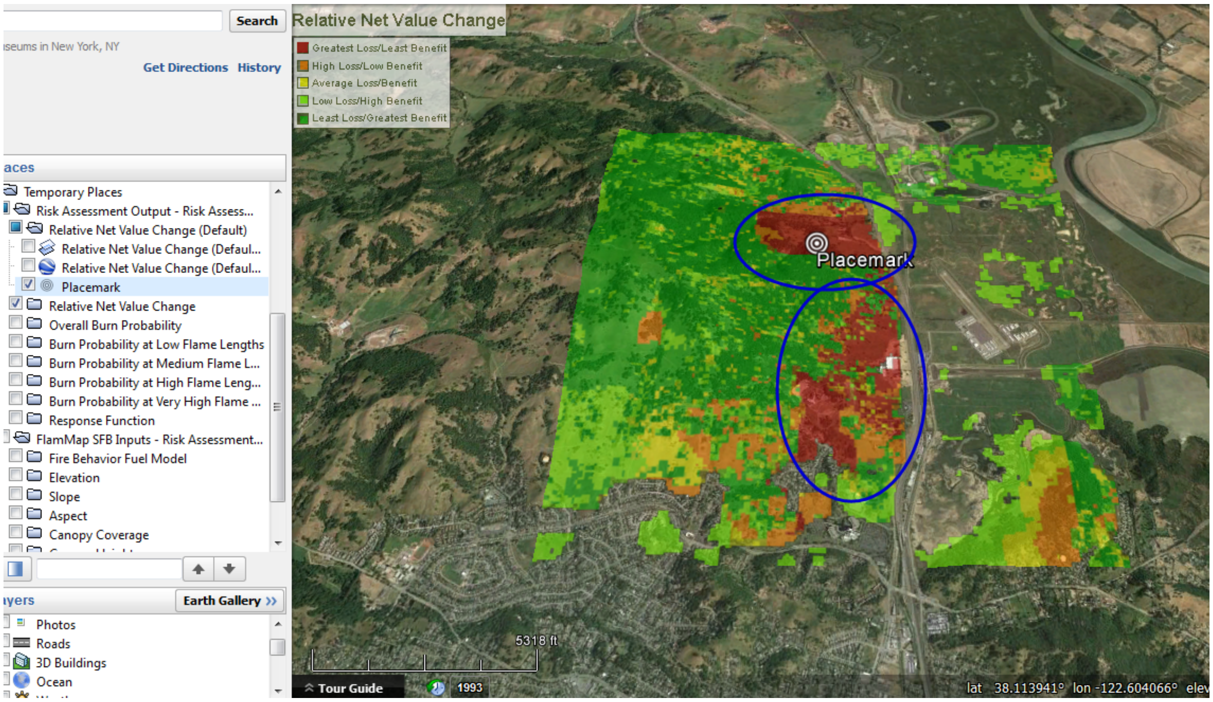


Tip: In Google Earth, click on the triangle icon to the left of each layer to expand more detailed sub-layers.

Identifying Potential Fire Hazards and Risk

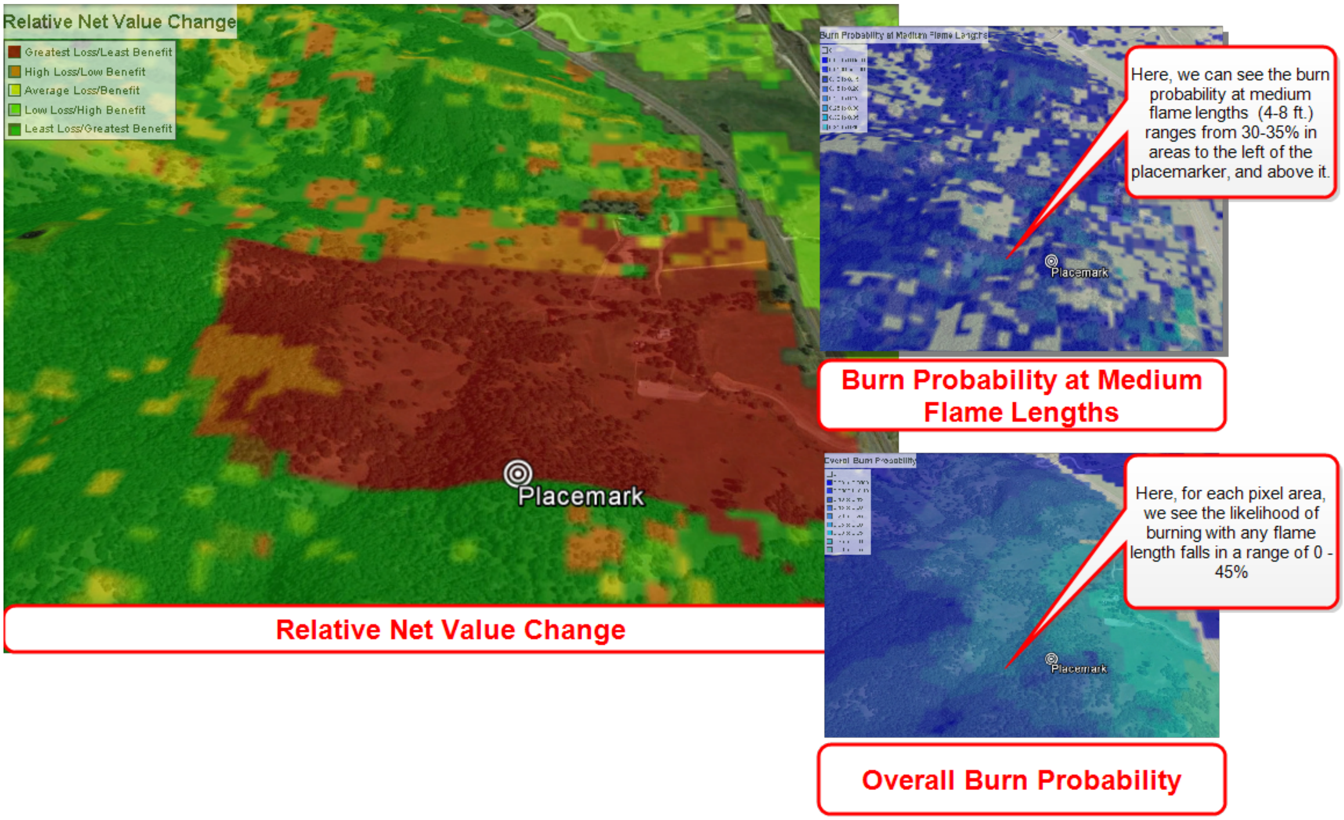
While still in Google Earth, using information derived from the modeled fire behavior, as well as the spatial landscape data, you can identify potential fire hazard and risk areas surrounding the Olompali State Historic Park (see outlined areas).

In this example, we **selected the custom relative net value change layer** to view highest risk areas across our area of interest (outlined in blue).



Next, we will take a more in-depth look at the wildland-urban interface identified by the bullseye placemarker.

Lets focus on one of our highest risk areas near the Olompali State Park. It is important to review a number of different fire behavior descriptor variables, such as burn probability at medium flame lengths and overall burn probability.



Relative Net Value Change

Burn Probability at Medium Flame Lengths

Overall Burn Probability

This area is at risk for high potential loss from fire. Under the red flag warning conditions, which predicted high to very high flame lengths, the likelihood this area will ignite is moderate.

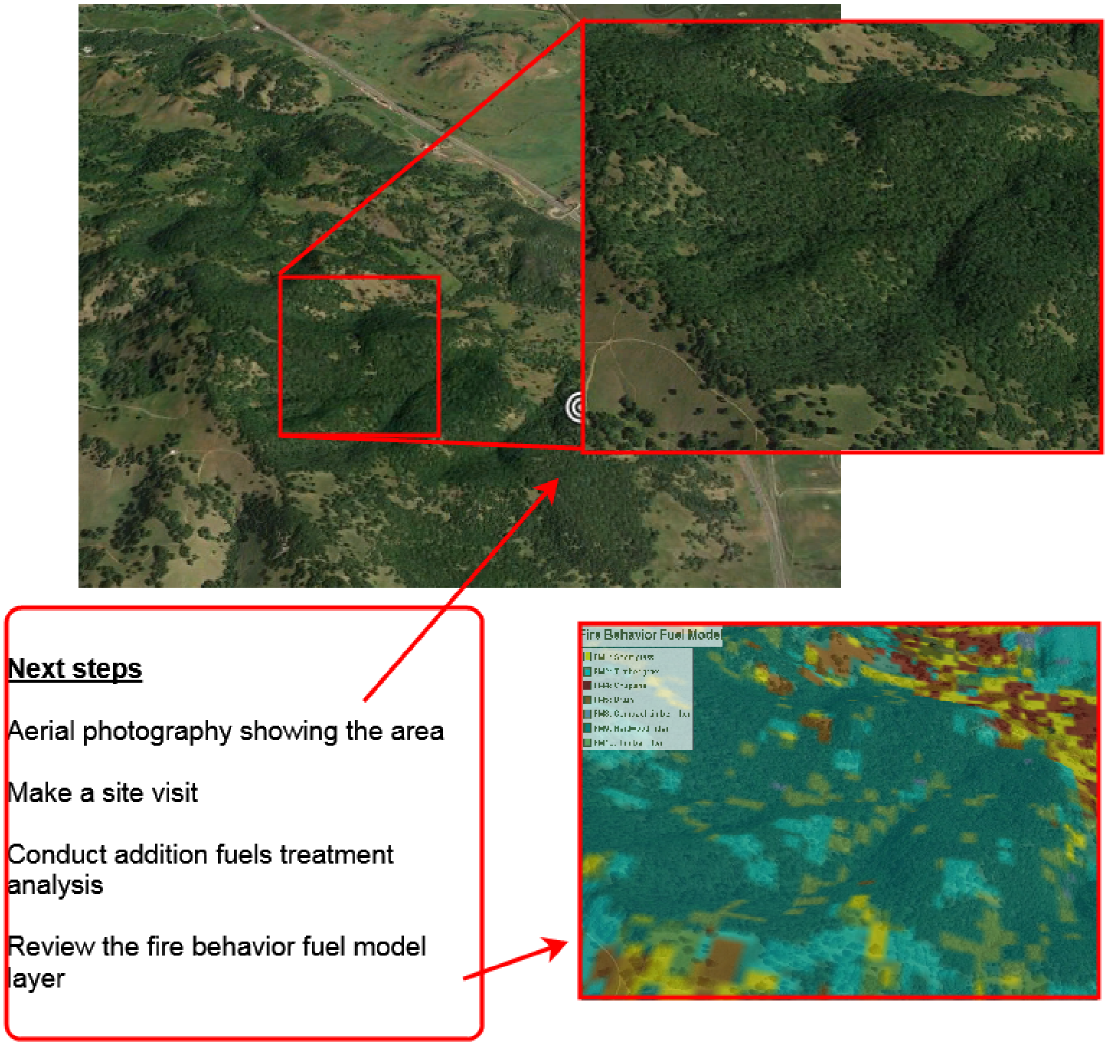
It is also important to **review the landscape data in your area of interest**. This location is a mix of Hardwood litter (FM9), Timber grass (FM2), with patches of short grass (FM1) and some chaparral (FM4), and moderate slopes.

After reviewing the modeled fire behavior, fire risk, and spatial landscape data, these areas may warrant further analysis and may require site visits and/or fuels treatments.

Next Steps: Assessing Further Needs

The information from this risk assessment can be used with other ecological and natural resource planning information to rapidly assess areas within the landscape that may warrant fuels treatment.

After reviewing the aerial photography and the fire behavior fuel model layer, it is clear that the LANDFIRE data needs to be edited; return to the editing spatial landscape data step to edit your fuel models. Then rerun the module to see differences in the fire behavior and risk outputs.



Analysis Considerations: Things You Need to Know

As we conclude the analysis and data review portions of the tutorial, consider the following points when analyzing data for your own areas of interest in the future:

- The LANDFIRE data resolution is 30 x 30 m spatial resolution, which affects data interpretation.

- The flame lengths probabilities approach assumes random ignitions across the area of interest; however, some areas have higher ignition potentials than others. This approach does not take this into account.
- For example, human-caused ignitions often occur close to roads and houses, and natural ignitions caused by lightning occur at elevated areas.

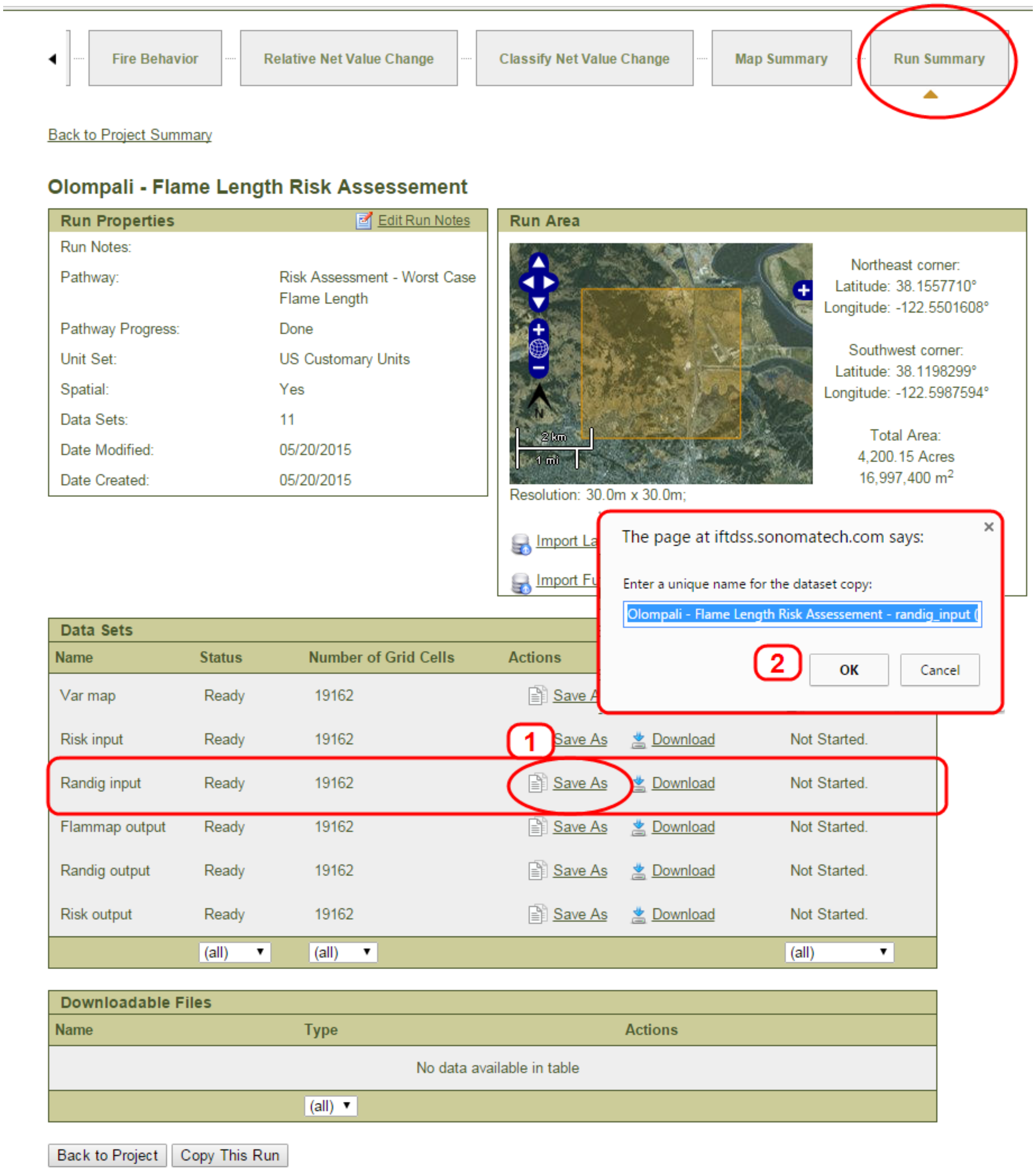
Saving Data Sets for Future Use

From the Run Summary page, you can choose to save or copy datasets for future use.

At this step, you can save your input and output data sets for future use in other runs. Saving your data sets is useful; for example, if you edited the spatial landscape data, you can reuse the data you edited.

- You can also Copy This Run. This feature is useful if you want to rerun the same run with different inputs.
- Select Save As on your dataset of interest.

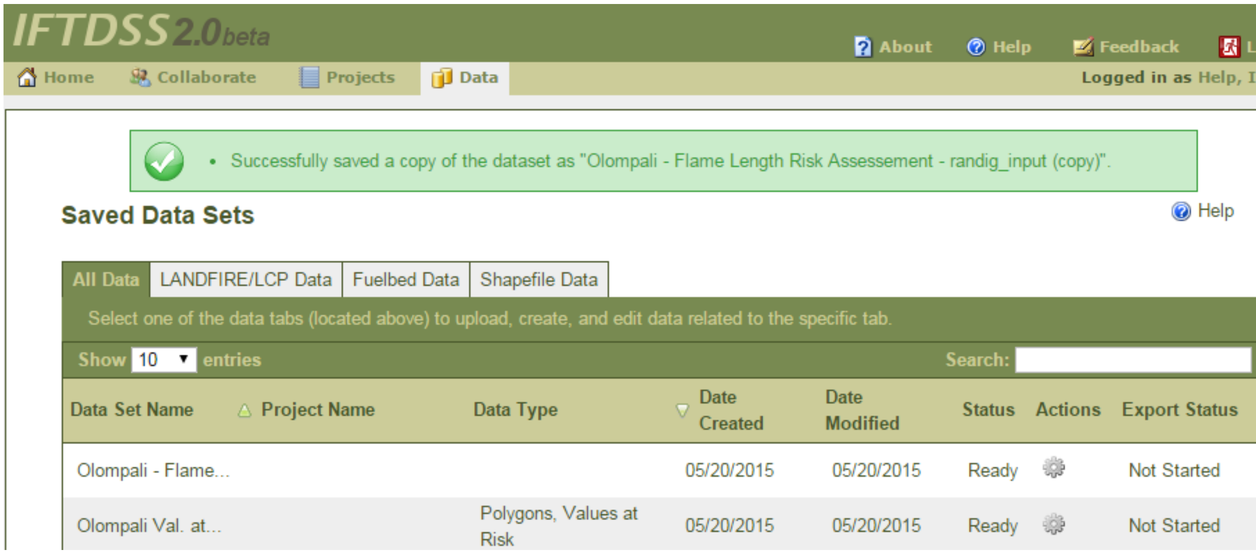
Enter a unique name for the data set copy and choose OK.



After entering a unique data set name, you are taken to the Data tab. All of your data sets are saved here. You can use your saved data set in any spatial run.

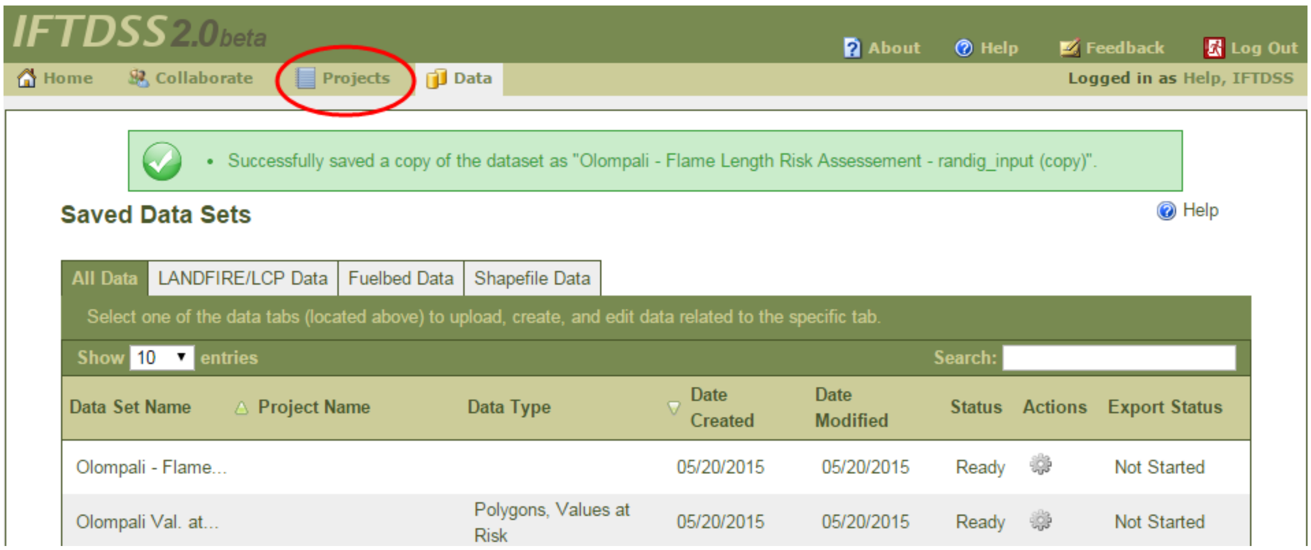
For example, if you edited the spatial landscape data during your run, the edits are saved in this data set.

If you create a new spatial run, such as calculating fire behavior across a landscape (IFT-FlamMap), you can choose to use the saved input data on the Configure step of the run.

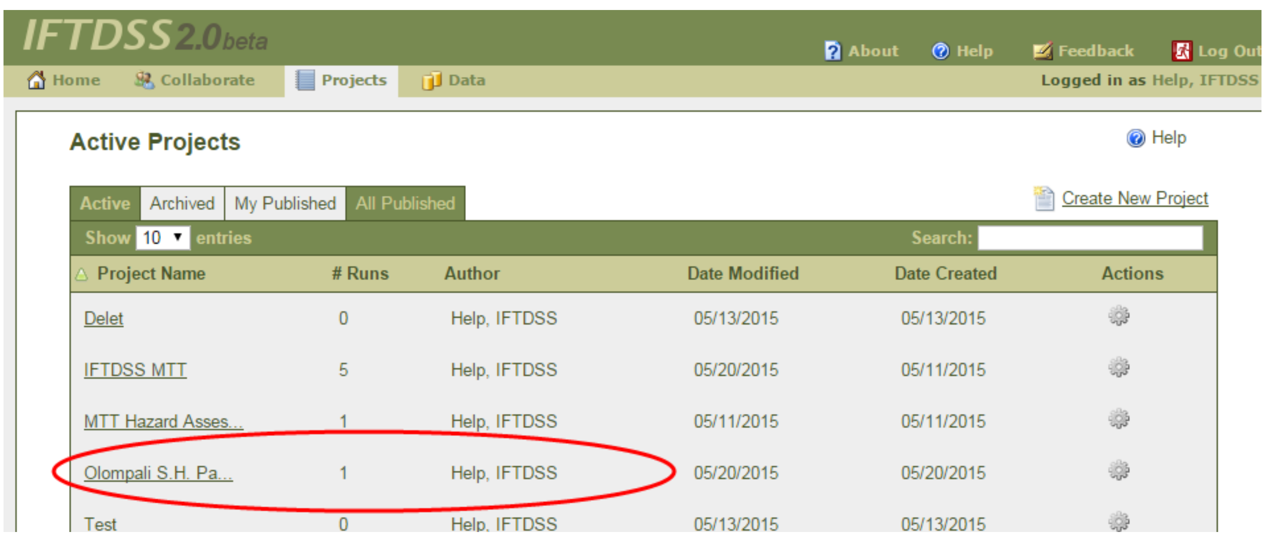


Copying Runs for Future Use

From the **Data** tab, navigate to the **Projects** tab.



On the **Active Projects** page, select your desired project to view all the runs within that project.



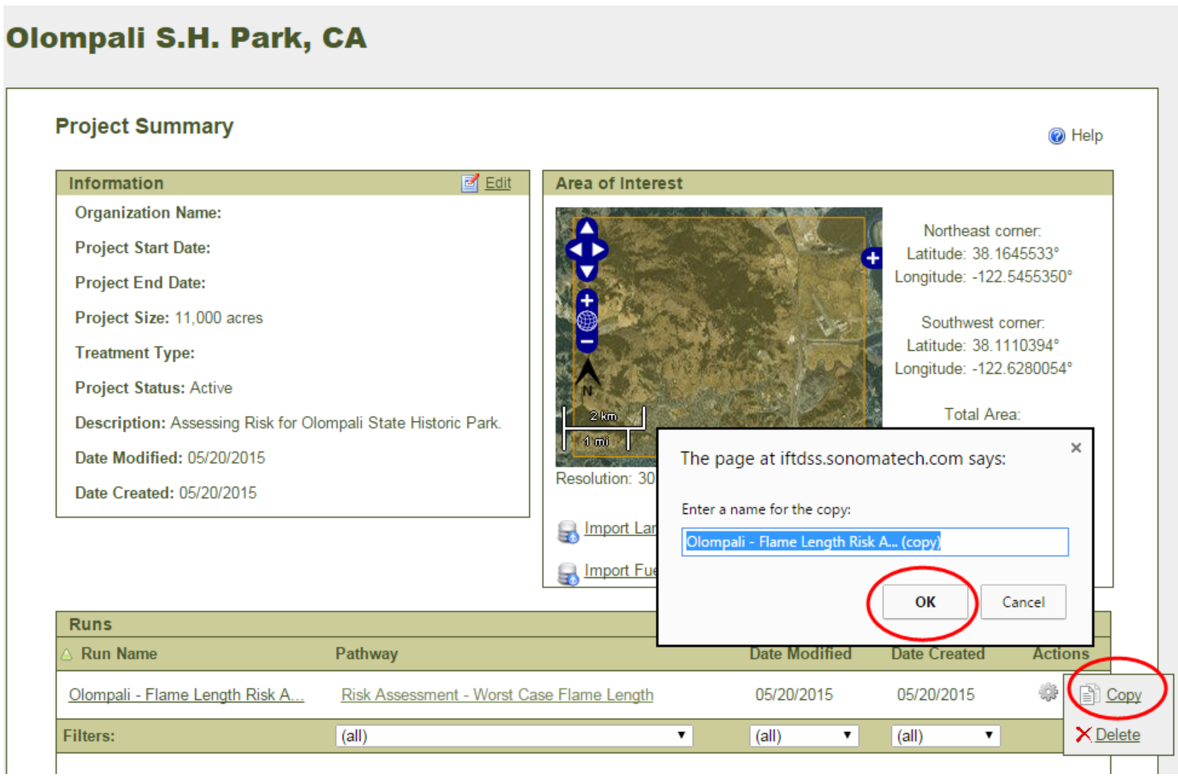
On the **Project Summary** page, you can copy runs.

Copying runs is useful if you want to re-use components such as a values-at-risk map. You can rerun the module using different inputs. This way, you can perform risk assessments across a variety of environmental conditions.

Under **Actions**, select **Copy** for your desired run.

Enter a name for the copied run and choose **OK**.

After choosing **OK**, you are taken to the pathway of the copied run.



Review

Using the risk assessment workflow in IFTDSS, we were able to:

- Acquire LANDFIRE data and set up a project in IFTDSS.
- Create a run focused on fire risk across a landscape (using IFT-RANDIG).
- Develop a values-at-risk map.
- Establish environmental parameters.
- Review/edit spatial landscape input data.
- Analyze potential fire behavior output data.
- Identify potential fire hazards and risks across a landscape.
- Examine data relative to points of interest and other geographic features using Google Earth.

This concludes the tutorial on creating a risk assessment using the flame length probabilities approach.

Additional Help

To navigate to additional tutorials in the IFTDSS online help content,

1. Click the **Help** button.

2. Then select **Getting Started (Tutorials and Videos)** from the side menu.

On that page, you'll find links to tutorials and videos on such topics as hazard analysis, prescribed burn planning, fuels treatment, spatial analysis across a landscape, and many more.