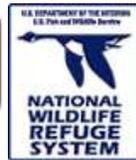


Fuels Treatments Reduce Wildfire Suppression Cost Merritt Island National Wildlife Refuge May 2012



Merritt Island National Wildlife Refuge – Where Technology and Nature Intersect

Authors

Jennifer Hinckley
Prescribed Fire Specialist, St Marks National Wildlife Refuge

Jon Wallace
Prescribed Fire Specialist, ARM Loxahatchee National Wildlife Refuge

Executive Summary

Introduction

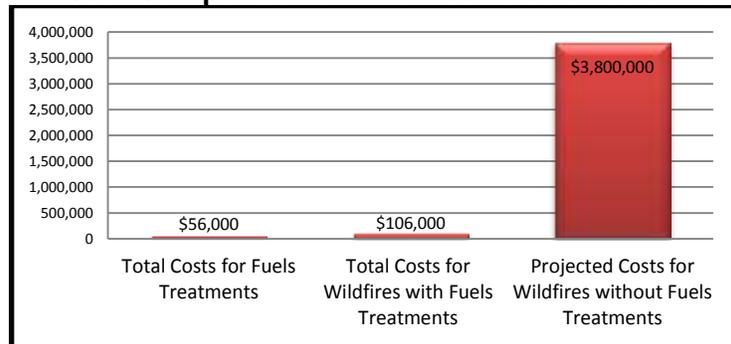
In May 2012, lightning strikes ignited three wildfires in two recently treated fire management units on Merritt Island National Wildlife Refuge (Refuge). To measure the effectiveness of hazardous fuels management, the U.S. Fish and Wildlife Service analyzed wildfire impacts and suppression costs.

Fuels Treatments and Wildfires

From 2008 to 2012, a total of 57,158 acres were prescribed burned on the Refuge. These acres included two fire management units (FMU 2.3 – 3,990 acres in June 2010; FMU 7.2.A– 2,174 acres in January 2012) that experienced three wildfires in May 2012. The total area burned by the May 2012 wildfires in FMU2.3 and 7.2.Awas 553 acres.

FSPRO, a model which estimates the probability that a fire will burn an area, was used to show the difference in fire size probabilities in an area that had not been treated with prescribed fire versus the same area that had been treated with prescribed fire. One model run showed current fuel loads based on fuel treatments since 2008. The second model run showed probable fuel loads based on no fuel treatments since 2008. The resulting wildfire size projections were coupled to a Stratified Cost Index analysis. That analysis projected cost for the three wildfires without the 2010 and 2012 prescribed fires is \$3,800,000 (Figure 1). This cost estimate does not take into consideration potential damage to NASA or Refuge infrastructure, lost time due to employee evacuations, adverse impacts to critical space-related operations and impacts to NASA and Refuge visitor services. Also not included in this analysis are the impacts a wildfire would have on habitat and dependent species due to increased fire intensity and duration.

Figure 1: Cost Comparison of Wildfires versus Fuels Treatments

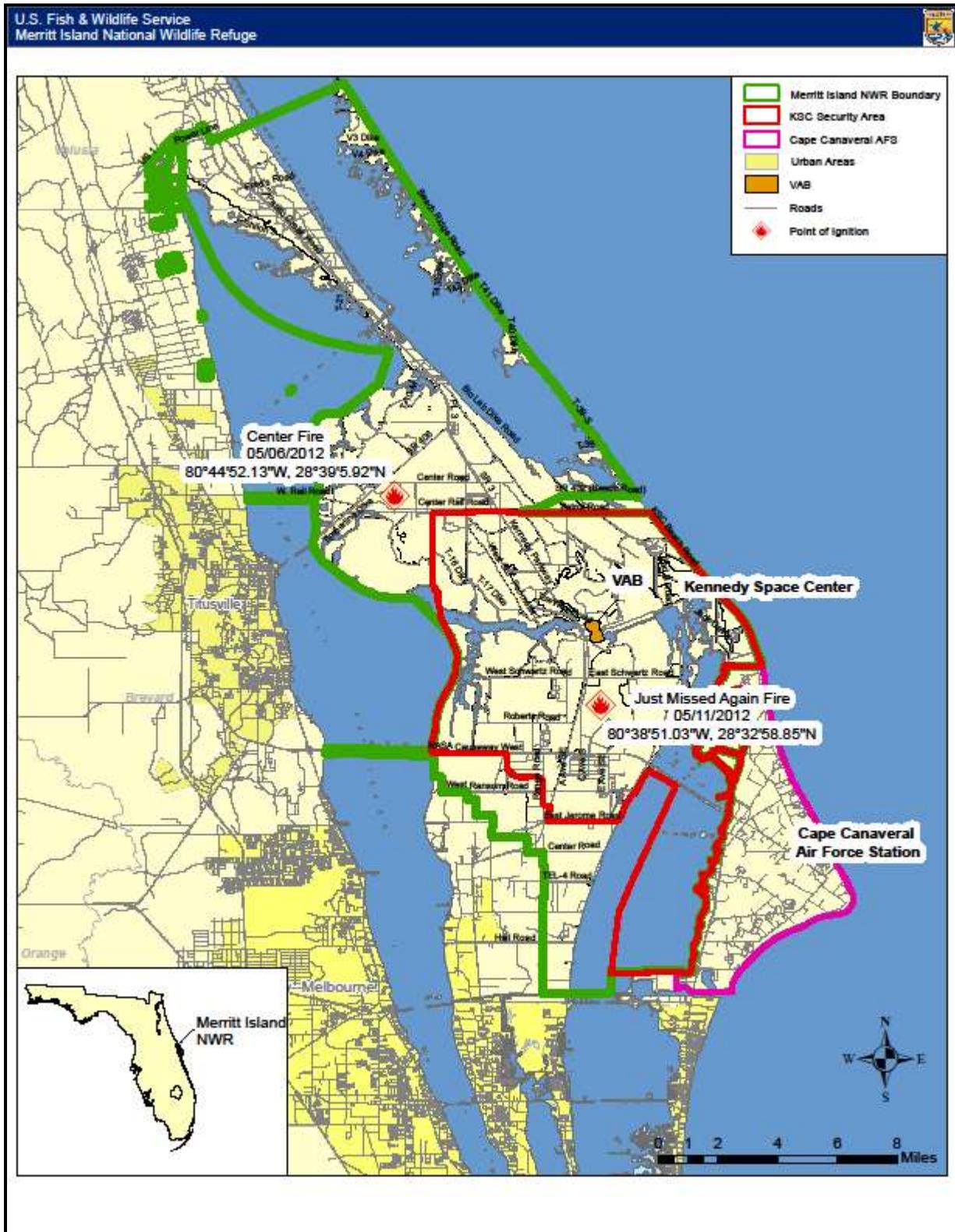


Summary

Prescribed fires conducted during the past five years reduced hazardous vegetation fuels, thereby protecting NASA and Refuge infrastructure, employees and visitors by mitigating and minimizing the intensity and duration of wildfires and significantly reducing impacts and costs of wildfires. The two prescribed burns cost \$56,000 (\$9.08/acre) to complete. The three wildfires cost \$106,000 (\$191.68/acre) to extinguish. Projected cost savings of wildfire suppression following the hazardous fuels treatments on these two units was \$3.6 million.

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Map 1: Merritt Island National Wildlife Refuge Locator and Vicinity Map



Introduction

Merritt Island National Wildlife Refuge (Refuge) was established in 1963 as an overlay of the National Aeronautical Space Administration (NASA), John F. Kennedy Space Center (KSC), creating a unique partnership of technology and nature (Map 1). Consisting of 140,000 acres, the Refuge has a variety of habitats: coastal dunes, saltwater estuaries and marshes, freshwater impoundments, scrub, pine flatwoods, and hardwood hammocks. More than 1,500 species of plants and animals are found in these habitats, including 16 federally-listed threatened and endangered animal and plant species. The Refuge co-manages over 34,000 acres with National Park Service (NPS) as part of the Refuge and Canaveral National Seashore.

KSC serves as the nation's spaceport for manned and numerous scientific space missions. Approximately 8,800 employees and contractors work at KSC. Annual visitation to the space center is 1.5 million people. The Refuge and Canaveral National Seashore each receive approximately 1 million visitors each year.

Since the mid-1980s, the U.S. Fish and Wildlife Service staff has conducted fire operations on the Refuge including wildfire suppression, prescribed fire and wildland fire training. By agreement, protection of NASA resources, personnel and visitors from wildland fire is the responsibility of the U.S. Fish and Wildlife Service. The Refuge staff is also responsible for utilizing fire to maintain high quality wildlife habitat.

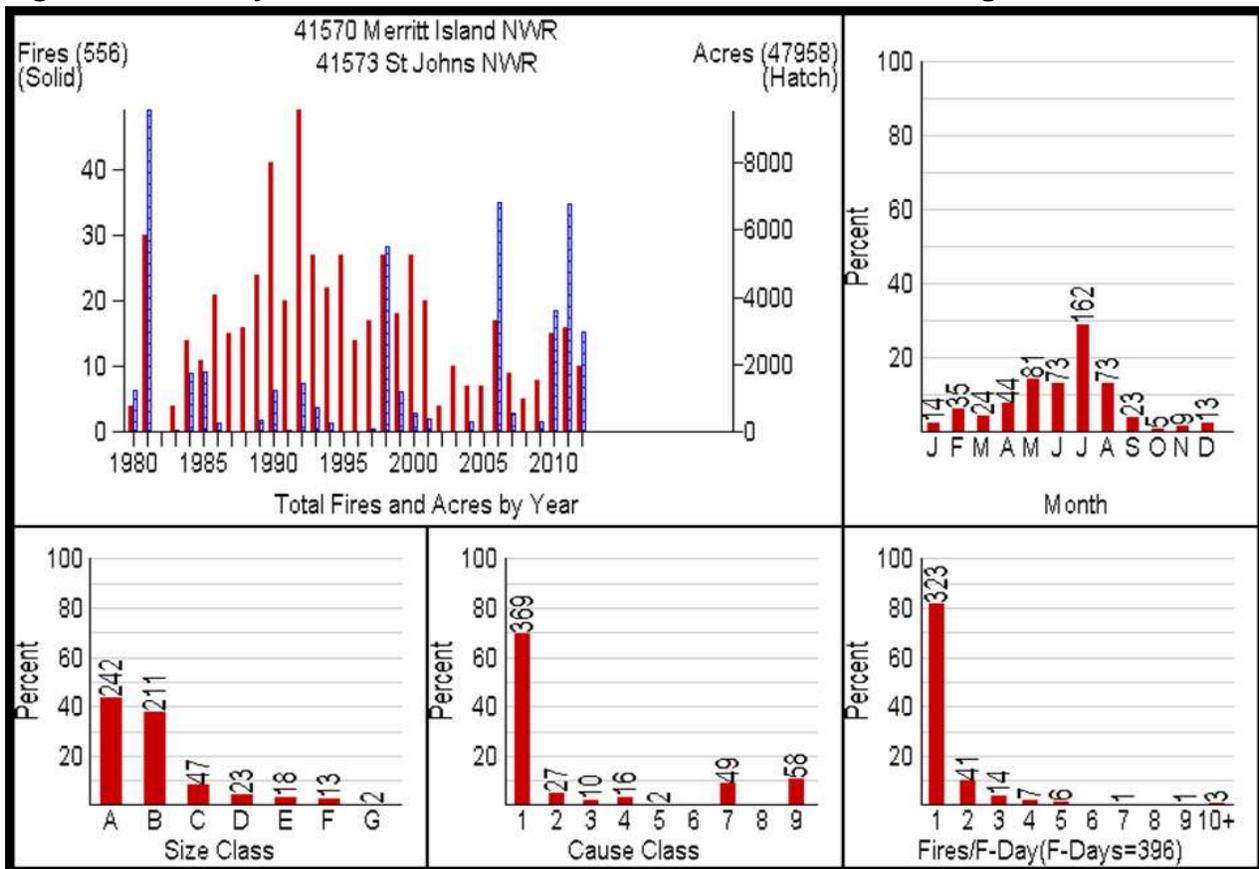
Historical wildland fire management on the Refuge can be divided into three phases. The first phase (1963 to 1981) was characterized by no comprehensive fire planning, little prescribed fire, limited wildfire suppression, poor equipment and little training for personnel. In 1981, the Refuge experienced a severe wildfire season when almost 17,000 acres burned. During one of these wildfires, two Refuge employees were killed. Following these fatalities, significant changes occurred in the Refuge's fire program. Thus began the second phase of wildland fire management. Fire personnel started receiving extensive training and new fire equipment was purchased. Prescribed fire objectives during this second phase were directed primarily toward the reduction of hazardous fuel loads by prescribed burning during the winter dormant season. With direction from the 2001 National Fire Plan, the third phase of the Refuge fire program began. The National Fire Plan goals ensured sufficient wildfire suppression resources to reduce fuel loads (especially near communities) and improve fire protection and rehabilitate and restore fire-damaged ecosystems. The 2001 National Fire Plan enabled the Refuge to provide wildfire suppression on the Refuge and to adjacent communities, increase the number of acres prescribed burn annually, burn at various times of the year to better mimic natural burn cycles, continue extensive training and maintain and upgrade equipment as needed.

As would be expected in the "Lightning Capital of the World", the Refuge experiences frequent wildfires (Figure 2). Fire staff prepare for wildfire response by monitoring the drought index year-round. Refuge wildfire response is determined with respect to the location of the wildfire, the fuel load and the current and forecasted weather. The response is either direct-attack or

indirect-attack. Direct attack is a suppression strategy in which resources work close to the active fire edge. Indirect attack is a suppression strategy in which the control line, a natural or constructed fire break, is located some distance from the active fire edge.

The Refuge has nine Fire Management Units (FMU) that can be divided into subunits as needed. The average sized FMU is 8,000 acres. There are five major fuel (vegetation) groups: scrub, palmetto with pine overstory, hammock, short grass and tall marsh grass. The average burn frequency to mitigate fuel loads is every three to four years for each FMU. Data from the National Fire Plan Operations and Reporting System (NFPORS) show from 2003 to mid-2012 the Refuge prescribed burned 136,937 acres (Figure 3). An FMU could potentially have been prescribed burned three times since 2003 to mitigate fuel loads.

Figure 2: Summary of Wildfires on Merritt Island National Wildlife Refuge 1980 – 2012



- Upper Left Box: Number of Wildfire Starts per Year– Red
 Number of Wildfire acres per Year – Blue Hatch
- Upper Right Box: Number of Wildfires per Month
- Lower Left Box: Size of Wildfires (Acres) – A 0 -.25; B .26 – 9.9; C 10 – 99.5; D 100 – 299; E 300 – 999; F 1000 - 4999
- Lower Middle Box: Cause of Wildfires – 1 Lightning; 2 Campfire; 3 Smoking; 4 Debris Burning; 5 Arson; 6 Equipment; 7 Railroads; 8 Children; 9 Miscellaneous
- Lower Right Box: Duration of Wildfire (Days until Out)

**Figure 3. NFPORS Prescribed Fire Acres for Merritt Island National Wildlife Refuge
 2003 – 2012**

<i>Fiscal Year</i>	<i>WUI</i>	<i>Non-WUI</i>	<i>Total</i>
2003	14,170	5,343	19,513
2004	12,741	3,761	16,502
2005	8,221	3,943	12,164
2006	13,884	0	13,884
2007	11,563	6,153	17,716
2008	13,694	3,356	17,050
2009	13,694	2,277	15,971
2010	14,097	2,378	16,475
2011	4,457	0	4,457
2012	5,562	0	5,562
Cumulative Total Acres			136,937

WUI – Wildland Urban Interface

Center Wildfire

The Center Wildfire was ignited by lightning on May 6, 2012. The fire was located in FMU 2.3. (Map 2). The fuel consisted of tall grass marsh, palmetto with pine overstory and hardwood hammock. FMU 2.3, which is 3,990 acres, was prescribed burned on June 29, 2010. Fire staff decided the most effective strategy for the Center Wildfire was to use an indirect-attack by burning out and holding the fire on maintained roads. The Center Fire was bounded by Titusville Road (SR 406), Center Road, Beach Road (SR 402) and NASA railway system. Titusville Road is a main transportation artery for the north end of Merritt Island. Beach Road is the main entrance to the Refuge, Canaveral National Seashore and Kennedy Space Center from Titusville. Traffic was not impacted on any of the roads during the wildfire. Both NASA and NPS have infrastructure located inside FMU 2.3, but the infrastructure was not located inside the Center Wildfire perimeter. The Center Wildfire was controlled at 800 acres on June 23 at a cost of \$65,000 (\$81.25/acre).

Map 2: Center Wildfire (800 acres) inside FMU 2.3 (3,990 acres) on 5/12/2012

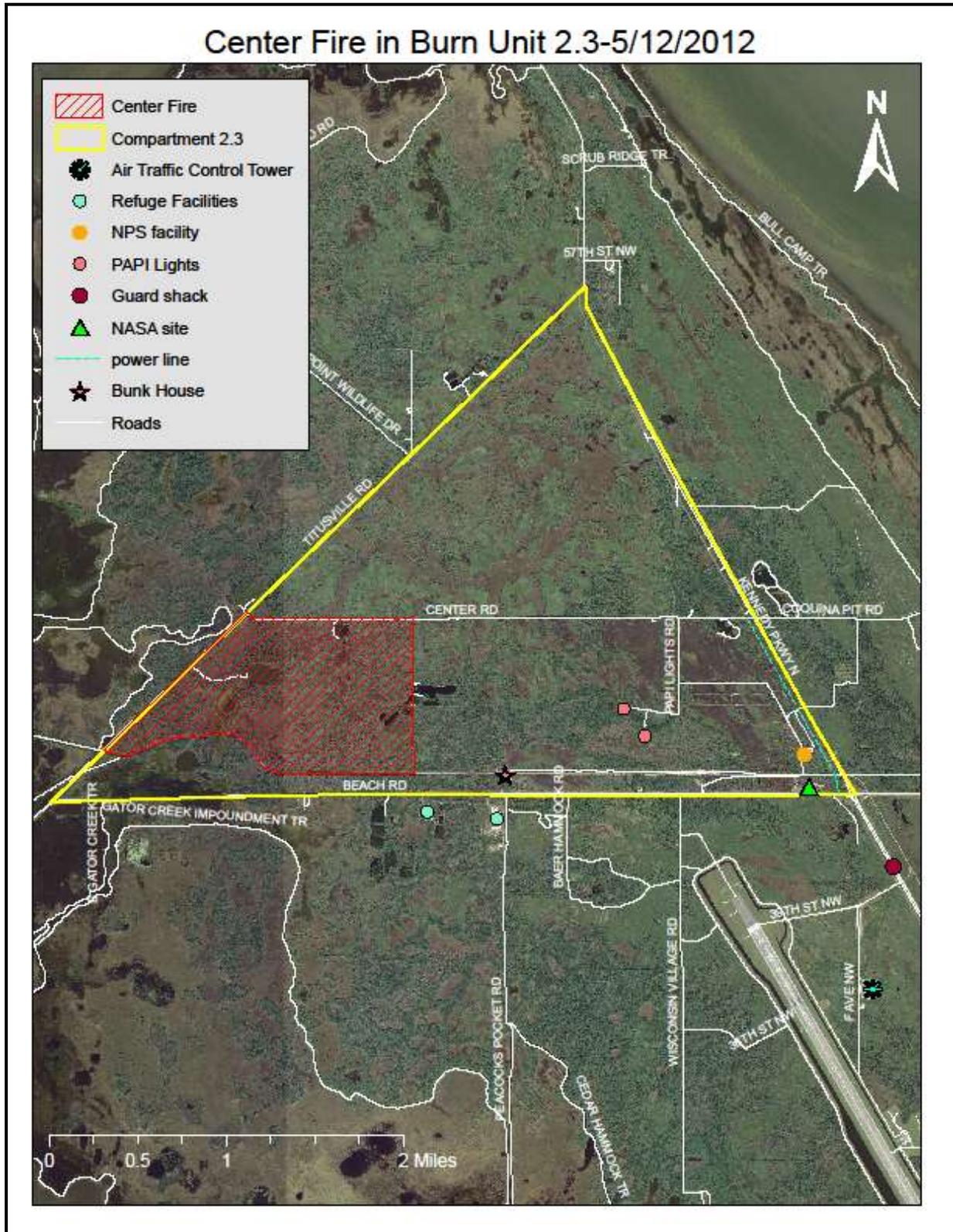


Photo 2: Center Wildfire Burnout Operations 5/6/2012



The suppression strategy for the Center Wildfire was to burn out from the roads, then use the helicopter to ignite the interior. The objective was to safely control the fire with fire and hold it in the predetermined boundaries of maintained roads. Traffic to and from NASA, Canaveral National Seashore and the Refuge was not impacted during the burnout operations.

Just Missed and Just Missed Again Wildfires

The Just Missed Wildfire was ignited by lightning on May 6, 2012 in FMU 7.2.A (Map 3). The fuel consisted of scrub, palmetto with pine overstory, hardwood hammock and tall grass marsh. FMU 7.2.A, which is 2,174 acres, was prescribed burned three months prior on January 31, 2012. The prescribed fire cost was \$27,000 (\$13.34/acre). The Fire staff decided the best response to the Just Missed Wildfire was to aerielly monitor due to the poor access and the fact that the surrounding fuel had been consumed during the recent prescribed fire.

On May 11, 2012 another lightning strike ignited the Just Missed Again Wildfire which was also located inside FMU 7.2.A. The fire staff decided to use indirect-attack by aerielly burning out both wildfires. The Just Missed and Just Missed Again Wildfires inside FMU 7.2 are bounded by Kennedy Parkway (SR 3) and NASA Causeway (SR 405) and Static Test Road. Kennedy Parkway is the main transportation artery north and south through Kennedy Space Center. NASA Causeway is the main entrance to Kennedy Space Center and Cape Canaveral Air Force Station. Traffic was not impacted on any of the roads during the Just Missed or Just Missed Again Wildfires. Located on the interior FMU 7.2.A is NASA Environmental Health Facility and Communication Facility. On the perimeter of FMU 7.2.A is the Armament Refurbishment Facility (ARF), K-9 Training Facility, Landfill, and NASA Administration and Industrial Area. Within one mile of the perimeter of FMU 7.2.A is the NASA Kennedy Space Center Visitor Center and the Vehicle Assembly Building.

The Just Missed and Just Missed Again Wildfires were a total of 553 acres. The Just Missed Wildfire was controlled at 20 acres in 13 days at a cost of \$17,000 (\$850/acre). The Just Missed Again Wildfire was controlled at 533 acres in 27 days at a cost of \$24,000 (\$45.03/acre). The combined total cost for both the Just Missed and Just Missed Again Wildfires was \$41,000 (\$74.14/acre).

Map 3:

Just Missed and Just Missed Again Wildfires (553 acres) in FMU 7.2.A (2,174 acres) 5/12/2012

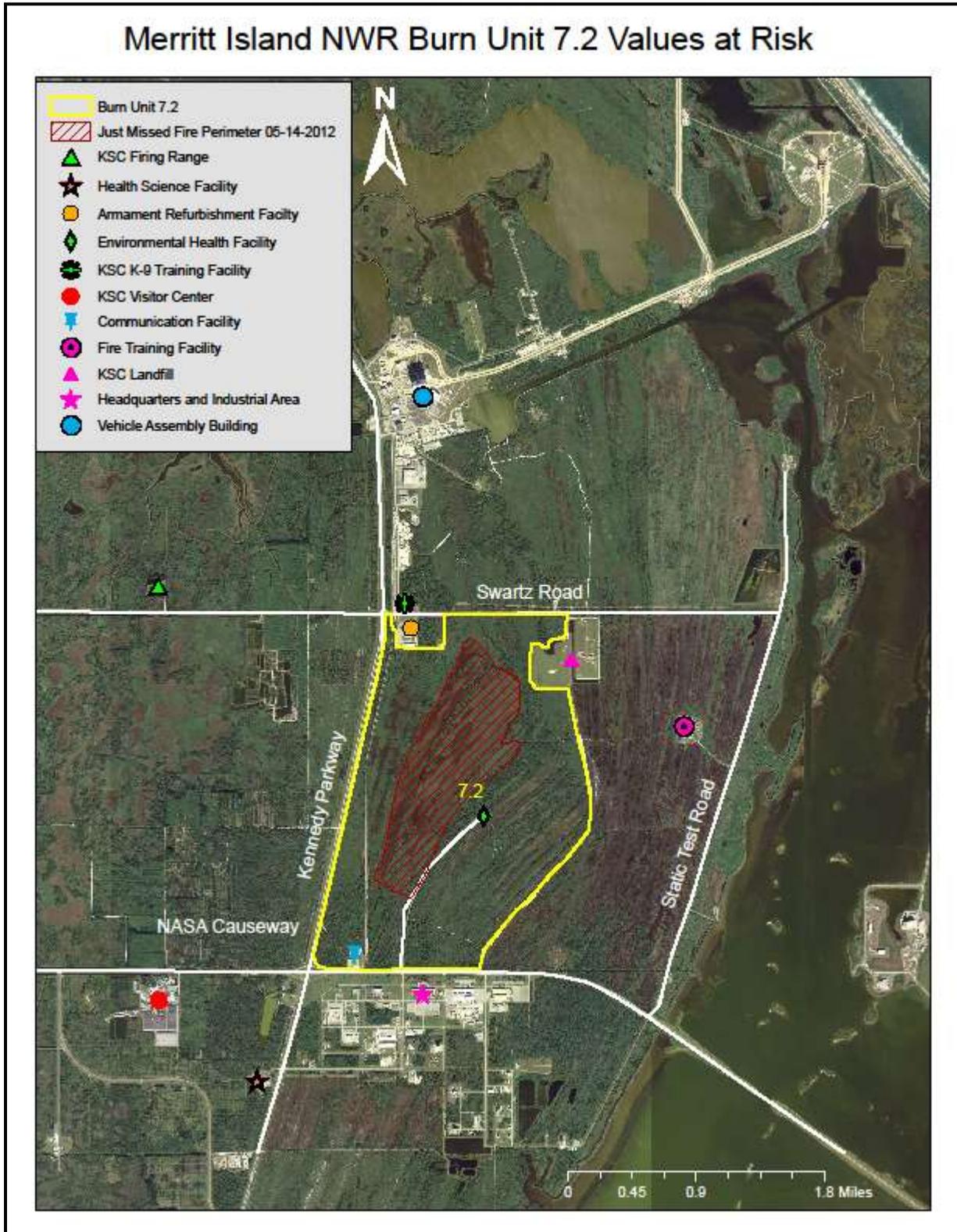


Photo 3: Unburned area after Prescribed Fire in FMU 7.2.A 1/31/2012



The Vehicle Assembly Building (VAB) is in the background of this picture of Burn Unit 7.2.A. This is the morning after the prescribed burn in January. The green areas in the picture were unburned swales due to high water tables.

Photo 4: Just Missed Wildfire 5/12/2012



This is an aerial reconnaissance flight over the Just Missed Fire. The fire was ignited by lightning in a swale that did not burn in the prescribed fire in January and moved into new plant growth. The swale is the brownish vegetation and the new plant growth is green.

Photo 5: Just Missed Again Wildfire 5/12/2012



Photo 6: Just Missed Again Wildfire after the Burnout Operations Completed 5/12/2012



NASA's VAB is the backdrop for the Just Missed and Just Missed Again Wildfires. The swale which did not burn in the prescribed burn in January burned during the wildfire in May. The burned areas from the prescribed burn kept the wildfire in the interior of the burn unit.

FSPRO Modeling for the Center and Just Missed Again Wildfires

FSPRO is a fire spread probability model developed by the Missoula Fire Sciences Laboratory. This program models the probability that an ongoing fire will affect a given pixel on a map within a specified number of days. The model is based on historical weather, forecasted weather, fuels and topography. The model “grows” a set number of fires based on different weather conditions. It then produces a probability that a fire will affect a pixel on a map based on the number of times that pixel burned in the simulations. The higher the probability, the more likely that area would have burned.

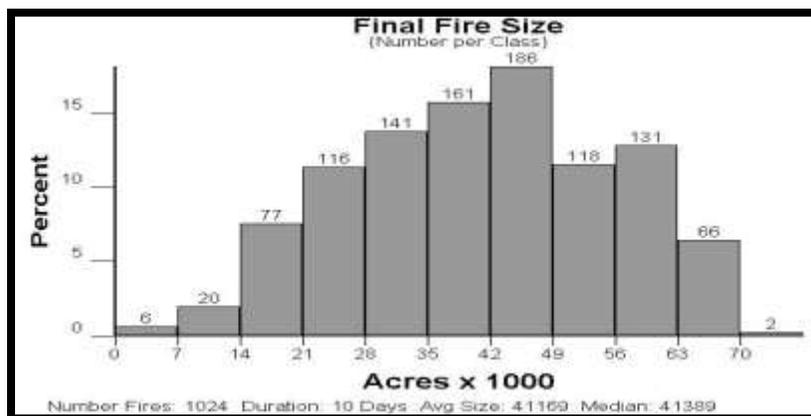
The Center and Just Missed Again Wildfires were run in FSPRO to model the difference in actual fire size with recent fuels treatments against probable fire size and with a five-year fuel load (no recent fuel treatments).

FSPRO Fire Size Probability

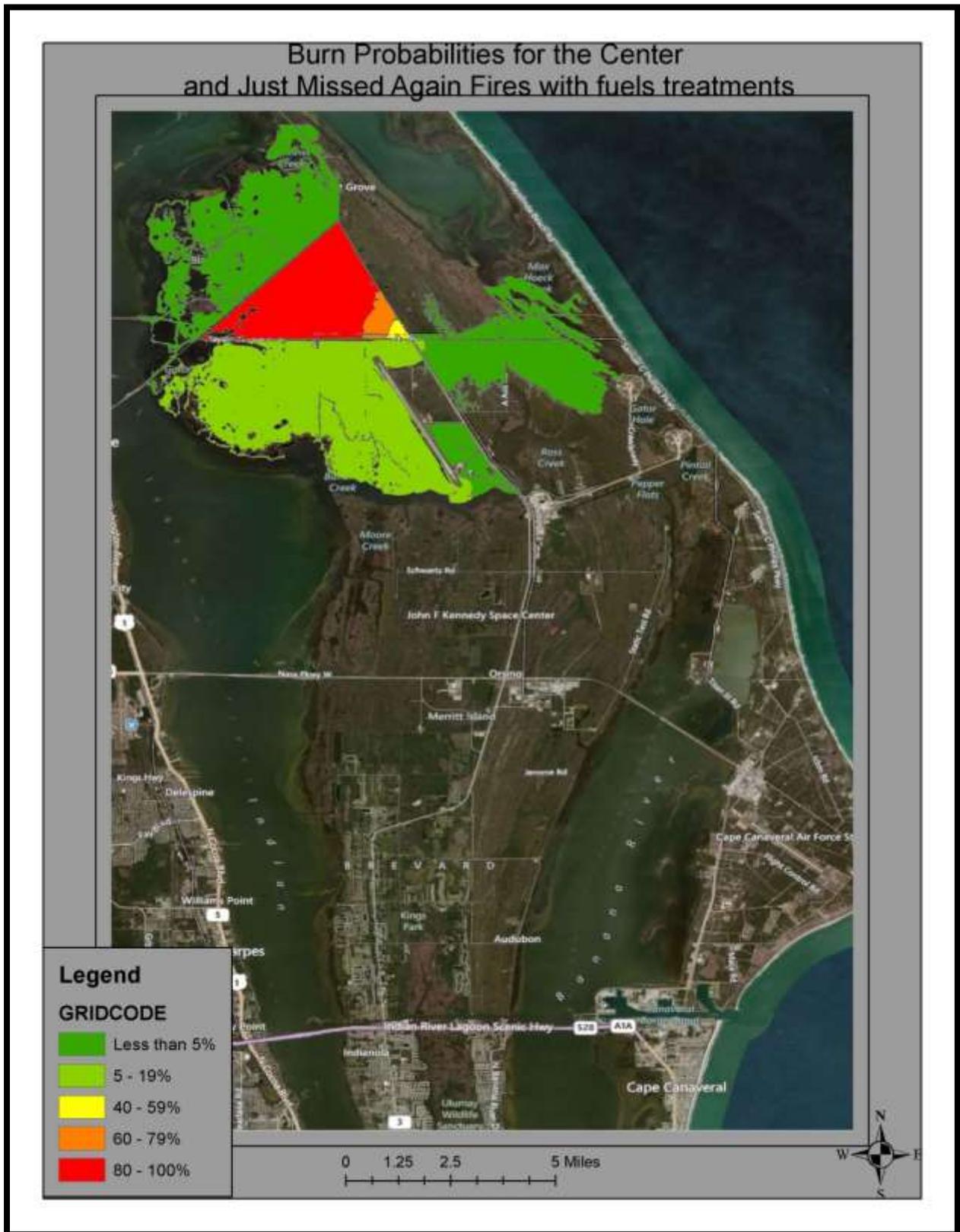
The first set of runs in FSPRO showed the spread probability of the Central and Just Missed Again Wildfire with recent fuels treatments incorporated in the model. The FSPRO model, with fuels treatments, burned a total of 1,333 acres for ten modeled-days before being controlled (Map 4). In the case of the Just Missed Again Wildfire, fuel loads were very minimal due to the prescribed fire conducted three months prior to the wildfire. Due to the reduction in available fuel, the probability that the fire would spread across the landscape was significantly reduced. Therefore, a wildfire that was burning less than ½ mile from critical NASA infrastructure went out with almost no fire firefighter intervention.

The second set of runs in FSPRO used the 2008 LANDFIRE fuels layer. Using the 2008 LANDFIRE fuels layer gives the modeled fire a minimum of a five-year fuel load over the entire Refuge. FSPRO projected that there was a high probability that the total average acreage consumed by the Center and Just Missed Again Wildfires in ten-modeled days would have been in excess of 41,169 acres. (Map 5) Figure 3 shows that the average fire size for the FSPRO model runs without treatments is 41,169 acres.

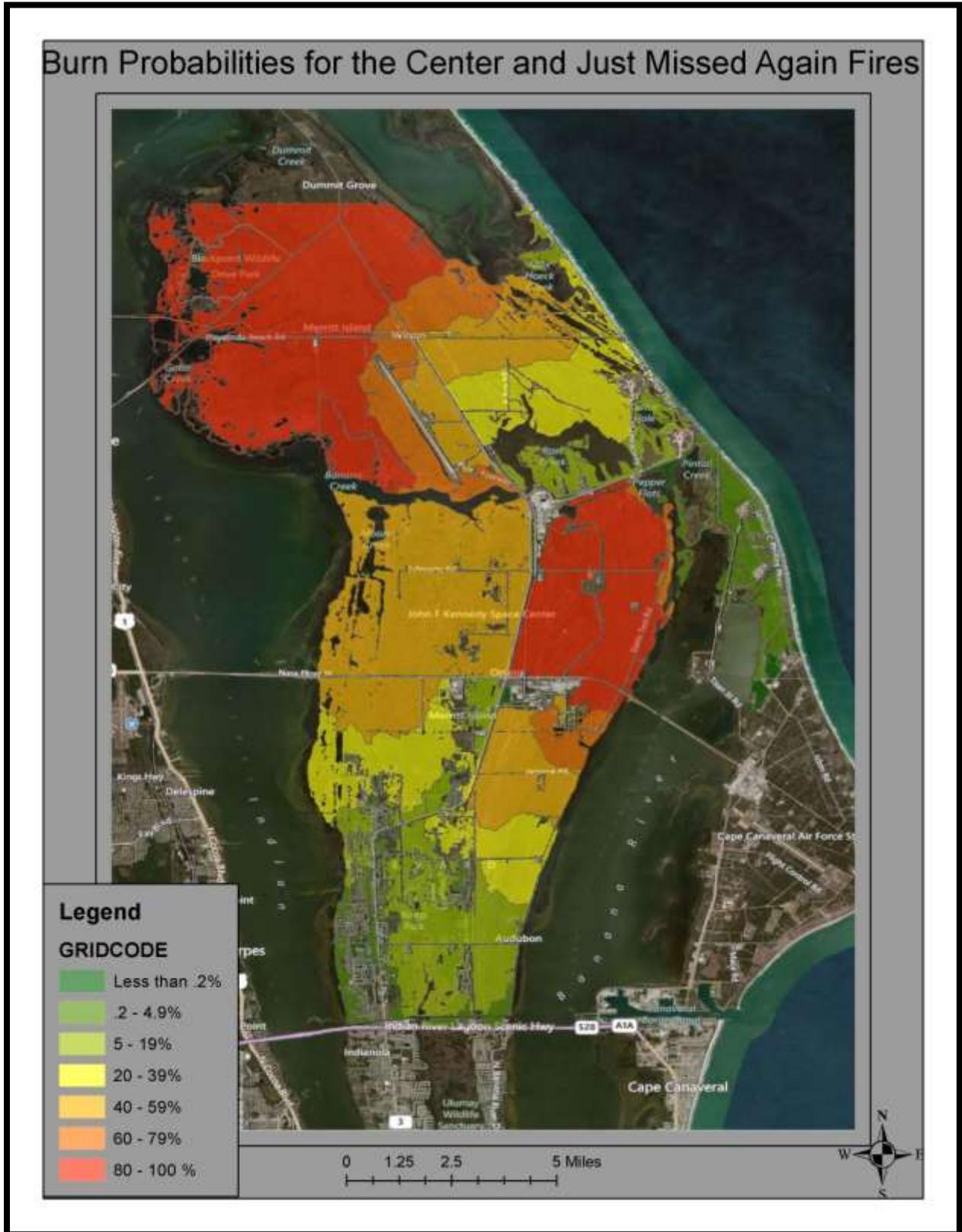
Figure 4: FSPRO Final Fire Size with no fuel treatments after 2008.



Map 4: FSPRO Burn Probabilities WITH Recent Fuel Treatments



Map 5: FSPRO Burn Probabilities With No Fuel Treatments after 2008



Actual Cost for Center, Just Missed and Just Missed Again Wildfires

The actual cost for fuels treatments in FMU 2.3 and FMU 7.2.A was \$27,000 and \$29,000 respectively, with the total cost for the fuel treatments being \$56,000 for 6,164 acres (\$9.08/acre).

The actual cost of the Center Fire, Just Missed Fire and the Just Missed Again Fire was \$65,000, \$17,000 and \$24,000 respectively. Combined cost for the 3 wildfires is \$106,000 for 1,353 acres (\$78.35/acre).

Both of the treatments and all three wildfires used aviation during operations. Aviation use increases the cost of fires but provides the fire manager with an effective tool in containing and controlling both prescribed and wildfires.

Modeling Cost with Stratified Cost Index

Due to growing fire suppression costs in the United States and the lack of a quantifiable performance measure for suppression expenditures, Congressional appropriation language (2005) directed the Forest Service (FS), in collaboration with the Department of Interior (DOI), to develop an interim performance measure for suppression expenditures and to begin reporting on this measure in FY 2006.

The interim performance measure called for by Congress was a stratified cost index (SCI), originally specified in the appropriation language as cost per acre/energy release component. After discussions between FS and DOI representatives and economists at the Rocky Mountain Research Station (RMRS), it was decided the SCI would assess a variety of factors that influence suppression expenditures, rather than focusing solely on energy release component.

Three models (FS west, FS east, DOI) were built using data on nearly 2,000 large FS and DOI wildfires occurring over the past ten years. The models are located in the Wildland Fire Decision Support System (WFDSS). The SCI is run in WFDSS for each wildfire that exceeds 300 acres or is nationally significant. The SCI regression equations are used to calculate the expected suppression cost of a large fire (≥ 300 acres) given its characteristics. The expected cost can then be compared to actual suppression expenditures.

SCI outputs a Cost Index based on the multiple factors including fire size, duration, weather and topography. Since the wildfires were active for ten-days, the input time in the model was set to ten days. For comparison with actual costs, an SCI was built in WFDSS for the combined Center and Just Missed Again Wildfires based on the FMUs being untreated since 2008 (Figure 5).

Figure 5: Stratified Cost Index by Percentage for the Center and Just Missed Again Wildfires in FMUs untreated since 2008.

Acres Burned	25%	50%	75%	90%
25000	\$8	\$31	\$122	\$218
40000	\$6	\$25	\$95	\$170
50000	\$6	\$22	\$84	\$151
70000	\$5	\$18	\$71	\$127

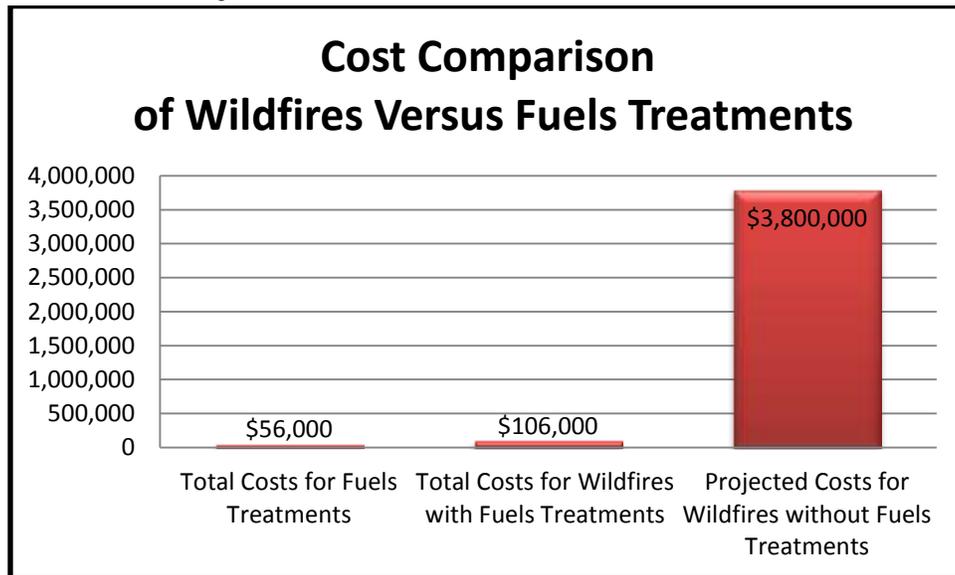
- 25% - 25 percent of fires with similar characteristics had a cost per acre less than the acres burned
- 50% - 50 percent of fires with similar characteristics had a cost per acre less than the acres burned
- 75% - 75 percent of fires with similar characteristics had a cost per acre less than the acres burned
- 90% - 90 percent of fires with similar characteristics had a cost per acre less than the acres burned

To determine the most appropriate SCI percentage to use for this comparison, the Pad Fire in 2011, which was located less than one mile from the Just Missed Again Wildfire, had an actual cost of \$110/acre. The SCI 75% column was chosen due to the interpolation of \$110 between \$122 and \$95.

In Figure 5, 40,000 acres was utilized to determine the SCI for the FSPRO Model average burned acres of 41,169. Combining the 75% column with the 40,000 row gives a cost of \$95/acre. Using the \$95/acre SCI projected cost multiplied by 40,000 burned acres gives a projected cost of the Center and Just Missed Again Wildfires without fuels treatments since 2008 as \$3,800,000.

Figure 6 shows a comparison of the fuels treatments costs, the wildfires with fuel treatments costs and the projected wildfires without fuel treatment costs.

Figure 6: Cost Comparison of the Fuels Treatments, the Wildfires with Fuel Treatments and the Projected Cost of Wildfires Without Fuels Treatments.



Conclusion

Wildfires from lightning are frequent. The Refuge averages over 25 ignitions each year, burning more than 2,200 acres annually since 1980.

The combined actual cost of the fuels treatments for FMU 2.3 and FMU 7.2.A was \$56,000. The combined actual cost for the Central, Just Missed and Just Missed Again Wildfires was \$106,000. The projected cost for the Central, Just Missed and Just Missed Again Wildfires, if there had been no fuels treatments since 2008, was \$3,800,000. The difference between the actual cost of the wildfires and the fuels treatments and the projected cost of the wildfires without fuel treatments is \$3,600,000. This cost estimate does not take into consideration potential damage to Refuge, NPS, or NASA infrastructure, lost time due to employee evacuations, adverse impacts to critical space-related operations and impacts to Refuge, NPS, or NASA visitor services that could have been caused by larger wildfire incidents. Also, not included in this analysis are the impacts a wildfire could have on habitat and dependent species due to increased fire intensity and duration.

The hazardous fuels reduction strategy of prescribed burning frequently at Merritt Island National Wildlife Refuge is reducing impacts from wildfires that threaten NASA, Canaveral National Seashore, Cape Canaveral Air Force Station and surrounding communities by minimizing the size and duration of wildfires and reducing the cost significantly for each wildfire.