

An evaluation of the risk from wildfire in Memphis, TN

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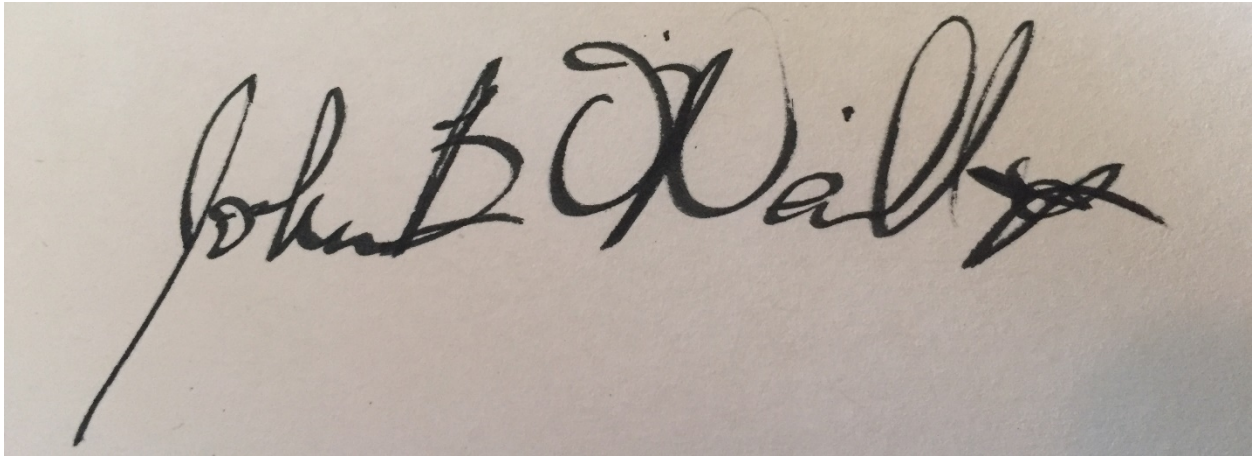
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Certification Statement

I hereby certify that this work is my own product. Any work by any other author or authors is properly cited and any direct quotes are duly noted and identified. Full credit is given to those whose work was used for the development of this product.

Signed: John Barry O'Neill, Jr.

A photograph of a handwritten signature in black ink on a light-colored surface. The signature is written in a cursive style and reads "John Barry O'Neill, Jr." with a stylized flourish at the end.

Date: January 27, 2017

Abstract

The Memphis Division of Fire Services has neither evaluated the risk from fire in the wildland urban interface, nor has it prepared its members to fight a fire in such an environment. The purpose of this research was to evaluate the risk from wildfire in Memphis, TN. The research was evaluative in nature and answered three questions: 1. What was the likelihood that the City of Memphis would experience a fire in an urban forest or green space that threatens the public? 2. How well were Memphis firefighters prepared to mitigate a wildfire event? 3. What were the prevailing attitudes of recreational users of urban forests and green spaces toward wildfire? By evaluating Geographical Information Services data from the Tennessee Department of Forestry and other agencies as well call data from the Memphis Fire Division and other adjacent jurisdictions, it was determined that the threat from wildfire was moderate in Memphis, but a large part of Memphis was in a wildland-urban interface zone and affected by some risk. Also, the volume of wildland incidents was related to unpredictable and fluctuating drought conditions. Memphis firefighters were questioned and it was determined that very few were trained to fight wildfires, most felt unprepared and ill-equipped to fight wildfires, and most were willing to receive the training needed to meet wildland firefighter standards. Users of the urban forests were surveyed and it was determined that they felt that the Memphis Fire Division was ill-prepared to fight wildland fires, but that the natural resource of the urban forest was a valuable resource that deserved to be protected. It was recommended that the Memphis Fire Division enter a partnership with various stakeholders to develop a Community Wildfire Protection Plan and that Memphis firefighters should be trained and equipped to mitigate wildfires.

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Introduction:

The City of Memphis Division of Fire Services (Fire Division) is a fire department with a compliment of 1,784 personnel. Its members staff 57 fire stations with 56 engine companies, 21 truck companies, 35 Advanced Life Support Units (ambulances), three heavy rescue companies, three Airplane Rescue Fire Fighting companies, and various unstaffed support elements including six “brush trucks.” The Fire Division touts itself as an all-hazards provider to address public safety concerns for the citizens of Memphis, to include fire suppression, code enforcement, emergency medical services, hazardous materials, and disaster preparedness. (City of Memphis, 2016) The problem is, the Memphis Fire Division has neither evaluated the risk of fire in the wildland-urban interface (WUI) nor has it prepared its members to fight a fire in such an environment. The purpose of this research is to evaluate the public risk from wildfire in the urban interface in Memphis, TN.

The evaluative research will reveal the level of preparedness to mitigate a fire in the wildland-urban interface and identify changes needed (if any exist) to improve preparedness. This research answers three questions: 1. What is the potential for the City of Memphis to experience a fire in an urban forest, wildland-urban interface, or other green spaces that threaten the public? 2. How well are Memphis firefighters prepared to mitigate a wildfire event? 3. What are the prevailing attitudes of recreational users of urban forests and green spaces toward wildfire?

Background and Significance

According to the United States Census Bureau, the City of Memphis is a city of 315.06 square miles (816 square kilometers) and 655,770 residents. Those residents live in 249,775 households with 2.57 people per household. There are 70,891 businesses of any size throughout the city. (2010) According to a Southern Wildfire Risk Assessment Summary Report, approximately 114,000 acres (461 square kilometers) is in a WUI. The report goes on to state that approximately 70 percent of the population lives in what meets the definition of WUI. (2016)

Memphis shares two ecoregions. (USGS, 2016) The Mississippi River Alluvial Basin has historically natural vegetation of oak-hickory forests interspersed with oak-gum-cypress forests. The Mississippi Valley Loess Plains is also historically dominated by oak-hickory forests, but also is interspersed with areas of short-leaf pines. (USEPA, 1998) Most of both ecosystems in the Memphis area, however, has either been developed or converted to agricultural use. (USEPA, 1998)

Since 2006, the Memphis Fire Division has responded to 6,048 incidents of fire involving natural vegetation with a total loss of approximately \$2,400,000.00 million. During the same period, the Fire Division responded to 55 fires involving cultivated vegetation (crops and landscaping plants) with a total loss of more than \$4,000,000.00. Of those incidents, fires extended into structures 21 times at a loss of approximately \$90,000.00 (Memphis Fire Division, 2016). There is no record of the acreage involved.

Because there is no standard for responding to or mitigating wildfires, there is no operational guidance for developing incident action plans, identifying tactical objectives, or

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determining logistical needs. The Fire Division does have access to heavy equipment, such as bulldozers, through the Memphis Public Works Division, however, Public Works bulldozer operators have no wildfire training requirements or protective equipment, and no arrangement exists to provide access to that equipment during non-business hours. Additionally, per Deputy Chief of Operations Kirk Lock, the Fire Division has no mutual aid agreement established with the Tennessee Department of Forestry or any other agency capable of extended wildfire operations in the event of a significant wildfire in Memphis (personal communication, December 6, 2016).

Evaluative research conducted will not only evaluate the risk of wildfire to the community in the WUI of Memphis, TN, but the preparedness of the Memphis Fire Division to mitigate that hazard. Additionally, the research will meet multiple goals of the U. S. Fire Administration (n.d.):

1. Goal 1: Reduce fire and life safety risk through preparedness, prevention, and mitigation by initiating an assessment of risk from wildfire in Memphis, TN.
2. Goal 2: Promote response, local planning, and preparedness for all hazards by initiating an evaluation of the capabilities of the Memphis Fire Division to respond to and mitigate the risk from wildfire.
3. Goal 3: Enhance the fire and emergency services' capability for response to and recovery from all hazards by including the mitigation of the hazard associated with wildfire in the list of services provided by the Memphis Fire Division.

Literature Review

The first question of risk evaluation, which attempts to quantify the potential of a wildfire in the Memphis area asks more than “How likely is a wildfire to occur?” The question is much more complicated than that. The question, to be properly answered, requires the explanation of wildfire and WUI. The answer also requires an evaluation of the risk that examines the potential outcome of the worst case scenario, as well as the much more likely low-intensity event.

The *National Fire Incident Reporting System Complete Reference Guide*, as written and published by the U. S. Fire Administration (USFA) defines a *wildland fire* as “Any fire involving vegetative fuels, other than a prescribed fire, that occurs in the wildland. A wildland fire may expose and possibly consume structures (Incident Type 141)” (2015). The National Fire Incident Reporting system further defines *wildland* as “An area where development is essentially nonexistent, except for roads, railroads, power lines, and similar facilities.” (USFA, 2015) The guide further specifies that any fire involving vegetative fuels, either in the wildland or WUI is considered a wildfire (USFA, 2015).

According to the Wildland Urban Interface Mitigation Committee of the National Wildfire Coordinating Group (NWCG), the WUI refers to the area where "structures meet or intermingle with undeveloped wildland or vegetative fuels" (2014). Mitigation of fire in the WUI benefits the public by creating safer communities; allowing communities to minimize post-disaster disruptions; decreasing financial impact on individuals, businesses, and society; and contributing to both firefighter and public safety by reducing the risk of structures being involved (NWCG, 2014). One mitigates risk by adhering to two principles. First, assess the risk by quantifying two components: the magnitude of the potential loss and the probability that the loss will occur. Second, reduce the risk must using common risk reduction methods, including

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regulation, land use, and risk reduction task completion such as prescribed burns and fuel removal (NWCG, 2014).

A community that encompasses a WUI and takes steps to mitigate the possibility of wildfire is known as a fire adapted community (FAC). The FAC does not adhere to a specific program or plan but demonstrates an end state (NWCG, 2014). Persistent maintenance, adaptation, and re-assessment are essential to maintaining that adaptation. Stakeholders in the FAC include not only residents, but businesses, policy makers, land managers, government agencies at all levels, and responders. While no two communities would develop the same plan for becoming fire adapted, the NWCG identifies several elements to include in most, if not all, plans (2014):

1. Development of a Community Wildfire Protection Plan (CWPP) that identifies key community values at risk and ways to reduce the risks.
2. A vegetation management plan for homes and businesses affected by wildfire risk.
3. Local responder understanding of unique considerations when preparing for and responding to wildfires.
4. Fuel reduction activities on public and private land to reduce hazards and create buffers between human activities and at risk areas.
5. Codes and ordinances to ensure growth and development minimize risk.
6. Cooperation between jurisdictional authorities at multiple levels.

One should note that any CWPP developed requires a collaborative effort. Local governments must involve state and federal agencies. Additionally, key stakeholders like homeowners, businesses and trade associations, and conservation and land management

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organizations must have a voice in planning. Priorities of the plan must include fuel reduction in areas at risk and provide measures for reducing the ignitability of structures in the WUI (NWCG, 2014). The private homeowner need not feel oppressed by regulations designed to mitigate the risk for the homeowner. Education programs should be considered to allow the homeowner to take ownership of mitigation efforts by outlining several protective measures. These actions include vegetation management that replaces fuels around the home with less flammable vegetation, maintaining roofs and decks by removing tree litter from those surfaces, and reducing the ignition potential in a home by using fire-resistive roofing and installing non-flammable mesh in vents (NWCG, 2014).

Keith Smith, in *Environmental Hazards: Assessing Risk and Reducing Disaster*, states that, historically, wildfire is a generic term referring to fires ignited by lightning in unpopulated areas. Modern wildfires, however, are more often ignited by human action and present the higher risk to life because of more common areas considered to be the wildland-urban interface (2013). Smith explains that the risk of wildfire is especially high during periods of elevated temperature and drought that follow periods of vegetative growth (2013). He further explains that trends in drought are difficult to define clearly, but that there are close links to El Nino/La Nina weather cycles. He states that global climate simulations suggest that levels of aridity will increase over much of North America in the future, therefore significantly increasing the occurrence of wildfire in many parts of the United States (2013).

Risk management regarding wildfire is no simple task and must address multiple factors. Many areas of the nation are historically predisposed to wildfire as an ecological factor that affects much of the development of North America both presently and historically. (Calkin, Cohen, Finney, Thompson, 2014, p. 746) Today, many communities develop in or spread to

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areas prone to wildfire, yet current social and political expectations are unrealistic when addressing wildfire management and protection under both existing and future economic, ecological, and climatic conditions. Fire spread is dependent on fuel continuity rather than urban or suburban development. Risk arises because fire may spread vast distances from its origin of ignition. (Calkin et al., 2014)

Two principal risk management objectives are to reduce the wildfire severity in the ignition zones by limiting the opportunity for fire to spread through fuel reduction and enhancing fire suppression effectiveness. Firefighting agencies well versed in wildland firefighting are highly efficient in suppressing most fires. However, fuel reduction and suppression efforts will not eliminate fire risk. Short explained, as cited by Calkin et al., that 3% of wildfires account for 97% of the area burned from 1992-2011. (2014, p. 748) The risk management planning partners and agencies responsible for suppression must be willing to overestimate fire conditions and can recognize that fuel treatment, or prevention efforts, alone are ineffective in mitigating risk. (Calkin et al. 2014, p. 748) Their claim is evident, in part, by noting that during many WUI disasters, many structures burn without contact by high-intensity flames, rather by flying firebrands that provide the source of ignition. In fact, many of the structures evaluated are adjacent to unburned, even green, landscape. (Calkin et al. 2014, p. 748)

A recent wildfire in East Tennessee provides an excellent example of how a wildfire can spread great distances into the WUI and even the urban environment. On November 23, 2016, witnesses reported a fire on the Chimney Tops Trail of the Great Smokey Mountains National Park. According to the timeline released by the National Park Service, the fire was in a remote area of rocky terrain with thick vegetation interspersed throughout the area. The fire, dubbed Chimney Tops 2 since a fire extinguished only a few days before was named Chimney Tops, was

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less than 1.5 acres (0.006 km²) and located 5.5 miles (8.9 km) into the park, inaccessible to fire engines. The incident commander delayed a direct attack while the area remained under observation of wildfire crews. (NPS, 2016) By November 26, despite 0.12 inches (0.3 cm) of rain, the smoldering, low-intensity fire had grown to 8 acres (0.32 km²). That region, however, was experiencing “exceptional drought” with a Keetch-Byram Drought Index (KBDI) of 599. (Gabbert, 2016) A KBDI of 600 would indicate the need to expect a rapidly growing, high-intensity fire with spotting, or fire spread from embers lifted aloft and moved by the wind, at great distances. (Gabbert, 2016) The initial responders failed to anticipate extreme fire conditions or a rapidly advancing fire, and by November 28, spot fires began to pop up as far as 1 mile (1.6 km) away. (NPS, 2016) Winds on November 28 had gusts as high as 87 mph (140 km/h) and caused rapid and extensive fire spotting by flying embers. By the time the fire was brought under control on December 14, 2016, over 17,000 acres (68.8 km²) burned, monetary losses had exceeded \$500 million, firefighting costs had reached an estimated \$8.8 million, and 14 visitors and residents of the area perished. (Ahillen, 2016)

The U.S. Department of Interior (USDO I) publishes the *Interagency Standards for Fire and Fire Aviation Operations*, a manual created to standardize and guide wildfire mitigation efforts on public lands. Colloquially known as “The Red Book,” *Interagency Standards for Fire and Fire Aviation Operations* encompasses standards and policies from the major groups responsible for that mitigation: Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, National Park Service, and Bureau of Indian Affairs managers. (2017, p. 1) The manual serves as a single, easily used resource by reprinting policies of the various organizations verbatim while limiting redundancy in the various policies of the member organizations. The manual identifies key elements of operational doctrine for wildfire mitigation, including the

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nature of fire operations, risk management, preparedness, command philosophy, leadership, and suppression efforts. (USDOJ, 2017, pp. 8-11) Other key elements in the text identify common philosophies across the agencies for setting standards for training, equipping, coordinating, and communicating with the firefighters both on land and in the air.

Additionally, *Interagency Standards for Fire and Fire Aviation Operations* specifies the necessary elements of a national wildfire management policy, including but not limited to safety, fire administration and ecosystem sustainability, response to and use of wildfire, suppression considerations, protection priorities, the Federal role in the WUI, standardization, and interagency coordination. *Interagency Standards for Fire and Fire Aviation Operations* goes on to outline guiding principles to implement any wildfire plan. Of key importance in this outline is that Federal agencies “will review, update, and develop agreements that clarify the jurisdictional inter-relationships and define the roles and responsibilities of local, state, tribal, and federal fire protection entities.” (USDOJ, 2017, p. 5) It goes on to state that “Responses to (a) wildland fire will be coordinated across levels of government regardless of the jurisdiction at the ignition source.” (USDOJ, 2017, p. 5) In short, the document specifies that any potential wildfire event that involves Federal agencies must be preplanned. That preplan should include not only a risk assessment, but also an establishment of roles, a standardization of training and equipment, and the evaluation of capabilities.

While *Interagency Standards for Fire and Fire Aviation Operations* standardizes policies, training, and equipment across various Federal agencies, and calls for coordination, cooperation, and standardization amongst Federal, state, and local agencies, none of the policies have direct regulatory authority over local agencies unless they respond to incidents on Federal property. *Interagency Standards for Fire and Fire Aviation Operations* still serves an excellent

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resource for local organizations in training, staffing, and equipping wildland firefighting resources. For example, Appendix M defines the minimum equipment lists for normal unit stocking of Bureau of Land Management engines, therefore applying it to all Federal Resources. (USDOJ, 2017, Appendix M) *Interagency Standards for Fire and Fire Aviation Operations* also establishes the National Wildfire Coordinating Group (NWCG) as the sanctioning body for firefighter training, even though each of the individual agencies establishes its workforce development policies. The manual does specify what training “non-agency personnel” must be complete to work on the fire-line. (USDOJ, 2017, pp. 248-251)

While *Interagency Standards for Fire and Fire Aviation Operations* stands as a comprehensive resource for mitigating wildfire at multiple levels, other organizations publish documents that establish risk management guidelines, training requirements, and equipment specifications. The National Fire Protection Association (NFPA) publishes several standards specifically written to address wildfire. Standard 1051 of the NFPA establishes job performance requirements to be met to achieve certification as a wildland firefighter or fire officer. While these standards are not duplicates of the training requirements set by the NWCG, they do give state and local agencies a means of certifying training standards that are common to the training standards already established for many organizations that adhere to NFPA codes and standards. Another important document is NFPA 1977 which specifies the performance and design requirements of wildfire personal protective equipment and should. The standard for structural firefighting personal protective equipment, NFPA 1971, is the inappropriate substitute for NFPA 1977.

Because NFPA 1051 is a standalone document, it does not provide a tangible means for the municipal firefighter (i.e., training hours, techniques to acquire) to become a wildland

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firefighter, only a set of job performance standards to meet to be considered a wildland firefighter. (NFPA 1051, 2016). The Federal Emergency Management Agency, however, has developed a training paradigm in a document titled *Skills Crosswalk: Wildland training for structural firefighters*. The paper was written in conjunction with the NWCG to build on municipal firefighter training and job performance standards set by the NFPA to meet training requirements established by the NWCG. For example, an NFPA 1001 Firefighter 1, a basic, non-supervisory firefighter, would have to complete 21 hours of additional training to meet the minimum standards for NWCG Firefighter 2, which is also a basic, non-supervisory firefighter. (FEMA, n.d., p. 2) An individual with no training would have to complete 67.5 hours of training to meet the minimum training requirements of NWCG Firefighter 2. (FEMA, n.d., p. 5) Other levels of NFPA firefighter certification have similar crosswalk training requirements.

The final question of preparedness involves the social climate and personal attitudes of those affected by the wildfire risk. Paveglio, Jakes, Carrol, and Williams determined that relationships amongst residents in the WUI must be viewed as equally important to preparedness as is scientific knowledge of fire behavior and environmental factors, structural characteristics (as determined by local code), and experience in mitigating risk in the given environment. (2009) Paveglio et al. go on to state that effective policy and environmental resource management necessitate a thorough understanding of the social context of the affected region. (2009)

Winter, Vogt, and Fried examined the attitudes of residents of the WUI towards fuel reduction using fuel treatments or prescribed fire. They established that common concerns of residents include air quality, costs, aesthetic of vegetation, and rights of the property owner. (2002) When planning for fuel reduction through prescribed burns, authorities must address these concerns by seeking public input on fuel management. Some factors that Winter et al.

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identified in soothing those public concerns include well developed and publicized plans, burning only the smallest area possible per treatment, and ensuring firefighting resources are adequate in staffing, training, experience, and equipment. (2002)

Pelligrino, Bryner, and Johnson, in a workshop summary report for the National Institute of Standards and Technology of a stakeholder workshop to identify wildland fire mitigation challenges in the WUI. In addition to factors such as limited resources and experience of local fire departments and vulnerability of structures to resist wildland fire, Pelligrino et al., identified public perception as a key hindrance to effective mitigation efforts. Specifically, general obstacles of concern include inadequate education of stakeholders on wildfire risks, the lack of community motivation before a catastrophic event, weak political support of risk reduction efforts, and the public misperception of or ignorance of the benefits of risk reduction efforts, to include prescribed fire. (2012)

Procedures

To fully evaluate the potential of wildfire in the WUI of Memphis, TN, data was evaluated from several sources. In instances where data lacked clear implication, guidance and explanation from subject matter experts were applied to clarify the impact of the data. In some cases, data from areas outside Memphis, TN was analyzed to identify an impact of Memphis that originated in another community.

The first set of data came from requests for National Fire Incident Reporting System (NFIRS) data that provided information regarding the total number of wildfire incidents for the last ten years by the Memphis Fire Division and those jurisdictions adjacent to Memphis. The Shelby County (TN) Fire Department, The Olive Branch (MS) Fire Department, and the Southaven (MS) Fire Department all provided information. The Germantown (TN) Fire Department, Arlington (TN) Fire Department, and the Desoto County (MS) Fire Department did not provide complete information regarding wildfire responses for the last ten years or did not respond to requests. Data provided included the number of responses coded in the 140 series and the 170 series of NFIRS (the two code series that indicated vegetative fires). The data contained economic losses in some cases and land area losses in others. Memphis Fire Division requirements for documenting wildfire do not include the measurement of land area lost. Weather data from the National Oceanic and Atmospheric Administration provided a correlation between annual precipitation and wildfire run volume.

Next, Geographic Information Systems (GIS) data used by the Tennessee Department of Forestry and obtained from the Southern Group of State Foresters Wildfire Risk Assessment Portal provided indicators of physical risk in the WUI. In instances where the GIS data was without obvious implication of risk in publicly accessed areas, input from subject matter experts

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with accurate information regarding those areas was sought out. The areas and subject matter experts for Overton Park (a municipal park in Memphis) were Paul Flowers, the Administrator of Planning and Development for the City of Memphis Division of Park Services and Eric Bridges, a certified forester and the Director of Operations and Capital Improvements for the Overton Park Conservancy. For the Wolf River Greenway, Ryan Hall, certified forester, and Land Protection Associate for the Wolf River Conservancy acted as the subject matter expert. Shelby Farms (a large urban park in Memphis and owned by Shelby County, TN), which is managed by the Shelby Park Conservancy, did not respond to requests for information. Shawn Posey, the West Tennessee urban forester for the State of Tennessee Department of Forestry provided commentary. For other instances not related to specific areas, David Fiorella, a wildfire risk mitigation specialist for the state of Tennessee Department of Forestry added input.

While assessing the information regarding the physical risk of wildfire, current equipment inventories, operating procedures, and training standards of the Memphis Fire Division were evaluated and compared to state and Federal standards. Next, the abilities and attitudes of Memphis firefighters were assessed to gauge the ability of the Memphis Fire Division to respond to a wildfire event and the willingness of those firefighters to seek training and experience for fighting wildfires in the WUI. A group email presented a ten-question questionnaire to all Fire Division employees and asked for voluntary participation. There were 179 respondents, though some respondents failed to answer all questions.

Finally, the attitudes and habits of members of the public were gauged using a six-question questionnaire. The habits measured were the overall frequency of use of public green spaces; the incidence of risky behavior, specifically smoking and lighting fires; the desire to see public green spaces in Memphis protected; and opinion regarding the perception of preparedness of the

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Memphis Fire Division to respond to wildfire. The questionnaire was distributed using social media and open to any individual interested in participating. There were 70 respondents with all respondents answering all questions. Because some of the subject matter experts who provided clarification on the physical risk to wildfire provided comment on public perception, their commentary was also used to clarify public opinion.

Results

The Memphis Fire Division and several fire departments contiguous to the Memphis Fire Departments were asked to submit NFIRS data related to wildfires dating from January 2006 to October 2016. The contiguous departments were the Shelby County (TN) Fire Department, the Germantown (TN) Fire Department, The Arlington (TN) Fire Department, the Olive Branch (MS) Fire Department, The Southaven (MS) Fire Department, and the Desoto County (MS) Fire Department. The Germantown (TN) Fire Department, Arlington (TN) Fire Department, and Desoto County (MS) Fire Department did not respond with sufficient information for the incident and loss totals. Since 2006, of the respondents to the requests for NFIRS data from vegetation fires, there have been at least 9,613 fires meeting the classification criteria as wildfires with at least \$11,732,754.00 in damage to either the property directly involved or damaged through exposure to the wildfire event. Of the respondents that provided wildfire damaged acreage burned (Olive Branch and Southaven (MS) Fire Departments And Shelby County (TN) Fire Department) 2,482.95 acres(10.05 km²). Of the total number of incidents and financial losses, 6,073 incidents with a total loss of property and exposures (vehicles or structures affected by or initiating the wildfire) of \$6,503,708.00 occurred in the city limits of Memphis, TN.

It is also important to note that wildfires occurring in jurisdictions contiguous to the City of Memphis may or may not have been at a location sufficient to directly threaten property inside of Memphis city limits. Information from Gabbart regarding KDBI and fire spread (2016) precludes the researcher from dismissing wildfires in neighboring jurisdictions as not establishing the risk to the City of Memphis. Annual rainfall totals from 2006, demonstrate a reverse correlation per data from National Oceanic and Atmospheric Administration (2017). Figure 1 illustrates the number of wildfire events, per reporting jurisdiction, regardless of

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financial loss or land area involved. Figure 2 shows the annual rainfall recorded at the Memphis International Airport.

Figure 1 A comparison of run volumes of the responding fire departments

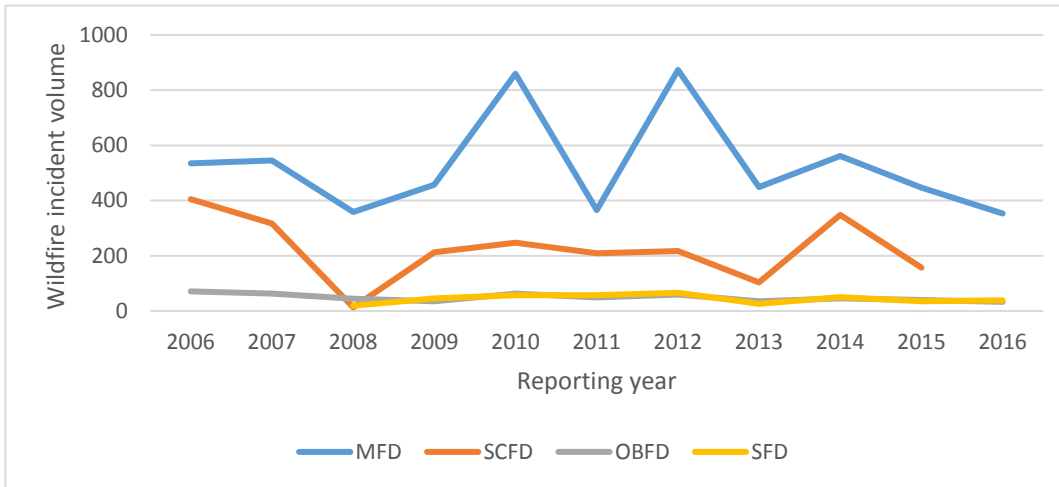
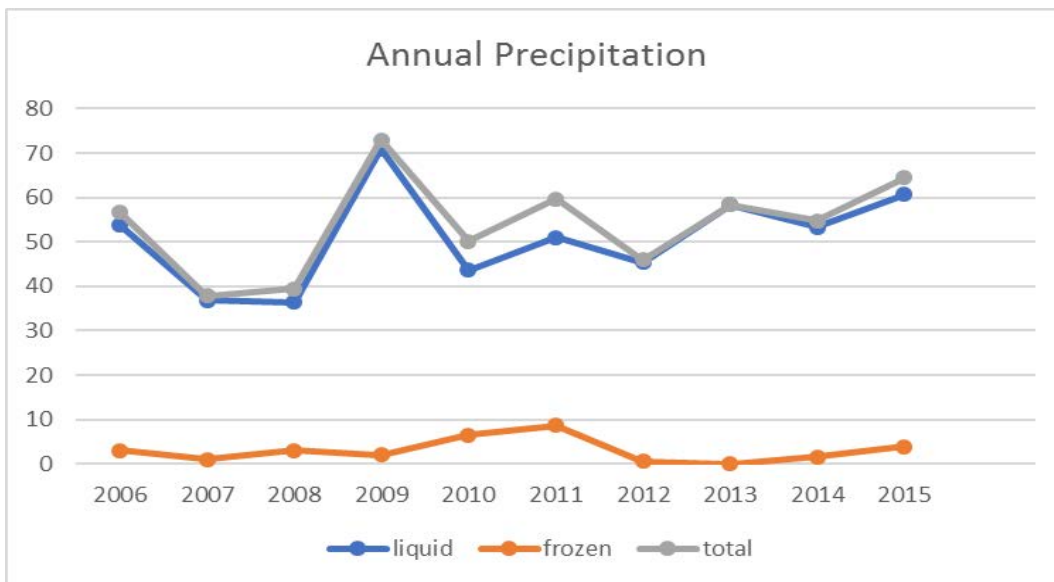


Figure 2 A representation of precipitation at the Memphis International Airport



While call volumes can help clarify the relationship between drought and fire risk, there are more complicated issues, however, that influence the risk of wildfire. According to data compiled by the Southern Group of State Foresters and accessed through the Southern Wildfire Risk Assessment Portal (SWRAP), approximately 70% of the population does not live in a completely developed, urban-core setting, and therefore lives in a WUI zone of some degree. (2017, p. 4) The completely developed, urban-core setting would be considered downtown Memphis or the perhaps the Poplar Avenue corridor. Of the total estimation of the land area deemed to be in the WUI within the city limits of Memphis, 84.5% of the estimated land area of Memphis, or 84,780 acres (343.09 m²), is moderately impacted by risk from wildfire of any severity. (SWRAP, 2017, p. 9)

Location of residents in proximity to the WUI does not complete the analysis of risk. Numerous other factors are evaluated, including the burn probability. The SWRAP categorizes land area on a scale of 1-10 (1 being the least) based on contemporary weather data, ignition patterns, and fire management policies (prevention and suppression). According to the 2017 report, 99.9% of the area has a burn probability of 3 or less. (SWRAP, 2017)

Equally important is the fire intensity scale rated Class 1 (least severe) to Class 5 (most severe). The area estimated is approximately 205,000 acres (829.61 km²), and 62.9% is considered unburnable (urban); however, 36% or 73,969 acres is at risk of wildfire of low to moderate intensity. The SWRAP indicates that well-equipped and well-trained firefighters easily suppress fires of low and moderately low intensity. Of that area at risk, 10,264 acres (41.54km²) are at risk of moderately intense fires that would be difficult to suppress without aviation and dozer assets in coordination with well-trained firefighters and properly equipped wildland engines. (SWRAP, 2016)

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While the overall risk of wildfire is moderate for the city, there are smaller locations within the city that require more scrutiny. Overton Park, a 342 acre (1.38 km²) municipal park that includes a zoo, a college, a golf course, and a 126 acre (0.51 km²) old growth forest and state natural area. (Tennessee Department of Environment and Conservation, 2016) This park is centrally located in the city and has an estimated population of 28,571 surrounding the park. According to SWRAP, 35% of those residents are in a WUI. (SWARP, 2016, p. 4) Additionally, 98% of the land area surrounding the park is has a moderate WUI risk impact with 96% having a low burn probability. The intensity scale is a 3 for approximately 3% of the area and 1 or less for 86.8 percent of the area. The trails through the old growth area are only accessible by foot, making an attack with bulldozers or engines unlikely (Figure 3).

Figure 3 Limited access to vehicles in Overton Park



According to Eric Bridges, a certified forester and the Director of Operations and Capital Improvements for the Overton Park Conservancy, there are unique hazards and benefits of fire in

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Overton Park. The hazards include the unlikely possibility that a severe fire may ignite during extreme, long-term drought and that smoke from a less severe surface fire would be sufficient to extend into areas of WUI. These interface areas include the Memphis Zoo, a high-rise retirement community adjacent to the park, and the neighborhood of Binghampton a neighboring community, with a population of 9,236. Of that population, 2,640 individuals lie below the population line, and 969 of those are disabled, as well. (U.S. Census, 2015) Mister Bridges goes on to say that fire would be beneficial to the health of the understory of the forest, allowing the resurgence of the naturally occurring vegetation currently suppressed by vines and invasive shrubbery species (Figure 4-6). (personal communication, January 10, 2017) Any prescribed fire, however, would have to be well planned, to include smoke management, to avoid impacting the zoo or at risk populations.

Figure 4 Understory and forest litter in Overton Park



Figure 5 Vines and invasive hedge in the understory



Figure 6 Vines and invasive hedge in the understory



The Wolf River Conservancy manages the Wolf River basin and is a land trust organization whose goal is protecting the watershed of the Wolf River and the natural ecology of the river basin. In the section of the Wolf River basin in Memphis, one area is of concern, known colloquially as the "Wolf River Bottoms," is a section frequented by off-road vehicle enthusiasts. Because the area is not a designated off-road vehicle area, the users are trespassing, according to Ryan Hall, certified forester and Land Protection Associate for the Wolf River Conservancy. Mister Hall compared the area to the "Wild-Wild-West," with unmaintained trails ridden to the point of being inaccessible and "Wolf River Bottoms" users cut new trails without planning. He reinforced the claim by suggesting law enforcement is either unwilling or unable to effectively police the areas and users frequently dump trash and light camp fires without regard to season or weather. Mister Hall, like Mr. Bridges, stated that prescribed burning in the area would not only aid in reclaiming some pasture areas interspersed through the hardwood forest and allow them to have vegetation more closely matching historical flora, as well as aiding in fuel reduction. (personal communication, January 10, 2017)

Regarding physical risk, over 80% of the area is in a moderate WUI impact zone. The burn probability is a 1 for 81.7% of the area, and 59.4% of the area is non-burnable. It must be noted, however, that the river and its flood zones, as well as a nearby interstate highway, account for much of that non-burnable area. The area has a fire intensity rating between 1 and 3.5, with most of the area inaccessible to engines or dozers. If a fire does ignite, approximately 40.7% of the area will be affected by a surface fire, but approximately 0.1% will be subject to passive canopy fire, or fire that ignites individual tree-tops, but not the entire canopy. Fires that enter the canopy are more likely to send embers further aloft than surface fires and lead to far-reaching

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spotting. (SWRAP, 2016) Because of the unregulated human activity in the area, it is reasonable to assume that human action is more likely to ignite a wildfire than anticipated in the SWRAP.

Shelby Farms, a 3,100 acre (12.55 km²) park developed from land used as a farm and ranch for a county correctional facility, is managed by the Shelby Farms Conservancy in partnership with Shelby County Government. (shelbyfarmspark.org, 2016) It consists of several lakes, large pastures, and sporadic forested areas. An evaluation of the park using SWRAP revealed a pocket of higher risk as compared to other pockets. The WUI impact risk is moderate for 85% of the land area, much like most of the city, and the burn probability is 3 or lower for all of the 5,700 acres of the land area in and surrounding the park.

What is unique is the pocket of unmanaged pine plantation within the park and its contribution to fire severity. While the SWRAP classifies much of Shelby Farms as unburnable because of bodies of water, roads, and parking areas, 1,988 acres (8.05 km²) is burnable. The anticipated flame spread rates are between 10 chains per hour (0.125 mph or 0.20 km/h) and 50 chains per hour (0.625 mph or 1.01 km/h). (SWRAP,2016) "Chains per hour" is the metric used by the NWCG in determining the rate of flame spread and fireline construction.

While several other groups have provided subject matter experts, the Shelby Farms Conservancy did not. Therefore, input from Shawn Posey, an urban forester with the Tennessee Department of Forestry could provide input. Mister Posey, whose office is adjacent to Shelby Farms, stated that much of the park is in need of fuel management. He stated particular concern for an old growth pine plantation area within the park. He indicated that in this plantation, it was entirely likely that a small fire would grow rapidly to one of a stand clearing capacity with crowning, or active canopy burning. (personal communication, January 25, 2017) Data from

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SWRAP indicated, however, that there were approximately 25 acres (0.10 km²) that were subject to passive canopy fire (2016).

An attempt to evaluate training and operational guidelines of the Memphis Fire Division was unsuccessful because those guidelines do not exist as it pertains to wildfires. Current response guidelines for the Memphis Fire Division call for a single, structural, engine company to respond to reports of any fire that does not involve a structure, to include what should be considered wildfire (natural or cultivated vegetation). (Memphis Fire Division, 2012, p. 1-84) Upon arrival, if needed, the first arriving officer may establish command and request additional resources. One commonly requested resource is a brush truck. These vehicles are commercially available pick-up trucks equipped with commercially available, wildland skid-units carrying 250 gallons of water; 200 feet of pre-connected, one-inch hose on a reel; and a gasoline-powered pump capable of pumping 140 gallons per minute. Each brush truck has a small selection of hand tools, including brooms, structural fire-axes, and shovels. Specialized wildland firefighting tools, such as Pulaski tools; fire rakes; extra hose for long, progressive hose deployments; and back-fire igniting instruments such as flares or torches are not carried (Figure 7-9).

Figure 7 Memphis Brush Truck Passenger's Side Inventory



Figure 8 Memphis Brush Truck Pump and Water Tank



Figure 9 Memphis Brush Truck Driver's Side Inventory



These brush trucks are only temporarily staffed as needed at the discretion of the officer in the fire station in which the brush truck resides. For example, an officer may send one firefighter with the brush truck, or the officer may deploy the brush truck with a crew of four by taking another response asset out of service. There is no qualification requirement to operate a brush truck as a driver (operator), or as an officer. Officers and drivers, however, are required to complete a qualification process on to operate engines, ladder trucks, and other specialized apparatus. (Memphis Fire Division, 2009)

To gauge the individual experience and attitude of Memphis firefighters overall, individuals answered questions about their particular attitudes toward wildfire and identified previously acquired training to mitigate wildfire in any environment. The results revealed that, apart from opinions about training adequacy and response guidelines, firefighters of all experience levels held opinions in similar proportions. Overall, Memphis firefighters feel they

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are inadequately trained, inadequately equipped, and inadequately dispatched to fires.

Firefighters with less than five years' experience were more likely to feel adequately trained and equipped but held similar opinions in other categories. Additionally, the results indicated that very few Memphis firefighters had formal training in wildfire mitigation, but many were interested and willing in gaining the training needed to meet NWCG standards.

There were 179 respondents to the email request for questionnaire participants. Of the respondents, 8.9% had less than five years' experience, 7.8% had 6-10 years' experience, 19.6% had 11-15 years' experience, and 63.7% had 16 years or more. When asked to identify conditions that met the definition of wildfire, 50.4% failed to recognize a grass fire as a wildfire event, 69.8% failed to recognize cultivated crops as a wildfire event, and 5.6% failed to recognize fire in forests or woodland areas as wildfire.

Most respondents (83.7%) expressed the willingness to deploy to other parts of the state or nation in the event of a major wildfire. There is a significant interest in obtaining the required training. When asked if willing to participate in FEMA crosswalk training to get wildfire certification, 87.7% said they would be prepared to complete the training to be considered a "deployable asset" for wildfire events in other regions of the state or nation. Similarly, 86.9% felt that the Memphis Fire Division should be willing and able to deploy wildfire firefighting teams to other parts of the state or nation.

When asked to identify whether they feel adequately trained or equipped to fight wildfire, respondents answered "no" 86.5% to both questions. When asked if current operating procedures were adequate, 81.3% indicated they were not. Most respondents, 78.5%, felt that a brush truck driver should complete a qualification process with minimum training standards like drivers of other fire apparatus. Of the 179 respondents, 5% have wildland firefighting training or

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experience that meets the standards and definitions of the NWCG for deployment as a wildland firefighter or to the norm established by NFPA 1051.

No risk assessment would be complete without addressing stakeholders affected by the risk. In this case, the stakeholders are the users of the public green spaces of Memphis and the taxpayers responsible for the costs involved in managing the green spaces. A questionnaire posted on various social media sites asked for completion by those from the Memphis area or who have ever frequented Memphis green spaces. There were 70 respondents, of which 27.5% frequently used the green spaces in Memphis, 39.1% occasionally frequented the green spaces, 26.1% rarely visited the green spaces, and 7.2% never used the green spaces.

Behavior leading to the accidental ignition of wildfire was infrequent, but not insignificant. Of the respondents, 13.0% admitted either igniting a campfire or using charcoal grills while visiting the green spaces and 2.9% admitted smoking while using the green spaces. When asked to quantify their confidence in the Memphis Fire Division to mitigate a major wildland fire in the WUI, 52.2% of the respondents estimated that the Fire Division would only be able to control a wildfire with the help of state and Federal resources. There were respondents, 23.2%, who felt that the Memphis Fire Division could handle any wildfire in the Memphis area without assistance from any agency. A similar number, 24.6%, felt that the Memphis Fire Division would have to abdicate authority to a state or Federal agency for successful mitigation of a major wildfire event.

Finally, respondents were allowed to express their willingness to use tax dollars and local resources. Many users of local green spaces felt that the Memphis Fire Division should be willing and able to send local firefighters and equipment to other parts of the state or nation to assist in controlling major wildfires in other jurisdictions. Those who use local green spaces

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more often were more likely, at 45.5%, to agree with sending Memphis firefighters to other jurisdictions under any circumstances. Those who enjoy the green spaces less frequently felt that Memphis firefighters should deploy to other regions to fight wildfire only if reimbursed by state or Federal agencies for any expenses incurred by the city. Only 5.9% of all respondents felt local resources should not aid firefighting efforts anywhere other than in Memphis.

After pointing out to respondents that acquiring wildfire training and equipment would incur additional costs to the taxpayer, respondents expressed their willingness to cover the expense. Of all those questioned, 44.9% stated that expenses related to improving wildfire preparedness should be covered, regardless of the funding source, because the urban forest areas of Memphis are critical resources that need to protection. Fewer, 30.4%, stated that increased expenses were tolerable if the state or Federal agencies helped to foot the bill and 11.6% would be comfortable only if funding came by making other budgetary cuts. Of all respondents, 13.0% felt that wildfires were too infrequent in Memphis to justify the capital investment needed for improving wildfire response capabilities.

Discussion

Replies from the various fire departments, provided in the form of both spreadsheets and email are in the appendix. It is important to note that difference in the information, or lack of information, provided could come from a list of causes, including different state requirements for logging data, various agency requirements for logging data, different software packages for logging data, and inattention by members responsible for logging data. One cannot ignore incomplete or inadequate data, however. As mentioned by Calkin et al., 3% of wildfires account for 97% of losses from 1992-2011, (2014, p. 748) therefore, years with under-reported incidents most likely have more significant losses than immediately visible. Figure 1 does illustrate the similar pattern in wildfire incidents followed in all reporting jurisdictions. Figure 2 shows an inverse correlation between rainfall and wildfire call volume. The visually apparent increase in wildfire incidents as precipitation decreases supports the commentary by Gabbart regarding the KDBI. (2016)

After reviewing the data in the light of normal weather patterns, it seems most Memphians live in an area that bears some risk to being affected by wildfire. It would be difficult to ignite a wildfire in most of the affected area, and once ignited, the fire would be of low to medium intensity and involve mostly ground cover. When considering Calkins et al., however, it becomes apparent that the low to moderate risk to most of the City of Memphis should not be relied upon to establish risk preparedness. Being able to mitigate wildfire in the WUI in Memphis depends upon being prepared to address the 3% of the fires that will cause 97% of the losses. Planners would experience difficulty predicting a loss regarding life and monetary value. The 17,000 acres (68.8 km²) burned, \$500 million in property damage, \$8.8 million in operational costs, and 14 lives lost during the Chimney Tops 2 fire were unlikely estimates of

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officials East Tennessee before November 2016. (Ahillen, 2016) Because none of the individually evaluated areas have specific forest management plans that address fuel reduction or prescribed fire for forest understory management, there is no effort to mitigate risk from increased fire severity, a higher rate of spread, or burn probability as forest litter and shrub understory accumulate.

Paul Flowers and David Fiorella both made other important points regarding wildfire risk. Mister Flowers commented that the City Parks Services Division did not currently have a forest management plan, to include any provision for fuel reduction in any of the city's greenspace. He did indicate that the employment of an urban forester was in planning by Park Services, but that the position would be part-time and primarily concerned with public information rather than forest management. (personal communication, December 29, 2016)

Mister Fiorella stated that the data from SWRAP often understated the actual risk from wildfire and should be used to establish a baseline risk rather than a worst-case scenario. He also stated that fire severity scales and the ability of well-trained and equipped crews to operate under the conditions described would be crews trained and equipped to NWCG standards. He was unable to estimate the effectiveness of municipal firefighters lacking wildland experience, tools, and operating in structural fire protective clothing. (personal communication, January 17, 2017)

One must also be willing to address the regular weather pattern changes as well as the rare weather pattern changes that cause severe drought conditions. Smith made it clear by explaining that trends in drought are difficult to define clearly, but fluctuate in cycles. He also stated that drought is likely to increase in the future based on global climate simulations. Smith suggests that there will be significantly increasing occurrences of wildfire in many parts of the United States. (2013)

To put the concept of flame spread and fire severity in the perspective of an urban firefighter using the worst-case scenario, a grass fire with a flame spread rate of 50 chains per hour, as is found in parts of Shelby Farms, would cover roughly ten football fields in an hour. A well-trained wildland engine crew of three firefighters can construct a fire line at a rate of 10 chains per hour (0.13 mph or 0.20 km/h). (NWCG, 2013) That rate of spread describes a fire front capable of out-pacing an engine crew by a factor of 5. A light dozer could flank the fire front at a rate of 90 chains per hour (1.13 mph or 1.81 km/h). (NWCG, 2013) Unfortunately, the delay experienced waiting for a wildfire capable dozer lacks reliable estimation. The SWRAP goes on to identify that as much as 894 acres of the park fall in the moderate to high range of the fire intensity scale which would require aviation assets, well-trained engine crews, and the necessity indirect attack through establishing containment zones. (2016)

Because there is no formal training for Memphis firefighters to respond to or mitigate a wildfire incident, it is a simple statement to say Memphis firefighters are ill prepared to fight a wildfire. Basic firefighting training conducted at the Fire Training Academy is per standards established by the Tennessee Commission on Firefighting (2016). Initial training of Memphis firefighters consists of 520 hours of didactic and field instruction. None of the training hours include any mention of wildland tactical, safety, or planning considerations. Current requirements of NFPA 1001 call for "combat[ing] a ground cover fire[s]" to demonstrate competency to the level of Firefighter I (, 2012). Additionally, there is no operating procedure or policy specifically addressing wildfire response; therefore there is no plan to mitigate wildfire from a response standpoint.

Memphis firefighters have, however, expressed an interest in being trained to meet at least the minimum standards expected of a basic wildland firefighter and some have expressed

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interest in training to the advanced level. They are eager to deploy to other regions to gain experience and aid other jurisdictions. They also recognize that their training and equipment is inadequate for operations in the WUI.

If assets do respond to a wildfire, of any severity or size, Memphis Fire Division personnel do not have personal protective equipment suitable for wildfire operations. Current personal protective equipment consists of structural firefighting turnout clothing. According to NFPA 1051, all job performance requirements must be completed in appropriate personal protective equipment (2016, p. 1051-23) and goes on to define appropriate personal protective equipment as that clothing designed for wildland firefighting per the 2016 edition of NFPA 1977. (p. 1051-8) Structural turnout gear increases the risk to firefighters during wildfire events because structural firefighting gear is designed to provide greater protection against high temperatures in a structural environment. Specifications for protective clothing call for the measure of its ability to release heat emitted by the firefighter to maintain effectiveness. The total heat loss value (THL) is heat released through the clothing and measured in Watts per square meter of fabric. (NFPA 1971, 2013, p. 1971-128) Structural turnouts have a value of not less than 205 W/m² (NFPA 1971, 2013, p. 1971-128) and wildland protective clothing has a THL of not less than 450 W/m². (NFPA 1977, 2016, p. 1977-68) Regarding comfort, a firefighter will not perceive increased heat in segments less than 20 W/m² (NFPA 1971, 2013, p. 1971-128), so firefighters working in structural turnouts will perceive retained heat that is almost double that of wildland protective clothing. It is not unreasonable to expect shortened work periods from individuals wearing structural protective equipment and significantly higher numbers of personnel needed to operate in the wildland environment.

The Fire Division brush trucks meet the minimum standards for Type 7 wildfire engines as specified by *Interagency Standards for Fire and Fire Aviation Operations* and are suitable for patrolling for spot fires during wildland events. These brush trucks lack the tools and equipment to be suitable for a direct attack against wildfire. Municipal fire engines, or Type 1 engines, also lack the equipment needed for a direct or indirect attack against a wildfire front. To be used effectively, equipment must be added to brush trucks as specified in Chapter 14 and Appendix M of *Interagency Standards for Fire and Fire Aviation Operations*. (2017, pp. 271-2711, appendix m1-m6)

The public also recognizes some risk from wildfire. Many believe that Memphis firefighters are ill-equipped to control a wildfire without aid from state and Federal resources. Those same citizens are willing to foot the bill to train and equip their firefighters to meet the challenges of wildfire. They are also willing to give aid to fellow Tennesseans and Americans when threatened by wildfire in other parts of the state or nation. The fact that some users of the parks and other green spaces admit to behavior that adds to fire risk, like smoking and igniting campfires and charcoal grills, makes it reasonable to view these two data points with suspicion because of off-road vehicle users of the Wolf "River Greenway Bottoms" access that land illegally.

Recommendations

First, the Memphis Fire Division should commit itself to leading the process of Memphis to become a Fire Adapted Community. It should follow the points established by the NWCG to negotiate that process. First, the Fire Division should work to develop a Community Wildfire Reduction Plan (CWRP). The CWRP should include fuel management plans for residents in the WUI as well as the urban forest areas within Memphis. Before any fuel reduction occurs, the process should be well planned with input from people living in the affected WUI are of any prescribed fire. The prescribed fire should be planned based on geographical information and WUI impact data with clear estimates of costs and the impact on air quality. (Winter et al., 2002)

Because the Memphis Fire Division lacks knowledge and experience in mitigating wildfire, the Fire Division should select an individual with job knowledge and expertise from outside sources to coordinate the process. That individual should seek out and foster relationships to form a development committee with the Memphis Division of Park Services, the Memphis Division of Police Services, the Wolf River Conservancy, the Overton Park Conservancy, the Shelby Farms Conservancy, the Tennessee Division of Forestry, and any other agency that shares in the responsibility for protecting the urban forest of Memphis. A wildfire in the WUI is a reasonably expected threat to business entities as well private individuals, and they deserve inclusion in any potential CWRP development. As the CWRP develops, the planning coordinator should work with planning partners to identify necessary code modifications to protect buildings in the WUI.

Once a CWRP coordinator begins the development process, basic wildland firefighter training should start for all Memphis firefighters following FEMA's *Skills Crosswalk: Wildland training for structural firefighters*. This training could adhere to the current supplemental

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training program provided by the Fire Division. Instructors from wildfire training agencies may be needed to initiate the training and provide current Memphis fire instructors with the knowledge, skills, and abilities required to continue the training for future employees. There already is funding available in the current Fire Division budget to pay the expense of the professional services of contractors and consultants. (City of Memphis, 2016, p. 160) Once the training program ends and all Memphis firefighters meet the Wildland Fire Fighter 2 standard, firefighters interested in advancing their training to the Wildland Fire Fighter 1 standard or higher could proceed with more advanced training as defined by the *skills crosswalk*.

During the training process, the CWRP development team must construct response guidelines, operating procedures, communication plans (for integration with state and Federal agencies), and safety consideration policies according to NWCG standards. The Fire Division should issue personal protective equipment specified by NFPA 1977 to all members and equip fire apparatus with inventories as specified in Chapter 14 and Appendix M of *Interagency Standards for Fire and Fire Aviation Operations*. This equipment should be added to current brush trucks to elevate them to at least the level of a Type 6 wildland engine. While this equipment procurement will be a significant cost, funding from other agencies and grant opportunities should be sought out. Concurrent to firefighter training and CWRP development, the Fire Division should seek out and enter a mutual aid agreement with the Tennessee Department of Forestry for wildland firefighting. This agreement, as seen in the appendix, will allow for more rapid deployment of wildland firefighting crews and dozers, and specialized wildland firefighting expertise in the event of a moderate to severe wildfire.

Lastly, the Fire Division should seek out residents living in the WUI to inform them of the real risks they face, no matter how moderate. Residents should be instructed, guided, and

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assisted to become fire adapted as specified by the NWCG. Predeveloped programs exist and are available from the International Association of Fire Chiefs, the National Fire Protection Association, the Tennessee Department of Forestry, and other groups and should be used to minimize costs.

It is now evident that wildfire is not a phenomenon unique to the Western part of the United States or areas that are predominately undeveloped. Wildfire events that normally considered "once in a lifetime" or "impossible" will cause financial and human losses of devastating proportions to residents, businesses, and the government. The risk of wildfire in the WUI requires mitigation while it is still in the pre-event stage to keep the cost of mitigation to the absolute minimum.

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Appendix A

Memphis Fire Division NFIRS

Total Outside Vegetation Fires

1 January, 2006 - 18 October, 2016

compiled by Buddy Cantrell, Fire Data Analyst

Note: NFIRS program management and training by Buddy Cantrell initiated in 2006

	Original Fire				First Exposure				Second Exposure				Annual Total			
	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss
2006	565	\$97,239,882	\$164,641	0.169	1	\$0	\$0						566	\$97,239,882	\$164,641	0.169
2007	545	\$3,798,022	\$658,206	17.330	3	\$75,000	\$2,300	3.067	1	\$800	\$800	100.000	549	\$3,873,822	\$661,306	17.071
2008	359	\$10,178,321	\$153,304	1.506	2	\$109,070	\$45	0.041					361	\$10,287,391	\$153,349	1.491
2009	457	\$17,425,620	\$19,507	0.112									457	\$17,425,620	\$19,507	0.112
2010	859	\$71,285,664	\$173,510	0.243	3	\$40,100	\$350	0.873					862	\$71,325,764	\$173,860	0.244
2011	635	\$788,271,724	\$2,315,227	0.294	2	\$43,700	\$12,000	27.460					637	\$788,315,424	\$2,327,227	0.295
2012	873	\$141,262,371	\$1,728,125	1.223	3	\$65,750	\$3,100	4.715	2	\$9,000	\$1,000	11.111	878	\$141,337,121	\$1,732,225	1.226
2013	449	\$22,250,722	\$1,089,394	4.896	1	\$547,300	\$60,000	10.963					450	\$22,798,022	\$1,149,394	5.042
2014	561	\$172,897,439	\$75,404	0.044	2	\$85,900	\$11,650	13.562	0	\$0	\$0		563	\$172,983,339	\$87,054	0.050
2015	447	\$9,663,984	\$23,396	0.242	1								448	\$9,663,984	\$23,396	0.242
2016	353	\$943,592	\$11,821	1.253									353	\$943,592	\$11,821	1.253
					18											
	6,103	\$1,335,217,341	\$6,412,535	0.480	18	\$966,820	\$89,445	9.251	3	\$9,800	\$1,800	18.367	6,124	\$1,336,193,961	\$6,503,780	0.487

140 Series Incident Types

Natural Vegetation

	Original Fire				First Exposure				Second Exposure				Annual Total			
	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss
2000	9	\$0	\$18,200		1	\$0	\$0						10	\$0	\$18,200	
2001	18	\$0	\$11,000		2	\$0	\$1,700						20	\$0	\$12,700	
2002	9	\$0	\$22,300		1	\$0	\$500						10	\$0	\$22,800	
2003	20	\$0	\$15,800		1	\$0	\$1,000						21	\$0	\$16,800	
2004	14	\$2,000,000,100	\$2,000,009,000										14	\$2,000,000,100	\$2,000,009,000	
2005	29	\$11,000,340,234	\$11,000,000,434										29	\$11,000,340,234	\$11,000,000,434	
2006	564	\$97,239,882	\$164,641	0.169	1	\$0	\$0						565	\$97,239,882	\$164,641	0.169
2007	540	\$2,756,922	\$157,206	5.702	3	\$75,000	\$2,300	3.067	1	\$800	\$800	100.000	544	\$2,832,722	\$160,306	5.659
2008	357	\$10,177,821	\$152,804	1.501	2	\$109,070	\$45	0.041					359	\$10,286,891	\$152,849	1.486
2009	451	\$16,425,320	\$17,507	0.107									451	\$16,425,320	\$17,507	0.107
2010	854	\$71,077,164	\$47,310	0.067	3	\$40,100	\$350	0.873					857	\$71,117,264	\$47,660	0.067
2011	632	\$785,214,223	\$1,279,717	0.163	2	\$43,700	\$12,000	27.460					634	\$785,257,923	\$1,291,717	0.164
2012	865	\$138,540,471	\$351,125	0.253	3	\$65,750	\$3,100	4.715	2	\$9,000	\$1,000	11.111	870	\$138,615,221	\$355,225	0.256
2013	440	\$11,632,022	\$58,694	0.505	1	\$547,300	\$60,000	10.963					441	\$12,179,322	\$118,694	0.975
2014	557	\$172,834,439	\$62,904	0.036	2	\$85,900	\$11,650	13.562	0	\$0	\$0		559	\$172,720,339	\$74,554	0.043
2015	440	\$7,393,984	\$17,296	0.234	1								441	\$7,393,984	\$17,296	0.234
2016	348	\$943,592	\$11,771	1.247									348	\$943,592	\$11,771	1.247
	6,048	\$1,314,035,840	\$2,320,975	0.177	18	\$966,820	\$89,445	9.251	3	\$9,800	\$1,800	18.367	6,069	\$1,315,012,460	\$2,412,220	0.183
	6,147	\$14,314,376,174	\$13,002,397,709		23	\$966,820	\$92,645		3	\$9,800	\$1,800		6,173	\$14,315,352,794	\$13,002,492,154	

170 Series Incident Types

Cultivated Vegetation

	Original Fire				First Exposure				Second Exposure				Annual Total			
	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss	Number	Total Value	Total Loss	Percent Loss
1900					16	\$101,200	\$0		1	\$600	\$0		17	\$101,800	\$0	
2000	44	\$135,300	\$0										44	\$135,300	\$0	
2001	61	\$109,300	\$0										61	\$109,300	\$0	
2002	49	\$412,100	\$0										49	\$412,100	\$0	
2003	70	\$226,500	\$0										70	\$226,500	\$0	
2004	41	\$134,300	\$0										41	\$134,300	\$0	
2005																
2006	1	\$0	\$0										1	\$0	\$0	
2007	5	\$1,041,100	\$501,000	48.122									5	\$1,041,100	\$501,000	48.122
2008	2	\$500	\$500	100.000									2	\$500	\$500	100.000
2009	6	\$1,000,300	\$2,000	0.200									6	\$1,000,300	\$2,000	0.200
2010	5	\$208,500	\$126,200	60.528									5	\$208,500	\$126,200	60.528
2011	3	\$3,057,501	\$1,035,510	33.868									3	\$3,057,501	\$1,035,510	33.868
2012	8	\$2,721,900	\$1,377,000	50.590									8	\$2,721,900	\$1,377,000	50.590
2013	9	\$10,618,700	\$1,030,700	9.706									9	\$10,618,700	\$1,030,700	9.706
2014	4	\$263,000	\$12,500	4.753	0	\$0	\$0		0	\$0	\$0		4	\$263,000	\$12,500	4.753
2015	7	\$2,270,000	\$6,100	0.269									7	\$2,270,000	\$6,100	0.269
2016	5		\$50										5		\$50	
	55	\$21,181,501	\$4,091,560	19.317	0	\$0	\$0		0	\$0	\$0		55	\$21,181,501	\$4,091,560	19.317
	320	\$22,199,001	\$4,091,560		16	\$101,200	\$0		1	\$600	\$0		337	\$22,300,801	\$4,091,560	

Olive Branch Fire Department

From January 1, 2006 to October 18, 2016 we ran a total of 537 wild land fires that resulted in approximately 950 acres burned with a total loss of \$46, 408.00. If you need any further please let me know.							
2016---33							
2015---40							
2014---45							
2013---35							
2012---60							
2011---49							
2010---63							
2009---35							
2008---44							
2007---63							
2006---71							

An evaluation of the risk from wildfire in Memphis, TN

Shelby County Fire Department

FD_Name Shelby County Fire Dept
 TypeGroup (Multiple Items)

Year	IN_Type	TypeClass	Values		
			Fires	Acres Burned	Property Loss
2006	140	Natural vegetation fire, other	342		
2006 Total			342		
2007	140	Natural vegetation fire, other	173		\$0
	141	Forest, woods or wildland fire	7	15	\$0
	142	Brush, or brush and grass mixture fire	43	22	\$0
	143	Grass fire	42	77	\$0
	170	Cultivated vegetation, crop fire, other	2	5	\$1,500
	171	Cultivated grain or crop fire	2	6	\$0
	173	Cultivated trees or nursery stock fire	1		\$0
2007 Total			270	125	\$1,500
2008	140	Natural vegetation fire, other	3		\$0
	141	Forest, woods or wildland fire	2		\$0
	142	Brush, or brush and grass mixture fire	54	31	\$0
	143	Grass fire	84	24	\$0
2008 Total			143	55	\$0
2009	141	Forest, woods or wildland fire	5		\$0
	142	Brush, or brush and grass mixture fire	55	39	\$0
	143	Grass fire	109	12	\$0
	171	Cultivated grain or crop fire	2	4	\$0
2009 Total			171	55	\$0
2010	140	Natural vegetation fire, other	1		\$0
	141	Forest, woods or wildland fire	4	10	\$0
	142	Brush, or brush and grass mixture fire	67	27	\$0
	143	Grass fire	138	35	\$300
	171	Cultivated grain or crop fire	1	2	\$0
2010 Total			211	74	\$300
2011	141	Forest, woods or wildland fire	8	123	\$0
	142	Brush, or brush and grass mixture fire	50	29	\$0
	143	Grass fire	111	81	\$0

An evaluation of the risk from wildfire in Memphis, TN

FD_Name Shelby County Fire Dept
 TypeGroup (Multiple Items)

Year	IN_Type	TypeClass	Values		
			Fires	Acres Burned	Property Loss
2011	171	Cultivated grain or crop fire	3		\$0
	173	Cultivated trees or nursery stock fire	1		\$0
2011 Total			173	233	\$0
2012	140	Natural vegetation fire, other	1		\$0
	141	Forest, woods or wildland fire	8	31	\$0
	142	Brush, or brush and grass mixture fire	58	10	\$0
	143	Grass fire	119	11	\$0
	171	Cultivated grain or crop fire	2	56	\$0
	173	Cultivated trees or nursery stock fire	1		\$0
2012 Total			189	108	\$0
2013	141	Forest, woods or wildland fire	1		\$0
	142	Brush, or brush and grass mixture fire	25	6	\$0
	143	Grass fire	58		\$0
	170	Cultivated vegetation, crop fire, other	1		\$0
2013 Total			85	6	\$0
2014	141	Forest, woods or wildland fire	3		\$0
	142	Brush, or brush and grass mixture fire	54	18	\$0
	143	Grass fire	112	78	\$1,500
	171	Cultivated grain or crop fire	1		\$0
	173	Cultivated trees or nursery stock fire	1		\$0
2014 Total			171	96	\$1,500
2015	140	Natural vegetation fire, other	1		\$0
	141	Forest, woods or wildland fire	1		\$0
	142	Brush, or brush and grass mixture fire	48	12	\$0
	143	Grass fire	82	14	\$0
	171	Cultivated grain or crop fire	2		\$0
2015 Total			134	26	\$0
Grand Total			1,889	778	\$3,300

Southaven Fire Department



Entries contained in this report are intended for the sole use of the [redacted] Estimates and evaluations made herein represent "most likely" and "most probable" cause and effect. Therefore, any representation as to the validity or accuracy of reported conditions outside the [redacted] is neither intended nor implied.

Incident Reports By Incident Type

Incident Type: 140 Natural vegetation fire, other

Incident #	Exp #	Date	Time
801408	0	8/6/2008	3:59:00PM
900270	0	2/9/2009	4:11:00PM
900513	0	3/19/2009	9:17:00PM
900841	0	5/16/2009	8:22:00PM
901408	0	8/29/2009	1:21:00AM
1000388	0	3/14/2010	12:23:00AM
1000411	0	3/20/2010	12:40:00PM
1000615	0	4/22/2010	8:43:00AM
1000620	0	4/23/2010	10:31:00AM
1001444	0	9/13/2010	4:00:00PM
1001741	0	10/22/2010	6:32:00PM
1001797	0	10/31/2010	4:54:00PM
1002034	0	12/10/2010	1:00:00PM
1100935	0	6/11/2011	12:22:00AM
1101337	0	8/27/2011	1:35:00AM
1200331	0	3/2/2012	10:22:00AM
1200336	0	3/2/2012	4:47:00PM
1200343	0	3/3/2012	3:50:00PM
1200982	0	7/4/2012	10:50:00AM
1201304	0	8/22/2012	12:00:00AM
1201307	0	8/22/2012	4:35:00PM
1500374	0	2/12/2015	1:58:00PM
1501013	0	5/3/2015	5:03:00PM
1501782	0	8/2/2015	8:14:00AM
1502792	0	11/26/2015	10:09:00AM
1502929	1	12/11/2015	4:02:00PM
1502965	0	12/15/2015	4:19:00PM
1502993	0	12/18/2015	3:40:00PM
1600741	0	3/23/2016	5:05:00PM
1600944	0	4/14/2016	3:41:00PM

Total Incidents: 30

Incident Reports By Incident Type

Incident Type: 141 Forest, woods or wildland fire

Incident #	Exp #	Date	Time
802023	0	11/27/2008	1:24:00PM
901093	0	7/2/2009	6:00:00PM
1000064	0	1/11/2010	12:16:00PM
1002102	0	12/20/2010	9:28:00PM
1101183	0	7/28/2011	4:44:00PM
1101184	0	7/28/2011	6:29:00PM
1202037	0	12/14/2012	2:24:00PM
1401660	1	8/8/2014	2:54:00PM

Total Incidents: 8

Incident Reports By Incident Type

Incident Type: 142 Brush, or brush and grass mixture fire			
Incident #	Exp #	Date	Time
90008	0	1/1/2009	5:02:00PM
800873	0	5/12/2008	8:29:00PM
801104	0	6/18/2008	1:57:00PM
801317	0	7/24/2008	2:02:00AM
801319	0	7/24/2008	7:32:00AM
900115	0	1/19/2009	2:10:00PM
900145	0	1/24/2009	11:56:00AM
900162	0	1/26/2009	4:25:00PM
901378	0	8/23/2009	5:23:00PM
901427	0	9/1/2009	9:42:00PM
901922	0	12/4/2009	2:47:00PM
902074	0	12/28/2009	9:08:00PM
1000308	0	2/27/2010	4:54:00PM
1000447	0	3/27/2010	6:27:00PM
1000911	0	6/12/2010	10:45:00PM
1001038	0	7/4/2010	7:26:00PM
1001040	0	7/4/2010	8:10:00PM
1001104	0	7/14/2010	4:25:00PM
1001367	0	8/31/2010	5:24:00PM
1001556	0	9/29/2010	10:19:00AM
1001563	0	9/30/2010	8:01:00PM
1001589	0	10/3/2010	6:11:00PM
1001670	0	10/14/2010	4:41:00PM
1001671	0	10/14/2010	5:48:00PM
1001795	0	10/31/2010	3:33:00PM
1002099	0	12/20/2010	8:06:00PM
1100177	0	1/30/2011	4:11:00PM
1100185	0	1/31/2011	12:44:00PM
1100312	0	2/22/2011	12:46:00PM
1100646	0	4/17/2011	10:15:00AM
1100768	0	5/8/2011	2:14:00PM
1100909	0	6/6/2011	12:21:00PM
1100916	0	6/8/2011	5:42:00PM
1100954	0	6/13/2011	1:54:00PM
1101027	0	6/28/2011	5:34:00AM
1101098	0	7/11/2011	7:37:00PM
1101109	0	7/13/2011	5:34:00PM
1101223	0	8/5/2011	11:17:00AM
1101470	0	9/17/2011	7:43:00PM
1101471	0	9/17/2011	8:01:00PM
1101675	0	10/25/2011	12:53:00PM
1101676	0	10/25/2011	2:24:00PM
1101745	0	11/3/2011	6:02:00PM
1101809	0	11/13/2011	3:29:11PM
1101816	0	11/14/2011	7:35:00PM
1102073	0	12/31/2011	6:38:00PM
1200362	0	3/6/2012	4:26:00PM
1200363	0	3/6/2012	4:42:00PM
1200375	0	3/7/2012	12:56:00PM

Incident Reports By Incident Type

1200447	0	3/20/2012	2:00:00PM
1200639	0	4/29/2012	3:57:00PM
1200749	0	5/24/2012	2:56:00PM
1200915	0	6/23/2012	12:02:00PM
1200998	0	7/5/2012	3:52:00PM
1201003	0	7/5/2012	9:06:00PM
1201006	0	7/6/2012	2:51:01AM
1201290	0	8/19/2012	10:24:00AM
1201308	0	8/22/2012	11:00:00AM
1201430	0	9/11/2012	4:55:00PM
1201654	0	10/19/2012	9:27:00AM
1201700	0	10/25/2012	5:07:00PM
1202028	0	12/12/2012	1:55:00PM
1300746	0	4/14/2013	1:46:00PM
1301045	0	5/29/2013	2:47:00PM
1301742	0	9/7/2013	10:14:00PM
1302054	0	10/29/2013	9:36:00PM
1302135	0	11/10/2013	2:01:00PM
1302298	0	12/1/2013	9:36:56PM
1302318	0	12/3/2013	9:55:00PM
1400179	0	1/20/2014	4:38:00PM
1400193	0	1/22/2014	5:07:00PM
1400430	0	2/22/2014	4:03:00PM
1400581	0	3/10/2014	10:36:00PM
1400607	0	3/14/2014	11:12:00AM
1400613	0	3/14/2014	3:36:23PM
1401019	0	5/6/2014	1:44:00PM
1401032	0	5/8/2014	4:00:00PM
1401271	0	6/13/2014	11:03:00PM
1402545	0	12/9/2014	2:06:00PM
1402563	0	12/12/2014	8:49:00PM
1500617	1	3/16/2015	4:47:00PM
1500850	1	4/12/2015	4:40:00PM
1501059	0	5/7/2015	12:49:00PM
1501415	0	6/16/2015	6:02:00PM
1502174	0	9/15/2015	7:13:00PM
1502496	0	10/22/2015	1:32:00PM
1502687	0	11/13/2015	1:36:00PM
1502793	0	11/26/2015	10:48:00AM
1502850	0	12/2/2015	4:42:00PM
1600258	0	2/2/2016	5:51:23AM
1600596	0	3/8/2016	6:26:00PM
1601447	0	6/7/2016	10:44:00AM
1601643	0	6/23/2016	4:46:00PM
1601749	0	7/4/2016	11:41:00AM
1601893	0	7/17/2016	6:43:00PM
1602501	0	9/15/2016	12:01:00AM
1602655	0	9/28/2016	7:27:00PM
1602656	0	9/28/2016	7:40:00PM
1602690	0	10/2/2016	12:53:00AM
			Total Incidents: 99

Incident Reports By Incident Type

Incident Type: 143 Grass fire

Incident #	Exp #	Date	Time
90005	0	1/1/2009	11:24:00AM
90007	0	1/1/2009	1:27:00PM
801115	0	6/19/2008	5:51:00PM
801187	0	7/3/2008	8:50:00PM
801195	0	7/4/2008	7:08:00PM
801201	0	7/5/2008	2:29:00AM
801389	0	8/4/2008	8:51:00AM
801419	0	8/8/2008	5:37:00PM
801697	0	9/28/2008	4:59:00PM
801723	0	10/2/2008	6:59:00PM
801813	0	10/19/2008	3:50:00PM
801919	0	11/8/2008	10:42:00AM
802028	0	11/28/2008	1:54:00PM
802219	0	12/30/2008	11:44:00AM
802222	0	12/30/2008	1:44:00PM
900090	0	1/14/2009	5:17:00PM
900101	0	1/15/2009	9:42:00PM
900187	0	1/31/2009	10:18:00AM
900242	0	2/5/2009	4:38:00PM
900243	0	2/5/2009	5:03:00PM
900247	0	2/6/2009	12:29:00PM
900252	0	2/6/2009	5:21:00PM
900258	0	2/7/2009	3:02:00PM
900263	0	2/8/2009	3:09:00AM
900265	0	2/8/2009	3:00:00PM
900267	0	2/9/2009	9:04:00AM
900282	0	2/11/2009	6:23:00PM
900311	0	2/14/2009	2:58:00PM
900314	0	2/15/2009	2:08:00AM
900317	0	2/15/2009	1:31:00PM
900322	0	2/16/2009	4:19:00PM
900339	0	2/18/2009	7:47:00PM
900352	0	2/20/2009	4:42:00PM
900377	0	2/24/2009	5:29:00PM
900504	0	3/17/2009	11:24:00AM
900527	0	3/22/2009	12:57:00PM
900594	0	4/1/2009	7:51:00PM
901084	0	6/30/2009	9:08:00PM
901101	0	7/4/2009	7:13:00PM
901102	0	7/4/2009	8:57:00PM
901103	0	7/4/2009	9:48:00PM
901105	0	7/4/2009	10:38:00PM
902024	0	12/21/2009	3:03:00PM
902034	0	12/23/2009	2:58:00AM
902055	0	12/26/2009	12:31:00PM
1000008	0	1/4/2010	10:14:00AM
1000157	0	1/28/2010	5:21:00PM
1000234	0	2/12/2010	3:53:00PM
1000264	0	2/18/2010	3:24:00PM

Incident Reports By Incident Type

1000316	0	2/28/2010	8:47:00PM
1000346	0	3/6/2010	6:02:00PM
1000356	0	3/8/2010	12:56:00PM
1000405	0	3/19/2010	6:38:00PM
1000413	0	3/20/2010	3:24:00PM
1000458	0	3/31/2010	6:42:00PM
1000473	0	4/2/2010	4:11:00PM
1000478	0	4/2/2010	7:54:00PM
1000544	0	4/12/2010	3:45:00PM
1000562	0	4/14/2010	11:54:00AM
1000611	0	4/21/2010	3:01:00PM
1001036	0	7/4/2010	12:02:00AM
1001039	0	7/4/2010	7:35:00PM
1001048	0	7/5/2010	5:46:00PM
1001053	0	7/7/2010	10:21:00AM
1001060	0	7/8/2010	1:45:00AM
1001451	0	9/14/2010	2:07:00PM
1001558	0	9/29/2010	10:08:00PM
1001574	0	10/1/2010	3:53:00PM
1001613	0	10/6/2010	4:34:00PM
1001622	0	10/7/2010	6:47:00PM
1001650	0	10/12/2010	9:36:00AM
1001662	0	10/13/2010	9:20:00PM
1001682	0	10/15/2010	4:55:00PM
1001683	0	10/15/2010	5:30:00PM
1001696	0	10/17/2010	9:06:00PM
1001742	0	10/22/2010	9:22:00PM
1002057	0	12/14/2010	11:34:00AM
1002137	0	12/26/2010	8:52:00PM
1100167	0	1/29/2011	11:02:00AM
1100221	0	2/6/2011	2:15:00PM
1100259	0	2/13/2011	12:51:00PM
1100260	0	2/13/2011	6:50:00PM
1100572	0	4/5/2011	11:35:00AM
1100925	0	6/9/2011	3:15:00PM
1100942	0	6/11/2011	4:28:00PM
1100959	0	6/15/2011	1:38:00AM
1100996	0	6/19/2011	7:26:00PM
1101015	0	6/25/2011	11:36:00AM
1101053	0	7/3/2011	4:33:01PM
1101060	0	7/4/2011	7:16:00PM
1101300	0	8/20/2011	4:56:00PM
1101371	0	8/31/2011	3:46:00PM
1101430	0	9/11/2011	6:50:00PM
1101435	0	9/12/2011	9:22:00AM
1101498	0	9/22/2011	4:44:00PM
1101519	0	9/27/2011	2:48:00PM
1101537	0	10/1/2011	3:04:00AM
1101586	0	10/9/2011	2:44:00PM
1101589	0	10/9/2011	6:44:00PM
1101662	0	10/22/2011	4:05:00PM

Incident Reports By Incident Type

1101797	0	11/11/2011	10:21:00PM
1101803	0	11/12/2011	4:15:00PM
1101840	0	11/19/2011	2:41:00PM
1101907	0	12/3/2011	6:46:00PM
1102067	0	12/31/2011	4:18:00PM
1102071	0	12/31/2011	6:17:00PM
1102076	0	12/31/2011	8:22:00PM
1102078	0	12/31/2011	8:40:00PM
1102079	0	12/31/2011	8:53:00PM
1102080	0	12/31/2011	9:14:00PM
1102083	0	12/31/2011	10:49:00PM
1200009	0	1/1/2012	1:12:00PM
1200010	0	1/1/2012	1:18:00PM
1200011	0	1/1/2012	6:36:00PM
1200012	0	1/1/2012	8:40:00PM
1200013	0	1/1/2012	9:09:00PM
1200037	0	1/7/2012	6:32:00PM
1200256	0	2/18/2012	2:05:00PM
1200291	0	2/24/2012	7:50:00AM
1200361	0	3/6/2012	2:47:00PM
1200366	0	3/6/2012	2:47:00PM
1200367	0	3/6/2012	2:47:00PM
1200368	0	3/6/2012	2:47:00PM
1200369	0	3/6/2012	2:47:00PM
1200377	0	3/7/2012	2:18:00PM
1200378	0	3/7/2012	2:21:00PM
1200488	0	3/28/2012	6:43:00PM
1200569	0	4/15/2012	4:17:00PM
1200647	0	4/30/2012	8:43:00AM
1200727	0	5/20/2012	3:00:00PM
1200774	0	5/30/2012	11:23:00AM
1200810	0	6/6/2012	11:01:00AM
1200878	0	6/18/2012	3:21:00PM
1200918	0	6/23/2012	4:02:00PM
1200942	0	6/27/2012	12:45:00PM
1200954	0	6/29/2012	5:06:00PM
1200977	0	7/3/2012	6:27:00PM
1200991	0	7/4/2012	10:20:00PM
1201008	0	7/6/2012	10:58:00AM
1201122	0	7/26/2012	3:59:00PM
1201171	0	8/3/2012	2:28:00AM
1201242	0	8/11/2012	5:03:00AM
1201305	0	8/22/2012	2:02:00PM
1201309	0	8/22/2012	2:07:00PM
1201310	0	8/22/2012	2:18:00PM
1201311	0	8/22/2012	7:30:00PM
1201323	0	8/25/2012	1:08:00AM
1201496	0	9/23/2012	5:46:00PM
1201646	0	10/18/2012	2:04:00PM
1201647	0	10/18/2012	3:02:00PM
1201897	0	11/23/2012	3:06:00PM

Incident Reports By Incident Type

1201962	0	12/4/2012 9:44:00AM
1201988	0	12/7/2012 12:38:00PM
1202022	0	12/11/2012 7:05:00PM
1300057	0	1/7/2013 10:55:00AM
1300058	0	1/7/2013 11:14:00AM
1300174	0	1/20/2013 1:36:00PM
1300344	0	2/11/2013 2:51:00PM
1300462	0	3/4/2013 3:51:00PM
1300463	0	3/4/2013 4:01:00PM
1300614	0	3/27/2013 4:02:00PM
1301487	0	8/3/2013 2:32:00PM
1301647	0	8/23/2013 5:43:00PM
1301779	0	9/14/2013 3:06:00PM
1301802	0	9/16/2013 11:28:00AM
1301820	0	9/19/2013 4:41:00PM
1301821	0	9/19/2013 4:49:00PM
1302203	0	11/19/2013 1:27:00PM
1302205	0	11/19/2013 4:42:00PM
1302295	0	12/1/2013 2:37:00PM
1302372	0	12/11/2013 1:21:00PM
1302414	0	12/18/2013 4:14:00PM
1302481	0	12/26/2013 12:13:00PM
1400014	0	1/2/2014 3:57:00PM
1400167	0	1/18/2014 6:40:00PM
1400185	0	1/21/2014 2:29:00PM
1400217	0	1/25/2014 9:35:00AM
1400226	0	1/26/2014 1:21:00PM
1400228	0	1/26/2014 6:07:00PM
1400265	0	1/30/2014 6:26:00PM
1400385	0	2/16/2014 12:55:00PM
1400421	0	2/21/2014 3:27:15PM
1400447	0	2/24/2014 12:51:00PM
1400467	0	2/26/2014 3:02:00PM
1400482	0	2/26/2014 3:02:00PM
1400483	0	2/26/2014 3:02:00PM
1400484	0	2/26/2014 3:02:00PM
1400485	0	2/26/2014 3:02:00PM
1400486	0	2/28/2014 11:28:00AM
1400489	0	2/28/2014 11:28:08AM
1400577	0	3/10/2014 1:07:00PM
1400578	0	3/10/2014 1:49:00PM
1400592	0	3/12/2014 4:13:00PM
1400604	0	3/13/2014 6:15:00PM
1400680	0	3/23/2014 5:13:00PM
1400695	0	3/25/2014 11:09:00AM
1400703	0	3/26/2014 1:14:00PM
1400782	0	4/3/2014 4:37:00PM
1400871	0	4/17/2014 5:39:57PM
1400920	0	4/24/2014 3:40:00PM
1400921	0	4/24/2014 4:30:00PM
1400985	0	5/2/2014 11:32:00AM

Incident Reports by Incident Type

1401058	0	5/12/2014	12:38:00PM
1401130	0	5/23/2014	7:24:00PM
1401463	0	7/11/2014	11:30:00AM
1401600	0	7/31/2014	5:27:00PM
1401738	0	8/18/2014	7:48:00PM
1402093	0	10/7/2014	11:04:00AM
1402455	0	11/26/2014	5:10:00PM
1402636	0	12/22/2014	12:33:00PM
1402694	0	12/31/2014	2:56:00PM
1500159	0	1/18/2015	3:48:00PM
1500163	0	1/18/2015	4:15:00PM
1500391	0	2/14/2015	2:10:00PM
1500392	0	2/14/2015	2:25:00PM
1500698	0	3/25/2015	5:15:22PM
1500814	0	4/8/2015	3:22:00PM
1500848	0	4/12/2015	10:51:00AM
1500992	1	4/30/2015	4:17:00PM
1501036	0	5/5/2015	12:03:00PM
1501895	0	8/14/2015	2:45:00PM
1502029	0	8/28/2015	1:34:00PM
1502192	0	9/18/2015	1:24:00PM
1502374	0	10/11/2015	2:16:00PM
1502440	0	10/17/2015	7:56:00AM
1502444	0	10/17/2015	1:36:00PM
1502453	0	10/18/2015	3:36:01PM
1502605	0	11/4/2015	1:21:00PM
1502640	0	11/8/2015	3:00:00PM
1502997	0	12/19/2015	10:02:00AM
1600023	0	1/3/2016	4:56:00PM
1600199	0	1/25/2016	1:40:00PM
1600233	0	1/30/2016	1:22:00PM
1600235	0	1/30/2016	3:17:00PM
1600236	0	1/30/2016	4:00:00PM
1600241	0	1/31/2016	12:04:00PM
1600247	0	1/31/2016	5:18:00PM
1600497	0	2/27/2016	12:50:00PM
1600507	0	2/28/2016	3:00:00PM
1600508	0	2/28/2016	4:04:00PM
1600761	0	3/25/2016	12:04:00PM
1600763	0	3/25/2016	2:24:00PM
1600776	0	3/26/2016	4:33:00PM
1600796	0	3/28/2016	5:07:00PM
1600884	0	4/7/2016	10:03:00PM
1601016	0	4/22/2016	2:23:00PM
1601164	0	5/8/2016	5:06:00PM
1601644	0	6/23/2016	6:50:00PM
1601732	0	7/2/2016	6:40:00PM
1601739	0	7/2/2016	11:20:43PM
1601760	0	7/5/2016	2:41:00PM
1601821	0	7/9/2016	4:12:00PM
1602123	0	8/8/2016	8:11:00AM

Incident Reports By Incident Type

1602554	0	9/19/2016	4:43:13PM
1602556	0	9/19/2016	6:12:00PM
1602711	0	10/3/2016	7:40:00AM
1602775	0	10/8/2016	11:39:00PM
			Total Incidents: 257

Appendix B

Assessment of Memphis Firefighters: Attitudes Toward Wildfire

This survey is to aid in the completion of applied research for the National Fire Academy. It is intended to gauge the existing attitudes, knowledge, skills, and abilities towards wildfire. It consists of ten questions and should take no more than five minutes.

1. How long have you been employed by the Memphis Fire Division?

- 1-5 years
- 6-10 years
- 11-15 years
- 16 or more years

2. How do you personally define wildfire? (Choose all that apply)

- Grass fires in undeveloped areas
- Woodland or forest fires
- Fires involving cultivated crops

3. Do you feel you are adequately trained to fight wildfires?

- Yes
- No

An evaluation of the risk from wildfire in Memphis, TN

4. Do you feel you are properly equipped to fight wildfires?

Yes

No

5. Do you feel that “Brush Truck Driver” should require the completion of a qualification packet to fill that position?

Yes

No

6. Do you feel that current response guidelines and operating procedures for response to wildfire are adequate?

Yes

No

7. Do you feel that the Memphis Fire Division should be willing and able to send firefighters to other parts of the state or country to assist with wildfire events?

Yes

No

8. Would you be willing to deploy to other parts of the state or country as part of a wildland firefighting team?

An evaluation of the risk from wildfire in Memphis, TN

Yes

No

9. Have you ever had, or do you currently have, any wildland firefighter position certifications as defined by the National Incident Management System: Wildland Fire Qualification System Guide? (NFPA structural firefighter qualifications do not meet qualification requirements without additional training)

Yes

No

10. The United States Fire Administration administers a “crosswalk” program that would allow structural firefighter certifications to be used toward wildfire qualifications. This program requires additional training, meeting minimum standards for physical fitness, and the completion of a qualification packet (task book). Would you be willing to complete this process as a prerequisite for being deployable as a wildland firefighter?

Yes

No

Attitudes and Abilities of Memphis Fire Fighters Regarding Wildfire						
1. How long have you been employed by the Memphis Fire Division?						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
1-5 years	16	0	0	0	8.9%	16
6-10 years	0	14	0	0	7.8%	14
11-15 years	0	0	35	0	19.6%	35
16 or more years	0	0	0	114	63.7%	114
<i>answered question</i>						179
<i>skipped question</i>						0
2. How do you personally define wildfire? (Choose all that apply)						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Grass fires in undeveloped areas	9	7	12	56	46.9%	84

An evaluation of the risk from wildfire in Memphis, TN

Woodland or forest fires	16	13	33	107	94.4%	169
Fires involving cultivated crops	7	5	6	36	30.2%	54
<i>answered question</i>						179
<i>skipped question</i>						0
3. Do you feel you are adequately trained to fight wildfires?						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	4	3	3	13	13.5%	23
No	12	11	31	94	86.5%	148
<i>answered question</i>						171
<i>skipped question</i>						8
4. Do you feel you are properly equipped to fight wildfires?						
	How long have you been employed by the Memphis Fire Division?					

An evaluation of the risk from wildfire in Memphis, TN

Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	7	4	3	10	13.5%	24
No	9	10	32	103	86.5%	154
<i>answered question</i>						178
<i>skipped question</i>						1
5. Do you feel that “Brush Truck Driver” should require the completion of a qualification packet to fill that position?						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	13	11	29	86	78.5%	139
No	3	3	6	26	21.5%	38
<i>answered question</i>						177
<i>skipped question</i>						2
6. Do you feel that current response guidelines and operating procedures for response to wildfire are adequate?						

An evaluation of the risk from wildfire in Memphis, TN

	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	7	3	9	14	18.8%	33
No	9	10	26	98	81.3%	143
<i>answered question</i>						176
<i>skipped question</i>						3
7. Do you feel that the Memphis Fire Division should be willing and able to send firefighters to other parts of the state or country to assist with wildfire events?						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	15	12	30	96	86.9%	153
No	1	1	5	16	13.1%	23
<i>answered question</i>						176
<i>skipped question</i>						3

8. Would you be willing to deploy to other parts of the state or country as part of a wildland firefighting team?						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	15	13	31	90	83.7%	149
No	1	1	4	23	16.3%	29
<i>answered question</i>						178
<i>skipped question</i>						1
9. Have you ever had, or do you currently have, any wildland firefighter position certifications as defined by the National Incident Management System: Wildland Fire Qualification System Guide? (NFPA structural firefighter qualifications do not meet qualification requirements without additional training)						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	1	2	2	4	5.0%	9
No	15	12	33	110	95.0%	170

<i>answered question</i>						179
<i>skipped question</i>						0
<p>10. The United States Fire Administration administers a “crosswalk” program that would allow structural firefighter certifications to be used toward wildfire qualifications. This program requires additional training, meeting minimum standards for physical fitness, and the completion of a qualification packet (task book). Would you be willing to complete this process as a prerequisite for being deployable as a wildland firefighter?</p>						
	How long have you been employed by the Memphis Fire Division?					
Answer Options	1-5 years	6-10 years	11-15 years	16 or more years	Response Percent	Response Count
Yes	16	13	32	96	87.7%	157
No	0	1	3	18	12.3%	22
<i>answered question</i>						179
<i>skipped question</i>						0

Appendix C

Attitudes of Green Space Users Toward Wildfire

The Memphis Fire Department is an urban fire department that responds to various emergencies affecting the public. Since 2006, the Memphis Fire Department has responded to over 6,000 emergencies categorized as wildfires that resulted in over \$6.4 million in losses. Your participation in this brief survey should take less than five minutes and help guide future responses to wildfires in the Memphis area.

1. How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?

- Frequently
- Occasionally
- Rarely
- Never

2. Do you ever light campfires or use barbecue grills while using any of those areas?

- Yes
- No

3. Do you ever smoke while using any of those areas?

- Yes
- No

4. Per a local news report, the recent wildfire in East Tennessee resulted in \$500 million in damage, damage or destruction of 2,460 structures, and the loss of 14 lives. Wildfire events of similar severity are unlikely in Memphis for numerous reasons, including topography and vegetation, but not completely out of the question. Do you feel confident the Memphis Fire Department is properly trained and equipped to respond if a similar wildfire occurred in the Memphis area?

- Yes, without assistance from outside agencies
- Yes, with assistance from state and Federal Agencies
- No. The Memphis Fire Department would have to allow state or Federal Agencies to manage such an event.

5. Members of the Memphis Fire Department recently sent personnel to East Tennessee, as part of a Federally funded search and rescue team, to assist with the search for missing victims after a major wildfire. Should the Memphis Fire Department be willing and able to send personnel and equipment to other parts of the state or country to help with firefighting efforts during major wildland fires in the future?

An evaluation of the risk from wildfire in Memphis, TN

- Yes, under any circumstances
- Yes, if expenses were recovered through state or Federal reimbursement agreements and local resources were not depleted
- No. Memphis resources should not leave the city.

6. Wildland firefighting requires specialized training and equipment not typically required for structural firefighters in an urban environment. Should the Memphis Fire Department allocate funding to train and equip its members for the infrequent wildfire event?

- Yes, green spaces and urban forest areas are important assets that should be properly protected using city tax dollars.
- Yes, only if state or Federal assistance is available to supplement any extra costs
- Yes, if there is no budgetary increase for the fire department and if administrative costs are covered from cuts in other places
- No, major wildfires are too unlikely in Memphis to justify increases in fire department spending

1. How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?						
	How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?					
Answer Options	Frequentl y	Occa sional ly	Ra rel y	Ne ve r	Res pon se Per cent	Res pon se Cou nt
Frequently	19	0	0	0	27.5 %	19
Occasionally	0	27	0	0	39.1 %	27
Rarely	0	0	18	0	26.1 %	18
Never	0	0	0	5	7.2 %	5
<i>answered question</i>						69
<i>skipped question</i>						0
2. Do you ever light campfires or use barbecue grills while using any of those areas?						
	How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?					
Answer Options	Freq uentl y	Occa sional ly	Ra rel y	Ne ve r	Res pon se	Res pon se

					Per cent	Cou nt
Yes	2	5	2	0	13.0 %	9
No	17	22	16	5	87.0 %	60
<i>answered question</i>						69
<i>skipped question</i>						0
3. Do you ever smoke while using any of those areas?						
	How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?					
Answer Options	Freq uentl y	Occa sional ly	Ra rel y	Ne ve r	Res pon se Per cent	Res pon se Cou nt
Yes	1	1	0	0	2.9 %	2
No	18	26	18	5	97.1 %	67
<i>answered question</i>						69
<i>skipped question</i>						0
4. Per a local news report, the recent wildfire in East Tennessee resulted in \$500 million in damage, damage or destruction of 2,460 structures, and the loss of 14 lives. Wildfire events of similar severity are unlikely in Memphis for numerous reasons, including topography and vegetation, but not completely out of the question. Do you feel confident the Memphis Fire Department is properly trained and equipped to respond if a similar wildfire occurred in the Memphis area?						
	How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby					

	Farms, or Wolf River trails, in Memphis?					
Answer Options	Frequentl y	Occa sional ly	Ra rel y	Ne ve r	Res pon se Per cent	Res pon se Cou nt
Yes, without assistance from outside agencies	6	5	3	2	23.2 %	16
Yes, with assistance from state and Federal Agencies	9	14	12	1	52.2 %	36
No. The Memphis Fire Department would have to allow state or Federal Agencies to manage such an event.	4	8	3	2	24.6 %	17
<i>answered question</i>						69
<i>skipped question</i>						0
5. Members of the Memphis Fire Department recently sent personnel to East Tennessee, as part of a Federally funded search and rescue team, to assist with the search for missing victims after a major wildfire. Should the Memphis Fire Department be willing and able to send personnel and equipment to other parts of the state or country to help with firefighting efforts during major wildland fires in the future?						
	How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?					
Answer Options	Freq uentl y	Occa sional ly	Ra rel y	Ne ve r	Res pon se Per cent	Res pon se Cou nt
Yes, under any circumstances	11	13	7	2	48.5 %	33
Yes, if expenses were recovered through state or Federal reimbursement agreements and local resources were not depleted	8	11	11	1	45.6 %	31
No. Memphis resources should not leave the city.	0	2	0	2	5.9 %	4
<i>answered question</i>						68
<i>skipped question</i>						1

6. Wildland firefighting requires specialized training and equipment not typically required for structural firefighters in an urban environment. Should the Memphis Fire Department allocate funding to train and equip its members for the infrequent wildfire event?						
	How often do you utilize urban greenspaces and forests, such as T.O. Fuller State Park, The Greenline, Shelby Farms, or Wolf River trails, in Memphis?					
Answer Options	Frequentl y	Occa sional ly	Ra rel y	Ne ve r	Res pon se Per cent	Res pon se Cou nt
Yes, green spaces and urban forest areas are important assets that should be properly protected using city tax dollars.	9	12	8	2	44.9 %	31
Yes, only if state or Federal assistance is available to supplement any extra costs	7	8	6	0	30.4 %	21
Yes, if there is no budgetary increase for the fire department and if administrative costs are covered from cuts in other places	2	4	1	1	11.6 %	8
No, major wildfires are too unlikely in Memphis to justify increases in fire department spending	1	3	3	2	13.0 %	9
<i>answered question</i>						69
<i>skipped question</i>						0

Appendix D

NUS ENGINES

APPENDIX M

Appendix M NUS Engines

The following chart shows the NUS minimum stocking levels required for agency engines.
BLM units see the agency-specific NUS on the NFEP website.

Category	Item Description	NFES #	Type	
			3, 4, & 5	6
Fire Tools and Equip	McLeod	0296	1	
	Combination Tool	1180	1	1
	Shovel	0171	3	2
	Pulaski	0146	3	2
	Backpack Pump	1149	3	2
	Fusees (case)	0105	1	½
	Foam, concentrate, Class A (5-gallon)	1145	1	1
	Chainsaw (and chaps)		1	1
	Chainsaw Tool Kit	0342	1	1
	Drip Torch	0241	2	1
Portable Pump		*	*	
Medical	First Aid Kit, 10-person	1143	1	1
	Bum Kit		1	1
	Body Fluids Barrier Kit	0640	1	1
General Supplies	Flashlight, general service	0069	1	1
	Chock Blocks		1	1
	Tow Chain or Cable	1856	1	1
	Jack, hydraulic (comply w/GVW)		1	1
	Lug Wrench		1	1
	Pliers, fence		1	1
	Food (48-hour supply)	1842	1	1
	Rags	3309	*	*
	Rope/Cord (feet)		50	50
	Sheeting, plastic, 10' x 20'	1287	1	1
	Tape, duct	0071	1	1
	Tape, filament (roll)	0222	2	2
	Water (gallon/person) minimum		2	2
	Bolt Cutters		1	1
	Toilet Paper (roll)	0142	*	*
	Cooler or Ice Chest	0557	*	*
	Hand Primer, Mark III	0145	*	*
	Hose Clamp	0046	2	1
	Gaskets (set)		1	1
	Pail, collapsible	0141	1	1
Hose Reel Crank		*	*	

Release Date: January 2016

APPENDIX M-1

An evaluation of the risk from wildfire in Memphis, TN

APPENDIX M

NUS ENGINES

Category	Item Description	NFES #	Type	
			3, 4, & 5	6
Safety	Fire Extinguisher (5 lb)	2143	1	1
	Flagging, Pink (roll)	0566	*	*
	Flagging, Yellow w/Black Stripes (roll)	0267	*	*
	Fuel Safety Can (Type 2 OSHA, metal, 5-gallon)	1291	*	*
	Reflector Set		*	*
Vehicle and Pump Support	General Tool Kit (5180-00-177-7033/GSA)		1	1
	Oil, automotive, quart		4	2
	Oil, penetrating, can		1	1
	Oil, automatic transmission, quart		1	1
	Brake Fluid, pint		1	1
	Filter, gas		1	1
	Fan Belts		1	1
	Spark Plugs		1	1
	Hose, air compressor w/adapters		1	0
	Fuses (set)		1	1
	Tire Pressure Gauge		1	1
	Jumper Cables		1	1
	Battery Terminal Cleaner		*	*
	Tape, electrical, plastic	0619	1	1
Tape, Teflon		1	1	
Personal Gear (Extra Supply)	File, mill, bastard	0060	*	*
	Head Lamp	0713	1	1
	Hard Hat	0109	1	1
	Goggles	1024	2	2
	Gloves		*	*
	First Aid Kit, individual	0067	1	1
	Fire Shirt		*	*
	Fire Shelter w/case and liner	0169	2	1
	Packsack	0744	2	1
	Batteries, headlamp (pkg)	0030	6	4
Ear Plugs (pair)	1027	3	3	
Radio	Portable		1	1
	Mobile		1	1
	Batteries (for portable radio)		2	2

An evaluation of the risk from wildfire in Memphis, TN

NUS ENGINES

APPENDIX M

Category	Item Description	NFES #	Type	Type
			3, 4, & 5	6
Hose	Booster (feet/reel)	1220	100	100
	Suction (length, 8' or 10')		2	2
	1" NPSH (feet)	0966	300	300
	1½" NH (feet)	0967	300	300
	¾" NH, garden (feet)	1016	300	300
	1½" NH, engine protection (feet)		20	20
	1½" NH, refill (feet)		15	15
Nozzle	Forester, 1" NPSH	0024	3	2
	Adjustable, 1" NPSH	0138	4	2
	Adjustable, 1½" NH	0137	5	3
	Adjustable, ¾" NH	0136	4	2
	Foam, ¾" NH	0627	1	1
	Foam 1½" NH	0628	1	1
	Mopup Wand	0720	2	1
	Tip, Mopup Wand	0735	4	2
	Tip, Forester, Nozzle, fog	0903	*	*
	Tip, Forester Nozzle, straight stream	0638	*	*
Wye	1" NPSH, Two-Way, Gated	0259	2	1
	1½" NH, Two-Way, Gated	0231	4	2
	¾" NH w/Ball Valve, Gated	0739	6	4
Adapter	1" NPSH-F to 1" HN-M	0003	*	*
	1" NH-F to 1" NPSH-M	0004	1	1
	1½" NPSH-F to 1 ½" NH-M	0007	1	1
	1½" NH-F to 1 ½" NPSH-M	0006	*	*
Increaser	¾" NH-F to 1" NPSH-M	2235	1	1
	1" NPSH-F to 1 ½" NH-M	0416	2	1
Coupling	1" NPSH, Double Female	0710	1	1
	1" NPSH, Double Male	0916	1	1
	1½" NH, Double Female	0857	2	2
	1½" NH, Double Male	0856	1	1
Reducer/ Adapter	1" NPSH-F to ¾" NH-M	0733	3	3
	1½" NH-F to 1 NPSH-M	0010	6	4
	2" NPSH-F to 1 ½" NH-M	0417	*	*
	2½" NPSH-F to 1 ½" NH-M	2229	*	*
Reducer	1½" NH-F to 1" NH-M	0009	1	1
	2½" NH-F to 1 ½" NH-M	2230	1	1
Tee	1" NPSH-F x 1" NPSH-M x 1" NPSH-M, w/cap	2240	2	2
	1½" NH-F x 1 ½" NH-M x 1" NPSH-M w/cap	0731	2	2
	1½" NH-F x 1 ½" NH-M x 1" NPSH-M w/valve	0230	2	2

Release Date: January 2016

APPENDIX M-3

An evaluation of the risk from wildfire in Memphis, TN

APPENDIX M

NUS ENGINES

Category	Item Description	NFES #	Type	Type
			3, 4, & 5	6
Valve	1½" NH-F, Automatic Check and Bleeder	0228	1	1
	¾" NH, Shut Off	0738	5	5
	1" Shut Off	1201	1	1
	1½" Shut Off	1207	1	1
	Foot, w/strainer		1	1
Injector	1" NPSH x 1/12" NH, Jet Refill	7429	*	*
Wrench	Hydrant, adjustable, 8"	0688	1	1
	Spanner, 5", 1" to 1½" hose size	0234	4	1
	Spanner, 11", 1½" to 2 ½" hose size	0235	2	2
	Pipe, 14"	0934	1	1
	Pipe, 20"		1	1
Engine	Fireline Handbook	0065	1	1
	GPS Unit		1	1
	Belt Weather Kit	1050	1	1
	Binoculars		1	1
	Map Case w/ maps		1	1
	Inventory List		1	1
	Current <i>Interagency Standards for Fire and Fire Aviation Operations</i>		1	1

* No minimums – carried by engines as an option, within weight limitations

NPS – Additional or Differing Items Recommended by NPS

Category	Item Description	NFES #	Type	Type
			3, 4, & 5	6
Fire Tools and Equip ¹	Flapper (NPS)		*	*
	Council Rake (NPS)	1807	*	*
	Leaf blower		*	*
	Shovel	0171	2	1
	Extra Quart, 2 cycle mix		2	1
	Portable Pump		1	*
General Supplies	Chock Blocks		1	1
	Tape, filament (roll)	0222	2	1
	Bolt Cutters		*	*
	Hose Clamp	0046	2	2
Safety	Reflector Set		1	1
Vehicle and Pump Support	Oil, automotive, quart		2	1
	Power steering Fluid		1	1
	Antifreeze (seasonal)		*	*
	Filter, air for engine and pump		*	*

An evaluation of the risk from wildfire in Memphis, TN

NUS ENGINES

APPENDIX M

Category	Item Description	NFES #	Type	
			3, 4, & 5	6
Personal Gear (Extra Supply)	File, mill, bastard	0060	*	*
	Fire Shelter w/case and liner	0925/0975	1	1
	Packsack	0744	2	1
Radio	Batteries (for portable radio)		2	2
Hose	2½" Refill Hose, Water tender		*	*
Nozzle	Adjustable, 1 ½" NH	0137	3	3
Wyes	¾" NH w/Ball Valve, Gated	0739	6	2
Coupling	1" NPSH, Double Male	0916	2	1
	1" NH, Double Male	0856	2	2
Reducer/ Adapter	1" NPSH-F to ¾" NH-M	0733	3	2
	1½" NH-F to 1" NPSH-M	0010	6	3
Tee	1" NPSH-F x 1" NPSH-M x 1" NPSH-M, w/cap	2240	2	*
Valve	1½" NH-F, Automatic Check and Bleeder	0228	1	*
	¾" NH, Shut Off	0738	4	2
Wrench	Pipe, 20"		1	*
Engine	Accident Forms (Vehicle and Personnel)		1	1
	Compass		1	1

¹ A minimum of eight tools for type 3, 4, 5 engines and a minimum of five tools for type 6 engines is required. The listed numbers of tools in each box are required to be on the engine. Beyond that, the tools listed as optional or additional required tools can make up the rest of the minimum number required for engines.

* No minimums – carried by engines as an option, within weight limitations