Urban Forest

Storm Plan and Strategies

Best Management Practices

"The City of Brookhaven is honored to have been chosen by the Mississippi Urban Forest Council as a model for this project. Brookhaven is known for its historic homes and tree lined streets and we recognize that value to our city. The incorporation of storm resistant trees in our rights-of-ways and public parks will preserve our tree canopy and maintain the character that they bring to our community. We look forward to implementing these recommendations into our policies and ordinances for future planning and growth." Mayor Joe Cox of Brookhaven, MS

"The connection between Mississippians and our trees is strong, especially in our urban and community settings. While our state continues to grow in its appreciation of our urban and community forests, we also realize these benefits don't happen by chance. It is only through active planning and management that our state's urban forests may realize their full potential. Tornados, hurricanes and ice storms are common in our state and detailed plans for storm preparedness and mitigation are becoming a necessity. The Mississippi Forestry Commission is proud to work with cities as they prepare for the coming storm." State Forester, Charlie Morgan, Mississippi Forestry Commission

Model Urban and Community Project

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A copy of the Storm Plan and Strategies can be found on the Mississippi Urban Forest Council web site: www.msurbanforest.com and the City of Oceans Spring's web site: http://ci.ocean-springs.ms.us/. Also, you may request a copy to dyowell@aol.com.

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Planning For Storms in the Urban Forest

Following Hurricane Katrina it became abundantly clear that storms affecting the urban forest were a major concern for communities and their trees. The urban forest industry as well as the U.S. Forest Services itself had not taken a careful look at storms and storm damage caused by weather systems and other natural disasters effecting community forests especially in regard to pre-storm activity, immediate response and post storm cleanup and recovery.

Certainly, in the past when wind, water, ice, fire, mudslide and other disasters happened the industry was involved with cleanup and debris removal. But that was about all communities were doing in regard to trees.

The impact to the Gulf Coast resulting in widespread loss of tree canopy from Houston to Alabama as a result of Katrina-Rita, two storms that slammed the coast, in the same month of 2005. This continental scale impact to trees gave everyone in the industry as well as communities themselves and government agencies pause to start to think in a more holistic way in regard to trees and storms. Research in regard to natural disaster and community forests was very limited before 2005. As an example, a brief study conducted in 2006 determined the fact that community tree ordinances in cities and counties bordering the Gulf and Atlantic states had never been written to even consider the impact of storms on trees. Clearly the industry was not prepared for what happened.

The U.S. Forest Service was the first to notice that the country had no local or regional approach that could be applied to this type of natural impact to trees. They consequently called for a 'listening session' to be held in Biloxi. Mississippi in June of 2007 to get information, gather view points and outline some policy requirements that should be addressed both at the national level and the local level. Knowledge gained from this all day session as well as written responses to the listening session resulted in some basic policy ideas toward creating a 'storm damage assessment protocol' that could be used to help communities prepare for, respond to, and recover from any manner of natural disaster effecting trees and community forests.

The **National Urban & Community Forestry Advisory Council** (NUCFAC) responded with a report to the Secretary of Agriculture in 2008 with findings and recommendations for a range of activities from research, to project implementation, tree ordinance development to leadership, education, specific actions and funding for planning and program development related to storms and community trees. Coordination with states, cities, universities, industry and various Federal Programs (FEMA, EPA, HUD) were specifically called out as places where work needs to take place.

Work is taking place in regard to planning and creation of a standardized storm response protocol. Several states, local urban forestry councils and university researchers are now providing information to help local communities set up local Storm Plans to integrate community trees into storm planning, response, and recovery operations. That is largely the purpose of this project. Using some o up-to-date information gathered from across the country, the **Mississippi Urban Forest Council** is working with three cities across the state to develop a Storm Plan and working procedure. The purpose of this will reduce cleanup costs, strengthen and protect community forests, mitigate storm damage and allow cities and towns to rapidly recover from future storm incidents.

* * * * * * * * * * * *

Storms in the Urban Forest

Natural disasters strike cities and towns across Mississippi on a frequent basis. This is primarily due to weather patterns crossing the state from North to South and bumping up against weather patterns from the Gulf. When storms invade cities moderate to severe damage can be done to people and property. Some of the most widespread damage takes place to the urban forest and this damage can upset the city by blocking roads, downing power lines, disrupting other utilities and occupying the time and attention of emergency service personnel such as police, fire and rescue operators.

Public works departments can be occupied for weeks cleaning tons of debris, much of it "green waste" from the city. Cities with the assistance of State and Federal government agencies are often prepared and trained to deal with disruption caused by natural disasters.

However the one area of preparedness that does not get much attention is how to deal with the community urban forest before, during and after the storm. Many times city officials, clean up operators and indeed even citizens see the urban forest as so much trouble and the cause for most of the hard work and expense of clean up and restoration following the storm. Some even wonder why all trees in the city are not removed to reduce the problems caused by

storms. Others disagree and cite the importance of trees in the community. Some even say that the urban forest provides some protection from storms if properly managed.

But fact remains that cities are not usually prepared, trained, budgeted or staffed to deal properly with the urban forest following a storm. Many cities do not see the green infrastructure of the city as something of public concern. But as we have seen, green infrastructure provides many benefits in terms of water, air, climate, erosion control, pollution abatement, beauty and human health. Certainly some communities have trained tree crews and others contract out those services to professional tree care companies. But for the most part even these communities do not have a "Storm Plan" in place to properly deal with the urban forest aspects of storms.

This document has been prepared to help cities understand how to better deal with the effects of storms that do damage to trees in the urban forest of the city. Within this document a five part Storm Plan that is outlined for use by municipal government for trees on public land and storm debris from private property that is generally collected and disposed as a storm service of government. Communities are urged to seek professional assistance in modifying this plan for the particular needs and budgets of the community. Within the document are guidelines that pertain to the interrelationship of public trees and private trees both affected by storms in the city. There are also recommendations about tree selection, tree planting, tree maintenance, tree removal and tree restoration that can be incorporated into the municipal tree ordinance or community landscape code.

* * * * * * * * * * * *

Concepts, ideas and methodologies contained in this work come from a limited research base and experience associated with trees and storms. The sources of information contributed to the content that follows. These documents include;

Storms over the Urban Forest, Second Edition, 1994 written by Lisa Burban and John Andresen and published by the USDA Forest Service. Chapters in this document dealing with storm response management operations in several cities were particularly helpful.

Mississippi Urban and Community Forestry Management Manual, 2nd edition, 2008,. Written by Grado, Strong, Measells of the College of Forest and Wildlife Research Center Publication FO 375, at Mississippi State University. Chapter 7 Storm over the Urban Forest was most helpful in defining the types of storms that affect Mississippi communities. Several of the technical appendices dealing with tree growth structure are particularly pertinent to this document, especially Appendix D, Table D-8 providing environmental characteristics of native trees better adapted to coastal environments subject to high wind based upon growth rate and life span.

Hurricane Recovery Program 2007. Documents, toolkit and seminar information developed by IFAS Extension Service at the University of Florida. This information is summarized in a document *Assessing Damage and Restoring*

Trees after a Hurricane, document ENH1036 written by Duryea, Gilman and Kamph and others was extremely helpful in regard to arboricultural technique and strengthening the urban forest to better withstand storms.

Urban Forestry Response Manual, nd. written by Stephen Shurtz, ISA arborists, Landscape Architect, City of Baton Rouge, Louisiana, Department of Public Works was very helpful in understanding how large cities prepare, respond and clean-up following storms. This documents was very helpful in understanding are office operations work particularly during the response phase of storm operations.

When Storms Strike, Tree City USA Bulletin No. 2, 1988, edited by James Fazio and published by the National Arbor Day Foundation now Arbor Day Foundation this documents presents some general information about working with the media following storms that leave devastation to city trees.

Helping Trees Weather Nature, written by Anne Semrau and published in American Forests, Volume 13, No. 1 February/March 1993 sets forth a catalogue of potential natural disasters facing urban trees.

Hurricane Resistant Landscapes, 1998 written by the author and published by the School of Landscape Architecture at Louisiana State University. Technical aspects of this document provided guidelines for "*site plan adjustments*" to allow private land owners to better prepare and withstand tropical wind.

Urban Forestry EOP Guide, 2013. Emergency Operations Planning Guide prepared by Smart Trees Pacific, an urban forestry advocacy group from Hawaii that provides solutions for urban tree planting, management and care.

Urban Forestry, 2nd edition, Robert W. Miller, Waveland Press, Long Grove, IL 2007. (Appendix G)

Workbook-Community Forest Storm Mitigation Plan for Georgia Communities, Georgia Urban Forestry Council, March 2013. A storm plan template for use by Georgia communities. www.gufc.org

The Urban Forest

The forest where we live is different than it was when the Gulf Coast and the location of Brookhaven was populated

by native Americans of the Natchez tribe. These people understood the forest and knew that its rich resources made survival possible. Hunter gatherers made use of the trees not only for shelter but for food, simple tools, medicine, decorative arts, fragrances, poisons and all manner of daily needs. Trees were used to make canoes, mark trails and some trees were considered sacred. All parts of trees, shrubs or grasses were utilized for special purposes. Tree parts such as bark, roots, leaves, nuts, fruits, berries and stems were used. The native *Bois D'Arc* tree also called osage orange but botanically known as or *Maclura pomifera* was used extensively to produce bows and war clubs to hunt the wildlife that lived among the trees. Gulf coast Indians most likely traded with Osage Nation inhabitants of the Red River Valley to the west to get this superior wood. Even some of the chemical qualities of the large compound fruit were used to ward off insects and mosquitoes.

The Indians took advantage of their forest, swamps and marshes for the sustainable benefits and they provided. Certainly, Indians attracted to the forests surrounding present day Brookhaven found value in trading trees of the forest for shellfish shells of the brackish water and the generally healthful qualities of the sea side coastal environment to the south.

Fig. No. 1.0. Mississippi Business Man, J.W. McGrath Memorial

In the ancient urban forest of the Native Americans who lived upon wooded ridges overlooking inland streams the trees were considered sacred. They would likely not be with us today if it was not for our knowledge of the benefits of urban forestry and the work of kind people who preserve great trees and existing forests as found in this city in South central Mississippi.

The benefits of urban trees are many. Everyone understands the beauty and tranquility that a canopied urban forest brings to a city. Many people plant trees in their yard for shade, to direct the breeze, McGrath Memorial screen unsightly views, and to provide privacy. Other people plant for the fruit, nuts, flowers and natural mulch materials that trees provide. A well-planted yard will increase a property's curb appeal and perceived value and will allow the home to sell more quickly. But there are other benefits that are called 'eco-services' that are not well understood by the general public.

It is these services that really make the urban forest something worth keeping, something worth managing, and something worth the investment of city government.

Benefits of the Urban Forest

In our modern age we now understand that the urban forest where we live is also providing services not only to individual residents but to the community at large. Trees, and more impressively groves of trees or preserved forests within cities, ameliorate climate, clean the air of particulate matter and carbon dioxide (CO^2), and produces pure oxygen that all people and creatures need on a daily basis. Forested land within cities, stream banks protected with groves of trees, parks, private gardens and even planted streets all add to the livability of a community. Even shaded parking lots beckon customers and assist the economic viability of commercial areas through increased customer traffic. Trees provide many benefits to the city and we now know to calculate them.

But many people do not understand that urban foresters have methods, equipment and technology to measure a tree's effect upon the environment of a city. Trees and forest remnants influence urban climate, absorb common pollutants such as CO^2, process volatile organic compounds and manage non-point pollutants borne in storm water. Urban foresters have techniques to measure the amount of carbon that is sequestered in trees, the productivity of its biomass, and even the amount of energy savings produced from a shade tree or a forest grove.

In the South the shade canopy is very important. It not only cools parking lots and yards and perhaps more importantly shields people from the harmful radiation effects of the sun. The urban forest in communities such as Brookhaven even bring a measure of protection from violent storms.

The economic value of trees as well as the nature of a community forest can be measured.

In Mandeville, Louisiana, an urban forest assessment was recently completed by the urban forestry program of Southern University. Researchers wanted to measure the value of the urban forest canopy and determine if value

to the city. As a result of on the ground survey, air photo analysis and computations they defined species composition, diversity and tree sizes for the forest within the city. From this data they were able to determine spacing density, tree biomass, tree canopy coverage and pollution removal for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter all things that affect the health and well-being of citizens.

They established for this community that the value of the urban forest of this 12,500 resident coastal community was valued at over $766 millions of dollars and that its urban forest sequestered 8600 tons of carbon worth over $1.5 millions of dollars. The forest canopy produces energy savings well over $80 thousands of dollars per year. The tree canopy of this coastal community estimated to cover 75% of the city was heavily damaged from hurricane Katrina. It has been reduced to 41% of the city and has an average density of 86 trees per acre. Citizens there are actively replanting the city.

Urban forests do indeed provide environmental services well beyond the beauty and character they bring to people and the important habitat, food and shelter they provide for wildlife. Science continues to understand that trees in cities provide benefits to people. Science continues to understand that trees in the city provide benefits to people that are cultural, economic and physical.

The urban forest must be managed to gain these values. The urban forest must be sustainable. It must not only provide services and benefits for the present generation but must be there for those that follow.

Fig. No. 2.0. Brookhaven Train Station at the Town Center

Community Tree Canopy

Trees found in the community today are generally second growth native plants found in forest remnants, forest preserves, public wildlife habitat facilities along property lines, streams or in preserved groves often in wetlands. Urban trees area also planted by residents or installed as part of commercial construction projects. It is most common to find shade trees planted in neighborhoods, along public streets on grassy boulevards within parks and at other municipal facilities such as schools, libraries, recreation facilities, parks, playgrounds and city hall. In commercial areas and built up areas of the communities trees are found growing on plazas, along walkways and parking lots trees are typically used ornamentally for their size, winter structure, flowers, fruiting effects, fall color or interesting bark patterns. It is common to find growing in cities a few virgin native trees dating back hundreds of years. These special trees have been set aside simply because they are historical, unique or very large examples of their kind.

Every state has a list of Champion Trees some of which like the cypress are well over 1000 years old. In fact the oldest cypress tree grows near Orlando. It is a pond cypress, *Taxodium ascendens* known as the 'Senator' and is judged to be 3500 year old. It lives with a younger bald cypress, *Taxodium distichum*, known as 'Lady Liberty.' Liberty is a mere 2000 years old. The 'Seven Sisters Live Oak', *Quercus virginiana*, in Mandeville, Louisiana is thought to be

1500 years old. The largest Mississippi champion trees in the Brookhaven area are in near-by Jefferson county. The largest is a 152' tall native black willow tree, *Salix nigra*. Nearby is an old 123' sourwood tree, *Oxydendrum arboretum* as well as a 52" devil's walking stick, *Aralia spinosa*. Old trees have their importance in the urban forest. They connect us to the past and inspire hope for the future.

The urban forest canopy of Brookhaven is one of the town's greatest resources. This canopy is important ecologically, culturally and even economically. We have mentioned the ecological benefits above. But perhaps more importantly the canopy not only provides shade for gardens, sidewalks and streets but it becomes part of the unique identity of the town. This may not be apparent to those that live in the area, but for out-of-town visitors Brookhaven stands out as a green-canopied jewel. Visitors cannot help admire the size and complexity of the trees that shade the city during the hot humid summers characteristic of the lower South.

Fig. No. 3.0 Historic South Jackson Street Home. CityData.com

Visitors also admire the trees and forests that hug the floodplains of the city. Trees on floodplains and in sensitive habitats within the City of Ocean Springs comprise a large percentage of the existing urban forest of the city. The remainder of course is largely found in residential zoning districts and a lesser amount in commercial areas due to the wide expanse of paving to support parking lots.

Tree canopy loss or decline is a process that is increasing across the cities and towns of the southeast as a response to rapid urban development. One study which is an example was conducted measured the change in tree cover and impervious surface cover in the Atlanta metro region from 1992 to 2001 The study indicated that the 16 counties in the Atlanta area are losing '54 acres of tree canopy and building more than 28 acres of impermeable surface each day. (Head 2006) Over a decade '197,000 acres of trees have been removed and
103,000 acres of impervious surfaces' have been built to replace the forest. Urban forest loss such as this is unsustainable and must be corrected. One way to do this is to determine what the amount of tree canopy is today and set a minimum tree cover standard that cannot be compromised by development. When trees are removed, they must be replaced. Residential and mixed-use development accounts for much of this loss and storms and death at old age for the remainder.

So obviously tree ordinances and community landscape codes need to include regulations for all new development, residential land included, that require the replacement of the tree canopy being removed. The same is true for tree removal caused by storms. If the trees are not replaced, the city will soon be without a tree canopy. Community tree and landscape ordinance revision and up dating is the best tool to maintain a healthy canopy.

Site Planning Standards for Canopy Retention

To set such a standard the community ought to base standards upon those recommended by American Forest, the oldest conservation organization in the nation. American Forests standards can be seen in the Table No. 1.0 below.

Fig. No. 4.0 *Magnolia grandiflora,* Mississippi State Flower

American Forests, one of the nation's oldest conservation organizations recommends as minimum canopy coverage for most American communities based upon the following zoning classifications. Coverage is calculated is a percentage of a building lot.

The building lot consists of canopy coverage, footprint coverage and open space. Canopy coverage can be measured in one of three ways, that is literally the square footage of canopy cover, trees per acre of site and caliper inches per acre that better recognizes the fact that different age trees have different canopy coverage sizes. Footprint coverage are impermeable areas covered by construction that is usually buildings, paving and such things as parking lots, pools, terraces, walkways and the like.

When the footprint alone is calculated about 40% of a building site will be impermeable. The final coverage is open space. This is often covered with grass and in most communities a minimum open space percentage is required. Average for most communities is 15% although many communities have less, and some more. Open space can be used for plantings and even plant beds. Paved open areas and stripped areas covered with dirt, sand, stone or gravel do not qualify as open space in most zoning codes.

Tree canopy may in fact cover a larger portion of a building site than the open space that is provided. This is because tree canopy can actually overlay paved areas as well as building roofs.

Average tree cover (entire city) to be 25%
Suburban residential zoning districts 50%
Urban multi-family residential zoning districts 25%
Within the CBD and commercial zoning districts 15%

Table No. 1.0. American Forests Canopy Standards

Community tree ordinances ought to contain standards for minimum canopy coverage for each building site. This can easily be done by basing a standard upon the extent of tree canopy coverage upon maturity. Since is it shade that is wanted for most residential and commercial building sites It is relatively easy to write a standard based upon square footage canopy cover that is easy to calculate and enforce. This standard assists the community in meeting its environmental improvement goals while also setting a standard to provide for the replacement of trees removed by development or storms. Having a standard to replace trees downed by storms will ensure a long term consistent amount of canopy over a city.

You can see recommended canopy coverage as seen in the site plan for a residential building site in Figure No. 5

This is a standard A1 zoned residential lot that is **90'** x **200'** consisting of **18,000** square feet of land. The building footprint shows a home of **1980** sf. When the pavement, driveway and terraces are added to this coverage the actual footprint of development is **3701** sf or **21%** of the building site. Therefore **79%** (**14,220** sf) of the site is open space and permeable. If we use the American Forest standard for minimum canopy coverage as seen above in Table 1.0 seen above we will need to have a minimum of **50%** of the lot covered by canopy. That would be a minimum of **9000** square feet of coverage. The drawing shows that the canopy is composed of existing trees of four different sizes referred to as XL, L, M, & S trees. This obviously refers to extra large (**2826** SF), large (**1256** sf), medium (**706** sf), and small (**314** sf) trees or very large shrubs. Respectfully the radius of each canopy is **30**', **20**' **15**' and **10**'. Other tree found on building site include noted at NP trees. These are "newly planted trees" really too small to calculate but whose main purpose is to replace the oldest, XL trees on the site after they fail and die. Canopy coverage calculates to **5809** sf or **32%** of Site Area.

Since the minimum canopy standard of **50%** of site area is not met, additional trees must be planted to add **3191** sf of canopy. The planting of three (3) large trees will allow this site to meet that standard in fifteen (**15**) years. In canopy calculations NP

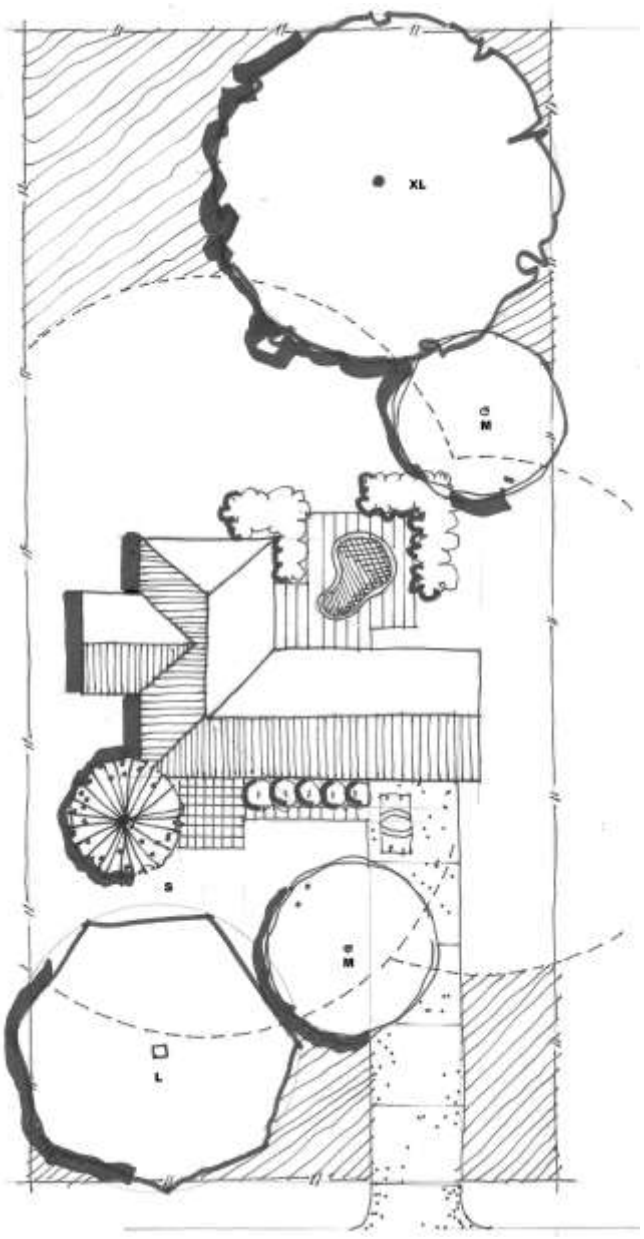

Fig. No. 5.0. Recommended Minimum Canopy Standard, Residential Zoning

trees are assumed to cover 10% of the minimum the building site so **900** sf could be credited immediately for planting four (**4**) large trees and two (**2**) medium trees. In **15** years they will exceed the standard.

XL trees are old specimens with a diameter reaching **60'** or more. Large trees (L) have a mature canopy of at least **40**', M trees have a canopy with a minimum **15**' diameter, and S trees have a diameter up to **10'**. NP, newly planted trees have canopies so small they are insignificant for at least fifteen (15) years after planting.

All city zoning ordinance mandate the minimum percentage of open space on all development sites. Most communities require 10 to **25%** of a site to remain as open space with and average being 15%. More open space is usual in residential, institutional, and PUD zoning districts. Commercial and industrial have little if any open space.

It is suggested that the following canopy percentages to be written into community tree regulations, landscape design requirements or zoning codes to set a minimum canopy standard for all building lots.

In this drawing zoning requirements require a minimum ¼ acre (**10.800 sf**) lot with a minimum size home of 1500sf of living area + 500sf of non-livable. The footprint (impermeable area) of a site generally consists of a maximum **40%** of the building site leaving a permeable area of **60%** of the site. The building shown is **1980** square feet in size. Site Area (SA) is **18,000** square feet, **90**' across the front and rear and **200**' deep. Minimum open space (OS) according to the local zoning regulations is a minimum **15%**. All zoning requirements are met, including the minimum canopy standard so the trees provide ample shade.

XL Trees 5% of the building site
L Trees 20%
M Trees 15%
S Trees 5%
NP Trees Assumed 10% of site Open Space
Minimum Canopy per site 50% coverage
Footprint (FP) Maximum of 40% of building site
Permeability Ratio (PR) 60% of site
Open Space (OS) 15% of site
Site Area (SA), based on zoning, total=100%

Table no. 2.0 Site Specific Canopy Standards
(LSU Green Laws Research Project)

Note how the drawing shows the fall zone in which trees that exceed **1.33%** of the height of the building are not allowed. In this drawing the roof gable is **30'** high. Within this fall zone, tree height shall not exceed **1.33** x **30'**=**39.9'**. Trees over forty feet tall should not be planted in the fall zone. Existing trees that exceed 40 feet in height with the fall zone should be exempt from tree removal restrictions but should be mitigated to meet tree preservation regulations or meet the minimum canopy standard for the development site.

The site planning standards indicated here are based upon good site planning standards that can easily be worked into any community's zoning and tree or landscape ordinance. With standards such as these include in a community's set of ordinances landscape architects and other design professionals can calculate the amount of existing canopy on a building site, determine how much is to be removed for development and how much must be replaced with newly planted trees. Similar calculations can be made when storms remove community trees.

Calculating Canopy

An important step in preparing a urban forestry storm plan is to understand the nature of the urban forest within the community. It is important to have some understanding of the character, species, age, composition and health

of the forest. But it is also important to understand the extent of the urban forest within the city. The latter will assist the city in establishing an acceptable 'minimum canopy standard' under which the extent of the forest will never fall. A tree inventory or survey is needed in part to help develop a storm plan.

This can be done in one of several ways. The two most common methods include inventorying trees in the field with the use of I-Tree software or calculating canopy using high-resolution aerial photography. With either method sampling of test plots from various zoning districts will be necessary to develop a risk factor that is developed based upon the percentage of trees or canopy from potential victim trees. These include trees that are dead, dying, in obvious decline or known to be 'victim trees' under storm conditions. Once and inventory is made, a reasonable standard can be set.

This project uses a limited inventory method to gather data about the trees and minimum tree canopy of the city of Ocean Springs. Three study areas were selected and sampled.

This inventory project has been undertaken by the Mississippi Urban Forest Council as part of a project to develop a model Urban Forestry Storm Plan for the City of Brookhaven. The purpose of the Storm Plan is to develop a strategy to preserve and protect trees in the city that might be damaged during clean-up operations following a storm. But a storm plan offers more to the city.

The plan provides guidelines for both the City administration and residents. The plan covers five activities that are referred to as Urban Forest Best Management Practices (UFBMP's) that will help the city prepare for a storm, respond to a storm and recover from a storm that causes damage to the urban forest. . The five parts of the storm plan include management, planning, risk reduction, response and recovery.

The purpose of the inventory and mapping below will help the city become familiar with the community tree canopy in a general way to allow a better understanding of how storms may affect this urban forest. A digital field survey can be conducted at a later date to establish specific facts and values associated with the urban forest canopy. For understanding the purpose of and use of a storm plan, this level of detail is not required at this time.

To this end a 'limited canopy inventory' of the tree cover of the City of Brookhaven to determine some arboricultural facts concerning the urban forest. Three sites were selected that seemed to be representative of the canopy coverage of the city. The sites were identified from air photographs, the general area observed by 'windshield' survey and by foot. The canopies were mapped on the office computer and calculations were undertaken to determine the canopy coverage of the neighborhood. The purpose of the study was to develop knowledge of the canopy, not to locate every tree, identify each species or every tree and its condition, size (DBH, height, spread) and canopy coverage. This type of inventory might be very useful at a later date, but not necessary for this study.

The plan provides guidelines for both the City administration and residents. The plan covers five activities that must be done to prepare for a storm and clean up afterwards. The five parts of the storm plan include management, planning risk reduction, response and recovery. The purpose of these inventories and mapping is to become familiar with the community tree canopy in a general way to allow a better understanding of how storms may affect this

urban forest. A digital survey can be conducted to establish specific facts and values associated with this urban forest canopy. For this study however, this level of detail is not required.

Study Area One

Study area one is mixed commercial development in the central business district of the city. This is the old town created by the initial development of Brookhaven to take advantage of the railroad and its connection to both North and South. This site sits along a section of West Cherokee Street and South Railroad Avenue. The character of this street is one mildly dominated by commercial buildings such as banks, law offices, the forestry department, a bakery, and a pharmacy. Paved parking areas dominate the scene and clutter the street. The railroad presently used by AMTRAC also runs parallel to South Railroad Avenue. Of what very little vegetation exists, mostly in a small dedicated to Lola Boling. There are few live oak, camellias, roses, abelias and myrtles planted there.

A boulevard runs between South Whitworth Avenue and South Railroad Avenue. Within the boulevard are parking areas estimated to hold almost **230** cars. It would be ideal to pull up some pavement and plant a grove of trees along the boulevard. The Brookhaven landscape ordinance has a parking lot screening requirement yet these parking areas are fully exposed to the street and go unscreened. Parking lot screens and additional interior parking lot plantings will not only beautify the area, but aid in storm damage prevention. It is estimated that about **140** class A trees could be planted along South Whitworth Avenue and South Railroad Avenue within this boulevard. This will considerable green the commercial center of the city.

The tract of land studied consists of **1,072,240 square feet** (sf) or **24.61** acres included both sides of West Cherokee from South Jackson Street to South 1st Street. The canopy coverage was mapped along with all buildings, paved

areas and grass open space. Elements as thin as sidewalks were not mapped and anything below the canopy was not determined or mapped. Any canopy extending over the project boundary line or over paved parking edges or buildings were dropped as incalculable since the map technician did not want to count the square footage twice. It is not surprising that the quantity of built over area dominated canopy extensively. This is a common symptom of highly developed central city landscapes. They are often over paved. With the canopy coverage of **36,194 sf** / **.83 acres** the canopy occupies **3%** of the project study area. This calculates to be 29 mostly native overstory trees.

The total built over area, areas that are paved or covered by building footprints comprises 1,015,677 sf or **23.3 acres** of the 24.61 acre study area. Built over area comprises **95%** of the study area.

Canopy coverage of 3% is clearly not a respectable number for a city center area of a community. It is estimated by American Forestry, the nation's oldest conservation organization, that commercial developments should provide a minimum of 15% canopy coverage in suburban commercial developments. Since Brookhaven has a very low number, 3%, when people pass this section of the town they cannot sense, or see, that Brookhaven is a community that cherishes its trees. A well thought out down town plan created by a landscape architect could considerably green up the downtown with a higher percentage of canopy cover.

Two other calculations worth thinking about are the calculations to determine how many additional trees can be planted in this study area and what its effect might be on the maximum canopy possible. For this study we make the assumption that a Class A native tree has on average a 40' crown diameter with canopy coverage of **1256** sf. Therefore if you divide the total un-canopied open space by the area of the individual trees, you will have the total number of trees that can be planted in the study area. In this instance it calculates to **16** new trees with a canopy coverage area of 20,096 sf. When this canopy coverage is added to the mapped canopy coverage the study area has the potential to have a 5% canopy cover, consisting of a calculated total of **45** trees.

In summary, the urban forestry study of this section of West Cherokee Street and South Railroad Avenue, in Brookhaven points out that this street with its 3% canopy coverage is below average in its streetscape greening. We know there are approximately 29 trees planted here and that an additional 16 can be planted that can potentially result in a total of **1.29 acres** of canopy and a total number of **45 trees**.

Study area two is a commercial area along a section of Interstate 55 and Brookway Boulevard. The character of the area is moderately dominated by hotels, a car dealership, and fast food restaurants. It is scarcely canopied with vegetation, most of which are live oaks, crape myrtles, and cypress. It is obvious that the businesses along this street have done special landscaping to make the street have a lovely planted character. However, there appears to be too much variety in planting and well-designed streetscape tree plantings. What is also obvious is

Study Area Two

that the MDOT had done little landscaping on the interchange to make this a significant entry gate into the City of Brookhaven. Perhaps this is something to work toward in future years.

The tract of land studied consists of 1,209,019 square feet (sf) or **27.7 acres** included I-55, Brookway Boulevard, and MageeDrive. Straight north of the site is a railroad. The canopy coverage was mapped along with all buildings, paved areas and grass open space. Elements as thin as sidewalks were not mapped and anything below the canopy was not determined or mapped. Any canopy extending over the project boundary line or over paved parking edges or buildings were dropped as incalculable since the map technician did not want to count the square footage twice. Since this is near an interstate highway, it is disappointing to find that the area is sparse in vegetation and tree canopy. With the canopy coverage of **99,255 sf** / **2.28 acres** the canopy occupies **8%** of the project study area. This is a number much lower than it need be. This area can support more tree canopy as we will see below. The present canopy calculates to be about 79 trees many of which are *Quercus laurifolia.*

The total built over area comprises 732,865 sf or **16.82 acres** of the 27.75 acre study area. Built over area comprises **60%** of the study area. This area is paved or covered with commercial buildings. Some of them big box retail in excess of 100 000 square feet in size.

Canopy coverage of **8%** is clearly below average for a commercial area in a community. It is estimated by American Forest recommends that commercial developments such as this should provide a minimum of **15%** canopy coverage. There is a lot of grass around some of these developments so it will be easy to increase the amount of canopy. Since Brookhaven has a very low number, 8%, when people pass this section of the town they can sense, as well as see,

that Brookhaven is not a community that cherishes well designed streescapes and planted parking lots. This is an area where most people enter the city, and with little vegetation, it lacks a proper welcome.

Two other calculations can help determine how many additional trees can be planted in this study area and what their affect might be on the maximum canopy possible. For instance, what will happen to the canopy coverage amount of the large amount of grass in this area is planted in trees rather than grass? For this study we make the assumption that a Class A native tree has on average a 40' crown diameter with canopy coverage of **1256** sf. Therefore if you divide the total un-canopied open space by the area of the individual trees, you will have the total number of trees that can be planted in the study area. In this instance it calculates to **300** new trees with a new canopy coverage area of 476,024 sf. When this canopy coverage is added to the mapped canopy coverage the study area has the potential to have a **39.3%** canopy cover, consisting of a calculated total of **379** trees. That is an astounding number compared to the original 8%. Considering the area is mostly built over area, it is ideal that new tree plantings be done along Brookway Boulevard and Magee Drive. There is also ample area for massive tree planting closer to I-55. By doing this, the area right off the interstate would create that sense of welcome mentioned above.

In summary, the urban forestry study of this section of Interstate 55, in Brookhaven, points out that with its 8% canopy coverage it is below average in its streetscape greening, and could be greatly improved by further planting along I-55, Brookway Boulevard and Magee Drive. It is highly suggested that a gateway plan be created by a landscape architect working with both the City and MDOT. We know there are approximately 79 trees planted here and that an additional 300 can be planted that can potentially result in a total of **10.9 acres** of canopy and a total number of 379 trees.

Study area three is residential development between West Minnesota Street and McNair Avenue bounded on the side by Cassedy Street and Byrd Street. Appropriately Storm Avenue cuts through the center of the site. The character of this area is one completely dominated by middle class homes, most of which roughly share the same size lot of about 16,000 square feet. This is an older part of Brookhaven so many of the homes have a nice settled charm. Trees have been growing for some time in this neighborhood so there appears to be a good canopy in this neighborhood, perhaps one of the most consistent in town. The houses in this neighborhood also seem to be fairly evenly spaced; deeming it to appear middle class and lacking unusual curb appeal which is often found in more historic or more contemporary neighborhoods. There is an exceptional percentage of tree canopy.

The tract of land studied consists of 611,819 square feet (sf) or **14.05 acres**. The canopy coverage was mapped along with all houses, paved driveways and grassed open space. Elements as thin as sidewalks were not mapped and anything below the canopy was not determined or mapped. Any canopy extending over the project boundary line or over paved parking edges or buildings were dropped as incalculable since the map technician did not want to count the square footage twice. It is not surprising that the quantity of built over area dominated canopy only slightly. This is common of suburban residential development. With the canopy coverage of 183,372 sf / **4.21 acres** the canopy occupies **30%** of the project study area. As an estimate of the number of trees in this area we calculates **145** mostly native overstory trees.

The total built over area comprises 182,513 sf or **4.18 acres** of the 14.05 acre study area. Built over area comprises 30% of the study area. With a 30% canopy and a 30% built over area it leaves a considerable portion of the area that can also be planted with trees.

Canopy coverage of 30% is a respectable number for an urban residential area of a community. It is estimated by American Forestry, the nation's oldest conservation organization, that urban residential developments should provide a minimum of **25%** canopy coverage in suburban developments. Since this section of Brookhaven has a reasonable number of tree canopy at 30% coverage, visitors will see the town as one that recognizes the importance of urban shade. With additional infill plantings it might be easy to raise the percentage of canopy to If at least a tree canopy cover of **50%** of the neighborhood. A good tree canopy will give residents and passers-by a good understanding that Brookhaven cherishes its trees.

Two other calculations worth thinking about are the calculations to determine how many additional trees can be planted in this study area and what its effect might be on the maximum canopy possible. For this study we make the assumption that a Class A native tree has on average a 40' crown diameter with canopy coverage of 1256 sf. Therefore if you divide the total un-canopied open space by the area of the individual trees, you will have the total number of trees that can be planted in the study area. In this instance it calculates to **195** new trees with a canopy coverage area of 427,040 sf or 9.8 acres of tree cover. When this canopy coverage is added to the mapped canopy coverage the study area has the potential to have a **70%** canopy cover, consisting of a calculated total of **340** trees.

Study Area Three

But there are still other trees that can be planted in this study area. There appears to be plenty of room for street tree plantings along the several streets of the study area. In fact there is 3900 linear feet of right of way that can be planted. A very conservative planting plan could add **39** new class A shade producing street trees or **78** class B ornamental flowering trees. Adding these trees will move the canopy percentage to over 75% making this neighborhood one of the best treed areas of the city.

In summary, the urban forestry study of this section of Byrd Street and Cassidy Street, in Brookhaven points out that these streets with its 30% canopy coverage is just a little below average in its streetscape greening. We know there are approximately 145 trees planted here and that an additional 195 can be planted that can potentially result in a total of 9.8 acres of canopy and a total number of 340 trees.

Study area four is Brookhaven City Park along a section of Adams Street and Lipsey Street. The character of the area is moderately dominated by middle class houses and a school located west of the site. Brookhaven City Park is one of three parks located in the city. It is heavily canopied with vegetation, mostly consisting of large evergreens.

Study Area Four

The tract of land studied consists of **359,659 square feet** (sf) or **8.2** acres included Adams Street, Lipsey Street, and Hartman Street. The southern property line falls right before the residential area. The canopy coverage was mapped along with all buildings, paved areas and grass open space. Different from previous studies, sporting courts, walking trails and work out areas were also included into the built environment. Elements as thin as sidewalks were not mapped and anything below the canopy was not determined or mapped. Any canopy extending over the project

boundary line or over paved parking edges or buildings were dropped as incalculable since the map technician did not want to double count this square footage. Since this is a city park, it is not

surprising that the quantity of canopied area dominated the built over area extensively. With the canopy coverage of 176,204 sf / **4.04 acres** the canopy occupies **49%** of the project study area. This calculates to be 140 mostly native overstory trees. Parks with good tree canopy such as this throughout the city will significantly increase the overall city tree density.

The total built over area comprises 55,874 sf or **1.28 acres** of the 8.2 acre study area. Built over area consisting of paved areas and game courts comprises **15.7%** of the study area.

Canopy coverage of 49% is clearly a respectable number for a park area in a community. It is estimated by the author that city parks should provide a minimum of **40% - 60%** canopy coverage within playgrounds, neighborhood parks, and regional parks all within cities. Since Brookhaven has an even higher number, 49%, when people pass this section of the town they can sense, as well as see, that Brookhaven is a community that cherishes its parks, planted with native trees such as oaks, hickories and magnolias.

Two other calculations allow us to determine how many additional trees can be planted in this study area and what their affect might be on the maximum canopy possible. For this study we make the assumption that a Class A native tree has on average a 40' crown diameter with canopy coverage of **1256** sf. Therefore if you divide the total un-canopied open space by the area of the individual trees, you will have the total number of trees that can be planted in the study area. In this instance it calculates to **99** new trees with a new canopy coverage area of 300,548 sf or **6.9 acres** of canopy. When this canopy coverage is added to the mapped canopy coverage the study area has the potential to have a **84%** canopy cover, consisting of a calculated total of **239** trees.

In summary, the urban forestry study of Brookhaven City Park in Brookhaven points out that with its 49% canopy coverage is average in its streetscape greening, but could be improved by further planting along Hartman Street and Lipsey Street. We know there are approximately 140 trees planted here and that an additional 99 can be planted that can potentially result in a total of 6.9 acres of canopy and a total number of 239 trees.

The information gathered from these three study areas gives us some basic information about the character, condition age and health of the urban forest in addition to the percent or urban forest covering the city. An inventory by canopy does not provide precise information about the urban forest. It provides just enough to make it possible to prepare a storm plan. Upon completion of the plan, it may be adventitious to do a detailed inventory where all public trees are inventoried on the ground using field methods. Of course, this is not possible with private land due to extreme costs and entry rights but sampling could be done on various forested properties.

Summary of Canopy Findings

From this study of both residential, commercial and park landscapes we conclude that a major storm such as an ice storm, tornado or hurricane will provide considerable damage to the residential areas of the city and to parks. Damage will be less along streets that presently are not heavily occupied by street trees. Little damage will occur in commercial areas since the amount of tree canopy is below standard. This study also proves that much additional shading of the city is possible. It is particularly desirable in parking lots since most parking lots of the city do not have adequate shade canopy. And finally, Brookhaven should consider having a streetscape planting plan prepared for the I-55 interchange as well as Brookway Boulevard.

A downtown landscape plan prepared by a landscape architect will find many available planting spaces available for increase the canopy in the city center. The landscape code ought to be enforced a little better to ensure that parking lots are screened from public streets and are partially shaded from the fierce summer sun.

Large and small storm water detentions could be built in the city to manage storm water runoff from parking lots and infiltrate it into landscape areas. On-site storm water management practices should be represented in the community landscape ordinances. The landscape ordinance should require the planting of wetland trees within these facilities such as the one that fronts Brookway Boulevard in front of the Walmart store.

Urban forests and floodplains within the city provide valuable services to the city. Their impact on urban flooding and stormwater management is significant. By maintaining a minimum canopy coverage as these mappings suggest, there will always be in Brookhave urban forests that can mitigate flood damage caused as a result of tropical storms that will drop hundreds of thousands of gallons of stormwater with every storm event.

Fig. No. 6.0. Lincoln County Chamber of Commerce

Jay Perkins Photo, City Data.com

Storm Resistant Urban Forests

Buildings are constructed to meet building codes with strict design parameters for structural strength to resist forces and loads. These standards ensure public safety since buildings are constructed to withstand most common storms. Current Louisiana building codes require specialized bracing, special structural detailing and FEMA required floor elevations all as methods to make building more storm resistant.

The urban forest canopy however reacts differently to wind, ice, flooding, storm surge, and lightning. Some adapted coastal species resist natural calamity a little more due to their structure, density, and height. They seem to be able to survive the strength of the force being applied to them. Trees such as the live oak, cypress, hickory and tupelo fall into this category. These trees are survivor trees since studies confirm that they weather storms a little better than other species

The cypress tree, either *Taxodium distichum* or *Taxodium acendens* is the Gulf Coast's premier storm resistant tree. This is largely due to their deciduous nature, fine leaf pattern, well tapered and balanced central leader, minimal branch pattern, broadly balanced root system with their peculiar "knees," and roots that exit the root ball at 45d angle and sink deep in clay based soils in their native habitat along coastal margins. As a rule of thumb, the closer a native tree grows to the sea, the more storm resistant it becomes through the marvelous procession of adaptation and evolution. No wonder, palms, live oak and cypress are the Gulf Coasts most hurricane resistant species. It is important to use plant materials that are more suited to local climate. They stand up to vagaries of the weather.

Fig. No. 7.0. Laurel Oak Trees, Downtown Brookhaven

Some species are less strong and their resistance to wind, flood, ice, often will cause the tree to fail by overturning, structural breakage or massive deformation. These trees are structurally weaker and cannot resist a strong force applied to the leaves, trunks, stems, and branches. Long-lived trees are preferred over quick growing short lived trees. Trees that live long and usually grow slow develop stronger wood.

Single trees and trees in groves react differently. Native trees often survive, exotic or non-native trees often fail. Younger trees have a better chance of survival, older trees and trees that are weakened by disease often fail. The typical urban forest is composed of all of these types of trees so management is often needed to preserve the strong and eliminate the weak.

In coastal Mississippi wind is the most important factor affecting the urban forest. We know from hurricane Katrina 2005, when both wind and storm surge come into play only live oak can withstand such stress. All other trees were

removed from Mississippi shoreline and even the live oak shows the scars of this combination of 175 mph wind and estimated 27.8 foot storm tide at Pass Christian.

A profile of the perfect wind resistant tree that will survive low category storms paints a picture of a tree that can withstand moderate hurricane winds and offer protection to homes, gardens and private property. We know for example that after every windstorm, some damage to trees can be expected. This damage may take the form of de-leafing, branch removal, severe structural damage or terminal death of the tree.

De-leafing occurs where leaves are either blown away or desiccated by fast moving wind or wind above 20 miles per hour (mph). Desiccation, the forced removal of oxygen from leaves will cause leaves that remain on the tree to wither and fall off within days. Normally within hours or days, the tree will send up a new generation of leaves to replace the old and carry on the business of capturing sunlight. Leaf damage is not a problem by itself, but the density and texture of the crown has effect upon the tree's ability to survive strong winds. Branch breakage caused in weak wooded or fast growing trees.

Stronger storms, those with winds between 40 and 60 mile mph may cause twig removal and branch breakage. This type of damage will litter the yard but will not cause major problems to the tree. Minor pruning can remove any hanging branches called 'hangers' or branches that are holding dead leaf matter.

Severe storms coming out of the Gulf of Mexico and over the beach can have a severe impact on the urban forest of this city. Cat two and Cat three hurricanes, with winds over 100 mph can cause major structural damage to trees often leading to disfigurement. Major branching, prime leaders and the trunk of the tree itself can be twisted, split or cracked. Professional arborists in some instances can treat this type of damage and insure the life of the tree. Arborists can remove broken limbs, reshape leaders, treat minor structural damage, lower the center of gravity of the tree and reshape the trees outline to improve it appearance. The tree will show scars but can function for years after the storm.

Fig. No. 8.0. Laurel Survivor Live Oak on the Mississippi Coast

High winds, those coming out of Cat four storms or from tornados that are often spawned within hurricane fronts, cause major structural damage, severe wood splitting, trunk twisting, uplifting, overturning and bole snapping all of which can result in loss of the tree. In some instances if expert arboricultural practices are performed quickly and the tree is of a forgiving species, the tree can be pruned, anchored and severely trimmed to new form. Quick action may save the tree but the scars of the storm will remain. Many examples of these survivor trees can be seen in Louisiana communities. They are part of our native landscape. They are an important part of the visual character of community urban forests near the sea. Their misshapen, lopsided, truncated, open, character adds considerable charm to coastal yards and gardens.

Very strong storms with wind speeds above 150 mph will cause terminal damage. Tree can explode so to speak in Cat five storms or inland tornados. De-barking as a result of sand and stone throw will in itself strip the tree of its protective bark leading to tree termination. Structural breakdown, uprooting, over-throw, stem splitting and saturated soil root failure also lead to the death of the trees. Trees are often overturned and uprooted during these storms and must be replaced and should be replaced with more hurricane resistant species.

Professor Kim Coder of the University of Georgia sums up hurricane damage to trees in his paper published by U of G Extension, Circular 806.3/1995. Coder in *Storm Damaged Trees, Prevention and Treatment*, says there are six main types of storm damage to trees. They include blow over, stem failure, crown twist, root failure, lightning strike and branch failure. These observations are consistent with the descriptions above.

Coder suggests that some trees are biologically engineered to better withstand wind loading. Citing a U.S. Forest Service report *Tree Species Resistance to Storm Damage*, AS-FR 20, USDA 1982, he points out that the more wind resistant tree species include trees like longleaf pine, live oak, bald cypress, black gum, sweetgum, red oak and magnolia. Other good hurricane resistant trees include all of the coastal palms, tulip tree, American beech, sweetbay magnolia, coastal slash pine and laurel oak. (Duryea, Kampf, Littell 2007) These are all good garden trees for the South if given enough room to grow and properly maintained. What not to use according to Coder? He would place on a banned tree list such trees as boxelder, ash, basswood, white oak, yellow poplar, and red maple. According to Duryea, bradford pear, red cedar and tall spruce pine trees are others that should be added to this list.

Fig. No. 9.0. Storm Tossed Live Oaks on the Mississippi Coast. Internet Sourced Photograph

New studies of trees following hurricanes offer new knowledge into the way vegetation reacts to hurricane storms. We know from studies of storms like Camille 1969, Hugo 1989, Andrew 1992, Erin 1995 and Charley 2004 that the trees that come down during storms are always the weakest and most misshapen trees in the area. They are often non-native trees unsuited by nature to our exposed coastal landscape. This type of tree is often called a 'victim tree' do to its inability to withstand tropical weather.

Classic victim trees are often of inappropriate species, not arranged in protective compositions and have had been poorly maintained with little if any pre-storm arboricultural practices. See *Notes on Hurricane Andrew* in *Storms Over the Urban Forest* published by the USDA, Northeastern Area and related organizations to find additional detail about a trees reaction to high wind. Trees that are often snapped, broken or overturned are often found to be diseased, hollow and rotten in the core, old and in decline and severely imbalanced. Many of these trees have had severe root pruning from sidewalk construction or the installation of underground pipe, line and cable. Many trees that come down during storms show scars from mankind's interference and carelessness during construction.

Healthy and well-maintained trees and well-composed urban forests have a much better chance at surviving tropical winds. Urban forest trees a different from forest trees in that they often grow very broad and very dense since they

are generally planted as specimen in wide open areas with lots of nurturing sunshine and limited root space. For this reason it makes sense to use good arboricultural practices such as 'storm training' to build a stronger structure to be more able to withstand high winds.

Arborist who train trees to be more hurricane resistant use a variety of cuts to restructure a trees. These might include removing co-dominant stems, reducing weak branch unions and balancing the canopy with removal cuts, reduction cuts and heading cuts, all techniques use by arborists to thin out a tree and strengthen its structural capability. (Gilman 2006)

Poorly maintained trees or urban trees that are never maintained and those not native to coastal landscapes will have a hard time surviving hurricanes and their removal and disposal creates a tremendous problem for cities within hurricane prone regions.

It is known that trees off the beach have a better chance of surviving high wind due to the fact they often grow in groves where they offer protection to each other. This protective grove will also offer some additional protection for homes and building.

The urban forest over a community will offer limited buffering effects to homes and property in Cat 1 and Cat 2 storms. This is especially so, if they are actively maintained, have a reasonable amount of species diversity, fine leaf texture and are layered with small, medium and large species. See Appendix I for trees likely to survive a storm.

Stormwater, Drainage and Forested Wetlands

Not as well understood as lighting, ice and wind is the importance of stormwater drainage and forested wetlands and the role they play in regard to establishing a storm resistant urban forest. Flooding tends to cause property damage based upon the intensity and duration of storms. Communities have a tendency to put stormwater into pipes for the purpose of moving storm water quickly from the town or city. This may be efficient in regard to moving water but quickly moving water out of the city causes flooding, particularly back up flooding. As more and more trees are removed from natural drainage channels, flood plains and forested wetlands within cities damage from storm flooding multiplies. Nature does not move stormwater quickly but slows it down to allow infiltration, evaporation and plant material uptake. These three important elements of the natural drainage cycle moves moisture from the atmosphere to the ground, into the water table and eventually to the sea and back into the atmosphere where more rain will eventually be produced by storms.

Urban forestry plays a role in this cycle by slowing drainage down and allowing water to be slowly released to prevent flooding. Cities therefore need to preserve forested wetlands, natural drainage channels and even constructed large detention ponds (dry) and retention pond (wet) that will slow the process of moving stormwater. Even runoff from rooftops and parking lots ought to be directed to forested parking lot detentions, rain gardens, rain groves and bioswales. Wetland tree species should be planted within the urban forest to prevent flooding and reduce the use of concrete lined channels, pipe and other means that cause rapid runoff and flooding.

A Sustainable Urban Forest

Agricultural forestlands that are cut periodically to produce lumber and wood products are sustainable in the sense that forest managers husband the resource to produce renewable wood products. It is in the interest of landowners

who grow trees for industrial purposes to be able to grow crop after crop of prime lumber and wood product. For this reason forestland is not clear cut and striped as it once was and then left to go fallow. Those who practice sustainable forestry understand that the forest resource must be handled differently. They want the resources to produce over long periods of time with little if any decrease in productivity. Deforestation is replaced by eco-system management and selective cutting. For the forest to be sustainable, the soils, climate, moisture capability and forestry practices must be conducted in a way in which the wood product can be classed as 'certified wood' meaning wood produced from sustainable forestry practices

Sustainability in the urban forest is different but no less important. The goal is for the forest of the city to continue to provide not wood projects but environmental services. The urban forest is managed to provide environmental services such as shading, temperature control, uptake of carbon, management of stormwater and use by humans for human health and mental and physical enjoyment.

Where rural forests are allowed to regenerate quite naturally over a period of some 30-50 years the urban forest require human intervention. The urban forest is a planted, maintained and cared for natural system as well as a visual and physical feature of the city. Trees are planted, grow and produce environmental services die, are removed and restocked. Storms often take a toll of consequence and trees must be pruned, restored, or thinned out and or replanted.

This is how an urban forest becomes sustainable. The sun, soil, water and climate allow the forest to continue to produce services. But society must intervene when storms strike and when trees die of natural causes and must be removed. Caring for the urban forest prevents the build-up of fire hazard material, the recycling of downed or removed trees and the continuous restocking of the urban forest. Restocking allows a community to maintain an appropriate minimum canopy percentage that is recognized in the communities building and zoning codes.

Fig. No. 10.0. StormwaterDetentions Add Tree Canopy

The goal of a sustainable urban forest needs to be the goal of any community forestry program. But what is a sustainable urban forestry? The experts are still debating this but general consensus seems to indicate that a certain percentage of the area of a community is covered with forest canopy.

Therefore a sustainable urban forest requires a healthy vegetation resource, a strong community framework and appropriate management of the resource. (Clark 1997)

The vegetation resource must have adequate canopy coverage over a city. Canopy coverage generally varies by land use or zoning district but on average for small to medium cities will be in the range of 30 to 60 percent. For very large cities like New York, Chicago and San Francisco this canopy may be lower due to the heavy concentration of buildings and paving. The trees of the urban forest must primarily be native species of wide diversity, size and age mix. It is important that the urban forest weave together public parks, public lands, neighborhoods, schools and significant street tree plantings. And of course, it is

important that the forest resource be used for hiking, walking, jogging, biking, picnicking, nature study and other passive activities that improve people's physical health and well-being.

The community framework for a sustainable urban forest requires cooperation. Active interaction and communication is required among public agencies, large land holders, neighborhood associations and green industry personnel. But more importantly perhaps, citizens must fully support the planting and maintenance of trees in parks, along streets and in forest preserves and wetlands.

Citizens must be willing to volunteer for tree plantings and willing to have a percentage of their taxes directed toward urban forest management. As a goal a "two percent for trees" is a good starting point. The Arbor Day Foundation who sponsor the TREE CITY USA program require a minimum investment of two dollars per capita. For Brookhaven this calculates to $35,648.00. So with a $14 million dollar budget (Mississippi Press) two percent for trees would generate $280,000.00 for a community tree program.

The last criteria required to ensure a sustainable urban forest is active management of the resource. This requires an Urban Forestry Management Plan, minimal annual funding, some staffing or staff sharing, access too maintenance tools, a active green matter recycling program, annual planting programs and protection for the resource base through adoption of a suitable tree preservation ordinance, community landscape code and sustainability ordinance.

These three elements work together to make an urban forest sustainable.

This may seem like a complicated program to add to the responsibilities of local government. But when one measures the input of this green infrastructure program against the long term sustainable output it is clear the latter dominates. Since the urban forest is seen and used daily by residents of the community they will understand that the urban forest is one of the aspects of city that make the place livable, rewarding and secure.

Fig. No. 11.0. High Wind Storm Damage, University of Florida image.

Storms over the Urban Forest

Somewhere in the United States a storm is brewing, in violent progress, or has just passed a community leaving it with many problems and challenges. Among those challenges are problems caused to the urban forest.

Each year in the country 100,000 thunderstorms are in progress, lighting is hitting the ground every few seconds. On an annual basis several hundred people lose their lives to a storm. Property damage is horrific and results in high personal loss as well as loss to public property paid for and repaired with tax dollars.

Storms over the urban forest come in many forms. But generally they involve high wind, ice, snow load, lightening, severe hail, excessive rain, dust storm, flooding and insect attack. To a lesser degree, other weather factors such as

freeze, drought, fire and climate change can be damaging to tree populations as well. FEMA even considers volcano's, land slides, earthquakes, tsunamis and space weather as storm factors that affect the United States. Continental weather storms and tropical storms cause the most frequent storm damage along the Gulf coast.

Tornados, ice and storm tides are perhaps the most aging to urban forest trees.

Hurricanes by far are the most wide spread form of tree damage along the Gulf Coast. Snow storms are very rare but are the most beautiful and interesting in this subtropical climate. Flooding as seen in New Orleans in 2005 is perhaps the most costly and debilitating over very long recover time period. Katrina had a 28 (7.6M) foot storm tide that destroyed many homes along Front Beach and East Beach. Tidal surge inundated much of the town. Earthquake activity even has some bearing on Brookhaven. In recent years quakes were recorded in 93, 97 and 2007. Even mudslides have been recorded on some of the slopes in and around the city. (City Data.com, Advameg, Inc.). But there are even lesser natural factors that also cause destruction to trees. They include fog, dam failure and even termites under some conditions.

Storms affect communities in many ways. They can disrupt traffic, interfere with public utilities, change people's schedules, bring cessation to business operations, close schools and disrupt community events, meetings and entertainment options. Communities are aware these extra ordinary events happen and generally have an emergency management program in place. They often will have a set aside emergency budget available for police, fire and the Public Works Department. These departments are usually charged with getting the city back in order following a storm.

When a storm emergency falls upon a city, local government finds itself buried in solving multiple problems. These problems are related to public safety, health and welfare, law and order and public utilities. They also have the responsibility of getting the streets opened and looking out for public employees who turn out no matter what the emergency situation might require. For purposes of this discussion, the material below only addresses impact and response to the urban forest infrastructure of the community caused by a storm. These storm maybe from ice, wind, microbursts, flooding, lightning strikes, fire, storm tides or earth quakes and in some situations perhaps insect infestation, drought, rapidly spreading fungal disease or public lawlessness all effecting the tree population of the community.

Fig. No. 12.0. Trees Growing Within the Fall Zone

Tree emergencies are considered for any event that poses potential harm for people or damage to public property. This work may actually begin hours in advance of the storm as in the case of a hurricane or quickly thereafter in the case of a lighting strike or microburst or in the even an old tree just falls over expectantly blocking a

a street or bringing down public utilities.

Response is primarily directed to public trees or private trees that fall on public property. However storm damage to private property must be considered since access to those damaged trees or removal of damaged tree parts make use of public right of way.

In the spirit of cooperation the public sector has developed rules for working closely with private land owners, contracted tree service companies and public utilities all of who use the public right of way to solve emergency problem confronting private land owners. These three principal parties must work together under difficult situations immediately following a storm.

When a public tree falls in a park, a public facility city hall, school, fire station), municipal tree preserve (forest) or along a public street it is cleaned up by the public. Generally an Office of Forestry or a Landscape & Forestry Office often attached to a Department of Public Works will be responsible for this activity.

When a tree falls from private property on to public land the public will cut the tree at the property line and clean up public land. The property owner is responsible for the fallen tree on private property. If a private tree falls on adjacent private property each property owner is responsible for the tree on their side of the property line. If the falling tree causes damage to the neighboring private landowner the neighbor's insurance company is responsible for the damage caused by the act of God that brought the tree down. Problems with '*property line trees*,' those that often occur directly on the property line, sometimes are worked out in civil court. The general rule is one property owner cannot cause harm, or disfigurement that could kill the tree owned in part and enjoyed by the neighboring property owner.

Of course there is the problem of green debris being generated on private property and then stored for pick up on public property. Private land owners are responsible for any damage they cause to public property, mail delivery, or public street side infrastructure damaged as a result of their choice of storage location, the amount of debris stored how is delivered and when and how it is removed. This needs to be set forth by ordinance and every property owner needs to be informed of it. They need to know when they can store it on public land, where it is to be stored and how they are to store it. They must be aware of property lines, overhead lines and below grade lines. Some communities even require that the green debris be sorted and not mixed with garbage or other storm damaged materials such as concrete, wood products, roofing, glass etc.

Legal question do come up during emergency operations and the city must establish the policy in print and make them known to all parties through their local tree ordinance. There are also safety problems that arise with the use of power equipment and damage to protected tree classes or specific site planting areas required by local zoning ordinances and landscape codes. These too are covered by public ordinances.

The purpose of the discussion below is to clarify the responsibility of municipal personnel and establish some guideline operating procedures for dealing with the four phases of storm related activities facing a community.

Yet perhaps the least well understood damage caused by storms is the effect upon a community's trees and urban forest.

Communities are finding that storm damage to trees in the city is an under estimated problem that results in a costly budget supplements following any type of storm that causes severe damage to the urban forest. Perhaps the biggest problem with tree damage in the city is the vast amount of material that is left in its wake. Broken and downed trees must be cleaned up, transported and processed. In addition, tree fall usually closes streets, bring down power lines, causes disruption to gas and water services. Flying tree debris or downed limbs usually shuts down cable and telephone lines. All of this must be repaired to restore order.

Fig. No. 13.0. Tree Damage Being Recycled as Green Waste.
KSL.Com, Salt Lake City Image.

Storms over the urban forest requires Much hand labor, use of power equipment, a fleet of trucks, temporary neighborhood storage areas and final processing or disposal of thousands of cubic yards of waste. Post storm costs involve storm clean up, tree cut up, chipping, removal, pruning and tree structure damage repair. Transportation, storage and processing of organic vegetation matter, so called green waste, is a time consuming and costly affair. Some enlightened communities recognizing the stored energy in green waste have developed processing programs to convert the waste to energy production or mulch. They often sell the processed waste to help generate dollars for future storm clean up expenses and post storm replanting operations. As an example, in December of 2011 a massive windstorm hit Davis County, Utah and severely damaged thousands of trees. It was estimated 400 hundred trees alone were lost at a local community golf course. This storm, not a wide spread storm but one of limited extent generated some 15,000 tons of green waste that was all processed at a local land fill equipped with track hoes and tub grinders.

Fig. No. 14.0. Tree Damage To Utilities Times Picayune Photo: K. Kamenitz

Storm damage costs involving trees or urban forest canopy are often not reimbursed by government grants or insurance policies and communities never seem to be ready for storms, storm clean up and replanting operations. Since this involves trees on public land as well as private land most cities find themselves unprepared, understaffed and certainly under budgeted for all of the work that is associated with clean up and recovery.

Well before a storm strikes a city needs to be prepared with a '***Storm Plan.'*** This is defined in respect to the urban forest and public trees so the process of planning, risk reduction, storm response, clean up and recovery can proceed in a planned, orderly and well thought out manner. The objective of a Storm Plan is to set forth policy, procedures, details and methodology for acquiring personnel, equipment, and supplies that will increase the efficiency and productivity of those in the city charged with tree emergency response Ti operations.

In small communities, primarily public works employees, work with contracted outside tree companies and utility repair industries. Volunteers may also assist. In larger communities, a community may have its own Office of Forestry who would be charged with:

Clearing leaves and debris from storm drains, natural drainage ways, floodplains and forested wetlands

Clearing streets, sidewalks and public lands

Removing line of site conflicts for street safety and signage

Eliminating blockage of street lamps, and safety signage

Locating and minimizing conflicts with above ground and below ground utilities

Removing downed trees, tree parts and transporting waste (APWA)

In addition to those primarily charged with dealing with the results of a storm's impact on vegetation this group of people must work closely and efficiently with other parts of city government that will include parks, police, fire, rescue, administration, purchasing, state and local utility providers as well as state and local emergency management agencies.

A Storm Plan for vegetation management will set forth '*urban forestry best practices*' that will allow the entire storm event from its inception to its recovery to proceed in a professional manner. A well thought out Storm Plan will expedite the work, minimize costs, reduce incidents related to poor communications.

Best Practices for Emergency Storm Response

A community should have a Storm Plan in place based upon a five (5) part approach to solving problems associated with storms over the urban forest. As recommended by the American Public Works Association (APWA), the Davey Resource Group and the Society of Municipal Arborist the best plans for storms in the urban forest are built around *planning*, *management, risk reduction*, *response* and *recovery*. (APWA). There five steps constitute "best practices" toward recognizing city trees, prior to, during and after storm events. These storm management practices will assist cities in recognizing the importance of urban trees, how to plan for storms, effect of storms on urban trees, minimization of post storm vegetation debris, coordinated, efficient and ecologically sound clean-up operations that prevent collateral clean-up tree damage. In addition, the best practices guide cities into replanting the damaged urban forest with more hurricane resistant species and involving the public in replacing the city tree canopy lost due to disaster caused by wind, flood, ice, heat, drought and climate change.

The primary reason for a community to have a Storm Plan for the urban forest is to set forth policies, procedures, work routines and a communications network to increase the efficiency, productivity and arboricultural skill and

work place safety of attending arborists and tree management companies. In addition, this plan will allow the proper decisions to be made about pruning cuts, tree storm-training, tree restoration and tree removal without excess collateral damage caused to other trees in the urban forest by clean up personnel who work without a plan or proper guidance by city administrations.

The discussion below concerning best practices for trees and storms is based in part upon urban forest storm response plans used in Oak Park, Illinois, Milwaukee, Wisconsin, and Baton Rouge, Louisiana.

Fig. No. 15.0. A Tree Crew Stands Ready for a Storm Over the Urban Forest. www.agtree.com image

To implement a Storm Plan for Brookhaven the following practices or some modification of them should be incorporated into the normal operations of city government and in some ways to the activities of private property owners.

Planning. A community knows that violent storms will at some point in time create damage to the urban forest so they must prepare for it with a Storm Plan. The plan must determine what people, or city departments, outside agencies and outside contracted services will be involved with the various tasks associated with storm preparation, response and recovery. The plan should develop the role that each person or each agency takes and the working relationship between all parties.

The plan might set forth disaster planning guidelines and early warning strategies. There should be a telephone/email contact network as seen in Appendix A attached that can be used as a communications chain. This list will set forth a communication network between the city, state, federal government and outside contracted parties such as tree companies, equipment companies, material supply companies and even companies that can supply food, water and other items needed by administrators, disasters workers and public safety people who are all working together during the response or recovery phase of the project. A notification or warning strategy for the general public might include sirens, email contact, cell phone warning and releases to newspapers, radio and television.

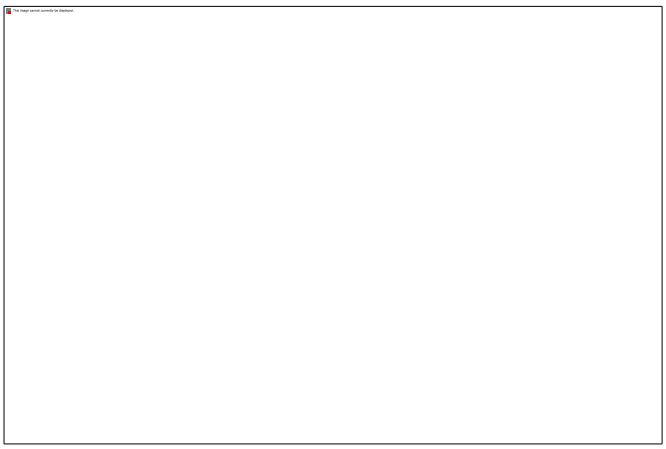

Fig. No. 16.0. Planning Prepares A Community for Future Storms

All departments in City Government should set at least one day a year aside to have an urban storm training exercise. This storm response walk through will allow key employees of all divisions, parks, public works, planning, public relations, police, fire, rescue, emergency response and administration can practice their particular role and interact with other team members who will have some input to trees and tree care response during storms.

The planning phase ought to have documentation and working relationships prepared for the following activities or actions.

Making contact with the Mississippi Emergency Management Agency (MEMA) is one of the first planning actions to take in finalizing a storm plan for trees. The main office of MEMA is located in Pearl Mississippi. (www.msema.org) This agency is involved with all kinds of disasters from storms to nuclear incidents. They are involved with various aspects of storm including 'preparedness, response, recovery and hazard mitigation.' They offer public information, logistics, support services, field services and are a direct link to Federal Agencies such as FEMA, NWS (National Weather Service), NOAA (National Oceanic and Atmospheric Administration) and private support groups like the American Red Cross. They have experience with all types of disasters. Trees however is not a main concern of this agency and that is the primary reason a storm plan for trees is needed at the local level.

The EMA district officer from one of the nine (9) districts or the assigned county officer can be very helpful in assisting the city to prepare and take advantage of the services they offer. They offer many services from shaping an emergency plan, training to teaching the Principles of Emergency Management.

One of the services they provide is critical. They monitor all weather conditions and report on all storm damage anywhere within Mississippi. They constantly blog out the information and release PSA's to local media outlets. This pet friendly organization encourages people to use social networking software to keep family and friends aware of changing weather conditions and to monitor changing conditions during a disaster. They post bulletins to the Mississippi Public Broadcasting system.

For more detailed information about MEMA see *Mississippi Emergency Management Act of 1995 (Title 33, Chapter 15 Mississippi Code of 1972)* and the National Incident Management System Incident Command System training as mandated by *Executive Order 932, March 2005*.

_____ _____ _____

* Establish a Tree Reports mechanism to allow people to call or email to report tree damage & hazards

* Monitoring or early warning system for detect storms before they occur

*Listing of Key Personal from City Government and related agencies (telephone/email network see)

*Current inventory of equipment available for field operations

*Listing of local or regional vendors for equipment, supplies and pre-contracted emergency tree services

*Seek neighbor communities able to augment local emergency tree crews with equipment or personnel

*The establishment of '*tree authority*' and '*Storm Team*' for the community as necessary.

* Develop ways and means of responding to community needs before, during and after storms.

*Improve coordination of management activities with neighborhood associations, city departments and emergency response coordinators.

* Establish and map urban forest response zones based upon response time from dispersed storm response staging areas or equipment yards.

*Pre-establish and mark with signage a series of '*brush staging areas*,' or '*mulching parks'* of 1 to 3 acres in size must located at prime spots throughout the various neighborhoods where green waste can be collected, processed and distributed.

Table No. 4. Urban Forestry Storm Planning Tasks

One planning problem is to determine risk and impact on community forests caused as a result of storms and violent weather. Since community trees have never been acknowledged as public green infrastructure in most cities little documentation exists to gage the impact of storms on trees. We simply do not keep records of tree damage. Some cities do track debris in cubic yards, but often this is a combination of building materials, damaged movable property and green waste. So planning must determine risk, impacts and potential loss of community trees. Urban foresters can make a vulnerability assessment, including calculations and an inventory or vulnerable properties, in advance if they have an inventory and plan in place.

Management. A community must have an incident command or management method or strategy to deal with urban trees. In a small community it might even be a volunteer Tree Board that meets on a regular basis to discuss community trees to determine what actions ought to be taken to protect, preserve of replant trees on pubic property. In addition, it is common for volunteer organizations such as this to offer management services, advise and educational programming about trees for private property owners. The essence of management is leadership. Who will lead a community's efforts and actions toward trees? Since trees are such an important aspect to quality of life every community a needs to have a least one person in charge who understands, or is capable of learning about trees and their needs and care in a city. This person might be an arborist, urban forester, horticulturist or even a landscape architect. For larger communities management can be more formal with actual city employees assigned the task of managing community trees. At this level key management concerns include the analysis of the tree resource, organizing a management staff, hiring and training employees, acquiring equipment and seeking resources that may include an annual budget, grants, gifts and an income stream from the performance of specific services. A summary of key management activities include:

Fig. No. 17.0. Management Requires That Someone Be In Charge
New Orleans Times Picayune image

*For larger communities preparation of a digital survey or '*Tree Inventory Database*' of tree resources found though out the city. Inventory should address all public trees as well as address species compositions on private lands.

* Prepare an annual program of activities.

* Develop job descriptions for needed staff employees.

*Prepare of a program of activities used for a one-day intensive storm response training exercise.

* Develop an *Urban Forest Management Plan* to defines the relationship and responsibility of local government toward the urban forest. This plan should describe public policy, define the management structure used, management recommendations, tree care, maintenance, planting, preservation and removal specifications, minimum canopy standard and budgeting.

Table. No. 4.0. Management Tasks

Fig. No. 18.0. Management of Public or Private Tree Crews

KEY STORM MANAGEMENT PERSONNEL *

Mayor -Administrative decisions & control
Emergency Manager -Administrative assistance
Director of Public –Infrastructure decisions & control
Business Manager -Contracts, revenue, expenses
Public Relations Clerk –Public coordination & media
Chief Forester -Provides direction & staff management
Contracted Personnel -Various arboricultural operations & special equipment operation by contract
Assistant City Forester -Manages field work, grants
Forestry Operations -Direct field crews, staff, safety
Technical Services Coordinator -Reports & records
Arborist III -Works in the trees, ISA qualified, training
Arborist II -Equipment, supplies & ground work control
Arborist I -Equipment operator, communications
Laborer -Ground work, clean up

Table. No. 5.0. Tree Staff, Large City Forestry Office *(large community)

Fig. No. 19.0. Planning & Management Require Equipment to be Ready

www.ytgloves.comheadlines.asp www.tuffequipco.com.jpg

Risk Reduction. A One way a community can better manage storms that involve damage to the urban forest to have a pro-active program in place to monitor the condition of the urban forest on a yearly basis. The advantage of this is to reduce the risk of un-necessary damage by examining boulevard trees and trees on public facilities such parks, schools, court houses, libraries and other public lands. The latter would include examination of edge lines on forest preserves, natural forested land along utility line edges and street frontage on private property.

Cities get to know their urban forest in several ways. The easiest way is a 'windshield survey' of all streets, parking, preserves and public lands. This type of survey will not gather all of the information that is needed, however it is a start. A better approach is to have a 'digital survey' of all public trees using an advanced hand held GPS instrument where the location of the tree can be determined as well as the essential characteristics of that tree such as species, size, condition and risk potential. These locations and this information is of course mapped into the Public Works, Planning Department or Tax Office GIS system so all public trees can be monitored and maintained according to a tree management schedule. Using the information from this survey will all tree workers to remove problem trees or storm train other trees by structural pruning techniques.

Risk reduction involves assessing a trees ability to withstand yearly storms. "Storm training" is an arboricultural service being offered by some companies and some independent arborist who come on to property and after a care analysis of the structural characteristics of a tree can proceed with pruning procedures to make the individual tree more storm resistant. Various techniques are used to lower the center of gravity that balance, reduce the mass of the crown, thin the tree to reduce wind load and remove weak joints and dead and dying tree parts. The several pruning methods used can be used effectively.

Fig. No. 20.0. Pre-storm Reduction Cuts

ScottServicesllc.com.jpg

Pine trees for instance with fast growing cellular matter and a high center of gravity are subject to high wind loads and bending stresses high in the tree. An off balance crown with relatively think tree mass can be strengthened by raising the crown of the tree and reducing dead and slowing dying lateral branches. Since it is normal for the pine to shed branches from the ground up as it grows it is easy to remove branches by raising the crown and thinning the leaf mass as a method of strengthening the tree and make it less susceptible to stem snap-off. Removing minor side branches and dead wood on the lateral branches is called cleaning. This too strengthens the tree and makes it more storm resistant.

The tree database in the GIS system allows the forestry manager to plan remediation of potential problem trees, remove hazard trees and track storm related damage all of which are important components of an urban forest storm preparation plan. Once a quarter all street for instance should be examined in the field with deficiencies noted. With this information listed in the database with a scheduled maintenance visit can take place to storm train the tree.

Removing non-native, deformed, off balance, insect or disease attacked trees along public streets before a storm reduces the possibility of blocked streets and downed wire following a storm. Trees that are obviously in decline and dying along streets and in public parking lots should be removed on an annual basis.

Also, trees that are growing in tight urban spaces surrounded by concrete or whose roots have been damaged by construction activities should be removed and replaced. It is common for trees with limit root space to tumble to the ground during high wind.

PREVENTIVE PRUNING-(STORM TRAINING)

Structural pruning
Cleaning
Thinning
Raising
Reducing
Balancing
Root pruning
Palm frond pruning

Table. No. 6.0. Storm Training of Trees

Interior trees within forests are not as important for two reasons, they are protected by other trees that surround them and there usually are not people around to be hurt or property to be damaged. In addition, if a tree falls in the forest it is part of a natural process that produces forest duff and natural mulch. This decay is important to wildlife and helps the forest floor to become an even better stormwater infiltrator.

Fig. No. 21.0. Thinning and Storm Training. Internet Sourced.

Tree debris following storms is a natural event needed by the forest to promote diversity of plants and wildlife. Downed trees, limbs and branches do not need to be removed following a storm. If they are removed, they would be the last elements to be cleaned up during recovery since there is no urgency. However, if wildfire is an issue too much organic storm debris can increase the risk of forest fire.

Having a pro-active tree management program is one of the prime reasons a community should invest in the creation of a Forestry and Landscape Office as a division of Public Works. This office can:

*Identify and remove hazard trees

*Storm train trees by pruning reduction cuts and shaping for structural integrity

*Remove trees and replant with appropriate sized species for the planting area

*Trees in decline should be removed on an annual basis and replacement tree planted

*Trees in conflict with power, gas, water and sewer lines should be removed on an annual basis

*Oversized trees breaking up sidewalks ought to be removed and replaced with a small stature tree

*Mulch, fertilize and stake young trees to ensure strong roots to prevent overturn in a storm

*Work with contractors to minimize root damage and soil disturbance during public construction

Table. No. 7.0. Risk Reduction Tasks

Risk reduction can also be increased by ensuring that all public trees that are planted are the right tree for the right place. All too often landscaping contractors who plant public project do not pick the proper species for the planting site available. How often do you see a native forest tree planted in a parking lot in a space that is only thirty-six square feet? This is a tree that is destined to come down during a storm from the day it is planted. Hurricane resistant trees with low profiles, sound structure, fine leaf texture and strong roots should be planted in exposed location within hurricane areas. In flood zones, only trees that can survive days of water cover should be planted. There are even proper species that ought to be planted in public parking lots. "Right tree, right place", one of the best ways to reduce risk.

Fig. No. 22.0. Structural Pruning. Internet Sourced.

Finally, storm damage to trees in snow belts and wind zones can be greatly reduced by '*storm training'*. This is work that is done by very experienced ISA arborists as a method or reducing stress reaction in trees. Storm training essentially means reshaping the tree by thinning, opening up, removing secondary leaders and cross branching. In addition pruning technique that reduce the trees height and leaf mass will assist in keeping the tree stable. Reduction cuts are used to shorten limbs. Tree topping or '*hatracking*' is never allowable as an arboricultural practice to reduce risk. However, '*lion tailing'* that removes too much of the lower branching yet leaves branching and leaf mass at the very end of a long primary limbs can actual increase the stress the tree. Main leader limbs should never be removed. This type of pruning should not be practiced as a risk reduction technique. Palms can be prepared for hurricane season by removing '*hanging petticoats'* that surround the top of tall palms.

Hazard reduction on private land is a different topic. Damage and breakage from trees growing on private property are the responsibility of the property owner. If private trees fall into the right of way or on to public property city staff is only allowed to remove what falls on to public land. They do not remove private trees. In the case of a '*property line tree'*, the public employees can remove a fallen or broken tree but only with private property owner permission.

Private land owners also need to understand that hazard elimination prior to a storm is in their benefit since removing trees that can fall may do great personal and property damage. Yard trees that are more than eighty (80) from a building are not such a problem if the tree is less than sixty feet tall. This will allow for a '*clear fall zone'*

where the tree can come done with killing someone in the house. Any tree that towers over a house is a threat and ought to be removed with the possible exception of live oaks. Smart planting will ensure that smaller trees should be planted close to houses. A best practice is to not plant any tree that gets more than 1.33 the height of the building. If the building is thirty (30) feet tall, a tree planted with within twenty feet of a house should not be taller than forty (40) feet tall.

Yard trees are not much of a problem to the public unless the stand next to and above power lines. If this is happens, then these trees become a hazard for the city as well as the property owner. Private land owners should have their property visited every few years by an arborist, urban forester or landscape architect who can assess the potential danger of a misplaced or too tall tree.

But what can a local government do to correct hazardous tree conditions on private property? Since damage to utility lines, public streets or street-side infrastructure is a liability to the community a community has a right to regulate the planting and maintenance of trees on private property. This is particularly so for trees that are planted within twenty (20) of the property line. In addition, since this is a matter of public safety to the unknowing resident, government has the responsibility do something to reduce risk. What can government do?

Government might provide public education classes to teach residents about trees. This is something a Tree Board or Tree and Landscape Commission might do as public service. If a community has a Forestry and Landscape Office there will be people employed who could offer this service too. Universities often have well qualified people who are capable and willing to lead workshops and offer advice to the general public.

The other thing a community can do is to change its local "Tree Ordinance" or the tree maintenance section of the 'Landscape ordinance"). Storm prevention changes to community tree regulations can do several things. For instance the codes might require annual inspections by citizens of their trees. It can require removal of any hazard tree planted within twenty (20) feet of a right of way (ROW) edge. If land owners do not remove trees that the public determines to be a hazard to public utilities, public walkways or roadways, then the public has the right by Tree Ordinance requirements to enter the property, remove the tree and then lien the property owner for the pruning or take down of the potential public risk. The code might also allow citizens to storm train their trees to make them stronger more capable of withstanding wind, flood and ice.

Fall zone requirements and planting distances might even be added for private property that would allow private citizens to remove dangerous trees growing to close to building and other private property. Finally, code revisions ought to suggest a list of trees that are more storm resistant, as well as a list of banned species whose growing characteristics have given them a reputation of being victim trees. On the list of trees that should be planted in Brookhaven would be the slow growing long-lived oaks, cypress, tupelo's and hickories. On the list of species to be banned due to structural problems or short lives include Bradford pear, red cedar, silver maple, perhaps even Chinese elm and water oak.

Response. The key to any Storm Plan is the response that is taken from the time the city tree staff is called out to take their appointed positions in anticipation of a storm to the time that recovery operations have been completed.

With minor storms that cause the downing of just a few trees operations may be finished in less than twenty-four hours. In the case of a major storm, a storm where trees are down and neighborhoods are cluttered across town, response operations including clean-up and repair efforts may extend well beyond twenty-four hours. Major storms can keep a community occupied for weeks if not months. Major and minor storms are also differentiated by the amount of damage, the number of lost trees, tonnage of green waste and the amount of help that is needed for recovery operations. Clean-up for major storms will take longer and recovery will involve systematic re-greening of the urban forest. This may take years of time. (Burban 1994)

Normally three to five hours of advance warning may be given for major storms but with micro-burst and other sudden events, warnings may be issued in minutes and not hours. City tree staff or administrative officers will mobilize the crews, prepare the equipment and gas up the vehicles as soon as the city is notified by the NOAA weather bureau that a major storm is expected to affect the community.

Fig. No. 23.0. Overturning in High Wind. Internet Sourced.

Once the warning has been given to mobilize the response it is critical to continue to monitor the weather for changing conditions. At this same time, alerts concerning tree damage, chain saw safety, yard clean up advice, and streetside green waste storage should be released by the City Public Relations Department for release to local newspapers, radio and television.

CALL RECORDS

Name and phone number of reporter
Exact location or address of incident
Is anyone hurt? Pets in danger? Elderly people involved?
Ownership of damaged tree
Proximity of damaged tree (residential, commercial, open field, paved area, utilities, in forest)
Proximity to utilities (power, gas, water, sewer, phone, cable)
Damage to surrounding features (roadway, utilities, signage, lighting, buildings, walls, fences)
Trees condition (leaning, overturned, split, snapped, downed branches, hangers, litter or debris)
Approximate size (diameter of tree or branch, height of tree, diameter of uplifted rootball)
Is further damage likely

Table No. 8.0 Call Record Log.

In a small community it may be the director of public works who is charged with recovery operations. In larger communities a forestry division supervisor may issue commands to an assistant forester who passes them on to crew chiefs who in turn manage the work of arborists, laborers and contracted assistance. Administrative people issue purchase orders, monitor working time, and prepare records of clean-up activities. Proper documentation and damage assessment and careful recording of all field activities and in house administrative procedures is key to receiving reimbursable funding. Field crews once in the field or up in the trees begin operations following industry (ISA) established working procedures and safety strategies that are routinely followed to prevent accidents and harm to property.

Some of the critical operations in this phase include:

*Mayor, police and media issue public storm proclamation if needed.

*Utilize telephone or on-line damage reporting system in which all communications between the public and the city are recorded. A hot line or web site should be established for tree damage emergencies.

*Prioritize all incoming calls (see inset) into a '*Emergency Service Log*' or call log.

*Expedite contract agreements with outside tree companies and help from various departments both from within city government and adjacent communities if needed.

*Dispatch damage appraiser(s) to scout the town immediately after storm abatement to determine key points where damage is exceptional, exceptionally disruptive or potentially lethal. For instance it is critical to get power restored for hospitals, elder care institutions, fire and police facilities and emergency response centers.

*Clean streets, right of ways, public lands and access points to private property of downed trees and broken limbs. Mark downed power lines with special signage and report incident to local utility.

*Coordinate movement of crews from one location to the next on a district by district basis

*Coordinate the movement of debris to several centralized temporary disposal and grinding areas.

*Tracking costs associated with cleanup, arboricultural services and prepare damage reports an assessment of repair or replacement costs.

*Assist other agencies as needed and support private property owners in critical and dangerous situations following owing strict city policy and insurance guidelines.

Table No. 9.0 Response Stage Tasks

Response winds down during and after clean-operations. However, this is when paperwork seems to begin. The conclusion of this phase makes the conversion of all incoming damage reports, work reports from various locations determined in the field, supply and equipment usage reports, summaries of contracted services and hourly work of

city employees into a 'Storm Damage Summary Report.' With interdepartmental cooperation this will give a proper accounting of the extent of property damage, tree loss, tree work conducted during operations and cleanup costs associated with each storm event. The contributions and work of each party will be easily understood and documented. This makes it possible understand to how to better deal with future storms.

Response is the critical part of a Storm Plan that requires constant training on the part of city employees. After each storm participants should have a debriefing session to discuss response operations. Other training sessions might follow on a periodic basis to keep all parties of the Storm Team abreast of all trends in urban forestry affecting Storm Planning, management, risk reduction and response. Each action performed during clean-up operations must be conducted using sound arboricultural and administrative procedures that will achieve predictable outcomes. Due to variation in storm types, such as flooding, ice, high wind, drought as well as storm intensity and duration it is not possible to list all possible response concerns of the Storm Plan. But these are general guidelines that can be used to develop a custom model for the city administration to follow.

PRIORTY OF DAMAGE NOTIFICATION
Trees down, injured people, people trapped in car or home
Trees or limbs blocking arterial streets
Overturned trees impacting utilities or infrastructure
Tree debris blocking access to private residences
Trees split, leaning or with significant hangers
Trees or large branches fallen blocking minor streets
Trees fallen or leaning on private homes
Trees on public lands or facilities
Trees fallen on automobiles

Table No. 10.0 Priority of Tree Damage Notification

ESSENTIAL ARBORIST DECISIONS
Identification of species
Determination of tree condition
Knowing when to storm-train a tree
Knowing when to restore a tree
Knowing when to remove a tree
Determining priority of tree treatment
Knowing how to replace a removed tree
Knowing proper cuts
Knowing work place safety

Table No. 11.0 Essential Arborist Decisions

Out of Town Tree Workers

Many communities, large and small rely upon out-of-town tree workers during major storms. These workers come in from other communities under a contracted basis just to help during the response phase. Contracts are always arranged in advance so pricing, work areas, work methods, equipment needs and reporting criteria are all prearranged. These people are contracted to assist the city and help people when necessary.

Other tree workers come in by speculation to earn money first and help people second. Special concerns and problems are presented in each case. Contracted response workers must be careful considered by any community devising a local Storm Plan. Small cities and towns often do not that the staff or the equipment to manage major storms. Small communities, medium size communities and even larger communities with limited staff and equipment find that emergency tree service staff and equipment are necessary. Outside tree companies are efficient, well trained, fully equipped and suitably financed but they must be managed by someone familiar with local trees to identify work to be done and to prevent collateral damage to healthy trees. They have a management structure that allows them to work under contacts and grants, stay within budget, record time and equipment use, mileage, supplies and miscellaneous expenses in an organized manner. Crew members are trained to work under emergency conditions and understand how to work safely within and around trees and power lines.

But when outside crews are used they must be provided with certain resources. A marshaling area for truck storage, equipment repair and fueling is required. Housing must be provided as well as food, water and emergency health care. Since they may be in the community for the first time it is important to provide them with a map, with emergency forestry clean up districts outlined showing temporary brush storage or green waste disposal areas. The map should also show hospitals, police districts and other necessary visitor safety facilities. It would be efficient to offer Chamber of Commerce information or brochures indicating where equipment could be leased, chain saws sharpened, supplies acquired or other needs the visiting crews and their employees.

Fig. No. 24.0. Health Services Must Be Available for Out-of-town Crews

For pubic work, the municipality uses organized contract labor. Yet much of the community will have tree damage to private property to. What do private property owners do?

Some residents will grab a chainsaw as soon as the storm passes and go to work on their property. There certainly is not anything wrong with this approach for people to take care of their own property. But this is where problems can occur that involves public safety. Many people do not realize the dangers involved in cutting up trees and working with chainsaws. Many citizens cause additional damage to their property, or neighbor's property, get hurt or even killed during cleanup operations. Through the media, citizens should be reminded of safety and the requirements of the local tree ordinance. A public brochure or web site should contain information for private property clean up and safety operations, especially those with chainsaws.

Fig. No. 25.0. Marshaling Areas, Food Service, Equipment www.bennetttreeinc.com. Image

A big problem is 'chainsaw backlash.' This phenomenon occurs when citizens go after their trees and begin to remove them out of fear alone. In Jefferson Parish, Louisiana, following Katrina it was estimated that as many trees came down as a result of chainsaw backlash as were actually removed by the storm. These trees, impetuously removed by nervous citizens, are healthy trees that made it through the storm and will likely make it through many other storms in the years ahead. But people get scared and start clearing their trees and this is damaging to the

urban forest and should be prevented by requiring tree removal permits, mitigation of tree loss by replanting and fines for disregarding the local tree ordinance. Removal of healthy trees following storms should be discouraged by changes to the community tree ordinance.

If a tree crews are available, they will assist private property owners too. In fact, some out of town contracted companies usually send additional crews just to handle private property requests. For major storms, tree service companies, not under contract to the city, will send crews in for clean-up activities to private properties. In addition, privately owned tree businesses will often show up just wanting to help and earn profits. They too can be put to work by the private property owner but some rules should be followed. But the private property owner must make sure the company is efficient, qualified, and experienced. Private property owners must require a written contract, proof of insurance, proof of worker compensation coverage, tax id, bonding capability and licensing. It is even smart to know exactly where a business is located. If the yellow pages list a tree company and no address is given this is a warning flag to be aware. The property owner can find themselves in court if someone is hurt on the job, a tree is dropped on a neighbor' house or even their own or if they are given an outrageously high priced bill at the end of the service. It is also a good idea for a community to issue temporary "tree service permits" to anyone coming in to the community to work on public or private trees.

DAMAGE REPORTS & RECORDS
Work Order number, Work assignment & authorization (name title telephone)
Crew names and job titles
Exact location or address of incident
Was anyone hurt? Pets in danger? Elderly people involved?
Ownership of damaged tree (public, private) (name and address of damage party)
Proximity of damaged tree (residential, commercial, open field, paved area, utilities, in forest)
Proximity to utilities (power, gas, water, sewer, phone, cable)
Damage to surrounding features (roadway, utilities, signage, lighting, buildings, walls, fences)
Size, species and health of tree service
Trees condition (leaning, overturned, split, snapped, downed branches, hangers, litter or debris)
Approximate size (diameter of tree or branch, height of tree, diameter of uplifted rootball)
Probably cause of damage
Nature of corrective action taken
Tree service provided, use of equipment, use of personnel by hour
Cubic yards of debris, how delivered, vehicle number, mileage to processing point
Disposal of debris (green waste mulch, land fill, burning, processing and sale of mulch)
Cost and revenue of disposal operations
Estimated cost of damage
Proposed recovery activity and potential cost
Instructions on follow up work
Job site work accidents or incidents
Name and contact number of recorder (date of incident, date of service)

Table No. 12.0 Damage Reports and Records

Reputable out of town companies always work under contract and have the qualifications necessary to engage in this type of work. They are properly trained and know how to make all responsible and safe tree cuts and remove or restore trees that have been damaged. But that is not always the case. One example, two elderly people in their

80's needed tree work in Baton Rouge following Hurricane Gustav. They engaged what is known as a "*fly-by-night tree expert*" or and "*opportunistic arborists*" who offered to remove two 40-50' tall water oaks that were broken and leaning near their house. Under non-emergency conditions these trees could have been removed, cut up, carried away and the stumps ground and the area cleaned up for what would cost no more than three thousand dollars. They were efficient. They had the trees down in two days. The owner's paid a bill for $22,000.00!

Some communities regulate the work of people offering arboricultural services and this might be a qualification addressed in the local tree ordinance. Buyer beware may not be adequate under emergency storm conditions.

The business operation manager is generally responsible for taking these field reports by work order number and formatting them for reimbursable expense accounting. It generally will be the work of the administrative staff to determine from the field reports the amount of equipment use, personnel time, vehicle mileage, supply expenses, contracted services and overhead cost that may be reimbursable.

Private Response

Public response and private response often take place at the same time. But for the most part activities take place in a most uncoordinated way. This happens since many communities have no health and safety regulations or public tree policy guidelines. And as a result, much damage is done to trees on private land. A well written community tree policy will provide private land owners guidelines for tree care before and after a storm.

Since the public has limited responsibility for trees deep with a private property it is up to the land owner to deal with storm damaged trees with just a few exceptions. One exception is where boundary line trees encroach onto public property. Another exception is when private trees may cause damage to public trees or neighboring trees as a result of insect infestation or disease. The third exception is when public safety personnel assist as a result of pending danger as when a tree has fallen on a home, or threatens to do so. It is a public responsibility to protect and serve the elderly and infirm and citizens in an extremely dangerous situation that may result during a storm. The public will stabilize the situation removing a fallen tree from the roof of home but the private land owner must finish the job once the dangerous condition has been abated.

Curbside collected brush removal does not take place for several days to several weeks following abatement of the storm. But this is one area in which the public and private landowner must work together.

A delay in clean up gives owners of private land plenty of time to plan their recovery and find out what they must do to get their property cleaned-up. They need to assess damage, determine what work they can do, and what work ought to be done by experienced professionals. In some cases they may not even know what the city policy is toward clean–up on private property. And this assumes that the public does have public regulations for private storm clean up and that the property owner knows what that policy requires. As a minimum, the following is an outline of the regulations that might be adopted into a community tree ordinance to be helpful to the general public.

This policy for private property response and recovery should be included within or referenced to the municipal tree ordinance. Any storm requirements that are placed on private property owners must be enacted into the tree ordinance and knowledge of that ordinance must be made widely known.

*Private property owners should assess the situation on their land by a careful inspection of all trees

*Owners need to be aware of chainsaw and equipment operation safety practices

*Owners should look carefully for downed power lines and immediately report them

*Out of town tree service contractors must obtain a temporary tree service permit from the city

* Owners should and then check all public utility connections to ensure operation, (water, sewer, electric)

*The first thing they do is determine open locations where green debris should be stored for city pick-up

*First priority will be cleaning driveways so that emergency and utility vehicle can access the home

*Secondary priority should be given to trees that are partially down, and or on homes or cars

*Third priority shall be cleaning up downed branches, leaves and wind blown or flood dispersed debris

*Last priority shall be replanting the trees that were lost using the right tree in the right place

*Green waste at curbside shall not impinge upon public utilities, block circulation nor create visual hazards

*Green waste at curbside shall not be mixed with other debris or household garbage or trash

*Some communities insist property owners transport green waste to neighborhood chipping yards

*Large property owners shall store green waste on private property, not curbside

*Chainsaw backlash is a serious problem. It should be discouraged by ordinance

* Have a professional arborist examine trees after recovery operations are complete

*Public trees and trees given protected tree status by the community tree ordinance cannot be removed by property owners without a permit.

Table No. 13.0 Response on Private Property

It may take some time for private landowner to even contract with help so it will often take longer for them to clean up than it might take the public. But following a storm and after cleanup operations on both public and private land is finished is when the storm recovery period begins.

This phase of the project is important at well. The main objective is of course to recover from a storm to replace valuable community assets that were was lost. Damage to the urban forest canopy must be repaired just as any other urban infrastructure system will be rebuilt following storm damage.

Recovery for the urban forest is to ensure that the rebuilt urban forest is stronger and more storm resilient than before. As a minimum, the public policy ought to be that one tree should be replanted for each tree that was removed. This no net loss approach to the urban forest canopy will ensure that the canopy over the city stays consistent. In fact, since it takes many years for small trees to grow a good canopy, a better policy to maintain the canopy is to plant three trees for each one removed during the recovery period.

Recovery (re-greening). During a storm a lot of activity and work takes place very quickly to get the community back in order. During the response period clean-up crews work tirelessly to get the city cleaned up enough that every day activities can resume. Arborist's work during the storm response period is involved with clearing near down lines, major branch reduction and removal of '*hangers,*' branches broken but hanging dangerously in the tree. Low priority damage, for instance with trees down in parks and in forest preserves may wait until the recovery period when less rush is required on the part of workers. They usually do not worry about restoration pruning and will not take time to remove smaller hangers unless they occur in an area with many people present. Most severely damaged trees are removed during the recovery period. Restoration pruning is something that usually the first stage of recovery.

Fig. No. 26. Wentworth College/Mississippi School for the Arts, City Data.com image.

Fig. No. 27.0. Restoration Pruning. ehow.com, Dagny Roark image

Tree Restoration Activities

Restoration practices and take-downs of badly damaged trees are the first part of recovery. These are both major arboreal operations that require skill, experience and safety training.

Safety comes first when cleaning up after a storm. Major injuries or even death can result working around power lines, severely structurally damaged trees and from extending oneself with a powered up chainsaw.

WHEN TO REMOVE A TREE
Lower main trunk is cracked, broken or twisted.
Co-dominant leader stems broken
Larger lower limb split from trunk
Large tree leaning toward a target
Major roots severed by tree overturning
Remaining tree thought to be a problem tree
Ill shaped with several limbs and leaders removed
Noticeable girdling roots
Slightly uplifted root plate in a restricted area
Misshapen non-native tree

Table No. 14.0 Tree Take-downs Are Necessary

Trained professionals wear protective equipment such as hard hats, eye ware, safety boots, gloves, chaps, hearing protection. Well-stocked first aid kits must always available. Water is provided to avoid heat exhaustion. Arborist all assess each tree to be worked on from the ground before work begins. They map out in their head a plan of action for the tree work required on each and every tree. Before work begins they ensure that the work zone is clear, free of debris and combustibles and marked with flaggers, barriers or ribbon. They must understand the safe operation of equipment and know all of the proper cutting procedures.

Most work is done by a crew with various responsibilities. It is not safe to work alone and while working cutters must be aware of where the ground workers are located at all time. Work is always safer from a highrise lift so avoid climbing in trees if possible and never work from a ladder. Only line clearance arborists should work near power line.

Felling trees in tight areas must be done very carefully. If not possible then the parts are slowly lowered to the ground piece by piece. Once a tree is down there is a sequence of cutting it up that is usually mapped in the head before chopping and chipping operations begin. Cutters begin by removing and clean-up of the branches first. These are immediately chipped. Then they proceed to reduce the limbs to manageable size, then the leaders are sawn into sections and finally the trunk is sectioned to sizes that are often removed to a sawmill. Stump removal is the last operation.

Restoration activities can save many storm damaged trees and through preventive pruning can prepare trees to withstand future storms.

Arborist assess damage to storm harried trees immediately after the storm. It is important to conduct 'tree triage' or tree damage assessment and determine the condition of the tree. Is the lower trunk split or broken? Is there a large leader stem that has split at a crotch along the trunk?

Are major roots damaged by uplifting? Certainly the tree will be de-leafed but the leave will sprout again soon. Is the tree off center? Is it leaning over a building or street? These are all assessment questions that are asked by the treating arborists before and cutting is commenced.

No. 28.0. Planting For The Future. Buckshort.blogspot.com, Penn State University, Horticulture

If major limbs are broken and the tree is leaning it might still be restored by careful pruning. Sometimes these trees end up looking ghostly to some people but to those who live in hurricane zones they are just mementos of past storms. There is not an urban forest along the gulf coast that does not have its share of very sculptural trees. In fact, they are expected in coastal areas and are just part of the seaside landscape character. Trees like live oaks that are pretty decay resistant recover well from storm tree damage. Other species that are not decay resistant ought to be removed if they are split, twisted, broken or overturned.

Restorative pruning techniques being applied by an experienced arborist can save many trees and make damaged tree look good in the landscape. Several techniques of pruning trees are used to make trees more wind resistant.

Structural pruning is used to reshape a tree have major stems or limbs have been removed. Removal of a co-dominant leader is an example of structural pruning. It reshapes the vary character of the tree. Cleaning can make trees more storm resistant by removing some of the interior branches that are dead, broken, crossed, rubbing or diseased. Hanger removal are of course an example of this technique. Thinning is another strategy that is used to increase the load carrying capacity of a tree. Thinning essentially is the selective removal of small live branching to reduce crown density, increase light and air penetration and reduces the risk of storm damage. Too much thinning of the interior is called 'lion tailing' since what remains are not interior leaves but twigs and leaves at the very end of limbs that resemble a lion's tail.

Fig. No. 29.0. Recovery by Tree Planting. www.blog.arborday.org

Reduction is another restoration pruning technique that selectively removes branches and stems to decrease the height and spread of a tree. This reduces the mass and the wind friction load of the tree and allows it to be more storm resistant. Live side branches can be removed to reduce the profile of a tree or certain branches may be reduced to avoid power lines. Tree topping is not an acceptable reduction technique. Raising is similar to reduction. Raising removes branching close to the ground. This allows more of the trunk to be seen and can be used to proportion the height of the tree to the height of the trunk. Raising is a pruning technique used to development more clearance along sidewalks and around the perimeter of parking lots.

Balancing is a controversial technique. Arborist often feel that a tree look better if symmetrically balanced. These trees tend to resemble balls or lollypops. Landscape architects and sculptors however tend to favor asymmetrically balanced trees that are not static but in effect give a since of motion, spatial character and a slightly off balanced canopy. Either way, a good arboricultural practice is to make a tree look better and have a good visual profile against the sky or a building.

But where balancing is really important is where you have clumped trees. If a clump or grove is damage by wind, flood or ice it will take the eye of an artist to make the clump look good after restoration. The key is to examine the

clump or grove from all directions. A good end solution may result where you have symmetrically and asymmetrical balance both present in the finished composition of tree materials.

Arboreal cuts using chainsaws, extension saws or loppers to a storm damaged tree is both a science and an art. Improper cuts can disfigure trees and in the case of decay may even lead to the death of the tree.

Arborist must utilize several kinds of cuts during restoration. They include 'removal cuts', 'reduction cuts,' and 'heading cuts.' No 'collar cuts' are allowed and when removing large limbs several cuts, top cut, middle cut and bottom cut must be made to prevent a large limb from splitting or debarking the tree trunk. Of course every arborist understands that 'no topping' or 'hatracking' is allowed since they completely destroy the structure of a tree. 'Flush cuts' that remove branches all the way back to the trunk is a poor practice as a restoration technique. Cuts like this encourage interior decay. Special care is given to pines, palms and large shrubs.

Fig. No. 30.0. Preparing The Tree Pit.www.arborday.org

CHAINSAW SAFETY
Wear Protective Gear
Understand Owner's Manual
Know Chainsaw Safety Features
Cut Below Head Level
Cut at Waste Level Preferred
Avoid Kickback
Be aware of Spring Poles
Both Hands on the Saw
Adjust Blade Tension
Cut Only Wood
Carefully Fuel the Chainsaw
Engine Off While Walking
Do Not Approach a Cutter from Behind
Keep Equipment Properly Maintained

Table No. 15.0 Chainsaw Use

Young trees with limited root development will often be blown over in wind or flood. Crape myrtle trees are highly susceptible to this. If the stem is less than 6" it can often be upturned, and staked and will recover well.

Risk reduction as noted above may be necessary as well to remove trees that were weakened, broken badly or completely overturned by the storm.

Arboricultural work used in recovery such as storm training, and restoration pruning, and planting make a more storm resistant urban forest. This is the planned outcome and results in the re-greening of the community and strengthening of the urban forest to stand up to future storms. Community organizations and volunteers from neighborhoods are often called upon for this phase of the work.

Patience is required during recovery. Trees that look dead following a storm may in fact only be de-leafed. Dropping of leaves is common reaction of a tree to protect itself from wind damage. They usually will spout new leaves in a matter of days or weeks at the most. Some trees do suffer from de-leafing and will not be fully leafed

out for years following a storm. Have patience, and give the tree time to return to normal. Also, it might be noted that some trees do get heavily damaged by storms but do not show the immediate effects. They may in fact start a long slow decline. Keep your eyes trained on the upper most leaves of the tree. Dieback at the top is the sign the tree is in decline and will eventually die since trees die from the top down.

Tree Replacement Activities

In August 1990 a tornado strikes a Midwestern community destroying property and leaving twenty-nine people dead and over 3000 community trees destroyed in its wake. This by itself is a prime disaster since human life has been lost and homes and property must all be replaced. And of course people's live are extremely disrupted and they too need to be put back together. This has to come first. The landscape becomes a back burner issue until lives and property has been restored. To accomplished which may take several years. But there eventually comes a time that a community will consider its trees.

The trees in this community are nearly gone and those that were able to survive are severely deformed and may not be able to be restored at all. Tornado activity at the F3 scale with wind speed wind speed of 158-206 mph is enough to uproot trees in a forest. Cat F5 on an F6 scale, is considered violent tornado will debark trees which kills them completely.

But a community must have its trees, if for no other reason than to remove the psychological impact of the denuded landscape. But how is this to be accomplished.

To 'releaf' a community that has been storm damaged requires people, trees and money and an organization to make it all work. Since there are Federal, State and local agencies all willing to assist with technical advice and some potential grant sources this is a place to start

Fig. No. 31.0. Restoration Can Be A Social Function.
www.tullahomatn.gov

when it comes to re-greening a community after a storm. However, public money is scarce for tree planting and agencies are hampered by the fact that most of the trees to be replaced are on private land must be provided by donations from private individuals and commercial enterprises.

If a community has a forestry department they can take the lead on organizing a replanting program. If not, there are non-profit tree planting groups or conservation organizations or some foundation or in some instances NGO's (non-governmental organizations) that get public money to do private work government cannot do.

The lead organization is responsible for collecting money, disbursing it and keeping all records. Private volunteers must however assist in the mechanics of all of this and these volunteers are not paid. Since the lead organization is

the responsible fiscal party due in part to being tax exempt, the volunteers get to lead people and volunteer organizations who will do the planting and other activities, including social fund raising events, acquiring the tree stock from local nurseries and issue vouchers for private tree planting and work groups for public planting operations. Local landscape architects may volunteer time, drawings and specifications to assist with the implementation of plans for reforestation of public lands.

The organization that leads this effort usually chooses a flashy name such " *Ice Storm Planters*" or "*Flooding Re-leafers*' or "*Hurricane Helpers*' that will attract attention and increase excitement about helping or donating money to the cause.

Several interesting things occur as a result of a program such as this. The amount of tree education that is spread around the community as a spin-off of a restoration program leads people to plant trees on their own property as their own expense since they too want to contribute to rebuilding the urban forest. What is nice about this, everyday homeowners find out what trees are the best to be planted in the community. They learn from the program and tend to plant well-adapted native trees and not weak wooded non-native species which may break up in future storms.

It is amazing what a committed re-leafing organization can do with donors, volunteers such as Boy Scouts and the churches working under the expertise and guidance of the green industry when it comes to releafing a community. We will never replace the lives of lost loved ones but we can replace the trees lost in the storm.

Codes and Standards

Re-leafing a community following a storm is an event that happens rarely, takes place relatively quickly, adds new trees that are planted and eventually fill out to provide their share of the community tree canopy. But a community cannot maintain the minimum urban forest canopy desired by replacing storm damaged trees alone. Volunteer plantings must be accompanied by required plantings that are included as a central feature of the develop process. Since development removes urban forest trees by the acre, a community must have codes in place to require that trees removed for development are replaced. This is the common way that a community ensures a minimum canopy standard to provide the environmental services that an urban forest can supply.

All cities of any size that have planning and zoning regulations have some regulations generally referred to green laws.

Green laws are defined as public policy that protects, preserves and rebuilds nature in the city. These regulations in the form of tree ordinances, landscape codes or land development regulations have been adopted widely to manage the green infrastructure of a community. At the very least, all communities should have some management regulations for urban trees that are an important part of any communities livability and charm. These regulations are enacted to in part to prepare standards for the planting and maintenance of new trees as well as the preservation of existing native trees. They may take the form of standards for street and park trees, trees and shrubs for buffers and screens and tree planting in expansive parking lots. But equally important but not so widespread are urban forestry standards to minimize damage caused by storms to a communities tree population. These urban forestry standards as set forth below in in Fig. no. 18 may also make a communities tree ordinance more storm responsive.

The '*green infrastructure*' is defined as the sum of natural processes or conditions in the city that are part of nature's realm that are constantly providing natural services dealing with air, water, vegetation, soil, wildlife and climate.

Visually, the green infrastructure of a city is composed of all open space such as parks, gardens, yards, street corridors, forests, meadows, wetlands and water bodies and constructed landscapes. Even grassed lawns that make a pattern within the city, that have about as much ecological value as an asphalt parking lot, allows the infiltration of water and the production of limited amounts of biomass. So grass lawns by our definition add to the production of environmental benefits accruing to a city and its citizens

Fig. No. 32. South Jackson Street Garden

Brookhaven, Mississippi, Jay Perkins Photo: CityData.com

Brookhaven has limited regulations or policy toward nature in the city. The town does have a Land Development Ordinance that covers landscaping and trees in a very general way. It discusses trees in regard to parking lots, and street protective yards and provide lists of acceptable trees. Tree regulations are not very specific however. It would be important to upgrade the tree requirements of the Land Development Regulations to reflect the commonly accepted standards found in Table no. 16. To upgrade would mean to simply add a new Subsection XII following the subsection that describes land disturbance and erosion. This section could cover plantings, maintenance and storm preparation, risk reduction and recovery.

Certainly rules and regulations for trees on public property must be addressed. But it would also be useful to at least provide some regulation for planting and maintenance guidelines for trees on private property.

The most difficult thing to achieve is to get a workable ordinance into the code book. Once there, it is much easier to update and improve it. The Storm Plan being discussed in this document could be referenced to this new subsection XII. The ordinance could make it possible to set aside wooded wetland areas within the city as locations for the collection of storm water. Flood plains within the city, which is where most flooding storm damage occurs should be preserved and protected as natural drainage areas. The urban forest of most cities set aside natural flood plains as areas to accept storm overflow. It is important when stormwater overflows a flood plan and sedimentation causes the death of trees to replace those trees with wetland species that have adventitious root systems that will allow sedimentation without killing the trees. Trees like willow sprout this type of root system as land builds up over the roots during flooding events. Cypress and tupelo also thrive in overflow areas.

The tree ordinance might be updated to reflect a more current state of the art in tree regulations. For instance a recent survey in Georgia that questioned 686 communities and thoroughly reviewed 85 ordinances from this population of cities sheds a great deal of factual light on what community tree ordinances are designed to do. (Head, C., Georgia's Tree Ordinances 2006). This study defined five (5) variations of ordinances in Georgia. They consisted of ordinances to regulate public trees, private trees, landscaping, buffers and ordinances that created Tree Boards. Within these five types four broad classes or articles of regulations were included. Included within these three articles will be found specific categories (sections) that include 'regulations', 'administrative procedures', 'community tree management structure,' and an 'educational component.' These categories or sections of specific regulations consists of 47 various regulations that cover the full range of tree regulations. Some of the more important include;

TREE ORDINANCE REGULATIONS

Purpose & Intent
Authority
Definitions
Administrator (arborist, forester)
Creation of a Tree Board
Budget
Tree Inventory
Canopy Cover Measurements
Public Trees (streets, parks, public grounds)
Tree Species List(s) & Diversity
Licensing, Procedures, Permits
Tree Density Requirements
Storm Plan & Planning Regulations
Preservation & Protection
Tree Replacement
Root Zone Requirements
Tree Protection & Replacement Plans
Fees
Enforcement, Violations & Penalties

Table No. 16.0 Tree Ordinance Regulations

Fig. No. 33.0. Restoration Begins in the Ground. www.arborday.org

Presently the Brookhaven tree ordinance as adopted after a long vocal public discussion is essentially a two category code. It creates a Tree Protection Committee and a case by case arborist to work for the public on questions involving trees.

It is highly suggested that the city consider and upgrade to the tree ordinance to include at least the following sections.

Adoption of a 'minimum canopy standard' for the city is critical to maintain the character and quality of the town. In addition this will ensure that environmental services benefiting the community by the urban forest is sustainable for generations to come. Minimum canopy standard will apply to each zoning district. This will be written in such a way that there is more protection to the existing tree canopy, and that when any native trees are removed they are replaced. This will ensure that every new and re-permitted development site plants a certain number of young trees to maintain the city wide minimum canopy percentage.

Secondly, when protected trees are removed, they should be replaced with planted and maintained trees. Allowing a cash payment does not ensure the city tree canopy is sustained and in some instances it appears to be a tax and that does not sit well with the development community. But having a tree fund is used by many communities since it is very easy for the developer and the city to handle. Developers look at it as a cost of construction to be factored into the cost of a development. Since the developer writes a check it frees them from the responsibility of actually mitigating the loss to the public for the tree plantings. This technique is used in the small community of Coral Springs, Florida to completely fund their municipal tree planting program.

Third, since most tree ordinances treat trees on public land such as streets, parks and public grounds it would be very useful to define suitable trees to be planted along streets, under power lines, above underground lines and in parking lots. Having specific street trees selected to convey the street character the town desires would do much to promote quality of life and tourism. By selecting the right tree(s) for streets would avoid many problems conflicts with utilities, sidewalks, streets and corner view blockage.

Forth, the reader may have noticed above that storm management plans are not found in Georgia. Why is this so? Well this is a developing area of public safety and welfare that can help ensure the sustainability of the urban forest. So adding a section to the Tree Ordinance that covers, planning, management, risk reduction, response and recovery as this document suggests makes a lot of sense.

Fifth, The community tree ordinance ought to recommend the most storm resistant trees to be planted in yards in gardens. Similarly, the tree ordinance should ban all trees that are fast growing, weak wooded, with shallow rootballs and heavy texture. These are the types of tree structure that do not hold up well to wind, ice and flood on private property.

Fig. No. 34.0. Tom Brady Home Brookhaven, CityData.com

Last, the present ordinance is a little disjointed from a written point of view and needs to be cleaned up. For instance it does not define technical terms and implies certain responsibilities that are not clear or written in such a way as to be prescriptive, proscriptive, an incentive, disincentive or regulatory

A community landscape code is all about rebuilding nature in the city and it is one of the prime document needed to have some regulation over private property, especially in regard to tree protection during construction

and tree planting in general. Since we have seen that commercially zoned districts generally remove more tree canopy than they replace an updated landscape code will see that more trees are planted. Specifically in yard buffers, along street front perimeters and in parking lots. A community landscape ordinance will increase the amount of trees that are planted in the city by an estimated 15% and may reduce the clearing of existing trees by 10% for a net gain of 25%.

LANDSCAPE CODE REGULATIONS
Purpose & Intent
Authority
Definitions
Plant Material Standards
Sustainable Landscape Design (LEED, SITES)
Minimum Canopy Cover
Street Yard Buffer
Parking Lot Screens
Parking Lot Interiors
Parking Lot Detention
Parking Lot Stormwater Management
Parking Lot Shading
Land Use Buffer Requirements
Service Area Screening
Irrigation Design
Landscape Plans & Specifications
Licensing, Procedures, Permits
Tree Density Requirements
Tree Preservation & Protection (see Tree Ordinance)
Plant Material Installation & Maintenance
Enforcement, Violations & Penalties

Table No. 17.0 Landscape Code Regulations

The effects of this can be visualized by looking at Brookway, Boulevard. If a landscape code was in place requiring a minimum canopy standard of 15 trees per acre, this street which is not that visually unappealing would be greened up considerably. Minimum standard that might be enacted in your landscape code would be standards for plant material sizes, planting operations, irrigation, street yard buffers, minimum canopy standard, parking lot screening, parking lot shading and interiors (including stormwater management) planted buffers between conflicting land uses and screening of service facilities.

Landscape code generally apply to commercial development but you could include a lot planting requirement for all home construction to include a minimum of three 'storm resistant trees' per lots as a storm protective measure and to help maintain a minimum canopy standard as directed by your tree ordinance. These should be trees that follow the 1/3 rule in regard to height over the roof of homes. These trees could be planted within a designated fall zone within a sixty (60) foot radius to a building. Within this fall zone, existing trees failing the 1/3 rule could be removed to prevent storm damage to homes from falling trees.

Each of the Brookhaven ordinances are limited and somewhat out of date compared to other communities of its size. Mandeville, Louisiana's green law regulations would be a very good model for Brookhaven to follow. When landscape codes are upgraded they should consider the inclusion of sustainable landscaping practices that are earth friendly. This is the direction that contemporary landscape codes are taking across the nation today as they are being written to support landscape sustainability. A landscape code is an essential tool to ensure that nature is providing services and benefits to a community in regard to all new construction and redevelopment.

Storm Responsive Codes

When the State of Louisiana adopted a new statewide building code on January 1, 2007 following the devastating Hurricane Katrina they underlined the fact that hurricanes along the Gulf Coast cause tremendous damage to coastal cities as a result of local building practices. Louisiana and other states along the Gulf of Mexico realize that building codes must be responsive toward hurricane storms by reflecting the state's concern for health, safety and welfare in regard to development in areas subject to hurricane winds and tidal surges. Building codes have been adopted as a state wide regulation to make the coastal parishes of the state more resistant to the threats posed by tropical weather, high winds and inland flooding, all a result of tropical weather.

Fig. No. 35.0. Tree And Landscape Code Administrator, Baton Rouge, Louisiana. S. Shurtz Photo

These building codes were designed to protect buildings and people who shelter within them. The building codes do not address the urban forest which when damaged by tropical storms creates the largest volume of storm clean up debris and is largely responsible for power outage for weeks following such an event.

Sadly the new storm resistant building codes do not address trees, urban forests or public safety in private gardens. These natural parts of urban communities are subject to the same stresses and potential destructive forces of nature that impact houses, shops, schools, hospitals and places of recreation and worship. Yet there is no public policy in regard to storms and trees in any tree ordinance or landscape code along the Gulf Coast.

It is important to recognize that that community tree laws and landscape codes are the proper forum for public policy towards trees. Communities express in their green regulations their official recognition of trees as an essential part of the community fabric. They should also express their concern for trees under the stress of hurricane conditions. But they do not.

But as seen in the side bar, there are proper tree ordinance storm responsive regulatory methods and procedures that can be codified into community tree ordinances in severe risk zones such as along coastlines and other openly exposed locations. However, some of the clauses listed below are seldom included in local tree ordinances or landscape codes. For instance there are few regulations that call for annual tree inspections for trees located where high wind is a threat.

Fig. No. 36.0. Planting To Code Standards. www.arborday.org

STORM RESPONSIVE REGULATIONS

Purpose & Intent
Authority
Definitions
Tree Inventory
Annual Tree Inspection
Tree Relationship to Buildings
Tree Fall Zones Defined
Horizontal & Vertical Layering
Removal Criteria
Use of Storm Groves & Flood Plains
Storm Resistant Species Selection
Banned Species
Proper Planting Procedures
Protection of Root Zone Areas
Storm Training
Pre-storm Risk Reduction
Development of Emergency Operations Program (EOP)

Table No. 18.0 Storm Responsive Regulations

A survey and review of adopted tree ordinances was conducted at LSU several years ago to determine if the ordinances addressed storm damage. Researchers found that few community tree laws from Texas to Virginia properly puts forth public tree policy in regard to hurricanes or other storms that may be caused by tornados, ice, drought, earth movement, lightning or fire.

No community tree ordinance in Louisiana, Mississippi, Alabama and Texas address the threat of hurricanes on the urban forest or the private garden. None of the ordinances addressed planting practices or species selection in regard to storms

Why don't tree ordinances address hurricanes or other weather event that cause damage to public and private trees? The reason for this is that storms come, and quickly go and communities have never considered regulations for public safety or for the sequence of activities related to storms we have been discussing.

It is seems reasonable in light of health, safety and welfare for a community tree ordinance to include regulations or practice guidelines for storm management.

Tree ordinances within the coastal regions of this country can be more storm responsive! It is appropriate for contemporary tree ordinances to provide minimal regulations as public policy to deal with storms and the urban forest.

There are some obvious standards that will protect the public health, safety and welfare of citizens that might be included in the body of a storm responsive tree ordinance. Some of these policies fit in nicely with the proposed storm plan and can be a supportive element to the plan.

Consider these factors that could easily be added to any community's tree ordinance to make it more responsive to storms caused by wind, ice, flooding, lighting or other natural factors affecting the urban forest.

A storm resistant tree ordinance begins with recognizing in the purpose and intent clause of the ordinance the fact that the urban forest tree canopy is an important element of the infrastructure of the city and must be managed before and after storms. To properly manage an urban forest for storms it is important to section the city into forest zones and inventory the trees in those areas to create scientific data that will assist in understanding health, age and condition and species of trees which are the factors most related to storm damage.

For a tree ordinance to be responsive to its local population of trees, on both public and private land the ordinance must be written to contain several technical standards that will either strengthen the forest or reduce the risk of weak, damaged or older trees from falling. The first standard will encourage the city to write an urban forest storm plan, appoint a tree manager to be in charge and prepare a plan based around planning, management, risk reduction, response and recovery operations. The storm plan will set forth a tree emergency operations plan for tree related operations immediately following a storm disaster.

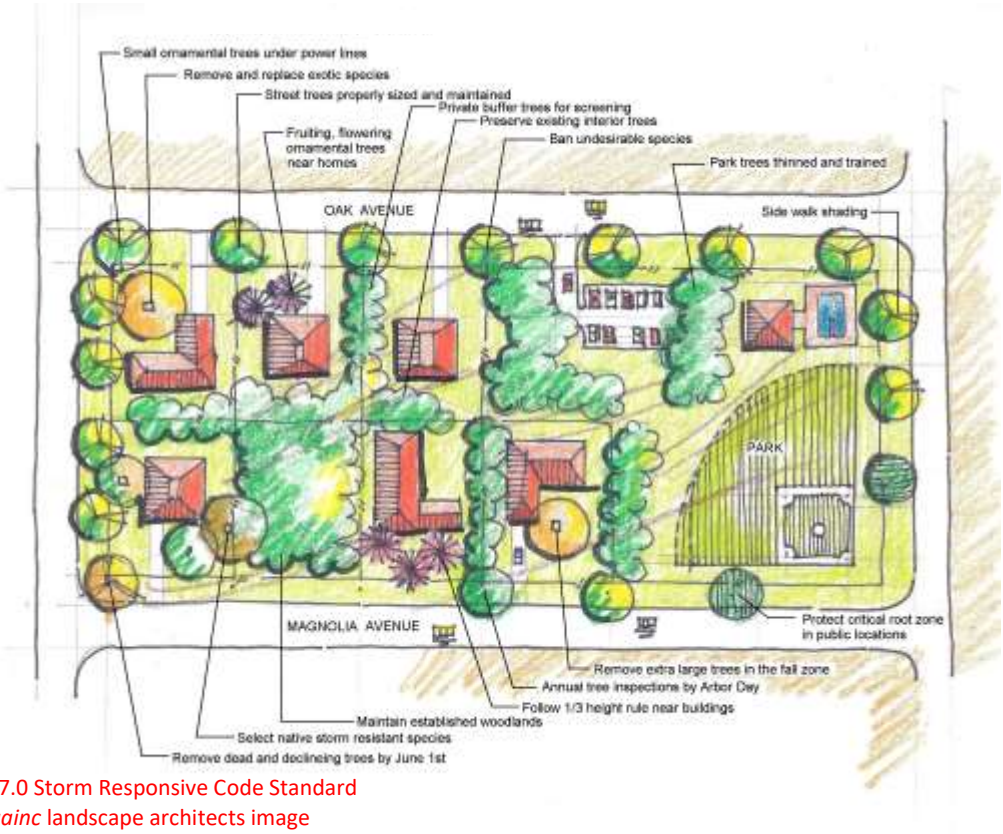

Fig. No. 37.0 Storm Responsive Code Standard
aainc landscape architects image

Fig. No. 36.0. Planting To Code Standards. Secondly, another standard will encourage annual inspections by property owners of all trees near buildings, public streets and in public locations that could fall during a storm and cause damage to life or property. Inspection is one of the most cost effective ways to reduce risk and to notice trees that are in decline or are species known to break up in storms. Inspection by citizens on private property is also important and should be mandatory for all trees that could fall into public streets.

Thirdly, a series or pro-active risk reduction, planting and tree removal criteria should be built into the ordinance. These are considered the technical essence of the storm responsive actions to be included within the ordinance. They include defining a fall zone and tree height restrictions near residential buildings based upon the gable elevation of the building. Other technical policy will include standards for tree removal, layering of trees to reduce wind damage, removal of non-native species and planting more storm resistant trees. It is very important to include storm training of trees as one method of reducing tree damage and clean up operations. Damage prone species should be identified and listed in

the ordinance to be banned near residences, along public streets and in community parks. All trees planted within the designated fall zone should be designated as the most, wind, ice and hardy species known to thrive in the community. And finally, proper planting and critical root zone protection must be observed with the planting trees.

Lastly, a storm responsive tree ordinance will set standards for operations training for staff, other city employees involved with emergency tree activities, arboriculture professionals, contracted tree service companies, volunteers and interested property owners on a regular basis. Training and education along with annual tree inspection's and proper planting techniques are perhaps the most effective way to reduce or mitigate storm damage to the urban forest.

A well-written tree ordinances will include the above technical standards and bring to the attention of the city as well as residents that the green infrastructure of the city is and important community asset well worth the cost of managing the urban forest. As pointed out by Robert Miller in his 1998 book *Urban Forestry*, a community tree ordinance must do three things. They must "provide authority, define responsibility and establish minimum standards for management. We would add, that one of the standards needs to be, to make the ordinance more responsive to storms of all types, fire, ice, wind, flood, lightening, erosion, heat, cold, drought, insect invasion, disease distribution, climate modification and perhaps the biggest storm of all, mechanical damage caused by mankind building cities.

The Brookhaven Land Development Ordinance contains landscape regulations. These regulations are very good for a small community. The City should be proud that their landscape regulations are among the best in the state. These regulations set forth landscaping procedures and general requirements for landscaping street yards, parking lots, loading and services as well as installation and maintenance of landscaping. In addition the ordinance addresses land disturbance and erosion. Tree regulations within the ordinance are too general.

More specific tree regulations should be set forth in a new subsection (Subsection XII) of the Brookhaven landscape code. There should be more guidelines for trees written as city standards for selecting tree species; planting young trees; pruning to shape and strengthen; tree removal and maintenance to maintain a healthy urban forest. A new tree ordinance for Brookhaven should adopt the recommended general tree ordinance regulations as seen in Table 17. It would also be good to add the recommended storm responsive regulations as seen in Table 18 too. Both should be incorporated into the community tree regulations in an appropriate manner.

Street Trees for Brookhaven, Mississippi.
aainc landscape architects image

A Summary of Best Management Practices as part of a Storm Plan.

Planning. Planning is a critical factor in reducing storm damage to the urban forest. Public and private land owners shall understand that storms occur over the city and they must be aware of what to do to prevent property damage and loss of life as a result of poor species selection, improper planting and lack of maintenance. All property should have their trees examined once each year to uncover defects and finding signs of decline.

Management. Property owners must understand the effects of storms on the urban forest. For each property, both public and private someone must be responsible for tree management and making decisions about tree care and maintenance. An incident command system must be developed for each city to be prepared for storms and tree damage.

Fig. No. 38.0. Downtown Brookhaven, Mississippi

Risk Reduction. Risk reduction is one sure method of reducing storm damage and clean-up following a storm. A variety of techniques are available to land owners from the arboricultural industry to reduce the risk of tree failure. Some of these techniques include storm training, preventive pruning, species selection, proper tree maintenance and removal of potential problem or hazard trees. Site plan adjustment is a reasonable risk reduction technique for use on both public and private land.

Response. Response must be timely following a storm since danger will always be present with damaged or downed trees. Only arborist having a Tree Surgeon license or equivalent from another state shall work on public trees during the response period. Only ISA certified arborists shall be allowed to work around power lines. Green waste must be responsibly temporarily stored, collected and recycled.

Recovery. Severely damaged trees that can be restored following the storm shall be, Especially if they are a native tree, well adapted to the soils and climate of the community. Non-native damaged trees ought to be removed and replaced with a hardier native tree better able to with stand the forces of nature associated with wind, ice, drought, flood damage, insect invasion, cold weather and lightening. Chainsaw backlash to non storm damaged trees that are solely based upon fear shall be repressed. The community tree ordinance shall have a requirement that a tree removal permit shall be necessary for all undamaged trees left standing if they occur outside of a dedicated tree fall zone or do not exceed the 1/3 height rule. All trees lost due to storms shall be replaced with hardy native species only. The City should work with private donors, private citizens and especially young boys and girls to replant community trees lost during a storm Tree species selected shall be more storm resistant native 'overstory species' or smaller flowering-fruiting- fall color bearing- structurally interesting 'ornamental trees' properly planted in the right location.

Recovery activities must make the urban forest more resilient to future storms that surely will hit the community.

Best Practices Standards

The following best practices standards have been prepared and are recommended in appendix Form. Collectively the appendix material adds valuable content to this documents that can be used to customize a storm plan for any size community in Mississippi. They provide content and procedure that can be inserted into a community's Storm Plan. The standards presented for each of the five (5) best practices can be refined by inclusion or exclusion of any of the standards presented.

Some of the standards included below for implementing as best practices may not be suitable for small communities. They may not be feasible due to complexity, cost or personnel shortage. Others may be most appropriate. Some may simply be modified to meet local needs.

Figure No. 39.0. Trees Form the Backdrop for Brookhaven, Mississippi. CityData Image

There are some obvious standards that will protect the public health, safety and welfare of citizens that might be included in the body of a storm responsive tree ordinance. They follow and are included within one or more of the Appendices that are related to each urban forestry best practice.

They include;

Appendix A - PLANNING

Standards for **planning** for a storm for both the public and the private sector.

1..A pre-storm or once-a-year inspection standard added to the local tree ordinance for instance would encourage both public and private tree owners to inspect the trees on their property. The best day for this annual inspection should be Arbor Day in the spring.

Trees should be inspected yearly for hazard potential, decay, die back on upper branches, splits and root uplift. Check each tree for structure to ensure a dominant leader is healthy and growing.

Eliminate excessive co-dominate leaders in favor of one strong central leader

Check canopy yearly looking for discoloration in the leaves.

Check all major limbs to find co-dominate stems, weak joints. Ladder branching by removing limbs that stunted, crossing or at unnatural angles to the main truck of the tree.

Check major limbs for included bark joints since these are weakened points in need of correction.

Check critical root zone areas for any mechanical damage that may have occurred as a result of construction contact.

2.. A removal standard that addressed 'hazard trees,' those overhanging houses for instance, or 'problem trees,' those suspected of decay, disease or obvious decline should be marked for removal.

3.. Incorporate the ***Florida Principles*** in the tree ordinances to strengthen private and public landscapes to better withstand coastal storms.

4.. Remove all trees that fail to releaf in the spring.

5.. Check trees for lighting strikes that tend to expose a long linear strip of removed bark along the outer edge of the tree trunk.

6.. Make a list of all corrective tree work that may be necessary

FLORIDA PRINCIPLES
Use Tree Care Professionals
Prune for Wind & Ice Resistance
Selecting Wind or Ice Resistant Species
Evaluating Trees for Hazard Potential
Know When to Remove or Restore Trees
Use Preventive Pruning Procedures (storm training)
Cleaning Up After Hurricanes
Restoration Pruning Procedures
Establish Young Trees for a Storm Resistant Urban Forest

Table 19. The Florida Principles

Appendix B - MANAGEMENT

Standards for **management** during and following storms for both the public and private sector.

1.. Standards might be included within the tree ordinance for those engaged in the tree service industry to ensure they are qualified to provide the technical services required before and after storms. Standards for this certification might include;

Licensing standard with a State of Mississippi, Bureau of Plant Industry, Mississippi Department of Agriculture and Commerce "Tree Surgery License" for those that contract with the public or private sector for regular and emergency tree services

Work experience standards for working procedures and equipment operations in regard to safety for contracted tree care companies and arborists working both on private land and public land or ISA Certification.

Certification by the International Society of Arboriculture (ISA) for any work near power lines

Ability by city staff to manage people, contracted tree service companies and organize a body of information in regard to storms, trees, and public safety

Communication between city administration and forestry staff, other city agencies, emergency personnel (city, state, national), contracted tree service companies, neighborhood associations and city residents. Communication is absolutely essential before a storm, immediately after a storm and throughout the clean up and recovery period that may be a matter of days in the case of a small storm, but perhaps months in case of a large storm causing widespread damage to the urban forest.

Appendix C – RISK REDUCTION

Standards for **risk reduction** before a storm for both public and privately owned trees.

1..Standards to give preferences for the selection, planting and proper care of suitable native species of trees.

2..Tree policy should ban as unsuitable for the planting of storm prone tree species are often exotic trees not native to the region, trees that get very tall and trees with thick dense crowns and trees that grow fast and have a short life span. Examples of typical banned species include; *Acer saccharinum*, *Ailanthus altissima, Albizia julibrissin, Eleagnus angustifolia, Cinnamomum camphora, Ligustrum lucida, Melia azedarach Paulownia tomentosa, Pyrus calleryana'*Bradford' , *Salix nigra*, *Syagrus romanzoffiana*, *Triadica sebifera*.

3..Other standards that can be included to reduce the risk of tree failure during storms include;

Unhealthy trees, trees that are diseased or decayed often fail in storms, remove them.
Trees that are cracked splintered with gaping hole may be hollow and should be removed.
Trees close to power lines should be replaced with a smaller species.
Trees with poor structure, off balanced trees or trees growing in limited root space often fail in storms, remove them.

4..Structural pruning and storm training also reduces risk of tree failure and will make trees more storm resistant. Structural pruning techniques encourage the use of appropriate arboricultural guidelines such as;

Develop a dominate leader stem.
Eliminate co-dominate leaders
Do not allow lower branches to grow too large
Remove side branching to allow spacing of lateral branches along the main stem leader
Keep all laterals that less than ½ diameter of the trunk.
Suppress growth of included bark joints
Thin out the canopy without lion tailing to allow better airflow and a little more sun light to the interior.

5..Preventive pruning shall be used to reduce the risk of tree failure and will make trees more storm resistant.

Preventive pruning techniques that can strengthen a tree to better resist wind storms by improving its form, eliminating weak crotches, included bark joints and co-dominant stems.
Preventive pruning techniques that can strengthen a tree to better resist wind storms by improving its form, eliminating weak crotches, included bark joints and co-dominant stems. This technique can be used to lower the trees center of gravity and reduce the overturn load of the canopy. Storm training can also remove all dead wood from the canopy and thin the crown to reduce wind resistance. The height of a tree, especially near buildings is a major factor in storm failure. Through sensitive form sculpting reduction cuts to a mature tree can be lower it height and its center of gravity by 1/3 of its height. It is even possible, with newly planted trees and older mature trees to use permanent 'tree staples' to better anchor the root ball to the ground to lessen the weakening of the root plate by saturated soils. This anchoring devise is made of metal and anchored deeply into the ground with screw in anchor bolts. A technique such as this is used in Japan to permanently anchor trees susceptible to typhoons. Storm training ought to be included in the tree regulations of the city.

Natural wooded drainage ways, flood plains and forested wetlands are an essential element in allowing run off to slowly leave the city after a storm. For this reason main channels needed to have downed debris removed and some brush pruned away periodically so when storms do arrive, these valuable drainage areas can accept run off to prevent flooding.

6.. Tree planting standards can also be included in the tree ordinance to strengthen the urban forest to reduce risk and to make it more storm ready. These arboricultural standards might include.

Standards that preserve groves of native trees,

Standards the encourage the planting of urban forest storm buffers,

Standards to add plantings and tree canopy within public parks and community open spaces.

Standards that encourage planting more hurricane resistant tree species.

Standards the promote the planting of trees that are lower than 40 feet in height

Standards that encourage the planting of trees with fine texture crowns.

Native pine often will snap off so keep clear of buildings.

7..Standards may be written into the tree ordinance that would help both the public and the private tree owner to prepare for future storms by maintaining trees properly. These practices will include;

Mulching of root zone

No disturbance to the root zone

Recycling leaf drop back to the root zone

Watering when needed

Annual fertilization

Tree staking for a minimum of two years after planting

8..Standards for plant material sizes, structural supports, annual or seasonal storm preparation pruning.

9.. Site Plan adjustments as pre-storm preventives measures.

Standards to create 'fall zone' limits around public buildings as well as around privately owned structures. This prevents having very tall trees planted too close to a building or above buildings.

Adoption of '2/3 distance rule' requires that trees shall be planted no closer than 2/3 of their maximum mature height away from the building

Adoption of the '1/3 height overage rule,' bans trees being planted within a fall zone of being more than 1/3 taller than the height of the building near where they are planted. For example, if a building is 18 feet tall, then no tree should be planted in the fall zone that is taller than 24 feet in height at maturity.

Three fall zones are created by radius line from the edge of a building. Small trees may be planted in the 'A Fall Zone,' medium size trees in the 'B Fall Zone' and large trees in the 'C Fall Zone.' The fall zones are classified as

Zone A 30' radius from the edge of a building

Zone B 45' radius from the edge of a building

Zone C 60' radius from the edge a building

Zone D 80' radius from the edge of a building

Planting of heavy shrub masses should be encouraged around walls of one story buildings as "living walls" to reduce impact to building structure and un-shuttered windows.

Plant groves of low wind resistant 'deflector trees' close to buildings that deflect wind flows up and over and around one-story frame buildings.

Plant tall 'sentinel trees' at property edges outside the fall zone in order to begin wind friction disturbance away from the walls of buildings.

Preserved habitat that surrounds buildings consisting of 100 feet of 'layered plantings" will offer protection to the building and provide shelter for urban wildlife.

'Green walls' constructed with reinforced concrete and covered with vines can provide significant protection to building openings such as windows, doors, patios and terraces.

All site structures such as pavilions, decks, arbors and pergolas built of wood shall be constructed using metal strapping, cross bracing and roofing ties to reduce wind borne debris.

'Wind baffles' and 'storm walls' constructed of wood, metal, block, stone or concrete can be used in the garden to divide up garden space while offering protection from both wind flows and water surges.

Wood fencing should be avoided in areas subject to wind or flood. Vine covered 'hurricane fencing' generally will stand up to wind and flood.

'Storm pavilions' should be built to house all garden accessories such as lawn furniture, game court fixtures, outdoor grilling equipment, dog houses, potting accouterments and other movables that can become wind thrown object or float-a-ways.

Decorative 'stone ground cover mulch' can be lifted by wind and tossed like rifle bullets so this shall not be used near homes and parked cars.

'Deadman tree anchors' can be used on all trees less than twenty years old to help stabilize them as their roots develop strong soil anchoring capability.

Standard might promote the use of 'arboreal armoring' of buildings. Tree planting for wind protection should be encouraged with the use of mass tree plantings and the planting of small evergreen, large evergreen shrubs, vegetative hedges and bamboo stands.

Appendix D - RESPONSE

Standards for **response** and clean up directly after a storm for both the public and private sector.

1..Standards of operations to prevent collateral damage to un-damaged trees shall be followed during response by tree services companies working in the city. This applies to publicly contracted service firms, individuals and utility companies working in the city.

2..Standards for handling storing and processing green waste including pick-up, sorting, chipping, tub grinding, disposal, processing, recycling and selling green mulch. This standard might include;

Standard that defines green waste

Standard as to where green waste is to be curbed

Standards for sorting and stacking green waste from private land

Standards for the delivery for grinding, chipping and process green waste from private land

3..Standards for work during the response period for tree pruning, removal and tree care vendors including the following.

Standards for storm training a tree, including thinning, reductions, lifting, shaping

Standards for proper pruning cuts including removal, reductions, heading and non-collar cuts or flush cuts

Standards for take downs and removal that do little if any damage to surrounding vegetation or property

Standards for local licensing of arborists based upon knowledge of arboriculture, chainsaw safety, proper clothing, safe vehicle and power equipment use.

4. Standards for curb side storage and pick up of storm damaged material. This material and the way it is stored curb side by residents following a storm ought to be codified. Residents must be knowledgeable as to how the storm pick up program works and what their responsibility is toward placement and stacking. (

Appendix E - RECOVERY

Standards for **recovery** and re-greening of public and private land.

1..Standards for restoration of damaged trees following a storm

Badly damaged trees can be salvaged with good restoration pruning, reshaping, and fertilization and mulching of the root zone.

Trees that are damaged beyond repair shall be removed and replaced.

2..Standards to require that replacement trees to be planted, staked, mulched and watered in a proper manner. Other planting standards include;

Plant more storm resistant trees that are native to coastal areas. These trees might feature cabbage palmetto, Canary island date palm, coastal live oak, cypress, hickory, highrise elm, holly, hophornbeam, magnolia, Mexican fan palm swamp oak, overcup oak, podocarpus, tupelo, Washington palm, winged elm.

Avoid planting less wind resistant trees such as Bradford pear, cherry laurel, Chinese elm, laurel oak, loblolly pine, red cedar, red oak, slash pine, spruce pine, sweet pecan, tulip poplar, water oak

All replacement trees are to be properly spaced. Rule of thumb, spacing should be the same as the mature height of the plant.

Plant several species of both trees and shrubs to promote diversity and layering of the plants.

Public policy standards might be written to ensure the use of high quality trees.

Policy standard to ensure replacement trees are staked to support their root growth and development for a least a two year period of time.

Standards should promote planting replacement trees in groves rather than individual trees.

Standards should encourage the use of coastal live oak around building as windbreak trees.
In addition, community tree ordinances might set standards for better planting location selection. This will include standards on planting space size, location, soil type, depth and surroundings such as overhead lines, underground pipes, concrete walks, curbs and street edges.

These are some to the tree management strategies that can be placed in tree ordinances or landscape codes as storm mitigation regulations or suggested public safety guidelines.

Appendix F - DEFINITIONS

Arboreal armoring. The use of selective vegetation to surround buildings to offer a measure of storm protection.

1/3 height overage rule. This is the rule that regulates how close to a building an existing tree can be situated. The rule requires that an existing tree near a building shall not exceed the height of the building by more than 1/3 the height of the building. An example, a medium size tree exists in the A Fall Zone and is 30 feet tall. The building nearby is 20 feet high. The tree exceeds the height of the building by 10 feet. The tree is only 1/3 the height of the building taller than the building so it is safe to keep it there without removal.

2/3 distance rule. The 2/3 distance rule will regulate how close to a building you can plant a small, medium, large or super-size tree. This calculation will also tell you what fall zone (A, B, C, D) the tree ought be planted in as well. This also regulates trees on adjacent property that prevents neighbors from planting super-size or large trees too close to the property line.

Brush staging areas. Dedicated areas within neighborhoods where storm damaged vegetation can be temporarily sorted, stored, and chipped prior to be transported to green waste processing center in a more remote location. These maybe a neighborhood park or piece of public land set aside for the purpose of storm management use.

Call record. Generally point of contact between the Storm Team or City Forester when citizens call to report storm damage, see a dangerous situation or need assistance with a fall tree. Very important for the person taking this call to gather specific information since that starts a chain of activity all of which becomes part of the public record.

Cleaning. The removal of dead, crossing, weak and damaged branching that has the effect of reducing the wind resistance of a tree while making the tree more storm resistant.

Crown lifting. This is the storm training technique that removes limbs and small branches to a specified height above ground. Lifting produces a smaller windward profile and will reduce wind loading on a tree.

Crown thinning. Is an arboricultural technique that removes a portion of secondary growth throughout the crown to produce a more open and even density of foliage around a well-balanced trunk and limb structure. This results in a tree able to withstand a stronger wind load and hold less iceing.

Crown reduction. A pruning technique to reduce the volume of the canopy by thinning to remove co-dominate limbs while still preserving the shape of the tree and increasing it ability to take a stronger wind load.

Deadwood. Woody parts of a tree consisting of no living cells. Deadwood provides natural habitat to a host of forest creatures so it removal is generally discouraged unless its appearance is unacceptable. In hurricane region, deadwood presents a threat of flying projectiles and should be removed by June 1st of each year.

Deadman tree anchors. This is a method of anchoring newly planted tree to keep them stable during wind storm.

Deflector trees. Are tree groves of wind resistant trees planted close to a building whose purpose is to break the wind or deflect the wind upward and over a building.

Digital survey. A high accurate ground truthing tree survey method using GPS hand held device and software such as I-Tree that will not only show location of specific trees but allow for the storage of field measurements and visual assessments.

Emergency Service Log. This is a written record all damage to public trees and perhaps private trees that are attended too by public employees or contracted service personnel during the risk reduction, response and recovery phases of a Storm Plan. This record also includes expenses, time sheets, contracted service records, physical description, locations, ownership, quantities and unit costs for all material and services expended or reimbursed for storm related activity.

Fall Zone. This is an area surrounding a building in which trees are planted whose height and structural characteristics must be considered in regard to storms and tree fall.

Fall Zone A for planting small trees average height 20 feet, crown spread 10 feet.
Fall Zone B for planting medium size trees average height 30 feet, crown spread 20 feet
Fall Zone C for planting large trees average height 40, crown spread 40 feet
Fall Zone D for planting super large trees* average height 100 feet
*pines, red oaks, Washingtonia palms, southern magnolia

Fall Zone Distance. Zone A 30' radius from the edge of a building
Zone B 45' radius from the edge of a building
Zone C 60' radius from the edge a building
Zone D 80' radius from the edge of a building

Floodplains, parks and preserved forests. These are the natural areas of a community that provide environmental services to cities and ought to be preserved by regulation or fee simple purchase to clean the water, air of the community and provide valuable open space for wildlife and healthy human recreation activities.

Hanging petticoat. This consists of old leaves of a palm that are persistent and hang below the growth point of a palm. These are sometimes removed to lower the center of gravity of a palm to make it more storm resistant.

Hatracking. Very server practice sometimes called topping consisting of the reduction of major stems almost all the way back to the trunk to eliminate the leafed out crown. This practice outlawed in many landscape codes leaves the tree structurally misshapen. This is also referred to as pollarding.

Hazard tree. Is a tree that is recognized to be capable of falling, overturning or breaking up in a storm as well as causing damage to property or to people. Time is of the essence with a hazard tree.

Hurricane fencing. This is a type of chain link fencing that allows flood water to flow through the fence rather that overturn it and wash it away. High wind often overturns and destroys wood fencing.

Green walls. Masonry walls covered with a matting of vines used to stop wind throw of common debris carried by high winds and to block windflows through windows and doors.

Green waste. Debris caused by storms that damage and rip apart trees in the urban forest is referred to as green waste. Many communities rather than use the biological productivity of tons and tons of vegetative debris discard it in landfills or simply burn it. A few communities process it as garden mulch and give it away or sell it so the energy can be returned to the soil.

ISA Certification. This recognizes that a trade association active member has been tested for one or more levels of experience working with trees. State licensing in arboriculture practice is not a requirement of certification.

Landscape Code. This is also commonly called community landscape ordinance. This is a part of zoning regulations that regulate planting on private property. The regulations are applied to post construction landscaping for new development or redevelopment. Policies call for the planting of street yards, buffers, screens, parking lot screening, parking lot interiors, parking lot detention and the planting of trees to achieve a minimum canopy coverage. Landscape plans and specifications are prepared, reviewed and permits are given to the developer to install the plantings according to the plans.

Lion tailing. This is an arboricultural practice that is frowned upon since it removes all laterals and sub-laterals along major stems leaving the very tip of all stems covered with small branches, twigs and leaves. This practice changes the structural balance of a tree and opens the center of the tree to added environmental stresses that are usually suppressed by the crown.

Limited canopy inventory. A survey of community tree canopy performed using air photography and calculations for the purpose of understanding general characteristics of the urban forest canopy of a site, neighborhood or district.

Living walls. Wind screens composed of tightly planted evergreen hedge shrubs or small evergreen trees that block and buffer strong winds.

Loading. In structural mechanics loading refers to the pounds of pressure exerted by a force. In the case of trees, loads are caused by the weight of the tree itself as well as the pressure of wind, flood, and ice loading.

Management. Activity and actions performed by a tree authority as part of a Storm Plan to deal with all aspects of a storm inflicting damage to trees and the urban forest of a community.

Minimum canopy standard. This is a set limit of the minimum amount of tree canopy cover required at a certain point in time on a single building lot, in a zoning district or within an entire community.

Overstory trees. Large native trees usually over 40 feet tall at maturity with a canopy of 30 or more feet in diameter that constituted the principal trees of a community's urban forest.

Planning. Activity, actions and the preparation of records, procedure and methodology as part of a Storm Plan to be ready to lead a city to react to a storm.

Problem tree. A tree that is causing problems to walkways, street, overhead utility lines, underground utility pipe, building foundations, parking lot surfaces, sight lines, growing in too tight of a space and may in fact be in decline or in need of some manner of pruning.

Property line tree. Literally a tree growing directly on a property line whose ownership is shared giving legal rights to two owners.

Recovery. Actions and activities following the clean up of a city to repair or replace damage caused to trees or to the urban forest. Actions that involve removal, restoration or pruning of trees as well as the planting of trees to replace those lost in the storm.

Response. A central part of a Storm Plan where the Storm Team directs activities of employees, contacted individuals, tree service companies, equipment operators and emergency service personnel in a rapid and safe clean up of fallen trees, vegetative debris and other storm damage causing an impact to streets, public utilities and access points to private land or harm to citizens.

Risk reduction. A series or pre-storm activities including preventive pruning, storm training, structural pruning, installation of storm resistant trees, and tree removals as part of a Storm Plan to reduce risks of property damage or loss of life as a result of falling trees or tree parts during any of a number of storm events.

Sentinel trees. Trees planted at property edges whose purpose is to break and eddy, deflect and diffuse the wind before it gets to a building.

Site plan adjustments. Changes made to the site plan of a property near buildings undertaken by removing or planting vegetation as part of a risk reduction strategy.

Stems. The main supporting structure of the canopy from ground level to the first major division into branches. Tall multiple stemmed tree structure often show less resistance to wind load and can easily snap off from the main trunk of the plant.

Storm Damage Summary Report. The final report bringing together all records related to a storm, its costs, actions and request for reimbursement taken toward recovery. Tree damage reports and the work of tree service personnel and green waste deposition are a major part of this document.

Storm pavilions. These can be built to hold yard elements that are gathered and stored prior to a hurricane. They are often sited to protect windows and doors of buildings.

Storm Team. A group of city employees and perhaps contacted consultants or services that work together to manage a response to a storm that may involve public safety, property damage or damage to trees and the urban forest.

Stone ground cover mulch. Stone ground cover is to be avoided in hurricane zones since the stone is picked up by high wind and distributed like flying bullets.

Storm training. Arboricultural preventive pruning method of shaping, balancing, reduction, raising, thinning and cleaning of a tree to make it more storm resistant. A technique generally applied to specimen plants standing alone or in small groves.

Topping. Often called hatracking, it is the removal of the crown or a significant part of the crown which often happens when the tree overgrows the spot in which it has been planted.

Tree. Trees are regulated by Class, size, planting location, and distance from a structure or roadway. Trees then are classes as;

Class AA- **Super-size** trees such as pine, pecans, oaks, southern magnolia, American sweetgum, and bald cypress grow to be 100 feet tall with a 40-50' crown

Class A- **Large** native overstory tree growing to at least 50' tall with a 40' crown such as many oaks, maples, tuliptree, spruce pine, hickory, black walnut, tupelo gum, black locust. Coastal live oaks fall into this category.

Class B- **Medium** size trees growing to 30' tall with a 20' crown such as maples, magnolias, hollies, crape myrtles, redbud, black cherry, honey locust, Eastern red cedar.

Class C- **Small trees** and large shrubs that grow to 20' tall with a 10' crown. These are trees such as oriental magnolias, crape myrtles, wax myrtles, grancy greybeard, hawthorns, holly shrubs, dogwood, camellia, vitex, and ironwood.

Tree anchorage. The size and character of the root system is fixed within the soil and involves cohesion between the branched roots and soil giving a tree its ability to withstand wind, flood pressure and gravitational forces all of which must be in balance to give a tree its ability to withstand storms

Tree architecture. A term used to describe the branching of the crown, its texture, density and flexibility and root system that provides the anchorage into the soil. The branching and roots gives the plant its overall shape, its structural strength, and its ability to resist the stresses of storms.

Tree authority. The employee of community government charged with the responsibility of caring for and managing public trees or the urban forest in general. This person generally has a technical background and may be licensed with a background of education and experience in Forestry, Urban Forestry, Arboriculture, horticulture or landscape architecture. Often called Chief Forester or City Arborist.

Tree canopy coverage. The area within the leafed area of the crown calculated as a circle whose radius is used to determine square footage of canopy cover.

Tree defect. Is any feature of a tree which detracts from the uniform distribution of tree strength and minimizes the trees ability to withstand stresses caused by wind, flood, ice.

Tree Inventory Database. A computer database created to store information about individual trees or trees in specific neighborhood of a city or piece of property. Information usually includes GPS location, species, health, size, maintenance requirements, adjacent utilities, ownership and other data needed to better manage trees.

Tree Ordinance. Public policy toward trees that usually will set standards for planting, maintenance, spacing, size, species, removal, preservation, mitigation, arboricultural specifications and other policy toward trees of public concern for both public trees and private trees.

Tree Service Permits. A license granted by a local community to anyone providing emergency tree management services under emergency conditions.

Tree stress. A condition in plants in which one or more physiological functions are not operating correctly within their natural range often caused by lack of soil moisture, insect invasion, inadequate nutrition, temperature extremes and outside pressure exerted by storms or human activity.

Tree surgery license. This is a document provided by the State of Mississippi to certify that a person processes knowledge and experience of working with trees to protect the public health, safety and welfare of the general public. A person who processes this license can be called a tree surgeon but is often called an arborist.

Urban Forestry Management Plan. A plan prepared to determine the extent, character, species composition, health and value of an urban forest or a specific part of an urban forest (street trees for example) so that this resource can be better managed in regard to maintenance, preventive pruning, tree restoration, removal and planting as well as staffed with qualified people capable of implementing the plan.

Victim tree. A term commonly used to describe a not capable of withstanding a violent storm.

Wind baffles and storm walls are constructed of reinforced masonry construction whose purpose is to block, buffer or diffuse strong wind flows around buildings.

Wind throw. The overturning of a tree at its root zone often caused by high wind and a high center of gravity.

Windshield survey. A marginally accurate but helpful study of public street tree conducted from inside of a car.

Figure No. 40.0. Young Trees Become Ancient Trees and Shade Our Cities.

Appendix G – STORM RESPONSE DIRECTORY

Storm Response Directory

OFFICE	CONTACT PERSON	PHONE NUMBER / E-MAIL
Mayor's Office		
Mayor's Direct Line		
Director of Public Relations		
Director of Public Works		
City Engineer		
Police Chief		
Deputy Police Chief		
Fire Chief		
Ambulance/Rescue Service		
Airport Meteorologist Office		
Water Department Chief		
Water Department Supervisor		
City Hall		
Sewer System Manager		
Land Fill Manager		
Planning Director		
(Planning and Grants Administrator)		
Emergency Response Manager		
Director of Parks and Grounds		
Purchasing Office		
Office of Landscape & Forestry		
City Arborist		
City Landscape Architect		
City Tree Committee Chair		
IT Supervisor		
DPW Equipment Manager		
Supervisor of Motor Pool		
Green Recycling Center Director		
CITY TREE CREW EMPLOYEES & VOLUMTEER LEADERS		
Public Works		
LOCAL PRIVATE SECTOR		
Local Water Service Company		
Local Power Company		
Local Gas Service		
Local Cable Service Company		

Appendix H – MODEL ENACTMENT ORDINANCE

Model Urban Forestry Storm Management Ordinance

(Ordinance #) Ordinance # ____

(Title) An Ordinance of Adoption Establishing **Urban Forestry Storm Management Guidelines and Regulations** for the City of Brookhaven, Mississippi

(Enacting Clause) The Board of Aldermen of the City of Brookhaven, Mississippi ordains:

(Body of ordinance)

The Brookhaven Municipal Code of Ordinances, shall be amended with the following Article and Sections.

Article I. Urban Forestry Storm Management Regulations.

Sec. 1.0 Purpose.

Sec.2.0. Definitions.

Sec.3.0. Management Authority.

Sec.4.0. Enforcement.

Sec.5.0. Enforcement and Penalty.

Sec.6.0. Reserved.

Sec.7.0. *Interpretation*.

Sec.8.0. Severability.

Sec.9.0. Effective Date.

(Closing) So enacted by vote of the Board of Aldermen , on a __ to __ vote of the Board, City of Brookhaven, Mississippi on this __ day of _____, 2014__.

Chairperson: _____(Y) (N)_vote_, Alderman At large _____ (Y) (N)__vote_,

Alderman Ward 1: :_____ (Y) (N)_vote_, Alderman Ward 2: :_____ (Y) (N)_vote_,

Alderman Ward 3: :_____ (Y) (N)_vote_, Alderman Ward 4: :_____ (Y) (N)_vote_,

Alderman Ward 5: :_____ (Y) (N)_vote_, Alderman Ward 6: :_____ (Y) (N)_vote_,

Attested to by: _____

City Clerk

Editor Note: This model ordinance outline shall be modified by the City Attorney to suit the needs of the City. This outline is drafted for educational purposes only to be as a guide document. The Mississippi Urban Forestry Council accepts no responsibility for its public use, or warrants the performance of it contents. Words within ( ) in red ink are to be removed.

Appendix I – STORM RESISTANT TREES FOR BROOKHAVEN

American Beech	*Fagas grandifolia*
American Holly	*Ilex opaca*
Bald Cypress	*Taxodium distichum*
Bitternut Hickory	*Carya cordiformis*
Black Oak	*Quercus velutina*
Cherrybark Oak	*Quercus pagoda*
Eastern Redbud	*Cercis canadensis*
Laurel Oak	*Quercus laurifolia*
Live Oak	*Quercus virginiana*
Mockernut Hickory	*Carya tomentosa*
Nuttall Oak	*Quercus nuttalli*
Overcup Oak	*Quercus lyrata*
Pignut Hickory	*Carya glabra*
Post Oak	*Quercus stellata*
Scarlet Oak	*Quercus coccinea*
Shortleaf Pine	*Pinus echinata*
Southern Magnolia	*Magnolia grandiflora*
Shagbark Hickory	*Carya ovata*
Southern Red Oak	*Quercus falcata*
Swamp Chestnut Oak	*Quercus michauxii*
White Oak	*Quercus alba*
Crape myrtle	*Lagerstroemia indica*
Dogwood	*Cornus florida*
Riverbirch	*Betula nigra*
Saucier Magnolia	*Magnolia soulangiana*
Scarlet Oak	*Quercus coccinea*
Shumard Oak	*Quercus shumardii*
Sweet Bay Magnolia	*Magnolia virginiana*
Sweet Gum	*Liquidambar styraciflua*
Yaupon Holly	*Ilex vomitoria*
Yellow Poplar	*Liriodendron tulipifera*

*Large trees based upon medium to slow rate of growth and long life span and native to the soils and climate of the state. It should be noted that many of these are not suitable for planting in tight urban spaces with limited root space. By arborist Jim Heinzel.

Appendix J – SAMPLE MANAGEMENT BUDGET

Sample Management Budget

Staff

Chief Forester -……..... $ 00,000

Forestry Operations -……..... $ 00,000

Arborist III -……..... $ 00,000

Arborist II -……..... $ 00,000

Arborist I -……..... $ 00,000

Laborer -……..... $ 00,000

Administrative Expenses - ……$00,000

Contracted Storm Services

Contracted Arborist -……..... $ 00,000

Contracted Landscape Architect -……..... $ 00,000

Contracted Tree Service Company -……..... $ 00,000

Annual Clean up Fund Supplies & Expenses - ……..... $ 00,000

Contracted Supplies

Arborist Supplies -……..... $ 00,000

Equipment -……..... $ 00,000

Operations

Annual Tree Maintenance Fund -……..$ 00,000

Annual Risk Reduction Fund - ……..$ 00,000

Annual Arbor Day Plantings -……..$ 00,000

Capital Projects - ……..$ 00,000

Revenue Sources

Appropriated Funds - ……..$ 00,000

Tree and Landscape Fees - ……..$ 00,000

Gifts and Grants - ……..$ 00,000

Sale of Wood Products / Green Waste - ……..$ 00,000

Contracted Personnel -Various arboricultural operations & special equipment operation by contract
Assistant City Forester -Manages field work, grants
Forestry Operations -Direct field crews, staff, safety
Technical Services Coordinator -Reports & records
Arborist III -Works in the trees, ISA qualified, training
Arborist II -Equipment, supplies & ground work control
Arborist I -Equipment operator, communications
Laborer -Ground work, clean up

Appendix K – STORM DEBRIS

Storm Debris Separation

Vegetation Debris, Green Waste ^

Cut Up Tree Trunks
Tree Sectioned Logs
Sectioned Large Branches
Small Branches
Leaves
Washed Up Seaweeds
Christmas Trees

^Do not place vegetative matter
In bags, trash cans or carts

Construction Debris #

Building Materials
Drywall
Dimensioned Lumber
Carpet
Furniture
Mattresses
Plumbing
Wire
Fencing

Contractor trash from pre-storm
new construction or
remodeling will not be pick-up.

White Goods Waste

Refrigerators*
Washers, Dryers
Freezers*
Air Conditioners
Stoves
Water Heaters
Dishwashers

*Doors Wired or Tapped Shut

Electronics

Televisions
Computers
Printers
Radios

Stereos
Telephones
DVD Players
Telephones

Household Garbage +

Bagged Trash
Discarded Food
Packaging, Papers
Discarded Clothing
+ All garbage placed at curbside the day of weekly pickup

Recyclable Materials

Glass
Plastic
Metal
Paper
Beverage Containers
Tires
Used Oil
Cardboard
Magazines
Concrete
Clothing

Household Hazardous Waste

Oils & Grease
Batteries
Pesticides
Paints
Fertilizers
Cleaning Supplies
Compressed Gas

Residents are reminded that by separating storm damage debris in to various piles and placing it curb side they can assist in the speed of the clean up. Careful stacking requires less space. Residents are reminded not to stack the debris around telephone poles, lights, signs since these cannot be scooped up by mechanical means and therefore not removed. Household garbage must be placed in 32 gallon containers or bagged in heavy duty plastic bags to ward off animal feeders. Debris on private property cannot be picked up. Debris must not be placed in streets, but only in the right-of-way. Also, fire plugs must never be hidden from view or made un-accessible and trash shall not be placed under utility lines, especially electric lines.

Appendix L – SAMPLE DAMAGE REPORT

Sample Tree Damage Report

Date _____ Time _____AM PM Report Recorded By_____

Address _____ Owner _____

Type of Tree

Size DBH _____inches, Height of Tree <15', 15' to25', >25"

Description of Tree _____

_____

_____

Species of Tree _____ Protected Tree _____Y_____N_____

Street Tree_____ Yard Tree_____

Accessible by Truck _____

Type of Damage

Street Blocked _____ Tree On R-O-W_____

Tree Down on House _____ Tree Down & Blocking Driveway_____

Wires Down_____ Utilities Damaged_____

Drainage Clogged with Debris_____ Private Property Damage_____

Person(s) Hurt in Need of Help _____

Damage to Tree(s)

Limb Down _____Size <3", 4-6", 7"-8", 9"-12", >12"

Hanger in Tree _____ Size <3", 4-6", 7"-8", 9"-12", >12"

Tree Twisted or Split_____ Tree Snapped _____

Tree Overturned _____

Service Provided

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Crew Chief Assigned _____

Suggestions for Property Owners

PLANNING	Establish a minimum tree canopy cover of 30%.
	Inspecting trees on home property once a year.
	Determining safe fall zone of 40 feet around homes.
RISK REDUCTION	Removing overly tall trees within the fall zone.
	Removing dead and failing yard trees.
	Maintain healthy yard trees.
	Looking for dead or failing trees along public streets and report them to the City.
RESPONSE	Clean up yard following passing of storm.
	Beware of chainsaws and downed power lines.
	Store bulky green waste curbside for pick up.
	Mulch in place landscape beds, with light storm debris.
RECOVERY	Assist neighborhood with storm clean up,
	Re-plant with more hurricane resistant trees.

Table No. 20 Suggestions for Property Owners

Benefits of Trees in the Urban Environment

1. Trees beautify urban landscapes and soften the harshness of concrete.
2. Trees clean the air by absorbing pollutants and releasing oxygen.
3. Trees lower ambient air temperature.
4. Trees provide wind reduction and/or windbreaks.
5. Trees provide shade and noise reduction.
6. Trees reduce energy consumption in buildings.
7. Trees improve water quality by reducing runoff and erosion.
8. Trees reduce urban flooding by water absorption and infiltration.
9. Trees provide privacy screens and increase property values.
10. Trees make a community more appealing to newcomers and residents.
11. Trees in recreational areas invite more frequent use of local resources.
12. Trees provide shelter and food for wildlife and enhance biodiversity.
13. Trees provide health benefits associated with cleaner air and water.
14. Trees contribute to stress reduction and increased productivity.
15. Urban reforestation increases community pride and involvement.
16. Trees can provide food in the form of fruit, berries, nuts and roots.
17. Trees provide shade and reduce the urban heat island effect.
18. Urban forests produce plant biomass that is useful and renewable.
19. Trees in parking lots reduce pollutants emitted for vehicles.
20. Street trees in particular define neighborhoods and provide identity.

From ***Benefits of Urban Trees***-USDA Forest Service

Table No. 22 Benefits of Trees in the Urban Forest

"The connection between Mississippians and our trees is strong, especially in our urban and community settings. While our state continues to grow in its appreciation of our urban and community forests, we also realize these benefits don't happen by chance. It is only through active planning and management that our state's urban forests may realize their full potential. Tornados, hurricanes and ice storms are common in our state and detailed plans for storm preparedness and mitigation are becoming a necessity. The Mississippi Forestry Commission is proud to work with cities as they prepare for the coming storm."

Charlie Morgan, State Forester, Mississippi Forestry Commission

www.facebook.com/MSForestryCommission

www.twitter.com/MSForestryComm

The Mississippi Urban Forest Council is proud to present these storm preparedness and mitigation strategies to help communities and land- owners to prepare for the next storm.

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Storm preparedness and mitigation of storm damage is an increasingly important focus for Mississippi communities. Trees are an important concern when storms strike. How and where communities plant trees, select species and maintain trees will help determine community resilience toward storms and decrease storm damage. Communities can adopt some sound strategies to help manage trees to provide the best possible storm protection. The plan presented here provides some simple best management practices to better manage trees for future storms and reduce costly cleanup associated with storm events. Assessments of community trees will identify current site and species relationships likely to contribute to future storm damage. The program contained within also provides education about the importance of storm resistant trees, planting, tree species, soil types, identifying hazard trees, and where to plant for mitigating storm damage. Information is also provided to assist in disaster recovery, clean up and replanting.

Comprehensive storm strategies, plans, policies, best management practices and a model ordinance are provided for three model communities within three regions of Mississippi; North, Central and Coastal. Each comprehensive storm plan includes five aspects of storm preparedness and mitigation. Each plan can be seen on a website for all Mississippi communities to study and implement strategies and plans that fit their individual needs. A plan can be customized and adopted into policy for any community. Model ordinances, storm resistant tree species list, emergency procedures and much more is included in the plan. All communities are encouraged to prepare for the next storm and manage your urban and community forest trees in such a way as to mitigate damage, reduce cleanup costs, and recover faster. Visit our web site www.msurbanforest.com at the link Storm Mitigation and Preparedness.

Conserve – Storm preparedness will help to manage and ensure the long term life of community eco-system and high-priority forests. These strategies will not only conserve the trees and forests in communities, but ensure better management and placement with storm resistant varieties, while conserving other natural resources such as parks, water, streams, wildlife habitats, clean air and other important resources in the community.

Protect- These plans and educational concepts provide education opportunities local managers and elected officials on a number of issues related to protection of community forest / trees. Subjects such as protection and management of existing trees, placement of trees and forest for the maximum benefits in preparedness and mitigation, protecting the investment of landscape and trees, protecting structures, recognizing and managing hazard trees. Protection avenues will also be included by correct placement of new plantings, such as buffers and flood control practices. We include recommended policy on storm water and other hazards, tree removal specifications after a storm, citizen education and other avenues to ensure a healthy community forests. Better strategies to manage trees before, during and after an event can decrease property damages and services restoration.

Enhance- Healthy forests and trees create a safer community. This program shows how a community can generate

all the environmental and social benefits derived from trees while creating a safer community before, during and after a storm. A local urban forest storm plan will help to protect buildings and citizens from storm damage.

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"This model plan is a collaboration of multiple cities and agencies. The project is made possible by a USDA Forest Service Grant administered by the Mississippi Forestry Commission.

The Mississippi Forestry Commission provides equal employment opportunity and services to all individuals regardless of disability, race, age, religion, color, gender, creed, national origin, or political affiliation. *"In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on bases of race, color, national origin, sex, age or disability. (Not all

***prohibited bases apply to all programs.)* Mississippi Forestry Commission EEO Coordinator Gerry Farmer, 660 North Street, Suite 300 Jackson, MS 39202 – Office: (601) 359-2833.**


Brookhaven, Mississippi
Lincoln County
Homeseeker's Paradise