


# Benefit–Cost Analysis Attachment F

**RESILIENT**  
  
**SHELBY**

**Shelby County, Tennessee**  
Greenprint for Resilience  
National Disaster Resilience Competition  
Phase Two – October 27, 2015  
[AttachFBCAShelbyCOTN.pdf](#)

## **I. BCA PREPARATION PROCESS**

For the proposed Greenprint for Resilience, Shelby County procured three consulting teams: Sasaki, Kimley-Horn, and Barge, Waggoner, Sumner & Cannon (BWSC) to provide a high level engineering and design that would ensure “shovel-readiness” and to conduct a thorough benefit cost analyses of the proposed project. GCR provided project management of the overall effort. The goal in this undertaking was to ensure that the activities throughout the three geographic project activity areas was distinctly and jointly cost-effective for both the community and the U.S., in accordance with HUD guidelines. The three firms utilized traditional engineering BCA computation methodology, combined with the enhanced BCA framework identified in the NOFA under Appendix H. This framework incorporated traditional quantitative measures and qualitative factors typically not included in a BCA calculation.

## **II. PROPOSAL COST**

The total cost of the Greenprint for Resilience Project is \$117,711,957. Shelby County is requesting \$71,111,957 in NDR funding and has secured direct leverage in the amount of \$46,600,000. The full budget, including Sources and Uses, is available in the application. The complete life cycle costs of the proposal is **\$125,146,644**. The benefits total **\$411,137,956**. The result of this effort is a robust compilation of data reconciliation which yields a combined BCR of **3.29** for the Greenprint for Resilience Project.

The table below presents the totals for each of the activity areas for benefit and life cycle costs, with the individual activity BCR similarly indicated. It is important to note that the ‘Life Cycle Costs’ includes total project costs and soft costs (contingency, admin, etc.), the sum of which includes the portion being requested of HUD through the NDRC as well as direct leverage. For example, the NDRC share requested for the Wolf River Greenway activity is \$21.8

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million, while direct leverage of \$35 million is being contributed for additional portions of the activity.

Project Activity Title	Total Benefit	Life Cycle Costs	BCR
Big Creek	\$194,000,227	\$52,126,205	3.72
Wolf River Greenway	\$202,300,874	\$56,828,564	3.55
South Cypress Creek	\$14,836,855	\$12,020,653	1.23
Regional Resilience Plan	++	\$2,100,000	--
Administrative	++	\$2,071,222	--
Design Life (yr)	25 years	Total Project Costs	Project BCR
Discount Rate (%)	7%	\$125,146,644	3.29

The table below indicates sub-values which combined equal the total benefit listed in the table above. These four core benefit areas include: Resilience Value, Environmental Value, Community Development, and Economic Revitalization. Each of the engineering and design firms conducted analysis and calculations for each of these four benefit areas, utilizing available data from county staff, homeowner input, and emergency response personnel. This is outlined in detail with additional qualitative analysis in the supporting narrative in Attachment F. The ‘Economic Revitalization’ set of benefits includes increased property values (and taxes), talent retention and acquisition, attraction of business, increased spending and tourism, and reductions in vehicle operating costs. The ‘Resilience Value’ for each of the activities accounts for factors that equate to “avoided future damages” such as reductions in property damage, displacement, and loss of service. The ‘Environmental Value’ accounts for ecological and environmental benefits like air quality, reductions in vehicle emissions, green open space, riparian areas, and additional trees to reduce heat islands. ‘Community Development’ accounts for benefits including reduction in human suffering, health benefits, social/community cohesion, reductions

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in medical costs and productivity losses. These four core benefit areas are outlined in the table below for each of the activity areas, with further detail within.

<b>Project Activity Title</b>	<b>Resilience Value</b>	<b>Environmental Value</b>	<b>Community Development</b>	<b>Economic Revitalization</b>
<b>Big Creek</b>	\$53,271,883	\$138,920,516	\$1,461,717	\$346,111
<b>Wolf River Greenway</b>	\$600,773	\$115,265,785	\$19,286,369	\$67,147,946
<b>South Cypress Creek</b>	\$445,097	\$11,195,714	\$1,664,828	\$1,531,216

### III. PROJECT CONTEXT AND CURRENT SITUATION

Shelby County, Tennessee is a leader in resilience. The Phase 1 application identified unmet recovery needs from three severe storms in April 2011 (FEMA 1974-DR, 1978-DR and 1979-DR), resulting in historic flooding and \$2 billion in damages. Four years later, Shelby County has unmet recovery needs for housing, environmental degradation and infrastructure. By “making room for the river,” Shelby County’s proposed Greenprint for Resilience Project elevates the Mid-South Greenprint and Sustainability Plan (“GREENPRINT”) (GREENPRINT 2015/2040), a tri-state planning initiative funded by a HUD Sustainable Communities Regional Planning Grant, into a replicable, scalable framework for county and regional resilience. Phase 2 of NDRC project development utilized the network of green infrastructure and strategic directions of the GREENPRINT to develop resilient activities to address unmet recovery needs within the county.

The project will provide flood protection for areas that were flooded in the 2011 disaster, most of which are in LMI communities; address environmental degradation, particularly along damaged stream channels; create a long-term strategy for infrastructure resilience and protection from storm and flood damage; and create co-benefits of recreation, transportation choice, community health, and economic and community revitalization. A combination of these activities

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will be undertaken within three [areas hardest hit](#) in 2011: (1) flood protection, recreational amenities, and urban agriculture along Big Creek in Millington, benefitting LMI residents and the U.S. Naval Support Activity Command Center; (2) flood protection, recreational amenities, and greenways and complete streets to increase access to economic opportunity in Wolf River communities of Memphis; and (3) flood protection, vacant lot remediation, food production, and community programs to increase socio-economic capital in South Cypress Creek in Southwest Memphis.

The fourth activity, the Regional Resilience Plan, will further the GREENPRINT's efforts to expand resilience throughout the region. The Regional Resilience Plan will develop hydraulic models of three watersheds across Shelby County and region, providing scientific data to identify ways to increase resilience in the region. The plan will also consider recommendations to make Shelby County more resilient to other climate risks, such as heavy wind, extreme heat, drought, and severe snow and ice. While the activities proposed for Phase 2 will address areas with URN from the 2011 disaster, the Regional Resilience Plan will enable a replicable and scalable series of interventions to be implemented throughout the region following the GREENPRINT framework. Through extensive engagement, Shelby County has ensured its Greenprint for Resilience Project addresses the prevalent risks facing the region and develops resilient interventions. The total cost for this project is \$117,711,957. Shelby County is requesting \$71,111,957 in NDR funding. The request has direct leverage of \$46,600,000, additional supporting commitments of \$93,413,390, and long term commitments to ensure efforts undertaken make lasting impacts. The project has a benefit-cost ratio of 3.29. Through implementation of this project, Shelby County will continue to invest in communities in need and remain a regional resilience leader.

**Summary of Disaster Impacts.** Severe storms and flooding remain the greatest disaster risk facing Shelby County. According to the National Centers for Environmental Information, from 2005 to 2015, Shelby County experienced approximately 95 flooding/flash flood events, the equivalent of 9.5 events per year. The impact of the qualifying storm events in 2011 alone are estimated by the NWS to have cost more than \$2 billion in damages. In the immediate aftermath of the qualified disasters, electrical service to over 345,000 Shelby County residents was disrupted at a cost exceeding \$7,000,000. Debris clearance and removal and infrastructure damage cost the City of Bartlett over \$50,000. Erosion from flooding damaged a key bridge over the Loosahatchie River in Shelby County necessitating an estimated \$9,800,000 to return the bridge to full service. Shelby County still faces URN in housing, infrastructure and environmental degradation caused by the 2011 storm events. *Housing:* During the three 2011 storms, 198 homes in Shelby County flooded and there has been no allocation of CDBG-DR funds for home repair. On February 5th, 2015 Shelby County officials completed a windshield survey of homes with remaining damage from the 2011 declared disaster. The survey found 80 homes with unmet repair needs due to the 2011 storm events, and 37 vacant lots adjacent to these damaged properties that regularly experience flooding during similar storm events. Further, county staff collected 26 signed affidavits from housing owners certifying that they were unable to repair the storm-related. *Infrastructure:* The 2011 storm events caused damage to permanent infrastructure across Shelby County. Shelby County identified \$2,828,632 in unmet infrastructure needs for Rodney Baber Park along the Wolf River in Memphis. *Environmental Degradation:* The 2011 storms left a scarring impact on President’s Island, affecting an industrial area, farmlands, and a wildlife refuge. ETI Corporation assessed damage to President’s Island at \$8,956,775 to address this URN. The 2011 storms resulted in bank destabilization and

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stream/creek bed damage in Bartlett, Germantown and Collierville. The cost of repairing the Fletcher Creek bed in Bartlett; Laterals C, D and G in Germantown; and the Center St. stream in Collierville is estimated at \$4,447,000. URN are described in greater detail in the application in Exhibit D: Factor 2 – Need/Extent of the Problem.

In the *Big Creek Activity* area, flooding of the drainage basin has been a persistent problem for the residents of Millington. The qualifying event in 2011 resulted in estimated damages of approximately five million dollars. Repetitive flooding over the past 30 years has resulted in damages in excess of \$200 million to public and private infrastructure in the Millington area. The three most significant events occurred in 1987, 2010 and 2011. The 2010 event alone resulted in an estimated \$233 million in damages. Thirty percent of those who live in houses or apartments and sixty percent of those who live in mobile homes have not yet returned to their dwellings. According to Finance Director John Trusty, the City of Millington spent \$1,137,000 in identified costs due to the 2010 flood event. Although data is not available to determine wages lost and reduced revenue for local businesses, those economic impacts were quite significant in 2010.

In addition to adverse impacts in the City of Millington, the adjacent Naval Support Activity (NSA) Mid-South is also susceptible to repeated flooding from Big Creek. In the 2010 flood, one hundred forty six residents of NSA Mid-South were displaced from their homes. In a briefing provided by NSA Mid-South entitled “Flood Recovery Lessons Learned”, the 2010 flood cost the Navy an estimated of \$154,000,000 including \$54,000,000 in facility repair costs.

In a briefing presented to the Millington Chamber of Commerce by Commanding Officer Captain Doug Walker, the total economic impact of NSA Mid-South to the local community has been estimated to be approximately \$300,000,000 which comprises \$130,000,000 in military and

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civilian personnel salaries and \$170,000,000 in contracting and support services. Local investment in recreational and social services alone totals nearly \$8,000,000 annually. The installation supports a workforce in excess of eight thousand people, approximately half of which are government civilians and local contractor personnel. The City of Millington and Shelby County can ill afford to lose such a vital economic engine for the local area.

During the 2011 flood event, the *Wolf River Greenway Activity* area, experienced \$2,800,000 in infrastructure damage to Rodney Baber Park and \$139,600 in damage to housing as well as severe disruptions such as power outages and damaged mechanical and electrical equipment; residential and commercial infrastructure damage; and road inundation.

Approximately 80 properties were identified to exhibit remaining unmet recovery needs with 16% of those in the Wolf River Greenway Activity limits. Continued adverse impacts to infrastructure and residential properties in low-income neighborhoods will perpetuate the blight problem within the City of Memphis in addition to decreasing property values within these communities. Social cohesion will disengage and crime will continue to propagate throughout the area.

The *South Cypress Creek Activity* area experienced \$5,000,000 of property damage in the 2011 flooding and disruptions such as power outage and road closures. Mitchell Road, a main connection for the surrounding area economy and one of two access roads connecting the City of Memphis to T.O. Fuller State Park, experienced flooding in 2011 and is at risk for future flood events. Following the 2011 flooding, many homes have remained or become vacant. Many residents were evacuated; 29 properties, including some in the 100-year floodplain, exhibit URN. The current conditions and low property values for the region mean that the equity and market value of homes can often be exceeded by the estimated cost to repair and maintain the properties



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over time. Subsequent abandonment of low value, damaged properties has led to blighted conditions in the neighborhood. 29 properties were identified as exhibiting unmet need. Cost of unmet recovery needs, including the cost of unmet housing recovery needs, exceed available CDBG-DR and other resources such as FEMA and SBA. The list of addresses from the windshield survey, along with photos of the homes, can be found in Attachment.

**Existing Vulnerabilities.** The GREENPRINT provides a concise snapshot of the vulnerable populations in the region. As of the 2010 Census, the four counties containing the GREENPRINT study area had a combined population of 1,178,211 in 432,438 households. In 2010, African Americans made up the largest share of the region with 47% of the population, followed by Whites with 44%. Other minority groups also saw substantial growth rates between 2000 and 2010. Most notably, the Hispanic population added 35,152 persons, an increase of 131%, to make up 5% of the region's population by 2010. In addition, it is estimated 10.4% of the Mid-South population is over the age of 65, as compared to 13% nationwide. An estimated 12.6% of the regional population has a disability, roughly equal to the percentage nationwide. As compared with the rest of the U.S., individuals living in the Memphis urbanized area have considerably less income. Per capita income in Shelby County has remained about 7% below the national average. Per the FBI Violent Crime Statistics, 2013 data, Memphis has a crime rate of 1,656 violent crimes per 100,000 in population, the third highest in the nation for cities with population over 200,000. The GREENPRINT region as a whole is comparable to the nation in percent of population with poor or fair health at 16%. Heart disease is a leading cause of death in the U.S., and is particularly high in the Mid-South. Heart disease mortality rate in the region is measured at 182 persons per 100,000, well above the national rate of 135. Heart disease mortality rates are particularly acute for African Americans in the region, with a rate of 211.

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Rates of death due to stroke are also high for the region. Close to 34% of the region's adult population is classified as obese and 37% overweight, above national rates of 27% and 36%, respectively. These rates have implications for other chronic diseases such as diabetes. Close to 12% of the region's population has been diagnosed with diabetes.<sup>i</sup>

As discussed elsewhere in the application, the risks associated with the qualified disaster disproportionately affect LMI residents of Shelby County who reside in low-lying areas in the northern and western portion of the county, closest to the Wolf and Loosahatchie Rivers and Nonconnah Creek. Shelby County has selected its three target areas because, in addition to being the most impacted by the 2011 events, they are home to some of the most vulnerable populations in the county. More than 50 percent of the population within each of the three target areas are LMI.

**General Environmental Conditions.** A majority of the land along the Wolf River in *Wolf River Greenway Activity Area* consists of floodplain and bottomland hardwood forests. Bottomland hardwood forests are river swamps found along the broad floodplains of the rivers and streams of the southeast and south central U.S. and serve a critical role in the watershed by reducing the risk and severity of flooding to downstream communities by providing areas to store floodwater. In addition, these wetlands improve water quality by filtering and flushing nutrients, processing organic wastes, and reducing sediment before it reaches open water. Lowering the water surface level enough to alleviate flooding for the overall drainage basin is determined to be the best alternative to prevent future flooding in the area. The interventions in Rodney Baber and Kennedy Parks prevent further damage and loss of investment from future flood events. The terraced landscape approach in Rodney Baber Park will allow water to rise one level at a time, dissipating the initial inundation surge while the excavation east of the site will

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add flood storage capacity and increase stormwater detention. The proposed wetlands in Kennedy Park will collect stormwater and provide further storage capacity for flood water where it will infiltrate the ground or evaporate from the surface. Elevation along Orchi Road will prevent future flooding on a vulnerable neighborhood.

The watershed in *South Cypress Creek* is designated by the US Environmental Protection Agency as environmentally sensitive. The EPA's 2012 303(d) Impaired Waterbody Report for the Watershed identifies the following impairments: arsenic, dissolved oxygen, and phosphorus, which impair fish, shellfish, wildlife protection and propagation as well as ability to use the water body for recreational uses. Current environmental vulnerabilities in the South Cypress Creek community include approximately 226 parcels including residential properties, infrastructure, roads and recreational spaces that fall within the FEMA 100 and 500 year flood plains. Development in the South Cypress Creek area is dispersed; neighborhood services and amenities (e.g. a grocery store) are more spread out than in more densely populated areas. The neighborhood faces considerable physical barriers to other, more developed parts of Memphis and Shelby County, including interstate highways, railyards, and waterways. Access to services for residents without vehicles can be a challenge. The project activity area falls within a USDA designated Food Desert.

The Millington *Big Creek* area experienced major damage from the 2011 flood and other major flood events. A major contributor to the flooding is attributed to increased rainfall because of global warming. However, another contributing factor is development in the upper portions of the Big Creek drainage basin. There is increased pressure to develop these areas of farmland in the drainage basin. The overdevelopment of these areas without institutional controls will pose a risk by increasing surface water elevations in Big Creek, which could proliferate flooding. The

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proposed activity includes measures to account for additional runoff due to upstream development and proposed changes to runoff requirements by upstream governmental agencies. However if the activity is not implemented, the changes in weather patterns and future development pose a serious future risk to LMI households to become displaced, jobless and the facing the potential for additional loss of life from future flooding.

The Millington Big Creek channel and its tributaries within the activity area are listed as impaired streams. Impairment of Big Creek and its tributaries is most likely a result of increased peak flows, high nutrient loads, and increased sediment runoff caused by surrounding agricultural practices. Additionally, current bank erosion has resulted in extremely poor habitat conditions as well as low oxygen levels within Big Creek and its tributaries.

The federal Clean Water Act requires that all municipal, industrial and commercial facilities that discharge wastewater or stormwater directly from a point source (a discrete conveyance such as a pipe, ditch or channel) into a water of the U.S. (such as Big Creek) must obtain a National Pollutant Discharge Elimination System (NPDES) permit to ensure Water Quality Standards. According to the EPA's Envirofacts database, no current or previously permitted NPDES sites or facilities are located within the activity area. NPDES permitted sites or facilities near the activity area (within approximately 3 miles) that are currently reporting or have previously reported to either the Tennessee Department of Environment and Conservation (TDEC) or the EPA include the Pleasant Ridge Trailer Park, Millington Stp #2, and 51 Concrete Millington Ready Mix.

#### **IV. PROPOSED PROJECT DESCRIPTION**

After full evaluation of methods to address unmet recovery needs from the April 2011 storms and further resilience in the county and surrounding region, Shelby County has developed

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the Greenprint for Resilience Project. Each of the identified unmet needs are directly related to the identified county-wide resilience imperative - to find ways to live *with* water and “make room for the river.” The Greenprint for Resilience Project is a comprehensive set of activities designed to protect Shelby County’s communities from natural hazards while increasing environmental, economic and social opportunity for all residents of the region, especially vulnerable communities.

The Greenprint for Resilience includes interventions in three vulnerable watersheds in Shelby County: Big Creek, Wolf River, and South Cypress Creek. These watersheds are increasingly vulnerable to flooding, and home to communities with high levels of poverty, blight, and health disparities. Each intervention will address unmet needs from 2011; one of the main methods used will be to develop new flood protection through wetland storage and detention. The county will also offer to purchase the properties of residents within repetitive flood zones, helping to get them out of harm’s way. These activities will create additional greenway trails and enhanced recreation areas as well as areas for local food production. A fourth activity will create a Regional Resilience Plan over a three-year period to provide a means to tie these and other similar efforts to the recently released GREENPRINT , which was developed with the support of a HUD Sustainable Communities grant. The Greenprint for Resilience will establish replicable models of these interventions that will be transferrable to other areas within the region.

**Geographic Boundaries of Project.** The Greenprint for Resilience Project will take place within three areas of Shelby County ([ProjectAreaMapFigure1.pdf](#)):

**Activity 1: Big Creek.** This activity takes place in Millington, Tennessee, a municipality in northern Shelby County, between the Naval Support Activity (NSA) and Paul Barret Parkway along Big Creek.

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**Activity 2: Wolf River.** This activity takes place in Memphis, Tennessee, along and within the floodplain of the Wolf River. Interstate 40 runs along the river throughout most of Memphis. This activity also includes the adjacent Rodney Baber Park and Kennedy Park, as well as Orchi Road, a key street for connecting the neighborhood to the recreational elements of the project along the Wolf River. Orchi Road is located east of Highland Street, north of Chelsea Avenue, and west of Jackson Avenue. The county has identified Orchi Road as a pivotal local connector between the low income, Hispanic community south of the road and other key economic epicenters within the region. This neighborhood has also been identified by the GREENPRINT as a Social Equity Priority area.

**Activity 3: South Cypress Creek.** This activity also takes place in Memphis, along South Cypress Creek in the Weaver Park neighborhood. This area, south of Nonconnah Creek and east of T.O. Fuller State Park along Mitchell Road, is a physically and economically isolated section of Memphis. The neighborhood surrounding Mitchell High School is the main geographic area for this activity.

**Activity 4: Regional Resilience Plan.** The planning activity will involve all municipalities in Shelby County as well as several regional partners in Tennessee, Arkansas and Mississippi.

**Anticipated Changes to Local Policies.** For the Big Creek activity, to prevent future increases in flows entering Big Creek from neighboring Tipton County, the Tipton County government and the municipalities in southern Tipton County need to adopt or enhance runoff detention policies on land to be developed. Shelby County government and the City of Millington are currently partnering with Tipton County government and local upstream municipalities to develop polices to address this need.

**Project Timeline.** The project will start at approval by HUD and end in September 2019. See the project schedule in [Exhibit E](#).

**Estimated Useful Life of Proposal.** In accordance with FEMA’s BCA Reference Guide, the standard useful life for both major infrastructure and concrete infrastructure is 50 years. The acceptable range non-structural equipment is 15 to 30 years such as will be required in the recreational areas. Based on these recommendations, a useful life of 25 years for infrastructure was assumed. Equipment needed for the community gardens, play lots, and other uses are low maintenance and are unlikely to require replacement for the extent of the activity life. Equipment needed for the recreational facility includes wooden boardwalks, disk golf course equipment, and fencing and bleachers for the softball fields are low maintenance and are typically treated lumber or galvanized steel which are unlikely to require replacement for the extent of the activity life.

**Discount Rate.** A discount rate of 7% was used for all analyses.

## V. RISKS IF PROPOSAL IS NOT IMPLEMENTED

### Future Risks.

Severe storms and flooding remain the greatest disaster risk facing Shelby County. According to the National Centers for Environmental Information, from 2005 to 2015, Shelby County experienced approximately 95 flooding/flash flood events, the equivalent of 9.5 events per year. The impact of the qualifying storm events in 2011 alone are estimated by the National Weather Service (NWS) to have cost more than \$2 billion. Excluding the 2011 events, on an annual basis during the 2005-2015 study period it is estimated that flooding cost Shelby County an average of \$13 million annually. Within the same 10 year period, the county also experienced 114 high wind/tornado events with estimated damage of \$105.67 million according to the NWS.

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It is anticipated that climate change will accelerate the intensity and frequency of these events. According to the National Climate Assessment, the Southeast region of the United States has experienced a 27 percent increase in precipitation from 1958 to 2012. This trend is predicted to continue while, “the amount of rain falling in very heavy precipitation events has been significantly above average”<sup>ii</sup> meaning the impact of these normal rain occurrences has become more dramatic. Decadal averages of annual number of days per year where precipitation exceeded 2.99 inches has increased from 0.8 days to 1.6 days over the last 80 years. In addition to increased precipitation, communities like Shelby County are increasingly vulnerable to extreme heat. A recently completed study by the Tennessee Department of Transportation (TDOT) assessing the impact of extreme weather vulnerability on state transportation assets, found that Shelby County was one of two areas most vulnerable to extreme heat. One of the greatest concerns within the report is extreme weather in the Memphis area which could disrupt one of the key multimodal transportation hubs in the state and nation.<sup>iii</sup> Extreme heat also contributes to health problems increasing air pollution and thus asthma rates. Extreme weather has serious impacts on the economic, social and ecological construct of an area.

**Community Impacts.** The threat of cyclical flooding impacts the overall community by potentially driving local businesses away, discouraging future business development, negatively impacting the local job market, and engendering a steady decline in the morale and general welfare of area residents. The most vulnerable lower income populations will be hardest hit as they are the most likely to experience low and stagnant wages, long term unemployment, inadequate education and training opportunities, and practical difficulties like limited access to transportation and childcare.



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The mix of interventions proposed in the Greenprint for Resilience Project such as flood protection infrastructure, wetlands development, property acquisitions to help residents get out of harm's way and restoration of the environment will have extensive co-benefits for the community including of recreation, transportation choice, community health, and economic and community revitalization.

**Additive Benefits.** While additive benefits are difficult to quantify, the activities all build on each other to produce additional benefits for Shelby County. In the qualifying disaster, flooding affected disparate areas of the county across multiple watersheds; because of the numerous rivers and tributaries in the county, resilience cannot come from one watershed alone. By combining recreational and natural elements with flood protection, communities upstream and downstream will receive benefits in addition to the communities immediately adjacent to the Greenprint for Resilience project activity areas. For example, every household downstream of the three rivers in this project will benefit from the reduced flood risk and improved water quality from the improved stormwater storage capacity. Households upstream from the project areas might not see improved flood risk, but they will be able to use the recreational features of the project and witness firsthand the effects of combining stormwater management with recreational components.

**Risks to Highly Impoverished Areas.** Each target area (Big Creek, Wolf River, South Cypress Creek) is home to many LMI households. LMI households make up more than fifty percent of the Millington (Big Creek) area. In Big Creek, the primary areas that will remain adversely impacted are the Hiwassee Park, Bill Knight Road, and Plainview Heights subdivisions and the Shady Oaks Mobile Home Community. In South Cypress Creek, the Weaver Park neighborhood will remain adversely impacted. In Wolf River, the Orchi Road

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neighborhood is considered a Social Equity Priority Area by the GREENPRINT; the neighborhood has a poverty level of over 50% and nearly one third of households do not have access to a vehicle.

**Avoided Costs.** The qualifying disaster affected the three targeted activity areas in different ways. Thus, avoided costs are broken out by each Activity Area.

**Activity 1: Big Creek.** Flooding in the Big Creek drainage basin has been a persistent problem for the residents of Millington. The qualifying event in 2011 resulted in an estimated damages of approximately five million dollars. In addition to adverse impacts to the City of Millington, the adjacent Naval Support Activity (NSA) Mid-South is also susceptible to repeated flooding from Big Creek. In a 2010 flood that costs the City of Millington \$1,137,000, one hundred forty six residents of NSA Mid-South were displaced from their homes. In a briefing provided by NSA Mid-South entitled “Flood Recovery Lessons Learned”, the 2010 flood cost the Navy an estimated of \$154,000,000 including \$54,000,000 in facility repair costs.

The total economic impact of NSA Mid-South to the local community has been estimated to be approximately \$300,000,000. The City of Millington and Shelby County can ill afford to lose such a vital economic engine for the local area. The loss of life, the cost of residential property damage, the cost of facility damage and the cost of lost jobs in the Millington community could be avoided with implementation of the Greenprint for Resilience project.

These improvements would be expected to reduce the 100-year and 500-year flood levels in the vicinity of the activity by approximately 0.5’ to 3.5’, depending on location. As mentioned in Section 3.d, there are significant water resource features adjacent to Big Creek, such as wetlands. This activity will, to the extent possible, incorporate those wetlands into the functionality of the recreational area. Any loss of wetlands will be mitigated offsite.

**Activity 2: Wolf River.** Without the proposed activity within the Wolf River area, a flood event would be estimated to cause millions in damage including \$50,000 dollars of property damage. Continued adverse impacts to infrastructure and residential properties in low income neighborhoods will perpetuate the blight problem within the City of Memphis in addition to decreasing the property values within these communities. Those residents with limited relocation options due to poverty (upside down on their mortgages, etc.) will be especially vulnerable to worsened living conditions following a major flood event. Without this project, in each subsequent flood event the damages and their associated costs will continue to accrue.

The subactivity that is being proposed at Orchi Road will protect homes that were previously damaged in the 2011 storm event. This area is also identified as a Social Equity Priority Area by the GREENPRINT. Raising the roadway to protect the homes that are repeatedly damaged along Orchi Road will help to alleviate continuing impacts to the neighborhood.

The subactivities at both Rodney Baber and Kennedy Parks will help to reduce the disruption to those neighborhood amenities. During the 2011 storm event, not only was there damage to the mechanical and electrical equipment at Rodney Baber Park, but the majority of the park was underwater which caused disturbance to the neighborhood recreational amenities. By raising the main activity area of the park to the same grade as James Road, more of the amenities will remain out of the floodplain and minimize the loss of use/access to recreational amenities and services for area residents.

**Activity 3: South Cypress Creek.** Without the South Cypress Creek proposed project activity, a 100 year flood event would be estimated to cause \$2.2 million dollars of property damage and, if trends continue similarly to after 2011 flooding, that damage will result in

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additional vacant properties. Those residents with no other relocation options will be especially vulnerable to worsened living conditions following a flood event. Without this project, in each subsequent flood event, the damages and their associated costs will continue to accrue.

**VI. COSTS AND BENEFITS**

**Benefit Cost Ratio.** The full project as submitted for the application has a total project cost of **\$125,146,644**. With a total benefit of **\$411,137,956**. The BCA is based on a 7% discount rate with a 25 year life cycle. The combined BCR of this project is **3.29**. The full BCA is located in Attachment F ([AttachFBCASummaryShelbyCOTN.xlsx](#)).

To demonstrate the scalability of the Greenprint for Resilience project, an analysis of the project scaled down by 15% was also completed. The total project cost of this scaled project is **\$112,843,314**. The combined BCR of the scaled project is **3.64**. However the 15% scaled down project eliminated many of the social economic amenities of the activities.

**Lifecycle Costs.** The lifecycle costs of each activity are provided below.

**Activity 1: Big Creek.** Total life cycle cost for the activity is \$52,126,205. This activity's investments will include the acquisition of approximately 1265 acres of property adjacent to Big Creek and located just north of Paul Barrett Parkway in Shelby County and just to the east of Highway 51. Approximately one-third of this property is currently owned by the City of Millington, the State of Tennessee, or the Henderson Revocable Trust. The remainder of the property would be acquired from individual property owners and is currently undeveloped. This property would be developed into a multiuse recreational facility featuring athletic fields, an amphitheater, a community garden, water features, a disk golf course, and trails. The activity would be accomplished by excavating the left overbank from Big Creek to Paul Barrett Parkway

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to the 10-year flood elevation. Figure E-2 presents a conceptual typical section for the proposed work.

In addition to the excavation, 18 ft. x 10 ft. box culverts will be installed at bridges and culverts on both Highway 51 and Raleigh-Millington Road over Big Creek. A new levee and pump station along North Fork Creek will be constructed to an average height of 6 feet to protect a flood-risk neighborhood not previously protected from flooding. [Figures 1.16](#) and [1.17](#) show the extent of flooding from the 2011 event. [Figure 1.18](#) shows the proposed levee improvements and additions.

Operations and maintenance (O&M) costs for the activity elements, including the recreational area, additional culverts and pump station and levee improvements, were estimated using guidance from the EPA. According to guidance, an amount of 1.5% times the initial construction cost is appropriate for estimating the annual O&M costs for civil works activities. For mechanical equipment, the guidance recommends multiplying the initial construction cost by 2.5% to estimate the O&M costs for items like pump stations and recreational equipment. The O&M costs for the Big Creek activity are \$294,879 and will be covered by the City of Millington.

The full BCA for Big Creek can be found in Attachment F ([Big Creek Workbook.xlsx](#)).

**Activity 2: Wolf River.** This activity's major investments include property acquisition for the core of the activity along the Wolf River Greenway, the Orchi Road complete street project, earthwork and utilities, and the recreational and stormwater improvements to Rodney Baber Park and Kennedy Park.

The calculated engineer's opinion of probable construction costs for each of the sub-activities is as follows: The acquisition of the property in the floodplain and the construction of

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the Wolf River Greenway (\$40,828,580). The total cost of this activity is \$56,828,564. Orchi Road (\$2,963,672), Baber Park (\$5,342,105), Kennedy Park (\$2,865,824), earthwork and utilities (\$4,715,982), and property acquisition (\$112,400).

The full BCA for Wolf River can be in Attachment F ([Wolf River BCA Workbook.xlsx](#)).

**Activity 3: South Cypress Creek.** The total investment for this activity is \$12,020,653. This activity's major investments include infrastructure costs, flood mitigation/stormwater costs, programming capital costs, property acquisitions, housing redevelopment, operations and maintenance, and soft costs/contingencies.

Infrastructure costs include a bike lane on Mitchell Road, high visibility crosswalks, street lighting, multi-use trails, and brush clearing in wooded areas. These costs total \$1,644,500.

Flood mitigation and stormwater costs include the main channel enhancement, tributary enhancement, earthwork for flood protection berms and the removal of blockages, wetland expansion, additional stream crossings, stormwater improvements, and stream restoration. These costs total \$4,089,676.

Program capital costs include the Vacant Lot Land Trust program, included as a pilot program at \$250,000. Neighborhood watch training is also included at \$25,000. A new farmers market, based on others in Memphis, is included at \$200,000, and a community gardening program is also included at \$100,000. These costs total \$575,000.

Property acquisitions through a buyout program as well as associated demolition totals \$1,233,638. New housing development will cost \$2,012,500.

The full BCA for South Cypress Creek can be found ([South Cypress Creek BCA Workbook UPDATED.xlsx](#)).

**Activity 4: Regional Resilience Plan.** The planning effort to create the Regional Resilience Plan is included in the Greenprint for Resilience at a cost of \$2,100,000.

**Resiliency Value.** The resilience values for each activity are provided below.

**Activity 1: Big Creek.** Expected property damages in the Millington area from a future disaster would be reduced by \$4,525,148 for a 100-year flood and by \$27,927,212 for a 500-year flood. During a previous flooding event in 2010, approximately 900 residents were displaced. 4 to 5 feet of water flooded between 200 and 300 homes on the NSA naval base. If this activity had been complete prior to the May 2010 floods, \$79 million of property damages would have been prevented. If fully implemented, this activity will prevent large-scale flooding of Big Creek from occurring in Millington or the naval base. Flooding from both the 100-year and 500-year flood events in the adjacent neighborhoods would be prevented.

**Activity 2: Wolf River.** Recorded damages in Rodney Baber Park were \$2,800,000. If this activity were fully implemented, these damages would not occur in future flood events. Loss of service of nearby roads would be reduced, and rental costs for displaced families from future flooding events would be reduced as well.

**Activity 3: South Cypress Creek.** If this activity were fully implemented, loss of service of nearby roads would be reduced, and rental costs for displaced families from future flooding events would be reduced as well. Property damage reductions, calculated using a GIS analysis of the watershed area, would occur with this activity's implementation.

**Environmental Value.** The environmental values for each activity are provided below.

**Activity 1: Big Creek.** The property around Big Creek has transitioned through the years from an active naturally forested floodplain, to cultivated pastures, to its current mix of wooded wetland, shrubs, and pasture. Over several decades, Big Creek has become a severely incised and

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over-widened channel that does not adequately convey the discharge it receives from large storm events. As the stream becomes increasingly impaired, channel degradation exacerbates downstream water quality and threatens the recovery of connected natural aquatic systems. Although the primary purpose of the activity is to alleviate the flooding risk to adjacent communities, this activity also intends to restore and enhance the existing floodplain and natural aquatic systems by reconnecting Big Creek with its 10-year and bank full flood stages. Restoration and enhancement of the floodplain's natural communities will include transitioning some of the currently drained (previously converted) wetland soils into native herbaceous wetlands. In addition, currently degraded tributaries of Big Creek located within its floodplain will be restored by increasing channel sinuosity and constructing appropriate bank full channel dimensions where appropriate.

There are 20 acres of the activity site designated for solar farm development. The designated area could accommodate up to a 5 megawatt solar facility. A solar farm has the potential to generate 8 gigawatt-hours annually, which is enough energy to power over 550 homes. Greenhouse gases have been shown to be a contributing factor to climate change. The proposed 5 megawatt solar farm would prevent 3,900 metric tons of coal from being burned to produce the same amount of energy. This would eliminate 8,400 metric tons of carbon dioxide, 50 metric tons of sulfur dioxide, and 20 metric tons of nitrogen oxides from the atmosphere each year. The elimination of these greenhouse gases has a combined social benefit of \$2,765,964.

A result of climate change may be an increase in the magnitude of storm events. The Intergovernmental Panel on Climate Change (IPCC) 2013 report suggests that while the average annual rainfall remains consistent, the number of rainfall events occurring each year has decreased slightly and the amount of rainfall occurring in individual large storm events is



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greater. If more of the rain events each year are larger in magnitude, the likelihood of flooding would increase and, as such, have a significant effect on the Millington community.

To quantify the potential effect of climate change on flooding in the Millington community, Big Creek stages, as measured at the Millington gage, were examined. Maximum flood stage data were available for the past 25 years. A frequency analysis was performed on the flood stage data. Recognizing that 25 years is a short time period in which to identify weather and flooding trends, the frequency of the recent large storms affecting Millington were evaluated. Based on the data collected for 25 years, the 2010 flood event would have a two-percent chance of occurring in any given year. The 2011 flood would have a recurrence interval of fewer than 10 years. A supplemental BCA considering this greater frequency interval of the 2010 flood was performed and resulted in a cost-benefit ratio of 3.75.

The stream restoration portion of the Big Creek activity would provide erosion and scour protection improvements to Big Creek. It would also add streambank protection and result in reduced velocities downstream of the activity. These creek channel improvements will reduce the transport of sediment into Big Creek improving the quality of the water in the creek.

While the activity area is currently vegetated, a permanent 1265 acre park facility would protect the area from increased urban heat-island effect in the future by preventing future urban development in the area.

**Activity 2: Wolf River.** The surrounding wetlands along the river provide biodiversity not only in plant vegetation but also serve as a habitat for several native animal species. The proposed project does not disturb animal habitats but rather mitigates emissions through addition of 1,009 trees and green space. These activities capitalize on existing public green space by renovating and creating usable parks and trails and revamping areas often used as dumping

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grounds that fail to foster positive community interactions. The Kennedy Park proposal identifies an existing wetlands area to be enlarged and enhanced.

A portion of the noise in the activity area will be reduced by the proposed improvements. For instance, by depressing the playing fields at Kennedy Park seven feet, it will create an earthen berm that will help to shield the surrounding neighborhood from the noise emanating from the playing area.

One of the largest environmental benefits of this activity is the amount of vast open space. The activity area contains approximately 264 acres of open space within the park boundaries, and the city owned properties that will be used for either detention or tree mitigation. Open spaces in urban environments have many benefits such as providing access to study and enjoy nature, promoting biodiversity, connecting fragmented natural areas, and providing a home for natural species in environments that are otherwise uninhabitable due to city development.<sup>6</sup> The activities will also provide a cooling effect, lowering temperatures to mitigate the urban heat island effect. This has health benefits and could reduce the loss of life during extreme heat waves.

Water quality enhancements will occur on the activity sites through the enhancement and enlargement of wetlands, the increase in tree canopy along Orchi Road, increased detention volume at the playing fields of Kennedy Park, and the protection of existing wetlands at Rodney Baber Park.

**Activity 3: South Cypress Creek.** The South Cypress Creek Watershed provides important habitats for many plants and animals. The proposed activity adds 121.2 acres of habitat and mitigates emissions through addition of 7,429 trees and green space. It will also protect

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existing open space areas by creating a *usable* park and trail atmosphere in the place of wooded areas today that are often used as dumping grounds and can serve as havens for criminal activity.

Because this area is not densely populated or heavily developed, impact on urban heat island effect will be minimal.

The water quality of the sensitive Cypress Creek watershed will benefit from reduced storm water runoff capacity.

**Social Value.** Social value goes beyond the concept of producing a monetary profit in the service of society and benefits from activities that will influence entities outside their immediate construction. It is the idea of generating positive externalities that are intrinsically valuable and subjectively viewed. In 2014, the Center for the Study of Social Policy published the Building Neighborhood Capacity Program (BNCP). The BNCP strives to improve and promote positive change as well as cultivate a cohesive and unified neighborhood. A key element of the Wolf River Activity is to provide the means for surrounding neighborhoods to develop a unified atmosphere.

The driving concept behind the BNCP is that sustainable neighborhood and social transformation requires knowledge, skills, relationships, and resources.<sup>1</sup> Shelby County understands the need for communal cohesion and increased social value in LMI areas such as Frayser and Binghampton evaluated in the BNCP study. The push for change in the community is fully evident in the number of non-profit and philanthropic organizations within the project area that have established relationships with several of these LMI communities and exist to bring about social reconciliation and restoration in Memphis. Through these relationships, Shelby County has identified needs within the communities such as updated recreational facilities to accommodate the growing interests in soccer, alternative transportation options for those lacking

a vehicle, and safe centers where residents can gather and enjoy their community. The social values for each activity are provided below.

**Activity 1: Big Creek.** In May of 2010, an approximate 500-year flood event devastated the Millington Community when a levee along Big Creek was breached. Nearly 900 people were displaced during the flooding. Hundreds of homes flooded with several feet of water. The water rose so rapidly residents were forced to their roofs to await rescue. The NSA base was evacuated. Red Cross shelters were filled with stranded residents because blocked roads prevented family members from reaching them. The Big Creek activity will reduce human suffering by preventing the flooding of homes in future storms.

LMI household neighborhoods make up large portions of the area north of Big Creek that has experienced past flooding. Additionally, the flooded neighborhoods of the NSA base are made up of LMI households. The households in these areas would benefit from the improved flood protection as they are most vulnerable to the economic effects of natural disasters.

The LMI residents living in neighborhoods that would be protected would also benefit from access to the new parks, gardens and sports facilities. Currently, the neighborhoods in the Millington community have limited access to parks and outdoor activities. Existing parks include an 11 acre park (primarily baseball fields) and another 36 acre park. The Big Creek activity would provide a 1,265 acre park with hiking trails, natural wildlife habitat, a newly restored Big Creek, camping areas, amphitheater, and softball fields (Park amenities will be constructed in phases). The proposed park would improve the living environment by providing greater opportunities for those in the Millington community to get outside and be active. 49% of Americans get less than the minimum recommended amount of physical activity and 36% of American adults do not engage in any leisure-time physical activity. A large portion of the

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population that would use this facility are considered low income and at risk of poorer health than those who are of higher income because of higher obesity rates among low income individuals. The proposed facility will offer a variety of reasons to be outside and active.

Low income neighborhoods frequently lack full-service grocery stores and farmers markets where residents can buy a variety of fruits and vegetables. Instead, residents without reliable transportation may be limited to buying food from small neighborhood convenience stores. Additionally, healthy food is often unaffordable for lower income individuals. This project will help alleviate that problem by creating a large community garden plot connected to local neighborhoods by a pedestrian bridge. Citizens would have a place to grow their own fruits and vegetables and likely grow relationships with others working in the gardens, strengthening the sense of community in Millington.

**Activity 2: Wolf River.** The Wolf River activity revolves around the key concept of social value. As a result, the Wolf River Activity will use resources received in this grant along with assistance from area partners to fund the creation of focal points of social and recreational activities at Rodney Baber and Kennedy Parks. These focal points will foster and encourage community interaction and relationships, but will also impart opportunities for neighborhood ownership and leadership. The vision is to provide facilities that will draw residents out of their homes and into the community to stimulate interaction and interfacing between neighbors. Through the help of organizations in the area, these focal points will serve the surrounding community and will also initiate further growth by providing opportunities to learn new skills through a weekly farmer's market or experience different cultures through festivals, concerts, and cultural events at the parks.

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The Orchi Road subactivity is located in an LMI neighborhood as shown on Figures [2.12 through 2.14](#). The neighborhood around Orchi Road, has a poverty rate of 50.7 percent, and 32.1 percent of the residents do not have access to a vehicle. The exhibits also indicate a trend of increased poverty and reduction of vehicle access migrating from west to east. It is anticipated that this complete street project would be an initiative to invest in the neighborhood and curb the growing poverty trend from expanding access to job opportunities. It would also serve as a connection between neighborhoods and the Wolf River Greenway thus linking different demographic groups.

The 2011 storm event inundated the neighborhood and impacted several homes specifically along Kendrick Street. By providing voluntary buyouts, those homes will be removed from the floodplain, which will eliminate the displacement costs, lost wages, and emotional distress caused by future similar events for this LMI area. By raising Orchi Road, which connects directly to the GREENPRINT, this project will also add an attractive neighborhood amenity and connect this neighborhood and the Jackson Avenue neighborhoods to the southeast to the Greenway.

By encouraging community cohesion in the neighborhoods through these activities, neighbors will begin looking out for each other, therefore increasing the sense of security. The project team estimates that the proposed project activity in the area surrounding the Wolf River Greenway at Rodney Baber and Kennedy Parks specifically, will result in an additional 2,200 volunteer hours contributed to various proposed program activities by community members valued at over \$55,000 annually.

Access to a variety of recreational amenities, a robust trail network, and connections to the Wolf River Greenway through Rodney Baber Park, Orchi Road, and Kennedy Park are

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expected to increase physical activity within the surrounding communities providing short and long term health benefits.

The added social value for this project bolsters the financial argument for the resilience benefits of implementing this proposal. The proposed project activity will sufficiently address lingering unmet needs and will aid in fostering community identity and unity.

**Activity 3: South Cypress Creek.** The proposed activity will help the community better face future flooding events from a physical standpoint, but more importantly, will help build community identity and improve the environmental quality, making real impacts on quality of life in the near term.

Removal of blight will also avoid the lost tax revenue and lost property value that surrounds blighted properties (summed as part of economic benefits section). Furthermore, it will save the cost of higher insurance premiums and quality of life that result from blight. Demolition of abandoned buildings and conversion of vacant lots have into planned open space will help make the neighborhood safer and reduce crime, saving the city costs on expensive municipal services.

The project team estimates that the proposed project activity in the South Cypress Creek study area will result in an additional 2,880 volunteer hours contributed to various proposed program activities by community members valued at over \$72,000.

Access to a robust trail network and connections to T.O. Fuller State Park are expected to raise rates of physical activity in the neighborhood and generate short and long term health.

**Economic Revitalization Benefits.** The economic benefits from each activity are provided below.

**Activity 1: Big Creek.** Parks and open space provide a number of benefits to urban areas. Parks and open spaces can positively impact the property values of residential properties in their immediate vicinity. Additionally, parks and open space can draw visitors, attract businesses, and attract retirees to the community. Finally, parks provide other harder-to-measure benefits, such as air cleansing, groundwater recharge, flood control, water treatment, and aesthetic values.

Crompton (2004) has outlined a research-based approach, derived from peer-reviewed journal articles, thesis and dissertations, and documents produced by land trusts, planners, or consultants, to estimate the impact that parks and open spaces have on property values, and by extension, tax revenues. Properties within 500 ft. of the proposed park (Figure 1.15) have an aggregate assessed value of approximately \$12.94 million. Thus the overall impact on near-field property values due to the proposed park in Millington, Tennessee would be \$1.94 million (for an ‘Unusual Excellence’ quality park) and the total annual impact on property tax revenues would be \$29,700.

It is important to note that these estimates represent the minimum economic benefits derived from parks and open space in the City of Millington. This analysis does not account for the economic impact derived from attracting visitors, business, and retirees, nor does it account for the less quantifiable impacts of improved environmental conditions and aesthetics. These benefits would only act to increase the overall economic impact to the City of Millington.

**Activity 2: Wolf River.** The Wolf River Greenway will provide many economic revitalization opportunities through its connectivity with Rodney Baber Park and Kennedy Park in addition to it tying to the GREENPRINT network along Highland Street to the Orchi neighborhood. It is anticipated that the Wolf River Greenway construction alone will increase



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annual tourism spending within the activities boundaries, increase tax revenue from tourism, and increase property values. It is also anticipated that there will be annual savings in vehicle operating costs in the amount of \$2,842,000 by reducing the reliance on motor vehicles and promoting walking and biking as alternatives.<sup>3</sup>

Properties close to the Wolf River Greenway will see increased property values. The Shelby Farms Conservancy has a study prepared titled “The Economic Impact and Significance of Shelby Farms Park”<sup>7</sup> that stated that properties within 500 feet of a Greenline or trail, see an increase of 5% in their property values. By protecting the Orchi Road neighborhood from flood inundation with elevation of the roadway, the homeowners will not only see the elimination of the flooding damage, but they will also see an increase in their home values based on their proximity to the “complete street” connection along Orchi Road to the greenway.

According to the Wolf River Conservancy report, the entire greenway will produce roughly \$7,185,000 savings from reduced vehicle emissions per year. The natural landscape and proposed amenities such as recreational facilities, wetlands, ponds, and increased vegetation surrounding the trail will provide a unique atmosphere and multi-modal access to daily activities within the community. The improvements to Orchi Road will make the roadway more conducive to outdoor activities such as walking and biking. This can provide a safer pathway for the neighborhood to travel to and from work and school.

The proposed program activities in Rodney Baber Park will have the opportunity to initiate potential revenue streams. An area designed as a festival grounds and health food market have the potential to attract local food producers and outdoor entertainment events. Based on the reliability of the ball fields having lighting, the City could schedule more ball games for the site

which would bring more people to the area that would spend money at local stores and restaurants.

**Activity 3: South Cypress Creek.** The South Cypress Creek area has a convenient location between two of Memphis' key job centers, Pidgeon Industrial Park (and surrounding industrial employment on President's Island) and the Memphis International Airport and FedEx headquarters. Mitchell Road is a key area connection that is at risk during a flood event. Mitchell Road is also important for access to education at Mitchell High School and Ford Road Elementary School.

This project is also expected to increase visitation to T.O. Fuller State Park by 500 non-resident visitors per year and generate nearly \$350,000 in additional tourist spending over the next 25 years. Property values in the area are anticipated to increase by approximately \$110,094 per year.

## **VII. RISKS TO ONGOING BENEFITS**

**Uncertainties.** A number of uncertainties can be identified with an activity of this scale. The uncertainties can be divided into environmental, flood protection, and socio-economic categories.

The environmental permitting of this activity contributes to a significant amount of uncertainty due to the riparian nature of the activity. The outcome of the permitting process could shape the final layout of the activity, including the timeline for which the activity will be completed. Phases of the activity may take longer than anticipated and the net benefits may not be realized for a longer period of time than originally assumed.

In addition to environmental benefits, the project greatly enhances flood protection along Big Creek, Wolf River, and South Cypress Creek. The enhanced flood protection is based on the

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current watershed configuration including land use and development. It is assumed that the effects on storm flow from future development will be mitigated individually and not impact the overall basin flood response.

The usable open space created by this project is expected to deliver an economic stimulus to the surrounding area. This stimulus will be in the form of increased tourism, increased property values and increased tax revenue. Another potential economic benefit could come from the use of proposed recreational facilities. Revenue could come in the form of fees for recreational clubs to use the facilities. Larger amounts of revenue would be realized if local or regional tournaments were held at the facilities which would bring in additional tourism dollars.

Conversely, safety and crime in the project area presents a risk for the proposed activities. New trails and improved open space will only add value to the community if they are perceived to be safe enough to use regularly. Adequate police presence in the neighborhood supplemented by neighborhood watch and other safety measures should successfully mitigate this risk.

**Adaptability.** The proposed Greenprint for Resilience project incorporates elements that are commonly utilized by governmental agencies, i.e., the Corps of Engineers, throughout the U.S to mitigate flooding. These types of projects routinely add floodplain storage areas and improve stream conveyance to mitigate flooding adjacent to rivers. In recent years, these projects have also incorporated playground and sports fields, which are constructed in the floodplain to take advantage of open space. This project will marry these elements together on a large scale to address multiple needs of the adjacent communities, which have a large percentage of LMI households. As with activities of this size and proximity to waterways, challenges will always be encountered.

Environmental resources will be located and mapped and regulatory agencies will ultimately impact the final design. One of the strengths of this project is the adaptability to accommodate multiple uses and stakeholder requirements. There are substantial natural resources currently onsite that will be incorporated into the design to the extent possible or mitigated offsite.

The goal of this project from a flood reduction standpoint is to increase conveyance and available flood storage along the reaches of Big Creek, Wolf River, and South Cypress Creek. This will be accomplished by lowering the flow resistance from existing vegetation and increasing the floodplain. If financial constraints are encountered, the installation of certain amenities at the recreational facilities could be implemented in stages as long as the reduction of the overbank's elevations and improvements to the stream's conveyance took place. Additionally, if environmental issues are encountered that cannot be incorporated into the proposed project limits or mitigated off-site, additional environmental restoration components could be incorporated into upstream areas. Though the local community has provided input into the proposed recreational amenities, modification to these elements may be required as additional input is received from public meetings during the design process. The goal will be to incorporate amenities into the recreational facility that match the desires of the community.

## **VIII. IMPLEMENTATION CHALLENGES**

**Political or Stakeholder Risks.** The major stakeholder risk to this proposal is negotiating with owners of parcels targeted for acquisition and/or buyout. While the community has been receptive to the plans and this application, building and maintaining trustworthy relationships is of critical importance to projects that involve elements as fundamental as one's

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own land or home. Shelby County's extensive outreach efforts through this application process, as well as the larger tri-state region's buy-in to the GREENPRINT, demonstrate that this risk can be effectively mitigated by the Shelby County team.

**Technical Risks.** There are few technical risks or challenges to this proposal. As the project is implemented, detailed hydraulic and hydrologic analysis of the activity sites will be completed for final design of the flood protection elements. This will inform more detailed solutions at the activity level.

In the South Cypress Creek watershed, the Mississippi River's backwater flow poses a technical risk. During flood events, the river backwater flows almost up to the Weaver Road bridge, reducing the total area with opportunity for stormwater management.

**Procedural Risks.** There are few procedural and legal risks to this proposal. The Greenprint for Resilience project has been designed and vetted by an experienced team with capacity to implement a project of this size and scale.

**Community Support.** In the South Cypress Creek area, community support at meetings so far has been moderate. Residents have lived in blighted conditions for so long, they are somewhat skeptical about efforts to improve the condition of the neighborhood. Community engagement as the plan develops will be very important. Preliminary surveys regarding potential property buyouts have had mostly positive results. Nine owners were interested in buyouts, two expressed that they were not interested. The few community member respondents who were not interesting in selling their properties expressed desire to donate them for community uses, such as community gardens, expressing sentiment that additional vacant land would hurt the neighborhood, not help it. With proper communication surrounding the project plan, it seems that the community can overcome any resistance to implementation.

In the Wolf River and Big Creek areas, community support has been high. In Big Creek, the Naval Support Activity offered their enthusiastic support of the proposed project activity, noting how it would reduce the risk of the residents on the base. Near the Wolf River, community members supported the return of park facilities that had been damaged in the 2011 qualifying disaster.

**Consultation with Environmental Groups.** SCRC has engaged in extensive consultation with community and environmental groups during the project development process. A complete list of consultations are available in Attachment D, the consultation summary.

## **IX. SCALING AND SCOPING**

Shelby County and its partners believe that the geographic locations and scale of the projects as developed in this application are the most prudent and appropriate for increasing resilience in areas affected by the 2011 storms. However, Shelby County analyzed a scaled approach that both looked to how increased funding could enhance the project's purpose as well as how to scale the project down without losing resilience interventions.

In the scaled up model, the county identified opportunities for scaling the South Cypress Creek area through including: \$2 million for a new bridge on Mitchell Road, \$1 million for infill housing in the form of seven multi-family units, and \$3.1 million to create four linear miles of additional GREENPRINT trails to further integrate the community into the master plan. In the Big Creek area, future phases of the activity include: a solar farm(s) to increase power redundancy and reduce emissions from coal sources. Along Wolf River Greenway, a large component of the Rodney Baber Park and Kennedy Park activities comprises a large scale earth moving initiative to create stormwater detention and lower surface water elevation of the Wolf River during peak events. The parks will include a number of amenities to serve the LMI

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community in close proximity and are being built out on a semi-robust level. Future scaling features will include community gardens, picnic areas, solar lighting, skate parks, and multi-use trails.

In keeping with NOFA requirements, Shelby County also analyzed a 15 percent reduction in project costs which largely removed the socio-economic programming in the project. While the BCA developed in the scaled down scenario is slightly higher at 3.64 rather than 3.29, the negative impact on the quality of the overall project is significant. Residents throughout the engagement process made it clear to the county the importance of the social and economic programming developed for the project.

Project Activity Title	Total Benefit	Life Cycle Costs	BCR
Big Creek	\$194,000,228	\$44,260,658	4.38
Wolf River Greenway	\$202,300,873	\$54,610,709	3.70
South Cypress Creek	\$14,836,855	\$9,800,725	1.51
Regional Resilience Plan	++	\$2,100,000	--
Administrative	++	\$2,071,222	--
Design Life (yr)	25 years	Total Project Costs	Combined BCR
Discount Rate (%)	7%	\$112,843,314	3.64

**Activity 1: Big Creek.** The Big Creek activity consists of creating additional flood plain area for water storage and increasing the ability of the area to convey water during major flood events. As mentioned earlier, this is common practice with the U.S. Corps of Engineers and other agencies to control flooding for various size projects ranging from major rivers to small tributaries. The proposed activity is currently at the conceptual stage and may need to be scaled up or down in the final design process if funding levels or design criteria have to be adjusted.

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Scaling of the project in the final design project can also provide the most cost-effective design to mitigate the identified flooding problem.

The recreational components can also be scaled to match the scope of the available funding. It is currently planned to install the improvements in at least two phases with the first phase, estimated to cost about \$10 million, to be installed immediately following the earthwork construction. The remaining facilities, estimated at about another \$15 million can be developed in one, or more, following phases as funding is available. If additional funds are allocated originally, then the portion of the proposed amenities installed in phase one can certainly be increased as funding allows. If funding falls short of requested levels, the amenities may be scaled back slightly, but it is important that enough of them be installed that access be provided to the entire site so that the open space benefits used in the Benefit Cost Analysis remain valid.

**Activity 2: Wolf River** In the event that the entire scope of the Wolf River Greenway activity cannot be funded, several changes can be made that will still meet the goals and intent of the overall project. For instance, up to \$1,000,000 could be eliminated by either excluding the trails interior to the parks, or by using a less durable construction material. The connectors from the parks to the greenway would remain, and therefore access to the full Wolf River Greenway would still be functional. The activity would meet the goals of connecting the communities to the parks and the greenways, improving health benefits, and providing access to job and retail centers.

Another modification that could be made is to reduce the amount of sodding and plantings in both Rodney Baber and Kennedy parks. While a robust tree canopy is more inviting, provides shade, and reduces heat island affects, these changes could reduce the activity budget by \$300,000, and still leave the ability to install these elements at a later date. Removing



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playground equipment at each of the parks is another opportunity to reduce the budget. The parks could be planned so that the equipment and associated infrastructure could be installed at a later date. Eliminating the playground equipment from both parks would yield a savings of \$500,000. It may be possible to find funding for this equipment in the private sector or through local fundraising.

Pavilions and shade structures could be added in future phases to the parks as well. The identified areas where these structures would be installed, can be graded and paved accordingly in preparation for the pavilions being added at a later date.

The activity areas were designed in such a way that if additional funding is identified, these amenities can be added in the future.

**Activity 3: South Cypress Creek** The proposed activities can also be scaled up or down without compromising the overall vision and effectiveness of the proposal. The costs summary outlines additional measures to be undertaken (additional miles of trail, more aggressive reinforcement of Mitchell Road Bridge) in the event that additional sources of leverage or funding are found. In the event that costs exceed expectations or project is not fully funded, the project activity in South Cypress Creek could be scaled back in several ways. First, the recommended scenario includes property buyouts of all parcels that fall within the FEMA 500 year flood plain, both for safety and damage avoidance, but also for urban design continuity of creating an urban edge at Anderson Road. If the proposal needed to be scaled back, some of the proposed buyouts closest to Anderson Road could be left for future phases since they are still contiguous with existing urban fabric. Furthermore, the stormwater and flood protection interventions can also be scaled back if necessary since the eventual buyouts will not leave privately owned property as vulnerable. Several viable options for scaling down the stormwater

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and flood protection measures were explored, one scenario which prioritizes the stream restoration and reduces scope of other interventions and one that scales back all interventions proportionally.

### **X. LONG TERM COMMITMENTS**

Long term commitments were also analyzed for benefits and costs. The costs of the LTCs are \$83,975,421 and benefits \$189,119,554 resulting in a BCA of 2.25. Many of the benefits, especially social programs, were not quantifiable but Shelby County knows that residents connected to healthy activities and economic opportunity is the cornerstone of a strong community. Shelby expects significant benefits for the county as long-term commitments are fulfilled. Documentation can be found in Attachment F ([Long Term Commitment BCA.xlsx](#)).

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<sup>i</sup> Mid-South Regional Greenprint and Sustainability Plan, Greenprint 2015/2040: Connecting Communities for Our Future, Shelby County Government, 2015.

<sup>ii</sup> <http://nca2014.globalchange.gov/report/our-changing-climate/heavy-downpours-increasing#tab2-images>

<sup>iii</sup> Assessing the Vulnerability of Tennessee Transportation Assets to Extreme Weather, Final Report, February 13, 2015, Mark Abkowitz, Janey Camp, Leah Dundon, 3 Sigma Consultants, LLC. Tennessee Department of Transportation.

Activity 1: Big Creek, Shelby County, TN					
Costs and Benefits by category	Page # in Factor Narratives or BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable)	Uncertainty
<b>Life cycle costs</b>					
Land Acquisition	19-33	Acquire 1,265 acres of land prone to flooding	Funds required to purchase 1,265 acres of land prone to flooding. Property values obtained from the Shelby County Assessors Office.	\$ (1,743,591)	
Overbank Excavation	19-33	Left overbank excavation to increase flood storage	BWSC cost estimate to excavate approximately 5.5 million cubic yards on the left overbank to increase flood storage and conveyance.	\$ (23,104,114)	
	19-33	Annual Operations and Maintenance		\$ (4,038,686)	
Recreational Facilities	19-33	Construction of multi use facilities	BWSC cost estimate to construct multi use recreational facilities in the excavated overbank areas.	\$ (9,880,100)	
	19-33	Annual Operations and Maintenance		\$ (2,878,464)	
Levee Improvements	19-33	Construction of levee elements	BWSC cost estimate to raise existing levee protecting the City of Millington, and constructing a new levee to protect a LMI neighborhood.	\$ (727,697)	
	19-33	Annual Operations and Maintenance		\$ (154,289)	
Bridge Modification	19-33	Additional culverts at Raleigh-Millington Road	BWSC cost estimate to add additional capacity to the Raleigh-Millington bridge at Big Creek that will reduce flooding upstream.	\$ (746,417)	
	19-33	Annual Operations and Maintenance		\$ (130,476)	
Bridge Modification	19-33	Additional culverts at US Hwy 51	BWSC cost estimate to add additional capacity to the US Highway 51 bridge at Big Creek that will reduce flooding upstream.	\$ (1,206,611)	
	19-33	Annual Operations and Maintenance		\$ (210,920)	
Solar Farm	19-33	Construct Solar Farm	5 MW solar farm to be constructed by others.	+	2
	19-33	Annual Operations and Maintenance		+	2
Tree planting	19-33	Planting of additional trees	BWSC cost estimate to mitigate the removal of trees during construction	\$ (125,000)	
	19-33	BWSC Cost Estimate		\$ (21,850)	
Engineering	19-33	Plans/Permits/Schedules		\$ (7,157,988)	
Mitigation	19-33	Project Evolution		+	
<b>Resiliency Value</b>					
Reduced Loss of Service	19-33	Reduction in loss of service of roads	Several roads and bridges were inundated forcing drivers to take alternate routes. ADT values taken from TDOT Traffic History. FEMA BCAR calculates \$29.63 per vehicle per hour x 5,194 vehicles assuming out of service 24 hours	\$ 860,889	
Reduced Property Damage	19-33	Reduction in amount of property damage	Project will reduce or eliminate the amount of damage realized during a flood.	\$ 5,821,329	
NSA Damages	19-33	Reduction in damage to the Naval Support Activity of the Mid South	Project will reduce or eliminate the amount of damage at the NSA realized during a flood.	\$ 17,247,351	
Reduced Displacements	19-33	Reduction in rental costs for displaced families	FEMA displacement costs = (\$0.73 x sq) x 13,124 sq ft (county assessor) x 12 month recovery time (FEMA BCAR Tables 2 and 3)	\$ 1,373,685	
Additional Damages	19-33	Additional reduction in damages to the areas adjacent to Big Creek	Values provided by Shelby County	\$ 27,968,630	
<b>Environmental Value</b>					
Green Open Space	19-33	1,246 acres of open space	Using FEMA's 2013 guidance on consideration of environmental benefits, a value of \$7,346 per acre of open space per year	\$ 106,687,067	

5 MW Solar Farm	19-33	Social cost of CO2 reduction	8,378 Metric tons of CO2 offset per year at \$40 per metric ton	\$	3,905,262	
	19-33	Social cost of SO2 reduction	48 Metric tons of SO2 offset per year at \$46,561 per metric ton	\$	26,276,431	
	19-33	Social cost of NOx reduction	22 Metric tons of NOx offset per year at \$7,877 per metric ton	\$	2,051,695	
Increased Air Quality	19-33	Reduction in amount of cars detoured as a result of impassable roads	Using FEMA's 2013 guidance on consideration of environmental benefits, a value of \$7,346 per acre of open space per year	\$	61	
<b>Community Development Value</b>						
Reduction in Human suffering	19-33	Reduces the chances of lives lost and illness from exposure to contamination			+	2
Benefit to LMI persons/households	19-33	Large portion of affected area are LMI households			+	2
Improved Living Environment	19-33	Access to parks increases physical activity and overall health			+	2
Reduction in Mental Stress and Anxiety	19-33	Catastrophic loss of property and livelihood can lead to counseling and treatment		\$	320,116	
Reduction in Loss of Productivity	19-33	Household wage earners unable to work		\$	1,141,601	
<b>Economic Revitalization</b>						
Increased Property Value	19-33	Real property values are positively affected.		\$	346,111	
Increased Property Tax	19-33	Municipal revenues are increased.			+	2
Talent Retention	19-33	Affluent retirees are attracted and retained.			+	2
Talent Acquisition	19-33	Knowledge workers and talent are attracted to live and work.			+	2

### Activity 2: Wolf River, Shelby County, TN

1	2	3	4	5	6
Costs and Benefits by category	Page # in Factor Narratives or BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable)	Uncertainty (1-5)
<b>Life cycle costs</b>					
<b>Combined Parks:</b>					
Demolition	19-33	Removal of 3 existing baseball structures and pavement	KHA lump sum cost estimate for demolition of structures including pavement in the vicinity of the structure as well.	\$ (75,250.00)	
Earthwork	19-33	Earthwork required to elevate the electrical equipment (unmet need) out of the flood plain	KHA cost estimate for removal of 500,000 cubic yards	\$ (3,822,485.00)	
Utilities	19-33	Water connection and materials for irrigation and drinking fountains	KHA lump sum cost estimate for utility demolition connection	\$ (32,250.00)	
<b>Engineer's Opinion of Probable Cost</b>				<b>\$ (4,715,982.00)</b>	
<b>Infrastructure for Kennedy Park:</b>					
Paving and Curbing	19-33	Includes asphalt and concrete paving, striping, permeable parking pavers, ADA amenities	RSA cost estimate for all paving and curbing required in Kennedy Park	\$ (960,388.10)	
Structural Infrastructure*	19-33	Includes masonry, pavilion structure, restroom buildings, tool shed, etc.	RSA cost estimate for structures required in Kennedy Park	\$ (9,810.00)	
Lighting	19-33	Includes roadway/parking lights, meter and connection wiring, outlets, feeder panel, etc.	RSA cost estimate for site lighting required at Kennedy Park	\$ (108,455.00)	

Recreational Equipment	19-33	Construct sports field, maintenance and equipment	RSA cost estimate for sports equipment and operations at Kennedy Park	\$	(295,063.00)
Protection and Safety Infrastructure	19-33	Handrails, bollards, fencing, gates, etc.	RSA cost estimate for safety equipment and ADA required railings at Kennedy Park	\$	(44,254.00)
Signage	19-33	Park identification, trail wayfinding signs, kiosk, temporary construction signs	RSA cost estimate for park and educational signage	\$	(57,334.00)
Plantings	19-33	Planting trees; Seeding and Sodding	RSA cost estimate for additional vegetation at Kennedy Park	\$	(484,991.14)
Site Furnishings	19-33	Bike Facilities, Benches, trash receptables, picnic tables, ADA accessible entities, etc.	RSA cost estimate for pedestrian amenities at Kennedy Park	\$	(75,755.00)
Irrigation and Drinking Water Fountains	19-33	Watering needs for fields and pedestrians at Kennedy Park	RSA cost estimate for irrigation and water fountain accomodations at Kennedy Park	\$	(137,340.00)
Alziehmers Stroll Garden	19-33			\$	(214,796.49)
Ongoing and Maintenance Costs					
<b>Engineer's Opinion of Probable Cost</b>				<b>\$</b>	<b>(2,865,824.08)</b>
<b>Infrastructure for Rodney Baber Park</b>					
Paving and Curbing	19-33	Includes asphalt and concrete paving, striping, permeable parking pavers, ADA amenities	RSA cost estimate for all paving and curbing required in Rodney Baber Park	\$	(1,672,892.76)
Structural Infrastructure	19-33	Includes masonry, pavilion structure, restroom buildings, tool shed, etc.	RSA cost estimate for structures required in Rodney Baber Park	\$	(653,961.85)
Lighting	19-33	Includes roadway/parking lights, meter and connection wiring, outlets, feeder panel, etc.	RSA cost estimate for site lighting required at Rodney Baber Park	\$	(318,280.00)
Recreational Equipment	19-33	Includes sports field maintenance and equipment; playground, and skate park.	RSA cost estimate for sports equipment and operations at Rodney Baber Park	\$	(347,840.26)
Protection and Safety Infrastructure	19-33	Includes handrails, bollards, fencing, gates, etc.	RSA cost estimate for safety equipment and ADA required railings at Rodney Baber Park	\$	(71,155.20)
Signage	19-33	Includes Park identification, trail wayfinding signs, kiosk, temporary construction signs	RSA cost estimate for park and educational signage	\$	(77,717.00)
Plantings	19-33		RSA cost estimate for additional vegetation at Rodney Baber Park	\$	(938,326.50)
Boardwalk Trails and Pier	19-33	Includes boardwalk and fishing pier along lake and wetland	Quantity takeoff and typical unit costs were applied	\$	(19,075.00)
Site Furnishings	19-33	Bike Facilities, Benches, trash receptables, picnic tables, ADA accessible entities, etc.	RSA cost estimate for pedestrian amenities at Rodney Baber Park	\$	(113,796.00)
Irrigation and Drinking Water Fountains	19-33	Watering needs for fields and pedestrians at Kennedy Park	RSA cost estimate for irrigation and water fountain accomodations at Rodney Baber Park	\$	(238,710.00)
Ongoing and Maintenance Costs					
<b>Engineer's Opinion of Probable Cost</b>				<b>\$</b>	<b>(5,342,105.48)</b>
<b>Property Acquisition</b>					
		Property acquisition required to provide fill material and compensate for the amount of area filled in the floodplain	Used land appraisal values from Shelby County Parcel Assessor's website	\$	(112,400.00)
<b>Infrastructure for Orchi Road</b>					
Paving and Curbing	19-33	Includes asphalt and concrete paving; striping	Cost estimate for all paving and curbing required for Orchi Road	\$	(2,194,741.48)
Earthwork	19-33	Includes filling road to protect homes	Earthwork_Demo Estimate	\$	(229,009.00)
Landscaping	19-33	Includes street trees and sodding along ROW	RSA cost estimate for landscaping required along Orchi Road	\$	(45,976.20)
<b>Engineer's Opinion of Probable Cost</b>				<b>\$</b>	<b>(2,963,672.02)</b>
<b>Infrastructure for Wolf River Greenway</b>					
Total Project	19-33	Cost estimate for Wolf River Greenway per Wolf River Conservancy	Cost estimate for Wolf River Greenway per Wolf River Conservancy and 5B Connector	\$	(40,828,580)
<b>Total Engineer's Opinion of Probable Cost</b>				<b>\$</b>	<b>(56,828,564)</b>
*Noted for potential Phase II construction at a later date					

<b>Resiliency Value</b>					
<i>Reduced Property Damage</i>	19-33	Reduction in amount of future property damage	\$50,000 estimated in damages to Rodney Baber	\$	19,422.58
<i>Value of reduced displacement cause by future/replacement</i>	19-33	2956 SF impacted over 12 months	\$0.73/SF/Month (Source: FEMA-BCAR-Resource PDF, Table 2: Rental Costs and Disruption Costs)	\$	60,922.58
<i>Loss of Service</i>	19-33	1,884 Vehicles average daily count per TDOT ADT	\$29.63 per hour per vehicle	\$	520,428.07
<b>Total</b>				<b>\$</b>	<b>600,773.23</b>
<b>Environmental Value</b>					
<i>Green Open Space</i>	19-33	264 acres of open space	\$7,346 per acre of open space per year (Source: FEMA's 2013 guidance on consideration of environmental benefits)	\$	22,600,306.62
<i>Wetlands</i>	19-33	15.08 acres	\$37,493 per acre of Riparian Open Space (Source: FEMA's 2013 guidance on consideration of environmental benefits)	\$	6,588,871.14
<i>Fishing Lake</i>	19-33	5.00 acres	\$37,493 per acre of Riparian Open Space (Source: FEMA's 2013 guidance on consideration of environmental benefits)	\$	2,184,638.97
<i>Carbon Dioxide Reduction</i>	19-33	Provided 1009 Trees	\$0.61 per tree savings (Source: Shelby Farms Economic Impact & Significance)	\$	7,172.66
<i>Storm Water Runoff</i>	19-33	Provided 1009 Trees	\$0.46 per tree savings (Source: Shelby Farms Economic Impact & Significance)	\$	5,408.89
<i>Air Quality(quantity of pollutants and particulate matter)</i>	19-33	Provided 1009 Trees	\$12.62 per tree savings (Source: Shelby Farms Economic Impact & Significance)	\$	148,391.83
<i>Reduced Energy Use(alternative energy sources)</i>	19-33	Solar Panels to be installed at pavilion; offsetting operational costs; reducing air pollution			
<i>Reduced urban heat island effect</i>	19-33	Provided 1009 Trees			
<i>Annual Environmental Benefits</i>	19-33	Benefits to the environment related to the Wolf River Greenway	Savings from reduced vehicle emissions per year	\$	83,730,995.14
<b>Total</b>				<b>\$</b>	<b>115,265,785.25</b>
<b>Community Development Value</b>					
<i>Reductions in human suffering:</i>	19-33	Reduces chance of lives lost and illness from exposure and contamination			
<i>Asthma and Cancer Rates (general health impacts)</i>	19-33	14% of Memphis children have asthma; asthma-related illnesses account for 40% of visits to the local children's hospital, Le Bonheur			
<i>Healthcare Benefits Annually</i>	19-33	Healthcare benefits from Wolf River Greenway	Reduction in healthcare costs	\$	17,095,806.52
<i>Reduction in Mental Health and Stress</i>	19-33	Catastrophic loss of property and livelihood can lead to counseling and treatment		\$	13,042.33
<i>Average Annual Medical Cost Difference</i>	19-33	Savings based on number of users under Age 65	No. of Users multiplied by \$250 (Source: Shelby Farms Economic Impact & Significance Analysis)	\$	1,214,405.34
<i>Average Annual Medical Cost Difference</i>	19-33	Savings based on number of users over Age 65	No. of Users multiplied by \$500 (Source: Shelby Farms Economic Impact & Significance Analysis)	\$	315,608.17
<i>Benefits to Low- and Moderate-Income persons and/or Households</i>	19-33	Providing parks and recreation facilities within an LMI area			
<i>Reduction of slum/blight conditions</i>	19-33	Increase in property value with implemented Greenway and Recreation facilities			
<i>Improved community identity and social cohesion</i>	19-33	Provides a place for community interaction and ownership within the neighborhood			
<i>Improved recreational value(incl. access to open space)</i>	19-33	All the improved areas provide recreational value to the community			

Monetary value of volunteer hours for proposed activities	19-33	2,204 volunteer hour opportunities projected within the park facilities	KHA monetary estimation at Shelby County's average hourly wage (Source: Shelby Farms Economic Impact & Significance Analysis)	\$ 647,506.18	
<b>Total</b>				<b>\$ 19,286,368.53</b>	
<b>Economic Revitalization</b>					
Effects on local or regional economy (i.e. tourism revenue) new of opportunity costs	19-33	Unforeseen benefits will evolve as programs develop to supplement infrastructure and community facilities			
Annual Tax Revenue from Tourism	19-33	Tourism tax revenue accumulated from Wolf River Greenway	Tax revenue generated from Tourism spending	\$ 3,041,585.21	
Annual Tax Revenue from Property	19-33	Property tax revenue accumulated from Wolf River Greenway	Tax revenue generated from property	\$ 30,986,877.67	
Annual Savings in Vehicle Operating Costs	19-33	Savings due to alternative infrastructure for multi-modal transportation	Reduction in household and community-wide vehicle operation costs	\$ 33,119,483.39	
Access to employment	19-33	Greenway and proposed trails to provide further access to job centers			
Access of employers to workforce	19-33	Improved bicycle and pedestrian infrastructure will stimulate alternative modes of travel, resulting in a less auto-dependent workforce			
Job Creation	19-33	Provides potential job opportunities through sports, events, farmers market			
Revenue opportunities through special events such as concerts and farmer's markets	19-33	Potential for possible events in the future			
<b>Total</b>				<b>\$ 67,147,946.27</b>	

<b>Activity 3: South Cypress Creek, Shelby County, TN</b>					
1	2	3	4	5	6
Costs and Benefits by category	Page # in factor BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable, if not -/+)	Uncertainty (1-5)
<b>Life cycle costs</b>					
<b>Infrastructure</b>					
			Lifecycle assumed 25 years		
Bike Lane on Mitchell Road	19-33	Key component to launching Greenprint, regional green space plan. 6 miles of bike trail connection TO Fuller State Park, which serves the neighborhood, Shelby County, and the region	Costs from 2015 Mid South Greenprint Study, \$133,000/mile	\$ (465,500)	
High Visibility Cross walk	19-33	Safe crossing of Mitchell Road for pedestrian and cyclists utilizing trail network in wetland area	Costs from 2015 Mid South Greenprint Study with input from Powers Hill Engineering, \$8,000/unit	\$ (8,000)	
Street Lighting	19-33	30 additional units of street lighting	Costs from 2015 Mid South Greenprint Study, \$4,880/unit	\$ (175,000)	
Multiuse Trail	19-33	0 mile paved multiuse trail, future phases only	Costs from 2015 Mid South Greenprint Study, \$777,000/linear mile	\$ -	
Multiuse Trail - Unpaved	19-33	6.8 miles unpaved multiuse trail	Costs from 2015 Mid South Greenprint Study, \$120,000/linear mile	\$ (816,000)	
Brush Clearing in Wooded Areas	19-33	Vacant lots and undeveloped areas on the edge of the Weaver Park neighborhood are overgrown to the point where they are not usable as open space and are at risk as havens for crime and illegal dumping	Powers Hill Engineering Estimate	\$ (180,000)	

<b>Flood Mitigation/Stormwater</b>					
Main Channel Enhancement	19-33	Modify existing channel to accommodate wider flow range	Stantec Engineering Estimate, \$75/linear foot	\$	(320,768)
Tributary Enhancement	19-33	Divert tributary flows from main channel	Stantec Engineering Estimate, \$150/linear foot	\$	(375,000)
Flood Protection / Berms / Earthwork	19-33	Proposed Levees and berms will help protect vulnerable areas	Stantec Engineering Estimate, \$25/cubic yard	\$	(270,768)
Flood Protection (removal of blockage)	19-33	Removal of blockages will allow for improved flow	Stantec Engineering Estimate, \$25/cubic yard	\$	(128,440)
Wetland Expansion	19-33	Enhancement and Protection of wetlands	Stantec Engineering Estimate, \$7,500/acre	\$	(787,500)
Additional Stream Crossing	19-33	Proposed culverts below Mitchell and weaver roads will help direct and improve water flow	Stantec Engineering Estimate, \$175,000/each	\$	(350,000)
Stormwater Improvements (BMP)	19-33	Series of BMPs throughout study area, both in undeveloped land and vacant lot areas.	Stantec Engineering Estimate, \$75,000/acre	\$	(275,000)
Stormwater Improvements (Stream)	19-33	Modify existing channel to accommodate wider flow range	Stantec Engineering Estimate, \$150/linear foot	\$	(562,500)
Stream Restoration	19-33	Stream restoration to promote natural systems function	Stantec Engineering Estimate, \$325/linear foot	\$	(1,019,700)
<b>Program Capital Costs</b>					
Vacant Lot Land Trust Program	19-33	Launch costs for vacant lot program and pilot lot projects		\$	(250,000)
Neighborhood Watch	19-33	Launch costs	Assumed training hours for volunteers	\$	(25,000)
Healthy Food Retail Program	19-33	Launch costs	Assumed training hours for volunteers, assumes community center insurance can already accommodate this type of event	\$	(200,000)
Community Gardening Program	19-33	Launch costs and pilot projects	See above	\$	(100,000)
<b>Buyouts</b>					
Property Acquisitions	19-33	Purchase of various land parcels and homes prone to flooding	Funds required to purchase 23 homes and 15 vacant parcels outlined in proposed plan. Property Values obtained from Shelby County Assessors Office	\$	(1,818,750)
PB Demolition Costs	19-33	Powers Hill Engineering Estimate	Assumed at \$8,000/unit	\$	(216,000)
<b>New Housing Development</b>					
New Housing Development	19-33	Replacement housing development projects to benefit displaced residents	This item also scalable based on funding availability	\$	(2,012,500)
<b>Soft Costs &amp; Contingency</b>	19-33	Calculated as 40% of hard costs	Calculated as 40% of hard costs	\$	(1,664,228)
<b>Total Lifecycle Cost:</b>				<b>\$</b>	<b>(12,020,653)</b>
<b>Resiliency Value</b>					
Avoided property damages	19-33	Combination of flood protection and storm water management measures will reduce the 100 year flood lines	Value of property protected calculated using risk level for various storm events (2, 10, 25, 50, 100 and 500 year events) and existing property values (2014 Shelby County appraised value)	\$	353,411
Value of reduced displacement cause by future/repeat disasters	19-33	Avoided cost of residents moving elsewhere during and after disaster	FEMA BCAR - Tables 2 and 3 (\$0.73/sq ft/month rent, assumed 12 months)	\$	64,620
Avoided Cost of Lost Service on Mitchell Road	19-33	Several roads and bridges were inundated forcing drivers to take alternate routes.	ADT values taken from TDOT Traffic History. FEMA BCAR calculates \$29.63 per vehicle per hour x 5,194 vehicles assuming out of service 24 hours. (FEMA BCAR pg 2)	\$	27,066
<b>Total Resiliency Benefit:</b>				<b>\$</b>	<b>445,097</b>
<b>Environmental Value - benefits calculated on a 25 year design life assumption</b>					
Habitat Creation (acres)			121.2 Acres	\$	11,091,689
					1



Wetlands	19-33	wetlands restoration and preservation enhancement will provide valuable animal habitats and could be used to fulfill mitigation requirements from projects elsewhere in the county	105 Acres		summed above	1
Forest	19-33	of urban forest on vacant lots restored as part of vacant lot reuse program	5.7 acres		summed above	1
Meadow	19-33	urban meadows on vacant lots restored as part of vacant lot reuse program	10.5 acres		summed above	1
Species Biodiversity	19-33	Restored stream corridor and increased base flow will improve water quality and habitats			summed above	1
Water Quality	19-33	Stream Restoration will fulfill NPDES MS--4 stormwater management and water quality requirements as well as have mitigation value			++	1
Air Quality(quantity of pollutants and particulate matter)	19-33	Reduction in number of cars detoured as a result of impassable roads	Vehicles forced to detour 2.6 miles at a cost of 1.6 tons of CO2 for each event	\$	6	
Tree Planting	19-33	Environmental benefit of trees added, air quality, storm water, CO2 reduction	USDA Forest Service, \$14/year per tree calculation	\$	104,018	
Reduced urban heat island effect					+	3
Noise Reduction					+	3
<b>Total</b>				<b>\$</b>	<b>11,195,714</b>	
<b>Community Development Value</b>						
<i>Reductions in human suffering:</i>						
Reduction in Mental Stress and Anxiety	19-33	Catastrophic loss of property and livelihood can lead to counseling and treatment	FEMA BCA V5.1 specifies \$2,433 per person per flooding event	\$	14,956	
Increase in Physical Activity	19-33	Access to parks increases physical activity and overall health, leading to savings in lifetime health costs	Parks Health Benefit Calculator National Rec & Park Association	\$	557,500	
Benefits to Low- and Moderate-Income persons and/or Households	19-33	33% household poverty rate in study area (2013 ACS data) At risk population			+	2
Improved Living Conditions	19-33					
Reduction of slum/blight conditions	19-33	Blighted conditions contribute to neighborhood insecurity			+	2
Improved community identity and social cohesion	19-33	Infrastructure investments and programming run out of the community center will help rebrand community			++	2
Improved recreational value(incl. access to open space)	19-33	Trails will improve access to Roosevelt Park and new vacant lot mini-parks will serve community as well as new trails along Cypress Creek. Finally, the Mitchell Road Bike Lane will also increase access to TO Fuller State Park			++	2
Equal access to resilient community assets	19-33	Site currently considered USDA Designated Food Desert, community gardening and farmers market program will help give access to healthy food and accompanying health benefits			++	2
Safety	19-33	Lighting additions, neighborhood watch program and reduction of blight will contribute to neighborhood revitalization			++	2
<b>Total Social Benefits:</b>					<b>\$572,456</b>	
<b>Economic Revitalization</b>						

Total area visitors/dollars spent (ex. TO Fuller State Park for Weaver)	19-33	Mitchell Road Bike Lane will improve access to TO Fuller State Park, generating an estimated 500 non resident visitors per mile per year	Wolf River Greenway Impact Study (2014) \$60 tourism related spending per visitor	\$	248,221	
Tax revenue generated from new development	19-33	Increase in property values also increase municipal tax revenue			+	
Property value increase	19-33	Positive value impact from reduction of blight and reuse of vacant lots	Temple University Philadelphia Blight Study (2001)	\$	1,282,994	
<b>Total Economic Revitalization Benefit:</b>					<b>\$1,531,216</b>	

**Activity 4: Regional Resilience Plan, Shelby County, TN**

1	2	3	4	5	6
Costs and Benefits by category	Page # in Factor Narratives or BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable, if not -/+)	Uncertainty (1-5)
<b>Life cycle costs</b>					
Procure consultant for regional resilience plan	19-33	Main cost for completing the plan	Based on comparable plans and past experience with planning efforts	\$ (2,100,000.00)	1
<b>Resiliency Value</b>					
Drainage basin modeling increases knowledge of specific interventions needed to reduce flood risk	19-33	Developing a HEC-RAS model of the Loosahatchie, Wolf, and Nonconnah basins	Best way to determine the exact locations for future green space and wetland development	++	3
<b>Environmental Value</b>					
Develop recommendations to increase resilience to heavy wind, severe snow and ice, extreme heat and cold, or drought	19-33	Expand the environmental benefits beyond water-based and flood-based modeling to include interventions that address climate risks	Recommendations TBD but will address Shelby's long term climate risks	++	3
<b>Community Development Value</b>					
Incorporate regional approach beyond Shelby County; build on Greenprint for Resilience engagement efforts	19-33	Municipalities and citizens will continue to be engaged in developing resilient projects	Efforts will grow beyond project target areas to all parts of the Mid-South region	++	3
<b>Economic Revitalization</b>					
Projects TBD will have a positive impact on property values and decrease repetitive losses	19-33	The plan's projects will increase the property values of nearby communities and decrease repetitive losses from storm events	Reduced risks will increase the land's value	++	3

**Project Administration: Greenprint for Resilience, Shelby County, TN**

1	2	3	4	5	6
Costs and Benefits by category	Page # in Factor Narratives or BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable, if not -/+)	Uncertainty (1-5)
<b>Life cycle costs</b>					
Administration	19-33	Admin Costs necessary for grant award		\$ (2,071,222.00)	1

**Big Creek**

Design Life (yr)	25
Rate (%)	7%
<b>BENEFITS</b>	
Resilience Value	\$ 53,271,883
Environmental Value	\$ 138,920,516
Community Development	\$ 1,461,717
Economic Revitalization	\$ 346,111
Total Benefit	\$ 194,000,228
<b>COSTS</b>	
Life Cycle Costs	\$52,126,205
BC Ratio	3.72

**Big Creek - 15% reduced**

Design Life (yr)	25
Rate (%)	7%
<b>BENEFITS</b>	
Resilience Value	\$ 53,271,883
Environmental Value	\$ 138,920,516
Community Development	\$ 1,461,717
Economic Revitalization	\$ 346,111
Total Benefit	\$ 194,000,228
<b>COSTS</b>	
Life Cycle Costs	\$44,260,658
BC Ratio	4.38

**Wolf River**

Design Life (yr)	25
Rate (%)	7%
<b>BENEFITS</b>	
Resilience Value	\$ 600,773
Environmental Value	\$ 115,265,785
Community Development	\$ 19,286,369
Economic Revitalization	\$ 67,147,946
Total Benefit	\$ 202,300,873
<b>COSTS</b>	
Life Cycle Costs	\$56,828,564
BC Ratio	3.56

**Wolf River - 15% reduced**

Design Life (yr)	25
Rate (%)	7%
<b>BENEFITS</b>	
Resilience Value	\$ 600,733
Environmental Value	\$ 115,265,785
Community Development	\$ 19,286,369
Economic Revitalization	\$ 67,147,946
Total Benefit	\$ 202,300,873
<b>COSTS</b>	
Life Cycle Costs	\$54,610,709
BC Ratio	3.70

**South Cypress Creek**

Design Life (yr)	25
Rate (%)	7%
<b>BENEFITS</b>	
Resilience Value	\$ 445,097
Environmental Value	\$ 11,195,714
Community Development	\$ 1,664,828
Economic Revitalization	\$ 1,531,216
Total Benefit	\$ 14,836,855
<b>COSTS</b>	
Life Cycle Costs	\$12,020,653.50
BC Ratio	1.23

**South Cypress Creek - 15% reduced**

Design Life (yr)	25
Rate (%)	7%
<b>BENEFITS</b>	
Resilience Value	\$ 445,097
Environmental Value	\$ 11,195,714
Community Development	\$ 1,664,828
Economic Revitalization	\$ 1,531,216
Total Benefit	\$ 14,836,855
<b>COSTS</b>	
Life Cycle Costs	\$9,800,725.50
BC Ratio	1.51

**For more details on life cycle cost and benefit calculations for each project activity, see the associated workbooks in Dropbox, labeled by area (Big Creek, Wolf River, South Cypress Creek).**

**BCA - Full Project**

Project Activity Title	Total Benefit	Life Cycle Costs	BCR
Big Creek	\$194,000,227	\$52,126,205	3.72
Wolf River Greenway	\$202,300,874	\$56,828,564	3.55
South Cypress Creek	\$14,836,855	\$12,020,653	1.23
Regional Resilience Plan		\$2,100,000	--
Administrative		\$2,071,222	--
Design Life (yr)	25 years	Total Project Costs	Project BCR
Discount Rate (%)	7%	\$125,146,643.9	3.29

Project Activity Title	Resilience Value	Environmental Value	Community Development	Economic Revitalization
Big Creek	\$53,271,883	\$138,920,516	\$1,461,717	\$346,111
Wolf River Greenway	\$600,773	\$115,265,785	\$19,286,369	\$67,147,946
South Cypress Creek	\$445,097	\$11,195,714	\$1,664,828	\$1,531,216

**BCA - 15% Reduced Project**

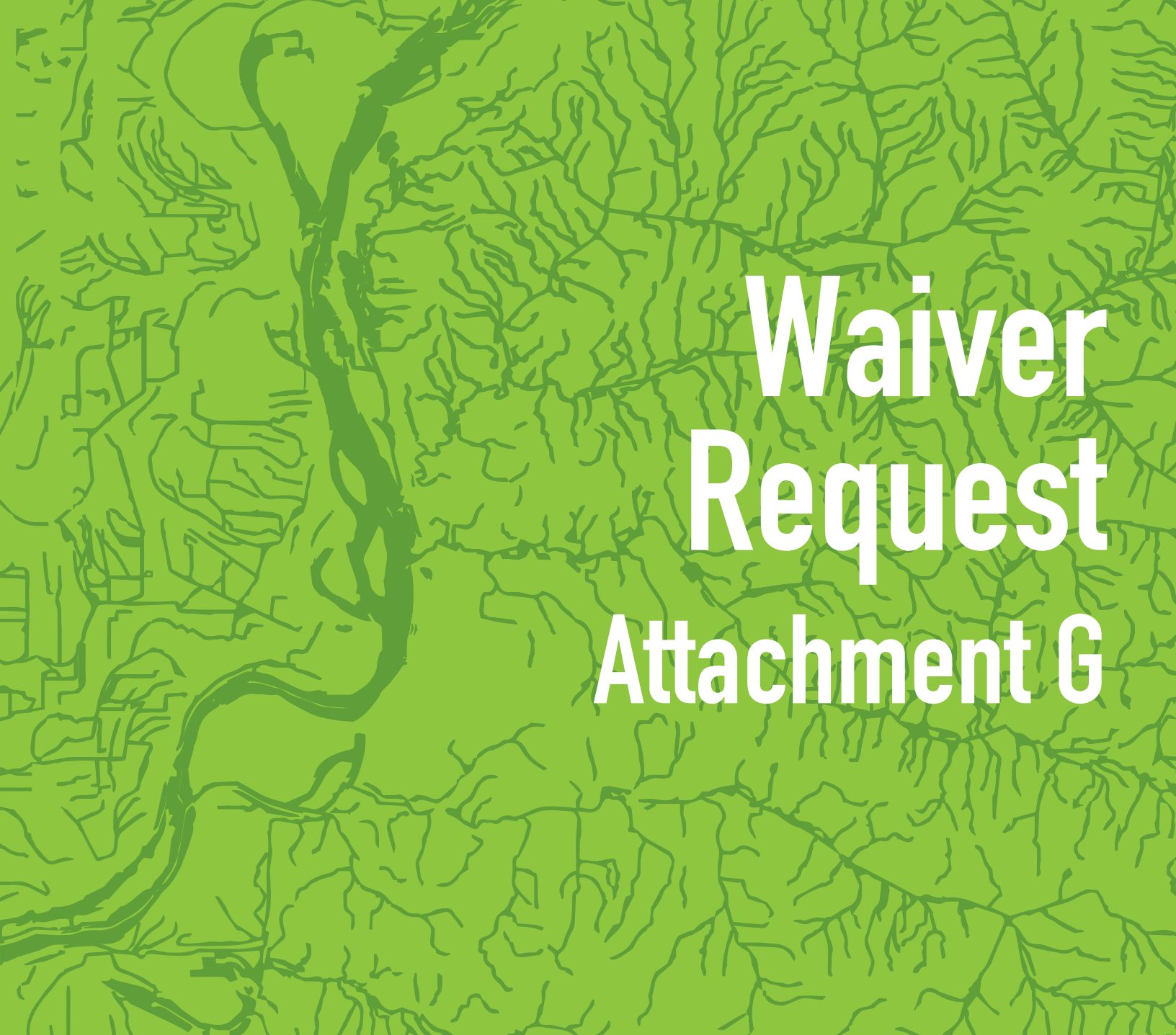
Project Activity Title	Total Benefit	Life Cycle Costs	BCR
Big Creek	\$194,000,228	\$44,260,658	4.38
Wolf River Greenway	\$202,300,873	\$54,610,709	3.70
South Cypress Creek	\$14,836,855	\$9,800,725	1.51
Regional Resilience Plan		\$2,100,000	--
Administrative		\$2,071,222	--
Design Life (yr)	25 years	Total Project Costs	Combined BCR
Discount Rate (%)	7%	\$112,843,314	3.64

Project Activity Title	Resilience Value	Environmental Value	Community Development	Economic Revitalization
Big Creek	\$53,271,883	\$138,920,516	\$1,461,717	\$346,111
Wolf River Greenway	\$600,733	\$115,265,785	\$19,286,369	\$67,147,946
South Cypress Creek	\$445,097	\$11,195,714	\$1,664,828	\$1,531,215.77

**BCA - Long Term Commitments**

LTCs	Total Benefit	Life Cycle Costs	BCR
Long Term Commitments	\$189,119,544	\$83,975,421	2.25
Design Life (yr)	25 years	Total Project Costs	Combined BCR
Discount Rate (%)	7%	\$83,975,421	2.25

LTCs	Resilience Value	Environmental Value	Community Development	Economic Revitalization
Long Term Commitments	++	\$118,223,574	++	\$70,895,970



# Waiver Request Attachment G

**RESILIENT**

**SHELBY**

**Shelby County, Tennessee**

**Greenprint for Resilience**

**National Disaster Resilience Competition**

**Phase Two – October 27, 2015**

**[AttachGWaiversShelbyCOTN.pdf](#)**

## Expenditure Deadline Waiver Request

Per Section 904(c) under Title IX of Public Law 113-2 which states that all NDR funds shall be expended within two years of the date HUD obligates funds to a grantee (funds are obligated to a grantee upon HUD's signing of the grantee's CDBG-DR grant agreement). Additionally, all NDR funds must be obligated by September 30, 2017 and expended by September 30, 2019. Shelby County understands that while all CDBG-NDR funds must be expended by September 30, 2019, the project does not have to be completed by this date, only the portions of the project using CDBG-NDR funds. The project could use leverage funds and meet a National Objective after September 2019.

Shelby County has designed a project schedule which will obligate all NDR funds by September 2017, and complete expenditures by September 30, 2019. However, the County has a procedural element that may impact the 24-month expenditure requirement from time of obligation of funds. The first is that Shelby County has proposed a number of large infrastructure projects that require environmental review and design. It is the county's experience that for certain flood protection and wetlands restoration projects, the review and permitting process can take up to six months.

As HUD outlines in the October 8, 2015 version of the NDRC Frequently Asked Questions, each grantee is able to obligate funds through a grant agreement in phases. The two-year expenditure clock is triggered only on the funding included in a grant agreement. Shelby County would like to request a waiver that allows a phased grant agreement approach to stagger the obligation of the award during the obligation period and thus expend the award within the September 30, 2019, expenditure deadline.

Shelby County anticipates it will require three grant agreements on the following schedule.

<b>Grant Obligation Schedule</b>			
	<b>Activity Subtotals</b>	<b>Obligated by September 2017</b>	<b>Expended by September 2019</b>
<b>Obligation 1: Round 1:      \$11,190,396</b>		May-16	May-18
Activity 1: Architecture, engineering, contract approvals, appraisals environmental, Property acquisitions, public engagement	\$ 5,076,187		
Activity 2: Architecture, engineering, contract approvals, appraisals, environmental, public engagement, buyouts	\$ 1,329,218		
Activity 3: Architecture, engineering, contract approvals, appraisals, environmental, public engagement, buyouts	\$ 2,752,115		

Activity 4: Hydraulic Modeling, Program Management	\$ 1,500,000		
<b>Subtotal</b>	\$ 10,657,520		
Project Administration	\$ 532876		
<b>TOTAL ROUND 1 OBLIGATION</b>	\$ 11,190,396		
<b>Obligation 2: Round 2: \$24,998,256</b>		Jan-17	Jan-19
Activity 1: construction clearing and grubbing, Testing, Construction administration	\$ 5,165,282		
Activity 2: construction Greenway, Orchi Road, Earthwork and Drainage, construction, administration, testing	\$ 14,836,166		
Activity 3:Construction Bike and multiuse trails, Housing Development, Construction, administration, testing	\$ 3,668,703		
Activity 4: Program Management, Master Planning	\$ 600,000		
<b>Subtotal</b>	\$ 24,270,151		
Project Administration	\$ 728,105		
<b>TOTAL ROUND 2 OBLIGATION</b>	\$ 24,998,256		
<b>Obligation 3: Round 3: \$34,923,305</b>		Sep-17	Sep-19
Activity 1: Overbank Excavation and Recreational facilities construction, testing, construction administration/closeout	\$ 24,450,049		
Activity 2: Rodney Baber and Kennedy Parks construction, Construction Administration/closeout	\$ 5,663,180		
Activity 3: Flood Control construction, Construction Administration /closeout	\$ 3,999,835		
<b>Subtotal</b>	\$ 34,113,064		
Project Administration	\$ 810,241		
<b>TOTAL ROUND 3 OBLIGATION</b>	\$ 34,923,305		