

# MissoulaTREE



## Workplan

1. Overall Project Summary and Approach.....	1
a. Description of GHG Reduction Measures .....	7
1. Carbon Removal and Avoidance .....	7
2. Transportation Sector .....	8
3. Waste, Water and Sustainable Materials Management.....	9
b. Demonstration of Funding Need .....	10
c. Transformative Impact.....	11
2. Impact of GHG Reduction Measures .....	12
a. Magnitude of GHG Reductions from 2025 through 2030.....	13
b. Magnitude of GHG Reductions from 2025 through 2050 .....	14
c. Cost Effectiveness of GHG Reductions.....	15
d. Documentation of GHG Reduction Assumptions .....	16
3. Environmental Results – Outputs, Outcomes, and Performance Measures .....	17
a. Expected Outputs and Outcomes .....	17
b. Performance Measures and Plan.....	17
c. Authorities, Implementation Timeline, and Milestones .....	18
4. Low-Income and Disadvantaged Communities .....	19
a. Community Benefits .....	19
b. Community Engagement .....	20
5. Job Quality .....	21
6. Programmatic Capability and Past Performance .....	22
a. Past Performance .....	22
b. Reporting Requirements .....	23
c. Staff Expertise .....	24
7. Budget.....	25

## Climate Pollution Reduction Grants: MissoulaTREE

### 1. OVERALL PROJECT SUMMARY AND APPROACH

“We, as citizens of Missoula, recognize that we are the benefactors of the past, as well as the stewards of the future. We envision a healthy, vibrant, safe, and sustainable urban forest for current and future generations. We strive to address the urban forest issues of the day in a proactive, cooperative manner, while always keeping a keen eye towards the future.” City of Missoula, Parks and Recreation (2015) *Urban Forestry Management Plan*.<sup>1</sup>

The City of Missoula is requesting \$3,525,201 in federal CPRG Implementation funding to increase carbon sequestration and reduce the urban heat island effect in Downtown Missoula. The Missoula Tree Revitalization for Energy and the Environment (MissoulaTREE) project will revitalize Missoula’s collapsing downtown tree canopy, improve accessibility and walkability, and utilize new technology and innovative products to create optimal growing conditions to ensure trees are healthy and vibrant for many years to come. As noted in Montana’s Priority Climate Action Plan (MPCAP),<sup>2</sup> urban and community forests provide over \$17M in ecosystem and economic value, providing increased ability to mitigate climate pollution directly and to withstand climate impacts. This project specifically will benefit downtown Missoula over the long-term by avoiding 203,460.2 kg of CO<sub>2</sub>, removing 46.16 kg of NO<sub>2</sub>, and avoiding 4.74 kg of VOC over the next 40 years.

The goals of this project are to create a robust, creative, and multi-generational solution to Missoula’s climate goals. It aims to increase ecosystem benefits of our urban forest exponentially over the next 5 to 25 years; increase sustainable multimodal travel; enhance walkable connections between two of Missoula’s low-income and disadvantaged communities; provide a replicable program for other cities to follow; and facilitate the use of best management practices within urban arboriculture.

When Downtown Missoula’s current trees were planted, the City utilized the best science at that time; however, it is now understood that the planting of one species and not varying the age class, as well as sub-optimal growing conditions, have led to decreased environmental benefits and an imminent urban forest collapse. This project will develop green infrastructure to create a system of tree plantings that will maximize the ecosystem benefits provided by each tree and site, and positively affect the adjacent businesses, residents and visitors of downtown Missoula. This will be done by planting trees in suspended pavement systems, planting the correct classification of tree in the correct site, and diversifying the species according to industry standards. The intent of the MissoulaTREE project is to establish improved growing conditions to support a thriving, healthy urban forest in Downtown Missoula that sequesters carbon, absorbs polluted runoff, filters airborne particulates, cools our densest urban environment, and encourages low-energy transportation options like biking and walking.

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<sup>1</sup> City of Missoula, *Missoula Parks & Recreation Design Manual* (2018).  
<https://www.ci.missoula.mt.us/DocumentCenter/View/41022/Missoula-Parks-and-Recreation-Design-Manual-2018-Edition-?bidId=>

<sup>2</sup> Montana DEQ, *Montana Climate Pollution Reduction Priorities* (2024).  
<https://www.epa.gov/system/files/documents/2024-03/montana-pollution-reduction-plan.pdf>



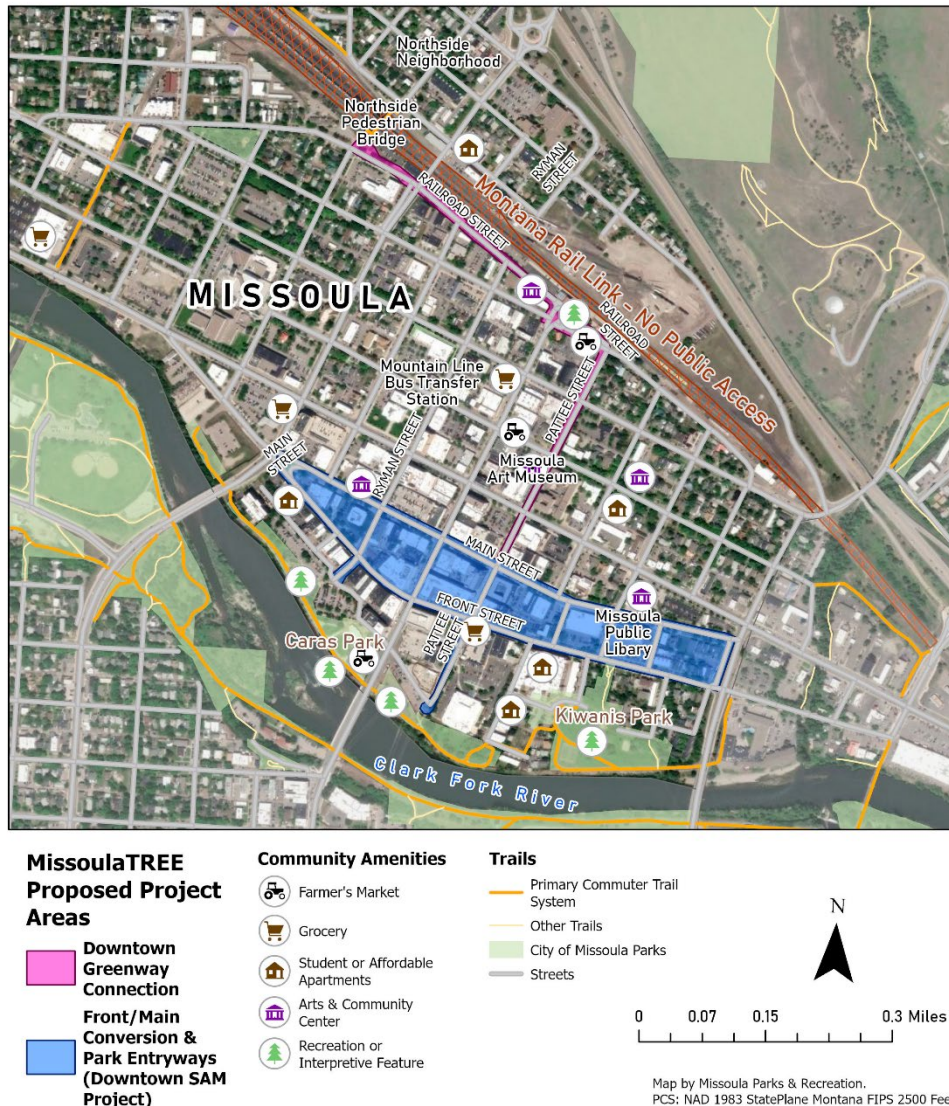


Figure 1. Map of MissoulaTREE project area.

The MissoulaTREE project<sup>3</sup> has four primary elements that will be completed over the 5-year implementation period of the grant (**Figure 1**): 1) design & engineering, 2) foresting unplanted boulevards; 3) constructing green infrastructure (suspended pavements with trees), and 4) post-planting tree care. The first and second years of the project will be largely focused on the design, engineering and permitting necessary to complete the project. In year two, trees will be planted into unforested boulevards. In year three, planting trees and installing irrigation in suspended pavement systems along Front Street and Main Street will complement the 2023 RAISE Downtown Safety-Access-Mobility (DowntownSAM) multimodal transportation project, focused on sidewalk and protected bike infrastructure. In year four and five, planting trees and installing irrigation in suspended pavement systems along N Pattee St and west on E Alder Street will create an “Urban Greenway” linking Missoula’s Northside to important amenities in Downtown Missoula. Throughout years 3-5 City arborists will supply critical tree care to ensure establishment of all newly planted trees.

<sup>3</sup> See attachments 1 and 2 for detailed maps of project area.

### *Background and History*

While Missoula has benefited from our urban forest for over 100 years, our downtown canopy is comparatively young. In 1983, a downtown revitalization project was launched by the Missoula Redevelopment Agency (MRA). This project was one of many across the country to reinvest in historic downtowns and grow local economies. Leaders with the MRA recognized the value of urban trees and the many positive impacts they have in a business district, including increased sales, pedestrian safety, urban heat mitigation, and a 15% increase in commercial property values. Missoula's downtown was a very different place in 1982: many stores had closed or relocated into midtown, the infrastructure including sidewalks were failing, and the MRA recognized the need for infrastructure updates which included tree planting. At the time, the downtown area only had ten trees. In the 1980s Missoula planted trees according to the best science of the time: an even aged, monoculture of Honeylocust trees were installed in narrow tree pits surrounded by concrete. While these trees provided benefits for the past 40 years, the MissoulaTREE project uses an evolved understanding of the urban tree canopy to capitalize on the co-benefits of street trees: reduction of Greenhouse Gas (GHG) emissions through carbon removal, increased mode split of those walking and biking, and intentioned and sustainable management of materials used in the project and the stormwater captured through the proposed suspended pavement system.

### *Current Conditions*

Of the 1,103 trees within the downtown area and grant boundaries, 50.3 percent are Honeylocust. Most of these trees are planted in traditional tree pits, with an average opening of 4 feet by 4 feet. While Missoula's downtown forest is less than 40 years old, due to sub-optimal growing conditions the environmental benefits of these trees are greatly diminished and a wholesale canopy collapse is imminent.

The traditional tree pits currently established throughout downtown Missoula have a 4-foot average opening and contain on average 64 cubic feet of potential soil volume. The "soil" in these tree pits is  $\frac{3}{4}$  minus gravel that was used as base material for the concrete sidewalks and road pavements, and lacks the important nutrients and structure needed to support thriving trees. A lack of nutrients and the compacted nature of these gravels create little or no pore space, and severely limit root growth and water absorption. The foundation for healthy tree growth is appropriate soil volume, nutrients, soil texture and water availability, which is lacking in all the tree pits in downtown Missoula. Trees planted 40 years ago should be over 20 inches in diameter with crowns that span at least 40 feet. A similar amount of biomass should be found underground within the root systems. Instead, the average 40-year-old tree in downtown Missoula is 7.5 inches in diameter with a crown width of only 15 feet. Belowground root mass is similarly stunted with roots largely confined to the small tree pit.

Honeylocust trees are a resilient species that have survived these conditions in part due to their aggressive rooting, which has led to structural roots following cracks and gaps in the sidewalks and curbs in search of water. This has led to heaved and buckled sidewalks that are no longer ADA compliant, and in many areas has created trip/fall hazards, interruptions to stormwater flow, and has reduced the lifespan of this infrastructure. The existing trees, while at only one-third of their life cycle, have maximized the growing space. Rather than continuing to grow and sequester carbon, they are dying and shedding their limbs. The maximum ecosystem benefits these trees could provide was realized years ago and these benefits are now declining. When these trees die there is no ability to replace them due to the spatial limitations of the existing tree pits, which will result in significant loss of the downtown tree canopy. Missoula must reinvest in improving growing conditions in downtown to achieve any further benefits from the urban forest.

### *Innovating for the Future*

Missoula, progressive in nature and looking to innovate, installed the first suspended pavement system in the State of Montana in October 2016. Since 2016, Missoula has installed twenty suspended pavement sites, replacing 3% of traditional downtown tree pits. The success of these innovative planting strategies is clear: suspended pavement system plantings (**Figure 2**) with class 2 trees can “catch up” in diameter to existing 40-year-old trees planted in traditional tree pits in a matter of a few years. This is primarily due to the correct soil volume and type, optimizing the tree’s growth potential and subsequent ecosystem benefits. However, at our current pace of replacement, it could take up to 100 years to fully upgrade traditional tree pits to suspended pavement systems.



*Figure 2. Example of suspended pavement system. Source: <https://www.landscapeperformance.org/blog/2015/06/tracking-silva-cell-tree-performance>*

The Missoula TREE project is focused on reforestation of entire blocks of downtown Missoula to exponentially increase the ecosystem benefits by creating optimal growing conditions to support actively growing trees. MissoulaTREE will replace or replant 157 tree locations in Downtown Missoula (see Attachment 2 for specific tree locations). Within the geographic project area, the MissoulaTREE project will upgrade 40% of existing traditional tree pits with suspended pavement systems and newly planted trees. Across the entirety of Downtown this represents an upgrade of 14.2% of all existing traditional tree pits, and an increase of the entire downtown urban forest canopy of 16.5%. Funding from the CPRG program will stimulate a generational change in the health and benefits of Missoula’s urban forest which cannot be reached by our current rate of replacement and replanting. The urban forest improvements also tie into innovative infrastructure projects like the DowntownSAM RAISE grant, ensuring we maximize our sustainable transportation goals for increasing the percent of trips taken by walking and bicycling.

Suspended pavement systems have been shown to be the best way to provide adequate soil volumes for trees in urban environments. These systems create pockets of uncompacted, nutritious soils that trees require, while still providing structural support for sidewalks and roads. Larger soil volumes allow for more tree growth, directly translating to greater carbon sequestration within the soil biome and the tree's biomass. As a form of green infrastructure, suspended pavement systems can blend traditional infrastructure with new, innovative technologies including permeable pavers and stormwater catchment and filtration from building roofs and other adjacent impermeable surfaces. Suspended pavement systems allow for trees to reach their maximum potential size in height and canopy spread, greatly increasing the ecosystem benefits that each tree provides. By maximizing the below-ground growing space, trees have the potential to reach their mature age while increasing sequestered carbon and overall stormwater absorbed, passively cooling, and decreasing the heat island effect of the built environment. Suspended pavement systems are an investment in the future, providing optimal growing conditions that result in multi-generational benefits.

### *Climate Benefits*

Healthy urban forests are proven measures for reducing climate pollution, particularly through carbon sequestration. According to the MPCAP, urban forests in Montana currently sequester 9.5 million pounds of CO<sub>2</sub> and 20 metric tons of other pollutants. MissoulaTREE is strategically positioned to enhance and increase those sequestration benefits in Missoula by establishing a healthy urban forest in our downtown that will last multiple generations.

An additional important climatic benefit of urban trees is the shade they provide to the urban environment. A healthy urban forest can reduce ambient temperature by 20-40°F compared to exposed surfaces, as noted in the MPCAP. These cooler temperatures reduce the need for summertime energy use by adjacent businesses and decrease maintenance needs of the adjacent asphalt on our streets.

A healthy urban forest also increases an area's walkability and bike-ability by providing shade as well as protection from traffic. Missoula is seeing an increase in summer temperatures and an increase in days above 100 degrees Fahrenheit. With our current urban forest in decline, this investment is critical to ensure that low-energy modes of transportation are comfortable and accessible, despite increasingly severe heat events caused by the climate crisis. Not only will a healthy urban forest support a more resilient community, but as an added benefit a tree-lined street will cause pedestrians to spend more time downtown, increasing the sense of community and money spent in adjacent businesses.

The benefits of the GHG emission reduction measures are maximized over the long term. The benefits of planting 157 trees are 203,460.2 kg of CO<sub>2</sub> avoided 40 years out, while the benefits are 22,779.6 kg of CO<sub>2</sub> avoided 5 years out. Over the 40-year period, the cost of removing trees and not replacing them is that trees slated for removal only avoid an average of 988.56 kg of CO<sub>2</sub> per tree while the proposed plantings avoid an average of 1,295.99 kg of CO<sub>2</sub> per tree; this is 307.43 of CO<sub>2</sub> avoided per tree, or 48,266.51 kg of CO<sub>2</sub> total avoided, assuming the existing trees last a full 40 years without mass mortality.

### *Improved Health Outcomes*

Trees offer a wide variety of different health effects, based on a 2020 paper published in the International Journal of Environmental Research and Public Health<sup>4</sup> that reviewed 201 studies on the various physical and mental health impacts of urban trees. Effects were grouped into three categories: 1) reducing harm (such as by curbing air pollution, heat exposure or crime), 2) restoring people's

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<sup>4</sup> Nuccitelli, D., *The little-known physical and mental health benefits of urban trees* (2023).

<https://yaleclimateconnections.org/2023/02/the-little-known-physical-and-mental-health-benefits-of-urban-trees/>



capacities (such as by reducing stress, restoring mental cognition and attention, or improving mental health), and 3) building peoples' capacities (such as by strengthening immune systems or motivating active living).

As we see a trend towards increased frequency and severity of wildfires throughout Montana and the West, the resulting wildfire smoke means more days of unhealthy air quality for Missoula residents. Due to the nature of the topography of Missoula, air pollutants from wildfire smoke become trapped in our valley and can quickly create unhealthy conditions that last for hours or days. Air pollutants such as Volatile Organic Compounds (VOCs), Nitrogen Dioxide, and others are subject to the same inversion effect and threaten our vulnerable residents with poor air quality. Trees are an integral part of the solution to healthy air quality as they can remove air pollution by intercepting particulate matter on plant surfaces and absorb gaseous pollutant through their leaves.

### *Merging projects and plans*

Missoula was awarded a 2023 RAISE grant to fund Missoula's Downtown Safety-Access-Mobility (DowntownSAM) project (**Figure 3**).<sup>5</sup> This project will complete a network of multimodal transportation improvements in the heart of Downtown Missoula on three key corridors: Higgins Avenue, Front Street/Main Street, and Riverfront Trail Connections. The MissoulaTREE project will complement the



Figure 3. Map showing the DowntownSAM project area.

<sup>5</sup> City of Missoula, *Downtown Safety Access Mobility Project*.



multimodal transportation improvements and sustainability of the DowntownSAM project by adding street trees along the Front/Main two-way restoration and nearby streets. The addition of street trees within suspended pavement systems enhances the pedestrian and bicycle infrastructure by adding to a safe and comfortable multimodal experience, protecting other infrastructure, encouraging non-vehicular transportation, and helping to reduce greenhouse gas emissions. While MissoulaTREE is a standalone project, it will build upon and enhance the DowntownSAM federal funding and project.

In addition, the MissoulaTREE project will provide a connection to Parks and Recreation's Northside Pedestrian Bridge revitalization project, which serves to connect two disadvantaged, low-income neighborhoods—Missoula's Northside and Missoula's Downtown.<sup>6</sup> The Northside pedestrian bridge provides an important non-motorized connection, bridging a major impediment to travel the Burlington Northern train corridor. This project would bridge two large municipal projects, the redesign and alignment of Front and Main and the refurbishment of Missoula's bicycle and pedestrian bridge.

#### **a. Description of GHG Reduction Measures**

The MissoulaTREE project addresses several of the measures identified in the Carbon Pollution Reduction Program, including: 1) remove carbon pollution through sequestration by a healthy urban forest, 2) reduce urban heat island effects on energy usage, 3) increase low-energy, sustainable transportation through increased comfort and accessibility of new multimodal transportation infrastructure, and 4) improved stormwater management. The project encompasses quantifiable carbon reduction benefits, such as sequestration and avoidance, and qualitative benefits such as increased walkability and accessibility, reduced pavement maintenance, economic activity, and stormwater treatment. The details and description of this project's proposed measures address all benefits; however, the quantitative carbon reduction will be focused primarily on carbon sequestration from a healthy urban forest, and potential carbon avoided through reduced energy usage in our downtown.

##### ***1. Carbon Removal and Avoidance***

As noted in the project overview, a healthy urban forest can be a significant source of carbon reduction through biological sequestration and storage. A report by the US Department of Agriculture<sup>7</sup> estimates that urban forests store more than 12% of the country's average CO<sub>2</sub> emissions and capture an additional 0.05% of emissions annually. The report also notes that urban forests play an important role in creating communities resilient to the impacts of climate change. **The MissoulaTREE project is based primarily on these carbon reduction measures; however, we are also including other important co-measures in the application as described below.**

MissoulaTREE will remove, replace or plant a total of 157 trees: 108 trees will be planted in suspended pavement systems, 23 in vegetated boulevards, and 26 in tree pits large enough to support a healthy mature tree. Twenty-four additional sites are identified as alternative locations for tree planting if engineers identify complications within the prioritized 157 locations (e.g., utilities, building infrastructure, sightlines, etc.).

Missoula's entire downtown urban forest is comprised of 1,103 tree sites. Of those 26% are maple, 4% are ash and 50.3% are honeylocust. Missoula's downtown has a high concentration of traditional tree pits: 651 or 59% of the total tree sites. The bulk of these trees, 83.6%, are even-aged honeylocust planted during a beautification project started in 1983, resulting in a monoculture, even-aged forest that is now in decline, as discussed above. The overall ecosystem benefits have plateaued; most of the trees

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<sup>6</sup> See Attachment 3.

<sup>7</sup> Safford, H., Larry, E., McPherson, E.G., Nowak, D.J., & Westphal, L.M., *Urban Forests and Climate Change* (2013). [https://www.climatehubs.usda.gov/sites/default/files/Urban-Forests\\_CCRC.pdf](https://www.climatehubs.usda.gov/sites/default/files/Urban-Forests_CCRC.pdf)

are not growing but are maintaining at best and at worst are in decline. Due to Missoula's arid climate and lack of fungi, and the species resilience to pathogens, the decline is slow. This has given our planning staff some time to plan a replacement program. Unfortunately, we have exhausted all funding streams locally and at the state level. The state of Montana only raises funds with property and income taxes and does not have a local sales tax or dedicated funds for urban forestry projects of this scale.

The City of Missoula recognizes the importance of green infrastructure and has begun to mandate policies for development. The Missoula, Parks and Recreation Design Manual adopted by City Council in 2018<sup>8</sup> outlines the importance of and requirement for appropriate soil volumes and the technologies approved to achieve it. Missoula's Municipal Code regarding urban trees, 12.32 and the Missoula Complete Streets Policy<sup>9</sup> both support building "complete streets" with multi-modal transportation AND healthy urban forests. The MissoulaTREE project would tie together several private development projects and complete sections of the downtown in suspended pavement systems with medium class trees, to provide increased ecosystem benefits for a much longer period.

Construction of Suspended Pavement Systems to reforest 43.5% of traditional tree pits in the MissoulaTREE project area will provide multiple benefits. Suspended pavement systems have proven their effectiveness at growing large, healthy trees that provide maximum ecosystem benefits in urban areas while protecting costly grey infrastructure (sidewalks & curb/gutter), lengthening the life of asphalt and removing trip hazards. Each suspended pavement system has a dedicated irrigation system, so the trees will receive adequate water. There are also storm water inlets, designed into the cells to capture runoff and treat it on site.

#### *Energy Use Reduction*

As a resultant benefit of this project, the improved quality and quantity of shade produced by the trees in the area will serve to keep nearby building walls cooler than they would be with stunted, unhealthy trees, and far cooler than they would be without any shade coverage. From this, energy use associated with indoor cooling, as well as the associated energy production emissions, are expected to decrease significantly. This reduction in energy consumption would not only create more comfortable buildings downtown but would also save the businesses and residents money.

## *2. Transportation Sector*

MissoulaTREE is primarily about carbon reduction from trees, however, there is a strong co-benefit from increased walkability and removal of other transportation-related air quality pollutants such as NOX, VOCs, and particulate matter (PM10 and PM2.5). These benefits are measured closely in Missoula as a valley with historically poor air quality stemming from CO<sub>2</sub> and PM2.5.<sup>10</sup> In part to address these air quality issues, as well as growing traffic congestion, Missoula adopted ambitious mode split goals in 2016, targeting a 34% reduction drive-alone goal through increased multimodal travel. Achieving this goal will require addressing transportation infrastructure at multiple levels, including high-quality multimodal facilities and accessibility for all ages and abilities.

Shifting trips away from single-occupancy vehicles (SOVs) and towards sustainable modes such as walking, biking and transit provides one of the most cost-effective ways to address climate change in Missoula. Increasing the urban canopy, combined with sidewalk and curb and gutter improvements, will

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<sup>8</sup> City of Missoula, Resolution 7473 (2009).

<https://www.ci.missoula.mt.us/DocumentCenter/View/2154/Resolution-7473?bidId=>

<sup>9</sup> City of Missoula, Resolution 7473 (2009). <https://www.ci.missoula.mt.us/DocumentCenter/View/2154/Resolution-7473?bidId=>

<sup>10</sup> Missoula Public Health, A History of Missoula's Air Quality Program (2016). <https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/history>

increase transportation options, reduce reliance on motor vehicles, reduce the number of vehicle miles traveled over time, and support transportation-efficient land use and infill urban development, thereby significantly reducing air pollutants attributed to our transportation system. Street trees are an integral part of transportation as the tree canopy provides shade, reduces the heat-island effect, filters stormwater, and mitigates other climate change related events.

It is estimated that the DowntownSAM RAISE grant project, which MissoulaTREE will support through an improved urban canopy, will reduce annual vehicle miles traveled (VMT) by up to 582,000 due to increased active transportation mode choice (biking and walking).<sup>11</sup> However, in order to fully realize these benefits, we need to ensure that the new on-the-ground facilities are supported by healthy street trees.

A healthy urban forest also benefits transportation equity and increases walking and biking via the decreased urban heat island effect. One of the most fundamental components to encouraging multimodal transportation is a connected, fully ADA-compliant pedestrian network. Street trees serve to protect those walking and biking when combined with appropriate multimodal facilities as they would be in downtown Missoula. Street trees create a physical barrier between vehicular traffic and vulnerable users, making these facilities safer and more comfortable. In the heat of the summer, the trees shade the facilities. When facilities are safe and comfortable, people are more prone to use them, helping to increase the multimodal mode split and decrease GHG emissions.

MissoulaTREE will also build 18,960 square feet of sidewalk and 2,370 linear feet of curb and gutter, meeting all ADA requirements, with newly installed trees. The combined DowntownSAM and MissoulaTREE projects would rebuild aging and failing infrastructure along Front and Main Streets. The MissoulaTREE project would help complete the sidewalk network by addressing accessibility issues, lined with street trees that connect low-income and disadvantaged communities, such as Missoula's Downtown to Missoula's Northside.<sup>12</sup> These projects are intentionally integrated to improve connectivity to the downtown trail system and commuter trails, as well as to all the amenities downtown has to offer. The MissoulaTREE project creates a more walkable connection from Missoula's Northside to Downtown and community centers, via an existing Parks Project to rebuild the Northside Pedestrian bridge that provides safe crossing of the BNSF railway bisecting the Northside neighborhood from Downtown.

### *3. Waste, Water and Sustainable Materials Management*

The City of Missoula has adopted a Zero by Fifty zero waste plan<sup>13</sup> that commits to 90% diversion from the landfill by the year 2050. All city departments work within this goal to expand programs that provide access, education, infrastructure, and policy updates to support reducing, reusing, and recycling of our waste streams. The City of Missoula Parks & Recreation Department has adopted a zero-wood waste program under the Ecosystems Services Division. All trees removed by city staff or contractors are evaluated for lumber potential. If deemed suitable to lumber use, trees are milled on site at the City-owned Garden City Compost facility and the unused portions are composted and sold as a soil amendment.

From the MissoulaTREE project, an estimated board footage of 2,686 feet will be milled into kiln-dried lumber. The carbon captured in the removed trees will be retained to the maximum extent possible. Although it varies slightly by species, wood is roughly 50% carbon by weight and will be stored for the

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<sup>11</sup> See attachment 4.

<sup>12</sup> See attachment 3.

<sup>13</sup> City of Missoula, ZERO by FIFTY: Missoula's Pathway to Zero Waste. <https://www.zerobyfiftymissoula.com/zero-by-fifty>

lifetime of the wood product. Milled lumber resulting from this program will be used locally by city departments for construction projects.

The remaining biomass resulting from MissoulaTREE will be composted at the City-owned Garden City Compost facility. Composting yields significant greenhouse gas emissions reductions when compared to landfilling the same material. The finished compost material will be utilized in the soils mixture for backfill into the suspended pavement systems for new tree plantings. Each suspended pavement system has a stormwater catchment system designed to capture stormwater runoff and treat it on site. To prevent the trees from being saturated in a large storm, drains are built into the cells that pipe back into the stormwater system or into a French drain, depending on the site. With healthy soil and stormwater collection, newly planted trees are set up for success. Overall, 109,890 pounds or 54.9 tons of mulch will be created; this is the approximated mass of the trees not milled into lumber.

The MissoulaTREE project will cause 43.9 cubic meters of runoff to be avoided per year during the 2025-2030 timeframe and 245.4 cubic meters in the 2025-2050 timeframe. This value is based on the average precipitation for our area and the interception and absorption of the tree sites based on the tree species and soil volumes. The bulk of the project area is within one block of the Clark Fork River. The project will have a positive effect on the stormwater discharge into the Clark Fork River and its downstream watershed. These values will increase exponentially over time, as the trees grow.

#### **b. [Demonstration of Funding Need](#)**

Within the MissoulaTREE proposed project area, we anticipate losing up to 136 trees within the coming years. Many of these trees are already partially dead, and many others are in a state of decline. Twenty-nine of these trees will be impacted and removed by adjacent road upgrades along Front & Main Streets. Losing this many trees in our downtown area directly conflicts with Missoula's adopted Climate resiliency goals.

The City's Urban Forestry Program manages roughly 45,000 urban trees growing along boulevards and sidewalks, and within developed parks. While Missoula has done an excellent job of planting trees in our urban area, the City's Urban Forestry Program is grossly underfunded compared to similar Cities in the Western U.S. For example, Boulder, Colorado and Bend, Oregon, cities whose urban forest and populations are most like Missoula's, have Urban Forestry programs that are twice the size of Missoula's. Unlike other states, Montana does not have a sales tax or other funding source to support a robust urban forestry program; the sole source of permanent funding comes from local property taxes. Given these funding constraints, Missoula's Urban Forestry program is primarily focused on managing risk and liability within the urban forest. Over the past few decades, as monocultures of even-aged tree stands are reaching the end of their life cycle—exactly what is occurring within our downtown project area—our program has shifted to more tree removals and less tree planting. For example, to date in fiscal year 2024 (July 2023-June 2024) we have removed roughly 112 trees and only have enough budget left to plant 86 trees in Spring of 2024.

Our Urban Forestry program is heavily dependent on grants and donations to supplement our tree planting efforts. Replacement plantings for the 136 trees we anticipate losing within our proposed project area are not funded. If this project's proposal is awarded, all 136 trees would be replaced, and an additional 21 trees will be planted in new locations. Accomplishing this scale of replanting in our dense downtown area is a feat that may otherwise take decades given the smaller scale of traditional grant opportunities and donations, as well as the higher cost of appropriate tree-supportive infrastructure such as structural soils and irrigation upgrades. These upgrades will allow for trees to reach their full maturity (up to 100+ years old) versus the current average lifespan of trees in downtown Missoula (40-50 years). This investment in suspended pavement will greatly reduce long-term costs to



the city and produce amplified environmental and climate benefits. The suspended pavement system infrastructure is designed to be permanent, with minimal maintenance required. It is expected that these systems will host the replacement trees for 100+ years, adding to the cost effectiveness of the project.

This investment in our urban forest is especially critical for Missoula as we continue to see more frequent and intense heat events and wildfire smoke events. Heat events can often exacerbate causes of climate change by encouraging residents to drive instead of walk in the heat, or to use more energy to cool their homes or businesses. Wildfire smoke is a public health and safety issue, and Missoula's urban area is especially prone to harmful air quality due to our local topography. A healthy urban forest can reduce those impacts. By providing shade and a comfortable environment for cyclists and pedestrians, urban forests can encourage low-energy transportation options even during heat events. Similarly, the reduced heat island effect from urban forests can lower building facade temperatures and therefore reduce the energy needed to maintain cool indoor temperatures. Healthy urban forests also provide filtration of airborne particles and improve air quality during wildfire smoke events. In these ways and more, the MissoulaTREE project addresses our need to mitigate the impacts of climate change while making our community more resilient to the impacts we're already experiencing. Without the significant investment proposed in this project, we could lose the climate mitigation and adaptation benefits of our urban forest exactly when we need them most.

### **c. Transformative Impact**

It is well known that trees in urban areas are crucial for passive cooling, carbon sequestration, absorption of pollution, encouraging multimodal transportation, improving mental health, and increasing property values and retail business. Our community's choice to forest downtown Missoula in the 1980's provided 40 years of benefits. However, the limited soil volume and nutrient availability of the heavily compacted gravels in the traditional sidewalk tree pits trees in Missoula's downtown have produced stunted trees that are steadily dying-back and providing ever-diminishing ecosystem benefits. It is obvious that Missoula's downtown urban forest is in jeopardy. A major investment in our urban forest is needed. If funded, our proposed project would be the largest, most comprehensive investment in green infrastructure ever implemented in Missoula, and possibly the state.

Simply replacing the trees in Missoula's harsh downtown urban environment without improving growing conditions would severely limit the possible impacts. Making communities more resistant to climate change requires embracing and implementing long-range solutions to complex problems. This project is not focused on simply planting trees: it also invests in a long-term solution to grow and maintain an urban forest for generations to come. MissoulaTREE provides positive long-lasting climate and economic benefits, but it will also set the standard for future reforestation efforts throughout our City and the State of Montana.

Missoula is experiencing more prolonged drought, record heat and severe storm events. Proactively managing our urban forest to cool our community's largest heat islands are priorities for our community and climate team. The current tree pits in downtown Missoula can grow trees for approximately 30 years before the trees begin to decline and the root systems begin heaving adjacent sidewalk panels, creating trip and fall hazards. Annually, City maintenance staff utilize gas-powered equipment to grind away these buckles in the sidewalk. Without improving growing conditions in downtown sidewalk tree pits, City arborists will need to plan for full-scale removal of downtown trees every 40 years.

Suspended pavement systems create active, living soils and biome that support carbon sequestration. A living biome helps trees achieve a greater growth potential compared to traditional tree pits. Soil

filtration of stormwater runoff, root zone sharing between trees, and utilizing correct soil textures allow natural processes to occur, a result not possible in trees planted within road base. Underground drip irrigation will further improve growth rates while limiting the loss of precious water to evaporation in our arid climate.

As noted in the Missoula Grant Support Memo from Davey Tree Service, ***“Comparing Proposed Plantings with Proposed Removals: Although it is expected that a larger number of trees would provide greater total benefits, each individual tree would provide a higher average number of benefits due to the better growing conditions. For example, trees slated for removal only avoided an average of 988.56 kg of CO<sub>2</sub> per tree while the proposed plantings would avoid an average of 1,295.99 kg of CO<sub>2</sub> per tree over the 40-year period.”***

Our comparison of the environmental benefits of new tree planting (with improved growing conditions) versus the benefits provided by the current trees and trees pits showed significantly increased rates of carbon avoidance and sequestration, reduction of other pollutants, and reduced energy consumption. Total benefits include an increase of carbon sequestration and avoidance of 50% or more **per tree**.

MissoulaTREE will treat 40% of all urban tree sites (157 of 392) within the project area. This project includes the new tree sites in MissoulaTREE areas that currently do not have boulevards or tree pits and are contributing the most to the urban heat island effect as there are no other mitigation factors being utilized.

This increased canopy will be concentrated along two main transportation routes (Front & Main Streets) and two heavily used walking corridors (Railroad & Pattee Streets) used to connect adjacent neighborhoods to Riverfront parks, Farmers’ Markets and Missoula’s Art Museum. As these trees grow and the tree canopy expands, the localized climate along these forested streets will cool the pavement and increase its longevity, as well as create a safer, more comfortable space for pedestrian usage. The public may not understand all the environmental benefits of the trees they walk under. However, we are confident that growing a mature forest along these heavily used downtown corridors will set a new aesthetic and create increased demand for more reforestation projects in Missoula’s Urban Areas.

While this is not a new technology, our state only has a few suspended pavement systems, with Missoula being the first city to install them. Although suspended pavement systems are common across the country, and are widely recognized as industry standard, so far, Missoula is also the only community in the State that is incorporating suspended pavement requirements into our design and development standards. Missoula will be building more suspended pavement systems; however, unlike other communities where these systems are commonplace, Montana has a shortage of skilled contractors who are trained in their installation. This project will provide a large-scale opportunity for local contractors to develop new skills and qualifications.

## **2. IMPACT OF GHG REDUCTION MEASURES**

As stated above while describing the measures requested for this grant-funded project, the quantitative metrics in this section are focused on the calculated avoided and sequestered carbon from diverting biomass from our landfill and from a healthy urban forest. The impacts of a healthy urban forest include direct carbon sequestration and estimated reduced energy usage from cooling benefits of the tree canopy on adjacent properties. Co-benefits from increased multimodal transportation, pavement condition, and stormwater treatment are included as qualitative benefits but not as part of the cost-benefit. It is important to recognize that urban forests provide significant benefits beyond what is easily calculated using i-TREE (described in more detail below).

### a. Magnitude of GHG Reductions from 2025 through 2030

By the end of the 5-year implementation timeframe of this program, 136 removed trees will be milled into lumber with the remaining biomass composted at the city-owned Garden City Compost facility. Composting the remaining biomass yields greenhouse gas emissions reductions of 7.57 metric tons of CO<sub>2</sub> when compared to landfilling the same material (Table 1). The finished compost material will be utilized in the soils mixture for backfill into the suspended pavement systems for new tree plantings.

**Table 1. Carbon benefits from composting**

	Pounds of Mulch	Landfill Emissions Average MT CO <sub>2</sub> e	Compost Emissions Saved MT CO <sub>2</sub> e
Honeylocust	46,365	0.14671	3.1871
Norway maple	52,800	0.17828	3.6424
Austrian pine	10,725	0.036195	0.73952
<b>Total</b>	<b>109,890</b>	<b>0.361</b>	<b>6.83</b>

Once stunted and declining trees have been removed, the MissoulaTREE project will repair and replace critical multimodal infrastructure, as well as re-plant 157 trees of diverse varieties in our downtown core. While the trees are still young, they will begin to demonstrate their diverse benefits, which will only increase for decades to come. By 2030, we can expect to see a cumulative total of a) 3,264.2 kilograms, or 3.26 metric tons, of CO<sub>2</sub> sequestered through above-ground biomass and b) an additional 1,305.7 kilograms, or 1.31 metric tons, of CO<sub>2</sub> sequestered by below-ground biomass – for a total of 4,569.9 kilograms, or 4.57 metric tons, of CO<sub>2</sub> emissions sequestered by the new trees. In addition to this direct sequestration of pollution, we can also expect a reduction in the urban heat island effect compared to existing conditions. This lower ambient temperature in our urban core will also impact our GHG emissions.

Shade coverage and solar irradiance are found to be inversely related to building wall surface temperatures.<sup>14</sup> Considering this, the buildings through the project area will experience less heat stress and will require less energy to maintain cool indoor temperatures, as heat transfer through building envelopes constitutes the dominant part of indoor cooling loads in the summer.<sup>15</sup> Based on the reduced heat island effect from these young trees we can estimate that 5,381.8 kWh of electricity will be saved, which results in 22,779.7 kilograms, or 22.78 metric tons, of CO<sub>2</sub> avoided from energy use in buildings for the 5-year timeframe. As the trees mature, they will provide more shade, further alleviating the heat island effect, and this emissions impact will continue to grow substantially.

The reduced heat island impacts from the MissoulaTREE project will also encourage more active transportation. Downtown Missoula, an already walkable urban space, could see a reduction in walkability unless properly shaded and designed with heat mitigation in mind.<sup>16</sup> Increasing urban greening can decrease the urban heat effect by 2–3°C (3.6–5.4°F), on average, improving Missoula's resilience to anticipated climate change impacts.<sup>17</sup> When the reduced heat island effect from our young

<sup>14</sup> Berry, R., *Tree canopy shade impacts on solar irradiance received by building walls and their surface temperature* (2013).

<https://doi.org/10.1016/j.buildenv.2013.07.009>

<sup>15</sup> Zhang, Z., Long, E., Li, Y., & Li, P., *Solar radiation reflective coating material on building envelopes: Heat transfer analysis and cooling energy saving* (2017). <https://www.jstor.org/stable/90014055>

<sup>16</sup> American Planning Association, *Planning for Urban Heat Resilience* (2022).

<https://www.planning.org/publications/report/9245695/#:~:text=This%20PAS%20Report%20lays%20out,mitigation%20and%20management%20strategies%3B%20managing>

<sup>17</sup> Jamei, E., Ossen, D.R., Seyedmahmoudian, M., Sandanayake, M., Stojcevski, A., & Horan, B., *Urban Design Parameters for Heat Mitigation in Tropics* (2020). <https://www.sciencedirect.com/science/article/abs/pii/S136403212030650X>

trees and infrastructure improvements of these projects are combined, we can predict that we will see an increase in active transportation trips in the downtown core. As people are encouraged to choose walking or biking due to the combination of a decreased urban heat island effect and an increase in comfortable multimodal infrastructure, we can estimate that CO<sub>2</sub> emissions will be reduced from this project, even when our new trees are still quite young.

Success in meeting the community's mode split goals is demonstrated by high rates of biking, walking, busing, and carpooling. Today, non-SOV trips account for 30% of daily commute trips in Missoula compared to the state average of 24.8%.<sup>18</sup> The MissoulaTREE project will continue to support shifting modes via more comfortable and safer transportation facilities created by the urban tree canopy. Several critical parcels surrounding Higgins, Front, Main, and adjacent to the Riverfront commuter trail all have potential to create housing, commercial, retail, and other core downtown services. This project will provide the appropriate infrastructure to ensure trips generated by those developments are highly multimodal and do not rely solely on SOV modes. Increasing density and mixed use linked by sustainable transportation also creates a more resilient region and is a core climate mitigation strategy for Missoula.

When considering the reduction in greenhouse gas emissions from this project over the 5-year period, we estimate the total emissions sequestered and avoided to be 34,918.58 kilograms, or 34.92 metric tons of CO<sub>2</sub>. This does not consider the impact of the reduced heat island effect on encouraging a switch in transportation from driving to walking, rolling, and biking. This switch in transportation modes would further increase the total emission reductions of this project but are difficult to estimate given limited local data.

#### **b. Magnitude of GHG Reductions from 2025 through 2050**

One of the initial steps of the MissoulaTREE project is to remove 136 stunted and declining trees, which will be milled into lumber with the remaining biomass composted at the city-owned Garden City Compost facility. Composting the remaining biomass yields greenhouse gas emissions reductions of 7.57 metric tons of CO<sub>2</sub> when compared to landfilling the same material, as noted above for the shorter evaluation period from 2025-2030.

Beyond these avoided CO<sub>2</sub> emissions from composting, we also expect the reduction in CO<sub>2</sub> emissions from tree plantings through 2050 to be significant given that the benefits from our initial investments will grow over time. As the newly planted trees mature, they will be able to grow healthier and larger over the decades thanks to the structural soils and irrigation that will increase the soil availability for their roots and provide consistent access to water. The diverse species of trees selected for this project will also increase their resilience to pests and disease, helping them grow larger and healthier. By 2050, we can estimate that the replanted trees will have sequestered 28,003.5 kilograms, or 28 metric tons above-ground, and 11,201.4 kg or 11.2 metric tons below-ground, for a total of 39,204.9 kg or 39.2 metric tons of CO<sub>2</sub> emissions. While the direct CO<sub>2</sub> sequestration from our urban forest will have increased significantly over time, we can also project significant reductions in the heat island effect and increases in non-SOV trips in our downtown core thanks to this project.

For buildings in the project area, we can expect to avoid 49,340.9 kWh of electricity use for cooling, which would equate to 121,874.5 kilograms, or 121.88 metric tons, of avoided CO<sub>2</sub> emissions. When considering all avoided and sequestered CO<sub>2</sub> emissions through 2050 directly related to this project, we can estimate a total reduction of 168.65 metric tons of CO<sub>2</sub>.

Beyond these direct benefits, we also recognize that the reduced heat island effect and the benefits of the infrastructure improvements made through this project will continue to encourage active

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<sup>18</sup> Montana Department of Transportation, *Volume II Transportation Users* (2017). <https://www.mdt.mt.gov/tranplan/docs/TPMT-USERS.pdf>



transportation. As the trees' canopies continue to expand, the impacts of this project will continue to support our community's mode split goals through providing a more comfortable environment for pedestrians and cyclists. This project will provide the appropriate infrastructure to ensure trips are highly multimodal and do not rely solely on SOV modes. Shifting trips away from SOVs and towards sustainable modes such as walking, biking, and transit provides one of the most cost-effective ways to address climate change in Missoula. The DowntownSAM project is expected to reduce almost 13 million<sup>19</sup> vehicle miles traveled (VMT) by 2050. This reduction in VMT would save about 5,270.65 metric tons of CO<sub>2</sub><sup>20,21</sup> within the first 25 years of the DowntownSAM project. While these are not direct emissions reductions of MissoulaTREE, we emphasize that the investment in the urban tree canopy proposed by this project will help realize and maximize the benefits of the DowntownSAM, which might not come to fruition if Missoula's urban forest experienced a significant collapse.

While we highlight here the greenhouse gas impacts of this investment through 2050, it is critical to emphasize that these are the benefits seen in the first 25 years since planting, and these trees will easily live to be 80 years old in the conditions we propose in this project. We know that the GHG reduction we've described will grow in magnitude as the trees continue to mature through the remainder of the 21<sup>st</sup> century. This is the kind of long-term, transformational investment needed for the magnitude of the climate crisis we face.

### **c. Cost Effectiveness of GHG Reductions**

This project will remove 136 dead and/or dying trees. **Table 2** demonstrates which materials will be utilized by milling operations to produce valuable lumber and which materials will be composted by reusing these materials; we document an overall average of 695.6% reduction in GHG emissions versus disposal at the local landfill. **Table 3** shows the total cost per metric ton and illustrates the substantial long-term benefits of increased carbon sequestration and avoidance from healthy, maturing trees.

In addition to the direct benefits of increased carbon sequestration and avoidance from a healthy, mature urban forest, composting all materials from the dying/decaying trees will add significant benefit to the project. This near-term benefit decreases over the 25-year period as disposal needs drop drastically due to the longevity of a healthy urban forest. However, the cost per metric ton overall by 2050 of MissoulaTREE is substantially less due to these long-term benefits. Although it was not modeled, it is expected that during the remaining 75 years of these trees lives significantly more carbon will be sequestered/avoided.

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<sup>19</sup> 12,823,967

<sup>20</sup> See Attachment 4.

<sup>21</sup> Based on an EPA estimated 411 grams of CO<sub>2</sub> per vehicle mile traveled.

<https://nepis.epa.gov/Exe/ZyPDF.cgi/P100JPPH.PDF?Dockey=P100JPPH.PDF>

**Table 2. Primary GHG Reduction Measure: Carbon Avoided by Milling and Composting**

	Carbon in Metric Tons Produced	Carbon in Metric Tons Saved	
<b>Honey Locust</b>			
Branches	0.2024		
Leaves	0.1164		
Lumber	0.1213		
<b>Total</b>	<b>0.4401</b>	<b>3.1871</b>	<b>724.2% savings</b>
<b>Maple</b>			
Branches	0.2631		
Leaves	0.1331		
Lumber	0.1386		
<b>Total</b>	<b>0.5348</b>	<b>3.6424</b>	<b>681.1% savings</b>
<b>Austrian Pine</b>			
Branches	0.0534		
Leaves	0.027		
Lumber	0.0281		
<b>Total</b>	<b>0.1085</b>	<b>0.7395</b>	<b>681.5% savings</b>
<b>Overall Total</b>	<b>1.0834</b>	<b>7.569</b>	

**Table 3: Primary GHG Reduction Measure: Carbon sequestration & avoidance from planting 157 trees within the project area.**

Planned Project	Total Carbon Sequestered from new trees (MT)	Carbon Avoided from new trees (MT)	Carbon Avoided from above table (MT)	TOTAL Carbon Sequestered and Avoided (MT)	Overall Project Cost	Cost per Metric Ton
2025-2030	4.57	22.79	7.57	34.93	\$3,525,201.00	\$100,921.87
2025-2050	39.2	121.8	7.57	168.65	\$3,525,201.00	\$20,902.47

**d. [Documentation of GHG Reduction Assumptions](#)**

The GHG Emission Reduction Calculations Spreadsheet contains detailed analysis conducted to demonstrate the carbon reduction potential of this project. As discussed at length in this application, MissoulaTREE has significant direct benefits to carbon reduction and avoidance, as well as co-benefits that will help to maximize the carbon reduction potential of related federal investments such as the DowntownSAM RAISE grant. Missoula is focused on a multifaceted approach to climate change mitigation and resiliency, including healthy ecosystems, sustainable transportation, and a growth strategy that supports a clean, healthy, and climate-friendly future. While many of these projects have funding and dedicated prioritization via other sources such as transportation grants, private development, or investment, in addition to shifting market trends, our urban forest remains an underfunded program with few alternatives.

The i-Tree calculations assume trees will be planted at 2" caliper, ball and burlap and in excellent condition. The report provided by Davey Resource Group assumes a 3% mortality for all newly planted trees. This is a cost that will be absorbed by the Urban Forestry Division, and any trees which die will be replaced during the following spring planting season.

### 3. ENVIRONMENTAL RESULTS – OUTPUTS, OUTCOMES, AND PERFORMANCE MEASURES

#### a. Expected Outputs and Outcomes

The MissoulaTREE project anticipates planting a minimum of 157 trees in a mix of suspended pavement systems, traditional tree pits and boulevards. We anticipate a reduction in the level of risk associated with trees in poor and very poor condition, including a decrease in the potential insurance claims. The anticipated carbon sequestration and avoided quantities will increase, as will canopy area, tree height, and basal area, all leading to increased direct ecosystem benefits.

Based on the report provided by Davey Tree Service, using the i-Tree software, we anticipate the following results shown in **Table 4**.

**Table 4. Estimated climate pollutants removed and avoided by MissoulaTREE**

157 Proposed Plantings 5 Years Out:	157 Proposed Plantings 25 Years Out:
22,779.7 kg of CO2 avoided	121,874.50 kg of CO2 avoided
3,264.2 kg of CO2 sequestered above ground	28,003.40 kg of CO2 sequestered above ground
1,305.7 kg of CO2 sequestered below ground	11,201.40 kg of CO2 sequestered below ground
5,381.8 kWh of electricity saved	49,340.10 kWh of electricity saved
192.7 MMBtu of fuel saved 43.9 cubic meters of avoided runoff	847.70 MMBtu of fuel saved 245.50 cubic meters of avoided runoff
6.25 kg of O3 removed	45.21 kg of O3 removed
5.16 kg of NO2 avoided	27.65 kg of NO2 avoided
1.10 kg of NO2 removed	7.85 kg of NO2 removed
40.98 kg of SO2 avoided	219.28 kg of SO2 avoided
0.03 kg of SO3 removed	0.22 kg of SO3 removed
0.56 kg of VOC avoided	2.89 kg of VOC avoided
1.54 kg of PM2.5 avoided	13.54 kg of PM2.5 avoided
0.2 kg of PM2.5 removed	.71 kg of PM2.5 removed

#### b. Performance Measures and Plan

The City of Missoula will ensure that project implementation includes a process for tracking, measuring, and reporting specific performance measures detailed below. All results will be catalogued and reported publicly through a site established on the Engage Missoula website ([www.engagemissoula.com](http://www.engagemissoula.com)), demonstrating progress on the goals for reducing and avoiding carbon pollution and other project measures.

**Tree planting, health & growth:** The trees will be inspected each year until year 5 after installation and then at year 10 and 25. This inspection will take place at the end of the growing season in October or November. Trees will be evaluated for diameter at breast height (DBH), canopy spread, height, and condition. Condition ratings will follow standard industry guidelines of dead, very poor, poor, fair, good, and excellent. The evaluations will be done by Urban Forestry staff that carry at minimum a certified arborist qualification and up to a municipal specialist qualification. Staff will enter the data into the TreeKeeper inventory software (which utilizes i-Tree software) and run a report to measure the ecosystem benefits and if the program is on track per the Davey Tree projections. The TreeKeeper and i-

Tree software track ecosystem benefits in real time as trees are added, updated, or removed from the inventory. The results of the inspections will be compared to the results provided by Davey Tree Service, to map the true growth and benefits the trees are providing.

**Carbon emissions reduction:** Direct carbon reduction will be measured and tracked using calculations in i-Tree and compared to the target reduction numbers detailed in this application. These calculations will be used in the required grant reporting, posted publicly on the Engage Missoula project page, and in annual reports presented during our Parks Board and City Council updates. These measures will be reported at a minimum of every 5 years.

**Transportation Mode-split:** In coordination with the DowntownSAM project, the city will collect and report on downtown sustainable trips and overall VMT for the project area. Special attention will be paid to locations that are included in this MissoulaTREE project application. The city uses several data collection methods to account for VMT and bicycle/pedestrian traffic, including: 1) mobile automated bike/ped counters, 2) on-street hose counts for vehicles, 3) volunteer bike/ped counts, and 4) “big data” aggregate data such as Replica or Streetlight. Data on transportation measures will typically be reported annually for the first 5 years post-project completion, and then every 5 years for the remainder of the project.

**Other co-benefits:** Additional performance measures, including ambient temperature and adjacent property energy usage, will be collected as available. These tend to be the most challenging to access, particularly energy data. However, similar estimates can be calculated based on tree growth and estimated cooling benefits and compared to real-world data as we find partner businesses or properties to collaborate with. Reporting timeframes will depend heavily on availability of consistent, comparable data.

### **c. Authorities, Implementation Timeline, and Milestones**

**Authority to implement:** The MissoulaTREE project will be managed cooperatively by the City of Missoula Parks & Recreation Department and Public Works & Mobility Department. Due to the potential for coordination with the awarded DowntownSAM RAISE grant, the city anticipates a single point of contact project manager for both projects. This will ensure smooth, integrated design and construction processes, as well as cross-departmental coordination.

All proposed improvements associated with the primary Carbon Reduction Measure (trees) and the additional co-benefits will be implemented within existing City-owned right-of-way (ROW) and parkland. The City has authority to make improvements within the City-owned ROW and parkland as needed for public benefit. To avoid unnecessary delays or project impacts related to adjacent property owner coordination, the City will use the planned public engagement and design process for DowntownSAM to avoid project impacts on MissoulaTREE. DowntownSAM and MissoulaTREE have already invested in significant outreach to adjacent business and property owners through the Missoula Downtown Partnership and Missoula Business Improvement District. There is strong public support for both projects.

**Implementation Timeline and Milestones:** Upon successful award and execution of a grant agreement, the City will begin implementing the proposed Carbon Reduction measures per the schedule in **Table 5** below. Key milestones are designated with blue diamonds. The first primary milestone will be execution of a grant agreement and obligation of funding. Years 1 and 2 will be focused primarily on engineering and design to ensure a successful construction project, followed by milestones of final design and permit approvals (as necessary). At the same time, planting will occur in the grassy boulevards where no engineering or design services are required. A final milestone will be completion of installation of the



suspended pavement systems and planting of trees in the side-walked portions of downtown Missoula. As with all City projects, stakeholder and public engagement will be robust and ongoing.

**Table 5: Project Schedule in calendar years**

	2024	2025	2026	2027	2028	2029	2030
Grant Award							
Grant Agreement							
Procurement							
Engineering & Design (structural)							
Preliminary Design							
Public Involvement							
Final Design							
Permitting & Approvals							
Grant Funding Obligation							
Advertisement/Bidding (structural)							
Planting (grass boulevards)							
Construction & Planting of Structural Soil Systems							

## 4. LOW-INCOME AND DISADVANTAGED COMMUNITIES

### a. Community Benefits

Through the reforestation of Missoula’s downtown core, this project aims to rectify the inequitable distribution of trees in the community, ensuring that the environmental benefits provided will be accessible to our low-income and disadvantaged neighbors. By bridging two significant municipal projects, namely the DowntownSAM RAISE grant and the Northside Pedestrian Bridge, this initiative promotes complete streets and enhances connectivity between low-income neighborhoods through the expansion of biking, walking, and rolling options. Notably, the entire project area is situated within a disadvantaged community (**Figure 4**).<sup>22</sup>

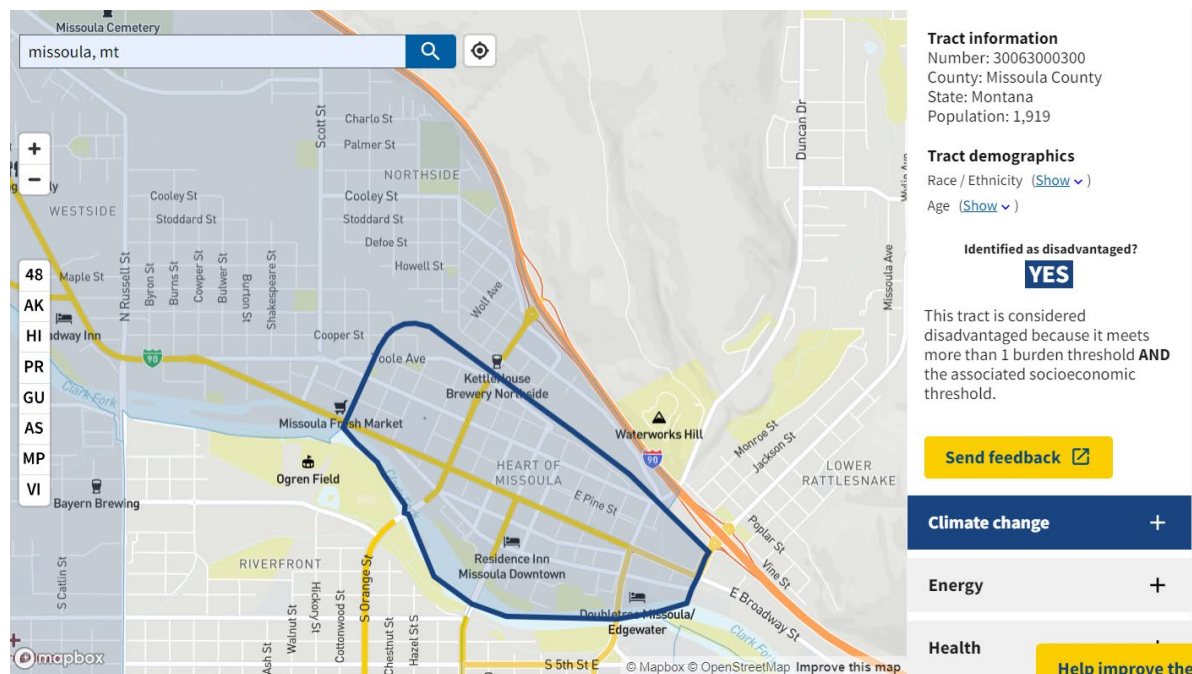


Figure 4. Map Showing Missoula’s Downtown and Northside as a “disadvantaged community” on the CEJST Mapping Tool. Source: <https://screeningtool.geoplatform.gov/en/#12.63/46.87253/-113.98864>

<sup>22</sup> See attachments 3 and 12.

In the census tract targeted by this project, establishing a robust urban forest is deemed crucial for addressing the environmental injustices prevalent in the area. Data reveals alarming disparities, with the community scoring in the 96th percentile for low income compared to the state (and 93rd compared to the U.S.),<sup>23</sup> the 97th percentile for housing costs, and the 85th percentile for lack of green space.<sup>24</sup> Additionally, the community ranks in the 81st percentile for adult asthma and the 88th percentile for persons with disabilities.<sup>25</sup> This urgency is further underscored by the pressing need for trees to mitigate particulate matter, a significant contributor to respiratory issues such as asthma.<sup>26</sup> Our project area scored in the 86th percentile (compared to the state) for Particulate Matter (PM) 2.5 and in the 99th percentile when combined with the supplemental demographic index.<sup>27</sup>

This proposed urban forestry project stands out for its comprehensive approach to addressing socio-economic indicators of disadvantage and vulnerability. By increasing tree canopy coverage, the project not only alleviates housing costs but also reduces cooling demand in the summer and provides a vital windbreak in the winter, thereby lowering the expenses associated with maintaining a livable indoor environment. Moreover, urban forests play a pivotal role in mitigating intense heat, which disproportionately affects low-income and vulnerable populations and leads to thermal discomfort, heat stress, and even mortality.<sup>28,29</sup> The air-filtering capacity of trees reduces the community's risk of respiratory illnesses like asthma.<sup>30</sup>

MissoulaTREE's focus on expanding green spaces offers additional qualitative benefits, including improved mental well-being and a heightened sense of community cohesion. Lastly, by addressing ADA compliance issues with sidewalks, the project ensures that individuals with disabilities can navigate the community seamlessly, regardless of their mobility needs.

## **b. Community Engagement**

For this project, we will conduct neighborhood outreach and engagement to provide project area residents the chance to participate in decision making about grant activities. Through the City's existing community outreach platform, Engage Missoula, we will offer residents of this disadvantaged community opportunities to comment on the project online, as well as in person. Utilizing a resident working group for the concurrent DowntownSAM project (aka the DowntownSAM Citizen's Working Group), this group will assist in advising decisions made related to this urban forestry project. We will also offer community conversations in conjunction with our community partners to provide education about this grant and gather feedback from neighbors.

Our community partners will help facilitate conversations to help residents understand project logistics and timelines and communicate the community benefits associated with this grant, including the environmental, social, and economic value of urban trees and the increased opportunities for bike and

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<sup>23</sup> See attachments 5, 6, and 7.

<sup>24</sup> See attachment 5.

<sup>25</sup> See attachment 8.

<sup>26</sup> See attachment 9.

<sup>27</sup> See attachments 10 and 11.

<sup>28</sup> Wong, N.H., Tan, C.L., Kolokotsa, D.D., & Takebayashi, H., *Greenery as a mitigation and adaptation strategy to urban heat* (2021). <https://doi.org/10.1038/s43017-020-00129-5>

<sup>29</sup> Stone, B. Jr., *The city and the coming climate: Climate change in the places we live* (2012). [https://scholar.google.com/scholar\\_lookup?title=The%20city%20and%20the%20coming%20climate%3A%20Clim%20ate%20change%20in%20the%20places%20we%20live&author=B.%20Stone%20Jr&publication\\_year=2012](https://scholar.google.com/scholar_lookup?title=The%20city%20and%20the%20coming%20climate%3A%20Clim%20ate%20change%20in%20the%20places%20we%20live&author=B.%20Stone%20Jr&publication_year=2012)

<sup>30</sup> Kim, D., & Ahn, A., *The contribution of neighborhood tree and greenspace to asthma emergency room visits: An application of advanced special data in Los Angeles County* (2021). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8036821/>

pedestrian transportation. We will rely on partner organizations to assist with communications and outreach, as many of these groups have a proven track record of engaging with underserved Missoula neighborhoods through their community engagement work and have maintained strong neighborhood partner relationships and clear understandings of how to successfully work with area residents.

The location of our project is situated entirely in the downtown core, a disadvantaged neighborhood<sup>31</sup> which contains residential properties, businesses, local government offices, medical practices, nonprofit organizations, and other cultural institutions. Based on the diverse stakeholders in our project area, we anticipate differing community needs related to the project. We will address these needs via our targeted communications strategy to be employed throughout the duration of the grant process. This strategy will include educational mailings, e-newsletters, social media updates, and door-to-door canvassing. We will also offer an array of opportunities to solicit project feedback from neighbors, including listening sessions and Q&A sessions. Finally, we will create a resident advisory board that will be responsible for communicating neighborhood priorities related to the grant.

## 5. JOB QUALITY

The City of Missoula is committed to supporting the development of high quality, good-paying jobs through federal grants and other infrastructure investments. City Council passed a resolution establishing the Apprenticeship Bidder's Preference Program in 2019;<sup>32</sup> this program is optional for bidders on City projects on projects exceeding \$500,000 in value. Under the program, contractors who can prove that they are part of a Montana-registered (state-approved) apprenticeship training program and can show that 10% of all labor hours will be comprised of registered apprentices, will receive a 5% preference during the bidding selection process, with the preference not to exceed \$100,000. The City's Apprenticeship Bidder's Preference Program directly incentivizes apprentice employment; the creation of good-paying, union jobs; construction workforce development and training; and strong labor standards. The City of Missoula has in place an affirmative action policy supporting equal employment opportunities for all and preventing workplace harassment and discrimination.

In addition to preference to bidders with workforce development programs, the MissoulaTREE project will provide high quality training in the construction and installation of suspended pavement systems. As more communities within Montana begin to utilize these systems, and as Missoula continues to install them in other locations, there will be a growing need for highly trained contractors familiar with the systems. In fact, the city believes that due to the scale of investment, MissoulaTREE will be a catalyst for developing more suspended pavement projects throughout the region and increasing the resultant quality jobs necessary to meet the need for design and construction.

Finally, Missoula has a burgeoning coalition of public, private and non-profit sector partners focused on workforce development. This partnership was selected by the National League of Cities for the "Good Jobs, Good Cities Academy" and is in the planning stages for a comprehensive workforce development program. Currently, the City is focused on building jobs and capacity within the green jobs employment sector; however, large federal grants are identified as a good source for increasing funding, capacity and opportunity for growing that program. If awarded, the city will work with this coalition to further identify opportunities to grow our workforce of skilled, quality, and highly paid employment opportunities.

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<sup>31</sup> See attachment 3.

<sup>32</sup> City of Missoula, *Resolution 8356* (2019).

<https://www.ci.missoula.mt.us/DocumentCenter/View/50669/Resolution-8356>

## 6. PROGRAMMATIC CAPABILITY AND PAST PERFORMANCE

### a. Past Performance

The City is in a good position to deliver this project within a timely and efficient manner, and within the parameters of Federal, State, and local approval processes. Other federal grant awards and projects leave us in an experienced position and understanding of project delivery and public engagement. The City's strong Public Involvement and Planning efforts to date have readied downtown projects for streamlined delivery, and this project can easily be added to other engagement efforts, such as the DowntownSAM Citizen's Working Group. Immediately after notification of grant award, the city will begin discussions with the EPA to finalize the grant agreement and subsequently solicit a consultant to lead the project delivery and engineering work.

In recent years, the City of Missoula has gained direct experience managing successful grant-funded projects. At a large project scale, City staff worked in collaboration with Missoula County on a joint \$20M BUILD grant, which utilized the Construction Manager/General Contractor deliver method to finish the project on time and within budget during the COVID-19 pandemic. This project was completed successfully in just over 4 years, from concept to construction, all while managing supply chain and inflation issues during the global pandemic. The City and County partnered to follow all applicable federal regulations, reporting, and performance measures for the project.

The city is also underway on several new federal grant awards, including a \$11.2M Safe Streets and Roads for All (SS4A) reconstruction, \$25M DowntownSAM RAISE grant, and a \$380,000 SS4A planning grant. The DowntownSAM grant is particularly relevant to this application for the MissoulaTREE project, as the two will be complimentary and will be managed together to minimize conflicts and leverage delivery efficiencies. Even if the MissoulaTREE is delivered wholly independent of DowntownSAM, the lessons and experience managing a large federal aid project in our downtown core will be instrumental in ensuring the success of this CPRG project.

The City of Missoula has the following recent federal aid project experience:

1. Rattlesnake Creek Dam removal and Restoration:
  - a. Award #: FEMA-DR-5194-MT, Project-7-R
  - b. Federal Emergency Management Agency, CFDA# 97.047
  - c. This agreement was for distribution of \$716,340 for the removal of a defunct drinking water dam and reservoir on Rattlesnake Creek. This \$2.5M project was the largest restoration project to improve endangered bull trout habitat on Rattlesnake Creek. Project was completed in 2023.
  - d. Federal Agency contact: Delila Bruno, MT Disaster & Emergency Services, P.O. Box 4789, Fort Harrison, MT 59636-4789. Phone: (406) 324-4794. Email: dbruno@mt.gov
2. South Avenue Safe Streets:
  - a. Award No. 693JJ32440022
  - b. Department of Transportation, CFDA 20.939
  - c. This agreement is for distribution of a \$9,311,254 grant from the Safe Streets and Roads for All discretionary grant program. This project will construct roadway safety improvements along Missoula's South Avenue corridor, including sidewalks, bike lanes, turn lanes, crossing improvements, and landscaping.
  - d. Federal Agency contact: Stephen Parker, Safe Streets and Roads for All Program Manager, Federal Highway Administration, Office of Safety, HSSA-1, Mail Stop: E71-117,



1200 New Jersey Avenue, S.E., Washington, DC 20590. Phone: (202) 366-4668. Email: [stephen.parker@dot.gov](mailto:stephen.parker@dot.gov)

3. Caras Park River Access
  - a. Award No. 05-79-06168; URI 119483
  - b. Economic Development Administration, CFDA 11.307
  - c. \$1,220,304 EDA investment for the construction of river access improvements including an ADA accessible path, stone access stairs, concrete access stairs, concrete viewing platform, and stone terrace seating to the Clark Fork River, adjacent to Caras Park in the City of Missoula.
  - d. Federal Agency Contact: Ryan Smith, Civil Engineer, Economic Development Administration 1244 Speer Blvd. Suite 431 Denver, CO 80204. Phone: (303) 489-8717. Email: [rsmith4@eda.gov](mailto:rsmith4@eda.gov)
4. Westside Park and Playground Improvements
  - a. Award No. #30-00771
  - b. Land and Water Conservation Fund, CFDA 15.916, (Administered by Montana Fish, Wildlife, and Parks)
  - c. \$1,056,875 in LWCF funds for demolition of old/damaged playground, basketball court, and asphalt walkways; construction of utility extensions; concrete playground pod; playground toys designed for ages 6 to 12 years; all-inclusive poured in place fall zone; multi-use paved court; new paved paths; and restoration of site to include park irrigation system amendments, fencing, sod and new trees.
  - d. Agency Contact: Sandy Crawford ASLO, LWCF Grant Manager, Financial Assistance and Compliance Bureau, Montana Fish, Wildlife & Parks, P.O. Box 200701 Helena, MT 59620-0701. Phone: (406) 444-3791. Email: [SaCrawford@mt.gov](mailto:SaCrawford@mt.gov)

#### **b. Reporting Requirements**

The City of Missoula has a long history of successfully meeting reporting and grant management requirements. In addition to the examples provided above, the City of Missoula can point to the following examples of comprehensive reporting and project evaluation success:

1. *Missoula Metropolitan Planning Organization (MPO) performance measures*

The City of Missoula acts as the staff and administrator of the Missoula MPO. As required by federal regulations, the MPO successfully manages a diverse set of performance measures and reporting, including: annual traffic count programs; complete streets policy reporting and tracking; Vision Zero transportation safety reporting (including evaluation of progress on target metrics such as severe and fatal crash rates, reductions in crashes and progress on priority emphasis area tasks); and federal PL funding grant reporting requirements, including financial record-keeping and reporting, annual work plan progress reports, and compliance with all applicable federal codes for appropriate use of federal planning funds.
2. *2019 Mullan BUILD grant*

While the City of Missoula was not the primary grant awardee for this project, staff assisted Missoula County with all reporting and fulfillment of all federal grant requirements. These included quarterly financial reports, grant performance measures, and final grant close-out.
3. *Safe Streets and Roads for All grants – South Ave Safe Street & Reserve Street Safety Action Plan*

The City of Missoula is currently in process with these two federal grant award projects and has started appropriate reporting and data collection. Measures include pre-construction safety, equity, and sustainability measures identified in approved grant agreements. Staff expect to continue monitoring and measuring the effectiveness of these projects over the next 5-10 years

for the grant funding, and beyond for other regional performance measures such as traffic safety and multimodal trip statistics.

### **c. Staff Expertise**

The City of Missoula, despite our relatively small-sized City and government, has excelled at creating a highly qualified and functioning staff. This includes decades of combined experience in urban forestry, transportation, and climate and sustainability fields. For this project, the following experience is expected to support this project:

*Urban Forestry:* City of Missoula Parks staff include 6 dedicated forestry staff with a combined 95 years of experience in national best practices for managing complex tree and infrastructure projects. As noted previously, these staff have successfully implemented the first structural pavement systems in the state of Montana and continue to lead the state in modernizing our urban forest program to meet national standards. Staff regularly manage urban forest projects and review, partner with private developments, and contribute to public infrastructure projects.

*Public Works & Mobility:* Within the Transportation division of PW&M, staff have a combined 30+ years of experience in planning, designing, and developing complete streets projects, and collaboration in unique partnerships to deliver complicated urban transportation projects. These staff manage the Missoula MPO, direct federal funding, and provide detailed data monitoring and analysis for a range of federal performance measures and planning targets (including safety, climate/air quality emissions, and multimodal transportation metrics). Transportation staff will be available to assist with all design, development, and reporting measures. In addition to planning staff, PW&M develops and delivers a range of challenging urban infrastructure projects, from utilities to surface transportation. We expect to leverage this robust project delivery team to manage this MissoulaTREE project in tandem with the 2023 DowntownSAM RAISE grant, a \$25M federal investment in our downtown transportation infrastructure.

*Climate and Sustainability:* As a part of the city's Community Planning, Development and Innovation Department, the climate and sustainability team staff work to ensure that Missoula is making progress towards our ambitious climate goals, including the goal of being carbon neutral as a community by 2050. As part of this effort, investments in climate mitigation and adaptation tools, like urban trees, are seen as a significant part of the solution. The City's three Climate and Sustainability Specialists have a combined 27 years of experience working within the environmental sustainability field. Staff members regularly work with other city departments, government entities, and community partners to implement shared climate action projects and programs.

## 7. BUDGET

Please see the **Additional Budget Narrative pdf** for a detailed Budget Narrative.

BUDGET BY YEAR							
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Direct Costs	TOTAL PERSONNEL	\$28,950	\$32,316	\$32,316	\$29,792	\$29,792	\$153,166
	TOTAL FRINGE BENEFITS	\$8,975	\$9,580	\$9,580	\$9,126	\$9,126	\$46,387
	TOTAL TRAVEL	\$0	\$0	\$0	\$0	\$0	\$0
	TOTAL EQUIPMENT	\$0	\$0	\$0	\$0	\$0	\$0
	TOTAL SUPPLIES	\$14,700	\$0	\$5,800	\$15,800	\$0	\$36,300
	TOTAL CONTRACTUAL	\$85,000	\$234,300	\$724,763	\$1,118,491	\$806,321	\$2,968,875
	TOTAL OTHER	\$0	\$0	\$0	\$0	\$0	\$0
	TOTAL DIRECT	\$137,625	\$276,196	\$772,459	\$1,173,209	\$845,239	\$3,204,728
	TOTAL INDIRECT	\$13,762	\$27,620	\$77,246	\$117,321	\$84,524	320472.838
TOTAL FUNDING		\$151,387	\$303,816	\$849,705	\$1,290,530	\$929,763	\$3,525,201