



American Recovery and Reinvestment Act Projects to Enhance Urban Tree Canopy And Increase Green Infrastructure



**District Department of Transportation
Urban Forestry Administration**

**Impervious Surface Reduction
Green Median Renovation
Tree Canopy Renovation**





ARRA Final Report

Table of Contents

Introduction	5
Project Summaries	7
Impervious Surface Reduction:	7
Green Median Renovation.....	7
Tree Canopy Renovation.....	7
Project Implementation:	8
Planning:	8
Field Inspections:	8
Marking:.....	8
Community Outreach:.....	8
Coordination:	9
Construction:.....	9
Existing Street Trees and Soil Amendments:	9
Maintenance:	9
Project Practices:	10
Tree Box Expansion:	10
Tree Box Creation:.....	11
Continuous Planting Strip Creation:.....	12
Large Area Greening:	13
Green Median Renovation:.....	14
Table 1: Summary Statistics	15
Table 2: Project Distribution by Ward.....	15
Tree Canopy Renovation	16
Contract Tree Removal:	16
Contract Tree Planting:	16
In House Tree Planting:.....	17
Table 3: Tree Canopy Renovation Accomplishments by Ward	17
Project Continuation	18
Conclusion.....	18
Table 4: Impervious Surface Reduction Project Locations.....	20
Table 5: Green Median Project Locations	22



Appendix A: Listing of all Project Locations 23

Seaton School..... 24

Foggy Bottom 25

East Capitol Street NE 26

A Street NE 27

Kennedy Street NW..... 28

10th Street NE 29

12th Street SE (CVS) 30

P Street NW..... 31

Hanover Place, NW 32

Florida Avenue and North Capitol Triangle Park, NW..... 33

P Street NE 34

Brent Elementary School 35

4th and Adams, NE 36

Adams Morgan 37

10th Street NW 38

Safe Shores..... 39

Minnesota Avenue NE and SE 40

Edmund Burke Park..... 41

North Capitol Greenway 42

Kalorama Park, NW 43

Shaw 44

Linden Place NE..... 45

Eckington Park..... 46

NOMA..... 47

Washington Avenue SW..... 48

3rd Street NW..... 49

Rhode Island Avenue NE 50

Calvert Street NW 51

Bladensburg Road NE..... 52

Alabama Avenue SE 53

Southern Avenue SE..... 54

Bladensburg Road NE..... 55

Mass Ave and New Jersey Ave NW 56



Appendix B: American Reinvestment and Recovery Act Requirements	57
Reporting.....	57
Davis-Bacon Act	58
Buy American	58
Appendix C: Job Creation	59
Appendix D: Stormwater Benefits	60
Appendix E: Environmental Benefits of Trees	61
Acknowledgements	63



Introduction

In the District of Columbia, the Urban Forestry Administration (UFA) is the governmental agency responsible for managing the urban forest in public space. UFA's duties include planting, pruning, removing, and maintaining the health of the District of Columbia's street tree canopy which consists of approximately 144,000 street trees and additional trees on District parkland and recreational properties.

In late 2008, the District of Columbia and four northeastern state partners (Connecticut, Massachusetts, Rhode Island and Vermont) were awarded a Northeastern Area State and Private Forestry Redesign Competitive Grant for a project, Urban Tree Canopy Tool Development and Assessment, Goal Setting, and Implementation. This grant provided for urban tree canopy analyses of 13 communities and the District of Columbia. The results of the satellite imagery analysis (based on land use percentages) for the District showed that we had 35% urban tree canopy, 33% of land not suitable for tree planting and 32% of the land use area that could be used as possible planting sites. Of the 32%, the analysis showed that 8% was impervious or paved surface that could be reviewed or modified into planting areas to increase urban tree canopy in the District. As a result of this study, the District set a goal of achieving an urban tree canopy goal of 40% by 2035.

Determined to find ways to begin addressing the findings of the above study, UFA applied for and received American Reinvestment and Recovery Act (ARRA) Grants in late 2009 to fund three coordinated projects: Impervious Surface Reduction, Green Median Renovation, and Tree Canopy Renovation. Each of these projects was designed to reduce impervious surfaces, storm-water runoff and increase the urban tree canopy. These projects were all funded by ARRA via the Environmental Protection Agency (EPA), through the Clean Water State Revolving Fund (CWSRF), and were administered by the District Department of the Environment (DDOE).

Converting the District's impervious surfaces into tree canopy planting areas has the double benefit of both reducing the amount of impervious surface on which stormwater travels into the drainage system and increasing the amount of urban tree canopy to absorb runoff. These ecosystem benefits are particularly important in Washington, DC because about one-third of the District of Columbia is served by a combined sewer system (CSS) that was built before 1900 and conveys sanitary sewage and stormwater in one system.

Prior studies have shown that during periods of significant rainfall, large amounts of water run quickly over impervious surfaces, entering the combined sewer system at a high rate of speed. The system capacity can frequently be exceeded leading to combined sewer overflows; the release of a combination of stormwater and sanitary wastes directly into the District's waterways including: the Anacostia River (one of seven polluted waterways included in the federal Urban Waters Initiative), Rock Creek, the Potomac River, tributary waters, and ultimately into the Chesapeake Bay.

To mitigate this effect, DDOE and UFA proposed expanding the size of existing tree boxes, linking tree boxes to create continuous planting strips, and greening impervious medians. By removing impervious



surfaces; UFA has increased the soil area for root expansion and intercepting stormwater runoff, obtained increased environmental benefits by allowing urban trees a longer healthier lifespan, and provided the growing space to support larger tree species in the tree boxes or continuous planting strips. The focus of these projects was originally intended to be centered on the land area or sewershed of the Combined Sewer System (CSS) or more commonly the Combined Sewer Overflow (CSO) since the combined sanitary and stormwater sewers frequently have overflows during heavy rains that discharge untreated sewage into the Potomac River and ultimately the Chesapeake Bay. Over time however, projects were identified in areas outside of the CSO and the projects were expanded to include work in the area of the Municipal Separate Storm Sewer System.

In 2011, the District of Columbia signed an updated Municipal Separate Storm Sewer System (MS4) agreement with the EPA through which the District agreed to take tangible action to improve water quality. Due to additional benefits to quality of life, property values, and air quality, the District government is committed to using green infrastructure, such as green roofs and vegetation, as a way to reduce costs and demand for tunnels and other gray infrastructure being built within the CSO and MS4 sewersheds. These ARRA projects completed by UFA provide a demonstration of this effort and the types of infrastructure improvements that can be made in public space without extensive engineering and design costs. While not the only solution to stormwater and environmental issues in the urban environment, the practices outlined in this report are an important tool that DDOT can use to provide environmental benefits and should be utilized where applicable.

The District's urban tree canopy reduces stormwater runoff, particularly during the smaller rains that are most frequent and often carry high concentrations of pollutants. Based on current models, trees that overlap impervious areas tend to have greater capacity to mitigate stormwater. UFA's unique position within the District Department of Transportation (DDOT) provides opportunities to address this capacity directly while having the authority to remove excess impervious surface in the right-of-ways where most stormwater is collected. UFA's position also allows it to demonstrate the critical role trees play in building a multi-modal transportation system that attracts users and ensures trees are a fundamental aspect of transportation and infrastructure project planning within overall efforts to reach a 40% urban tree canopy. The three ARRA projects conducted by UFA clearly help the District meet its environmental goals of reducing stormwater runoff and increasing the urban tree canopy. By taking a two-pronged approach of reducing impervious surfaces and simultaneously expanding the urban tree canopy, the overall environmental benefits are enhanced and greener more livable communities are created.



Project Summaries

Impervious Surface Reduction:

The goal of the impervious surface reduction project was to increase the green space within the right of way (ROW) of DDOT roads. This was accomplished through a combination of practices: tree box expansion, tree box creation, continuous strip creation, and large area greening. Most of these practices were implemented within the sidewalk dimension of the DDOT right of way, but one project included significant greening within the public parking dimension of public space and one project was located on District of Columbia Public School (DCPS) property. By removing impervious surfaces, UFA has increased the soil area for root growth, intercepted stormwater runoff, and obtained increased environmental benefits by planting larger canopy tree species in the tree boxes and continuous planting strips.

Green Median Renovation

The goal of the green median renovation project was to demonstrate potential opportunities to reduce the amount of impervious surface in the District of Columbia, increase the retention of stormwater, and expand the urban tree canopy by greening existing medians. These efforts were focused on medians within the CSO, though several medians in the MS4 were also renovated. Retrofits to existing medians began with the removal of existing impervious surfaces, which were typically either concrete, or brick set on a concrete base. Once the impervious surface was removed, the existing trees or lack of trees dictated the final depth of excavation. Existing compacted fill soils were replaced with new topsoil or Cornell University structural soil to a standard depth of three feet when no trees were present, but to only the depth of the impervious surface removed if trees were located within the space. Once the median was brought back to grade, the finished surface was mulched and/or sodded and street trees planted.

Tree Canopy Renovation

The goal of the Tree Canopy Renovation project was to improve the condition and coverage of the urban tree canopy so that additional rainfall is intercepted and does not enter the stormwater system. This goal was met by removing trees that were dead or dying and planting new trees in the now open tree boxes. Replacing dead and dying trees which had a limited canopy with a newly planted tree with a vigorous canopy will provide for net canopy increases. This should dramatically improve the canopy coverage for the CSO area resulting in increased rainfall interception and decreased stormwater runoff.



Project Implementation:

Impervious Surface Removal and Green Median Renovation

Planning:

Planners from Office of Planning (OP) and DDOT's Policy, Planning, and Sustainability Administration (PPSA), and staff from District Department of the Environment (DDOE), identified a number of sites for impervious surface removal within the CSO. The Office of Planning compiled a list of all proposed sites, and began a process of evaluating the feasibility, benefits, constraints and potential conflicts present at the proposed locations. Important criteria throughout this process included site ownership, sewer system type, maintenance, whether the project was associated with an existing District goal, initiative, Small Area Plan, Transportation Study or other existing plan, and possible conflicts with other planned construction projects.

The selected sites were then ranked based on the anticipated environmental benefits, amount of impervious surface removed, and anticipated cost. In addition to sites submitted to OP, UFA urban foresters and members of the ARRA team identified locations where basic tree box expansions and median greening could be done without a larger planning process. In addition, community requests for tree box creation and expansion were received and evaluated for inclusion in the projects.

Field Inspections:

After all sites were ranked, UFA urban foresters completed field inspections including feasibility surveys to determine where boxes could and could not be expanded and where medians could or could not be greened. Considerations that were evaluated during this process that might have been missed during a desk review were traffic considerations, overall sidewalk condition, minimum clear space for sidewalks, and Americans with Disabilities Act (ADA) compliance. If a project location was deemed to be unfeasible due to any of the above considerations, it was eliminated from the list of potential projects.

Marking:

After the field inspection, sites that were still considered viable were then marked by UFA urban foresters to indicate to the contractor the extent of impervious surface removal. All impervious surface removal work was painted on the sidewalk, measurement of square feet of impervious removal recorded in a spreadsheet for data tracking and recorded by address. Once the field marking was completed, a scope of work was prepared for delivery to the contractor and a walkthrough of the project conducted.

Community Outreach:

As soon as marking and preparation of the scope of work was completed, the local Advisory Neighborhood Commission (ANC) was notified of the planned project. In addition, letters informing residents of the proposed work were hand delivered to all residential and commercial buildings within the project area. UFA urban foresters frequently attended ANC or Civic Association meetings to present project plans and discuss these projects. When projects were located within the boundary of a Business Improvement District (BID), these groups were notified of the project and support for maintenance of



the project was solicited. Input from all of the above groups was considered, and plans were altered as necessary to accommodate community concerns, particularly in terms of the final finish of green surfaces created and maintenance concerns (sod or mulch), as well as issues related to ADA compliance and handicap access within the project area.

Coordination:

As project plans were finalized and the scope of work for each location completed, this documentation was forwarded to the team leads of the System Inspections Oversight Division (SIOD) of Public Space Operations Project (PSOP). This coordination was essential since these inspectors are responsible for ensuring all use of the public space was permitted, traffic control plans were implemented and any necessary safety precautions taken while working in the public space. Ensuring that this group was informed about the project's activities and the contractors work location was important so there were no misunderstandings or work stoppages due to questions related to public space permits or authorization to conduct improvements in the public space.

Construction:

Once the community outreach was completed, the contractor was given the go ahead to begin work and implement the project. All work was completed by Capitol Paving Inc. under the existing 1st Citywide Sidewalk Contract. The contractor went through the required steps to begin work such as: obtain traffic control plans, identify utilities and post no parking signs in an appropriate time frame. While impervious surface reduction and green median renovation work was being conducted a UFA inspector was on site to inspect the quality of the work, ensure protection of any existing trees, and mediate any field related issues. Newly created tree boxes and planting locations were added to the GIS database for future tree plantings, and a separate GIS data layer created to identify all impervious surface work locations.

Existing Street Trees and Soil Amendments:

The presence of existing street trees was a major factor in determining the extent to which excavation and soil replacement or amendment was possible. When there were trees in good condition within the tree box or median that were retained, the additional upgrades of deep excavation and top soil replacement were not possible while retaining existing tree cover. In these cases, the only option was to remove the impervious surface and bring the soil surface back to grade using topsoil, and mulching or sodding the site. When existing trees were in poor condition and needed to be removed, or when the tree box or median did not contain any trees, then replacement of the existing fill with new top soil occurred. Whenever possible, the existing fill was removed to a depth of 3 feet, and the area backfilled with either topsoil or CU structural soil.

Maintenance:

All maintenance responsibilities for public space within the ROW between the property line and the curb are by law DCR 21-702 assumed by the adjoining property owner. In all locations where work has taken place within a BID, this organization has been requested to assist with maintenance responsibilities. The maintenance of all medians is ultimately the responsibility of DDOT and the Department of Public Works (DPW) and will be either handled internally or through contracted landscape maintenance services.



Project Practices:

Tree Box Expansion:

The primary limiting factor for the growth and development of trees within the streetscape is the lack of available rooting space. Within the District, the minimum tree box size is 4' x 9' which assuming a soil depth of 3' only provides 108 cubic feet of soil volume. The prevailing research indicates that this is only enough space for the development of a 4 inch diameter tree. In order for a tree to grow larger than this size, it must be able to obtain below ground resources such as water and nutrients beyond the confines of the tree box. A review of UFA's street tree inventory will reveal that most trees are larger than 4 inches in diameter. The roots of these trees have evidently grown beyond their tree box and beneath the sidewalk in some cases resulting in infrastructure damage to the sidewalk. By expanding the size of existing tree boxes, additional rooting space can be created and additional stormwater captured to benefit and promote the growth of these street trees.

The original tree box shown below on Old Morgan School Way was 2.5' X 5' covering 12.5 square feet, while the newly expanded tree box is 4' X 15' covering 60 square feet. This greatly expanded rooting zone will provide for increased stormwater retention and allows for a larger, healthier, longer lived tree to develop ultimately increasing the urban tree canopy and providing many more environmental benefits. The remaining clear path of 4.5' provides ample pedestrian space for ADA requirements and volume of pedestrian sidewalk use.





Tree Box Creation:

In many locations across the District, there are significant portions of the streetscape without any tree canopy and without any tree boxes. As a result there is an excessive amount of gray infrastructure and an insufficient amount of green infrastructure in these locations. The addition of new tree boxes where there is currently no or very limited tree space, will greatly enhance the quality of the public space by providing many more environmental, aesthetic and economic benefits than a block without trees.

When this Department of Employment Services (DOES) building was constructed on Minnesota Avenue, tree spaces and trees were not included as part of the streetscape. By adding tree boxes and trees, the monolithic concrete sidewalk and building façade can be softened and a more desirable streetscape created. The desire to have retail on the ground floor of this building and the potential for sidewalk cafes will be greatly enhanced by the shade and protection afforded by street trees.





Continuous Planting Strip Creation:

The creation of a greenway along District streets can significantly reduce the amount of impervious surface within the streetscape. A continuous planting strip also provides multiple environmental benefits. First, it creates the largest amount of rooting space for urban trees while maintaining the needed sidewalk. Secondly it provides for the most flexibility in terms of providing additional planting locations. Finally, it has the potential to intercept the largest amount of rainfall through direct interception and slowing stormwater runoff from the adjacent sidewalk.

This continuous planting strip located on P Street NW removed 7,200 sq feet of impervious surface and created numerous planting locations.



Similar results were achieved on R Street near New Jersey Avenue NW in the Shaw neighborhood.





Large Area Greening:

Where opportunities within public space exist to green large expanses of impervious surface, there can be a significant change in the aesthetic and environmental impact of the built environment. When contiguous areas of over 10,000 square feet of impervious surface are greened, the benefits are immediately apparent as at this location at North Capitol and P Street NE.



Even when smaller areas are converted from all grey infrastructure to green space it can make a significant impact on a neighborhood triangle park as demonstrated at the intersection of Florida Avenue and North Capitol.





Green Median Renovation:

Medians within the right of way (ROW) of District roadways represent a significant opportunity to decrease impervious surfaces, reduce stormwater runoff, and increase the green space and provide for significant expansions of the urban tree canopy, even if the median already has trees. In addition to the stormwater benefits, tree lined streets and medians provide needed environmental and aesthetic benefits.

Calvert Street had two medians that were surfaced with brick. One had existing tree boxes and trees, while the second had only two very unhealthy trees. The addition of new green space and additional tree canopy made possible by this greening project enhances the exterior environment around the Oyster Adams School located nearby.



This project on Massachusetts Avenue illustrates how greening a median that has existing tree cover can enhance the appearance and function of the streetscape to improve a business district. This median will now capture and store additional rainwater resulting in healthier trees. Future tree planting will also support larger shade trees than the currently planted species.





Table 1: Summary Statistics

	Impervious Surface Reduction	Green Median Renovation	Total
ARRA Funding	\$ 1,450,000.00	\$ 750,000.00	\$ 2,200,000.00
Contractor	\$ 1,215,000.00	\$ 635,000.00	\$ 1,850,000.00
Spending	\$ 1,223,414.34	\$ 636,386.37	\$ 1,859,800.71
Local	\$8,414.34	\$1,386.37	\$9,800.71
Staff	\$235,000.00	\$115,000.00	\$350,000.00
Square feet	80,303	44,203	124,505
Cost / sq ft*	\$ 15.23	\$ 14.40	\$ 14.94

* All project costs based on contractor expenses only.

Table 2: Project Distribution by Ward

Ward	Impervious Surface Removed	%	Spending by Ward	%	% CSO AREA	UTC Percent Possible Impervious
1	9,250	7%	\$ 146,620.02	8%	13%	7%
2	39,092	31%	\$ 673,680.02	36%	23%	18%
3	2,498	2%	\$ 25,213.58	1%	3%	7%
4	647	1%	\$ 26,956.27	1%	17%	8%
5	40,895	33%	\$ 543,350.13	29%	21%	16%
6	24,288	20%	\$ 334,007.56	18%	21%	17%
7	4,085	3%	\$ 84,170.01	5%	0%	11%
8	3,750	3%	\$ 25,803.12	1%	2%	17%
Total	124,505	100%	\$ 1,859,800.71	100%		
CSO	107,176	86%	\$ 1,614,000.45	87%		
MS4	17,329	14%	\$ 245,800.26	13%		

Table 2 presents the division of project resources based on the ward boundaries. Since the project was focused within the CSO, wards with the largest amount of the CSO within their boundaries received the most work. Based on this analysis Wards 2, 5, and 6 have the largest amount of the CSO within their boundaries. UTC percent possible impervious is the percentage of the currently impervious surface that could be converted to tree canopy within each ward. The wards within the CSO, which also had the highest potential to be converted to tree canopy, were also wards 2, 5, and 6.



Tree Canopy Renovation

Contract Tree Removal:

Trees slated for removal were identified, inspected, and assigned a condition rating by a UFA urban forester. These staff recorded their findings using Panasonic toughbook field computers, Cityworks work management software and Arc View GIS software. This inventory was used to create tree removal lists and work orders which were distributed to the removal contractor. There were two categories of removals listed in the contract: whole tree removals and stump removals: whole tree or complete removals include the removal of the stump; while stump removals indicate trees that were removed by another entity such as by a public utility or following a tree failure or other emergency situation during which the stump was not removed. Once removals were completed, the work was reinspected by UFA urban foresters for verification, proper stump grinding depth, and work order close out.



Contract Tree Planting:

Planting sites were identified by UFA urban foresters and work orders were created and planting lists developed and submitted to the contractor. UFA urban foresters were on site for tree delivery, during tree handling by the contractor and throughout the tree planting process. UFA staff documented the effort using Panasonic toughbook field computers, Cityworks asset management software and Arc View GIS software. All plantings were conducted during the spring 2010 planting season by Lorenz Landscaping, and a total of 1995 trees were planted with ARRA funding of the 4063 trees planted by UFA in fiscal year 2010.



In House Tree Planting:

Tree planting was also completed using UFA in-house staff. This project was designed to supplement the normal tree planting that is completed annually by a contractor. Trees were planted in newly created tree boxes under the Impervious Surface Reduction Project, and the Green Median Renovation Project, as well as in other locations throughout the CSO where empty tree boxes were located. Trees that were planted were watered during the summer months with tanks mounted on pick-up trucks. Field staff filled 25 gallon tree ring watering tubs that release the water slowly over a period of 2-5 hours. This cycle was repeated as necessary up to twice a week based on the weather conditions.



Table 3: Tree Canopy Renovation Accomplishments by Ward

	Tree Canopy Renovation by Ward									Total	Cost
	1	2	3	4	5	6	7	8	citywide		
Trees Removed	457	722	83	126	199	538	26	58	0	2209	\$1,180,207.00
Stumps Removed	58	67	8	2	19	20	0	1	0	175	
Trees Planted	289	625	30	381	519	528	54	151	55	2632	
Trees Planted by Contractor	236	560	22	378	291	378	0	75	55	1995	\$554,793.00
Trees Planted by In House Crew	53	65	8	3	228	150	54	76		637	
Staff											\$315,000.00
Total ARRA Funding											\$2,050,000.00



Project Continuation

The projects that UFA implemented as part of the Green Median Renovation and Impervious Surface Reduction Project were new initiatives that did not currently exist prior to the ARRA grants, but that were designed to meet the unmet needs and requests to:

- 1) Reduce impervious surfaces and storm water runoff.
- 2) Expand the urban tree canopy and contribute to achieving a 40% canopy overall.
- 3) Provide residents with tree spaces where none previously existed.
- 4) Improve the health and longevity of the street trees of the District.

The projects implemented as part of the Tree Canopy Renovation Project were a continuation of the core mission of UFA. These grants allowed UFA to continue to provide the level of service in terms of removing dead, dying, or hazardous trees and replanting open tree boxes that is expected by the residents of the District even during budget cuts and difficult financial times.

Despite the fact that ARRA funding for these projects has ended, there is an expectation from residents and other District government agencies that this work will continue. Fortunately, for the near term, these projects are continuing as funding from Federal Highways Administration (FHWA) Transportation Enhancement Grants has provided \$1 million to remove additional impervious pavement, and the Clean Water State Revolving Fund (45%) and Municipal Separate Storm Sewer System Fund (55%) are providing a combined total of \$1.2 million towards additional impervious surface removal, and \$800 thousand for enhanced tree planting and maintenance efforts.

Dependence on grants for the long term funding of efforts to reduce the impervious infrastructure in the right-of-way is not a sustainable way to ensure that these projects continue, that the full benefit of this work is implemented throughout the District, and the environmental benefits of stormwater reduction and canopy expansion are maximized. Several options are available to ensure that these programs continue long term along with the benefits that accrue to the District through reductions in impervious surfaces and the expansion of the urban tree canopy. A long term funding source could be developed to ensure these improvements can be made on a continual basis, and/or the practices developed during the ARRA funded project could be adopted throughout DDOT so that as sidewalks and streetscapes are upgraded these green infrastructure improvements can be incorporated and implemented.

Conclusion

The projects at Urban Forestry Administration (UFA) that received ARRA funding have been successful in terms of fulfilling the goals of the stimulus act – job creation and reinvesting in America’s infrastructure - and supporting the mission of DDOT and UFA.

- 1) Job Creation: Numerous jobs were either created or saved as part of this project. At UFA five jobs were created to manage the projects, while the Tree Canopy Renovation Project created an average of six jobs over the length of the project and the Green Median Renovation and Impervious Surface Reduction Projects combined also created six jobs. Refer to Appendix C for additional details.



- 2) **Tree Canopy Renovation:** This project invested heavily in the street trees of the District of Columbia. Over the course of the project 2209 trees were removed that were dead, dying, or diseased, while 2632 trees were planted in open or newly created tree spaces. Over 300 new planting spaces were created through the removal of impervious surfaces. A backlog of tree removals was able to be cleared and additional tree planting was possible during a period severe budget constraints. All of this investment will lead to a larger and healthier tree canopy as the trees planted become established and grow.

Preliminary data from a study assessing the urban tree canopy using multispectral imagery shows the District of Columbia is getting greener. According to the assessment, DC's urban tree canopy has grown by 2.1 percent over the past 5 years, and now covers 37.2% of the city. This is a move in the right direction towards achieving a 40% urban tree canopy and occurs before the effects of the current ARRA projects have had an impact since all trees planted are only a year or two old.

- 3) **Impervious Surface Removal:** The combined work of the Green Median Renovation Project and the Impervious Surface Reduction Project eliminated 124,505 square feet or 2.86 acres of excessive brick and concrete from the right of way of District roadways. This is equivalent to nearly 3 football fields, excluding the end zone. In addition to the 334 new tree boxes created, over 500 existing tree boxes were expanded, and many more were combined into continuous planting strips. This expansion of the green space in the DDOT ROW makes a significant contribution to the green infrastructure in the District, and improves the quality of life for District residents.
- 4) **Stormwater Reduction:** Stormwater runoff within the Combined Sewer System has been reduced through the combined effort of the three projects instituted by UFA. The impervious surfaces removed should prevent 60 thousand gallons of stormwater per 1.2" rain event from entering the sewer system based on direct interception by the green infrastructure created. Refer to Appendix D for additional details. In addition, the trees planted will over time intercept additional rainfall and provide further reductions in stormwater runoff. Appendix E details the potential environmental benefits from expanding the tree canopy.

The projects at Urban Forestry Administration funded by the American Reinvestment and Recovery Act were of great benefit to UFA, DDOT, and the residents of the District of Columbia. The jobs created, continuation of services at or above pre-recession levels, the improvements to DDOT's green infrastructure, and the new and innovative projects that were made possible by this funding fulfilled the goals of the stimulus act. Furthermore, these projects have contributed to DDOT's mission by protecting and enhancing the natural and environmental resources of the District, and improving the quality of life in the nation's capital by creating more sustainable streetscapes.



Table 4: Impervious Surface Reduction Project Locations

Impervious Surface Removal	Ward	Square Feet of Impervious Removed	Total Cost	Cost per Square Foot	Description
Seaton School 1503 10th St NW	2	14,000	\$217,552.40	\$15.54	Large expanse of concrete in front of this DCPS facility was removed. The existing soil removed and replaced with structural soil followed by 10 inches of topsoil and sod. 13 new trees planted.
Foggy Bottom 19th-20th St. NW	2	539	\$14,266.37	\$26.47	47 tree boxes expanded an average of 13 sq. ft.
East Capitol NE 400 - 1500 block	6	3,476	\$68,841.48	\$19.80	100 tree boxes expanded an average of 35 sq ft.
A Street NE 300 - 1100 block	6	2,828	\$42,260.00	\$14.94	64 tree boxes expanded an average of 44 sq ft.
Kennedy St. NW 200 - 900 block	4	647	\$26,956.27	\$41.66	12 tree boxes expanded, 10 new boxes created. Community tree planting organized by Casey Trees.
Mount Pleasant	1	80	\$0.00	N/A	6 boxes expanded beside Asbury Park before community concerns canceled the project.
10th Street NE 100 - 400 block	6	578	\$25,509.92	\$44.13	21 tree boxes expanded, 3 new boxes created
12th Street SE (CVS) 500 block	6	239	\$5,056.85	\$21.16	5 tree boxes expanded, 2 new boxes created.
P Street NW Unit Block to Logan Circle	2,5	7,193	\$121,098.60	\$16.84	Create a continuous strip along P Street from New Jersey Avenue to Logan's Circle. Expand tree boxes from the Unit block to New Jersey Avenue.
Hanover Place NW	5	686	\$20,195.94	\$29.44	Create 24 new boxes on a block that currently has no tree boxes.
Florida Avenue and North Capitol Triangle Park, NW	5	2,129	\$23,609.93	\$11.09	Remove impervious surface from triangle park and replace with top soil and sod. Create 3 new tree boxes.
P Street NE Unit Block and North Capitol	5	11,196	\$116,983.19	\$10.45	Remove excessive impervious surface from sidewalk and create a large green space by replacing with top soil and sod and planting 12 trees. Create 5 large planting boxes beside Peoples Building. Create 3 new tree boxes. Expand 6 existing boxes.
Brent School 300 Block 3rd Street SE	6	1,616	\$18,672.01	\$11.55	Remove impervious surface from sidewalk to create a continuous strip and replace with top soil and either mulch or sod.
4th and Adams NE	5	488	\$12,265.10	\$25.13	Cut 8 new tree boxes on 4th Street and Rhode Island Ave. Expand 2 existing boxes.

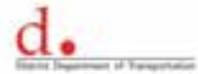


Table 4: Impervious Surface Reduction Project Locations Continued

Impervious Surface Removal	Ward	Square Feet of Impervious Removed	Total Cost	Cost per Square Foot	Description
Adams Morgan	1	4,286	\$87,236.61	\$20.35	Expand 31 boxes from 3'-6' in length. Create 32 new boxes, and create a continuous strip on the 2200 block of 16th Street.
10th and Rhode Island NW	2	1,657	\$22,177.87	\$13.38	Create a continuous strip along 10th Street between Rhode Island Avenue and P Street, beside the Seaton School. Increase the number of planting locations from 8 to 11. Create root channels from CU soil beneath sidewalk to athletic field.
Safe Shores School O Street and New Jersey Ave NW	2	4,974	\$42,220.93	\$8.49	Create and continuous strip along O Street between New Jersey Avenue and 5th Street NW. 5 additional planting locations were created.
Minnesota Ave NE and SE	7,8	2,945	\$58,307.96	\$19.80	10 new tree boxes created and 1 box expanded in front of DOES building on 2500 block. Continuous strip restoration on 3300 block. 4 tree boxes created and 2 expanded on the 2900 block of Minnesota Ave. 10 new tree boxes created, 2 expanded, and a continuous strip created at Minn. Ave and Penn. Ave.
Edmund Burk Park	2	918	\$14,640.30	\$15.95	Expand 6 existing boxes, Create 4 new tree boxes, and create a continuous planting strip around the Edmund Burke Park located at Mass Ave, and 12th Street NW.
North Capitol Greenway, NE	5	2,866	\$43,485.53	\$15.17	Create 4 new tree boxes. Create 5 continuous strips. Expand 6 existing tree boxes. Create a large area green space in the triangle located at Lincoln Road, North Capitol, and Quincy Place.
Kalorama Park	1	4,884	\$59,383.41	\$12.16	Expand 92 boxes and create 7 new boxes on Kalorama Road, Wyoming Avenue, Columbia Road, Cliffbourne Place, and Biltmore Street, NW.
Shaw, NW	2	4,729	\$82,709.69	\$17.49	9 new tree boxes created, and 83 boxes expanded; 9 of which were converted or combined into a continuous planting strip.
Linden Place NE	6	3,404	\$47,827.10	\$14.05	12 new tree boxes were created, 5 continuous planting strips created by combining or expanding 11 existing tree boxes, and 37 tree boxes expanded.
Eckington Park, NE	5	1,300	\$22,686.19	\$17.45	Remove large concrete area in old traffic circle beside the NY Pizza.
NOMA, NW	6	2,644	\$29,470.69	\$11.15	13 tree boxes expanded on New Jersey Avenue and I Street, and a continuous strip created on First Street.
Total		80,303	\$1,223,414.34	\$15.23	

All project costs based on contractor expenses only.



Table 5: Green Median Project Locations

Green Median Renovation	Ward	Square Feet of Impervious Removed	Total Cost	Cost per Square Foot	Description
Washington Avenue, SW	2	6849	\$159,013.86	\$23.22	Existing trees removed. Cobblestone and other impervious surface removed. 3 feet of existing fill removed and replaced with structural soil.
3rd Street NW Mass Ave to K St.	6	3116	\$35,964.69	\$11.54	Brick covering median removed, and replaced with topsoil and mulch. All trees retained.
Rhode Island Avenue, NE 600 - 800 block	5	4964	\$77,635.53	\$15.64	Concrete covering median removed, fill removed and backfilled with topsoil. 16 trees planted.
Calvert St. NW 2800 - 2900 block	3	2497.5	\$25,213.58	\$10.10	Brick covering median removed, and replaced with topsoil and mulch. Trees retained in first median and removed in second median.
Bladensburg Rd NE 17th St. to Neal Street	5	6005	\$90,661.59	\$15.10	Concrete covering median removed, fill removed and backfilled with topsoil. 29 trees planted in partnership with Casey Trees.
Alabama Ave SE	7	2416	\$25,862.05	\$10.70	Concrete and cobblestone covering 3 medians removed, existing fill removed and backfilled with topsoil. 2 existing trees preserved. 6 existing tree boxes maintained and 3 additional planting spaces created.
Southern Ave SE	8	2474	\$25,803.12	\$10.43	Concrete covering median removed, fill removed and backfilled with topsoil. Spaces for 6 trees created.
Bladensburg Rd NE Yost Street to Eastern Avenue	5	9494	\$135,827.13	\$14.31	Concrete covering median removed, fill removed and backfilled with topsoil. Medians covered with sod. Spaces for 52 trees created.
Massachusetts Ave & New Jersey Ave NW	6	6387	\$60,404.82	\$9.46	Brick covering median surface removed on 3 medians. 2 medians containing trees were not excavated, but topsoil and sod added. 1 median without trees was excavated to a depth of 2 feet, topsoil added, and covered with sod. 3 additional tree spaces created.
Total		44,203	\$636,386.37	\$14.40	

All project costs based on contractor expenses only.



Appendix A: Listing of all Project Locations

Impervious Surface Reduction Green Median Renovation



Location Seaton School	Address / Streets and Blocks Rhode Island Ave and 10th Street NW	Ward 2
Active Dates August 11–21, 2010	Impervious Surface Removed 14,000 square feet	Total Cost \$ 217,552.40
		Cost per sq ft \$15.54

Description
Large expanse of concrete in front of this District of Columbia Public School (DCPS) facility was removed. The existing soil was removed and replaced with structural soil followed by 10 inches of topsoil and sod. 13 new trees planted.

Before



After





Location Foggy Bottom	Address / Streets and Blocks 19th-20th Street NW	Ward 2
Active Dates August 9-25, 2010	Impervious Surface Removed 539 square feet	Total Cost \$14,266.37
		Cost per sq ft \$26.47

Description

47 tree boxes expanded an average of 13 square feet.

Before



After





Location East Capitol Street NE	Address / Streets and Blocks 400 - 1500 block	Ward 6	
Active Dates Aug 26 - Sept 9, 2010	Impervious Surface Removed 3476	Total Cost \$68,841.48	Cost per sq ft \$19.80

Description
100 tree boxes expanded an average of 35 square feet.

Before



After





Location A Street NE		Address / Streets and Blocks 300 - 1100 block		Ward 6
Active Dates Sept 20 – Oct 2, 2010	Impervious Surface Removed 2,828 square feet	Total Cost \$42,260.00	Cost per sq ft \$14.94	

Description
64 Tree boxes expanded an average of 44 square feet.

After



After





Location Kennedy Street NW	Address / Streets and Blocks 200 - 900 block	Ward 4	
Active Dates November 5-15, 2010	Impervious Surface Removed 647	Total Cost \$26,956.27	Cost per sq ft \$41.66

Description
12 tree boxes expanded, 10 new boxes created. Community tree planting organized by Casey Trees.

Before



After





Location 10th Street NE	Address / Streets and Blocks 100 - 400 block	Ward 6	
Active Dates November 1-24, 2010	Impervious Surface Removed 578	Total Cost \$25,509.92	Cost per sq ft \$44.13

Description
21 tree boxes expanded, 3 new boxes created.

Before



After





Location 12th Street SE (CVS)	Address / Streets and Blocks 500 block	Ward 6	
Active Dates November 29, 2010	Impervious Surface Removed 239	Total Cost \$5,056.85	Cost per sq ft \$21.16

Description
5 tree boxes expanded, 2 new boxes created.

Before



After





Location P Street NW	Address / Streets and Blocks Unit Block to Logan Circle	Ward 2,5	
Active Dates Dec 15-Feb 24, 2011	Impervious Surface Removed 7,193	Total Cost \$121,098.60	Cost per sq ft \$16.84

Description
Created a continuous strip along P Street from New Jersey Avenue to Logan Circle. Expanded 45 tree boxes and added 5 new tree boxes from the Unit block to New Jersey Avenue.

Before



After





Location Hanover Place, NW	Address / Streets and Blocks Unit block	Ward 5	
Active Dates February 10-15, 2011	Impervious Surface Removed 686 square feet	Total Cost 20,195.94	Cost per sq ft \$29.44

Description
Created 24 new boxes on a block that had no tree boxes.

Before



After





Location Florida Avenue and North Capitol Triangle Park, NW		Address / Streets and Blocks Unit block	Ward 5
Active Dates Feb 16-18 and Nov 2, 2011	Impervious Surface Removed 2,129 square feet	Total Cost \$23,609.93	Cost per sq ft \$11.09
Description Removed impervious surface from triangle park and replaced with top soil and sod. Created 3 new tree boxes in adjacent sidewalks.			

Before



After





Location P Street NE		Address / Streets and Blocks Unit Block and North Capitol		Ward 5
Active Dates March 4-25, 2011	Impervious Surface Removed 11,196 square feet	Total Cost \$116,983.19	Cost per sq ft \$10.45	
Description Removed excessive impervious surface from sidewalk and created a large green space by replacing with top soil and sod and planting 12 trees. Created 5 large planting boxes beside Peoples Building. Created 3 new tree boxes. Expanded 6 existing boxes. (Photos: P Street NE)				
Before 		After 		



Location Brent Elementary School	Address / Streets and Blocks 3rd Street SE, 300 Block	Ward 6
Active Dates March 17-22, 2011	Impervious Surface Removed 1,616 square feet	Total Cost \$18,672.01
		Cost per sq ft \$11.55

Description
Removed impervious surface from sidewalk and created a continuous strip. Replaced brick with top soil and either mulch or sod. (Photos: 3rd Street SE)

Before



After



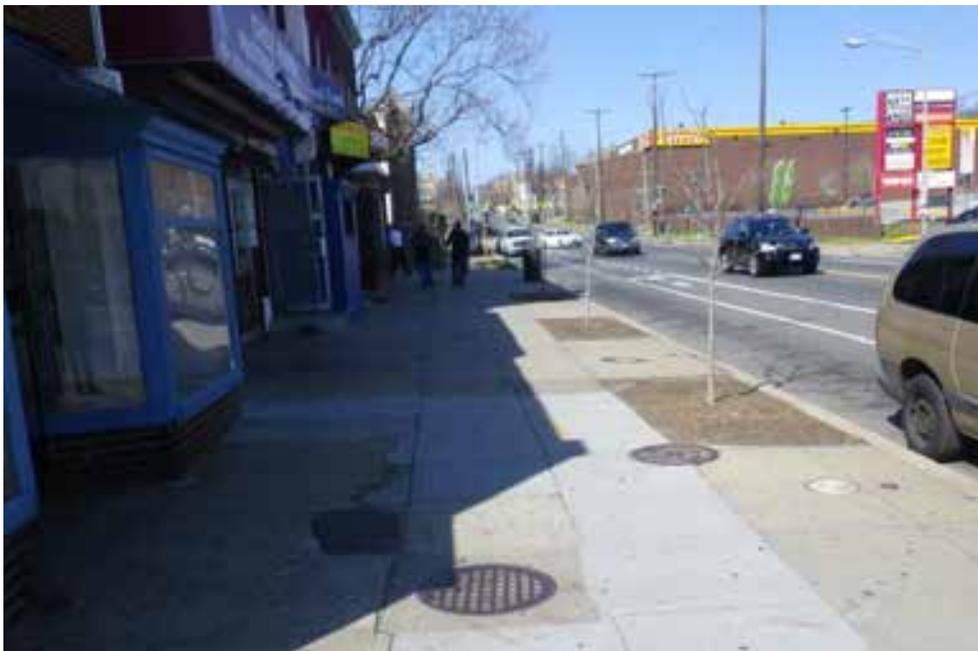


Location 4th and Adams, NE	Address / Streets and Blocks 4th Street, 2200-2300 blocks, Rhode Island Avenue, 400 block		Ward 5
Active Dates April 6-7, 2011	Impervious Surface Removed 488 square feet	Total Cost \$12,265	Cost per sq ft \$25.13
Description Cut 8 new tree boxes on 4th Street and Rhode Island Avenue. Expanded 2 existing boxes.			

Before



After





Location Adams Morgan		Ward 1	
Address / Streets and Blocks Champlain Street, 2200-2300 blocks; Old Morgan School Way, 2200 block Ontario Road, 2200 block; Florida Ave., 1600-1700 blocks; V Street, 1700 block 16th Street, 2000-2400 blocks; 17th Street, 2500 block; Euclid Street, 1700 block			
Active Dates April 11-May 20, 2011	Impervious Surface Removed 4,286 square feet	Total Cost \$87,236.61	Cost per sq ft \$20.35
Description Expanded 31 boxes from 3'-6' in length. Created 32 new tree boxes, and created a continuous strip on the 2200 block of 16th Street NW. (Photos: Champlain Street NW)			
Before 		After 	



Location 10th Street NW		Address / Streets and Blocks 1500 block		Ward 2
Active Dates April 18-May 5, 2011	Impervious Surface Removed 1,657 square feet	Total Cost \$22,177.87	Cost per sq ft \$13.38	

Description
Created a continuous strip along 10th Street between Rhode Island Avenue and P Street, beside the Seaton School. Increased the number of planting locations from 8 to 11. Created root channels from CU soil beneath sidewalk to athletic field. (Photos: 10th Street NW)





Location Safe Shores	Address / Streets and Blocks O Street NW, 400 block	Ward 2	
Active Dates May 10-26, 2011	Impervious Surface Removed 4,974 square feet	Total Cost \$42,220.93	Cost per sq ft \$8.49

Description
Created a continuous strip along O Street between New Jersey Avenue and 5th Street NW. 5 additional planting locations were created. (Photos: O Street NW)

Before



After





Location Minnesota Avenue NE and SE	Address / Streets and Blocks multiple blocks see below	Ward 7,8	
Active Dates June 21-28, Sept 26-Oct 4, 2011	Impervious Surface Removed 2,945 square feet	Total Cost \$58,307.96	Cost per sq ft \$19.80

Description:
10 new tree boxes created and 1 box expanded in front of DOES building on 4500 block. Continuous strip restoration on 3300 block. 4 tree boxes created and 2 expanded on the 2900 block of Minnesota Ave. 10 new tree boxes created, 2 expanded, and a continuous strip created at intersection of Minnesota Ave, L'Enfant Sq. and 2300 block of Pennsylvania Ave.

Before



After





Location Edmund Burke Park	Address / Streets and Blocks Massachusetts Avenue and 12th Street NW	Ward 2	
Active Dates Oct 5-7, 2011	Impervious Surface Removed 918 square feet	Total Cost \$14,640.30	Cost per sq ft \$15.95

Description
Expanded 6 existing boxes, created 4 new tree boxes, and created a continuous planting strip around the Edmund Burke Park.

Before



After





Location North Capitol Greenway	Address / Streets and Blocks Multiple blocks: see below	Ward 5
Active Dates Oct 11 – Nov 1, 2011	Impervious Surface Removed 2,866 square feet	Total Cost \$43,485.53
		Cost per sq ft \$15.17

Description
Created 4 new tree boxes, 5 continuous strips, and expanded 6 existing tree boxes on 1600-1700 block of North Capitol, and Unit blocks of Quincy Place, Randolph Place and R Street. Created a large area green space in the triangle located at 1700 block Lincoln Road.

Before



After





Location Kalorama Park, NW		Address / Streets and Blocks Multiple blocks see below		Ward 1
Active Dates Oct 20- Nov 1, 2011	Impervious Surface Removed 4,884 square feet	Total Cost \$59,383.41	Cost per sq ft \$12.16	

Description
**Expand 92 boxes and create 7 new boxes on 1800 block of Kalorama Road, 1800 block of Wyoming Avenue, 1800 block of Columbia Road, 2500 block of Cliffbourne Place, and 1800-1900 block of Biltmore Street.
(Photos: Cliffbourne Place NW)**

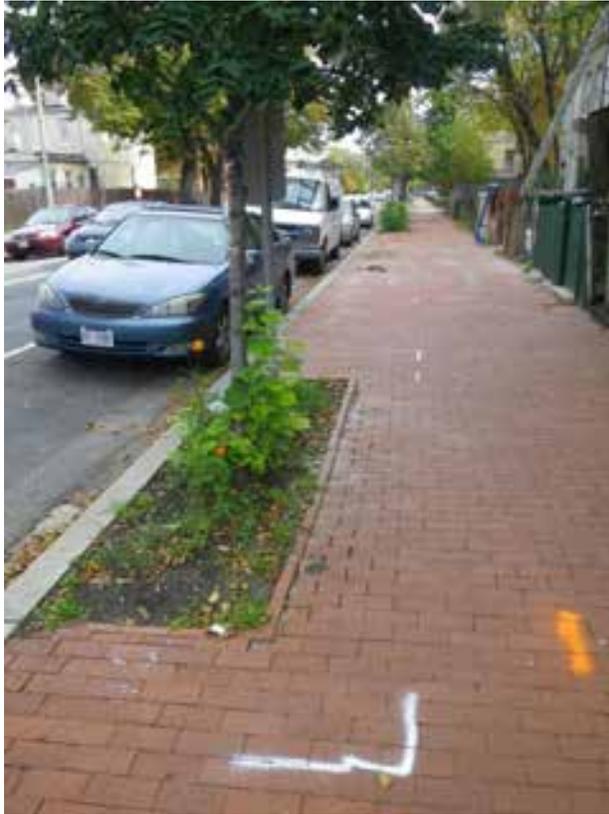




Location Shaw		Address / Streets and Blocks R Street NW, 400-600 blocks S Street, 600 block 5th Street, 1700-1800 blocks 6th Street, 1800 block		Ward 2
Active Dates Nov 18 – Dec 13, 2011	Impervious Surface Removed 4,729 square feet	Total Cost \$82,709.69	Cost per sq ft \$17.49	

Description
9 new tree boxes were created, and 83 boxes were expanded, of which 9 were converted or combined into a continuous planting strip. (Photos: S Street NW)

Before



After





Location Linden Place NE		Address / Streets and Blocks Linden Place, 1200 block 12th Street, 600-700 blocks 13th Street, 600-700 blocks		Ward 6
Active Dates Nov 28 – Dec 15, 2011	Impervious Surface Removed 3,404 square feet	Total Cost \$47,827.10	Cost per sq ft \$14.05	
Description 12 new tree boxes were created, 5 continuous planting strips created by combining or expanding 11 existing boxes, and 37 tree boxes expanded. (Photos: 13th Street NE)				

Before



After





Location Eckington Park	Address / Streets and Blocks North Capitol and Florida NE	Ward 5
Active Dates Dec 14 – 16, 2011	Impervious Surface Removed 1,300 square feet	Total Cost \$22,686.19
		Cost per sq ft \$17.45

Description
Removed large concrete area in old traffic circle beside the NY Pizza.

Before



After





Location NOMA	Address / Streets and Blocks First Street NW, 900 block; Eye Street NW, 100 block; NJ Ave, 700 block	Ward 6	
Active Dates Dec 14 – Jan 12, 2012	Impervious Surface Removed 2,644 square feet	Total Cost \$29,470.69	Cost per sq ft \$11.15

Description
13 tree boxes expanded on New Jersey Avenue and Eye Street, and a continuous strip created on First Street. (photos First Street NW)

Before



After





Location Washington Avenue SW	Address / Streets and Blocks 200 block	Ward 2	
Active Dates July 26-Aug 23, 2010; Feb 10-11 & June 10-13, 2011	Impervious Surface Removed 6,849 square feet	Total Cost \$159,013.86	Cost per sq ft \$23.22

Description
Existing trees removed. Cobblestone and other impervious surface removed. 3 feet of existing fill removed and replaced with structural soil.

Before



After





Location 3rd Street NW	Address / Streets and Blocks Massachusetts Avenue to K Street	Ward 6	
Active Dates December 2-10, 2010	Impervious Surface Removed 3,116 square feet	Total Cost \$35,964.69	Cost per sq ft \$11.54

Description
Brick covering on median removed, and replaced with topsoil and mulch. All trees retained.

Before



After





Location Rhode Island Avenue NE	Address / Streets and Blocks 600-800 block	Ward 5	
Active Dates February 15 – March 1, 2011	Impervious Surface Removed 4,964 square feet	Total Cost \$77, 635.53	Cost per sq ft \$15.64

Description
Concrete covering median removed, fill removed and backfilled with topsoil. 16 trees planted.

Before



After





Location Calvert Street NW	Address / Streets and Blocks 2800 – 2900 blocks	Ward 3	
Active Dates March 1-3, March 23, 2011	Impervious Surface Removed 2,497 square feet	Total Cost \$25,213.58	Cost per sq ft \$10.10

Description
Brick covering median removed, and replaced with topsoil and mulch. Trees retained in first median, 2 trees removed in second median and 5 trees planted.

Before



After





Location Bladensburg Road NE	Address / Streets and Blocks 17th Street to Neal Street	Ward 5	
Active Dates March 3 - 25, 2011	Impervious Surface Removed 6,005 square feet	Total Cost \$90,661.59	Cost per sq ft \$15.10

Description
Concrete covering median removed, fill removed and backfilled with topsoil. 29 trees planted in partnership with Casey Trees.

Before



After





Location Alabama Avenue SE	Address / Streets and Blocks 2800-2900 blocks	Ward 7
Active Dates May 24 – June 2, 2011	Impervious Surface Removed 2,416 square feet	Total Cost \$25,862.05
		Cost per sq ft \$10.70

Description
Concrete and cobblestone covering 3 medians removed, existing fill removed and backfilled with topsoil. 2 existing trees preserved. 6 existing tree boxes maintained and 3 additional planting spaces created.

Before



After





Location Southern Avenue SE	Address / Streets and Blocks Southern Avenue Metro entrance	Ward 8	
Active Dates June 3 – 8, 2011	Impervious Surface Removed 2,474 square feet	Total Cost \$25,803.12	Cost per sq ft \$10.43

Description
Concrete covering median removed, fill removed and backfilled with topsoil. Spaces for 6 trees created.

During



After





Location Bladensburg Road NE		Address / Streets and Blocks Yost Street to Eastern Avenue		Ward 5
Active Dates July 21-27, Aug 29-Sept 19, Nov 14-19, 2011		Impervious Surface Removed 9,494 square feet	Total Cost \$135,827	Cost per sq ft \$14.31

Description
Concrete covering median removed, fill removed and backfilled with topsoil. Medians covered with sod. Spaces for 52 trees created. Trees planted in partnership with Casey Trees.





Location Mass Ave and New Jersey Ave NW	Address / Streets and Blocks 200 Mass & 700-800 blocks NJ		Ward 6
Active Dates November 23 – December 9, 2011	Impervious Surface Removed 6,387 square feet	Total Cost \$60,404.82	Cost per sq ft \$9.46

Description
Brick covering median surface removed on 3 medians. 2 medians containing trees were not excavated, but topsoil and sod added. 1 median without trees was excavated to a depth of 2 feet, topsoil added, and covered with sod. 3 additional tree spaces created. (photo New Jersey Ave)

Before



After





Appendix B: American Reinvestment and Recovery Act Requirements

Reporting

Reporting requirements under the American Recovery and Reinvestment Act were extensive. In order to track and document the spending on the projects, the following reports were created on a monthly basis:

SOAR 80 Report: Screen shot of the soar 80 screens detailing the project summary, Phase 3 – Design, and Phase 4 – Construction spending and revenue (intradistrict transfers).

Purchase Order Report: Report generated that details the project expenditures that have been made against specific purchase orders.

Expenditure Report: Report generated that details the total expenditures made to each vendor or contractor.

Certified Payroll Report: provided by the contractor to document the hours of work performed and the wages paid. This report served to document work done and jobs created as part of the economic stimulus. A similar report is produced for DDOT employees by Resource Management. This report also served to document that the Davis-Bacon Act, Service Contract Act, and Living Wage Act requirements were followed. Department of Employment Services (DOES) performed an audit of certified payrolls to verify that these requirements were met.

Progress Report: A summary of the work completed by the contractor and by DDOT employees working on the projects.

Reconciliation Report: Report that breaks out the expenditures on labor by both the contractors and DDOT versus the expenditures on materials and services.

Invoices: Submittal of invoices to DDOE along with the supporting documentation detailed above was required for payment approval.

Many of the reports generated by Office of the Chief Financial Officer (OCFO) and Resource Management were automated and then simply needed to be filed and delivered to DDOE for record keeping purposes. Other reports such as the progress report and the reconciliation report required either tracking of progress in the field or the compilation of data from the various other reports (especially the certified payroll reports and material invoices). All of the above reports are considered supporting documentation to the online reporting and have been stored electronically and transferred to DDOE on a monthly basis.

Online reporting was accomplished through the reporting.dc.gov website which was maintained by the Office of the Chief Technology Officer (OCTO). This website allowed all DC government agencies that received ARRA funding to report to a single centralized location where the reports could then be tracked and certified by project managers, in the case of UFA projects by managers at DDOE. The results of the Certified Payroll Reports and the Progress Reports were updated to the ARRA reporting site online on a monthly basis.



Davis-Bacon Act

The Davis-Bacon Act regulates the prevailing wage that is paid on construction projects that receive federal funding. The Impervious Surface Reduction and Green Median Renovation Projects were both subject to the Davis-Bacon Act. Since the paving contractor, Capitol Paving Inc., is regularly contracted to work on federally funded DDOT projects maintaining compliance with Davis-Bacon Act requirements was not an issue. The Tree Canopy Renovation Project was not a construction project and therefore was not subject to the Davis-Bacon Act. The two contracts that were utilized to complete the tree planting and tree removal portions of this project were both service contracts, and as such were required to meet the requirements of the Service Contract Act. In addition, all District government contracts are required to meet the DC living wage requirements. This was the primary purpose of providing certified payrolls which could then be audited by DOES to ensure compliance with these provisions.

Buy American

The purpose of Buy American requirements of ARRA funding is to ensure that iron, steel and manufactured goods used in infrastructure projects are produced in the United States. A manufactured good is defined as a good brought to the construction site for incorporation into the building or work that has been (a) processed into a specific form or (b) combined with other raw material to create a qualitatively different material. On the other hand, raw materials, e.g., trees, soil, mulch, sod and gravel, are not applicable to Buy American provisions. Due to the nature of the projects that UFA undertook, none was subject to Buy American provisions. The construction projects all involved the removal of manufactured materials like brick, and their replacement with raw materials like soil, mulch, trees, and sod; while the tree canopy renovation project dealt only with raw materials.



Appendix C: Job Creation

One of the principal goals of ARRA was the creation or preservation of jobs during the financial crisis and ensuing economic recession. To that end, the funding that was provided to UFA created five jobs within UFA to plan, manage, and implement these projects. In addition, the funding helped to preserve many existing jobs since financial pressure was taken off of these positions through the ability to charge time to these federally funded projects. Finally, the three contractors that were utilized under these projects were able to maintain more employees during the period when these projects were active. In particular, Lorenz landscaping had a tree planting crew actively working on the project from January 2010 – April 2010. C&D Tree services had a tree removal crew working on the project from April 2010 through January 2012, and Capitol Paving Inc. had a crew working on either green median renovation or impervious surface reduction projects from July 2010 through December 2011.

	Lorenz	C&D		Capitol Paving		
	Tree Planting	Tree Removal	Total TCR	Green Median	Impervious Surface	Total GM+ISR
Months Active	4	22	25	18	18	18
Total Hours	5,908	18,090	23,997	6,192	12,724	18,916
Jobs Created (1)	9	5	6	2	4	6

Based on the number of hours reported through certified payrolls, the Tree Canopy Renovation (TCR) project saved or created six jobs, and the Green Median (GM) and Impervious Surface Reduction (ISR) projects saved or created six jobs. That comes to a total of 12 contractor jobs and 5 jobs at UFA for a total of 17 jobs created.

- (1) Jobs created were calculated by summing the total number of hours reported on certified time sheets, then dividing by the number of weeks the projects were active, then dividing by a 40 hour work week to determine the number of jobs created.



Appendix D: Stormwater Benefits

Quantifying the benefits that these projects will produce is a challenging task. Based on the stormwater permits issued to the District, the improvements that are being made are intended to intercept and treat all rainfall from the 90th percentile rainfall event. The projects that have been implemented by UFA should meet these criteria for the rainfall that is directly intercepted by the area where the impervious surface was removed, since none of these projects was designed to capture stormwater flowing into a tree box, planting strip, or other stormwater retention structure. To achieve the treatment of 90% of all storm events, each of these areas must be able to infiltrate 1.2 inches of rainfall. Considering that the majority of the work involved soil replacement of 12 inches or more, only 10% of the soil volume would need to consist of pore space in order to accommodate this amount of precipitation. In comparison, an ideal soil is 50% pore space, while most urban soils are considered to have from 10% to 30% pore space.

Given that there is sufficient pore space within the areas where impervious surface were removed, then the amount of stormwater that would have run off into the storm sewer, but is now being detained is 60 thousand gallons per storm event that delivers 1.2 inches of precipitation.

	Impervious Surface Removed (Sq. feet)	Gallons of Rainfall from 1.2" event	Gallons of Runoff from Impervious Surfaces	Gallons of Runoff from Greened Surfaces	Gallons of Rainfall Retained
Impervious Surface Reduction	80,303	60,066	54,060	15,017	39,043
Green Median Renovation	44,203	33,063	29,757	8,266	21,491
Total	124,505	93,130	83,817	23,283	60,535

While a total of 93 thousand gallons of rainfall lands on the area of former impervious surface that has been greened, not all of this volume would have runoff previously, nor will it all be retained by the newly greened surface. The runoff coefficient for impervious surfaces such as sidewalks and roadways is 90% which means that 10% of the rainfall does not runoff, but either remains on the surface or is lost to evaporation. Similarly, the greened surfaces have a runoff coefficient of 25% which means that despite being pervious 25% of rainfall still results in runoff. Therefore, the difference between the runoff coefficient of the impervious surface (90%) and the runoff coefficient of the pervious surface (25%) is the amount of rainfall that is retained. In this case 65% of rainfall is considered to be retained by the green infrastructure created.

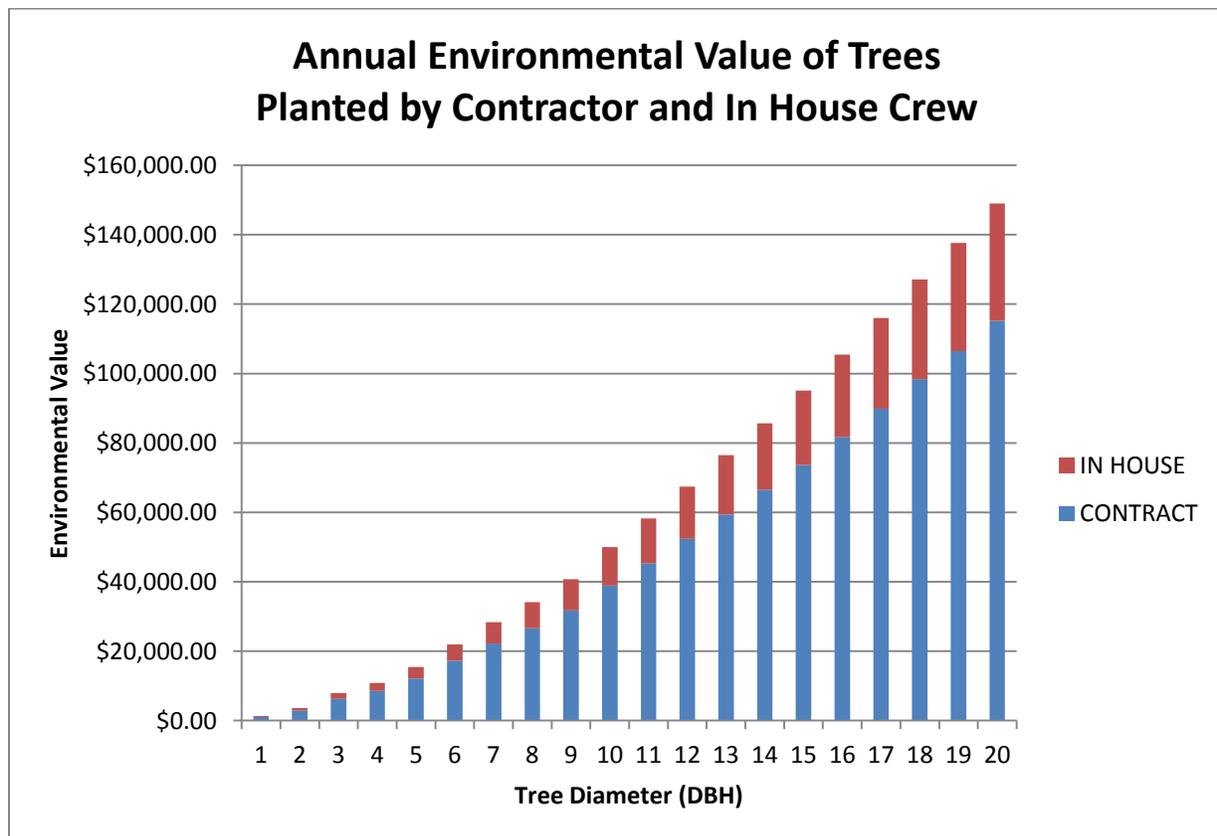


Appendix E: Environmental Benefits of Trees

Calculating the environmental benefits that are provided to a city, neighborhood, or individual residence by street trees is a very difficult and imprecise task. In an attempt to quantify the environmental benefits of the tree planting that has taken place under ARRA, the i-Tree Design tool has been utilized.

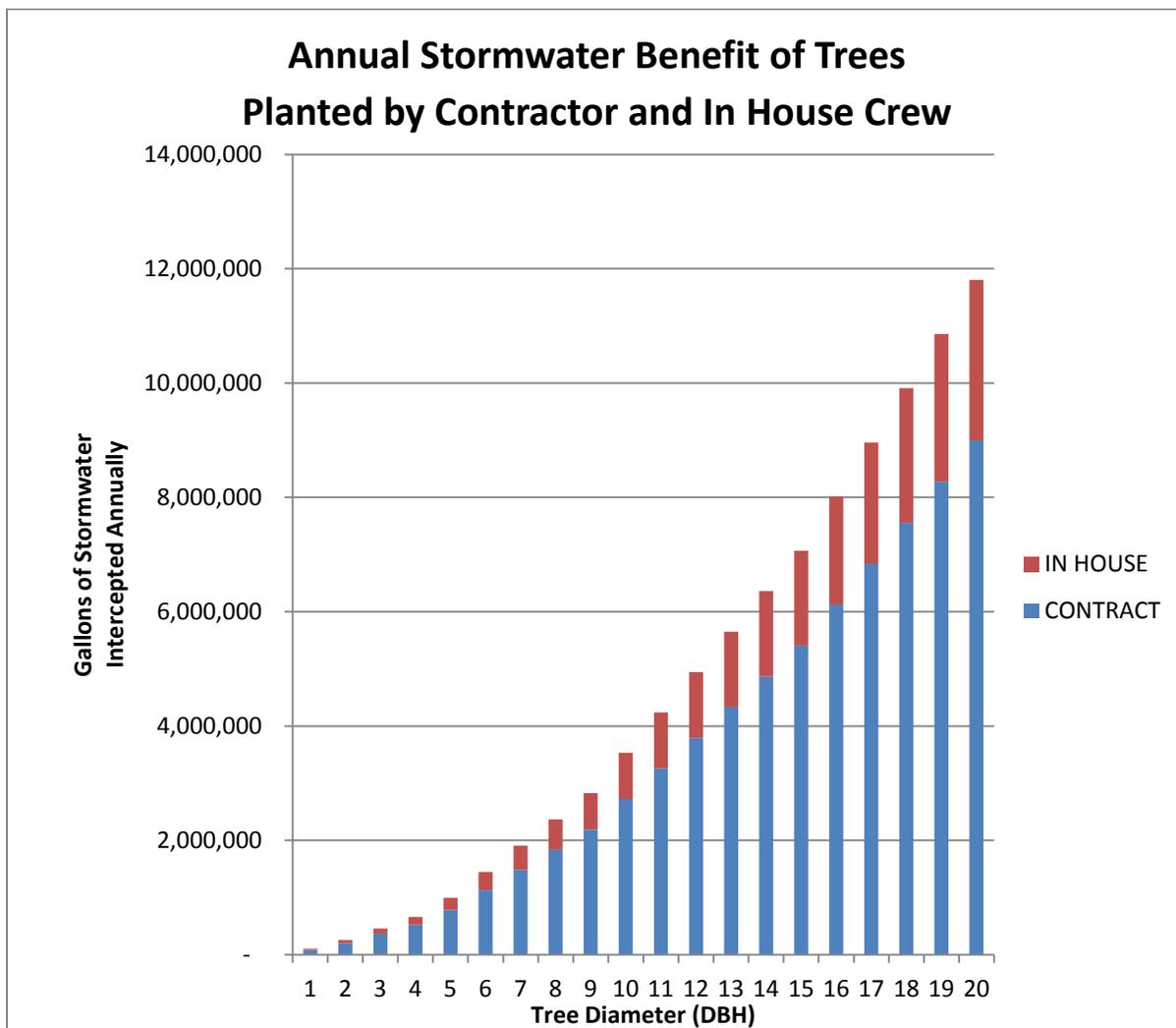
i-Tree Design (beta) allows the calculation of the approximate benefits individual trees provide. The carbon, air quality and stormwater calculations are based on methods and models derived from the i-Tree Streets application. As such, this tool relies on average species growth and geographic parameters for 16 national climate zones and, consequently, should be considered a starting point for understanding trees' value in the community rather than a scientific accounting of precise values.

The overwhelming majority of the benefit of street trees to the built environment is the stormwater benefit. For that reason we are reporting here only the overall environmental benefit in dollars which is the sum of the total value of stormwater intercepted, air quality improved through pollutants filtered, intercepted or otherwise reduced, and CO2 reduced through sequestration and emissions avoidance. As the graph below demonstrates, while the initial annual benefit of trees is small, the benefits quickly become very significant as the tree's canopy increases in size. A tree's diameter at breast height (DBH) which is 4.5 feet is commonly used as a proxy value for the size of a tree's canopy.





As discussed above, the stormwater benefits of street trees are the largest component of the environmental benefits provided. As with the overall environmental benefits provided by trees within the landscape, the volume of stormwater intercepted is initially very small, but as the street trees grow and become established their environmental contribution does as well. For this reason it is important in as many situations as the streetscape and infrastructure allow to plant large shade trees that will maximize the environmental benefits provided by trees. Equally critical to receiving the full benefits from street trees is creating the growing conditions within the tree space that will enable a street tree to reach the large mature size that provides the full benefits anticipated.



The large amount of stormwater that is intercepted by the tree canopy further reinforces the importance of a two pronged approach which increases the planting area and root zone for trees by removing impervious surfaces which are then able to provide an even greater benefit to stormwater interception through increases in the urban tree canopy.



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