



Green Infrastructure Barriers and Opportunities in Dallas, Texas

An Evaluation of Local Codes, Ordinances, and Guidance

About the Green Infrastructure Technical Assistance Program

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, the water is absorbed and filtered by soil and plants. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems and discharged into nearby waterbodies. The stormwater carries trash, bacteria, heavy metals, and other pollutants from the urban landscape, polluting the receiving waters. Higher flows also can cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water. These neighborhood or site-scale green infrastructure approaches are often referred to as *low impact development*.

EPA encourages the use of green infrastructure to help manage stormwater runoff. In April 2011, EPA renewed its commitment to green infrastructure with the release of the *Strategic Agenda to Protect Waters and Build More Livable Communities through Green Infrastructure*. The agenda identifies technical assistance as a key activity that EPA will pursue to accelerate the implementation of green infrastructure.

In February 2012, EPA announced the availability of \$950,000 in technical assistance to communities working to overcome common barriers to green infrastructure. EPA received letters of interest from over 150 communities across the country, and selected 17 of these communities to receive technical assistance. Selected communities received assistance with a range of projects aimed at addressing common barriers to green infrastructure, including code review, green infrastructure design, and cost-benefit assessments. The City of Dallas was selected to receive assistance identifying green infrastructure barriers and opportunities.

For more information, visit http://water.epa.gov/infrastructure/greeninfrastructure/gi_support.cfm.

Acknowledgements

Principal USEPA Staff

Suzanna Perea, EPA Region 6
Tamara Mittman, USEPA
Christopher Kloss, USEPA
James Pittman, USEPA

Community Team

Susan Alvarez, City of Dallas Trinity Watershed Management Department
Dorcy Clark, City of Dallas Trinity Watershed Management Department

Consultant Team

Christy Williams, Tetra Tech
Brad Wardynski, Tetra Tech

February 5, 2013 City of Dallas Green Infrastructure Charrette

David Schleg, Strategic Planning
Kristina Tippie, Trinity Watershed Management Department
Jennifer Cottingham, Trinity Watershed Management Department
Bert Vandenberg, City Attorney's Office
Art Torres, Department of Water Utilities
Rick Galceran, Public Works Department
Alan Hendrix, Public Works Department
Luis Tamayo, Sustainable Development and Construction Department
Philip Erwin, Sustainable Development and Construction Department
Kevin Lefebvre, Office of Environmental Quality
Henry Nguyen, Public Works Department
Keith Manoy, Public Works Department, Transportation Planning
David Whitley, City Design Studio
Bonnie Meeder, Real Estate
Stefan Kesler, Public Works Department
Lloyd Denman, Sustainable Development and Construction Department
Peer Chacko, Sustainable Development and Construction Department
Zaida Basora, Public Works Department, Facilities
Phil Sikes, Sustainable Development and Construction Department
Tanya Brooks, Public Works Department, Transportation Planning

This report was developed under EPA Contract No. EP-C-11-009 as part of the 2012 EPA Green Infrastructure Technical Assistance Program.

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Project Summary

The City of Dallas (City) is actively promoting sustainable building and development practices that improve air quality, protect the climate, preserve water resources, and protect public health. The City maintains a long-term goal of becoming carbon-neutral by 2030. In an effort to reach this long-term goal, Dallas is among the first major cities in the U.S. to adopt a comprehensive green building standard for all residential and commercial construction (http://www.greendallas.net/pdfs/Green_Building_Ordinance.pdf). The City's green building program regulates new construction for both residential and commercial projects, and includes requirements for energy efficiency, water conservation and cool roofs. The City also promotes development that enhances water quality and preserves natural features by encouraging developers to use the North Central Texas Council of Governments (NCTCOG) integrated stormwater management (iSWM) manual when developing parcels larger than three acres. In December 2009, the Dallas City Council approved the use of the Regional iSWM Manual (available at <http://iswm.nctcog.org/>). Currently the City of Dallas local provisions of the iSWM Manual (available at <http://clients.freese.com/dallas/documents/iswm/Dallas%20iSWM%20Criteria%20Manual%2006-28-10.pdf>) are voluntary and have not been approved by City Council.

Additionally, the City is working with other North Texas cities through the NCTCOG to develop and implement a plan to address bacteria in watersheds throughout the region. Many of the City's waterbodies have bacteria levels that exceed water quality standards, and monitoring indicates that stormwater is often the primary source. By reducing and treating stormwater discharges, green infrastructure can play a significant role in restoring bacteria-impaired waters. Green infrastructure can also play a significant role in meeting the City's sustainability goals. Given its emphasis on preserving natural features, minimizing impervious surfaces, and utilizing stormwater runoff, green infrastructure can contribute to carbon sequestration, energy efficiency, water conservation, and heat island mitigation. These environmental and economic benefits, along with the requirement in the City's MS4 Permit to implement post-construction stormwater controls, drives the City's commitment to green infrastructure. The City recognizes green infrastructure as an important tool to be used in the Infrastructure Plan, the Stormwater Management Plan for the City, and several other local planning initiatives.

The City has invested considerable resources into the development of various design manuals that outline specifications and standard construction details for select green infrastructure practices. Each of the manuals was written by a different department or combination of city departments (Sustainable Development and Construction, Public Works, Parks and Recreation, and Dallas Water Utilities), and all address the issues of infrastructure, streets and site development. However, the manuals do not work well together. As a result, the City's current regulatory framework fails to streamline the process of promoting green construction and green infrastructure, and in some cases even impedes development.

As part of its commitment to implement green infrastructure, the City applied for U.S. Environmental Protection Agency (EPA) technical assistance to review the City's plans, policies, and codes to identify current practices that either support or present barriers to green infrastructure to assist the City in achieving its 2030 goals. Based on this review, the City and EPA developed a list of key barriers and inconsistencies to discuss at a charrette that was held on February 5, 2013. This report describes the code review and charrette processes and presents key findings from the reviews of the City's plans, policies and codes with a summary of the action items that the City could implement.

This report will assist other municipalities with recognizing barriers and inconsistencies in municipal codes and ordinances which may be impeding the implementation of green infrastructure practices in their communities. Further, the resources provided in this report will help communities begin to develop helpful tools to make implementation easier. The Approach and Document Review sections of this report provide a summary of the review methodology used and the documents reviewed during the evaluation.

Approach

This project included two phases—document review and determination of action items to address key inconsistencies and barriers. The document review identified existing City plans, codes and policies that support green infrastructure implementation. The review also identified language and provisions that actively limit or prevent the use of green infrastructure, create ambiguity that could discourage or prevent its use, or have omissions that, if remedied, could better promote the use of green infrastructure. This evaluation also included a detailed review of the stormwater management practice designs specifications included in the *iSWM Criteria and Design Manual for Site Development and Construction* and the *Complete Streets Design Manual*. The approach for each phase of the project is described below.

Document Review

Prior to conducting the code review, EPA worked with the City to identify the following codes, ordinances, standards, guidelines, and plans that could have bearing on green infrastructure implementation and should be subject to review:

- Green Building Ordinance No. 122428 (i.e., Dallas Green Construction provisions)
- Water Conservation Ordinance
- Landscape and Tree Preservation Ordinance (and revisions proposed by the Urban Forest Advisory Committee)
- Dallas Development Code
- City of Dallas iSWM Criteria and Design Manual for Site Development and Construction (iSWM Manual)
- Tax Increment Financing (TIF) District Design Manual
- City of Dallas Complete Streets Design Manual
- Dallas Development Guide
- Off-Street Parking and Driveways Handbook

In addition, EPA reviewed the following documents—as a whole or in part—to determine details necessary to identify typical inconsistencies and barriers or to review documents included by reference in the above.

- ForwardDallas! Comprehensive Land Use Plan
- Dallas Bike Plan
- Downtown Dallas 360
- Renaissance Plan
- Thoroughfare Plan
- Dallas Fire Code
- Dallas Plumbing Code

- Dallas Building Code
- Dallas Residential Code
- Paving Design Manual
- Drainage Design Manual
- Green Built Texas Construction Protocol
- USDGC LEED
- NAHB National Green Building Standard
- Environments For Living

To review relevant sections of the documents, EPA used two green infrastructure code and policy evaluation tools: Tetra Tech’s *Green Infrastructure Opportunity Checklist Tool* and the *EPA Water Quality Scorecard*¹. EPA used the tools to understand and describe where the City of Dallas’ land development regulations and other ordinances, policies and guidance documents might present barriers to or opportunities for implementing a comprehensive green infrastructure approach. The evaluation also included a detailed review of the stormwater management practice design specifications included in the City of Dallas local provisions of the *iSWM Criteria and Design Manual for Site Development and Construction and the Complete Streets Manual*.

The five goals that comprise the *Green Infrastructure Opportunity Checklist Tool* were used to organize and report findings. The section below discusses the rationale for each goal, and summarizes several key strategies for achieving the goal:

Goal #1 Minimize effective or connected impervious area

Disconnecting impervious cover can mitigate water quality impacts by allowing for infiltration and reducing the velocity and volume of surface runoff. This goal can be achieved at the watershed, neighborhood and site scale.

Municipalities can realize a significant reduction in regional runoff if they take advantage of underused properties, such as infill, brownfield or greyfield sites. Redeveloping already degraded sites such as abandoned shopping centers or underutilized parking lots rather than paving greenfield sites for new development can dramatically reduce total impervious area while allowing communities to experience the benefits and opportunities associated with growth. Sewer and water authorities can play a major role in directing a region’s growth by determining when and where new infrastructure investment will occur and where imperviousness already exists. Well-drafted facility planning areas can direct growth by providing sewer service in areas least likely to impact water resources.

Mixed-use developments allow for the co-locating of land uses, which decreases impervious surfaces associated with parking and decreases vehicle miles traveled—resulting in a reduction of hydrocarbons left on roadways and reduced air deposition. Transit-oriented development (TOD) produces water quality benefits by reducing: (1) land consumption due to smaller site footprints; (2) parking spaces and the impervious cover associated with them; and (3) average vehicle miles traveled, which, in turn, reduces deposition of air pollution into waterbodies.

The width of travel lanes, parking lanes and sidewalks should be tailored to the urban setting. Where appropriate, narrowing travel lane width to 10–11 feet, rather than the standard 12–13 feet, can

¹ The EPA Water Quality Scorecard is also available at http://www.epa.gov/smartgrowth/pdf/2009_1208_wq_scorecard.pdf.

significantly reduce the total amount of impervious surfaces. Such streets can also substantially improve conditions for walking, biking and transit use, which reduces automobile use and overall demand for parking spaces. Off-street parking and driveways contribute significantly to the impervious areas on a residential lot. Therefore, reducing such dimensions can minimize the amount of stormwater runoff from a site and improve water quality. Streets, sidewalks, and other hard surfaces contribute a large portion to a municipality's total imperviousness. Making these impervious surfaces more permeable protects water quality, reduces flooding, and can recharge groundwater.

Inflexible parking requirements that do not allow for alternative approaches, as well as standards that require too much parking for specific uses, increase the amount of impervious surface in a development. Oversupplying parking in a development also encourages greater vehicle use and detracts from the overall pedestrian environment. Incentives such as transit passes, vanpool arrangements, flexible work schedules, market-priced facilities, and separate leasing for spaces in apartments and condominiums have quantifiable impacts on parking demand. Incorporating these incentives into parking requirements creates the opportunity to meet demand with less impervious cover. Parking lots generate a large amount of impervious cover. Requiring landscaping reduces the environmental impact of parking and can provide additional community benefits by providing shade and, if appropriately placed, creating natural barriers between pedestrians and cars.

Goal #2 Preserve and enhance the hydrologic function of unpaved areas

Protection of significant tracts of critical lands and wildlife habitat aids in protecting and improving water quality by increasing infiltration and groundwater recharge, preventing erosion and contamination of ground water and surface water resources, and protecting sources of drinking water. Within individual development tracts, effective tools for reducing pollutant loads and hydrologic impacts (e.g. increases in peak flows) include protecting sensitive areas (e.g., wetlands, riparian areas, floodplains, erosive soils, and steep slopes) and minimizing the footprint of buildings and construction activity disturbance. These tools have the added benefit of improving rainwater infiltration and replenishing groundwater. Finally, protecting source water areas through land use controls and stewardship activities will help safeguard community health, reduce the risk of water supply contamination, and potentially reduce water treatment costs.

Goal #3 Harvest rainwater to enhance potable and nonpotable water supply

Downspout disconnection/redirection, rain barrels and cisterns can be used for outdoor water supply purposes such as irrigation and indoor uses such as toilet flushing. Such stormwater reuse not only enhances a community's efforts to conserve and augment its water supply, but can also reduce stormwater pollution and volume impacts. Communities often can strengthen opportunities for rainwater harvesting through plumbing code and building code revisions.

Goal #4 Allow and encourage the use of multi-use stormwater controls

Green infrastructure stormwater controls are more likely to be employed by developers if the code allows such BMPs to be located in required open space, recreation, landscaped, and right-of-way areas, and if the BMPs receive credit for such requirements. Allowing these areas to be used for multiple benefits (e.g. landscaping and stormwater retention) may provide incentives for developers to implement green infrastructure practices. Open space areas contribute little to stormwater loads and can provide large areas to infiltrate and treat stormwater. Urban tree canopy – for example along streets or within off-street parking – can improve water quality while also providing shade, reducing the urban heat island effect, and improving air quality. Greenways can provide community connectivity and

healthy recreation, as well as water quality benefits. Parks can provide active and passive recreational facilities and accommodate green infrastructure BMPs.

Goal #5 Manage stormwater to sustain stream functions

Green infrastructure approaches are more effective and cost-efficient than conventional stormwater management practices in many instances. Pre-site plan review is an effective tool for discussing with developers alternative approaches to meet stormwater requirements and incorporating green infrastructure techniques into new projects early in the design stage, well before construction begins. The sooner in the process green infrastructure is considered, the easier it is to ensure that multiple benefits are achieved in a cost-effective manner. Design standards should be in place that replicate the predevelopment hydrology of the site (to the extent practicable), maintain the water quality functions of the watershed, and minimize channel erosion and downstream flooding. Monitoring, tracking, and maintenance measures will help ensure that practices remain in proper working condition to provide the performance required by the stormwater ordinance. In some cases, it is impracticable or infeasible to meet all stormwater standards on site. In such instances, alternative means of compliance should be provided (e.g., contributing to off-site mitigation projects or off-site stormwater management facilities, preferably green infrastructure facilities).

The inconsistencies and barriers identified during the review of the City's plans, policies, and codes were summarized in a memo submitted to the city on January 4, 2013. The City provided corrections to these findings on February 15, 2013, and these corrections have been incorporated into the summary of findings. The Key Barriers described below formed the basis of the discussion at the City charrette.

Determination of Key Barriers

EPA and the City reviewed the evaluation findings and developed a list of six key barriers that were the most critical to address, as follows:

- Key Barrier No. 1** Green infrastructure elements are inconsistently or inadequately addressed in multiple guidance documents and portions of the Dallas City Code
- Key Barrier No. 2** The Dallas City Code currently inhibits effective land utilization to achieve multiple benefits
- Key Barrier No. 3** The Dallas City Code lacks incentives to promote green infrastructure
- Key Barrier No. 4** Current post-construction performance standards could be amended to further promote the goals of green infrastructure
- Key Barrier No. 5** Neither maintenance agreements nor inspection requirements currently apply to green infrastructure measures
- Key Barrier No. 6** City does not allow for alternative measures or off-site mitigation of stormwater impacts when on-site is infeasible

The purpose of the charrette on February 5, 2013, was to discuss the six key barriers and review individual inconsistencies and barriers identified during the document review. The discrete findings associated with each key barrier were compiled and provided as a handout during the charrette to provide the basis for discussions.

The charrette was moderated by EPA with the following City and EPA staff attending:

- David Schleg, Strategic Planning
- Kristina Tippie, Trinity Watershed Management Department
- Susan Alvarez, Trinity Watershed Management Department
- Dorcy Clark, Trinity Watershed Management Department
- Jennifer Cottingham, Trinity Watershed Management Department
- Bert Vandenberg, City Attorney's Office
- Art Torres, Department of Water Utilities
- Rick Galceran, Public Works Department
- Alan Hendrix, Public Works Department
- Luis Tamayo, Sustainable Development and Construction Department
- Philip Erwin, Sustainable Development and Construction Department
- Kevin Lefebvre, Office of Environmental Quality
- Henry Nguyen, Public Works Department
- Keith Manoy, Public Works Department, Transportation Planning
- David Whitley, City Design Studio
- Bonnie Meeder, Real Estate
- Stefan Kesler, Public Works Department
- Lloyd Denman, Sustainable Development and Construction Department
- Peer Chacko, Sustainable Development and Construction Department
- Zaida Basora, Public Works Department, Facilities
- Phil Sikes, Sustainable Development and Construction Department
- Tanya Brooks, Public Works Department, Transportation Planning
- Suzanna Perea, EPA Region VI
- Christy Williams, EPA Contractor
- Brad Wardynski, EPA Contractor

Determination of Action Items

During the moderated discussion, participants discussed possible actions necessary to begin eliminating the key barriers. These actions were documented at the charrette and are summarized below in Tables 1–5. The tables include resources or reference documents that might be useful to the City when implementing the described action items.

Key Barrier No. 1 Green infrastructure elements are inconsistently or inadequately addressed in multiple guidance documents and portions of the Code

The group discussed this barrier at length. It was agreed that currently, the two drivers with the greatest potential to require, promote and support the implementation of green infrastructure are the Dallas Green Construction provisions (DGC) in the Dallas City Code and the local iSWM provisions. However, the group acknowledged confusion regarding when each driver would apply, when in the development process each driver would be addressed, and who would be charged with ensuring their respective requirements are addressed. The group indicated that if staff are unclear about the practical applications of the DGC and iSWM, this represented a clear barrier to developers implementing the provisions. The following inconsistencies were discussed, including those previously identified during the document review and others expressed during the charrette:

iSWM

- The iSWM local provisions currently are voluntary; however, the City’s MS4 permit indicates that the within one year of permit issuance the City is required to implement a comprehensive master planning process to develop, implement, and enforce controls to minimize the discharge of pollutants from areas of new development and significant redevelopment, after construction is completed, on all projects that disturb one acre or more of land, including projects less than one acre that are part of a larger common plan of development or sale that will results in the disturbance of one acre or more.²
- The iSWM local provisions indicate that iSWM only would apply to development projects of three acres or larger, whereas the MS4 permit requires that the post-construction controls must apply to one acre or larger.
- The City currently is not implementing the incentives described in the local provisions of the iSWM Manual.
- If iSWM provisions are required by the City in the future, the regulatory flexibility inherent to Planned Development Districts could allow developers to avoid implementing the provisions in those Districts.
- Language in the City Code currently does not specifically define, permit or encourage green infrastructure as a means of stormwater management. Although the City encourages voluntary implementation of the iSWM program, it is unclear as to whether many practices would be legal per specific requirements in the Dallas City Code (i.e., requirement for curb and gutter and subsurface storm sewers for stormwater conveyance).

DGC

- The DGC stormwater reuse and infiltration provisions (prescriptive requirements) included in Phase 2 for new residential construction are optional and would be available only to new residential proposed projects (of any size) to use in lieu of designing projects to LEED for Homes, ICC700, Green Built Texas or any equivalent green building standard.
- DGC stormwater reuse and infiltration provisions for new residential proposed projects included under an alternative compliance option (i.e. LEED for Homes, ICC700, GreenBuilt Texas) are optional and would be available only if the credits are pursued under any of the alternative standards.
- DGC stormwater reuse and infiltration provisions for new commercial proposed projects are optional and would be available only if the credits are pursued under any LEED for new construction rating system or other equivalent system or standard. No provisions are included in the Dallas Green Construction Code (Chapter 61)
- The DGC only applies to surface parking lots that are part of a new proposed project.

General

- The Development Guide currently does not include either iSWM or DGC development requirements. There is no other central location or resource for developers to get information about requirements pertaining to green infrastructure.
- Currently neither iSWM nor DGC are addressed during pre-development meetings.
- The types and locations of stormwater practices implemented per iSWM or the DGC are not being tracked currently.

² Per Texas Pollutant Discharge Elimination System (“TPDES”) Permit No. WQ0004396000 issued to the City in October 2011.

- Currently the DGC is separate from other parts of the Development Code, and iSWM is not codified. The group was unclear regarding how and where to codify iSWM and how to ensure consistency with existing stormwater-related regulations (i.e., drainage code, escarpment code) and the DGC.

Participants identified the actions necessary to initiate progress towards eliminating Key Barrier No. 1, as summarized in Table 1.

Table 1. Key Barrier No. 1 Action Items and Entities Responsible

Item No.	Action	Entities Collaborating/ Responsible^a
1A	Make the iSWM local provisions mandatory and compliant with the federal post-construction threshold of one acre or larger and the City’s MS4 permit.	TWM; iSWM TF
1B	Investigate either integrating the existing Green Building and iSWM Task Forces or reinvigorating the prior Green Task Force to develop streamlined approach to action items.	TWM; PW; GB/iSWM/Green TF
1C	Determine how/where to authorize the City to begin requiring the local provisions included in the iSWM Manual, i.e., in the DGC, in the drainage code, in a separate “green infrastructure code,” or in another code.	TWM; GB/iSWM/Green TF
1D	Better define iSWM and DGC requirements/options: <ul style="list-style-type: none"> • Post-construction requirements which apply to new development and redevelopment • Applicability thresholds – size, percent imperviousness, etc. • Surface parking lot requirements • Applicable post-construction BMP performance standards 	TWM; PW; GB/iSWM/Green TF
1E	Implement green infrastructure practice tracking system, either through the existing Building Department system or through another more appropriate system.	TWM; PW; SDC; GB/iSWM/Green TF
1F	Determine how to educate and inform the developing public about green infrastructure options early in the design process in the context of the DGC, iSWM and other requirements/incentives.	TWM; PW; GB/iSWM/Green TF

a. TWM: Trinity Watershed Management Department; PW: Public Works Department; SDC: Sustainable Development and Construction Department; iSWM TF: iSWM Task Force; GB TF: Green Building Task Force

Resources to Address Key Barrier No. 1

NCTCOG iSWM Program Guidance

http://iswm.nctcog.org/program_guidance.asp

Supporting documentation for the iSWM program discusses strategies for adoption and implementation of iSWM. Included in the guidance is an example iSWM ordinance that could be used as a template by Dallas for addressing Action Item 1A.

City of Houston Storm Water Quality Permit, Code of Ordinances (Ch. 47, Article XII)

<http://library.municode.com/index.aspx?clientId=10123>

The City of Houston has adopted a water quality permit process for new development and redevelopment that could serve as example regulatory framework for addressing the action items associated with Key Barrier 1. Specifically, Chapter 47, Article XII, provides example ordinance language associated with the requirement of post-construction stormwater controls and addresses maintenance responsibilities.

City of Austin Environmental Criteria Manual

<http://austintexas.gov/department/stormwater-management>

Austin's development code cross-references the *Environmental Criteria Manual*, which provides a central resource for environmental rules and regulations. By incorporating stormwater management rules into a manual (instead of code), the document can be amended easily to maintain consistency and be updated continually on the basis of the current state of the science. This document also provides example language defining post-construction performance standards.

San Antonio Unified Development Code

<http://www.sanantonio.gov/dsd/udc.asp>

Although green infrastructure is not mandated by San Antonio's Unified Development Code, the City clearly states in Article V, Section 35-504, that it "encourages the installation of low impact development (LID) features such as engineered swales, engineered infiltration storm sewer systems, bioretention, and engineered wetlands." This promotional language is an example of how municipalities can show the development community that green infrastructure is an explicitly encouraged option.

Town of Huntersville, NC, LID Ordinance

<ftp://ftp1.co.mecklenburg.nc.us/WaterQuality/PCO%20Ordinances/Huntersville%20Post-Construction%20Ordinance%20FINAL.pdf>

A dedicated LID ordinance is another method to consolidate green infrastructure recommendations and regulations into one central document. The Town of Huntersville adopted a water quality ordinance that specifically promotes and defines green infrastructure practices and stormwater management requirements. The ordinance refers to an external water quality design manual for specific guidance.

Key Barrier No. 2 The Code currently inhibits effective land utilization to achieve multiple benefits

Many of the challenges and action items identified in the discussion of Key Barrier No. 1 apply to this barrier as well. The group also discussed the revisions to the Landscape and Tree Preservation Ordinance proposed by the Urban Forestry Advisory Committee and the Sustainable Development and Construction Department and how those changes could help address Key Barrier No. 2 by allowing green infrastructure practices to count towards landscaping requirements. Finally, the group discussed the current draft of the *Complete Streets Design Manual* and how it could be revised to be more supportive of green infrastructure.

Participants identified actions necessary to initiate progress towards eliminating Key Barrier No. 2, as summarized in Table 2.

Table 2. Key Barrier No. 2 Action Items and Entities Responsible

Item No.	Action	Entities Collaborating/ Responsible^a
2A	Update and implement Landscape and Tree Preservation Ordinance with proposed revisions by Urban Forestry Advisory Committee.	TWM; DEV; Urban Forestry Advisory Committee
2B	Incorporate additional language supportive of green infrastructure in the right-of-way throughout the Complete Streets Design Manual.	DEV

a. TWM: Trinity Watershed Management Department; DEV: Sustainable Development and Construction

Resource to Address Key Barrier No. 2

Arlington, Texas, LID Manual

<http://texaslid.org/pdfs/Arlington%20LID%20Guidance%20Manual.pdf>

The Arlington LID Manual provides regional guidance concerning green infrastructure implementation. Specific recommendations provided in this document, as well as in the iSWM program, should be considered when addressing Action Item 2B.

Key Barrier No. 3 The Code lacks incentives to promote green infrastructure

As previously noted, the City does not currently implement the incentives described in the local provisions of the iSWM Manual. Although the Sustainable Development and Construction Department is beginning to map imperviousness, site imperviousness is not a factor when calculating utility fees. The City is using digitized maps of imperviousness to support a utility fee study.

Participants identified the actions necessary to initiate progress towards eliminating Key Barrier No. 3, as summarized in Table 3.

Table 3. Key Barrier No. 3 Action Items and Entities Responsible

Item No.	Action	Entities Collaborating/ Responsible^a
3A	Include assessment of viability of green infrastructure incentives in currently planned utility fee study.	TWM
3B	Explore off-site mitigation (other than the optional pollution prevention provision in iSWM) and fee-in-lieu options as additional incentives.	TWM
3C	Explore implications of implementing a “Green Tape” plan review process that could incentivize green infrastructure implementation.	TWM; DEV

a. TWM: Trinity Watershed Management Department; DEV: Sustainable Development and Construction

Key Barrier No. 4 Current post-construction performance standards could be amended to further promote the goals of green infrastructure

The group discussed this barrier with regard to how post-construction performance standards might inhibit or deter development in the City if they were more stringent than those of the surrounding municipalities (i.e. water-quality based, retention, infiltration). The EPA representatives indicated that current Phase II NPDES MS4 requirements and potential requirements of the new post-construction federal rulemaking make it unlikely that surrounding localities have or will continue to have less stringent or prescriptive requirements.

As noted in the discussion of Key Barrier No. 1, staff participating in the charrette agreed to work toward making the iSWM local provisions mandatory and compliant with the federal post-construction threshold of one acre or larger and the City’s MS4 permit. The iSWM provisions include post-construction performance standards. In addition, participants developed and agreed upon the actions necessary to initiate progress towards eliminating Key Barrier No. 4, as summarized in Table 4.

Table 4. Key Barrier No. 4 Action Items and Entities Responsible

Item No.	Action	Entities Collaborating/ Responsible ^a
4A	Consider the development of a retention standard and address the following associated questions: <ul style="list-style-type: none"> • What would the standard be? • What would the threshold be? • Would infiltration be a required or optional site design practice in iSWM? • How would this standard relate to optional infiltration requirements in the DGC? • Where would the requirement or option be codified or described? 	TWM; GB/iSWM TF/Green TF; DEV
4B	Determine a process to ensure that public projects implement all required standards as well as applicable voluntary standards to serve as an example to the private development community and provide explicit examples of green infrastructure cost-effectiveness.	TWM; PW; PARKS ^b

- a. TWM: Trinity Watershed Management Department; GB TF: Green Building Task Force; iSWM TF: iSWM Task Force; PW: Public Works Department; DEV: Sustainable Development and Construction; PARKS: Park and Recreation Department
- b. PARKS was not represented at the charrette however, their participation has been assumed for this action item per direction from City staff

Resources to Address Key Barrier No. 4

USEPA NPDES Proposed National Rulemaking Considerations

<http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm>

EPA is involved currently in a national rulemaking process that will affect post-construction stormwater management. Municipalities nationwide are planning ahead for pending rules by adopting post-construction performance standards intended to mitigate urban hydrology to predevelopment conditions. These standards tend to consist of on-site retention and/or reuse of runoff associated with a certain percentile storm event. When addressing Action Item 4a and 4B, consideration should be given to national rulemaking activities that may impact regulated municipalities as early as 2014.

Harris County Low Impact Development and Green Infrastructure Design Criteria for Storm Water Management

http://www.hcfcd.org/dl_dcmanual.html

Although guidance in the Harris County LID manual is not required currently for conventional development, it is required when developers choose to implement an LID approach for site development. This document provides a Texas-specific example of post-construction water quality standards and area thresholds (e.g., treatment of the first inch of runoff for all sites greater than 1 acre).

Austin Watershed Protection Draft Ordinance

<http://austintexas.gov/page/watershed-protection-ordinance-0>

The draft Watershed Protection Ordinance for the City of Austin was developed “to improve creek and floodplain protection; prevent unsustainable public expense on drainage systems; simplify development regulations where possible; and minimize the impact on the ability to develop land.” As such, it is an example of how stormwater-related code language can be consolidated in a single location. This ordinance defines post-construction standards and refers to the *Environmental Criteria Manual* for guidance.

Key Barrier No. 5 Neither maintenance agreements nor inspection requirements currently apply to green infrastructure measures

Currently the City does not track the location or condition of green infrastructure practices. Further, the City does not inspect nor require the inspection of private practices. Charrette participants discussed exploring other cities’ requirements for private sector tracking, maintenance and inspection of green infrastructure BMPs. Staff also indicated that field staff were not adequately trained to recognize green infrastructure practices or know what maintenance was required.

Participants identified actions necessary to initiate progress towards eliminating Key Barrier No. 5, as summarized in Table 5.

Table 5. Key Barrier No. 5 Action Items and Entities Responsible

Item No.	Action	Entities Collaborating/ Responsible^a
5A	Implement practice-specific tracking system either into existing data tracking or with new system.	TWM; SDC
5B	Develop template for maintenance agreement.	TWM; SDC
5C	Develop checklist(s) for green infrastructure practice maintenance requirements for common BMPs to be given to practice owners.	TWM; SDC
5D	Explore other cities’ requirements for tracking, maintenance and inspection of BMPs.	TWM

a. TWM: Trinity Watershed Management Department; DEV: Sustainable Development and Construction Department

Resources to Address Key Barrier No. 5

City of San Diego Capital Improvement Projects Tracking System

<http://maps.sandiego.gov/cpm/default.aspx>

The City of San Diego tracks green infrastructure projects using a spatial database. This is an example of a tracking system that could be adopted to address action item 5A.

North Carolina Dept. of Environment and Natural Resources, Example BMP O&M Agreement

http://portal.ncdenr.org/c/document_library/get_file?uuid=7d81643b-b427-4d1c-9d57-4081d974f7a3&groupId=38364

This example operation and maintenance agreement can be used to address Action Items 5B and 5C.

Southeast Michigan Council of Governments LID Manual, Example Stormwater Management Practices Maintenance Agreement

<http://www.swmpc.org/downloads/lidmanual.pdf>

This example operation and maintenance agreement can be used to address Action Item 5B and 5C.

City of Philadelphia Water Department Green Stormwater Infrastructure Project Map

<http://phillywatersheds.org/biggreenmap>

Similar to San Diego, Philadelphia tracks green infrastructure projects spatially to raise public awareness and organize maintenance efforts.

City of Philadelphia Water Department Green Infrastructure Maintenance Manual Development Process Plan

<http://phillywatersheds.org/litcpu/Green%20Infrastructure%20Maintenance%20Manual%20Development%20Process%20Plan.pdf>

The process by which Philadelphia developed their green infrastructure maintenance manual provides an example framework for Dallas to address action items associated with Key Barrier 5.

Texas A&M AgriLife Extension & Research Center at Dallas—Recent trainings by field experts on bioretention and permeable pavement

<http://dallas.tamu.edu/>

The local Texas A&M extension staff hosted workshops with field experts on stormwater BMP design and maintenance. The workshops present an opportunity to encourage city maintenance staff and local engineers to learn the basics of BMP function, operation, and maintenance. Other universities and entities nationwide host similar trainings and certification programs, which could be used when addressing Action Item 5C to foster communication between the City of Dallas and other municipalities currently maintaining green infrastructure practices.

City of Bellvue Washington Public and Private BMP Maintenance Checklist

http://www.scvrppp-w2k.com/bmp_om_forms.htm

The City provides checklists and tables of maintenance requirements for private and public BMP maintenance.

King County, WA Maintenance Checklist and Tips for Inspection

<http://www.kinDGCounty.gov/environment/waterandland/stormwater/documents/drainage-maintenance-standards/checklist.aspx>

University of New Hampshire Stormwater Center Maintenance Fact Sheets and Checklists

<http://www.unh.edu/unhsc/specs-and-fact-sheets-0>

The Stormwater Center provides fact sheets regarding the design and specification of various BMPs in addition to checklists for use during maintenance.

Harris County Stormwater Quality Inspections Program

http://hcpid.org/permits/swqinsp_welcome.html

The Compliance & Environmental Inspectors Group of Harris County's Architecture and Engineering include a team of storm water inspectors who enforce the Texas Commission on Environmental Quality Construction General Permit and Harris County regulations as they relate to Post Construction and Stormwater Discharges Associated with Construction Activities.

Key Barrier No. 6 City does not allow for alternative measures or off-site mitigation of stormwater impacts when on-site is infeasible

Participants developed and agreed upon the actions necessary to initiate progress towards eliminating Key Barrier No. 6 by implementing action items 3B and 3C discussed under Key Barrier No. 3, namely that the City would explore both a fee-in-lieu program and additional off-site mitigation opportunities.

Resources to Address Key Barrier No. 6

EPA Study: Reducing Stormwater Costs through Low Impact Development Strategies and Practices

http://water.epa.gov/polwaste/green/costs07_index.cfm

This report provides information to cities, counties, states, private-sector developers and others on the costs and benefits of using Low Impact Development (LID) strategies and practices to help protect and restore water quality. LID practices are innovative practices that manage stormwater close to its source by mimicking a site's predevelopment hydrology and use design techniques that infiltrate, evapotranspire, and reuse runoff. LID practices are increasingly being used by communities across the country to help protect and restore water quality. This report provides information on the cost savings and benefits that can be achieved by implementing LID practices versus conventional stormwater practices.

Banking on Green: How Green Infrastructure Saves Municipalities Money and Provides Economic Benefits Community-wide

<http://www.asla.org/ContentDetail.aspx?id=31301>

This report looks at the most cost-effective options for managing polluted runoff and protecting clean water, and finds that green infrastructure solutions save taxpayer money and provide community benefits by managing stormwater where it falls.

Conclusions

The City of Dallas recognizes the importance of Green Infrastructure in addressing stormwater management as well as other key issues for the City, such as conserving and protecting the water supply and open space, creating more shade for bikeable and walkable streets, improving air quality, and reducing the urban heat index. Further, the City's MS4 Permit, along with the environmental and economic benefits of green infrastructure, drives the commitment to these alternative stormwater management techniques.

As discussed at the charrette, the City is undertaking many activities to support Green Infrastructure. For example:

- The Green Building Code requires the consideration of infiltration practices on certain types of development projects and protects greenfields.
- The City's Comprehensive Plan, forwardDallas!, includes and supports most of the recognized green infrastructure goals and principles.
- Article X of the Development Code (Landscape and Tree Preservation Ordinance) and the revisions recommended by the Urban Forestry Advisory Committee include many recommended tree protections and planting requirements that support green infrastructure goals.
- The proposed system of awarding credit for Integrated Site Design Practices (LID; Option 1 of iSWM program) is in line with goals of green infrastructure implementation and allows more flexibility to developers. This is rarely credited to this level of detail (despite low impact site design accomplishing the same goals as installing structural BMPs).
- Enhanced swale guidance serves as a great multi-benefit practice for the conditions in Dallas (e.g., fits into right-of-ways and can be used for both conveyance and treatment).
- The City's Thoroughfare Plan and Bike Plan support alternative forms of transportation, which could reduce the demand for roadway infrastructure.
- The City was one of the sponsors of the LID Design Competition, which demonstrates an interest in and commitment to green infrastructure principles.

However, the review process and charrette revealed several key barriers to green infrastructure implementation. Green infrastructure elements are inconsistently or inadequately addressed in multiple guidance documents and portions of the Code and the Code currently inhibits effective land utilization to achieve multiple benefits and lacks of incentives to promote green infrastructure. In addition, current post-construction performance standards could be amended to further promote the goals of green infrastructure. Finally, neither maintenance agreements nor inspection requirements currently apply to green infrastructure measures and the City does not allow for alternative measures or off-site mitigation of stormwater impacts when on-site is infeasible.

During the charrette, City staff considered each barrier and developed multiple action items designed to eliminate the barrier. Generally, the action items involved implementing currently voluntary stormwater requirements and clarifying sometimes seemingly contradictory requirements amongst key codes. City staff indicated that better communication and coordination was necessary amongst departments and that green infrastructure should be considered earlier in the development process. Staff also indicated that updating the post-construction standard may be appropriate to include a retention standard or to reduce existing applicability thresholds. Several guidance documents need to be updated to better clarify and consolidate green infrastructure requirements and existing and

potentially new incentives for implementation of green infrastructure needs to be better advertised to the developing public. Finally, City staff indicated that new tools to ensure that existing and newly installed green infrastructure practices are operated and maintained properly are necessary.

As is clear from the process conducted at the charrette and the thoughtful action items that resulted, the City is on the path to remove many of the key barriers that currently exist in the Dallas codes, ordinances and guidance documents. These actions, once completed, can result in a greater level of green infrastructure implementation in the future.