



RIVERS & ROADS

**Opportunities to Better
Integrate Green Infrastructure
and Transportation Projects
in Atlanta, GA and Toledo, OH**



American Rivers
Rivers Connect Us®

ABOUT AMERICAN RIVERS

American Rivers is the leading organization working to protect and restore the nation's rivers and streams. Rivers connect us to each other, nature, and future generations. Since 1973, American Rivers has fought to preserve these connections, helping protect and restore more than 150,000 miles of rivers through advocacy efforts, on-the-ground projects, and the annual release of America's Most Endangered Rivers®.

ACKNOWLEDGEMENTS

Written by Stacey Detwiler

Copyright August 2015 © American Rivers ©

This report was made possible by funding from the Surdna Foundation, Joyce Foundation and Mott Foundation.

I would like to thank Katherine Baer, Katie Mika, Jeff Odefey, Katie Rousseau, Jenny Hoffner, Ben Emanuel, and Gary Belan for their assistance, input, and review. Additionally, I would like to thank Janet Attarian, Tory Syracuse, Linda Dobson, Maureen Meehan, Nette Compton, Lacy Shelby, Tim Murphy, Susan Rutherford, Jessica Lavandier, Julie Owens, Larry Schaffner, Mark Mauer, and Susan McLaughlin for their assistance and contributions to this report.

The author is responsible for any factual errors. The recommendations are those of American Rivers and the views expressed in this report are those of the author and do not necessarily reflect the views of our funders or those who provided review.

Cover Photo: American Society of Landscape Architects

RIVERS & ROADS

Opportunities to Better Integrate
Transportation Projects and Green Infrastructure
in Atlanta, GA and Toledo, OH

TABLE OF CONTENTS

Executive Summary	5
Key Recommendations to Better Integrate Green Infrastructure into Transportation Projects	6
Key Recommendations for Toledo, Ohio	9
Key Recommendations for Atlanta, Georgia	11
Chapter 1: Introduction	14
The Impact of Polluted Runoff from Roads and Highways	14
Post-Construction Stormwater Management on Roads and Highways	16
Transportation Planning and Stormwater Management	17
Transportation Planning Structure	17
Transportation Planning Process	18
Capital Improvement Planning for Transportation Projects and Stormwater Management	18
Green Infrastructure on Roads and Highways	19
Chapter 2: Planning and Project Development Recommendations for Regional, State, and Local Transportation Agencies	22
Planning	22
Project Development	26
Chapter 3: Funding	33
Paying for Stormwater Management	33
Paying for Stormwater Management from Transportation Projects	34
Recommendation	35

Chapter 4: Toledo, Ohio Case Study	43
Toledo, Ohio	43
Transportation Planning	43
Stormwater Management for Roads and Highways	45
Recommendations for Ohio Department of Transportation and TMACOG	46
Planning	46
Project Development	47
Recommendations for the City of Toledo	48
Planning	48
Project Development	48
Funding	50
Chapter 5: Atlanta, Georgia Case Study	53
Atlanta, Georgia	
Transportation Planning	55
Stormwater Management for Roads and Highways	56
Recommendations for Georgia Department of Transportation and the Atlanta Regional Commission (ARC)	58
Planning	58
Project Development	60
Recommendations for the City of Atlanta	64
Planning	64
Project Development”	64
Funding	65
Chapter 6: Conclusions	67
Appendix A	69
Federal Laws and Regulations that Impact Stormwater Management in Transportation Project Development	
Appendix B	77
Transportation Planning Structure and Process	
Endnotes	80

RIVERS & ROADS

Opportunities to Better Integrate Transportation Projects and Green Infrastructure in Atlanta, GA and Toledo, OH

Executive Summary

When rainwater hits hard surfaces like roads and parking lots, it can't soak into the ground and instead runs along the surface until it flows into a storm drain or into a local river or stream. Known as stormwater runoff, this water can pick up pollutants such as heavy metals, brake linings, and deicing salts which contaminate local waters. Additionally, high volumes of stormwater can exacerbate localized flooding posing a threat to public health and safety. In older urban areas with combined sewer systems, high volumes of stormwater runoff can overwhelm the capacity of the system and result in combined sewer overflows (CSOs) which send untreated sewage and stormwater into rivers and streams.

While polluted stormwater runoff can occur wherever there are surfaces impervious to water, highways and roads are a significant source. Across the United States, there are approximately 4 million miles of publicly owned roads, including federal-aid highways and other state or locally-owned roads.¹ Traditional stormwater management has included practices such as detention ponds that can manage volume but don't necessarily provide water quality benefits. As a result, many local governments are shifting towards the use of cost-effective green in-

frastructure practices that capture and treat rainwater where it falls while often providing additional benefits such as reduced urban heat island effect and flooding. Green infrastructure can be defined as an approach to wet weather management that uses vegetation, soils, natural systems, or engineered systems that mimic natural processes to infiltrate, evapotranspire, or recycle stormwater runoff. For the purposes of this report, green infrastructure used on roads and highways includes natural dispersion where stormwater runoff is directed into a naturally vegetated area; bioinfiltration techniques that utilize vegetation to capture and filter out pollutants from stormwater are considered green infrastructure practices for roads and highways such as grass buffers, vegetated filter strips, bioinfiltration swales, conserving or planting vegetation, or media filter drains; and infiltration practices such as infiltration trenches and permeable pavements, with limited application on highways, that may be incorporated into transportation projects.²

This report evaluates opportunities to better integrate green infrastructure for post-construction stormwater management into transportation projects, focusing specifically on roads and highways. The report summarizes transportation planning and struc-

ture, capital improvement planning, and the role of stormwater management in these processes. It examines the role of the Clean Water Act and other regulatory drivers for stormwater management on roads and highways and highlights case studies from across the country to identify best practices in integrating green infrastructure at the transportation planning and project development stages. The report also provides recommendations to fund green infrastructure on roads and highways. Although the overall focus is primarily on the federal con-

text, the report provides two case studies in Toledo, Ohio and Atlanta, Georgia and develops specific recommendations for both the state Departments of Transportation (DOTs) and the cities themselves to better integrate green infrastructure into transportation projects. Both cities are moving forward with green infrastructure planning and these recommendations can provide additional resources as they address specific opportunities and challenges related to transportation.

Key Recommendations to Better Integrate Green Infrastructure into Transportation Projects

According to the Federal Highway Administration (FHWA), there are six stages of a transportation project: 1) visioning and policy, 2) long-range planning and programming, 3) environmental studies and preliminary design, 4) final design and right-of-way, 5) construction, and 6) operations and maintenance. The following recommendations for integrating green infrastructure are limited to the first three phases in the life of a transportation project which can be broadly considered as the project planning and project development stages.³ Additionally, recommendations are made to address funding needs and challenges.

Planning

1. Require use of a Context Sensitive Solutions (CSS) planning process. Departments of Transportation and other transportation agencies should require the use of a CSS process which establishes a structure to consider the environmental impacts of a transportation project. One of the core principles of CSS is to use

flexibility and creativity to preserve and enhance community and natural environments, which supports the overall goal of green infrastructure to use natural or engineered systems that mimic natural systems to capture and filter rainwater, reducing stormwater runoff to protect water quality.⁴

2. Implement Green Highways Watershed approach. Building upon a CSS policy, transportation agencies should implement a Green Highways Watershed Approach that uses six principles to require greater collaboration across diverse departments and interests to address stormwater management.

3. Prioritize green infrastructure within Long-Range Statewide Transportation Plans (LRSTP) and Long-Range Transportation Plans (LRTP): State DOTs and Metropolitan Planning Organizations (MPOs) should incorporate strategies and goals into their long-term planning that prioritizes water quality and watershed planning. Establishing stormwater man-

agement as a priority in broader planning processes is critical to implementing more green infrastructure into near-term projects.

4. Prioritize green infrastructure in transportation projects through capital improvement planning processes. The capital improvement planning process offers an important pathway to prioritize green infrastructure for roads and highways. Asset management practices for different departments should be standardized or developed so that they are easily integrated into a city-wide analysis for capital projects. Additionally, local governments should revise planning processes to ensure that opportunities to address stormwater management needs are considered in capital projects. They should also consider establishing criteria to prioritize transportation capital projects that include green infrastructure. At the broadest scale, local governments should establish a capital planning process that requires consideration of sustainable, green infrastructure elements following the example of cities like Seattle, Washington and its Sustainable Infrastructure Initiative.

Project Development

1. Revise stormwater permits. To encourage the use of green infrastructure on roads and highways, stormwater permits for state DOTs and municipalities should be revised to include at least one of the following: objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area.

2. Adopt or revise design manuals and design standards. Currently, many stormwater permits are written with narrative requirements to comply with the state's or transportation agency's stormwater technical manual. This can introduce additional uncertainty if requirements are not clearly stated in the permit itself. To better integrate green infrastructure on roads and highways, technical manuals and design standards should be revised to support permit revisions that encourage green infrastructure.

3. Implement Green Streets policies. Across the country, some local governments have established green street policies and programs to encourage the integration of forward-thinking green infrastructure stormwater management in road and street projects. These can vary in scope and scale, but typically set criteria or requirements that encourage the use of green infrastructure in city street projects.

Funding

1. Implement a stormwater utility. When stormwater management is funded through general funds, stormwater priorities are forced to compete for limited dollars against a number of other critical municipal services from police departments to schools. A stormwater utility is similar to a designated water or sewer fee. It establishes a user or service fee based on impact to cover the costs to the municipality of managing stormwater runoff. Stormwater utilities began emerging in the 1970s and as of 2012 there were more than 1,000 stormwater utilities across the country.^{5,6} Local governments should consider implementing a stormwater utility to establish a dedicated revenue stream for stormwater management, including green infrastructure.



PHOTO: Jessie Thomas-Blate

Permeable pavement from OhioPyle project in PA.

- 2. Integrate into capital improvement planning processes.** Either in combination with a stormwater utility fee or alone, municipalities should consider integrating green infrastructure elements into planned capital improvement projects. Cost savings can be found by adding in green infrastructure practices to planned projects. For example, a city could add in bioswales or permeable pavement elements into a planned street reconstruction project and potentially make the project eligible for more diverse funding streams while at the same time creating multiple benefits such as reducing stormwater runoff or mitigating local flooding.
- 3. Evaluate alternative financing mechanisms.** Municipalities should evaluate alternative financing mechanisms, such as business improvement districts or tax increment financing, to provide funding for integrating green infrastructure into transportation projects.

- 4. Explore grant opportunities.** There are a number of different state and federal grant opportunities that municipalities and transportation agencies can pursue to fund transportation projects that incorporate green infrastructure. Grant funding can be used to fully fund a project or to provide match. Examples of grant opportunities include the Transportation Investment Generating Economic Recovery (TIGER) which contains specific language on green infrastructure. Included in the environmental sustainability criterion in the most recent funding cycle, the Transportation Alternatives Program (TAP) under the surface transportation authorizing legislation, Urban Forestry Grants, Community Development Block Grants, and the Metropolitan Planning Program and State Planning and Research Program.

Key Recommendations for Toledo, Ohio

Based on these broad recommendations, the report examines the case of Toledo, Ohio and provides more specific recommendations at the state, regional, and local levels.

Recommendations for Ohio Department of Transportation (ODOT) and the Toledo Metropolitan Area Council of Governments (TMACOG):

- 1. Establish a Context Sensitive Solutions policy** to build upon ODOT's Aesthetic Design Initiative.⁷ Aesthetics and consideration of how transportation projects fit into the existing environment is an important element of CSS policies. However, this could be strengthened to further support consideration of the impact of transportation projects on water quality and quantity.
- 2. ODOT should consider implementing a Green Highways Watershed Approach** to better integrate the use of green infrastructure on road and highway projects to manage stormwater runoff. Even if ODOT does not establish a formalized policy, the department could implement different aspects of this overall approach. For example, ODOT could develop partnerships with local governments, natural resource agencies, and other stakeholders to develop a stormwater management plan that takes into account watershed-wide priorities or ensure that stormwater management is prioritized in the NEPA process.⁸
- 3. Prioritize stormwater management needs and projects that utilize green infrastructure in Long Range Transportation Plans** by strengthening ODOT's draft plan, Access Ohio 2040. The draft plan should be revised to encourage upfront analysis and implementation of green infrastructure practices to improve resiliency and reduce localized flooding.⁹ TMACOG should similarly revise its draft 2014-2045 Transportation Plan to better prioritize green infrastructure in its long-range planning process.
- 4. ODOT should update its MS4 permit and design manual.** To prioritize the use of green infrastructure BMPs, ODOT's permit should be revised to include objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area. Additionally, even if the permit is not revised, the *Location and Design Manual: Volume Two Drainage Design* manual should be updated to provide more information about green infrastructure and expand eligible BMPs, including practices such as permeable pavement.
- 5. TMACOG should revise its Complete Streets Policy, adopted in March 2014, to include green infrastructure.** Under this policy, TMACOG will promote the use of complete streets and recommend adoption of a consistent complete streets policy by the state and by local governments. TMACOG should consider including green street elements into this existing policy or adopt a complimentary Green Streets Policy. Requiring that projects meet a Green Streets policy will ensure that more transportation projects incorporate green infrastructure to manage stormwater runoff.

Recommendations for the City of Toledo:

1. Update the capital improvement planning process to include evaluation of stormwater management needs.

Although the City takes into account the need for water and sewer line replacement, it does not currently include stormwater management needs in its capital improvement planning process. The City should add additional criteria to evaluate stormwater needs to better leverage funds to implement green infrastructure rather than constructing stand-alone projects.

2. The City should update its MS4 permit,

which currently does not include specific language that supports or prioritizes green infrastructure.¹⁰ The current permit expires July 31, 2015 and the City should consider opportunities to include objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area, the recommendations of the Green Infrastructure Task Force, and the potential to include specific milestones and metrics in the permit draft.

3. Revise the existing design manual.

Under the *Infrastructure Design and Construction Requirements Manual* which provides design and construction requirements for roadways, stormwater management, sanitary sewers, and water distribution facilities within the City of Toledo, “linear construction projects (e.g. pipeline or utility line installation), which do not result in the installation of additional impervious surface, are not required to include post-construction BMPs.”¹¹ Where post-construction requirements are triggered, the design typically follows the ODOT “Location and Design (L&D)

Manual,” which highlights the importance of revising the L&D manual to include additional technical information about green infrastructure.¹² The City should consider adjusting this standard under the *Infrastructure Design and Construction Requirements Manual* to more comprehensively apply post-construction management practices to road projects.

4. Toledo should revise its Complete Streets Policy to include Green Streets elements.

The City should consider amending its existing Complete Streets Policy, which was adopted in 2010, to strengthen criteria that encourage the use of green infrastructure. Revising the goal of the policy to include “promoting environmental sustainability” or similar language could be a first step to strengthening it to better encourage green infrastructure. As a next step, the City should consider incorporating green elements into its Complete Streets policy following the model of La Crosse, Wisconsin or Cleveland, Ohio. Alternatively, Toledo could consider adopting a separate Green Streets Policy, following the model of cities like New York, NY, Portland, OR or Tucson, AZ.

5. Strengthen the existing stormwater credit program to better incentivize green infrastructure.

Toledo adopted a stormwater utility fee in 1999 and a stormwater credit program in 2001. The City should consider recommendations developed by the University of Michigan to streamline credit categories into quantity and quality, create priority zones, and divide the existing fee into a fixed fee to cover administrative and maintenance costs and a property fee based on the amount of impervious surface on the property to cover the costs of stormwater management. Building on these suggested changes, the City of Toledo should consider opportunities to prioritize green

infrastructure as an eligible practice under the stormwater credit program following models such as the City of Syracuse, New York which created a Green Improvement Fund which provides financial incentives to installing green infrastructure practices in high priority areas throughout the city.

6. Evaluate alternative financing mechanisms and grant opportunities. The City should consider additional financing mechanisms, such as Business Improvement Districts (BIDs), tax increment financing, and other grant opportunities to provide additional sources of funding to better integrate green infrastructure into transportation projects.

Key Recommendations for Atlanta, Georgia

In addition to Toledo, Ohio, the report examines the case of Atlanta, Georgia and provides the following recommendations at the state, regional, and local levels.

Recommendations for Georgia Department of Transportation (GDOT) and the Atlanta Regional Commission (ARC)

1. GDOT should strengthen its existing Context Sensitive Solutions policy to better prioritize stormwater management and the use of green infrastructure specifically by incorporating elements of the Green Highways Watershed Approach.

2. Prioritize stormwater management needs and projects that utilize green infrastructure in Long Range Transportation Plans. Neither PLAN 2040 developed by the Atlanta Regional Commission (ARC) nor the Statewide Transportation Plan (SWTP) developed by GDOT substantively address stormwater management for transportation projects. At the minimum, these long range transportation plans should be revised to forecast challenges and needs not just to water supply, but also to water quality that may impact transportation planning. Additionally, GDOT and the ARC should

establish goals and strategies that prioritize water quality and watershed planning. The Unified Planning Work Program (UPWP) developed annually by the ARC is used to coordinate transportation planning activities across the region. This plan should be updated to include watershed planning or studies related to water supply or water quality impacts from transportation projects. It could include any ongoing or planned studies regarding the use of green infrastructure on roads and highways.

3. Strengthen GDOT MS4 permit to prioritize green infrastructure. GDOT's current MS4 permit includes a provision that encourages the use of green infrastructure on both new and redeveloped sites and requires GDOT to "review all projects during the design phase to ensure the plans consider the use of green infrastructure practices, including infiltration, reuse, and evapotranspiration." Additionally, the permit requires GDOT to, at the minimum, develop a program to conduct a green infrastructure feasibility study and to implement green infrastructure where feasible.¹³ This is a critical first step towards encouraging greater implementation of green infrastructure in transportation projects. However, GDOT's permit could be further strengthened by

prioritizing green infrastructure, following models such as the California Department of Transportation (Caltrans) MS4 permit which requires that post-construction stormwater management best practices be designed to first prioritize infiltration, harvest, re-use, and/or evapotranspiration of stormwater runoff and second, capturing and treating stormwater runoff.¹⁴ Other alternatives include establishing objective numeric performance standards to mimic pre-development hydrology and setting a limit or ceiling on the amount of effective impervious area.

4. Enhance the GDOT Drainage Manual.

As part of its effort to promote GI/LID practices under its MS4 permit, in October 2014 GDOT released a revised version of its Manual on Drainage Design for Highways, with a chapter (Chapter 10) devoted to post-construction stormwater design guidelines. For applicable projects as defined within the chapter (section 10.2), the manual requires consideration of green infrastructure or low impact development (LID) practices. This is in keeping with the current approach in Georgia's Blue Book, and GDOT's manual should be updated in the future to reflect updates to the Blue Book that are expected to further promote and guide the implementation of green infrastructure. The new drainage manual should be updated to reflect the most recent information regarding the effectiveness and applicability of appropriate green infrastructure technologies for roads and highways. The selection process for best management practices should be amended to prioritize and require consideration of green infrastructure first, and then where it is infeasible, allow for alternative practices.

5. Update the GDOT Complete Streets Policy to include green infrastructure.

Although the Complete Streets policy

improves pedestrian and bicycle safety and access to public transportation, it does little to incorporate environmental impacts or considerations. The existing Complete Streets policy offers an opportunity to better prioritize green infrastructure by establishing similar requirements and guidelines that promote stormwater management practices that use infiltration, evapotranspiration, harvesting, or re-use. GDOT should either revise its Complete Streets policy to include green street elements or adopt a complementary Green Streets policy.

Recommendations for the City of Atlanta

- 1. Update the capital improvement planning process to include an evaluation of green infrastructure opportunities.** In its capital improvement planning process, the City should identify opportunities to incorporate stormwater management, and specifically green infrastructure, into planned transportation projects as appropriate. For example, Atlanta should add criteria to evaluate stormwater needs in order to better leverage funds and leverage multiple benefits from a single infrastructure investment.
- 2. Update Atlanta's MS4 permit to better prioritize green infrastructure.** Similar to the GDOT MS4 permit, the City's MS4 permit includes a provision that EPD encourages the use of green infrastructure for post-construction stormwater management on new and redeveloped sites and requires the City to review and revise ordinances and other regulations to ensure that they do not limit or prohibit the use of green infrastructure.¹⁵ The Atlanta permit requires the City to have a program in place for considering the use of green infrastructure and developing an inventory of privately and publicly owned practices and must include



PHOTO: City of Atlanta Dept of Watershed Management

Bioretention cul-de-sac

an inspection and maintenance component.¹⁶ The Atlanta MS4 permit could be further strengthened by establishing objective numeric performance standards to mimic pre-development hydrology and setting a limit or ceiling on the amount of effective impervious area.

3. Atlanta should adopt a Green Streets or Green Complete Streets policy. The City of Atlanta should consider adopting a Green Streets Policy or follow the model of GDOT and adopt a Green Complete Streets Policy, with the addition of stormwater management requirements and guidelines that prioritize the use of green infrastructure. Establishing a Green Streets Policy would be in line with the City's post-construction stormwater management ordinance and permit requirements to encourage the use of green infrastructure for new and redeveloped sites.

4. Implement a stormwater utility.

Although the City implemented a stormwater utility in 1999, it was not appropriately structured and was struck

down by the courts. Since this time, many other stormwater utilities have emerged across Georgia. In fact, 44 utilities are represented in a "dashboard" published by the University of North Carolina Environmental Finance Center.¹⁷ Four years later, the Columbia County stormwater utility was the second to be challenged in court in 2003, but this time was found to be a fee and was upheld unanimously by the Georgia Supreme Court.¹⁸ Although there are significant challenges to implementation, the City should consider implementing a stormwater utility to provide funding for stormwater management, including increased utilization of green infrastructure across the City.

5. Atlanta should evaluate alternative financing mechanisms and grant opportunities. In addition to evaluating the structure and implementation of a stormwater utility, the City should examine alternative financing mechanisms such as Business Improvement Districts (BIDs), tax increment financing, and grant opportunities.

CHAPTER 1

Introduction

The Impact of Polluted Runoff from Roads and Highways

Across the United States, there are approximately 4 million miles of publicly owned roads including federal-aid highways and other roads under state and local jurisdiction.¹⁹ This network of roads and highways creates a web of surfaces that are impervious to water that stretches across the country. Surface transportation infrastructure from roads to sidewalks can be one of the largest sources of impervious surface in a community.²⁰ When precipitation hits these hard surfaces, it washes off of them and the resulting runoff can pick up heavy metals, brake linings, deicing salts, and other contaminants. This polluted runoff flows untreated into storm drains and ultimately into local rivers, lakes, and streams. As a result, this polluted runoff from roads and highways can have a significant impact on water quality. For example, a 1993 study examining 300 samples of runoff from 46 sites in two watersheds found that streets generated the largest volume of runoff when compared to parking lots, lawns, and rooftops, and had the highest concentrations of phosphorous, suspended solids, bacteria, and several types of heavy metals.²¹

Polluted runoff from roads and highways, particularly in heavily urbanized areas, can contain a wide range of contaminants. Heavy metals such as zinc, lead, iron, copper, cadmium, and nickel associated with automobile exhaust, brake linings, and in-

secticides, are a major constituent of runoff from highways.²² Any heavy metals that are picked up by runoff and washed into local rivers and streams pose a risk to aquatic life and can accumulate over time in sediment and fish tissue.²³ Pavement wear can leach and release heavy metals, polycyclic aromatic hydrocarbons (PAHs), and carcinogens such as coal tar pitch.²⁴ Particulate matter such as sediment, oil, and grease are also components of runoff from roads and highways. Sediment can increase turbidity of local waters and increase the transport of other pollutants that are bound to sediment.²⁵ Oil and grease can get trapped in sediment in the form of semi-volatile organic compounds (SVOCs). SVOCs can be detrimental to aquatic organisms, causing mortality or abnormal growth.²⁶ Fertilizers carrying high levels of nutrients such as nitrogen and phosphorous are also found in highway runoff. High levels of nutrients create ideal conditions for algae to grow and for eutrophication to occur. As turbidity increases and the algae use up the available nutrients, they start to die off and decompose. Available dissolved oxygen and water clarity decrease significantly which threatens the health of aquatic life.²⁷ Deicing salts can contaminate drinking water supplies, alter water chemistry, and harm aquatic life.²⁸

Additionally, high levels of impervious surface can raise water temperatures. Impervious surfaces, such as asphalt, are often dark colored which absorbs heat and can increase the temperature of stormwater that runs along these surfaces and

Definitions

Effective Impervious Area (EIA):

Hard surfaces that channel precipitation directly to a waterbody or man-made drainage system.

Green infrastructure: An approach to wet weather management that uses vegetation, soils, natural systems, or engineered systems that mimic natural processes to infiltrate, evapotranspire, or recycle stormwater runoff. For the purposes of this report, green infrastructure used on roads and highways includes natural dispersion where stormwater runoff is directed into a naturally vegetated area; bioinfiltration techniques that utilize vegetation to capture and filter out pollutants from stormwater are considered green infrastructure practices for roads and highways such as grass buffers, vegetated filter strips, bioinfiltration swales, conserving or planting vegetation, or media filter drains; and infiltration practices such as infiltration trenches and permeable pavements, with limited application on highways, that may be incorporated into transportation projects.¹

Highway: A highway includes “roads, streets, and parkways and all their appurtenances.”

Post-construction stormwater management: Stormwater management practices that minimize pollutants and manage flow after construction has been completed.^{2,3}

Public road: As defined under U.S. code, a public road is “any road or street owned and maintained by a public authority and open to public travel.” Public authorities are defined as “a Federal, State, county, town or township, Indian tribe, municipal or other local government or instrumentality with authority to finance, build, operate, or maintain toll or toll-free facilities.”⁴

¹ Miccio, Claire Elisabeth, Barriers to Implementing Low Impact Development Approaches in Washington State Roadways and Highways, Washington State Department of Transportation, June 2010, Available online < <http://www.wsdot.wa.gov/research/reports/fullreports/756.1.pdf> >, Accessed 27 February 2014.

² Chapter 2: Definitions, Highway Performance Monitoring System, Federal Highway Administration, Available online <https://www.fhwa.dot.gov/ohim/hpmsmanl/chapt2.cfm> , Accessed 27 February 2014.

³ Stormwater Phase II Final Rule: Post-Construction Run-Off Control Minimum Control Measure, U.S. Environmental Protection Agency, January 2000, Available online < <http://www.epa.gov/npdes/pubs/fact2-7.pdf> >, Accessed 29 April 2014.

⁴ National Menu of Stormwater Best Management Practices, U.S. Environmental Protection Agency, Available online < <http://cfpub.epa.gov/npdes/Stormwater/menuofbmps/index.cfm> >, Accessed 29 April 2014.

⁵ Chapter 2: Definitions, Highway Performance Monitoring System, Federal Highway Administration, Available online <https://www.fhwa.dot.gov/ohim/hpmsmanl/chapt2.cfm> , Accessed 27 February 2014.

flows into local rivers and streams. Sudden increases in temperature can cause a drop in dissolved oxygen, posing a threat to aquatic life.²⁹ High levels of impervious surface change the hydrology of a system by reducing infiltration that would typically happen in a less urbanized system. As a result, higher volumes of runoff flow into local waters more quickly. These types of “flashier” urbanized systems can exacerbate localized flooding when large volumes of runoff overwhelm existing infrastructure and flood nearby waterways.³⁰

Post-Construction Stormwater Management on Roads and Highways

Polluted runoff from roads and highways is managed through a complex network of local, state, and federal laws. For the purposes of this report, a post-construction stormwater best management practice (BMP) refers to stormwater management practices that minimize pollutants and manage flow after construction has been completed.^{31, 32} A public road as defined under U.S. Code is “any road or street owned and maintained by a public authority and open to public travel.” Public authorities are defined as “a Federal, State, county, town or township, Indian tribe, municipal or other local government or instrumentality with authority to finance, build, operate, or maintain toll or toll-free facilities.” A highway includes “roads, streets, and parkways and all their appurtenances.”³³ From county owned roads to highways that are part of the National Highway System developed by the federal United States Department of Transportation (USDOT) in cooperation with local, state, and metropolitan planning organizations, roads and highways can fall under a diverse range of jurisdictions.³⁴

To further define the scope of this analysis, this report will highlight the federal regula-

tions that impact stormwater management on roads and highways and discuss state and local laws in Ohio and Georgia as appropriate. In summary, the Clean Water Act is an important driver of road and highway design to manage stormwater runoff. Transportation agencies at the municipal, county, and state levels are typically known as Departments of Transportation (DOTs). Under the Clean Water Act, transportation agencies that discharge stormwater from the roads and highways under their jurisdiction are considered point source dischargers and must acquire a National Pollutant Discharge Elimination System (NPDES) permit to regulate the discharge of stormwater runoff. DOTs must develop a stormwater management program and a stormwater management plan to implement best management practices to reduce stormwater runoff.³⁵ Many transportation agencies have developed guidance manuals that outline policies and practices regarding stormwater management, including best management practices (BMPs).³⁶ Conventional post-construction BMPs vary by state but typically include stormwater ponds, open channels such as dry swales, drywells, and wetlands.³⁷ Traditional design approaches often involve selecting a BMP based on a particular pollutant and then appropriately sizing and designing that practice to fit the site.³⁸

More stringent stormwater management practices may be required if the DOT is included in a Total Maximum Daily Load (TMDL), or plan to cap pollution for an impaired waterbody. DOTs may also be required to include additional stormwater management practices to receive certification from the state that a proposed activity meets state requirements including state water quality standards. Known as a “401 certification,” any applicant for a federal permit or license must receive this certification. Under Section 404, the Clean Water Act establishes a permitting program specifically for dredge and fill activities, such as

mining projects or infrastructure development.³⁹ A DOT may be required to implement additional stormwater management practices to meet a 401 certification that would be required to receive a 404 dredge and fill permit.^{40,41} Additionally, other federal statutes can play a role in driving stormwater management from roads and highways such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Safe Drinking Water Act (SDWA), and the Endangered Species Act (ESA). Local and state laws as well as planning priorities, such as the implementation of a climate adaptation plan, can also drive stormwater management on roads and highways.⁴² Please refer to Appendix A for a more comprehensive discussion regarding federal laws and regulations that impact stormwater management for transportation projects.

Transportation Planning and Stormwater Management

The full universe of transportation planning is complex, involving many diverse stakeholders at the local, state, and federal levels. In order to understand how stormwater management plays a role in transportation project planning and potential opportunities to incorporate green infrastructure, however, it is important to put it into context within the broader framework of transportation planning structures and processes as well as to examine the specific regulatory drivers that come into play. Additionally, planning is tied closely to funding which will be more comprehensively addressed in Chapter 4.

Transportation Planning Structure

The United States Department of Transportation (USDOT) is responsible for developing, implementing, and maintaining the nation's transportation infrastructure including roads, airlines, and rail systems. State and

local governments and the related agencies and departments are primarily responsible for transportation planning. Additionally, the USDOT also plays a primary role in providing funding to state and local governments to implement those plans.⁴³ Key transportation agencies at the federal level with the most impact on stormwater management include the Federal Highway Administration (FHWA), the Federal Transit Administration, and the Research and Innovative Technology Administration (RITA).⁴⁴ The FHWA provides financial and technical assistance to state and local governments to support the design, construction, and maintenance of the National Highway System. Three offices within the FHWA focus on environmental planning, specifically the Offices of Natural Environment and Human Environment that work primarily on air quality, climate change, sustainability, and transportation enhancements. The Office of Project Development and Environmental Review is focused on the review process established under the National Environmental Policy Act (NEPA).⁴⁵ In 2002, the FHWA included environmental stewardship as one of its "Vital Few Goals" encompassing improving environmental decision making as well as increasing ecosystem and habitat conservation.⁴⁶ The Federal Transit Administration (FTA) is responsible for providing technical and financial assistance to public transit systems. The Research and Innovative Technology Administration (RITA) conducts research to address the challenges and opportunities for the nation's transportation systems. This includes supporting research on stormwater best management practices and the use of green infrastructure on roads and highways.⁴⁷

While the federal DOT and related agencies play an important role in providing financial and technical assistance, local governments and state DOTs play a primary role in transportation planning. Every state, including Puerto Rico and the District of Columbia,

has an agency or a department with the authority and responsibility to plan and implement transportation projects. These are commonly referred to as the state's Department of Transportation, or DOT. The state DOT is the largest governmental unit that develops transportation plans and projects.⁴⁸ Communities in urbanized areas with populations greater than 200,000 are required to form Metropolitan Planning Organizations (MPOs) that are both federally recognized and funded. MPOs are also required to develop specific short- and long-term transportation plans. Local governments and transportation entities are important players in transportation planning as well.^{49,50,51} Transportation agencies or departments, also generally known as Departments of Transportation (DOTs) at the municipal and county levels are responsible for the roads and streets under their jurisdiction. Outside of urbanized areas where an MPO is not required, the state DOT takes over this collaborative role to bring together local governments and appropriate agencies.⁵²

Transportation Planning Process

The scope of this report will be primarily limited to the first phases in the life of a transportation project, which can be broadly considered as the project planning and project development stages.⁵³ During the first stage, elected officials at different levels of government make long-term policy and planning decisions that set guidelines and impact decisions made throughout the other stages of the transportation project. Once this stage is complete, a transportation project moves into the long-range planning and programming stage under which a Long-Range Transportation Plan (LRTP) and a shorter-term Transportation Improvement Program (TIP) are developed by a Metropolitan Planning Organization (MPO) and a Long-Range Statewide Transportation Plan (LRSTP) and a Statewide Transporta-

tion Improvement Program (STIP) are developed by the state Department of Transportation (DOT).^{54,55} The project planning stage offers opportunities to shape goals and policies that support integration of green infrastructure into transportation projects. After project concepts are approved under the long-range planning process, a transportation project moves into the environmental studies and preliminary design phase. Federal and state regulations require environmental review for individual projects and technical analysis as well as consideration of alternative projects helps to drive decision-making. It is during the project development stage that laws and regulations regarding stormwater management and supporting the use of green infrastructure can impact the use of these practices in transportation projects. Following the initial planning and project development stages, a transportation project goes through final design, construction, and then operations and maintenance.⁵⁶ Please refer to Appendix B for further detail about transportation planning structure and process.

Capital Improvement Planning for Transportation Projects and Stormwater Management

At the local level, capital improvement planning can play a critical role in transportation planning for a town, city, or a county. Although a comprehensive analysis of capital improvement planning is beyond the scope of this report, this summary provides context to inform specific recommendations for the incorporation of green infrastructure as a stormwater management practice for roads and highways.

A capital improvement plan (CIP) identifies and prioritizes capital projects, describing how and when they will be funded over a three to five year period. CIPs are planning tools that local governments and depart-

ments or agencies within local governments can use to determine what projects to fund as well as how and when to fund them.⁵⁷

The longer planning time horizon enables local governments, departments, and agencies to act strategically to prioritize projects based on longer-term strategies, goals, and values for the community. Capital projects include streets as well as water facilities, buildings, sewers, equipment, or the purchase of land and their definition varies among local governments.⁵⁸

The Public Works and Finance departments of a local government often lead the CIP process with significant contributions from the city or county manager. Developing a capital improvement plan requires bringing together the appropriate stakeholders including local government department heads, citizens, and elected officials. Capital assets should be inventoried and assessed for relevant upgrades or replacements. A Capital Needs Study can provide a more technical document that includes a comprehensive inventory of existing facilities and other assets, schedules for replacement and repair, and proposed new projects. As part of the capital planning process, criteria should be established to prioritize projects for funding and implementation. A financial assessment and forecast will determine the funding available for projects during the length of the CIP. The budget for the first year of the CIP is typically known as the capital budget and, unlike the CIP, is voted on by elected officials and is legally binding. The capital budget is used to inform the annual operating budget.⁵⁹ Stormwater management is unlikely to be a primary driver behind broader transportation processes, but may play a larger role in specific project design and in capital improvement planning depending upon the priorities of the local or state government.

Green Infrastructure on Roads and Highways

Importantly, these requirements and planning processes can drive the use of green infrastructure as a post-construction BMP on roads and highways. Across the country, many communities are increasingly incorporating green infrastructure to capture and infiltrate precipitation onsite, reducing stormwater runoff, mitigating impacts to existing infrastructure, and protecting clean water in local rivers and streams. For example, the City of Philadelphia developed its 25-year Green City, Clean Waters Plan which incorporates green infrastructure to reduce polluted runoff and combined sewer overflows, where stormwater and untreated sewage are released into local rivers and streams. As part of the plan, the City will invest \$1.67 billion in green infrastructure across the city to capture the first inch of rainwater.⁶⁰

Green infrastructure is also emerging as a best management practice for roads and highways, although it can differ in appearance and applicability from green infrastructure for new or redevelopment projects due to the unique constraints of transportation projects. For instance, the Washington State DOT (WSDOT) is required to consider green infrastructure practices, termed low impact development (LID), first before other more traditional BMPs. If green infrastructure isn't feasible for a particular site, then the WSDOT can implement an alternative BMP.⁶¹ Highway design is determined by the Federal Highway Administration's (FHWA) guidelines with little flexibility to reduce impervious surface area. Additionally, highways are linear and constrained within the right-of-way (ROW). This can limit the available space for infiltration and onsite treatment of stormwater. For instance, a rain garden that may have adequate space to allow for infiltration in a parking lot may not



PHOTO: Bureau of Laboratory Services / Michelle Adams

Green Street

be practicable in the constrained right-of-way of an urbanized street.⁶² At the same time, ownership by one entity for continuous stretches of land area may create opportunities for increased implementation of green infrastructure throughout a watershed. Other challenges include the potential diversity of soil types, climate, and land uses

through which one highway might run. In other words, green infrastructure may be appropriate in one section of a highway, but not in a different section.⁶³ The unique constraints of roads and highways compared to other new or redevelopment projects create both challenges and opportunities to the implementation of green infrastructure.

In the literature, there are different definitions of green infrastructure, or low impact development (LID) for use on roads and highways. Researchers from Washington State University recommend developing a consistent definition across all agencies and departments within a state and suggest that the definition of green infrastructure for highways to include best management practices that use “as much of the full site hydrology as possible within the ROW. That is, to strive to disperse stormwater and mimic all of the natural hydrologic processes, including infiltration, filtration, storage, evaporation, interception, and transpiration as much as possible.”⁶⁴ For the purposes of this report, green infrastructure used on roads and highways includes natural dispersion where stormwater runoff is directed into a naturally vegetated area; bioinfiltration techniques that utilize vegetation to capture and filter out pollutants from stormwater are considered green infrastructure practices for roads and highways such as grass buffers, vegetated filter strips, bioinfiltration swales, conserving or planting vegetation, or media filter drains; and infiltration practices such as infiltration trenches and permeable pavements, with limited application on highways, that may be incorporated into transportation projects.⁶⁵

While increased integration of green infrastructure practices in transportation projects has the potential to better leverage funds and provide multiple benefits from reduced flooding to improved air quality, there remain a number of challenges. From a planning perspective, the lack of political will, coordination among municipal departments or state agencies, regulatory drivers, data regarding technical constraints, or defined process that prioritizes green infrastructure make it more difficult to implement transportation projects that integrate green infrastructure. Additionally, in many municipi-

palities, states, and even at the federal level, a lack of a clear funding stream can make it challenging to invest in this approach.

Importantly, there are multiple strategies that local governments and transportation agencies can pursue to address these potential barriers. Transportation agencies should require the use of the context sensitive solutions (CSS) planning process, which is an approach to planning that works to maintain or enhance the existing environment.⁶⁶ These agencies can build on a CSS approach by adopting the Green Highways Watershed Approach, which requires prioritization of practices that provide multiple benefits particularly in regards to water resources.⁶⁷ In the Long-Range Statewide Transportation Plan (LRSTP) and the Long-Range Transportation Plan (LRTP) processes, transportation agencies should prioritize green infrastructure and stormwater management. Municipalities should also consider prioritizing green infrastructure in transportation projects through the capital improvement planning process. Working with the appropriate permitting authority, transportation agencies and local governments should revise stormwater permits to encourage the use of green infrastructure through objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area. Relevant technical Best Management Practices manuals should be updated to include detailed technical information about the applicability and implementation of green infrastructure practices. Municipalities should also consider adopting a green streets policy to demonstrate an inter-departmental commitment to green infrastructure in transportation projects. These strategies are discussed in Chapter 2 and 3 in more detail with specific recommendations for both Atlanta and Toledo in Chapter 4.

CHAPTER 2

Planning and Project Development Recommendations for Regional, State, and Local Transportation Agencies

Planning

Planning refers to the initial stages of a transportation project where decision makers set long-term policy and planning goals, develop a vision for a transportation system or municipality, create transportation plans, and establish prioritization processes. It's important to address stormwater management during this phase and the following recommendations outline different strategies that transportation agencies and local governments can pursue to better integrate green infrastructure and transportation projects.

1) Require Use of Context Sensitive Solutions (CSS) Planning Process

State and regional transportation agencies should consider requiring Context Sensitive Solutions (CSS) as a planning framework for roads and highways. Transportation agencies first started incorporating this planning approach in 1998 which works to design and plan transportation projects that maintain or enhance the existing environment. Environmental stewardship practices in line with CSS can mitigate costs associated with energy consumption, material storage, environmental mitigation, and waste generation.⁶⁸ Most importantly, the CSS approach ensures that goals and values beyond transportation, such as sustainability, are considered.⁶⁹

Today, CSS is defined by Federal Highway Administration (FHWA) and American As-

sociation of State Highway and Transportation Officials (AASHTO) as “a collaborative, interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure conditions.” Both FHWA and AASHTO encourage its use in project planning and design. As part of its recommendations, the FHWA suggest that planners work collaboratively to understand the landscape, community, and resources before the engineering design stage begins.⁷⁰ One of the core principles of CSS is to use flexibility and creativity to preserve and enhance community and natural environments.⁷¹ This is in line with green infrastructure goals to use natural or engineered systems that mimic natural systems to capture and filter rainwater, reducing stormwater runoff to protect water quality. Best practices with the CSS planning approach include developing an upfront planning process that allows stakeholders including the public and environmental agencies to identify issues as well as identifying and considering existing plans relating to land use, water and sewer, and watershed management.⁷²

In Washington, the WSDOT requires Context Sensitive Design on all of its projects. In 2003, the Secretary of Transportation signed an Executive Order to define CSS and require its use in transportation planning. Delaware's Department of Transpor-

tation (DELDOT) established a Context Sensitive Design Policy in 2001 and recent guidelines for applying CSD to Delaware Byways from 2011 include the use of rain planters and bioswales as recommended BMPs.⁷³ In 2005, Washington, DC's District Department of Transportation (DDOT) established a Context Sensitive Solutions

Context Sensitive Solutions Policy Helps Drive Green Infrastructure in Bainbridge Island, WA

The Federal Highway Administration (FHWA) highlighted the Winslow Way project in the City of Bainbridge Island, Washington during its second National Context Sensitive Solutions (CSS) Dialogue in 2012. The City needed to replace water, sanitary sewer, and storm sewer infrastructure along Winslow Way which would require removal of as much as 70 % of the right-of-way. As a result, the City decided to update the existing streetscape which went through the commercial and community center of the city but had narrow sidewalks and no stormwater management or bike facilities. The City rebuilt the road with rain gardens, stormwater planters, porous pavements, bike facilities, and wider sidewalks to address the needs of bicyclists and pedestrians.¹ This example illustrates how CSS policies can drive the use of green infrastructure for roads and highway projects.

¹ Winslow Way Street Planning and Design, U.S. Department of Transportation Federal Highway Administration, 2005, Available online < http://contextsensitivesolutions.org/content/case_studies/winslow_way_street_planning_and/ >, Accessed 3 September 2014.

policy that requires the use of CSS on all transportation projects. Many other state transportation departments have implemented similar policies for CSS, however they are not universal.⁷⁴ According to the FHWA's website, 17 state DOTs have adopted a CSS policy, some of which have additionally adopted specific CSS legislation or an Executive Order.⁷⁵ A 2007 study from the Center for Transportation and Environment at North Carolina State University conducted a survey of metropolitan planning organizations (MPOs) to evaluate best practices in adopting CSS in transportation planning. Of the 45 MPOs that responded to the survey reported, 47 % incorporate CSS into local transportation plans yet only 13 % have adopted a CSS policy.⁷⁶ While a CSS policy is an important step in prioritizing approaches that enhance and conserve the environment, it is only a first step in developing a planning process that encourages or prioritizes green infrastructure for roads and highways.

2) Implement Green Highways Watershed Approach

If a transportation department has a CSS policy in place, it could be strengthened to require a greater focus on impacts to water resources and even prioritization of practices that provide multiple benefits to communities in line with the goals of CSS, such as green infrastructure. The Green Highways Partnership was established in 2005 by the Environmental Protection Agency (EPA) and the Federal Highway Administration (FHWA) and brings together public and private entities to integrate transportation function with ecological sustainability.⁷⁷

As part of its efforts, the Green Highways Partnership created a Green Highways Watershed Approach that establishes principles that transportation departments could use to build on a CSS policy to better address stormwater management and prioritize

green infrastructure. This approach outlines six principles: 1) regulatory compliance is a minimum requirement for acceptance; 2) requires a stormwater management plan that considers watershed-wide needs that is based on collaborative watershed improvement goals and plans, and developed in collaboration with local governments and resource agencies; 3) focuses on achieving good environmental results for the watershed in a cost-effective manner, not just meeting regulatory requirements by using traditional, end-of-pipe approaches; 4) integrates stormwater plans into project development and project features; 5) uses collaborative partnerships to leverage and deliver a combination of watershed improvements to cohesively and consciously produce tangible results; and 6) a coordinated mitigation/enhancement strategy is important – coordination with other projects in the watershed is necessary.⁷⁸ To summarize, the Green Highways Watershed Approach requires collaboration among different stakeholders outside of traditional transportation entities. This can mean working with private organizations, resource agencies, and local governments in the project planning and design phase. As part of this collaboration, this approach requires looking at impacts to the entire watershed to reflect existing water quality plans, Total Maximum Daily Loads (TMDLs), or 303(d) listings. Cost-effective and sustainable BMPs should be incorporated and coordination with other projects and planning processes are critical.

3) Prioritize Green Infrastructure within Long-Range Statewide Transportation Plans (LRSTP) and Long-Range Transportation Plans (LRTP)

The Long-Range Statewide Transportation Plan (LRSTP) is developed by state DOTs to identify long-term priorities and strategic goals over an approximately 20-year period.⁷⁹ Similarly, Metropolitan Planning Organizations (MPOs) are required to develop

a Long-Range Transportation Plan (LRTP). Under the most recent surface transportation bill reauthorization, MAP-21, both states and MPOs must develop long range plans that consider projects and practices that support economic vitality, increase safety and security, increase accessibility and mobility, protect and enhance the environment, improve quality of life, enhance integration and connectivity of the transportation system, promote efficient system management, and emphasize preservation of the existing system. Importantly, MAP-21 includes the requirement that these plans must consider projects and strategies that “protect and enhance the environment” and that “improve the quality of life.”⁸⁰ Within this framework, state DOTs and MPOs could develop strategies and goals that go a step further by prioritizing water quality and watershed planning. For example, the LRTP sets that broader agenda for the MPO and its goals and projects must be considered in the development of the Transportation Improvement Plan (TIP) that identifies more immediate projects. By establishing a framework that prioritizes green infrastructure practices, the MPO would allow for more transportation projects that incorporate green infrastructure to be implemented.

4) Prioritize Green Infrastructure in Transportation Projects through Capital Improvement Planning Processes

At the local level, there are also opportunities to better integrate green infrastructure into transportation projects to manage polluted runoff. Specifically, the capital improvement planning process offers an importation pathway to prioritize green infrastructure for roads and highways. Funding sources for transportation construction, upgrades, and repairs are typically much larger than those for stormwater management, which may not even have a dedicated funding source. Municipalities across the country are already starting to leverage transporta-

tion funding sources by incorporating green infrastructure into these projects.⁸¹ For example, the city of Olympia, Washington

Identifying Green Street Opportunities Citywide in Milwaukee, Wisconsin

Funded by a grant from the Wisconsin Coastal Management Program and the National Oceanic and Atmospheric Administration under the Coastal Zone Management Act, CH2MHill prepared an analysis of opportunities to implement green infrastructure in street and alley repaving and reconstruction projects for the City of Milwaukee, WI. This type of analysis illustrates the importance of identifying stormwater management needs and planned capital improvement projects early in the planning process to find opportunities to integrate green infrastructure into transportation projects. The document develops a process to identify and select potential green street strategies, describing different green infrastructure practices, such as bioretention, and outlining maintenance needs and best practices, factors to consider in determining appropriate placement, and opportunities where that practice may be an appropriate fit. Additionally, the document provides recommendations to adapt the existing planning process to include opportunities to identify places to implement green infrastructure. This document could provide a useful model that could be adapted for specific local conditions.¹

¹ Green Streets Stormwater Management Plan, City of Milwaukee, March 2013, Available online < http://city.milwaukee.gov/ImageLibrary/Groups/cityGreenTeam/documents/2013/Green_Streets_Stormwater_Manag.pdf >, Accessed 3 September 2014.

first began using permeable pavement in 1999. These early demonstration projects enabled the city to study the costs and benefits as well as longer-term maintenance data. As a result, in 2005 the City developed a memorandum that described its rationale for using pervious concrete for sidewalks funded and maintained by the City based on the resulting cost-savings and water quality benefits.⁸²

While the opportunities and challenges will vary for each municipality, in many places opportunities to save money and leverage benefits may be lost by a lack of coordination or integrated planning processes. Asset management practices for different departments should be standardized or developed so that they are easily integrated into a city-wide analysis for capital projects. At the broadest scale, local governments should establish a capital planning process that requires consideration of sustainable, green infrastructure elements. For example, the City of Seattle developed a Sustainable Infrastructure Initiative to better evaluate capital projects within the frame of their environmental and social impacts. This includes requiring consideration of alternative green approaches, such as green infrastructure.⁸³

Refining this further, the local government should implement criteria to prioritize transportation projects that incorporate green infrastructure or to set aside a small %age of capital dollars to be used for green designs. At the department level, the capital improvement plan for the relevant transportation department should include, at the minimum, requirements for coordination among the relevant water quality, permitting, and environmental departments in the planning process. The transportation department should develop and implement criteria to prioritize transportation projects in the capital improvement planning process that integrate green infrastructure elements.

For example, the City of Bremerton, Washington updated its NPDES permit in 2009 to encourage the use of green infrastructure and, as a result, also updated its Stormwater Management Plan to be in line with the new permit's requirements. This plan was integrated into the City's Comprehensive Plan which was approved by the city council and the capital improvement plan included a specific line item for green infrastructure projects. Additionally, Bremerton included a line item in its transportation improvement program specifically for green streets.⁸⁴

The capital planning process at both the department and municipal scales represents an opportunity to better leverage transportation dollars to fund green infrastructure elements that help to cost-effectively meet permit requirements and protect water quality. Specific recommendations for Toledo, OH and Atlanta, GA below can serve as models for how these recommendations could be adapted to meet specific local conditions.

Project Development

Project development refers to the phase of a transportation project related to environmental review and preliminary design. This stage in the life of a project builds on the planning and visioning stage to ensure that a project will be in compliance with relevant local, state, and federal laws. If stormwater management is not considered in the planning phase, it will be most likely addressed during project development to ensure compliance with the Clean Water Act and other applicable laws and requirements.

1) Revise Stormwater Permits

State DOTs are considered point source dischargers under the Clean Water Act. As a result, state DOTs are required to hold a municipal separate storm sewer (MS4) permit under the National Pollutant Discharge

Elimination System (NPDES) program. At the municipal level, stormwater runoff from roads and streets that are owned by the local government fall under the municipality's MS4 permit. For instance, stormwater runoff from a highway under the Ohio Department of Transportation's (ODOT) jurisdiction would be managed under ODOT's MS4 permit while runoff from municipal streets in Toledo must be managed under Toledo's MS4 permit.

In most cases, the EPA has delegated authority to the state to administer the permitting program. Many state DOTs were required to be covered under a NPDES permit when the Phase I program went into effect for large and medium-sized urban areas in 1990. Typically, Phase I MS4s are covered under individual permits, meaning that the permit conditions are specific to that particular discharge.⁸⁵ Many Phase I permit holders have gone through several permit cycles and in some progressive jurisdictions, Phase I permits are beginning to incorporate standards that require on-site management of stormwater runoff.⁸⁶ Other transportation agencies were brought into the permitting program under the Phase II permits which went into effect in 1999 for small urbanized areas.⁸⁷ Phase II permits are commonly administered as general permits rather than individual permits. In this case, the permitting authority writes a general permit after determining limits and standards that would be applicable to similar point source discharges in the same region. Permittees apply for coverage by submitting a Notice of Intent (NOI) to comply with the terms and requirements of the general permit.⁸⁸ State DOTs can be either Phase I or Phase II permittees and may hold a permit separately or together with the relevant municipality. An Information Collection Request (ICR) from EPA found that most state DOTs hold general Phase II permits and approximately 57 % of state DOTs have only one MS4 permit.⁸⁹

In 2009, the National Research Council (NRC) released a report examining the state of the nation's stormwater program which found that "EPA's current approach to regulating stormwater is unlikely to produce an accurate or complete picture of the extent of the problem, nor is it likely to adequately control stormwater's contribution to waterbody impairment."⁹⁰ In other words, the current approach to stormwater management is unlikely to be effective at comprehensively addressing the problem. Most relevant to stormwater runoff from roads and highways, the report identified two significant areas of concern. First, MS4 permits are difficult to enforce because they lack clear, objective, numeric performance standards. Under the Clean Water Act, pollutants discharged by

MS4s must be reduced to the "maximum extent practicable" (MEP), yet few permitting authorities have developed a numeric limit for this standard. Additionally, stormwater permits typically require practices that convey or detain stormwater but that do little to reduce runoff. Although the EPA has developed guidance for greater implementation of green infrastructure in MS4 permits to encourage its use, only a limited number of states have changed to support the use of green infrastructure through MS4 permits.⁹¹ Establishing objective numeric performance standards and shifting towards green infrastructure practices that provide both water quantity and water quality benefits will be critical to improve management of stormwater runoff.

Performance Standards

For example, the state of Idaho is a non-delegated state which means that the EPA is the permitting authority. In 2007, the Energy Independence and Security Act (EISA) included a provision under Section 438 which required federal facilities to manage stormwater onsite for the 95th %ile storm. In other words, capturing and infiltrating rain where it falls to mimic a more natural system. As the permitting authority, the EPA included elements of this requirement in the City of Boise's most recent Phase I MS4 permit which also includes the Idaho Transportation Department District #3 as a co-permittee. Under the permit, permittees must establish standards or ordinances that will require new development and redevelopment projects to manage the first 0.6 inches of rainfall onsite, effectively the 95th %ile storm for the region. Relevant design criteria and technical manuals must be updated to reflect implemen-

tation and design criteria for each acceptable practice. By September 2015, permittees must develop and implement a green infrastructure incentive strategy with at least three pilot projects. Most relevant for roads and highways, the permit also requires permittees to evaluate the feasibility of integrating green infrastructure practices such as bioretention and rain gardens when public streets, roads, and parking lots are being repaired. This example demonstrates both an objective numeric performance standard and specific green infrastructure requirements. American Rivers' recent Permitting Green Infrastructure: A Guide to Improving Municipal Stormwater Permits and Protecting Water Quality report provides more detail and additional case studies to demonstrate how MS4 permits can be improved to encourage the use of green infrastructure.

To encourage the use of green infrastructure on roads and highways, stormwater permits for state DOTs and municipalities should be revised to include at least one of the following: objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area. An objective numeric performance standard would mean including a specific numerical limit in the permit itself regarding the volume of precipitation that must be managed onsite. In other words, a permit could require a permittee to reduce runoff by managing the first one-inch of rainfall onsite rather than reducing runoff to the maximum extent practicable. Specific green infrastructure requirements might include requirements for permittees to prioritize green infrastructure when evaluating stormwater management practices for roads and highways. A ceiling on effective impervious area could also drive the use of green infrastructure by limiting the overall amount of impervious surface. The Phase I permit for Ventura County, California requires new and redevelopment projects to manage runoff by reducing the effective impervious area of the project to five % or less.⁹²

2) Adopt or Revise Design Manuals and Design Standards

Currently, many stormwater permits are written with narrative requirements to comply with the state's or transportation agency's stormwater technical manual. This can introduce additional uncertainty if requirements are not clearly stated in the permit itself. Technical and design manuals are most effective when they act as a tool to support the requirements and specific standards included in the permit. To better integrate green infrastructure on roads and highways, these technical manuals should be revised to support permit revisions that encourage green infrastructure. However, if permit revisions

are not feasible, the relevant technical manuals should still be updated to include appropriate green infrastructure practices as potential best management practices (BMPs). Revising these technical manuals is one strategy to address some of the barriers to green infrastructure on roads and highways that are cited, including a lack of technical information, minimal program support, or conservative design criteria.⁹³

One example of a technical manual that includes green infrastructure is the Washington State Department of Transportation's (WSDOT) Highway Runoff Manual (HRM). The Washington State Department of Ecology finalized the WSDOT's NPDES permit in March 2014 and the HRM was updated to ensure consistency with the updated permit. The WSDOT NPDES permit covers the entire state including Phase I and Phase II areas and for stormwater discharges to a waterbody with a Total Maximum Daily Load (TMDL) with specific limitations for WSDOT. Importantly, the updated permit includes new requirements to prioritize Low Impact Development (LID), or green infrastructure.⁹⁴ The HRM provides technical criteria for best management practices (BMPs) and a selection process for those BMPs which requires the use of LID "in all facilities where feasible." Following the detailed selection process which prioritizes natural, non-structural, and LID or green infrastructure practices, the HRM provides design criteria for the approved BMPs. This includes appropriate application and limitations for vegetated filter strips, bioinfiltration swales, natural dispersion, media filter drains, bioretention areas, infiltration trenches, and permeable pavement.⁹⁵

At the municipal level, New York City's Department of Transportation (DOT) developed design standards for green streets in its Street Design Manual released in 2009. The manual lists appropriate applications for the use of green streets, clarifies that green

streets are maintained by the New York City Department of Parks and Recreation (DPR) or by a neighborhood or volunteer group subject to a maintenance agreement, and details specific design standards.⁹⁶ In 2013, the manual was updated to add a new chapter on Landscapes which provides additional guidance for plantings in the public right-of-way (ROW), including green infrastructure. This manual provides design principles for green infrastructure on municipal streets within the public ROW that can be applied across the City as appropriate. For example, under the Street Design Manual, the City will focus on building Department of Environmental Protection (DEP) ROW Bioswales within priority areas for combined sewer overflow (CSO) control. The manual clearly states that, in those areas, New York City DEP will install the ROW bioswales and the DPR will conduct maintenance according to a third party agreement. Before installation, subsurface conditions should be considered; plants should be selected that can tolerate salt, sediments, and variable levels of water; parking regulations and curb access should all be considered along with other factors.⁹⁷ Design of ROW Bioswales should follow DEP bioswales siting criteria and follow DEP Standards for Green Infrastructure.⁹⁸

In Washington, DC, the District Department of Transportation (DDOT) released its Green Infrastructure Standards to supplement the existing standard specifications for roads and highways and the District's design and engineering manual. The Green Infrastructure Standards will be required for use in any construction activities or material control within the public ROW. To the maximum extent practicable (MEP), projects within the ROW are required to implement stormwater retention practices in compliance with the requirement to retain the 80th %ile rainfall event onsite across most of the District.⁹⁹ In other words, capturing and treating rainwater onsite. This guidance manual provides

design standards and technical specifications for permeable pavement, bioretention, and bioswales. Other green infrastructure practices can be used with approval from DDOT and the District Department of the Environment (DDOE).¹⁰⁰ In municipalities or states where such technical guidance doesn't exist for green infrastructure on roads and highways, these examples and others can be used as models to develop locally relevant design standards, planning considerations, and specification.

3) Green Streets Policies

In addition to permit revisions, local governments should develop and implement a green streets policy and program. A green street is defined by the Low Impact Development Center as "urban transportation right-of-ways integrated with green techniques."¹⁰¹ For the purposes of this report, green streets are defined as streets including the right-of-way that incorporate practices that use vegetation, soils, natural systems, or engineered systems that mimic natural processes to infiltrate, evapotranspire, or recycle stormwater runoff. Green streets can incorporate different green infrastructure practices such as permeable pavement, bioretention areas, and street trees to capture and treat stormwater. These practices, when integrated and coordinated with ongoing planning processes, can complement planned street upgrades, aesthetic improvements, and urban forestry efforts. Green streets can provide improved bicycle and pedestrian access, increase safety by improving traffic calming, and can act as urban greenways.¹⁰²

Across the country, some local governments have established green street policies and programs to encourage the integration of forward-thinking green infrastructure stormwater management in road and street projects. These can vary in scope and scale, but typically set criteria or requirements that



Green Street

encourage the use of green infrastructure in city street projects. Challenges involving green street policy implementation include establishing ownership, responsibility for maintenance, and funding.

As a well-established policy with a dedicated funding stream, the Portland case offers an important model for other green street policies. Portland, Oregon established its Green Streets Policy in 2007. The policy requires that all city-funded new development, redevelopment, or upgrade projects incorporate green street facilities. If a green street is not incorporated, an off-site project or fee is required. Additionally, the policy requires maintenance of the green streets in compliance with the Green Streets Maintenance Policy. To address the issue of ownership, regardless of who built the green street facility, it becomes an asset of the

Portland Bureau of Environmental Services two years after establishment.¹⁰³ If the City funds a new development, redevelopment, or upgrade project that does not trigger the City's stormwater requirements but occurs in the right-of-way or requires a street opening permit must pay 1% of the construction costs into the "% for Green" Street fund.¹⁰⁴ The % for Green fund provides funding for green street projects in the City located in the public right-of-way or on private property.¹⁰⁵

Importantly, Portland's Green Streets Policy is one element of an ongoing city-wide effort to integrate green infrastructure.¹⁰⁶ Portland's stormwater program began in the 1990s in response to its MS4 permit requirements. Since that time, Portland has developed programs and policies that support onsite management of stormwater and

green infrastructure. The original permit required municipal staff to research and evaluate alternative methods to manage stormwater. For example, in 1993, Portland implemented its Downspout Disconnection program which created financial incentives for homeowners to disconnect their downspouts from the sewer system, allowing for more natural infiltration of stormwater runoff. In 2001, the City established a Sustainable Infrastructure Committee to evaluate city-wide opportunities to better incorporate sustainable infrastructure. Five years later, the City revised their stormwater fee to provide incentives to property owners for managing stormwater runoff onsite. Starting with small demonstration projects allowed the City to modify designs on a small scale to improve performance and to create a record of monitoring data to demonstrate effectiveness.¹⁰⁷ Engaging community members and working with private property owners, even though green streets can be built completely in the City-owned right-of-way, also supports Portland's success. While not all of Portland's Green Streets policy will be applicable in other municipalities, different elements can serve as models that could be adapted for specific local conditions.

In the Great Lakes region, the City of Chicago's Department of Transportation (CDOT) released its Sustainable Urban Infrastructure Guidelines in 2013 to integrate the City's approach to the more than 4,000 miles of publicly owned streets and 2,100 miles of public alleys and other urban infrastructure. These guidelines are based on four core principles that the public right-of-way serves as public space, streets should be designed to optimize pedestrian mobility, urban infrastructure design should support public health and a healthy environment, and climate resilience should be a critical element of urban infrastructure design. The guidelines establish specific requirements and outline different strategies to meet them. For example, reducing basement and

street flooding, reducing combined sewer overflows (CSOs), and reducing non-point source pollutions are listed as objectives and to meet those goals, the guidelines require that "green infrastructure shall be used to control stormwater from all the public right-of-way" and that green infrastructure should be installed to the maximum extent practicable to provide rate control.¹⁰⁸ The guidelines provide examples of different strategies for commercial and residential streets with variously sized rights-of-way.

This effort builds upon a strong foundation of incorporating sustainability and green approaches into streets and alleys. In 2006, CDOT adopted a Complete Streets Policy and initiated its Green Alleys Program to address flooding in garages and basements along the City's publicly owned alleys using permeable pavement. Many of the public alleys in the City were originally unpaved and therefore built without a connection to the sewer system. As the alleys were paved over, the resulting stormwater caused flooding in basements and garages. Around the same time, CDOT released its Green Alley Handbook designed for local residents which explained the benefits of green alleys, how they function, and what property owners can do on their private property to reduce flooding and ensure that the green alleys continue to function properly.¹⁰⁹ One of the major drivers for the Green Alleys Program was strong local leadership from the current mayor.¹¹⁰ Although the City does not currently have a stormwater utility fee, funding for the green alleys comes from the Capital Improvements Funds, neighborhood capital improvement bonds, as well as the vehicle tax and motor fuel tax funds.¹¹¹

Green streets and alleys aren't just found in places with frequent rainfall. The city of Tucson, Arizona established its Green Streets Policy in 2013.¹¹² The policy requires the Tucson Department of Transportation (TDOT) to design new and upgraded streets that

convey stormwater into green infrastructure features, capturing at least the first half-inch of rainfall onsite. Additionally, the policy requires TDOT to include native vegetation so that the streets are covered by a 25 % tree canopy.¹¹³ Currently, there is no specific funding mechanism in place but there are efforts to develop a stormwater utility for the City that could fund implementation.¹¹⁴ In Tucson's case, the primary driver for adopting a Green Streets Policy was not stormwater management. Instead, mitigating the urban heat island effect and improving the urban forest and water conservation were the major focus. Increased water consciousness among community members about the City's drinking water sources, largely groundwater, also played a role in encouraging the Green Streets Policy.¹¹⁵

In the Northeast, New York City established its Greenstreets Program in 1996 to increase street tree planting, beautify the landscape, calm traffic, and increase pedestrian safety. The program was a partnership between New York City Parks Department and the New York City Department of Transportation (DOT). In 2010, the New York City Department of Environmental Protection (DEP) joined the partnership, the program was re-named the Green Infrastructure Unit, and the focus shifted to green streets that capture stormwater runoff onsite.¹¹⁶ This shift was part of the City's Green Infrastructure Plan released the same year to reduce combined sewer overflows and improve water quality.¹¹⁷ The City focuses primarily on "right-of-way (ROW) bioswales" and "stormwater greenstreets" that use planted

areas in the municipal street right-of-way to capture, infiltrate, and evapotranspire stormwater.¹¹⁸ In 2013, the City developed specific design standards for ROW bioswales to be used by City agencies when developing project and contract plans. This standardized design will reduce time and costs for associated design and approval processes.¹¹⁹ That same year, the DEP also began its BioSwale Care Program in partnership with Million Trees NYC (MTNYC). The purpose of the program is to engage property owners and neighborhood groups, offering hands-on training about how to maintain green streets. Participants can then volunteer to "adopt" a green street, taking on responsibility for their maintenance.¹²⁰ Importantly, responsibility for maintenance is also formalized in a Memorandum of Understanding (MOU) between the Department of Transportation, the DEP, and the Parks Department. A 1983 memorandum first established the breakdown of responsibility for activities in the right-of-way, which was used as a basis when applied to green streets. The ROW property is owned by the DOT, the DEP is responsible for the green infrastructure practices, and the Parks department is responsible for the maintenance.¹²¹

These are just few examples that demonstrate green streets policies that have been implemented across the country in a variety of climates, from the arid Southwest to the rainy Northwest. These cases illustrate the different drivers that may come into play and how these policies can be adapted for local conditions.

CHAPTER 3

Funding

Paying for Stormwater Management

Stormwater management is consistently underfunded across the country. As of 2008, the U.S. EPA estimated that investment needs for combined sewer overflows total \$63.6 billion and investment needs for stormwater management alone total an additional \$42.3 billion.¹²² At the municipal level, local governments typically use a combination of local, state, and federal dollars to pay for stormwater management of publicly owned projects to remain compliant with permit requirements, local ordinances, and state or federal law. The following are some of the most common strategies that municipalities use to pay for stormwater management and many municipalities utilize a combination.

General Funds

Many local governments pay for stormwater management out of general funds, which are often paid for through property taxes on residents. This poses a challenge, however, because stormwater management often falls to the bottom of the priority list when competing for limited dollars with other priorities such as schools or police departments.¹²³ Additionally, using general funds is not an equitable distribution of the cost burden. For instance, tax-exempt properties might have large parking lots or rooftop areas which contribute to stormwater runoff but may not pay into general funds used for stormwater management. Without dedicated funding specifically for stormwater, many

municipalities divide the responsibilities for its management among multiple departments. A 2007 survey by the Charles River Watershed Association found that 75 % of local stormwater management programs surveyed in Massachusetts did not have staff members that were solely responsible for stormwater management.¹²⁴ Despite these challenges, general funds remain the most common way to pay for stormwater management.

Bonding

Bonding allows the municipality or county to borrow money to pay for capital improvement projects or operations needs that might exceed the current financial capacity of the local government.¹²⁵ Unlike general funds assessed through property taxes, bonding is not a source of revenue but rather a loan. As a result, the interest accumulated over the course of the loan can increase the overall capital costs of a project. For general obligation bonds, the debt can be secured through the general revenues of the municipality. For revenue bonds, the debt is secured through a specific revenue stream, such as a stormwater utility fee. In some places, a city or county may use a combination of both where the general revenues are used as a back up to cover the revenue stream.¹²⁶

Stormwater Utility

Some local governments may establish a stormwater utility, which is similar to a designated water or sewer fee. A stormwater utility is a user or service fee that is charged

for a specific service that will benefit the user, designed to cover the actual costs of service, and based on contribution to the problem. In other words, a stormwater fee should be designed to cover the costs to the local government of managing runoff to reduce pollution or flooding and the rate structure should be based on how much a site contributes to that problem.¹²⁷ Stormwater utilities first emerged in the 1970s and a 2012 survey found that there were approximately 1,000 stormwater utilities across the country.¹²⁸

Loans and Grants

State and federal grant or loan programs also provide an important source of funding for stormwater management. In general, grants may be used to fund the full cost of a project or to provide cost-share, or match. For example, Section 319 of the Clean Water Act established a grant program to fund non-point source pollution programs. These 319 funds are allocated to each state using a formula and can be used to implement programs and projects that reduce non-point source pollution, or stormwater.¹²⁹ Grants may be more restrictive and can be constrained by limited budgets and appropriations processes. Loan programs are similar to bonding in that they are not a new source of revenue; however, they may offer lower interest rates or more favorable terms. For example, the federal Clean Water State Revolving Funds provide low-interest loans to fund stormwater and wastewater infrastructure. Each state is allocated a specific funding level and maintains a program which distributes the funding within that state. Loan repayments are cycled back into the program which helps to maintain the fund.¹³⁰

These strategies illustrate some of the more common approaches that local governments use to pay for stormwater management. Many use a combination of these

approaches and others. As many municipalities struggle to pay for stormwater management, integrating green infrastructure elements into transportation projects can help to maximize the value of every dollar spent. Transportation agencies may also benefit from incorporating green infrastructure elements into projects by improving access to a broader range of funding opportunities.

Paying for Stormwater Management from Transportation Projects

A comprehensive discussion of transportation funding is beyond the scope of this report. While funding for transportation projects comes from a mix of federal and state funding, local assessment districts, tolls, impact fees, and general fund contributions such as sales tax, much of the funding for these projects comes from federal sources.¹³¹ At the federal level, surface transportation legislation authorizes programs and funding to states to assist with the construction, reconstruction, and improvement of eligible federal-aid highways and bridges. In July 2012, the most recent surface transportation legislation, known as the Moving Ahead for Progress in the 21st Century (MAP-21) Act, was reauthorized. MAP-21 authorizes funding for transportation programs, such as the National Highway Performance Program, the Transportation Alternatives Program, and the Surface Transportation Program, which are funded by the Highway Trust Fund largely paid for through federal motor fuel taxes. Once funding is allocated to these core programs, it is distributed through a formula to the states. MAP-21 also continues requirements for transportation planning by states and Metropolitan Planning Organizations (MPOs) through the long-range and short-term planning processes. Additionally, MAP-21 authorizes funding for research, training, and education through programs.¹³²

At the state level, states can use the revenues from taxes and fees, tolls, general fund appropriations, and bond proceeds to invest in transportation projects.¹³³ General fund appropriations at the local level, from property taxes or other local taxes, represent the most common source of funding for transportation from local governments.¹³⁴

When it comes to stormwater management, state DOTs don't typically separate costs of stormwater management from the costs of planning, designing, constructing, and maintaining a transportation project. A report prepared by the National Cooperative Highway Research Program requested by the American Association of State Highway and Transportation Officials (AASHTO) on strategies to address NPDES Phase II requirements found that many state Departments of Transportation (DOTs) couldn't provide specific budget figures for their MS4 programs to meet stormwater requirements. More specifically, the cost of designing stormwater management to comply with MS4 permits is typically included in the overall design cost of the project. Maintenance costs are not typically broken out specifically for stormwater management. Partnerships with other state agencies that are also responsible for public education and outreach often results in shared resources, which made it difficult for DOTs to estimate overall cost of education and outreach on stormwater management as well.¹³⁵

This summary illustrates one of the primary challenges to increased implementation of green infrastructure in road and highway projects. At the municipal level, stormwater management without a dedicated revenue stream is often forced to compete for limited general funds with other priorities. This poses a challenge at the local level to fund green infrastructure projects, but at the same time creates an opportunity to better leverage limited dollars by integrating green

infrastructure into planned construction and reconstruction. At the state DOT level, this is further borne out by the lack of specific tracking regarding costs of stormwater management. The following recommendations illustrate different strategies that local governments and transportation agencies could pursue to fund green infrastructure on roads and highways, depending on local conditions and needs.

Recommendations

1) Implement a Stormwater Utility Fee

When stormwater management is funded through general funds, stormwater priorities are forced to compete for limited dollars against a number of other critical municipal services from police departments to schools. Establishing a dedicated and equitable source of funding for stormwater management creates additional resources to protect clean water and implement green infrastructure practices that provide multiple benefits to communities. Additionally, in the capital improvement planning process, the municipality could use funds from its stormwater utility to fund the addition of green infrastructure elements into an already planned capital transportation project rather than funding stand-alone green infrastructure projects that might incur higher costs. Stormwater utilities also have the added benefit of creating a dedicated stream of funding that can be used to pay for maintenance.

A stormwater utility is similar to a designated water or sewer fee. It establishes a user or service fee based on impact to cover the costs to the municipality of managing stormwater runoff. Stormwater utilities began emerging in the 1970s and as of 2012 there were more than 1,000 stormwater utilities across the country.^{136, 137} The state of Maryland recently passed a law in 2012



DC Stormwater

requiring many MS4s in the state to implement a stormwater utility program. Montgomery County, MD has been a leader in this area and established its Water Quality Protection Charge in 2002.¹³⁸ Importantly, a stormwater utility fee is different than a tax. While the specific differences can vary by state, in general a user fee such as a stormwater utility fee must be charged for a specific service that benefits the user and the amount of the fee must be equitably based both on the contribution to the problem and on the cost to provide the service.¹³⁹

After meeting these basic requirements, municipalities have significant flexibility in developing a fee and rate structure that fits the needs of their residents.

For example, many municipalities develop their stormwater utility fee based on the amount of impervious surface on a site. This directly impacts the amount of stormwater runoff generated from a site, and therefore the site's contribution to overall water quality problems and stormwater management needs. Two common measurements of impervious area that can be used to establish a user fee are % impervious surface area and gross parcel area.¹⁴⁰ Municipalities can also

refine the rate structure of the stormwater utility fee using a combination of flat, tiered, and variable fees.¹⁴¹ A typical rate structure would establish a flat fee for single-family homes and then either a tiered or variable fee of other non-residential properties. Examples of stormwater utility fees include Griffin, Georgia and Union, Ohio. The City of Griffin, located approximately 40 miles south of Atlanta, established Georgia's first stormwater utility fee in 1997. Griffin's stormwater utility fee is based on a tiered system for residential properties that sets a fee for small and large residential properties and a variable rate for non-residential properties. For example, a small single-family home would pay a set fee of \$1.77 per month which is approximately 60 % of the Equivalent Residential Unit (ERU), or the typical amount of impervious surface on a parcel of that size. A non-residential property would pay \$2.95 per ERU per month under the variable rate. The City of Union, Ohio is located north of Dayton, Ohio and established its stormwater utility fee in 1998. Due to unique local conditions, such as 95 % residential parcels, relatively small population, and limited staff capacity, the City established a three tiered flat rate structure. As of 2005, residential properties were charged \$3 per month, commercial properties were charged \$6 per month, and industrial properties were charged \$9 per month.¹⁴² These two examples illustrate how a stormwater utility fee can be adapted to local needs and specific conditions.

Establishing a dedicated revenue stream for stormwater management increases the resources available to fund stormwater management, including green infrastructure. For planned construction, improvement, and reconstruction of municipal roads, revenue from a stormwater utility fee could potentially be used to cover the costs of adding green infrastructure elements to the project.

2) Integrate Green Infrastructure into Planned Capital Improvement Projects

Either in combination with a stormwater utility fee or alone, municipalities should consider integrating green infrastructure elements into planned capital improvement projects. Cost savings can be found by adding in green infrastructure practices to planned projects. For example, a city could add in bioswales or permeable pavement elements into a planned street reconstruction project and potentially make the project eligible for more diverse funding streams while at the same time creating multiple benefits such as reducing stormwater runoff or mitigating local flooding. The city of Lancaster, Pennsylvania rebuilt a hazardous intersection while incorporating green infrastructure into the design. The City took a dangerous merge lane and transformed it into an outdoor patio for the Lancaster Brewing Company that uses permeable pavers, native plants, and a cistern that the brewery can use to irrigate its garden.¹⁴³ This project is part of a broader effort through which the City created a Green Infrastructure Plan to reduce gray infrastructure capital investments and lower wastewater pumping and treatment costs of managing its combined sewer system as well as increasing environmental benefits throughout the City. The estimated capital costs of the 25-year implementation plan for the City was \$141 million with an estimated marginal cost for green infrastructure elements of \$77 million. The estimated cost for implementing these green infrastructure practices was 45 % less as part of the overall capital improvement plan than if the green infrastructure practices were implemented as stand-alone projects.¹⁴⁴ In order to effectively integrate green infrastructure into planned capital improvement projects, greater coordination among municipal departments must occur in the initial planning process to identify potential opportunities to include green infrastructure elements.

3) Evaluate Alternative Financing Mechanisms

Municipalities should evaluate alternative financing mechanisms, such as business improvement districts or tax increment financing, to provide funding for integrating green infrastructure into transportation projects. Local governments could also consider supporting the development of innovative approaches similar to a stormwater utility, such as the San Mateo County, California vehicle registration fee that is used to pay for programs that reduce traffic congestion and stormwater pollution or the Portland % for Green fund.

In a Business Improvement District (BID), a group of property owners share in the cost of infrastructure improvements and maintenance costs. A BID creates a legal mechanism for property owners to plan and develop a joint funding source for infrastructure in a defined area. They are often initiated when a group of stakeholders votes to approve their creation and can take a variety of forms, such as Community Improvement Districts or Neighborhood Improvement Districts. BIDs are generally managed by a Board of Directors composed of business owners within the district or representatives elected by the owners.^{145, 146} Funding through a BID comes from a special assessment fee paid by property owners directly into the BID to pay for a variety of services such as public safety, marketing, and capital improvement projects. While a municipality would not lead the development of a BID, it should ensure that local ordinances and other regulations don't prohibit or limit their use when appropriate. Municipalities should also engage property owners in the capital improvement planning process and provide education about the importance of stormwater management and green infrastructure solutions. The creation of a BID can support the efforts of the municipality and provide increased opportunities to integrate green

infrastructure into transportation projects. For example, in Portland, Oregon, a group of property owners created the Northeast 97th Avenue Green Street Local Improvement District in 2010. Funding from the Local Improvement District along with additional funding from the Gateway Urban Renewal Area through the Portland Development Commission, a tax increment district, and the 1% for Green Fund paid for the installation of vegetated swales and street trees to manage stormwater.¹⁴⁷

Tax increment financing (TIF) offers another potential funding mechanism. TIF works by selling bonds to fund development in a particular area and then using the “tax increment” based on expected increased property values as a result of the public improvements to pay back the bonds. In other words, the debt is financed through expected future tax revenues.¹⁴⁸ While not without criticism, TIF offers a potential strategy for local governments to pursue to better integrate green infrastructure in transportation projects. There are different ways that TIF can be structured, for instance, passing the risk onto developers by requiring developers to pay the debt if the tax revenues are unable to cover the total. However, this can create a disincentive for private investment.¹⁴⁹ As demonstrated by the Northeast 97th Avenue example from the city of Portland, tax increment financing can be used to support green infrastructure in transportation projects.

Municipalities should also consider other innovative financing approaches from across the country. In San Mateo County, California, Assembly Bill 1546 passed into law in 2005 which required a \$4.00 annual fee for motor vehicles registered in the county. The proceeds from this fee would go towards programs to reduce traffic congestion and stormwater pollution. Funding from the fee was used for green infrastructure demonstration projects as well as a design

guidebook released in January 2009 for the construction of sustainable green streets and parking lots. In 2010, voters decided to maintain the fee and increased it to \$10.00 annually. As a result, the fee is expected to yield more than \$6.7 million annually.¹⁵⁰ This fee makes a clear connection between the impact that roads and parking lots have on stormwater pollution and water quality and offers a mechanism to provide additional funding for green infrastructure in transportation projects. As discussed in more detail previously, the City of Portland requires new development and redevelopment projects that occur in the right-of-way but don't trigger the the City's stormwater requirements to pay 1% of the construction costs into the % for Green fund.¹⁵¹ These two examples highlight innovative approaches to pay for green infrastructure in transportation projects.

4) Grant Opportunities

There are a number of different state and federal grant opportunities that municipalities and transportation agencies can pursue to fund transportation projects that incorporate green infrastructure. Grant funding can be used to fully fund a project or to provide match. The following list of grant opportunities is not exhaustive, but rather illustrates a wide spectrum of grants that may be available at the state and federal level for planning or implementation of transportation projects that incorporate green infrastructure. There are opportunities for decision makers to advocate for continued funding of these programs and for changes in how these grants are disbursed to better prioritize transportation projects that incorporate green infrastructure.

The Transportation Investment Generating Economic Recovery, or TIGER, Discretionary Grant Program

In 2009, the American Recovery and Reinvestment Act (ARRA) established

the Transportation Investment Generating Economic Recovery (TIGER) Program. Under the first round of funding, \$1.5 billion was appropriated to the U.S. Department of Transportation (USDOT) for discretionary grants available on a competitive basis to state and local governments, tribal governments, U.S. territories, transit agencies, port authorities, metropolitan planning organizations (MPOs), and other eligible entities for eligible surface transportation projects of national or regional significance that met certain criteria. Eligible projects included highway or bridge projects such as interstate rehabilitation or bridge replacements, public transportation projects, passenger and freight rail transportation projects, and port infrastructure investments. Selection criteria included sustainability, prioritizing projects that improve energy efficiency and benefit the environment; livability, including projects that improve the quality of life for communities; partnership, including projects that bring together a wide range of partners and stakeholders that support other public service efforts; and innovation, prioritizing projects that incorporated forward-thinking strategies with multiple benefits. The TIGER program is part of the USDOT's partnership with the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD) known as the Partnership for Sustainable Communities to increase collaboration across these agencies to improve livability by increasing access to affordable housing and transportation options, investing in safe and walkable neighborhoods, and supporting a healthy and sustainable environment for communities. Since it was established in 2009, the Partnership has provided an estimated \$3.5 billion to 700 communities across the country to put its livability principles into practice.¹⁵²

In the first round of TIGER funding, the Mercer Corridor Project in Seattle received TIGER funds for a street reconstruction and rehabilitation project that included green infrastructure. The Mercer Corridor Project received \$30 million to reconstruct and realign Mercer and Valley Streets to reduce a major traffic bottleneck, improve safety and access, as well as integrate more sustainable elements. As part of the road reconstruction, bioretention and rain gardens were added to create "wet medians" that capture and infiltrate stormwater runoff reducing impervious surfaces by 0.7 acres. Additionally, the project included installation of 269 shade trees which work to mitigate the urban heat island effect, can reduce heating and cooling costs, and can lower pavement maintenance costs.¹⁵³

Since 2009, funding for TIGER grants has continued in the budgeting and appropriations processes. Multiple funded projects have included green infrastructure elements, demonstrating the potential for green infrastructure to make a project application more competitive. For example, in fiscal year 2010, New York City Department of Transportation received \$10 million for the Fordham Transit Plaza project. The DOT will reconstruct the transit plaza to improve pedestrian and vehicle safety and will include bioswales to capture stormwater runoff.¹⁵⁴ In fiscal year 2012, the City of Hartford received \$10 million in support of its Intermodal Transportation Triangle project that is part of its "One City, One Plan" regional vision for economic development and job creation. The project will improve connections between the City's Main Street and its rail and bus transportation hub, Camden Union Station. As part of the project, the City will rebuild several streets known as Bushnell Park North and install a boulevard with traffic calming elements,

wider sidewalks, enhanced crosswalks, and bioswales to capture stormwater runoff, turning it into a green street. The boulevard will connect the Main Street with Camden Union Station and its bike path will become part of the East Coast Greenway, which is a 2,900 mile trail system linking Maine to Florida.^{155, 156} In fiscal year 2013, the City of Olean, New York received \$6.5 million to transform an older main road, reducing the width and transforming it into a boulevard with street trees in the median, bike lanes on either side of the road, and traffic calming elements. The full \$8.8 million project will use additional capital, state, and private funds. To both improve stormwater management as well as snow and ice removal, the project includes bioretention areas along the sidewalks and parking areas. The City estimates that impervious surface would be reduced by 50 % using green infrastructure elements in the street, reducing stormwater runoff and supporting compliance with the City's consent decree to minimize overflows into the Allegheny River.¹⁵⁷

Importantly, the primary selection criteria for TIGER grants in the most recent round of funding available for fiscal year 2014 included specific language on green infrastructure. Included in the environmental sustainability criterion, the USDOT will assess a project's ability to "provide environmental benefits, such as brownfield redevelopment ground water recharge in areas of water scarcity, wetlands creation or improved habitat connectivity, and stormwater mitigation, including green infrastructure." Additionally, the notice encourages applicants to provide quantitative information regarding how the project will reduce stormwater runoff and provide other environmental benefits.¹⁵⁸ The deadline for applications closed at the end of April 2014 and there is \$600 million available under the TIGER

program for this round of projects. This language represents an important step forward to increasing prioritization of transportation projects that incorporate green infrastructure and provides additional incentives for applicants to include green infrastructure to make their project more competitive. Municipalities and transportation agencies should consider opportunities to integrate green infrastructure into transportation projects to make them more competitive.

Transportation Alternatives Program

Under MAP-21, the surface transportation authorization legislation enacted in 2012, the Transportation Alternatives Program (TAP) was established to provide funding to states for transportation alternatives, such as recreational trails, sidewalks, and pedestrian or bicycle facilities. Importantly, TAP also provides funding for environmental mitigation activities, "including pollution prevention and pollution abatement activities and mitigation to address stormwater management, control, and water pollution prevention or abatement related to highway construction or due to highway runoff."¹⁵⁹ Under MAP-21, the TAP program receives 2 % of the total amount authorized for federal-aid highways under the Highway Trust Fund each fiscal year. For example, the national total for fiscal year 2014 for TAP was \$819 million. Each state receives a proportional share of the overall total based on a formula and funds are typically administered, by the state DOT. Once the state receives its allocation, 50 % of the available funds are sub-allocated for use in certain areas of the state based on relative population and made available through a competitive process. The remaining 50 % can be used anywhere in the state and a state can decide to transfer that money into other federal-aid highway programs, such

as the Congestion Mitigation Air Quality Improvement (CMAQ) Program. Eligible entities for funding include local governments, transit agencies, regional transportation authorities, tribal governments, and natural resource or public land agencies. Although not eligible directly, state DOTs or MPOs can partner with an eligible project sponsor. Under TAP, cost-share requirements are the same as for general federal-aid highway projects with 80 % Federal and 20 % state or local match.¹⁶⁰ Funding through TAP could support the integration of green infrastructure into transportation projects, although changes to the program and funding availability may change as the surface transportation bill is re-authorized in the fall of 2014.

Urban Forestry Grants

The Urban and Community Forestry Challenge Cost-Share Grant Program is run through the National Urban and Community Forestry Advisory Council (NUCFAC) established in the 1990 Farm Bill under the U.S. Forest Service. NUCFAC assists the Secretary of the U.S. Department of Agriculture in the grant application and development process. The purpose of the grant program is to fund urban and community forestry projects that have a national or regional impact.¹⁶¹ While this program is not designed to fully fund capital projects or demonstration projects, it could be an important source of funding for capacity building and planning to set policies that incentivize green infrastructure for transportation. For example, the FY2015 funding cycle requests project applications that will address significant barriers to green infrastructure, focusing on the role of trees and urban forests. One example of an eligible project includes designing model design standards to improve the health

and function of trees used for stormwater management. This could help a local government fund design standards for street trees on green streets.¹⁶² The Urban Forestry Grants illustrate how transportation agencies and local governments can look to alternative sources of funding to support efforts to develop a green street policy, integrate green infrastructure upfront in planning processes, or address specific barriers to including green infrastructure in transportation projects.

Community Development Block Grants

The Community Development Block Grants (CDBG) through the U.S. Department of Housing and Urban Development (HUD) provides annual grants through a formula to local governments and states. The CDBG program is designed to assist in community redevelopment, providing funding to expand economic activity, improve community services, and revitalize neighborhoods. Eligible activities include the construction of water infrastructure and streets.¹⁶³ States and local governments could look to the CDBG program as a potential source of funding to add green infrastructure elements into a street reconstruction project, for example. In June 2013, the Secretary of HUD initiated the multi-state Rebuild by Design competition to encourage innovative design proposals to rebuild following Hurricane Sandy.¹⁶⁴ The City of Hoboken, New Jersey committed to set aside CDBG funding for disaster recovery to the winners of the Rebuild by Design competition to reduce the impact of flooding in the city. One of the submitted proposals includes a redesign of Washington Street adding permeable pavement, rain gardens, and bioswales to reduce the risk of flash flooding exacerbated by high volumes of stormwater runoff. The winning de-

sign will be selected in the spring of 2014. This example illustrates how local governments, states, and transportation agencies can look to alternative funding sources to leverage investment in green infrastructure for roads and highways.

Metropolitan Planning Program and State Planning and Research Program

Both of these grant programs are jointly administered by the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) to fund planning activities that enhance economic competitiveness, increase safety and accessibility, protect and enhance the environment, improve quality of life, and improve coordination between transportation development and planned growth and economic development. State DOTs and MPOs are both eligible for funding and each state DOT is apportioned funding through an established formula based on the urbanized population in the state. Once the state DOT has received funding, it is able to distribute funds to MPOs based on another formula.¹⁶⁵ The State Planning and Research Program is funded under a 2 % set-aside from the National Highway Performance Program (NHPP), the Surface Transportation Program (STP), the Highway Safety Improvement Program (HSIP), and the Congestion Mitigation Air Quality Improvement (CMAQ) Program. Funds can be used for research and technology transfer related to the planning, design, construction, and maintenance of highways; planning activities for future transportation systems and integration with metropolitan and state-wide planning; and training and research on engineering and design standards.¹⁶⁶ A state DOT could use this funding to develop appropriate design standards for

green infrastructure on highways, update its technical manuals to reflect the most forward-thinking best management practices including green infrastructure, and provide training to staff about the construction and maintenance of appropriate green infrastructure BMPs on highways.

These grant opportunities provide some examples of grants that may be available to local governments, states, or transportation agencies to leverage funding to incorporate green infrastructure into appropriate road and highway projects. The addition of green infrastructure may make these projects more competitive, as in the case of the City of Hoboken's efforts to address flooding using funding through the Community Development Block Grants or under the recently updated guidelines for projects funded under the Transportation Investment Generating Economic Recovery (TIGER) program that prioritize use of green infrastructure to manage stormwater runoff. Similar or related grant opportunities may be available at the state or local level.

In summary, there are a number of different financing mechanisms that local governments and transportation agencies should consider to help pay for green infrastructure in transportation projects. Implementing a stormwater utility, integrating green infrastructure into capital improvement plans, evaluating alternative financing mechanisms such as Business Improvement Districts or tax increment financing, and applying for grant funding represent various strategies that can be used alone or in combination to finance green infrastructure practices on roads and highways.

CHAPTER 4

Toledo, Ohio Case Study

Toledo, Ohio

Toledo, Ohio is located in northwestern Ohio along the Maumee River near the western end of Lake Erie. As of 2012, Toledo's population was estimated to be 284,000 with a median household income from 2008-2012 of \$33,374.00 according to the U.S. Census.¹⁶⁷ The City has a combined sewer system, which means that when rainfall overwhelms the capacity of the wastewater treatment system, stormwater and untreated sewage are released together into the Maumee.¹⁶⁸ Additionally, high levels of impervious surface exacerbate chronic localized flooding in the City.^{169, 170} In compliance with the Clean Water Act, Toledo manages discharges of stormwater runoff under its MS4 permit which is regulated by the City of Toledo Division of Environmental Services.¹⁷¹ The City is also under a federal court-ordered Consent Decree to reduce discharges from the combined sewer system, known as combined sewer overflows (CSOs). Referred to as the Toledo Waterways Initiative, the City's Long-Term Control Plan (LTCP) to reduce CSOs was revised and approved by both U.S. EPA and the Ohio EPA in 2010.¹⁷²

To address the need to reduce chronic localized flooding and CSOs, the City has taken steps to incorporate green infrastructure along with more conventional gray infrastructure practices to manage stormwater runoff. For example, the City has implemented multiple pervious alleys such as those on Dexter Alley installed in 2010 and six alleys in the New York Avenue area installed in 2011.¹⁷³ The City was also awarded nearly

\$1 million under the Green Project Reserve through the Clean Water State Revolving Fund (SRF) to retrofit Maywood Avenue using permeable pavement on sidewalks and driveway aprons and bioswales in the public right-of-way.¹⁷⁴ Additionally, the City has established a Green Stormwater Infrastructure Task Force to comprehensively evaluate opportunities to strategically implement green infrastructure across citywide.

At a broader planning scale, in 2011, the City approved its Toledo 20/20 Comprehensive Plan that outlines strategies and goals for growth and development, including a guide for large public investments and recommendations for land use. The plan includes specific transportation, infrastructure, and environmental quality recommendations for the City. Key recommendations include setting a 20-year timeframe to increase street trees and landscaping of arterial streets and creating a "sense of place" for the downtown area by standardizing street design including landscaping elements.¹⁷⁵ Citywide plans like Toledo 20/20 as well as more targeted programs or permitting requirements help to shape how green infrastructure can be integrated with transportation projects to better manage runoff from roads and highways.

Transportation Planning

The state transportation agency in Ohio is the Ohio Department of Transportation (ODOT). The Ohio governor, with input from the state Senate, appoints the director of transportation who leads the agency.¹⁷⁶



PHOTO: Dan Christian with Tetra Tech.

A street retrofit in Toledo, OH.

ODOT is a multimodal agency, responsible for the planning, construction, and maintenance of transportation systems including roads, bridges, highways, mass transit, freight rail, and aviation. As of 2009, there were 262,024 road and street lane miles and 241 miles of tolled roads under ODOT's jurisdiction. The agency is funded primarily through federal and state motor fuel taxes.¹⁷⁷ There are 12 district offices across the state and 17 Metropolitan Planning Organizations (MPOs).¹⁷⁸ Transportation projects are nominated by ODOT, MPOs, local governments, port authorities, and other eligible entities. The director of transportation develops a prioritization process for those projects and serves on the Transportation Review Advisory Council which reviews and ranks the projects. Public hearings are required as part of this review process.¹⁷⁹

The City of Toledo is under the jurisdiction of ODOT's District Two which includes approximately 3,381 lane miles of highways, 934 bridges, and an estimated 8,000 culverts.¹⁸⁰ Within Toledo, approximately 200 miles of the City's streets are unimproved, lacking curbs and gutters.¹⁸¹ The City is also a member of the Toledo Metropolitan Area Council of Governments (TMACOG), a regional council and Metropolitan Planning Organization (MPO) that brings together governmental and non-governmental entities in the region. As Toledo's MPO, TMACOG brings together transportation stakeholders, reviews funding requests for federal assistance, updates and releases the Transportation Improvement Program (TIP), and develops long-term plans.¹⁸² Within the City, streets are largely under the jurisdiction of the Department of Public Utilities'

Engineering Services and the Department of Public Services' Division of Transportation. Every year, street projects are prioritized for funding and implementation. Although this process currently takes into account water lines and sewer replacement, it does not include stormwater management needs. Capital improvement transportation projects are ranked and prioritized based on different criteria established under the Department of Public Utilities' capital improvement budget. Capital dollars through the City's general fund can be used for transportation as well.¹⁸³

Stormwater Management for Roads and Highways

Stormwater runoff from roads and highways under ODOT's jurisdiction is managed under the agency's Small MS4 General permit. The current permit does not include language to specifically support or prioritize green infrastructure practices.¹⁸⁴ However, the Location and Design (L&D) Manual does include some green infrastructure technologies as best management practices (BMPs) for water quality and water quantity treatment, such as bioretention cells. This manual serves as a guide for the design of stormwater facilities that allow ODOT to remain in compliance with its permit requirements.¹⁸⁵ Additionally, the Toledo Metropolitan Area Council of Governments (TMACOG), the regional MPO for the Toledo area, passed a

resolution in 2010 endorsing the use of the Low Impact Development Manual for the Lower Maumee and Ottawa Watersheds as official TMACOG policy.¹⁸⁶ The City of Toledo's MS4 permit covers stormwater runoff from municipal streets and roads and, similar to ODOT's permit, does not have specific language that supports or prioritizes green infrastructure. Toledo's MS4 permit expires July 31, 2015.¹⁸⁷

Although the City could strengthen its prioritization of green infrastructure across all road and highway projects, it is investing in demonstration transportation projects that incorporate green infrastructure. For example, Toledo was awarded nearly \$1 million under the Clean Water State Revolving Fund under the recently created Green Project Reserve to retrofit Maywood Avenue using permeable pavement on sidewalks and driveways and bioswales in the public right-of-way.¹⁸⁸ In March 2014 the City received a \$500,000 grant from the Great Lakes Shoreline Cities Green Infrastructure Grants under the U.S. Environmental Protection Agency. The grant will enable the City to fund several green infrastructure projects including a street retrofit using bioswales and rain gardens in the public right-of-way.¹⁸⁹ These examples illustrate how the City is taking critical steps to invest in demonstration green street projects, laying the groundwork for broader and more strategic integration.

Transportation Planning, Project Development, and Funding Recommendations to Better Integrate Green Infrastructure into Transportation Projects for Toledo, Ohio

Recommendations for Ohio Department of Transportation (ODOT) and Toledo Metropolitan Area Council of Governments (TMACOG)

Planning

- **Establish a Context Sensitive Solutions (CSS) Policy:** Currently, the Ohio Department of Transportation (ODOT) does not have a Context Sensitive Solutions (CSS) policy in place.¹⁹⁰ The department has taken steps in this direction by establishing its Aesthetic Design Initiative to improve the appearance of transportation projects that brings together diverse stakeholders and community members in the design process.¹⁹¹ Aesthetics and consideration of how transportation projects fit into the existing environment is an important element of CSS policies. However, this could be strengthened to further support consideration of the impact of transportation projects on water quality and quantity.
- **Consider implementation of a Green Highways Watershed Approach:** ODOT could implement a Green Highways Watershed Approach to better integrate the use of green infrastructure on road and highway projects to manage stormwater runoff. This approach is based on the following principles 1) regulatory compliance is a minimum requirement for acceptance; 2) requires a stormwater management plan that considers watershed-wide needs that is based on collaborative watershed improvement goals and plans, and developed in collaboration with local governments and resource agencies; 3) focuses on achieving good environmental results for the

watershed in a cost-effective manner, not just meeting regulatory requirements by using traditional, end-of-pipe approaches; 4) integrates stormwater plans into project development and project features; 5) uses collaborative partnerships to leverage and deliver a combination of watershed improvements to cohesively and consciously produce tangible results; and 6) a coordinated mitigation/enhancement strategy is important — coordination with other projects in the watershed is necessary.¹⁹² Even if ODOT does not establish a formalized policy, the department could implement different aspects of this overall approach. For example, ODOT could develop partnerships with local governments, natural resource agencies, and other stakeholders to develop a stormwater management plan that takes into account watershed-wide priorities or ensure that stormwater management is prioritized in the NEPA process.¹⁹³

- **Prioritize Stormwater Management Needs and Projects that Utilize Green Infrastructure in Long Range Transportation Plans:** ODOT released its long-range transportation plan, entitled Access Ohio 2040 in 2012. Public comment closed on the plan in January 2014. The draft plan includes six goals to guide ODOT's policies and investments through 2040, including a renewed focus on stewardship and minimizing environmental impacts.¹⁹⁴ Under this draft plan, ODOT notes that the impact of environmental regulations and policies should be considered in the project development phase but that climate variability is one element that should be considered in long-range planning. While an increase in severe storms and flooding is mentioned as a

likely outcome, the draft plan could be strengthened to encourage upfront analysis and implementation of green infrastructure practices to improve resiliency and reduce localized flooding.¹⁹⁵

At the regional level, TMACOG is also in the process of developing its 2015-2045 Transportation Plan which includes environmental sustainability as one of its eight goals. Results made publicly available of community member and stakeholder feedback found that 82 % of respondents either agreed or strongly agreed that “rain that falls on roads and parking lots runs into storm sewers and pollutes rivers and streams. To reduce pollution, we should use ‘green’ practices near pavement to filter stormwater and allow it to soak into the ground naturally.”¹⁹⁶ Building on successful investments in projects in Toledo such as Maywood Avenue and the support for these approaches as evidenced by this stakeholder survey, TMACOG should use this opportunity to better prioritize green infrastructure in its long-range planning process.

Project Development

■ **Update Permit and Design Manual:**

ODOT is required to manage stormwater runoff under its Small MS4 General Permit. As described in more detail previously, under an MS4 permit, DOTs are required to meet six minimum requirements including post-construction stormwater management. Ohio DOT provides technical information and guidance regarding best management practices for post-construction stormwater management in its *Location and Design Manual: Volume Two Drainage Design*. This document provides technical information about Best Management Practice (BMP) selection and implementation. Eligible BMPs include practices considered green infrastructure

for highways such as vegetated filter strips, bioretention cells, and infiltration trenches. BMPs are selected based on “providing maximum runoff treatment while minimizing impacts to the remaining project design features, including utilities and right-of-way.”¹⁹⁷ To prioritize the use of green infrastructure BMPs, ODOT’s permit should be revised to include objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area. ODOT should consider the Washington State Department of Transportation’s (WSDOT) model where WSDOT revised its NPDES permit to include new requirements to prioritize Low Impact Development (LID), or green infrastructure.¹⁹⁸

Additionally, ODOT should revise its *Location and Design Manual* to provide more information about green infrastructure and expand eligible BMPs, including practices such as permeable pavement. Even if ODOT does not revise its permit, it should provide greater technical information about the use of green infrastructure and amend its BMP selection process to encourage the use of green infrastructure. In addition to its permit requirements, WSDOT updated its technical manual to establish a BMP selection process that requires consideration of green infrastructure first and then using other BMPs if green infrastructure is not feasible.¹⁹⁹

- **Revise Complete Streets Policy to Include Green Infrastructure:** In March 2014, TMACOG adopted a Complete Streets Policy to ensure that project sponsors that receive federal funding through TMACOG consider, evaluate, and include diverse users and multiple transportation options. A complete street is defined in the policy as “streets, highways, and bridges that are routinely

planned, designed, operated, and maintained to safely and comfortably accommodate all transportation system users along and across the entire public right-of-way. This includes but is not limited to motorists, cyclists, pedestrians, transit and school bus riders, deliver and service personnel, freight shippers, and emergency responders.”²⁰⁰ Under this policy, TMACOG will promote the use of complete streets and recommend adoption of a consistent complete streets policy by the state and by local governments. Projects that request federal funding through

TMACOG must adhere to this policy and sponsors are required to complete a checklist ensuring that their project meets these requirements, with some exceptions. While this is an important step forward, TMACOG should consider including green street elements into this existing policy or adopt a complimentary Green Streets Policy. Requiring that projects meet a Green Streets policy will ensure that more transportation projects incorporate green infrastructure to manage stormwater runoff.

Recommendations for the City of Toledo

Planning

- **Update Capital Improvement Planning Process to Include Evaluation of Stormwater Management Needs:** Each year, the City evaluates street projects for funding and implementation. Although the City takes into account the need for water and sewer line replacement, it does not currently include stormwater management needs. Through its capital improvement planning process, the City should add additional criteria to evaluate stormwater needs. This could allow the City to better leverage funds to implement green infrastructure rather than constructing stand-alone projects.

Project Development

- **Update Permit:** Similar to ODOT’s MS4 permit, the City of Toledo’s MS4 permit does not include specific language that supports or prioritizes green infrastructure.²⁰¹ The City’s current MS4 permit expires July 31, 2015. Municipal staff members note that typically the City is notified at least 180 days prior to the

current permit expiration to submit their permit application. Current state and federal laws as well as compliance issues during the last permit cycle and applicable Total Maximum Daily Load (TMDL) requirements are all considered when the City drafts its new permit. Through this process, the City should consider opportunities to include objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area, the recommendations of the Green Stormwater Infrastructure Task Force, and the potential to include specific milestones and metrics in the permit draft.

- **Revise Design Manual:** The “Infrastructure Design and Construction Requirements” manual provides design and construction requirements for roadways, stormwater management, sanitary sewers, and water distribution facilities within the City of Toledo. These requirements apply to all new roads and streets, as well as new industrial, commercial, residen-

tial, and flood hazard zone development, and the reconstruction or expansion of those developments.²⁰² The Infrastructure Design and Construction Requirements manual requires the usage of design standards under the Stormwater Management Standards Manual developed by the TMACOG Stormwater Coalition, other laws and requirements that exceed those standards where applicable, and adherence to the following: “all development shall be planned, designed, constructed, and maintained to 1) protect and preserve existing natural drainage channels to the maximum practicable extent; 2) protect development from flood hazards; 3) assure that waters drained from the development are substantially free of pollutants, through such construction and drainage techniques as sedimentation ponds, reseeding, and phasing of grading; 4) assure that waters are drained from the development in such a manner that will not cause erosion to any greater extent than would occur in the absence of development.” The Stormwater Management Standards Manual developed by TMACOG specifically highlights green infrastructure and notes the importance of combining non-structural and structural practices to manage stormwater. This manual requires the use of a “Runoff Reduction Hierarchy” where non-structural approaches, such as green infrastructure, should be considered before consideration of structural practices. The manual also includes technical design standards for green infrastructure practices such as bioretention cells.²⁰³

Importantly, most roadway projects by the City are exempted from post-construction BMP requirements.²⁰⁴ Under the Infrastructure Design and Construction Requirements manual, “linear construction projects (e.g. pipeline or utility line installation), which do not result in the installation of additional impervi-

ous surface, are not required to include post-construction BMPs.”²⁰⁵ Projects that disturb greater than one acre trigger a requirement for post-construction BMPs which must be in accordance with the Ohio Environmental Protection Agency (EPA) General Stormwater Permit. When a post-construction BMP is required, the “Infrastructure Design and Construction Requirements” manual refers to the TMACOG “Stormwater Management Standards Manual” for applicable BMPs and requires that “strong consideration shall be given to designs incorporating low impact development solutions such as grassy swales and bioretention.”²⁰⁶ Toledo municipal staff noted that for road widening projects and other projects where the post-construction BMP requirement was triggered, the design typically follows the ODOT “Location and Design (L&D) Manual.”²⁰⁷ This illustrates the importance of revising ODOT’s L&D manual with additional technical information about green infrastructure. It also shows a potential opportunity to revise the threshold under which a roadway project would be required to implement post-construction BMPs. The City should consider adjusting this standard to more comprehensively apply post-construction management practices to road projects.

- **Revise Complete Streets Policy to Include Green Streets Elements:** The City should consider amending its existing Complete Streets Policy, which was adopted in 2010, to strengthen criteria that encourage the use of green infrastructure. Under its municipal code, the City requires the integration of complete street elements into public transportation and infrastructure projects where it is economically and technically feasible. Complete street elements include sidewalks, improved access to public transit, pedestrian crossings, street lighting and landscaping, as well as signage. The stated

goal of Toledo's Complete Streets Policy is to "plan, design and construct transportation and infrastructure improvements throughout the City in a manner which produces safe access to and active use by walkers and those on bicycles as well as accommodating those in public and privately owned vehicles."²⁰⁸ The landscaping element is already included in the existing policy and this could be clarified to ensure that landscaping for municipal streets is designed to manage stormwater runoff. Smart Growth America's National Complete Streets Coalition notes the important role that the landscaping element of a complete streets policy can play in encouraging the integration of green infrastructure such as bioswales, rain gardens, and street trees.²⁰⁹ Revising the goal of the policy to include "promoting environmental sustainability" or similar language could be a first step to strengthening it to better encourage green infrastructure.

As a next step, the City should consider incorporating green elements into its Complete Streets policy. Both La Crosse, Wisconsin and Cleveland, Ohio represent potential models. La Crosse adopted a Green Complete Streets ordinance which not only establishes standards to ensure safe and accessible access to multiple forms of transportation by diverse users, but is "further intended to provide a mechanism to combine the principles of complete streets and traffic calming with improving the stormwater quality and quantity problems that the City faces by incorporating stormwater considerations into each and every complete street or traffic calming activity where feasible."²¹⁰ This ordinance demonstrates the potential to integrate both the goals of a Complete Streets policy with those of stormwater management and green streets. Similarly, the City of Cleveland, Ohio also adopted a Green and Complete

Streets ordinance in 2011. The Cleveland ordinance authorizes the Director of Capital Projects to implement and enforce complete and green street policies that address livability needs; better accommodate walkers, cyclists, and public transportation; and reduce the environmental impact of transportation infrastructure "by incorporating green infrastructure strategies to reduce waste, storm water run-off, and energy consumption."²¹¹ Alternatively, Toledo could consider adopting a separate Green Streets Policy, following the model of cities like New York, Portland, or Tucson.

Funding

■ Strengthen the Stormwater Credit Program to Better Incentivize Green Infrastructure

In 1999, the City adopted a stormwater utility fee and created a stormwater credit program in 2001. Effectively, the stormwater credit program enables non-residential property owners an opportunity to apply for credits against their stormwater utility fee by installing stormwater management practices onsite.²¹² In Toledo, all residential properties are charged \$3.80 per month, effectively for one "Equivalent Residential Unit" (ERU). Non-residential properties are charged a stormwater fee based on the number of ERUs the property contains. An ERU is used to calculate a user fee that is proportional to the impervious surface area on the property. As of 2013, 93 different non-residential properties were enrolled in the stormwater credit program which gives credit for brownfield reuse, forested buffers and filter grass strips, detention and retention, direct discharge, industrial NPDES, open-channel maintenance, swales, wet ponds and extended detention, and sediment ponds.²¹³ A report by the University of Michigan released in



PHOTO: Scott Sibley, City of Toledo / Division of Engineering Services

A bioswale on Angola Road in Toledo, Ohio running through residential and commercial/office areas.

2013 identifies three broad revisions that should be made to the existing stormwater utility and credit program. First, the City should streamline credit categories into quantity and quality. Second, priority zones for areas that are prone to flooding or are located in the combined sewer area should be created. Third, the City should divide its existing stormwater utility fee into a fixed fee to cover administrative and maintenance costs and a property fee based on the amount of impervious surface on the property to cover the costs of stormwater management. Additionally, the report highlights case studies from the region and across the country including those that create specific incentives for green infrastructure. For example, the City of Syracuse, New York created a Green Improvement Fund which provides financial incentives to installing green infrastructure practices in high priority areas throughout the city. Building on these suggested changes, the City of Toledo should consider opportunities to prioritize

green infrastructure as an eligible practice under the stormwater credit program. In previous years the City offered incentives to homeowners who install rain gardens through the Toledo-Lucas County Rain Garden Initiative. Funding through the Great Lakes Protection Fund and the Institute of Water Research at Michigan State University enabled the City to offer homeowners grants up to \$150 and organizations up to \$500 to build rain gardens.²¹⁴ This type of incentive structure could be adapted for the stormwater credit program where participants receive more credit for building green infrastructure in high priority areas. The report also notes the importance of having a dedicated staff person who is able to work with property owners to determine the most appropriate stormwater management practices for that site. This could support the greater integration of green infrastructure into transportation projects across the city by providing more resources to private property owners.

■ Evaluate Alternative Financing Mechanisms and Grant Opportunities

The City should consider additional financing mechanisms, such as Business Improvement Districts (BIDs), tax increment financing, and other grant opportunities to provide additional sources of funding to better integrate green infrastructure into transportation projects. Downtown property owners in Toledo created the Downtown Toledo Improvement District (DTID) which functions as a special assessment district covering 38 city blocks that provides maintenance, marketing, safety, and economic development services.²¹⁵ If the City moves forward with green streets or other transportation projects that incorporate green infrastructure, the DTID could potentially play a role in financing those investments or providing funds for maintenance. The City should also evaluate opportunities to incorporate tax increment financing where appropriate and explore strategies to make planned transportation projects more competitive for diverse grant opportunities.

In conclusion, there are opportunities at the local, state, and regional levels to better integrate green infrastructure into transportation projects in Toledo. At the state level, ODOT could significantly strengthen its approach to green infrastructure and stormwater management more generally. ODOT's existing MS4 permit doesn't include any language that would encourage green infrastructure, the agency does not have a Context Sensitive Solutions (CSS) policy, and stormwater needs aren't substantively included in ODOT's long-range planning documents. However, at the regional level, TMACOG has made progress in integrating stormwater management and environmental impacts. For example, TMACOG has a Complete Streets policy which could be

strengthened by adding a green infrastructure component. At the city level, Toledo has demonstrated interest in further integrating green infrastructure through its existing demonstration projects and the development of the Green Stormwater Infrastructure Task Force. The City's capital improvement planning process should be updated to include an evaluation of stormwater management needs. Additionally, the City's MS4 permit doesn't contain language that would support or prioritize green infrastructure and should be revised to include objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area, the recommendations of the Green Infrastructure Task Force, and the potential to include specific milestones and metrics in the permit draft. To support changes to the MS4 permit, the City should utilize the Stormwater Management Standards Manual developed by TMACOG specifically highlights green infrastructure and notes the importance of combining non-structural and structural practices to manage stormwater.²¹⁶ Additionally, the City should evaluate the current exemption of most roadway projects from post-construction BMP requirements and revise the threshold under which a roadway project would be required to implement post-construction BMPs. Adding green streets elements into the City's existing Complete Streets policy would also support greater integration of green infrastructure in transportation projects. The City should consider updating its stormwater credit program to better incentivize green infrastructure and continue to evaluate alternative financing mechanisms and grant opportunities. Together with the recommendations of the Green Stormwater Infrastructure Task Force, the City should consider these strategies and make changes as appropriate to better implement green infrastructure citywide.

CHAPTER 5

Atlanta, Georgia Case Study

Atlanta, GA

The City of Atlanta, Georgia is the state capital and located in northwestern Georgia. Its population as of 2012 was estimated at 443,775 people with a median household income from 2008-2012 of \$46,146.00.²¹⁷ Atlanta is located in the Chattahoochee River, South River and Flint River basins.²¹⁸ Similar to Toledo and many older urban municipalities, Atlanta also has a combined sewer system to manage both stormwater and wastewater in older portions of the city.

Historically, there were seven discharge points from the Combined Sewer Area across the City that together drained over 13 square miles of urban land.²¹⁹ In 1998, the City of Atlanta signed a consent decree with the U.S. Environmental Protection Agency that required the City to eliminate water quality violations caused by CSO discharges into the Chattahoochee and South Rivers as well as in the local urban streams by 2008.²²⁰ The City met the compliance requirements of the Consent Decree by separating three historically combined areas and completed construction of system upgrades in October 2008. The City successfully reduced SSOs by 97 % by 2004, which in part led the courts to grant an extension on compliance with the 1999 consent decree until 2027.²²¹

Currently, there are four discharge points from the Combined Sewer Area. Due to the completion of a tunnel collection system network, facility upgrades, and construction of new facilities, there are now six auxiliary

treatment facilities for these 4 outfalls and all dry weather flows from the Combined Sewer Areas, as well as most wet weather flows, are transmitted to a Water Reclamation Facilities (i.e. publicly owned treatment works) for primary, secondary and tertiary treatment. The six Combined Sewage Treatment Facilities operate on an as-needed basis, only during those severe storm events when Combined Sewer Area flows and in-system storage are at capacity and additional treatment capacity is required. As a result of the system upgrades, Atlanta no longer has unpermitted discharges of untreated combined sewage.²²²

Although these upgrades have virtually eliminated discharges of untreated combined sewage, the City of Atlanta still recognizes the ongoing effects that general urbanization has on the environment, and has taken steps to incorporate green infrastructure to manage non-point source stormwater runoff within the City. Atlanta is a Phase I municipal separate storm sewer system (MS4) permittee and its most recent MS4 permit was issued in 2014. The City's current MS4 permit includes language in sub-section 3.3.10(b) which states that the Environmental Protection Division (EPD) "encourages the use of green infrastructure practices and approaches on both new and redeveloped sites."²²³ Under the permit, the City is required to review and revise building codes, ordinances, and other regulations to ensure that they do not prohibit or limit the use of green infrastructure. As part of these requirements, the City revised its standard construction details to include green infra-



PHOTO: City of Atlanta Department of Watershed Management

A dead end street retrofitted with a rain garden in the Custer Combined Sewage Area.

structure options and updated its existing post-construction stormwater management ordinance to better promote the use of green infrastructure for new development and redevelopment.²²⁴ The revised ordinance now requires new and redevelopment projects to treat the first inch of stormwater runoff with green infrastructure. New homes and large additions that would be considered single family residences are also required to manage the first inch of runoff on-site. Additionally, the revised ordinance addresses the importance of integrating stormwater management early in the planning process by requiring that any building permit applicants meet with City staff to ensure that they are familiar with these requirements and green infrastructure technologies.²²⁵ The City has conducted technical design workshops, created videos, and provided resources for the development

community about green infrastructure and the implementation of the post-construction stormwater management ordinance.²²⁶ Additionally, the City has established a Green Stormwater Infrastructure Task Force to develop green infrastructure goals, metrics, benchmarks and evaluate opportunities to strategically implement green infrastructure across citywide. The task force convenes educational events for City staff to learn more about green infrastructure, has developed recommendations for public and private initiatives to fund, track, implement green infrastructure across the city, and has identified immediate opportunities within the city's existing capital improvement plan to incorporate green infrastructure.

At a broader planning level, Atlanta is incorporating environmental sustainability and water quality into its infrastructure plans.

For example, the City of Atlanta's Capital Improvement Program (CIP) outlines the plan for the maintenance, construction, and re-construction of the City's major infrastructure systems. Every year, a committee with representatives from each City Department develops a list of projects with identified funding sources. The Office of Planning in the Department of Planning and Community Development reviews the CIP and the Department of Finance provides recommendations for funding sources. Following a public hearing, the CIP is sent to the Atlanta Regional Commission and to the Georgia Department of Community Affairs where it must be adopted every year by the City Council before October 31st.²²⁷ The most recent CIP includes green infrastructure projects, specifically permeable pavers, in the Custer Combined Sewage Area.²²⁸

Transportation Planning

In the state of Georgia, the Georgia Department of Transportation (GDOT) is the transportation agency for the state. GDOT is governed by the State Transportation Board (STB) which is composed of members from each of the Congressional districts in Georgia who are elected by state senators and representatives.²²⁹ The STB appoints the commissioner of GDOT and the governor appoints the director of planning for the agency. The director of planning works with different planning partners to develop transportation priorities and plans for the state. Projects prioritized under GDOT's prioritization process are included in the State Transportation Improvement Program (STIP), which is open to review by the state legislature.²³⁰

GDOT is responsible for planning, construction, and maintenance of roads, highways, bridges, mass transit, rail systems, and ports.²³¹ Seven district offices stretch across the state and are responsible for planning, design, construction, and maintenance of

transportation projects located within their service area. As of 2009, there were 256,952 road and street lane miles under GDOT's jurisdiction.²³² GDOT works with each of the fifteen different Metropolitan Planning Organizations (MPOs) in Georgia to develop their Transportation Improvement Program (TIP).²³³

The Atlanta Regional Commission (ARC) is the MPO for ten counties in Georgia including the City of Atlanta. The ARC includes three departments, the Center for Livable Communities, the Center for Strategic Relations, and the Center for Community Services.²³⁴ The ARC develops the Unified Planning Work Program (UPWP) every year coordinating with state and local governments to outline transportation planning priorities and planning activities that use federal, state, and local funding.²³⁵ Additionally, the ARC develops a long range transportation plan every five years. The current iteration is called PLAN 2040 and was adopted in 2011. Although the current plan doesn't address stormwater, it does highlight the uncertainty surrounding water supply for the region and future challenges that may result in planning.²³⁶ The short range transportation plan, known as the Transportation Improvement Program (TIP) was also adopted in 2011 and is updated every four years. Neither of these plans significantly addresses stormwater management. The ARC is also responsible for implementation of the Metropolitan River Protection Act (MRPA), which was enacted by the Georgia General Assembly in 1973. The MRPA created a 2,000 foot corridor along the banks of the Chattahoochee River and its impoundments to better protect this critical source of water supply for the City.²³⁷ Additionally, the ARC staffs the Metropolitan North Georgia Water Planning District, (Metro Water District), which was created by the Georgia General Assembly in 2001 to establish policy, create plans and promote intergovernmental coordination of all water issues in

the District from a regional perspective. The Metro Water District includes 15 counties and over 92 cities within the metro Atlanta region. The Metro Water District produces a district-wide Watershed Management Plan to address stormwater management issues at the level of local water and stormwater utilities.²³⁸ Also, the ARC facilitates implementation of the Clean Water Campaign, a regional education and outreach initiative on stormwater pollution for the Atlanta metropolitan area.²³⁹

The City of Atlanta is located in GDOT's District Seven. The City's Office of Transportation is located within the Department of Public Works and is responsible for managing the City's street network from traffic signals to street maintenance.²⁴⁰ There are 1,584 miles of surface streets, 51 miles of expressway lanes, and 54 miles of expressway access ramps throughout the City. In fact, the Department of Watershed Management found that more than 70 % of impervious public right-of-way surfaces across the City are paved roads.²⁴¹ The City's first comprehensive transportation plan, Connect Atlanta, was released in 2009. The plan highlights challenges and opportunities, including many streets which were built with more capacity than demand. The plan emphasizes the potential to re-think the use of public right-of-way, particularly for these larger streets that take up space that could be used for parking, bicycles, pedestrian facilities, or potentially green infrastructure.²⁴²

Stormwater Management for Roads and Highways

In 2012, the Georgia Environmental Protection Division (EPD) issued its first Phase II Municipal Separate Storm Sewer System (MS4) permit to GDOT to manage polluted runoff from roads and related facilities located within MS4 permitted areas of cities and counties.²⁴³ In addition to the Clean Water Act's MS4 permitting program under

Section 402, the Georgia Water Quality Control Act establishes requirements for how the Clean Water Act is implemented and sets water quality standards for the state.²⁴⁴ The Clean Water Act's MS4 program and the Georgia Water Quality Control Act, which complements the federal law, are the primary regulatory mechanisms that manage stormwater runoff from GDOT roads and highways.²⁴⁵ GDOT's MS4 permit includes in Section 4.2.5 Post-Construction Stormwater Management a sub-section with specific language that encourages the use of green infrastructure. Under 4.2.5.4 Low Impact Development/Green Infrastructure, the permit states that "EPD encourages the use of green infrastructure practices and approaches on both new and redeveloped sites. The permittee shall review all projects during the design phase to ensure the plans consider the use of green infrastructure practices, including infiltration, reuse, and evapotranspiration."²⁴⁶ Although this provision could be strengthened, it is an important step forward to ensuring that green infrastructure is considered at the design and planning stages and may encourage greater use of these practices.

As part of its effort to promote GI/LID practices under its MS4 permit, in October 2014 GDOT released a revised version of its Manual on Drainage Design for Highways, with a chapter (Chapter 10) devoted to post-construction stormwater design guidelines.²⁴⁷ For applicable projects as defined within the chapter (section 10.2), the manual requires consideration of GI/LID practices. It also requires that where applicable, BMPs must be sized to treat the initial 1.2 inches of runoff, as well as bringing about an 80% reduction in total suspended solids (TSS).²⁴⁸ This is in keeping with the current approach in Georgia's Stormwater Management Manual, known as "the Blue Book." GDOT's manual should be updated in the future to reflect updates to the Blue Book that are expected to further promote and guide the

implementation of green infrastructure. The chapter also details various LID/GI BMPs and provides guidelines for assessing their suitability for a given project. The drainage manual also now includes a template for a Post-Construction Stormwater Report to be submitted to GDOT with all plans where applicable, and this report's LID/GI Checklist is intended to assist GDOT with its tracking and reporting of the practices implemented where MS4 requirements apply.

Until GDOT revised its drainage manual in 2014, the Blue Book functioned as the stormwater management manual for GDOT. Although the Blue Book will no longer formally serve as the manual for GDOT projects, it will likely continue to provide useful design guidance beyond that which is provided in the GDOT drainage manual. The Blue Book is being updated in 2015, and green infrastructure is anticipated to play a much larger role in the updated version than it has in the current version of the manual. In addition, the manual is expected to include a focus on linear projects, which will likely tailor its focus even better to transportation projects.²⁴⁹ As part of these revisions, the technical handbook (Volume 2) should be strengthened; these enhancements could

follow many of the suggestions made below regarding enhancements to the post-construction stormwater chapter in GDOT's newly revised drainage manual.

Stormwater runoff from municipal streets and roads are covered under the City of Atlanta's Phase I MS4 permit effective June 12, 2009 through June 11, 2014. Under the terms of the permit, the City is required to implement and enforce a Stormwater Management Program (SWMP) to reduce discharges of pollutants from the MS4 to the maximum extent practicable. This permit amends the existing SWMP to include a requirement that the City review and revise ordinances, building codes, and other regulations to ensure that they don't prevent or impede the use of green infrastructure. The permit also requires that, at the minimum, the City specifically assess regulations governing road design and parking requirements. Additionally, during the regulatory review process the City should consider including incentives for green infrastructure in ordinances. Similar to the MS4 permit for GDOT, the City of Atlanta's MS4 permit encourages the use of green infrastructure for both new and redevelopment.²⁵⁰

Transportation Planning, Project Development, and Funding Recommendations to Better Integrate Green Infrastructure into Transportation Projects for Atlanta, Georgia

Recommendations for Georgia Department of Transportation (GDOT) and the Atlanta Regional Commission (ARC)

Planning

■ Strengthen the Existing Context

Sensitive Solutions Policy: In 2006, GDOT released its “Context-Sensitive Design Online Manual” to establish policy guidelines, research and development information, and project examples for GDOT staff, consultants, and other stakeholders.²⁵¹ The manual sets out five guiding principles and five steps to effectively implement context sensitive design (CSD), also known as context sensitive solutions. The manual includes recommendations that help to set the foundation for transportation projects that incorporate green infrastructure. For example, as part of the recommendation to initiate effective decision making, the manual recommends utilizing interdisciplinary project teams that include environmental staff and landscape architects in transportation planning and project development. The manual also prioritizes stakeholder input and public involvement. In its recommendation to integrate stakeholder interests through design solutions, the manual recommends incorporating flexibility and creativity into design that are generally consistent with the AASHTO Green Book, which provides general design policy and guidelines.²⁵² Additionally, the manual recommends achieving sensitivity to environmental and social concerns by understanding the problem and opportunities to minimize impacts. Including alternative perspectives early in the planning process, recommending creativity and flexibility in design, as well

as prioritizing opportunities to minimize environmental impacts may make it more likely for green infrastructure to be included in the project.

This policy could be strengthened to better prioritize stormwater management and the use of green infrastructure specifically by incorporating elements of the Green Highways Watershed Approach. As discussed previously, the six principles of this approach include: 1) regulatory compliance is a minimum requirement for acceptance; 2) requiring a stormwater management plan that considers watershed-wide needs that is based on collaborative watershed improvement goals and plans, and developed in collaboration with local governments and resource agencies; 3) focusing on achieving good environmental results for the watershed in a cost-effective manner, not just meeting regulatory requirements by using traditional approaches; 4) integrating stormwater plans into project development and project features; 5) using collaborative partnerships to leverage and deliver a combination of watershed improvements to produce tangible results; and 6) a coordinated mitigation or enhancement strategy is important.²⁵³

Including some elements of this approach could strengthen the existing CSD policy and lay the foundation for GDOT to increasingly look to green infrastructure to manage stormwater runoff. For example, the manual could be updated to include under Section 2.1 “Initiate Decision Making” a sub-section that recommends integrating stormwater plans into early stages of the planning and project development processes. Section 2.3 “Achieve Sensitivity to Social and Environmental

Concerns” could be updated to include consideration of watershed-wide needs as part of the scoping process. These examples illustrate ways to incorporate the Green Highways Watershed Approach into the existing CSD policy that would further encourage consideration of green infrastructure in transportation projects.²⁵⁴

- **Prioritize Stormwater Management Needs and Projects That Utilize Green Infrastructure in Long Range Transportation Plans:** Local, state, and regional transportation agencies are all involved in the transportation planning process. The long range transportation plans typically focus on broader goals and plans for the state or regional transportation systems while the short range plans include specific projects and strategies with full funding reasonably anticipated within the project and planning period. These planning processes offer additional opportunities to prioritize consideration of green infrastructure in transportation projects.

The Atlanta Regional Commission (ARC) is the Metropolitan Planning Organization (MPO) for the Atlanta area and is responsible for developing the region’s Long-Range Transportation Plan (LRTP) every five years, currently called PLAN 2040 which was adopted in 2011. PLAN 2040 describes both long and short-term actions over the next twenty years and must be consistent with the twenty year Long-Range Statewide Transportation Plan (LRSTP) developed by GDOT, called the Georgia Statewide Transportation Plan (SWTP) finalized in 2006. Neither PLAN 2040 nor the SWTP substantively address stormwater management for transportation projects. Under PLAN 2040, the ARC notes the ongoing uncertainty and challenges related to water supply in the Atlanta area. The SWTP

only recommends that best management practices for stormwater management be considered when a transportation project is located near a stream and would require a 404 permit.²⁵⁵ Additionally, neither long range transportation plan explicitly includes protecting or improving water quality that may be impacted by existing or future transportation projects. PLAN 2040 focuses on energy efficiency, while one of the overarching goals of the SWTP is to “protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns.” Additionally, a primary objective of the SWTP is to “ensure that the Statewide Transportation Plan and the Plan’s goals support the objectives of land use management agencies and organizations; natural resource management agencies; environmental protection agencies; and conservation and historic preservation agencies.”²⁵⁶

At the minimum, these long range transportation plans should be revised to forecast challenges and needs not just to water supply, but also to water quality that may impact transportation planning. Additionally, GDOT and the ARC should establish goals and strategies that prioritize water quality and watershed planning. The Unified Planning Work Program (UPWP) developed annually by the ARC is used to coordinate transportation planning activities across the region. This plan should be updated to include watershed planning or studies related to water supply or water quality impacts from transportation projects. It could include any ongoing or planned studies regarding the use of green infrastructure on roads and highways.

The new efforts by ARC to integrate the various water plans of the Metropolitan North Georgia Water Planning District, and to better connect the water plans with other ARC planning documents, could bode well for an approach to transportation planning in the region that considers land use and land planning impacts of transportation development as well as the potential to improve both water quality and water supply reliability through the use of green infrastructure in transportation projects in the Metro area.

Project Development

■ **Strengthen Permit to Prioritize Green Infrastructure:**

The Georgia Department of Transportation (GDOT) NPDES permit covers all new and existing point source discharges of stormwater from a municipal separate storm sewer (MS4) owned and operated by GDOT. Under the minimum control measure for post-construction stormwater management, the GDOT permit



PHOTO: City of Atlanta Department of Watershed Management

A street bump out using bioretention.

includes Section 4.2.5.4 “Low Impact Development/Green Infrastructure.” This provision encourages the Department of Natural Resources Environmental Protection Division (EPD) to use green infrastructure on both new and redeveloped sites and requires GDOT to “review all projects during the design phase to ensure the plans consider the use of green infrastructure practices, including infiltration, reuse, and evapotranspiration.” Additionally, the permit requires GDOT to, at the minimum, develop a program to conduct a green infrastructure feasibility study and to implement green infrastructure where feasible.²⁵⁷ The addition of the chapter on post-construction stormwater in GDOT’s revised drainage manual in 2014 reflects this requirement.

This permit is a critical first step towards encouraging greater implementation of green infrastructure in transportation projects. However, GDOT’s permit could be further strengthened by prioritizing green infrastructure. The California Department of Transportation (Caltrans) provides a model for how a DOT can further encourage the use of green infrastructure in a NPDES permit. In fact, one of the stated goals for Caltrans’ 2012 MS4 permit is to maximize opportunities to incorporate green infrastructure.²⁵⁸ Effective as of July 2013, the Caltrans MS4 permit requires all projects that create a disturbed soil area, including projects that are required to meet post-construction stormwater management requirements, to follow the “Design Pollution Prevention Best Management Practices” which consist of the following principles: “a) Conserve natural areas, to the extent feasible, including existing trees, stream buffer areas, vegetation and soils; b) Minimize the impervious footprint of the project; c) Minimize disturbances to natural drainages; d) Design and construct pervious areas to effectively receive runoff from

impervious areas, taking into consideration the pervious areas’ soil conditions, slope and other pertinent factors; e) Implement landscape and soil-based BMPs such as compost-amended soils and vegetated strips and swales; f) Use climate-appropriate landscaping that minimizes irrigation and runoff, promotes surface infiltration, and minimizes the use of pesticides and fertilizers; and g) Design all landscapes to comply with the California Department of Water Resources Water Efficient Landscape Ordinance.”²⁵⁹ This illustrates one approach to better prioritizing technologies, such as green infrastructure, that capture and treat stormwater runoff onsite. Additionally, the Caltrans permit requires that post-construction stormwater management best practices be designed to first prioritize infiltration, harvest, re-use, and/or evapotranspiration of stormwater runoff and second, capturing and treating stormwater runoff. Specifically, the permit states that the “Department shall always prioritize the use of landscape and soil-based BMPs to treat stormwater runoff. Other BMPs may be used only after landscape and soil-based BMPs are determined to be infeasible.”²⁶⁰ The Caltrans MS4 permit provides an example of how the GDOT permit could be strengthened beyond basic consideration of green infrastructure approaches to actually prioritize practices.

MS4 permits from Illinois and Minnesota, as detailed in the “Permitting Green Infrastructure” guide, provide two additional examples of how GDOT’s permit could better prioritize the use of green infrastructure.²⁶¹ The Illinois General MS4 permit from 2009 includes a list of prioritized general strategies: “i) preservation of the natural features of the developed site, including natural storage and infiltration characteristics; ii) preservation of existing natural streams, channels, and drainage

ways; iii) minimization of new impervious surfaces; iv) conveyance of storm water in open vegetated channels; iv) construction of structures that provide both quantity and quality control, with structures serving multiple sites being preferable to those serving individual sites; and vi) construction of structures that provide only quantity control, with structures serving multiple sites being preferable to those serving individual sites.”²⁶² These strategies are ranked by preference, requiring permittees to adopt one or more in order of preference, and to provide a rationale for selecting a different strategy. The GDOT permit could add a similar provision under Section 4.2.5.1(a) to not only encourage, but prioritize practices that reduce impervious surface, utilize natural infiltration, and address both water quality and water quantity.

Under the post-construction management section of the Minnesota Draft Phase II Permit adopted in 2012, permittees are required to “develop and implement a Post-Construction Stormwater Management program that requires the use of any combination of BMPs, with highest preference given to Green Infrastructure techniques and practices (e.g. infiltration, evapotranspiration, reuse-harvesting, conservation design, urban forestry, green roofs, etc.)” This permit clearly establishes green infrastructure as the preferred approach for post-construction stormwater management technologies. Additionally, the permit requires that for new development projects, there is “no net increase from pre-project conditions (on an annual average basis).”

Other alternatives to strengthen the post-construction stormwater management requirements and better encourage green infrastructure for GDOT new and redevelopment projects also include establishing

objective numeric performance standards to mimic pre-development hydrology and setting a limit or ceiling on the amount of effective impervious area. Additionally, the GDOT permit could incorporate the requirements from the City of Atlanta’s MS4 permit to establish a program develop an inventory of publicly and privately owned practices. The Atlanta permit also requires inspection and maintenance components as part of this program.²⁶³

■ **Enhance the GDOT Drainage Manual**

As part of its effort to promote GI/LID practices under its MS4 permit, in October 2014 GDOT released a revised version of its Manual on Drainage Design for Highways, with a chapter (Chapter 10) devoted to post-construction stormwater design guidelines.²⁶⁴ For applicable projects as defined within the chapter (section 10.2), the manual requires consideration of GI/LID practices. It also requires that where applicable, BMPs must be sized to treat the initial 1.2 inches of runoff, as well as bringing about an 80% reduction in total suspended solids (TSS).²⁶⁵ This is in keeping with the current approach in Georgia’s Blue Book, and GDOT’s manual should be updated in the future to reflect updates to the Blue Book that are expected to further promote and guide the implementation of green infrastructure. The chapter also details various LID/GI BMPs and provides guidelines for assessing their suitability for a given project. The drainage manual also now includes a template for a Post-Construction Stormwater Report to be submitted to GDOT with all plans where applicable, and this report’s LID/GI Checklist is intended to assist GDOT with its tracking and reporting of the practices implemented where MS4 requirements apply.

This creates a more relevant and somewhat more updated technical document building upon the expanding information available regarding the use of green infrastructure in transportation projects. With updated technical information, its guidance may need to shift and become more up-to-date and robust as more information regarding the use of GI practices in transportation projects becomes available.

The drainage manual could have a more enhanced stormwater control selection process. Chiefly, the WSDOT Highway Runoff Manual provides a model that better prioritizes green infrastructure. Under its Best Management Practice (BMP) selection process, green infrastructure technologies must be considered first and, if determined to be infeasible, then more structural practices can be considered. This change would complement a similar revision to the GDOT permit to require evaluation of green infrastructure first, as demonstrated in the Caltrans MS4 permit, the Illinois permit, and the Minnesota permit.

In summary, the new drainage manual should be updated to reflect the most recent information regarding the effectiveness and applicability of appropriate green infrastructure technologies for roads and highways. The selection process for best management practices should be amended to prioritize and require consideration of green infrastructure first, and then where it is infeasible, allow for alternative practices

■ **Revise Complete Streets Policy to Include Green Infrastructure**

In 2012, the Georgia State Transportation Board adopted a resolution in support of GDOT's Complete Streets policy which was incorporated into the Agency's state Design Policy Manual. The focus of the policy is to promote access to public transportation and to increase safety for pedestrians and bicyclists. Three general principles guide the Complete Streets policy for GDOT: 1) accommodations for transit should be integrated into roadway new construction and reconstruction through design features (such as park and ride lots); 2) the design of roadways and intersections near transit facilities should accommodate pedestrians and prioritize safety; and 3) the design or new or reconstructed roadways should not preclude future transit facilities.²⁶⁶

Although the Complete Streets policy improves pedestrian and bicycle safety and access to public transportation, it does little to incorporate environmental impacts or considerations. The existing Complete Streets policy offers an opportunity to better prioritize green infrastructure by establishing similar requirements and guidelines that promote stormwater management practices that use infiltration, evapotranspiration, harvesting, or re-use. GDOT should either revise its Complete Streets policy to include green street elements or adopt a complementary Green Streets policy. Green streets can complement complete streets in a variety of ways. For example, bioswales and rain gardens along streets that provide stormwater management can be integrated into traffic-calming elements such as chicanes, islands, or curb extensions which improve safety for all users.²⁶⁷

Recommendations for the City of Atlanta

Planning

■ Update the Capital Improvement Planning Process to Identify Opportunities for Green Infrastructure

The City creates a Capital Improvement Plan (CIP) for a period of five years that is reviewed by the ARC and the Georgia Department of Community Affairs (DCA) before it is adopted by the City. Additionally, a Short-Term Work Program (STWP) that covers unfunded and funded, capital and non-capital projects over a fifteen year time period is reviewed and adopted. Each city department puts together a CIP which is then coordinated citywide.²⁶⁸ In its capital improvement planning process, the City should identify opportunities to incorporate stormwater management into planned transportation projects as appropriate. For example, Atlanta should add criteria to evaluate stormwater needs in order to better leverage funds and avoid having to construct stand-alone green infrastructure projects that may be more expensive.

Project Development

■ Update Permit

Under the post-construction requirements of the current MS4 permit for the City of Atlanta, permittees must implement the standards under the Georgia Stormwater Management Manual, or an equivalent local design manual. Similar to the GDOT MS4 permit, the City's MS4 permit includes Section 3.3.10(b) entitled "Green Infrastructure/Low Impact Development (GI/LID)" which states that EPD encourages the use of green infrastructure for post-construction stormwater management on new and redeveloped

sites and requires the City to review and revise ordinances and other regulations to ensure that they do not limit or prohibit the use of green infrastructure.²⁶⁹ One important difference is that the Atlanta permit requires the City to have a program in place for considering the use of green infrastructure and developing an inventory of privately and publicly owned practices and must include an inspection and maintenance component.²⁷⁰ As discussed more completely in "Staying Green: Strategies to Improve Operations and Maintenance of Green Infrastructure in the Chesapeake Bay Watershed," inspection and maintenance are critical to ensure proper function of green infrastructure practices. As discussed in more detail in recommendations to strengthen the GDOT MS4 permit, the Atlanta MS4 permit could be further strengthened by establishing objective numeric performance standards to mimic pre-development hydrology and setting a limit or ceiling on the amount of effective impervious area.

■ Adopt a Green Streets or Green Complete Streets Policy

The City of Atlanta should consider adopting a Green Streets Policy or follow the model of GDOT and adopt a Green Complete Streets Policy, with the addition of stormwater management requirements and guidelines that prioritize the use of green infrastructure. Establishing a Green Streets Policy would be in line with the City's post-construction stormwater management ordinance and permit requirements to encourage the use of green infrastructure for new and redeveloped sites. Under the current MS4 permit, the City is required to review and provide comment, at the minimum, for any

regulations related to roads and parking lots that might limit or prohibit the use of green infrastructure. Roads and parking lots are clearly identified as opportunities to implement green infrastructure and adopting a stand-alone green street policy or in combination with a complete streets policy would build on this foundation. The City of Atlanta could look to the model of the green streets policy adopted by the City of Tucson, Arizona as a city with a similarly sized population that is also dealing with both water quality and water supply issues. The primary driver for Tucson's green streets policy were mitigating the urban heat island effect, improving the urban forest, and increasing water conservation rather than stormwater management.²⁷¹ Under its policy, the Tucson Department of Transportation (TDOT) must incorporate green infrastructure into new and upgraded streets to capture the first half-inch of rainfall on site and ensure that the streets are covered by a 25 % tree canopy.²⁷²

The City of Atlanta is already moving forward with at least one green street project, located on Boone Boulevard. Stormwater that runs off this street flows into nearby Proctor Creek, a low-income community of color that was recently designated as the focus of an Urban Waters Federal Partnership. The Department of Watershed Management proposes to use planter boxes, permeable pavement, and bioretention to address traffic, community, and water quality needs.²⁷³ Adopting a Green Streets Policy or a Green Complete Streets Policy would encourage and prioritize the use of green infrastructure practices with transportation projects on City of Atlanta streets.

Funding

■ **Implement a Stormwater Utility**

Currently, the City of Atlanta does not have a stormwater utility fee in place. In 1999, the City implemented a stormwater utility but in *Fulton County Tax Payers Association v. City of Atlanta*, the utility fee was declared a tax and therefore deemed unconstitutional.²⁷⁴ Although the City's stormwater utility was not appropriately structured, many other stormwater utilities have emerged across the state. The Columbia County stormwater utility was the second to be challenged in court in 2003, but this time was found to be a fee and was upheld unanimously by the Georgia Supreme Court.²⁷⁵ Although there are significant challenges to implementation, the City should consider implementing a stormwater utility to provide funding for stormwater management, including increased utilization of green infrastructure across the City. This would support the City's post-construction stormwater management ordinance and efforts to integrate green infrastructure into transportation projects. Models for effective stormwater utilities can be found across the country and in Georgia as well, such as the community of Griffin, Georgia which implemented Georgia's first stormwater utility in 1997. Griffin uses a tiered approach for residential properties, charging single family homes \$1.77 per month and large single family parcels \$2.95 per month. Non-residential properties are charged under a variable rate based on the "Equivalent Residential Unit" (ERU) which is used to calculate a user fee that is proportional to the impervious surface area on the property. Griffin charges \$2.95 per ERU every month, with the ERU value set at 2,200 square feet of impervious surface.²⁷⁶ The characteristics of 44 stormwater utilities across

Georgia can be compared via the Georgia Stormwater Utility Dashboard published online by the University of North Carolina Environmental Finance Center.²⁷⁷ At the minimum, Atlanta should evaluate the structure of different stormwater utilities as well as the related education and outreach that local governments have used across the country to develop specific recommendations for how a stormwater utility could be structured.

■ Evaluate Alternative Financing Mechanisms and Grant Opportunities

In addition to evaluating the structure and implementation of a stormwater utility, the City should examine alternative financing mechanisms such as Business Improvement Districts (BIDs), tax increment financing, and grant opportunities. In 1995, Central Atlanta Progress founded the Atlanta Downtown Improvement District (ADID) led by a board with representatives from both the public and private sector. The ADID stretches across 220 blocks in downtown Atlanta. The City, in coordination with this existing community improvement district, should consider opportunities to incorporate stormwater management and green infrastructure into its transportation and infrastructure projects. For example, in the 2013 annual report, ADID reported that 72 intersections were upgraded. In the future, opportunities to integrate green infrastructure elements into these types of improvements should be evaluated.²⁷⁸ Tax increment financing, termed tax allocation districts (TAD) in Atlanta, offer another potential financing strategy. Invest Atlanta acts as the redevelopment agent for

the ten existing TADs within the City.²⁷⁹ While not appropriate for every project, TADs offer another strategy to provide potential financing for green infrastructure in transportation projects. Additionally, the City should consider opportunities to incorporate green infrastructure into transportation projects that may make projects more competitive for different grant opportunities, such as Urban Forestry grants or through the Transportation Investment Generating Economic Recovery (TIGER) funds.

In conclusion, the City of Atlanta has some stronger regulatory drivers currently in place to encourage the use of green infrastructure, such as its MS4 permit and the City's post-construction stormwater management ordinance. Moreover, the City has demonstrated interest in further integrating green infrastructure through the convening of the Green Stormwater Infrastructure Task Force and the pursuit of goals, metrics and benchmarks with which to measure progress. Both the existing Context Sensitive Solutions Policy under GDOT and the Complete Streets Policy for the City help to lay the groundwork for future revisions to further support the use of green infrastructure on roads and highways. The Georgia Coastal Stormwater Supplement and the expected revisions to the Blue Book will also likely encourage greater implementation of green infrastructure. At the same time, the lack of a stormwater utility represents a barrier to implementation. As the City moves forward in evaluating opportunities to integrate green infrastructure citywide, these recommendations should act as a resource for how to address transportation projects specifically.

CHAPTER 6

Conclusions

Across the country, many communities are looking to green infrastructure as a cost-effective approach to manage polluted stormwater runoff that provides additional benefits beyond water quality. Roads and highways represent a significant source of impervious surface that can contribute to high volumes of runoff that pollute local waters and exacerbate flooding. Throughout the United States, there are approximately 4 million miles of publicly owned roads, including federal-aid highways and other state or locally-owned roads.²⁸⁰ Green infrastructure practices for roads and highways include natural dispersion where stormwater runoff is directed into a naturally vegetated area; bioinfiltration techniques that utilize vegetation to capture and filter out pollutants from stormwater are considered green infrastructure practices for roads and highways such as grass buffers, vegetated filter strips, bioinfiltration swales, conserving or planting vegetation, or media filter drains; and infiltration practices such as infiltration trenches and permeable pavements, with limited application on highways.²⁸¹ These practices not only manage stormwater, but can reduce the urban heat island effect, mitigate flooding, and provide other benefits to local communities.

Despite these benefits, unique challenges to green infrastructure in transportation projects remain. Highway design is determined by the Federal Highway Administration's (FHWA) guidelines with little flexibility to reduce impervious surface area. The linear nature of roads and highways also limits the available right-of-way for stormwater

management. Green infrastructure practices, such as permeable pavement, that can be used for new or redevelopment sites may not be appropriate for certain road or highway contexts. Additionally, during the planning stage, challenges such as a lack of political will, coordination among municipal departments or state agencies, regulatory drivers, data on technical constraints, or defined processes to prioritize green infrastructure can make it difficult to integrate green infrastructure into transportation projects. A lack of clear funding streams can also make it difficult to include green infrastructure in road and highway projects. However, increased integration of green infrastructure practices in transportation projects has the potential to better leverage funds and provide multiple benefits from reduced flooding to improved air quality. Across the country, a number of communities are incorporating green infrastructure into transportation and cities like Seattle, Portland, Tucson, Cleveland, and Syracuse provide models of different strategies.

State DOTs and local governments should consider the following planning, project development, and funding recommendations to address these challenges and better integrate green infrastructure into transportation projects. At the planning level, DOTs, local governments, and other transportation agencies should consider requiring the use of a Context Sensitive Solutions (CSS) planning process, implementing a Green Highways Watershed Approach, prioritizing green infrastructure within the Long-Range Statewide Transportation Plans (LRSTP)



PHOTO: Scott Sibley, City of Toledo —
Division of Engineering Services

Bioswale on Angola Road in Toledo, Ohio running through residential and commercial/office areas.

and the Long-Range Transportation Plans (LRTP), and prioritizing green infrastructure in transportation projects through capital improvement planning. At the project development level, DOTs, local governments, and other transportation agencies should consider revising MS4 permits to better prioritize green infrastructure through objective numeric performance standards to mimic pre-development hydrology, specific green infrastructure requirements, or limits or ceilings on the amount of effective impervious area. Additionally, local governments, DOTs, and other transportation agencies should adopt or revise design manuals and design standards that encourage green infrastructure and implement green streets policies. From a funding perspective, local governments should consider implementing a stormwater utility to provide a dedicated revenue stream for stormwater management and green infrastructure. Additionally, stormwater management needs should be incorporated into the capital improvement planning process to identify opportunities to integrate green infrastructure into transportation projects early in the planning process. Alternative financing mechanisms such as business improvement districts or tax increment financing should be considered and grant opportunities, such as the Transportation Investment Generating Economic Recovery (TIGER) grant program, should be evaluated.

Refining these recommendations further, this report examines two case studies, Toledo, Ohio and Atlanta, Georgia. Both cities are moving forward with green infrastructure planning and these recommendations can provide additional resources as they address specific opportunities and challenges related to transportation. The City of Toledo, Ohio has implemented a number of green infrastructure projects to reduce chronic localized flooding and combined sewer overflows, including pervious alleys and the Maywood Avenue project that uses permeable pavement and bioswales. To more strategically implement green infrastructure across the city, Toledo established a Green Stormwater Infrastructure Task Force. The specific recommendations in this report can be used by the Task Force to address opportunities to integrate green infrastructure into transportation projects citywide. The City of Atlanta is dealing with similar challenges regarding flooding and stormwater pollution. Like Toledo, Atlanta has started installing green infrastructure and is moving forward with a planning to identify strategies to implement green infrastructure more comprehensively. The specific recommendations developed for the local, state, and regional levels for Atlanta can be used in this process as a resource for how to better integrate green infrastructure into transportation projects across the city.

APPENDIX A

Federal Laws and Regulations that Impact Stormwater Management in Transportation Project Development

Within this broader context of transportation and capital improvement planning, transportation agencies must meet a number of different federal requirements relating to stormwater management including acquiring permits for stormwater discharges and developing stormwater management plans as well as meeting any local or state-specific requirements.²⁸² The regulatory landscape for roads and highways in regards to stormwater is complex. Federal, state, and local laws impact how stormwater runoff is managed from transportation projects. For instance, state laws may be more protective than federal laws, but they cannot preempt federal laws. At the local level, Departments of Transportation (DOTs) are not required to meet municipal water quality standards, but their National Pollutant Discharge Elimination System (NPDES) permits do require cooperation among other adjacent NPDES permittees which are often municipalities. This appendix will focus on federal laws that have the most impact on how stormwater is managed for transportation projects. Other federal statutes, such as the National Environmental Policy Act (NEPA) or the Clean Air Act, will have a more significant impact on transportation projects as a whole and should be considered in the broader context of transportation planning. Additionally, this section will outline key state and local laws relating to stormwater management from roads and highways in Atlanta, Georgia and Toledo, Ohio.

The Clean Water Act

The underlying objective of the Clean Water Act is “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” To implement this objective, the Clean Water Act establishes two interim goals that set the framework for the Act. The first goal is to eliminate discharges of pollutants into navigable waters by 1985 and the second is to achieve water quality that supports fishing, swimming, and that is protective of wildlife, fish, and shellfish by 1983. In order to achieve these goals, the Clean Water Act sets regulatory standards, permits, licenses, and enforcement procedures for municipal and industrial dischargers and establishes federal assistance programs to fund wastewater treatment.²⁸³ The Act relies on a balance of federal and state responsibility to protect clean water. For example, states set their water quality standards and can be authorized by the EPA to administer and enforce permitting programs. In general, this partnership can be characterized as the states taking responsibility for implementation and every day activities and the EPA providing oversight, setting pollution abatement agendas, and developing standards.²⁸⁴

The Clean Water Act and specifically Sections 402, 303, 401, and 404, are some of the primary drivers of stormwater management for transportation projects. Section 402 creates the National Pollutant Dis-

charge Elimination System (NPDES). Under the Act, it is illegal to discharge pollutants from discrete sources like pipes, known as point sources, into waters of the United States without a permit. This section establishes the permitting program to regulate discharges from point sources, including stormwater from roads and highways managed by Departments of Transportation (DOTs). The Clean Water Act under Section 303(d) requires states to prioritize waters that don't meet state water quality standards and develop pollution caps for specific dischargers. DOTs can be included in these pollution caps, known as Total Maximum Daily Loads (TMDLs), and be required to develop stormwater controls to meet those limits. Under Section 401, applicants for permits or licenses that may cause a discharge of pollutants into navigable waters are required to receive a certification from the relevant state that the discharge

won't violate water quality standards and other applicable requirements. These "401 certifications" can drive implementation of stormwater management practices for transportation projects to ensure that the proposed activity doesn't violate water quality standards. Section 404 establishes a specific permitting regime for activities that discharge "dredge and fill materials," such as mining projects or infrastructure development.²⁸⁵ In order to be issued a 404 permit, the applicant must receive a 401 certification and in some cases meet specific requirements that may require stormwater treatment or stormwater retrofits for transportation projects. Although other sections of the Clean Water Act impact the management of stormwater on roads and highways or provide funding, these four sections are the most important drivers for planning and are discussed in more detail below.

Definitions

Non-point source: Non-point source results from precipitation, land runoff, drainage, seepage, atmospheric deposition, or hydrologic modification and refers to water pollution that does not meet the definition of a point source.¹

Point source: A point source, as defined by the U.S. Environmental Protection Agency (EPA), is "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation,

or vessel or other floating craft, from which pollutants are or may be discharged."²

Total Maximum Daily Load (TMDL): For impaired waters listed under the Clean Water Act's 303(d) list, states must develop a Total Maximum Daily Load (TMDL). A TMDL is a calculation of the maximum amount of pollution that can be discharged into that water body to still meet water quality standards. Pollution caps are set for point sources, known as wasteload allocations (WLAs) and for non-point sources, known as load allocations (LAs).³

¹ What is Nonpoint Source Pollution?, U.S. Environmental Protection Agency, Available online <http://water.epa.gov/polwaste/nps/whatis.cfm>, Accessed 1 September 2014.

² What is Nonpoint Source Pollution?, U.S. Environmental Protection Agency, Available online <http://water.epa.gov/polwaste/nps/whatis.cfm>, Accessed 1 September 2014.

³ What is a TMDL?, U.S. Environmental Protection Agency, Available online <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overviewoftmdl.cfm>, Accessed 1 September 2014.

**Section 402:
The National Pollutant Discharge
Elimination System (NPDES)**

Section 402 of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) which requires permits for all facilities that discharge pollutants from point sources into waters of the United States.²⁸⁶ To address the emerging impacts of non-point source pollution, Congress amended the Clean Water Act in 1987 and the Environmental Protection Agency (EPA) issued the Phase I Stormwater Rule in 1990 followed by the Phase II Stormwater Rule in 1999. Under the Phase I Stormwater Rule, NPDES permits were required for operators of municipal separate storm sewer systems (MS4s) for large municipalities serving populations of 10,000 people or more and for industrial activity and construction sites of five acres or more. Under the Phase II Stormwater Rule, NPDES permits were required for smaller MS4s and construction sites between one and five acres.²⁸⁷

Under the Clean Water Act, Departments of Transportation (DOTs) are classified as operators of MS4s and are required to hold NPDES permits for stormwater discharges.²⁸⁸ In other words, this means that transportation projects and related construction activities are considered point sources of stormwater runoff.²⁸⁹ They fall under NPDES jurisdiction because highways and transportation infrastructure include storm drains that may either be directly connected to a municipal stormwater system or that are comparable to a municipal system. Additionally, construction of roads and highways is likely to disturb over an acre of land.²⁹⁰

As NPDES permittees, DOTs must develop a stormwater management program (SMP) that incorporates six minimum control measures 1) public education and outreach,

2) public involvement and participation, 3) illicit discharge detection and elimination, 4) construction site runoff control, 5) post-construction stormwater management in new development and redevelopment, and 6) pollution prevention and good housekeeping.²⁹¹ Additionally, DOTs must develop a Stormwater Management Plan (SWMP) that describes how the stormwater management program is being implemented and how the DOT is addressing stormwater pollution to the maximum extent practicable.²⁹² The SWMP must contain measurable goals for each of the six minimum control measures. The requirements for post-construction management in new and re-development as well as pollution prevention are potentially important drivers for the implementation of green infrastructure in transportation projects.

It is important to note that DOTs differ in important ways from other NPDES permittees like cities and towns. This can create unique challenges in developing effective stormwater programs. For example, one DOT can be covered by multiple Phase I and Phase II NPDES permits that may have different requirements. DOTs can act as a co-permittee with other agencies or municipalities under those permits.²⁹³

**Section 303:
Water Quality Standards and
Implementation Plans**

Section 303 of the Clean Water Act also impacts roads and highways regarding the management of stormwater runoff. Specifically, Section 303(d) requires states to identify waters that don't meet state water quality standards, even after full implementation of basic permitting requirements.²⁹⁴ Every two years, states are required to report the health of all waters across the state. This biennial water quality report, required under Section 305(b), is often used along with assessments of non-point source pollution as

required under Section 319 to develop this list of threatened and impaired waters, often referred to as a state's "303(d) list."²⁹⁵

After a waterbody is listed as impaired, the state must prioritize the listed waters based on criteria such as level of risk to human health and vulnerability of aquatic habitat. The state is required to develop a Total Maximum Daily Load (TMDL) for the impaired water which determines the maximum amount of a pollutant that the waterbody can receive to still meet water quality standards and then uses this cap to allocate allowable loads from different sources of that pollutant.²⁹⁶ TMDLs can be used for more than one pollutant and are increasingly being implemented at a watershed scale.

Discharges of stormwater that have a NPDES permit are point sources and must be given specific pollutant limits, known as

Waste Load Allocations (WLAs) under a TMDL. As point source discharges of stormwater, DOTs may be required to meet WLAs. Stormwater discharges that are not covered under a NPDES permit are considered non-point sources and may be required to meet Load Allocations (LAs). Where a TMDL is in place, NPDES permits must include effluent limitations, although the EPA recommends that effluent limitations of stormwater be expressed in terms of best management practices (BMPs) rather than setting a numerical limit.²⁹⁷ Because many roads and highways cross through different watersheds, DOTs may be required to meet multiple TMDLs. For example, New York State DOT (NYSDOT) as of 2009 was named as a stakeholder in five different TMDLs for pollutants such as phosphorous and nitrogen.²⁹⁸ As a result, TMDLs can be an important driver for implementation of stormwater retrofit BMPs, including green infrastructure.

The Maryland State Highway Administration (MSHA) and the Stormwater Management Act of 2007

The state of Maryland is located in the Chesapeake Bay watershed and is part of the Chesapeake Bay Total Maximum Daily Load (TMDL). The Maryland State Highway Administration (MSHA) is named in multiple TMDLs and therefore must meet specific pollution limits. As part of the state's efforts to comply with the limits set under the comprehensive Chesapeake Bay TMDL, Maryland passed the Stormwater Management Act of 2007 which requires the use of Environmental Site Design (ESD) to the maximum extent practicable. ESD, similar to green infrastructure or low impact development, is defined as the use of "small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources."¹ As a result, MSHA must also follow the ESD requirements for projects with new impervious area. This example illustrates how Clean Water Act requirements and state law can impact how stormwater management is addressed on roads and highways and provides a model for requiring the use of green infrastructure.

¹ Chapter 5.0 Environmental Site Design, Maryland Stormwater Design Manual, Maryland Department of the Environment, 2009, Available online < <http://www.mde.maryland.gov/assets/document/Design%20Manual%20Chapter%205%2003%2024%202009.pdf> >, Accessed 3 September 2014.

Section 401: Certification

Under the Clean Water Act, applicants for federal permits or licenses to allow activities that would include constructing or operating facilities which may result in a discharge into navigable waters must receive a certification from the state where the discharge will originate that the activity complies with applicable water quality standards, restrictions, or other requirements. This is known as a “401 certification.” As listed in the statute, the applicant must demonstrate that the activity is consistent with effluent limitations set by the state or tribe (Section 301), water quality related effluent limitations (Section 302), water quality standards and implementation plans (Section 303), national standards of performance (Section 306), toxic and pretreatment standards (Section 307), and any other appropriate or relevant requirement.

This section of the Clean Water Act offers an important tool to states and tribes to review proposed activities to protect against significant damage to wetlands, rivers, and other resources. States and tribes are able to grant a 401 certification with conditions, deny, or waive certification.²⁹⁹ This process has generally been applied to Section 404 permit applications for dredge and fill activities, private hydropower dam construction and operation that require a federal license, and NPDES permits in states where the EPA issues the permits (non-delegated states).

While there is a less direct connection to stormwater runoff from roads and highways, a state or tribe can use its 401 certification to require treatment or retrofits for stormwater to meet state water quality standards or other applicable requirements. For example, the Oregon Department of Transportation (ODOT) planned to widen a four lane highway to six lanes in a western suburb of Portland. Runoff from this highway flows into the Tualatin River which has TMDLs in place for phosphate, temperature,

and bacteria. Additionally, the Tualatin River supports habitat for salmon that have been designated as “threatened” under the Endangered Species Act. Copper, a common pollutant found in highway runoff, can cause neurological damage and behavioral changes in salmon. ODOT’s NPDES permit doesn’t specifically call for stand-alone stormwater retrofit projects. However, the combination of Oregon’s 401 certification required for a Clean Water Act Section 404 permit as well as compliance requirements under the Endangered Species Act led ODOT to improve treatment of the runoff from the existing lanes and add treatment for the new lanes. As a result, ODOT built a modified media filter drain which incorporates green infrastructure elements by allowing infiltration to occur.³⁰⁰ This example illustrates how the 401 certification process can impact management of stormwater runoff from transportation projects.

Section 404: Permits for Dredged or Fill Material

Section 404 of the Clean Water Act deals specifically with the discharge of dredge and fill material into waters of the United States and is administered by the Army Corps of Engineers subject to guidance from the EPA, which is legally binding and known as the Section 401(b) Guidelines. In general, Section 404 permits typically cover infrastructure projects, water resource projects, fill for development, and mining projects. Some activities are exempt, such as certain farming or forestry activities. These permits are important for planning and management of stormwater from roads and highways because they may include requirements for stormwater treatment and discharge or retrofit treatment requirements developed under a 401 certification.³⁰¹

The federal government and the states share responsibility for Section 404 permitting decisions. As discussed in the previous section, before the Corps can issue a 404

permit, the applicant must receive a 401 certification from the state or tribe. Once a 401 certification is received, the Army Corps can issue general permits for categories of projects that are considered to have minimal impacts and can be issued at the national, regional, or state level. As long as the conditions of the general permit are met, minimal review is required.³⁰² The Corps can also issue individual permits for larger projects that may have significant impacts and require more detailed review and analysis. Individual permits require analysis under the 401(b) Guidelines which consist of four requirements that must be met in order to issue the permit: 1) there must be “no practicable alternative” to the proposed discharge which would have less environmental impact; 2) the project can’t be permitted if it violates other laws, specifically if it would contribute to a violation of a state water quality standard, jeopardize species listed as “threatened” or “endangered” under the Endangered Species Act or adversely modify their habitats, or if the project would violate requirements to protect marine sanctuaries; 3) the project must not cause or contribute to significant degradation of the waters of the United States; and 4) the project must include steps to minimize adverse environmental impacts.³⁰³

Other Federal Statutes

In addition to the Clean Water Act, other federal statutes play a role in affecting the management of stormwater runoff from transportation projects. This is not intended to be a comprehensive list of every federal law that might impact stormwater management, but rather to highlight some examples that may act as drivers for green infrastructure and the prioritization of stormwater management. Some of these statutes and others that may not be listed may have a more significant impact on transportation planning as a whole, particularly the National Environmental Policy Act (NEPA).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act, also known as CERCLA or the Superfund Act, establishes authority for the EPA to enforce cleanup of hazardous wastes and environmental contamination and creates a trust fund to pay for cleanup when no responsible party can be identified.³⁰⁴ The law creates a framework that makes previous and current owners of contaminated sites liable for that contamination. The EPA administers the program and is required to develop a National Priorities List to identify and prioritize contaminated sites and related cleanup actions. These cleanup actions can include requirements for control of upstream sources of pollution including polluted stormwater runoff. Federal agencies can be liable for contaminated federal facilities and may be liable if they generate or transport waste even if it is ultimately disposed at a non-federal facility.³⁰⁵

This is particularly important in relation to stormwater management. A recent court decision in 2011 found that the Washington State Department of Transportation (WSDOT) was liable under CERCLA for the cleanup and response costs of discharges of stormwater that contained heavy metals, polycyclic aromatic hydrocarbons (PAHs), and other pollutants into a waterway designated as a Superfund site. In 1983, the Commencement Bay Nearshore Tidal Flats in Tacoma, Washington was listed on the National Priorities List. This area includes the Thea Foss and Wheeler Osgood Waterways. The WSDOT was named as a Potentially Responsible Party in 1989 due to discharges of highway runoff and construction of nearby highways.³⁰⁶ In May 2003, the EPA entered into consent decrees with many of the Potentially Responsible Parties, not including WSDOT. In 2008, the EPA filed a complaint against the WSDOT alleging that the

agency had designed its highways to drain and discharge runoff into the Thea Foss waterway and that WSDOT should be liable for the past, current, and future costs of responding to releases of contaminants such as metals and polycyclic aromatic hydrocarbons (PAHs) from that stormwater runoff. In 2011, the court ruled that WSDOT is liable for response costs at the Thea Foss Waterway and as of that time the agency has not pursued an appeal. If this decision is upheld, it would set a precedent whereby Departments of Transportation could be held liable under CERCLA for designing stormwater systems that may contribute to the contamination of sites.³⁰⁷ This liability could impact the way that roads and highways manage stormwater runoff to mitigate the potential to be held responsible under CERCLA.

The Safe Drinking Water Act

Enacted in 1974, the Safe Drinking Water Act (SDWA) establishes authority for the EPA and the states to regulate contaminants in drinking water. In general, the SDWA applies to publicly and privately owned water systems that have at least 15 service connections or regularly serve at least 25 people. It requires the EPA to set national primary drinking water regulations for contaminants likely to be found in drinking water supplies that pose risks to public health.

In 1996, amendments to the SDWA established source water assessment and protection programs to identify the source of contaminants and determine the vulnerability of the water supply to contamination. Stormwater runoff from transportation projects can threaten the water quality of source waters used as public drinking water supplies. For example, the 2002 Source Water Assessment from Fairfax County in Virginia indicated that the two major sources of drinking water for their service area, the Potomac River and the Occoquan Reservoir, were highly susceptible to contamination. Highways that run through the

Potomac River assessment area represent 5% of the total land area and 56% of the total impervious area.³⁰⁸ Within the Potomac River assessment area, the 2002 assessment showed 48 different highway stream or tributary crossings as well as five NPDES permitted facilities.³⁰⁹ Although there are no enforcement mechanisms, states have the authority to develop long-term source water protection strategies which could include addressing runoff from roads and highways.

Additionally, the SDWA addresses the impact of groundwater pollution on drinking water supplies by establishing state underground injection control (UIC) programs.³¹⁰ UIC programs regulate injection wells that store or dispose of fluids underground. Owners and operators of UIC wells, which can include DOTs, may be required to develop stormwater management programs including pre-treatment retrofits. For example, dry wells that are built above the water table can be designed to dispose of stormwater runoff, allowing infiltration into groundwater supplies. The SDWA may impose requirements on DOTs to meet pre-treatment standards.³¹¹

Endangered Species Act

In 1973, Congress passed the Endangered Species Act (ESA) which authorized the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) to list plant and animal species as “threatened” or “endangered” based on their risk of extinction. To summarize a complex process, once the appropriate Secretary has listed a species, the Secretary must designate critical habitat for that species and develop recovery plans. If a federal agency or non-federal entity wants to initiate an activity that requires federal approval that would affect the listed species, the appropriate federal agencies must complete a biological assessment to evaluate the impacts of the proposed activity. If the Secretary finds that the activity would jeopardize the existence

of the species and would adversely affect critical habitat, the Secretary must suggest preferred alternatives. If no alternatives are feasible, then the applicant can apply for an exemption, continue at the risk of penalties, or stop the proposed activity.³¹² The ESA provides a powerful legal tool to put in place protections for species that can have a significant impact on transportation projects. For instance, the ESA might come into play if a DOT proposed to build a highway through a wetland and required a Section 404 dredge and fill permit. If the wetland was designated as critical habitat for a threatened or endangered species and there were no feasible alternatives that would adequately protect that species or the wetland habitat, the project might never be implemented.

When it comes to stormwater management from roads and highways, the ESA may come into play if a proposed project might impact an aquatic species listed as threatened or endangered and the project is either federally funded in part or in full or the project requires a federal permit such as NPDES or 404 permits. The ESA has had a particular impact regarding stormwater management in the Pacific Northwest where critical habitat for threatened and endangered salmon often overlap with large urban centers with significant transportation infrastructure.³¹³ As a result, policies and design to manage stormwater from transportation has had to adapt to comply with ESA requirements, which may result in stricter water quality standards than under state requirements.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) was enacted in 1972 specifically to address impacts to coastal resources from increased development and economic activity in coastal areas. The Act authorizes grants to states to develop and implement coastal zone management programs. States that es-

tablish approved programs become eligible for management grants, funding to manage nonpoint source pollution, and for funding to support participation in the National Estuarine Research Reserve System established by the Act. Under Section 307, the Act authorizes federal consistency provisions which require each participating state to be allowed to certify that any federal action that would impact its coastal zone is consistent with the state's approved coastal management program. This tool can create greater cooperation between the states and the federal government over activities that impact coastal areas such as offshore energy production.³¹⁴ Although participation is voluntary, the grant programs and federal consistency provisions provide incentives for states to participate.

Because of the overall voluntary nature of these programs, the CZMA is less likely to impact transportation planning regarding stormwater runoff. However, amendments enacted in 1990, known as the Coastal Zone Act Reauthorization Amendments (CZARA) provisions, create financial incentives for participants with an approved coastal management program to include an additional program element to address nonpoint source pollution. The nonpoint source management plan must be approved by the Secretary of Commerce and the Administrator of the EPA. Unlike the full coastal management program, if a participant doesn't submit a nonpoint source management plan, it could lose up to 30 % of its funding for the full program from the National Oceanic and Atmospheric Administration (NOAA) and up to 30 % of grant funding under the Clean Water Act's Section 319 nonpoint source pollution management grants.³¹⁵ Guidance developed by the EPA for five major categories of polluted runoff including urban runoff from roads and highways doesn't apply to dischargers that are already covered by a NPDES permit.

APPENDIX B

Transportation Planning Structure and Process

The Transportation Planning Process

The Federal Highway Administration (FHWA) lays out six basic stages for a transportation project: 1) visioning and policy, 2) long-range planning and programming, 3) environmental studies and preliminary design, 4) final design and right-of-way, 5) construction, and 6) operations and maintenance. The scope of this report will be primarily limited to the first three phases in the life of a transportation project which can be broadly considered as the project planning and project development stages.³¹⁶

During the first stage, elected officials at different levels of government make long-term policy and planning decisions. For example, at the national or state level, members of Congress or state legislatures may make funding allocations or set requirements for transportation agencies. At the local or regional level, city councils may develop long-term visions for their transportation systems. The visioning and policy stage is critical because it sets guidelines and impacts decisions made throughout the other stages of the transportation project. Once this stage is complete, a transportation project moves into the long-range planning and programming stage. A regional transportation agency, known as a Metropolitan Planning Organization (MPO) develops a Long-Range Transportation Plan (LRTP) and a shorter-term Transportation Improvement Program (TIP) for their region. At the state level, each state Department of Transportation (DOT) develops a Long-Range Statewide Transportation Plan (LRSTP) and

a Statewide Transportation Improvement Program (STIP). Decisions about project prioritization are impacted by the previous visioning and policy setting stage. After project concepts are approved under the long-range planning process, a transportation project moves into the environmental studies and preliminary design phase. Federal and state regulations require environmental review for individual projects and technical analysis as well as consideration of alternative projects helps to drive decision making. This is where consideration of applicable laws and regulations regarding stormwater management may come into play. This stage is informed by the broader policy goals, values, and long-term priorities developed in the earlier stages. Following the initial planning and project development stages, a transportation project goes through final design, construction, and then operations and maintenance.³¹⁷

Transportation Planning Structure

The United States Department of Transportation (USDOT) is responsible for developing, implementing, and maintaining the nation's transportation infrastructure including roads, airlines, and rail systems. State and local governments and the related agencies and departments are primarily responsible for transportation planning. However, the USDOT plays a primary role in providing funding to state and local governments to implement those plans which will be discussed in more detail in a later section.³¹⁸ The USDOT is comprised of 13 different

agencies. Of most relevance to stormwater management from roads and highways are the Federal Highway Administration (FHWA), the Federal Transit Administration, and the Research and Innovative Technology Administration (RITA). The FHWA provides financial and technical assistance to state and local governments to support the design, construction, and maintenance of the National Highway System. Three offices within the FHWA focus on environmental planning, specifically the Offices of Natural Environment and Human Environment that work primarily on air quality, climate change, sustainability, and transportation enhancements. The Office of Project Development and Environmental Review is focused on the review process established under the National Environmental Policy Act (NEPA).³¹⁹ In 2002, the FHWA included environmental stewardship as one of its “Vital Few Goals” encompassing improving environmental decision making as well as increasing ecosystem and habitat conservation.³²⁰ The Federal Transit Administration (FTA) is responsible for providing technical and financial assistance to public transit systems. The Research and Innovative Technology Administration (RITA) conducts research to address the challenges and opportunities for the nation’s transportation systems. This includes supporting research on stormwater best management practices and the use of green infrastructure on roads and highways.³²¹

While the federal DOT and related agencies play an important role in providing financial and technical assistance, local governments and state DOTs play a primary role in transportation planning. Every state, including Puerto Rico and the District of Columbia, has an agency or a department with the authority and responsibility to plan and implement transportation projects.³²² These are commonly referred to as the state’s Department of Transportation, or DOT. The state DOT is the largest governmental unit that

develops transportation plans and projects. State DOTs vary widely by state regarding how they interact with local governments, the balance of roles and responsibilities, and their organizational structure. For instance, some state legislatures actively review DOT plans or programs.³²³ They also vary in the types of roads they manage, including state level highways, county level roads, or municipal roads. Only a small %age of state DOTs manage rural roads or manage all of the roads within the state.³²⁴ State DOTs are responsible for developing and maintaining a Long-Range Statewide Transportation Plans (LRSTP) that focus on long-term future goals and strategies within a 20-year period, at the minimum. These plans don’t require specific project information, a financial plan, performance measures, or federal approval.³²⁵ Additionally, state DOTs are also required to complete a Statewide Transportation Improvement Program (STIP) updated every four years that identifies and prioritizes transportation projects across the state that will use federal funding.³²⁶ The STIP also identifies regionally significant projects that may require federal action from the FHWA or FTA. Projects listed in the STIP can only be included if full funding for the project can reasonably be anticipated within the project period. Every project in the STIP must also be consistent with the LRSTP, the Metropolitan Transportation Plan (MTP), specific planning factors such as economic vitality, safety, and accessibility.³²⁷ The FHWA and the FTA review and approve the state’s STIP every four years. In addition to federal planning requirements, state DOTs must meet state-specific planning requirements. For instance, the New Jersey DOT must submit a proposed transportation capital program to the legislature every year in addition to its federal STIP requirements.³²⁸ These planning processes are continued in the most recent surface transportation reauthorizing legislation, Moving Ahead for Progress in the 21st Century Act, or MAP-21.³²⁹

Communities in urbanized areas with populations greater than 200,000 are required to form Metropolitan Planning Organizations (MPOs) that are both federally recognized and funded. Urban communities with populations greater than 50,000 may also form MPOs.³³⁰ MPOs are made up of representatives from local governments and transportation agencies and in some cases can be formed as part of a Regional Planning Organization (RPO) or Council of Governments. Since transportation systems involve multiple agencies and jurisdictions, the MPO provides an opportunity to bring together diverse stakeholders at the local, county, and state level. The MPO is responsible for developing a Unified Planning Work Program (UPWP) every year which describes transportation studies, planning tasks, and a schedule of activities for the next one or two years.³³¹ Additionally, the MPO completes and approves its Metropolitan Transportation Plan (MTP), also known as the Long-Range Transportation Plan (LRTP) every five years. This plan describes long-term and short-term actions to take place over approximately twenty years and must be consistent with the Long-Range Statewide Transportation Plan (LRSTP) developed by the state DOT.³³² MPOs must also develop a

Transportation Improvement Program (TIP) updated every four years that identifies projects and strategies from the MTP that the MPO will implement over the next four years. It must be fiscally constrained, meaning that full funding for each project must be reasonably anticipated within the project period. The TIP is approved by the MPO and then incorporated into the STIP developed by the state DOT.³³³

Local governments and transportation entities are important players in transportation planning as well. Transportation agencies or departments, also generally known as Departments of Transportation (DOTs) at the municipal and county levels are responsible for the roads and streets under their jurisdiction. For urbanized areas, MPOs create an opportunity for local governments to engage at the state and regional level on transportation planning. Stakeholders in an MPO can include local highway departments, airport authorities, or private operators. Outside of urbanized areas where an MPO is not required, the state DOT takes over this collaborative role to bring together local governments and appropriate agencies.³³⁴

ENDNOTES

- ¹ Transportation FAQs, American Road and Transportation Builders Association, 2014, Available online <http://www.artba.org/about/transportation-faqs/>, Accessed 3 September 2014.
- ² Miccio, Claire Elisabeth, Barriers to Implementing Low Impact Development Approaches in Washington State Roadways and Highways, Washington State Department of Transportation, June 2010, Available online <http://www.wsdot.wa.gov/research/reports/fullreports/756.1.pdf>, Accessed 27 February 2014.
- ³ Going the Distance Together: Context Sensitive Solutions for Better Transportation, A Practitioner's Guide, "Chapter 3: Shaping Transportation Decisions," Federal Highway Administration, Available online http://www.fhwa.dot.gov/context/practitionersguide/3_2.html, Accessed 20 March 2014.
- ⁴ Performance Measures for Context Sensitive Solutions – A Guidebook for State DOTs, Transportation Research Board, National Academies, October 2004, Available online < http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w69.pdf >, Accessed 28 February 2014.
- ⁵ *Guidance for Municipal Stormwater Funding*, National Association of Flood and Stormwater Management Agencies, Accessed 6 February 2013, Available online at <http://www.nafmsma.org/Guidance%20Manual%20Version%202X.pdf>, 2006.
- ⁶ *Western Kentucky University Stormwater Survey 2012*, Western Kentucky University, Accessed 20 February 2013, Available online at <http://www.wku.edu/engineering/documents/swsurveys/swsurvey-2012.pdf>, 2012.
- ⁷ Aesthetic Design Initiative, Ohio Department of Transportation, Available online <http://contextsensitivesolutions.org/content/reading/ohio-aesthetic-design/resources/ohio-aesthetic-design/>, Accessed 23 May 2014.
- ⁸ Green Highways Partnership Factsheet, Green Highways Partnership, 2008, Available online < <http://www.cityofmadison.com/sustainability/community/documents/GHP-watershed.pdf> >, Accessed 23 May 2014.
- ⁹ Task 11 Environmental Overview: Review of Environmental Resources and Climate Variability, Ohio Department of Transportation, 17 January 2014, Available online <http://www.dot.state.oh.us/Divisions/Planning/SPR/StatewidePlanning/access.ohio/Documents/Tech-Memos/Environmental%20Overview.pdf>, Accessed 23 May 2014.
- ¹⁰ Ohio Environmental Protection Agency Authorization to Discharge Under the National Pollutant Discharge and Elimination System, Ohio Environmental Protection Agency, 1 August 2010, Available online http://epa.ohio.gov/portals/35/storm/Toledo_2PI00003_CD.pdf, Accessed 14 April 2014.
- ¹¹ Infrastructure Design and Construction Requirements, City of Toledo, May 2014, Available online <http://toledo.oh.gov/media/118008/Infrastructure-Requirements-2014.pdf>, Accessed 12 June 2014.
- ¹² Haslinger, Lorie, City of Toledo, Written Communications, 2 June 2014.
- ¹³ General NPDES Stormwater Permit No. GAR041000 Authorization to Discharge Under the National Pollutant Discharge Elimination System Stormwater Discharges Associated with Municipal Separate Storm Sewer System Georgia Department of Transportation, State of Georgia Department of Natural Resources Environmental Protection Division, 3 January 2012, Available online http://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Final_DOT_SW_NPDES_Permit_MS4_Dec_2011.pdf, Accessed 28 July 2014.
- ¹⁴ Order No. 2012-0011-DWQ NPDES NO. CAS000003 National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements (WDRS) for State of California Department of Transportation, 2013, Available online http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2012/wqo2012_0011_dwq.pdf, Accessed 29 July 2014.
- ¹⁵ Authorization to Discharge under the National Pollutant Discharge Elimination System Discharges from the City of Atlanta Municipal Separate Storm Sewer System NPDES Permit No. GAS000100, 16 June 2014.
- ¹⁶ Authorization to Discharge under the National Pollutant Discharge Elimination System Discharges from the City of Atlanta Municipal Separate Storm Sewer System NPDES Permit No. GAS000100, 16 June 2014.
- ¹⁷ <http://www.efc.sog.unc.edu/reslib/item/ga-stormwater-utility-dashboard>
- ¹⁸ Smith, Joshua, Stormwater Utilities in Georgia, Land Use Clinic University of Georgia, 2006, Available online http://www.rivercenter.uga.edu/publications/pdf/luc_stormwater_utilities_2006_smith.pdf, Accessed 28 August 2014.
- ¹⁹ Transportation FAQs, American Road and Transportation Builders Association, 2014, Available online <http://www.artba.org/about/transportation-faqs/>, Accessed 3 September 2014.
- ²⁰ Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure, United States Environmental Protection Agency, August 2010, Available online http://www.sustainab-licitiesinstitute.org/Documents/SCI/Report_Guide/Guide_EPA_GICaseStudiesReduced4.pdf, Accessed 7 March 2014.

- ²¹ Bannerman, R.T., D.W. Owens, R.B. Dodds, N.J. Horner. 1993. Sources of Pollutants in Wisconsin Stormwater. *Wat. Sci. Tech.*, Vol. 28, No. 3-5, pp. 241-259.
- ²² Stormwater Best Management Practices in Ultra-Urban Setting: Selection and Monitoring, U.S. Department of Transportation Federal Highway Administration, Available online <http://environment.fhwa.dot.gov/ecosystems/ultraurb/uubmp2.asp#t>, Accessed 6, February 2014.
- ²³ Frazer, Lance, *Paving Paradise: The Peril of Impervious Cover*, Environmental Health Perspectives, Volume 113, Number 7, July 2005.
- ²⁴ Frazer, Lance, *Paving Paradise: The Peril of Impervious Cover*, Environmental Health Perspectives, Volume 113, Number 7, July 2005.
- ²⁵ Controlling Nonpoint Source Runoff Pollution from Roads, Highways, and Bridges, U.S. Environmental Protection Agency, Available online, <http://www.epa.gov/owow/NPS/roads.html>, 1995, accessed 6 February 2014.
- ²⁶ Erickson, A.J., et al., *Optimizing Stormwater Treatment Practices: A Handbook of Assessment and Maintenance*, Springer Science and Business Media, New York, 2013.
- ²⁷ Erickson, A.J., et al., *Optimizing Stormwater Treatment Practices: A Handbook of Assessment and Maintenance*, Springer Science and Business Media, New York, 2013.
- ²⁸ Stormwater Best Management Practices in Ultra-Urban Setting: Selection and Monitoring, U.S. Department of Transportation Federal Highway Administration, Available online <http://environment.fhwa.dot.gov/ecosystems/ultraurb/uubmp2.asp#t1>, Accessed 6, February 2014.
- ²⁹ Frazer, Lance, *Paving Paradise: The Peril of Impervious Cover*, Environmental Health Perspectives, Volume 113, Number 7, July 2005.
- ³⁰ Frazer, Lance, *Paving Paradise: The Peril of Impervious Cover*, Environmental Health Perspectives, Volume 113, Number 7, July 2005.
- ³¹ Stormwater Phase II Final Rule: Post-Construction Run-Off Control Minimum Control Measure, U.S. Environmental Protection Agency, January 2000, Available online <http://www.epa.gov/npdes/pubs/fact2-7.pdf>, Accessed 29 April 2014.
- ³² National Menu of Stormwater Best Management Practices, U.S. Environmental Protection Agency, Available online <http://cfpub.epa.gov/npdes/Stormwater/menuofbmps/index.cfm>, Accessed 29 April 2014.
- ³³ Chapter 2: Definitions, Highway Performance Monitoring System, Federal Highway Administration, Available online <https://www.fhwa.dot.gov/ohim/hpmsman/chapt2.cfm>, Accessed 27 February 2014.
- ³⁴ National Highway System, Federal Highway Administration, Available online http://www.fhwa.dot.gov/planning/national_highway_system/, Accessed 27 February 2014.
- ³⁵ Developing and Implementing a Stormwater Management Program in a Transportation Agency, AASHTO, Center for Environmental Excellence, 2009.
- ³⁶ Evaluation of Best Management Practices for Highway Runoff Control, National Cooperative Highway Research Program, Transportation Research Board of the National Academies, 2006, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_565.pdf, Accessed 27 February 2014.
- ³⁷ Best Practices in Addressing NPDES and Other Water Quality Issues in Highway System Management, U.S. Domestic Scan Program, NCHRP Project 20-68A, December 2009.
- ³⁸ Evaluation of Best Management Practices for Highway Runoff Control, National Cooperative Highway Research Program, Transportation Research Board of the National Academies, 2006, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_565.pdf, Accessed 27 February 2014.
- ³⁹ Section 404 Permitting, U.S. Environmental Protection Agency, 13 March 2013, Available online <http://water.epa.gov/lawsregs/guidance/cwa/dredg-dis/>, Accessed 27 February 2014.
- ⁴⁰ Copeland, Claudia, Clean Water Act: A Summary of the Law, Congressional Research Service, 23 April 2010, Available online http://www.in.gov/idem/files/rules_erb_20130213_cwa_summary.pdf, Accessed 19 February 2014.
- ⁴¹ Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ⁴² Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ⁴³ The United States Department of Transportation: A Brief History, U.S. Department of Transportation Office of the Historian, 1 March 2009, Available online <http://ntl.bts.gov/historian/history.htm>, Accessed 24 February 2014.
- ⁴⁴ Environment, U.S. Department of Transportation, Federal Highway Administration, 30 September 2013, Available online <https://www.fhwa.dot.gov/environment/>, Accessed 25 February 2014.

- ⁴⁵ Environment, U.S. Department of Transportation, Federal Highway Administration, 30 September 2013, Available online <https://www.fhwa.dot.gov/environment/>, Accessed 25 February 2014.
- ⁴⁶ FHWA's Vital Few Environmental Goal: Environmental Stewardship and Streamlining, Federal Highway Administration, Available online <http://www.environment.fhwa.dot.gov/strmlng/vfovervw.asp>, Accessed 6 March 2014.
- ⁴⁷ Our Administrations, U.S. Department of Transportation, available online <http://www.dot.gov/administrations>, Accessed 25 February 2014.
- ⁴⁸ A Guide to Transportation Decisionmaking, U.S. Department of Transportation, Available online http://www.fhwa.dot.gov/planning/publications/transportation_decision_making/decisionmaking.pdf, Accessed 28 February 2014.
- ⁴⁹ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/Briefing-Book/BBook.htm>, Accessed 24 February 2014.
- ⁵⁰ Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight, United States Government Accountability Office, December 2010, Available online <http://www.gao.gov/assets/320/314004.pdf>, Accessed 24 February 2014.
- ⁵¹ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/Briefing-Book/BBook.htm>, Accessed 24 February 2014.
- ⁵² The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/Briefing-Book/BBook.htm>, Accessed 24 February 2014.
- ⁵³ Going the Distance Together: Context Sensitive Solutions for Better Transportation, A Practitioner's Guide, "Chapter 3: Shaping Transportation Decisions," Federal Highway Administration, Available online http://www.fhwa.dot.gov/context/practitionersguide/3_2.html, Accessed 20 March 2014.
- ⁵⁴ A Guide to Transportation Decisionmaking, U.S. Department of Transportation, Available online http://www.fhwa.dot.gov/planning/publications/transportation_decision_making/decisionmaking.pdf, Accessed 28 February 2014.
- ⁵⁵ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/Briefing-Book/BBook.htm>, Accessed 24 February 2014.
- ⁵⁶ Going the Distance Together: Context Sensitive Solutions for Better Transportation, A Practitioner's Guide, "Chapter 3: Shaping Transportation Decisions," Federal Highway Administration, Available online http://www.fhwa.dot.gov/context/practitionersguide/3_2.html, Accessed 20 March 2014.
- ⁵⁷ Capital Plans and Planning, WM Financial Strategies, Available online <http://www.munibondadvisor.com/capitalplan.htm>, Accessed 28 February 2014.
- ⁵⁸ Elmer, Vicki, Capital Improvement Plans and Budgets, University of California-Berkeley, Solano Press: Point Arena, CA, Available online <https://www.lincolinst.edu/subcenters/teaching-fiscal-dimensions-of-planning/materials/elmer-CIP.pdf>, Accessed 28 February 2014.
- ⁵⁹ Elmer, Vicki, Capital Improvement Plans and Budgets, University of California- Berkeley, Solano Press: Point Arena, CA, Available online <https://www.lincolinst.edu/subcenters/teaching-fiscal-dimensions-of-planning/materials/elmer-CIP.pdf>, Accessed 28 February 2014; Capital Plans and Planning, WM Financial Strategies, Available online <http://www.munibondadvisor.com/capitalplan.htm>, Accessed 28 February 2014.
- ⁶⁰ Amended Green City, Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control Program Summary, Philadelphia Water Department, 1 June 2011, Available online http://www.phillywatersheds.org/doc/GCCW_AmendedJune2011_LOWRES-web.pdf, Accessed 27 February 2014.
- ⁶¹ 2014 Highway Runoff Manual Revision, Washington State Department of Transportation (WSDOT), Available online <http://www.wsdot.wa.gov/Environment/WaterQuality/Runoff/HighwayRunoffManual.htm#2014>, Accessed 6 March 2014.
- ⁶² Haselbach, Liv M. and Aimee Navickis-Brash, Final Technical Report Low Impact Development (LID) and Transportation Stormwater Practices, Transportation Northwest, December 2010, Available online <http://ntl.bts.gov/lib/36000/36000/36097/TNW2010-08.pdf>, Accessed 26 February 2014.
- ⁶³ Haselbach, Liv M. and Aimee Navickis-Brash, Final Technical Report Low Impact Development (LID) and Transportation Stormwater Practices, Transportation Northwest, December 2010, Available online <http://ntl.bts.gov/lib/36000/36000/36097/TNW2010-08.pdf>, Accessed 26 February 2014.
- ⁶⁴ Haselbach, Liv M. and Aimee Navickis-Brash, Final Technical Report Low Impact Development (LID) and Transportation Stormwater Practices, Transportation Northwest, December 2010, Available online <http://ntl.bts.gov/lib/36000/36000/36097/TNW2010-08.pdf>, Accessed 26 February 2014.
- ⁶⁵ Miccio, Claire Elisabeth, Barriers to Implementing Low Impact Development Approaches in Washington State Roadways and Highways, Washington State Department of Transportation, June 2010, Available online <http://www.wsdot.wa.gov/research/reports/fullreports/756.1.pdf>, Accessed 27 February 2014.

- ⁶⁶ Context Sensitive Solutions Primer, Federal Highway Administration, Available online https://www.fhwa.dot.gov/context/css_primer/docs/FHWA_CSS_Primer.pdf, Accessed 6 March 2014.
- ⁶⁷ Watershed Based Stormwater Management Group, Green Highways Partnership, 2010, Available online <http://www.greenhighwayspartnership.org/index.php>, Accessed 6 March 2014.
- ⁶⁸ Introduction and Research Approach, Center for Environmental Excellence by AASHTO, Available online http://environment.transportation.org/environmental_issues/construct_maint_prac/compendium/manual/1.1.aspx, Accessed 6 March 2014.
- ⁶⁹ Context Sensitive Solutions Primer, Federal Highway Administration, Available online https://www.fhwa.dot.gov/context/css_primer/docs/FHWA_CSS_Primer.pdf, Accessed 6 March 2014.
- ⁷⁰ Context Sensitive Solutions Guidelines, District Department of Transportation, 28 March 2005, Available online http://contextsensitivesolutions.org/content/reading/ddot_csd_guidelines/resources/CSSguidelines08Dec06.pdf/, Accessed 6 March 2014.
- ⁷¹ Performance Measures for Context Sensitive Solutions – A Guidebook for State DOTs, Transportation Research Board, National Academies, October 2004, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w69.pdf, Accessed 28 February 2014.
- ⁷² Integration of Context Sensitive Solutions in the Transportation Planning Process, U.S. DOT, Federal Highway Administration, 2007, Available online http://contextsensitivesolutions.org/content/reading/css_planning_process/resources/CSSinPlanning07.pdf/?, Accessed 10 March 2014.
- ⁷³ Context Sensitive Solutions for Delaware Byways, Delaware Department of Transportation, June 2011, Available online http://www.delDOT.gov/information/community_programs_and_services/byways/pdf/Context_Sensitive_Solutions_for_Delaware_Byways.pdf, Accessed 6 March 2014.
- ⁷⁴ Research, Documents, and Reports: Context Sensitive Solutions, Center for Environmental Excellence by AASHTO, Available online http://environment.transportation.org/environmental_issues/context_sens_sol/docs_reports.aspx#bookmarksSubStateDOTPolicyGuidanceandResearch, Accessed 6 March 2014.
- ⁷⁵ State Profiles - CSS Policy, Federal Highway Administration, Available online <http://contextsensitivesolutions.org/content/gen/state-profiles/sp-policy>, Accessed 10 March 2014.
- ⁷⁶ Integration of Context Sensitive Solutions in the Transportation Planning Process, U.S. DOT, Federal Highway Administration, 2007, Available online http://contextsensitivesolutions.org/content/reading/css_planning_process/resources/CSSinPlanning07.pdf/?, Accessed 10 March 2014.
- ⁷⁷ Background, Green Highways Partnership, 2010, Available online <http://www.greenhighwayspartnership.org/index.php>, Accessed 6 March 2014.
- ⁷⁸ Watershed Based Stormwater Management Group, Green Highways Partnership, 2010, Available online <http://www.greenhighwayspartnership.org/index.php>, Accessed 6 March 2014.
- ⁷⁹ Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight, United States Government Accountability Office, December 2010, Available online <http://www.gao.gov/assets/320/314004.pdf>, Accessed 24 February 2014.
- ⁸⁰ Moving Ahead for Progress in the 21st Century, Pub. L. No. 112-141, § 134, Available online <http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title23-section134&num=0&edition=prelim>, Accessed 18 March 2014.
- ⁸¹ Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater and Green Infrastructure, U.S. Environmental Protection Agency, August 2010.
- ⁸² Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater and Green Infrastructure, U.S. Environmental Protection Agency, August 2010.
- ⁸³ Sustainable Infrastructure Initiative, City of Seattle, Gibson Economics, Collins Woerman NEXT, 30 June 2009, Available online <https://sustainability.water.ca.gov/documents/18/3406674/Seattle+Sustainable+Infrastructure+Initiative+Indepartmental+Planning.pdf>, Accessed 17 April 2014.
- ⁸⁴ Matel, Larry, John, P.E., Creating an LID Environment in an Ultra Urban Setting – Part 2, City of Bremerton Department of Public Works, Available online <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/CreatinganLIDEnvironUltraUrbanSettingPart2.pdf>, Accessed 17 April 2014.
- ⁸⁵ Basic Course: Supplemental Topics (NPDES Permit 4): Types of NPDES Permits Individual versus General Permits, U.S. Environmental Protection Agency, 6 March 2012, Available online http://water.epa.gov/learn/training/standardsacademy/permit_page4.cfm, Accessed 15 April 2014.
- ⁸⁶ Odefey, Jeffrey, Permitting Green Infrastructure: A Guide to Improving Municipal Stormwater Permits and Protecting Water Quality, American Rivers, January 2013, Available online <http://www.americanrivers.org/newsroom/resources/permitting-green-infrastructure-a-guide-to-improving-municipal-stormwater-permits-and-protecting-water-quality/>, Accessed 15 April 2014.
- ⁸⁷ Water Quality/Wetlands, Center for Environmental Excellence by AASHTO, 2014, Available online http://environment.transportation.org/environmental_issues/water_wetlands/, Accessed 18 March 2014.

- ⁸⁸ Basic Course: Supplemental Topics (NPDES Permit 4): Types of NPDES Permits Individual versus General Permits, U.S. Environmental Protection Agency, 6 March 2012, Available online http://water.epa.gov/learn/training/standardsacademy/permit_page4.cfm, Accessed 15 April 2014.
- ⁸⁹ Connecting the DOTs through Collaboration in Stormwater Management, Center for Environmental Excellence by AASHTO, October 2012, Available online http://environment.transportation.org/pdf/water_wetlands/aashtoswwhitepaperoct2012.pdf, Accessed 19 March 2014.
- ⁹⁰ Urban Stormwater Management in the United States, National Research Council, Washington, DC: The National Academies Press, 15 October 2008, Available online http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf, Accessed 15 April 2014.
- ⁹¹ Odefey, Jeffrey, Permitting Green Infrastructure: A Guide to Improving Municipal Stormwater Permits and Protecting Water Quality, American Rivers, January 2013, Available online <http://www.americanrivers.org/newsroom/resources/permitting-green-infrastructure-a-guide-to-improving-municipal-stormwater-permits-and-protecting-water-quality/>, Accessed 15 April 2014.
- ⁹² NPDES Permit No. CAS004002 Waste Discharge Requirements for Storm Water (Wet Weather) and Non-Storm Water (Dry Weather) Discharges from the Municipal Separate Storm Sewer Systems within the Ventura County Watershed Protection District, State of California, California Regional Water Quality Control Board Los Angeles Region, 8 July 2010, Available online http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/ventura_ms4/AdoptedVenturaCountyms4/Order.pdf, Accessed 15 April 2014.
- ⁹³ Miccio, Claire Elisabeth, Barriers to Implementing Low Impact Development Approaches in Washington State Roadways and Highways, Washington State Department of Transportation, June 2010.
- ⁹⁴ Fact Sheet for the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Washington State Department of Transportation's Municipal Separate Storm Sewers, State of Washington Department of Ecology, 6 March 2014, Available online <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/WSDOTPermit-FactSheet2014.pdf>, Accessed 16 April 2014.
- ⁹⁵ Highway Runoff Manual, Washington State Department of Transportation, April 2014, Available online <http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-16/HighwayRunoff.pdf>, Accessed 16 April 2014.
- ⁹⁶ Street Design Manual, New York City Department of Transportation, 2009, Available online http://www.nyc.gov/html/dot/downloads/pdf/sdm_lores.pdf, Accessed 21 May 2014.
- ⁹⁷ Street Design Manual Second Edition, New York City Department of Transportation, 2013, Available online <http://www.nyc.gov/html/dot/downloads/pdf/nycdot-streetdesignmanual-interior-lores.pdf>, Accessed 21 May 2014.
- ⁹⁸ Standards for Green Infrastructure, Office of Green Infrastructure New York City Department of Environmental Protection, 16 October 2013, Available online http://www.nyc.gov/html/dep/pdf/green_infrastructure/bioswales-standard-designs.pdf, Accessed 21 May 2014.
- ⁹⁹ Chapter 2: Minimum Control Requirements, Stormwater Management Guidebook, District Department of the Environment, 2013, Available online <http://ddoe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/Chapter%202%20Minimum%20Control%20Requirements.pdf>, Accessed 21 May 2014.
- ¹⁰⁰ Green Infrastructure Standards, District Department of Transportation, 2014, Available online <http://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/2014-0421-DDOT%20Green%20Infrastructure%20Standards.pdf>, Accessed 21 May 2014.
- ¹⁰¹ Lukes, Robb, Chris Kloss, Low Impact Development Center, Managing Wet Weather with Green Infrastructure: Municipal Handbook Green Streets, December 2008, Available online http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_municipalhandbook_green_streets.pdf, Accessed 17 April 2014.
- ¹⁰² Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater and Green Infrastructure, U.S. Environmental Protection Agency, August 2010.
- ¹⁰³ Dunlap, Ivy, Portland Bureau of Environmental Services, Personal Interview, 2013.
- ¹⁰⁴ Green Streets Policy, City of Portland, 2007, Available online <http://www.portlandoregon.gov/shared/cfm/image.cfm?id=154231>, Accessed 18 April 2014.
- ¹⁰⁵ % for Green Funding, City of Portland Bureau of Environmental Services, Available online <https://www.portlandoregon.gov/bes/article/341452>, Accessed 18 April 2014.
- ¹⁰⁶ Green Streets Cross-Bureau Team Report Phase I, City of Portland, March 2006, Available online <https://www.portlandoregon.gov/bes/article/123793>, Accessed 26 August 2014.
- ¹⁰⁷ Lukes, Robb, Christopher Kloss, Low Impact Development Center, Managing Wet Weather with Green Infrastructure Municipal Handbook, December 2008, Available online http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_municipalhandbook_green_streets.pdf, Accessed 26 August 2014.
- ¹⁰⁸ Sustainable Urban Infrastructure Policies and Guidelines Volume I, Chicago Department of Transportation, 2013, Available online <http://www.scribd.com/doc/159032629/Sustainable-Urban-Infrastructure-Guidelines>, Accessed 26 August 2014.

- ¹⁰⁹ Lukes, Robb, Christopher Kloss, Low Impact Development Center, Managing Wet Weather with Green Infrastructure Municipal Handbook, December 2008, Available online http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_green_streets.pdf, Accessed 26 August 2014.
- ¹¹⁰ Attarian, Janet, Chicago Department of Transportation, Personal Interview, November 2013.
- ¹¹¹ Chicago, Illinois, Rooftops to Rivers II, Natural Resources Defense Council, 2013, Available online http://www.nrdc.org/water/stormwater/files/RooftopstoRivers_Chicago.pdf, Accessed 26 August 2014.
- ¹¹² Tucson to Capture Stormwater for Irrigation of Roadway Vegetation, City of Tucson, 29 May 2013, Available online <http://www.mayorrothschild.com/2013/05/29/tucson-to-capture-stormwater-for-irrigation-of-roadway-vegetation/>, Accessed 18 April 2014.
- ¹¹³ Overview: A Green Streets Policy for the City of Tucson, Watershed Management Group, 2013, Available online <http://www.pagnet.org/documents/committees/WPS/2013/WPS-2013-04-29-Presentation-WMG-Green-Streets-Policy.pdf>, Accessed 18 April 2014.
- ¹¹⁴ Syracuse, Tory, Watershed Management Group, Personal Interview, November 2013.
- ¹¹⁵ Syracuse, Tory, Watershed Management Group, Personal Interview, November 2013.
- ¹¹⁶ Green Infrastructure, NYC Parks, Available online <http://www.nycgovparks.org/greening/green-infrastructure>, Accessed 2 May 2014.
- ¹¹⁷ NYC Green Infrastructure Plan, New York City Department of Environmental Protection, 2010, Available online http://www.nyc.gov/html/dep/pdf/green_infrastructure/NYCGreenInfrastructurePlan_LowRes.pdf, Accessed 2 May 2014.
- ¹¹⁸ Types of Green Infrastructure, New York City Department of Environmental Protection, Available online http://www.nyc.gov/html/dep/html/stormwater/combined_sewer_overflow_bmps.shtml#greenstreets, Accessed 2 May 2014.
- ¹¹⁹ NYC Green Infrastructure 2013 Annual Report, New York City Department of Environmental Protection, 2013, Available online http://www.nyc.gov/html/dep/pdf/green_infrastructure/gi_annual_report_2014.pdf, Accessed 2 May 2014.
- ¹²⁰ Get Involved and Find Resources, NYC Department of Environmental Protection, 2014, Available online http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_outreach.shtml, Accessed 5 May 2014.
- ¹²¹ Compton, Nette, Director of Green Infrastructure, New York City Department of Parks and Recreation, Personal Interview, 2013.
- ¹²² Clean Watersheds Needs Survey 2008 Report to Congress, U.S. Environmental Protection Agency, 12 September 2013, Available online <http://water.epa.gov/scitech/datait/databases/cwns/2008reportdata.cfm>, Accessed 5 May 2014.
- ¹²³ Funding Stormwater Programs, U.S. Environmental Protection Agency, April 2009, Available online <http://water.epa.gov/infrastructure/greeninfrastructure/upload/FundingStormwater.pdf>, Accessed 5 May 2014.
- ¹²⁴ Urban Stormwater Management in the United States, National Research Council, 15 October 2008, Available online http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf, Accessed 5 May 2014.
- ¹²⁵ Guidance for Municipal Stormwater Funding, National Association of Flood and Stormwater Management Agencies, 2006, Available online at <http://www.nafsma.org/Guidance%20Manual%20Version%202X.pdf>, Accessed 5 May 2014.
- ¹²⁶ "Stormwater Program Funding Methods," Stormwater Utility Feasibility, City of Urbana, October 2010, Available online http://urbanaininois.us/sites/default/files/attachments/storm-water-funding-method-summary_0.pdf, Accessed 5 May 2014; Guidance for Municipal Stormwater Funding, National Association of Flood and Stormwater Management Agencies, Available online at <http://www.nafsma.org/Guidance%20Manual%20Version%202X.pdf>, 2006, Accessed 5 May 2014.
- ¹²⁷ Guidance for Municipal Stormwater Funding, National Association of Flood and Stormwater Management Agencies, Available online at <http://www.nafsma.org/Guidance%20Manual%20Version%202X.pdf>, 2006, Stormwater Strategies: Community Responses to Runoff Pollution, Chapter 4: Funding and Gaining Support for Stormwater Programs, Natural Resources Defense Council, Accessed 6 February 2013, Available online at <http://www.nrdc.org/water/pollution/storm/chap4.asp>, Accessed 5 May 2014.
- ¹²⁸ Western Kentucky University Stormwater Survey 2012, Western Kentucky University, 2012, Available online at <http://www.wku.edu/engineering/documents/swusurveys/swusurvey-2012.pdf>, Accessed 5 May 2014.
- ¹²⁹ Applying for and Administering CWA Section 319 Grants, U.S. Environmental Protection Agency, March 2003, Available online http://water.epa.gov/grants_funding/cwa319/319Guide.cfm#PurposeGrants, Accessed 5 May 2014.
- ¹³⁰ How the CWSRF Program Works, U.S. Environmental Protection Agency, 11 March 2014, Available online http://water.epa.gov/grants_funding/cwsrf/basics.cfm, Accessed 5 May 2014.
- ¹³¹ The Transportation Planning Process Key Issues: A Briefing Book for Transportation Decisionmakers, Officials, and Staff, Federal Highway Administration and the Federal Transit Administration.

- ¹³² Moving Ahead for Progress in the 21st Century (MAP-21) Summary of Highway Provisions, U.S. Department of Transportation, 17 August 2012, Available online <http://www.fhwa.dot.gov/map21/summaryinfo.cfm>, Accessed 21 May 2014.
- ¹³³ Transportation Funding and Finance, AASHTO Center for Excellence in Project Finance, American Association of State Highway and Transportation Officials, 2014, Available online http://www.transportation-finance.org/funding_financing/funding/state_funding/, Accessed 21 May 2014.
- ¹³⁴ Transportation Funding and Finance, AASHTO Center for Excellence in Project Finance, American Association of State Highway and Transportation Officials, 2014, Available online http://www.transportation-finance.org/funding_financing/funding/state_funding/, Accessed 21 May 2014.
- ¹³⁵ Venner, Marie and Kelly Brennan, State Transportation Agency Strategies to Address NPDES Phase II Requirements, Venner Consulting, Inc. and Parsons Brinckerhoff requested by the American Association of State Highway and Transportation Officials (AASHTO), February 2007.
- ¹³⁶ Guidance for Municipal Stormwater Funding, National Association of Flood and Stormwater Management Agencies, Accessed 6 February 2013, Available online at <http://www.nafmsma.org/Guidance%20Manual%20Version%202X.pdf>, 2006.
- ¹³⁷ Western Kentucky University Stormwater Survey 2012, Western Kentucky University, Accessed 20 February 2013, Available online at <http://www.wku.edu/engineering/documents/swsurveys/swsurvey-2012.pdf>, 2012.
- ¹³⁸ Water Quality Protection Charge, Montgomery County, MD, Accessed 21 February 2013, Available online at <http://www6.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/wqpc.asp>.
- ¹³⁹ Guidance for Municipal Stormwater Funding, National Association of Flood and Stormwater Management Agencies, Accessed 6 February 2013, Available online at <http://www.nafmsma.org/Guidance%20Manual%20Version%202X.pdf>, 2006, Stormwater Strategies: Community Responses to Runoff Pollution, Chapter 4: Funding and Gaining Support for Stormwater Programs, Natural Resources Defense Council, Accessed 6 February 2013, Available online at <http://www.nrdc.org/water/pollution/storm/chap4.asp>
- ¹⁴⁰ Mulcahy, Laura Anne, The Effectiveness of Stormwater Utilities in Mitigating Stormwater Runoff in the United States, Unpublished Thesis, Brown University, Accessed 6 February 2013, Available online at <http://envstudies.brown.edu/theses/archive20072008/lauramulcahythesis.pdf>, 2009.
- ¹⁴¹ Stormwater Utility Fees: Considerations & Options for Interlocal Stormwater Working Group (ISWG), New England Environmental Finance Center, May 2005, Available online at <http://efc.muskie.usm.maine.edu/docs/StormwaterUtilityFeeReport.pdf>, Accessed 23 May 2014.
- ¹⁴² Stormwater Utility Fees: Considerations & Options for Interlocal Stormwater Working Group (ISWG), New England Environmental Finance Center, May 2005, Available online at <http://efc.muskie.usm.maine.edu/docs/StormwaterUtilityFeeReport.pdf>, Accessed 23 May 2014.
- ¹⁴³ City of Lancaster Wins the BUBBA!, City of Lancaster, 28 May 2014, Available online <http://cityoflanca-sterpa.com/blog/city-lancaster-wins-bubba>, Accessed 27 August 2014.
- ¹⁴⁴ The Economic Benefits of Green Infrastructure: A Case Study of Lancaster, PA, U.S. Environmental Protection Agency, February 2014, Available online <http://water.epa.gov/infrastructure/greeninfrastructure/upload/CNT-Lancaster-Report-508.pdf>, Accessed 27 August 2014.
- ¹⁴⁵ Starting a Business Improvement District in Philadelphia, City of Philadelphia Department of Commerce and Drexel University's Center for Public Policy, 2012.
- ¹⁴⁶ Monacell, James P., Bond Practice: Community Improvement Districts as a Tool for Infrastructure Financing, Smith, Gambrell, & Russell, LLP, 2002.
- ¹⁴⁷ See NE 97th Avenue Green Street LID, City of Portland, Available online <http://www.portlandoregon.gov/transportation/article/303101>, Accessed 27 August 2014; Gateway URA: Overview, Portland Development Commission, Accessed 12 February 2013, Available online at <http://www.pdc.us/our-work/urban-renewal-areas/gateway/overview.aspx>, 1% for Green, Portland Bureau of Environmental Services, Accessed 12 February 2013, Available online at <http://www.portlandoregon.gov/bes/article/341452>.
- ¹⁴⁸ Tax Increment Financing: A Tool for Local Development, Lincoln Institute of Land Policy, 2006 (18):1, Available online http://www.lincolninst.edu/pubs/1078_Tax-Increment-Financing, Accessed 27 August 2014.
- ¹⁴⁹ Implementing Green Infrastructure: Developing a Winning Strategy to Fund Philadelphia's Ambitious Visions, Economy League Greater Philadelphia, October 2009, Available online http://wren.palwv.org/library/documents/Implementing_Green_Infrastructure-PEC.pdf, Accessed 27 August 2014.
- ¹⁵⁰ San Mateo County Sustainable Green Streets and Parking Lots Design Guidebook, Nevu Negan Associates and Sherwood Design Engineers for the San Mateo Countywide Water Pollution Prevention Program, 2012, Available online at <http://chesapeakestormwater.net/wp-content/uploads/downloads/2012/03/San-Mateo-Green-Streets.pdf>, Accessed 27 August 2014.

- ¹⁵¹ % for Green Funding, City of Portland Bureau of Environmental Services, Available online <https://www.portlandoregon.gov/bes/article/341452>, Accessed 18 April 2014.
- ¹⁵² Partnership for Sustainable Communities, U.S. Environmental Protection Agency, U.S. Department of Transportation, U.S. Department of Housing and Urban Development, 2012, Available online http://www.sustainablecommunities.gov/pdf/partnership_accomplishments_report_508%20compliant_final_062112.pdf, Accessed 14 May 2014.
- ¹⁵³ See Project Summary and Contact Information, Seattle Department of Transportation, Available online <http://www.seattle.gov/transportation/docs/mercer/MercerTIGERGrantFINAL091509.pdf>, Accessed 8 May 2014; Transportation Investment Generating Economic Recovery (TIGER) Grants, U.S. Department of Transportation, 17 February 2010, Available online http://www.dot.gov/sites/dot.gov/files/docs/Tiger_1_Awards.pdf, Accessed 8 May 2014.
- ¹⁵⁴ NYCEDC and Department of Transportation Introduce Conceptual Redesign of Fordham Plaza, NYCEDC, 10 August 2010, Available online <http://www.nycedc.com/press-release/nycedc-and-department-transportation-introduce-conceptual-redesign-fordham-plaza>, Accessed 9 May 2014.
- ¹⁵⁵ TIGER Discretionary Grant FY 2012: Project Narrative, City of Hartford, Connecticut, 16 March 2012, Available online <http://planning.hartford.gov/Oneplan/Transit%20Center/TIGER%20IV/Project%20Narrative.pdf>, Accessed 8 May 2014.
- ¹⁵⁶ East Coast Greenway, East Coast Greenway, Available online <http://www.greenway.org/>, Accessed 8 May 2014.
- ¹⁵⁷ See Walkable Olean North Union Complete Street Transformation, City of Olean, New York, 3 June 2013, Available online http://www.walkableolean.com/Tools/BroadCaster/Upload/Project25/Docs/NUS_App_WEB_smallest.pdf, Accessed 8 May 2014; Tiger 2013 Awards, U.S. Department of Transportation, 2013, Available online http://www.dot.gov/sites/dot.gov/files/docs/TIGER_2013_FactSheets.pdf, Accessed 8 May 2014.
- ¹⁵⁸ Notice of Funding Availability for the Department of Transportation's National Infrastructure Investments Under the Consolidated Appropriations Act, 2014, 79 Federal Register 41, 3 March 2014, Available online <http://www.gpo.gov/fdsys/pkg/FR-2014-03-03/pdf/2014-04627.pdf>, Accessed 8 May 2014.
- ¹⁵⁹ 23 U.S.C. §101(A)(29)(F)(i).
- ¹⁶⁰ Transportation Alternatives Program (TAP) Guidance, U.S. Department of Transportation Federal Highway Administration, 12 September 2013, Available online <http://www.fhwa.dot.gov/map21/guidance/guidetap.cfm>, Accessed 14 May 2014.
- ¹⁶¹ Urban and Community Forestry, U.S. Department of Agriculture U.S. Forest Service, Available online <http://www.fs.fed.us/ucf/nucfac.shtml>, Accessed 13 May 2014.
- ¹⁶² 2015 U.S. Forest Service National Urban and Community Forestry Challenge Cost-Share Grant Program Request for Pre-Proposals (RFP), U.S. Department of Agriculture U.S. Forest Service, Available online <http://www.fs.fed.us/ucf/nucfac.shtml>, Accessed 13 May 2014.
- ¹⁶³ Community Development Block Grant Entitlement Communities Grants, U.S. Department of Housing and Urban Development, Available online http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement, Accessed 20 May 2014.
- ¹⁶⁴ Rebuild by Design, President's Hurricane Sandy Rebuilding Task Force, Available online <http://www.rebuildbydesign.org/what-is-rebuild-by-design/#challenge>, Accessed 20 May 2014.
- ¹⁶⁵ Grants and Programs, U.S. Department of Transportation, Available online http://www.dot.gov/livability/grants-programs#Surface_Transportation_Planning, Accessed 21 May 2014.
- ¹⁶⁶ State Planning and Research (SP&R), MAP-21: Moving Ahead for Progress in the 21st Century, U.S. Department of Transportation, 12 September 2013, Available online <http://www.fhwa.dot.gov/map21/factsheets/spr.cfm>, Accessed 21 May 2014.
- ¹⁶⁷ Toledo (city), Ohio, United States Census Bureau, U.S. Department of Commerce, Available online <http://quickfacts.census.gov/qfd/states/39/3977000.html>, Accessed 5 May 2014.
- ¹⁶⁸ Tech Data, Toledo Waterways Initiative, 2014, Available online <http://www.toledowaterwaysinitiative.com/tech-data/>, Accessed 27 May 2014.
- ¹⁶⁹ About the Initiative, Rain Garden Initiative, 2008, Available online <http://www.raingardeninitiative.org/initiative.html>, Accessed 27 May 2014.
- ¹⁷⁰ Toledo's Chronic Urban Flooding, Great Lakes Coastal Resilience Planning Guide, Available online <http://www.greatlakesresilience.org/stories/ohio/toledo%E2%80%99s-chronic-urban-flooding>, Accessed 27 May 2014.
- ¹⁷¹ Stormwater Program, City of Toledo, 2014, Available online <http://toledo.oh.gov/services/public-utilities/environmental-services/water-resources/storm-water-program/>, Accessed 27 May 2014.
- ¹⁷² The Long-Term Control Plan Overview, Toledo Waterways Initiative, Available online http://www.toledowaterwaysinitiative.com/media/LTCP_Summary.pdf, Accessed 27 May 2014,
- ¹⁷³ Lehr, Mary, City of Toledo, Written Communications, 2 June 2014.

- ¹⁷⁴ Maywood Avenue, Rain Garden Initiative, Available online <http://www.raingardeninitiative.org/maywood.html>, Accessed 27 May 2014.
- ¹⁷⁵ Toledo 20/20 Comprehensive Plan: Toledo by Choice A Comprehensive Plan for Toledo's Future, City of Toledo, 26 July 2011, Available online <http://toledo.oh.gov/media/9898/Toledo-2020-Plan.pdf>, Accessed 5 May 2014.
- ¹⁷⁶ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/BriefingBook/BBook.htm>, Accessed 24 February 2014.
- ¹⁷⁷ Ohio Department of Transportation, Ohio Department of Transportation, May 2012, Available online <http://www.dot.state.oh.us/policy/ODOTStrategicPlan/Documents/2012%20Introduction%20to%20the%20Ohio%20Department%20of%20Transportation%20Booklet.pdf>, Accessed 14 April 2014.
- ¹⁷⁸ Metropolitan Planning, Division of Planning Ohio Department of Transportation, Available online https://www.dot.state.oh.us/Divisions/Planning/SPR/State-widePlanning/Pages/MPO_Map.aspx, Accessed 14 April 2014.
- ¹⁷⁹ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/Briefing-Book/BBook.htm>, Accessed 24 February 2014.
- ¹⁸⁰ District Two, Ohio Department of Transportation, Available online <http://www.dot.state.oh.us/districts/d02/Pages/default.aspx>, Accessed 14 April 2014.
- ¹⁸¹ Surface Treatment, City of Toledo, 2014, Available online <http://toledo.oh.gov/services/public-service/streets-bridges-harbor/surface-treatment/>, Accessed 29 August 2014.
- ¹⁸² Transportation, Toledo Metropolitan Area Council of Governments, Available online http://www.tmacog.org/tran_body.htm, Accessed 27 May 2014.
- ¹⁸³ Murphy, Tim, Personal Interview, 24 March 2014.
- ¹⁸⁴ Small Municipal Separate Storm Sewer Systems (MS4s) – General Permit, Ohio Environmental Protection Agency, Available online http://www.epa.ohio.gov/dsw/permits/GP_MS4StormWater.aspx, Accessed 14 April 2014.
- ¹⁸⁵ *Location and Design Manual Volume Two Drainage Design*, Ohio Department of Transportation, January 2014, Available online http://www.dot.state.oh.us/Divisions/Engineering/Hydraulics/Location%20and%20Design%20Volume%202/LD%20Volume%202%20Archive%2012013/entire_location_and_design_manual_volume2_january_2014.pdf, Accessed 14 April 2014.
- ¹⁸⁶ Resolution of TMACOG Endorsing the Low Impact Development Manual for the Lower Maumee and the Ottawa River Watersheds, 2010, Available online http://www.tmacog.org/Environment/Stormwater_meetings/2010/6_17_10/LID_Manual_Resolution.pdf, Accessed 27 May 2014.
- ¹⁸⁷ Ohio Environmental Protection Agency Authorization to Discharge Under the National Pollutant Discharge and Elimination System, Ohio Environmental Protection Agency, 1 August 2010, Available online http://epa.ohio.gov/portals/35/storm/Toledo_2PI00003_CD.pdf, Accessed 14 April 2014.
- ¹⁸⁸ Maywood Avenue, Rain Garden Initiative, Available online <http://www.raingardeninitiative.org/maywood.html>, Accessed 27 May 2014.
- ¹⁸⁹ Great Lakes Shoreline Cities Green Infrastructure Grants, U.S. Environmental Protection Agency, 2014, Available online <http://www.epa.gov/grtlakes/fund/shoreline/#toledo>, Accessed 27 May 2014; Narrative Proposal, City of Toledo, Available online <http://toledo.oh.gov/media/112556/Final-Workplan.pdf>, Accessed 27 May 2014.
- ¹⁹⁰ Integrating Context Sensitive Solutions into Transportation Practice, ICF International, CH2MHill, and TransTech, 30 June 2009, Available online http://contextsensitivesolutions.org/content/reading/integrating_context_sensitive_s/_resources/Integrating_CSS_into_Transportation_Practice_Guide.pdf/?, Accessed 23 May 2014; What is CSS?, AASHTO, Available online <http://contextsensitivesolutions.org/content/gen/state-profiles/OH>, Accessed 23 May 2014.
- ¹⁹¹ Aesthetic Design Initiative, Ohio Department of Transportation, Available online <http://contextsensitivesolutions.org/content/reading/ohio-aesthetic-design/resources/ohio-aesthetic-design/>, Accessed 23 May 2014.
- ¹⁹² Watershed Based Stormwater Management Group, Green Highways Partnership, 2010, Available online <http://www.greenhighwayspartnership.org/index.php>, Accessed 6 March 2014.
- ¹⁹³ Green Highways Partnership Factsheet, Green Highways Partnership, 2008, Available online <http://www.cityofmadison.com/sustainability/community/documents/GHP-watershed.pdf>, Accessed 23 May 2014.
- ¹⁹⁴ Technical Memorandum Guiding Principles (Goals and Objectives), Ohio Department of Transportation, July 2012, available online [http://www.dot.state.oh.us/Divisions/Planning/SPR/StatewidePlanning/access.ohio/Documents/TechMemos/Guiding%20Principles%20\(Goals%20and%20Objectives\).pdf](http://www.dot.state.oh.us/Divisions/Planning/SPR/StatewidePlanning/access.ohio/Documents/TechMemos/Guiding%20Principles%20(Goals%20and%20Objectives).pdf), Accessed 23 May 2014.

- ¹⁹⁵ Task 11 Environmental Overview: Review of Environmental Resources and Climate Variability, Ohio Department of Transportation, 17 January 2014, Available online <http://www.dot.state.oh.us/Divisions/Planning/SPR/StatewidePlanning/access.ohio/Documents/Tech-Memos/Environmental%20Overview.pdf>, Accessed 23 May 2014.
- ¹⁹⁶ Turning Graphical Results by Question, TMACOG, 11 April 2014, Available online [http://www.tmacog.org/Transportation/2045/Meeting%20Notes/turning%20pt%20report%20%20\(2\).pdf](http://www.tmacog.org/Transportation/2045/Meeting%20Notes/turning%20pt%20report%20%20(2).pdf), Accessed 27 May 2014.
- ¹⁹⁷ *Location and Design Manual: Volume Two Drainage Design*, the Ohio Department of Transportation, January 2014, Available online http://www.dot.state.oh.us/Divisions/Engineering/Hydraulics/Location%20and%20Design%20Volume%202/LD%20Volume%202%20Archive%2012013/entire_location_and_design_manual_volume2_january_2014.pdf, Accessed 27 May 2014.
- ¹⁹⁸ Fact Sheet for the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Washington State Department of Transportation's Municipal Separate Storm Sewers, State of Washington Department of Ecology, 6 March 2014, Available online <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/WSDOTPermit-FactSheet2014.pdf>, Accessed 16 April 2014.
- ¹⁹⁹ 2014 Highway Runoff Manual Revision, Washington State Department of Transportation (WSDOT), Available online <http://www.wsdot.wa.gov/Environment/WaterQuality/Runoff/HighwayRunoffManual.htm#2014>, Accessed 6 March 2014.
- ²⁰⁰ Complete Streets Policy, TMACOG, March 2014, Available online http://www.tmacog.org/Transportation/TMACOG_Complete_Streets_Policy_03_2014.pdf, Accessed 27 May 2014.
- ²⁰¹ Ohio Environmental Protection Agency Authorization to Discharge Under the National Pollutant Discharge and Elimination System, Ohio Environmental Protection Agency, 1 August 2010, Available online http://epa.ohio.gov/portals/35/storm/Toledo_2PI00003_CD.pdf, Accessed 14 April 2014.
- ²⁰² Infrastructure Design and Construction Requirements, City of Toledo, May 2014, Available online <http://toledo.oh.gov/media/118008/Infrastructure-Requirements-2014.pdf>, Accessed 12 June 2014.
- ²⁰³ Stormwater Management Standards Manual, Toledo Metropolitan Area Council of Governments, September 2008, Available online http://tmacog.org/Environment/TMACOG_Stormwater_Standards_Manual_.pdf, Accessed 14 June 2014.
- ²⁰⁴ Haslinger, Lorie, City of Toledo, Written Communications, 2 June 2014.
- ²⁰⁵ Infrastructure Design and Construction Requirements, City of Toledo, May 2014, Available online <http://toledo.oh.gov/media/118008/Infrastructure-Requirements-2014.pdf>, Accessed 12 June 2014.
- ²⁰⁶ Infrastructure Design and Construction Requirements, City of Toledo, May 2014, Available online <http://toledo.oh.gov/media/118008/Infrastructure-Requirements-2014.pdf>, Accessed 12 June 2014.
- ²⁰⁷ Haslinger, Lorie, City of Toledo, Written Communications, 2 June 2014.
- ²⁰⁸ Toledo, Ohio Municipal Code §901-02.
- ²⁰⁹ Green Streets, Smart Growth America, 2014, Available online <http://www.smartgrowthamerica.org/complete-streets/implementation/factsheets/green-streets/>, Accessed 28 May 2014.
- ²¹⁰ 5.18 Green Complete Streets, the City of La Crosse, Wisconsin, Available online <http://www.cityoflacrosse.org/index.aspx?NID=2524>, Accessed 4 August 2014.
- ²¹¹ Ordinance No.798-11, City of Cleveland, Available online http://www.cudc.kent.edu/pop_up_city/rockwell/img/Cleveland_Complete_and_Green_Streets_Ordinance.pdf, Accessed 4 August 2014.
- ²¹² Stormwater Solutions: Revising Toledo's Stormwater Credit Program, University of Michigan, December 2013.
- ²¹³ Stormwater Solutions: Revising Toledo's Stormwater Credit Program, University of Michigan, December 2013.
- ²¹⁴ Enhanced Homeowner and Organizational Grant Power, Rain Garden Initiative, 2008, Available online <http://www.raingardeninitiative.org/pilotsfunding.html>, Accessed 29 August 2014.
- ²¹⁵ Downtown Toledo Improvement District, Downtown Toledo Improvement District, 2012, Available online <http://downtowntoledo.org/>, Accessed 29 August 2014.
- ²¹⁶ Stormwater Management Standards Manual, Toledo Metropolitan Area Council of Governments, September 2008, Available online http://tmacog.org/Environment/TMACOG_Stormwater_Standards_Manual_.pdf, Accessed 14 June 2014.
- ²¹⁷ Atlanta (city), Georgia, United States Census Bureau, U.S. Department of Commerce, Available online <http://quickfacts.census.gov/qfd/states/13/1304000.html>, Accessed 5 May 2014.
- ²¹⁸ Meyer, Judith L. and Gretchen Loeffler, River Basins, New Georgia Encyclopedia, 28 August 2009, Available online <http://www.georgiaencyclopedia.org/articles/geography-environment/river-basins>, Accessed 28 August 2014.
- ²¹⁹ Julie Owens, Susan Rutherford, Personal Communications, City of Atlanta, 22 August 2014.
- ²²⁰ Consent Decree Program Management, Clean Water Atlanta, 2010, Available online <http://www.cleanwater-atlanta.org/consentdecree/overview.htm>, Accessed 27 June 2014.

- ²²¹ Atlanta will get more time to complete sewer upgrades/ City, state, and federal reach proposed agreement to extend deadline to 2027, U.S. Environmental Protection Agency, 31 May 2012, Available online <http://yosemite.epa.gov/opa/admpress.nsf/a21708abb48b5a9785257359003f0231/Od7c29db2b49a1b485257a0f0067c420!OpenDocument>, Accessed 12 August 2014.
- ²²² Julie Owens, Susan Rutherford, Personal Communications, City of Atlanta, 22 August 2014.
- ²²³ Authorization to Discharge under the National Pollutant Discharge Elimination System Discharges from the City of Atlanta Municipal Separate Storm Sewer System NPDES Permit No. GAS000100, 16 June 2014.
- ²²⁴ A Substitute Ordinance by City Utilities Committee, City of Atlanta, 2013, Available online <http://www.atlantawatershed.org/default/?linkServID=95836454-BAB0-48DC-AABE36297717215C&showMeta=2&ext=.pdf>, Accessed 1 July 2014.
- ²²⁵ Implementing Green Infrastructure: Atlanta's Post-Development Stormwater Ordinance, City of Atlanta, 2013, Available online <http://www.atlantawatershed.org/default/?linkServID=513ADABO-6965-4F92-AEBB38FC264C3DF6&showMeta=2&ext=.pdf>, Accessed 1 July 2014.
- ²²⁶ Green Infrastructure, City of Atlanta, Available online <http://www.atlantawatershed.org/greeninfrastructure/>, Accessed 14 August 2014.
- ²²⁷ City of Atlanta 2015-2019 Capital Improvements Program (CIP) Community Work Program, City of Atlanta, June 2014, Available online <http://www.atlantaga.gov/modules/showdocument.aspx?documentid=14485>, Accessed 7 July 2014.
- ²²⁸ City of Atlanta 2015-2019 Capital Improvements Program (CIP) Community Work Program, City of Atlanta, June 2014, Available online <http://www.atlantaga.gov/modules/showdocument.aspx?documentid=14485>, Accessed 7 July 2014.
- ²²⁹ Georgia Department of Transportation Fact Book, Georgia Department of Transportation, Available online at <http://www.dot.ga.gov/informationcenter/press-room/Documents/publications/FactBook/GeorgiaDOT-FactBook.pdf>, Accessed 9 April 2014.
- ²³⁰ Transportation Governance and Finance: A 50-State Review of State Legislatures and Departments of Transportation, National Conference of State Legislatures and the AASHTO Center for Excellence in Project Finance, May 2011, Available online http://www.transportation-finance.org/pdf/50_State_Review_State_Legislatures_Departments_Transportation.pdf, Accessed 25 February 2014.
- ²³¹ About Georgia DOT, Georgia Department of Transportation, Available online <http://www.dot.ga.gov/aboutGeorgiaDot/Pages/default.aspx>, Accessed 10 April 2014.
- ²³² Transportation Governance and Finance: A 50-State Review of State Legislatures and Departments of Transportation, National Conference of State Legislatures and the AASHTO Center for Excellence in Project Finance, May 2011, Available online http://www.transportation-finance.org/pdf/50_State_Review_State_Legislatures_Departments_Transportation.pdf, Accessed 25 February 2014.
- ²³³ Georgia Department of Transportation Statewide Travel Model Peer Review Report, Georgia Department of Transportation Overview, Federal Highway Administration, Available online http://www.fhwa.dot.gov/planning/tmip/resources/peer_review_program/gdot/page02.cfm, Accessed 9 April 2014.
- ²³⁴ Agency Structure, Atlanta Regional Commission, 2014, Available online <http://www.atlantaregional.com/about-us/overview/agency-structure>, Accessed 28 July 2014.
- ²³⁵ 2014 UPWP Unified Planning Work Program for the Atlanta Metropolitan Transportation Planning Area, Atlanta Regional Commission, 2013, Available online file:///C:/Users/sdetwiler/Downloads/tp_2014upwp_120413.pdf, Accessed 28 July 2014.
- ²³⁶ PLAN 2040 Framework, Atlanta Regional Commission, 2011, Available online http://documents.atlantaregional.com/plan2040/docs/lu_plan2040_framework_0711.pdf, Accessed 28 July 2014.
- ²³⁷ Metropolitan River Protection Act, Atlanta Regional Commission, Available online <http://www.atlantaregional.com/environment/water/mrpa-chattahoochee-corridor-protection>, Accessed 28 July 2014.
- ²³⁸ <http://www.northgeorgiawater.org/AboutUs/about-us>
- ²³⁹ Clean Water Campaign, 2013, Available online <http://www.cleanwatercampaign.com/about-us-1>, Accessed 28 July 2014.
- ²⁴⁰ Office of Transportation, City of Atlanta, Available online <http://www.atlantaga.gov/index.aspx?page=492>, Accessed 11 April 2014.
- ²⁴¹ Challenges and Needs, Connect Atlanta, City of Atlanta, 2009, Available online http://web.atlantaga.gov/connectatlanta/connectatl09/Chapter_2.pdf, Accessed 28 July 2014.
- ²⁴² Challenges and Needs, Connect Atlanta, City of Atlanta, 2009, Available online http://web.atlantaga.gov/connectatlanta/connectatl09/Chapter_2.pdf, Accessed 28 July 2014.
- ²⁴³ Municipal Separate Storm Sewer System (MS4) Permit Interdepartmental Correspondence, Department of Transportation State of Georgia, 20 January 2012, Available online [http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/PolicyAnnouncements/MS4-Chief%20Engineer%20\(1-20-12\).pdf](http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/PolicyAnnouncements/MS4-Chief%20Engineer%20(1-20-12).pdf), Accessed 1 July 2014.

- ²⁴⁴ Laws We Use, Chattahoochee Riverkeeper, Available online <http://www.chattahoochee.org/laws-we-use.php#The>, Accessed 1 July 2014.
- ²⁴⁵ Georgia Water Quality Control Act (Georgia), U.S. Department of Energy, Available online <http://energy.gov/savings/georgia-water-quality-control-act-georgia>, Accessed 1 July 2014.
- ²⁴⁶ General NPDES Stormwater Permit No. GAR041000, State of Georgia Department of Natural Resources Environmental Protection Division, 2012, Available online http://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Final_DOT_SW_NPDES_Permit_MS4_Dec_2011.pdf, Accessed 1 July 2014.
- ²⁴⁷ Georgia Department of Transportation Manual on Drainage Design for Highways, Revised September 2014, available online <http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/Pages/DesignPolicies.aspx>, accessed 30 October 2014
- ²⁴⁸ Ibid., page 10-8
- ²⁴⁹ Personal Communication, Chris Faulkner, Atlanta Regional Commission/ Metropolitan North Georgia Water Planning District, Aug. 12, 2014
- ²⁵⁰ Phase I Large MS4 NPDES Permit No. GAS000100, State of Georgia Department of Natural Resources Environmental Protection Division, 12 June 2009.
- ²⁵¹ Context-Sensitive Design Online Manual ver. 1.0, Georgia Department of Transportation, 21 April 2006, Available online http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/ContextSensitiveDesign/GDOT_CSD_Manual.pdf, Accessed 28 July 2014.
- ²⁵² Context-Sensitive Design Online Manual ver. 1.0, Georgia Department of Transportation, 21 April 2006, Available online http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/ContextSensitiveDesign/GDOT_CSD_Manual.pdf, Accessed 28 July 2014.
- ²⁵³ Watershed Based Stormwater Management Group, Green Highways Partnership, 2010, Available online <http://www.greenhighwayspartnership.org/index.php>, Accessed 6 March 2014.
- ²⁵⁴ Context-Sensitive Design Online Manual ver. 1.0, Georgia Department of Transportation, 21 April 2006, Available online http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/ContextSensitiveDesign/GDOT_CSD_Manual.pdf, Accessed 28 July 2014.
- ²⁵⁵ PLAN 2040 Framework, Atlanta Regional Commission, 2011, Available online http://documents.atlantaregional.com/plan2040/docs/lu_plan2040_framework_0711.pdf, Accessed 28 July 2014.; See 2005-2035 Georgia Statewide Transportation Plan, Georgia Department of Transportation, January 2006, Available online <http://www.dot.ga.gov/Projects/programs/Documents/Strategic/SWTPFinalReport.pdf>, Accessed 28 July 2014.
- ²⁵⁶ 2005-2035 Georgia Statewide Transportation Plan, Georgia Department of Transportation, January 2006, Available online <http://www.dot.ga.gov/Projects/programs/Documents/Strategic/SWTPFinalReport.pdf>, Accessed 28 July 2014.
- ²⁵⁷ General NPDES Stormwater Permit No. GAR041000 Authorization to Discharge Under the National Pollutant Discharge Elimination System Stormwater Discharges Associated with Municipal Separate Storm Sewer System Georgia Department of Transportation, State of Georgia Department of Natural Resources Environmental Protection Division, 3 January 2012, Available online http://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Final_DOT_SW_NPDES_Permit_MS4_Dec_2011.pdf, Accessed 28 July 2014.
- ²⁵⁸ California Department of Transportation (Caltrans) Statewide Stormwater Permit Factsheet, 2013, Available online http://www.waterboards.ca.gov/publications_forms/publications/factsheets/docs/caltrans_swpermit_fs_092112.pdf, Accessed 29 July 2014.
- ²⁵⁹ Order No. 2012-0011-DWQ NPDES NO. CAS000003 National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements (WDRS) for State of California Department of Transportation, 2013, Available online http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2012/wqo2012_0011_dwq.pdf, Accessed 29 July 2014.
- ²⁶⁰ Order No. 2012-0011-DWQ NPDES NO. CAS000003 National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements (WDRS) for State of California Department of Transportation, 2013, Available online http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2012/wqo2012_0011_dwq.pdf, Accessed 29 July 2014.
- ²⁶¹ Odefey, Jeff, Permitting Green Infrastructure: A Guide to Improving Municipal Stormwater Permits and Protecting Water Quality, American Rivers, January 2013, Available online <http://www.americanrivers.org/newsroom/resources/permitting-green-infrastructure-a-guide-to-improving-municipal-stormwater-permits-and-protecting-water-quality/>, Accessed 29 July 2014.
- ²⁶² Illinois General Stormwater Permit for Small Municipal Separate Stormwater Systems, 20 February 2009, Available online www.epa.state.il.us/water/permits/storm-water/ms4.html, Accessed 29 July 2014.
- ²⁶³ Authorization to Discharge under the National Pollutant Discharge Elimination System Discharges from the City of Atlanta Municipal Separate Storm Sewer System NPDES Permit No. GAS000100, 16 June 2014
- ²⁶⁴ Georgia Department of Transportation Manual on Drainage Design for Highways, Revised September 2014, available online <http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/Pages/DesignPolicies.aspx>, accessed 30 October 2014

- ²⁶⁵ Ibid., page 10-8
- ²⁶⁶ Chapter 9: Complete Streets, Design Policy Manual, Georgia Department of Transportation, 2014, Available online <http://www.dot.ga.gov/doingbusiness/Policies-Manuals/roads/designpolicies/Pages/DesignPolicy-Manual.aspx>, Accessed 4 August 2014.
- ²⁶⁷ Green Streets, National Complete Streets Coalition: Smart Growth America, 2014, Available online <http://www.smartgrowthamerica.org/complete-streets/implementation/factsheets/green-streets/>, Accessed 4 August 2014.
- ²⁶⁸ City of Atlanta 2015-2019 Capital Improvements Program (CIP) Community Works Program (CWP), Department of Planning and Community Development City of Atlanta, September 2014, Available online <http://www.atlantaga.gov/modules/showdocument.aspx?documentid=14485>, Accessed 3 September 2014.
- ²⁶⁹ Authorization to Discharge under the National Pollutant Discharge Elimination System Discharges from the City of Atlanta Municipal Separate Storm Sewer System NPDES Permit No. GAS000100, 16 June 2014.
- ²⁷⁰ Authorization to Discharge under the National Pollutant Discharge Elimination System Discharges from the City of Atlanta Municipal Separate Storm Sewer System NPDES Permit No. GAS000100, 16 June 2014.
- ²⁷¹ Syracuse, Tory, Watershed Management Group, Personal Interview, November 2013.
- ²⁷² Overview: A Green Streets Policy for the City of Tucson, Watershed Management Group, 2013, Available online <http://www.pagnet.org/documents/committees/WPS/2013/WPS-2013-04-29-Presentation-WMG-Green-Streets-Policy.pdf>, Accessed 18 April 2014.
- ²⁷³ Proctor Creek's Boone Boulevard Green Street Health Impact Assessment, U.S. Environmental Protection Agency, September 2013, Available online <http://www.epa.gov/research/healthscience/docs/proctor-creek-hia-factsheet.pdf>, Accessed 4 August 2014.
- ²⁷⁴ Stormwater Utility Passes Legal Test in Georgia, Stormwater, 30 April 2004, Available online http://www.erosioncontrol.biz/SW/Articles/Stormwater_Utility_Passes_Legal_Test_in_Georgia_255.aspx, Accessed 28 August 2014.
- ²⁷⁵ Smith, Joshua, Stormwater Utilities in Georgia, Land Use Clinic University of Georgia, 2006, Available online http://www.rivercenter.uga.edu/publications/pdf/luc_stormwater_utilities_2006_smith.pdf, Accessed 28 August 2014.
- ²⁷⁶ See Stormwater Utility Fees: Considerations & Options for Interlocal Stormwater Working Group (ISWG), New England Environmental Finance Center, 2005, Available online <http://efc.muskie.usm.maine.edu/docs/StormwaterUtilityFeeReport.pdf>, Accessed 28 August 2014; Guidance for Municipal Stormwater Funding, National Association of Flood and Stormwater Management Agencies, 2006, Available online at <http://www.nafmsma.org/Guidance%20Manual%20Version%202X.pdf>, Accessed 28 August 2014; Smith, Joshua, Stormwater Utilities in Georgia, Land Use Clinic University of Georgia, 2006, Available online http://www.rivercenter.uga.edu/publications/pdf/luc_stormwater_utilities_2006_smith.pdf, Accessed 28 August 2014.
- ²⁷⁷ <http://www.efc.sog.unc.edu/reslib/item/ga-stormwater-utility-dashboard>
- ²⁷⁸ Taking Downtown to the Next Level, Central Atlanta Progress and the Atlanta Downtown Improvement District, 2013, Available online <http://www.atlantadowntown.com/files/docs/2013-cap-annual-report-2014-calendar.pdf>, Accessed 28 August 2014.
- ²⁷⁹ Tax Allocation Districts, Invest Atlanta, Available online <http://www.investatlanta.com/builders-developers/tax-allocation-districts/>, Accessed 3 September 2014.
- ²⁸⁰ Transportation FAQs, American Road and Transportation Builders Association, 2014, Available online <http://www.artba.org/about/transportation-faqs/>, Accessed 3 September 2014.
- ²⁸¹ Miccio, Claire Elisabeth, Barriers to Implementing Low Impact Development Approaches in Washington State Roadways and Highways, Washington State Department of Transportation, June 2010, Available online <http://www.wsdot.wa.gov/research/reports/fullreports/756.1.pdf>, Accessed 27 February 2014.
- ²⁸² Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ²⁸³ Summary of the Clean Water Act, U.S. Environmental Protection Agency, 26 July 2013, Available online <http://www2.epa.gov/laws-regulations/summary-clean-water-act>, Accessed 19 February 2014; Copeland, Claudia, Clean Water Act: A Summary of the Law, Congressional Research Service, 23 April 2010, Available online http://www.in.gov/idem/files/rules_erb_20130213_cwa_summary.pdf, Accessed 19 February 2014.
- ²⁸⁴ Copeland, Claudia, Clean Water Act: A Summary of the Law, Congressional Research Service, 23 April 2010, Available online http://www.in.gov/idem/files/rules_erb_20130213_cwa_summary.pdf, Accessed 19 February 2014.
- ²⁸⁵ Section 404 Permitting, U.S. Environmental Protection Agency, 13 March 2013, Available online <http://water.epa.gov/lawsregs/guidance/cwa/dredg-dis/>, Accessed 27 February 2014.
- ²⁸⁶ Water Permitting 101, U.S. Environmental Protection Agency Office of Wastewater Management, Available online <http://www.epa.gov/npdes/pubs/101pape.pdf>.

- ²⁸⁷ Urban Stormwater Management in the United States, National Research Council, The National Academies Press, Washington, DC, 2008.
- ²⁸⁸ Stormwater Phase II Regulations: 40 CFR 122.32, The U.S. Environmental Protection Agency, Available online <http://yosemite.epa.gov/r10/water.nsf/95537302e2c56cea8825688200708c9a/a51068462d4b7ad988256c020076c072!OpenDocument>, Accessed 11 February 2014.
- ²⁸⁹ Water Quality/Wetlands, Center for Environmental Excellence, AASHTO, 2014, Available online http://environment.transportation.org/environmental_issues/water_wetlands/, Accessed 18 February 2014.
- ²⁹⁰ Developing and Implementing a Stormwater Management Program in a Transportation Agency, AASHTO, Center for Environmental Excellence, 2009.
- ²⁹¹ Venner, Marie and Kelly Brennan, State Transportation Agency Strategies to Address NPDES Phase II Requirements, February 2007.
- ²⁹² Developing and Implementing a Stormwater Management Program in a Transportation Agency, AASHTO, Center for Environmental Excellence, 2009.
- ²⁹³ Developing and Implementing a Stormwater Management Program in a Transportation Agency, AASHTO, Center for Environmental Excellence, 2009.
- ²⁹⁴ Clean Water Act Section 303(d) List of Impaired Waters, U.S. Environmental Protection Agency, Available online <http://yosemite.epa.gov/r10/water.nsf/tmdls/cwa+303d+list>, Accessed 12 February 2014.
- ²⁹⁵ Killam, Gayle, The Clean Water Act Owner's Manual Second Edition, River Network, 2005.
- ²⁹⁶ Fact Sheet: Introduction to the Clean Water Act (CWA) Section 303(d) Impaired Waters Lists, U.S. Environmental Protection Agency, 17 July 2009, Available online http://www.epa.gov/owow/tmdl/results/pdf/aug_7_introduction_to_clean.pdf, Accessed 13 February 2014.
- ²⁹⁷ Wayland, Robert H. and James A. Hanlon, Memorandum to Water Division Directors Regions 1-10, "Establishing Total Maximum Daily Load Wasteload Allocations(WLAs) for Storm Water Sources and NPDES Requirements Based on Those WLAs," 22 November 2002, Available online <http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf>, Accessed 18 February 2014.
- ²⁹⁸ Best Practices in Addressing NPDES and Other Water Quality Issues in Highway System Management, U.S. Domestic Scan Program, NCHRP Project 20-68A, December 2009.
- ²⁹⁹ Clean Water Act Section 401 Water Quality Certification: A Water Quality Protection Tool for States and Tribes, U.S Environmental Protection Agency, April 2010, Available online <http://water.epa.gov/lawsregs/guidance/cwa/upload/cwa-401-handbook-2010-interim.pdf>, Accessed 18 February 2014.
- ³⁰⁰ Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ³⁰¹ Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ³⁰² Section 404 Permitting, U.S. Environmental Protection Agency, 13 March 2013, Available online <http://water.epa.gov/lawsregs/guidance/cwa/dredgdgis/>, Accessed 18 February 2014.
- ³⁰³ Applying the Section 401(b) Guidelines in Transportation Project Decision-Making, AASHTO, Center for Environmental Excellence, 14 June 2011, Available online <http://environment.transportation.org/pdf/programs/pg14-lhandbook.pdf>, Accessed 19 February 2014.
- ³⁰⁴ CERCLA Overview, U.S. Environmental Protection Agency, 12 December 2011, Available online <http://www.epa.gov/superfund/policy/cercla.htm>, Accessed 20 February 2014.
- ³⁰⁵ Bearden, David M., Comprehensive Environmental Response, Compensation, and Liability Act: A Summary of Superfund Cleanup Authorities and Related Provisions of the Act, Congressional Research Service, 14 June 2012, Available online <http://www.fas.org/sgp/crs/misc/R41039.pdf>, Accessed 20 February 2014.
- ³⁰⁶ United States of America v. Washington State Department of Transportation, Case No. C08-5722RJB, United States District Court Western District of Washington at Tacoma, 7 June 2010, Available online http://www.lawandenvironment.com/uploads/file/US%20v_%20Washington%20DOT;%20Order%20on%20Motions%20for%20Partial%20Summary%20Judgment.pdf, Accessed 20 February 2014.
- ³⁰⁷ U.S. EPA v. WSDOT, The Washington State Department of Transportation, PowerPoint presentation, 20 July 2011, Available online <http://scoe.transportation.org/Documents/Boston%202011/Ken%20Stone.pdf>, Accessed 20 February 2014.
- ³⁰⁸ Fairfax County Water Authority Source Water Assessment Program, Fairfax County, Virginia, January 2002, Available online http://www.fairfaxwater.org/water/Redacted_FCWA_SWAP_Report.pdf, Accessed 21 February 2014.
- ³⁰⁹ Source Water Assessment Program Factsheet, Fairfax County Water Authority, 2002, Available online https://www.fcwa.org/water/swap_fact.htm#Potomac_PSC, Accessed 21 February 2014.

- ³¹⁰ Tiemann, Mary, Safe Drinking Water Act (SDWA): A Summary of the Act and its Major Requirements, Congressional Research Service, 10 December 2010, Available online <http://www.fas.org/sgp/crs/misc/RL31243.pdf>, Accessed 20 February 2014.
- ³¹¹ Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ³¹² Baldwin, Pamela, Eugene H. Buck, and M. Lynne Corn, The Endangered Species Act: A Primer, Congressional Research Service, 31 March 2005.
- ³¹³ Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra Urban Areas, National Cooperative Highway Research Program Report 728, Transportation Research Board of the National Academies, 2012, Available online http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_728.pdf, Accessed 18 February 2014.
- ³¹⁴ Upton, Harold F. Coastal Zone Management: Background and Reauthorization Issues, Congressional Research Service, 29 September 2010, Available online <http://crs.ncseonline.org/nle/crsreports/10Oct/RL34339.pdf>, Accessed 11 March 2014.
- ³¹⁵ Upton, Harold F. Coastal Zone Management: Background and Reauthorization Issues, Congressional Research Service, 29 September 2010, Available online <http://crs.ncseonline.org/nle/crsreports/10Oct/RL34339.pdf>, Accessed 11 March 2014.
- ³¹⁶ Going the Distance Together: Context Sensitive Solutions for Better Transportation, A Practitioner's Guide, "Chapter 3: Shaping Transportation Decisions," Federal Highway Administration, Available online http://www.fhwa.dot.gov/context/practitionersguide/3_2.html, Accessed 20 March 2014.
- ³¹⁷ Going the Distance Together: Context Sensitive Solutions for Better Transportation, A Practitioner's Guide, "Chapter 3: Shaping Transportation Decisions," Federal Highway Administration, Available online http://www.fhwa.dot.gov/context/practitionersguide/3_2.html, Accessed 20 March 2014.
- ³¹⁸ The United States Department of Transportation: A Brief History, U.S. Department of Transportation Office of the Historian, 1 March 2009, Available online <http://ntl.bts.gov/historian/history.htm>, Accessed 24 February 2014.
- ³¹⁹ Environment, U.S. Department of Transportation, Federal Highway Administration, 30 September 2013, Available online <https://www.fhwa.dot.gov/environment/>, Accessed 25 February 2014.
- ³²⁰ FHWA's Vital Few Environmental Goal: Environmental Stewardship and Streamlining, Federal Highway Administration, Available online <http://www.environment.fhwa.dot.gov/strmlng/vfovervw.asp>, Accessed 6 March 2014.
- ³²¹ Our Administrations, U.S. Department of Transportation, available online <http://www.dot.gov/administrations>, Accessed 25 February 2014.
- ³²² A Guide to Transportation Decisionmaking, U.S. Department of Transportation, Available online http://www.fhwa.dot.gov/planning/publications/transportation_decision_making/decisionmaking.pdf, Accessed 28 February 2014.
- ³²³ Transportation Governance and Finance: A 50-State Review of State Legislatures and Departments of Transportation, National Conference of State Legislatures and the AASHTO Center for Excellence in Project Finance, May 2011, Available online http://www.transportation-finance.org/pdf/50_State_Review_State_Legislatures_Departments_Transportation.pdf, Accessed 25 February 2014.
- ³²⁴ Connecting the DOTS through Collaboration in Stormwater Management, Center for Environmental Excellence by AASHTO, October 2012, Available online http://environment.transportation.org/pdf/water_wetlands/aashtoswwhitepaperoct2012.pdf, Accessed 18 March 2014.
- ³²⁵ Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight, United States Government Accountability Office, December 2010, Available online <http://www.gao.gov/assets/320/314004.pdf>, Accessed 24 February 2014.
- ³²⁶ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/Briefing-Book/BBook.htm>, Accessed 24 February 2014.
- ³²⁷ Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight, United States Government Accountability Office, December 2010, Available online <http://www.gao.gov/assets/320/314004.pdf>, Accessed 24 February 2014.
- ³²⁸ Transportation Governance and Finance: A 50-State Review of State Legislatures and Departments of Transportation, National Conference of State Legislatures and the AASHTO Center for Excellence in Project Finance, May 2011, Available online http://www.transportation-finance.org/pdf/50_State_Review_State_Legislatures_Departments_Transportation.pdf, Accessed 25 February 2014.

³²⁹ Moving Ahead for Progress in the 21st Century Act (MAP-21) A Summary of Provisions, U.S. DOT, FHWA, Available online <http://www.fhwa.dot.gov/map21/summaryinfo.cfm>, Accessed 18 March 2014.

³³⁰ Moving Ahead for Progress in the 21st Century, Pub. L. No. 112-141, § 134, Available online <http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title23-section134&num=0&edition=prelim>, Accessed 18 March 2014.

³³¹ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/BriefingBook/BBook.htm>, Accessed 24 February 2014.

³³² Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight, United States Government Accountability Office, December 2010, Available online <http://www.gao.gov/assets/320/314004.pdf>, Accessed 24 February 2014.

³³³ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/BriefingBook/BBook.htm>, Accessed 24 February 2014.

³³⁴ The Transportation Planning Process: Key Issues, Transportation Planning Capacity Building Program, Federal Highway Administration, Federal Transit Administration, September 2007, Available online <http://www.planning.dot.gov/documents/BriefingBook/BBook.htm>

Connect with us:

American Rivers
1101 14th Street NW, Suite 1400
Washington, DC 20005

202-347-7550

www.AmericanRivers.org



American Rivers
Rivers Connect Us®