LOCAL GOVERNMENT PLANNING FOR

STORMWATER GREEN INFRASTRUCTURE AND

HIGH PERFORMANCE LANDSCAPES

by

JAY SCOTT PIPPIN

(Under the Direction of Professor John Crowley)

ABSTRACT

Federal Clean Water Act embodies the United States' federal structure in its regulation of water quality. In regulating stormwater, the federal government establishes broad water quality goal but then relies on the state and local governments to implement regulations and programs to achieve these goals. In recent years the EPA has increasingly focused on using green infrastructure to address stormwater pollution. As the federal government promotes these practices, it is an opportune time for local governments to take the lead implementing green infrastructure plans in order to avoid unnecessary federal involvement in their planning and development and to capitalize on the multitude of benefits green infrastructure can provide. In Athens-Clarke County, the scale and speed of current development along with ongoing efforts to create a Master Plan for Athens' urban core make it an especially auspicious time to start a more comprehensive planning effort to manage stormwater with green infrastructure.

INDEX WORDS: Clean Water Act, municipal separate storm sewer system, MS4, water quality, green infrastructure, low impact development, high performance landscape.

LOCAL GOVERNMENT PLANNING FOR

STORMWATER GREEN INFRASTRUCTURE AND

HIGH PERFORMANCE LANDSCAPES

by

JAY SCOTT PIPPIN

Bachelor of Arts, Washington and Lee University, 2001

Juris Doctorate, University of Georgia, 2006

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial

Fulfillment of the Requirements for the Degree

MASTER OF ENVRIONMENTAL PLANNING AND DESIGN

ATHENS, GEORGIA

2013

LOCAL GOVERNMENT PLANNING FOR

STORMWATER GREEN INFRASTRUCTURE AND

HIGH PERFORMANCE LANDSCAPES

by

JAY SCOTT PIPPIN

Major Professor: John Crowley

Committee: Laurie Fowler
R. Alfred Vick
Ryan Eaves

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
August 2013

TABLE OF CONTENTS

TABLE OF FIGURES

I. INTRODUCTION

It has been 65 years since the United States federal government entered the realm of water quality regulation with the Federal Water Pollution Control Act of 1948 (FWPCA). Through the years federal policy has had some considerable success at addressing water pollution, but those successes have failed to keep pace with the threats to the nation's waters. The U.S. Environmental Protection Agency recently released its 2008-2009 National Rivers and Streams Assessment[1] and found that more than 55% of the nation's assessed waterways are impaired. While the present regulatory scheme has largely addressed pollution from identifiable sources such as municipal and industrial dischargers, pollution from diffused and unidentifiable sources continues to degrade water quality and threatens progress that has been made. Much of this pollution is mobilized by stormwater and carried into local waterways. In urban areas, stormwater runoff from roads, parking lots, buildings, and other surfaces carries nitrogen, phosphorous, and other nutrients, hydrocarbons and nitrogen oxides from vehicles, heavy metals, and an array of other pollutants from atmospheric deposition.[2]

It is becoming increasing clear that new and innovative approaches are needed to address the nation's gargantuan challenge of addressing stormwater pollution. This approach needs to account for the complex ecological, sociological, legal, and political aspects of this issue. The local planning process presents an opportunity for local

---

[1] U.S. Environmental Protection Agency, "2008-2009 National Rivers and Streams Assessment," *Draft* EPA/841/D-13/001, February 28, 2013.

[2] Forman, Richard T.T., Urban Regions: *Ecology and Planning Beyond the City*. Cambridge University Press, 2008, p.96.

governments to take proactive steps to protect and restore water quality and thereby satisfy federal environmental goals. Planning must aims to provide the synthesis of ecology, environmental policy and urban design to create better communities in which people can live and work.[3] This type of "environmental planning" presents the most effective and efficient means to incorporate local ecological functions into essential regulatory decision making.

The planning profession has traditionally focused on the architecture of urban spaces, though more recently it has begun to consider the landscape in conjunction with the built structural environment. Despite this expansion, local ecology rarely plays a central role in planning decisions beyond what is required by environmental regulations. The field of environmental planning attempts to balance and harmonize the enterprises that mankind imposes on the natural environment with the environment's natural functionality.[4] There is a growing movement to better incorporate ecological concerns and environmental regulation into local planning efforts. Environmental planning offers a means to synthesize technical and bureaucratic regulatory efforts with local land use and development decisions. This synthesis can incorporate measures of ecological functionality into the early stages of planning and development decision making and recognize opportunities to develop infrastructure options that utilize these ecosystem functions to provide more cost effective and efficient stormwater management.

---

[3] American Planning Association, What is Planning?. *Available at:* http://www.planning.org/aboutplanning/whatisplanning.htm. ("Planning, also called urban planning or city and regional planning, is a dynamic profession that works to improve the welfare of people and their communities by creating more convenient, equitable, healthful, efficient, and attractive places for present and future generations.")
[4] Edington, J.M., et al. Ecology and Environmental Planning, 1977. P.1.

A number of factors are driving federal regulators to adopt a more cooperative approach to achieving water quality goals. First, structural barriers in the U.S. regulatory system limit the federal government's ability to impose comprehensive stormwater controls. The United States is a federal republic in which 50 sovereign state governments ceded a portion of their sovereignty by adopting the U.S. Constitution to form a tripartite federal government. The relationship between the authority of the federal government and the sovereign states is what is known as constitutional federalism. As it becomes clear that very far reaching regulatory powers are needed to achieve federal water quality goals, a renewed interest in federalism indicates that federal authorities are reaching the extent of the federal government's constitutional authority. Planners are in a place to bridge this gap and merge federal goals for nationwide water quality with state and local goals that include environmental health and other community based priorities.

Secondly, because it comes from such diverse and ubiquitous sources, the nature of stormwater pollution makes developing a comprehensive regulatory scheme incredibly difficult. Every local situation will require some degree of specialized treatment based on the particular local conditions. Therefore, specialized local knowledge is necessary for effective treatment. The planning process can include increasingly sophisticated assessments of local conditions and craft site specific solutions to address local problems.

Thirdly, protecting water quality requires inter-jurisdictional standards. Rivers, streams, and creeks receive water from drainage basins that frequently cross jurisdictional boundaries. As the saying goes, everywhere is downstream of somewhere. Thus protecting water quality in one city, county or state is not enough to protect this nation's water resources unless common downstream water quality goals are shared by all the jurisdictions upstream. Therefore, regulating stormwater requires federal standards that transcend local jurisdictional boundaries as well as the involvement of state and local governments that have the legal authority and the local expertise to regulate the sources of stormwater pollution.

Local planning is an essential element in protecting water quality. The federal government requires a certain level of stormwater planning in many communities, and in Georgia, as in most states, the state requires stormwater controls. However, every component of a community's physical planning process needs to address water management and water quality if the United States' aquatic resources are going to be protected. In particular, planning efforts should identify opportunities for green infrastructure (GI) to be incorporated into community infrastructure and in individual site plans. Green infrastructure can be the most effective and efficient means for local governments to meet water quality requirements as well as community, economic, and environmental goals. Particularly in those communities with impaired waterbodies, proactive planning for more intensive stormwater management through green infrastructure can be a means of maintaining local control and avoiding onerous federal interference.

What follows is a discussion of the way stormwater regulation is increasingly relying on local planning and implementation efforts to achieve the federal water quality goals set out in the Clean Water Act (CWA). The first section briefly describes the federal regulatory structure governing stormwater under the CWA. The second section discusses how the U.S. EPA is increasing looking to local governments to control stormwater by promoting the use of green infrastructure elements in their planning and land use decisions. The third section will discuss how these developments could shape planning and development in downtown Athens-Clarke County, Georgia focusing on the possibilities for public-private partnerships in developing green infrastructure to control stormwater runoff and the construction of high performance landscapes to promote environmental quality.

II. FEDERALISM AND THE CLEAN WATER ACT

The United States regulatory systems enshrined in the U.S. Constitution is based on divided and overlapping authority between the federal government and the 50 constituent state governments. The drafters of the Constitution, fearing the possible agglomeration of too much political power in any one governmental body, created a political structure wherein semi-sovereign states are bound together under a unified federal government. Without digressing into the benefits of this system, one shortcoming of this divided authority is that it creates barriers to environmental regulation and to the protection of water quality in particular.

The Constitution bestows certain enumerated powers on the federal government, and the states retain all governmental authority not vested in the central government. The actual balance of power between the states and the federal government has ebbed and flowed over time, and their respective roles have evolved. This changing relationship between the states and the federal government is what is known as federalism. This concept shapes many federal programs as federal law makers and regulators must be sure that they do not stray beyond their proper role in this system for both legal and political reasons.

Much of Congress's authority to regulate the environment stems from the Constitution's "Commerce Clause".[5] The Commerce Clause states that Congress shall have the power "To regulate Commerce with foreign Nations, and among the several

[5] U.S. Const. art. I, §8, cl.3.

States, and with the Indian Tribes." While the courts' interpretation of the extent of federal power under the commerce clause has varied over the years, it is generally understood that the federal government possesses a plenary power to regulate trade between the states. [6]

The counterpoint to the Commerce Clause is found in the 10th Amendment, which states that "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people."[7] This amendment makes it clear that powers beyond those conferred to the federal government remain with the states, and the states therefore have much broader police powers than those vested in the federal republic.[8]

Up to 1937, the U.S. Supreme Court maintained a very restrictive reading of Congress's commerce clause authority limiting it to activities that directly impacted commerce between the states and prohibiting regulation of purely intrastate activities and those traditionally in the states' sphere of authority. Water quality regulation in this era primarily related to the maintenance of waterways to promote navigation, which was clearly aimed at regulating trade between the states and with foreign nations.[9]

---

[6]In Gibbons v. Ogden, 22 U.S. 1 (1824), Chief Justice Marshall wrote: "If, as has always been understood, the sovereignty of Congress, though limited to specified objects, is plenary as to those objects, the power over commerce with foreign nations and among the several states is vested in Congress as absolutely as it would be in a single government, having in its constitution the same restrictions on the exercise of the power as are found in the Constitution of the United States."

[7] U.S. Const. amend. X.

[8] Lagerre, Santiago. "The Historical Background of the Police Power," 9 U. Pa. J. Const. L. 745 (2007). *Available at*: Https://www.law.upenn.edu/journals/conlaw/articles/volume9/issue3/Legarre9U.Pa.J.Const.L.745(2007).pdf

[9] For example, the Rivers and Harbors Act, first past in 1824 authorized the Army Corps of Engineers to improve navigation in the Ohio and Mississippi River Valleys. Amendments in 1899 prohibited the discharge of refuse into navigable waters without a federal permit. These amendments made it the first federal environmental statute in the United States and significantly shaped the drafting of the Clean Water Act.

In the New Deal era of the 1930's, the Court began to allow the federal government more expansive powers. In National Labor Relations Board v. Jones & Laughlin Steel Corp.,[10] the Court ruled that the federal commerce power allowed Congress to regulate purely intrastate activities if in the aggregate the activities could be shown to impact interstate commerce. In 1981, the Supreme Court made it clear that environmental hazards could impact interstate commerce so as to implicate the federal commerce clause. In Hodel v. Virginia Surface Mining and Reclamation Ass'n,[11] the Court stated: "…the power conferred by the Commerce Clause [is] broad enough to permit congressional regulation of activities causing air or water pollution, or other environmental hazards that may have effects in more than one state."

By the 1990's, many believed Congress's commerce authority was effectively limitless. The standard laid out in *Laughlin Steel* and in similar cases seemed to indicate that any national regulation of any activity could be seen as affecting commerce in some way and thus could be authorized under the commerce clause.[12] However, the Supreme Court then made it clear that this was not the case.

The limits of the commerce clause power were reached in 1995 when the Supreme Court considered U.S. v. Lopez.[13] The *Lopez* decision revived the idea that the federal commerce clause power was limited, and it laid out three broad categories in which Congress could exercise its commerce clause authority: Congress could regulate the "channels" of interstate commerce. Congress could regulate to protect the "instrumentalities" of interstate commerce or persons or things in interstate commerce

[10] 301 U.S. 1 (1937),
[11] 452 U.S. 264 (1981).
[12] Craig, Robin Kundis. The Clean Water Act and the Constitution. 2nd ed. Environmental Law Institute, 2009. 109, 114. Print.
[13] 514 U.S. 549 (1995).

even if the threats were presented only from intrastate activities.[14] Finally, Congress could regulate those matters that have a substantial relation to interstate commerce.[15] Without getting into too much unnecessary detail about the Court's subsequent commerce clause jurisprudence, the important fact here is that *Lopez* and its progeny reasserted the idea of a limited federal government, which has a significant impact on the interpretation and implementation of many federal environmental laws such as the Clean Water Act.

By its statutory terms, the CWA regulates "navigable waters".[16] The federal government's authority to regulate traditionally navigable waters is a fundamental component of regulating interstate commerce and is well established.[17] Challenges to federal authority to regulate water pollution have focused on the precise limits of this term. Most federal courts have ruled that Congress recognized that all water moves in a continuous cycle and that all waterways are interconnected, and thus it intended to regulate water pollution the outer limits of its power under the commerce clause.[18] The statutory analysis of the definition of navigable waters thus became a constitutional question of the extent of Congress's power. Much like other commerce clause litigation,

---

[14] 29 C.F.R. 776.29 provides examples of instrumentalities and channels of interstate commerce: "Instrumentalities and channels which serve as the media for the movement of goods and persons in interstate commerce or for interstate communications include railroads, highways, city streets; telephone, gas, electric and pipe line systems; radio and television broadcasting facilities; rivers, canals and other waterways; airports; railroad, bus, truck or steamship terminals; freight depots, bridges, ferries, bays, harbors, docks, wharves, piers; ships, vehicles and aircraft which are regularly used in interstate commerce."

[15] Lopez 301 U.S. at 558-559.

[16] 33 U.S.C. § 1311(a).

[17] Gibbons v. Ogden, 22 U.S. at 227, ("Commerce, undoubtedly is traffic, but it is something more—it is intercourse... All America understands, and has uniformly understood, the word "commerce" to comprehend navigation.") *See also* U.S. v. Rands, 389 U.S. 121 (1967). ("The power to regulate commerce comprehends the control for that purpose, and to the extent necessary, of all the navigable waters of the United States.... For this purpose they are the public property of the nation, and subject to all the requisite legislation by Congress.")

[18] Craig at 119. *See e.g.* Natural Resources Defense Council v. Calaway, 32 F. Supp. 685 (D.D.C. 1975).

the early federal court decisions supported the government's regulation of virtually any surface water feature.[19]

The Supreme Court abruptly reversed course in 2001 in deciding Solid Waste Agency of N. Cook County v. Corps of Eng'rs,[20] now popularly known as the SWANCC decision. In SWANCC, the Court narrowed the scope of the Clean Water Act by backing away from its broadest rulings defining "navigable waters", and the Court refused to defer to the Corps of Engineers definition of "water of the United States," because of federalism concerns.[21] Subsequent federal court decisions read the SWANCC opinion very broadly interpreting it to eliminate federal jurisdiction over non-navigable intrastate wetlands that were not connected to navigable waters.[22] In terms of limiting the reach of CWA jurisdiction, this decision was not a dramatic change as these isolated wetlands at issue represent on a small fraction of the wetlands regulated by the CWA. However, SWANCC established that federal authority over water bodies was limited by Congress's constitutional authority regardless of a federal agency's interpretation of the regulation's connection to interstate commerce. Furthermore, it affirmed that statutory analysis of the reach of the CWA was inseparable from constitutional federalism concerns.[23]

The most significant recent Supreme Court decision regarding CWA jurisdiction is its 2006 plurality opinion in Rapanos v. U.S.[24] A Michigan real estate developer was seeking to expand upon the SWANCC ruling and challenged the Army Corps of Engineers' jurisdiction over additional isolated wetlands. Unable to find common ground

---

[19] *See e.g.* U.S. v. Riverside Bayview Homes, 474 U.S. 121, (1985).
[20] 531 U.S. 159 (2001)
[21] The Court stated: "…permitting [the Corp] to claim federal jurisdiction over ponds and mudflats falling within the Migratory Bird Rule would result in a significant impingement of the State's traditional and primary power over land and water use." 474 U.S. at 174.
[22] Craig at 127.
[23] Craig at 128.
[24] Rapanos v. U.S., 547 U.S. 715 (2006).

for a decision, the Court was split with 4-1-4 with four Justices signing on to an opinion written by Justice Scalia striking down the Corps' jurisdiction over the wetlands in question, and four joining Justice Stevens dissenting opinion. Justice Kennedy made the majority by voting with Scalia et al. to curtail the Corps' exercise of jurisdiction, but he did so based on a rationale independent of that expressed in the Scalia opinion. This created a complex debate among legal scholars regarding the precedential value of this decision that goes beyond the scope of this paper. However, the majority did strike down the Corps' exercise of jurisdiction focusing strongly on the federalism issues presented in the case. While the full implications of this decision are still taking shape in federal court houses and regulatory offices around the country, a majority of the Court expressed a perception that the CWA as applied in this case intruded upon traditional state authority to regulate land and private property rights.[25] This was the most restrictive interpretation of CWA jurisdiction since the enactment of the modern Act in 1972.

Despite the confusion caused by the *Rapanos* opinion, in practice the *Rapanos* and *SWANCC* opinions deal with waters where the agencies failed to show any impact to traditional navigable waters, and thus the decisions may not represent any real restriction in federal regulatory authority for most water bodies. However, these decisions show the Court setting a limit on federal regulatory authority based federalism concerns. This realization that the reach of the CWA would be restricted by the same revived federalism concerns that led to a reassessment of the commerce clause in *Lopez* and the invalidation of numerous other federal statutes and programs has informed the implementation of post-*Rapanos* federal clean water programs leading to a greater focus on local action. As

[25] The Court ruled that the Corps' interpretation impermissibly infringed on state authority despite the fact that 33 states filed briefs stating the Corps' interpretation was vital to their water quality protection efforts.

a result, in implementing its nonpoint source and stormwater control programs, federal agencies are increasingly relying on a cooperative approach that utilizes state and local planning efforts to achieve federal goals and priorities.

III. THE CLEAN WATER ACT

Congress first directly sought to regulate water quality with the Federal Water Pollution Control Act of 1948 (FWPCA).[26] Concerns about federalism were clearly present as §1 describes the intent of the act to: "recognize, preserve, and protect the primary responsibilities and rights of the States in controlling water pollution."[27] The 1948 FWPCA left primary responsibility for regulatory enforcement with the states and provided federal loans for state and local construction of sewage treatment facilities. Federal enforcement was limited to abatement actions on interstate waters.[28] The FWPCA of 1952 went further and specifically stated that federal enforcement actions were exercised on interstate waters "only after the efforts of the State have been exhausted and then only with their consent."[29]

Recognizing that FWPCA had largely failed to address water quality issues and that water pollution was a national problem, the Water Quality Act of 1965 introduced a federal requirement to set water quality standards. However, while initial drafts of the bill tasked federal authorities with developing these standards, concerns over federalism resulted in the states being tasked with setting the numerical standards and creating plans to achieve them. The federal government would provide financial and planning

[26] Federal attempts to control water pollution actually began with the Rivers and Harbors Act of 1899, sometimes referred to as the Refuse Act, which prohibited the discharge of pollution into navigable waters, though this was done primarily to protect navigation not for water quality concerns. However, concerns about water quality later influenced the permitting program that was administered under the Refuse Act, and that system was largely incorporated in the CWA's permitting process.

[27] 62 Stat. 1155 (June 30, 1948).

[28] Klein, Christine A., "The Environmental Commerce Clause," *Harvard Environmental Law Review* 25(2003).

[29] Ibid.

assistance in formulating and implementing state plans.[30] This was seen as remarkable advancement of the federal government's role in protecting water quality and a significant advancement of the cooperative approach to address this national problem. Despite the fact that the states took virtually no action to implement the 1965 FWPCA, this approach to setting water quality standards would form a significant part of the 1972 rewrite of the FWPCA that became known as the Clean Water Act (CWA).[31]

A. National Pollution Discharge Elimination System (NPDES)

The 1972 Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) permit program as the primary regulatory tool to control the direct discharge of pollution into waters of the United States.[32] The CWA describes these direct discharges at "point sources," and §402 of the CWA prohibits the discharge of pollutants from a point source without a NPDES permit. Point sources are generally defined as discrete conveyances, such as pipes or manmade ditches, that discharge pollutants into regulated waters of the United States.[33] NPDES permits must contain both technology based effluent standards as well as meet water-quality-based effluent requirements.[34]

Technology based limitations set limits on the amounts of particular pollutants based on economically feasible pollution control technology. The EPA has developed effluent guidelines for 55 industrial point source categories that include between 35,000 to 45,000 facilities. The EPA identifies the best available technology that it determines to be economically achievable for a particular industry and sets regulatory requirements based

[30] 79 Stat. 903 (Oct. 2, 1965).
[31] Though that name would not become officially enshrined in the legislation until the 1977 FWPCA amendments.
[32] CWA §402; 33 U.S.C. § 1342.
[33] CWA §502(14); 33 U.S.C. § 1362.
[34] Clean Water Act Handbook. P.1.

on the performance of that technology. The effluent guidelines do not require facilities to install any particular technology, but the regulations require facilities to achieve standards that were based on a particular model technology. These effluent guidelines establish a minimum level of control that becomes increasing strict as technology advances. Gradually this improves environmental outcomes as increasingly strict requirements are factored into individual permittees' discharge permits as they are renewed. Largely as a result of these technology-based permits industrial pollution levels plummeted and water quality improved, at least in regards most industrial pollutants.[35]

Water quality based effluent limitations base allowable discharges on achieving particular water quality standards in the receiving water body or downstream. These standards are to ensure that wherever possible water is of sufficient to provide for the propagation of aquatic life, is suitable for drinking water, provides for human recreation in and on the water, as is suitable for industrial use and other purposes.[36] Water quality based standards do not consider technological feasibility or costs, and they are used when technology based limitations are not sufficient to achieve applicable water quality standards.

During the early years of the CWA when EPA was first implementing the NPDES permitting program, EPA efforts focused on industrial and municipal discharges. However, concern about the impacts of stormwater on water quality was growing. Stormwater did not fit the traditional notion of a pollutant in that it was naturally occurring, and it was not the product of any discharger's primary activity. It was seen as a general problem that came from diffused sources that did not fit into the end-of-pipe

[35] Houck, 3.
[36] CWA Handbook p. 39.

regulations EPA was putting in to place. Nonetheless, it was becoming clear that by the time stormwater entered surface waters, it was contaminated with a wide range of pollutants including industrial chemicals, pesticides, heavy metals, bacteria, nutrients and sediment. It was clearly a significant contributor to water quality problems around the country.

In response to this growing concern, Congress passed the Water Quality Act of 1987,[37] which, among other things, added § 402(p) to the CWA making the NPDES requirements applicable to stormwater discharges from large construction sites, industrial sites, and from municipal separate storm sewer systems (MS4). In response to these new statutory directives, the EPA developed three permitting programs under the NPDES system for each of these stormwater dischargers. These regulated sites were now considered point sources discharges. Suddenly thousands of local governments across the country were under direct federal regulation and were required to have Clean Water Act NPDES permits for discharges that unavoidably occurred every time it rained.

In 1987, when the CWA stormwater program began, the reach of Congress's Commerce Clause power and thus the Clean Water Act's jurisdiction was at its most expansive, bordering on limitless. In the two and half decades since the passage of the Water Quality Act of 1987, concerns about the proper role of federalism have returned as discussed above. This federal action to direct local stormwater practices, which touch upon virtually all local planning and land use decisions, seems to run directly against this trend and assume federal supremacy to regulate stormwater. However, the concern for federalism principles informed the way the EPA has gone about implementing its

[37] EPA previously issued NPDES stormwater regulations several times between 1973 and 1987, but these efforts primarily resulted in litigation instead of regulation. It required specific statutory authorization for the program for EPA to actually implement it.

stormwater programs, the MS4 program in particular, and it is by considering the proper role for both the federal and local government in this federalist system that should shape the way stormwater is managed in the future.

B. Municipal Separate Storm Sewer Systems (MS4)

The Clean Water Act treats stormwater as both a point source and a nonpoint source. Runoff that is collected in drainage channels or other conveyances owned by a regulated public entity becomes pollution, the discharge of which requires an NPDES permit from EPA's MS4 program. All other rainfall such as that falling on agricultural fields remains unregulated though there are efforts to reduce the amount of pollutants conveyed to surface waters by this rainfall.[38]

An MS4 is defined as any conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, and storm drains) that is owned or operated by a State or local government entity designed for collecting and conveying stormwater which is not part of a publicly owned treatment works.[39] It is worth noting that "municipal" in this sense does not strictly refer to sewer systems owned by a municipality, but rather by definition it applies broadly to state transportation projects, universities, sewer districts, water authorities, hospitals, military bases or prisons.

Like other NPDES permits, MS4 permits regulate "end of pipe" discharges into regulated waters. However, regulation recognize that the pollutant loads contained in stormwater still come from diffused sources over which the permitee does not direct

---

[38] It is an interesting distinction that the MS4 program treats stormwater as a pollutant while nonpoint source programs look on the materials that are mobilized by stormwater as the pollutants.
[39] 40 C.F.R. 122.26(b)(8).

control. Therefore, unlike other NPDES permits that establish technology based numerical end-of-pipe pollution limits, MS4 permits establish best management practices (BMP) to reduce pollution "to the maximum extent practicable" (MEP)."[40] MS4 permits require permitees to reduce pollution loads by adopting specific BMPs. Permit writers have discretion to craft permits for individual MS4s or groups of MS4s.[41]

Phase I of the MS4 permitting process began in 1990 for "large" and "medium" MS4s. A "large" MS4 is defined as a separate storm sewer system that serves a population of 250,000 people or more. A "medium" MS4 serves a population between 100,000 and 250,000 people.[42] Over 1,000 cities, counties, and other governmental organizations are permitted under the Phase I MS4 program.[43]

Phase II of the MS4 program covers "small" MS4s. A small MS4 is defined as any MS4 not covered by a Phase II permit. However, not every small MS4 is covered by the Phase II program. All small MS4s located within the boundaries of a Census Bureau defined "urbanized area" (UA) are automatically designated as a "regulated small MS4" and must be covered by an NPDES permit. Other small MS4s are regulated if EPA determines they are contributing to water quality impairments. While the technical definition of an UA involves a complex and detailed list of published criteria, it is essentially a grouping of predetermined census blocks based upon total population and overall population density. The Census Bureau generally defines a UA as "one or more central place(s)—and the adjacent densely settled surrounding area—urban fringe—that

---

[40] CWA § 402(p)(3)(B); 33 U.S.C. § 1342(p)(3)(B).
[41] Gentile, Laura et al., "Storm Water Phase I MS4 Permitting: Writing More Effective, Measurable Permits," U.S. EPA Region IX. March 2013. There actually only about 750 individual MS4 permits, but many Phase I MS4 permits cover multiple jurisdictions with interconnected systems.
[42] 40 C.F.R. § 122.26, Appendices F-I.
[43] Gentile at 134.

together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile."[44] Athens-Clarke County, Georgia operates a small MS4. Unless it is determined that a particular small MS4 needs an individual permit, they are covered by statewide general permits.

Both Phase I and Phase II permits are based the development of comprehensive stormwater plans. Phase I permits require the creation of a stormwater management plan that addresses four sources of pollutants:

1. Runoff from commercial and residential areas;
2. Runoff from industrial areas;
3. Runoff form construction sites; and
4. Non-stormwater discharges resulting from illicit storm sewer connections or improper disposal practices.

Phase II permits require the MS4 operator must adopt a stormwater management plant that contains six minimum control measures to reduce pollutant loads to the maximum extent practical in order to "satisfy the water quality requirements of the Clean Water Act":

1. Public education and outreach on stormwater impacts;
2. Public involvement/participation;
3. Illicit discharge detection and elimination;
4. Construction site stormwater runoff control;
5. Post-construction stormwater management in development and redevelopment sites; and
6. Pollution prevention and good housekeeping for municipal operations.[45]

To be covered under the small MS4 General Permit, the MS4 operator submits a Notice of Intent (NOI) to be covered by the permit in which it identifies the BMPs that it or

[44] 55 F.R. 42592 (1990); 67 FR 11663 (2002)
[45] 40 C.F.R. §122.34(a).

another party will implement to address each of these six requirements.[46] EPA provides a menu of recommended BMPS to address each requirement.[47]

C. Nonpoint Source Pollution Programs

The Clean Water Act provides no statutory definition of "non-point source" pollution (NSP). Essentially, it is any source of pollution from dispersed sources that are not readily identifiable. Any pollution source that is not a point source is considered a nonpoint source.[48] Common NPS pollutants include fertilizers from agricultural land and residential lawns; oil, grease, and toxic chemicals from urban stormwater runoff and energy production; sediment from urban and rural areas and eroding stream banks; salt from irrigation or road deicing, and acid from drainage from abandoned mines; bacterial and nutrients from livestock and pet wastes, or faulty septic systems; and toxic substances from atmospheric deposition.[49]

The distinction between point sources and nonpoint sources can be confusing. For instance, stormwater runoff from MS4, large construction sites, some silviculture activities, and some concentrated animal feeding operations are considered point sources and are regulated under the NPDES permitting system. Meanwhile, other agricultural runoff, irrigation return flows, and stormwater that is not collected by a regulated MS4 are considered nonpoint sources. Thus depending on where it lands, stormwater can be

---

[46] General NPDES Permit No. GAG610000, effective December 6, 2012.
[47] EPA Nation Menu of Stormwater Best Management Practices. *Available at:* http://cfpub.epa.gov/npdes/stormwater/menuofbmps/.
[48] U.S. EPA Office of Water, "What is Nonpoint Source Pollution?" Last modified September 29, 2011. Accessed December 4, 2011. http://water.epa.gov/polwaste/nps/whatis.cfm (Nonpoint sources are any source of pollution that does not meet the definition of point source).
[49] Ibid. *See also* 40 CFR 130.6

treated as either a point source or a nonpoint source, and that treatment determines how local governments are supposed to regulate it.

The 1987 CWA amendments announced a new national policy on nonpoint source pollution: "It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act to be met through the control of both point and nonpoint sources of pollution."[50] However, despite this pronouncement more recently the EPA determined that nonpoint source pollution is the leading cause of water quality impairment in the United States.[51] In its current draft National Rivers and Stream Assessment, EPA found that 55% of the nations' waterways are in poor biological conditions.[52]

The impacts of individual NPS pollution sources are generally small, but when taken together, they cause significant negative impacts on water quality. Federal attempts to address nonpoint pollution are complicated by the fact that addressing the diffused and smaller scale sources of pollution requires basic powers that are denied the federal government in this federal system. Therefore, federal nonpoint source programs rely on incentives and technical assistance to drive state and local actors to implement measures to reduce nonpoint source pollution loads. The CWA programs that attempt to address nonpoint source pollution establish a process for states to identify waters with impaired water quality and then provide technical and financial assistance to them to plan and implement solutions to address these nonpoint sources of the impairment.

---

[50] 33 U.S.C. § 1251(a)(7)
[51] Ibid.
[52] EPA, National Rivers and Streams Assessment 2008-2009, *Draft*. EPA/841/D-13/001. February 28, 2013. ("Twenty-one percent of the nation's river and stream length is in good biological condition, 23% is in fair condition, and 55% is in poor condition, based on a robust, commonly used index that combines different measures of the condition of aquatic benthic macroinvertebrates (aquatic insects and other creatures such as crayfish).")

D. Section 303(d) & TMDLs

Section 303(d) of the CWA seeks to use federal authority to drive the states to develop water quality standards while respecting the idea of state sovereignty on the matter. The CWA directs EPA to develop a list of pollutants that were appropriate for water quality analysis.[53] Once that list was published, the burden shifts to the states to determine what uses best suit the state's waterbodies and then set water quality standards for those listed pollutants that preserve or restore waters to that standard.[54]

Once water quality standards are set, Sec. 303 directs states to: (1) identify waters that will remain polluted after the application of the technology based standards; (2) prioritize these waters based on their use and the severity of the pollution; and (3) establish "total maximum daily loads" (TMDLs) for these waters.[55] Sections 303 and 305 of the CWA require each state to implement a continuous planning process for all navigable waters in the state that designates specific water quality standards and reports which waterbodies fail to achieve the appropriate standard. The results of these two planning exercises are supposed to be incorporated into a general Water Quality Management Plan (WQMP) that specifies the best management practices (BMPs) that state and local governments will implement to control nonpoint sources of pollution in order to meet the designated water quality standards.

To encourage state and local governments to take a more active approach to achieve the needed nonpoint source pollution reductions, Congress added Section 319 to the CWA as part of the 1987 amendments. Section 319 increases federal oversight over state WQMPs, but it left ultimate implementation in local hands. Section 319 also requires

---

[53] 33 U.S.C. 1314
[54] 33 U.S.C. 1313
[55] 33 U.S.C. 1313

each state to prepare nonpoint source assessment reports for listed waterbodies that failed to meet the water quality standards. Sec. 319 also provides federal grants to states to facilitate development of these assessments and the state management plans. By 1991, EPA had approved all the states' management plans.

Through the mid-1990's, EPA's progress in addressing nonpoint source pollution was still largely ineffective.[56] However, in 1996 the Agency began to make a concerted effort to address nonpoint sources both through the TMDL program and by expanding the planning requirements of Sec. 319. A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet its designated water quality standard. A TMDL is the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources after natural background levels of the substance in question are considered. Also, a TMDL calculation includes a margin of safety to account for scientific uncertainty.[57]

Together the WLA and LA are known as the waterbody's "loading capacity".[58] Once the loading capacity of waterbody is reached for a given pollutant, or if the designated water quality standard for that pollutant is exceeded, no new discharges of that pollutant will be permitted. Thus local regulators have an incentive to reduce the LAs for nonpoint sources in order to accommodate necessary WLAs for point sources. In other words, the non point source program is structured so that local governments who may need a new or expanded NPDES permit on an impaired stream are incentivized to control nonpoint

[56] Houck, 56. Oliver A. Houck, *The Clean Water Act TMDL Program: Law, Policy, and Implementation*, Second ed. (Washington D.C.: Environmental Law Institute, 2002).

[57] U.S. Environmental Protection Agency, Handbook for Developing Watershed TMDLs,2009. P.9.

[58] U.S. Environmental Protection Agency, "Overview of Impaired Waters and Total Maximum Daily Loads Program." Last modified September 29, 2011. Accessed May19, 2013. http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/intro.cfm.

sources of pollution, because they would need to reduce the LA from nonpoint sources to accommodate a higher WLA from their new or expanded permit.

The TMDL analysis is the trigger for determining the sources of pollution entering a waterbody. Under the CWA, TMDLs are not self implementing. This means that EPA cannot directly enforce a TMDL where a nonpoint source is the cause of the impairment and there are no point sources associated with it. TMDLs are primarily a source of information for a given waterbody. TMDLs do not create any new federal regulatory authority over any type of sources. Hence, other authorities or programs (i.e. state or local authorities or private initiatives) must implement the pollutant reduction measures needed to meet a TMDL. The manner in which pollution reduction is achieved will depend on the type of sources present, as well as on social, political, and economic factors.[59]

Many critics argue that this "carrot-based" planning approach lacks a sufficient enforcement mechanism, and thus it is ineffective.[60] However, nonpoint source pollution cannot be controlled by the same type of technology based regulatory regime that is used to address point sources. The legal tools needed to address pollution from these widespread and diffused sources are land use controls and basic police power regulations that are traditionally the province of state and local authorities. Also, controlling nonpoint source pollution requires actions on a watershed scale, and, as discussed earlier, there is a growing question as to how far federal authority can reach under the CWA. Therefore, the control of nonpoint source pollution is meant to be an exercise of

---

[59] U.S. Environmental Protection Agency, "Watershed Academy Web: Introduction to the Clean Water Act." Last modified September 12, 2008. Accessed May 19, 2013. http://www.epa.gov/owow/watershed/wacademy/acad2000/cwa/.
[60] CWA Handbook p.194.

cooperative federalism between the states and the federal government wherein the federal government maintains a framework in which states, primarily acting through their local governments, plan and implement programs to control pollution under federal oversight and with federal incentives.

IV. LOCAL GOVERNMENT PLANNING FOR STORMWATER MANAGEMENT

Despite increasing federal attention to the issue, the nature of stormwater management makes it a matter for local regulation. Stormwater contaminants surface waters because it picks up sediment, nutrients, heavy metals, hydrocarbons, and other contaminants from the land. Land use determines the pollutants and the concentrations thereof in runoff. It also determines the volume, timing and velocity of stormwater as it enters local waterbodies. Therefore, land use determines how much stormwater contributes to water quality impairment.

Federal courts have made it clear that the U.S. Constitution leaves local governments primary authority over local land use. As Justice Scalia stated in Rapanos: "…the [Federal] Government's expansive interpretation would 'result in a significant impingement of the *States' traditional and primary power over land and water use*.' Regulation of land use…is a quintessential state and local power."[61] Local governments also have the specialized knowledge of local conditions and local development pressures that allow it to more effectively address environmental problems associated with development. The Georgia Stormwater Management Manual states: "Local governments have a large responsibility for stormwater management in Georgia since it is at the city and county level where land use, development and infrastructure decisions are typically made."[62]

---

[61] Rapanos, 547 U.S. at 737-38 *citing* SWANCC, 531 at 173. (*emphasis added*).
[62] GSMM p. 3-1. P. 39.

The CWA stormwater regulation programs highlight the need for a local emphasis on stormwater management through its cooperative federalism approach, which involves both direct federal regulation under the NPDES MS4 program[63] and through incentive and assistance based approached for nonpoint source regulation primarily under Sec. 303(d) and the TMDL program. In the past local governments have prepared the required water quality plans to avoid regulatory sanctions and take advantage of federal incentives. Generally these are independent planning exercises often carried out rather perfunctorily. However, these exercises can have real value for a community. Including stormwater management in a community's comprehensive planning process can identify the most efficient opportunities to comply with federal regulations and meet federal standards, and it can promote public/private partnerships in ways that create synergies that will make private development more efficient and offset the costs of providing public services. Specifically, planning for how green infrastructure can be used to manage stormwater provides an opportunity achieve federal permitting requirements for local governments while increasing community greenspace and providing a host of other public benefits associated with green infrastructure.

[63] EPA has approved 47 states to issue NPDES permits, but for the present purposes this should be considered direct federal regulation as this is a federal program administered by the states as opposed to allowing states and local governments to tailor their own approaches to regulation.

V. GREEN INFRASTRUCTURE IN STORMWATER REGULATION

A. Green Infrastructure and Stormwater Management

Green Infrastructure (GI), variably known as "Low Impact Development" (LID), is a trend in land development focusing on maintaining or replicating a landscape's prevalent natural regime.[64] While these terms are used to discuss design elements intended to provide numerous environmental and social benefits, green Infrastructure and low impact development are most commonly used to address hydrologic systems and particularly to eliminate or reduce urban stormwater runoff and pollutant loadings. Although the term Green Infrastructure is often used synonymously with Low Impact Development, for stormwater management and water quality purposes, the EPA defines green infrastructure as: "management approaches and technologies that utilize, enhance and/or mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and reuse."[65] Because this discussion focuses the use of GI to comply with federal regulatory requirement, what follows primarily focuses on GI elements that fit the EPA definition.

In LID, hydrologic infiltration, groundwater recharge, and volume and frequency of discharge are maintained through integrated use of various infrastructure elements, including the preservation of natural spaces. These elements can be utilized either as a single large scale design, such as a lake or open space that serves as a stormwater detention/infiltration facility, or as a collection of small-scale practices linked together on

[64] EPA LID Literature Review, p. 7.
[65] EPA GI Action Strategy p.5.

a site or across multiple sites. Implementing these elements can reduce the impacts of development and redevelopment activities on water resources by maintaining or replicating the predevelopment hydrology of the site.[66]

Wherever possible, LID projects should seek to preserve the natural functions of a site or a landscape. Limiting impervious cover and preserving natural opens space is the most effective means for maintaining natural hydrology. However, in urbanized settings where natural systems have already been disrupted by urban development, or on sites intended for dense development, man-made infrastructure elements can be implemented to recreate the functions of the lost natural systems to avoid disrupting the larger scale hydrologic system. Hydrologic changes caused by development can be mitigated either by eliminating or reducing impervious cover or mitigating its hydrologic impacts through the use of various GI design strategies and BMPS.

Stormwater management has traditionally focused on controlling peak flows and the time to peak concentration of runoff from storm events. It generally believed that retaining stormwater flows and spreading their release over a longer time frame would reduce flood risks downstream, decrease pollutant loads, as well as ameliorate erosion and other negative consequences associated with high volumes of runoff from urban and suburban development.

Research has shown that detention alone does not address many of the problems caused by excessive stormwater runoff.[67] In some instances reliance on detention alone may actually exacerbate flooding. Accumulating volumes of water with overlapping and uncoordinated times of release on different tributaries may add up to higher flows and

---

[66] U.S. Environmental Protection Agency, "Incorporating Green Infrastructure Concepts into Total Maximum Daily Loads (TMDLs)," October 2008.
[67] EPA LID Lit Review p. 1.

longer flow durations downstream of the discharge point compared to situations with no detention.[68] In a 1995 paper The University of Georgia's Bruce Ferguson presented a paper in which he wrote: "In Georgia, uniform on-site detention is almost the only approach to urban stormwater management. These results warn that this exclusive approach is probably having unintended effects on flow rate, duration and volume. These results invite consideration of infiltration on an equal basis with detention. They encourage infiltration even in small amounts for the purpose of reducing downstream channel erosion."[69] Incorporating green infrastructure into stormwater management systems decreases the reliance purely on stormwater detention, and it should lead to better results in protecting downstream channels and water quality.

Green infrastructure works better that detention alone because it reduces stormwater volume. Detention does not reduce runoff volume regardless of the length of time that water is contained. In a natural hydrologic setting, most rainfall infiltrates into the soil or evaporates back into the atmosphere as illustrated in Figure 1. Infiltration maintains higher groundwater levels. Instead of higher peak volumes, higher groundwater levels raise base flow levels, and much of this water taken up by vegetation and returned to the atmosphere via evapotranspiration. What does flow into the stream may be at a time sufficiently temporally disconnected from the rain event that it does not register as an effect of that rain event, but instead it shows up as higher base flow in the stream.

---

[68] Ferguson, Bruce, "Downstream Hydrographic Effects of Urban Stormwater Detention and Infiltration." *Proceedings of the 1995 Georgia Water Resources Conference*, held April 11 and 12, 1995, at the University of Georgia, Kathryn J. Hatcher, Editor, Vinson Institute of Government, The University of Georgia, Athens, Georgia.
[69] Id.

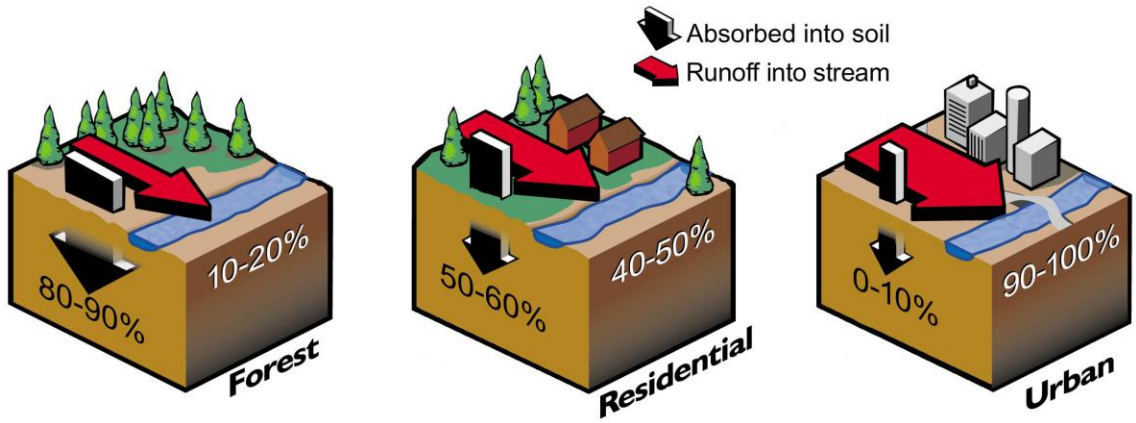

Figure 1: Changes in Hydrology and Runoff Due to Development
Graphic courtesy of Georgia Stormwater Management Manual

It is becoming increasingly clear that minimizing the disruption caused by human development and mimicking natural functions is the most cost effective means of stormwater management. Green infrastructure elements that are designed to operate like a natural system are generally cheaper than traditional stormwater infrastructure,[70] and they prevent the unnecessary disruption which forestalls the need for subsequent interventions to protect water quality or prevent erosion. Furthermore, by utilizing existing natural features and terrain and incorporating a variety of GI elements where necessary allows local communities to craft individualized stormwater solutions that better meet their particular needs.

B. Regulatory Drivers for Green Infrastructure

The EPA is actively promoting the incorporation of green infrastructure into local governments' planning and development processes as a means to address pollution from

[70] The EPA compared the costs of LID and GI stormwater BMPs with the cost of conventional stormwater management techniques for 12 case studies around the county in a study entitled "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices." In only one instance reviewed did the LID cost exceed that of the conventional systems, with an average cost savings of over 35%.

stormwater runoff. The Agency recognized that many localities have been reluctant to invest in GI initiatives that address stormwater because federal guidelines and enforcement actions call for more conventional measures for managing wet weather flows, and it has not been clear if these more creative local solutions would be counted toward the localities' CWA compliance.[71] In 2008, the EPA published an "action strategy" entitled "Managing Wet Weather with Green Infrastructure."[72] The document set forth a list of collaborative activities for the signatory organizations[73] to undertake to promote the use of green infrastructure in reducing stormwater runoff through "municipal stormwater (MS4) programs, and nonpoint source and watershed planning efforts."[74] Through the Green Infrastructure Action Strategy, EPA and its partners aim to address research gaps, develop protocols to quantify benefits and collect more empirical data. Ideally, this effort will provide more regulatory predictability and support for explicitly including green infrastructure requirement into permits, enforcement orders and long-term control plans.[75]

As a result of this strategy, Phase I MS4s permits are required to contain language about how they will incorporate GI elements into the SWMPs.[76] Phase I permitees are also required to review their codes and ordinances to assess whether there are

[71] Green Infrastructure Case Studies: *Municipal Policies for Managing Stormwater with Green Infrastructure* at 7.
[72] EPA Action Strategy, "Managing Wet Weather with Green Infrastructure," January, 2008.
[73] Along with U.S. EPA, the signatories were American Rivers, Association of State and Interstate Water Pollution Control Administrators, National Association of Clean Water Agencies, Natural Resources Defense Council , and The Low Impact Development Center.
[74] EPA Action Strategy, p.8. The Action Strategy also addresses Combined Sewer Overflows, but that aspect of Green Infrastructure planning will not be addressed here.
[75] Ibid. at 8.
[76] GA EPD Letter, RE: Municipal Separate Storm Sewer System EPD Guidance. July 30, 2020.

impediments to the use of GI.[77] In response to these reviews, MS4s should revise their codes to incentivize GI elements.[78] Small MS4s are not yet required to address green infrastructure, but the EPA is committed to a program that suggests that they soon will be.[79]

In Georgia, the principal document discussing this planning is the Georgia Stormwater Management Manual (GSMM), which was drafted by the Atlanta Regional Commission (ARC) under a federal 319 Grant.[80] Georgia's general permit for small MS4's requires all permittees adopt and enforce a SWMP for runoff from new development of redevelopment projects. The SWMP must include adoption of the GSMM or an equivalent local management program.[81]

The Georgia Stormwater Management Manual promotes comprehensive stormwater planning by setting out recommended minimum standards for local government stormwater programs. It directs local governments "to adopt a comprehensive approach to stormwater management that ties together stormwater quantity control with water quality protection, protection of stream channels and riparian corridors, floodplain management, habitat preservation and restoration, and the use of stormwater facilities for multiple purposes."[82] This comprehensive approach is intended

---

[77] Ibid. Large MS4s should have completed this review by the end of 2011. Medium MS4s should have completed it by the end of 2012.

[78] Ibid. Revisions in Large MS4s should be complete by the end of 2013, and revisions for Medium MS4s should be complete by the end of 2014.

[79] EPA Office of Wetlands, Oceans, and Watersheds, Green Infrastructure Case Studies: *Municipal Policies for Managing Stormwater with Green Infrastructure*. EPA -841-F-10-004, August 2010: "NPDES regulations require development and implementation of a municipal separate storm sewer system (MS4) program to address post-construction runoff from newly developed and redeveloped areas... *EPA is now developing guidance for state permit writers that will expand the requirements for using green infrastructure to meet MS4 permit requirements*." [emphasis added]

[80] Adoption of the GSMM Vol. 2 or its equivalent it required for all municipalities under the MS4 permit.

[81] General NPDES Stormwater Permit No. 610000, Sec. 4.2.5.1. December 6, 2012.

[82] GSMM Vol.1; p.3-3; p.39. However, the GSMM also recognizes that "For most communities in Georgia, the inclusion of water quality provisions and stream channel and habitat protection into

to: (1) Minimize the adverse impacts of stormwater runoff on the community; (2) Meet the state and federal regulatory requirements for stormwater runoff quantity and quality management; and (3) Ensure that the community's priorities, needs and desires are taken into account in meeting stormwater management goals. Planning for green infrastructure is a very effective means of accomplishing the goals outlined in the GSMM, and address the growing threat from stormwater pollution.

Georgia's Phase II MS4 General Permit also requires permitees to prepare an inventory of existing GI and LID stormwater and water quality related practices being used in the community. Permitees are also required to track the addition of new GI/LID structures and report the changes in each annual report.[83] This is a new requirement in the 2012 permit. This can only be a prelude to the drafting of more specific GI conditions in future permits or specific requirements for localities that are determined to require individual permits.

Moreover, Georgia's Phase II General Permit requires any MS4 operator discharging into an impaired waterbody to prepare an Impaired Water Plan (IWP). If a TMDL provides a WLA to the MS4, that allocation must be incorporated into a revised SWMP or the proposed IWP. The TMDL WLA would then serve as an enforceable effluent limitation in the permit. The IWP must also include a list of BMPs that will be implemented to address each POC identified in the TMDLs and a schedule for implementing them. Existing permitees such as Athens-Clarke County must submit this IWP by February 15, 2015.[84] Preparing the IWP along with the GI/LID inventory

---

stormwater management activities represents a new approach to the 'traditional' drainage responsibilities." P.41.

[83] General Permit GAG No.610000

[84] General Permit GAG No.610000, Sec. 4.4.1.

required by the MS4 permit creates a situation where the next logical step is to assess how additional GI BMPs will help ACC achieve local water quality standards, and how GI elements can be used to achieve the goals outlined in the IWPs that permitees are currently preparing.

In 2010, EPA published recommendations for improving strormwater permits. In order to promote volume retention practices, infiltration, evapotranspiration, and rainwater harvesting as primary stormwater management techniques, the EPA recommends using permit conditions based on restoring predevelopment hydrology.[85] In order to facilitate implementation of its own recommendations, in 2010 EPA began its rule making process to strengthen its MS4 program.[86] Among other goals, the proposed national rulemaking is considering the following actions:

- Develop performance standards from newly developed and redeveloped sites to better address stormwater management as projects are built;
- Explore options for expanding the protections of the municipal separate storm sewer systems (MS4) program;
- Evaluate options for establishing and implementing a municipal program to reduce discharges from existing development.

EPA is currently collecting information and input regarding the proposed rule making, and it intends to publish its proposed rule in the summer of 2013, though it has not done so at the time of this writing, with final action anticipated by December 2014.[87]

For these reasons, it seems very likely that the next time MS4 permits are renewed they will contain much more strict effluent limitations. Also it is likely they will contain requirements for reducing pollution from existing developments instead just from new construction and redevelopment projects. MS4 operators who discharge into

---

85 U.S. EPA, " MS4 Permit Improvement Guide," EPA- 833-R-10-001. April 2010.
86 *See* http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm.
87 *See* http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm.

impaired waters with existing TMDLs should be particularly concerned about these developments as the load allocation for MS4 operators are a natural source for effluent limits in MS4 permits. In other words, effluent limits in MS4 permits can become the means for EPA to enforce the loading requirements determined by TMDLs. If the more specific numerical standards appear in more permits, given EPA Green Infrastructure strategy and numerous other publications on the topic, numeric standards will likely be accompanied by directives to achieve those standards through green infrastructure requirements.

While the new MS4 permit will likely give TMDL load allocations much greater significance, federalism principles will prevent federal authorities from directly taking over local planning and development decisions that relate to stormwater. Instead EPA will continue to push local governments to adopt and implement more effective practices and policies to achieve federal water quality goals such as GI and LID practices. The EPA's approach will continue the cooperative approach to water quality management by leaving it to local authorities craft specific plans for meeting overarching federal goals. The EPA will not directly call on permitees to adopt certain ordinances or specifically require specific elements. Instead it will more likely try to push them in that direction with by continuing to publish technical assistance and provide incentives to promote these measures in permits. Where it has more leverage with permitee local governments, such as those with CWA violations or those needed new or expanded NPDES permits, EPA will increasingly mandate the use of GI elements. For all permitees, those localities that are most successful in meeting these goals by proactively adopting these strategies will retain the greatest autonomy while those that are not successful will be subject to increasingly close scrutiny and regulation.

C. Basic Green Infrastructure Elements

Green infrastructure refers to a broad range of practices that attempt to allow human developments to function more like predevelopment sites particularly as it relates to hydrologic functions. GI practices can be implemented at any scale from street side tree plantings to large landscapes dedicated to strormwater management. Below is a short list of green infrastructure elements compiled by the Virginia Cooperative Extension service. These elements are primarily implemented on a project site design scale to reduce runoff volumes and thereby decrease the need for centralized stormwater infrastructure.

These elements can be used in conjunction with larger scale stormwater planning elements. There is a growing trend to develop landscape scale projects that serve as stormwater infrastructure as well as park space, animal habitat, and other public purposes. These “high performance landscapes” layer functions to efficiently meet multiple community goals in the same space in order to make the most efficient use of increasingly limited space and resources. Effective stormwater planning will examine both what portion of a project’s stormwater volume can be efficiently treated onsite and what portion should be treated in a centralized system. This allows private developers to cooperate with public entities to implement stormwater management as efficiently as possible while also promoting other civic values and achieving other public goals such as increased greenspace, animal habitat, or transportation alternatives.[88]

Rooftop Disconnections:

Rooftop Disconnections are pretreatment measures that collect runoff from rooftops and roof gutters and directs it away from impervious areas and into infiltration zones such as landscaped areas, rain gardens, or bioretention ponds. Additional flow volumes can be accommodated and more water infiltrated if compost-amended flow paths are used to transport roof-top flow.

Cost: The cost of materials and installation are minimal, often costing less than $100 per downspout. Depending on the volume of water to be infiltrated, significant costs can be incurred to construct rain gardens or other biorentention areas or from the use of the compost-amended flow paths. These costs will vary based on site design.

Maintenance: Maintenance is minimal. It is similar to landscaping which may require periodic mowing or pruning. Much of this would have to be done anyway where vegetation is included in any site design. Downspouts and drainage areas must be inspected for clogging, and accumulated leaves, sediment or debris must be removed if it threatens to clog any part of the system.

Performance: Most of the benefit from rooftop disconnection comes from volume reduction. The disconnection itself provides little pollutant treatment as it serves primarily to redirect flow into other GI features, which then provide infiltration and treatment.

---

[88] The following list is adapted from a series of fact sheets prepared by Dr. David Sample with the Virginia Cooperative Extension Service. The complete set of the these fact sheets is available at: http://pubs.ext.vt.edu/author/s/sample_david_j-res.html.

Limitation: In areas with significant slopes, such as those of more than 2%, concentrating runoff may increase erosion problems.

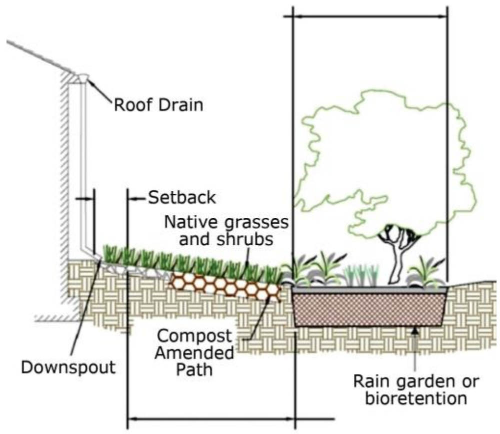

Figure 2: Rooftop Stormwater Disconnection
Image Credit (VA-DCR 2011)

Sheet Flow to Open Space:

Sheet Flow to Open Space (SOS) describes a group of practices that disperse concentrated runoff to sheet flow into filter strips, vegetated areas, or other infiltration areas. Runoff can be intercepted from small impervious areas by grassed areas or small plantings; runoff from larger areas with higher flow requires the installation of a gravel trench or other "level spreader" to reduce the velocity and disperse the water.

Cost: SOS is an inexpensive stormwater management practice. The primary direct cost is the installation of a level spreader or gravel trench if one is required. The true cost of an SOS is the land that it requires as this area will have to be maintained as open space. This opportunity cost can be minimized by designing otherwise necessary or desirable open spaces to serve as this SOS function.

Maintenance: SOS maintenance is minor. Regular inspections are necessary to prevent clogging of a trench or level spreader. Vegetated areas must also be inspected to ensure the stability of the vegetation and to identify and repair any erosion.

Performance: SOS increases the residence time of water moving across the site due to greater friction with vegetated area. This also increases infiltration and reduces pollutant loads through filtration and sedimentation. SOS can also function as a pretreatment option where the sheet flow is collected into an additional treatment mechanism such as a bioretention area. A typical SOS can reduce total phosphorous and total nitrogen by 50%. More advanced designs can be expected to reduce TP and TN by 75%.

Limitations: An SOS generally requires a large amount of space relative the impervious area it can treat, and its functionality in slowing runoff depends on the soils ability to support vegetations as well as the slope and soil types, while its infiltration and treatment capacity depends on the drainage of the soil.

Grass Channels:

Grass Channels (GC) are gently sloping, open channels that convey stormwater. GCs offer a modest amount of runoff reduction and water treatment by slowing water flows and increasing infiltration and filtration. At higher velocities, stormwater is only conveyed and is not treated. Unlike dry swales, GCs do not include a soil media and/or specific storage volume.

Cost: GC's are relatively inexpensive, especially considering that they provide stormwater conveyance, which is a necessary function that would require curbs or piping or similar infrastructure expenses. One estimate for engineering and construction of a GC that treats and conveys water from a five acre site is $2,160. This does not include the cost of land.

Maintenance: GC require moderate maintenance. Regular inspections are required to remove organic matter and debris that can clog the channel and to identify and repair erosion of the channel or slopes. Sediment accumulation must be removed from the channel. Vegetation must be maintained and reseeding is necessary if bare spots develop. Regular mowing is also required to prevent shrubs and trees from growing and obstructing the channel.

Performance: The primary purpose of GCs is conveyance of stormwater. However, when compared to piping, curb and gutter, or similar conveyances, GCs offer a opportunity to reduce velocity and infiltrate some volume of water. A typical GC can be expected to remove 25% of TP and 35% of TN. Soil amendments such as compost can be used to improve hydrologic functioning, and more sophisticated designs such as those involving long travel paths can enhance infiltration and treatment.

Limitations: Large, high velocity water volumes do not receive treatment. Infiltration and the extent of pollutant reduction depends on the underlying soil characteristics, slope, and the velocity of the flow. GC's are generally not suitable for handling runoff from sites greater than five acres.

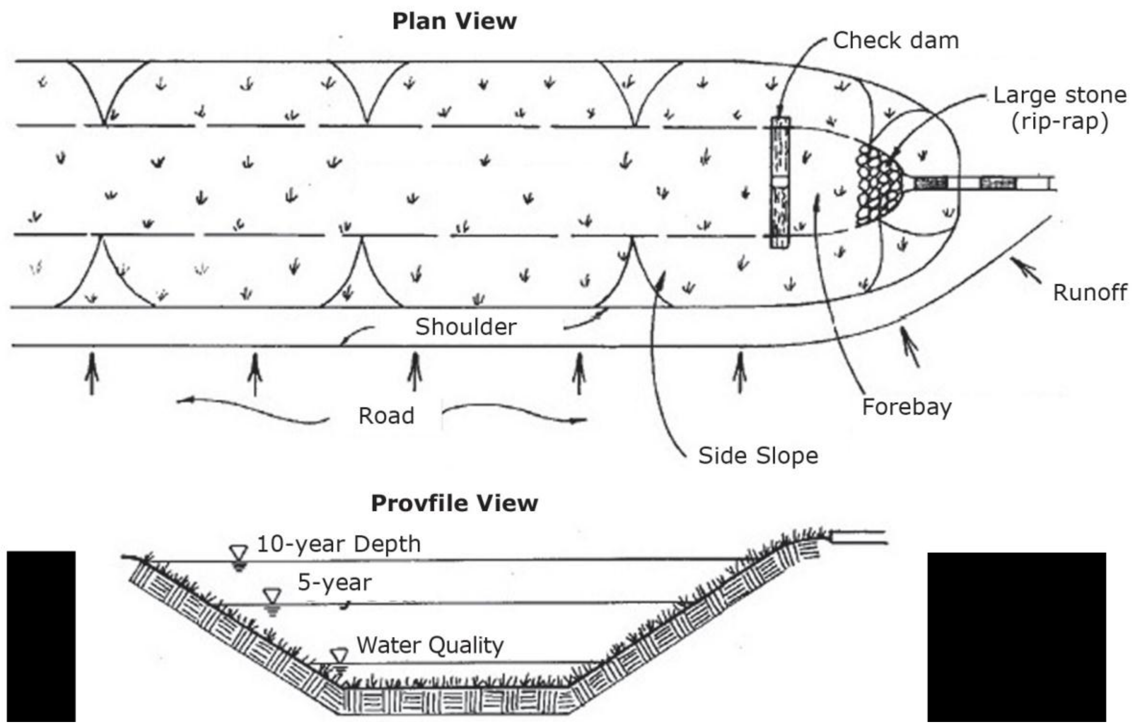

Figure 3: Grass Channels
Image Credit (VA-DCR 2011)

Soil Restoration:

Soil Restoration (SR) improves compacted soils to improve porosity and nutrient retentions by biological processes such as introducing worms, mechanical processes such as aeration or tilling, and applying soil amendments. SR is useful in treating runoff from broad areas with relatively gentle slopes, and it is often a useful tool when used in conjunction with rooftop disconnection, filter strips, or sheet flow to opens space.

Cost: SR is an inexpensive stormwater treatment practice. The specific costs will be very local, but in the Chesapeake Bay region mechanical restoration with two inches of compost coverage would cost approximately $7,000.

Maintenance: Maintenance is limited to what would be required to maintained vegetation place on the SR site. Dethatching turf may be advisable to increase permeability.

Performance: Lawn area that receive SR and do not receive runoff from other areas can remove as much as 75% of runoff volume, but its primary benefit is augmenting the effectiveness of other practices.

Limitations: SR should not be used on slopes greater than 3:1. It is not useful in areas with porous soils, and it is of limited use in areas with a shallow water table or bedrock. Increased infiltration can lead to increased groundwater contamination where contaminated soils are present.

Vegetated Roofs:

Vegetated roofs (VR) treat and reduce stormwater runoff by adding vegetation and other media to rooftops creating a permeable surface out of what was previous impervious thereby reducing runoff volume and velocity. There are two types of VRs. Intensive vegetated roofs are deeper and heavier and contain larger types of vegetations such as trees or food crops. Extensive vegetated roofs are much more common and are shallower and lighter with smaller plant species.

Cost: VRs have a relatively high initial cost, though they do not require addition land area, and therefore can be incorporated on sites that may not support many other GI practices. VR industry cost estimates range from $9 to $24 per square foot. Maintenance costs are frequently incorporated into the projects overall landscaping budget.

Maintenance: Moderate maintenance is required. Period weeding is usually necessary. Irrigation is often required at least for planting, and it may also be necessary during prolonged dry periods even if drought resistant plant species are used. Some reseeding and fertilizing are sometimes necessary to ensure adequate vegetated coverage.

Performance: VRs are an effective means of reducing nutrient pollution. An extensive vegetated roof can be expected to reduce TN and TP by 45%, and an intensive system can be expected to increase reductions to 60% due to additional runoff residence time.

Limitations: VRs are limited to rooftops specifically engineered to carry the additional weight or roofs that already have additional structural support or that can be retrofitted to bear the additional load. The weight issue also limits the amount of storage available, usually 4-6 inches for a common extensive vegetated roof. There are additional engineering issues incorporating VRs on sloped roofs.

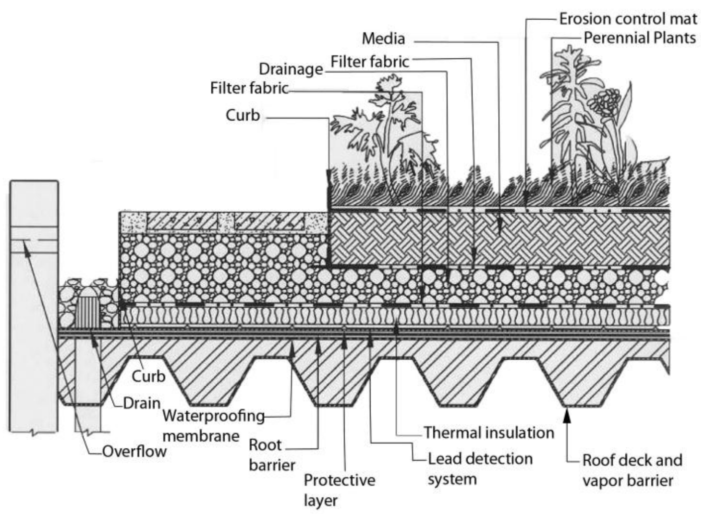

Figure 4: Vegetated Roof
Image Credit (VA-DCR 2011)

Rainwater Harvesting:

Rainwater harvesting makes use of cisterns or other storage devices to intercept, divert, store and ultimately release stormwater for later use. Rainwater can be harvested from any impervious surface, though roofs are preferred due to pollution concerns about runoff from parking lots or other ground level surfaces. Both above ground and underground tanks are frequently used. Elevated tanks offer the benefit of using gravity flow to move the water to where it will be used instead of relying on pumps. Stored water can be used for any non-potable use such as irrigation, toilet flushing, car washing, or fountains or other water features.

Cost: Rainwater harvesting is a generally inexpensive management practice. Rain barrels in particular can cost $60 or less and are sometimes subsidized by local water quality protection programs. More complex systems can cost thousands of dollars, but these systems can also lead so substantial savings if the water can be used to replace potable water uses onsite.

Maintenance: Maintenance is relatively minimal. Cistern screens and filters must be cleared of debris periodically as well as gutter or other conveyances that transport water to the storage device. Also the storage container must be cleaned of sediment on rare occasions.

Performance: Rainwater harvesting only treats stormwater for volume by delaying the time until its release. It does not treat for nutrients or any other contaminant. However, harvesting can be used in conjunction with other measures to treat for contaminants, or when the water is used for irrigation or some other such use additional treatment may occur.

Limitations: If stored water is not used, cisterns or whatever container is used may be full when it rains limiting their effectiveness. Storage removes some suspended solids, but it does not treat for nutrients. Also, many local governments may require additional permitting or other requirements to permit water reuse particularly if it is for indoor uses.

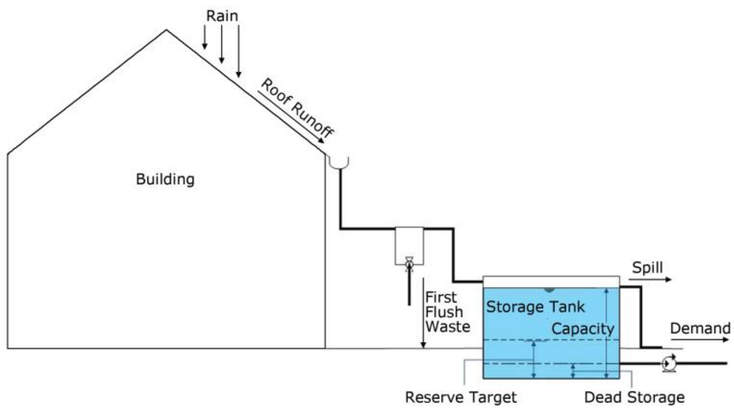

Figure 5: Rainwater Harvesting
Image Credit (VA-DCR 2011)

Permeable Paving:

Permeable paving refers to a type of concrete or asphalt that contains voids in its uppermost layer to allow water to filter through it. This kind of paving can be used in place of impervious covers to allow greater infiltration of rainfall into the ground and/or delaying its conveyance offsite. Permeable paving can be used anywhere traditional concrete or asphalt would be used, but it is better suited to low traffic areas, parking, or pedestrian areas.

Cost: Permeable paving is a relatively expensive treatment option. While costs will vary greatly depending on the design of the system, some estimates range from $45,000 to $100,000 to treat one acre of runoff. Maintenance costs are also relatively high, and this will vary greatly depending on the local market for such services and the frequency with which they are performed. However, in compact developments, permeable paving can conserve space and allow land to serve as both stormwater treatment and some other functional purpose, which will frequently justify the additional expense.

Maintenance: Permeable paving requires regular maintenance. Maintenance consists of vacuuming accumulated sediment out of the system as frequently as every month. Regular inspection need to be made to ensure water is infiltrating properly and that underdrains, if they are used, do not become clogged.

Performance: Permeable paving can reduce nutrient loads by 60-80% depending on the stormwater designed residence time in the system. In addition, permeable paving can significantly reduce the runoff volume or delay peak discharge from a rain event, but this effectiveness will depend a largely on the designed capacity of the sytem.

Limitations: Permeable paving can easily become clogged with sediment if specific maintenance is not properly performed. This requires some special precautions be taken when in design. The system should only receive runoff from impervious areas to reduce the sediment loads in the runoff. It should not be used in areas were snow or ice will be cleared frequently as this will increase the likelihood of clogging and it could facilitate the infiltration of salt into the groundwater.

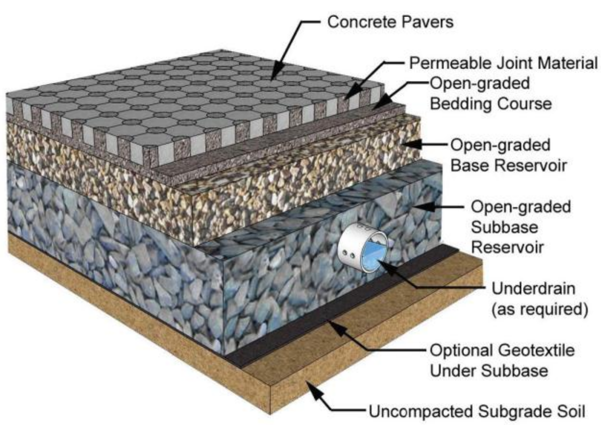

Figure 6: Porous Concrete
Image Credit (VA-DCR 2011)

Biorention:

A Biorention cell, popularly known as a rain garden, is a landscaped depression designed to capture runoff from impervious surface or grassed areas in order to provide biological treatment and discharge cleaner water. These systems attempt to mimic the hydrologic treatment that the stormwater would receive if the site were a forested watershed. Biorention provides both quantity and quality controls by providing both physical and biological treatment. It can also serve as an aesthetic element in the landscaping and provide habitat if situated in a larger greenspace framework.

Cost: The Low Impact Development Center estimates that a 900 sq. ft. Bioretention system, which would treat about 18,000 sq. ft of impervious surface, would cost approximately $10,000. It would also cost about $600 a year for maintenance, making this a relatively affordable stormwater treatment system.

Maintenance: Maintenance is similar to other landscaping. Dead plants must be removed and replaced. Regular mulching the bottom of the system will improve performance. The system must also be periodically checked to make sure clogs do not obstruct the underdrain if one is used.

Performance: A typical Biorention system will have 1.5 to 2 feet of storage media. This will remove 25% of phosphorous, 40% of nitrogen, and reduce runoff volume by 40%. Increasing the media depth to 2 or 3 feet and providing and underdrain can improve performance to remove 50% of phosphorous, 60% of nitrogen and reduce runoff by 80%.

Limitations: Adequate sunlight and water are required to maintain vegetation. During very dry periods irrigation may be required depending on plant selection. The system requires at least 2 to 4 feet or separation to the water table to function. It also requires adequate permeable material beneath the implanted media to prevent long term ponding and the development of anaerobic conditions. Plants must be able to survive dry periods and extended periods where their roots will be submerged in water.

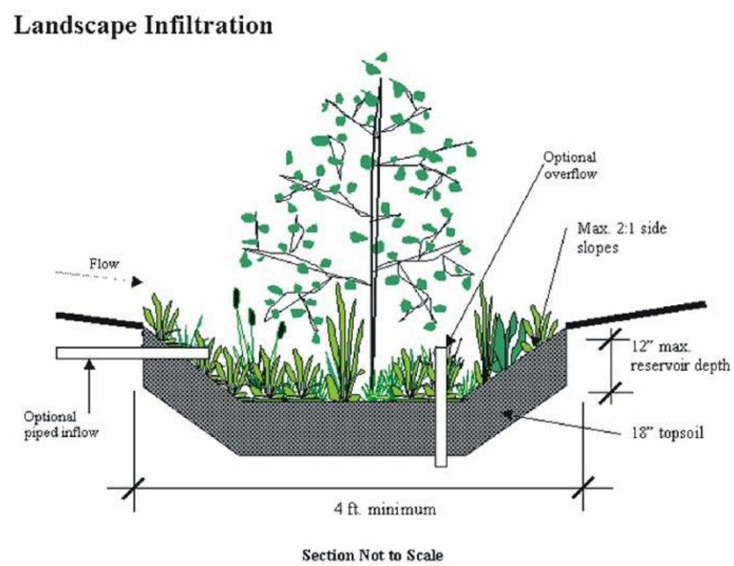

Figure 7: Bioretention Swale
Image courtesy of the U.S. EPA.[89]

Dry Swale:

A Dry Swale is shallow, gently sloping channel with broad vegetated slopes and a series of check dams to arrest water flow. Dry Swales treat stormwater through detention, filtration, and infiltration, much like a bioretention system or a wet swale, except that it would remain dry except during rain events. Dry Swales can be used in many environments and are often used in place of curb and gutter systems to transport stormwater but the gentle slope and vegetation slow flow allowing filtration and infiltration. A variety of vegetation can be used in these swales allowing them to fit easily into a site's landscaping plan.

Cost: According to the Federal Highway Administration, a Dry Swale designed to accept flow from 5 acres of impervious surface costs approximately $7,500. More complicated designs can be more expensive, but they are generally a cost effective stormwater control mechanism.

[89] http://www.epa.gov/oaintrnt/stormwater/cells_infiltration.htm

Maintenance: Dry Swales require minimal maintenance similar to other low intensity landscaping. Vegetation may need to be trimmed from time to time, and debris will need to be removed from check dams, but otherwise they are pretty self-sustaining.

Performance: Dry Swales can be very effective at reducing pollutant loads. Phosphorous can be reduced by 52% and nitrogen can be reduced by 55%. More sophisticated designs can reduce phosphorous and nitrogen loads by 76% and 74% respectively.

Limitations: A Dry Swale needs at least a two foot separation from the water table to allow infiltration. Soils must be highly permeable, thus parking or other compacting activities can destroy a Dry Swale. Underdrains may be necessary if soils are not sufficiently permeable. They can only be used to treat a limited impervious area to control the volume and velocity of the water moving through them and prevent erosion. Also if the runoff becomes contaminated, Dry Swales can facilitate leaching of contaminant to the groundwater.

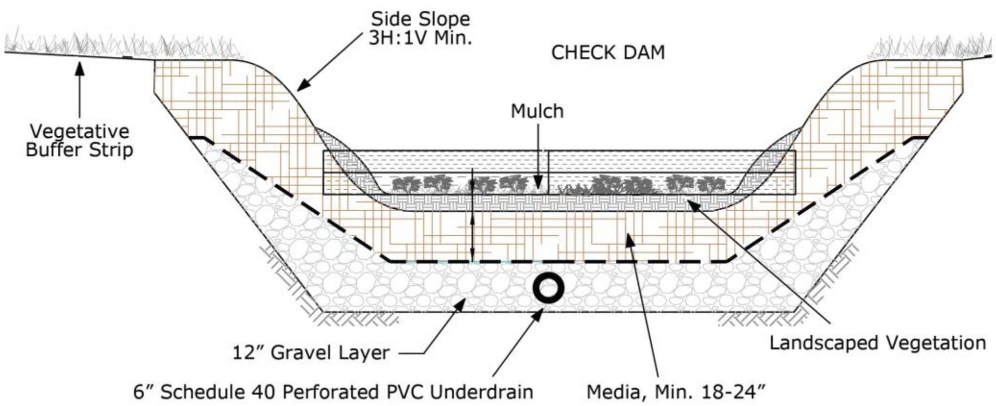

Figure 8: Dry Swale
Image Credit (VA-DCR 2011)

Wet Swale:

A Wet Swale consists of a broad shallow channel with gently sloping sides. Typically the bottom of the channel is below the water table allowing the channel to stay wet during dry weather. This promotes the growth of wetland vegetation, which in turn provides water treatment similar to a natural wetland. Wet swales are typically found in coastal plain areas with large flat areas and a high water table. They are generally designed to provide 24 hours of peak flow retention. Some infiltration may occur in this time, but temporary detention is the primary purpose. During this time, sediment settles out and plants and microbe take up nutrients in the water.

Cost: Wet swales are a moderately priced stormwater treatment practice in terms of construction costs. A preliminary, average estimate of a WS that would provide treatment of approximately 5 acres is $3,700 according, to the Federal Highway Administration (U.S. Department of Transportation 2002). The value of land is not included in this analysis. Note that wet swales tend to have high operation and maintenance costs that offset the savings from lower construction costs over time.

Maintenance: Maintenance is relatively minimal. They system must be inspected and xcess sediment and debris must be removed from time to time, and the vegetation will need to cut regularly to prevent clogging. Invasive species can be a problem and must be vigilantly monitored.

Performance: A basic Wet Swale can be expected to reduce phosphorous levels by 20% and nitrogen levels by 25%. An additional detention area can be added to the swale layout, which would be similar to a small constructed wetland. This would increase residence time for higher flows, and increase phosphorous removal to 40% and nitrogen removal to 35%. Also, peak flows for most storm events are detained for 24 hours.

Limitations: Persistently wet conditions may foster mosquito growth making vector control an issue. The need to maintain a gradual slope close to the water table makes this practice unsuitable for some areas and topographic conditions. Standing water in the swale can raise the temperature creating issues with dissolved oxygen and other problems. Driveways and other crossings can impact treatment functions so they need to limited as much as possible.

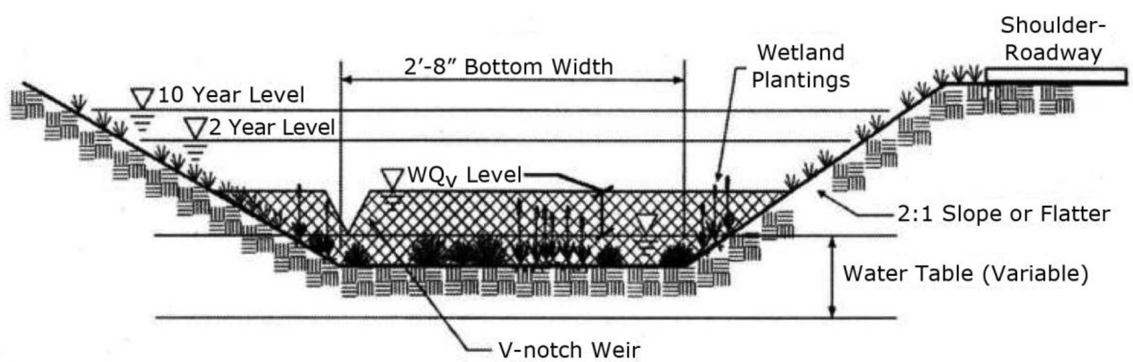

Figure 9: Wet Swale
Source: VA-DCR 2011.

Constructed Wetland:

Constructed Wetlands are generally thought to be one of the most reliable stormwater treatment BMPs. They are designed to function like as self-sustaining natural wetland area so that they should provide good water quality treatment with minimal maintenance. Constructed Wetlands provide storage that slow flows and thereby reduce peak stream flows after a rain event, and they simultaneously provide water quality treatment through facilitating biological uptake of nutrients and other contaminants, microbial decomposition, and settling a particulate matter. Wetlands are particularly useful in removing nutrients and sediment.

Cost: Constructing a wetland can be relatively inexpensive. Cost estimates based on projects in the mid-Atlantic regions indicate a large wetland system designed to treat runoff from a 20-30 acre site would cost approximately $60,000 to $70,000. However, this does not account for land costs, and Constructed Wetlands can be fairly large—about 3-5% of the size of the drainage they are supposed to treat. Therefore, where space is limited or land expensive this may not be a cost-effective option unless offsite wetland construction is possible.

Maintenance: Constructed Wetlands require some regular maintenance to remove accumulated trash and sediment. Inlet and outlet structures need to be checked periodically to prevent clogging. Plantings will need to be replaced if they die, and invasive species should be removed as quickly as possible. It is estimated that annual maintenance costs can range between 3% and 5% of construction costs.

Performance: A typical Constructed Wetland can remove 50% of total phosphorus and 25% of total nitrogen. In more sophisticated systems with longer residence time for water and varied vegetative zones, performance can be improved to remove 75% of phosphorus and 55% of nitrogen.

Limitations: A Constructed Wetland site must have hydric soils to retain water in the system and enough water to support vegetation. Plants need to be able to survive continual inundation and dry periods. Prolonged residence times may raise water temperature. Mosquito control can be an issue. Increased infiltration may impact groundwater if excessive contaminants are allowed to enter the wetland.

Wet Ponds:

Wet Ponds are ponds or lakes that provide stormwater storage. This storage increases onsite residence time, which increasing treatment, reduces peak flows, and protects downstream stream banks. Frequently these are large structures that can serve as community amenities.

Cost: Wet Ponds are generally an expensive stormwater management alternative. One estimate put the cost of a pond capable of handling one acre-foot of runoff at $45,000 not including land costs. Also, ponds can take up large areas, and if the pond is not designed to serve additional ancillary functions such as a park amenity, it can be an eye sore and diminish property values.

Maintenance: Wet Ponds require regular maintenance. Trash and debris must be removed, and inlet and outlet structures must be kept clear. Excess sediment must be removed regularly to maintain storage capacity and prevent remobilization and transport downstream. Vegetation must be mowed and maintained. Invasive species must be monitored and removed. Algae growth has to be controlled. Also, pests such as geese, muskrats, and beavers must be controlled. If dead vegetation is not removed, ponds an actually export nutrients during the nongrowing seasons. Pond can raise water temperatures. Mosquitoes need to be controlled.

Performance: Ponds provide a modest amount of pollutant removal. Total phosphorus can be reduced by 50% and total nitrogen by 30%. If a larger pond system with multiple cells is constructed can improve treatment to 75% of phosphorus and 40% of nitrogen.

Limitations: Wet ponds will require a impermeable liner where soils are not suitable for retaining water. Pond are also large and can take up substantial land.

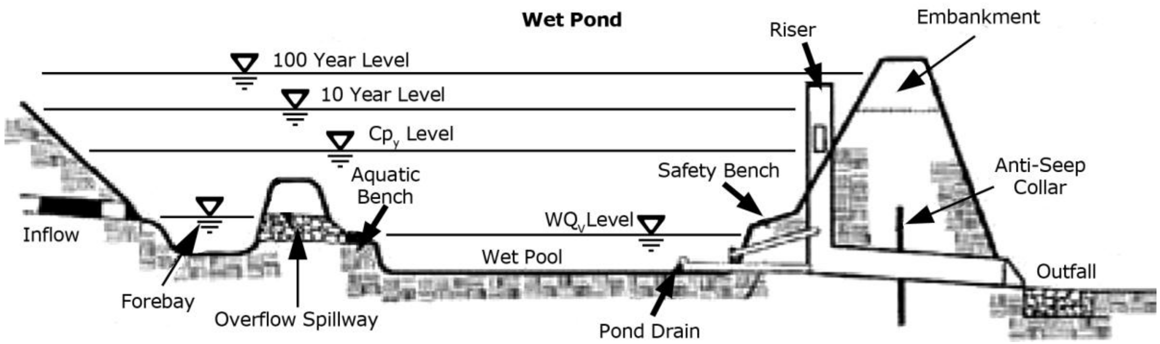

Figure 10: Wet Pond.
Typical wet pond profile.
Source: Fairfax County Department of Public Works and Environmental Services, 2011.

Extended Detention Ponds:

Extended Detention Ponds are dry ponds that retain runoff from 12 to 24 hours during peak flow runoff events. An outlet structure in the pond steadily releases water at a set rate. If runoff exceeds that rate, water backs up into the pond structure. The pool slows the water's velocity and allows particulate to settle out before the water is release downstream. These types of detention ponds provide little pollution treatment and are primarily used for peak flow reduction. Often Extended Detention Ponds are used in combination with other green infrastructure practices. Despite their limited water quality impacts, Extended Detention Ponds are probably the most common form stormwater treatment.

Cost: Extended Detention is one of the least expensive stormwater alternatives. One estimate indicates an Extended Detention Pond capable of handling one acre-foot of runoff is $41,000. Maintenance is expected to be 3% to 5% of the construction cost.

Maintenance: Some regular maintenance is necessary to ensure the function of the dry pond. In particular sediment must be removed before it builds up to reduce the storage capacity of the pond. Vegetation must be maintained and mosquitoes and other pests have to be controlled.

Performance: A dry pond can effectively remove sediments, but an Extended Detention Pond can only be expected to remove 15% of total phosphorus and 10% of total nitrogen.

Limitations: In low lying areas it may be difficult for the pond to fully drain. Though the time of detention is relatively short, the water can still be warmed. A dry pond can be an eyesore and a nuisance that reduced property values. They also can provide a breeding ground for mosquitoes. Sediment removal is generally good, though soluble pollutants are not substantially affected. If sediment is not cleaned from the pond regularly it can be re-suspended by subsequent rain events.

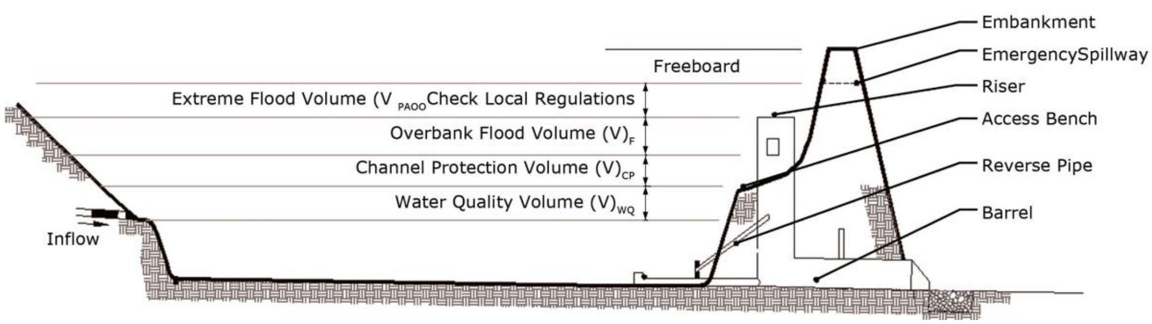

Figure 11: Extended Detention
Typical extended detention pond profile.
Source: Minnesota Stormwater Manual, 2011.

D. High Performance Landscapes

Green infrastructure is not limited to the site level design elements. There is growing interest in designing landscape level developments that serve as park space and provide stormwater management and other environmental services. Many cities' financial conditions do not allow for the construction of new parklands, but often these same cities are required by state and federal authorities to address water quality issues posed by stormwater. These cities also have intense economic incentives to address contaminated waters such as those on the Chesapeake Bay or with extensive riverfront developments. A single investment in these "high performance landscapes" can allow these communities to build functionally layered landscapes that serve to process stormwater, improve air quality, increase property values, and provide aesthetic and recreational opportunities constructing park spaces. Local governments can then leverage different funding avenues to construct a single project that will serve a variety of functions, which just makes fiscal and ecological sense.

Many parks such as Atlanta's Old Fourth Ward Park are built specifically to address stormwater issues. Others have added green infrastructure elements to existing parks or reconfigured parks to better accommodate stormwater. New York City, working in conjunction with the Design Trust for Public Space, developed "High Performance Landscape Guidelines: *21st Century Parks for NYC*."

The practice of using public space to serve environmental service functions dates back at least to Fredrick Law Olmsted, and his work on the Back Bay neighborhood in Boston. However, these practices were largely ignored in the 20th century as cities turned to increasingly complex engineering solutions to deal with these problems. The NYC

High Performance Landscape Guidelines are just a recent codification of these traditional practices.

Discussing the role of parks in protecting water quality, the NYC Guidelines state:

> The city's parks provide an important opportunity to manage water differently: to reduce stormwater runoff and to use soil and vegetation to capture water as a resource for the park system. High performance landscapes begin by intensively managing stormwater. Water from rainfall events should be managed at or near the source, returned to soils and vegetation in a manner that encourages soil absorption and evapotranspiration. Water should be allowed to infiltrate, where feasible. By designing a landscape that can capture the runoff from the small, frequent rainfalls, and allow that runoff to soak into the soil or be absorbed by vegetation, many of the various urban impacts on water quality (such as nonpoint source pollution, combined sewer overflows, flooding, and heat island effects) can be mitigated. *PlaNYC* highlights the importance of New York City's parks and open spaces in capturing and retaining stormwater. Water should not be wasted. Potable water should be treated as an especially valuable resource because it is water that requires significant energy to clean and deliver that water. Opportunities to reduce potable water use through more efficient designs, and to reuse all available water in general, are critical components of high performance landscapes.

To better address water quality, the NYC Guidelines direct the NY Parks Department to consider the following in park development or redevelopment:

- Protect and Restore Natural Hydrology and Flow Paths
- Reduce Flow to Storm Sewers
- Create Absorbent Landscapes
- Use Infiltration Beds
- Use Rain Gardens & Bioretention
- Use Stormwater Planter Boxes
- Use Porous Pavements
- Create Green and Blue Roofs
- Manage Rooftop Runoff

Examples of these types of parks include:

Name	City	Size
Udall Natural Area	Fort Collins, CO	26 Acres
Old Fourth Ward Park	Atlanta, GA	17 Acres
Tanner Springs	Portland, OR	.9 Acres

These examples were selected because they illustrate how a high performance landscape can be developed at different scales, in different climates, and with different levels of programming of public use.

Udall Natural Area is a recently constructed stormwater quality control feature. Stormwater is routed through a series of three ponds designed to remove waste and particulate matter and moderate high storm water flows such that the peak flows are reduced to more natural levels by the time they reach the river.

Figure 12: Aerial of the Udall Natural Area

A couple of trails run through the site that connect to Fort Collins's overall trail network, however most of the site is vegetated with little or no public access. The ecological functions of stormwater retention and expanded river buffers dominate this site though it also serves a public recreation function.

Atlanta's Old Fourth Ward Park is a 17 acre park that manages the stormwater from 958 acres of urban development. The City of Atlanta's Stormwater Management Department contributed $25 million to the project, which is a substantial savings over the estimated $40 million it was going to cost to lay new stormwater pipes in the area to meet the City's stormwater management requirements.

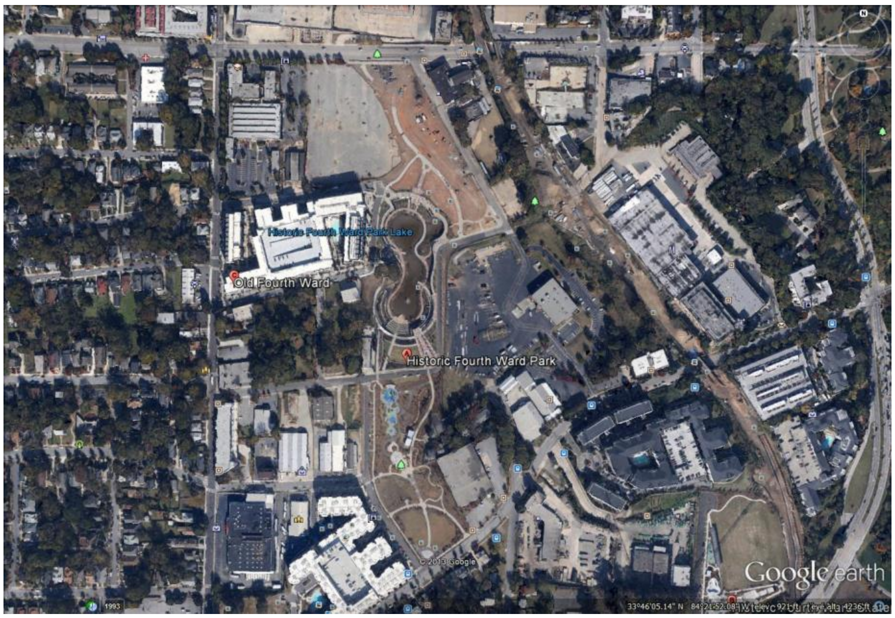

Figure 13: Aerial of the Old Fourth Ward Park

This park is roughly two-thirds the size of the Udall Natural Area discussed above, and it was developed in a much more urban setting being very near the center of Atlanta, Georgia. This park is also connected to a larger trail network as part of Atlanta's developing Beltline project. It incorporates many more structural elements than the Udall Natural Area discussed above, and the space is much more specifically designed for both active and passive public use, though it still serves important ecological functions.

Figure 14: Photo of Old Fourth Ward
Photo by Angle Poventud for the Creative Loafing

Tanner Springs Park is pocket park in Portland, Oregon's Pearl Street District. Built in 2005, it is slightly less than 1 acre. The park restores an old wetland fed by streams that originated in the hills now covered by southwest Portland. As the area developed the wetlands were filled and Tanner Creek was piped. The park features a restored wetland area and small pond that retain and filter stormwater before it flows into the Willamette

Tanner Springs Park is highly designed to make use of its small space. It is not part of a transportation corridor like the other parks discussed. Instead it was developed as a destination greenspace for a part of Portland that was considered lacking in park space. In contains a number of very stylized elements that make it a unique landscape feature that draws visitors specifically to see this park.

Figure 15: Aerial of Tanner Springs Park


Figure 16: Photo of Tanner Springs Park
Photo courtesy of Greenfab.com

Figure 17: Water Circulation in Tanner Springs Park
Image courtesy of Atelier Dreiseitl

VI. PHYSICAL PLANNING FOR STORMWATER

Designing urban spaces to accommodate GI elements and to incorporate multiple uses into dedicated public spaces allows for a more efficient use of space, a better allocation of public resources, and a superior integration of the functions of public and private spaces. Given the obvious benefits of designing in this way, community leaders and local governments should look for ways to actively encourage it through public/private collaborations where these opportunities exist.

The first step is for the local government to identify where these opportunities exist and where they would provide the most benefits to the local community and to the environment. Local planning efforts should indicate which areas are most appropriate for development or redevelopment and the type of development suited to the area. This analysis will inform many public infrastructure decisions such as street design and sewer capacity. At the same time, policy makers will shape the urban form by the provision of the infrastructure elements. In order to design more effective and efficient stormwater management into the urban fabric, stormwater infrastructure should be considered in the same way.

A model for this type of stormwater planning is the City Bellevue, Washington. Bellevue's Comprehensive Plan for the year 2025 contains specific vision to protect and restore aquatic areas to provide high quality fish and wildlife habitat.[90] This vision

[90] City of Bellevue, Washington, "2012 Storm and Surface Water System Plan," City of Bellevue Utilities Department.

informed the creation of a specific stormwater and water quality plan, which states the general policy that:

> Stormwater management supports many elements of a highly desirable and productive community. Economic development and a stable economy depend on good infrastructure, including stormwater infrastructure that keep businesses and homes from flooding. Maintaining high quality streams and lakes supports safe human recreation opportunities, allowing swimming and fishing without health concerns. Given these economic, transportation, human health, and recreational benefits, everyone benefits from a strong stormwater management program whether they live near a stream or in an upland area.[91]

The overarching purpose of Bellevue's plan is that: "All stormwater systems, both private and public, must operate together to minimize flooding and protect water quality." Bellevue's Stormwater plan recognizes that its stormwater management plan is a complicated system of interconnected public and private components. To that end, the city's stormwater plan promotes coordination and planning between private land owners and multiple City agencies and private property owners to ensure that water quality objectives can be met.[92]

In particular the city's Storm and Surface Water Utility partnered with the Parks and Community Services Department to create a system where the Utility purchased land and built stormwater infrastructure using funds collected from stormwater fees and the Parks Department built and maintained recreational facilities at each location. For example, if the Stormwater Utility built a stormwater vault, the Parks Department would place a tennis court on it; if the a detention basin was necessary, the Parks Department

[91] City of Bellevue, Washington, "2012 Storm and Surface Water System Plan," City of Bellevue Utilities Department.
[92] City of Bellevue, Washington, "City of Bellevue Stormwater Management Guide," City of Bellevue. January 2012.

would also try to use it as a soccer field or passive recreation area. These efforts are coordinated with private development to ensure that the overall stormwater infrastructure will sufficiently meet the community's needs. Such collaborations require a clear demarcation of private facilities from public, and each party develops an enforceable maintenance agreement for their portion of the infrastructure. Through this joint planning effort, local officials can more efficiently ensure that adequate facilities are built and maintained, and they can see multiple community goals advanced through their stormwater planning.

VII. APPLICATION TO ATHENS-CLARKE COUNTY, GEORGIA

The Downtown Athens Master Plan (DAMP) identified connections to the North Oconee River as one of the most significant issues for the future of Downtown Athens. In the process of collecting public input for the Master Plan, the planning team conducted dozens of public meetings with local interest groups. No topic was mentioned more frequently in these meeting than this segment of the North Oconee River.[93] It was frequently discussed as centerpiece for downtown, a place for public space and greenspace, and for further development. The most frequent comment was that the Athens community needs better access to the river and it should be better connected to downtown Athens. However, this part of the North Oconee River is polluted.

In Athens-Clarke County, 23 stream reaches comprising 112 miles are listed as impaired on EPA's 303(d) list.[94] These segments are shown in Figure 19 below. Most of these stream segments are listed for elevated fecal coliform levels, as are most listed streams in Georgia. Five segments totaling 29 miles are listed for biological reasons, two for the absence of fish populations and three for macroinvertabrate populations. Biological impairments are generally closely associated with sedimentation and stormwater runoff, though stormwater can contribute to fecal contamination as well.[95] Of particular importance to Athens, two miles of the North Oconee River including the

[93] UGA Masters of Environmental Planning and Design Downtown Athens Master Planning Team. Public Input Data. N.d. Raw data. N.p.
[94] Georgia Department of Natural Resources Environmental Protection Division. GIS Data for 2010 305(b) and 303(d) Stream Listings. N.d. Raw data. N.p.
[95] The most recent version of Georgia's NPDES General Permit for discharges from construction activities pays special attention to discharges to biologically impaired streams. *See* General Permit No. GAR 100001.

section along the eastern edge of downtown is listed as impaired. Upstream and downstream segments of the North Oconee are also listed as impaired including eight miles immediately downstream of the segment adjacent to downtown Athens.

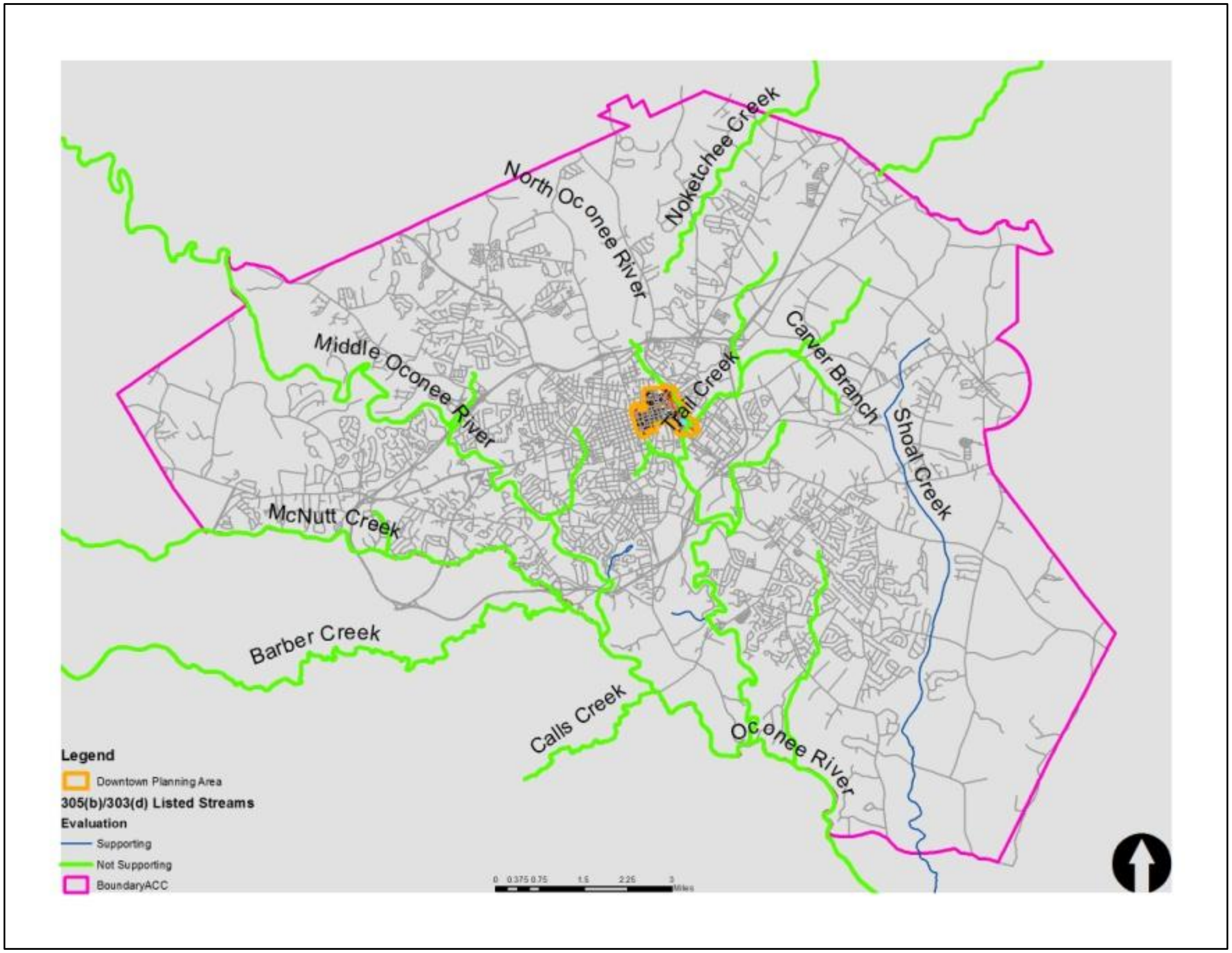

Figure 18: CWA Sec. 303(d) listings in Athens-Clarke County, Georgia

Downtown Athens is also the site of a great deal of commercial and residential development. Currently six projects valued at over $180 million are under construction or in the final approval phase of development.[96] Each of these projects brings increased impervious surfaces, increased car traffic, and overall larger stormwater flows and increased pollutant loads. Athens' existing urban development is the major source of its current water pollution, and increased development will only exacerbate the problem unless more ambitious measures are implemented.

Two TMDL Implementation Plans have been prepared for this for both fecal coliform and for biological diversity of macro invertebrates. In this case, biological diversity refers to the sediment load. The Oconee River TMDL Implementation Plan for Sediment describes the sediment loads in the listed waters as "legacy" sediment.[97] These loadings are from past land uses practices that supposedly are no longer occurring. Thus the Implementation Plan does not call for any reduction in sediment loads as EPD believes that if sedimentation is not increased, these loads will reduce over time and the streams will repair themselves. Therefore, in order to achieve this extremely hopeful outcome, sediment from new development must be closely managed.

Elevated fecal coliform levels from urban areas can be attributable to a number of sources, including: domestic animals, sanitary sewer leaks and overflows, illicit discharges, leaking septic systems, runoff from improper disposal of waste materials, as well as domestic animals and urban wildlife.[98] Bacteria enter streams by directly

---

[96] See the Downtown Athens Master Plan currently be prepared by Dr. John Crowley with the assistance from students in the Masters of Environmental Planning and Design Program. Expected publication in fall 2013.

[97] Georgia Department of Natural Resources Environmental Protection Division. Oconee River Basin Revised TMDL Implementation Plan for Sediment (Biota/Habitat Impacted). 2007. P. 3.

[98] Athens-Clarke County has a wastewater treatment plant that has an NPDES permit to discharge into the North Oconee above this segment. However, because the existing TMDL sets the WLA for that facility at

washing into the streams, or the runoff may be collected in a storm sewer system and discharged through a discrete outlet structures. While stormwater from these outfalls is regulated by the CWA NPDES system for point sources, it does not have to meet end pipe water quality standards. Instead MS4 permits require programmatic BMPs that seek to reduce pollutant loads to the "maximum extent practicable," and thus stormwater runoff rarely receives any direct treatment.

Green infrastructure offers great opportunities to reduce sediment loads in stormwater, and also help to address bacterial levels. As discussed above, GI elements reduce or eliminate flows from small storm events by infiltrating the water or increasing evaporation and uptake by vegetation. Sediment picked up by these flows is deposited in collection basins before being discharged into surface waters. Reducing flow also reduces bacteria that reach streams, and delaying flow volumes allows some of the bacteria to die off before reaching the receiving waters. Also, as more water is infiltrated, the groundwater will increase the base flow in the streams, which in turn dilutes bacteria concentrations.

Athens-Clarke County (ACC) is committed to restoring and protecting the water quality in its local surface waters. The ACC Watershed Protection Plan (ACC WPP) states:

> Even with the promulgation of regulations requiring stormwater detention in new developments, stream water quality has continued to degrade. Since increased storm water is only part of the problem, detention alone will fail to solve other fundamental problems downstream because it does not reduce total flow volume… *ACCUG is committed to protecting and enhancing their*

---

its current permitted fecal concentrations. Because it has substantial unused capacity and an related WLA, it is unlikely this permit provides much leverage or motivation to address other pollution sources unless the TMDL WLAs and LAs are revisited in the future. *See* Total Maximum Daily Load Evaluation for Seventy Two Stream Segments in the Oconee Basin for Fecal Coliform. 2007. *Available at*: http://www.epa.gov/waters/tmdldocs/EPD_Final_Oconee_Fecal_TMDL_2007.pdf.

> *watershed and streams so that all County streams meet water quality standards and designated uses*.[99]

The Athens-Clarke County Stormwater Ordinance sets a goal of managing stormwater so that sites function as if they are part of undeveloped watershed. One of its stated purposes is to "require that new development and redevelopment maintain the pre-development hydrologic response in their post-development state as nearly as practicable in order to reduce flooding, streambank erosion, nonpoint source pollution and increases in stream temperature, and to maintain the integrity of stream channels and aquatic habitats."[100] The ACC Stormwater Ordinance also specifically directs the County to "encourage the use of nonstructural stormwater management and stormwater better site design practices, such as the preservation of greenspace and other conservation areas, to the maximum extent practicable. Coordinate site design plans, with the county's greenspace program, parks and greenway network plan."[101] Both of the goals are substantially furthered if a more holistic view of stormwater management is incorporated into the local planning and development process.

Given the current acceleration of new urban development in and around downtown Athens, it is an opportune time to consider how stormwater management is planned and provided. There are a number of opportunities to establish a more comprehensive and holistic planning process for stormwater. The physical layout of downtown Athens allows for substantial coordination between the public and private sector to develop stormwater management systems that take advantage of natural features

---

[99] ACC Watershed Management Plan p.1. [emphasis added].
[100] ACC Stormwater Management Ordinance 5-4-1(2)
[101] ACC Stormwater Management Ordinance 5-4-1(5)

and greenspace through the implementation of green infrastructure elements and the development of high performance landscapes.

Downtown Athens sits on top of a hill overlooking the North Oconee River. Several small drainages naturally convey water from downtown to the river. These drainages present opportunities to develop greenspace that can serve as stormwater features for surrounding developments. These stormwater features would provide land owners with more cost effective stormwater management options for a developing urban area where land is at a premium so stormwater management practices are quite expensive. Meanwhile these features would provide public amenities that provide more urban greenspace, improved water quality, increased wildlife habitat, green corridors, improved air quality, and all of the host of benefits associated with greenspace and improved environmental quality.

There are a number of significant opportunities to incorporate high performance landscape features into Athens' stormwater plan. Figure 19 shows the Downtown Athens planning area divided into four stormwater planning areas based on opportunities for large scale stormwater features. These areas are based on the natural drainage pattern downtown. Topographic data was overlaid with County parcel data and hydrologic data to assess the direction that individual parcels would drain. Natural watershed boundaries are modified to account for parcel lines and blocks to make drainage areas clearly demarcated and more manageable. Each of these areas contains large public open spaces that offer the opportunity for providing stormwater infrastructure and public greenspaces. Private developments smaller scale green infrastructure elements into their site designs, and these private systems would tie into public green infrastructure elements in public rights-of-way or other public lands before connecting to the these landscape scale stormwater features. By combining diffused retention, detention and treatment with larger scale storage and treatment, substantial stormwater management capacity can be efficiently incorporated into the urban landscape in a more cost efficient manner than traditional stormwater infrastructure. Figure 20 outlines in green those publicly owned parcels that are located in areas that would be advantageous for centralized stormwater management along with private property that could be acquired for that purpose.

Stormwater Area 1, shown in red, consists of the former Armstrong & Dobbs site and the Pottery Town neighborhood. Stormwater infrastructure and greenspace opportunities exist along the proposed Firefly Trail, and along the small creek as the base of the slope northeast of the trail, which is shown here as Pottery Town Creek. A portion of this area also lies in the 100-year floodway. Ensuring that area is preserved will offer better flood protection both in this area and downstream. Public acquisition of this property would ensure its protection and allow for its more productive use as stormwater green infrastructure and public open space. These public high performance landscape areas would handle stormwater from the wide public rights-of-way, and they could be incorporated into the stormwater planning for any development proposed for the Armstrong & Dobbs site as well as for any more dense development that would take place in the Pottery Town neighborhood.

Stormwater Area 2, shown in yellow, is based on the large stormwater detention pond locate east of the Multi-Modal Transportation Center and a portion of the County's park on the river. These areas offer substantial stormwater capacity that can serve a large portion of the downtown's most urban core where infiltration will be the most difficult.

Also, its location adjacent to the Multi-Modal Center and its proximity to Downtown makes this a good location for a public park and community space.

Stormwater Area 3, shown in purple, covers the northeastern portion of downtown. A small unnamed creek, here shown as Dougherty Creek, pours out of a subterranean drainage pipe on the south side of Dougherty Street across from the Foundry Park Inn. This creek flows through an existing bioswale retention area before flowing behind the Whistleberry Condominiums on North Avenue. The creek passes under Willow Street and flows through a park before joining with the North Oconee River. This unnamed drainage could be reengineered to manage a portion of the stormwater from this portion of downtown and provide more accessible greenspace that reaches further into downtown.

Stormwater Area 4, shown in yellow, offers the potential to treat stormwater from a significant area of downtown including areas on the northern edge, which is the least develop border of Downtown Athens and where substantial development may occur in the future. Pulaski Creek flows through the middle of this area. An existing project from the 2005 SPLOST package calls for the construction of a greenway trail along Pulaski Creek connecting Downtown the Pulaski. The right-of-way for the Pulaski Greenway could be connected to the flow into this creek by a series of ponds and bioswales that store and treat stormwater from the upland drainage area. Pulaski Creek passes under CSX Railroad and through a property owned by the railroad before it re-enters County Property adjacent to the local wastewater treatment plant and the North Oconee River. These areas provide ample room for green infrastructure and greenspace enhancement.

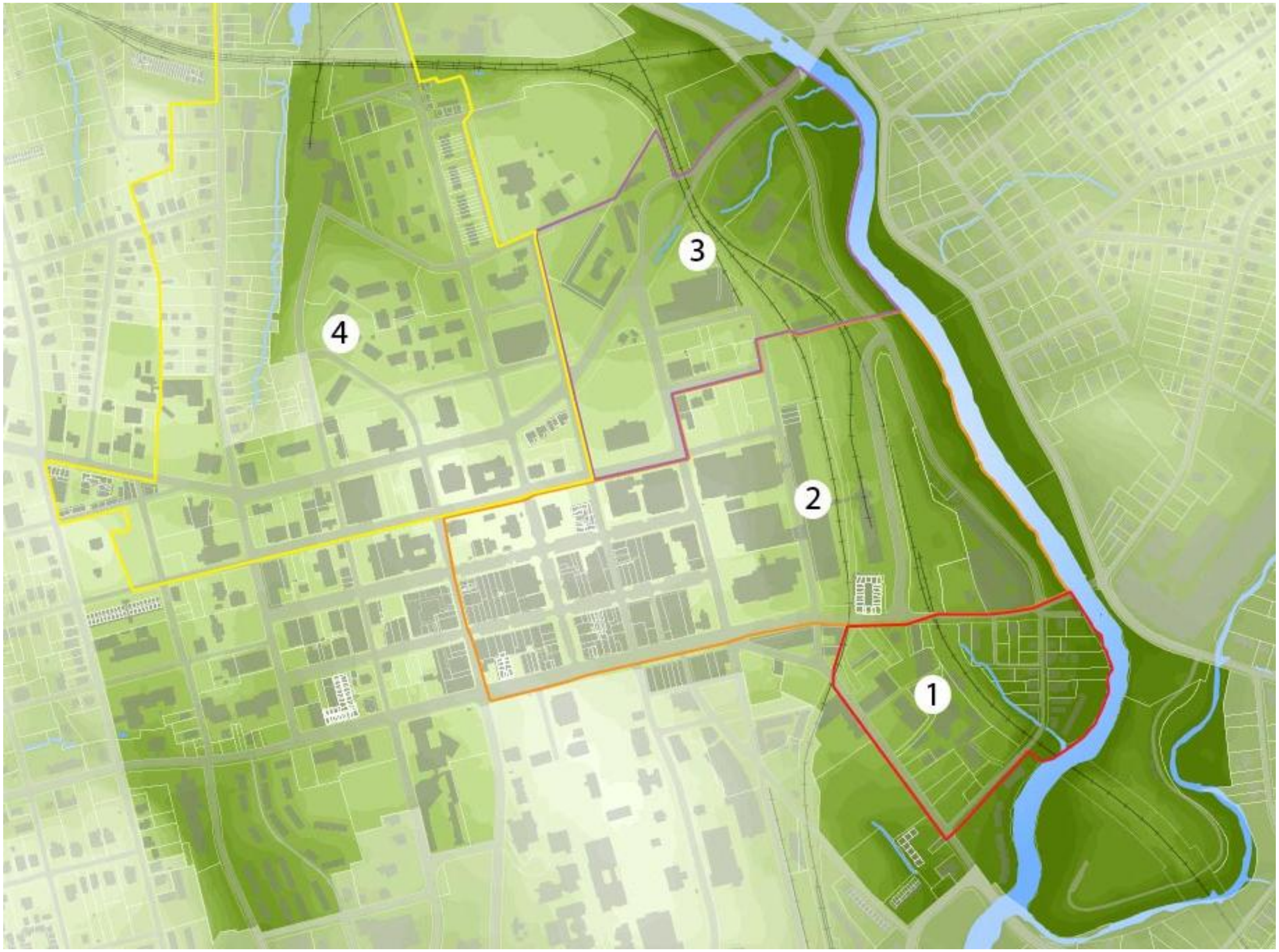

Figure 19: Map of the Downtown Athens Stormwater Drainage Areas.

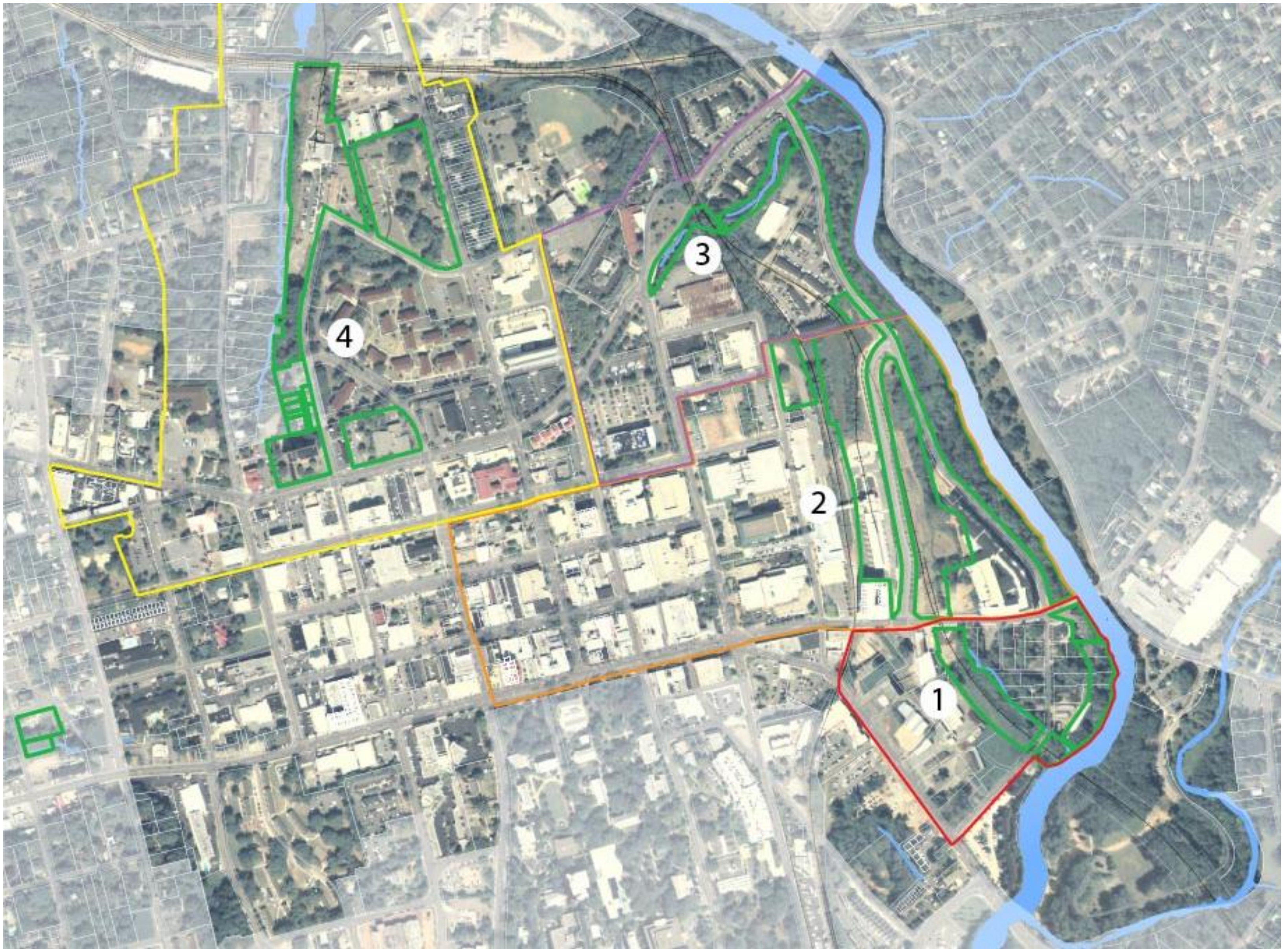

Figure 20: Map of opportunities for large scale GI projects in each drainage area.

While there are a number of possibilities for the centralized stormwater planning projects, the announced development at the site of the former Armstrong and Dobbs building components operations presents an opportunity to discuss how such a public private stormwater arrangement might work. Other developers and regulators can follow this model on other projects to take advantage of cost effective stormwater options and promote more efficient and productive urban greenspace.

VIII. ARMSTRONG AND DOBBS SITE

A. Stormwater Plan

The former Armstrong & Dobbs site in Downtown Athens, shown outlined in red below in a current aerial photograph in Figure 21, offers an opportunity to discuss how this centralized stormwater infrastructure planning might work. The 10-acre site has been identified by Selig Enterprises, Inc. as a site for a large scale mixed-use development on what is currently the edge of downtown. It is the largest of a number of current or proposed development projects that will dramatically impact Athens' urban core and have significant impacts on its natural environment. A recent site proposed site design for the site is shown as Figure 22 below.

The Armstrong & Dobbs (A&D) site lies adjacent to the proposed Fire Fly Trail, a multi-model trail and greenspace project, which lies along the northeast edge of the property. A small unnamed creek, which for the present purposes I refer to as Pottery Town Creek, runs on the opposite side of the proposed trail approximately 30 to 40 below the grade of the trail. The drainage for this creek consists entirely of the Armstrong & Dobbs site and a small residential area north of the creek. To the east of the property lies the North Oconee River.

This drainage empties into an impaired portion of the North Oconee River that is listed on the EPA's §303(d) list. TMDLs have been prepared indicating that increased pollution from stormwater would further harm water quality. The developer's conceptual site plan shows the development will have substantial impervious cover. There are no forested or wooded areas only a few small grassed areas. Street trees comprise the only significant vegetation on the site. In addition, though not pictured, the project will add a left turn lane to Oconee Street and possibly one on East Broad Street which will increase the already substantial runoff from those two roads.

The public space adjacent to this development and the drainage pattern around the site make it well positioned for collaborative stormwater planning. Pottery Town in the adjacent publicly owned land already conveys stormwater from most of the A&D site. It is also a very short distance between the development site and an impaired waterbody that is recognized as a valuable community resource. Finally this is a large scale and highly visible project that can make stormwater management a much more significant part of the public conversation about development practices in Athens. By making a concerted public effort to address stormwater on this site, the County can set a precedent for more sophisticated runoff management that can have significant impacts to local water quality while simultaneously providing many other community benefits.

Anecdotal reports suggest the developer paid about $7 million for the property. Given the high value of the land, using valuable space for strormwater management would be extremely expensive and an inefficient use of space. Therefore it is likely that under current regulations stormwater will primarily be managed through cisterns buried under the development. However, this would be a sub-optimal design, and it ignores Athens' stated goal to "coordinate site design plans, with the county's greenspace program, parks and greenway network plan."[102] There is a great opportunity for a public private partnership to develop community greenspace that coordinates with the planned Firefly Trail and the desired expansion of community greenspace accessible from downtown Athens.

As part of the right-of-way for the Firefly Trail, Athens-Clarke County owns 2.5 acres, more or less, adjacent to the A&D site as a portion of the right-of-way for the proposed Fire Fly

[102] ACC Stormwater Management Ordinance 5-4-1(5)

Trail. It is about 150 feet across. That is more than enough space for the trail, which should have a width of 10 to 15 feet more or less. If a portion of this space could be used for green infrastructure elements such as a series of stormwater retention and detention ponds, bioswales, and stormwater wetlands it would provide a more cost effective alternative for the development's stormwater while providing an ecologically vibrant context for the trail. These ponds would provide the bulk of the retention and infiltration capacity, but they could also be linked to a series of small retention areas and stormwater wetlands dispersed throughout the site as shown in Figure 23.

The runoff volume flowing into the ponds would first flow through a series of bioswales and tree boxes lining the roads throughout the site as shown in Figure 24. These swales will accept most of the volume for the smallest rain events and slow the flow as it flows to a central point at the location of the park shown as the connection between the site and the Firefly Trail. A pond in this area would serve as the first pond in a series that would retain and/or detain and treat stormwater as it makes its way to the North Oconee River. Cisterns could be installed in the parking structures to capture additional stormwater volume if this is necessary; these elements would be incorporated into the specific building plans and thus are not shown on the accompanying site drawings.

This pond should be designed to retain water at all times to provide a prominent water feature in this park space to highlight the stormwater management practices on the site. This pond will connect to three or more ponds between the development and the trail. These ponds could either be shallow enough to drain fairly quickly to allow relatively flat open space for passive recreation, or they could be designed to retain water to create a more natural wetland environment and more extensive wildlife habitat. If the ponds retain water, berms separating the ponds would serve as pathways connecting the trail to the development at strategic intervals.

These ponds would discharge down the slope to the existing drainage. The water's flow down this slope would be arrested in a series of terraces creating a cascading water feature moving down the slope. Stairs and an ADA compliant pathway could follow this water feature down the hill providing pedestrian connections from this lower elevation to the Firefly Trail and the A&D development as shown in Figure 25.

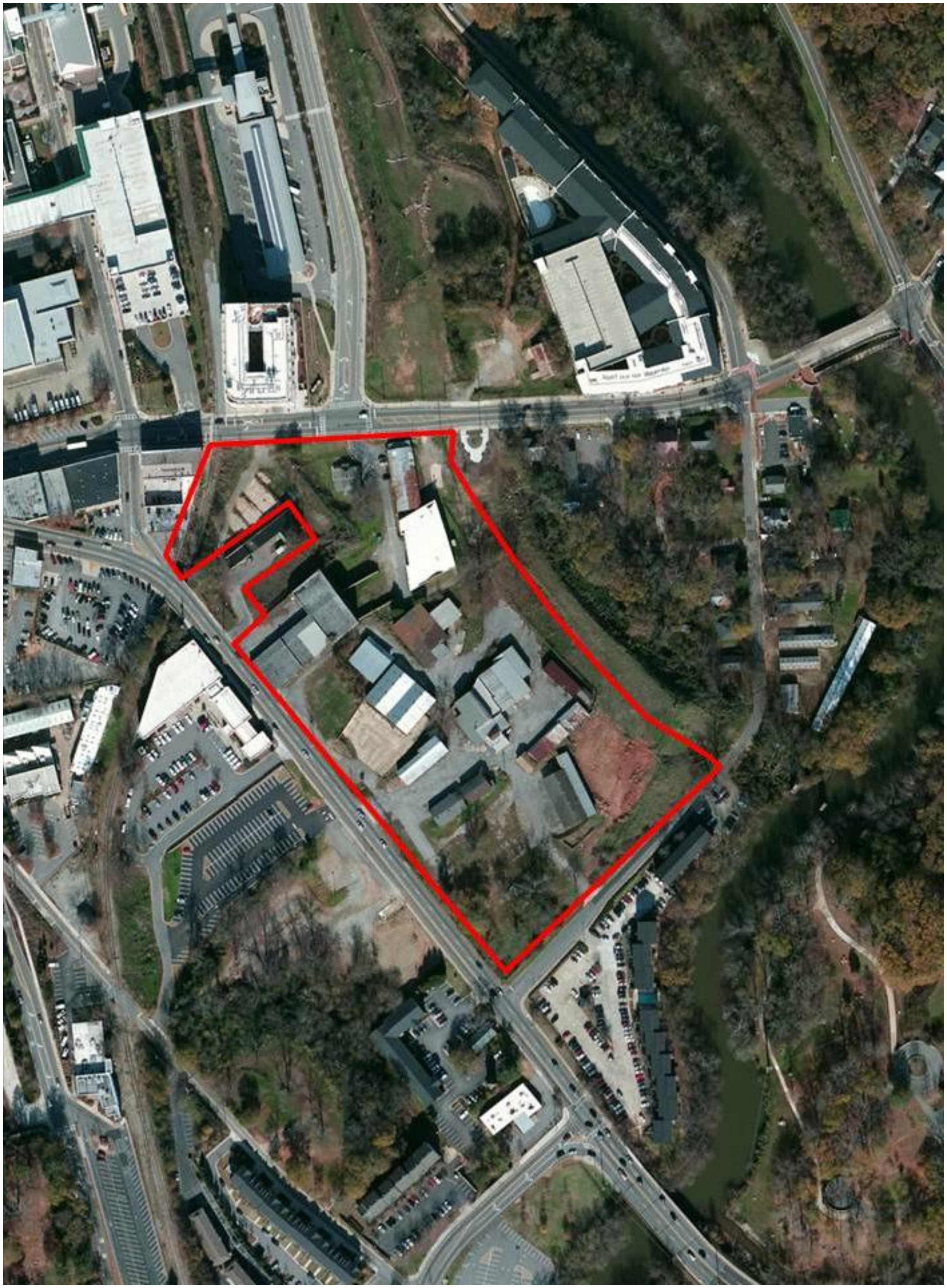

Figure 21: Aerial view of the Armstrong & Dobbs site.

Figure 22: Selig Enterprises site plan for the A&D site released in May 2013.

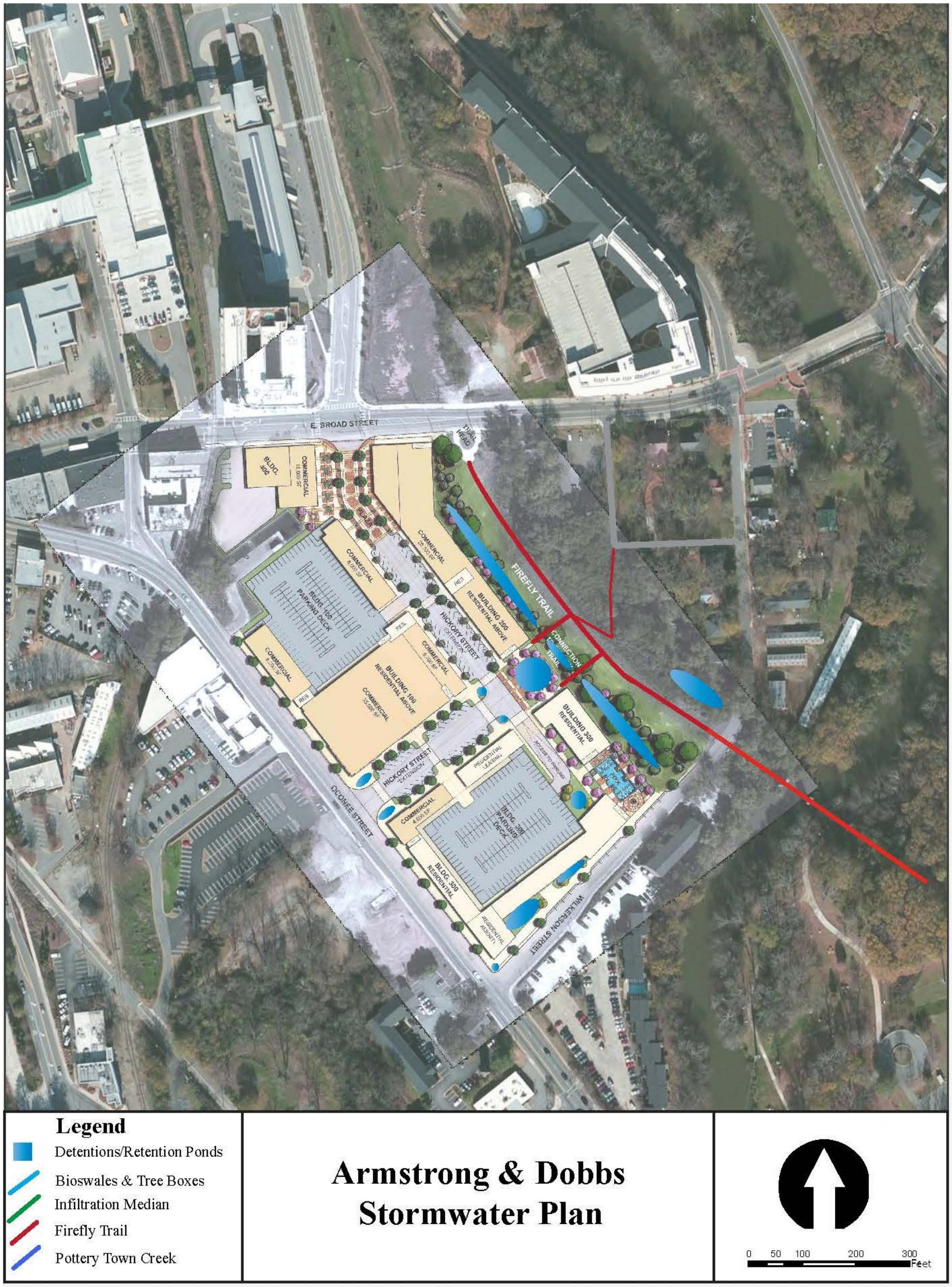

Figure 23: Stormwater Site Plan – Ponds.
The blue areas indicate potential locations for detention/retention areas dispersed throughout the A&D site.

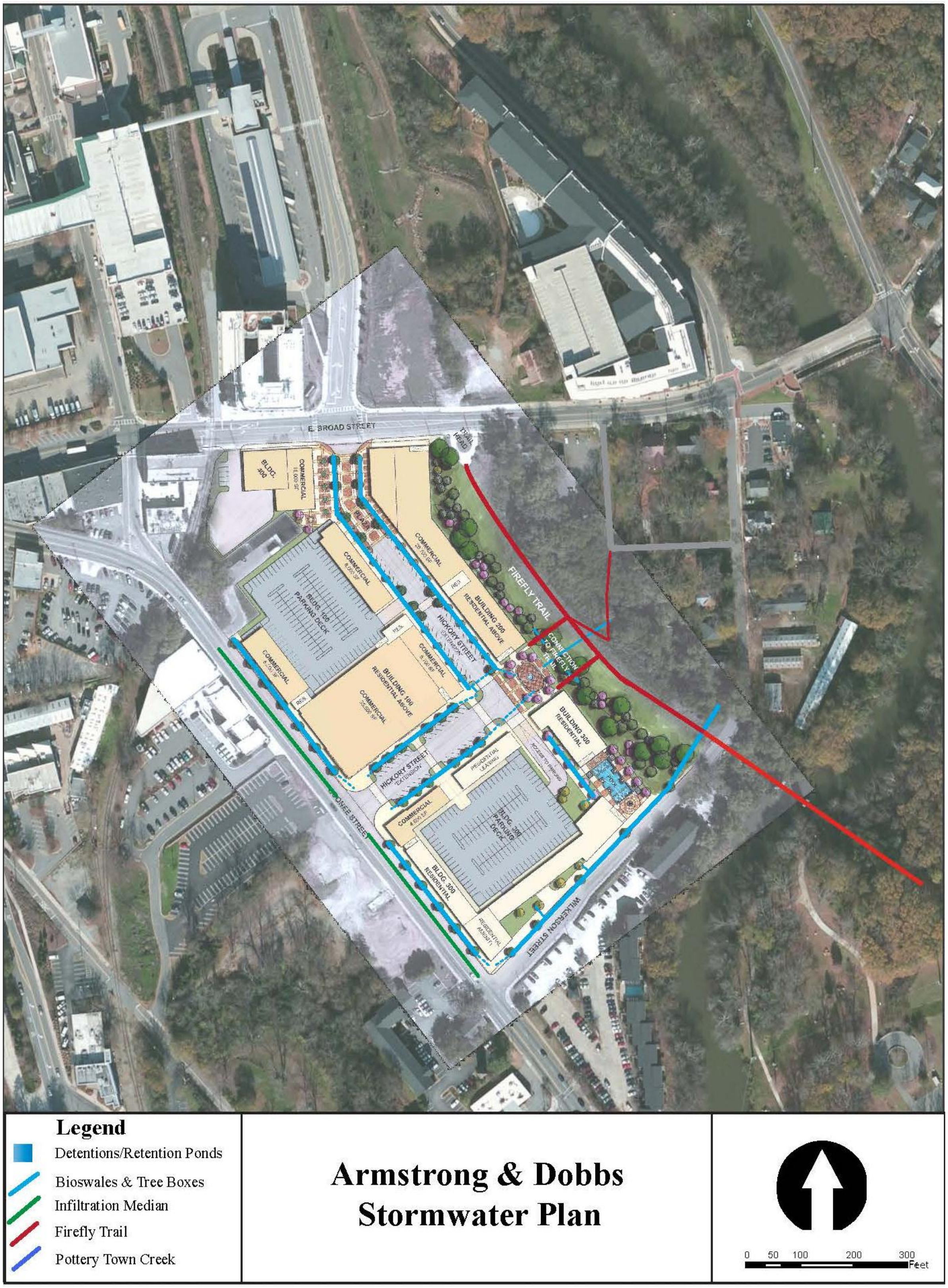

Figure 24: Stormwater Site Plan – Swales. The blue and green lines show possible locations for street side bioswales to transport and infiltrate stormwater. Dotted line segments denote pipes.

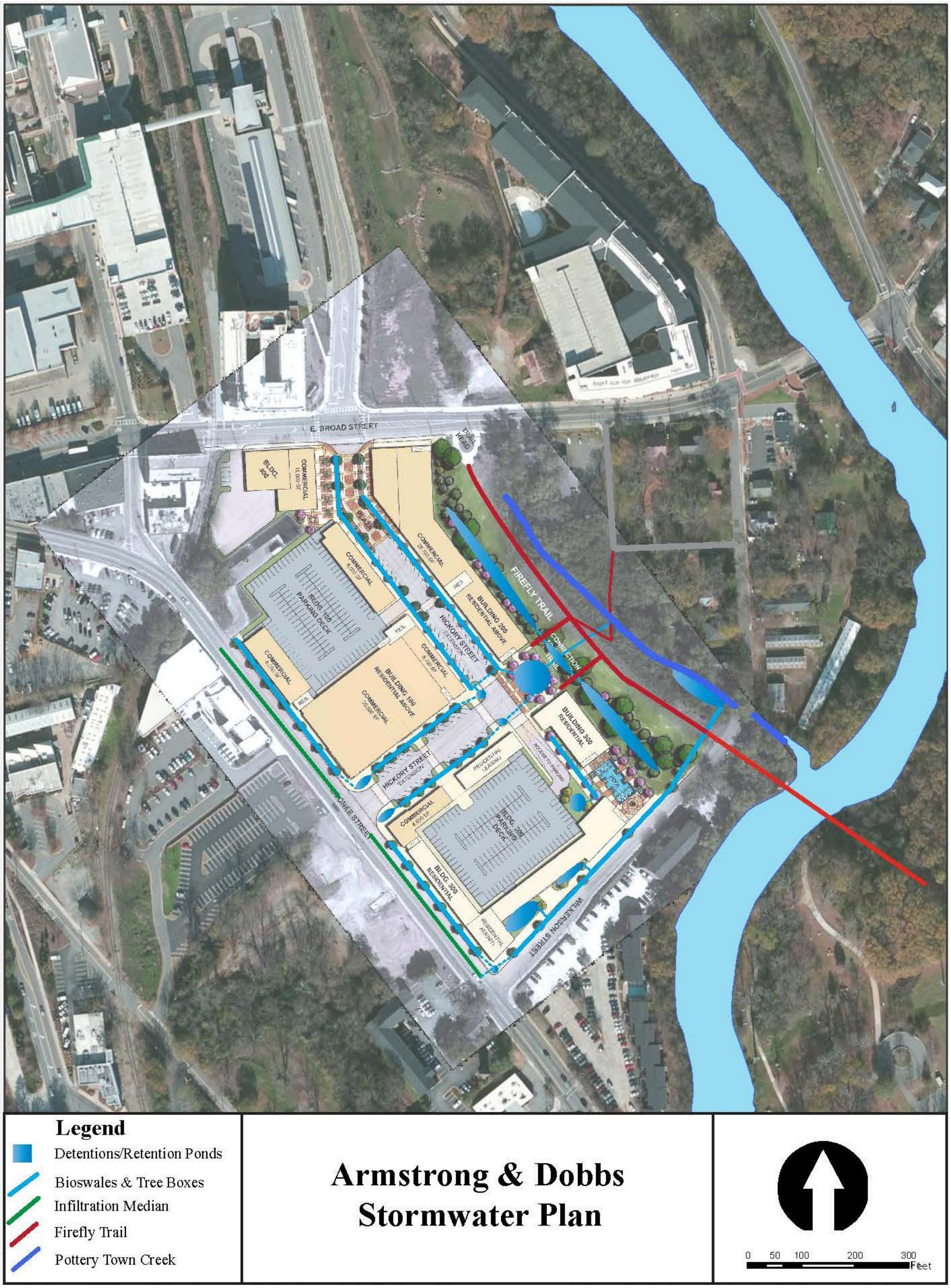

Figure 25: Stormwater Site Plan. This drawing shows both the proposed ponds and the interconnecting bioswales.

An additional 2.75 acres of private property along the river is located in the area shown as the North Oconee floodway on FEMA Flood Insurance Rate Maps. This area is shown in Figures 27 and 28. This property could be acquired by the County for incorporation into this stormwater system, though this area would more advantageously serve any further development along Wilkerson Street. This would also expand the buffer adjacent, and expand an existing small park adjacent to the river along East Broad Street. Use of the floodway for park space expands upon the small park adjacent to the River on the south side of East Broad Street. By connecting this existing pocket park to the public property along the trail right-of-way, both spaces are made more attractive and useful.

Public stormwater infrastructure would tie in to this same system. Runoff from Oconee Street and Wilkerson Street would flow through bioswales and tree boxes along these two rights-of-way and discharge into this drainage described above below the Firefly Trail bridge. Runoff from East Broad Street would be directed into a detention facility at the top of this drainage where it would be detained to allow settling and other treatment before flowing down the creek. This flow pattern is shown in Figure 28.

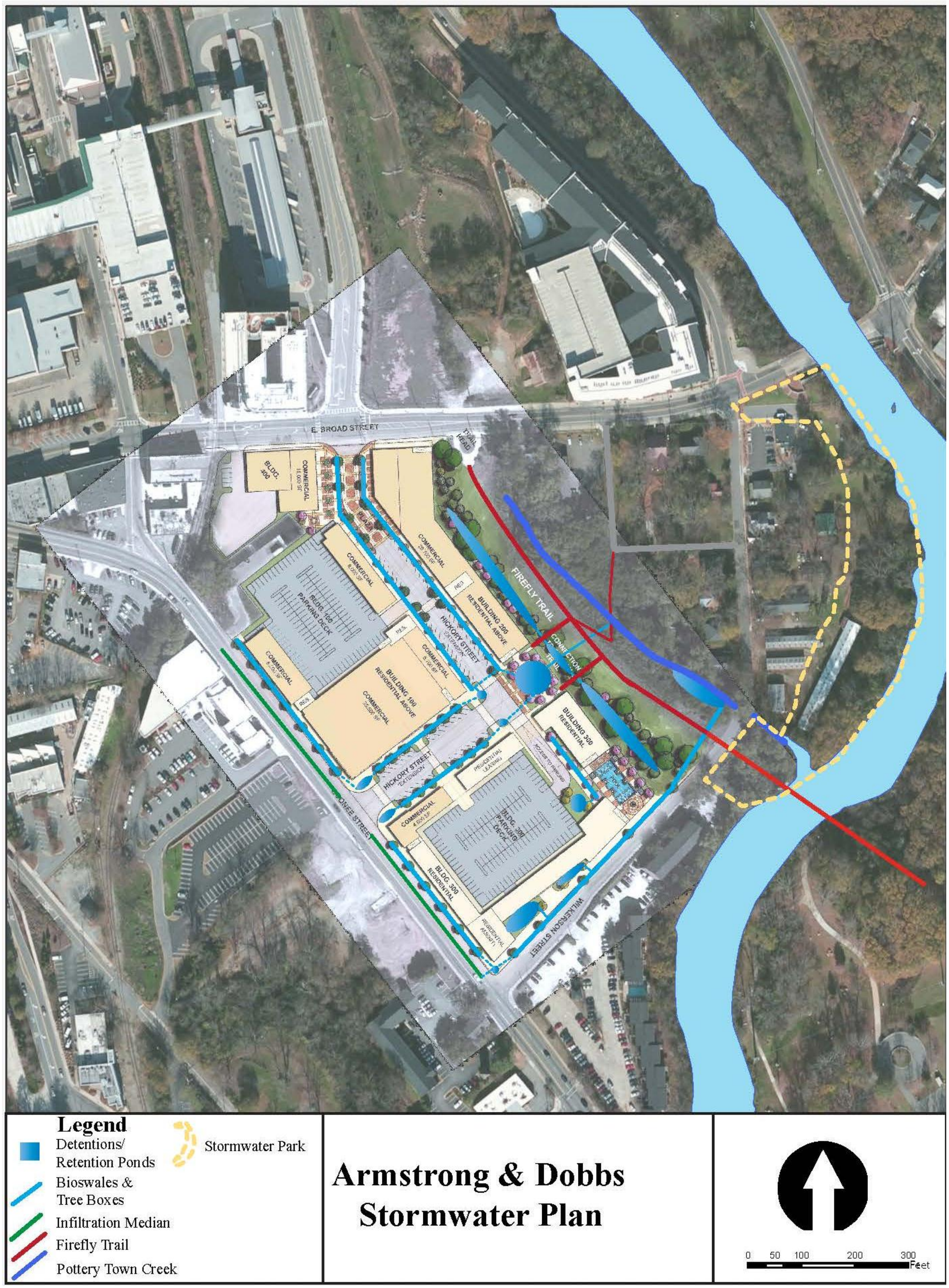

Figure 26: Stormwater/River Buffer Park.
Possible stormwater park in the buffer to the North Oconee River.

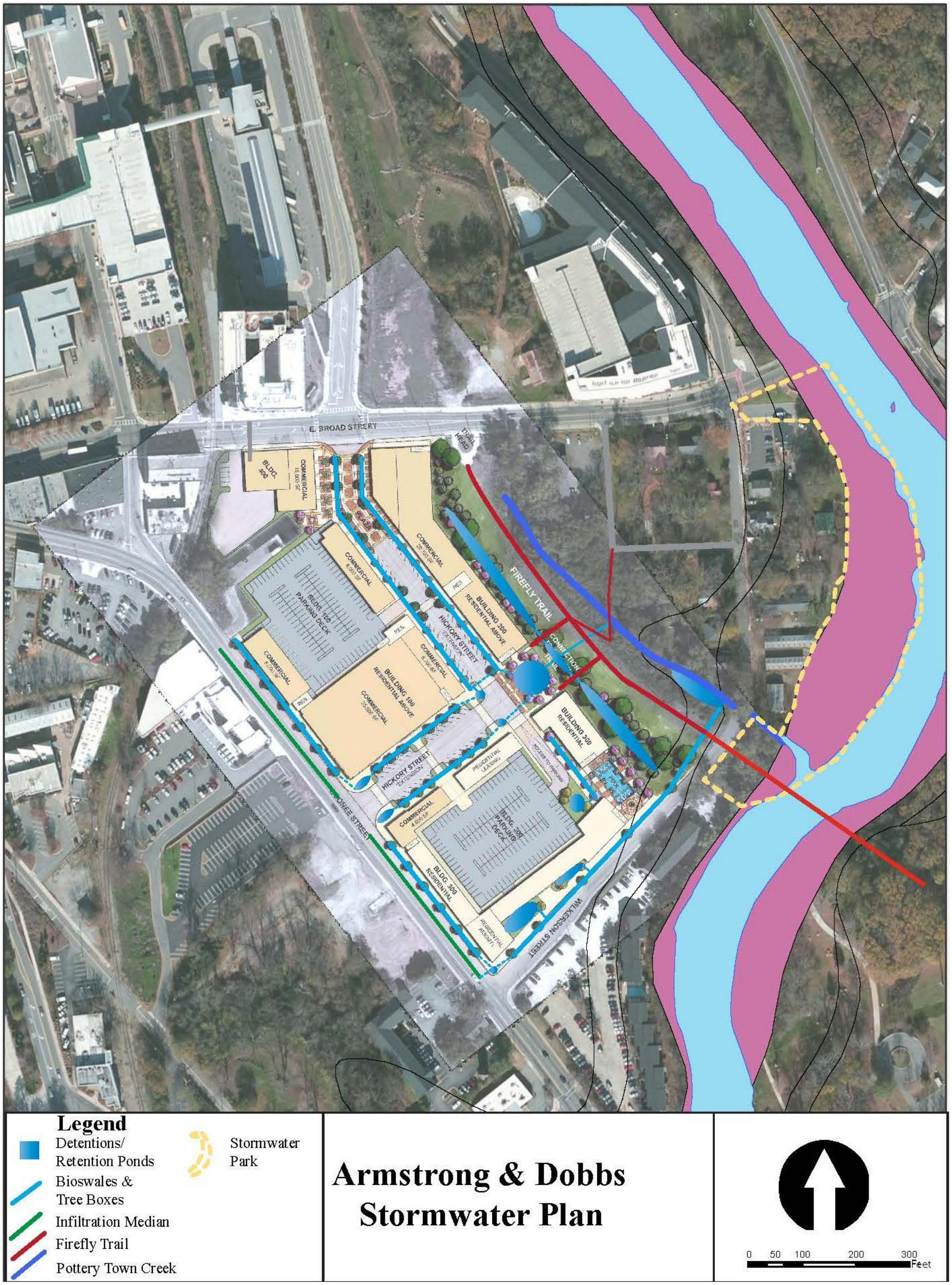

Figure 27: North Oconee Floodway.

The proposed park is located entirely in existing public land or in the 100-Floodway.

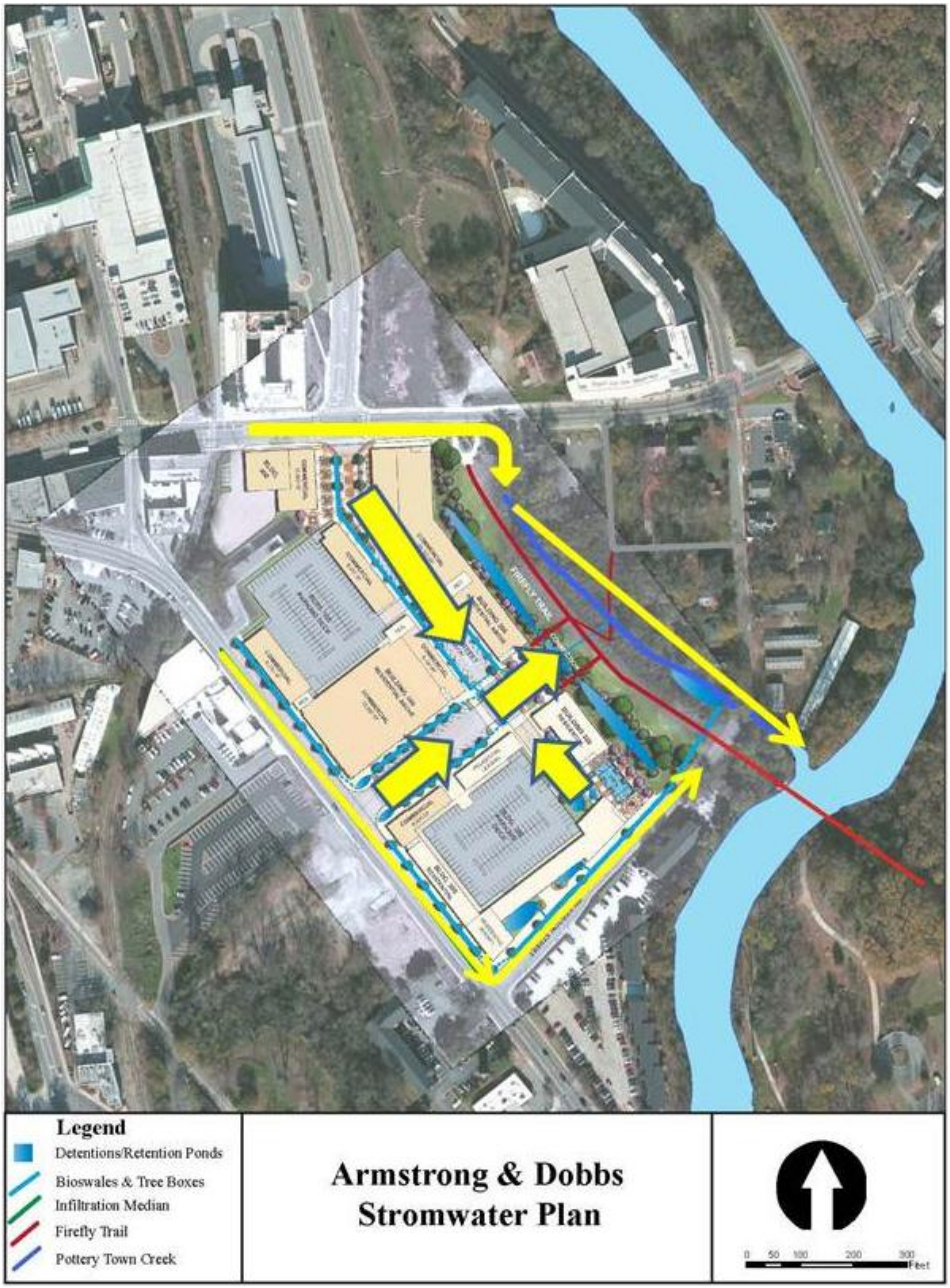

Figure 28: Stormwater Site Plan Flow Direction.

B. Functionality

The GSMM requires a post-development stormwater plan retain a 1.2 inch 24-hour rainfall event for 24 hours.[103] In north Georgia, this represents capturing the rainfall from slightly more than 85% of rain events,[104] which comprises 63% of all precipitation.[105] Research indicates that this standard is readily achievable primarily with bioswale infiltration augmented with runoff retention in all but the most challenging of conditions.[106]

A 1.2 inch rainfall on a 10 acre site equals one acre-foot of water, which is 43,560 cubic feet or 325,354 gallons. Using the design drawing for bioretention swale shown above with an average volume of 4 cubic feet per linear foot, the site plan calls for about 2,500 linear feet of swales, providing a storage capacity 10,000 cubic feet of water, or about 75,0000 gallons, onsite. Approximately an acre of additional rain gardens and retention/detention ponds can provide ample storage to make up the rest of the needed storage capacity with potentially much more capacity.

The 85th percentile rain event is not the ideal retention standard. Retaining the 95th percentile 24-hour rain event would retain 87% of all rainfall by volume, which would come much closer to mimicking the natural hydrology of the area. The 95th percentile event would require capacity for 1.79 inches, or an additional 0.5 acre-feet from a ten acre site. If a more

[103] Georgia Stormwater Management Manual, Vol. 2. Section 1.2.2.3. p.30.

[104] Horner, Richard and Jocelyn Gretz, "Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices Applied to Meet Various Potential Stormwater Runoff Regulatory Standards." Report the U.S. EPA from the National Resources Defense Council, p.14. December 2011. The 85th percentile rain event in Atlanta, Georgia was measured at 1.13 inches.

[105] Horner at 14.

[106] Ibid at 30-35. In this study runoff retention in a commercial development referred to the use of rooftop retention in the form of green roofs or rooftop cisterns because it was assumed space was extremely limited. In this design, that retention is moved to the pond areas, which is made possible by the public/private collaborative nature of this project. "The most challenging conditions" here refers to areas with extremely poor soils that do not allow significant infiltration.

protective regulatory standard were implemented, it readily could be achieved in this scenario by the inclusion of other GI measures such as green roofs, porous paving, or rainwater harvesting.

C. Financing and Acquisition

The right-of-way needed for the A&D stormwater ponds could be acquired from the County as a land swap. The County would acquire right-of-way along Oconee and Wilkerson in exchange for the strip of land needed for ponds from the rail right-of-way. A land swap allows the developer and the County to draw clear lines between publicly owned and maintained stormwater infrastructure and that which is privately owned. It also avoids the procedural complexity involved in disposing of local government property.[107]

In order to fund the public land acquisition and the construction of the public part of this plan, the County could establish a capital fund specifically for constructing high performance landscape type projects. It could be initiated with grant funds to improve water quality such as CWA §319 grants. Funds could be replenished by stormwater fees tied to the amount of private stormwater that enters the system. Additionally, these funds could be used encourage development of GI stormwater in private development by creating a revolving loan program to finance construction of particular GI elements or subsidize their use. The areas involved in this land swap are shown in Figure 30 below.

[107] O.C.G.A.§35-36-6(c): Nothing in this Code section shall prevent a municipal corporation from trading or exchanging real property belonging to the municipal corporation for other real property where the property so acquired by exchange shall be of equal or greater value than the property previously belonging to the municipal corporation; provided, however, that within six weeks preceding the closing of any such proposed exchange of real property, a notice of the proposed exchange of real property shall be published in the official organ of the municipal corporation once a week for four weeks. The value of both the property belonging to the municipal corporation and that to be acquired through the exchange shall be determined by appraisals and the value so determined shall be approved by the proper authorities of said municipal corporation.

Figure 29: Land Swap.

County property that could be swapped to the developer is shown in green with the area to be received by the County is shown in pink.

IX. CONCLUSION

Current trends in environmental law and policy indicate that the federal government will increasingly pursue its environmental goals and objectives by influencing the activities of local governments, particularly in regards to water quality. The federal Clean Water Act has been largely successful in controlling pollution from regulated point source discharges, but pollution from diffused sources like stormwater. The principle influence the federal government has over local governments in stormwater management is the MS4 permit. The EPA has repeatedly stated its intent to incorporate green infrastructure implementation into its planning, permitting and enforcement activities, particularly by incorporating such requirements into MS4 permits. As state and local governments continue to fail to achieve sufficient stormwater pollution reductions to meet federal water quality standards, the EPA and other federal agencies will push harder to influence local regulations.

As Athens-Clarke County plans its downtown and envisions its future, it is a precipitous moment to consider how Athens will meet its federal obligations in the future. This is particularly true given that Downtown Athens is beginning a building boom that will reshape the County's urban center. If the County would embrace the EPA's push for local government adoption of GI stormwater practices, it would find opportunities to address at least some factors causing local water quality impairments while at the same time leveraging money and administrative resources to expand greenspace and reap all the ancillary benefits greenspace provides, as well as improve alternative transportation connectivity.

The development proposed for the Armstrong & Dobbs site presents an opportunity for a collaborative stormwater planning that can actively promote the use of green infrastructure in both public and private projects. It also allows the County to plan its stormwater infrastructure to serve multiple purposes. By more efficiently designing infrastructure to serve multiple purposes, the County can better protect the local environment while also providing more community services for local residents.