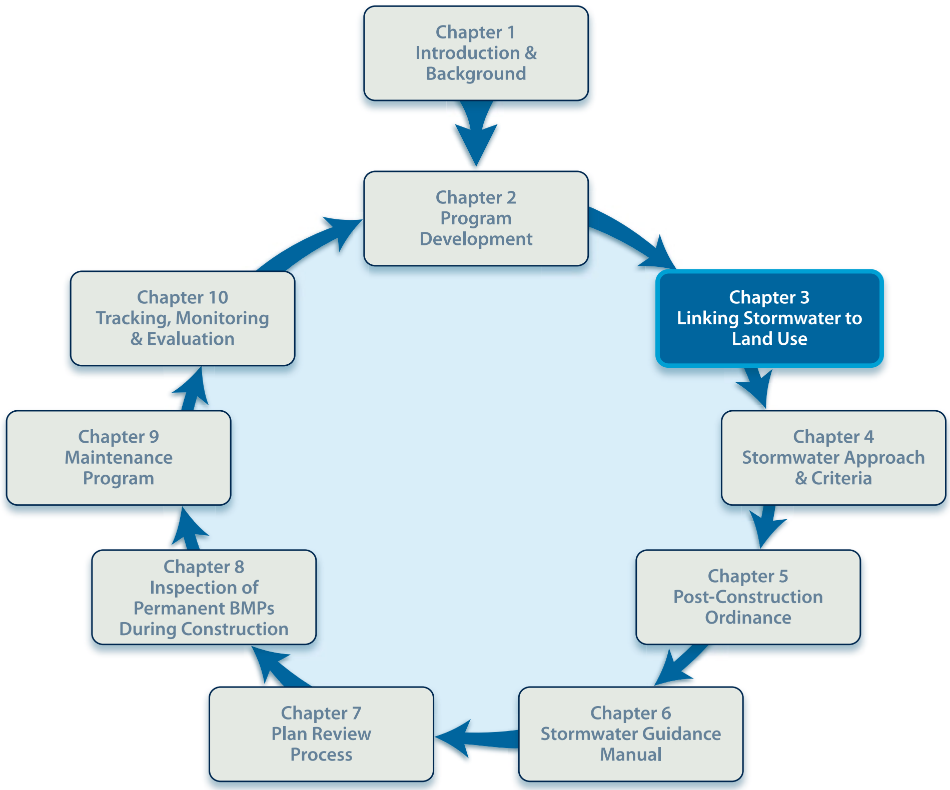
Chapter 3

Land Use Planning as the First BMP: Linking Stormwater to Land Use



What's In This Chapter

- Why stormwater managers should engage in land use decisions
- Planning at different scales
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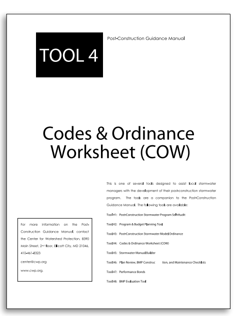
  - District or neighborhood
  - Site level
- A process for integrating stormwater and land use planning
  - Understand the role of impervious cover and other watershed factors
  - Examine and evaluate land use codes
  - Develop relationships between stormwater managers, land use planners, and other officials
  - Use watersheds are organizing units
- Considering climate change in the stormwater/land use program



Companion Tools for Chapter 3
Download Post-Construction Tools at:
www.cwp.org/postconstruction

3.1. Introduction

Increasingly, communities are looking for ways to maximize the opportunities and benefits associated with growth while minimizing and managing the environmental impacts of development. Balancing these priorities is playing out in planning commission meetings, boardrooms, mayors' offices, and public meetings throughout the United States. Stormwater managers can, and should, be central players in such conversations. Where and how development occurs can dramatically affect a community's watersheds, infrastructure, and water supplies. Effectively engaging in these discussions can help communities better balance development decisions with environmental protection.

The barrier, however, is where and how to engage in development decisions. Traditionally, the practice of stormwater management has been limited to site-level approaches. However, stormwater management is evolving beyond engineered approaches applied at the site level to an approach that looks at managing stormwater at the regional, district/neighborhood, and site scales.

By looking at stormwater management at various scales, stormwater managers can influence the development debate in a number of ways. For example, they can, and should, be active in helping a community craft policies and incentives to direct development to already disturbed or degraded land. Redeveloping a parking lot, abandoned mall, or already degraded site allows a community to enjoy the benefits of growth without increasing net runoff. In this way, engaging in growth and development discussions can be considered the "first stormwater best management practice."

The purpose of this chapter is to highlight opportunities where stormwater managers can engage in broader growth and development decisions. Every community is unique and has it own vision of its character. Certainly, a development discussion concerning redevelopment of an aging downtown area will cover issues substantially different from those of a rural town struggling to maintain its character. Both communities, however, will discuss policies and regulations, such as road and street width, building setbacks, parking requirements, and open space requirements, that can have a direct impact on stormwater runoff.

This chapter seeks to highlight those development-related policies and regulations and describe how stormwater managers might effectively engage and influence land use decisions.

3.2. Why Should Stormwater Managers Engage in Land Use Decisions?

Many stormwater managers do not see engaging in land use decisions as part of their job. Indeed, the past few decades of stormwater management have focused on using control and treatment strategies that are largely hard-infrastructure-engineered, end-of-pipe, and site-focused practices concerned primarily with peak flow rate and suspended solids concentration control.

Where and how communities grow affects water quality. The collective experience of communities across the United States demonstrates that looking only at site-level practices will not repair damaged waterbodies and will likely put more streams on impaired lists over time.

Indeed, factors at the site, district/neighborhood, and regional scales can drive the creation of unnecessary impervious cover and other land cover conditions that produce excessive runoff. These factors are embedded in a community's land use codes and policies. A comprehensive approach to stormwater management should therefore include an examination of a locality's land development regulations, policies, and ordinances to better align with water quality goals.

For example, a subdivision ordinance dictates minimum houses per acre, street width, and the distance a house is set back from the road. All of these measures create impervious surface. It is for the municipality to determine whether the creation of this impervious surface and the generation of the associated runoff are appropriate. In this way, the municipality aligns its subdivision regulations with its stormwater goals.

Table 3.1 lists common land use development regulations, codes, and policies that could be reviewed for consistency with stormwater goals. These documents are also needed to complete the "Codes and Ordinance Worksheet," which is a tool to assist with the systematic review of codes and policies for consistency with model development principles (see **Tool 4**).

A comprehensive approach to stormwater management involves developing stormwater management practices that can be applied at the regional, district/neighborhood, and site scales. It also involves looking at where and how development occurs within the community. This is best done by examining common land development regulations and policies that dictate the location, quantity or density, and design of development.

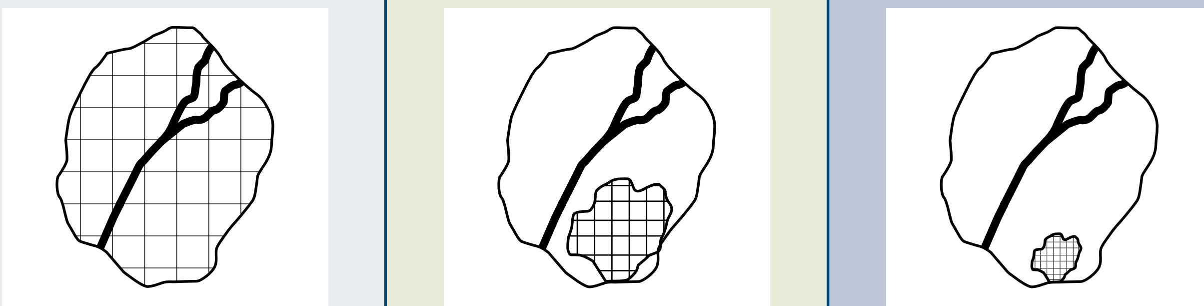
3.3. Planning at Different Scales

Decisions about where and how to grow are the first, and perhaps most important, development decisions related to water quality. A comprehensive stormwater management approach supports an interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while also providing recreational opportunities and wildlife habitat. These open spaces must be balanced with areas where growth and development are appropriate. Traditionally, stormwater managers have engaged at the development site level by restricting development within the riparian buffer, wetlands, or other critical natural features. However, engaging in this issue at the district/neighborhood scale or regional scale can have a greater water quality benefit.

A 2006 EPA study found that, conceptually, higher-density development can be more protective of regional water quality than lower-density scenarios because less stormwater and associated pollutants are produced on a per-unit basis (**USEPA, 2006a**). **Figure 3.1** illustrates how dense developments, although they have a high site-level impervious cover, can result in a lower watershed impervious cover compared to a scenario where development is equally spread out across the watershed. For example, in scenario C development is directed to 1/8-acre lots in a small

Table 3.1. Common Land Use Development Regulations, Codes, and Policies That Can Drive Impervious Cover

- ***Zoning ordinance*** specifies the type of land uses and intensity of those uses allowed on any given parcel. A zoning ordinance can dictate single-use, low-density zoning, which spreads development out throughout the watershed, creating excess impervious cover.
- ***Subdivision codes*** or ordinances specify specific development elements for a parcel: housing footprint minimums, distance from the house to the road, the width of the road, street configuration, open space requirements, and lot size—all of which can lead to excess impervious cover.
- ***Street standards or road design guidelines*** dictate the width of the road for expected traffic, turning radius, the distance for other roads to connect to each other, and intersection design requirements. Road widths, particularly in new neighborhood developments, tend to be too wide, creating considerable impervious cover.
- ***Parking requirements*** generally set the minimum, not maximum, number of parking spaces required for retail and office parking. Setting minimums leads to parking lots designed for peak demand periods, which can create acres of unused pavement during the rest of the year.
- ***Minimum setback requirements*** can spread development out by leading to longer driveways and larger lots. Establishing maximum setback lines for both residential and retail development brings buildings closer to the street, reducing the impervious cover associated with long driveways, walkways, and parking lots.
- ***Site coverage limits*** can disperse the development footprint and make each parcel farther from its neighbor, leading to more streets and roads and thereby increasing total impervious cover throughout the watershed.
- ***Height limitations*** limit the number of floors for any building. Limiting height can spread development out if square footage cannot be met by vertical density.



Scenario A	Scenario B	Scenario C
10,000 houses built on 10,000 acres produce:	10,000 houses built on 2,500 acres produce:	10,000 houses built on 1,250 acres produce:
10,000 acres x 1 house x 18,700 ft^3/yr of runoff =	2,500 acres x 4 houses x 6,200 ft^3/yr of runoff =	1,250 acres x 8 houses x 4,950 ft^3/yr of runoff =
187 million ft^3/yr of stormwater runoff	**62 million ft^3/yr of stormwater runoff**	**49.5 million ft^3/yr of stormwater runoff**
Site: 20% impervious cover	**Site: 38% impervious cover**	**Site: 65% impervious cover**
Watershed: 20% impervious cover	**Watershed: 9.5% impervious cover**	**Watershed: 8.1% impervious cover**

Figure 3.1. Watershed impervious cover at different development densities (Source: U.S. EPA, 2006a)

portion of the watershed, resulting in 65% impervious cover for the development site but only 8% impervious cover for the entire watershed. If an equivalent number of development units are spread out over the entire watershed (scenario A), the development has a lower impervious cover but the watershed has a much higher impervious cover, 20%.

The following sections describe potential approaches a stormwater manager can take to address stormwater at the regional, district/neighborhood, or site scale.

Regional Stormwater Management Approaches

Stormwater managers should begin to address stormwater at a regional scale by doing the following:

Preserving open space and critical ecological features. Preserving open space is critical to maintaining water quality at the regional level. Large, continuous areas of open space reduce and slow runoff, absorb sediments, serve as flood control, and help maintain aquatic communities. Preserving ecologically important land, such as wetlands, buffer zones, riparian corridors, and floodplains, is critical for regional water quality.

Encouraging development in already-degraded areas. Perhaps the biggest opportunity for any stormwater manager is to work with local governments to develop a range of policies and incentives to direct development to already degraded areas. Communities can enjoy a significant reduction in regional runoff if they take advantage of underused properties, such as infill, brownfield, or greyfield sites (sites in abandoned or underutilized commercial areas) (**Congress for New Urbanism, 2001**). Redeveloping already degraded sites such as abandoned shopping centers or underutilized parking lots rather than paving greenfield sites for new development can dramatically reduce total impervious area and water quality impacts.

Using land efficiently. Using land efficiently reduces and better manages stormwater runoff by putting development where it is most appropriate and reducing total impervious area. For example, by directing and concentrating new development in areas targeted for growth, communities can reduce or remove development pressure on undeveloped parcels and protect sensitive natural lands and recharge areas.

District or Neighborhood Stormwater Management Approaches

Stormwater at the district or neighborhood scale can be addressed through approaches, like the following:

Mixed use and transit-oriented development. Mixing land uses can have direct effects on reducing runoff because mixed-use developments have the potential to use surface parking lots and transportation infrastructure more efficiently, requiring less pavement. Transit-oriented development can help protect water quality by reducing (1) land consumption due to smaller site footprints, (2) the number of parking spaces, and (3) average vehicle miles traveled, which in turn reduces atmospheric sources of pollution that can end up in receiving waters. Because higher-density development is clustered around transit stops, the need for developing land elsewhere in a region can be reduced (if the proper policies and controls are in place).

Green streets. The green streets concept is a streetscape design with multiple functions that integrates the "natural" and the "manmade." Green street streetscapes facilitate natural infiltration wherever possible and therefore have less impervious surface such as concrete and asphalt. They allow for greater use of vegetation and other attractive materials, such as crushed stone and pavers, which can help to create an identifiable community character.

Parking requirements. Another strategy to reduce impervious cover is to assess parking requirements, particularly those for parking lots. Better balancing parking demand and supply could help remove some of the excess spaces. Some communities have found that "park once," shared parking strategies, and allowing on-street parking can help balance parking supply and demand. In 2006 EPA published *Parking Spaces/Community Places: Finding the Balance Through Smart Growth Solutions*. This document highlights approaches that balance parking with broader community goals (**USEPA, 2006b**).

Open-space amenities. In recent decades Americans have demonstrated their preference for living near or adjacent to parks or other open-space areas by their willingness to pay a premium for housing near these amenities (**Trust for Public Land, 1999**). Nationwide, easy access to parks and open space has become a measure of community health. These district/neighborhood open spaces can also serve critical stormwater functions, such as providing buffer areas for stormwater quality or areas to reduce stormwater flooding.

Site-level Stormwater Management Approaches

After minimizing runoff at the regional and district/neighborhood scales, stormwater management finally turns to the site scale. Many of the remaining chapters in this guide focus on site-level stormwater strategies. For instance, **Chapter 4** includes a recommended stormwater management approach that is largely relevant to the site scale.

Smart Growth Approaches to Stormwater Management

Table 3.2 lists various EPA publications about the relationship between planning and water quality that are relevant to water resources and stormwater management. It should also be noted that EPA's *National Menu of Stormwater Best Management Practices* lists many Smart Growth and site design techniques among post-construction best management practices (BMPs; see **Table 3.3**). EPA encourages a mix of structural, nonstructural, and planning techniques to address the post-construction minimum measure.

The remainder of this chapter introduces a process for integrating stormwater with land use planning. In other words, it outlines how a stormwater program can consider land use as the "first BMP" by integrating ideas and techniques that engage the stormwater manager in land use issues.

Table 3.2. EPA Publications Related to Water Resources and Stormwater
Note: See ***www.epa.gov/smartgrowth*** for more information.

Using Smart Growth Techniques as Stormwater Best Management Practices, EPA 231-B-05-002. December 2005.
www.epa.gov/smartgrowth/stormwater.htm
A guidance document that reviews nine common smart growth techniques and examines how they can be used to prevent or manage stormwater runoff.

Protecting Water Resources with Higher-Density Development, EPA 231-R-06-001. January 2006.
www.epa.gov/smartgrowth/water_density.htm
A guidance document that helps communities better understand the impacts of higher- and lower-density development on water resources. The findings indicate that low-density development might not always be the preferred strategy for protecting water resources.

Parking Spaces/Community Places, EPA 231-K-06-001. January 2006.
http://www.epa.gov/smartgrowth/parking.htm
A guidance document that helps communities explore new, flexible parking policies that can encourage growth and balance parking needs with their other goals.

*Protecting Water Resources with Smart Growth***,** EPA 231-R-04-002. May 2004.
www.epa.gov/smartgrowth/water_resource.htm
A guidance document intended for audiences that are already familiar with smart growth concepts and want specific ideas on how smart growth techniques can be used to protect water resources. Suggests 75 policies that communities can use to grow in the way that they want to while protecting their water quality.

Stormwater Guidelines for Green, Dense Redevelopment, December 2005.
www.epa.gov/smartgrowth/emeryville.htm
A City of Emeryville, California, grant product that is geared specifically to developers and designers. These guidelines offer ways to meet requirements to treat stormwater from development projects.

*Solving Environmental Problems through Collaboration: A Case Study of the New York City Watershed Partnership***,** EPA 231-F-06-005. June 2006.
www.epa.gov/innovation/collaboration
A fact sheet that provides a summary of the partnership, which works closely with government and nongovernmental partners to protect the drinking water supply of 9 million people while promoting economic viability and preserving the social character of the communities in the upstate watershed.

*Growth and Water Resources***,** EPA 842-F-02-008. September 2005.
www.epa.gov/smartgrowth/pdf/growthwater.pdf
A fact sheet that explains how land use affects water resources and offers resources and tools for communities.

Growing Toward More Efficient Water Use: Linking Development, Infrastructure, and Drinking Water Policies, EPA 230-R-06-001. January 2006.
www.epa.gov/smartgrowth/water_efficiency.htm
A guidance document that focuses on the relationships among development patterns, water use, and the cost of water delivery and includes policy options for states, localities, and utilities that directly reduce the cost and demand for water while indirectly promoting smarter growth.

*Smart Growth for Clean Water***.** National Association of Local Government Environmental Professionals, Trust for Public Land, ERG. 2003.
www.resourcesaver.com/file/toolmanager/CustomO93C337F42157.pdf
A grant product that offers ideas for using smart growth to advance clean water goals based on the experiences of communities across the nation.

Potential Roles for Clean Water State Revolving Fund Programs in Smart Growth Initiatives, EPA 832-R-00-010. October 2000.
www.epa.gov/owm/cwfinance/cwsrf/factsheets.htm
A guidance document that describes options for states to use their Clean Water State Revolving Funds to support more environmentally sound growth and development.

Table 3.3. EPA's *National Menu of Stormwater Best Management Practices*: Selected Post-Construction BMPs Consistent with Smart Growth and Site Design Strategies
www.epa.gov/npdes/menuofbmps

- Conservation Easements
- Development Districts
- Eliminating Curbs and Gutters
- Green Parking
- Green Roofs
- Infrastructure Planning
- Low-Impact Development and Green Design Strategies
- Narrower Residential Streets
- Open-Space Design
- Protection of Natural Features
- Redevelopment
- Riparian/Forested Buffer
- Street Design and Patterns
- Urban Forestry

3.4. A Process for Integrating Stormwater and Land Use

The following four steps are recommended to begin integrating stormwater with land use:

1. Understand the role of impervious cover and other watershed factors at the regional, district/neighborhood, and site scales.
2. Examine and evaluate land use codes for drivers of excess impervious cover and land disturbance.
3. Develop relationships between stormwater managers, land use planners, and other officials.
4. Use watersheds as organizing units for the linked stormwater/land use program.

The following sections discuss each step in more detail.

3.5. Step 1: Understand the Role of Impervious Cover and Other Watershed Factors at the Regional, District/Neighborhood, and Site Scale

Impervious cover has become one of the most important indicators of overall watershed health because it is relatively easy to measure and the correlations with stream health have been documented for small watersheds draining first- to third-order streams (e.g., 2 to 20 square miles) (**CWP, 2003a; Schueler et al., in review**). Thus, controlling overall impervious cover at the watershed or community level is one of the chief strategies currently employed to limit stormwater impacts.

Though development in various watersheds is highly varied, research finds that indicators of stream health decline with increasing impervious cover (**CWP, 2003a; Schueler et al., in review**). **Figure 3.2** presents a conceptual model that expresses the impervious cover/stream health relationship as a "cone" that is widest

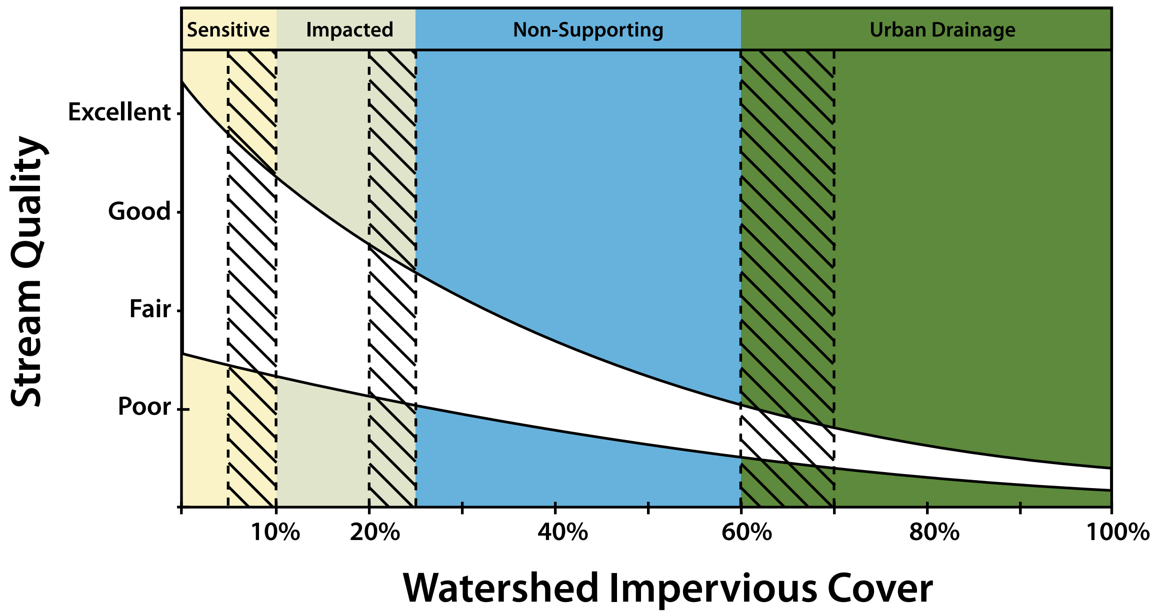


Figure 3.2. Conceptual model illustrating the relationship between impervious cover and stream health. (Source: Schueler et al., in review)

at lower levels of impervious cover and progressively narrows at higher levels of impervious cover (**Schueler et al., in review**).

The cone width is greatest at lower levels of impervious cover (e.g., less than 10 percent), reflecting the wide variability in stream response found in less-urban watersheds. The expected quality of streams in this lower range of impervious cover is generally influenced more by other watershed metrics, such as forest cover, road density, extent of riparian vegetative cover, and cropping practices (**CWP, 2003a**). At higher levels of impervious cover, the cone is narrower because most streams in highly impervious, urban watersheds exhibit fair or poor stream health conditions (i.e., the correlation between impervious cover and stream health is stronger) (**Schueler et al., in review**).

The model also illustrates how impervious cover can be used to classify and manage subwatersheds according to four categories of stream health: sensitive, impacted, non-supporting, and urban drainage. The transitions between management categories are shown as ranges (e.g., 5%–10%, 20%–25%, 60%–70%) as opposed to sharply defined thresholds, since most regions show a generally continuous but variable gradient of stream degradation as impervious cover increases (**Schueler et al., in review**).

Stormwater and watershed managers should define their own ranges based on actual monitoring data for their region, the stream indicators of greatest concern, and the predominant predevelopment regional land cover (e.g., crops or forest). This model can be used to make initial predictions about stream health based on impervious cover, coupled with supplemental field monitoring to confirm or refine the diagnosis. In addition, impervious cover should not be the sole metric used to predict stream quality, especially at the lower ends of subwatershed impervious cover.

Other watershed metrics—such as watershed forest cover, riparian forest cover, agricultural land, wetlands, road crossings, and impoundments—can strongly influence watershed and stream health. Therefore, it is important to understand the relationship between these factors and stream health, and to develop strategies to manage them (e.g., adopting regulations that require conservation of forest buffers). Nevertheless, impervious cover remains an important watershed metric for stormwater managers to track and manage.

The factors that drive the proliferation of impervious cover within watersheds are often embedded within complex land development codes and standards. These same codes and standards can also influence other land cover metrics that affect watershed health, such as the amount and location of forest cover present in the watershed. Before undertaking a large-scale program review, it is helpful to understand the factors that shape impervious cover and other land cover types in the built environment.

As discussed earlier in this chapter, these factors operate at three different scales: (1) the region, (2) the district or neighborhood, and (3) the site. The actual codes and policies that operate at these three scales are examined in more detail in the following section.

3.6. Step 2: Examine and Evaluate Land Use Codes for Drivers of Excess Impervious Cover and Land Disturbance

As explained at the beginning of this chapter, there are factors at the site, district/neighborhood, and regional scales that are hidden drivers of impervious cover. The next step in the process of linking stormwater to land use planning is to pry into these codes and policies to see if they can be made more consistent with overall stormwater management goals. For instance, if the local zoning code requires wide streets with curbs and gutters, perhaps alternative designs with less pavement and more vegetation should be considered.

Table 3.4 lists the most common local development codes and documents that should be reviewed for consistency with stormwater goals. These documents are also needed to complete the "Codes and Ordinance Worksheet," which is a tool to assist with the systematic review of codes and policies for consistency with Better Site Design model development principles (see **Tool 4**).

Table 3.4. Key Local Documents to Review for Consistency with Stormwater Goals

- Zoning ordinance
- Subdivision codes
- Subarea or district master plans
- Street standards or road design manual
- Parking requirements
- Building and fire regulations/standards
- Stormwater management or drainage criteria
- Buffer or floodplain regulations
- Environmental regulations
- Tree protection or landscaping ordinance
- Erosion and sediment control ordinances
- Public fire defense master plans
- Grading ordinance

The following sections highlight some of the most common local code and policy issues that might conflict with good stormwater management. **Chapter 5** goes into more detail on developing appropriate stormwater codes and how to identify inconsistencies with existing regulations.

Code and Policy Issues That Drive Impervious Cover at the SITE SCALE

Many codes and policies at the site scale can inadvertently increase impervious cover. For example, *setback requirements* can lead to inefficient use of land by spreading development out and creating the need for longer driveways. *Height limits* can spread development out if square footage cannot be met by going up. Site coverage limits can disperse the development footprint and make each parcel farther from its neighbor, leading to more public infrastructure. Many different *parking requirements*, including the following, increase impervious cover:

- ***Parking standards.*** Most land development codes contain detailed specifications on parking requirements that are based on bulletins from the Institute of Transportation Engineers (ITE). The bulletins, which are updated regularly, estimate parking demand for various uses, which are then translated into site plan requirements. These requirements are often listed as minimums. Often the number of spaces is driven by a few high-volume shopping days each year, and the studies used to estimate parking demand are often carried out in areas where the automobile is the only mode of transportation considered. In addition, the extra spaces trigger additional imperviousness in the form of drive aisles, access lanes, and turn lanes from roadways.

- ***Parking requirements for redevelopment.*** Older buildings might have fewer spaces than required in updated parking codes. Redevelopment of an older building often triggers the more recent requirements. Where the older buildings are on small lots, parking minimum requirements can be a barrier to redevelopment.
- ***Financial requirements.*** Developers who seek financing often meet resistance to the idea of supplying fewer spaces from lenders, who equate extra parking spaces with lower financial risk.
- ***District-wide and shared parking.*** Perhaps one of the larger, often unexplored drivers of excess parking is the practice of assessing parking needs one development project at a time. This precludes the ability to arrange efficient parking supply among users.
- ***Use of streets.*** Some localities are discovering on-street spaces as excess capacity for meeting parking needs. The imperviousness is already there, and thus using streets can alleviate the need to construct more parking.

Code and Policy Issues That Drive Impervious Cover at the DISTRICT/NEIHBORHOOD SCALE

At the district or neighborhood scale, impervious cover can be driven by policies such as separated use policies, street design practices, and subdivision design. These drivers are further discussed below:

- ***Separated uses.*** The zoning convention of assembling development projects consisting of a single use (e.g., all housing in subdivisions or all commercial uses in office parks) has been widely studied for impacts on travel, transportation, and congestion. According to the Bureau of Transportation Statistics, Americans average four trips per day, totaling on average 40 miles of travel, mostly in a personal vehicle. These trips, to commute, shop, and recreate, are used as input to models for parking requirements, travel demand, and the like. For stormwater, these separated uses result in an increased need for transportation infrastructure, and its related imperviousness.
- ***Street design.*** In the 1950s and 1960s, roadway design practices began to favor a less networked, "hierarchical" street design. Within housing subdivisions, the individual, smaller streets feed into collector roads, which then lead, often through only one intersection, to arterials. This type of system concentrates traffic onto fewer roads, which increases the pressure to build large public roads or widen existing roads originally planned for rural traffic patterns.
- ***Street and roadway widths.*** Early roadway standards established minimum lane widths for rural highways. Wider lanes were needed to provide the sight clearance and maneuvering space needed for higher speeds. Over time, these widths were integrated into local street standards.

  Roadway imperviousness is not limited to lane widths. The size of turning and queuing lanes is also governed by standard formulas. The wider street standards brought with them higher design speeds. These speeds, in turn, dictate the size of intersections and curb radii, which are referred to as "intersection geometry" in transportation handbooks. For a full discussion of street geometry and its relationship to site development, see ***http://safety.fhwa.dot.gov/ped_bike/univcourse/swless06.htm***.
- ***Subdivision design.*** Residential subdivision codes are the primary example of a district code. Subdivision codes (which are typically supported by enabling legislation at the state level) include requirements for roadways, drainage, open space, building alignments, lot sizes, and many other features.

  Planners have been working on improvements to subdivision codes to eliminate some of the commonly noted drawbacks, such as excessive site clearance and the lack of mixed use. Planned unit developments (PUDs) often add a mixed-use component to subdivisions, while conservation subdivisions strive to lessen environmental impacts by clustering home sites and preserving open space within residential areas. Nevertheless, conventional subdivision design still dominates site planning and residential construction. A 2004 study on subdivisions found street, driveway, and site imperviousness composed up to 50% of the total development site (**Local Government Commission, 2004**).

Code and Policy Issues That Drive Impervious Cover at the REGIONAL SCALE

Impervious cover drivers at the regional scale can include lack of coordination between units of government, state standards, and transportation requirements at the state/federal level. These drivers are further discussed below:

- ***Lack of regional governance structures.*** Jurisdictional boundaries often have the effect of spurring competition, not cooperation. This competition for tax base often leads to dispersed growth. With stormwater, the permitted agency is in many cases a relatively small unit of government, such as a township or village. Decision-making at this level is rarely coordinated at the watershed scale.
- ***Codes and standards at the state level.*** States often set requirements that result in a larger development footprint. For example, school siting standards often require at least 20, 50, or even 100 acres for new schools. School districts often find that the only parcels of this size are in undeveloped areas. School construction then generates new development interest in the surrounding area.
- ***Split responsibility for transportation.*** States are usually responsible for Interstates, state highways, and sometimes local roads. Localities might be responsible for local roads and district/neighborhood streets. Often, it is difficult to coordinate transportation and land use planning among the different agencies. Decisions to expand or improve transportation systems at the state level can run counter to local land use priorities.

3.7. Step 3: Develop Relationships Between Stormwater Managers, Land Use Planners, and Other Officials

If land use is to effectively become the "first BMP" for a stormwater program, it is imperative that stormwater managers form closer working relationships with

- Land use planners
- Transportation planners
- School officials
- Parks and recreation staff
- Public facility engineers
- Emergency management officials
- Other local officials

In many jurisdictions, the stormwater managers might have limited interaction with other municipal staff who have an impact on the stormwater program. The stormwater manager is likely housed within a public works or engineering department. If he or she is engaged in site plan review, the main focus is at the site scale. The stormwater manager might also work on capital projects involving drainage or other infrastructure.

Meanwhile, land use planners are customarily located in planning and community development departments. They engage most closely with zoning issues, such as setbacks and parking requirements, and they are also responsible for developing and revising the community's land use and comprehensive plans. They might also be involved in community-wide issues like economic development, housing, and transportation.

A more effective approach would promote integration across departments and professions, with the comprehensive plan being one of the primary mechanisms for working together. This integration would encourage more involvement on stormwater issues early in the planning process. For example, stormwater managers could be involved in the following areas:

- ***Land use.*** Stormwater managers might be called upon to estimate the stormwater and flooding impacts of growth alternatives, to point out opportunities to use low-impact and redevelopment alternatives, and to offer suggestions on which areas of land might be best suited for handling stormwater. In rural and suburbanizing areas, stormwater managers might be asked to assess various build-out scenarios for future growth and watershed management.

- ***Redevelopment.*** Because redevelopment is commonly more complex than new development, many comprehensive plans attempt to reduce barriers to redevelopment such as the limited space for stormwater BMPs at many urban redevelopment sites. Stormwater departments might be asked to design district-wide or shared facilities and/or tailored site-level BMPs suited to ultra-urban settings.
- ***Transportation.*** Transportation plans can be coordinated with stormwater by considering linear transportation projects within the context of watersheds and surrounding development. Sometimes, stormwater strategies can serve both transportation and development needs, and transportation projects might also be able to provide land or mitigation funds for protected or restored natural resources areas. Stormwater managers might also want to engage transportation engineers on innovative stormwater techniques that can be incorporated into the road section or right-of-way.
- ***Economic development.*** The funding of stormwater and flood control projects might provide a strong economic incentive for development and redevelopment decisions. Stormwater managers might be asked to work with economic development staff to see where improvements meet water and business development needs.
- ***Parks and open space.*** Stormwater managers might be asked to identify parcels with high value for stormwater management. In urban areas, these parcels might need to serve several purposes, so stormwater programs could be called upon to work with parks, recreation, habitat, or water supply organizations.

Table 3.5 describes several mechanisms to build better relationships between stormwater managers, land use planners, and other local officials.

Table 3.5. Tips for Building Relationships Between Stormwater Managers, Land Use Planners, and Other Local Officials

Include both land use planners and stormwater managers in pre-concept and/or pre-application meetings for potential development projects.
Use local government sites (e.g., schools, regional parks, office buildings, public works yards) as demonstration sites for innovative stormwater management. Form a team that includes land use planners, stormwater managers, parks and school officials, and others to work out the details.
Include stormwater managers in the comprehensive plan process so that overall watershed and stormwater goals can be incorporated.
Make sure that both land use planners and stormwater managers are involved in utility and transportation master planning.
Involve stormwater managers in economic development planning, especially for enterprise zones, Main Street projects, and other projects that involve infill and redevelopment. Encourage stormwater managers to develop efficient watershed-based solutions for these plans.
Develop cross-training and joint activities that allow land use planners, stormwater managers, and transportation, utility, and capital project planners to explore how various land use/stormwater processes can be better integrated.
For staff training, bring in speakers who are knowledgeable about stormwater management. Alternatively, encourage land use planners, stormwater managers, and other local officials to attend training on this topic as a team.

3.8. Step 4: Use Watersheds as Organizing Units for the Linked Stormwater/Land Use Program

Another critical tool for linking stormwater with land use is to consider land use policies in a watershed context. Each watershed is unique and has its own challenges, including:

- Important local resources, such as drinking water supplies, recreational uses, and sensitive features, such as wetlands, cold-water fisheries, and coastal bays
- Waterbodies listed as “impaired” on state Total Maximum Daily Load (TMDL) lists
- Streams and waterbodies that are currently healthy; future actions should ensure that they stay that way.
- Streams and waterbodies that are currently degraded, characterized by channel erosion and/or flooding, and/or have existing water quality problems; future actions should aim to restore watershed functions where feasible
- Watersheds that lie completely within a single jurisdiction versus those that cross one or more jurisdictional boundaries

There is no one-size-fits-all approach for integrating stormwater, land use, and watersheds. **Table 3.6** outlines various regulatory, site design, and policy strategies that can help with this integration.

Tables 3.7 and **3.8** synthesize the strategies presented in **Table 3.6** into a management framework and present a menu of options to consider. These tables list recommended strategies based on both watershed (**Table 3.7**) and land use (**Table 3.8**) characteristics. The tables also list other approaches that should be scrutinized because they might run counter to overall stormwater and land use goals.

Table 3.6. Regulatory and Site Design/Policy Strategies to Integrate Stormwater, Land Use, and Watersheds

Regulatory Tools
Overlay zoning. Overlay zoning is a technique to “overlay” more protective standards over land with existing zoning. This procedure can be helpful to stormwater managers who need special protection in a discrete area within the watershed. Examples are drinking water supply watersheds, wellhead protection areas, areas subject to flooding, and watersheds for critical resources, such as wetlands and special recreational areas. The overlay zone typically designates allowable land uses and performance standards (see below).
Special use permits. In zoning codes, there are often two lists—allowable uses and uses allowed by special use permit. Stormwater managers might want to explore the use of special use permits to apply BMPs for certain uses (e.g., stormwater hotspots, direct discharges to wetlands).
Performance standards. Performance standards are usually associated with particular land use categories, and they can also be tied to special use permits, overlay zoning, and/or rezoning applications. Examples of performance standards are minimizing clearing and grading, minimizing creation of new impervious surfaces, tree preservation or canopy targets, protection of riparian buffers, and septic system location and design.
Special stormwater criteria. Special stormwater criteria would likely reside in the stormwater ordinance and/or design manual. These are criteria that are specifically tailored to discharges to sensitive receiving waters. Examples would be temperature control for trout streams, more aggressive nutrient management for drinking water supplies and wetlands, groundwater protection criteria for wellhead protection areas, special detention criteria for flood-prone areas, and pollution prevention measures for stormwater hotspots. (See **Chapter 4** for more detail on special stormwater criteria.)
Site Design and Policy Tools
Compact development. Compact development seeks to meet a certain level of development intensity on a small footprint. Communities might be seeking this type of design to support walkability, transit station access, reduced infrastructure costs, or for water resource protection. Compact designs can be used in any development setting from ultra-urban retrofits to rural village centers.

Table 3.6. Regulatory and Site Design/Policy Strategies to Integrate Stormwater, Land Use, and Watersheds *(continued)*

Site Design and Policy Tools
Street design. Many state departments of transportation are issuing "context-sensitive" alternatives for street design. These designs include narrow streets and consider multiple transportation modes. For transportation planners, the narrow streets are aimed at slower speeds and neighborhood design models. Stormwater managers thus have overlapping interests in better street design.
Utility planning. The rational and planned expansion of public water, sewer, and other utilities is critical for both land use planning and stormwater management. Utility extensions will likely encourage future growth at higher densities. Utility extensions should be planned for areas designated for infill, redevelopment, and future growth. On the other hand, utility restrictions should be considered for sensitive watersheds.
Mixed-use development. Highly separated uses (e.g., retail, schools, housing, jobs) are implicated in highly dispersed development. A high degree of automobile-supporting infrastructure, which can be over 50% of development-related imperviousness, is "built in" because walking and other modes of travel cannot be effectively supported. Bringing the uses closer together can lower the number and length of auto trips or support trip substitution. Less roadway and parking can translate into a lowered overall development footprint.
Infill. Communities are increasingly interested in targeting development to areas where the surrounding land is already developed and served by public utilities. An example is developing housing surrounding a mall or office park. This "infilling" can satisfy a high degree of development demand in an efficient manner.
Redevelopment. One of the strongest watershed strategies is reusing (and improving) vacant or underused sites that are already under impervious cover. This is not only an urban strategy, but can work for abandoned sites in rural areas as well. Programs such as downtown revitalization, Main Street programs, and brownfield redevelopment programs support these efforts.
Conservation development. Conservation development is a strategy that can work in various development contexts (e.g., urban, suburban) to coordinate and conserve open space. For stormwater, a particular emphasis may be placed on riparian buffers, forest protection, and open-space areas that capture and disperse runoff.
Purchase and transfer of development rights (PDR, TDR). PDR programs purchase development rights from landowners and are particularly targeted to areas or watersheds where rural character and natural resources should be protected. TDR programs set up development rights markets whereby some landowners (in rural or sensitive watersheds) can sell their development rights to landowners in areas where growth, infill, and redevelopment are encouraged.
Fee-in-lieu programs for stormwater. In certain areas, stormwater management goals cannot be met solely with on-site stormwater BMPs. Watershed-based approaches are needed to address issues that extend beyond the site boundary. Examples would be areas with existing flooding or drainage problems, impaired watersheds, and watersheds with streambank erosion problems. In these cases, a fee-in-lieu payment or offset fee can be collected from developers to partially offset full on-site compliance. The local stormwater program then uses the accumulated fees to conduct needed watershed repairs and improvements. (See **Chapter 4** for more information on watershed-based stormwater management approaches and criteria.)

Table 3.7. **Integrated Stormwater and Land Use Strategies Based on *Watershed Characteristics***

Watershed Characteristics	Integrated Strategies to Consider[a]	Approaches That May NOT Be Appropriate
Special receiving waters: drinking water, trout streams, wetlands, etc.	▶ Overlay zoning and performance standards ▶ Conservation development ▶ Special stormwater criteria ▶ Low-impact development ▶ Purchase of Development Rights (PDR) ▶ "Sending" area for Transfer of Development Rights (TDR)	▶ Large-lot zoning (disperses and spreads out development impacts) ▶ Relying solely on stormwater ponds and basins ▶ Urban road sections ▶ Utility and transportation expansions
Existing flooding problems	▶ Overlay zoning and performance standards ▶ Special stormwater criteria ▶ Low-impact development ▶ Street design ▶ Fee-in-lieu program	▶ Relying solely on site-by-site stormwater approaches that are not coordinated at watershed scale ▶ Wide roads, urban road sections
Impaired streams (303(d) listed) or other water quality problems	▶ Special stormwater criteria ▶ Special use permits for certain uses (e.g., hotspots) ▶ Performance standards ▶ Low-impact development ▶ Conservation development	▶ Relying solely on stormwater ponds and basins ▶ Urban road sections

[a] See **Table 3.6** for brief descriptions of the various strategies.

Table 3.8. **Integrated Stormwater and Land Use Strategies Based on *Land Use Characteristics***

Land Use Characteristics	Integrated Strategies to Consider[a]	Approaches That May NOT Be Appropriate
***Urban core*: incentive/ enterprise zones, redevelopment zones, town centers, brownfields**	▶ Waivers and variances ▶ Fee-in-lieu program for watershed projects ▶ Compact and mixed-use development ▶ Infill and redevelopment incentives ▶ Low-impact development ▶ "Receiving" area for Transfer of Development Rights (TDR)	▶ Impervious cover limits ▶ Aggressive open space requirements ▶ Large-lot zoning ▶ Ambitious on-site infiltration requirements
***Urbanizing*: designated for future growth, planned utility and/ or transportation expansions**	▶ Fee-in-lieu program for watershed projects ▶ Compact and mixed-use development ▶ Conservation development ▶ Low-impact development ▶ Street design, Green Streets ▶ Good stream buffering ▶ Performance standards ▶ "Receiving" area for TDR	▶ Large-lot zoning ▶ Conventional development standards that disperse the development footprint
***Rural*: desire to maintain rural character and working farms, special or unique natural resources**	▶ Conservation development ▶ Aggressive stream buffering ▶ Performance standards ▶ Special stormwater criteria ▶ Low-impact development ▶ "Sending" areas for TDR	▶ Use of waivers and variances ▶ Urban road sections ▶ Utility and transportation expansions ▶ Conventional development standards

[a] See **Table 3.6** for brief descriptions of the various strategies.

3.9 Considering Climate Change in the Stormwater and Land Use Program

Many of the assumptions that stormwater managers use for runoff and storm system design might become outdated if climate change predictions become a reality (**Funkhouser, 2007; Oberts, 2007**). For example, such stormwater mainstays as the "design storm" will need to be scrutinized to ensure that future stormwater designs are responsive to changing climate conditions.

Integrated stormwater and land use solutions have an important role to play in this challenging task. It is safe to assume that we cannot rely solely on "hard" or technological solutions to deal with such climate change scenarios as more frequent flooding and more prolonged droughts. Solutions more rooted in land use planning will have to play a role. These will include improved floodplain management, urban stormwater forestry, and strategies to promote more efficient development layouts—to promote greater efficiency in stormwater management, water conservation, *and* energy consumption.

EPA's climate change Web site (***http://www.epa.gov/climatechange***) includes comprehensive information on the many different issues affecting climate change. EPA's National Water Program is developing a strategy on climate change that describes how best to meet clean water and safe drinking water goals in the context of a changing climate (***http://www.epa.gov/water/climatechange***).

Stormwater managers and land use planners can work together on important adaptations to climate change. Some of these adaptations will need to respond to changing hydrologic realities (hydrologic adaptations); others will have to be coordinated with broader policy initiatives to respond to climate change (policy adaptations). **Table 3.9** provides several conceptual ideas for how integrated stormwater and land use tools can help adapt to both the natural resources and policy outcomes of climate change.

3.10. Relating Stormwater and Land Use to This Guidance Manual

Certainly, there are challenges to integrating stormwater and land use planning. They include coordination across multiple departments, coordination among multiple permitted agencies and jurisdictions, and political forces that compel land use decisions away from a watershed approach. However, the value of managing the landscape by linking land use practices to water quality protection is that long-term solutions that reduce stormwater impacts throughout the region are created.

As local stormwater managers endeavor to build programs that are responsive to local conditions, state permit requirements, and existing practices, they should keep land use in mind as the "first BMP." Perhaps the simplest step is to forge stronger working relationships with land use planners and other local officials. This chapter can be a discussion starter for stormwater managers and land use planners as they begin important deliberations on how integration can and should take place at the local level.

Table 3.9. Climate Change and Conceptual Land Use/Stormwater Adaptations

Hydrologic Adaptations	
More frequent flooding	► Remap floodplains based on "new" frequent and infrequent events. ► Adopt stringent regulations to restrict development within floodplains. ► Develop mitigation programs to remove susceptible structures from floodplains. ► Conduct more frequent cleaning of storm sewer infrastructure in urban areas to maintain hydraulic capacity. ► Ensure that all new development has overland relief in case of system failure. ► Model storm sewer infrastructure using new climate scenarios and coordinate with emergency response plans.
More prolonged droughts	► Extend rainwater harvesting beyond individual rooftop scale to neighborhood/ community scale. Use stormwater as a resource. ► Develop drought-resistant planting plans for BMPs and municipal landscaping. ► Promote urban forestry and forest protection to promote shade and retention of moisture. ► Incorporate groundwater recharge into all BMPs where safe and feasible.
Increased temperature of runoff	► Include trees and other plantings in BMP designs. ► Develop methods to reduce "straight-piping" of runoff to streams; use disconnection methods to direct runoff to buffers, planted areas, pervious parking, forested BMPs, etc. ► Develop impervious limits and minimum tree canopy requirements for special temperature-sensitive receiving waters (e.g., high-value trout streams).
More combined sewer overflows	► Incorporate volume-reduction measures across landscape: individual homes, streets, businesses, etc. These can include rain gardens, rainwater harvesting, dry wells, etc. ► Strategically locate and use open-space areas for runoff capture to reduce flows into system.
Policy Adaptations	
Reduce carbon emissions	► Promote compact development and reduce vehicle trips/miles. ► Provide stormwater incentives for redevelopment close to urban centers and more stringent requirements for new (greenfields) development that requires more driving. ► Provide stormwater credits for transit and bicycle facilities at development sites. ► Consider the embodied energy of BMP materials and installation (e.g., plastic/wood components, land cleared for BMPs) as a BMP selection criterion.
Increase carbon sequestration	► Use urban forestry as a stormwater BMP. ► Incorporate trees into all or most new BMPs. ► Design integrated stormwater/carbon sequestration facilities; incorporate planting maintenance plans that maximize carbon uptake.
Increase clean, renewable energy sources	► Incorporate small-scale power generation into some BMP and storm sewer designs that have adequate head. ► Colocate neighborhood-scale stormwater BMPs with solar, wind, and other renewable-energy facilities.