The Role of EPA Region 10 in Smart Growth and Low Impact Development Planning and Implementation in the Puget Sound Region

By

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ABBREVIATIONS AND ACRONYMS

CCCD	Clallam County Conservation District
CWA	Clean Water Act
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EPA-R10	U.S. Environmental Protection Agency Region 10
ESA	Endangered Species Act
GMA	Growth Management Act
KCHBF	Kitsap County Home Builders Foundation
LID	Low Impact Development
NEMO	Nonpoint Education for Municipal Officials
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
PSAT	Puget Sound Action Team
RGI	Regional Geographic Initiative
SEA	Street Edge Alternatives
TMDL	Total Maximum Daily Load
WA OFM	Washington State Office of Financial Management

EXECUTIVE SUMMARY

This project examines current planning and implementation barriers to Smart Growth and low impact development (LID) in the Puget Sound Region. It is intended to inform Region 10 of the U.S. Environmental Protection Agency (EPA-R10) so it may address its current role in regional Smart Growth and LID efforts, with the goal to reduce the negative impacts of stormwater runoff to the health of Puget Sound.

Smart Growth and LID are emerging development practices that intend to improve water quality through the reduction of impervious surfaces, and thus stormwater runoff to local receiving waters. These development methods have implications for several key aspects of land-use planning in the Puget Sound region, including:

- Planning at a watershed scale,
- Multi-jurisdictional coordination, and
- Educational and outreach efforts.

In an effort to improve the role of EPA-R10 in local stormwater management, as well as realize the potential opportunities in the aforementioned aspects of land-use planning, specific barriers to Smart Growth and LID implementation in the Puget Sound region are identified and addressed. The most common barriers, indicated through a series of qualitative interviews with individuals involved in local and regional land-use planning, include political feasibility, financial, regulatory and technical issues, and a general lack of knowledge about watershed process and Smart Growth and LID concepts. In regards to the most pressing community concerns and needs for successful Smart Growth and LID planning, EPA-R10 should:

- Encourage watershed-scale planning versus planning within jurisdictional boundaries.
- Provide cross-jurisdictional assistance for watershed planning and stormwater management, and encourage county-city coordinated stormwater plans.
- Assist with integrating federal, state, and local stormwater policies and programs.
- Increase outreach efforts and package Smart Growth and LID to varying audiences: engineers, planners, developers, government officials, financial institutions, property owners, and the general public.
- Create a regional Smart Growth network.
- Monitor and collect data from existing projects to show proof-of-concept.
- While out of the scope of this project, EPA-R10 should determine specific programs and/or incentive mechanisms within its capacity that will best address the issues raised in this paper.

1.0 INTRODUCTION

1.1 Project Overview

The purpose of this project is to address ways in which Region 10 of the U.S. Environmental Protection Agency (EPA-R10) can encourage local and regional stormwater management strategies, specifically Smart Growth and low impact development (LID) practices, to reduce the negative impacts of stormwater runoff to the health of Puget Sound. However, before addressing specific ways in which EPA-R10 can be involved in Smart Growth and LID, regional opportunities and barriers to these kinds of planning must be recognized. This paper therefore aims to inform EPA-R10 about potential opportunities and challenges to innovative watershed planning, and provide a starting point from which to continue or adjust its current methods and levels of involvement in Smart Growth and LID planning and implementation in the Puget Sound region. This project examines current examples of Smart Growth and LID in the Puget Sound region, and elsewhere in the United States, to gain insight into what is needed in Puget Sound communities to facilitate planning and implementation of these emerging development practices.

An introduction to Puget Sound's stormwater issues and the concepts of Smart Growth and LID is given in the following sections of Chapter 1. Chapter 2 provides the regulatory context and discusses the need for stormwater planning and management at a watershed scale in the Puget Sound region. Chapter 3 and 4 explain and provide examples of Smart Growth and LID, and the current role of EPA in each, respectively. Chapter 5 discusses the regional implications for watershed-scale planning, multi-jurisdictional cooperation, and education and outreach through Smart Growth and LID planning efforts. Chapter 6 addresses potential barriers to Smart Growth and LID planning and implementation in the Puget Sound region, as discovered through qualitative interviews with those involved in local land-use planning. Finally, Chapter 7 presents recommendations for potential action steps to address the planning barriers discussed in Chapter 6, as well as recommendations for the role of EPA-R10 in regional land-use planning endeavors.

1.2 Background

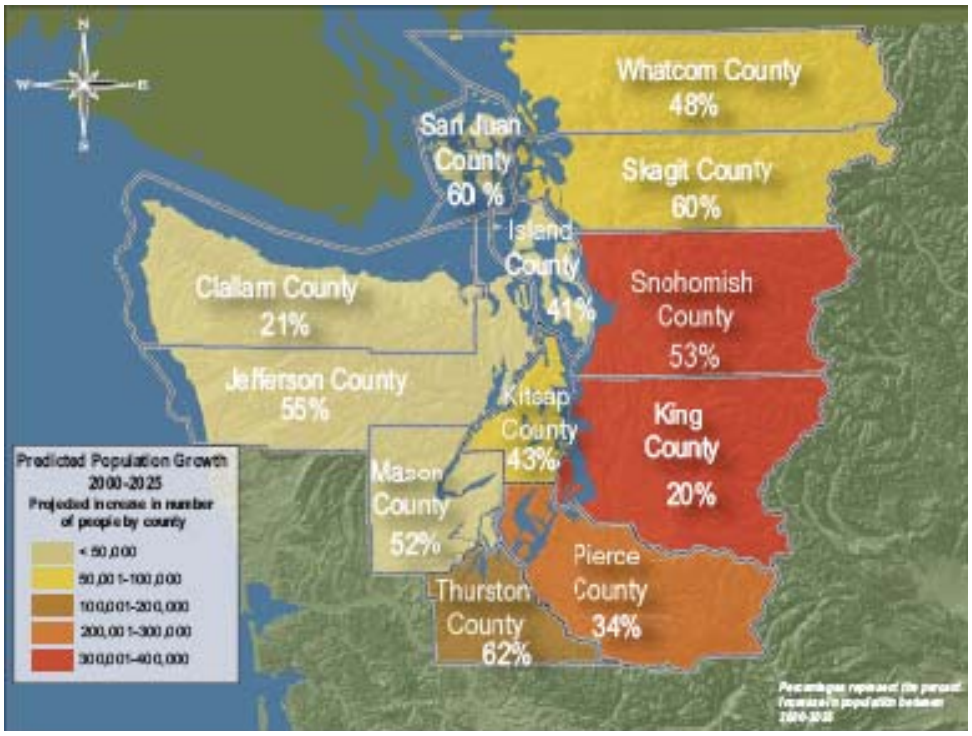
Puget Sound is a glacially-derived estuary in western Washington State. Over 10,000 streams and rivers drain into the Puget Sound basin. As defined for water quality planning purposes, the Puget Sound region includes the waters south of Admiralty Inlet, and the land of 12 counties, over 100 cities, and 17 tribes (Puget Sound Action Team, (PSAT), online).

Puget Sound supports a wide range of diverse natural systems and species. However, populations of species such as orca whales, salmon, and marine birds, are declining. PSAT describes the key components to a healthy Puget Sound ecosystem as being clean water, a connected habitat, and a robust food web (*2005-2007 Puget Sound Conservation and Recovery Plan*). All of these features are in peril due to increased development and pollution in the Puget Sound Region.

The Puget Sound region is the fastest growing region in Washington State. The total state population is projected to increase from roughly 6 million to 16 million people by the year 2025. Roughly one-third of this growth will be in Puget Sound counties[1] (Washington State Office of Financial Management (WA OFM)). Counties of the Puget Sound region and their projected population growth are illustrated in Figure 1.

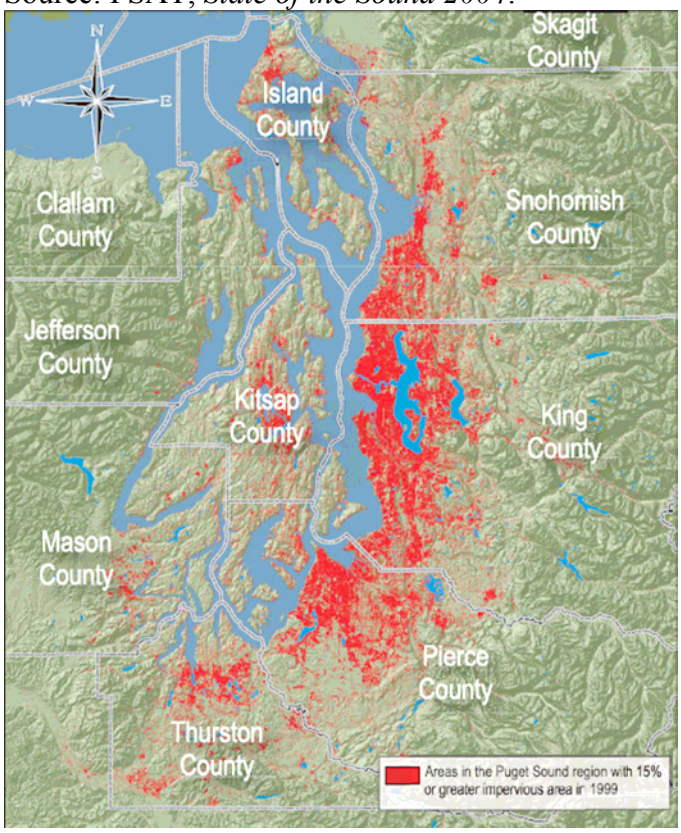
[1] Six of the twelve counties in the Puget Sound region, Clallam, Jefferson, Mason, San Juan, Skagit, and Whatcom counties, have current population densities of less than 100 people per square mile (WA OFM).

Figure 1. Predicted Population Growth in Puget Sound Counties. Percentages represent the percent increase in population between 2000 and 2025. Source: PSAT, *State of the Sound 2004*.



Population increases result in heightened development pressures. Conventional development patterns and practices typically lead to a decrease in forested land and open space, as well as increased impervious surface area. Impervious surface area increases the amount of stormwater runoff, carrying sediment and nonpoint source pollutants into local streams, rivers, lakes, and bays. Stormwater management is an important issue in the Puget Sound region. The Washington State Department of Ecology (Ecology) estimates that stormwater runoff is the leading cause of pollution in the state's waters that fail to meet water quality standards (PSAT, *State of the Sound 2004*, 23). As cities and suburbs expand, the amount of impervious land cover increases (Figure 2). Between 1991 and 1999, roughly six-percent of the land in the Puget Sound region was highly developed with more than 75-percent impervious surface area (PSAT, *State of the Sound 2004*, 24). Development pressures continue to climb with current and projected increases in population, which will likely result in more impervious surface area and negative impacts to water quality due to the associated excess stormwater runoff.

Figure 2. Impervious Surface Area in the Puget Sound Region (1999).
Source: PSAT, *State of the Sound 2004*.



In addition to water quality, stormwater negatively impacts natural habitat. Increased stream flow from stormwater erodes and undercuts stream channels, deposits higher sediment loads, and results in degraded or depleted fish and wildlife habitat.[2]

As population and development pressures increase, local governments are challenged to efficiently and effectively manage stormwater and its negative environmental effects, and meet state and federal stormwater mandates. Federal and state agencies are currently working with local governments to address stormwater issues. EPA-R10 has identified Puget Sound as one of its top seven priorities, and is in the process of creating a comprehensive stormwater strategy for Puget Sound, in support of the stormwater priority of the Puget Sound Action Team's (PSAT) 2005-2007 Puget Sound Conservation and Recovery Plan.

[2] Aquatic habitats are harmed at 10 to 25 percent impervious surface area, usually associated with moderate development levels (PSAT, *State of the Sound 2004*, 24).

"Smart Growth" and low impact development (LID) are two emerging development strategies being increasingly planned and implemented to address stormwater issues. Smart Growth, as defined by the U.S. Environmental Protection Agency, is development patterns that aim to produce improved community, health, economic, and environmental results (Smart Growth 2004). For instance, Smart Growth practices include more compact growth patterns and preservation of open space, intended to reduce the negative impacts to water quality from stormwater runoff. LID includes development techniques that attempt to mimic the drainage patterns that were present before development by encouraging runoff infiltration, storage, filtering, evaporation, and detention, and include buffers around water bodies, protection for native soil and vegetation, and reduced impervious surface area. Neither approach alone can protect Puget Sound's water resources. Thoughtful local land-use planning will determine where and how to develop to best protect and manage natural resources. Development techniques such as LID can then be implemented in sub-basin development activities to reduce the site-specific impact of excess stormwater runoff to the health of Puget Sound.

1.3 Research Methods

Two main research methods were utilized in order to understand the current state of Smart Growth and LID, and the potential for EPA involvement and assistance in local watershed and land-use planning efforts. A literature review and series of qualitative, semi-structured interviews were used to understand the background of Smart Growth and LID, opportunities and challenges to innovative stormwater management strategies, EPA assistance in local planning, as well as gain insight to how EPA can better support such planning endeavors.

Literature Review

The purpose of the literature review was to investigate the history and context of Smart Growth and LID, including best practices, and past and current research regarding innovative land-use approaches. The literature review was also used to explore the

intergovernmental relationships involved in environmental and land-use regulations, and local land-use decisions and planning.

Semi-Structured Interviews

The purpose of the qualitative, semi-structured interviews was to gain insight into current projects involving Smart Growth and/or LID, including an Alternative Futures project in Kitsap County, and LID efforts in Kitsap, Whatcom, and Clallam counties. Interviews informed about potential barriers to Smart Growth and LID planning, the pros and cons of current EPA assistance in local planning, and the potential for applicability in other Puget Sound communities. Interview participants are individuals who are or have the potential to be involved in local watershed and land-use planning efforts in the Puget Sound region or elsewhere, including member(s) of local, state, and federal agencies and the development community (Appendix A: Interview Participants). Interview questions pertained to the background, process, and outcomes of any current watershed or land-use planning projects, the community-specific planning context, as well as the specific circumstances, including use of Smart Growth and/or LID approaches and use of or potential for EPA assistance, unique to each project and/or community.

The literature review and interview responses were used to determine and evaluate the most pressing opportunities and challenges to general and community-specific watershed and land-use planning, Smart Growth and LID planning and implementation, and the role of EPA in these efforts.

1.4 Research Limitations

There are limitations to the research, involving sample size and selection of the jurisdictions in which to conduct qualitative, semi-structured interviews. Research was primarily focused at a county-scale. Three of twelve counties in the Puget Sound region were investigated through the interview process. Ten of the thirteen interview participants are involved in Smart Growth and/or LID efforts in the Puget Sound region. At the request of the client, EPA-R10, initial interviews focused on a limited number of locations, in consideration of time and potential depth of information gathered, in

counties with past or current stormwater or watershed-scale management projects involving Smart Growth and/or LID efforts. EPA-R10 has been or is currently involved with these local jurisdictions, specifically Kitsap and Whatcom counties, in technical assistance, outreach efforts, or project funding capacities regarding their planning efforts. Pertaining to the question of how EPA-R10 can encourage Smart Growth and LID practices, the focus on these jurisdictions may not give an accurate, representative assessment of the typical resources for innovative watershed and stormwater management practices, of jurisdictions elsewhere in the Puget Sound region. Clallam County was included in the interview process, at the discretion of the author, as they are involved in EPA funded projects, though are earlier in the process of initial watershed management and LID education and planning. Throughout the following paper, including findings and recommendations, it is important to recognize local, county, and regional differences in geologic and hydrologic conditions, political feasibility, technical expertise, human and financial resources, and pre-existing knowledge of environmental conditions and regulations that may or may not facilitate innovative watershed and land-use planning in the Puget Sound region.

2.0 PUGET SOUND REGULATORY CONTEXT AND THE NEED FOR WATERSHED-SCALE PLANNING

This chapter gives a brief overview of the federal and state stormwater-related regulations relevant in the Puget Sound region, as well as discusses some opportunities of planning at a watershed scale.

2.1 Stormwater-related Regulatory Context

In 1987, Congress amended the Clean Water Act (CWA) to include stormwater regulations. The amended act includes National Pollution Discharge Elimination System (NPDES) permit requirements for stormwater discharges to surface waters. Phase I of EPA's implementation of the revised rule regulates stormwater discharges from construction sites over 5 acres, and cities and counties with populations greater than 100,000 people. Phase II NPDES rules regulate discharges from construction sites between 1 and 5 acres, and all municipally-owned storm sewer systems in urban areas. Phase I and II regulations require jurisdictions with storm sewer systems to develop and implement a stormwater management program to protect water quality by reducing the discharge of pollutants carried by stormwater runoff. EPA requires the inclusion of specific measures in Phase II stormwater programs, including public education, outreach, and involvement, runoff control from construction and post-construction sites, and overall pollution prevention (Ecology, *Stormwater Management Manual for Western Washington, Vol. II*). Most states, including Washington State, are charged with assisting regulated communities with developing and implementing stormwater management plans.

The federal National Estuary Program (NEP) was also established through the 1987 CWA revisions. The purpose of the NEP is to improve the water quality in the nation's estuaries by protecting water supplies and aquatic resources, and reducing point and nonpoint source pollution to the estuary. Washington State, through PSAT, participates in the NEP and has developed an estuary management plan for Puget Sound. Also under CWA, states are required to identify and address sources of pollution to local receiving waters. This is done through Total Maximum Daily Load (TMDL) regulations, which

limit pollutant loads while allowing state water quality standards to be achieved. Also on the federal level, the Endangered Species Act (ESA) water quality and habitat specifications must also be considered in stormwater management.

Washington State initiatives, such as the Puget Sound Water Quality Protection Act, Shoreline Management Act, Growth Management Act (GMA), Watershed Planning Act, and the Salmon Recovery Act and Enhancement Plan, also have stormwater management implications. Counties and cities may choose, or may be required as with the GMA, to participate in such plans, and are subject to the goals and planning requirements under each program.

2.2 The Need for Watershed-scale Planning

Conventional low-density development typically limits development to 1 housing unit to between 1 and 5 acres of land. This practice has been thought to protect water quality, as impervious surface area on the development site is low. However, this does not always protect water quality at the watershed scale. Low-density development at the site level will also require development for infrastructure and amenities, such as roads, water and sewer lines. The natural land remaining in a low-density development area is often converted to roads, shopping centers, and other uses. The need for transportation infrastructure is especially increased if the low-density development area is dependent on automobile use. This not only affects water quality through impervious surface and increased pollutants, but air quality is impacted through vehicle emissions (EPA, *Protecting Water Resources with Smart Growth*). Water quality planning therefore, needs to be done at a watershed scale to accurately reflect the cumulative impacts of conventional development patterns.

Impervious surfaces, land cover, hydrology, and biological health are interconnected. Watershed assessment and landscape analysis investigates and documents the quantity, quality, and spatial extent of existing watershed processes and natural resources. Watershed-specific conditions and characteristics can then be accounted for and considered in land-use and stormwater planning. It is important for innovative land-use

and stormwater planning to be implemented in less urbanized, or developing, watersheds with high water-quality and integral habitat, where these essential features can still be protected. Landscape analysis tools are available to assist land-use managers and policy makers in designing specific development types and scenarios, and designating appropriate densities based on the projected cumulative impacts of different land-use patterns.

The complex and interrelated regulations in place regarding stormwater, water quality, and habitat protection indicate the also complex web of potential agency interaction. This, as well as the fact that watersheds and associated environmental issues often cross jurisdictional boundaries, highlights the need for multi- and intra-agency coordination, to most efficiently and effectively plan for stormwater management. The implications of Smart Growth and LID for watershed-scale planning and multi-jurisdiction coordination in the Puget Sound region will be discussed further in Chapter 5.

3.0 SMART GROWTH

This chapter provides a brief introduction to Smart Growth principles and use in terms of reducing the negative impacts associated with urban sprawl. This chapter also includes examples of Smart Growth activities, and a discussion of the current role of EPA in the promotion of this development strategy.

3.1 Smart Growth Context

"Smart Growth," as defined by EPA, includes development patterns that aim to produce improved community, health, economic, and environmental results (Smart Growth 2004). Smart Growth principles attempt to deal with the negative effects of urban sprawl by addressing issues such as traffic, access to public transportation, access to green space, and environmental problems. Smart Growth also addresses livability issues of cities, such as access to amenities and availability of pedestrian-friendly features. In regards to water quality, Smart Growth includes higher density growth patterns and preservation of open space, intended to reduce and limit the extent of impervious surface area, and the negative impacts to water quality from stormwater runoff. However, Smart Growth is not promoted solely through potential stormwater runoff reduction and improvements in water quality.

The impacts associated with urban sprawl are seen from many perspectives. There are economic effects, as sprawl moves people out of central cities to outlying suburbs with less access to amenities, as well as increased infrastructure needs and costs. Transportation issues arise as people have further to drive from their residences to the downtown corridors. Also, public transportation is lacking outside of urban centers, forcing people to drive more frequently. This coupled with increased impervious surface area from spread-out development and more connecting highways and roads, causes negative impacts to air and water quality.

As the problems of urban sprawl include multiple perspectives, so too must the solutions. Smart Growth is inclusive of the many perspectives of sprawl, addressing economic, transportation, and environmental issues. This multidisciplinary approach is necessary to

address all aspects of sprawl and to attract a wide variety of interests, all while providing solutions to commonly shared growth and development issues.

Smart Growth and Water Quality

Conventional development and land-use change impacts water resources. Development replaces natural land cover, such as forests and wetlands with impervious surfaces such as highways, roads, rooftops, and compacted grasslands, disrupting the natural hydrologic cycle. Increased impervious surface area leads to increased stormwater runoff, carrying nutrients, sediment, and pollutants in to local water bodies. Drinking water can also be adversely affected by poorly-managed growth patterns. Impervious surfaces decrease infiltration and recharge of groundwater systems, reducing the amount available for human use. Low-density growth also requires more infrastructure components such as roads, and water and sewer lines. Development activities are associated with increased pollutant loads such as metals, fertilizers, pesticides, household chemicals, and oil and gasoline. While Smart Growth has implications for enhancing the livability of cities at many levels, it is a key tool for improving water quality in developed and developing areas.

3.2 Current Smart Growth Activities

In 1990, the Washington State legislature passed the Growth Management Act (GMA), requiring local governments to adopt growth management plans to guide systematic community growth. The law closely parallels Smart Growth principles, in that it specifies higher density development in existing urban centers while managing and protecting open space. Smart Growth concepts are becoming more mainstream as communities all over the U.S. are implementing the approach.

Successful Smart Growth planning is seen in many jurisdictions throughout the U.S. For example, three of the EPA National Award for Smart Growth Achievement recipients and projects, and one example from the Puget Sound region, are described in Table 1.

Table 1. Current Smart Growth Activities: Examples from the EPA National Award for Smart Growth Achievement recipients,[3] and the Puget Sound region.

Recipient/Project Name and Location	Description	Accomplishments
Livable Communities Program, Metropolitan Council, Minneapolis-St. Paul Metro Area, Minnesota Year of Award: 2003	The state Livable Communities Act provides three grant programs in the areas of brownfield cleanup, lifecycle and affordable housing, and mixed use projects.	• Between 1996 and 2003, 292 grants totally almost 100 million dollars were awarded by the Metropolitan Council. • Grant funding has helped create over: - 7,000 new/renovated housing units, - 1,900 new/renovated rental units, - 11,000 new/retained jobs, and - 900 acres of reclaimed polluted lands.
Sacramento Region Blueprint: Transportation/Land Use Study, Sacramento Area Council of Governments, Sacramento Region, California Year of Award: 2004	The Blueprint project engaged 30 agencies and private businesses, and over 5,000 citizens to help develop and compare regional planning scenarios.	• Workshops were held, involving modeling tools to estimate the effects of various land-use scenarios on housing, transportation, environmental quality, and the economy. • A public education program was launched, and included multi-lingual efforts to reach all members of Sacramento area communities. • More than 1,300 participants voted on future land-use alternatives, and have informed the future development trends of the region.
Baldwin Park, City of Orlando, Orlando, Florida Year of Award: 2005	The City of Orlando created a mixed-use community on the site of the closed Orlando Naval Training Center.	• The new neighborhood reconnects surrounding neighborhoods and includes new homes, parks, stores, and economic opportunity. • The neighborhood also includes 50 miles of trails and sidewalks and an interconnected street grid for walkable and bike-friendly use.
King County, Washington[4]	King County has adopted several initiatives to reduce the amount of sprawl within the county. The updated county Comprehensive Plan includes efforts to protect the environment, preserve historic places, and encourage compact growth patterns. A tradable development rights (TDR) program was created to allow rural densities to be transferred to urban areas suited to increased growth.	• The Rural Forest Commission was created to encourage forestry activities and maintain forest lands in rural areas. • Revision of zoning codes to restrict subdivision of property in rural areas. • The annual development rate in the county's rural areas has dropped from 15% to 6% since the 1980s.

[3] Adapted from EPA National Award for Smart Growth, 2003, 2004, and 2005.
[4] King County Smart Growth. 2002. http://www.metrokc.gov/smartgrowth/rural.htm.

3.3 Current Role of EPA in Smart Growth

The EPA, on a national scale, maintains a Smart Growth program at its national headquarters in Washington, D.C. Through the program, EPA works with state and local decision-makers to identify development practices that meet the needs of the community and the natural environment by providing grants, site visits, publications, workshops, technical and outreach assistance, and encouraging local and regional collaborative partnerships. EPA also provides research publications and data. It serves as an information clearinghouse, and shares information about what is happening around the country in regards to land management, including watershed-scale planning, Smart Growth and low impact development (LID). For instance, EPA provides examples of state, city, or organization-developed Smart Growth "scorecards" that may assist other communities in assessing if Smart Growth would be a valuable tool in their community (EPA, Smart Growth, online).

EPA promotes Smart Growth as a multi-disciplinary, multi-interest solution to the effects of urban sprawl, as discussed in section 3.1. Mary Kay Bailey, of the Development, Community and Environment Division at the EPA National Office, believes that many actors are needed to change development practices, all of whom may have different motivations for doing so. As development issues and associated impacts face a diverse audience, all of the benefits of potential solutions, including Smart Growth, need to be addressed (personal communication, April 2006).

EPA-R10 does not have its own Smart Growth program, and relies on EPA at the national level to promote its benefits and uses. However, EPA-R10 is involved in growth issues through its National Environmental Policy Act (NEPA) review program, usually involving the review of transportation projects. EPA-R10 also provides funding for projects related to Smart Growth throughout the Pacific Northwest region. While not specifically labeled "Smart Growth," EPA-R10 is involved in local watershed-scale planning efforts involving identification and analysis of impact scenarios, such as in the Alternative Futures planning project in the Chico Creek watershed in Kitsap County, Washington. This project is discussed in more detail in Chapter 5. Regarding water

quality issues in general, EPA-R10 publishes a quarterly newsletter, *WaterTalk*, which provides regional resources and news, including Smart Growth topics, relevant to those who seek to protect water resources and ecosystems in the Pacific Northwest.

4.0 LOW IMPACT DEVELOPMENT (LID)

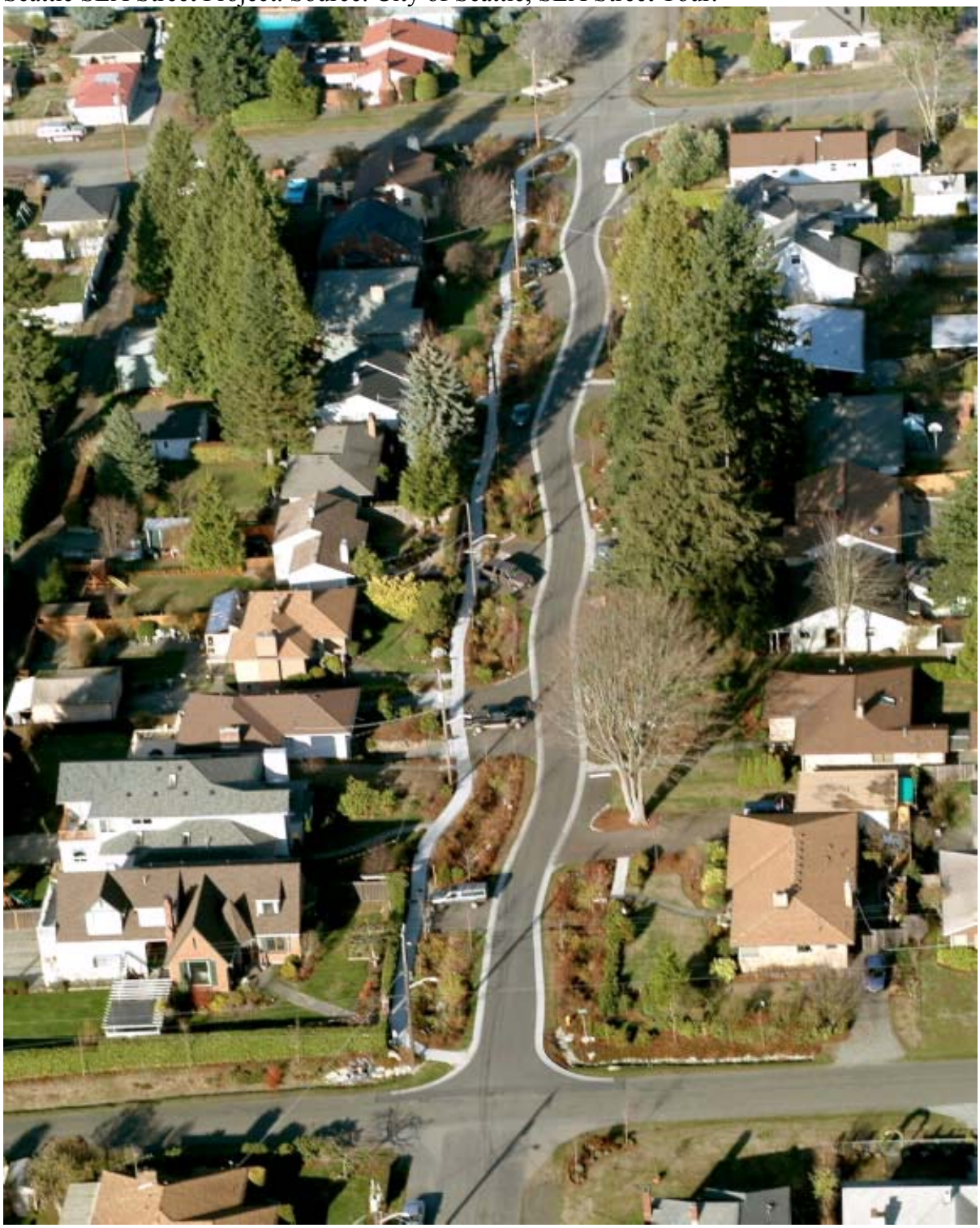
This chapter provides an introduction to the concepts and approaches of LID techniques, examples of LID activities, and a discussion of the current role of EPA in LID planning and implementation.

4.1 LID Context

LID is a more natural approach to land-use and stormwater management. In contrast, conventional development practices usually leave a site with high impervious surface area. When stormwater runs over roads, parking lots and other hard surfaces, it picks up pollutants along the way and carries many of those substances into streams, wetlands and bays, including Puget Sound.

LID approaches attempt to mimic the drainage patterns that were present before development by encouraging runoff infiltration, storage, filtering, evaporation, and detention, and include buffers around water bodies, protection for native soil and vegetation, and reduced impervious surface area. Unlike conventional development practices, LID aims to keep stormwater onsite for as long as possible, to minimize runoff to local stormwater systems or water bodies. LID techniques integrate site characteristics, such as topographic, geologic, hydrologic, and vegetation features, into the stormwater management practice. The underlying goals of LID are to design natural stormwater management systems that reduce runoff quantity and velocity, and improve excess runoff quality. LID methods can be applied at an individual home, residential subdivision, business, and transportation project scale, for new development as well as in retrofit efforts. Examples of LID techniques include narrow, curb and gutter-less street design, bioretention, or vegetated swales, green roofs, and permeable pavement. Figure 3 is an example of narrow, curb and gutter-less street design with roadside vegetated swales, part of the Street Edge Alternatives (SEA Streets) project in Seattle.

Figure 3. Narrow, curb and gutter-less street design with roadside vegetated swales. Seattle SEA Street Project. Source: City of Seattle, SEA Street Tour.



LID alone cannot solve stormwater problems at a watershed scale. The techniques cannot offset the cumulative impacts from urban sprawl and associated increased impervious surface area from additional infrastructure needs. LID is an effective stormwater management tool at the site-level, but should be part of a more comprehensive stormwater management and land-use planning program.

4.2 Current Low Impact Development Activities

LID techniques are becoming more widely-used, as more and more projects are completed, and stormwater reduction and cost data is collected. Table 2 on the following page lists four examples of LID activities, including two in the Puget Sound region.

Table 2. Current LID Activities: Examples of projects from around the U.S. and in the Puget Sound region.

Project Name and Location	Description	Results/Accomplishments
Somerset Subdivision, Prince George's County, Maryland[5]	The Somerset subdivision was one of the first large residential subdivisions to employ the use of rain gardens as part of an LID drainage plan.	• This implementation saved over $300,000 in capital costs over conventional stormwater management methods. • Average annual runoff volume per unit area has decreased by 20% compared to an adjacent conventionally developed area. • Metal content of runoff also significantly decreased in the LID area.
Gap Creek neighborhood, Sherwood, Arkansas[6]	LID and sustainable development techniques were employed in the development of the Gap Creek residential site.	• The site was built in accordance with natural drainage patterns. • Economic and other benefits[7] from LID implementation include: - 17 additional lots, - higher lot value (~$3000 more per lot vs. competitive lot), - lower lot cost (~$5000 per lot), - 80% of lots were sold in first year, - 23.5 acres of green space (compared to 1.5 acres in the conventional plan), including walking trails and a continuous wooded buffer, - professional recognition, and - more than $2M added profit
Street Edge Alternatives Project (SEA Streets), Seattle, Washington[8] (See also Figures 4 and 5))	Features of the SEA Streets project, such as vegetated swales, and use of native soil and plants, are designed to mimic the pre-development natural landscape and drainage patterns.	• The project includes 11% less impervious surfaces than a traditional street design. • Over 100 trees and 110 shrubs were added to the site. • The project has achieved 98% reduction of wet-weather stormwater runoff.
City of Langley, Washington[9]	In 2005, the City of Langley adopted PSAT's *LID Technical Guidance Manual for Puget Sound*	• The city is now requiring developers to include the use of LID in their designs.

[5] U.S. Environmental Protection Agency. May 2005. *Low Impact Development Pays* Off. Nonpoint Source News-Notes, May 2005, #75. U.S. Environmental Protection Agency.
[6] Tyne, Ron. 2000.
[7] See also Table 3.
[8] City of Seattle. Seattle Public Utilities SEA Streets Project. http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/
[9] Puget Sound Action Team. 2006. *LID is Law in Langley*. Sound Waves, Spring 2006, Vol. 21, No. 1. http://www.psat.wa.gov/Publications/soundwaves/spring_sw06/stormwater_lid.htm

The following figures are site photos from the SEA Streets project, described in Table 2, and are an example of a residential site, before and after application of LID techniques.

Figure 4. SEA Streets Project, Seattle Washington. A typical residential street, pre-LID application.

Figure 5. SEA Streets Project, Seattle, Washington, post-LID application.

Source: (Figures 4 and 5) City of Seattle, SEA Street Tour.

The SEA Streets project utilizes narrow street design to reduce impervious surface area (Figure 5, above). Vegetated swales along the roadway improve drainage in the area, as

well as slow, filter, and absorb runoff, preventing the possibly contaminated water from reaching local water bodies.

4.3 Current Role of EPA in Low Impact Development

The EPA National Office does not have a specific LID program, and relies primarily on regional offices to take the initiative for assistance in local LID planning and implementation. However, through its National Estuary Program (NEP), National Pollutant Discharge Elimination System (NPDES), and Nonpoint Source (NPS) programs, EPA hosts workshops and webcasts to educate and inform interested parties about conceptual and technical aspects of LID. EPA also promotes LID through other agencies, and provides grants for projects and development of standards or technical guidance manuals.

Although EPA-R10 has no regulatory authority in local land-use planning, it is very involved in encouraging and funding LID planning and implementation in the Puget Sound region. For instance EPA-R10 oversees and manages grant funding from national EPA programs, as well as provides assistance grants specific to EPA-R10. For instance, the Kitsap County Home Builders Foundation (KCHBF) has EPA funding through the national nonpoint source grants program, in accordance with CWA section 319, to develop county LID standards and design manual (Art Castle, personal communication, March 2006). Also, as mentioned in section 3.3, EPA-R10's quarterly newsletter, *WaterTalk*, provides information and resources pertaining to water quality issues and activities, including LID, in Region 10.

5.0 FINDINGS: IMPLICATIONS OF SMART GROWTH AND LOW IMPACT DEVELOPMENT IN THE PUGET SOUND REGION

This section reflects general findings from the interview process, including the potential implications of Smart Growth and LID planning and implementation in regard to watershed-scale planning, multi-jurisdictional coordination, and public education and outreach. Smart Growth and LID have the potential to facilitate or improve efforts in these general areas. The ideal land-use planning effort would include cross-jurisdictional, multi-agency planning at a watershed scale, with the incorporation of public outreach and involvement. Each of these topics is explored in the following sections.

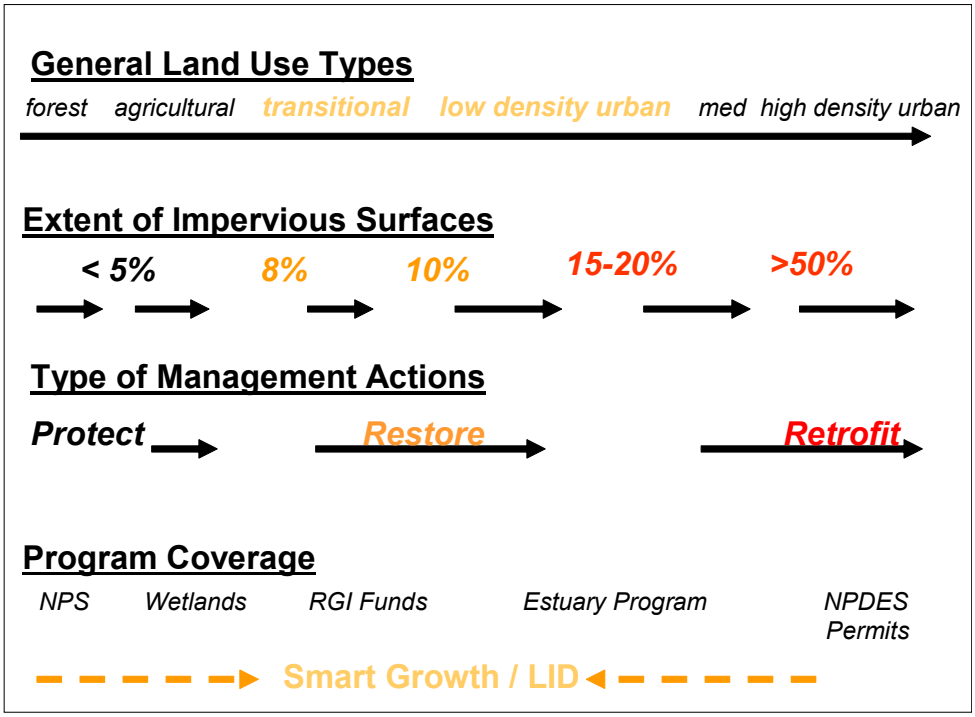
5.1 The Stormwater Gap and Watershed-scale Planning

Six of the twelve counties in the Puget Sound region, Clallam, Jefferson, Mason, San Juan, Skagit, and Whatcom counties, have current population densities of less than 100 people per square mile (WA OFM), and include more forested and open space area than do urban counties. As these counties experience increasing population, and therefore development pressures, they are prime locations to apply thoughtful, environmentally sensitive land-use planning, to conserve and preserve existing natural areas and protect water quality, while allowing the county to develop.

Figure 6 illustrates the gap in stormwater management that could be potentially filled by innovative land-use techniques such as Smart Growth and LID. Figure 6 illustrates the scales of land-use, percent of impervious surfaces, type of management actions, and federal program coverage conducive to development strategies such as Smart Growth and LID. For instance, stormwater in medium to high-density areas with over 15% impervious surface area is more likely to be regulated through NPDES permits. Retrofit stormwater management actions, such as retrofit of existing structures, roads, or stormwater control structures, may be most appropriate in such areas. Lower-density areas with 8-10% impervious surface area may not qualify for NPDES coverage. As indicated at the bottom of the figure, stormwater in these areas may be best managed

through restorative actions and the use of Smart Growth and/or LID techniques to preserve existing natural resources while allowing development to occur.

Figure 6. The Stormwater Gap. The potential role for innovative stormwater management methods based on land-use and density, percent impervious surface area, and regulatory context. Figure by Michael Rylko. Source: Rylko, Michael and Misha Vakoc. EPA-R10 Presentation: Stormwater: Opportunities in Puget Sound.



As discussed in Chapter 2, density, impervious surfaces, land cover, hydrology, and biological health are interconnected. The Stormwater Gap analysis allows stormwater managers to identify areas in which natural resources still exist, and where protective or restorative efforts may be successful. Watershed assessment and landscape analysis then investigates and documents the quantity, quality, and spatial extent of existing watershed processes and natural resources, allowing watershed-specific conditions and characteristics are accounted for and considered in land-use and stormwater planning.

Alternative Futures

A watershed-scale planning strategy which utilizes principles similar to Smart Growth, "Alternative Futures," is gaining popularity around the nation as well as in some Puget Sound communities. Alternative Futures encourages citizen collaboration to select future

land-use zoning on a watershed scale. It brings multiple jurisdictions and stakeholders together to plan collaboratively, and weigh trade-offs of development and conservation with multiple planning models (Figure 7).

Figure 7. Series of development scenarios for the Chicago Regional Environmental Planning Project. Source: EPA, Using Smart Growth Techniques as Stormwater Best Management Practices.

Locally, an Alternative Futures pilot project in the Chico Creek[10] watershed in Kitsap County is a successful model for future planning. The project was funded by EPA, with funds channeled through PSAT. The Chico Alternative Futures project was developed to compare land-use planning scenarios and impacts at a watershed scale. Each scenario was then analyzed for any effects on water quality, water quantity, and wildlife. For instance, runoff due to impervious surfaces was predicted to increase by as much as 26%, compared to 2001 conditions, under the Plan Trend scenario (Figure 8). Changes in aquatic habitat quality were also predicted by scenario (Figure 9).

[10] Chico Creek is the most productive salmon stream in Kitsap County (Parametrix, Inc. 2003).

Figure 8. Stormwater runoff comparison of Chico Creek Alternative Futures scenarios,[11] as compared to 2001 levels. Source: Parametrix, Inc. 2003.

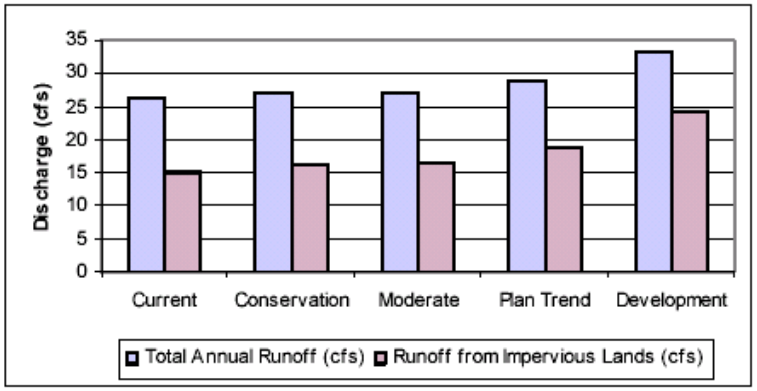
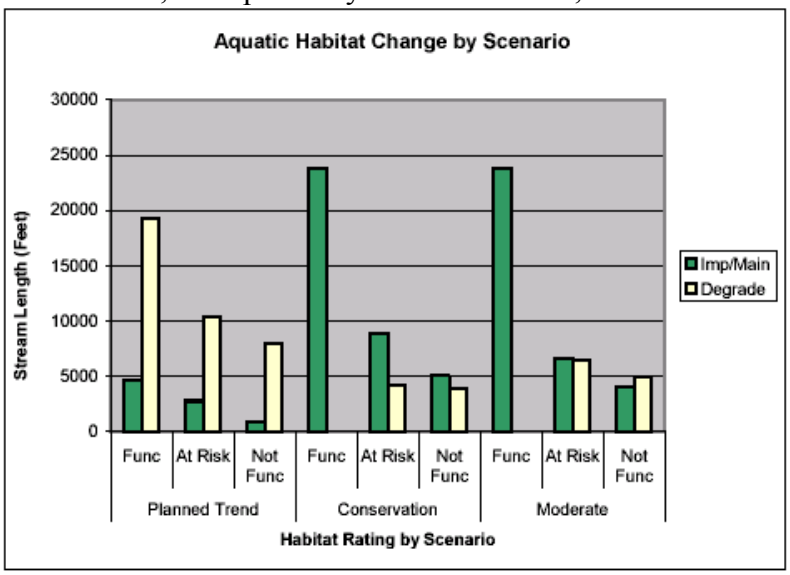


Figure 9. Predicted change to Functional, At Risk, and Not Functional aquatic habitat under full build-out conditions of the three Alternative Futures planning scenarios for Chico Creek, Kitsap County. Source: Nelson, 2003.



The Chico planning process included a substantial public process, involving multiple cities, agencies, and the Suquamish tribe. While this project did not result in implementation of the selected development plan, due to a lack of human and financial resources at the county-level to carry out the resulting, yet separate, subarea planning process, it resulted in the identification and acquisition by the county of critical wildlife corridors, and informed future planning strategies now currently being implemented in other Kitsap jurisdictions (Jim Bolger, personal communication, February 2006). The

[11] The Development scenario was dropped from the final scenario comparison and analysis (Nelson and Graham, 2003).

Chico project demonstrates the concept that planning is best accomplished when you fit development to the landscape, as through scenario and subarea[12] planning at the watershed scale, instead of the other way around, as in conventional development practices. Lessons suggested by this experience show that planning on a watershed scale is best done concurrently with subarea planning as to maximize the potential for actual implementation of the project.

5.2 Multi-jurisdictional Coordination

Similar to ecological systems, in policy everything is connected to everything else. "The policies of one community affect and are affected by the policies of other communities, regions, states, and the nation" (Bengston et al, 281). Multi- and intra-agency coordination can improve outcomes of planning processes, as details important to varying interests can be addressed during the planning process, instead of reacted to after the process is complete. Coordination is therefore a key part of initiating and sustaining successful watershed-scale and land-use planning efforts, including Smart Growth and LID.

Pollution and other water quality issues, especially those associated with stormwater runoff, are typically not constrained within jurisdictional boundaries. Many parties have a stake in water quality issues, yet often have differing goals and responsibilities, making coordination difficult. The following are examples of projects in which common interests among parties were recognized, such as water quality and habitat protection, improving overall communication and coordination.

The Chico Creek Alternative Futures project, described in the previous section, included the efforts and collaboration of several jurisdictions and multiple agencies. Specifically, EPA, the state (Ecology and PSAT), Kitsap County, local cities, the Navy, and the Suquamish tribe were all involved in the planning process. These partnerships were one of the strengths of the Chico process, and will help improve communication and

[12] In Kitsap County, subarea plans are usually constrained within jurisdictional or urban growth boundaries. The subarea plan for the Chico watershed would have been bounded by topographic and landscape features (Parametrix, Inc. 2003).

coordination for future natural resource and land-use planning (Bolger, Folkerts, personal communication, February 2006).

Also in Kitsap County, several jurisdictions and agencies are collaborating on the development of LID standards for the county. Here, the county, several cities, state agencies, the Suquamish tribe, and local fire districts are involved in the planning process, to ensure their interests are heard and/or met. This specific planning effort, headed by the Kitsap County Home Builders Foundation (KCHBF), is discussed further in Chapter 6.

The Clallam County Conservation District (CCCD), with a Regional Geographic Initiative (RGI) grant from EPA-R10, is currently developing partnerships for futures LID projects. There, a recently formed 60-member committee is working to establish a green building checklist with an LID component, possibly to include LID standards. The county, local jurisdictions and the building and development sector are all involved in the planning process. (Clea Rome, personal communication, April 2006).

Clea Rome also indicated that as the economic base of the county changes away from farming, a task force of 12 conservation districts is starting to meet regularly about land use issues. As non-regulatory agencies, conservation districts may be able to work more effectively than regulatory agencies with certain organizations and interested parties, such as landowners, property rights groups, and developers. They can also help with coordination between multiple jurisdictions within a county. Conservation districts are able to promote stormwater management without seeming threatening (personal communication, April 2006).

These examples suggest the increasing potential for regional coordinating bodies regarding land-use planning, such as Kitsap County, or the CCCD. Regional coordination may facilitate vertical coordination, such as between different departments or levels of state, county, or city government. It also has the potential to assist with horizontal coordination, serving as a "bridge" between state and local jurisdictions (Bengston et al,

2004), as well as other interested parties. Ideally, regional coordination will improve efficiency and sustainability of, and consistency between land-use or management plans, as multiple interests are involved and considered throughout the entire process.

5.3 Public Education and Outreach

The success of Smart Growth and LID in the reduction of negative impacts to water quality in the Puget Sound region relies heavily on public feedback and participation.

The Chico Creek Alternative Futures process, as described in section 5.1, included a working group focused on raising public awareness about the project and provided citizens with technical and planning information and tools to facilitate their participation in the process. This working group consisted of members of EPA, PSAT, county agencies, the U.S. Navy, the Suquamish tribe, the Kitsap Conservation District, and Washington State University Extension. The group educated local officials and citizens to allow them to understand watershed process and participate in the scenario planning process (Beale, 2003). The Nonpoint Education for Municipal Officials (NEMO) Network includes educational programs in 31 states about land-use planning and protecting natural resources. The Washington State NEMO program was involved in the Chico Creek project, educating residents and local officials about watershed processes and land use, "so they can constructively and effectively participate in comprehensive watershed planning" (National NEMO Network, Washington NEMO Program, online).

PSAT has become a central clearinghouse of information about LID and growth in the Puget Sound region. In 1987 PSAT began the Public Involvement and Education (PIE) Fund to support projects that help PSAT achieve its education goals regarding Puget Sound stewardship. Since the fund's inception, PIE grants have funded hundreds of projects with millions of dollars. In 2006 alone, the PSAT will provide over $480,000 to 15 projects aimed at involving and education the public around the health and protection of Puget Sound. PSAT also provides other funding opportunities, as well as publications and educational material (PSAT, online).

EPA provides educational resources specific to watershed management through its Watershed Academy online training modules. There, individuals and groups from all sectors, including the general public have access to basic watershed-related resources, including topics about basic watershed process, changes to watersheds, watershed management and planning, and applicable rules and regulations. The Watershed Academy also offers webcast seminars and live training courses for interested parties (EPA Watershed Academy, online). Clea Rome, of the Clallam County Conservation District, finds EPA's webcasts very valuable as a technical resource, as Clallam County begins to plan for LID (personal communication, April 2006).

EPA is also a source of Smart Growth resources, including educational and outreach material. They provide publications, workshops, technical and outreach assistance, and encourage local and regional collaborative partnerships. EPA also provides research publications and data. They serve as an information clearinghouse, and share information about Smart Growth activities around the country.

Education and outreach provided during the course of a planning project, such as in the Chico Creek project, and through individual agencies such as the efforts of NEMO, PSAT, EPA, and others, are targeting a wide variety of interests and sectors involved in land-use planning. Outreach such as this will facilitate, and ideally improve land-use planning, as more parties will be educated about the issues involved.

Land-use planning projects, including the use Smart Growth and LID, have implications for increased planning at a watershed scale, improved multi- and intra- agency and jurisdictional coordination, as well as increased awareness and knowledge about watershed processes, management, and planning. However, there are challenges involved in Smart Growth and LID planning and implementation in the Puget Sound region that need to be addressed. The following chapter will discuss potential regional barriers to Smart Growth and LID.

6.0 FINDINGS: REGIONAL BARRIERS TO PLANNING AND IMPLEMENTATION

The following sections discuss common themes in the feedback provided by the interview participants (Appendix A: Interview Participants) regarding the potential barriers to Smart Growth and LID planning and implementation in the Puget Sound region.

6.1 Smart Growth

Barriers to Smart Growth planning in the Puget Sound region include political feasibility and climate, the framing of Smart Growth principles and goals, and the lack of a central clearinghouse of information regarding regional Smart Growth activities.

Smart Growth is a politically sensitive issue. Smart Growth is perceived by some citizens as being linked to a potential infringement on property rights, similar to some perceptions of growth management in general. It may be for these reasons that Smart Growth is not being actively planned in the Puget Sound region other than in more urbanized counties. However, the idea of political infeasibility as a barrier to Smart Growth has been called a "myth," as described by Mary Kay Bailey of the EPA. Very rural areas in Idaho and North Carolina, typically areas one would not expect to plan Smart Growth due to the myth described above, have applied for the EPA Smart Growth Implementation Assistance Program (personal communication, April 2006). Political climate of an area, however, may indeed influence the feasibility of Smart Growth planning.

Another potential barrier to Smart Growth planning in the Puget Sound region is a too-narrowly defined solution to problems associated with sprawl. If Smart Growth is defined as a solution to transportation problems, a potential holistic solution may be missed by those primarily concerned with political or economic feasibility, or by those in the environmental community. Similarly, if Smart Growth is promoted as an environmental effort to improve water quality, it may be ignored by those concerned with transportation or economic issues, and its true potential in those areas of planning may be overlooked. While reduction of impervious surface area and improved water quality is both a goal and

an outcome of Smart Growth, other solutions and perspectives should be highlighted to encourage its use by a broader range of state and local interests. As a caution, however, defining Smart Growth too broadly may confuse or overwhelm some jurisdictions about how and where to begin.

A barrier to regional Smart Growth planning involves education and outreach efforts about watershed process and the role of Smart Growth in protecting water quality. Also, there is no Smart Growth program specific to EPA-R10. One downside of this is that there is no central clearinghouse of information regarding Smart Growth efforts specific to Washington State and the Puget Sound region.

6.2 LID

The primary barriers to LID planning and implementation in the Puget Sound Region, as expressed by some of the interview participants, are separated into three general categories: Financial, Technical, and Educational.

6.2.1 Financial Barriers

Many jurisdictions do not have the existing financial resource capacity to undertake LID projects. The financial barriers to LID planning and implementation are those most commonly seen in Puget Sound communities and mitigated by EPA-R10 through grant funding.

Lending institutions may be another potential financial barrier to implementation of innovative stormwater management strategies. Banks may be wary of lending for unconventional development designs, as the life-expectancy and risk of, and market demand for, these techniques is somewhat uncertain.

6.2.2 Technical Barriers

Technical barriers to LID planning include regulatory, construction/engineering, and maintenance issues.

Regulatory

Many communities feel overbooked with environmental mandates, and are resistant to further responsibilities regarding stormwater management. Many jurisdictions also do not know about the potential for LID practices to aid in meeting other environmental regulatory requirements. For instance, stormwater, shoreline, salmon recovery, and other requirements have the potential to be met or offset through the use of LID methods. This concern is similar to one confronted regarding barriers to LID planning in the Chesapeake Bay watershed. There, one challenge identified was how to integrate LID with other programs such as stormwater management and erosion control to make it more efficient for jurisdictions to include LID in land-use planning (Chesapeake Bay Program, 2002). Currently, EPA-R10 and the Multi Agency Watershed Task Force[13] are developing a watershed approach for meeting multiple state mandates. Multiple mandates often cause confusion and overlap in natural resource planning. The task force will develop a tool that allows multiple plans to be integrated, thereby improving planning and decision making, as well as efficiency. A pilot project in a Puget Sound community will include watershed characterization and analysis, as well as address and integrate multiple plans and mandates (Multi Agency Watershed Taskforce, 2006).

Regulatory barriers, as expressed by interview participants, also include the lack of LID ordinances in land-use regulations, the lack of standards for LID implementation and maintenance, and over-conservative estimates of stormwater reduction in determination of state issued flow credits. These issues are discussed further below.

Currently, there is a lack of requirements for LID inclusion for new or retrofit development projects. There is also a general lack of construction and maintenance standards for LID methods, as well as a clear path for LID plan approval. Many developers have to apply for exceptions in existing development codes, which can be

[13] The Multi Agency Watershed Task Force includes the Washington Department of Fish and Wildlife, Washington Department of Ecology, Washington Department of Transportation, Washington Department of Community Trade and Economic Development, Puget Sound Action Team, U.S. EPA, and the U.S. Fish and Wildlife Service.

costly and time-consuming. Also, there is currently no method of oversight, enforcement, or follow-up of LID projects to ensure they were implemented correctly.

Some local governments are taking the initiative to develop such standards. Kitsap County Home Builders Foundation (KCHBF), for instance, is in the process of developing LID standards, with support from EPA and the National Association of Home Builders. Other state and local agencies and organizations are also involved, including PSAT, Ecology, local cities, the Suquamish tribe, and local businesses. A KCHBF committee is holding workshops to develop standards for specific LID techniques. They will then write draft standards, a draft ordinance for inclusion of LID, and a manual for site design. The purpose of the manual is to assist developers in LID planning and implementation as well as regulators who will be charged with reviewing development permits. KCHBF expects to have a draft ordinance and manual by early 2007 (Art Castle, personal communication, March 2003). These initial developments may then serve to inform a general set of standards or other agencies' creation of standards for their specific jurisdictions.

Regarding flow credits, The Washington State Department of Ecology (Ecology) promotes the use of certain hydrology models to estimate the amount of stormwater runoff, the needed size of control or treatment facilities, and the estimated discharge reduction from inclusion of LID techniques. A multi-agency committee, including representatives from Ecology, determines the amount of applicable flow credits for various LID methods. A concern raised during the interview process for this project is that the Ecology estimated flow credits for reduced discharge from the inclusion of LID methods are too conservative. Art Castle, of the Home Builders Association of Kitsap County, believes that fair flow credits are crucial for market acceptance of LID techniques, and that not enough credit is currently given for their use (personal communication, March 2003). As more LID demonstration projects are implemented and monitoring data is collected and analyzed, flow credits for LID projects will ideally be adjusted based on actual performance of the specific techniques.

Construction/Engineering

Construction, or engineering barriers to LID planning and implementation exist primarily in communities with fewer existing technical resources to implement LID projects. This issue ranges from a lack of engineering or technical expertise within a local or county government's staff, to a lack of private engineering and consulting firms with LID experience in a jurisdiction. The former is the situation in Clallam County, according to Clea Rome of the Clallam County Conservation District (personal communication, April 2006). PSAT, as part of its 2005 Local Regulation Assistance Project, hired one engineering firm, AHBL, to work with five cities and six counties, including Clallam, to review and develop regulatory frameworks for LID, including development standards, ordinances, and maintenance guidelines (PSAT, online). This provided more rural counties access to technical and regulatory expertise, as well allowed the technical and regulatory support to be consistent across jurisdictions. More generally, there are also questions regarding the life-expectancy of LID techniques, which may make engineers cautious and less likely to implement.

Maintenance

LID is a relatively new practice, and there are few long-term, local LID projects in place. Because of the variation in natural and jurisdictional site-specific characteristics, there is still some question as to what the proper maintenance of different LID techniques should be, who is responsible for maintenance, and how to ensure regular maintenance is being performed correctly, to ensure the most efficient and lasting function of the LID method. Maintenance is similar to landscaping needs, as opposed to engineering maintenance, and may include weeding, vegetation clearing, mulching of vegetated bioretention swales, and washing of permeable pavement. Periodic removal of accumulated pollutants from swales may also be required. Clearly written general maintenance manuals, as well as site specific maintenance plans, are currently lacking.

6.2.3 Educational Barriers

As expressed by many of the interview participants, LID planning and implementation barriers exist regarding environmental and conceptual/engineering education and outreach. Another educational barrier involves the benefits and costs of LID methods.

Environmental

Many citizens currently lack a basic understanding of watershed processes and environmental threats to those processes. Increased public awareness about pollutants, for instance, may reduce the type and amount of fertilizers and pesticides used, decrease pollution from pet wastes, and promote environmentally friendly practices for automobile washing. Local knowledge may also increase citizen participation in land-use planning processes.

Conceptual/Engineering

The initial need for outreach and education components of LID, including the general techniques and processes, is diminishing as more and more LID practices are implemented throughout the state and country. However, the basic elements of LID planning and implementation are relatively unknown or misunderstood in relatively undeveloped areas in the Puget Sound region. Some less-developed areas may not see the opportunity and applicability of such projects when the only examples they see are in urbanized counties with more financial and technical resources. Developers in counties with relatively little LID experience, such as Clallam County, may not see the demand for the use of LID techniques if they can actively sell traditionally developed lots (Clea Rome, personal communication, April 2006). Also, some in the engineering community are not convinced of the potential benefits of LID. This likely arises because LID is relatively new in local development practices, and engineers may be uncomfortable with LID design and implementation.

Regarding maintenance, property owner support and cooperation is key to maintaining the environmental effectiveness of LID. Property owners need to be educated about proper maintenance to sustain the life of LID methods.

Costs and Benefits

Information about the cost-savings potential of LID over conventional development is becoming more widely known as more LID projects are completed. However, interview participants suggested that many developers and property owners do not know, or are skeptical about, the capital, maintenance, and lifetime costs of LID techniques, especially in less developed areas. The Low Impact Development Center describes the most common cost concern regarding LID is that they may require more costly design and construction, and be subject to a more lengthy, and thus more costly, permitting and approval process. Another cost concern relates to the potential increased expenses for landscaping materials (Low Impact Development Center, online).

Costs are site-specific and depend on characteristics such as soil and vegetation conditions, topography, geology, hydrologic conditions, and the specific designer or engineer. However, the costs of LID are increasingly becoming known as more projects are being implemented throughout the country and the Puget Sound region. For instance, analysis of the Gap Creek neighborhood, the project described previously in Table 2, resulted in a comparison of two different land plans, a conventional plan, and a sustainable plan incorporating LID. The cost comparison, as well as non-monetary benefits is shown in Table 3.

Table 3. Low Impact Development: A Comparison of Two Different Land Plans. Adapted from Ron Tyne, 2000.

PROJECTED RESULTS FROM TOTAL DEVELOPMENT

Total Site	**Conventional Plan**	**Sustainable Plan**
Lot Yield	358	375
Linear Feet Street	21,770	21,125
Linear Feet Collector Street	7,360	0
Linear Feet Drainage Pipe	10,098	6,733
Drainage Structures: Inlets/Boxes/Headwalls	103	79
Estimated Total Cost	$4,620,600	$3,942,100
Estimated Cost Per Lot	$12,907	$10,512

ACTUAL RESULTS FROM PHASE ONE

Phase I	**Conventional Plan** (Engineer's Estimated Figures)	**Sustainable Plan** (Actual Figures)
Lot Yield	63	72
Total Cost	$1,028,544	$828,523
Total Cost Per Lot	$16,326	$11,507

ECONOMIC AND OTHER BENEFITS FROM LID

Higher Lot Yield	17 additional lots
Higher Lot Value	$3,000 more per lot over competition
Lower Cost Per Lot	$4,800 less cost per lot
Enhanced Marketability	80% of lots were sold in the first year
Added Amenities	23.5 acres of green space/parks
Recognition	National, state and professional groups
Total Economic Benefit	More than $2,200,000 added to profit

The developer of the Gap Creek neighborhood, Terry Paff, credits the economic benefits to reduced development costs, increased lot yield, and higher lot value (Tyne, 2000).

A study in Pierce County, Washington, investigated the use of LID in a 24-acre, 103-lot, single-family, conventional residential development. Cost estimates for LID materials and design efforts, including porous pavement and narrow streets, were higher than conventional development strategies, though the study showed a savings of 20% in actual construction costs compared to a conventional design. In addition to construction cost savings, all of the planned 103 lots could be built while leaving 62% of the total acreage as open space. The need for stormwater ponds and other conventional stormwater infrastructure was reduced, and the site would have zero effective impervious surfaces (EPA, *Nonpoint Source News-Notes*, May 2005 #75).

Benefits of LID projects not monetized in typical cost assessments include positive public perception and firm recognition associated with environmentally friendly development practices. Also, livability, or neighborhood quality, and aesthetics may be enhanced through the increased use of vegetation and the creation or expansion of open space. And of course, improved water quality and protection or restoration of watershed processes are principal benefits of LID applications.

Education and outreach efforts about LID studies and projects, such as those mentioned above, and especially those specific to the Puget Sound region, have the ability to educate local planners, developers, and land owners, and others about the potential cost savings and benefits of LID applications.

7.0 SUMMARY AND RECOMMENDATIONS

There is ample opportunity for EPA-R10 involvement in Puget Sound Smart Growth and low impact development planning and implementation. To improve to the role of EPA-R10 in the process, opportunities for and barriers to planning and implementation in the Puget Sound region have been identified. The following sections will address and suggest recommendations for watershed-scale planning, multi-jurisdictional coordination, education and outreach, as well as for the specific barriers to Smart Growth and LID in the Puget Sound region.

7.1 The Stormwater Gap and Watershed-scale Planning

As discussed in Chapter 5, half of the counties in the Puget Sound region have current population densities of less than 100 people per square mile (WA OFM), and include more forested and open space area than do urban counties. As these counties experience increasing population, and therefore development pressures, they are prime locations to apply thoughtful, environmentally sensitive land-use planning, to conserve and preserve existing natural areas, while allowing the county to develop.

Development, especially the effects of impervious surfaces, and the health and processes of watersheds are connected. Land-use planning must move beyond site-specific conditions to account for the watershed as whole. The Stormwater Gap model allows stormwater managers to identify areas in which natural resources still exist, and where protective or restorative efforts may be successful. Watershed assessment and landscape analysis then investigates and documents the quantity, quality, and spatial extent of existing watershed processes and natural resources, allowing watershed-specific conditions and characteristics are accounted for and considered in land-use and stormwater planning.

Planning strategies such as Alternative Futures allow local officials, planners, and citizens to analyze watershed-scale scenarios and weigh tradeoffs of development alternatives. Alternative Futures and other planning strategies should be promoted, as

they may facilitate smarter growth patterns while not specifically including the sometimes politically sensitive label of Smart Growth.

EPA-R10 has opportunities to enhance the use of watershed-scale planning through grant funding, and dissemination of information about watershed processes and planning to Puget Sound communities. They should also offer assistance for general planning and plan integration, as they are doing through the Multi Agency Watershed Taskforce and its upcoming Puget Sound pilot project.

7.2 Multi-jurisdictional Coordination

EPA-R10 is currently involved in several projects in the Puget Sound region that involve multi- and intra-agency coordination (see Chapter 5). Feedback from interview participants suggest these relationships and growing partnerships are going well and are invaluable to current and future projects. However, in counties where coordination is lacking, a role for EPA-R10 should initiate multi-jurisdictional relationships, and encourage or facilitate land-use planning on a more regional, for instance watershed, scale. EPA-R10 partnerships with local agencies, such as conservation districts, may facilitate multi-party and jurisdictional relationships that may be more difficult if initiated solely by a federal regulatory body.

7.3 Public Education and Outreach

As discussed in Chapter 5, education and outreach provided during the course of a planning project, such as in the Chico Creek project, and through individual agencies such as the efforts of NEMO, PSAT, EPA, and others, are targeting a wide variety of interests and sectors involved in land-use planning. Outreach such as this will facilitate, and ideally improve land-use planning, as more parties will be educated about the issues involved.

However, there are some sectors to which education and outreach should be more heavily targeted. In general, outreach about basic watershed processes and planning, and past and current projects should be targeted to all sectors, including the public. Specifically,

outreach to financial institutions is needed. Lenders may be wary of LID projects, as the risk, costs, and return on investments is not well understood. Outreach should also target members of the engineering, development, and real estate community about the financial, technical, and marketability aspects of Smart Growth and LID, especially in currently low-density, developing areas. More demonstration projects are needed to show LID methods can be applied in areas other than the more urbanized counties with more technical and financial resources. These demonstration projects will provide monitoring opportunities to show the long-term results of LID effectiveness and efficiency. Incorporation of feedback from property and home owners employing LID techniques will also be helpful in providing proof-of concept in outreach efforts.

7.4 Addressing Specific Barriers to Smart Growth and LID

The following discussion and tables address the specific regional barriers to Smart Growth and LID planning and implementation as suggested by interviewees, and discussed in more detail in Chapter 6.

Barriers to Smart Growth

Potential regional barriers to Smart Growth include political climate, the definition and framing of Smart Growth principles, and the lack of a central information clearinghouse about Smart Growth activities in Washington State and the Puget Sound region. These barriers are discussed further below, and are summarized with recommendations in Table 4.

Political sensitivity about growth patterns and property rights is a potential obstacle in Smart Growth planning. Collaboration between multiple stakeholders should be increased, as more parties' interests will be considered and addressed throughout a plan or project's duration. Revised framing of Smart Growth principles, such as through planning strategies like Alternative Futures, may increase the feasibility of compact growth patterns and watershed-scale planning in politically sensitive areas.

The definition of Smart Growth, if too narrow or too broad, may dissuade local planners to its use and benefits. Smart Growth should be marketed to multiple interests and sectors, though local jurisdictions may need assistance in planning to address their specific needs.

Finally, increased outreach to all relevant sectors is needed regarding basic watershed process and the potential of Smart Growth to reduce or eliminate negative water quality impacts associated with conventional development practices. Also, there is no central information clearinghouse of Smart Growth information and activities specific to Washington State or the Puget Sound region. A regional Smart Growth network should be created or encouraged to promote local efforts. This may be done through EPA-R10 directly, through a state or regional agency, or through a collaborative agency partnership.

Table 4 summarizes and provides recommendations for specific barriers to Smart Growth planning and implementation in the Puget Sound region. Check marks (✓) in the third column indicate the magnitude of potential for EPA-R10 involvement. These judgments are a reflection of what interview participants think the role of EPA should include. Scale is from one to three checks, with three checks being a prime situation for EPA-R10 involvement in addressing the indicated barrier.

Table 4. Regional Barriers to Smart Growth. Check marks (✓) in the third column indicate the magnitude of potential for EPA-R10 involvement. Scale is from one to three checks, with three checks being a prime situation for EPA-R10 involvement in addressing the indicated barrier.

Recommendation(s)	Regional Barriers Addressed by Recommendation(s)	Potential for EPA-R10 Involvement
• Increase collaboration and partnerships with organizations or agencies that span multiple stakeholder interests. • Reframe the concept and/or name of Smart Growth to appeal to politically sensitive areas.	Political sensitivity	✓✓✓ ✓✓✓
• Use the multiple aspects and benefits of Smart Growth to promote to varying interests.	Narrowly-defined solution to sprawl impacts	✓✓✓
• Assist local governments in planning to identify which needs can be addressed through Smart Growth.	Broadly-defined solution to sprawl impacts	✓✓✓
• Increase outreach • Create/encourage a regional Smart Growth network to promote Smart Growth and inform about regional and local Smart Growth activities.	More public outreach needed regarding watershed processes and associated environmental issues No local clearinghouse of Smart Growth information specific to Washington State, or the Puget Sound region.	✓✓✓ ✓✓✓

Barriers to LID

Regional barriers to LID planning and implementation, as discussed in Chapter 6, include financial, technical, and education and outreach issues. The specific barriers are discussed further below, and are summarized with recommendations in Table 5.

The main financial barrier for regional and local LID planning is that many jurisdictions do not believe they have the capacity to take on new plans or projects. EPA-R10 currently provides funding for such endeavors, and this level of support should be continued or increased. Also, outreach to communities about other funding opportunities, such as through other agencies, nonprofits, or private institutions, will help support current and future projects, while alleviating some of the funding burden from EPA.

Technical barriers involve regulatory obstacles and issues regarding construction, engineering, and maintenance of LID methods. The development of such standards at a state or county level should be encouraged, through financial support or federal or state requirements, to address the current lack of LID construction and maintenance standards and/or planning requirements in many jurisdictions. Clearly written general maintenance manuals, as well as site specific maintenance plans, should also be developed for maintaining the efficiency of LID techniques.

The lack of program integration around watershed-scale planning and stormwater issues is currently being addressed by the Multi Agency Watershed Taskforce. Financial or technical assistance to jurisdictions wanting to integrate multiple mandates may reduce or alleviate this problem.

Construction, engineering, and maintenance barriers to LID planning and implementation are that many basic environmental processes are not understood, and that proof-of-concept of LID techniques is lacking in less-developed areas. More demonstration projects, and the resulting runoff reduction and project cost data are needed to address these issues. Another barrier is that many rural or low-density jurisdictions may not have the technical expertise within the local government or engineering firms to design and implement LID standards and/or methods. Agency-provided technical assistance, through agency experts, contracted engineering firms, or otherwise, is one way this problem may be addressed. On-the-ground training for engineers, developers, and contractors may also help to alleviate this barrier, as well as provide proof-of-concept opportunities. In summary, LID planning needs to be specific to local communities at the scale of local needs. For this, local jurisdictions need to be able to identify how and where LID may applicable in their community, have the design and engineering capacity to tailor LID technologies to specific local and site conditions, and to maintain their efficiency.

Finally, educational barriers can be mainly addressed through increased outreach efforts. Heightened outreach efforts about environmental and watershed processes, and to

specific sectors about the potential benefits of LID, will likely increase public and private buy-in for these emerging land-use techniques.

Table 5 summarizes and provides recommendations for specific barriers to LID planning and implementation in the Puget Sound region. Check marks (✓) in the third column indicate the magnitude of potential for EPA-R10 involvement. Scale is from one to three checks, with three checks being a prime situation for EPA-R10 involvement in addressing the indicated barrier. Similar to the barriers to Smart Growth discussed in Table 4, these judgments are a reflection of what interview participants think the role of EPA should include. EPA-R10 may not be the best-suited agency to address the indicated barrier where less than three check marks exist. Its efforts in these areas may be better spent may encouraging the involvement of, or partnering with, other agencies or organizations to help eliminate the barrier(s).

Table 5. Regional Barriers to LID. Check marks (✓) in the third column indicate the magnitude of potential for EPA-R10 involvement. Scale is from one to three checks, with three checks being a prime situation for EPA-R10 involvement in addressing the indicated barrier.

Barrier Category		Recommendation(s)	Regional Barriers Addressed by Recommendation(s)	Potential for EPA-R10 Involvement
Financial		• Increase funding opportunities or awareness of such opportunities. • Target funding opportunities to jurisdictions in all phases of LID efforts, especially those with less capacity and/or more existing natural resources.	Jurisdictions with no/little capacity	✓✓✓ ✓✓✓
Technical	**Regulatory**	• Encourage uniform state or county planning requirements. Code revisions to allow for LID are needed. • Encourage uniform state or county construction and maintenance standards.	Lack of LID construction/maintenance standards and/or planning requirements	✓✓ ✓✓
		• Encourage jurisdictions to determine how LID programs can be integrated with other environmental programs and initiatives	Lack of program integration	✓✓✓
	Construction/Engineering/Maintenance	• More demonstration projects in more rural areas • Increase/improve monitoring of existing projects	Basic concepts are not understood in some less developed areas Proof-of-concept; some interests not convinced of LID potential Conservative flow credits	✓✓✓ ✓✓
		• Agency-provided/sponsored technical assistance, including but not limited to: - Agency-contracted engineering firm(s) to provide technical expertise in areas where none/little available. - Agency-recommended or certified firms, willing/able to work in more rural areas. - Agency encouragement/subsidization of firms to work in more rural areas. - On-the-ground training for engineers/developers/contractors	Lack of engineering or technical expertise within jurisdictional capacity Lack of private firms with engineering or technical expertise for LID	✓✓ ✓ ✓✓ ✓✓ ✓✓
Education/Outreach		• Increase outreach	More public outreach needed regarding watershed processes and associated environmental issues Financial institutions wary of lending for LID techniques Not all relevant interests are receiving information	✓✓✓

7.5 Recommendations for EPA-R10

Smart Growth and LID methods, when implemented together, have the ability to reduce or eliminate the negative effects of stormwater runoff to the health of Puget Sound. Opportunities associated with Smart Growth and LID efforts for increased watershed-scale planning and improved multi-jurisdictional coordination and outreach were discussed in previous chapters. Similarly, the specific barriers to regional Smart Growth and LID planning, as indicated by interview participants, as well as recommendations for actions steps to reduce or eliminate the barriers, were also discussed.

EPA-R10 has many very successful working with relationships with state agencies, and county and local jurisdictions. The following are specific aspects of the potential role of EPA-R10 in stormwater runoff reduction efforts, and Smart Growth and LID planning and implementation in the Puget Sound region. This list reflects the most common problems faced by local communities in Smart Growth and LID planning.

EPA-R10 should:

- Encourage watershed-scale planning versus planning within jurisdictional boundaries.
- Provide cross-jurisdictional assistance for watershed planning and stormwater management, and encourage county-city coordinated stormwater plans.
- Assist with integrating federal, state, and local stormwater policies and programs.
- Increase outreach efforts and package Smart Growth and LID to varying audiences: engineers, planners, developers, government officials, financial institutions, property owners, and the general public.
- Create a regional Smart Growth network.
- Monitor and collect data from existing projects to show proof-of-concept.
- While out of the scope of this project, EPA-R10 should determine specific programs and/or incentive mechanisms within its capacity that will best address the issues raised in this paper.

APPENDICES

A: Interview Participants

1. Bailey, Mary Kay
   Date: 4/24/06
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2. Beale, Harriet
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   Director of Outreach, Puget Sound Action Team (PSAT)

3. Bolger, Jim
   Date: 2/27/06
   Director, Kitsap County Department of Community Development

4. Cambalik, John
   Date: 3/24/06
   Regional Liaison, Clallam, Jefferson, and Kitsap counties, Puget Sound Action Team (PSAT)

5. Castle, Art
   Date: 3/23/06
   Home Builders Association of Kitsap County

6. Chalfant, Jeff
   Date: 3/28/06
   Whatcom County Department of Planning and Development Services

7. Estornell, Paula
   Date: 4/27/06
   Manager, Stormwater Program, EPA Region 3 (EPA-R3)

8. Folkerts, Keith
   Date: 2/27/06
   Kitsap County Department of Community Development, Natural Resources Division

9. Goo, Robert
   Date: 4/14/06
   Nonpoint Source Program, EPA National Office

10. Rome, Clea
    Date: 4/14/06
    Clallam County Conservation District

11. Rylko, Michael
    Date: 2/15/06
    EPA Region 10 (EPA-R10)

12. Stanley, Stephen
    Date: 3/24/06
    Washington State Department of Ecology, Shorelands and Environmental Assistance

13. Wenger, Barry
    Date: 3/28/06
    Washington State Department of Ecology

REFERENCES

In addition to the references listed below, the thirteen people interviewed during the research process were invaluable resources for this project. Please see **Appendix A** for a list of interview participants.

Bailey, Chrissy. June 2003. *Low Impact Development: Barriers Towards Sustainable Stormwater Management Practices in the Puget Sound Region.* Masters Thesis, The Evergreen State College.

Beale, Harriet. 2003. *Alternative futures in Puget Sound: The Chico Creek project as a model of integrated land use planning and resource protection*. Puget Sound Action Team.

Bengston, David N., Jennifer O. Fletcher, and Kristen C. Nelson. 2004. Public policies for managing urban growth and protecting open space: policy instruments and lessons learned in the United States. *Landscape and Urban Planning,* 69 (2004) 271-286.

Booth, Derek B. 1991. Urbanization and the natural drainage system – Impacts solutions, and prognoses. *The Northwest Environmental Journal, 7*, 93-118.

Booth, Derek B., David Hartley, and Rhett Jackson. June 2002. Forest cover, impervious-surface area, and the mitigation of stormwater impacts. *Journal of the American Water Resources Association, 38*, 835-845.

City of Seattle. Seattle Public Utilities SEA Streets Project. http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/

Chesapeake Bay Program. December 2002. *Impediments to Low Impact Development and Environmental Sensitive Design*. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC). STAC Publication 02-003.

Davis, Allen P., and Richard H. McCuen. 2005. Stormwater Management for Smart Growth. Springer Science+Business Media Inc. New York.

Hinman, Curtis. 2005. *Low Impact Development Technical Guidance Manual for Puget Sound*. Puget Sound Action Team and Washington State University Pierce County Extension. Publication No. PSAT 05-03

King County Smart Growth. 2002. King County, Washington. http://www.metrokc.gov/smartgrowth/rural.htm.

Low Impact Development Center. May 2006.
http://www.lid-stormwater.net/intro/background.htm

Multi Agency Watershed Task Force. April 2006. DRAFT: *Developing a Watershed characterization & Analysis Approach for Meeting Multiple Mandates in Washington State*.

National Nonpoint Education for Municipal Officials (NEMO) Network. 2006. Washington NEMO Program.
http://nemonet.uconn.edu/programs/about_members/wa/wa_stats.htm

Nelson, Paul. 2003. *Evaluating the implications of watershed change on stream conditions and aquatic habitat.* 2003 Georgia Basin/Puget Sound Research Conference.

Nelson, Paul and Susan Graham. 2003. *Assembling and Presenting Watershed Process Models*. 2003 Georgia Basin/Puget Sound Research Conference.

Parametrix, Inc. 2003. *Kitsap County Chico Watershed Alternatives Analysis: Process and Recommendations*. Project Number 247-1578-098.

Puget Sound Action Team (PSAT). August 2005. *2005-2007 Conservation and Recovery Plan*. Puget Sound Action Team, Office of the Governor. Publication No. PSAT05-09.

Puget Sound Action Team (PSAT). January 2005. *State of the Sound 2004.* Puget Sound Action Team, Office of the Governor. Publication No. PSAT05-01.

Puget Sound Action Team. 2006. *LID is Law in Langley*. Sound Waves, Spring 2006, Vol. 21, No. 1.
http://www.psat.wa.gov/Publications/soundwaves/spring_sw06/stormwater_lid.htm

Puget Sound Action Team. May 2006. http://www.psat.wa.gov/index.htm

Rylko, Michael and Misha Vakoc. Presentation: *Stormwater: Opportunities in Puget Sound.* U.S. Environmental Protection Agency Region 10.

Tyne, Ron. 2000. *Bridging the Gap: Developers Can See Green: Economic Benefits of Sustainable Site Design and Low-Impact Development*. Land Development, Spring/Summer 2000, pg. 27 – 31.

U.S. Environmental Protection Agency. 2006. National Pollution Discharge Elimination System (NPDES) Program. http://cfpub.epa.gov/npdes/index.cfm

U.S. Environmental Protection Agency. 2006. Smart Growth.
http://www.epa.gov/smartgrowth/

U.S. Environmental Protection Agency (EPA). October 2000. *Potential Roles for Clean Water State Revolving Fund Programs in Smart Growth Initiatives*. U.S. Environmental Protection Agency. EPA 832-R-00-010.

U.S. Environmental Protection Agency (EPA). EPA National Award for Smart Growth. 3 citations: 2003 (EPA 231-F-03-002), 2004 (EPA 231-F-04-001), and 2005 (EPA-231-K-05-001). Office of Policy, Economics, and Innovation.

U.S. Environmental Protection Agency (EPA). May 2004. *Protecting Water Resources with Smart Growth*. U.S. Environmental Protection Agency. EPA 231-R-04-002

U.S. Environmental Protection Agency (EPA). October 2004. *Smart Growth 2004*. 2004 Workplan for the Development, Community and Environment Division, U.S. EPA.

U.S. Environmental Protection Agency. May 2005. *Low Impact Development Pays Off.* Nonpoint Source News-Notes, May 2005, #75. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency (EPA). December 2005. *Using Smart Growth as Stormwater Best Management Practices*. U.S. Environmental Protection Agency. EPA 231-B-05-002.

U.S. Environmental Protection Agency. 2006. Watershed Academy. http://www.epa.gov/owow/watershed/wacademy/

Washington State Department of Ecology (Ecology). February 2005. *Stormwater Management Manual for Western Washington, Vol. I-V*. Washington State Department of Ecology Water Quality Program. Publication No. 05-10-30.

Washington State Department of Ecology (Ecology). April 2005. *Wetlands in Washington State, Volume 2: Guidance for Protecting and Managing Wetlands.* WA Department of Ecology Shorelands and Environmental Assistance Program. Ecology Publication #05-06-008.

Washington State Office of Financial Management (WA OFM). 2006. Population Information. http://www.ofm.wa.gov/pop/default.asp