Low Impact Development At The Local Level: Developers' Experiences and City and County Support

Prepared for

The Rock Creek Sustainability Initiative

By

ECONorthwest
99 W. Tenth, Suite 400
Eugene, OR 97401
(541) 687-0051

February 25, 2009

CONTACT INFORMATION

Ed MacMullan and Sarah Reich of ECONorthwest prepared this report for the Rock Creek Sustainability Initiative.

ECO specializes in the economic and financial analysis of public policy. ECO has analyzed the economics of resource-management, land-use development, and growth-management issues for municipalities, state and federal agencies, and private clients for more than 30 years.

For more information, please contact:

Ed MacMullan
macmullan@eugene.econw.com

Sarah Reich
reich@eugene.econw.com

ECONorthwest
99 W. 10th Ave., Suite 400
Eugene, Oregon 97401
541-687-0051
www.econw.com

I. Introduction

In this report we describe the second part of a two-part study organized by the Rock Creek Sustainability Initiative (RSCI). RSCI is a collaboration of Water and Environmental Services of Clackamas County, the City of Happy Valley, and the Sunrise Water Authority. The study focused on developing a 400-acre parcel of industrial land in the City of Happy Valley using sustainable-development principles.

Part one of the study evaluated the effectiveness and costs and benefits of managing stormwater on the study site under three scenarios—conventional controls, conventional with some Low Impact Development (LID) controls, and intensive LID controls. A research team of graduate students from the Department of Urban Studies & Planning and Environmental Sciences at Portland State University, under the direction of Robert Williams and Dr. Barry Messer, conducted the analysis. A report describing the results of the first part of the study can be downloaded from the City of Happy Valley's web site.[1]

This report describes the second part of the analysis, which focused on two aspects of LID adoption at the local level: the experiences that developers have had with LID, and actions that local jurisdictions can take to increase LID use. This part of the analysis looked beyond the study site and relied on descriptions of LID case studies from across the U.S.

In the next subsection of this report, Subsection II, we describe experiences that developers have had with LID. The first part of this subsection summarizes the major challenges that can inhibit developers' use of LID. The second part lists the results of economic analyses of developments that included LID vs. conventional stormwater controls. Under the conditions described in these studies, developments with LID can cost less than comparable developments with conventional stormwater controls, can sell for more, or both.

In Subsection III, we describe actions taken by local jurisdictions that increase LID adoption. This Subsection also has two parts. We first summarize some of the steps taken by local jurisdictions that modify building and inspection codes to include LID. We then list the types of incentives that local jurisdictions use to promote LID.

The last Subsection of this report, Subsection IV, lists actions that the RSCI partners and stakeholders can take to increase LID adoption in their jurisdictions.

[1] The report, "Rock Creek Sustainability Initiative Research Findings" by the Portland State University Research Team, dated December 2008, is available at http://www.ci.happy-valley.or.us/. Find the link to the report by searching on the keywords "Rock Creek Sustainability Initiative."

The Bibliography lists the sources referenced in this report and Appendix A lists additional sources of information on LID.

II. Developers Experiences With Low Impact Development

Baring regulations that mandate LID controls, developers include LID in projects because they believe doing so will help reduce construction costs, increase sales, boost profits, or some combination of the three. The developers' decisions focus primarily on their costs and benefits and not on the costs and benefits that affect others such as municipal stormwater managers or area residents. For example, managing stormwater by LID can reduced downstream flooding, improved water quality of receiving water bodies, reduce combined-sewer overflow events, and reduce the costs of operating municipal-stormwater infrastructure. This report examines LID costs and benefits from the developers' perspective. See ECONorthwest (2007) for information on the wider range of economic benefits that LID can provide.

In this section we summarize developers' experiences with LID. As with other new technologies, adopting LID includes opportunities and risks. We begin by describing the risks and challenges that developers face by including LID in their projects. These risks include uncertain construction delays as developers apply for variances to local zoning codes because the codes do not explicitly recognize LID as an accepted stormwater control. Next, we describe successes that developers have had adopting LID and the resulting impacts on construction costs, sales, and profits.

A. Challenges Developers Face Using LID

Much of the general public is unaware of LID, the benefits these technologies can provide, or their operations and maintenance (O&M) costs. Potential buyers may not understand or appreciate why a developer included LID in a project. A recent study of the barriers of LID adoption in three communities in Oregon found a general lack of understanding by the public of the connections between land-use decisions, stormwater-management alternatives and the resulting impacts on water quality. (Godwin, et al. 2008) This general lack of understanding may give developers pause because they supply products that they believe their customers—homebuyers—want and will purchase. Potential buyers may shy away from homes that include an unfamiliar technology.

A general lack of understanding of LID may concern developers in part because including on-site treatment of stormwater will also require on-site management of stormwater facilities, the LID technologies. Homeowners unfamiliar with LID likely will have limited understanding of their maintenance requirements. (Lewis 2006; England 2002; Foss 2005) For example, a bioswale clogged with sediment may not control stormwater volume or quality as designed, which could negatively reflect on the builder. Another concern has to do with the lack of understanding as to the life expectancy of LID controls. (Lewis 2006) A builder may be concerned that an untimely failure of stormwater controls could negatively affect their reputation.

Similar to the public's general lack of understanding of LID, many builders are also unfamiliar with the technology. A builder may not be able to identify the most effective and least-cost LID technology for a given development from the wide variety of possible LID controls. (Foss 2005; Lewis 2006) A related point is that construction costs for LID technologies are site specific. For example, not all soils can support LID technologies that emphasize stormwater infiltration. Assessing a site and designing LID technologies that will function on the site may also increase a builder's design costs. (Coffman 2002; Strassler et al. 1999)

A much-mentioned impediment to builders' adoption of LID is when building codes do not account for LID as stormwater controls. Many municipalities have zoning and building-inspection standards that were adopted many years ago, long before LID was an option. (Coffman 2002; NAHB Research Center Inc. 2003; Foss 2005; Lewis 2006; CBP 2002; American Rivers and Midwest Environmental Advocates 2008) These standards emphasize conventional stormwater controls that collect stormwater and transport it off site to a receiving water body or to a treatment facility. Municipalities with outdated stormwater regulations typically require that builders file variances if they want to use LID. Filing variances increases design and regulatory costs, which delays construction and can increase a builder's financing costs. (Clar 2004; Coffman 2002; Lewis 2006; NAHB Research Center Inc. 2003)

A related constraint in some jurisdictions with outdated regulations is a lack of technical expertise or understanding by regulators regarding LID stormwater controls. In some cases, regulators unfamiliar with LID must be convinced of the effectiveness of these techniques, which also increases a builder's design and regulatory costs. (Coffman 2002; NAHB 2003; Lewis 2006)

B. Benefits To Developers of Including Low Impact Development in Their Projects

Developers who accept the regulatory uncertainty and other challenges of adopting LID do so with the expectation that controlling stormwater on site can have economic advantages. These advantages include increasing the number of developable lots and reducing expenditures associated with stormwater infrastructure. Managing stormwater on site using LID controls can mean doing away with stormwater ponds, thus increasing a site's developable area. (Coffman 2002; NAHB Research Center Inc. 2003) Selling additional lots can increase a builder's revenues and profits. Replacing curbs, gutters and stormwater pipes with bioswales, pervious pavers and other LID controls can reduce construction costs. (Coffman 2002; NAHB Research Center Inc. 2003; Center for Watershed Protection 2001)

An analysis of a development in Prince George's County, Maryland, documented the impacts that controlling stormwater on site with LID can have on the site's buildable area and construction costs. The Somerset Community development installed rain gardens, grass swales along streets, and other LID controls. Substituting LID for conventional controls saved the developer approximately $900,000. Doing away with the site's stormwater ponds gave the developer six additional lots. (Foss 2005)

A study of the Pembroke Woods Subdivision in Frederick County, Maryland found similar results. (Clar 2004) The developer substituted LID for conventional curbs and gutters, and also eliminated two stormwater ponds. Eliminating the curbs and gutters saved the developer $60,000. Installing narrower streets eliminated impervious area and reduced paving costs by 17 percent. Excluding the stormwater ponds saved $200,000 in construction costs and added two developable lots, valued at $45,000 each. Other economic benefits to the developer included reduced costs of clearing land for development of $160,000, and adding 2.5 additional acres of open space, which lessened the developer's wetland-mitigation requirements.

Conservation subdivisions take a comprehensive approach to stormwater management by combining LID controls with a site design that takes advantage of existing drainage patterns. Narrow streets and clustered building lots make maximum use of natural stormwater controls, thus reducing construction costs. (Center for Watershed Protection 2001) A study of ten subdivisions found that conservation subdivisions that emphasized LID and protected natural drainage patterns cost, on average, thirty-six percent less than subdivisions that relied on conventional stormwater controls. (Conservation Research Institute 2005)

Researchers note that some conservation subdivisions have an additional benefit in that there's greater demand for lots in these subdivisions compared with the demand for lots in conventional subdivisions. Greater demand for lots means the developer can charge more for the lot and lots may sell faster. (Center for Watershed Protection 2001)

A case study of conservation and conventional subdivisions in South Kingstown, Rhode Island quantified the market benefits of conservation developments. The study compared the costs of developing the lots and the market value of the lots. (Mohamed 2006) Results show that the conservation lots cost less to develop and sell for a higher price. On average, conservation lots cost $7,400 less to produce than lots in conventional subdivisions, and sold for 12 to 16 percent more, per acre, than conventional lots. Lots in the conservation subdivision also sold in approximately half the time it took to sell lots in conventional subdivisions.

Another study of cluster developments in New England found that houses in these types of developments appreciate faster than houses in conventional developments. (Lacy 1990) Lacy identified developments in Concord and Amherst, Massachusetts that were characterized by smaller individual lots surrounded by natural open space, limited lot clearing, and narrower streets. He compared these with nearby conventional developments. The Concord cluster development appreciated 26 percent more than conventional developments over an eight-year study period. The Amherst cluster development also yielded a higher rate of return on investment over a 21-year study period, compared to nearby conventional development.

In Tables 1 and 2 below we summarize the results of studies that compared construction costs using LID vs. conventional stormwater controls for residential and commercial developments (respectively). The studies listed in Tables 1 and 2 described the *source* of the cost difference between LID and conventional controls, e.g., substituting a bioswale for curbs and gutters saved $Z. The literature includes many more studies that report cost savings attributed to LID relative to conventional controls, but do not describe the details of the cost savings. We excluded such studies from our analysis.

We distinguish between study results for built developments from results for proposed or modeled developments. In some cases the studies report total cost savings for a development but not savings per lot in the development. In these cases we calculated the per-lot cost savings. We recognize that the cost savings values reported below are in dollars from different years, and so comparisons of cost savings between examples may not be appropriate. We found insufficient data in most case studies to convert all values to the same-year dollars.

The large majority of studies listed in Tables 1 and 2 describe LID installed in, or proposed for, new developments. We found very few studies that measured the economic outcomes of including LID in urban, redevelopment projects. We identified these studies as “retrofits” in the tables.

Table 1: Cost savings from installing LID stormwater controls in residential developments.

Location	Description	LID Cost Savings[a]
Meadow on the Hylebos Residential Subdivision Pierce County, WA	9-acre development reduced street width, added swale drainage system, rain gardens, and a sloped bio-terrace to slowly release stormwater to a creek. Stormwater pond reduced by 2/3, compared to conventional plan. (Zickler 2004)	LID cost 9% less than conventional
Somerset Community Residential Subdivision Prince George's Co., MD	80-acre development included rain gardens on each lot and a swale drainage system. Eliminated a stormwater pond and gained six extra lots. (NAHB Research Center Inc. 2003)	$916,382 $4,604 per lot
Pembroke Woods Residential Subdivision Frederick County, MD	43-acre, 70-lot development reduced street width, eliminated sidewalks, curb and gutter, and 2 stormwater ponds, and added swale drainage system, natural buffers, and filter strips. (Clar 2004; Lehner et al. 2001)	$420,000 $6,000 per lot[b]
Madera Community Residential Subdivision Gainesville, FL	44-acre, 80-lot development used natural drainage depressions in forested areas for infiltration instead of new stormwater ponds. (PATH 2005)	$40,000 $500 per lot[b]
Prairie Crossing Residential Subdivision Grayslake, IL	667-acre, 362-lot development clustered houses reducing infrastructure needs, and eliminated the need for a conventional stormwater system by building a natural drainage system using swales, constructed wetlands, and a central lake. (Lehner et al. 2001; Conservation Research Institute 2005)	$1,375,000- $2,700,000 $3,798-$7,458 per lot[b]
SEA Street Retrofit Residential street retrofit Seattle, WA	1-block retrofit narrowed street width, installed swales and rain gardens. (Tilley 2003)	$40,000
Gap Creek Residential Subdivision Sherwood, AK	130-acre, 72-lot development reduced street width, and preserved natural topography and drainage networks. (U.S. EPA 2005; Lehner et al. 2001; NAHB Research Center Inc. 2003)	$200,021 $4,819 per lot
Poplar Street Apartments Residential complex Aberdeen, NC	270-unit apartment complex eliminated curb and gutter stormwater system, replacing it with bioretention areas and swales. (U.S. EPA 2005)	$175,000
Kensington Estates* Residential Subdivision Pierce County, WA	24-acre, 103-lot hypothetical development reduced street width, used porous pavement, vegetated depressions on each lot, and reduced stormwater pond size. (CH2MHill 2001; U.S. EPA 2005)	$86,800 $843 per lot[b]
Garden Valley* Residential Subdivision Pierce County, WA	10-acre, 34-lot hypothetical development reduced street width, used porous paving techniques, added swales between lots, and a central infiltration depression. (CH2MHill 2001)	$60,000 $1,765 per lot[b]
Circle C Ranch Residential Subdivision Austin, TX	Development employed filter strips and bioretention strips to slow and filter runoff before it reached a natural stream. (EPA 2005)	$185,000 $1,250 per lot

Location	Description	LID Cost Savings[a]
Woodland Reserve* Residential Development Lexana, KS	Reduced land clearing, reduced impervious surfaces, and added native plantings. (Beezhold 2006)	$118,420
The Trails* Multi-Family Residential Lexana, KS	Reduced land clearing, reduced impervious surfaces, and added native plantings. (Beezhold 2006)	$89,043
Medium Density Residential* Stafford County, VA	45-acre, 108-lot clustered development, reduced curb and gutter, storm sewer, paving, and stormwater pond size. (Center for Watershed Protection 1998b)	$300,547 $2,783 per lot[b]
Low Density Residential* Wicomico County, MD	24-acre, 8-lot development eliminated curb and gutter, reduced paving, storm drain, and reforestation needs. Eliminated stormwater pond and replaced with bioretention and bioswales. (Center for Watershed Protection 1998b)	$17,123 $2,140 per lot[b]

Source: ECONorthwest, with data from listed sources.
Notes: * indicates hypothetical or modeled project, not actually constructed.
[a] Dollar amounts as reported at the time of study.
[b] Per-lot cost savings calculated by ECONorthwest.

Table 2: Cost savings from installing LID stormwater controls in commercial developments.

Location	Description	LID Cost Savings[a]
Parking Lot Retrofit Largo, MD	One-half acre of impervious surface. Stormwater directed to central bioretention island. (U.S. EPA 2005)	$10,500-$15,000
Old Farm Shopping Center* Frederick, MD	9.3-acre site redesigned to reduce impervious surfaces, added bioretention islands, filter strips, and infiltration trenches. (Zielinski 2000)	$36,230 $3,986 per acre[b]
270 Corporate Office Park* Germantown, MD	12.8-acre site redesigned to eliminate pipe and pond stormwater system, reduce impervious surface, added bioretention islands, swales, and grid pavers. (Zielinski 2000)	$27,900 $2,180 per acre[b]
OMSI Parking Lot Portland, OR	6-acre parking lot incorporated bioswales into the design, and reduced piping and catch basin infrastructure. (Liptan and Brown 1996)	$78,000 $13,000 per acre[b]
Light Industrial Parking Lot* Portland, OR	2-acre site incorporated bioswales into the design, and reduced piping and catch basin infrastructure. (Liptan and Brown 1996)	$11,247 $5,623 per acre[b]
Point West Shopping Center* Lexana, KS	Reduced curb and gutter, reduced storm sewer and inlets, reduced grading, and reduced land cost, used porous pavers, added bioretention cells and native plantings. (Beezhold 2006)	$168,898
Office Warehouse* Lexana, KS	Reduced impervious surfaces, reduced storm sewer and catch basins, reduced land cost, added bioswales and native plantings. (Beezhold 2006)	$317,483
Retail Shopping Center*	9-acre shopping development reduced parking lot area, added porous pavers, clustered retail spaces, added infiltration trench, bioretention and a sand filter, reduced curb and gutter and stormwater system, and eliminated infiltration basin. (Center for Watershed Protection 1998b)	$36,182 $4,020 per acre[b]
Commercial Office Park*	13-acre development reduced impervious surfaces, reduced stormwater ponds and added bioretention and swales. (Center for Watershed Protection 1998b)	$160,468 $12,344 per acre[b]
Tellabs Corporate Campus Naperville, IL	55-acre site developed into office space minimized site grading and preserved natural topography, eliminated storm sewer pipe and added bioswales. (Conservation Research Institute 2005)	$564,473 $10,263 per acre[b]
Vancouver Island Technology Park Redevelopment Saanich, British Columbia	Constructed wetlands, grassy swales and open channels, rather than piping to control stormwater. Also used amended soils, native plantings, shallow stormwater ponds within forested areas, and permeable surfaces on parking lots. (Tilley 2003)	$530,000

Source: ECONorthwest, with data from listed sources.
Notes: * indicates hypothetical or modeled project, not actually constructed.
[a] Dollar amounts as reported at the time of study.
[b] Per-acre cost savings calculated by ECONorthwest.

III. Promoting Low Impact Development at the Local Level

In this Subsection we describe the two most common and effective methods that local jurisdictions across the U.S. use to promote LID: LID-friendly regulations, and construction incentives.

A. Modifying Building and Inspection Codes to Include Low Impact Development

During the early years of LID use, the most often heard complaint against LID from developers was cost. LID labor and material cost more than the costs of installing conventional controls. Over time, as developers learned more about LID technologies and as the number of suppliers of LID materials and the number of design firms with LID experience increased, developers found that in many cases, LID controls can cost less than conventional controls. The results described in the previous subsection, Subsection II, illustrate this point.

Today, the most often-heard complaint against LID from developers who have some LID experience is meeting building and inspections codes that were written long before LID controls were developed. Most codes emphasize conventional methods of managing stormwater. In many cases, developers interested in using LID must file for variances from established building codes. Such a process may require additional design and engineering studies, takes more time, which increases the developer's uncertainty and interest charges, and includes the risk that the variance will not be granted. In some cases, LID approval depends on *also* installing conventional controls, thus defeating the purpose of filing for the variance.

Municipal entities that enforce building and inspection standards can also modify these standards in ways that acknowledge LID. In this subsection we list sources of information on modifying building and inspection codes to make them more LID friendly. The list includes sources specific to Oregon and the Pacific Northwest, as well as from outside the region.

Godwin et al. (2008) conducted case studies of barriers and opportunities for LID adoption in three Oregon communities. Their report describes the challenges that both developers and regulators face when proposed developments include LID but local building and inspection standards do not account for anything but conventional controls.

The Oregon Department of Land Conservation and Development (2000) developed a guidebook of model water-quality codes. The guidebook was written specifically for small city and county governments and includes model zoning-code ordinances and comprehensive plan policies. The LID controls addressed in the guidebook include porous pavers, vegetated filter strips, infiltration trenches, and roof downspout drains.

The Metro regional government developed a Habitat Protection Model Ordinance. (Metro, No Date) Metro produced this draft ordinance to help communities comply with habitat-protection requirements. Even though the document focuses on habitat, the model ordinance includes a number of LID controls including:

- Using pervious paving materials for driveways, parking lots and walkways.
- Landscaping with rain gardens that provide on-site stormwater detention and filtration and groundwater recharge.
- Disconnecting downspouts from stormwater pipes and directing flows to vegetated infiltration areas or to rain barrels.
- Using swales and other open drainage systems in place of curb-and-gutter systems.

Beginning in 2005, the Puget Sound Partnership implemented its Low Impact Development Local Regulatory Assistance Project. (Puget Sound Partnership, No Date) The Project consists of Partnership staff and city and county staff developing new regulations and modifying existing regulations. The Project started because most local regulations in Puget Sound at the time impeded or prohibited LID-type stormwater controls.

To date, the Partnership has conducted Projects with local government staff during 2005, 2006 and 2008. Each year's Project produces a report that describes the local governments that participated in the Project, the regulations reviewed, recommendations for specific language changes, and descriptions of maintenance considerations. These reports can be downloaded from the Partnership's Project web site http://www.psparchives.com/our_work/stormwater/lid/lid_regs.htm .

Thurston County's Development Services Department conducted a review of existing stormwater regulations to determine if the County should develop LID-specific regulations and standards. (Thurston County, No Date) The County describes the Department's deliberation process on its website, http://www.co.thurston.wa.us/permitting/low-impact-development/index.htm . The Department included input from a Citizen Advisory Committee and a Technical Working Group. Committee and Group reports are also available on the website.

The U.S. Environmental Protection Agency (EPA) (No Date-A) developed model ordinances that target designing, maintaining and inspecting stormwater controls. The EPA's web site also includes the text of five local stormwater ordinances from cities around the U.S.

The Center for Watershed Protection (No Date) includes a list of model ordinances that address stormwater management on its web site, http://www.cwp.org/Resource_Library/Model_Ordinances/ . The model ordinances can be use as-is or modified to meet specific requirements or conditions of a given city or county stormwater management plan.

American Rivers and Midwest Environmental Advocates (2008) developed a handbook on stormwater-management issues for local decisionmakers and stakeholders. The handbook is general in scope—it does not include model ordinances for example—but it does list the major steps to consider when developing stormwater-management regulations. Chapter 4 of the handbook describes the general process of modifying ordinances to make them LID friendly and the major topics that such ordinances should address.

A number of cities and counties list LID-friendly stormwater ordinances on their web sites. A recent Google search of "LID regulation" found the following LID ordinances:

- City of Sammamish, Washington: Ordinance 02008-236 Low Impact Development Regulations. An ordinance of the City of Sammamish, Washington, amending the City of Sammamish Municipal Code to create a Low Impact Development Chapter, and amending certain other Chapters of the City of Sammamish Municipal code to ensure consistency with the Low Impact Development Chapter. http://www.ci.sammamish.wa.us/Ordinances.aspx?ID=107 (accessed January 5, 2009).

- Fauquier County, Virginia: A zoning ordinance text amendment to Sections 5-006.5, 12-610 and 15-300 related to utilization of Low Impact Development techniques with site development. http://www.fauquiercounty.gov/government/departments/BOS/pastagendas/02-14-08/lid_ord.htm (accessed January 5, 2009).

- Township of Lower Makefield, Pennsylvania: Ordinance No. 364. An ordinance of the Township of Lower Makefield, Bucks County, Pennsylvania, amending the Lower Makefield Township Codified Zoning Ordinance of 1996, as amended, so as to provide for Low Impact Development Standards. http://www.lmt.org/LID%20-%20ZONING%20v%206%20_4_.pdf (accessed January 5, 2009).

B. Incentives That Promote Low Impact Development

Cities and counties offer a range of incentives to the private sector that promote green development in general, and LID specifically. (Yudelson Associates, 2007; U.S. Green Building Council, 2008; Dunn and Stoner, 2007; US EPA, 2008; US EPA, No Date-B; City of Portland, Oregon, No Date; and Merrill et al., 2008) These incentive programs generally work in one of three ways.

1. *Reduce developers' costs*, for example by lowering permitting fees.
2. *Reduce developers' risks,* for example by expediting permitting.
3. *Increase developers' revenues*, for example by allowing development densities greater than that permitted by code.

Incentives that help reduce costs include:

- *Reduced Fees*. Fee incentives include reduced application fees that developers pay for proposed developments, or reduced monthly stormwater fees that property owners pay.

- *Tax Rebates*. In some cases cities rebate a portion of a development's property tax in exchange for including LID or other green components. Tax rebates can be a one-time payment or a series of payments over a set number of years, with the payments declining each year.

- *Grants.* Cities or counties may award grants to green-development projects based on a set of pre-defined criteria. The grants can help offset construction costs. Cities can also apply for state and federal grants[2] that support LID demonstration projects on private lands or add LID controls to public buildings (e.g., schools and libraries).

Incentives that help reduce risk include:

- *Expedited Permitting*. Some jurisdictions give priority to projects that include LID or other types of green development and process permits for these projects faster (and at lower cost to the developer) than permits for conventional projects.

- *Clearly Defined Guidelines*. Cities and counties can help reduce the risks that developers face when including a new-to-them green technology such as LID in a project by clearly defining the building and inspection guidelines for the green technology. Establishing a dedicated review team that focuses on LID or green-development aspects of projects can also help.

[2] See US EPA 2008, and US EPA No Date-B for a list of funding sources.

- *LID Education Outreach*. Conducting education programs targeting builders that focus on LID construction techniques and supplies can also help reduce the risks for developers who are unfamiliar with these techniques.

Incentives that help increase revenues include:

- *Density Bonuses*. Builders that include LID in their projects can build at a higher density than they would otherwise be allowed.

- *Zoning Variance*. Builders that include LID in their project can build to a different land use (e.g., multiple use rather than commercial) than they otherwise would be allowed.

IV. Next Steps

Possible next steps to promote LID in the RSCI jurisdictions include the following.

1. Evaluate Technical Aspects of LID

Evaluate the engineering, soils, hydrology and other technical requirements of LID controls that could be included in local developments. The feasibility and performance of LID practices depends on local site conditions. Identify the LID options that work best given local soil permeability, slope, aspect and other factors. Limiting the range of LID options to those that work best under local conditions will also help reduce some of the uncertainty that developers face when designing projects.

Jurisdictions elsewhere are starting to do this. For example, the Kitsap Home Builders Foundation (2008) developed a handbook of LID practices for Kitsap County. The handbook was designed to help developers and landscape and road designers add LID stormwater controls to their projects. The handbook focuses on site assessment and planning and technical guidance on specific LID practices (e.g., pervious pavement, vegetated roofs, bioretention, and cluster development). The handbook is significant because it was published by home builders—those who install LID controls that must meet local building codes and inspection standards—and because it includes input from both developers *and* local jurisdictions in Puget Sound. As a result, the handbook serves as a guide to both groups interested in expanding LID stormwater controls in Puget Sound and elsewhere.

2. Develop LID-Friendly Building Codes and Inspection Standards

One of the most effective methods of promoting LID is removing the regulatory barriers that increase developers' risks and costs, which in turn, inhibit LID adoption. The resources listed in Subsection III.A. above, can help decisionmakers and stakeholders identify building and inspection codes that limit LID installations, and modify these coded or write new LID-friendly codes. To the extent that the partner jurisdictions limit their LID promotion to one area or process it should be this topic—develop LID-friendly building and inspection codes.

3. Consider Feasible Incentives

It is not uncommon that when decisionmakers modify building and inspection codes to make them more LID friendly they also develop LID incentives. As described in Subsection III.B. above, these incentives help mitigate developers' costs or risks, increase their revenues, or a combination of the three. Some of the incentives, such as expedited permitting or density bonuses, have little to no impact on a jurisdiction's costs or budget. Others, such as fee reductions or tax rebates, have little to no direct impact on costs but reduce revenues. The full economic impact on the jurisdiction, however, may be positive, to the extent that the LID controls help reduce demands for services or indirectly reduce costs, e.g., by reducing flooding.

Bibliography

American Rivers, Inc. and Midwest Environmental Advocates, Inc. 2008. *Local Water Policy Innovation*. September. Retrieved January 6, 2008, from www.americanrivers.org/site/DocServer/Local_Water_Policy_Innovation_Stormwater_Oct_2008.pdf?docID=8401

Beezhold, M.T. and D.W. Baker. 2006. *Rain to Recreation: Making the Case for a Stormwater Capital Recovery Fee*. Presented at the WEFTEC.06 Conference in Dallas, TX. October 22. Retrieved October 26, 2007, from http://www.environmental-expert.com/resultEachArticlePDF.aspx?cid=5306&idmainpage=70&level=2&codi=11741

Center for Watershed Protection. 1998. *Nutrient Loading from Conventional and Innovative Site Development*. Chesapeake Research Consortium. July. Retrieved October 26, 2007, from http://cwp.org.master.com/texis/master/search/+/form/nutrient.html

Center for Watershed Protection. 2001. *The Economic Benefits of Protecting Virginia's Streams, Lakes, and Wetlands and The Economic Benefits of Better Site Design in Virginia*. Virginia Department of Conservation and Recreation. December. Retrieved October 26, 2007, from http://www.dcr.virginia.gov/soil_&_water/documents/swmecon.pdf

Center for Watershed Protection. No date. *Tool 3 Post-Construction Guidance Manual Post-Construction Stormwater Model Ordinance*; and *A Local Ordinance to Protect Wetland Functions*. Retrieved January 9, 2009, from http://www.cwp.org/Resource_Library/Model_Ordinances/

CH2MHill, Inc. 2001. *Pierce County Low Impact Development Study*. Final Report. Pierce County, Washington. April 11. Retrieved October 26, 2007, from http://piercecountywa.gov/xml/services/home/environ/water/CIP/LID/final-lid-report.pdf

Chesapeake Bay Program's Land (CBP), Growth and Stewardship Subcommittee and Virginia Tech's Institute for Innovative Governance. 2002. *Proceedings of Three Workshops on Impediments to Low Impact Development and Environmental Sensitive Design*. Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC) Publication 02-003. December.

City of Portland, Oregon. No date. Appendix I Summary of Government LEED Incentives.http://www.portlandonline.com/BDS/INDEX.CFM?a=217410&c=46633 accessed January 5, 2009.

Clar, M. 2004. *Pembroke Woods: Lessons Learned in the Design and Construction of an LID Subdivision*. Presented at the Low Impact Development 2004 Conference in College Park, MD. Prince George's County, MD and the Anacostia Watershed Toxics Alliance. September 21-23. Retrieved October

26, 2007, from http://www.mwcog.org/environment/LIDconference/downloads/Final LID Conference Program_091504.pdf

Coffman, L.S. 2002. "Low Impact Development: Smart Technology for Clean Water - Definitions, Issues, Roadblocks, and Next Steps." In E.W. Strecker and W.C. Huber, eds., *Urban Drainage 2002: Global Solutions for Urban Drainage, 9th International Conference on Urban Drainage*. American Society of Civil Engineers.

Conservation Research Institute. 2005. *Changing Cost Perceptions: An Analysis of Conservation Development*. Prepared for the Illinois Conservation Foundation and Chicago Wilderness. February. Retrieved October 26, 2007, from http://www.cdfinc.com/CDF_Resources/Cost Analysis - Part 1 - Report - with Exec Summary.pdf

ECONorthwest. 2007. *The Economics of Low-Impact Development: A Literature Review*. November.

England, G. 2002. "Low-Impact Development Revisited." *Stormwater* 3 (1). Retrieved October 26, 2007, from http://www.mswmanagement.com/sw_0201_low.html

Fauquier County, Virginia. No date. "A Zoning Ordinance Text Amendment to Sections 5-006.5 and 15-300 Related to Utilization of Low Impact Development Techniques with Site Development." http://www.fauquiercounty.gov/government/departments/BOS/pastagendas/02-14-08/lid_ord.htm. Accessed January 5, 2009.

Foss, A. 2005. "Low Impact Development: An Alternative Approach to Site Design." *PAS Memo*: May/June. Retrieved October 26, 2007, from http://www.pathnet.org/si.asp?id=1592

Goodwin, D.; Parry, B.; Burris, F.; and Chan, S. 2008. *Barriers and Opportunities for Low Impact Development: Case Studies from Three Oregon Communities*. Oregon Sea Grant and Oregon State University. ORESU-W-06-002.

Kitsap Home Builders Foundation. 2008. *Low Impact Development (LID) Guidance Manual – A Practical Guide to LID Implementation in Kitsap County*, Version 1 (Review Draft). http://www.kitsaphba.com/foundation.html accessed February 14, 2009.

Lacy, J. 1990. *An Examination of Market Appreciation for Clustered Housing with Permanent Open Space*. University of Massachusetts, Amherst, Department of Landscape Architecture and Regional Planning. Retrieved October 26, 2007, from http://www.umass.edu/larp/crm/Lacy/LacyMarket.html

Lehner, P.H., G.P. Aponte Clark, D.M. Cameron, and A.G. Frank. 2001. *Stormwater Strategies: Community Responses to Runoff Pollution*. Natural

Resources Defense Council. May. Retrieved October 26, 2007, from http://www.nrdc.org/water/pollution/storm/stoinx.asp

Lewis, K. 2006. *The Role of EPA Region 10 in Smart Growth and Low Impact Development Planning and Implementation in the Puget Sound Region*. Master's Thesis. University of Washington, Daniel J. Evans School of Public Affairs. June 8. Retrieved October 26, 2007, from http://evans.washington.edu/research/psclinic/pdf/05-06/Lewis_DP_final.pdf

Liptan, T. and C.K. Brown. 1996. *A Cost Comparison of Conventional and Water Quality-Based Stormwater Designs*. Portland, OR: City of Portland, Bureau of Environmental Services and Woodward-Clyde Consultants.

Lower Makefield, Township. No date. *Ordinance No. 364. An Ordinance of the Township of Lower Makefield, Bucks County, Pennsylvania, Amending the Lower Makefield Township Codified Zoning Ordinance of 1996, as Amended, so as to Provide for Low Impact Development Standards*. Retrieved January 9, 2009, from http://www.lmt.org/LID%20-%20ZONING%20v%206%20_4_.pdf

Merrill, S., et al. 2008. *Sustainable Portland: Implementation Series 1*. Community Planning and Development Program, Muskie School of Public Service, Portland, Maine. New England Environmental Finance Center Series Report #08-04. Spring.

Metro. No date. *Habitat Protection Model Ordinance*. Retrieved January 9, 2009, from http://www.oregonmetro.gov/index.cfm/go/by.web/id=15311

Mohamed, R. 2006. "The Economics of Conservation Subdivisions: Price Premiums, Improvement Costs and Absorption Rates." *Urban Affairs Review* 41 (3): 376-399.

NAHB Research Center Inc. 2003. *The Practice of Low Impact Development*. U.S. Department of Housing and Urban Development, Office of Policy Development and Research. July. Retrieved May 4, 2007, from http://www.huduser.org/Publications/PDF/practLowImpctDevel.pdf

Oregon Department of Land Conservation and Development. 2000. Water Quality Model Code and Guidebook. October. Retrieved January 9, 2009, from http://www.oregon.gov/LCD/waterqualitygb.shtml

Partnership for Advancing Technology in Housing (PATH). 2005. *Low-Impact Development in the Madera Community, Gainesville, Florida*. August. Retrieved August 23, 2007, from http://www.pathnet.org/si.asp?id=1627

Puget Sound Partnership. No date. *LID Local Regulation Assistance Project*. http://www.psparchives.com/our_work/stormwater/lid/lid_regs.htm. Accessed January 9, 2009.

Sammish, City of. No date. *Ordinance 02008-236: Low Impact Development Regulations*. http://www.ci.sammamish.wa.us/Ordinances.aspx?ID=107. Accessed January 5, 2009.

Strassler, E., J. Pritts, and K. Strellec. 1999. *Chapter 6: Costs and Benefits of Storm Water BMPs*. Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA Report No. EPA-821-R-99-012. Washington D.C.: U.S. Environmental Protection Agency, Office of Water. August. Retrieved May 10, 2007, from http://www.epa.gov/waterscience/guide/stormwater/files/usw_d.pdf

Thurston County, WA. No date. Development Services: Low Impact Development. Retrieved January 9, 2009, from http://www.co.thurston.wa.us/permitting/low-impact-development/index.htm

Tilley, S. 2003. *Natural Approaches to Stormwater Management: Low Impact Development in Puget Sound*. Puget Sound Action Team. March. Retrieved August 2, 2007, from http://www.psat.wa.gov/Publications/LID_studies/lid_natural_approaches.pdf

U.S. Environmental Protection Agency. 2005. *Low-Impact Development Pays Off*. Nonpoint Source News-Notes. No. 75. May. Retrieved August 23, 2007, from http://www.epa.gov/NewsNotes/issue75/75issue.pdf

________. No date A. *Model Ordinances to Protect Local Resources; Stormwater Control Operation & Maintenance*; and *Model Ordinances Language*. Retrieved January 9, 2009, from http://www.epa.gov/owow/nps/ordinance/

________. No date B. *Green Infrastructure Funding Opportunities*. http://cfpub.epa.gov/npdes/greeninfrastructure/fundingopportunities.cfm accessed January 5, 2009.

________. 2008. *Managing Wet Weather with Green Infrastructure Municipal Handbook Funding Options*. EPA-833-F-08-007. September.

U.S. Green Building Council. 2008. Summary of Government LEED Incentives. http://www.usgbc.org/showfile.aspx?documentid=2021.

Virginia, Commonwealth. No data. *Virginia Stormwater Management Program: Code of Virginia-Stormwater Law*; *Chapter 60 Virginia Stormwater Management Program Permit Regulations*; and *Virginia Stormwater Utility Law*. Retrieved January 9, 2009, from http://www.dcr.virginia.gov/soil_&_water/stormwat.shtml#pubs

Yudelson Associates. 2007. *Green Building Incentives That Work: A Look at How Local Governments Are Incentivizing Green Development*. Prepared for and Funded by The National Association of Industrial and Office Properties Research Foundation.

Zickler, L. 2004. "Low-Impact Development Comes to Pierce County." *Seattle Daily Journal of Commerce* July 29. Retrieved August 2, 2007, from http://www.djc.com/news/en/11159535.html

Zielinski, J. 2000. "The Benefits of Better Site Design in Commercial Development." *Watershed Protection Techniques* 3 (2): 647-656.

Appendix A: Additional Low-Impact Development Resources

American Water Resources Association Cahaba/Warrior Student Chapter http://www.eng.ua.edu/~awra/download.htm

Center for Watershed Protection's Stormwater Center http://www.stormwatercenter.net/

Chesapeake Bay Program and Virginia Tech Institute for Innovative Governance. 2002. *Proceedings of Three Workshops on Impediments to Low Impact Development and Environmental Sensitive Design*. STAC Publication No. 02-003. December. Retrieved October 26, 2007, from http://www.chesapeake.org/stac/Pubs/ILIDFinalReport.pdf

Dreher, D.W. and T.H. Price. 1997. *Reducing the Impacts of Urban Runoff: The Advantages of Alternative Site Design Approaches*. Chicago, IL: Northeastern Illinois Planning Commission and the Illinois Environmental Protection Agency, Division of Water Pollution and Control. April.

Hager, M.C. 2003. "Low-Impact Development: Lot-level Approaches to Stormwater Management are Gaining Ground." *Stormwater* 4 (1): 15. Retrieved October 26, 2007, from http://www.forester.net/sw_0301_low.html

Horsley Witten Group. *Low-Impact Development Case Study: Pinehills, Plymouth, MA*. Massachusetts Executive Office of Environmental Affairs. Retrieved October 26, 2007, from http://www.mass.gov/envir/lid/pdf/smartgrowth_pinehills.pdf

Kollin, C. 2006. "How Green Infrastructure Measures Up to Structural Stormwater Services." *Stormwater* 7 (5). Retrieved October 26, 2007, from http://www.forester.net/sw_0607_how.html

Low Impact Development Center, Inc. http://www.lowimpactdevelopment.org

Low Impact Development Center. No Date. *Low Impact Development (LID) Urban Design Tools*. Retrieved October 26, 2007, from http://www.lid-stormwater.net/intro/sitemap.htm

Low Impact Development Center. 2005. *Low Impact Development for Big Box Retailers*. U.S. Environmental Protection Agency, Office of Water. November. Retrieved October 26, 2007, from http://www.lowimpactdevelopment.org/bigbox/lid%20articles/bigbox_final_doc.pdf

Prince George's County, Maryland, Department of Environmental Resources http://www.goprincegeorgescounty.com/government/agencyIndex/DER/index.asp

Price George's County, Maryland, Department of Environmental Resources, Programs and Planning Division. 1999. *Low-Impact Development Design*

Strategies: An Integrated Approach. June. Retrieved November 14, 2007, from http://www.epa.gov/OWOW/nps/lidnatl.pdf

Puget Sound Action Team. 2005. *Low Impact Development Technical Guidance Manual for Puget Sound*. Puget Sound Action Team and Washington State University Pierce County Extension. January.

Puget Sound Action Team. 2000. *Local Government Low Impact Development Ordinances and Regulations*. Retrieved November 14, 2007, from http://www.psat.wa.gov/Programs/LID/LID_ordinances.htm

Puget Sound Water Quality Action Team http://www.psat.wa.gov

U.S. Environmental Protection Agency http://www.epa.gov/owow/nps/urban.html

University of British Columbia Sustainable Communities http://www.sustainable-communities.agsci.ubc.ca

University of Washington Center for Urban Water Resources http://depts.washington.edu/cuwrm/

Urban Lands Institute http://www.uli.org

Van Roon, M. 2005. "Emerging Approaches to Urban Ecosystem Management: The Potential of Low Impact Urban Design and Development Approaches." *Journal of Environmental Assessment Policy and Management* 7 (1): 125-148.

Washington State Department of Ecology http://www.ecy.wa.gov/programs/wq/wqhome.html

Weinstein, N. 2002. "Low Impact Development Retrofit Approach for Urban Areas." In *Proceedings of the Seventh Biennial Stormwater Research & Water Management Conference*. Brooksville, FL: Southwest Florida Water Management District. May. Pp. 98-104. Retrieved March 21, 2007, from http://www.swfwmd.state.fl.us/documents/publications/7thconference_proceedings.pdf