Integrating LID into Local Codes:

A GUIDEBOOK FOR LOCAL GOVERNMENTS

Final
July 2012

Prepared by AHBL for the Puget Sound Partnership





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AHBL

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FORWARD

When a group of early implementers and I were planning our region's (and the nation's) first conference on LID in 2000, many regional professionals asked "LID? Do you mean local improvement district?"

We have come a long way in 11 years. Not only is the term Low Impact Development, or LID, well understood today, our region is viewed by many as a national leader as a result of our many LID projects, LID professional training and certificate programs, *Low Impact Development Technical Guidance Manual for Puget Sound (LID Technical Guidance Manual)*, continual refinements to LID techniques, and LID monitoring and research. The Washington State University Puyallup Research & Extension Center is now one of the most extensive research centers for LID in the nation. Seattle Public Utilities' Natural Drainage Systems projects have won national awards. Local government staff and private sector design professionals and developers, too numerous to list here, provide a robust knowledge and experience base to draw from as new projects are contemplated.

We in the stormwater field in the Puget Sound region are indeed fortunate. I feel very fortunate to have been given the opportunity to move LID forward in this region by collaborating with many fine people on LID education, professional training, technical guidance development, and local code assistance.

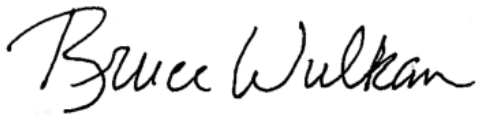
Over the past decade, our region has been transitioning from the use of conventional stormwater management practices to the LID approach, and for very good reasons. Science and monitoring shows the Sound is in decline and stormwater runoff from developed lands plays a big role in that decline. Salmon are threatened with extinction. The majority of many toxic compounds reach the Sound via surface runoff. Bottom-dwelling species like English sole bear a toxic burden due to chemicals carried by stormwater. Harvest at more and more shellfish growing areas is restricted due to polluted stormwater runoff. Many swimming beaches are closed due to stormwater runoff. Urban bay sediments are contaminated due to stormwater and other sources. The overall health of many freshwater ecosystems, as measured by insects in streams, is declining due to our inability to completely mitigate the range of harms caused by watershed development. Clearly, our past stormwater management and land development practices are not working.

The reasons for using LID go well beyond environmental protection. Like most other things, stormwater management is becoming more costly, and we need more cost-effective means of managing runoff than expensive pipes, catch basins, and ponds. Communities want to grow greener and more sustainably. Conventional practices, like stormwater ponds surrounded by chain link fences, can be eyesores and typically provide only the one function while LID techniques, such as bioretention and vegetated roofs, provide multiple benefits.

These and other reasons led the Pollution Control Hearings Board to issue a series of decisions in 2008 and 2009 directing the Department of Ecology (Ecology) to require rather than just encourage LID in municipal stormwater permits for western Washington. Ecology has developed LID requirements for the municipal stormwater permits, and this guidebook is intended to help permittees comply with requirements to change their local codes and standards. The guidebook is equally intended to help staff at local governments not covered by municipal stormwater permits revise their codes and standards to make LID the preferred choice for stormwater management.

From 2005 through 2009, the Partnership led the LID Local Regulation Assistance Project, which provided detailed recommendations to 36 local governments for removing barriers to LID, and either encouraging or requiring LID. After this experience, I fully appreciate the time and effort that goes into revising existing and developing new local codes and standards to make LID the recommended option for stormwater. It takes a lot of time and energy. Yet this critical step must be taken.

I hope you find this guidebook helpful as you undertake the process of revising your local codes and standards to include LID. By doing so, you will also be helping to transition your community to a greener, more sustainable form of stormwater management.



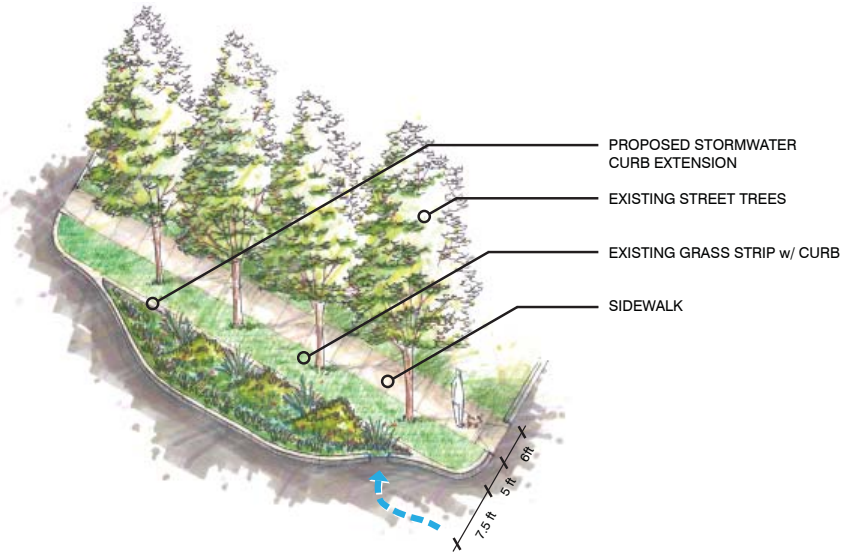
Bruce Wulkan, Puget Sound Partnership

Introduction

Purpose of This Guidebook

The purpose of this guidebook is to help local government staff throughout Western Washington incorporate low impact development (LID) into local land development and stormwater management codes, standards, and regulations. The guidebook represents the best ideas that we have found for implementing LID. LID requirements are envisioned to be part of Ecology's Western Washington NPDES (National Pollutant Discharge Elimination System) Municipal General Stormwater Permit, and the permit is the source for LID requirements. In the guidebook, this permit will be referred to as the municipal stormwater permit.

The guidebook describes a systematic approach for integrating LID into existing and new codes. The intent of the guidebook is to encourage the use of LID as the first choice to manage stormwater where feasible. This guidebook is intended as a resource for local governments complying with LID requirements associated with the pending reissuance of the Phase I and Phase II municipal stormwater permits. Permittees need to refer to the Ecology permit for specific requirements. In addition, the guidebook is meant to be used by local governments that are not subject to the reissued permits, but who wish to integrate LID requirements into their codes and standards.



This guidebook includes approximate timelines for the various tasks as well as important lessons we've learned about the adoption and implementation of LID codes. In the Appendix, the guidebook provides citations to additional information sources on LID and links to websites as well as the link to "My Puget Sound," which will include a blog for discussing LID code adoption and implementation. For information on definitions of LID terms and specific technical information on LID techniques, please refer to the latest edition of the *LID Technical Guidance Manual*.

Intended Audiences

This guidebook is intended primarily for local government staff responsible for integrating LID into development codes and standards and other staff involved in stormwater management and planning. In addition, the guidebook is intended for members of the development community who wish to gain a better understanding of LID and implications for new development, and others who are interested in LID and its implementation.

How to Use the Guidebook:

THE SECTIONS ARE ORGANIZED AS FOLLOWS:

INTRO

WHY LID? — Why Integrate LID into Codes?

Explains the reasons behind integrating LID into local codes and standards.

START

STEP 1 {WHO}: — Assemble the Project Team

Discusses ***Who*** needs to be included to make the project team comprehensive, such as key internal participants and potential key external parties who need to be brought into this process.

STEP 2 {WHAT}: — Understand General Topics to Address

Links the ***Who*** in Step 1 to the ***Where*** in Step 3 and identifies the topics to be addressed.

STEP 3 {WHERE}: — Review Existing Codes and Standards

Identifies ***Where*** general LID topics are found in codes and standards, and how to perform a gap analysis to determine where changes are needed.

STEP 4 {FILL THE GAPS}: — Amend Existing Codes and Develop New Codes

Describes the site analysis process and explains how to translate that process into codes and standards by ***Filling the Gaps*** in existing codes and standards or presenting recommendations for new codes and standards.

STEP 5 {REVIEW & ADOPT}: — Public Review and Adoption Process

Explains the importance of identifying and engaging stakeholders early in the ***Public Review and Adoption Process***, presents an overview of the code modification process, and reviews the timing and steps in the public review process.

STEP 6 {IMPLEMENT}: — Ensure Successful Implementation

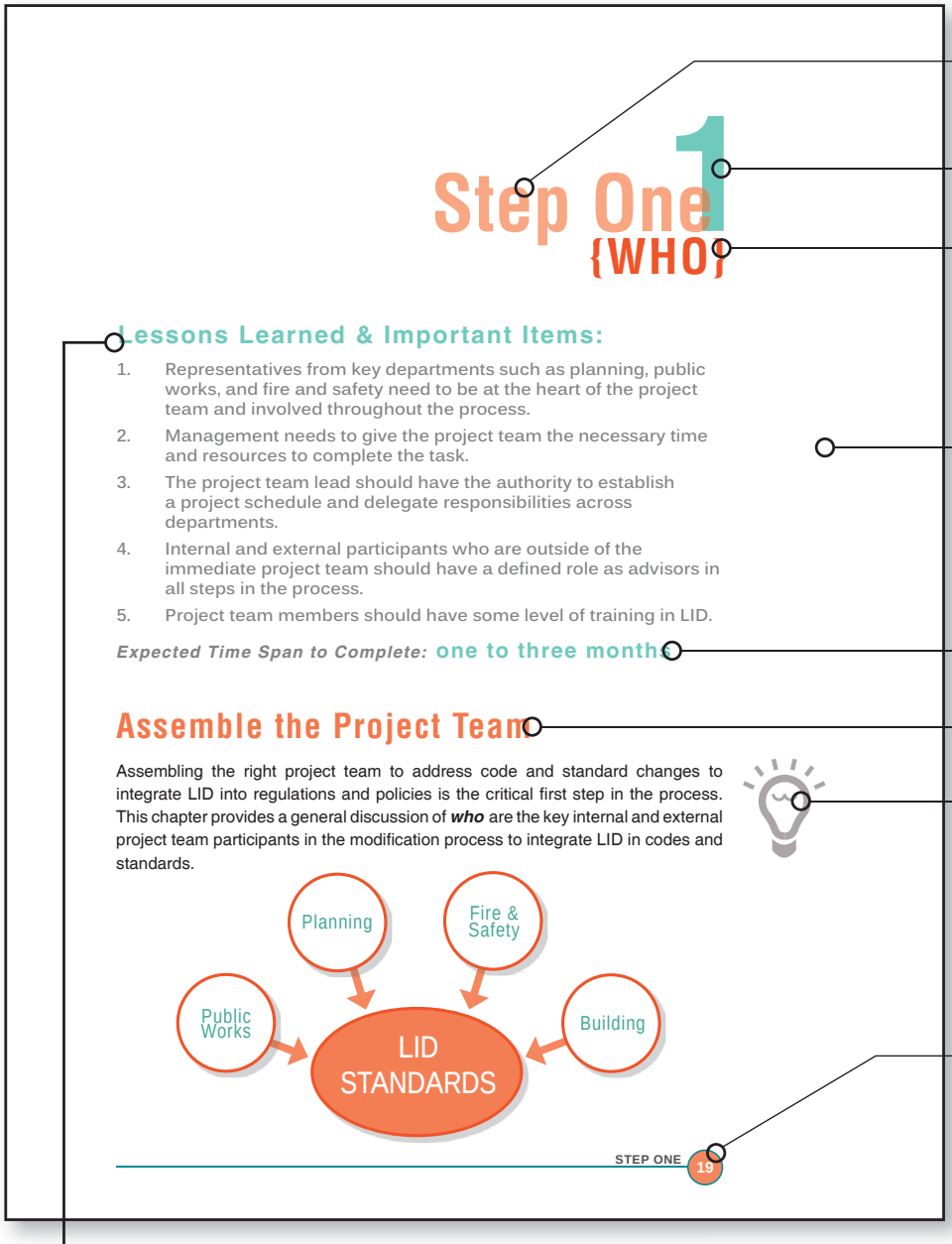
Discusses how to ***Implement the Changes*** successfully through permit review procedures, ongoing training and education, establishing maintenance procedures for LID facilities, and enforcement.

RESOURCES

APPENDIX

The Appendix provides citations to additional information on LID and links to websites.

HOW PAGES ARE FORMATTED:



Each Step can be identified by its individual color

Step Number

Action Item

Area for Notes

Expected Time Span to Complete Step

Section Subject

Icons to point out helpful tips, resources, etc.

Page Number with corresponding color for quick reference to each Step

Lessons Learned as a result of working directly with the 36 local governments during the 2005 - 09 LID Local Regulation Assistance Project and other related experience

THIS GUIDEBOOK IS ORGANIZED AS FOLLOWS:

ICON KEY

COST SAVINGS

LID DEFINITIONS

DID YOU KNOW?

LID EXAMPLES

Introduction

{Why LID?}

WHO

Why LID?
Why Integrate LID into Codes?

This chapter provides background on LID, including what LID means, ***why*** it is the best way to manage stormwater, and the key judicial and regulatory decisions that have resulted in LID becoming part of the municipal stormwater permits. This guidebook outlines how to conduct a systematic review of codes to integrate LID in the jurisdiction's requirements for development.

Why Review Codes

In order to meet the expected requirements of the municipal stormwater permit to integrate LID into existing codes, rules and standards, jurisdiction staff may need to look beyond just amending their stormwater code. Because the full implementation of LID designs involve stormwater and land use code approvals, it is important to ensure that existing codes, such as landscaping, parking, or building codes, do not preclude or create barriers to the use of LID.

Low Impact Development Defined

From Ecology's *Phase I Municipal Stormwater Permit Appendix 1 - Minimum Technical Requirements for New Development and Redevelopment*, formal draft LID requirement language released October 19, 2011:

> ***LID Definition:***
> "**Low-impact development (LID)** is a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design."

The treatment goal and flow control objectives for LID are achieved through the following site design objectives adapted from the *LID Technical Guidance Manual*.

1. Conservation Measures

- Maximize retention of native forest cover and vegetation and restore disturbed vegetation to intercept, evaporate, and transpire precipitation.
- Preserve permeable, native soil, and enhance disturbed soils to store and infiltrate storm flows.
- Retain and incorporate topographic site features that slow, store, and infiltrate stormwater.
- Retain and incorporate natural drainage features and patterns.

2. Site Planning and Minimization Techniques

- Utilize a multidisciplinary approach that includes planners, engineers, landscape architects, and architects at the initial phases of the project.
- Locate buildings away from critical areas and soils that provide effective infiltration.
- Reduce hard surfaces, total impervious surface area, minimize effective impervious areas, and increase retention of native vegetation.

Effective Impervious Area (EIA) is defined in Step 2.

3. Distributed and Integrated Management Practices

- Manage stormwater as close to its origin as possible by utilizing small scale, distributed hydrologic controls.
- Create a hydrologically rough landscape that slows storm flows.
- Increase reliability of the stormwater management system by providing multiple or redundant LID flow control practices.
- Integrate stormwater controls into the development design and utilize the controls as amenities to create a multifunctional landscape.
- Reduce the reliance on traditional conveyance and pond technologies.

4. Maintenance and Education

- Develop reliable and long-term maintenance programs to provide clear and enforceable standards.
- Educate owners of LID projects, landscape management professionals, and other interested parties on the operation and maintenance of LID systems.
- Protect LID systems by promoting community participation.

Hydrology 101

The important differences between the natural water cycle and the developed, urban water cycle are illustrated in Figures 1 and 2 on the next page.

Under natural, forested conditions, the majority of precipitation is infiltrated, evaporated, or is taken up by vegetation. Very little precipitation becomes surface

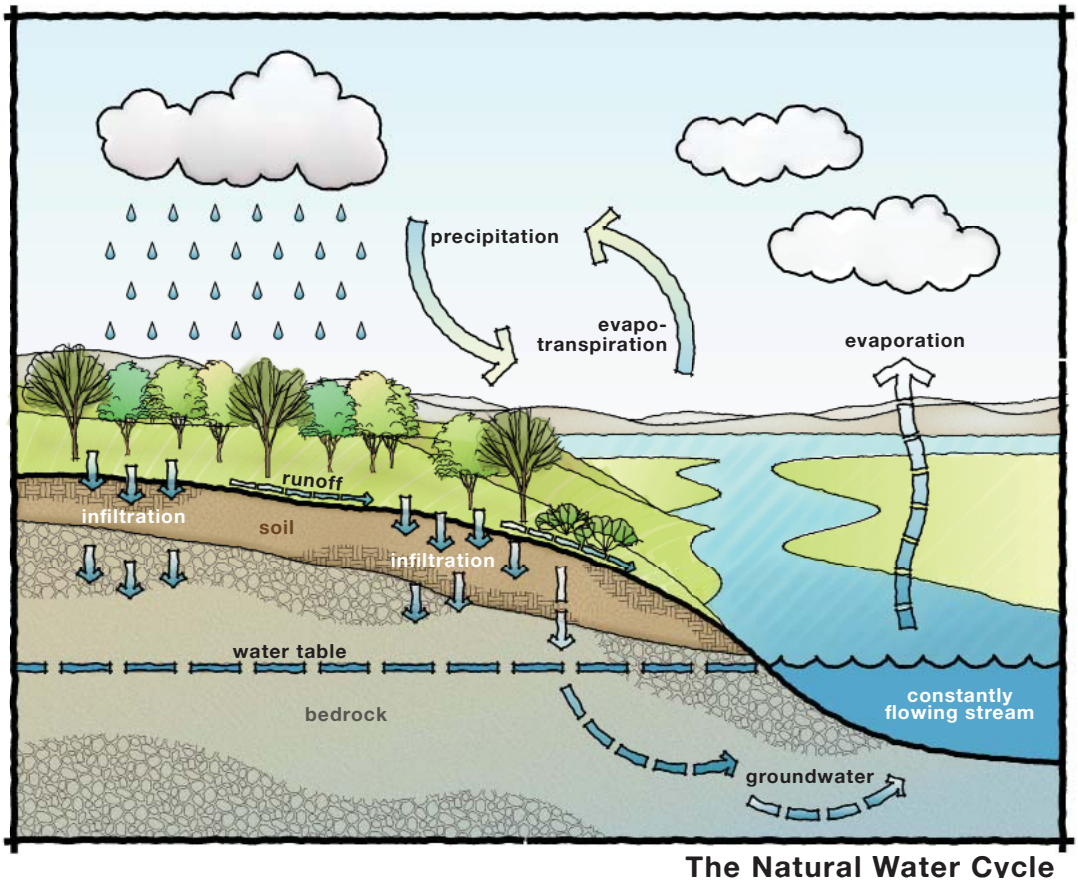


FIGURE 1
water cycle pre-development

The Natural Water Cycle

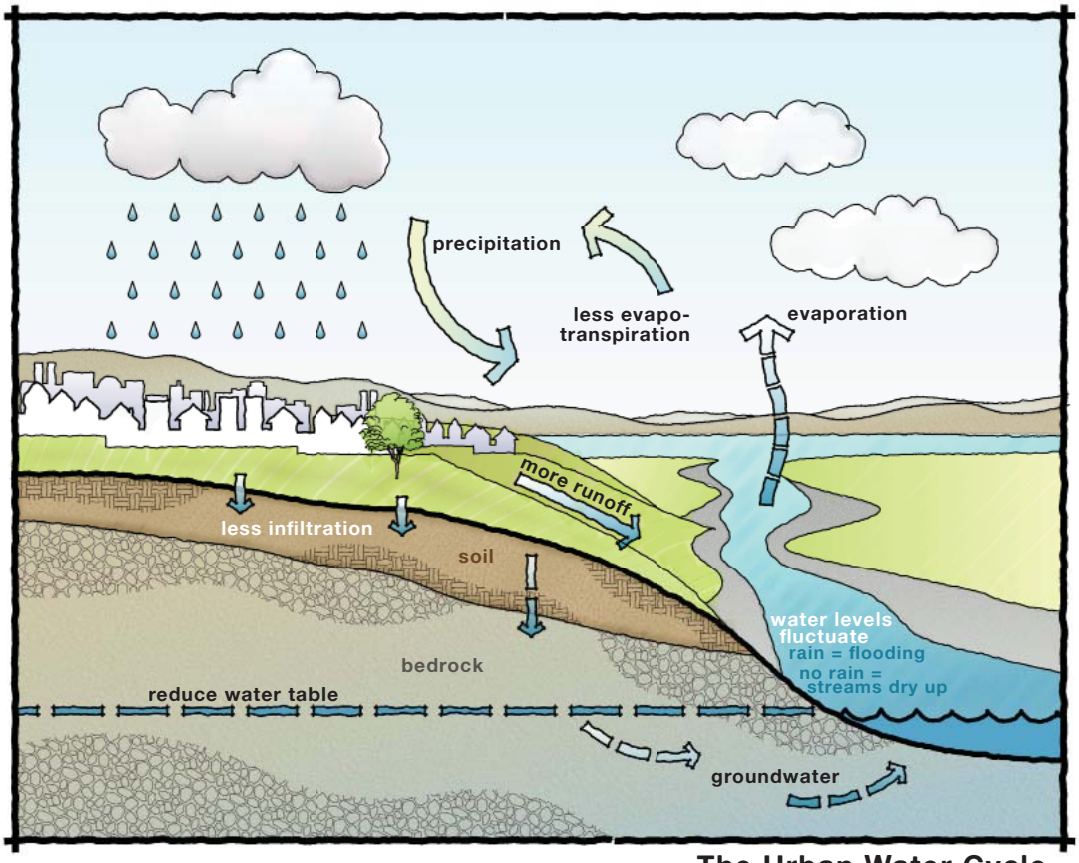


FIGURE 2
water cycle post-development

The Urban Water Cycle

runoff. The natural water cycle relies on vegetation and infiltration to manage stormwater, replenish groundwater, and maintain year round water levels in streams and rivers. With the loss of vegetation, the urban water cycle increases runoff, provides less infiltration, produces greater fluctuation in stream and river water levels, and increases stream temperature.

FIGURE 3
conventional development compared to LID design

Best Way to Manage Stormwater

Because the LID approach manages and treats stormwater close to its source, it can surpass conventional stormwater management techniques by reducing both environmental impacts and infrastructure costs. By carefully siting buildings, minimizing effective impervious areas, and infiltrating runoff, LID helps to preserve wildlife habitat, decrease stormwater runoff, and prevent erosion that can harm aquatic systems.

LID facilities can serve as amenities, adding both aesthetic and financial value to developments. In addition, LID Best Management Practices (BMPs) are a good way to protect water quality by removing pollutants.

LID does not take the place of good land use planning. It is important that the use of LID occur within the larger framework of the Growth

FIGURE 4
parking lot bioinfiltration swale
Lacey, WA

Management Act (GMA) and in compliance with codes related to protection of critical areas, shorelines, and flood plains. It is important to understand that there are areas where LID techniques relying on infiltration are not a good choice for stormwater control, such as those areas adjacent to steep slopes and in areas with high groundwater.

By managing stormwater in small-scale, distributed facilities, the flooding effects to downstream properties from flash storm events are reduced. Moreover, by managing stormwater close to where it falls, modification of the existing hydrologic cycle is minimized. Other benefits include:

- The LID approach often results in infrastructure cost savings when compared with traditional catch basin, pipe, and pond strategies.
- Bioretention, the workhorse of LID, is an approved method of reducing the concentration of metals in stormwater. Bioretention also offers flow reduction, additional landscaping, habitat, and reduction of other stormwater pollutants such as petroleum products, solids, and bacteria.
- The use of natural features, such as native vegetation, results in increased habitat areas.
- The use of the LID approach helps meet the Federal Emergency Management Agency's (FEMA) Biological Opinion requirements and objectives.
- The LID approach helps to avoid costly cleanup efforts such as Total Maximum Daily Loads (TMDLs), stream and wetland rehabilitation, shellfish restoration, and sediment cleanup.
- LID helps protect local jobs involved in the shellfish and other aquatic-based industries.

The *LID Technical Guidance Manual* is a good source for more detailed descriptions of the performance of LID techniques. It describes how these techniques can help protect and restore community environmental values.

A list of resources can be found in the Appendix of this guidebook.

Potential Cost Savings

As conventional stormwater infrastructure becomes more costly and the value of land required for these facilities appreciates, LID becomes a more attractive stormwater management option.

LID can in many cases result in reduced costs and multiple environmental and community benefits. ECONorthwest, in their 2007 report, *The Economics of Low-Impact Development: A Literature Review* states in the report's executive summary:

> "Low-impact development (LID) methods can cost less to install, have lower operations and maintenance (O&M) costs, and provide more cost-effective stormwater management and water-quality services than conventional

stormwater controls. LID also provides ecosystem services and associated economic benefits that conventional stormwater controls do not."

Regarding combined sewer overflow (CSO) controls, a high priority for many municipal government managers, the report further states:

"LID can help minimize the number of CSO events and the volume of contaminated flows by managing more stormwater on site and keeping flows out of combined sewer pipes. Some preliminary evidence exists that LID can help control CSO volumes at lower cost than conventional controls."

FIGURE 5 an example of using LID to manage stormwater

The Appendix contains references to studies of the economics of LID. ECONorthwest has prepared a number of other good literature reviews of the economics of LID. The US Environmental Protection Agency, North Carolina State University Extension, and others have compared the design and construction costs of LID designs and those employing standard urban stormwater management practices. Those studies found significant cost savings for projects using LID techniques. The EPA prepared perhaps the most comprehensive study. That study found that all but one project employing LID was less expensive than its counterpart that used conventional practices. Moreover, for the one project where LID was deemed more expensive, the authors failed to include the purchase and

FIGURE 6 flow control system at *High Point, West Seattle, WA*

development of an off-site stormwater management facility. This omission meant that all of the LID designs were less expensive than designs with standard urban stormwater management practices.

Use of Incentives

Incentives can be an effective approach to encourage LID for those local governments not covered under municipal stormwater permits and not inclined to require LID. Incentives may also be attractive for local governments wishing to entice applicants to use green stormwater infrastructure in excess of minimum municipal stormwater permit requirements. Incentives may include reduced stormwater utility and/or application fees, expedited project review and approval, relief from specific development standards (e.g. density, lot size, setback reductions, etc.), property tax reduction for a given period, and stormwater facility size reduction if minimum thresholds are met.

The Partnership identified several incentives to consider during its regulatory assistance project in 2005-2009. These included the following:

- ***Reduced Review Time / Expedited Review***
  Commit to a priority review status for LID projects. This may include a maximum time between receipt and review and the use of outside consultants to perform reviews. Rationale is that one of the benefits of choosing LID for developers is a shorter review time. However, LID projects may need special studies and reviews that must be identified early and there would be impacts to staffing resources and other project review schedules.

- ***Reduced Application Fees***
  Waive all or a portion of the submittal fees on LID projects. Rationale is that one of the benefits of choosing LID for developers would be reduced fees. However, lower costs in one area may be offset by higher costs for application fees elsewhere.

- ***Dedicated Review Team***
  Create an LID review team that is familiar with and dedicated to LID projects. Rationale is that a specialized review team would be able to review LID projects more quickly based on their experience and commitment to LID projects and a specialized team with technical expertise can provide reviews more efficiently. However, there may not be sufficient staff or LID projects to warrant a separate LID review team.

- ***Property Tax Reduction***
  Reduce or waive property taxes on an LID project for a given number of years. Rationale is that lower service requirements result in lower impacts. However, this could result in reduced revenues.

- ***Public Recognition***
  Emphasize LID projects on website, at council meetings and in utility mailers. Rationale would be to create public awareness and highlight good LID projects. However, there may be additional work for staff.

- ***Increased Densities***
  Allow greater residential densities with the implementation of a minimum threshold of LID techniques. Rationale is that the land is able to manage more units with a more sensitive design. However, potentially greater impacts need to be evaluated and mitigated.

- ***Flexibility in Bulk, Dimensional & Height Restrictions***
  Allow greater building heights and floor area ratios as well as reduced setbacks. Rationale would be to allow developer to have more flexibility in the overall site design, while allowing for reductions in building footprints and increased clustering. However, this may raise issues of consistency and compatibility with existing development and urban design goals.

- ***Adjustments to the Required Parking***
  Reduce requirements for the number and size of parking spaces. Rationale for this would be that reducing parking is an LID technique for reducing impervious surfaces. However, such reductions may conflict with other community objectives.

- ***Reduced Surface Water Management Fees***
  Reduce monthly surface water management fees for project sites employing LID practices. Rationale is that examples abound of local governments providing reductions ranging between 25 and 90 percent of the monthly surface water management fees for sites using LID practices. The fee reduction is typically based on performance and is renewed through a letter from a professional engineering certifying that the LID BMPs are continuing to operate as designed. This incentive is particularly attractive to commercial and industrial users. However, this may result in reduced local revenues and require compensation by raising fees for conventional stormwater systems.

- ***Lower Stormwater System Development Fees***
  Reduce charges when development meets thresholds. Rationale is that with lower impacts to the larger community stormwater system capacity through LID, lower fees are appropriate. However, this may result in reduced local revenues and require compensation by raising fees for conventional stormwater systems.

- ***Fee Structure***
  Reduce stormwater utility fees by developing a new fee structure that is

based on impervious surface. Fee reduction will be awarded based on LID implementation thresholds. Rationale is that reducing impervious surface is an important tenet of LID. However, this may result in reduced local revenues and require compensation by raising fees for conventional stormwater systems.

- ***Reduced Requirements for Conventional Stormwater Management or Reduced Fee for Implementing LID Techniques***
  Allow developers to reduce the amount of conventional stormwater management when they implement LID or LID techniques. For example, if roof runoff is re-used onsite, or infiltrated on-site, the development can remove the roof square footage in the calculations for determining detention pond size. Rationale is that this is a means for encouraging LID projects. However, this may result in reduced capital funds and require compensation by raising charges for conventional stormwater systems.

- ***City-Furnished LID Materials***
  City supplies materials (pervious concrete, plants, soil, mulch, compost, etc.) to offset development costs on LID projects. Rationale is that may be a way to encourage the development of smaller LID facilities on single-family lots. However, there are the costs and the management of the program to consider.

Municipal Stormwater Permit Background

While to date, LID has been encouraged, and even required by some local governments in the Puget Sound region, it may be a completely new approach for other jurisdictions. This section provides background information on the regulatory and judicial decisions that led to LID being in municipal stormwater permits. Information is presented on why LID is the preferred approach to managing stormwater, and why those local governments not currently covered under a municipal stormwater permit may wish to require the use of LID techniques.

MUNICIPAL STORMWATER PERMIT REQUIREMENTS

The federal Clean Water Act, as amended in 1987, requires that municipal separate storm sewer systems (MS4s) which collect stormwater runoff and discharge it to surface waters have municipal stormwater permit coverage. As the delegated authority by the US EPA, Ecology develops and administers municipal stormwater permits in Washington State.

Issuance of municipal stormwater permits has been divided into Phase I, which apply to municipalities with populations of more than 100,000 as of the 1990 US Census, and Phase II, which apply to smaller communities. Phase I and Phase II Municipal Stormwater Permits were last issued in January 2007. They were modified in 2009 to implement the outcomes of appeals to the PCHB decision, including the addition of some LID-related requirements, and are set to be reissued in August 2012.

POLLUTION CONTROL HEARINGS BOARD RULING

In August 2008 and February 2009, the PCHB ruled on appeals to the Phase I and Phase II Municipal Stormwater Permits, respectively. Among many conclusions, the PCHB ruled that the Phase I Municipal Stormwater Permit did not achieve the standards of "maximum extent practicable" (MEP) found in the Clean Water Act and "all known and reasonable treatment" (AKART) found in the Washington State Water Pollution Control Act. The Phase I Permit decision directed Ecology to modify the permit to require LID where feasible.

The PCHB Phase I Municipal Stormwater Permit ruling noted that permit provisions that only encouraged LID were insufficient to meet MEP and AKART standards. The Board ruled that the Phase I Municipal Stormwater Permit must be modified to require the use of LID where feasible. Because of this ruling, Phase I Municipal Stormwater permittees in Western Washington are expected to require new developments to implement LID where feasible.

In 2009, the Board ruled on the Western Washington Phase II Municipal Stormwater Permit. Due to varying technical and financial resources of Phase II Permit communities, the ruling concluded that rather than directing Ecology to modify the existing permit to require LID where feasible, Ecology should prepare Phase II Municipal Stormwater permittees for future permit requirements and permittees should:

> "Identify barriers to implementation of LID and identify actions taken to remove those barriers, to establish goals regarding the future use of LID, and to require other specific actions on reasonable and flexible time frames, both during this permit cycle and in anticipation of future permits."

For cities and counties in Western Washington covered by the municipal stormwater permits, the LID requirements and feasibility standards adopted must meet the minimum requirements outlined in the appropriate permit and referenced stormwater manuals. This guidebook provides the road map for reviewing codes and standards for compliance with the permit. The guidebook does not cover all of the requirements of the municipal stormwater permits which are found in the individual municipal stormwater permits. Cities and counties not covered by a municipal stormwater permit are encouraged to use this guidebook to amend their codes as well.

ECOLOGY LID STANDARDS

In 2009 and 2010, Ecology assembled two working groups of stakeholders to provide guidance for new municipal stormwater permit language that would respond to the directives in the PCHB decisions. Central to this endeavor were:

- Establishing applicability criteria;
- Establishing performance standards for LID techniques in combination with conventional stormwater management practices; and
- Establishing criteria for determining when LID is not feasible.

Ecology will reissue the Phase I and Western Washington Phase II Municipal Stormwater Permits in August 2012.

Why LID?

{WHO}

WHAT

Step One 1
{WHO}

Lessons Learned & Important Items:

1. Representatives from key departments such as planning, public works, and fire and safety need to be at the heart of the project team and involved throughout the process.
2. Management needs to give the project team the necessary time and resources to complete the task.
3. The project team lead should have the authority to establish a project schedule and delegate responsibilities across departments.
4. Internal and external participants who are outside of the immediate project team should have a defined role as advisors in all steps in the process.
5. Project team members should have some level of training in LID.

Expected Time Span to Complete: **one to three months**

Assemble the Project Team

Assembling the right project team to address code and standard changes to integrate LID into regulations and policies is the critical first step in the process. This chapter provides a general discussion of ***who*** are the key internal and external project team participants in the modification process to integrate LID in codes and standards.

Make the Project Team Comprehensive

It is important to assemble an inclusive and comprehensive project team of local government staff and public safety personnel. This approach ensures that the expertise of individual departments is sought early in the process, before moving forward to the review, adoption, and implementation phases.

In addition, it is important to understand that the department that is the champion of the amendment and adoption process may change as the process moves forward. For instance, it is common for planning to take the lead on preparing the code amendments with public works and public safety staff later taking over as the regulations are translated into project review, maintenance, and enforcement standards.

Designate a Team Lead

As the team vested with the responsibility to amend the codes and standards is established, local governments should consider identifying a project lead that will carry the amendment package through the adoption process. The project lead should be someone who will have active involvement in writing or implementation of the updated standards and who has the authority to establish a project schedule and delegate responsibilities across departments. The project lead should also be sufficiently familiar with LID to be able to assemble the necessary materials to bring the remainder of the project team to an appropriate level of understanding and mastery of LID techniques and principles.

It is important for the project lead and team members to discuss the many benefits related to integrating LID into local codes and standards that may go beyond meeting Ecology's municipal stormwater permit requirements. These benefits should be emphasized to the internal stakeholders on the project team throughout the process as well as outside stakeholders to obtain greater buy-in to the process.

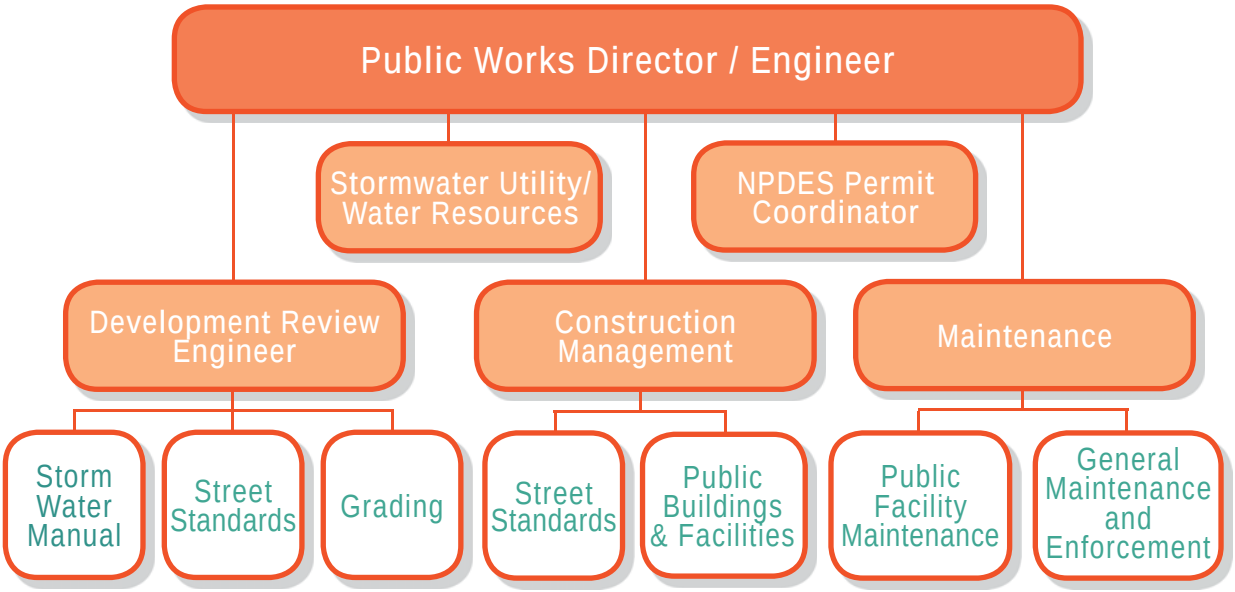
FIGURE 7
internal staff meeting

Key Internal Participants

Key internal participants should include staff from public works, planning, building, and fire and public safety departments. Each jurisdiction has its own departmental organization and responsibilities, so the following graphics are intended only for illustrative purposes. Smaller jurisdictions may likely combine many of these functions into a single position. Department managers will need to prioritize workload to increase staff availability to implement changes to code and regulations for LID. Since staff time is allocated toward other required and higher-priority tasks, LID will need to be made a priority by management.

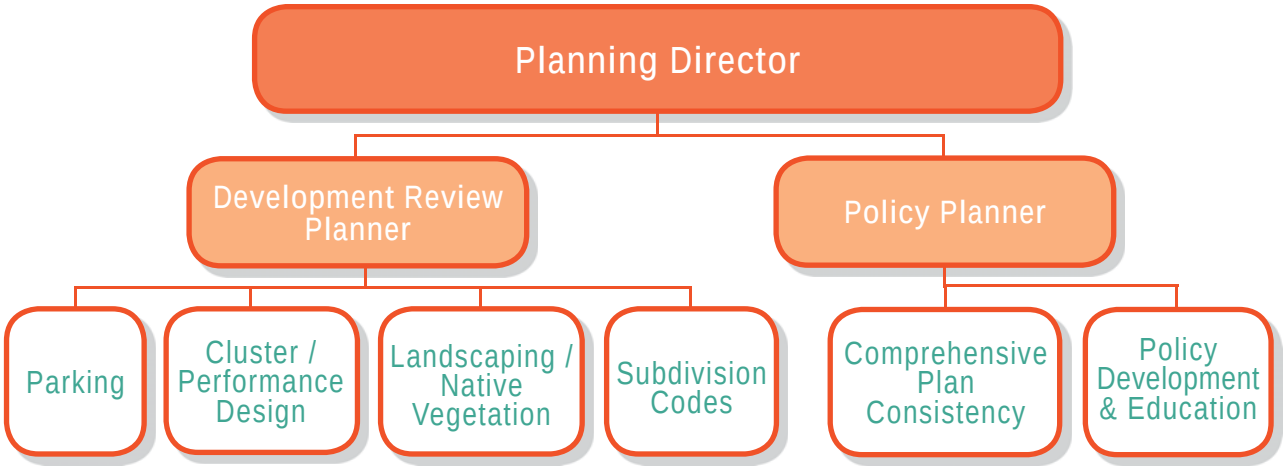
PUBLIC WORKS

Public works staff should include those involved in development review of stormwater, street, and grading and site work proposals, as well as those who work on public facilities such as streets and public buildings. Maintenance staff should play a critical role on the project team, as they will likely provide ongoing maintenance of public LID facilities and possibly the inspection and enforcement of the maintenance of private facilities. These responsibilities make maintenance personnel particularly well suited to reviewing the codes for any omissions that could lead to later problems.



PLANNING

By being involved in development review and policy development, planning department staff are an integral part of the project team, and may even serve to initiate and facilitate the process depending on the internal structure of the jurisdiction. The responsibility to prepare new ordinances and amendments is often conferred upon planners, as is the role of assembling supporting studies and other documents used during the adoption process. Planning department staff may also play a key role in educating decision makers and the public after adoption.



FIRE AND PUBLIC SAFETY

Fire and public safety staff are concerned about street widths, access for emergency response, street layout within subdivisions, and street surfacing materials.

BUILDING DEPARTMENT

Finally, building department staff, who may review plans for green roofs, minimal excavation foundations, and rainwater re-use systems should be included on the project team and brought up to speed on the latest approaches and technologies.

OTHER PARTICIPANTS

In addition to the four departments described above, it is often useful to have representatives from the jurisdiction's elected officials, such as council or commission staff, as well as the city manager or executive's office involved early in the process to make the adoption process smoother.

Natural resources staff can make good advocates for LID, as well as providing an

important function in making sure that there are no conflicts between proposed LID techniques and critical areas codes.

Staff from parks departments can be an excellent source for examples of LID practice implementation, LID projects and experience with maintaining LID facilities.

Key External Participants

The project team should also include key external participants whose involvement is necessary for a smooth process of change to codes and standards, and subsequent successful LID implementation. Such participants include health departments, utility providers such as water, sewer, and other services, and agencies owning and maintaining streets such as state and county departments of transportation.

Health departments will be interested in ensuring that water reuse systems meet state and local health codes, as well as ensuring that the placement of LID facilities in relation to septic systems is done properly. Utility purveyors will have an interest in how the stormwater infiltration may affect underground pipes and cables. Amendments to utility setbacks and crossing standards related to LID techniques may also require discussion and agreement.

Other external participants who have a stake in the outcome of code amendments, but who may not need to be part of the project team, include major property owners or developers, regional governments, citizen's groups, environmental groups, and special districts. It is useful to seek the input of developers and outside design consultants at the appropriate time, such as after the project team has developed draft material that is ready for external stakeholder review. It may be helpful to establish a public stakeholder advisory group to assist in the process.

Bringing the Project Team Up to a Common Level of Understanding

Each project team participant may have a different level of knowledge of LID at the project outset. To facilitate an effective amendment process, the project team should be brought up to a common level of understanding. Achieving this helps to establish early buy-in on overall objectives, and will establish a context from which decisions are made. Ideally, this understanding will also reduce the potential for discussions and proposals being postponed until later in the process.

The amount of LID training needed depends on the team member's role. For most staff, an LID PowerPoint presentation should be sufficient to get started, while LID project leads should seek opportunities for more formal training.

There are a variety of excellent local resources in the Appendix to deepen staff's understanding and mastery of LID.

The ***LID Technical Guidance Manual*** is an excellent resource for describing LID techniques to both technical and non-technical audiences. In addition to describing non-structural and structural practices, maintenance, cost, and practical design considerations are presented.

University of Washington Professional & Continuing Education has offered certification in LID. This certificate program is a three quarter offering that includes an examination of the legislative authority for stormwater management and LID, the design of LID techniques, and strategies and lessons for maintenance and implementation.

Washington State University Extension - Puyallup offers a series of two-day workshops that also lead to a certificate. This program is practical in nature and includes sessions on bioretention, permeable paving, green roofs, minimal excavation foundations, rainwater collection systems, site planning, and inspection.

In addition, there are valuable resources involving better site planning by the ***Center for Watershed Protection***, permeable paving by ***Bruce Ferguson***, and green roofs and living walls by ***Nigel Dunnett*** and ***Noel Kingsbury***.

The Appendix includes citations to the sources noted above, as well as other sources of information.


WHO
{WHAT}
WHERE

Step Two 2
{WHAT}

Lessons Learned & Important Items:

1. The project team needs to educate internal and external participants who are outside of the immediate project team about LID practices and approaches to site design.
2. LID involves looking at how an entire project site functions together, so explore the interconnections between land use, public works, and fire and safety requirements, and think about how to build in flexibility to meet LID requirements.
3. Recognize the importance of native vegetation in meeting LID goals and maximize its use and protection.
4. Understand the different types of impervious and hard surfaces and the role they play in LID.

Expected Time Span to Complete: **one to three months**

Understand General Topics to Address

Once the project team is assembled and a common level of understanding of LID is established among the participants, the next step is to establish a work program that includes ***what*** topics to be addressed by the team. Key staff from planning, public works, building, and fire and safety should be assigned tasks that could include summarizing existing standards and provisions, and providing examples or suggestions for how these standards and provisions may be modified under an LID approach.

This section discusses the primary regulatory and policy areas where LID may be addressed and integrated. Under each topic below, a general discussion is provided regarding the challenges and opportunities for LID integration and what an LID approach typically entails when reviewing and amending codes and policies. The project team should look for ways to use this step in the process to educate outside stakeholders about how LID policies, regulations, and standards fit into the larger regulatory context.

Site Planning and Assessment

Existing conditions on a site strongly influence the extent and location of LID practices for the project. It is important to realize that designers of projects that use LID will need to understand site hydrology, soils, and other features in the initial site assessment and planning phases of the project. This in turn will influence the clearing and grading of the site, as well as the final locations of buildings, parking areas, and stormwater management facilities. The *LID Technical Guidance Manual* is a very good source for understanding how site planning and assessment function when using LID.

Designing buildings, parking areas and streets to minimize site grading preserves natural watercourses, native vegetation and soils on a site.

Healthy Soils

Soil performs valuable functions for absorbing and treating stormwater. These functions are compromised through development when soil is removed or compacted. Protecting and restoring healthy soil is essential to protecting waterways, salmon, and the way of life in western Washington.

Appendix 1 of the Municipal Stormwater Permit requires a minimum soil quality and depth in all lawn and landscaped areas. BMP T5-13

Ecology's *Stormwater Management Manual for Western Washington,* the *LID Technical Guidance Manual,* and the *Soils for Salmon* website offer great resources for healthy soils where standards do not exist in local codes. References to these are included in the Appendix.

Landscaping, Native Vegetation, and Street Landscaping

Landscaping in the form of trees, shrubs, and ground cover provides important LID functions such as rainwater interception, rainwater uptake, and removal of pollutants, in addition to providing site and community aesthetics, economic value to properties, and wildlife habitat.

Retaining and replacing native vegetation during the site development process is a primary tenet of LID. Native vegetation species are well adapted to seasonal changes, particularly the extremes of the Pacific Northwest's wet winters and dry summers. Often local codes do not have native vegetation well defined, nor do the regulations provide strong enough requirements for native vegetation retention.

Local governments may also struggle with how much retained or re-established native vegetation is reasonable. This can be especially true in existing higher density areas of cities, where there is little to no existing vegetation on the site now. Another common obstacle is that many landscape codes do not allow for landscaping within LID facilities to be counted towards site, parking, or perimeter screening requirements.

An LID approach to landscaping does not necessarily result in more vegetation than conventional landscaping requirements, but rather emphasizes native vegetation retention and native soil conservation as a means to manage stormwater effectively during both the construction and occupancy phases. This allows the site's natural hydrology to manage the stormwater and it may prevent the need to re-create this system later. The LID approach would also allow vegetation planted within LID facilities, such as bioretention swales, rain gardens, and green roofs to count toward landscaping requirements. The use of drought tolerant plantings is a good way to ensure the survival of landscaping without additional irrigation during the summer.

FIGURE 8
LID landscaping and native vegetation retention examples
photos provided by CamWest Development

Native vegetation retention is probably the least expensive way to meet LID stormwater goals because existing natural site amenities may be used to disperse, store and infiltrate stormwater.

Helpful reference:
2005 LID Guidance Manual Study, page 53, table 4.1, AHBL, 2000

Hard and Impervious Surfaces

Hard surfaces are permeable pavements, impervious surfaces, or vegetated roofs. Ecology is using this term instead of "impervious surfaces" in the municipal stormwater permits to determine thresholds for applying minimum requirements. Because Ecology is concerned about ground water pollution in addition to surface water, and because it wants to maintain the same regulatory control over water quality, Ecology is using the same square footages of "hard surfaces" as it previously used for "impervious surfaces" to trigger minimum requirements. Ecology does this because, although permeable pavements should result in less surface runoff, there is an increase in the amount of water potentially discharged to the ground. Hard surfaces can be impervious or pervious. Permeable pavements are pervious surfaces, but also hard surfaces.

FIGURE 9
Pervious paving examples

There are two types of impervious surfaces. **Total Impervious Area (TIA)** is any surface created by humans that cannot be easily or effectively penetrated by water, thereby resulting in stormwater runoff. Examples of TIA include asphalt or concrete pavement, buildings, driveways, parking lots, and sidewalks.

Effective Impervious Area (EIA) is a subset of TIA and is often used in stormwater manuals, critical areas ordinances, and FEMA's biological opinion. EIA is defined in the *Stormwater Management Manual for Western Washington* as impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces on residential development sites are considered ineffective if the runoff is dispersed through at least one hundred feet of native vegetation and the runoff meets the criteria of BMP T5-30 for full dispersion. Disconnected surfaces are encouraged wherever possible as well.

In the past, impervious surface standards found in stormwater and zoning codes focused on controlling stormwater runoff. The LID approach enhances neighborhood aesthetics and the desired community character with more green space and natural landscaping.

Code requirements and standards that can reduce the amount of hard surfaces include requirements for maximum impervious surface or site/lot coverage, clustering, parking requirements, street standards, and construction standards. The next step is to reduce the use of impervious surfaces within those hard surfaces. Codes and standards should be amended to require the use of permeable surfaces where site conditions make it feasible, but only to replace impervious surfaces and not at the expense of vegetation. While impervious surface areas often occur on sites in an urban context, reducing EIA through cluster site design, infiltration where rainwater falls, and disconnecting impervious surfaces are proven methods for reducing stormwater impacts.

Bulk and Dimensional Considerations

Standards that apply to the size, form, and placement of structures may affect the integration of LID into a development.

Some local codes have rigid bulk and dimensional standards (e.g., setbacks, height limitations, etc.), which may result in new and existing development being unable to minimize site disturbance and fully integrate LID into site design. An LID approach to dimensional standards allows greater flexibility in site design so that less native vegetation and native soils on the site are disturbed, building and road footprints are minimized, and stormwater can be managed in small-scale, distributed facilities across the site. Review the vision of your jurisdiction in your

Comprehensive Plan to see where you have opportunities for increasing the use of LID. Opportunities may include increasing heights or reducing setbacks in higher density areas or encouraging clustering in lower density, environmentally sensitive areas.

Establishing flexibility in setbacks and building height, as well as clustering of structures, is an effective way to minimize the footprint of the development thereby conserving vegetation and minimizing modification to the hydrologic cycle.

In addition to flexible bulk and dimensional criteria, incentives can further accelerate LID integration. Popular incentives include allowing greater flexibility in dimensional standards.

FIGURE 10
flexible lot configurations

Clearing and Grading

The clearing and grading of a site may have a major impact on the site's capacity to manage stormwater using LID techniques. Preserve native vegetation, native soils, and natural topographical site features, such as small depressions, to help slow, store, and infiltrate stormwater. Clearing these features from a site reduces the potential for effective management of stormwater using LID techniques.

Clearing and grading regulations should emphasize minimizing site disturbance and protecting native vegetation and soils, and should complement other regulations such as native vegetation retention and dimensional standards that affect overall site design.

It is very important to ensure that clearing and grading does not degrade LID techniques that will be expected to infiltrate stormwater, such as bioretention and permeable pavement. If clearing and grading activities transport fine sediment to these areas, or other forms of degradation occur, the infiltration areas must be restored so they will function as designed. The *LID Technical Guidance Manual* contains recommendations on protecting and restoring LID techniques during clearing and grading.

FIGURE 11
site work
Homestead Park
Gig Harbor WA
Courtesy of
Woodward & Co.

Equipment for clearing and grading activities should be sized to minimize disturbance of soils and vegetation, and minimize soil compaction. Consider how best to include this in site development permit language.

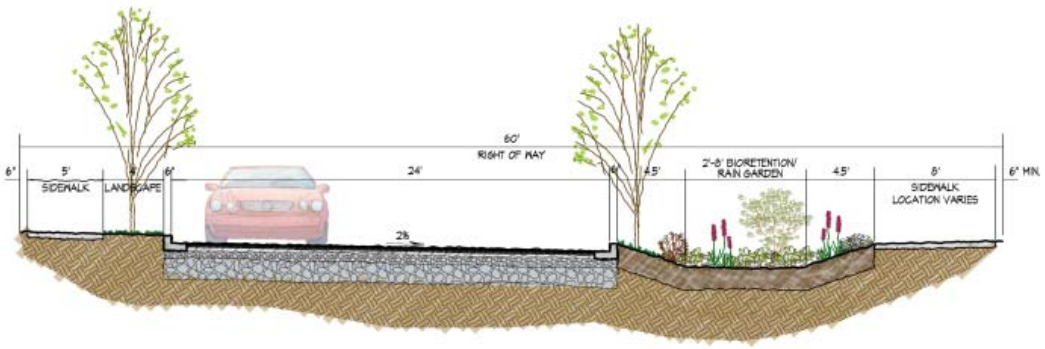
Lastly, clearing activities should ensure efficient sequencing of construction phases and minimal site disturbance.

Streets and Roads

Streets and roads comprise a significant portion of the EIA in urbanized areas. There are many competing needs in rights-of-way, including addressing stormwater from development within the right-of-way. Engineering standards, including those that detail street sections, sidewalks, and driveways should emphasize minimizing EIA. Reducing excessive travel width and using pervious paving are two techniques for minimizing the impervious surfaces associated with streets.

Lane widths often are larger than the minimum necessary for providing safe access for larger vehicles, particularly on local access streets. There may also be opportunities to reduce EIA associated with driveways by minimizing driveway width and curb radii, designing shared driveways, or providing different surfacing options. Integrating LID BMPs such as bioretention into the right-of-way is a good

FIGURE 12
LID street
section example



option to reduce and manage stormwater flows from street surfaces. For municipal stormwater permittees, this may be required where site conditions allow. Street standards should incorporate LID BMPs, and may be required where feasible.

Parking

In most communities, surface parking is second only to streets in the total amount of impervious surface areas in a jurisdiction.

There are a number of strategies for reducing the amount of pollution-generating impervious surface associated with surface parking. One such strategy involves reviewing and adjusting minimum parking ratios to ensure that they do not require more parking than is needed.

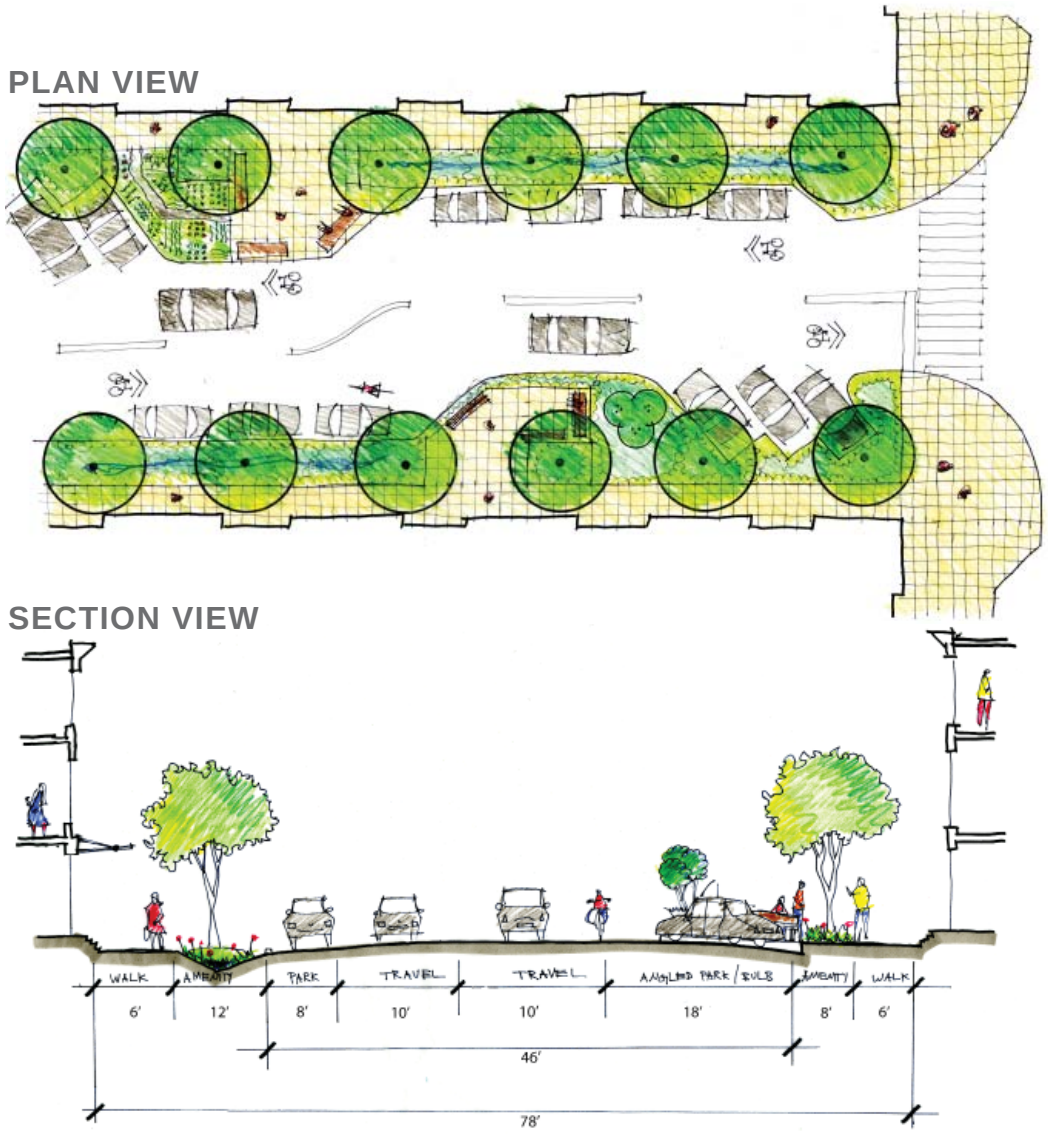
Establishing maximum parking ratios is another effective strategy, particularly for those uses that tend to provide parking to meet peak annual demand, such as during holidays. Using pervious pavement for parking areas, parking lanes, and parking spaces, where feasible, is a practice that greatly reduces stormwater runoff.

Standards for parking space dimensions should also be reviewed. While many local codes allow for a certain amount of "compact spaces," which typically involve a narrowing of the parking space, there often remains an opportunity to reduce the length of parking spaces. Since the full length of parking spaces is rarely used even in "standard" spaces, reducing the length of a standard space can have a potentially large impact on reducing the overall area of the parking lot.

The design standards for parking lots should also be reviewed to ensure that they do not present barriers to LID. Design standards should accommodate integration of LID BMPs such as rain gardens, filter strips, bioretention swales, and filter boxes. Provisions that facilitate and encourage retrofitting of parking lot stormwater

FIGURE 13
parking lot incorporating pervious paving, bioretention & compact spaces
Spokane, WA

FIGURE 14 example of design flexibility allowing LID components along with a pedestrian focus



systems should also be considered. Other design standards affecting parking lot design such as landscaping, pedestrian circulation, and parking lot placement, which are found often within zoning codes, may also need to be examined to ensure that the requisite flexibility is built in to facilitate the use LID techniques.

Design Guidelines and Standards

Design guidelines and standards may address a broad range of building and site design elements. It is important to review these standards and guidelines to ensure LID may be used unless infeasible.

For example, in urban commercial areas, a common objective may be to enhance the pedestrian environment by strengthening the building-street relationship, such as locating the building at the edge of the sidewalk and then siting parking behind buildings.

Other examples might include particular pedestrian character or design aesthetic guidelines that require a certain street tree species for boulevard landscaping. It

may be that the species is incompatible with the use of the landscaped area for bioretention. A jurisdiction can instead list other species that provide aesthetic quality and pattern along the streetscape, but which are compatible with variable moisture conditions typical of bioretention.

Stormwater Management and Maintenance

LID facilities need to be properly designed, constructed, and maintained to ensure they perform as designed. This requires staff involved in project review and regulatory enforcement to be trained on LID BMPs. Staff should have knowledge of the components of the LID design and understand maintenance practices. Refer to the maintenance information in Step 6.

To maintain the benefits of LID facilities over time, clearly written maintenance specifications and protection mechanisms need to be in place. Maintenance and enforcement procedures should be reviewed and modified periodically. Maintenance provisions are usually contained in the stormwater management manual or engineering design standards. Existing maintenance standards may include only the practices associated with standard urban stormwater management facilities. As such, new language may need to be prepared to cover LID techniques.

Good sources for maintenance practices:

- *LID Guidance Manual*
- *Seattle Public Utilities Natural Drainage Systems*
- *Portland Bureau of Environmental Services*

Inspection of LID facilities should occur regularly to ensure they are performing and that adjacent property owners have not modified them in any way. Some mechanisms for protection include dedicated tracts, conservation and utility easements, homeowner association covenants, and title restrictions. Attention should be paid to making sure that legal access to each LID facility is established.

Education of adjacent property owners through direct outreach, and educating the public using signage and other means is critical to ensuring that LID facilities are

CONVENTIONAL

LID

FIGURE 15
examples of stormwater facility maintentance, conventional vs. LID

not altered. Education also encourages individuals to take ownership and help maintain the facilities.

Subdivision and Planned Unit Development

In some jurisdictions, subdivision standards may pose impediments to the use of LID techniques. Subdivision standards may stipulate percentages of the overall site that must be retained as open space. Sometimes uses are assigned to the open spaces such as the need to accommodate active or passive activities. Integrating LID into subdivision codes can allow designers to count bioretention areas, dispersion areas, and other conserved open space toward passive open space standards. In some instances, subdivision standards may require curb and gutter for all new streets or areas used for LID are not allowed to count towards open space requirements, which can limit the use of LID. Examples of standards for LID curb cuts are provided in Step 4.

In jurisdictions where subdivision standards mostly follow the procedural requirements of the State Subdivision Code (RCW 58.17), special care should be taken to review local planned unit development (PUD) chapters. PUD chapters often include many of the challenges to LID as described above.

PUDs may be known by a variety of names such as a planned residential development or cluster development. Such types of developments allow for flexibility from the strict application of zoning standards in exchange for meeting other jurisdiction goals. The most typical exchange is an allowance for the flexibility to cluster uses in exchange for increased open space. PUDs allow both the developer and jurisdiction flexibility in designing projects in a manner that increases opportunities to employ LID techniques.

Critical Areas and Shoreline Management

Regulations affecting critical areas, shorelines, and other sensitive areas may not allow some LID techniques within these areas or their associated buffers. Local governments should consider requiring LID techniques adjacent to these areas only where other standard urban stormwater management practices are permitted as specified in the Appendix D-1 Wetlands and Stormwater Management Guidelines of the Ecology manual. While critical areas such as frequently flooded areas, steep slopes, wetlands, habitat, and aquifer recharge areas benefit from retaining and replacing native vegetation, they all contain features that may not allow the use of some LID BMPs.

Well-designed and well-functioning LID facilities situated outside buffer areas are likely to have minimal impact on sensitive areas and may even enhance them. LID BMPs should not be placed where conventional BMPs, such as ponds or filter systems, are not permitted.

FIGURE 16
example of wetland protection signage

Since critical area regulations are based on best available science as established by state guidelines, local governments should be careful in making modifications. However, the goals and approaches of LID are consistent with the protection of critical areas. Adding specific guidance for LID within critical areas regulations helps to ensure that the functions and values of critical areas and their buffers are not impacted. In addition, it increases the understanding that developers, engineers, planners, and landscape architects will have of the relationship between critical areas and stormwater when designing projects.

Shoreline management and other regulations set up to protect natural resources and assets should be reviewed to ensure they do not include unnecessary barriers to the use of LID. In no instance, however, should LID techniques be used to reduce buffers or in ways that would not otherwise be allowed using standard urban stormwater management practices.

WHAT
{WHERE}
FILL THE GAPS

Step Three 3
{WHERE}

Lessons Learned & Important Items

1. Understand that regulations that are needed for LID can be found in various sections of a jurisdiction's codes and standards.
2. Think about ways to use the gap analysis for other needed code revisions and review processes beyond just LID.
3. Look for ways to involve internal and external participants in the process.
4. Make sure that the comprehensive plan provides the necessary policy support for regulatory changes to add LID.
5. Understand there are many different codes and standards that affect key LID concepts such as native vegetation retention and restoration and limiting impervious surfaces.

Expected Time Span to Complete: **one to three months**

Review Existing Codes and Standards

Once a local government's project team identifies ***what*** should be addressed under an LID approach in Step 2, the next step is to determine ***where*** changes need to be made to integrate LID fully into a jurisdiction's policies, regulatory code, and standards. This step focuses on the review of codes and standards against what is needed to determine where changes are needed for LID integration. This step discusses the major topics that should be reviewed during the LID integration process and shows where these topics are typically found within development regulations and standards. The gap analysis work done here will form the basis for the work done in Step 4 to amend the codes.

No two codes are integrated in the same manner. As an example, parking lot landscaping may be discussed in an off-street parking chapter in one jurisdiction's code and the landscaping chapter in another jurisdiction's codes. Still others may stipulate the amount of landscaping in an off-street parking chapter and the type/size of the required plantings in a landscape chapter. Consequently, the review of existing codes and standards is presented topically with notation as to the locations where each topic may likely be found.

These major topics include the following:

- Comprehensive Plan Goals and Policies
- Zoning Code
  - Landscaping, Native Vegetation, Tree Protection, and Open Space
  - Impervious Surface Standards
  - Bulk and Dimensional Standards
  - Site Plan Review
  - Parking
- Development Code and Standards
  - Clearing and Grading Standards
  - Engineering and Street Standards

The project team should look for ways to use the gap analysis and review work in this step to apply to other needed code revisions and review processes beyond just integrating LID into policies, regulations, and standards. The project team should have discussions internally and with outside stakeholders about where changes in the jurisdiction's regulatory code may make sense.

Perform Gap Analysis and Review

GAP ANALYSIS

A gap analysis identifies those places in a jurisdiction's codes and policies where amendments or new codes and policies may be needed in order to allow LID where feasible.

COMPREHENSIVE PLAN GOALS AND POLICIES

Comprehensive plan goals and policies provide an important means of supporting any changes made to incorporate LID into a jurisdiction's regulatory structure. It is important to review these goals and policies to make sure that they do not provide a barrier to using LID, and that they provide support for the use of LID. Goals and policies that could affect how LID is integrated into regulations can be found in each element of the comprehensive plan. For example, there may be policies in the transportation element that may have unnecessarily narrow definitions of curb and gutter drainage systems that would preclude roadside bioretention. This would be an appropriate amendment, as would the addition of land use policies that encourage the dual use of landscaping for drainage and screening purposes.

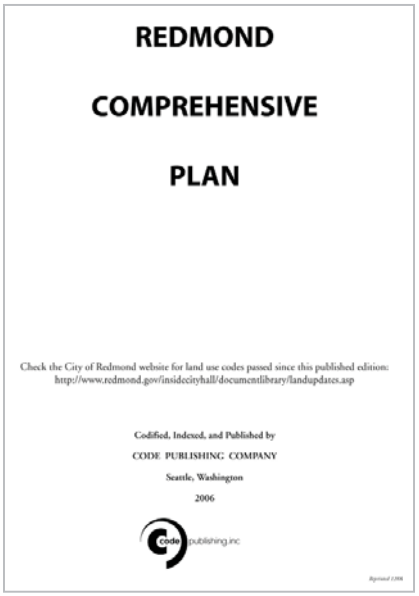


FIGURE 17
City of Redmond Comprehensive Plan

The need to make wholesale changes to the comprehensive plan to support LID is unlikely and such changes that are needed could be handled as part of the jurisdiction's regular comprehensive plan amendment cycle.

ZONING CODE

Landscaping, Native Vegetation, Tree Protection, and Open Space

Vegetation is an integral component of an LID approach. Most development codes contain landscaping requirements that are primarily intended to reduce visual impacts and enhance the aesthetic character of development. At a minimum, code sections that address landscaping should be reviewed and amended to allow for LID where feasible. Changes should be made to landscaping requirements to emphasize native vegetation preservation and allow for LID techniques such as bioretention to be counted toward passive open space requirements. Native vegetation retention is a prime way to address LID.

- *Landscaping and Screening* – Code requirements addressing site landscaping are focused usually on reducing visual impacts (screening) and enhancing site aesthetics. Requirements are often very prescriptive. An LID approach to landscaping requirements emphasizes native vegetation preservation or replanting and allows more flexibility for how landscaping is provided and what is counted towards the required landscaping. It also takes advantage of landscaped areas for stormwater dispersion and infiltration.

- *Open Space and Tree Preservation* – Development codes may have separate tree preservation provisions, or these requirements might be part of the code section addressing landscaping. Tree preservation codes often focus on preservation of significant or heritage trees (e.g., trees of a particular species, size, or cluster, etc.).

FIGURE 18
parking lot screening using drought tolerant and native plants

FIGURE 19
tree retained at Sehmal Homestead Park
Gig Harbor, WA

An LID approach places greater emphasis on the preservation of conifers than other heritage trees because of the superior ability of conifers to intercept stormwater during the winter months when precipitation is most likely to fall. The LID approach also emphasizes strategies to orient retained vegetation and open space in corridors in ways that will result in the disconnection of impervious surfaces and allow for increased habitat opportunities.

The size of existing trees is typically expressed as a measurement of diameter at breast height. Replacement trees are expressed in inch-denominated caliper size or height.

- *Street Frontage Landscaping* – Landscaping requirements for street frontages are found typically in the landscaping section. Such requirements primarily address street trees and do not get very prescriptive about other landscaping found between the sidewalk and the street. An LID approach ensures that street frontage landscaping requirements include LID facilities such as bioretention. It also allows for the dual use of those areas for both landscaping and stormwater management.

- *Design Guidelines and Standards* – Vegetation requirements are sometimes found in design guidelines and standards. In some development codes, these may be integrated into zoning codes while other times they exist as stand-alone documents that are referenced within the code. Special zoning districts may also have specific design codes developed in a lengthy community planning process with elements that conflict with LID practices, such as building orientation, zero lot line development, or

roof pitch. Design guidelines and standards should be flexible enough to encourage creative LID solutions that meet the intent of the design guidelines and can be amended for LID landscaping, paving, and other elements.

FIGURE 20
existing street trees incorporated into bioretention swales
Spokane, WA

Impervious Surface Standards

A key component of an LID approach is minimizing impervious surfaces and hard surfaces and reducing or eliminating EIA. This section discusses the typical code sections and standards that should be reviewed with an eye toward reducing all types of impervious surfaces. Standards should be considered that allow for the use of pervious pavements where feasible since the municipal stormwater permit may require permeable pavement. Avoid adding pervious pavement at the expense of vegetation.

- *Parking* – Careful examination of parking requirements can offer tremendous opportunities to effect meaningful reductions in effective impervious area. Refer to the previous discussion of parking in Step 2 and the discussion of parking later in this step for more information.

- *Street Standards* – Street standards are typically within a jurisdiction's public works manual or engineering design standards. Given the large proportion of impervious surface that streets contribute, a significant reduction in impervious surface may be achieved through modest reductions in street

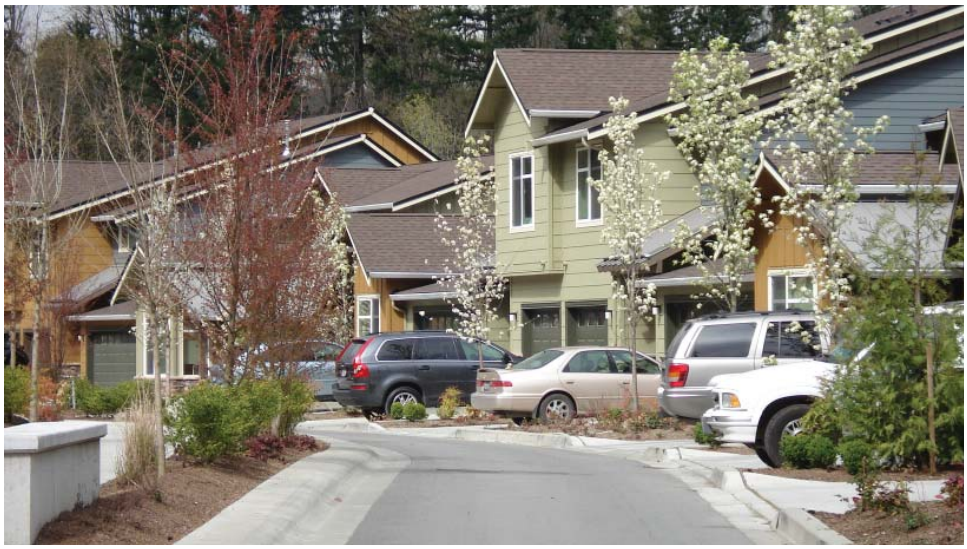


FIGURE 21
reduced width one way street and short driveways minimizing impervious surfacing
Issaquah, WA

If you are trying to minimize street width, fire fighting equipment should match the level of development.

widths. Often there are opportunities to reduce street widths, particularly on local access streets, while still maintaining safe access and accommodating emergency service vehicles. Permeable pavement should be used where feasible. Permittees may be required under the municipal stormwater permit to use permeable pavement where feasible for access streets.

Construction Standards – Construction standards for site improvements (e.g., driveways, walkways, curb and gutter, etc.), are typically found within a jurisdiction's public works manual or engineering design standards. These could be modified to reduce impervious surface. Examples include standards for shared driveways and reducing the minimum driveway width and curb radii to the minimum necessary to provide safe access and accommodate emergency vehicles. Standards should also allow for pervious pavement for driveways, walkways, and streets. Consult the *LID Technical Guidance Manual* for design standards and the feasibility criteria in the *Stormwater Management Manual for Western Washington (2012)*.

Bulk and Dimension Standards

Bulk and dimension standards apply to building placement, size, and shape (e.g., lot coverage, density, impervious surface coverage, height, etc.). Usually, standards are very prescriptive and do not allow much deviation, which can present barriers to effectively integrating LID into a site. Such standards should be reviewed and modified so the LID approach is used and there is enough flexibility to allow the best design possible. This section discusses where bulk and dimension standards are found typically in codes, and briefly describes how such code provisions can be modified to accommodate an LID approach.

- *Individual Zoning District Bulk and Dimensional Regulations* – In typical codes, each zoning district has specific dimensional standards that dictate building setbacks, maximum building square footage, density, height, maximum lot coverage or impervious area, and possibly other elements related to the visual appearance of structures and a project site. An LID approach should utilize flexibility for setbacks and heights, and should allow clustering of buildings and minimizing building footprints as an approach to maintain natural hydrologic functions and native vegetation. Increased residential densities may be offered in exchange for reducing impervious surfaces or managing stormwater on-site beyond what is required.

- *Performance Based Designs* – Performance based designs, often called PUDs, allow greater flexibility in code requirements for site and building design than is otherwise permitted in the underlying zoning. In exchange for this flexibility, a jurisdiction may require a greater level of investment

in public amenities and open space. In many performance based design chapters, significant emphasis is placed on open space that can be used for recreational purposes. Performance based design chapters can be effective mechanisms for integrating LID to the extent that LID techniques are recognized as amenities and they can count toward passive open space requirements. Similar performance design chapters for housing products such as cottages, townhomes, and multi-family structures should be examined as potentially effective tools for establishing meaningful native vegetation tracts.

- *Subdivision Standards* – Standards for subdivisions are usually found in the "Subdivision" section of a development code. Subdivision codes and processes are rooted in state laws (RCW 58.17) that address the segregation of land. Some jurisdictions have adopted subdivision codes that are primarily procedural in nature. For those jurisdictions, there will be little opportunity or need to amend the subdivision code to integrate LID. In other communities, subdivision codes contain standards that guide the design of new lots (e.g., lot width, amount of open space, cul-de-sac length, and curb and gutter requirements, etc.). In subdivision codes that contain design criteria, opportunities exist to integrate LID. Similar to performance based design codes, subdivision codes can be amended to provide greater flexibility for setbacks, express preferences for clustering, and provide more guidance for integrating LID into common open space, recreation areas, and streets. In addition, subdivision codes should be explicit about

FIGURE 22
bioretention swale incorporated into parking lot at Lacey Crossroads
Lacey, WA

how LID facilities will be maintained and how that information is recorded.

- *Design Guidelines and Standards* – In many codes, there are design guidelines and standards either in the zoning code or as a separate chapter. These codes are often intended to enhance the visual quality and identity of communities and establish or maintain character. They may include specific goals for building or site design. Modifications to these codes, especially to those codes that address landscaping and site design can help to integrate LID BMPs into a project and help meet two purposes at once.

Site Plan Review

Some jurisdictions have a review process outlined in their permit and approval process codes that requires all elements of a site plan be reviewed and approved on one plan. In the LID approach, it is very important that a detailed initial site inventory and assessment be performed early in the process. This is done to provide the baseline information necessary to substantiate design strategies that preserve natural resources, preserve areas most appropriate to evaporate, transpire, and infiltrate stormwater, and to achieve the goal of mimicking the natural hydrologic conditions of the site. The *LID Technical Guidance Manual* provides a systematic approach for performing a composite site analysis.

Parking

Parking is a major contributor to impervious surface. Any opportunity to reduce the amount of parking in a community can go a long way towards reducing overall effective impervious area.

- *Off-street Parking Regulations* – Off-street parking regulations are usually found within zoning codes and are focused on establishing a minimum number of off-street parking spaces based on specific land uses or zones. Parking construction standards may be found in the same section or may be part of the public works standards. An LID approach to parking first addresses the amount of parking that is built by critically reviewing minimum parking requirements, and then integrating mechanisms for reducing parking requirements (e.g., shared parking, proximity to transit, car share, etc.). Requiring, where feasible, structured or tuck-under parking is another strategy for reducing effective impervious area, particularly within urban areas. Instituting maximum parking standards allowed for certain land uses is an effective strategy for reducing large and underutilized parking areas.

- *Public Works Construction Standards* – Parking lot design requirements are typically found within the zoning code or the public works standards. Examining these design requirements presents another opportunity for reducing impervious surface. Often minimum standards for drive aisles

and stall dimensions may be reduced, which taken together can result in significant reductions in impervious area. Parking design standards should be modified to allow flexible design and integration of LID facilities. Pervious pavement should be allowed where feasible, and may be required under the municipal stormwater permit.

Clearing and Grading Standards

Clearing and grading standards affect how a site is prepared for development and play an important role in preserving native vegetation and locating LID BMPs. Such standards may be overly permissive in terms of the amount of clearing and grading that is allowed. Clearing and grading standards should be reviewed to ensure that clearing and grading practices minimize disturbance to native soils and native vegetation. They should protect areas to be used for infiltration, such as bioretention and permeable pavement, and retain native vegetation and soils during construction.

- *Fill and Grade Ordinance* – Grading and filling standards are found usually in a local government's development code. The successful integration of LID into grading and filling standards should emphasize conserving native vegetation and soils as well as site design strategies that minimize unnecessary contouring of the site.

- *Clearing Ordinance* – Clearing standards may be found in engineering standards, landscaping and tree retention standards, or exist as a stand-alone document. Under an LID approach, regulations affecting site clearing should emphasize minimizing site disturbance by maintaining native vegetation and soil conservation.

ENGINEERING AND STREET STANDARDS

Streets represent a large proportion of a community's total impervious surface. An LID approach emphasizes reduction in impervious surface. Reducing minimum street widths offers an excellent opportunity to achieve this objective. This section describes where street standards are typically found within local development controls, and how they may be strengthened to implement an LID approach.

- *Street Standards* – Street standards may be integrated into a jurisdiction's engineering standards or they may be standards from either the Washington State Department of Transportation (WSDOT) or another agency, such as a County, adopted with local amendments. Street standards typically include street sections for a range of arterials, collectors, and local streets. These show right of way widths, travel lane and parking lane width, and location and size of area for sidewalks, landscaping and utilities. Details are included for curbing, stormwater facilities, and cul-de-sac designs, among other items.

LID should be used where feasible in street sections. Under an LID approach, reduced street widths and flexibility in meeting design intent should be examined. Standard plans should show options for conveyance using bioretention rather than curb, gutter, and pipe. Permeable pavement should be used where feasible, and bioretention and permeable pavement may be required under the municipal stormwater permit.

- *Design Standards* – Standards for minimum street width also may be found in the local fire and public safety codes. It is important that any changes to street standards agree with these design standards. There are a number of perceived barriers and challenges related to reducing street widths. These include concerns related to traffic safety, solid waste collection, and fire and emergency vehicle access. These challenges were addressed during the 2005 - 2009 LID Local Regulatory Assistance Project and are addressed in more detail in Step 4 of this guidebook.

- *Subdivision Code* – In some jurisdictions, right-of-way widths and design standards for streets are found in the subdivision code where short plats, preliminary plat, binding site plans, and other means of subdividing property are regulated. In some cases, changes may need to be made to allow for greater flexibility in meeting any requirements established for LID.

- *Landscaping and Tree Preservation* – Landscaping and tree requirements may be found in a jurisdiction's zoning code as well as in street sections for street standards. It is important to allow for landscaping to be used for LID, screening, street tree requirements and aesthetics.

WHERE
{FILL THE GAPS}
REVIEW & ADOPT

Step Four 4
{FILL THE GAPS}

Lessons Learned & Important Items

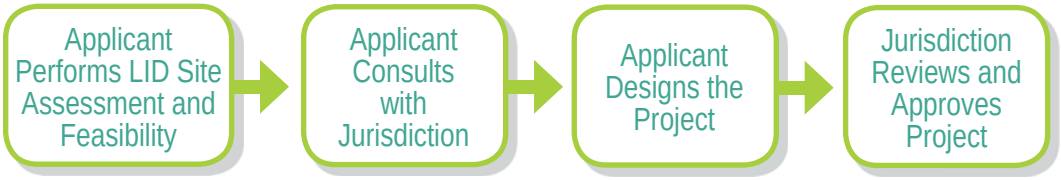
1. Every jurisdiction has developed its codes and standards to its own conditions and concerns, so make sure that new or amended codes for LID work within this local framework.
2. When preparing code amendments or new sections of codes, involve staff who review projects in the process. Their knowledge and experience are valuable.
3. Look for ways to involve internal and external participants in the code revision process.
4. Look to make the composite site analysis the heart of the LID review process and write codes and standards to support this.
5. Before starting the code and standard amendment process, work out the steps in the LID project review and approval process. Think about what information staff will need to review LID projects and when in the process this information will be needed.

Expected Time Span to Complete: **three to nine months**

Amend Existing Codes and Develop New Codes

After the project team identifies ***where*** there are gaps and barriers in existing codes and standards, the next step is to ***fill the gaps*** and remove the barriers by amending existing codes and developing new code language. This step will likely be an iterative process as the project team reviews concepts and examples of how existing code and standards may be modified to emphasize an LID approach. Draft language may be revised multiple times to address concerns and specific local conditions. This section discusses and provides numerous examples of LID designs and text for the range of topics discussed in Step 3.

REVIEW & APPROVAL PROCESS:



The examples of code and comprehensive plan language that are presented in this chapter are intended to provide sample approaches and language for adopting LID principles, but were not written to meet the LID requirements in the draft Ecology municipal stormwater permits. In addition, many of the examples were developed during the time when LID was used in a voluntarily approach rather than requiring it where feasible. Local governments subject to the municipal stormwater permit, and others if they choose to, may choose to modify the language to comply with the permit.

The project team should look for ways to involve the outside stakeholder group, especially those with experience developing and permitting projects in this step of the process. For efficiency, the project team should also consider using this process as a means to incorporate other needed code or policy changes outside those needed to comply with requirements regarding LID in the municipal stormwater permit.

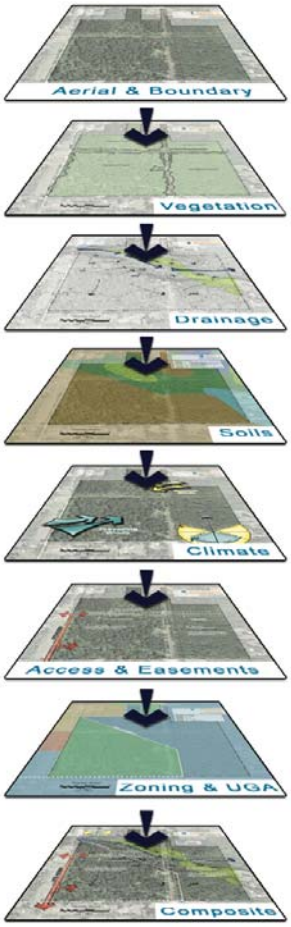


FIGURE 23
site analysis process

Establish Process for Reviewing and Approving an LID Project

Before starting the code amendment process, it is a good idea to lay out the steps of the intended project-specific LID review and approval process to provide a framework for the process. Because LID site design mimics the natural hydrology of the site, it is very important to specify the details that need to be known by the applicant and jurisdiction early in the project review and approval process so there is sufficient technical information to guide design of the site. This evaluation and documentation is known as a site analysis or composite site analysis. In most jurisdictions, integrating the elements of a composite site analysis will require adding the following elements to existing site plan submittal requirements:

- *Requiring initial site assessment and feasibility by the applicant* - Most applicants already perform some level of site feasibility prior to initiating formal design. The goal of LID is to mimic a site's natural hydrology; therefore, it is essential that this analysis occur at the earliest stages of project initiation. This will allow the applicant to identify those areas most suitable for development and design a system of distributed small-scale LID BMPs throughout the site.

  The elements of an LID site assessment do not vary much from the site plan submittal requirements that many jurisdictions currently require.

The primary difference between LID site assessment objectives and the traditional site plan submittal requirements involve the need for field verified on-site soils information and surveys of on-site vegetative cover early in the design process. These elements, which comprise vital components of a composite site analysis, typically are required by local government during the engineering design phase but seldom during earlier phases of a project.

In LID projects, requiring these materials at the beginning of the site planning process represents the biggest departure from traditional site plan submittal requirements. These materials form the basis for a site analysis that allows the applicant and local government staff to confirm which on-site areas are most suitable for development and which are most suitable for placement of LID techniques. Local government staff may be the source for the information necessary to prepare the initial site assessment and feasibility. Local government staff often includes professional engineers and planners with familiarity of the local site conditions. In addition, local government staff may be aware of existing studies for adjacent properties that might aid the applicant.

See the Subdivision Code section later in this Step for details on what an LID Site Analysis Checklist could contain.

- *Applicant consultation with the jurisdiction* - Once the applicant completes the initial site assessment work, it is important to have a pre-application process that allows the jurisdiction's development review team to review the applicant's preliminary feasibility evaluation and discuss the design and approval of the LID project.

- *Project design review and approval process* - After the applicant and the jurisdiction have the opportunity to make a preliminary determination on the feasibility of the LID design for the project, the formal application submittal and review process can begin.

LID Considerations and Examples and Ideas

The following sections examine comprehensive plan goals and policies, subdivision codes, zoning regulations, and engineering standards. In each section, some general considerations are given to think about as part of the LID code revision process as well as examples and ideas on the type of language to add in each section of code in support of LID. These examples are drawn in part from the Puget Sound Partnership's LID Local Regulation Assistance Project as well as codes and standards that have been adopted by a variety of jurisdictions.

Comprehensive Plan Goals and Policies

Comprehensive plans are intended to reflect the long-term vision and goals of a jurisdiction and its citizens as well as meet statutory requirements for

required elements and coordination with other plans, such as the GMA. In part, comprehensive plans contain goals and policies that are intended to guide the regulation of the built environment and are an important way to support changes for LID in a jurisdiction's development code.

LID Considerations:

- Comprehensive plan goals and policies should promote LID and not present a barrier or hindrance to the use and adoption of regulations supporting LID. For example, a land use or transportation policy that calls for the use of standard curb and gutter for all development in a jurisdiction would not allow the flexibility to use LID BMPs in street design.
- Stormwater policies should state that LID is the preferred method of addressing stormwater management unless proven infeasible.
- Policies or goals that present barriers to LID should be modified or removed.
- Policies supporting dual use of landscaping or open space and LID should be added as well as policies that preserve native vegetation and trees.
- Policies should include a preference for projects that minimize TIA and seek to eliminate EIA.

Examples and Ideas:

The following is an example of policy language adopted by City of Snoqualmie that establishes policies supporting LID techniques:

City of Snoqualmie, Snoqualmie Vicinity Comprehensive Plan. 2006.

C.3 Low Impact Surface Water and Stormwater Management Techniques

The quantity and quality of surface water leaving a developed site must be carefully managed to limit impacts on receiving water bodies including flooding, siltation and sedimentation, pollutant runoff, and increased temperature. Traditionally, stormwater is controlled using storm drainage systems and detention ponds that collect runoff from the impervious portions of a developed site. Detention ponds help to settle sediments and regulate the discharge of stormwater from the site, but have a number of disadvantages and negative environmental externalities. These include costly construction, need for regular maintenance for proper operation, changes to the flow regime of a drainage basin, increasing the temperature of the water leaving the site, and a lack of filtration capability to address finer suspended solids and chemical runoff.

Municipalities throughout the Puget Sound Region are beginning to use innovative approaches to land development and stormwater management, termed "Low Impact Development" (or LID), that better

preserve the natural environment and promote natural hydrologic functions. LID strategies use a site's natural features along with specially designed best management practices to minimize and manage rainfall runoff at the source. Rather than collecting and directing rainfall runoff to constructed ponds to manage stormwater flow, remove pollutants and discharge to streams and wetlands, LID strategies seek to integrate site design, landscaping, natural hydrologic functions and various other techniques to generate less runoff from developed land and to infiltrate rainfall to underlying soils and groundwater as close to where it hits the ground as possible. LID uses a number of practices and design techniques, which include minimizing street widths, utilizing construction methods and devices that disperse stormwater or collect it for use on the site, retaining native soils and vegetation, and utilizing pervious paving surfaces.

Objective:

5.C.3 To better protect streams, wetlands, wildlife habitat and groundwater resources, utilize low impact development techniques wherever feasible to minimize runoff and manage surface water and stormwater impacts resulting from development.

Policies:

5.C.3.1 Minimize street widths with reduced, but adequate, parking opportunities and access for public safety to minimize impervious surface.

5.C.3.2 Encourage the use of pervious paving surfaces for parking lots, sidewalks, driveways, alleys, and low-use roadways.

5.C.3.3 Utilize bio-retention catchments in the design of parking lots and roadways to infiltrate stormwater runoff on site.

5.C.3.4 Where pervious paving surfaces are used for driveways or sidewalks, gently slope these surfaces away from the street and towards vegetated strips or bio-retention catchments.

5.C.3.5 Encourage building construction that minimizes impervious surfaces, such as construction on pilings rather than a solid foundation, locating parking for commercial and multifamily structures under the building where feasible, and using "green roofs" (roofs that incorporate vegetation to infiltrate stormwater).

5.C.3.6 Consider adopting impervious surface standards for residential, commercial, and industrial development to

limit the amount of runoff contributing to the stormwater system.

5.C.3.7 For new structures, utilize alternative methods to collect or disperse stormwater other than connection to the stormwater system. Alternative methods include the use of roof gardens, roof rainwater dispersal grates rather than gutters, cisterns for the collection of stormwater for on-site uses such as toilets and landscape irrigation, and on-site retention through the use of catch basins and devices.

5.C.3.8 Limit clearing, grading and soil disturbance outside of the building footprint on newly developed residential and commercial sites, especially those sites with sensitive features. Reduce compaction and restore infiltration capacity on already cleared sites whenever practical.

5.C.3.9 To promote natural hydrologic functions, carefully stockpile site topsoil for later redistribution on the site for yards, landscape areas, vegetated swales and other bio-retention facilities. Topsoil should not be removed from a development site.

5.C.3.10 Ensure local regulations for surface and stormwater management allow for and encourage LID practices.

The following is an example of policy language adopted by City of Sammamish supporting LID techniques:

City of Sammamish Comprehensive Plan, IV. Environment & Conservation Element. September 16, 2003.

ECP-3.65 For new and redevelopment, City regulations and programs should manage storm water to preserve natural hydrographs through low impact development standards, and/or best management practices and site design requirements that provide for active storm water management. Storm Water Management Programs shall closely emulate natural hydrologic processes and protect water quality. Such programs should outline standards for development activities for both the construction and post-construction phases, including management of storm water runoff and maintenance of storm water facilities.

The following is an example of policy language adopted by City of Tumwater and Thurston County encouraging the use of LID in the urban growth shared by the jurisdictions:

Tumwater/Thurston County Joint Plan, Chapter 3 - Land Use, 3-17. 2009.

Policy 6.10 Encourage the development and use of low impact development standards similar to those contained in the Zero Effect Drainage Discharge Ordinance as adopted by the City of Tumwater [Chapter13.22 TMC].

Subdivision Code

The subdivision code provides rules and standards for subdividing land whether it is by preliminary plats, short plats, binding site plans, or other means.

LID Considerations:

- In many cases, the subdivision code will be primarily concerned with enacting the procedural requirements of RCW Chapter 58.17, but in some cases, there will be additional requirements dealing with subdivision improvements that could affect the ability of a jurisdiction to implement LID BMPs.
- Allow for the use of LID techniques as a condition of approval for preliminary subdivisions. Add language to require appropriate measures to be taken to manage stormwater by LID where feasible and emphasize conservation and use of on-site natural features.
- Add provisions to require LID unless proven infeasible and other provisions that support LID such as preserving open space, native vegetation and sensitive environmental areas, minimizing impervious surfaces, clustering, and eliminating EIA.
- Requiring a higher degree of site analysis during the early stages of project conception is important to maximize design and functionality of LID BMPs. Have applicants conduct an LID site analysis and bring the results of this analysis to the required pre-application conference. The analysis would include information similar to that shown below and would identify proposed LID BMPs.
- The site assessment needs to distinguish between soil testing for overall site assessment and soil testing for an individual facility design. Consider two phase soil evaluations to include a general assessment, which might include some soil testing, but at a lesser standard than facility design and then more detailed soil work for facility design.

Examples and Ideas:

The following example establishes the use of LID Site Analysis for all new subdivision projects. It was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project:

18.24.005 LID Site Analysis.

A. Applicability. All subdivision projects, as defined by this Title, shall conduct an LID site analysis in accordance with Chapter 4, part (8) of the Engineering Design Standards (EDS). Site assessment findings shall be a component of the project submittal.

18.24.007 LID Standards.

The LID standards set forth in Chapter 4, part (5) of the EDS apply to all subdivisions defined under this Title.

Example LID Site Analysis Checklist Language

A. The site analysis requirements shall be submitted in addition to all other requirements for development approval for a project and may be submitted prior to the filing of other applications. The Administrator may choose to waive certain components required in this section as appropriate.

B. Purpose of the Site Analysis: Low impact development (LID) site design is intended to complement the predevelopment conditions on the site. LID Site Analysis is part of the process to determine feasibility of a project site for LID. The initial inventory and analysis process will provide baseline information necessary to design strategies that preserve natural resources, preserve areas most appropriate to evaporate, transpire, and infiltrate stormwater, and achieve the goal of maintaining pre-development natural hydrologic conditions on the site.

C. The site analysis shall include, at a minimum, the following information:

1. A survey prepared by a registered land surveyor showing existing public and private development, including utility infrastructure on and adjacent to the site, major and minor hydrologic features, including seeps, springs, closed depression areas, drainage swales, and contours as follows:
    a. Up to 10 percent slopes, two-foot contours.
    b. Over 10 percent to less than 20 percent slopes, five-foot contours.
    c. Twenty percent or greater slopes, 10-foot contours.
    d. Elevations shall be at 25-foot intervals.
2. A soils report prepared by a licensed geotechnical engineer or licensed engineering geologist. The report shall identify:
    a. Underlying soils on the site utilizing soil pits, soil grain analyses, and saturated hydraulic conductivity (shc) testing to assess infiltration capability on site. The frequency and distribution of soil pits and shc testing shall be adequate to direct placement of the roads, parking lots, and bioretention/rain gardens over those soils.
    b. Documentation of any possible shallow groundwater.
3. Preliminary drainage report consistent with the requirements of the jurisdictions stormwater management code.
    a. Topologic features that may act as natural stormwater storage or conveyance and underlying soils that provide opportunities for storage and partial infiltration.
    b. Depth to groundwater.
    c. Geologic hazard areas and associated buffer requirements as defined by the jurisdiction.

4. A survey of the existing native vegetation cover by a licensed landscape architect, arborist, qualified biologist identifying any forest areas on the site, species and condition of ground cover and shrub layer, and tree species, and canopy cover.
5. A streams, wetland, and water body survey and classification report by a qualified biologist showing wetland and buffer boundaries consistent with the requirements of the jurisdiction if present.
6. Flood hazard areas on or adjacent to the site, if present.
7. Aquifer and wellhead protection areas on or adjacent to the site, if present.
8. Any known historic, archaeological, and cultural features located on or adjacent to the site, if present.
9. Description of the proposed complete LID project including:
    a. Project narrative showing how the project will fulfill the requirement for on-site management of stormwater to the maximum extent feasible,
    b. Total area of designated development area,
    c. Total area of Native Vegetation Area,
    d. Total number of multi-family units proposed, if applicable,
    e. 1. Listing and extent of each LID BMP to be used. Explanation and documentation for any determination that an LID BMP was considered infeasible for the site, OR
    2. A statement that the site will achieve the LID performance standard,
    f. Maximum impervious surface proposed for the development,
    g. Total area of impervious surface and effective impervious surface and how proposed drainage plan reduces (to max extent) or eliminates EIA, and
    h. Proposed ownership of land areas within the complete LID project both during and after construction;
10. Areas of disturbed soils to be amended. (NOTE: All lawn and landscaped areas are to meet BMP T5.13. Use of compost is one way to meet the requirement).
11. The location and square footage or approximate location and square footage or acreage of all areas to be conveyed, dedicated or reserved as common open spaces, public parks, recreational areas, school sites, and similar public and semi-public uses with notations of proposed ownership included where appropriate.

* Check your Surface Water Manual and the Low Impact Development Technical Guidance Manual for Puget Sound for actual language.

Zoning Code

Because implementing LID techniques involves more than just the stormwater code, look for all opportunities to integrate the LID approach throughout the zoning code.

LANDSCAPING, NATIVE VEGETATION, TREE PROTECTION, AND OPEN SPACE

LID Considerations:

Native Vegetation

- Native vegetation is a fundamental method for achieving LID goals and its retention and protection should be stressed.
- Where possible, first look to retain existing native vegetation and emphasize the use of native and other drought-tolerant species in landscaping, especially conifers.
- Add a native vegetation retention section of code that allows for the setting aside of an undeveloped portion of the site.

- Set native vegetation retention standards for sites based on land use and density.
- Include a definition of native vegetation that includes minimum tree density, minimum retention requirements, protecting native vegetation areas, replanting requirements, soil amendment standards, management plan specifications, and maintenance requirements.
- The code should include plant lists, replanting standards, management plan specifications, and maintenance requirements. A list of native species either in the code or referenced by the code would be a good addition.
- Language addressing native vegetation retention can be especially beneficial when combined with other requirements for open space, reserve areas, critical area buffers, and development of other tracts of undeveloped land through the subdivision, PUD, or site plan review process.

Tree Protection

- Explore how tree protection, retention, and planting standards can work to maintain and expand vegetative cover in support of LID.
- Adopt specific language emphasizing the benefits of retaining and replacing trees and native vegetation in development. Include requirements for tree and native vegetation retention as well as replanting standards in support of LID.
- Tree conservation standards and minimum tree density standards can be based on a number of different systems such as a tree unit credit system or percentage of coverage or clustering. These standards can be adjusted to address different development intensities in a jurisdiction.
- Provide a tree species table in the code or referenced by the code listing Pacific Northwest native and near native species appropriate for native vegetation requirements. The list could consider species that are appropriate for different settings.
- Because of their ability to intercept more stormwater during the winter months, emphasize the presentation and planting of conifers over deciduous trees.
- Review options for providing tree credits. Some jurisdictions offer stormwater credits for use of urban trees. For example, the City of Seattle provides stormwater tree credits based on a study of trees and stormwater management conducted by Herrera Environmental Consultants.

Other

- Look for opportunities to support the dual use of landscaping for screening, buffers, aesthetics, and LID stormwater facilities. This includes promoting the preservation of open space where possible to meet stormwater and other desired functions.
- Require landscape performance bonds to ensure plant survival.

Examples and Ideas:

Native Vegetation

The following is an example of code language adopted by Mason County to preserve native vegetation:

Mason County. 17.80.030 - Design and development standards.

Conformance to the following criteria is required for all development reviewed under the provisions of this chapter:

(1) LID projects shall meet the minimum peak and duration flow control standards per the Department of Ecology Stormwater Management Manual for Western Washington, current edition.

(2) Through the use of LID integrated management practices identified in the Puget Sound Action Team's Low Impact Development Technical Guidance Manual for Puget Sound, flow control facilities may be reduced in size as calculated under the Department of Ecology's 2005 Stormwater Management Manual for Western Washington.

(3) Water quality treatment BMPs shall be provided to treat ninety-five percent of the annual runoff volume per the Department of Ecology standards.

(4) All areas subject to clearing and grading that have not been covered by impervious surfaces, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, shall comply with Section 17.80.090 MCC.

(5) After the certificate of occupancy is issued, there shall be no net increase in effective impervious surfaces for all LID projects. The maximum impervious surfaces allowed for each lot shall be added to the face of the plat.

(6) All projects with Type A (outwash) soils shall infiltrate one hundred percent of runoff.

(7) All projects shall provide a maintenance plan/program that has been approved by the county, including source control BMPs.

(8) LID projects shall reduce the size of conventional detention facilities (e.g., ponds) as follows:

(A) Calculate the pond volume of a conventional project by using the conventional modeling assumptions in Table 17.80.030-2: Impervious Surface Maximum Limits and Modeling Assumptions.

(B) Reduce the conventional volume by the percentage shown in Table 17.80.030-1: Pond Reduction and Native Vegetation Requirements to find the allowed LID pond size.

(C) Apply sufficient LID techniques to the project so that when

the techniques are modeled using guidance from Chapter 7 of the LID Technical Guidance Manual for Puget Sound the conventional pond volume is reduced to the required pond reduction percentage found in Table 17.80.030-1. LID projects shall preserve native vegetation area according to the percentages shown in Table 17.80.030-1. If the site has already been disturbed, the site shall be revegetated to meet the percentages shown in Table 17.80.030-1.

(9) LID projects shall not exceed the maximum impervious surface limits shown in Table 17.80.030-2 under the column "LID Project."

Table 17.80.030-1: Pond Reduction and Native Vegetation Requirements

	Minimum Pond Reduction (Infiltration <30 in/hr or less)[1,2]	Minimum Pond Reduction (Infiltration of = 0.30 in/hr or more)[1,2]	Native Vegetation Area[3]	Maximum Impervious Surface
Rural Residential	100%	100%	65%	10%
Non-Multifamily Residential = 1.4 du/ac	50%	60%	35%	15%
Non-Multifamily Residential 1.5 -2.4 du/ac	50%	60%	35%	15%
Non-Multifamily Residential 2.5 - 3.4 du/ac	50%	60%	35%	20%
Non-Multifamily Residential 3.5 - 4.9 du/ac	50%	60%	35%	30%
Non-Multifamily Residential 5.0 - 6.9 du/ac	50%	60%	20%	35%
Non-Multifamily Residential 7.0 - 9.9 du/ac	50%	60%	20%	40%
Non-Multifamily Residential = 10.0 du/ac	50%	60%	20%	60%

Multifamily [4,5]	40%	80%	20%	70%
Commercial	40%	80%	10%	70%
Roads [6]	50%	50%	n/a	n/a

1 The volume reduction in the table represents a reduction as compared to the volume needed for a detention pond serving a standard development..

2 Infiltration rates are as measured in the field at the proposed LID location using techniques recommended in the Stormwater Management Manual for Western Washington and the Low Impact Technical Guidance Manual for Puget Sound.

3 Native vegetation area includes native, undisturbed areas or rehabilitation of previously disturbed areas. Native vegetation areas may integrate passive recreation facilities. Active recreation areas shall not count towards native vegetation areas total.

4 Multifamily projects are those projects containing more than four dwelling units attached in a single structure, regardless of ownership mechanism.

5 Multifamily and commercial projects must use pervious pavement for at least twenty percent of all paved surfaces.

6 County roads should provide ecology embankment or bio-retention facilities along a minimum of seventy-five percent of the total road length.

Table 17.80.030-2: Impervious Surface Maximum Limits and Modeling Assumptions[1]

Dwelling Units Per Acre[2]	*Conventional % Impervious: Modeling Assumptions*	*Conventional % Turf: Modeling Assumption*
Non-Multifamily Residential = 1.4 du/ac	15%	85%
Non-Multifamily Residential 1.5-2.4 du/ac	25%	75%
Non-Multifamily Residential 2.5-3.4 du/ac	35%	65%
Non-Multifamily Residential 3.5-4.9 du/ac	40%	60%
Non-Multifamily Residential 5.0-6.9 du/ac	50%	50%
Non-Multifamily Residential 7.0-9.9 du/ac	60%	40%
Non-Multifamily Residential =10 du/ac	80%	20%
Multifamily Residential	90%	10%
Commercial	90%	10%

1 Impervious area includes all hard surfaces that impede infiltration of rainfall into the underlying soil profile. Many LID techniques improve the ability of water to infiltrate into the soil. These techniques count against the impervious surface totals only to the extent indicated by Chapter 7 of the LID Technical Guidance Manual.

2 Dwelling units per acre is based on gross density.

(Ord. 76-08 Attach. A (part), 2008).

The following examples use native vegetation and impervious surface percentages for Planned Unit Development or Cottage Housing projects. One is recommended code language provided to the City of Kent during the Partnership's 2009 LID Local Regulation Assistance Project. The code established native vegetation retention standards as part of the City's Planned Unit Development requirements. The City was provided native vegetation retention standards for sites based on land use and density. These standards included a definition of native vegetation and minimum tree density, minimum retention requirements, replanting requirements, soil amendment standards, and other general considerations.

Native vegetation standards.

1. Applicability. The native vegetation and impervious standards in this Section are preferred for PUDs unless proven infeasible, as determined by the Public Works Department. All other development projects are encouraged to meet these standards where site and soil conditions make it feasible.
2. Definition of Native Vegetation and Allowed Uses. Native vegetation includes native, undisturbed areas or rehabilitation of previously disturbed areas. Native vegetation shall consist of plants that are indigenous to the Pacific Northwest or near natives that are suitable for the Pacific Northwest climate. For the purposes of this chapter, native vegetation is defined by a tree density of no less than one tree per 600 square feet.
3. Allowed Uses. Native vegetation may integrate pervious passive recreation facilities, stormwater dispersion facilities, and approved surface water restoration projects. Active recreation areas and open space shall not count towards native vegetation requirements. Activities within native vegetation areas shall be limited to passive recreation (e.g. trails), removal of invasive species, amendment of disturbed soils, and planting of native vegetation.
4. Native vegetation requirements.

Table 15.08: Native Vegetation and Impervious Surface Standards

Proposed Use[2]	*Minimum Native Vegetation Area*	*Maximum Impervious Surface[3]*
Non-Multifamily Residential 3.5-4.9 du/ac[2]	35%	30%
Non-Multifamily Residential 5.0-6.9 du/ac[2]	20%	35%
Non-Multifamily Residential 7.0-9.9 du/ac[2]	20%	40%

Non-Multifamily Residential ≤10.0 du/ac[2]	20%	60%
Multi-Family[1, 2]	20%	70%
Commercial[2]	10%	70%

[1] Multi-family projects are those projects containing more than four dwelling units attached in a single structure, regardless of ownership mechanism.

[2] Dwelling units per acre is based on gross density.

[3] Impervious area includes all hard surfaces that impede infiltration of rainfall into the underlying soil profile. Many LID Techniques improve the ability of water to infiltrate into the soil. These techniques count against the impervious surface totals only to the extent indicated by Chapter 7 of the LID Technical Guidance Manual for Puget Sound (January 2005 or as amended).

5. General Provisions.
   a. Trees to be retained or replanted shall be healthy and free of disease.
   b. Healthy, significant existing vegetation should be retained to the maximum extent possible. Healthy trees over twenty-four inches in diameter at d.b.h. or that are over one hundred years of age shall be priority trees for preservation.
   c. Trees shall be retained in stands or clusters. A professional forester, arborist, or landscape architect shall prepare the vegetation management plan to ensure that retained vegetation is not susceptible to windthrow.
   d. Native vegetation may be accommodated within perimeter landscaping or other required landscaped areas.
   e. The minimum native vegetation retention may be decreased to 10 percent for non-residential uses (e.g., churches, schools, etc.) that are allowed in the underlying zone.
   f. The calculation of the native vegetation retention area for public school sites shall be based upon the total acreage of the school site minus the areas set aside for playfields in the school site plan; provided that for the purposes of the calculation, such playfield areas shall not exceed 30 percent of the gross site area.
   g. Critical areas and their buffers may be counted towards this standard so long as they contain existing native vegetation (e.g., a steep slope with Douglas fir may be counted while one with Himalayan blackberry may not). Critical areas and their buffers that will be counted towards native vegetation shall not have to comply with the replanting standards within this chapter. Land below an ordinary high water mark shall not be counted towards the required native vegetation. Dispersion of stormwater into critical areas is not permitted per Chapter 5, Volume V, of the Stormwater Management Manual for Western Washington-2005 (or as amended).

h. Any soils disturbed through the site development process that are to be counted toward the native vegetation requirements shall be amended in accordance with the "Guidelines for Implementing Soil Quality and Depth" (BMP T5.13 in the Stormwater Management Manual for Western Washington-2005 or as amended).

i. Trees preserved under the tree preservation requirements of this Chapter may be counted towards the native vegetation retention standards, so long as they meet the provisions of this Chapter.

6. Replanting Requirements.

a. If the site or lot has been previously cleared, then the minimum percentage of native vegetation shall be replanted to achieve the requirements of this section.

b. New trees that will be planted in native vegetation areas shall meet the following standards:

(1) Replacement deciduous and broad-leaf evergreen trees shall have a minimum 2" d.b.h. at planting. Replacement coniferous evergreen trees shall have a minimum height of 8' at planting;

(2) Native vegetation areas shall be replanted with species indigenous to the Northwest or suitable for the Pacific Northwest climate; Reforested areas shall be replanted with a minimum of 25% deciduous species and 30% coniferous species;

(3) Trees within the designated protected environmentally sensitive areas shall be replanted at a 2:1 ratio.

c. Where unique site and building design requirements (e.g., certain industrial uses and public schools) preclude the retention of existing native vegetation to the percentages specified in this Section, replacement and supplemental planting may be utilized. The replacement and supplemental plantings should be located in clusters or contiguous tracts and placed to maximize aesthetic, hydrologic, or habitat function and values.

7. Native Vegetation Guidelines. The following guidelines should be used with the applicant's design concept in order to meet the required standards outlined in this Section.

a. Minimize changes to natural topography in effort to maintain pre-development flow path lengths in natural drainage patterns.

b. Maintain surface roughness to reduce flow velocities

and encourage sheet flow on the lot by preserving native vegetation, forest litter and micro surface topography.

c. Amend disturbed soils to regain predevelopment stormwater storage capacity (See Section 6.2 of the LID Technical Guidance Manual for Puget Sound (January 2005 or as amended for soil amendment standards).
d. Preserve native vegetation, forest litter, and surface topography to the extent possible to most closely mimic natural hydrology.
e. Utilize the site inventory and analysis techniques to determine which portions of the site are best suited to leave native vegetation. Typically these are the most environmentally sensitive areas such as wetlands, steep slopes, floodplains, critical fish and wildlife habitat areas. In residential developments, up to 25 percent of the native vegetation specified in this Section may be incorporated into the individual lot design where strict covenants or other protection measures are put in place.

8. Permanent Protections. A permanent protective mechanism shall be legally established to ensure that the required native vegetation area is preserved and protected in perpetuity in a form that is acceptable to both the applicant and the City and filed with the County Auditor's office. Restrictions on the future use of the native vegetation area shall also be recorded on the face of the plat for subdivision applications. A permanent native vegetation area shall be established using one of the following mechanisms.

a. Placement in a separate non-building tract owned in common by all lots within the subdivision;
b. Covered by a protective easement or public or private land trust dedication;
c. Preserved through an appropriate permanent protective mechanism that provides the same level of permanent protection as subsection (8) of this section as determined by the approval authority.
d. To ensure compliance with the requirements of this Chapter, all development activity subject to the provisions of this Chapter shall include the submittal of a vegetation management plan as specified below:
e. Applications for subdivision, short subdivision, large lot division, planned development district, or binding site plan approval;
f. Site development permit applications;
g. Use permit and commercial building permit applications.

9. To ensure compliance with the requirements of this Chapter, all development activity subject to the provisions of this Chapter shall include the submittal of a vegetation management plan as specified below:

a. Applications for subdivision, short subdivision, large lot division, planned development district, or binding site plan approval;
b. Site development permit applications;
c. Use permit and commercial building permit applications.

10. The vegetation management plan shall comply with the minimum requirements specified below:

a. The vegetation management plan shall be prepared by a licensed landscape architect or qualified professional forester.
b. Provisions for tree conservation and protection on the site shall be in conformance with the requirements of this section.
c. A vegetation management plan shall be submitted either as part of the preliminary plat or other appropriate plan, or as a separate drawing, and shall include the following information:
    (1) Vegetation Protection Plan: Drawn to scale; designating vegetation to be preserved. It should include the following information:
        i. Locations of perimeters of individual and strands of trees to be preserved. The tree protection area for trees to be preserved shall be shown on the plan.
        ii. Size, species, and health of trees to be preserved.
        iii. General locations of trees proposed for removal.
        iv. Limits of construction and existing and proposed grade changes on site.
        v. Narrative description and graphic detail of tree protection and tree maintenance measures required for the trees to be preserved.
        vi. Timeline for clearing, grading, and installation of tree protection measures.
    (2) Planting Plan: Drawn to scale on the site plan. It shall include the following information:
        i. Location, size, species, and number of trees to be planted.
        ii. Narrative description and detail showing any site preparation, installation, and maintenance measures

necessary for the long-term survival and health of the vegetation.

iii. Timeline for site preparation, installation, and maintenance of vegetation.

iv. Cost estimate for the purchase, installation and 5-years' maintenance of vegetation.

(3) Tree Density Calculation: The following information shall be included on the site plan:

i. Acreage of on-site critical areas, excluding critical area buffer.

ii. Acreage of on-site public and private roads.

iii. Calculation of trees per acre for existing trees proposed for preservation.

iv. Calculation of trees per acre for new trees to be planted.

(4) A watering plan is required for the establishment phase of new plantings. The plan must provide for adequate watering of the newly installed trees for a minimum of three years.

11. Vegetation management plans shall be reviewed by the planning director. Upon completion of its review, the City of Kent shall take one of the following actions:

a. Approve the vegetation management plan, with or without conditions; or

b. Disapprove the vegetation management plan, indicating deficiencies to the applicant. If the vegetation management plan is determined to be deficient, the applicant shall be notified in writing of the deficiency and shall be provided the opportunity to modify the plan as necessary to comply with the provisions of this Chapter.

c. Vegetation management plans shall be reviewed by the planning director prior to the approval of the associated underlying permit or application. The underlying permit may not be approved until such time as the planning director has approved the plan.

d. Vegetation management plans shall be incorporated by reference in any approval issued for the underlying permit or application. Compliance with the plans shall be a condition of such approval.

12. The planning director may allow or approve minor modifications to an approved vegetation management plan during the site

development construction process to account for unforeseen site conditions and circumstances. The submittal of an amended vegetation management plan meeting the requirements of this Chapter shall be required.

The following example establishes native vegetation and impervious surface standards for PUDs and cottage housing developments. It was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project:.

6. Native Vegetation and Impervious Surface Standards.
   a. The following standards are recommended for new development projects where site and soil conditions make them feasible as determined by the Public Works Department. These standards are required for PUDs and cottage housing developments, unless site and soil conditions make them infeasible as determined by the Public Works Department.

Proposed Use	*Minimum Native Vegetation Area[1]*	*Maximum Impervious Surface[2]*
Non-Multifamily Residential ≤1.4 du/ac[6]	35%	15%
Non-Multifamily Residential 1.5-2.4 du/ac[6]	35%	15%
Non-Multifamily Residential 2.5-3.4 du/ac[6]	35%	20%
Non-Multifamily Residential 3.5-4.9 du/ac[6]	35%	30%
Non-Multifamily Residential 5.0-6.9 du/ac[6]	20%	35%
Non-Multifamily Residential 7.0-9.9 du/ac[6]	20%	40%
Non-Multifamily Residential ≤10.0 du/ac	20%	60%
Multi-Family[5, 6]	20%	70%
Commercial[5, 6]	10%	70%

1 Native vegetation area includes native, undisturbed areas or rehabilitation of previously disturbed areas. Native vegetation areas may integrate passive recreation facilities. Active recreation areas shall not count towards native vegetation areas total (See Chapter 17.24 for definition of recreation areas).

2 Impervious area includes all hard surfaces that impede infiltration of rainfall into the underlying soil profile. These surfaces include but are not limited to compacted soil, asphalt concrete pavement, cement concrete pavement, roofs, and gravel paved areas. Green roofs and minimal excavation foundations,

subject to conformance with applicable Department of Ecology BMPs, are not included in the total impervious area. Rainwater harvesting systems based on documented water balance may be used to reduce the calculated total impervious area. Permeable pavement systems such as modular grid pavement or pervious concrete count against the impervious surface totals only to the extent indicated by Section 7.1.1 of the LID Technical Guidance Manual for Puget Sound (January 2005 or as amended).

b. Native Vegetation Areas Definition: Native vegetation areas shall have a minimum tree density of one native tree for every 600 square feet. Native Vegetation Areas that do not contain sufficient tree canopy coverage shall be planted or replanted in accordance with 19.06.130 PTMC. See Chapter 4 of the EDS for a list of native and near native species.
c. For the purposes of calculating native vegetation areas, inundated lands shall not be included; however, other sensitive areas and their buffers may be included within the Native Vegetation Area boundaries. Land below an ordinary high water mark shall not be counted towards the required native vegetation.
d. Existing native vegetation, forest litter and understory should be preserved to the extent possible in the Native Vegetation Areas in order to reduce flow velocities and encourage sheet flow on the site. Runoff discharged into native vegetation areas shall be dispersed in accordance with BMP T5.30, Volume V, of the Stormwater Management Manual for Western Washington - 2005 or as amended. Further guidance on full or partial dispersion of stormwater runoff is provided in Section 7.2.2 and 7.2.3 of the LID Technical Guidance Manual for Puget Sound (January 2005 or as amended).
e. Development within Native Vegetation Areas shall be limited to stormwater dispersion facilities, pervious pedestrian trails, and approved surface water restoration projects. Activities within the Native Vegetation Areas shall be limited to passive recreation, removal of invasive species, amendment of disturbed soils consistent with all applicable regulations, and planting of native vegetation. Development shall be consistent with critical areas requirements and restrictions in 19.05 PTMC.
f. A permanent protective mechanism shall be legally established to ensure that the required Native Vegetation Area is preserved and protected in perpetuity in a form that is acceptable to both the applicant and the City and

recorded with the County auditor's office. A permanent Native Vegetation Area shall be established using one of the following mechanisms:

i. Placement in a separate non-building tract owned in common by all lots within the subdivision;
ii. Covered by a protective easement or public or private land trust dedication;
iii. Preserved through an appropriate permanent protective mechanism that provides the same level of permanent protection as subsection (a) of this section as determined by the approval authority.
iv. Restrictions on the future use of the Native Vegetation Area shall be recorded on the face of the final plat, short plat, or large lot subdivision.

g. Native soil protection and amendment.
   i. The duff layer and native topsoils shall be retained in an undisturbed state to the maximum extent practicable. Any duff layer or topsoil removed during grading shall be stockpiled on-site in a designated, controlled area not adjacent to public resources and critical areas. The material shall be reapplied to other portions of the site where feasible.
   ii. Except as otherwise provided in subsection (c), areas that have been cleared and graded or subject to prior disturbance shall be amended in accordance with the "Guidelines for Implementing Soil Quality and Depth" (BMP T5.13 in the Stormwater Management Manual for Western Washington - 2005 or as amended). Prior disturbance shall include soil compaction or removal of some or all of the duff layer or underlying topsoil. The amendment shall take place between May 1 and October
   iii. This section does not apply to areas that would harm existing trees proposed for retention, or that, at project completion, are covered by an impervious surface, incorporated into a drainage facility, or engineered as structural fill or slope.

The following is an example of code language adopted as part of the 2009 City of Newcastle Stormwater and Low Impact Development Code Update, establishing how native vegetation needs to be addressed in an LID project.

City of Newcastle. 18.21.080 Native vegetation areas.

A. For the purposes of this Chapter, native vegetation areas shall have a tree density of one native tree for every 600 square feet.

B. Native vegetation area includes native, undisturbed areas or rehabilitation of previously disturbed areas. Native vegetation areas may integrate passive recreation facilities. Active recreation areas shall not count towards native vegetation areas total.

C. For the purposes of calculating the required native vegetation area required in 18.21.050-1, inundated lands shall not be included; however, other sensitive areas and their buffers may be included within the Native Vegetation Area boundaries. Land below an ordinary high water mark shall not be counted towards the required native vegetation.

D. Native Vegetation Areas shall be forested or reforested.
   1. Native Vegetation Areas that do not contain sufficient tree canopy coverage shall be planted with native or near native trees at the minimum tree density specified in 18.21.080(A) and shall be replanted in accordance with 18.16.090(C) and (D) for broadleaf and evergreen trees, respectively. This requirement does not apply to areas addressed by Chapter 18.24.
   2. Native Vegetation Areas shall be planted with vegetation that is indigenous to the Pacific Northwest or suitable for the Pacific Northwest climate.
   3. A minimum of 25% replanted trees shall be of deciduous species and a minimum of 25% replanted trees shall be coniferous species.

E. Existing native vegetation, forest litter, and understory shall be preserved to the extent possible in the Native Vegetation Areas in order to reduce flow velocities and encourage the dispersion of the storm water on the site. Runoff discharged into native vegetation areas shall be dispersed in accordance with the latest adopted version of the KCSWDM.

F. Development within Native Vegetation Areas shall be limited to stormwater dispersion facilities, non-compacted pedestrian trails, and approved surface water restoration projects. Activities within the Native Vegetation Areas shall be limited to passive recreation, removal of invasive species, amendment of disturbed soils consistent with all applicable regulations, and planting of native vegetation. Development shall be consistent with critical areas requirements and restrictions in Title 14.

G. A permanent protective mechanism shall be legally established to ensure that the required Native Vegetation Area is preserved and protected in perpetuity in a form that is acceptable to the City and filed with the County auditor's office. A permanent Native Vegetation Area shall be established using one of the following mechanisms:

1. Placement in a separate non-building tract owned in common by all lots within the subdivision;
2. Covered by a protective easement or public or private land trust dedication;
3. Preserved through an appropriate permanent protective mechanism that provides the same level of permanent protection as subsection (1) of this section as determined by the approval authority.

F. Restrictions on the future use of the Native Vegetation Area shall be recorded as part of the site plan review approval, final PUD approval, final short plats, final plat, final binding site plans, or other permit approval.

18.21.090 Native soil protection and amendment.

A. The duff layer and native topsoil should be retained in an undisturbed state to the maximum extent practicable. In any areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.

B. Soil quality. All areas subject to clearing and grading that have not been covered by impervious surface, incorporated into a drainage facility or engineered as structural fill or slope at project completion, shall meet the soil quality and depth requirements of the Grading Code Soil Amendment Standard referenced in the KCSWM. More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

The following is an example of code language adopted by City of Bellingham establishing Native Vegetation Protection Areas (NVPAs) to protect Lake Whatcom.

City of Bellingham Municipal Code, Title 16 - Environment, Chapter 80 - Lake Whatcom Reservoir Regulatory Chapter

16.80.080 - Development Standards for Residential Single Development.

Development standards for residential single development shall be as required under BMC Title 20, except as modified by this regulatory chapter and as stated below.

[…]

E. Native Vegetation Protection Area (NVPA) Requirements. The purpose of retaining a NVPA (BMC 16.80.050) is to prevent phosphorous inputs to Lake Whatcom by the interruption, infiltration, and evapotranspiration that forest cover provides. Areas in a natural forested condition (BMC 16.80.050) are generally considered the optimum natural condition for minimizing stormwater runoff, including strategies to control the phosphorus leaving the site.

1. **NVPA Minimum Area**
   (a) Fully Engineered Method
      i. At least 30% of the total site area shall meet the natural forested condition (BMC 16.80.050) and retained as the NVPA.
      ii. See full requirements in BMC 15.42.060.A.3.
      or
   (b) Forested Method
      i. At least 75% of the total site area shall meet the prerequisites for natural forested condition (BMC 16.80.050) and be retained as NVPA.
      ii. See full requirements in BMC 15.42.060.A.3.b.

2. **NVPA Standards**
   (a) A site analysis shall be conducted by an ISA-certified arborist, in conjunction with the stormwater engineer and other professionals prior to site design and building permit application submittal. At a minimum, the analysis shall be done to determine the extent to which the NVPA meets the definition of natural forested condition (BMC 16.80.050).
   (b) The following criteria shall be included in the site analysis report submitted to the City:
      i. The site analysis shall assess the soils for their capacity to support the NVPA and their ability to provide stormwater attenuation.
      ii. The site analysis shall evaluate the health and long-term viability of the trees within the NVPA, considering

potential changes to adjacent properties and the surrounding vicinity that could impact the NVPA.

iii. The site analysis shall include recommendations on tree preservation, tree removal to avoid hazards, and tree replacements to promote long-term forest canopy viability based on factors taken into account by the ISA-certified arborist.

iv. The site analysis shall include identification and protection of the critical root zone of trees to be saved using the methodology adopted in the City's Parks and Trails Design Standards, # 02950.06 and 02950.07.

v. A site visit prior to activities authorized to occur in the NVPA, such as, but not limited to hazard tree removal, shall be supervised by an ISA-certified arborist. The soil profile, including the organic duff layer, within the NVPA shall not be disturbed unless authorized by the City and in accordance with the ISA-certified arborist recommendations. Subgrade soils may not be placed within the NVPA.

vi. If the site analysis results in a determination that the NVPA does not meet the natural forested condition, a full restoration plan to re-establish the site to a natural forested condition is required for approval prior to building permit submittal. The restoration plan shall include the following:

(c) The restoration plan shall include all components and specifications necessary to achieve a timely re-establishment of the NVPA to a natural forested condition. The minimum monitoring period shall be five years.

(d) The restoration plan shall be developed and implemented by an ISA-certified arborist or a professional ecological restoration specialist with at least five years of experience in designing and implementing ecological restoration projects or qualified professional as determined by the Director.

(e) The restoration plan shall include cost estimates for fully implementing the restoration plan on which a surety can be based.

(f) A financial surety for all required restoration work shall be submitted and approved prior to building permit issuance.

3. NVPA Permanent Protection. The NVPA shall be protected during construction and in perpetuity by covenants or

conservation easements, granted to the City of Bellingham prior to building permit issuance.

[Ord. 2009-06-040; Ord. 2007-04-031; Ord. 2001-01-001]

Tree Protection

A good, detailed example of tree protection regulations can be found in the City of Olympia's code for Green Cove Basin (Chapter 16.54 – Tree Protection and Replacement).

Pierce County has also adopted tree conservation requirements. Pierce County's code, adopted in 2010, is part of county-wide design standards.

City of Olympia. 18J.15.030 Tree Conservation.

The purpose of this Section is to retain and/or restore the overall tree canopy in the County by using plant materials as a unifying element and tool to protect the health, safety and welfare of the public by using the environmental services provided by trees to mitigate the negative effects of impervious surfaces and vehicular traffic such as increased temperatures, airborne particulates, carbon dioxide, noise, and stormwater runoff.

A. Applicability. The standards of this Section apply to:

1. New uses and divisions of land proposed on vacant or redeveloping parcels;
2. Expansions of existing commercial, industrial, and multi-family uses exceeding 10 percent of the existing building footprint or associated impervious areas (parking lots, storage areas, etc.) that do not have an existing approved tree conservation plan; and
3. Class IV Forest Practices.

B. Exemptions. The following uses shall not be subject to the standards of this Section:

1. Development occurring within any designated airport safety area or object-free area.
2. Land utilized for agricultural activities, except for Agricultural Product Sales, Agricultural Supply Sales, and Agricultural Services Use Types, which meets one of the following requirements:
   a. The land is located within the Agricultural Resource Lands (ARL) or Rural Farm (RF) zones;
   b. The land is subject to an approved Hobby Farm Agreement;

c. The land meets the definition of Farm and Agricultural Land pursuant to RCW 84.34 and is being taxed as such; or
d. The land is existing pasture land and is utilized for agricultural purposes such as livestock production.

3. Silvicultural activities occurring within the Forest Land (FL) zone.
4. Surface mining conducted within a designated Mineral Resource Overlay.
5. Urban short subdivisions of 4 lots or less on project sites of 1 acre or less except that the significant tree retention provisions specified in 18J.15.040 E.2. shall apply. The significant trees shall be shown on the site plan and can be reviewed in conjunction with the short plat without Administrative Design Review, unless Administrative Design Review is otherwise required.
6. Expansion, remodeling, or maintenance of structures provided that the existing building footprint is not increased by more than 10 percent.
7. Construction, reconstruction, or maintenance of public roads, paths, bicycle ways, trails, bridges, sewer lines, storm drainage facilities, related critical area mitigation activities, and other similar public infrastructure, excluding public buildings.

C. Credits. All trees on-site that meet the standards of this Section and are required, provided, or are retained for residential street trees, perimeter buffering or otherwise, may be counted toward the minimum tree unit requirements.

D. Design Objective. To promote tree conservation by establishing minimum tree density requirements, expressed as tree units per acre, for new or expanding uses proposed on vacant and redeveloping parcels. It is intended that the tree density requirements will be met primarily through the conservation of existing trees. However, in order to provide for continued flexibility in the design of new development, in those situations where an applicant's design would preclude the retention of the required number of trees, the use of replacement or supplemental tree planting is authorized. It is also recognized that some sites may not contain a sufficient number of existing trees to meet the tree density standards. In those situations, additional trees are to be planted as necessary to achieve the minimum tree density requirements.

E. Standards – General.

1. Construction Buffer. No construction shall occur within the mature tree canopy area of a tree planted or retained to meet tree unit density requirements. (See also 18J.15.130, Plant Protection and Maintenance, for additional standards and 18J.15.100, Plant Lists, for tree species and canopy sizes.)
2. Residential Lot Location. To minimize development related conflicts and foster long-term success of tree conservation in residential spaces, the following standards shall apply to tree conservation on residential lots:
   a. Lots must be at least 8,000 square feet in size to include trees that count toward tree unit density requirements.
   b. Replacement coniferous and broadleaf evergreen trees shall not be less than 4 feet in height at time of planting. Deciduous trees shall be fully branched, have a minimum caliper of 1½ inches and a minimum height of 8 feet at time of planting. Seedlings are not permitted.
   c. All retained trees located on lots shall be identified with a permanent cable tie tree tag at breast height.
3. Significant Trees. At a minimum, 30 percent of significant trees on site shall be retained, preferably reflective of the diversity of species and age within the stand, up to the minimum tree density requirements.

Table 18J.15.030-1. Significant Trees

Tree Species	Size
Garry (Oregon White) Oak (1)	8” d.b.h. or greater
Pacific Yew	5” d.b.h. or greater
Pacific Madrone	10” d.b.h. or greater
Ponderosa Pine, Grand Fir, Big Leaf Maple, Western Hemlock, Western Red Cedar, Shore Pine, Western White Pine	15” d.b.h. or greater
Douglas Fir, Sitka Spruce	24” d.b.h. or greater
Legacy Tree (any species)	40” d.b.h. or greater

Footnote:
(1) See also habitat protection standards for Oregon White Oak trees/stands in 18E.40.020 D. and 18E.40.040 C.

F. Standards – Tree Unit Density.

1. General. The following minimum tree unit densities apply to new development activities; calculated using net developable acreage of the project site:

Table 18J.15.030-2. General Minimum Tree Unit Density (1) Tree Species Size	
Urban Centers, Employment Centers, Rural Centers	20 tree units/acre
Urban Residential (2)	30 tree units/acre
Rural Residential (3)	40 tree units/acre
Resource Lands and Other Zones	Not Applicable

Footnotes:
(1) If the calculation results in a fractional quantity, it shall be rounded to the nearest whole number (greater than or equal to .5 is rounded up, less than .5 is rounded down).
(2) Non-residential uses, other than schools, permitted within Urban Residential zones shall be subject to a required tree unit density of 20 tree units/acre.
(3) Non-residential uses, other than schools, permitted within Rural Residential zones shall be subject to a required tree unit density of 20 tree units/acre.

2. Property and Use Expansion.
   a. For expansion on legally established commercial, industrial, and multi-family properties which do not conform to the tree density requirements, the following tree conservation requirements shall apply:
      (1) A minimum of 1 tree unit shall be provided for each 500 square feet of building or use area expansion; and
      (2) A minimum of 3 tree units shall replace each tree unit removed, up to a maximum of 25 tree units per acre.
   b. For properties with an approved Tree Retention Plan, the applicant shall provide:
      (1) Information to explain how the removal of tree conservation trees cannot be avoided;
      (2) Replacement trees for each tree unit lost, based upon tree size at the time of removal; and
      (3) A revised plan demonstrating that no net loss of tree units will occur.
3. Schools. Schools shall be subject to a required tree unit density of 10 tree units per acre in all zone classifications.
4. Rural Residential Land Division. Rural land divisions which result in the creation of residential lots each having a minimum lot size of 5 acres or 1/128th of a Section or larger; or residential lots of less than 5 acres where the density of the land division is 0.2 dwelling units per acre or less, shall have the following special standards:
   a. For project sites containing forest, at least 50 percent of forested area shall be retained. If the retained forest area does not achieve 50 percent forest site coverage

within the division additional tree plantings shall be provided into achieve such coverage. Forested areas shall meet a minimum tree unit density of 40 tree units per acre. Additional tree planting shall be provided as necessary to achieve this tree density.

b. Non-forested project sites shall retain and/or replant trees as necessary to meet a tree unit density of at least 40 tree units per acre on a least 50 percent of the site.

G. Standards – Tree Unit Credits. Tree unit credits for the retention and planting of trees shall be awarded as follows:

Table 18J.15.030-3. Tree Unit Credits	
Tree Category	**Tree Unit Credits**
Existing Tree 1" to 6" d.b.h.	1.0 tree unit per tree retained
Existing Tree > 6" </= 12" d.b.h.	**1.5 tree units per tree retained**
Existing Tree > 12" </= 18" d.b.h	**2.0 tree units per tree retained**
Existing Tree > 18" </= 24" d.b.h.	**2.5 tree units per tree retained**
Existing Tree > 24" d.b.h.	**3.0 tree units per tree retained**
Significant Tree < 24" d.b.h.	**2.5 tree units per tree retained**
Significant Tree >/=24" d.b.h.	**3.0 tree units per tree retained**
Legacy Tree	10 tree units per tree retained
Replacement Tree – 2-1 Seedling (1)	.25 tree units per tree planted
Replacement Tree – Coniferous ≥ 4' in height, Deciduous ≥1 ½ " caliper	.75 tree units per tree planted

Footnote:
(1) Seedlings shall not be credited toward tree unit density requirements if placed on lots. (See
18J.15.030 E.2., Standards – Residential Lot Location)

1. Retained Trees. Trees to be retained on site must meet the following minimum standards to be credited toward the tree density requirements of this Section. Trees identified as having significant habitat value (i.e., Legacy Trees, snags or nesting trees) and those located within a critical area or its buffer may be credited toward the tree density requirements, regardless of the health or state of the tree. An evaluation of individual tree health shall not be required for such trees except for those trees within 1½ tree lengths of proposed structures or improvements:
   a. Post-development life expectancy of greater than 10 years;

b. Relatively sound and solid trunk with no extensive decay or hollow and no significant trunk damage;
c. No major insect or pathological problem;
d. No significant crown damage;
e. Full branching and general proportionality in height and breadth for the tree age; and
f. Individual trees and groupings of trees proposed for retention must be wind-firm in their post development state.

2. Replacement Trees. Each tree proposed for planting must meet the following minimum standards to be credited toward satisfying the tree density requirements of this Section:
   a. Developments shall locate a minimum of 25 percent of the required trees in protected tracts, such as tree conservation tracts, recreation tracts, stormwater tracts, and critical area tracts;
   b. Trees shall be free from injury, pests, diseases and nutritional disorders and must be fully branched and have a healthy root system;
   c. Trees utilized for planting shall be a minimum 2-1 seedling size, unless a larger size is specified;
   d. Trees planted shall include a mix of coniferous and deciduous trees, with a minimum of 30 percent coniferous, unless the area is deemed to have been Oregon white oak habitat, in which case the standards in Title 18E, Development Regulations – Critical Areas, shall apply;
   e. Replacement trees proposed to be planted within open space, greenbelts, native buffer areas and landscape areas such as street trees must be compatible with the intended growing location;
   f. Individual species of replacement trees planted shall not exceed 25 percent of the total number of all replacement trees;
   g. Irrigation shall be provided until the tree is established; and
   h. Trees may be planted on a solitary basis or within clusters to form stands.

H. Guidelines.

1. When lots or building sites are located next to protective tracts (such as park, stormwater, or critical area tracts), the preferred location of the trees is the area adjacent to these tracts.

(Ord. 2010-70s § 15 (part), 2010; Ord. 2009-98s § 2 (part), 2010)

Other

The following example illustrates the integration of stormwater facilities into required landscaping. It was provided to the City of Kent during the Partnership's 2009 LID Local Regulation Assistance Project.

> Required landscaping may be integrated with LID stormwater management facilities unless site and soil conditions make LID infeasible, subject to the approval of the Planning Director and Public Works Department. LID facilities shall not compromise the purpose or intent of required landscaping and landscaping shall not result in the disruption of the LID facilities functions. LID facilities shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition).

The following is an example of code language adopted by the City of Fife in 2009, establishing the use of LID in city parks:

> ***12.22.050 Low impact development in city parks.***
> Stormwater runoff in city parks shall be managed via low impact development techniques and facilities to the maximum extent practicable. Where it does not impede the programmatic uses of the park, city parks shall be used to help control stormwater runoff for municipal rights-of-way and/or adjacent development. (Ord. 1685 § 1 (Exh. A), 2009).

IMPERVIOUS SURFACE STANDARDS

LID Considerations

- Reducing total impervious surface area, hard surfaces and eliminating EIA, where feasible is a primary principle of the LID approach.
- Establish standards for both TIA and EIA.
- Establish standards for hard surface areas.
- Establish maximum EIA percentages for a range of zoning classifications in a jurisdiction, as opposed to just defining building coverage percentage. Allow certain uses such as commercial that require more surface area to use pervious surfacing to go above the effective impervious surface requirements.

Examples and Ideas

The following example of code language adopted by the City of Bellingham illustrates establishing impervious and partial pervious surface limits to protect Lake Whatcom.

16.80.090 - Impervious and Partially Pervious Surface Limits

A. Residential Single Development – One of two development "methods" can be selected, as described below and further detailed in BMC15.42.060.
   1. Fully Engineered Method
      (a) See full requirements in BMC 15.42.060.A.3. and BMC 15.42.060.B.3.

      or
   2. Forested Method
      (a) Impervious surface limits not to exceed 2,000 square feet or 20% of the gross lot area, whichever is lesser.
      (b) Partially pervious surface limits not to exceed 1,000 square feet or 10% of the gross lot area, whichever is the lesser.
      (c) Together, the total impervious surface and partially pervious surfaces shall not exceed 25% of the gross lot area nor exceed 2,500 square feet.
      (d) See full requirements in BMC 15.42.060.A.3.b and BMC 15.42.060.B.3.b.

B. Redevelopment of an existing nonconforming lot with regard to impervious and partially pervious surface area limits. When an owner of a lot that exceeds the impervious limits expressed in BMC 16.80.090 A. desires to remodel or add on to an existing building or impervious area or partially pervious surface, they shall comply with BMC 15.42.060 B.3 or may:
   1. Add an additional story to any existing portion of the residential building that will not change the footprint, subject to height limitations in BMC Title 20.

C. Reconstruction of a building that is non-conforming with regard to impervious area limits is allowed on a like-for-like basis when damaged by earthquake, fire, vehicular collision or similar accidental causes. Owners of non-conforming lots with regard to impervious area may not re-build buildings that have been abandoned or are more than 50% destroyed by reason of neglect unless they conform to impervious limits in BMC 16.80.090 A.

D. Impervious limits for residential multi and commercial development: The maximum impervious limit for residential multi and commercial development shall be determined during the SEPA review process. The SEPA process shall consider stormwater impacts, ambient water quality, contaminant and nutrient loading and the adopted

goals and policies for the Lake Whatcom Watershed in effect at the time of application. All residential multi and commercial development review shall emphasize best management practice prevention efforts over treatment strategies for the minimization of water quality impacts and a finding of fact must be made that no increase in phosphorous or fecal coliform loading will result from the approval of the development.

[Ord. 2009-06-040; Ord. 2001-01-001]

BULK AND DIMENSIONAL STANDARDS

LID Considerations

- To offset reductions in EIA, review existing bulk and dimensional standards to look for ways to allow more flexibility in site design for LID, such as increasing building height or reducing building setbacks.
- Examine performance based design standards to allow greater flexibility in site design in exchange for more opportunities to make LID work.
- When building footprints are reduced, increase height limits to help meet density goals and reduce EIA either by incentives or in specific higher density areas where LID is applied.
- Reduce setbacks to allow greater flexibility with site design for LID either through incentives or higher intensity areas.
- Look for opportunities to balance changes made to support LID with ways to achieve other goals, such as increasing density in higher intensity areas, clustering to protect sensitive areas, providing flood plain protection, or supporting commercial development.
- Consider increasing density within Urban Growth Areas that are suitable for more intense development to preserve areas more suitable for large-scale LID development.

Examples and Ideas

The following example illustrates how LID might be integrated into a City's engineering design standards for existing single-family residential. This example was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project.

LID Requirements for New Development on Existing Single-Family Residential Lots

a. Applicability: The requirements of this section apply to new development on existing single-family lots. The requirements of this section do not apply to new lots in a subdivision, which shall comply with Part 5 of this Chapter.

b. Stormwater generated on-site from all new impervious surfaces shall be managed through any combination of the LID BMPs below,

or any other LID best management practices approved by the city, unless site and soil conditions make LID infeasible as determined by the Public Works Director:

1. Raingarden and Bioretention Areas: All bioretention areas shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition) and raingardens shall be designed and constructed in accordance with the Raingarden Handbook for Western Washington Homeowners (WSU Pierce County Extension). A raingarden is preferred to be used instead of a dry well, conventional stormwater vault, or large detention pond.
2. Permeable surfacing: Pervious surfacing for areas of a site that are typically impervious, such as driveways or parking areas, shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition) and the manufacturer's recommendations.
3. Disperse your stormwater into a native vegetation retention area.
    i. Stormwater dispersion shall comply with the design standards set forth in the LID Technical Guidance Manual for Puget Sound (current edition).
4. Roof Rainwater Harvesting: Rainwater harvesting techniques shall follow the standards outlined in the LID Technical Guidance Manual for Puget Sound (current edition).
    5. Green roof: Green roofs shall be designed and constructed using the current edition of the LID Technical Guidance Manual for Puget Sound.
    6. Minimal excavation foundation systems: All minimal excavation foundation systems shall be designed and constructed using the current edition of the LID Technical Guidance Manual for Puget Sound and the manufacturer's specifications.

SITE PLAN REVIEW

LID Considerations

- Site analysis requirements should be a necessary addition to the code in the early stages of project conception. See sample site analysis checklist. Site analysis requires the applicant to document the site with both textual and graphic information early in the development review process. That allows LID to be incorporated into the site design at the early stages of project conception and it will not compromise the placement and function of LID facilities.
- Requiring a higher degree of site analysis during the early stages of project conception is important to maximize design and functionality of LID BMPs.

Have applicants conduct an LID site analysis and bring the results of this analysis to the required pre-application conference. The analysis would include information similar to that shown below and identify proposed LID BMPs.

- The site assessment needs to distinguish between soil testing for overall site assessment and soil testing for an individual facility design. Consider two phase soil evaluations to include a general assessment, which might include some soil testing, but at a lesser standard than facility design and then more detailed soil work for facility design.
- Look at mechanisms in other sections of the code to decrease building footprints, reduce EIA, reduce hard surfaces, and retain tracts of native vegetation.
- Review the project design to ensure that stormwater is being adequately managed in distributed, small-scale LID hydrologic controls.
- Think about how to protect LID related features during the entire development and construction process.
- Outline construction sequencing and practices for protecting pervious areas and LID BMPs during construction.
- Consider an LID consultation process for small residential development activities and for single-family residential lots where LID is required.

The following is an example of code language adopted by the City of Fife in 2009, establishing the use of LID in the city. In addition, FMC 21.10 provides details on what is required for an LID project submittal and review.

City of Fife. 21.10.000 Low impact development drainage and land alteration.

A. Land alteration may commence when a stormwater drainage permit has been issued per Chapter 15.32 FMC.

B. Drainage plans and improvements shall be in compliance with city of Fife drainage standards. Alternative BMPs not specifically referenced in the Fife standards may be considered subject to approval by the public works director.

C. Low impact development techniques shall be required as part of all storm drainage permits submitted to the city of Fife. Permitted activities are in FMC 15.32.040. If permitted development does not require a change in stormwater management, then low impact development techniques shall not be required. Low impact development facilities shall replace or supplement other stormwater drainage facilities.

D. Retrofitting properties with low impact development facilities shall not require a stormwater permit if both of the following conditions are met:

   1. The property is zoned single-family residential (Chapter 19.14 FMC), small lot residential (Chapter 19.20 FMC),

medium density residential (Chapter 19.24 FMC), high density residential (Chapter 19.28 FMC), neighborhood residential (Chapter 19.32 FMC), or neighborhood commercial (Chapter 19.36 FMC).

2. The low impact facility receives water from an area not larger than 1250 square feet. (Ord. 1685 § 1(Exh. A), 2009).

The following is an example of code language adopted by the City of Seattle, establishing the use of LID in the city. In addition, review Chapter 4.4-Green Stormwater Infrastructure of Vol. 3 of the City of Seattle's Stormwater Manual.

City of Seattle. SMC 22.805.020 Minimum Requirements for All Projects

F. Implement Green Stormwater Infrastructure. All Single-family residential projects and all other projects with 7,000 square feet or more of land disturbing activity or 2,000 square feet or more of new plus replaced impervious surface must implement green stormwater infrastructure to infiltrate, disperse, and retain drainage water onsite to the maximum extent feasible without causing flooding, landslide, or erosion impacts.

SMC 22.805.080 Minimum Requirements for Flow Control

A. Applicability. The requirements of this subsection apply to the extent required in Section 22.805.050 to Section 22.805.070.

B. Requirements. Flow control facilities shall be installed to the extent allowed by law and maintained per rules promulgated by the Director to receive flows from that portion of the site being developed. Post-development discharge determination must include flows from dewatering activities. All projects shall use green stormwater infrastructure to the maximum extent feasible to meet the minimum requirements. Flow control facilities that receive flows from less than that portion of the site being developed may be installed if the total new plus replaced impervious surface is less than 10,000 square feet, the project site uses only green stormwater infrastructure to meet the requirement, and the green stormwater infrastructure provides substantially equivalent environmental protection as facilities not using green stormwater infrastructure that receive flows from all of the portion of the site being developed.

SMC 22.805.090 Minimum Requirements for Treatment.

A. Applicability. The requirements of this subsection apply to the extent required in Section 22.805.050 to Section 22.805.070

B. Requirements. Water quality treatment facilities shall be installed to the extent allowed by law and maintained per rules promulgated by the Director to treat flows from the pollution generating pervious and impervious surfaces on the site being developed. When stormwater flows from other areas, including non-pollution generating surfaces (e.g., roofs), dewatering activities, and offsite areas, cannot be separated or bypassed, treatment BMPs shall be designed for the entire area draining to the treatment facility. All projects shall use green stormwater infrastructure the maximum extent feasible to meet the minimum requirements.

SMC 22.801.080 "G"

"Green stormwater infrastructure" means a drainage control facility that uses infiltration, evapotranspiration, or stormwater reuse. Examples of green stormwater infrastructure include permeable pavement, bioretention facilities, and green roofs.

SMC 22.801.140 "M"

"Maximum extent feasible" means the requirement is to be fully implemented, constrained only by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts.

The following is an example of code language provided to the participants of the 2009 Low Impact Development Local Regulation Assistance Project establishing the LID consultation process.

16.19.075 Low Impact Development (LID) Consultation

A. Purpose. The purpose of the LID consultation is to discuss the potential for using LID best management practices (BMPs) where site and soil conditions make LID feasible as determined by the Public Works Department. LID is intended to complement the predevelopment conditions on the site through design strategies that preserve natural resources, preserve areas most appropriate to evaporate, transpire, and infiltrate stormwater, and achieve the goal of maintaining pre-development natural hydrologic conditions on the site.

B. Applicability. An LID consultation is required for small residential development activities and for single-family residential lots where LID is required per 11.03.105 ICC.

C. An LID consultation shall be scheduled by the Department, upon the request of an Applicant, and shall be held in a timely manner, typically within thirty (30) days from the date of the Applicant's request.

D. LID consultation preliminary materials. In addition to discussing application requirements, applicants should have a preliminary site plan or series of maps with the following elements:

1. Location of streams, wetlands, ditches, or other water bodies on or adjacent to the site.
2. Site topography in 5' or 10' contours.
3. Steep slopes and their approximate gradient.
4. Location of species habitat, if applicable, on or adjacent to the site (include any protected species observed).
5. Location of existing vegetation on-site including significant or mature trees. Indicate the type of vegetation (e.g. blackberries, alder, evergreen, etc.).
6. Location and type of soils on-site, and indicate the infiltration capacity of those soils. Use the LID Technical Guidance Manual for Puget Sound (current edition) for guidance on conducting pit-infiltration test. Because soil types vary considerably from site to site, the National Soils Survey should be used for background information and not serve as the primary source for soil type identification.
7. Location and approximate amount of clearing activities. Please provide this information in square footage or acres of clearing and the percent of the lot that will be cleared.
8. Location and amount of impervious surface coverage proposed, including structures, patios, driveways, roofs, or any other hard surfaces that prevent the infiltration of stormwater. Provide this estimate in total square feet and as a percentage of the total lot size.
9. Location for potential bioretention swales, raingardens, or other LID stormwater management facilities.

The following is an example of language provided as part of the 2009 Low Impact Development Local Regulation Assistance Project for the City of Port Townsend, establishing the LID Site analysis process as part of the City's Engineering Design Standards.

LID Site Analysis

A. Applicability. All long subdivisions, short subdivisions of 5 lots, PUDs, cottage housing developments, new commercial, and multi-family projects shall conduct an LID site assessment in accordance with Chapter 4, part (8) of the Engineering Design Standards (EDS). Site assessment findings shall be a component of the project submittal.

B. LID site design is intended to complement the predevelopment conditions on the site. The development context shall be established by an initial site assessment consistent with the requirements of this section. The initial inventory and assessment process will provide the baseline information necessary to design strategies that preserve natural resources, preserve areas most appropriate to evaporate, transpire, and infiltrate stormwater, and achieve the goal of maintaining pre-development natural hydrologic conditions on the site. The assessment will result in a series of maps identifying streams, lakes, wetlands, and buffers; steep slopes, and other hazard areas; significant wildlife habitat areas; and permeable soils offering the best available infiltration potential. Maps can be combined as hard copies or as GIS layers to delineate the best areas to direct development. Designated development areas, which will contain all impervious surfaces and landscaped areas on the site, should be configured to minimize soil and vegetation disturbance, buffer critical areas, and take advantage of a site's natural stormwater processing capabilities. Designated development area boundaries shall be delineated on site plans and identified on the site during site preparation and construction. Areas outside of the designated development area envelope shall be designated Native Vegetation Areas or reserve areas.

   The site assessment shall include, at a minimum, the following:

   1. A survey prepared by a registered land surveyor or registered civil engineer showing existing public and private development, including utility infrastructure, on and adjacent to the site, major and minor hydrologic features, including seeps, springs, closed depression areas, drainage swales, and contours as follows:
      a. Up to 10 percent slopes, two-foot contours.
      b. Over 10 percent to less than 20 percent slopes, five-foot contours.
      c. Twenty percent or greater slopes, 10-foot contours.
      d. Spot elevations shall be at 25-foot intervals.

2. Location of all existing lot lines, lease areas and easements, and the location of all proposed lot lines, lease areas, and easements.
3. A soils report prepared by a licensed geotechnical engineer or licensed engineering geologist. The report shall identify:
   a. Underlying soils on the site utilizing soil pits and soil grain analysis to assess infiltration capability on site. The frequency and distribution of soil pits shall be adequate to direct placement of the roads and structures away from soils that can most effectively infiltrate stormwater.
   b. Topologic features that may act as natural stormwater storage or conveyance and underlying soils that provide opportunities for storage and partial infiltration.
   c. Depth to groundwater.
   d. Geologic hazard areas and associated buffer requirements as defined in Title 19 PTMC.
4. A survey of existing native vegetation cover by a licensed landscape architect, arborist, qualified biologist identifying any forest areas on the site, species and condition of ground cover and shrub layer, and tree species, and canopy cover.
5. A survey of wildlife habitat by a qualified biologist.
6. A streams, wetland, and water body survey and classification report by a qualified biologist showing wetland and buffer boundaries consistent with the requirements of Chapter 19.05 PTMC, if present.
7. Flood hazard areas on or adjacent to the site, if present.
8. Aquifer and wellhead protection areas on or adjacent to the site, if present.
9. Any known historic, archaeological, and cultural features located on or adjacent to the site, if present.

C. Textual information required.
The applicant must respond to each of the items below but the response may include estimates or approximations where exact figures are not known at the time of submittal. All estimates should be based on the applicant's best knowledge and intent of the proposal. When estimates or approximations are used they must be identified as such. The applicant should be aware that any estimates or approximations provided may be used to set development conditions or thresholds.
1. Description of the proposed LID elements, including:
   a. Project narrative showing how the project achieves the goals of 18.04.030 and incorporates LID whenever site and soil conditions make it feasible;

b. Total gross area of the site;
c. Total project area (total gross site area minus total reserve area);
d. Total area of designated development area;
e. Total area of Native Vegetation Area;
f. Total units proposed;
g. Proposed number of dwelling units by type;
h. Conventional impervious surface assumptions used for volume reduction calculations;
i. Maximum impervious surface proposed for each lot;
j. Lot sizes and dimensions;
k. Total area of impervious surfacing;
l. Proposed ownership of land areas within the LID project both during and after construction;
m. Gross density of dwelling units;
n. Requested dimensional modifications;
o. Development schedule indicating the approximate date when construction of the LID project or stages of the LID project can be expected to begin and be completed.

2. Copy of all existing deeds, restrictive covenants, or other legal restrictions, which apply to the project site. The applicant may submit a copy of any proposed restrictive covenants that have been drafted.
3. The names and addresses of all property owners within 300 feet of the site taken from the latest equalized tax roles.

4. Preliminary drainage report as described in Chapter 4 of the Port Townsend Engineering Design Standards. The report should clearly state the assumed conventional storage volume and LID storage volume in the introduction, and explain how the proposed development will meet the LID stormwater management standards as defined in part (5) of this Chapter.

PARKING

LID Considerations

- Revise the parking code to facilitate permeable surfacing in parking areas where feasible.
- Look for opportunities to reduce the amount of EIA in parking lots through a variety of methods such as:
  - Reducing the number of required parking spaces.
  - Specifying a maximum number of parking spaces that cannot be exceeded.
  - Reducing parking space dimensions and circulation corridors and/or provide for compact spaces.

- Utilizing pervious pavement and other materials that allow surface water to infiltrate and/or evaporate rather than enter storm ponds.
- Requiring all parking spaces above the minimum number required by code to be pervious unless infeasible.
- Encourage structured parking where possible to reduce EIA. If structured parking is not feasible, use pervious pavement to increase parking areas, sidewalks, or plazas.

- Consider conducting a parking survey to evaluate current parking requirements. The survey would help to analyze whether or not current parking requirements are in line with other jurisdictions in the Puget Sound area. Results of the parking survey could help to determine if parking code revisions to support LID are needed for future redevelopment projects. Adjust parking ratios as needed after reviewing existing standards.
- Allow the dual use of parking lot landscaping for both an aesthetic and stormwater management function. Allow parking curbs and gutters to have "breaks" to allow surface water to enter bioretention facilities within parking landscape islands.

Examples and Ideas

The following example illustrates the integration of stormwater facilities into parking lot design. It was provided to Island County during the Partnership's 2009 LID Local Regulation Assistance Project.

LID best management practices (BMPs) shall be used for parking lot design and construction, unless site and soil conditions make LID infeasible as determined by the Public Works Department. LID BMPs for parking lot design include, but are not limited to pervious surfacing and bioretention swales. Pervious surfacing may be an option for all or a portion of the lot depending on the use, soil conditions, and associated vehicular traffic. LID BMPs shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition) and approved by the County Engineer.

The following is another illustration of the integration of stormwater facilities into parking lot design. It was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project.

9. Using low impact development (LID) best management practices BMPs) where site and soil conditions make it feasible. LID BMPs include, but are not limited to:
   a. Pervious surfacing;
   b. Integrating stormwater management facilities, such as bioretention swales, with required parking lot landscaping; and

c. Using native species in the landscape design.
d. LID BMPs shall be designed and constructed in accordance with Port Townsend LID Engineering Design Standards - Detail XX and the LID Technical Guidance Manual for Puget Sound (current edition).

A requirement to use pervious surfacing for parking that exceeds minimum requirements is shown in the following example. This was provided to the City of Kent during the Partnership's 2009 LID Local Regulation Assistance Project.

Surfacing for spaces above minimum. All parking spaces included in the site plan which are above the minimum number of spaces required in this Section shall be constructed of pervious surfacing unless site and soil conditions make pervious surfacing infeasible, as determined by the Public Works Department. Pervious surfacing shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition) and the manufacturer's recommendations.

PLANNED UNIT DEVELOPMENTS

LID Considerations

- Look at a range of mechanisms that support clustering development, such as cottage housing developments, to reduce building footprint and EIA, and retain tracts of native vegetation.
- Preserve the ecological benefits of large tracts of undeveloped land.
- Recommend adding LID site analysis as a requirement for PUDs so that LID can be incorporated into the site design in the early stages of project conception.
- Require native vegetation retention, native soil protection and amendment, and site design flexibility as well as LID where feasible.

Examples and Ideas

The following is an example of code language adopted as part of the 2009 City of Newcastle Stormwater and Low Impact Development Code Update, establishing how clustering is addressed in an LID project:

18.21.100 Clustering.

A. To achieve the goals of low impact development, development shall be clustered within the designated development area of the site. Clustering is intended to preserve open space, reduce total impervious surface area, and minimize development impacts on critical areas and associated buffers (Title 14 NMC). Preservation of open space reduces potential stormwater

runoff and associated impacts and provides area for dispersion, filtration, and infiltration of stormwater.

B. The arrangement of clustered building lots shall be designed to avoid development forms commonly known as linear, straight-line or highway strip patterns.

Engineering and Street Standards

In many jurisdictions, clearing, grading, streets, and engineering details can be found either in the development code or in administratively adopted construction standards. Wherever they are located, they will need to be evaluated to see how well they address LID requirements.

LID Considerations

General

- Minimizing on-site disturbance is a good way to protect the natural vegetation, soils, and natural water flow on a site.
- Outline construction sequencing and practices for protecting pervious areas and LID BMPs during construction.
- Adopt the *LID Technical Guidance Manual* to help ensure BMPs are appropriately sited, designed, built, and maintained. Add language for LID projects to conform to the most current edition of the *LID Technical Guidance Manual*.
- Permeable paving is a valuable LID technique, and is proposed to be required under the new permit.
- Look at standards for proper separation of LID facilities and utilities. Avoid locating utilities below bioretention facilities.
- Review phasing, bonding and project sequencing processes to protect LID facilities.
- Address maintenance responsibilities, procedures, and guidelines for LID stormwater management facilities in the Engineering Standards, including bioretention swales, rain gardens, permeable paving, vegetated roofs, rainwater harvesting collection systems, and other LID management techniques.
- Make sure that the appropriate code language is in place to allow staff the right to inspect facilities annually and bill the appropriate party for labor and materials if the facility is not being maintained.
- Establish the means to require financial guarantees for LID facilities, when deemed necessary, in order to help ensure the success of LID facilities.
- Consider how to address LID on small, residential sites, especially in infill situations that fall below Ecology's threshold for flow control and/or treatment of stormwater. Look at requirements for new development on existing single-family lots to manage stormwater through a combination of LID BMPs unless infeasible.

Street Standards

- The use of LID should not require approval of variances or deviations to accommodate LID within public rights-of-way.
- Street standards should be evaluated to incorporate LID street design alternatives and support the use of pervious surfaces. Street standards should not be a barrier to the application of LID, such as requirements for curb and gutter on all streets.
- Street trees and landscaping along streets are valuable tools in LID and stormwater management, and can add great value to neighborhoods.
- LID techniques, such as bioretention and dispersion, can be an important component of street design.
- Recommend standards that will minimize impervious surface and provide opportunities to manage stormwater generated by roads and streets within the right-of-way using assorted LID techniques. Street sections should be the minimum necessary for safe access and emergency response according to International Fire Code, section 503 (or local equivalent). Street sections should accommodate LID facilities where appropriate and feasible, and not conflict with other goals, such as native vegetation retention, minimizing site disturbance, etc.

Examples and Ideas

The Charles River Watershed Association (CRWA) in Boston prepared options that give a good overview of LID design elements and best practices. The matrices provide an evaluation of their relative contributions to various goals of storm water volume, rate, and quality; an assessment of site limitations; and a comparison of installation and maintenance costs and requirements. A link to the matrices is provided in the Appendix. The CRWA has also done work in integrating LID into the designs of complete streets.

The following is an example of code language adopted by the Town of Langley, establishing the use of LID as the first option for stormwater management:

Section 15.01.430 Detailed drainage plan – mandatory requirements

A. A detailed drainage plan shall be prepared by a registered civil engineer based upon the City Engineer's determination as provided in 15.01.425(E). Detailed drainage plans are not required for single-family or duplex development or redevelopment that includes the creation of less than 5,000 square feet of impervious surface area. Detailed drainage plans are also not required for commercial/industrial of multi-family development or redevelopment that includes the creation of less than 5,000 square feet of impervious surface area except if the development is located in the critical drainage sub-basins E1 or E2.

B. The use of all reasonable and appropriate low impact development measures shall be required prior to consideration of conventional stormwater management methods.
C. Surface water entering the subject property shall be received at the naturally occurring location, and surface water exiting the subject property shall be discharged at the natural location, with adequate energy dissipaters within the subject property to eliminate downstream damage and with no diversion at any of these points. Deviations consistent with law may be permitted.

Section 15.01.445 On-site detention and infiltration

A. All reasonable and appropriate low impact development measures shall be incorporated into site design before conventional on-site detention and infiltration methods are considered.
B. Open retention/detention facilities and infiltration facilities shall not be located in public road right-of-way. The City Engineer is authorized to require all persons, associations, and/ or corporations constructing or maintaining retention/detention facilities to secure a liability insurance policy for the duration of the operation of the facility.
C. An emergency overflow system is required for all retention/ detention facilities.
D. Detention basin design must account for antecedent conditions which may contribute to a partially full basin at the beginning of the design storm, i.e., a minimum of one foot of freeboard above the maximum design water surface.
E. Existing wetlands may function as both a control feature in the natural surface drainage system and as areas of groundwater recharge. Any reduction of such features shall be replaced with equivalent drainage controls.
F. Infiltration is preferred where practical because it reduces the demand for conveyance capacity and hence, reduces potential flooding. It also recharges the aquifer and has water quality benefits. Figure 207 of the City of Langley "Comprehensive Stormwater Management Plan" identifies areas where infiltration shall be considered in other areas as determined by the City Engineer. The Low Impact Development Technical Guidance Manual for Puget Sound, (Puget Sound Action Team Publication No. PSAT 05-03 as it now exists or is hereafter amended) and the Department of Ecology's Stormwater Management Manual for Western Washington) Publication #s 05-10-029 through 05-10-033 as they now exist or are hereafter amended) provide

general guidelines for analyzing the feasibility of the infiltration systems, which shall be recognized as minimum standards. The basic design shall follow the Stormwater Manual for Western Washington. Infiltration may be restricted or disallowed, as determined by the City Engineer, in those areas designated and defined in LMC as Sensitive Areas.

G. Detention systems shall be designed in accordance with Chapter III-4 of the Stormwater Manual for Western Washington. Water shall be released at a rate not to exceed the runoff which occurred before development. (Ord. 743, 1997) (Ord. 862, 2005)

Section 15.01.460 Transportation - general considerations

A. The overall goal of this chapter is to encourage the uniform development of an integrated, fully accessible public transportation system that will facilitate present and future travel demand with minimal environmental impact to the community as a whole.

B. This chapter provides minimum construction standards supplementing the applicable standards as set forth in section 15.01.025, provided that applicants shall, to the maximum extent practicable, apply low impact development alternatives where site conditions are favorable and upon a recommendation by the City Engineer and approval by the City Council. (Ord. 743, 1997) (Ord. 862, 2005)

Section 15.01.470 Design standards

E. Width. The pavement and right-of-way width depend upon the street classification. The table of Minimum Street Design Standards shows the minimum widths allowed. Upon a determination by the City Engineer and approval by the City Council, standards in the Low Impact Development Technical Guidance Manual for Puget Sound, (Puget Sound Action Team Publication No. PSAT 05-03 as it now exists or is hereafter amended) may be substituted.

The following is an example of code language allowing permeable surfacing for streets and sidewalks if feasible and the use of LID BMPs within rights-of-way. This example was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project.

Where site and soil conditions make permeable surfacing feasible, streets and sidewalks may be surfaced with a material appropriate for the soil type, use, and associated vehicular traffic. Permeable surfacing and other LID techniques shall be designed and constructed in accordance with the LID details in the Engineering and Design Standards (EDS) and the current edition of the LID Technical Guidance Manual for Puget Sound.

LID BMPs for rights-of-way are preferred where site and soil conditions make it feasible, as determined by the Public Works Department. LID BMPs shall be designed and constructed in accordance with the LID details in the Engineering Design Standards (EDS) and the LID Technical Guidance Manual for Puget Sound (current edition).

The following is an example of code language allowing shared driveways as a means for reducing effective impervious surface. It was provided to the City of Sequim during the Partnership's 2009 LID Local Regulation Assistance Project.

17.32.095 Shared driveways – Common drives.

A. Shared and common driveways provide the required traveled path to or through a parking lot for multiple single-family dwellings, multi-family structures, and commercial developments. These "driveways" provide vehicular access for a single family, multi-family and commercial developments. All areas identified within developments that are intended for shared, routine use and/or passage during all hours by all residents and their guests shall be noted on the face of the preliminary and final plats and/or site plans. Shared driveways and common drives shall be designed to meet the below criteria:
   1. The use of Low impact development (LID) best management practices (BMPs) in shared and common driveway construction shall be required whenever site and soil conditions make LID a feasible option, as determined by the City Engineer;
   2. Adequate ingress/egress for fire apparatus shall be provided as approved by the Public Works Director after consultation with the Clallam County Fire Department; and
   3. In no circumstance shall a shared or common driveway be less than 9-feet in width.

The following is an example of code language requiring the use of permeable surfacing for sidewalks where feasible. It was provided to the City of Sequim during the Partnership's 2009 LID Local Regulation Assistance Project.

> Permeable surfacing shall be used for sidewalks when site and soil conditions make permeable surfacing feasible as determined by the City Engineer in conformance with SMC, 12.08. Permeable surfacing shall be consistent with the manufacturer's recommendations and the standards set forth in the LID Technical Guidance Manual for Puget Sound (current edition).

The following is an example of code language requiring the use of permeable surfacing, where feasible, for both sidewalks and driveways. It was provided to the City of Sequim during the Partnership's 2009 LID Local Regulation Assistance Project.

> ***12.08.093 Driveway and Sidewalk Surfacing.***
> Driveways and sidewalks shall be surfaced with a material appropriate for the soil type, and use. Permeable surfacing materials shall be used whenever site and soil conditions make it a feasible option, as determined by the City Engineer. Permeable surfacing includes, but is not limited to: paving blocks, pervious concrete, porous asphalt, and other similar approved materials. Pervious materials shall be constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current version) and the manufacturer's recommendations.
>
> ***12.08.095 Low Impact Development (LID).***
> The City may approve alternatives to the minimum sidewalk standards set forth in this chapter in order to accommodate proposed LID best management practices (BMPs). LID BMPs shall be used where site and soil conditions make LID feasible, as determined by the City Engineer. LID BMPs shall be designed and constructed in accordance with the City of Sequim's LID Design Standards 18.22.035 and the LID Technical Guidance Manual for Puget Sound (current edition).

The following is an example of code language provided to the City of Sequim as part of the 2009 Low Impact Development Local Regulation Assistance Project, encouraging the use of permeable surfacing for right-of-ways where feasible.

12.10.022 Right-of-Way Surfacing.

Right-of-way surfacing shall be a material appropriate for the soil type, use, and associated vehicular traffic. Permeable surfacing materials are encouraged whenever site and soil conditions make it a feasible option, as determined by the City Engineer. Permeable surfacing includes, but is not limited to paving blocks, pervious concrete, porous asphalt, and other similar approved materials. Permeable surfacing materials may be approved for parking areas, emergency parking areas, public and private roads, road shoulders, bike paths, walkways, driveways, and easement service roads, unless site constraints make the use of such materials detrimental to water quality, public health, or safety. Pervious materials shall be constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current version) and the manufacturer's recommendations.

12.10.025 Low Impact Development.

The City may approve alternatives to the right-of-way standards set forth in this chapter in order to accommodate proposed LID design techniques. LID best management practices (BMPs), (such as bioretention swales), shall be used where site and soil conditions make LID feasible. LID BMPs shall be designed and constructed in accordance with the City of Sequim's LID Design Standards 18.22.035) and the LID Technical Guidance Manual for Puget Sound (current edition).

The following is an example of code language requiring ongoing maintenance of LID BMPs. It was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project.

13.32.035 Maintenance of Low Impact Development (LID) stormwater management facilities.

LID stormwater management facilities on private property shall be maintained by the property owner or appropriate designee, in accordance with the Chapter 4 of the city's Engineering Design Standards. The city reserves the right to annually inspect all LID stormwater management facilities that are not owned by the city to ensure proper functioning. If the city finds during the inspection that LID stormwater management facilities have not been properly maintained, the city will conduct any necessary maintenance and

bill the appropriate party for labor and materials. Some critical LID facilities may require more frequent inspection, as determined by the city.

The following is an example of code language establishing financial securities to ensure the performance of LID BMPs. It was provided to the City of Port Townsend during the Partnership's 2009 LID Local Regulation Assistance Project.

13.32.037 Financial securities for LID stormwater management facilities.

The city may require a five-year financial security for performance of LID stormwater facilities, including plant survival within a bioretention swale or raingarden. The approved financial security shall be posted with the public works department prior to the issuance of a building permit. The financial security amount shall be 120 percent of a bid amount submitted and approved by the city. The bid amount must include labor and materials for the facility. The type of financial security (e.g., bond, assignment of funds, etc.) shall be determined by the city.

The following is an example of code language adopted as part of the 2009 City of Newcastle Stormwater and Low Impact Development Code Update, establishing what needs to be addressed in an LID project's maintenance plan:

City of Newcastle. 18.21.050 Design and development standards.

A. All projects shall provide a maintenance plan/program that has been approved by the City, including source control BMPs.
   1. The maintenance plan/program shall address the following:
      a. How all of the elements of the LID system will be maintained.
      b. The schedule for ongoing maintenance of all LID project facilities
      c. The responsible party for ongoing maintenance of all LID project facilities.
      d. Declaration that failure to maintain all LID project facilities as established in the maintenance plan/program may result in the City performing the necessary maintenance and billing the responsible property owner(s).

2. Low impact development projects shall record a legal instrument acceptable to the City against the land title to ensure that the low impact development features are protected and maintained.

The following is an example of code language adopted by the City of Fife in 2009, as part of their Green Streets project, providing a definition of a "green street or arterial":

City of Fife. 12.14.100 Green street or arterial.

A "green street or arterial" means a paved public or private right-of-way that either completely or partially manages stormwater on site through use of low impact development facilities that provide water quality benefits and infiltrate stormwater (if an infiltration facility); creates attractive streetscapes that increase neighborhood livability by enhancing the pedestrian environment and introducing park-like elements into neighborhoods; serves as an urban greenway segment that connects neighborhoods, parks, recreation facilities, schools, main streets, and wildlife habitats; and meets broader community goals by providing pedestrian and, where appropriate, bicycle access. (Ord. 1685 § 1(Exh. A), 2009).

The following is an example of code language adopted by the City of Fife in 2009 as part of their Green Streets project, establishing the public improvements to streets need to incorporate LID:

City of Fife. 12.20.025 Required public improvements – Green streets.

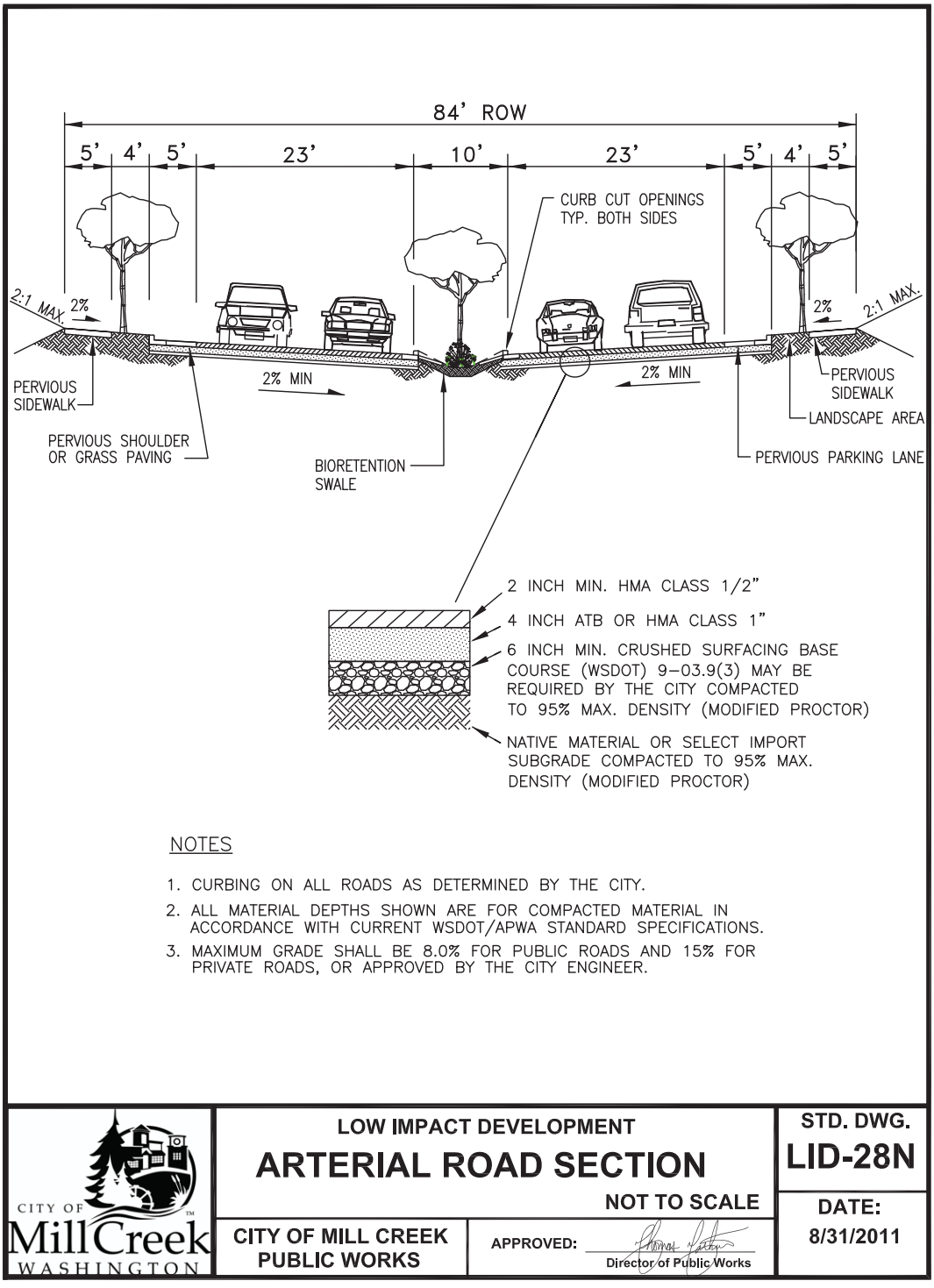
All right-of-way improvements that change the drainage characteristics of the right-of-way shall incorporate low impact development facilities or techniques into redevelopment or enhancement projects in the right-of-way as required by the current stormwater requirements including but not limited to an increase in impervious surfaces, increase in drainage volumes, and increase in time-to-peak runoff. Streets designated as principal arterials and the North Levee Road are exempt from this section. For improvements to existing streets, low impact development shall be used to the maximum extent possible. For new streets, green streets standards shall be used per FMC 12.20.045, 12.20.055, 12.20.065, and 12.20.075. (Ord. 1685 § 1(Exh. A), 2009).

LID practices will also need to be integrated into engineering standard details and drawings. Street sections, curb details and bioretention drawings are but a few examples of technical drawings that will require preparation. There are a number of sources for adopted LID street standards and details. Here are a few:

- City of Mill Creek - Design and Construction Standard Plans were adopted in August 2011. They include a number of LID details.
- City of Portland, Bureau of Environmental Services - Stormwater Management Manual Typical Details - 2010 Green Streets were adopted in March 2010. They include a number of LID Details.
- Contact the jurisdiction to receive the most current version.

Example of an LID Street (Arterial) - shows an example of an LID street section with bioretention swales, driving lanes, parking lanes, and sidewalks.

FIGURE 24
City of Mill Creek, Low Impact Development: Arterial Road Section, dated 8/31/2011



Example of an LID Cul-de-Sac Plan - shows an LID cul-de-sac plan that includes pervious sidewalks and a bioretention swale in the middle of the cul-de-sac.

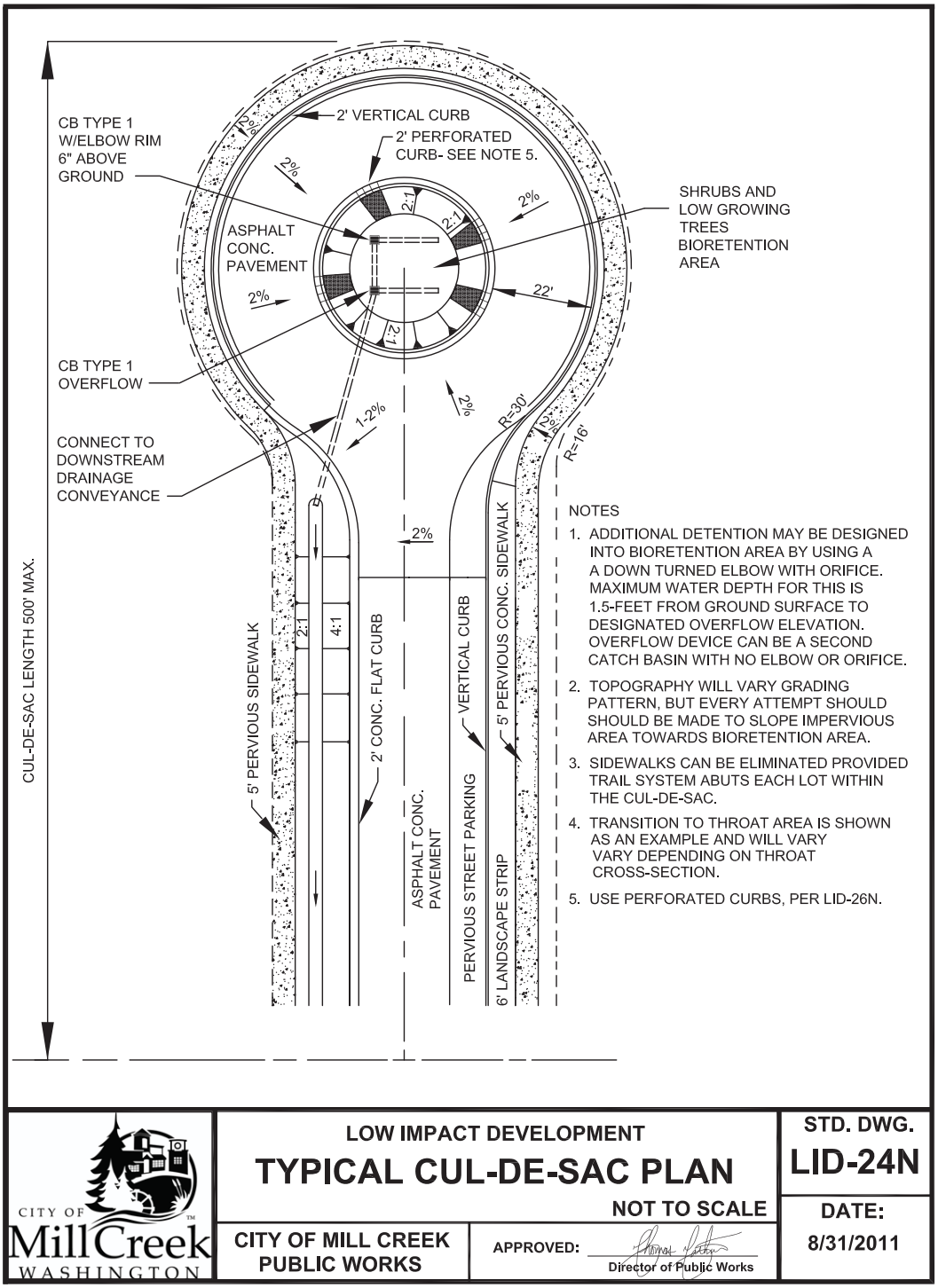
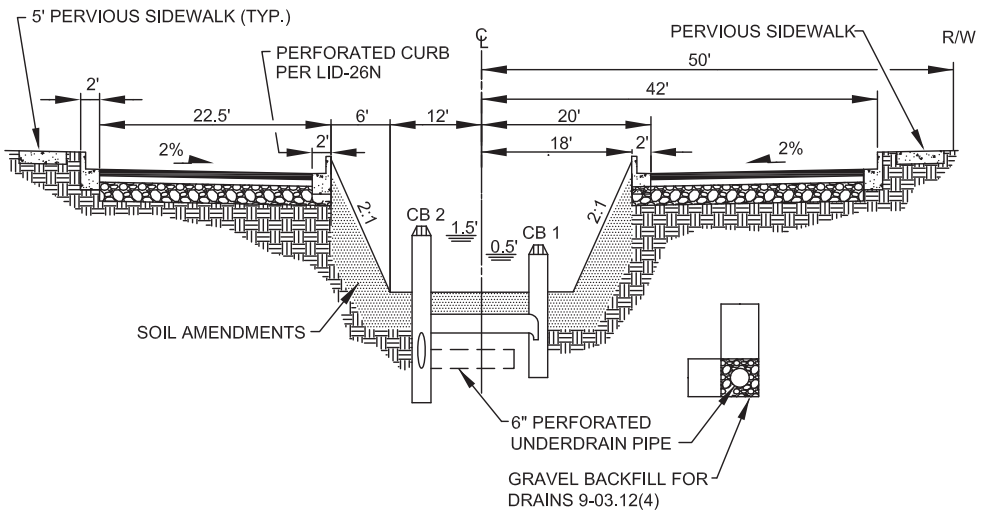


FIGURE 25
City of Mill Creek, Low Impact Development: Typical Cul-de-Sac Plan, dated 8/31/2011

Example of an LID Cul-de-Sac Swale – shows an LID cul-de-sac plan that includes pervious sidewalks and a bioretention swale in the middle of the cul-de-sac.

FIGURE 26
City of Mill Creek, Low Impact Development: Cul-de-Sac bioretention detail, dated 8/31/2011



LOW IMPACT DEVELOPMENT TYPICAL CUL-DE-SAC SWALE

CB 1 - DETENTION CB
RIM ELEV. SET 6 INCHES ABOVE FINISHED GRADE.
SHOULD BE CB TYPE 1 OR EQUIVALENT 18" DIAMETER ADS TYPE.
OUTLET IS DOWNTURNED ELBOW WITH ORIFICE. CONNECT OUTLET TO CB 2.

CB 2 - OVERFLOW CB
RIM ELEV. SET 18 INCHES ABOVE FINISHED GRADE. CONNECT PERFORATED UNDERDRAIN PIPES TO CB. OUTLET TO CONVEYANCE CHANNEL WITHIN THE DEVELOPMENT OR TO DISPERSION TRENCH ADJACENT TO NATURAL RESOURCE PROTECTION AREA.

NOTES
1. IN BIORETENTION AREA COMPOST SHOULD BE AMENDED TO A 13 INCH DEPTH (ABOUT 5 INCHES OF COMPOST TO 8 INCHES OF SOIL). COMPACT SUBSOILS MUST BE SCARIFIED AT LEAST 4 INCHES BELOW THE 13 INCH DEEP AMENDED LAYER. THE BIORETENTION SOIL, COMPOSITION AND PH LEVELS SHALL MEET THE STANDARDS SET FORTH IN THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (CURRENT EDITION).
2. BIORETENTION AREA SHALL BE VEGETATED WITH NATIVE TREES AND SHRUBS HOWEVER VEGETATION WITHIN 6 FEET OF THE INSIDE RADIUS EDGE OF THE REINFORCED GRASS SHALL NOT BE OVER 18 INCHES IN HEIGHT.

CITY OF Mill Creek WASHINGTON	LOW IMPACT DEVELOPMENT **TYPICAL CUL-DE-SAC SWALE** NOT TO SCALE	STD. DWG. **LID-23N**
CITY OF MILL CREEK PUBLIC WORKS	APPROVED: Director of Public Works	DATE: 8/31/2011

Example of an LID Curb Inlet - features a detail of a vertical curb with breaks at bioretention swales.

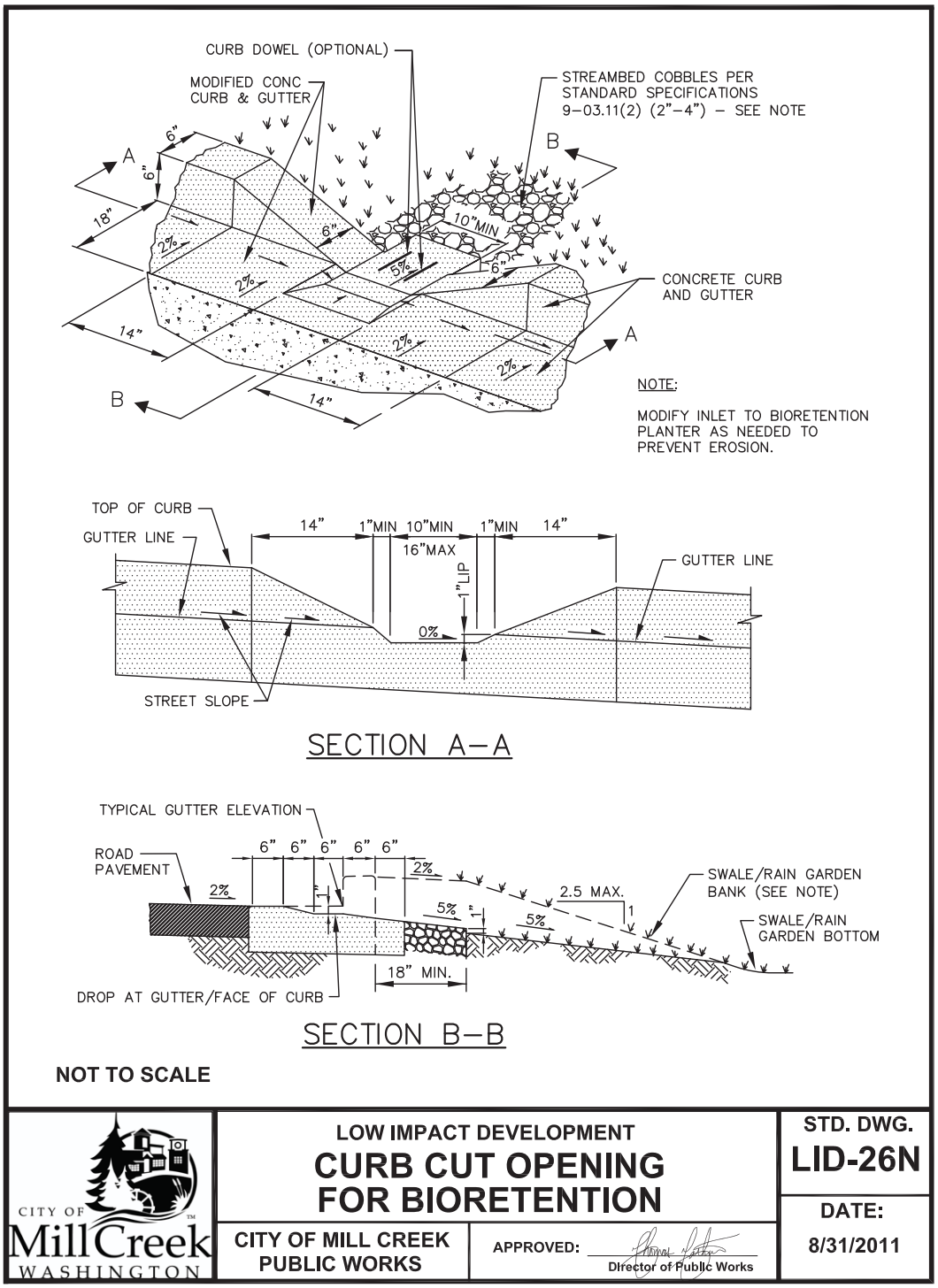
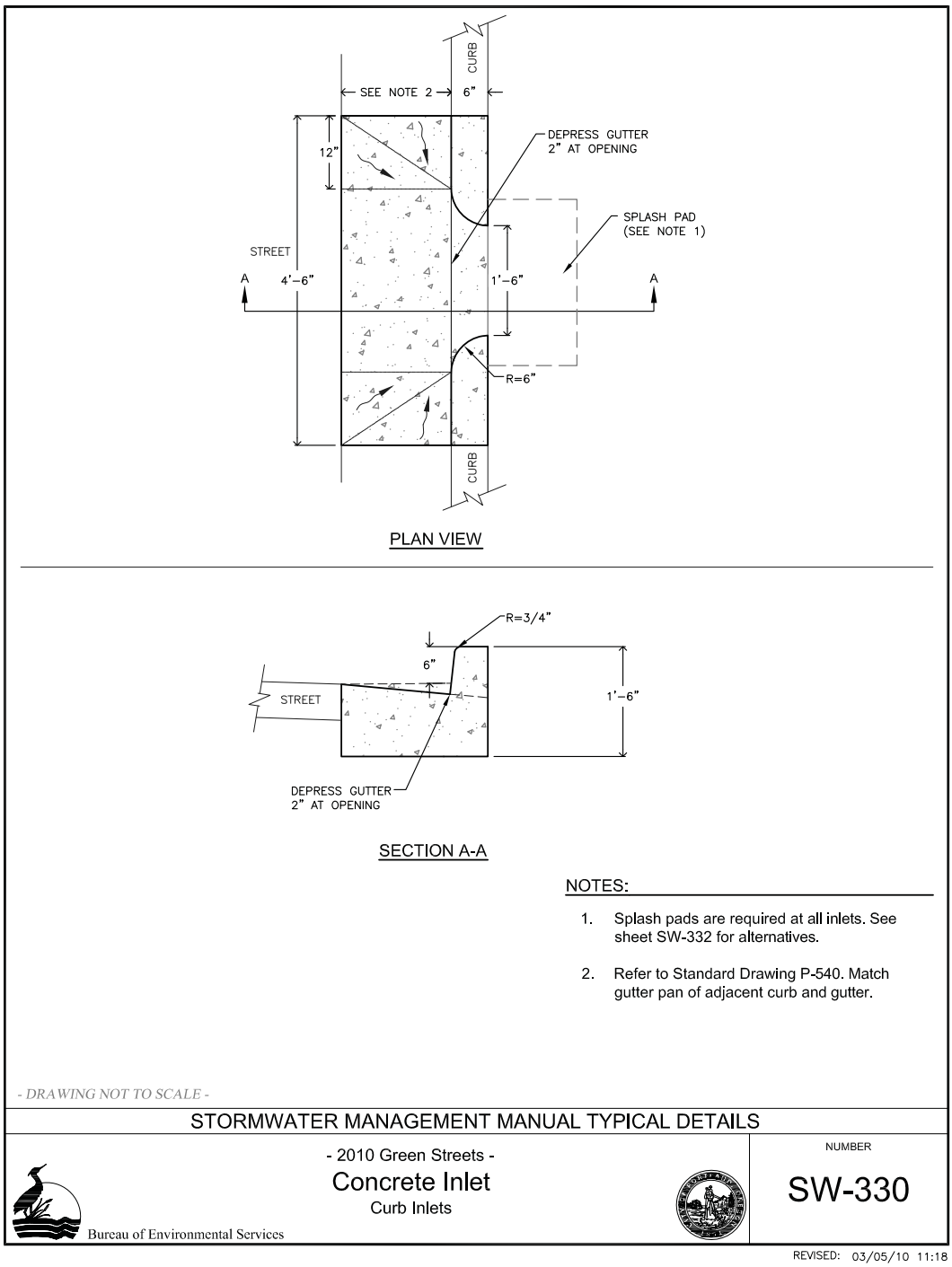


FIGURE 27
City of Mill Creek, Low Impact Development: Curb Cut Opening for Bioretention, dated 8/31/2011

Example of an LID Vertical Curb and Gutter with Inlet – features a detail of a vertical curb with breaks.

FIGURE 28
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Concrete Curb Inlet, dated 3/5/2010



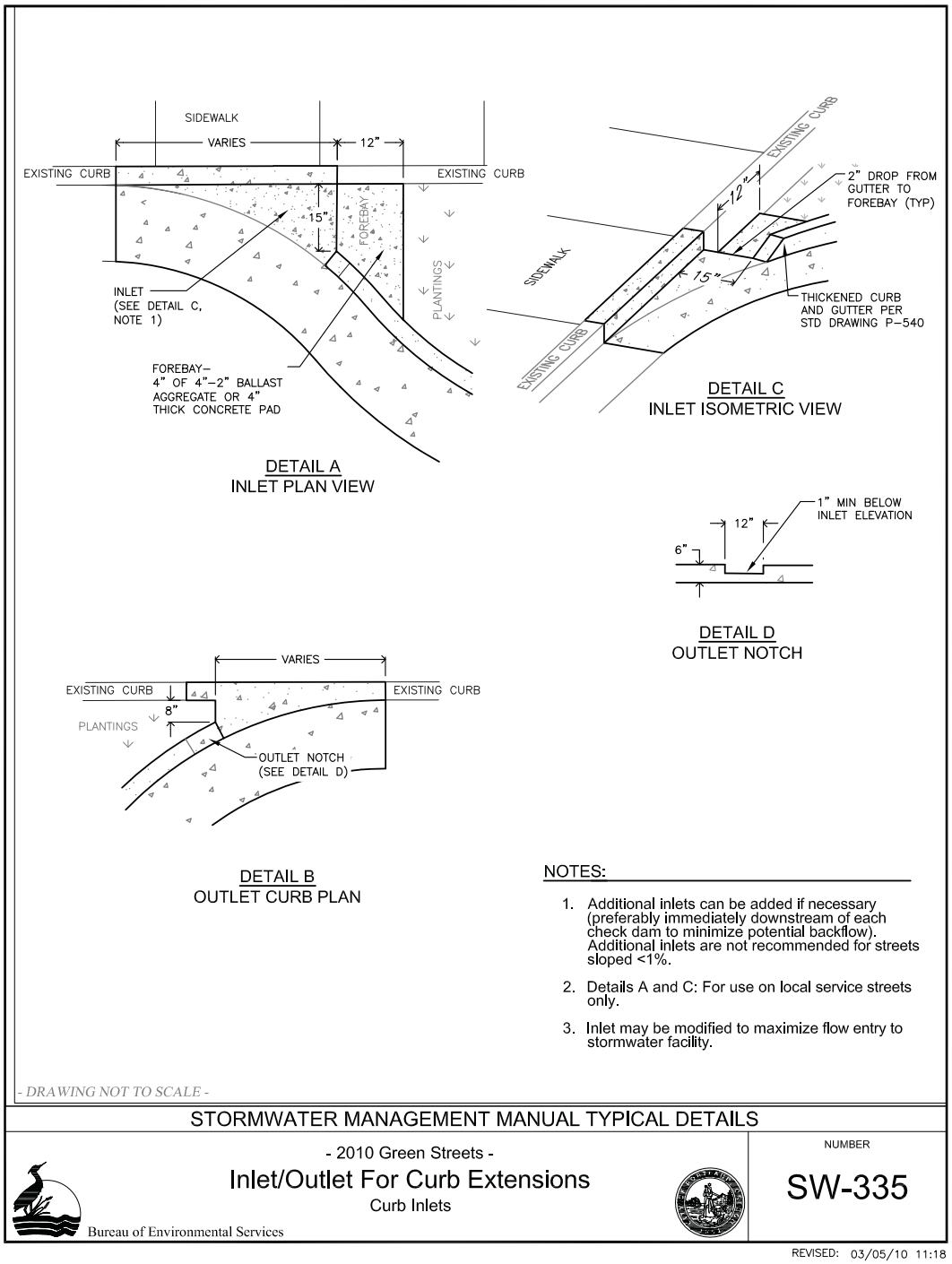
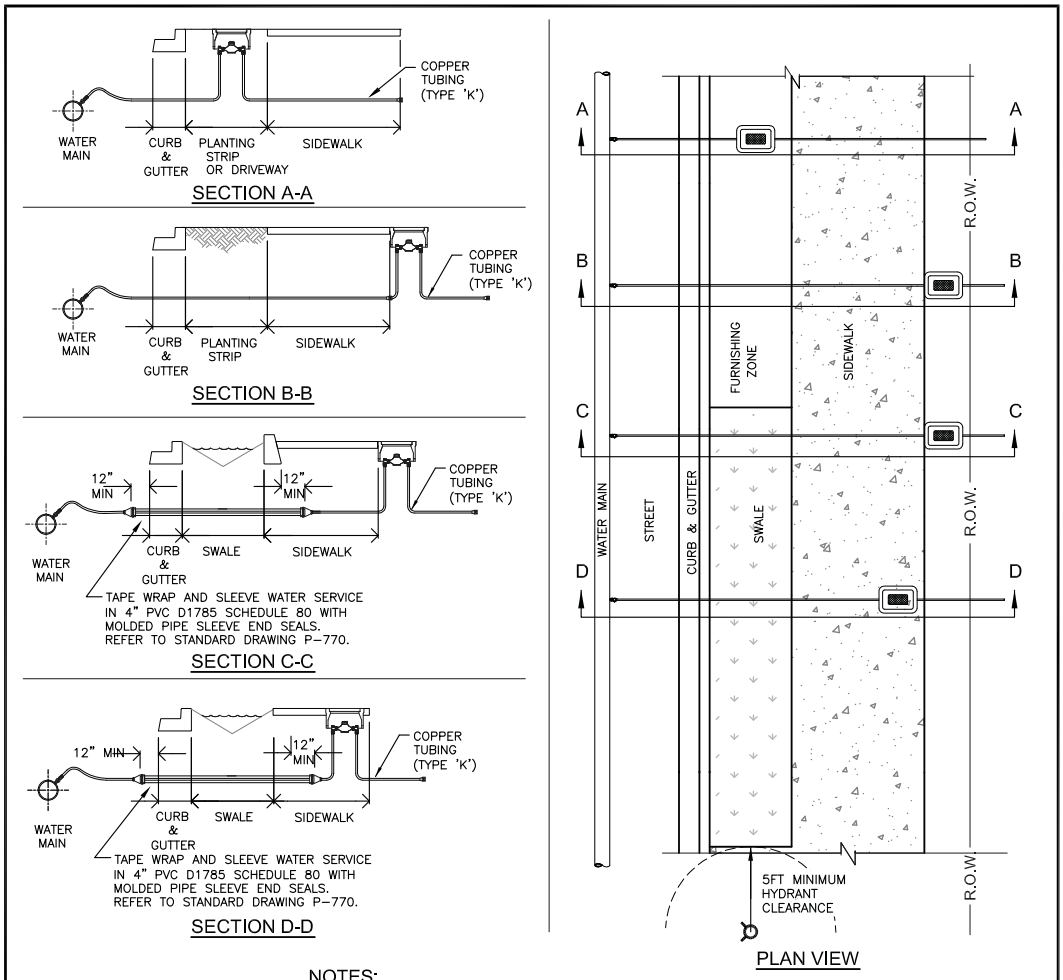


FIGURE 29
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Inlet/Outlet for Curb Extensions, dated 3/5/2010

Example of an LID Meter and Hydrant Location – shows locations for meters and hydrants within an LID road right-of-way.

FIGURE 30
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Meter & Hydrant Locations Across Swales - dated 3/5/2010



NOTES:

1. Refer to Fire Hydrant Assembly Standard Drawing P-700. Hydrants must have min 5ft clearance from the edge of stormwater facility.
2. Standard meter location is Option A. Option B or C can be used only if the meter box is fully within the Right-of-Way. Option D can only be used where the meter box cannot be placed fully behind the sidewalk, within the Right-of-Way.
3. Refer to 1" Service Assembly Standard Drawing P-780. For larger services or other appurtenances, contact PWB development services at (503) 823-7368. Water service line must be 1ft min below bottom of excavation for the stormwater facility.
4. If water main is under or behind proposed curb the water main must be relocated, unless otherwise approved by PWB.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

Bureau of Environmental Services

- 2010 Green Streets -

Meter & Hydrant Locations

Swales

NUMBER

SW-304

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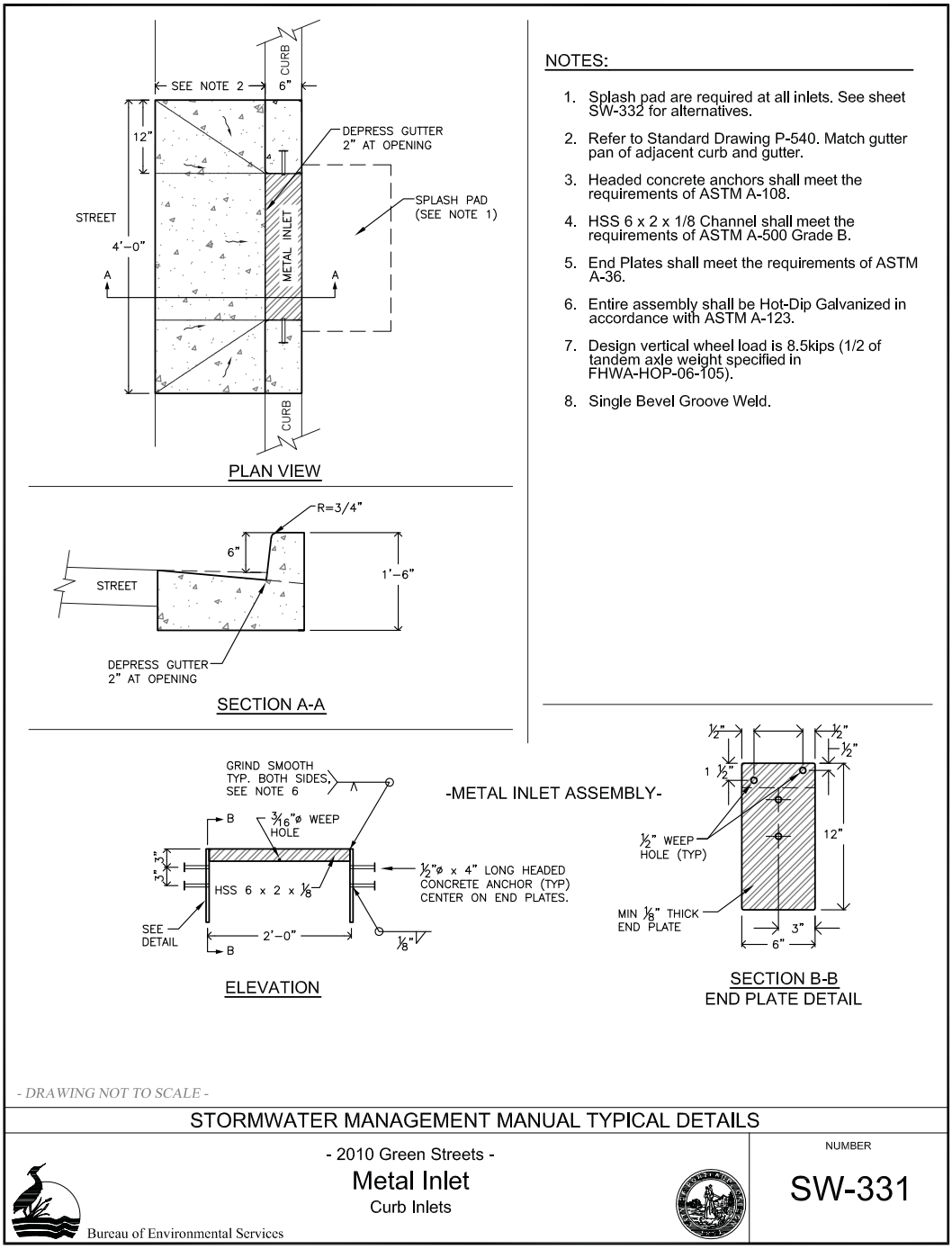
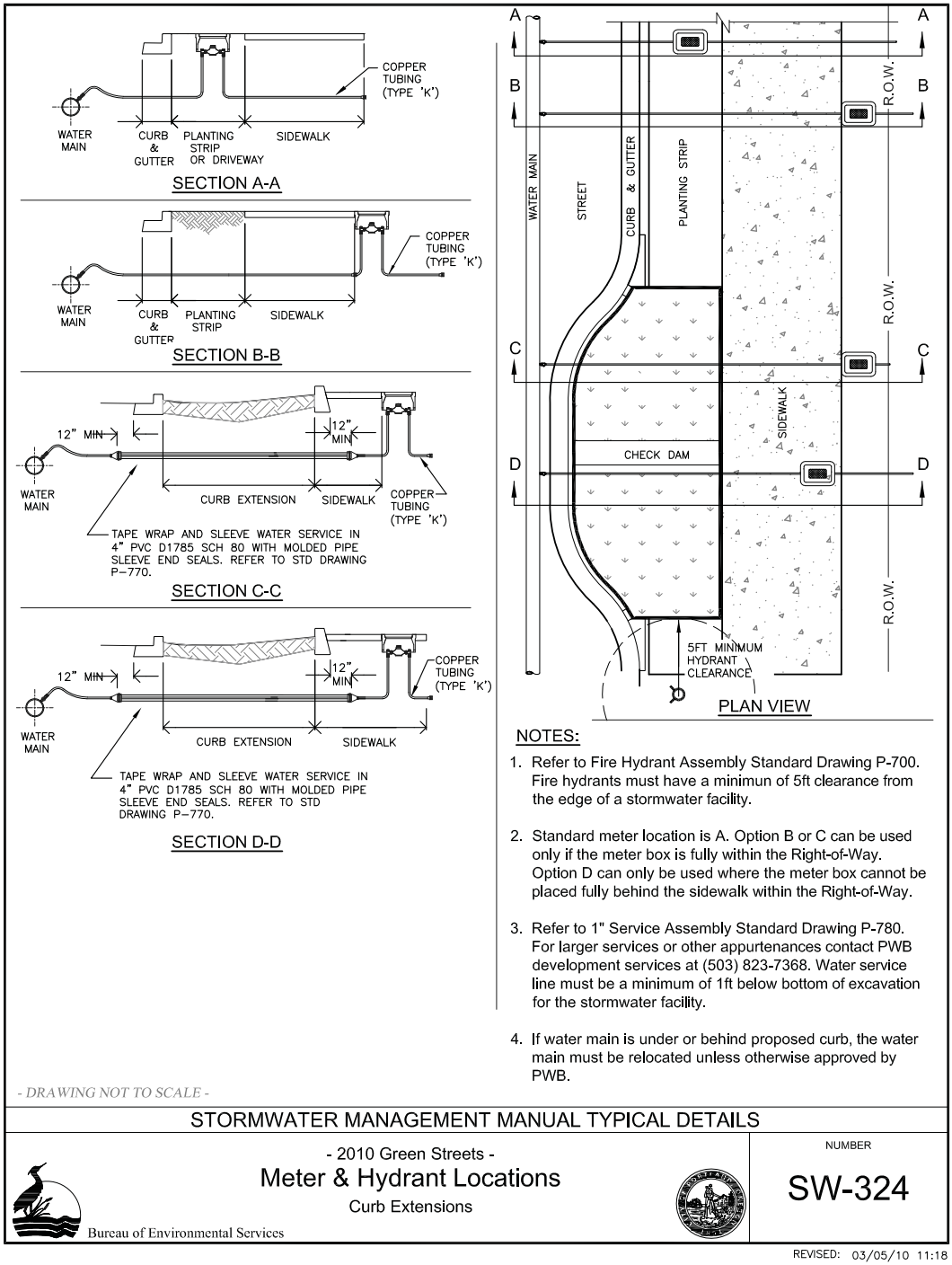


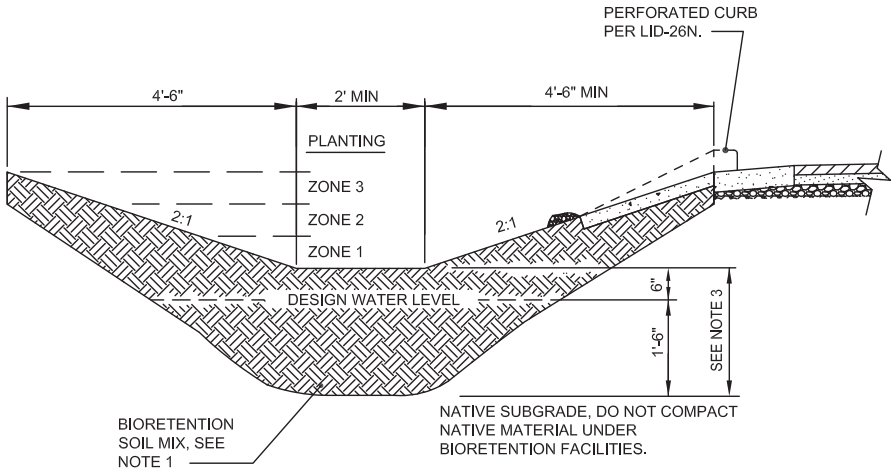
FIGURE 31
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Metal Curb Inlets, dated 3/5/2010

FIGURE 32
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Meter & Hydrant Locations Across Curb Extensions, dated 3/5/2010



Example of an LID Bioretention Detail - shows the minimum standards for a bioretention swale, with requirements for soil depth and type, maximum slopes, and swale depths.

FIGURE 33
City of Mill Creek, Low Impact Development: Typical Bioretention Swale, dated 8/31/2011



SECTION

LOW IMPACT DEVELOPMENT TYPICAL SWALE BIORETENTION

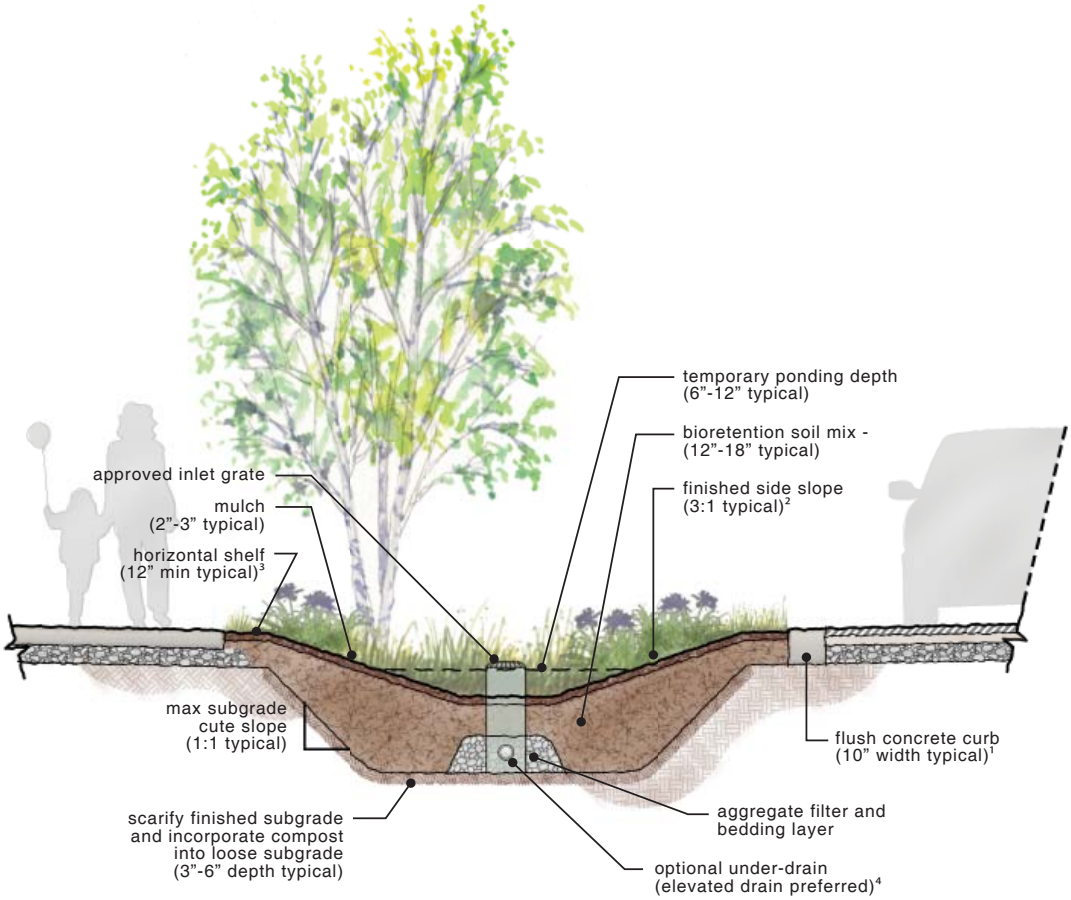
NOTES:

1. BIORETENTION SOIL, COMPOSITION AND pH LEVELS SHALL MEET THE STANDARDS SET FORTH IN THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (CURRENT EDITION).
2. PLANTING SHALL CONSIST OF NATIVE SPECIES ABLE TO TOLERATE VARIABLE SOIL MOISTURE CONDITIONS, PONDING WATER FLUCTUATIONS, AND VARIABLE SOIL MOISTURE CONTENT. SEE APPENDIX 3 IN THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (CURRENT EDITION) FOR A "BIORETENTION PLANT LIST".
3. AT LEAST 18 INCHES OF BIORETENTION SOIL MIX IS REQUIRED BELOW THE DESIGN WATER ELEVATION. ABOVE THIS ELEVATION AT LEAST 6 INCHES OF BIORETENTION SOIL MIX IS REQUIRED. COMPACT SUBSOILS MUST BE SCARIFIED AT 4 INCHES BELOW THE AMENDED LAYER.
4. UNDERDRAINS ARE REQUIRED IN SOILS WITH INFILTRATION RATES INADEQUATE TO MEET MAXIMUM POOL AND SYSTEM DEWATER RATES.
5. ZONE 1 PLANTINGS SHOULD BE USED BELOW THE DESIGN WATER ELEVATION.

CITY OF Mill Creek WASHINGTON	LOW IMPACT DEVELOPMENT TYPICAL BIORETENTION SWALE NOT TO SCALE	STD. DWG. LID-22N
CITY OF MILL CREEK PUBLIC WORKS	APPROVED: _____ Director of Public Works	DATE: 8/31/2011

FIGURE 34

Bioretention Swale Detail - *Low Impact Development Technical Guidance Manual for Puget Sound (2012)*



GENERAL NOTES:

- Area and depth of facility are based upon engineering calculations and right-of-way constraints
- Check dams may be required depending on slope and flow velocities
- Bottom width should be a minimum of 2 feet to prevent channelization

FOOTNOTES:

1. See section for additional curb designs
2. Steeper side slopes may be necessary depending on setting and require additional attention for erosion control, plant selection vehicle and pedestrian safety, etc.
3. Horizontal shelf between sidewalk or road and bioretention area slope for safety.
4. Elevated drain provides benefits compared to an under-drain placed on bottom of facility including improved stormwater, retention, plant survival in drier months and possibly nitrogen removal.

FIGURE 35

Urban Bioretention Planter - *Low Impact Development Technical Guidance Manual for Puget Sound (2012)*

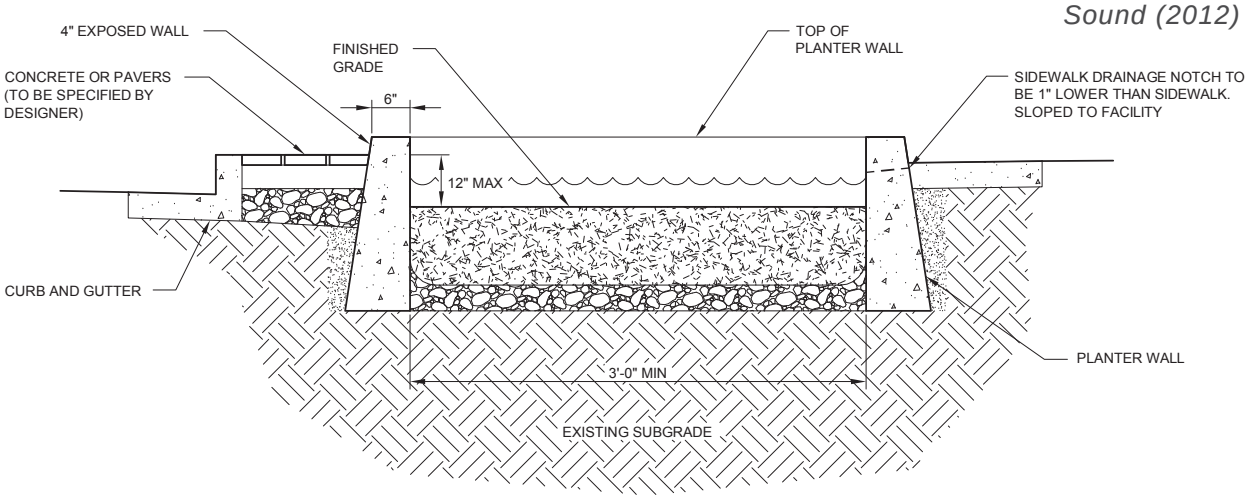
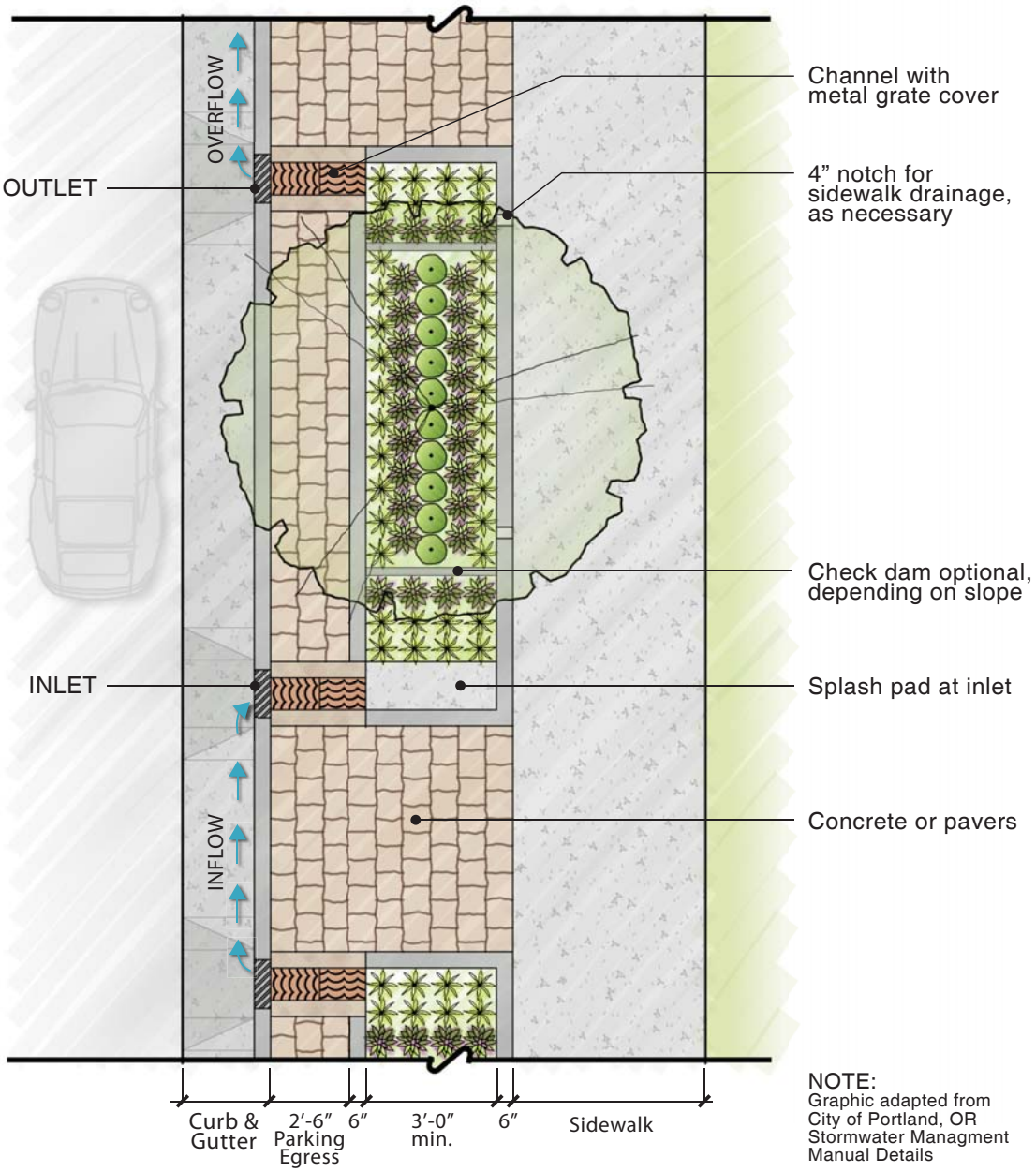
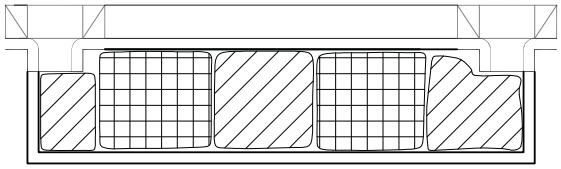


FIGURE 36
Plan View Detail of Urban Bioretention Planter - *Low Impact Development Technical Guidance Manual for Puget Sound (2012)*



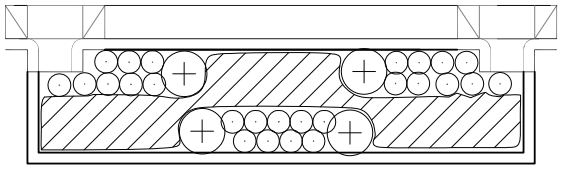
NOTE:
Graphic adapted from City of Portland, OR Stormwater Managment Manual Details



TEMPLATE 1

PLANT LEGEND 1

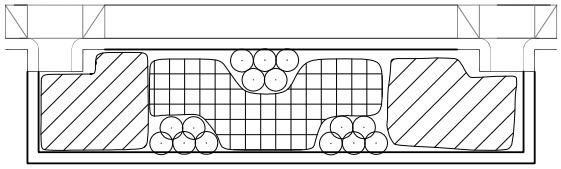
Symbol	Botanical Name / Common Name	
	Carex testacea Orange sedge	
	Juncus patens Spreading rush	*w/ OPTIONAL CAMAS BULBS*



TEMPLATE 2

PLANT LEGEND 2

Symbol	Botanical Name / Common Name
	Carex obnupta Slough sedge
	Deschampsia cespitosa Tufted hair grass
	Cornus Sericea 'kelseyii' Kelsey dogwood



TEMPLATE 3

PLANT LEGEND 3

Symbol	Botanical Name / Common Name
	Carex obnupta Slough sedge
	Deschampsia cespitosa Tufted hair grass
	Juncus patens Spreading rush

NOTES:

1. These are examples of approved planting templates. Other planting plans may be approved.
2. See Section 2.3.3 and Appendix F.4 of the SWMM for planting requirements.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

Bureau of Environmental Services

- 2010 Green Streets -

Landscape Planting Templates

Planters

NUMBER

SW-315

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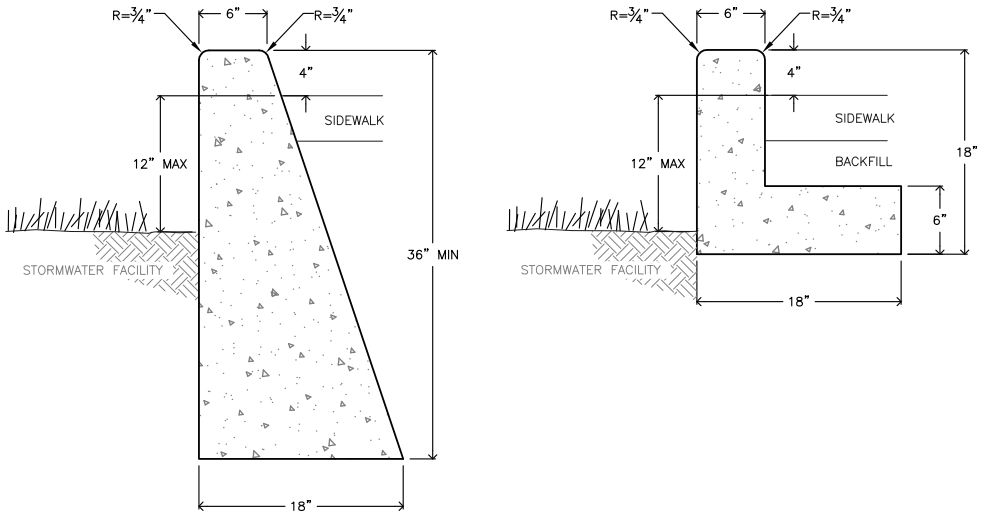
FIGURE 37
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Landscape Planting Templates, dated 3/5/2010

FIGURE 38
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Plan View with Parking, dated 3/5/2010



NOTE:

1. Special design considerations or structural review may be required for longer planter wall spans. Steel reinforcement or additional concrete check dams may be needed for stability.
2. Finish all exposed concrete surfaces.
3. Specify one of the above planter wall options based on site conditions.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

Bureau of Environmental Services

- 2010 Green Streets -

Wall Details

Planters

NUMBER

SW-313

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Example of an LID Curb Extension – shows how LID stormwater management facilities can be incorporated into curb extensions.

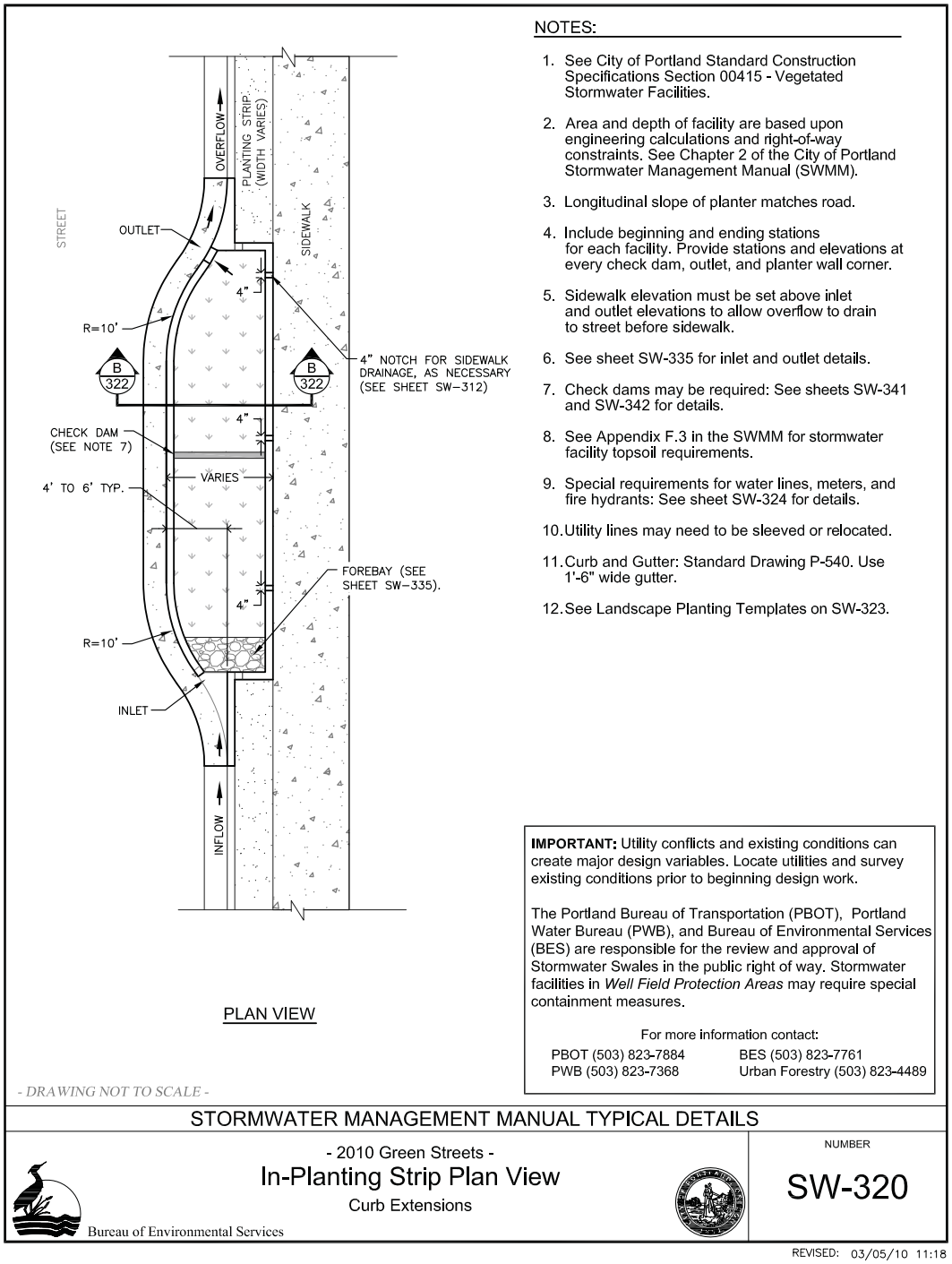
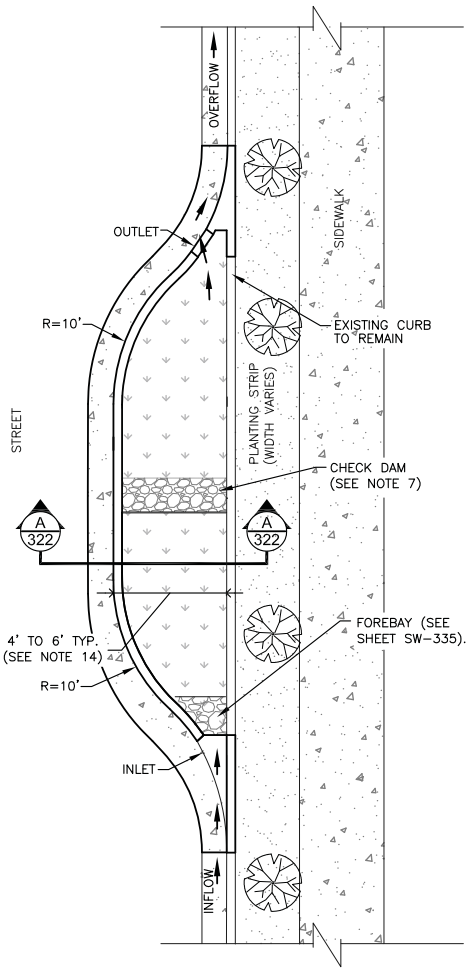


FIGURE 39
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: In-Planting Strip Plan View Curb Extensions, dated 3/5/2010

FIGURE 40
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: In-Street Plan View Curb Extensions, dated 3/5/2010



PLAN VIEW

NOTES:

1. See City of Portland Standard Construction Specifications Section 00415 - Vegetated Stormwater Facilities.
2. Area and depth of facility are based upon engineering calculations and right-of-way constraints. See Chapter 2 of the City of Portland Stormwater Management Manual (SWMM).
3. Longitudinal slope of planter matches road.
4. Include beginning and ending stations for each facility. Provide stations and elevations at every inlet, outlet, and check dam.
5. Sidewalk elevation must be set above inlet and outlet elevations to allow overflow to drain to street before sidewalk.
6. Inlets and outlets required: See sheet SW-335 for inlet and outlet details.
7. Check dams may be required: See sheets SW-340, SW-341, and SW-342 for details.
8. See Appendix F.3 of the SWMM for stormwater facility topsoil requirements.
9. Special requirements for water lines, meters, and fire hydrants: See sheet SW-324 for details.
10. Utility lines may need to be sleeved or relocated.
11. Curb and Gutter: Standard Drawing P-540. Use 1'-6" wide gutter.
12. Where feasible, width of stormwater facility should extend into existing planting strip (See sheet SW-320).
13. See Landscape Planting Templates on SW-323.

IMPORTANT: Utility conflicts and existing conditions can create major design variables. Locate utilities and survey existing conditions prior to beginning design work.

The Portland Bureau of Transportation (PBOT), Portland Water Bureau (PWB), and Bureau of Environmental Services (BES) are responsible for the review and approval of Stormwater Swales in the public right of way. Stormwater facilities in *Well Field Protection Areas* may require special containment measures.

For more information contact:

PBOT (503) 823-7884 BES (503) 823-7761
PWB (503) 823-7368 Urban Forestry (503) 823-4489

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

Bureau of Environmental Services

- 2010 Green Streets -
In-Street Plan View
Curb Extensions

NUMBER
SW-321

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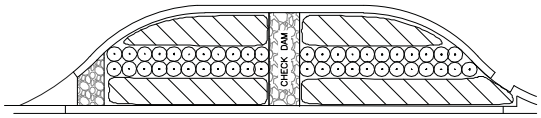
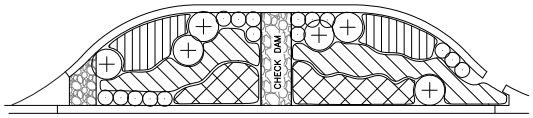


TEMPLATE 1

PLANT LEGEND 1

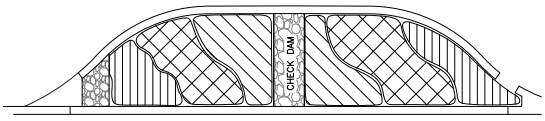
Symbol	Botanical Name / Common Name
	Carex testacea *w/ OPTIONAL*
	Orange sedge *CAMAS BULBS*
	Deschampsia cespitosa
	Tufted hair grass



TEMPLATE 2

PLANT LEGEND 2

Symbol	Botanical Name / Common Name
	Camassia quamash
	Common camas
	Carex densa
	Dense sedge
	Cornus sericea 'kelseyii'
	Kelsey dogwood
	Deschampsia cespitosa
	Tufted hair grass
	Juncus patens
	Spreading rush



TEMPLATE 3

PLANT LEGEND 3

Symbol	Botanical Name / Common Name
	Carex obnupta
	Slough sedge
	Carex testacea
	Orange sedge
	Juncus patens
	Spreading rush

NOTES:

1. These are examples of approved planting templates. Other planting plans may be approved.
2. See Section 2.3.3 and Appendix F.4 of the SWMM for planting requirements.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

Bureau of Environmental Services

- 2010 Green Streets -

Landscape Planting Templates

Curb Extensions

NUMBER

SW-323

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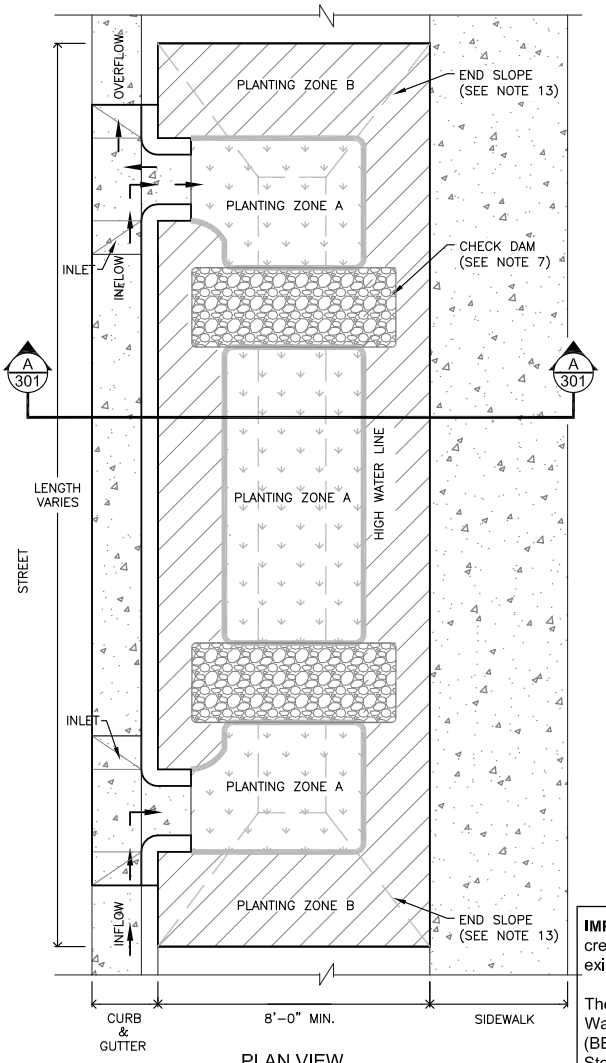
FIGURE 41
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Landscape Planting Templates, dated 3/5/2010

FIGURE 42
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Swale Sections, dated 3/5/2010



PLAN VIEW

NOTES:

1. See City of Portland Standard Construction Specifications Section 00415 - Vegetated Stormwater Facilities.
2. Area and depth of facility are based upon engineering calculations and right-of-way constraints. See chapter 2 of the City of Portland Stormwater Management Manual (SWMM).
3. Longitudinal slope of swale matches road.
4. Include beginning and ending stations for each facility. Provide stations and elevations at every inlet, outlet, and check dam.
5. Sidewalk elevation must be set above inlet and outlet elevations to allow overflow to drain to street before sidewalk.
6. See sheets SW-330 and SW-331 for inlet details.
7. Check dams may be required, see sheet SW-340 for details.
8. See Appendix F.3 of the SWMM for stormwater facility topsoil requirements.
9. Special requirements for water lines, meters, and fire hydrants, see sheet SW-304 for details.
10. Utility lines may need to be sleeved or relocated.
11. Curb and Gutter: Standard Drawing P-540.
12. See Landscape Planting Templates on SW-303.
13. End slopes of swale shall be a minimum of 1:3.

IMPORTANT: Utility conflicts and existing conditions can create major design variables. Locate utilities and survey existing conditions prior to beginning design work.

The Portland Bureau of Transportation (PBOT), Portland Water Bureau (PWB), and Bureau of Environmental Services (BES) are responsible for the review and approval of Stormwater Swales in the public right of way. Stormwater facilities in *Well Field Protection Areas* may require special containment measures.

For more information contact:

PBOT (503) 823-7884	BES (503) 823-7761
PWB (503) 823-7368	Urban Forestry (503) 823-4489

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

Bureau of Environmental Services

- 2010 Green Streets -
Plan View
Swales

NUMBER
SW-300

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Example of LID Landscape Planting Templates – shows examples of planting templates to LID stormwater facilities.

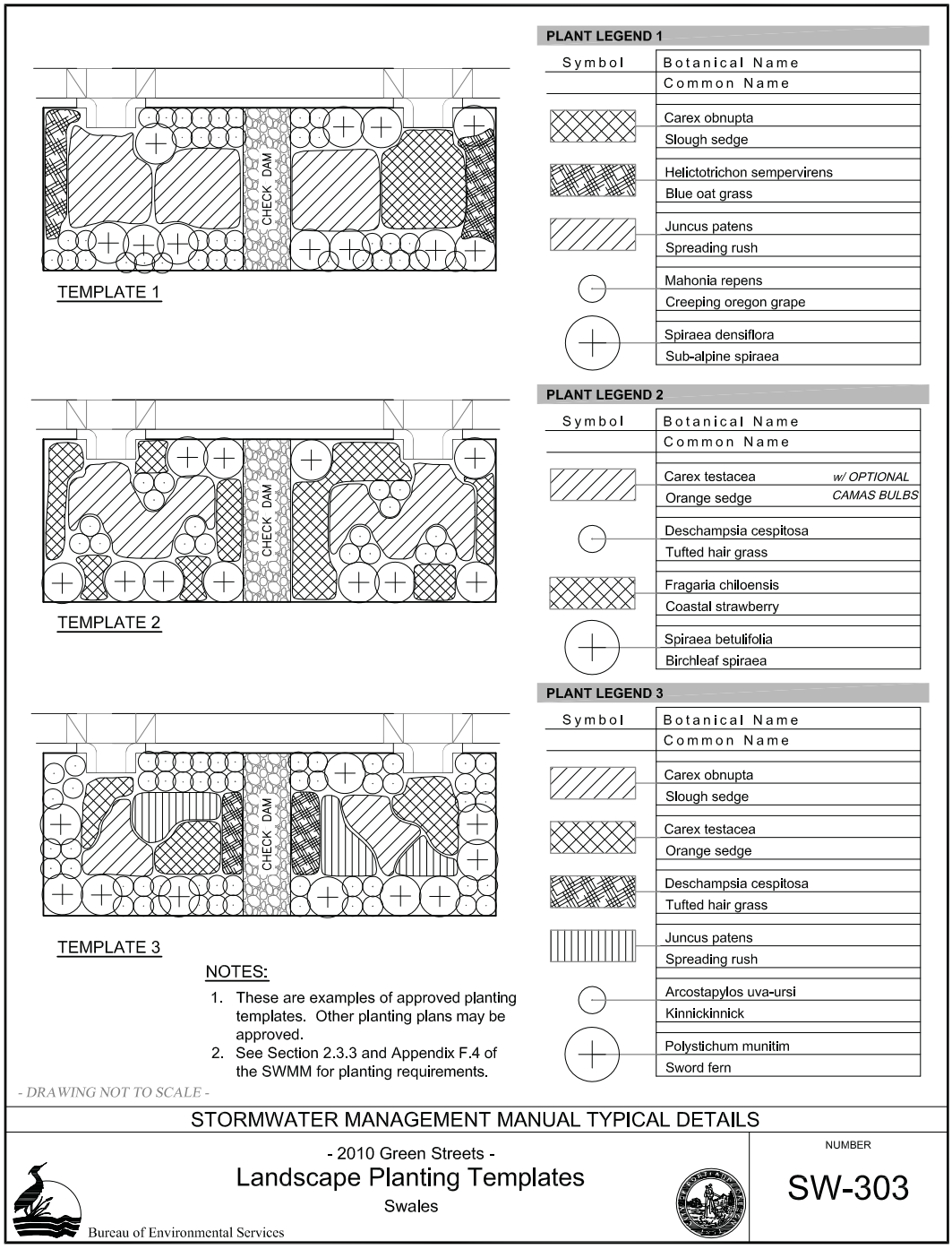


FIGURE 43
City of Portland, Stormwater Management Manual Typical Details - 2010 Green Streets: Swale Landscape Planting Templates, dated 3/5/2010

FIGURE 44
Permeable Asphalt Detail - *Low Impact Development Techincal Guidance Manual for Puget Sound (2012)*

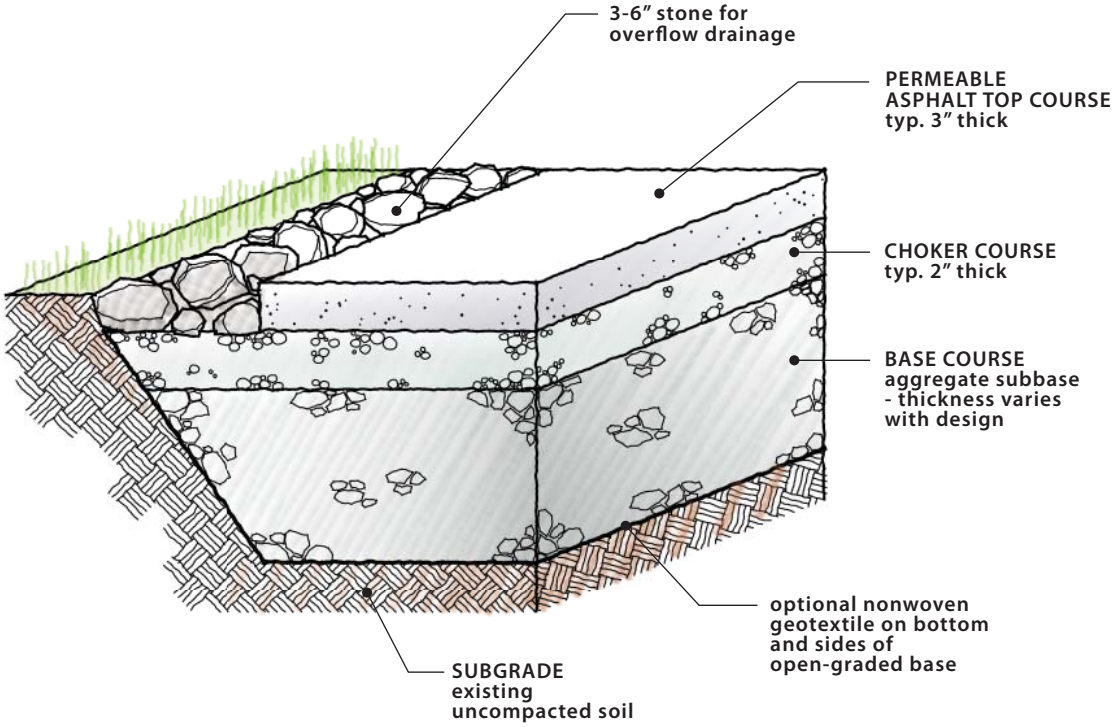
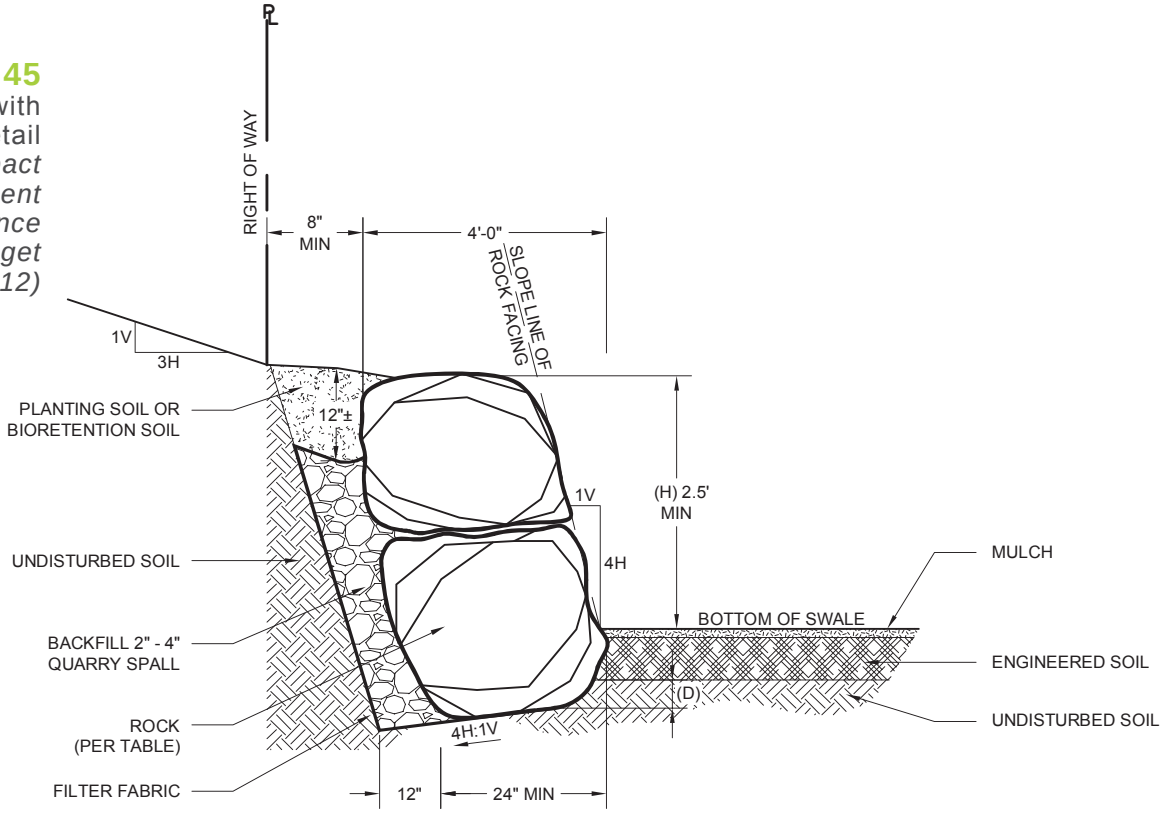


FIGURE 45
Rockery with Bioretention Detail - *Low Impact Development Technical Guidance Manual for Puget Sound (2012)*



MINIMUM ROCK SIZES

(H)	SIZE(BASE)	SIZE(TOP)	(D)
2.5'	2-MAN	1-MAN	3"
4'	3-MAN	2-MAN	6"
7'	4-MAN	2-MAN	9"

NOTE:
GRAPHIC ADAPTED FROM CITY OF SEATTLE, BROADWVIEW GREEN GRID PROJECT DETAIL


FILL THE GAPS
{REVIEW & ADOPT}
IMPLEMENTATION

Step Five 5
{REVIEW & ADOPT}

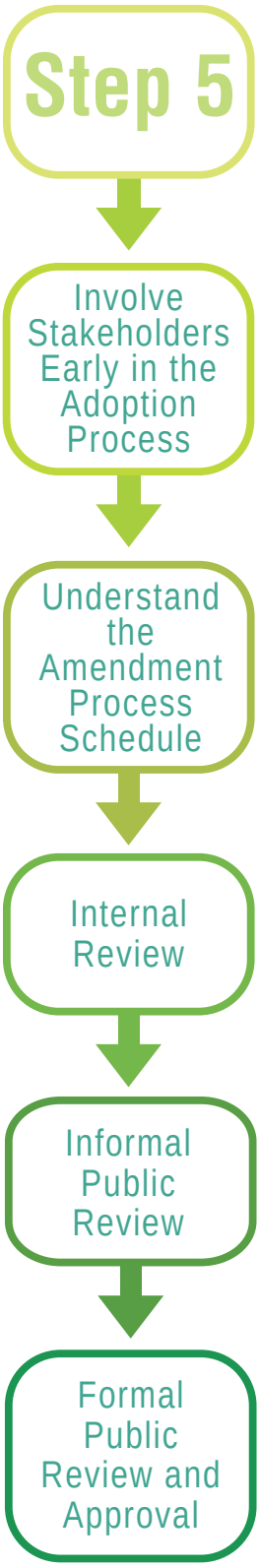
Lessons Learned & Important Items

1. Make sure that codes and standards have been thoroughly reviewed by management before starting the adoption process.
2. Develop internal and external participant ownership in the process by involving them during each step. This will help the adoption process run more smoothly.
3. Avoid surprises; make sure that management, commissions, and councils have received regular updates throughout the process.
4. Identify adoption challenges and solutions before beginning the public adoption phase.
5. Be prepared to discuss how the LID review process is different from the standard project review process.

Expected Time Span to Complete: **three to nine months**

Public Review and Adoption Process

Once the project team has developed new codes or modified existing codes and standards to ***fill the gaps*** in addressing LID, the next step is to ***review and adopt*** the new codes and standards. This step provides a general overview of a typical code modification process and discusses the timing and duration of the review and adoption process. In addition, this step includes lessons on presenting the proposed amendments to elected officials and a summary of some of the adoption lessons learned from presenting proposed amendments to elected officials.



Public works staff administratively adopt a variety of development controls in the form of technical engineering standards and guidelines. Although there are many ways to integrate development standards into local land use controls, often public works directors are vested with the authority to adopt details for public streets, including curb, gutter and sidewalk standards, as well as storm drainage BMPs. This step does not describe in detail the adoption process associated with administratively adopted standards but rather focuses on strategies for the successful adoption of *legislatively* adopted development controls.

Involve Stakeholders Early in the Adoption Process

The key external participants identified in Step 1 should be made part of the public review and adoption process. Ideally, the project team will have involved outside stakeholders throughout the previous steps in the code and standards review and revision process. This level of involvement by key external participants in the previous steps will help all parties understand the need for the changes, as well as provide opportunities for input and buy-in. When community members with technical expertise (e.g., civil engineers, landscape architects, etc.) participate, they can share important lessons and other technical information relevant to development in the jurisdiction with local decision makers.

General Overview of Code Modification Process

Amendments to local zoning, subdivision, landscape, parking, stormwater, street standards, and other development codes serve to achieve one or more of the following overall objectives of the LID amendment process:

- Removal of impediments to the use of LID BMPs and LID principles
- Defining structural and non-structural LID techniques
- Establishment of standards for LID BMPs and LID principles
- Establishment of minimum standards for LID projects

Understand the Amendment Process Schedule

It is important to begin the amendment process early to accommodate several rounds of both internal and external review and refinement. Every jurisdiction should be able to project how long each step should take from experience and anticipate where more time may be needed to ensure that each part of the review and approval process is completed.

The municipal stormwater permits will identify compliance schedules for local jurisdictions to integrate LID into codes and standards. The project team must understand the compliance schedule and plan an adoption process by working backward from the compliance date of the municipal stormwater permit.

Internal Review

Building on the project team's work together that started in Step 1 and progressing through the development of the draft regulations in Step 4, if it has not happened already, department managers should review the proposed changes to the standards if they did not actively participate in the preparation of the amendments. The managers will need to understand the changes to ensure regulatory consistency, make sure that there is buy-in by all departments to the new standards, and present the proposed changes to the public and elected officials.

Public Review

IDENTIFY ADOPTION CHALLENGES

As local government staff complete the preparation of code amendments and review by the department managers, it is important to consider specific questions and concerns that may be raised during both the informal and formal adoption process and how they may be addressed. The project team should have a good idea about what specific concerns outside stakeholders have based on their participation during the previous four steps.

The Puget Sound Partnership conducted a survey in the spring of 2010 of local government recipients of the 2005-09 LID Local Regulation Assistance Project. Survey respondents cited a number of challenges they faced as well as potential solutions in the code review and adoptions process:

Challenges:

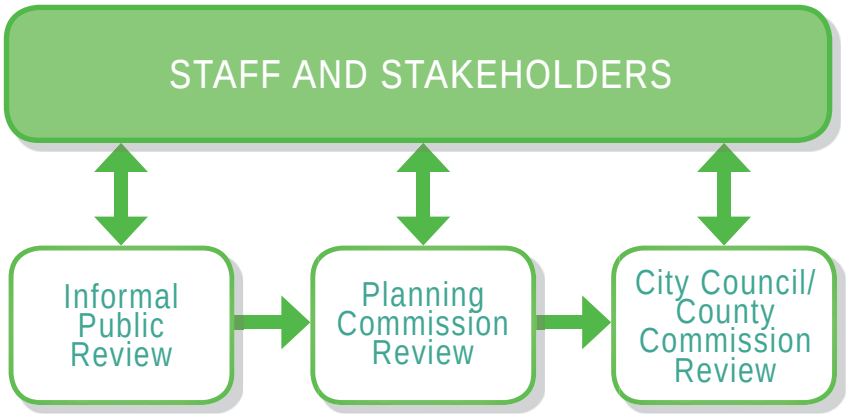
- Opinions that LID was not a proven, tested, and trusted means of handling stormwater.
- Misunderstandings about LID among elected officials related to cost and function.
- Perceptions of LID as expensive or not as effective compared with conventional methods.
- Available staff resources have been reduced due to economic conditions and there are fewer financial resources to fund staff time and staff training.

Solutions:

- Review the technical findings on efficacy of LID that are available.
- Prepare a list of local examples of completed LID projects for interested parties and elected officials. Consider setting up a tour of projects.
- Present cost studies that have been completed comparing LID techniques with standard urban stormwater management practices.
- Alternative sources of State and Federal funding will need to be requested to fund the required changes and subsequent implementation.

Informal Public Review Process

Prior to going into the formal adoption process, it is recommended that the proposed code changes be made available for informal public review. Use the external stakeholder groups that you have been working with since Step 1 to solicit targeted feedback. Provide background information as well as the proposed code changes to stakeholders. This will allow the context of the proposed code amendments to be fully understood. Based on the input received, the amendments will be further refined and staff reports prepared to address issues identified in the informal public review process.



Formal Public Review Process

Depending on the individual jurisdiction, there may be a number of steps in the formal public review and approval process. It is during this phase that white papers or other technical documents about cost, maintenance, or other design and construction methods should be assembled for use as findings-of-fact for the amendment package. In most cases, code amendments will go through a planning commission for their review, comment, and recommendation. From there, the amendment package may go to a subcommittee of the elected council or commission for further review and comment. Finally, there will be a formal comment period where additional public comment is accepted prior to a public hearing by the legislative body.

Some of the public meetings will be in workshop, study session, or open house format. Materials and presentations for informal meetings vary considerably from public hearings. Staff should consider preparing a wide variety of communication tools suitable for differing audiences and public forums.

REVIEW & ADOPT

{IMPLEMENTATION}

APPENDICES

Step Six 6
{IMPLEMENTATION}

Lessons Learned & Important Items

1. Ensure that staff are well trained and have adequate time to address LID project review, implementation, and ongoing maintenance.
2. Provide sufficient funding for project review and ongoing maintenance and inspections.
3. Recognize that LID projects will require both an initial monitoring phase to make sure the project functions as designed and provisions for ongoing maintenance.
4. Make sure that the codes and staffing for enforcement are in place to ensure that regular, proper maintenance occurs.
5. Look for opportunities to collaborate with other jurisdictions to share maintenance equipment and successful approaches after codes and standards are adopted.

Expected Time Span to Complete: ongoing

Ensure Successful Implementation

After the new regulations have completed the public review and adoption process and standards have been administratively updated, the next step is to ***implement*** the new regulations and standards successfully. This step includes addressing staffing, permit review procedures, ongoing training, and education for staff and applicants, and establishing maintenance procedures and enforcement. The project team should use its experience developing and adopting codes, regulations and standards to inform the implementation process. Consider keeping the project team active after the initial implementation process is complete to provide the means to monitor which processes and regulations are working as well as those that should be modified.

Staff Resources

To help ensure the successful implementation of LID, staff resources may need to be rebalanced and reprioritized so that local commitments for project review, construction inspections, and maintenance are kept. This rebalancing of staff resources is similar to the "getting up to speed" process that local jurisdictions face when other substantial amendment packages to codes or standards are adopted. There may need to be retraining or the hiring of new staff to implement these new requirements. Budgets for individual departments should be evaluated for staffing requirements. Additional sources for internal funding or grants may be needed to provide dedicated staff time that cannot be used on other priority tasks. To the extent possible, neighboring jurisdictions should look for ways to share resources.

Ongoing Training and Education

TRAINING STAFF

Staff training should cover the effective review of LID designs, the design of LID projects and individual LID BMPs, LID construction and facility inspection techniques, and maintenance. Counter staff, permit reviewers, inspectors, and enforcement staff should receive training so they can successfully guide project applicants, review permit applications, and inspect LID facilities both during and after construction. Training certification programs are available through a variety of sources discussed below. Managers should plan to send staff to LID training sessions.

TRAINING APPLICANTS, DESIGNERS, AND CONTRACTORS

FIGURE 46
WSU Extension/ Partnership LID Technical Workshop 2010 Series photo courtesy of Bruce Wulkan

Training applicants on LID BMPs, LID feasibility evaluation, and maintenance considerations is important for effective implementation of LID. Training can enhance the quality of permit applications. Training is also valuable for maintenance activities. As LID techniques become more pervasive in projects, broader segments of the public and professional communities will understand the practices and the need for training and education may reduce over time.

There are a variety of training programs, as well as manuals, brochures, and other resources available illustrating the benefits provided by LID, the uses of LID, and the types of LID BMPs and these are identified in the Appendix. In addition, resources are available for residential homeowners to implement on-site stormwater retention when an engineer is not required.

CERTIFICATION PROGRAMS

Staff certification adds legitimacy and precision to the steps of LID implementation – from gap analysis to drafting code change language to adoption, enforcement, and maintenance. The University of Washington Professional & Continuing Education has offered an LID certification program spanning three quarters that includes the legislative authority for stormwater management and LID, the design of LID techniques, and construction, inspection and post-construction principles and practices. The Washington State University Extension - Puyallup offers an LID Technical Workshop Series. These two-day workshops include sessions on bioretention, permeable paving, green roofs, minimal excavation foundations, rainwater collection systems, site planning, and inspection.

LOOK FOR EFFICIENCIES WITH OTHER LOCAL GOVERNMENTS

Local governments of similar size or regulatory structure that have made progress in implementing LID may offer examples, guidance, and lessons to other jurisdictions. Other opportunities for efficiencies include shared training, demonstration projects, and maintenance equipment.

REVIEW AND ESTABLISH APPLICATION REVIEW PROCEDURES

Jurisdictions will need to review and revise application materials, permit review bulletins, process flow charts, and permitting information given to the public. It is important to discuss these changes with relevant staff and seek their input.

Maintenance of Low Impact Development Facilities

REVIEW AND ESTABLISH MAINTENANCE PROCEDURES

Like standard urban stormwater management practices, LID facilities must be regularly maintained in order to perform as designed. Some of the maintenance agreements and activities associated with LID techniques are similar to those performed for conventional stormwater systems; however, the scale, location, and the nature of an LID approach will also require new maintenance skills and strategies, since LID facilities range in size and complexity. LID maintenance often involves different equipment (e.g., sweeper with suction for permeable pavement versus a vactor truck for catch basin cleaning). In preparing a local maintenance program, permittees should consider the following:

- **Facility inspections** – How are the facilities performing? Is pervious pavement draining well or is it becoming clogged? Are bioretention areas attractive or becoming overgrown with weeds or littered with trash?
- **Maintenance practices** – Maintenance programs should document the type of maintenance required for the stormwater structure. Vacuuming may be stipulated for pervious pavements, while weeding, pruning, and trash removal may be required for bioretention areas. What equipment and staffing is necessary to facilitate the maintenance?
- **Maintenance frequency** – How often should the pervious pavement be

vacuumed? At what frequency should weeding, pruning, and trash removal occur for bioretention areas?

- **Maintenance cost** – What is the cost for performing the maintenance? How much should be budgeted for capital (e.g., equipment) and operations costs?
- **Maintenance guarantees and enforcement** – What mechanisms should be considered to ensure the long-term maintenance of LID practices that are located on private property? Should public easements be recorded for public maintenance of LID practices on private property? Are maintenance covenants and other legal agreements a better strategy?

FACILITY INSPECTIONS

Inspecting the performance of LID facilities is vital to ensuring that a municipality's stormwater system is operating as designed. Periodic inspections should occur for LID practices. Local governments should request that the developer provide operation and maintenance plans and manuals that include maintenance standards, maintenance practices, and inspection frequencies for LID facilities. The developer can obtain this information from their project engineer, installer, or manufacturer. Ecology has provided grant funding to develop detailed LID maintenance standards, which will be available in early 2013. Developers can also refer to the LID Technical Guidance Manual. Inspection checklists should be created to facilitate the uniform evaluation of various practices. There are a number of useful inspection checklists available.

MAINTENANCE PRACTICES

Municipal stormwater permittees should refer to the developer's maintenance plans or other information referenced in the previous section for specific maintenance techniques by LID practice.

To ensure long-term facility performance, the entities responsible for performing maintenance should be matched appropriately to the necessary tasks. An individual homeowner may be able to maintain a rain garden or other small facility on their property; however, larger facilities, including those in the right-of-way or common area tracts, often are more successfully maintained by private contractors or the responsible jurisdiction. The use and ownership of properties can often help dictate the most appropriate provider of facility maintenance.

MAINTENANCE FREQUENCY

Maintenance needs will vary among different types of LID facilities. Some maintenance is done on a routine (annually or semi-annually) basis while other maintenance practices may be done less frequently as determined by inspection. Maintenance and inspection includes at time of installation and short-term establishment (typically up to 5 years) followed by long-term ongoing maintenance for the life of a project.

The frequency of maintenance practices should occur consistent with the guidance found in developer's maintenance plans or other source provided in the Facilities Inspections section.

MAINTENANCE COST

Annual budgeting should include maintenance practices. After understanding the maintenance regime and frequency, the permittee should be able to attach costs for capital and operations costs to a budget for inclusion in the local Capital Improvement Program (CIP). Like other O&M budgeting exercises, the permittee will need to understand labor costs, services available through contract or sharing with neighboring municipalities, and costs associated with equipment.

MAINTENANCE GUARANTEES AND ENFORCEMENT

LID stormwater facilities are not just located within public rights-of-way. Often stormwater facilities are located on private property. There are a variety of mechanisms to ensure that stormwater facilities located on private property are maintained to a properly functioning condition. One important element is to ensure that the permittee will have access to inspect, maintain, and if necessary repair the facility should the private property owner fail with the obligation.

Access can be established through easements or attached as a condition associated with the granting of a permit. Covenants represent another means of ensuring that maintenance occurs in perpetuity regardless of whether property is sold and memories of permit conditions fade.

Maintenance enforcement should include provisions that allow the permittee to perform maintenance on private property when maintenance has not occurred and provide mechanisms to ensure that the permittee will be repaid for maintenance activities. Many permittees already have such provisions within local codes and standards.

Appendix

Sources of Information

WEBSITES:

Center for Watershed Protection:
www.cwp.org

Charles River Watershed Association (CRWA):
www.crwa.org

City of Santa Barbara, California:
www.santabarbaraca.gov/Resident/Community/Creeks/Low_Impact_Development.htm

Department of Ecology:
Municipal Stormwater Permits/NPDES
www.ecy.wa.gov/programs/wq/stormwater/municipal
LID Standards
www.ecy.wa.gov/programs/wq/stormwater/municipal/LIDstandards.html

Kitsap Home Builders Foundation Low Impact Development:
www.kitsaphba.com/LID/

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

Low Impact Development (LID) Urban Design Tools Website:
www.lid-stormwater.net

City of Mill Creek:
Design and Construction Standards Plans, adopted in August 2011
www.cityofmillcreek.com

Municipal Services and Research Center (MSRC):
Source of adopted LID code language in the guidebook
http://www.mrsc.org/codes.aspx

Natural Resources Defense Council:
www.nrdc.org/water/pollution/storm/stoinx.asp

City of Olympia:
Green Cove Basin
http://olympiawa.gov/documents/PublicWorks/Technical_services/EDDS09/newformat/Chapter9_Green_Cove_Basin.pdf

Puget Sound Partnership:
Main website:
www.psp.wa.gov
My Puget Sound:
www.mypugetsound.net

Portland Bureau of Environmental Services Sustainable Stormwater:
www.portlandonline.com/bes/index.cfm?c=34598

Soils for Salmon:
www.soilsforsalmon.org

SPU Natural Drainage Systems:
www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/index.htm

Stormwater Management Manual for Western Washington:
www.ecy.wa.gov/programs/wq/stormwater/manual.html

The Economics of Low-Impact Development: A Literature Review:
www.econw.com

U.S. Environmental Protection Agency (EPA) LID resources:
LID Literature Review and Fact Sheet:
www.epa.gov/owow/NPS/lid/lidlit.html
Costs Fact Sheet:
www.epa.gov/owow/NPS/lid/costs07/factsheet.html

University of Washington Professional and Continuing Education:
www.pce.uw.edu/certificates/low-impact-development.html

Washington State University Extension:
LID Research:
www.puyallup.wsu.edu/stormwater
Washington State University/Puget Sound Partnership LID Technical Workshop Series:
http://conferences.wsu.edu/conferences/lidworkshops

MANUALS AND BOOKS:

Bay Area Stormwater Management Agencies Association. Start at the Source Design Guidance Manual for Stormwater Quality Protection. 1999.

CH2MHill, Inc. Pierce County Low Impact Development Study. Final Report. 2001.

Charles River Watershed Association. Urban Low Impact Development Best Management Practices Matrices. 2008.

The Conservation Fund. Green Infrastructure Case Study Series. 2003.

Department of Ecology. Stormwater Management Manual for Western Washington. Revised 2005 with Update Expected 2012.

Dunnett, Nigel and Kingsbury, Noel. Planting Green Roofs and Living Walls. Portland, Oregon: Timber Press. 2010.

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

ECONorthwest. Low Impact Development at the Local Level: Developers' Experiences and City and County Support. February 25, 2009.

ECONorthwest. Managing Stormwater in Redevelopment and Greenfield Development Projects Using Green Infrastructure: Economic Factors that Influence Developers' Decisions. June 2011.

Ferguson, Bruce K. Porous Pavements. Boca Raton: CRC Press. 2005.

City Of Flagstaff. Low Impact Development Manual. January 2009.

Foss, Asa. Low Impact Development: An Alternative Approach to Site Design. PAS Memo. May/June 2005.

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

Natural Resources Defense Council. Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows. June 2006.

City Of Portland Environmental Services. Sustainable Site Development Stormwater Practices for New, Redevelopment and Infill Projects. November 2003.

Prince George's County, Maryland, Department of Environmental Resources, Programs and Planning Division. Low-Impact Development Design Strategies: An Integrated Design Approach. June 1999.

Puget Sound Partnership and the Washington State University Extension. Low Impact Development Technical Guidance Manual for Puget Sound. January 2005 with Update Expected in 2012.

Rhode Island Department of Environmental Management and Coastal Resources Management Council. Rhode Island Stormwater Design and Installation Standards Manual - 4.0 Low Impact Development (LID) Site Planning and Design Strategies. December 2010.

County of San Diego, California. Low Impact Development Handbook: Stormwater Management Strategies. December 31, 2007.

City of Santa Barbara, California. Storm Water BMP Guidance Manual. June 2008.

United States Environmental Protection Agency. Water Quality Scorecard. October 2009.

U.S. Department of Housing and Urban Development, Office of Policy Development and Research. The Practice of Low Impact Development. July 2003.

Washington State University Extension. Rain Garden Handbook for Western Washington Homeowners: Designing Your Landscape to Protect Our Streams, Lakes, Bays, and Wetlands. June 2007.

IMAGE CREDITS:

All graphics and photographs are from AHBL, Inc. unless noted otherwise.