EXECUTIVE SUMMARY

The purpose of this document is to provide detailed implementation guidance to stakeholders in Grants Pass**,** Oregon (City). Although this is a technical document, every effort has been made to write in non-technical and clear language so that planners, designers, engineers, landscape architects, architects, developers, contractors, maintenance staff, field crews, and other watershed stewards in both the public and private sectors can develop, redevelop and retrofit more environmentally sound and cost-effective sites.

Implementing a Low Impact Development (LID) site is similar to conventional development in many ways; however, the main difference is that the site's natural and built conditions drive decisions. Site design should lead with stormwater considerations as a primary programmatic element. Interdisciplinary collaboration can provide perspectives and knowledge that can streamline the development process and result in less costly sites than conventional development. This document has been adapted by the City to account for the natural variations in rainfall, soils, and other considerations specific to the City. The LID Implementation Forms (described in more detail below) are a critical tool in this guidance that steps users through the chapters and appendices that provide the essential information needed to avoid costly mistakes and poorly functioning sites. The general structure of the document is described below:

Chapter 1 introduces the concept of low impact development as one solution to improve water quality in the City by defining it, offering a brief history of stormwater management, documenting benefits, summarizing the Best Management Practices (BMPs), offering critical information on the intersection of LID with Department of Environmental Quality (DEQ) regulations such as the Underground Injection Control, and discussing costs of LID.

Chapter 2 covers the applicability of a project to this document and the requirements to meet landscaped area, water quality, and flow control management requirements.

Chapter 3 details the LID site development process through planning, design, construction, and maintenance. Early interdisciplinary collaboration and communication are the foundation of implementing cost-effective and environmentally effective BMPs. Planners, designers, contractors, and maintenance staff each play unique but interwoven roles in impacting or protecting water quality.

Chapter 4 provides detailed guidance for each BMP through the planning, design, construction and maintenance project phases, as well as BMP-specific cost considerations. A quick reference table (Table 4-1) helps guide the user to determine what each BMP can manage, what sizing approaches can be used, and if infiltration testing is required. BMPs are grouped into categories: those that limit disturbance, those that minimize impervious area, those that manage the rainfall that lands on them, those that manage runoff directed to them, and those that improve water quality of runoff without significantly reducing its quantity (See Appendix G for BMP Suitability Matrix).

Chapter 5 provides instructions on completing the LID Implementation Forms, which defines a hierarchy of BMPs and steps the planner or designer can use to size BMPs. The LID Implementation Forms, provided in Excel format are a companion document to this Chapter.

Chapter 6 provides instructions to complete and file the Operations and Maintenance Agreement Form, which documents who will be responsible for BMP maintenance, what specific maintenance activities are needed, where the BMPs are located on a site map, and legal language.

Chapter 7 presents on-site source controls for managing site specific sources of pollutants. The implementation of this chapter is in addition to the water quality and flow control measures required.
Appendix A is a checklist of site planning reports and specific information for what should be included in each report, so that the proper scope of work to implement LID sites is known.

Appendix B describes design criteria and construction and maintenance techniques common to multiple BMPs to ensure proper function. Permit submittal requirements detail minimum information to be included on plans. This section also describes approved hydrologic modeling approaches.

Appendix C provides detailed information on infiltration testing, which is required to cost-effectively select and implement many of the BMPs. Included is a Simplified Sizing Approach Infiltration Testing Form and a data entry form for meeting submittal requirements.

Appendix D clarifies the materials specifications for a variety of components specified in the BMPs such as gravel, compost, impermeable liners. It also includes detailed specifications (i.e. both materials and installation) for constructing porous asphalt pavements and using structural tree soil underneath pavement.

Appendix E describes important considerations when choosing plants and lists approved plants.

Appendix F includes standard details for most BMPs included in this guidance, as well as supporting infrastructure.

Appendix G is the BMP Suitability Matrix. BMPs are grouped into categories: those that limit disturbance, those that minimize impervious area, those that manage the rainfall that lands on them, those that manage runoff directed to them, and those that improve water quality of runoff without significantly reducing its quantity

HOW TO USE THIS GUIDANCE DOCUMENT

This guidance document provides detailed planning, design, construction, and maintenance information on best management practices (BMPs) that treat stormwater runoff on-site and reduce runoff volumes to protect water quality and reduce flooding downstream. This document is accompanied by the LID Implementation Forms in Excel format that can be used to size BMPs.

Your LID project will be most successful and cost-effective if you examine the site holistically, considering stormwater and natural resources from the beginning and incorporating a few BMPs, rather than simply adding one or two large stormwater facilities at the end of the site planning process (***Figure 1-1***).

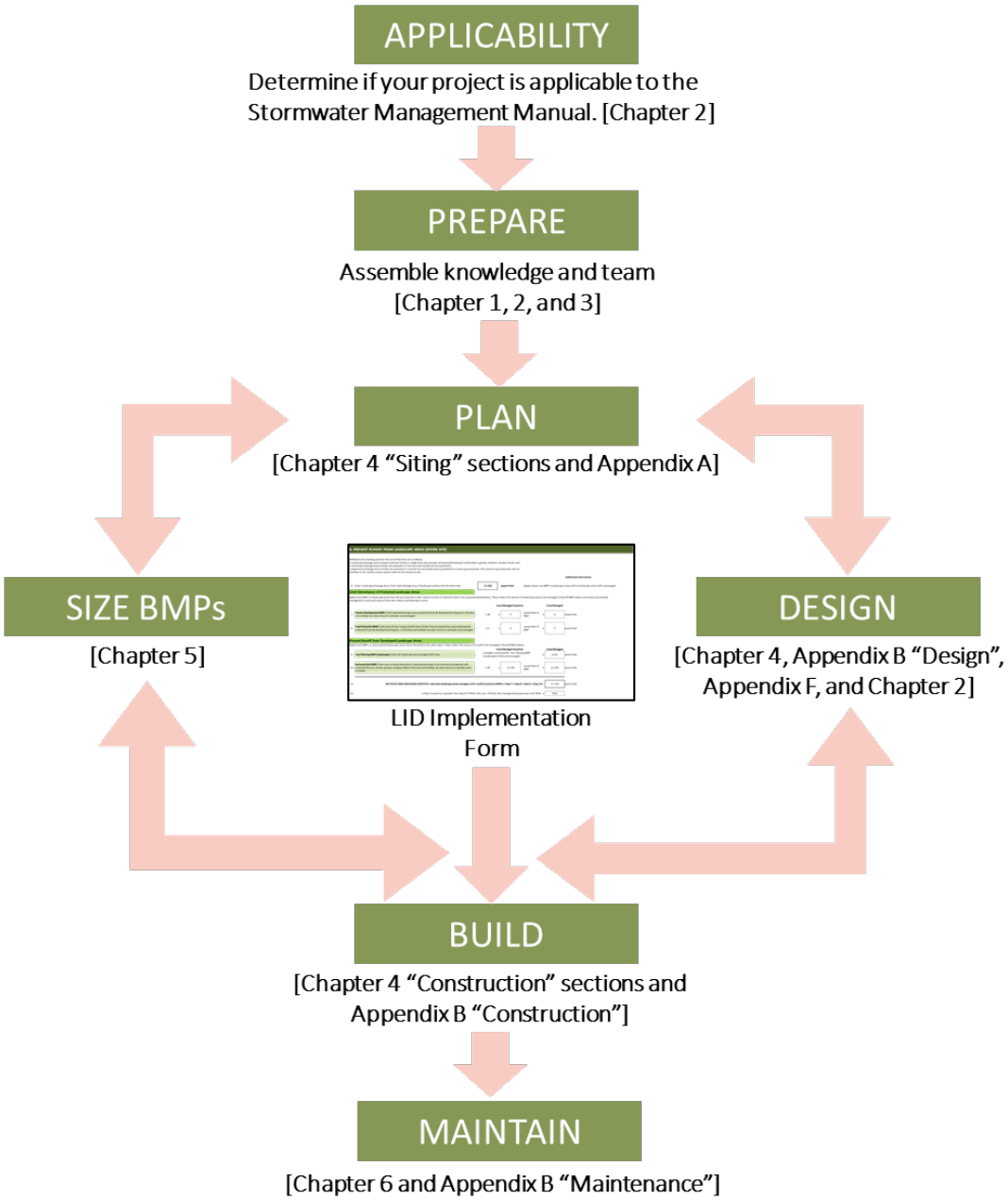

Figure 1-1. General approach to using this guide

APPLICABILITY: Determine if your project is applicable to the Stormwater Management Manual

Review Chapter 2: Applicability & Requirements

- Review section "*Applicability*" to determine if your project must follow the Stormwater Management manual requirements.

PREPARE: Educate yourself and assemble your team

Review Chapter 1: Overview of Stormwater and Low Impact Development

Learn:

- How runoff volumes impact water quality.
- Which BMPs may need authorization from DEQ as Underground Injection Controls.
- Early interdisciplinary collaboration and communication are the foundation of implementing cost-effective and environmentally-effective BMPs. Planners, designers, contractors, and maintenance staff each play unique roles in impacting or protecting water quality.

Review Chapter 2: Applicability & Requirements

Familiarize yourself with the requirements of the two BMP sizing approaches, the Simplified Sizing Approach and the Engineered Design Approach. Reviewing this section is critical in determining what will be required to size and design BMPs. This section will also allow the user to determine if a licensed engineer is required and if a qualified professional will be required for infiltration testing. The user can also determine how to meet requirements for landscaped area, water quality, and flow control management.

Learn:

- What BMP sizing methods are required and what they involve.
- "*Stormwater Management: Water Quality*": Determine what water quality is and how to manage it.
- "*Stormwater Management: Flow control*": Determine what flow control is and how to manage it.

Review Chapter 3: Understanding the LID Process

Thinking about stormwater earlier allows more effective strategies to be used throughout a site and adds efficiency to development. Because stormwater regulations are newer and less familiar than plumbing and building codes, a strategy for stormwater management is often not thought about until the end of planning or construction. This chapter provides some tools and insight on processes and describes the important roles members of the development team play in creating an LID site (described below):

- The LID Planning Process: Checklists, site planning steps
- The LID Design Process: Plans submittal requirements
- The LID Construction Process: The importance of protecting soil permeability and using erosion prevention and sediment control measures
- The LID Operations and Maintenance Process: Maintenance responsibility, tasks for maintaining impervious and landscape surfaces, writing a plan

Review Chapter 4: Specifics on the Recommended Best Management Practices (BMPs)

Review detailed siting, design, construction, and maintenance on BMPs. Choosing the "best" BMPs maximizes efficiency, cost-savings and effectiveness of the stormwater management component of development and redevelopment. This chapter offers specifics on each BMP that will be important to consider as the LID Implementation Forms provide a process of how best to reduce runoff and clean stormwater.

- Limit Disturbance BMPs (Conserve Fast(er) Draining Soils, Cluster Development, Tree Protection, Minimal Excavation Foundations, Construction Sequencing)
- Minimize Impervious Area BMPs (Share parking spaces, Minimize Front Setbacks, Share a Driveway)
- Restored Soil BMP
- Tree Planting BMP
- Depave Existing Pavement BMP
- Contained Planter BMP
- Vegetated Roof BMP
- Porous Pavement BMP
- Rain Garden, Stormwater Planter, and LID Swale BMPs
- Soakage Trench BMP
- Drywell BMP
- Water Quality Conveyance Swale
- Dispersion BMPs (Vegetated Filter Strip, Downspout Dispersion)
- Wet, Extended Wet, and Dry Detention Pond BMP

PLAN YOUR SITE

- ✓ Use **Chapter 3** and **Appendix A**. Consider your site holistically and consider where you might best place stormwater management facilities and which natural resources could be preserved.
- ✓ Review the Site Suitability Matrix **Table G-1, Appendix G**. This table indicates which BMPs are suitable for a variety of conditions (e.g. relative stormwater management effectiveness, site conditions, land uses).
- ✓ Use the "Siting" sections under each BMP in **Chapter 4**. Locate facilities carefully, according to the guidance provided.
- ✓ **Appendix C**. Test your site's infiltration rate to find fast(er) draining soils. Later, test your soil's infiltration rate in any locations where infiltration facilities will be installed.

SIZE YOUR BMPs

Work through **Chapter 5** using the Step-by-Step LID Implementation Form. This is where the information in the rest of the manual all comes together. Test drive the form and refer back to the other chapters and appendices as resources to locate and design the stormwater BMPs:

1. Open the Excel file "*LID Implementation Form*".
2. **IMPORTANT!** Refer to **Chapter 5** for instructions and criteria to complete the LID Implementation Form and worksheets.
3. Have a licensed engineer design BMPs if simplified sizing factors can't be used and when criteria in **Chapter 2** "*Stormwater Management: Water Quality*" and "*Stormwater Management: Flow Control*" require it.
4. Complete a first draft of the LID Implementation Form, preferably in the early planning phase.
5. Revisit and modify the LID Implementation Form:
    a. If all surfaces have not been managed by BMPs. Redesign the site and strategies, as feasible.
    b. If the site layout has changed.
6. Finalize the construction plans and the LID Implementation Form and submit for permits as described in **Chapter 3** "*The LID Design Process*".

DESIGN YOUR BMPs

- ✓ Use **Chapter 4** and the standard details in **Appendix F** to design your BMPs. Paying attention to

these details can help ensure your facilities will be easy to maintain and effective over the long term.

- ✓ Use **Appendices B and D** to specify materials and methods of placement. Clearly describing the best materials and how they should be installed is an important step in creating construction documents.

BUILD YOUR BMPs

- ✓ Refer to **Chapter 3** "The LID Construction Process", **Chapter 4** See "*Construction*" sections, and **Appendix B** "*Construction*". This will help ensure your stormwater facilities are properly built and/or planted. Clear and frequent communication between the designer and the construction team is essential for success.

MAINTAIN YOUR BMPs

Use **Chapter 6**: Operations and Maintenance Agreement. Once the LID Implementation Form has documented the BMPs for the site, the operations and maintenance information specific to each can be compiled into a legal form suitable for filing with the appropriate jurisdiction. Information includes:

- Identification of who is responsible for paying and performing maintenance
- BMP-specific maintenance activities to perform

GLOSSARY

AASHTO H-20 — The design load needed to design pavement sections that will support tractor-semi-trailer combinations, which are assumed to weigh 40,000 pounds.

approved discharge point — A location where overflow from a BMP may be directed, which includes a surface infiltration facility; storm drain or other conveyance system; a waterway (as approved by the Oregon Department of State Lands), or an underground injection control facility (as approved by the Oregon Department of Environmental Quality).

bedrock — A hard, solid rock surface that may underlie fragmented/decomposed rock and soil. Considered an impervious surface.

Best Management Practice (BMP) — "A device, practice, or method for removing, reducing, retarding, or preventing targeted stormwater runoff constituents, pollutants, and contaminants from reaching receiving waters."[1]

Cation Exchange Capacity (CEC) — "The amount of exchangeable cations that a soil can adsorb at pH 7.0 expressed in terms of milliequivalents per 100 grams of soil."[2] An adequate CEC in soil contributes to pollutant treatment.

contained planter BMP — A container with plants placed over an impervious surface intentionally implemented to reduce runoff and prevent or reduce pollution.

contaminated soils — Soils at sites where contaminants have accumulated because of historic activities, not necessarily limited to industrial sites. Contaminated sites have a highly regulated development path with additional permitting. Coordination with the local DEQ cleanup program is advised.

conveyance swale: — Long, open channel that conveys stormwater runoff, but may not provide substantial water quality treatment due to a lack of tall, structured plants to slow flows. These are not considered LID BMPs. An example of a conveyance swale is a rock lined roadside ditch.

detention basin: — A large depression in the ground where runoff is stored and released slowly. Detention basins are used to reduce flooding but have been found to be less effective at protecting downstream

[1] *U.S. Environmental Protection Agency. Preliminary Data Summary of Urban Stormwater Best Management Practices. Retrieved from: https://www3.epa.gov/npdes/pubs/usw_a.pdf*

[2] *Puget Sound Partnership. (2012). Low Impact Development Technical Guidance Manual for Puget Sound. Retrieved from: http://www.psp.wa.gov/downloads/LID/20121221_LIDmanual_FINAL_secure.pdf*

water quality. The Environmental Protection Agency now prefers low impact development BMPs, which reduce flooding and improve downstream water quality[3]. Because detention basins do not reduce runoff and have been found to pollute water with temperature, scouring, and changing flows that impact streams, detention basins are not considered an LID BMP.

dispersion — Spreading stormwater over a landscape area designed to treat runoff.

downspout disconnection — A form of dispersion that directs a building's roof drains to a lawn or garden instead of into stormwater pipes.

drywell — A well, assemblage of perforated pipes, or drain tiles that receive runoff and infiltrate that runoff underground.

evaporation — The process of water changing from a liquid to a gas. Evaporation is a significant portion of the annual water cycle that reduces runoff in undeveloped and/or forested areas of Western Oregon.

evapotranspiration — The collective term for the process of water returning to the atmosphere via interception and evaporation from plant surfaces and transpiration through plant leaves[2].

green street — Any BMP or collection of BMPs receiving runoff from and located in a public right-of-way. This term may refer to trees, vegetated filter strips, rain gardens, stormwater planters, vegetated roofs (e.g. bus stop shelters), and porous pavement.

invasive plants — Aggressive plants that outcompete native plants for water, sunlight and nutrients and therefore harm the environment, economy and human health.

impervious surface — A surface that prohibits water from soaking into the ground. Examples include roofs, concrete, asphalt, pavers, compacted gravel, compacted clay, plastic liners, and clogged landscape fabric.

landslide or landslide area — "The downslope movement of rock, soil, or related debris."[4] This term includes areas that already experienced a landslide and landscapes that have the potential to slide in the future.

level spreader — A strategy to spread flows evenly over a surface to reduce erosion and improve treatment as runoff enters a BMP.

LID swale — Long, planted, open channel that conveys stormwater runoff and is designed and constructed to promote infiltration.

limit disturbance BMP — Any BMP that protects a site or portion of a site in its current, natural vegetated state and/or protects soil permeability.

Low Impact Development (LID) — A pattern of land development that preserves natural resources and promotes opportunities to manage stormwater where it falls. LID relies on a collection of carefully selected techniques to reduce, receive, and clean stormwater runoff to protect and improve water availability and quality.

minimal excavation foundation BMP — A foundation type that allows groundwater to move freely through soil (not pipes) underneath the building (e.g. pier foundations and buildings with crawl spaces).

minimize impervious area BMP — Any BMP that reduces land area not able to infiltrate or evaporate rainfall or runoff as a result of being covered by buildings, roofs, and roads, parking lots and sidewalks.

mulch — Material such as compost, bark or wood chips spread on soil to retain moisture, discourage weeds and protect against wind and rain erosion.

mycorrhizae — The mycelium (roots) of a fungus.

mycorrhizal — "The symbiotic association of the mycelium (roots) of a fungus with the roots of a seed plant."[2]

native plants — Plants that occur historically in an area. If planted in conditions they naturally occur, these

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[3] *U.S. Environmental Protection Agency. (2009). Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act. Retrieved from: http://www.epa.gov/sites/production/files/2015-09/documents/eisa-438.pdf*

[4] *Oregon Department of Geology and Mineral Industries. Landslide Hazards in Oregon. Retrieved from: http://www.oregongeology.org/sub/Landslide/Landslidehome.htm*

plants need little or no fertilizer or care once established and provide wildlife habitat.

non-native (ornamental) plant — Plants that do not occur historically in an area, which may not be invasive, but also may not provide wildlife habitat.

new development — Any project where the land cover is changed from a natural, pre-developed state into another land cover.

pervious — See: porous

permeable — See: porous

predevelopment or predeveloped condition — The naturally vegetated land cover and contour (i.e. shape and slope) that would historically have been on a site prior to any construction.

porous — A material that allows water to pass through it.

porous pavement — Surface to walk, drive or park on that reduces stormwater runoff by allowing water to soak into the ground (i.e. permeable pavers, pervious concrete, porous asphalt, flexible paving systems and porous gravel).

post-development or post-developed condition — The land cover on a site as a result of development activities, which may include but is not limited to buildings, roads, sidewalks, ornamental, and working and protected landscapes.

qualified professional (infiltration testing)- A qualified professional for performing infiltration includes a Professional Engineer, Registered Geologist, Soil Scientist or other professional testing service with equivalent training and experience in determining the permeability of soils.

rainfall management — Use of BMPs to treat and reduce the volumes of stormwater leaving a site by infiltrating or evaporating rain that falls directly on the surface of the BMP. Examples of rainfall management facilities include restored soils, vegetated roofs, and contained planters. When rainfall management BMPs are used, they are referred to as "Runoff Prevention BMPs".

rain garden — A "sunken garden bed" with gentle side slopes that collects and treats stormwater runoff by ponding runoff and passing it through soils and plants. A rain garden does not function like a wetland nor is it considered a wetland for regulatory purposes.

redevelopment — Any project where existing land cover, which was previously developed, is changed to another land cover.

restored soil — The practice of amending disturbed soils (i.e. any soil in an urbanized area) to restore permeability and support plant establishment.

retrofit — Any project that improves water quality from an existing developed area.

runoff — Rainfall and snowmelt that flows off of a land surface instead of seeping into the ground or evaporating in the air. Runoff can carry pollutants to waterways.

runoff management — Using BMPs to treat and reduce the volumes of stormwater leaving a site by infiltrating or evaporating runoff collected and/or channeled from other areas to the BMP. Examples of runoff management facilities include rain gardens, stormwater planters, and LID swales. When runoff management BMPs are used, they are referred to as "Runoff Reduction BMPs".

runoff prevention BMP — Any BMP that reduces the volume of runoff leaving a site by evaporating and/or infiltrating rainfall that falls directly on it.

runoff reduction BMP — Any BMP that decreases the volume of runoff leaving a site by evaporating and/or infiltrating runoff directed to the BMP from another area.

runoff treatment — Use of BMP(s) to treat runoff. More desirable treatment BMPs also reduce runoff. Less desirable treatment BMPs allow treated runoff to leave the site. Examples include lined rain gardens, lined stormwater planters and lined LID swales.

run on – runoff from beyond the project boundary.

soakage trench — an excavated trench filled with coarse stone that receives runoff and stores it until it infiltrates underground into surrounding soils.

stormwater planter — A structural container (either above or sunken into the ground) with vertical side slopes and a flat bottom that collects and treats stormwater runoff, primarily from rooftops, driveways, sidewalks, parking lots, and streets by ponding runoff and passing it through soils and plants.

Total Maximum Daily Load (TMDL) — An analysis and written quantitative plan for attaining and maintaining water quality standards in a stream. It includes a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards, allocations of portions of that amount to the pollutant sources or sectors, and a Water Quality Management Plan to achieve water quality standards.

treatment soil — A naturally occurring or engineered mix which may include clay, silt, sand, gravel, compost, microorganisms, and mycorrhizae that has the desired physical and chemical properties needed to clean stormwater as it passes through it.

tree planting — to install a new tree in a permanent location that provides adequate soil volume and other site conditions to meet its long-term health needs.

tree protection — to preserve trees by fencing, limiting soil compaction, guarding from animal damage and other practices.

watershed — An area of land delineated by a ridge that causes water to drain to different rivers, ponds, lakes, seas, or oceans.

water quality conveyance swale — Long, planted, open channel that conveys stormwater runoff. These facilities are generally not designed to promote infiltration. Instead, they are designed for conveyance and sometimes detention, providing some water quality treatment.

wetland — An area that has surface water or saturated soils often enough to create unique soil characteristics that support vegetation that is adapted to inundation and saturation and lacks vegetation that is intolerant of inundation or saturation. Directing stormwater to wetlands is not considered a low impact development BMP.

urbanized — Any watershed where publicly or privately-owned land surfaces in a city, town, or rural area have been developed and cause that watershed to be 5% or more impervious. (This is definition differs from that used by the United States Census Bureau.)

Underground Injection Control (UIC) — "A manmade structure that places fluid underground"[5].

vegetated filter strips — A dispersion BMP that manages runoff flowing onto it from pavement and roof surfaces.

vegetated roof — A roof system with plants that reduces runoff, improves air quality, provides wildlife habitat, and saves energy. Vegetated roofs **can** last longer than conventional roofs.

vegetated stormwater facilities — This is a general term that applies to rain gardens, stormwater planters, and LID swales, which are configured differently, but achieve a similar, high level of treatment and runoff reduction through intentional temporary ponding of water.

[5] *Oregon Department of Environmental Quality. Frequently Asked Questions on UICs. Retrieved from: http://www.deq.state.or.us/wq/uic/faqs.htm#What_is_a_UIC_System*