CHAPTER 3: LID PROCESS

Table of Contents

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THE LID SITE PLANNING PROCESS[1]

The purpose of this chapter is to illustrate that a variety of parties are responsible for protecting and improving water quality and to provide critical information and tools to achieve water quality goals. This must be done holistically at the site scale, at the BMP scale (see **Chapter 4** "*Choosing and Implementing BMPs*" and Appendices), and at the drainage area scale (see **Chapter 5** "*LID Implementation, Step-by-Step*").

Site Planning Tools

Throughout the planning process, gather information about a variety of conditions. Three tools have been provided for site assessment and design.

Site Assessment Checklist, Appendix A. The Site Planning Checklist includes a comprehensive list of environmental, social, and financial considerations that might direct decision-making about best practices. A set of 6 steps, each with their own checklist items, are critical to the planning phase of low impact development sites. Consider:

1. On-site natural resources
2. On-site infrastructure/built environment
3. Off-site natural resources
4. Off-site infrastructure/built environment
5. Municipal, state, and federal guidelines/laws
6. Programmatic requirements

In each of the steps, the checklist reminds you to look for and log information as it relates to water resources, land forms, air quality, soils, livability, micro- and macroclimate, vegetation, renewable energy, cultural resources, staging and storage considerations, utilities, local suppliers and services, regulations, fire hazards, zoning, and stakeholder process. Additionally, **Appendix A** includes steps for making a site survey plan, infiltration testing report, tree inventory report, and for making a depaving project checklist.

Checklist is required for Simplified Sizing Approach and recommended for the Engineered Design Approach.

BMP Suitability Matrix. A list of the BMPs detailed in this guidance can be found in **Appendix G**, ***Table G-1*** **BMP Suitability Matrix**. This table serves as a guide for gathering preliminary information to help choose appropriate BMPs for a variety of natural conditions, land uses, and water quality considerations.

- Additional BMPs for protecting Oregon's water resources can be downloaded from the OSU Stormwater Solutions website[2].
- **LID Implementation Form.** The LID Implementation Form (**Chapter 5**) steps users through a preferred stormwater hierarchy, introducing the most preferred BMPs first. The Low Impact Development Worksheets (Excel sheets) remind the user which information is most critical to implementing the BMP and assist with sizing the BMP.

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[1] *This section adapted from the Southeast Michigan Low Impact Development Manual with permission from the Southeast Michigan Council of Governments.*

[2] *Oregon State University, Outreach & Engagement. Site Planning Check List. retrieved from: http://extension.oregonstate.edu/stormwater/site-planning-check-list*

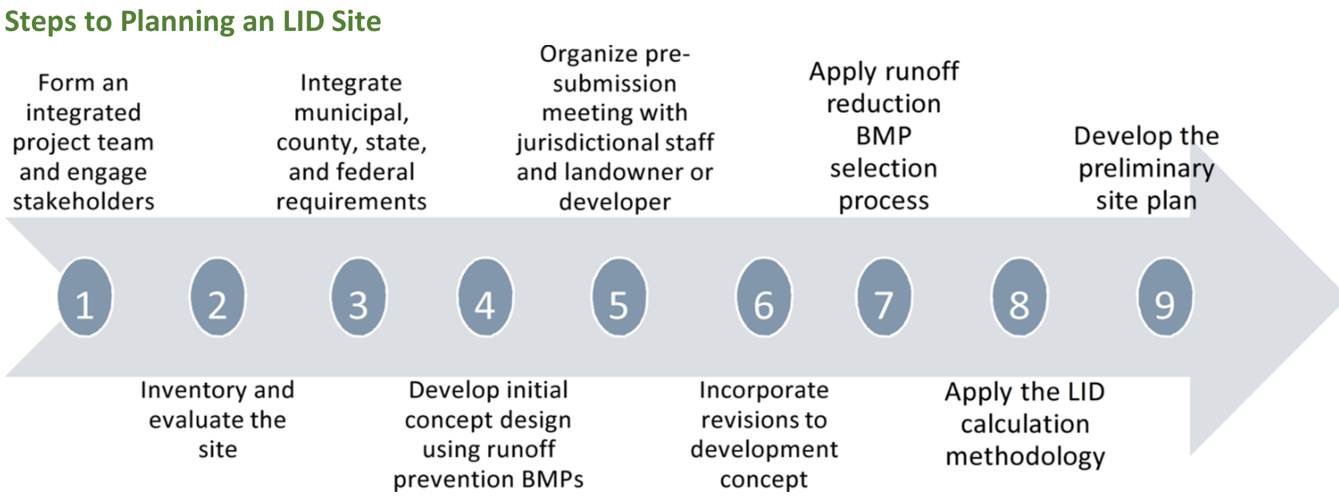

Figure 3-1. The LID site design process could be consolidated into nine basic steps as follows.

Planning Step 1: Form an integrated project team and engage stakeholders.

Table 3-1. Examples showing just a few ways various disciplines might affect water quality and runoff volume during the planning phase of a project with a building. Not all disciplines are needed on every project.

THIS DISCIPLINE:	MIGHT AFFECT RUNOFF VOLUME BY:
Architect	Choosing a building footprint or by stepping the finished floor elevations inside the building to reduce cut and fill on-site.
Geotechnical Engineer	Determining site suitability for infiltration. Infiltration rates of soils impact structural facility feasibility and sizing; however, non-structural practices may still be employed.
Contractor	Ensuring the design is within budget and constructible without causing damage to natural features intended to be protected.
Mechanical, Electrical, and Plumbing Engineer	Locating the sanitary, storm, and water main connections at the building exterior, which can limit where infiltration facilities are located.
Wetland Scientist	Delineating wetlands, which may be used to disperse stormwater if appropriate, but may limit application of LID practices. Wetland scientists can also help ensure that appropriate plants are chosen for the facility based on the calculated flood frequency and water depth.
Arborist	Performing an analysis of tree health to determine hazard trees and make recommendations for trees to be protected. A tree risk assessment will offer information such as preventative and remedial actions, tree related conflicts, tree defects in the crown, branches, trunk, root collar, and roots.
Landscape Architect	Responding to programmatic needs that generate impervious surfaces associated with roofs, driveways, parking lots, or sidewalks, or that generate semi-pervious surfaces such as lawns. Reduce runoff by locating trees and BMPs in the remaining landscapes and choosing low maintenance plants that will not require pesticides or herbicides.
Licensed Engineer	Prioritizing LID development facilities that improve water quality by reducing runoff and avoiding flow-based only facilities that allow excess volumes to leave the site.
Biologist	Identify threatened and endangered species on-site or provide guidance on soil restoration techniques.
Landscape Contractor	Installing vegetated stormwater facilities, protecting soils and porous surfaces through careful stockpiling of materials.
Facility Manager	Providing input on available maintenance equipment and current techniques so maintainable BMPs are implemented.

Figure 3-2. A stormwater planter and permeable pavers enhance the RCC/SOU Higher Education Learning Center in Medford, OR. All of the disciplines listed in Table 3-1 might have a stake in this design.

Planning Step 2: Inventory and evaluate the site. Site assessment includes inventorying and evaluating various natural resources that may pose challenges and/or opportunities for stormwater management and site development. Natural resources include floodplains, riparian areas, wetlands, natural and human-made drainage ways, soils and topography, geology, groundwater supplies, and vegetation. Mapping these resources in relationship to one another is one of the most helpful ways to understand the existing site-scale resources to identify places to build desired infrastructure. Although mapping at the watershed-scale may be outside the scope of most projects, understanding watershed-scale opportunities and constraints, such as the quality of receiving waters or the source of uphill run-on to your site, is also important.

See the items under the headings "*Consider regional natural resources*" and "*Consider regional infrastructure/built environment*" in the "*Site Assessment Checklist*" in **Appendix A**. Included are suggestions for information that might be needed in early site investigation reports including a site survey, an infiltration testing report, and a tree assessment report.

Planning Step 3: Integrate municipal, county, state, and federal requirements. Stormwater is regulated through multiple local, state, and federal regulatory organizations. The following are just a few of the most common jurisdictions you should be aware of when applying for a permit:

- **City**. Grants Pass can help you navigate requirements. Contact Public Works at (541-450-6110).

Figure 3-3. In accordance with the Fairview Masterplan, an existing ordinance in Salem, the Pringle Creek Community implemented numerous BMPs on a site with clayey soils and high groundwater. Pictured here are pervious concrete, porous asphalt, vegetated roofs, a preserved tree grove, and new trees.

- **State of Oregon**. The Oregon Department of Environmental Quality (DEQ) has jurisdiction over water quality at the state level.
  - The DEQ Water Quality Permitting program limits pollution allowed in stormwater discharges from sites in communities (Municipal Separate Storm Sewer System (MS4)), under construction (1200-C or 1200-CN), industrial activities (1200-A, 1200-Z, and 1200-COLS) and through individual permits[3].
  - Underground Injection Control (UIC)[4] Program" is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal."
  - The Oregon Department of State Lands regulates work in wetlands and waterways through the Removal-Fill Permit[5] "to protect public navigation, fishery and recreational uses of the waters".
  - The DEQ 401 Water Quality Certification program evaluates federal actions (like US Army Corps of Engineers permits) that impact waters of the state to certify that state water quality standards, policies and programs are met[6].
- **United States of America**. For in-stream work, US Army Corps of Engineers permits[7] are "necessary for any work, including construction and dredging, in the Nation's navigable waters"[21].

Refer to the heading "*Consider municipal, state, and federal guidelines/laws*" in the "*Site Assessment Checklist*" in **Appendix A.**

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[3] *Oregon Department of Environmental Quality. Water Quality Permit Program. Retrieved from: http://www.oregon.gov/deq/wq/wqpermits/Pages/default.aspx*
[4] *Oregon Department of Environmental Quality. Underground Injection Control Permit Program. Retrieved from: https://www.epa.gov/uic*
[5] *State of Oregon website. Wetlands/Waterways Removal-Fill. Retrieved from: http://www.oregon.gov/deq/wq/wqpermits/Pages/Section-401.aspx*
[6] *Oregon Department of Environmental Quality. Water Quality. Section 401 Removal/Fill Certification. Retrieved from:* http://www.oregon.gov/deq/wq/wqpermits/Pages/Section-401.aspx
[7] *U.S. Army Corps of Engineers. Obtain a Permit. Retrieved from: http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/ObtainaPermit.aspx*

Planning Step 4: Develop initial concept design using runoff prevention BMPs. Consider runoff prevention BMPs such as tree protection, cluster development, minimizing impervious surfaces, and conserving soil (discussed in detail in **Chapter 4**). See the ***Table G-1*** *BMP Suitability Matrix* in **Appendix G** and "*Site-Scale Treatment Trains*", also in **Chapter 4**, for more information.

Planning Step 5: **Organize pre-submission meeting and/or site visit with jurisdictional staff and the landowner or developer.** For development on private or public property, a predevelopment meeting between the Director and the developer and/or contractors are required to effectively communicate each entity's perceptions of the project early on, and potentially discern how each other's needs can be incorporated into the development concept. Consider incorporating site visits into the pre-submission meeting to minimize or prevent future problems with the development. Discuss goals for stormwater management regionally and highlight runoff prevention and runoff reduction BMPs that could be considered. Not all BMPs are appropriate for every site or stakeholder.

Planning Step 6: Incorporate revisions to development concept. Integrate the information collected from the previous steps and revise the initial development concept, if appropriate.

Figure 3-4. Pervious concrete and a stormwater planter were chosen for this public Park and Ride parking lot in Veneta, OR.

Planning Step 7: Apply runoff reduction BMP selection process. After applying runoff prevention in site planning step 4, determine the blend of runoff reduction BMPs for the remaining infrastructure impacting water quality and runoff volume. The calculations done in step 8 may be needed to make decisions on the runoff reduction BMPs that can be used at a site. Therefore, it may be necessary to combine steps 7 and 8 iteratively to complete the selection of BMPs. *See the* ***Table G-1*** *BMP Suitability Matrix.*

Planning Step 8: Apply the LID calculation methodology. Follow the water quality and flow control requirements of **Chapter 2** and in the LID Implementation Forms and Worksheets (**Chapter 5**). BMPs can be sized using the worksheets included with the LID Implementation Form described in detail in **Chapter 4**. BMPs may be designed with sizing factors when meeting the Simplified Sizing Approach requirements in **Chapter 2**; otherwise, BMPs must be sized using the Engineered Design Approach (see **Chapter 2**, "*Applicability*", "*Stormwater Management: Water Quality*", and "*Stormwater Management: Flow Control*").

Once sizing is completed, if space is limited or budgets are constrained, revisit the opportunities for incorporating runoff prevention BMPs and redesign the site to be less reliant on runoff reduction BMPs.

Planning Step 9: Develop the preliminary site plan. Once steps 1-8 of the site design process are implemented, the preliminary site plan is complete and ready to submit for planning review.

THE LID DESIGN PROCESS

Detailed Plans

Successful implementation of any kind of stormwater controls requires detailed and site-specific information. Existing natural and built conditions at the boundaries of any project drive the overall site layout, which, in turn, drives, the design at the BMP scale (see **Appendix B**). The grading plan is often integral to directing stormwater overland towards shallow facilities and may have to account for “run on”, which is runoff from beyond the project boundary (usually the property line). Tight tolerances for inlets, outlets, weir structures, and other infrastructure might apply to rain gardens and stormwater planters and careful detailing of these to ensure proper construction and function is essential.

Even if an approach is familiar, such as tree protection, extra detail over conventional developments will be helpful. For instance, tree protection fencing should be shown on the tree protection plan, the grading plan, the utility plans, and the landscape plans at minimum. Different contractors may be working on different portions of the work, but all of them need to know the limits of disturbance and where they may and may not stockpile materials.

Figure 3-5. A meticulous grading plan and a willing contractor limited disturbance by protecting many existing trees in this newly developed parking lot.

Permit Application Package Requirements for All Projects

At minimum, permit application package requirements include:

When Engineered Design Approach is used:

- Determine if the Engineered Design Approach requirements are met as directed in **Chapter 2**.
- Hydrologic modeling calculations (See **Appendix B** and **Chapter 2**) stamped and signed by a licensed engineer.

When the Simplified Sizing Approach is used:

- Determine if the Simplified Sizing Approach requirements are met as directed in **Chapter 2**.
- The LID Implementation Form and Worksheets for chosen BMPs must be submitted with the building or public works permit application. The LID Implementation Form and Worksheets documents to what extent BMPs are used and the size of those facilities for each basin on the project. Delineate the boundary of single or multiple basins, labeling them with capital letters (See **Chapter 5**).

- Submit Simplified Sizing Approach Infiltration Testing Form for each BMP infiltration test.
- Submit **Appendix A** checklist for at least “blue font” items.

For All BMPs:

- Location of BMPs in relation to the proposed buildings, parking lots, driveways, and street frontage. Label all setbacks and easements.
- Size of BMPs with dimensions labeled on the drawings.
- Areas that drain to BMPs (drainage area) should be outlined and labeled in square feet, if applicable.
- Safe overland path(s) downhill where water will flow when a storm size or intensity exceeds the capacity of any BMP.
- BMP scale treatment train elements and high flow bypass structures or strategies (see **Appendix B** “*BMP Implementation Criteria*”), if incorporated.
- Signed and recorded Operations and Maintenance Agreements (see Chapter 6) for privately owned and maintained facilities.

For All Infiltration BMPs:

- Infiltration testing (see **Appendix C**) results summary.
- Determine which BMPs require infiltration testing by looking at Table C-1 in Appendix C.

For All Vegetated BMPs:

- For all BMPs with vegetation, include the treatment soil specifications to be used if different from those provided in **Appendix D**, a detailed planting plan with species, size of plantings, and spacing noted. See Appendix E “*Planting Specifications*” and Appendix F for planting layout details.

For Tree Protection BMP and Tree Planting BMP:

- Size and species of new or existing trees to receive stormwater management credit. Size for new trees is the projected canopy area. Size for existing trees is the existing canopy area.
- Typical cross-section of vegetated roofs, rain gardens, stormwater planters, LID swales, porous pavements, soakage trenches, drywells, water quality conveyance swales, and/or dispersion BMPs to be implemented. Label depths, materials, and all dimensions. Typical cross-sections can be found in Appendix F or downloaded online (in jpg, pdf, and AutoCAD dwg format): [TBD]

For Porous Pavement BMP:

- For porous pavement applications, the material and placement specifications must be included for pavement mixes or pavers, open-graded base rock layer, and geotextile fabrics. Specifications are provided in Appendix D.
- Pervious surfacing materials such as concrete, grasscrete, or paved tire strips can be approved for use in the City of Grants Pass following review and approval by the City Engineer.
- The pervious surfacing material must have similar structural characteristics to asphalt or concrete and be capable of withstanding the normal wear and tear associated with the parking and maneuvering of vehicles. In addition, drainage should not adversely affect the public right-of-way or adjacent properties and the pervious material must be maintained throughout its use so that it continues to function as originally approved by the City Engineer.

- Porous pavements must include a geotechnical report that includes infiltration testing results and a pavement section design based on the project's predicted traffic loading or H-20, whichever is larger. The report must be signed and stamped by a licensed engineer.

For Vegetated Roof BMP:

- Vegetated roof designs must include a structural analysis of the roof's capacity to support all vegetated roof elements and the soil in a saturated condition. This structural analysis must be signed and stamped by a licensed engineer.

For Depave Existing Pavement BMP and Restored Soil BMP:

- Depaving and restored soil retrofit projects that will remove more than 1500 square feet of pavement must obtain a grading and erosion control permit.

For Cluster Development BMP:

- For larger projects include:
    - Existing Conditions (see list of survey items in **Appendix A**)
    - Site Protection Plan
    - Demolition Plan
    - Grading and Erosion Prevention and Sediment Control Plan
    - Stormwater Plan
    - Utility Plan
    - Details
- Sign O&M agreement (**Chapter 6**)

Additional Requirements for BMPs in the Public ROW (aka Green Streets)

The same design guidance for private facilities applies to public facilities. The following are additional requirements for BMPs in the public right-of-way:

- When used in the public right-of-way, BMPs must be designed in accordance with all jurisdictional roadway standards, which includes right- of-way widths, cross-sections, and typical plan views for each street use designation.
- Plans must also include easements and right-of-way property lines

THE LID CONSTRUCTION PROCESS

The following is intended to provide an overview of general construction considerations. Construction considerations for BMPs are presented in detail in **Appendix B**. Suggested construction sequencing is provided for each BMP in **Chapter 4**.

Avoid Site Disturbance Impacts to Water Quality

The contractor should not disturb areas of the site that don't need to be altered. When land is in an undisturbed well-vegetated condition, the vegetation and soil work together to capture almost all rainfall and manage it through infiltration, evaporation, and transpiration. Unnecessarily clearing vegetation and grubbing or disturbing soils will greatly impact this balance and affect the long-term habitat value of downstream waterways and watershed health in general. More information on limiting site disturbance is provided in **Chapter 4**.

Healthy soil plays a crucial role in water quality as:

- A growing medium for vegetation

- Habitat for beneficial microbes that break down pollutants and larger fauna that mechanically loosen the soil and preserve air pockets
- Storage medium for rainfall until it can evaporate or infiltrate

Both intentional and unintentional compaction consolidates soil and greatly reduces void space. Compacted soils can have densities almost as high as concrete[8]. This has long-term impacts on water quality and quantity because these soils:

- Won't have voids to store water and air for plants resulting in higher irrigation needs and less healthy plants, which will tend to be maintained with increased levels of fertilizers, herbicides, and pesticides.
- Generate runoff flows and volumes that are more similar to impervious surfaces than pervious landscapes.

Soils disturbed by current or previous activities are difficult to fully restore so they should be protected as much as possible and restored with compost amendment[9]. See the soil restoration guidance provided in **Chapter 4**. Since soil life may have died due to poor air and water conditions, mycorrhizae (mushrooms) and biological (bacteria) treatments can be added to soil to enhance the soil's biology and ability to support plant life. This is likely to speed establishment and reduce water demand during this period.

Figure 3-6. The presence of beetles indicates healthy soil with voids that provide soil animals access to air and water so that they may live in the soil, creating soil structure and providing long-term permeability.

Erosion Prevention and Sediment Control

Due to the high negative impact on water quality caused by suspended solids, the DEQ closely regulates construction sites that disturb 1 acre or larger through the 1200-C or 1200-CA permit process but may also regulate smaller disturbance areas when part of a larger development. Sediment from several smaller sites can have a cumulative negative impact on water quality and the habitat of our waterways.

Erosion Prevention. Erosion prevention is defined by the Oregon Department of Environmental Quality (DEQ) as "any practice that protects the soil surface and prevents the soil particles from being detached by rainfall or wind." Preventing erosion is often thought of as solely the contractor's realm, but everyone on the project team can contribute to this important practice and should consider it during the planning and

[8] Center for Watershed Protection. The Compaction of Urban Soils (Table 1). Retrieved from: http://www.cwp.org/online-watershed-library/cat_view/63-research/75-monitoring.

[9] The ODEQ published a document in July of 2001 Restoring Soil Health to Urban Lands[9], and Washington State University Extension and Puget Sound Action Team have produced similar resources and promoted compost amendments as an important BMP.

design phase.

Sediment Control. Sediment control is defined by DEQ as "any practice that traps the soil particles after they have been detached and moved by wind or water". This means that a more active role to install, monitor, and maintain these systems is required over simply preventing erosion in the first place.

DEQ has determined from a literature review of research papers and EPA guidance that properly installed sediment fences are 0-20% effective for fine-grained soils (clays and silts).[10] This is because clay and silt particles are much smaller than the mesh opening of a sediment fence[11]. Alternatives that work well to control sediment from overland (*i.e*. non-concentrated) flows for any soil type include compost berms, compost socks, and wattles. At the end of the construction phase, compost used for erosion control can be spread over landscape areas.

Construction Sequencing

EPA defines construction sequencing as "a specified work schedule that coordinates the timing of land-disturbing activities".[12] This approach is critical to protecting permeability and other on-site natural resources, as well as preventing erosion and controlling sediment. See **Chapter 4** "*Construction Sequencing BMP*".

Additional Best Management Practices

Several other best management practices should be used during the construction phase to protect water quality:

- Cover loads to be transported with a tarp.
- Use water tight trucks when hauling saturated soils since polluted water and sediment can easily be leak out onto roads during transportation in regular dump trucks.
- Use native seed mixes when temporarily stabilizing slopes during construction to reduce weed control maintenance long-term.
- When removing healthy, native vegetation, grind it on-site for use as a compost berm or other compost erosion control method.

THE LID OPERATIONS AND MAINTENANCE PROCESS

Maintenance Responsibility

BMPs managing runoff from privately owned lands will be maintained by the private landowner as signed in the Operations and Maintenance Agreement provided in **Chapter 6** to ensure that necessary maintenance activities are defined and understood by landowners with BMPs.

Site Maintenance

Since rain may fall on any surface outdoors, all those outdoor surfaces are a part of the stormwater infrastructure that could treat or pollute stormwater. Site-wide maintenance activities that could be included in every operations and maintenance agreement for LID sites are as follows:

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[10] *Oregon Department of Environmental Quality. (Feb. 2006). Best Management Practices for Storm Water Discharges Associated with Construction Activities. Retrieved from: http://www.deq.state.or.us/WQ/stormwater/docs/nwr/constrbmps.pdf*

[11] *Howland, M. (2000). When Silt and Sediment Controls Are Not Enough. Retrieved from: http://www.landandwater.com/features/vol41no4/vol41no4_2.html*

[12] *U.S. Environmental Protection Agency. Water: BMPS. Retrieved from:http://water.epa.gov/polwaste/npdes/swbmp/Construction-Sequencing.cfm*

- Asphalt pavement should not be sealed with coal tar sealants or PCBs, which are toxic to aquatic life and are a suspected human carcinogen. Alternatives to coal tar sealants[13] and caulks are commercially available.
- All pavements: Use an environmental deicer appropriate for the surface type instead of salt when ice on pavements must be addressed.
- If possible, avoid mossicides such as zinc strips on roofs. Use mechanical removal instead.
- Sweep pavements regularly. Degraded pavements and busy roads will require sweeping more often than newer, structurally sound pavements and lower traffic surfaces such as driveways.
- Remove sediment from structures and pretreatment facilities. Dispose of sediment in trash.
- Maintain landscape areas and lawns with integrated pest management techniques, which recommend using herbicides, pesticides and mossicides as a last resort. (See **Appendix E** "*Plant Specifications*" "*Integrated Pest Management*".)
- Restore eroded landscape areas by filling areas in with topsoil (not mulch) and planting.
- Use proper erosion prevention techniques such as covering the soil with jute fabric or compost per Appendix D: Specifications "*Organic Matter Compost*" or "*Mulch*" or vegetating, if needed.

Writing a Maintenance Plan

A maintenance plan for on-site stormwater infrastructure will help to ensure that operations and maintenance staff are holistically managing the site on a long-term basis. An operations and maintenance plan is required to be submitted to the City of Grants Pass, and provided to the owner before final permitting takes place (**Chapter 6**).

Figure 3-7. Overwatering and poor directional control waste water and increase runoff to streams.

[13] *City of Austin, Texas. FAQs. Retrieved from: https://www.austintexas.gov/content/1361/FAQ/2511*

Figure 3-8. Signage can help reduce maintenance by educating the public about their function.