

# STORMWATER SOLUTIONS

TURNING OREGON'S RAIN BACK INTO A RESOURCE

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Turning Oregon's Rain Back into a Resource



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## About the Oregon Environmental Council

The Oregon Environmental Council safeguards what Oregonians love about Oregon – clean air and water, an unpolluted landscape and healthy food produced by local farmers. For nearly 40 years we've been a champion for solutions to protect the health of every Oregonian and the health of the place we call home. We work to create innovative change on three levels: we help individuals live green; we help businesses, farmers and health providers thrive with sustainable practices; and we help elected officials create practical policy. Our vision for Oregon includes solving global warming, protecting kids from toxins, cleaning up our rivers, building sustainable economies, and ensuring healthy food and local farms. *It's your Oregon.*

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## CONTENTS

|  |    |
|--|----|
| ABSTRACT/INTRODUCTION                          | i  |
| CHAPTER 1: Impacts of Urban Stormwater Runoff  | 1  |
| CHAPTER 2: A Two-Pronged Solution              | 7  |
| CHAPTER 3: Regulatory Context                  | 15 |
| CHAPTER 4: Barriers to Overcome                | 20 |
| CHAPTER 5: Recommendations                     | 25 |
| CHAPTER 6: Potential Funding Sources           | 38 |
| CHAPTER 7: Appendices                          |    |
| • Appendix 1: Stormwater survey results        | 41 |
| • Appendix 2: Complete list of recommendations | 47 |
| • Appendix 3: EPA green infrastructure letter  | 52 |
| REFERENCES                                     | 54 |

### ABSTRACT

Cities in Oregon and throughout the United States were engineered to keep stormwater out of sight and out of mind. Unfortunately, that approach has turned a potential resource into a waste product and created new environmental hazards. Once rain falls onto the hard surfaces of streets, sidewalks, parking lots and rooftops, it picks up any and all pollutants that are in its path, gathering volume and speed until it enters a stormdrain and is piped underground or directly into a stream. It substantially alters the natural hydrology of watersheds and causes water pollution. Stormwater runoff hinders the ability of rivers and streams to support aquatic life and it contributes to bacteria-laden waters unsafe for swimming, fish so contaminated with toxins that they are unsafe to eat, and property damage caused by widening stream channels and increased flooding. The Stormwater Solutions Team, convened by the Oregon Environmental Council (OEC), studied the issue and developed a set of recommendations to protect human health, natural resources and public infrastructure from the impacts of urban runoff.

The team identified a two-pronged solution. First, prevent pollutants from entering stormwater in the first place. Second, improve stormwater management through Low Impact Development (LID), which preserves existing natural features of the site and uses distributed, small-scale stormwater technologies to capture and filter runoff and allow the cleaned water to recharge groundwater supplies, mimicking the way nature manages rainfall. Some of the rainwater can even be harvested for irrigation or indoor uses.

While many cities have begun implementing these solutions, several obstacles slow their broad adoption in small and large cities throughout the state. A survey conducted by OEC and the Stormwater Solutions Team identified the following challenges in Oregon: A lack of information about LID and pollution prevention; permitting delays; codes and rules that impede innovation; lack of resources; maintenance concerns, especially for private stormwater facilities; and resistance to change. The Stormwater Solutions Team developed more than 60 recommendations for overcoming these obstacles and reducing the impacts of urban runoff. The recommendations include strategies for improving stormwater management and reducing sources of pollution via policy changes, education and information sharing, and technical research. The team's top two recommendations are:

- Greater state support, including funding sources, for local efforts to develop stormwater programs, remove barriers from local development codes, and implement and monitor LID projects.
- Develop a comprehensive education and training program promoting sustainable stormwater management and LID in growing communities.

OEC and the team members are eager to work with additional partners to make pollution prevention and improved stormwater management standard practices throughout Oregon.

### INTRODUCTION

Once rain falls onto the hard surfaces of streets, sidewalks, parking lots and rooftops, it picks up any and all pollutants that are in its path, gathering volume and speed until it enters a stormdrain and is piped underground or directly into a stream. The two primary consequences of poorly managed stormwater are water pollution and altered hydrology.

Most urban stormwater systems send polluted runoff into Oregon's rivers, streams and groundwater untreated — carrying a vast array of pollutants such as petroleum byproducts from motor vehicles, fertilizers and pesticides from lawns, sediment from construction sites, bacteria from animal waste, and heavy metals such as copper, lead, zinc, and mercury from multiple sources. Anything that's on the land eventually ends up in the water.

In addition to polluting our rivers, streams and groundwater, conventional urban stormwater systems disrupt the natural hydrologic cycle. While the great majority of rainwater and snowmelt soaks into the ground or is absorbed by plants in a natural system, the hard (impervious) surfaces of urbanized areas prevent infiltration. There are also fewer trees and plants to absorb water. A one-acre paved parking lot generates 16 times more runoff than a meadow of the same size.<sup>1</sup> The unnaturally high volume and rate of overland runoff in urbanized areas increases peak flows and the risk of flooding during storms, scours out streambanks, reduces groundwater recharge and reduces base flows, thereby increasing summer water temperatures that harm endangered salmon.

The pollution and hydrologic disruption caused by poorly managed stormwater creates serious problems for the environment, our economy, and public health. These are primarily human-caused problems – raindrops are mostly clean when they fall from the sky and they generate very little runoff when they land in a natural environment.

- **Water pollution.** As more stormwater runoff enters our waterways, it contributes to the build-up of pollution in those waters. The Oregon Department of Environmental Quality (DEQ) is asking cities to reduce runoff pollution because it contributes to numerous

water quality impairments, including the high mercury levels in resident fish in the Willamette River that make them unsafe for human consumption.

- **Health advisories.** The Oregon Department of Human Services cites stormwater runoff as a common source of the fecal bacteria that causes coastal beach health advisories.<sup>2</sup> In 2006 the department issued 13 such advisories, warning the public against swimming at beaches with high levels of fecal bacteria in ocean waters.<sup>3</sup>
- **Property damage.** Increases in stormwater runoff can damage or degrade private and public infrastructure, such as property that is lost or damaged due to widening stream channels and unnatural flooding, and washed-out roads, bridges, culverts and sewer lines.
- **Endangered salmon.** Our society continues to urbanize, degrade and pollute the watersheds that provide precious fish habitat while at the same time we spend hundreds of millions of dollars in an attempt to restore endangered salmon species. Scientific studies show that as little as 4%-15% impervious area in a watershed significantly impairs aquatic life. A typical residential neighborhood has more than 30% impervious area, and a city center may be covered by more than 75% impervious surface, making it difficult to provide healthy fish habitat in nearby streams.<sup>4,5,6,7,8</sup>
- **Wasted water.** The water rights in most of Oregon's water basins are fully allocated, and groundwater is scarce in many parts of the state. Harvesting rainwater or letting it recharge groundwater could reduce stress on our over-committed water systems, but we continue to treat rainwater as a waste. The rain that lands on a 2,000

square-foot roof of a home in the Rogue Valley (20 inches average annual rainfall) generates more than 24,000 gallons of relatively pure water per year.<sup>9</sup>

### **Fortunately, there is a better way**

Modern stormwater management techniques either harvest rainwater for potable or non-potable uses, or utilize the natural abilities of plants and soil to capture and filter runoff and allow the cleaned water to recharge groundwater supplies, mimicking a natural hydrological system. Low Impact Development (LID) is a term used to describe a suite of development practices that reduce stormwater runoff by preserving existing natural site features and installing distributed, small-scale stormwater technologies that mimic the way nature manages rainfall. One example of an LID practice is a rain garden, which helps slow, capture, filter, and infiltrate stormwater that runs off of impervious surfaces.

When combined with efforts to prevent the contamination of rainwater by vehicle fluid leaks, pesticides and fertilizers, heavy metals, erosion from construction sites, industrial runoff and other sources, LID practices can reduce the negative impacts of urban stormwater and turn Oregon's rain back into the natural resource that it is. Business owners and residents are beginning to understand that what they put on the ground and what runs off their driveways or roofs makes its way into public waterways. Although most people have yet to alter their behavior to embrace best practices, change is beginning to take place.

The state's demographic forecasters expect there will be another 1.8 million people in Oregon by the year 2040.<sup>10</sup> As Oregon grows and more development occurs, we need to shift to more sustainable stormwater management methods before

additional damage is done to our waterways. Ensuring that new development manages stormwater runoff in a way that protects natural hydrology is much less costly and more beneficial to the environment than allowing urban runoff to degrade streams and then spending significant resources in an attempt to restore them later. By using LID extensively in all new developments and in re-development projects in already urbanized areas, Oregon has the opportunity to do things right and protect clean water before we reach the point of no return.

Expanding the use of LID practices presents an incredible economic opportunity for the state, as we position ourselves as a leader in the sustainability and green building movements. Sustainable stormwater lies at the intersection of green building, landscape architecture and engineering, and it represents a growing industry in Oregon. As LID is introduced around the state, the public is responding positively to its functionality, attractiveness, and the way it reflects the value the public places on clean water. For example, now that the City of Portland has installed a few green street facilities, they have received more than a hundred calls from residents requesting one in their neighborhood.<sup>11</sup> The demand for sustainable stormwater management is growing, but Oregon's cities are having a hard time keeping up with that demand. While excellent work is already being done in many cities, several barriers currently prevent sustainable stormwater management from becoming standard practice around the state, as outlined in this report.

The solutions for reducing runoff and protecting our rivers, lakes, coastal waters and groundwater exist; the barriers to reducing non-point source pollution and improving stormwater management are primarily social, political and behavioral. Because the sources of stormwater pollution

are found throughout the landscape, we all must be a part of the solution: residents, businesses, and governments alike. In the spirit of cooperation and constructive problem-solving, the Oregon Environmental Council convened a broad group of stakeholders to form Oregon's Stormwater Solutions Team to develop strategies for reducing urban stormwater impacts to our state's waters.

The team members worked collaboratively to develop the strategies recommended in this report and used a consensus process to reach agreement about the recommendations. Representation on the team does not imply that an organization or agency officially endorses every recommendation included in this report.

## GOAL STATEMENT

The Stormwater Solutions Team set the following goal for itself:

*To develop a focused list of recommended strategies (including policies, projects, and programs) that will reduce stormwater impacts in Oregon's urban areas.*

Over time, we will work toward the following indicators of a reduction in urban runoff's impacts:

- All development strives to mimic natural hydrology (volume, rate and duration)
- Urban stormwater runoff is no longer a significant contributor to water quality problems in Oregon's waterways and groundwater
- Urban stormwater runoff no longer makes Oregon's waterways or shores unsafe for human contact or other beneficial uses

The project's scope includes smaller towns as well as large cities. It pertains to urban storm-

water runoff and does not address agricultural runoff, a non-point pollution source that is outside the scope of this report.

## PRINCIPLES

The team developed the following set of principles to consider in developing and prioritizing recommendations.

### Achieve multiple objectives

- Include an education and outreach component
- Address behavioral and systemic changes

### Balance

- Be consistent across the state while addressing problems and needs specific to local urban areas
- Look for near-term and lasting benefits

### Results-oriented

- Develop practical and user-friendly tools
- Be innovative and build on work already done

### Accountability

- Identify costs associated with implementation, why the recommended action should be funded, and who should/will provide funding
- Include effectiveness measuring and monitoring components

The Stormwater Solutions Team developed a broad range of creative strategies for reducing urban stormwater runoff. Some of the recommendations pertain to state and local governments, while others are appropriate for non-governmental organizations, universities, professional associations, urban residents and other audiences. The Oregon Environmental Council looks forward to working with members of the team and other partners around the state to begin implementing the recommendations.



# IMPACTS OF URBAN STORMWATER RUNOFF

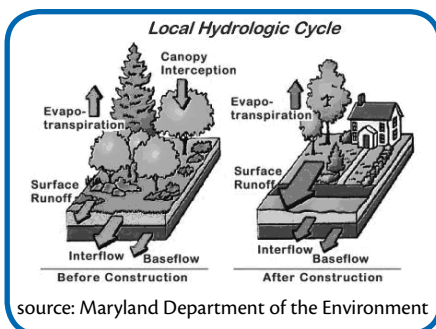
In urban areas, the impervious surfaces created by buildings and pavement cause rainwater and snowmelt to flow quickly over the landscape, rather than soaking naturally into the soil or being absorbed by plants. This can change stream flows, increase flooding, endanger private and public infrastructure, erode stream banks and channels, and destroy fish habitat. Runoff also carries pollutants such as oil, heavy metals, bacteria, sediment, pesticides and fertilizers into streams or groundwater. The combined impacts of hydrologic changes and water pollution can be disastrous for streams and rivers in urban areas.

## Altered Hydrologic Flow

Urbanization significantly alters the way water flows in a watershed. In natural areas, most rainfall and snowmelt soaks into the ground

to replenish groundwater or is absorbed or transpired by plants, and a significantly smaller amount runs directly into rivers. In urbanized areas, water flows rapidly off of the hard, “impervious surfaces” of buildings, streets and sidewalks, and it is piped into streams and rivers or discharged underground. Even lawns can contribute to urban runoff because their soils have been compacted. A one-acre paved parking lot generates 16 times more runoff than a meadow of the same size.<sup>12</sup> The unnaturally high volume and rate of urban stormwater runoff erodes streambanks and streambeds, changes the shape and dimension of river channels, and alters aquatic habitat and channel stability. Increases

in stormwater runoff can damage or degrade private and public infrastructure, such as property that is lost or damaged due to widening stream channels and unnatural flooding, and washed out roads, bridges, culverts and sewer lines.





# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

The total impervious surface area of a watershed can be estimated by associating a percentage of imperviousness with different land uses and totaling them up. Typical total imperviousness in medium-density, single-family home residential areas ranges from 25% to nearly 60%. Total imperviousness at strip malls or other commercial and industrial sites can approach 100%. Clean Water Services has estimated that 54.5% of the impervious surfaces in a suburban watershed are for “car habitat” (roads, driveways and parking lots) and 44.6% are for “human habitat” (buildings and sidewalks).<sup>13</sup>

Numerous studies show that aquatic life is impacted by very small amounts of impervious surface in a watershed.<sup>14,15,16,17</sup> Once about 10% of a watershed (or less, depending on the watershed’s physical and biological characteristics) has been converted to impervious surfaces, significant ecological damage has already been done. Therefore, ensuring that new development manages stormwater runoff in a way that protects the natural hydrology of the system is much less costly and more beneficial to the environment than allowing urban runoff to degrade groundwater and streams and then attempting to restore them later. Impervious surfaces have less impact on watersheds when green infrastructure techniques are used to allow the stormwater that collects on those surfaces to infiltrate into and be filtered by the soil, thereby disconnecting the impervious surface from the storm drainage system.

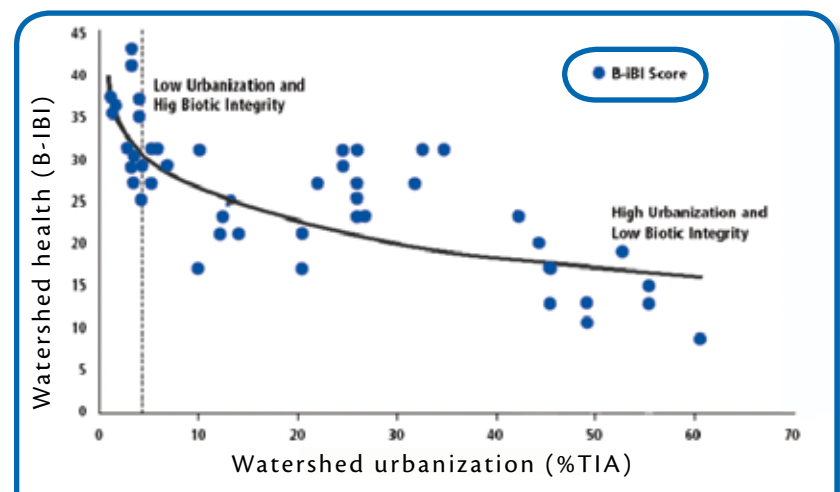
## Increased Pollution

Stormwater accumulates a variety of pollutants as it runs over roofs, lawns, sidewalks, streets, compacted soils and parking lots before entering streams or groundwater. This type of pollution is often called non-point source pollution because it comes from multiple sources, making it difficult to control. There are also some point-source contributors to stormwater pollution, such as industrial facilities and construction sites. Pollutants commonly found in urban stormwater include heavy metals, pesticides and fertilizers, oil and grease, bacteria, and sediment. Stormwater runoff contributes to water quality problems that endanger human health and wildlife.

## Sediment

Rapidly flushing stormwater can increase erosion from the land, including streambanks and streambeds. Soil exposed by construction activities is especially vulnerable to erosion during storm events. Poorly managed construc-

URBANIZATION (IMPERVIOUS AREA) AND WATERSHED HEALTH



The results of this Puget Sound study are similar to others conducted in watersheds around the country. Watershed health declines as urbanization (measured by Total Impervious Area, or %TIA) increases. Watershed health is measured by the Benthic Index of Biotic Integrity (B-IBI), the abundance of streambed-dwelling invertebrates, which are sensitive species commonly recognized as indicators of overall watershed health. Watershed health declines rapidly when low levels of impervious area are introduced into a previously undeveloped watershed. Highly urbanized watersheds are consistently associated with low B-IBI scores. Watershed health is generally good in areas with less than about 4% urbanization in the Puget Sound. That threshold varies in watersheds around the country, and it is often at less than 10% imperviousness<sup>19,20,21,22</sup>

tion sites can contribute significant amounts of sediment to urban runoff. Stormwater then transports the eroded soil downstream into nearby storm drains and waterways. Eventually, when sediment-laden water slows down, that sediment settles to the bottom of the stream, river, lake, or estuary. When sediment settles out, it may cover fish eggs or destroy important habitat such as spawning beds and submerged aquatic vegetation. Sediment can also plug underground injection systems when stormwater is discharged underground instead of to surface waters.

Sediment is commonly listed by the DEQ as a pollutant causing water quality problems in Oregon’s waters.<sup>23</sup> Impacts of excessive sediment include: damages to fish gills; increasing risk of infection and disease; reduced feeding efficiency for fish caused by reduced visibility; reduced light penetration causing limited aquatic plant growth; adverse impacts on aquatic insects, which are the base of the food chain; increased nutrients and metals carried by suspended sediments;

reduced survival rates for fish eggs; destruction of fish spawning areas; and loss of storage behind reservoirs. Excessive sediment deposition over time can fill in navigation channels, increasing the maintenance and safety costs of shipping.

**Metals**

The effects of metals on human and aquatic health can be far reaching. Lead, which is often used as an indicator for other toxic pollutants in stormwater, can be harmful or deadly for human and aquatic life. Zinc, although not harmful to humans at concentrations normally found in stormwater, can be deadly for aquatic life. Cadmium can bioaccumulate in an ecosystem, soil microorganisms are especially sensitive to it, and it is harmful to human health. Chromium damages fish gills, causes birth defects in animals, and is also dangerous to human health. Mercury is a neurotoxin that bioaccumulates and has led to fish consumption advisories in Oregon rivers. Recent research demonstrates that

| Urban stormwater pollutants   | Common sources   |
|---|--|
| Sediments and particulates  | Atmosphere, erosion, vehicle wear, industrial activities   |
| Nutrients (nitrogen and phosphorous)  | Atmosphere, fertilizers, detergents  |
| Heavy Metals (zinc, lead, iron, mercury, copper, cadmium, chromium, nickel, manganese, cyanide) | Fungicides, insecticides, galvanized building materials, tire wear, motor oil, engine parts, rust, machinery, erosion, industrial activities |
| Hydrocarbons (petroleum products)   | Spills, leaks, antifreeze, hydraulic fluids, asphalt surface leachate  |
| Organic Compounds (phthalate esters, phenolic compounds, and volatile organics)                 | Pesticides, plastics, cleaners   |
| Microorganisms (bacteria and viruses)   | Combined sewer overflows, illicit connections, pet waste   |
| Salts (sodium, magnesium and chlorides)   | Road de-icing salts  |

# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

low levels of copper inhibit the olfactory systems of salmonid fish, decreasing their ability to hide in response to warning signals.<sup>24</sup> Some metals bind to soils and organic matter and are transported in sediment, while other metals dissolve in water. Rainwater is naturally slightly acidic, which increases its ability to dissolve heavy metals and compounds the health and environmental effects of stormwater runoff from urban areas.

The transportation system is a primary source of metals in stormwater runoff to urban streams and groundwater.<sup>25</sup> Cadmium, copper, cobalt, iron, nickel, lead and zinc are deposited into the environment by vehicle exhaust, brake linings, and tire and engine wear. They accumulate on roads, waiting to be washed into storm drains with the next rainfall. Pollutant concentrations in roadway runoff are positively correlated with traffic volume.<sup>26</sup> All cars, even the cleanest vehicles, shed small amounts of metals, fluids, and other pollutants.

| Sources of Heavy Metals from Transportation |         |        |          |        |      |           |        |      |      |
|---|---------|--------|----------|--------|------|-----------|--------|------|------|
| SOURCE                                      | Cadmium | Cobalt | Chromium | Copper | Iron | Manganese | Nickel | Lead | Zinc |
| Gasoline                                    | X       |        |          | X      |      |           |        | X    | X    |
| Exhaust                                     |         |        |          |        |      |           | X      | X    |      |
| Motor oil & grease                          |         | X      |          |        | X    |           | X      | X    | X    |
| Antifreeze                                  |         |        |          |        | X    |           |        |      | X    |
| Undercoating                                |         |        |          |        |      |           |        | X    | X    |
| Brake linings                               |         |        |          | X      | X    |           | X      | X    | X    |
| Rubber                                      | X       |        |          | X      |      |           |        | X    | X    |
| Diesel oil                                  | X       |        |          |        |      |           |        |      |      |
| Engine Wear                                 |         |        |          |        | X    | X         | X      | X    | X    |

Adapted from: Local Ordinances: A Users Guide, Terrene Institute and EPA, Region 5, 1995.

Galvanized metal rooftops, gutters and downspouts, and moss killer are also a source of zinc in stormwater. Some copper comes from architectural uses and treated wood, and a primary source is brake pads. Outdoor storage of scrap metal can also contribute to metal pollution. Soil erosion is a significant source of mercury.<sup>27</sup>

## Nutrients

Excessive nutrient levels in waterways stimulate the growth of plants and algae, which can reduce dissolved oxygen levels and harm the entire aquatic ecosystem. The primary nutrients are phosphorous and nitrogen. Phosphates and nitrates enter stormwater from fertilizers applied to lawns and golf courses, decomposition of natural rock and soils, air deposition from vehicle exhaust, detergents used to wash cars on the street, and pet waste.

**Pesticides**

The Willamette and numerous other Oregon rivers are contaminated with DDT and dieldrin, pesticides that were banned in the seventies. These chemicals are highly persistent in the environment, and they continue to enter our waterways via the erosion of soils. In addition to the impacts of these legacy chemicals, a significant amount of other pesticides are currently applied in urban areas.

| Six Pesticides Found Frequently in Stormwater Samples |  |   |
|---|--|---|
| PESTICIDE NAME  | COMMON URBAN USES  | HUMAN HEALTH AND/OR ENVIRONMENTAL EFFECTS*  |
| 2,4-D   | Lawn care weed and feed products.                                | Associated with lymphoma in humans; testicular toxicant in animals.   |
| Chlorpyrifos  | Insecticide. Most residential uses restricted since 2001.        | Moderately toxic to humans; neurotoxicant; can be highly toxic to birds, aquatic organisms, and wildlife.   |
| Diazinon  | Insecticide. Residential uses are being phased out.              | Moderately toxic to humans; neurotoxicant; can be highly toxic to birds, aquatic organisms, and wildlife.   |
| Dicamba   | Herbicide for broad-leaved weeds in landscaping.                 | Neurotoxicant; reproductive toxicity in animals; association with lymphoma in some human studies.   |
| MCPA (Methoxane)                                      | Herbicide used on trees and lawns by certified applicators only. | Low toxicity to non-toxic in test animals, birds, and fish; suspected gastrointestinal, liver, and kidney toxicant.                                   |
| MCPP (Mecoprop)                                       | Lawn care weed and feed products.                                | Slightly to moderately toxic; some reproductive effects in dogs; suspected cardiovascular, blood, gastrointestinal, liver, kidney, and neurotoxicant. |

\*Research is primarily based on the effects of direct exposure to pesticides. Little research exists on the effects of exposure to pesticides in stormwater runoff at low concentrations.

Sources: T.R. Schueler, "Urban Pesticides: From the Lawn to the Stream," *Watershed Protection Techniques*, vol. 2, no. 1, Fall 1995, pp. 247, 250; Exttoxnet: Extension Toxicology Network Pesticide Information Profiles, <http://ace/orst.edu/info/exttoxnet>; Environmental Defense Fund, Scorecard Chemical Profiles, <http://www.scorecard.org/chemical-profiles>; and Northwest Coalition for Alternatives to Pesticides, Pesticide Fact Sheets <http://www.pesticide.org/factsheets.html#pesticides>

While the total amount of pesticides applied on agricultural lands is higher than the amount applied in urban areas, homeowners use up to 10 times more pesticides per acre on their lawns than farmers apply to their crops per acre.<sup>28</sup> Also, residential users do not have training in safe pesticide use. There has been little monitoring of the amounts of pesticides currently applied in urban areas, or their levels in Oregon’s rivers and stormwater.

**Bacteria**

The presence of E. coli and fecal coliform bacteria in our rivers, lakes and oceans makes them unsafe for swimming, as the pathogens can cause skin ailments and illness in humans and they indicate the presence of feces.

Stormwater often picks up bacteria from the fecal matter of domesticated pets and wild birds. If one considers the small number of wolves that would naturally live in a given area and compares that with the number of dogs in our cities, one can see that our pets do have a significant impact. Multnomah County Animal Services has about 40,000 registered dogs, and only about one-third of dogs are typically registered. With 120,000 dogs creating about five pounds of waste a week, that's 600,000 pounds of waste entering the watershed each week.<sup>29</sup> Under pre-development conditions, much of the bacteria contained in runoff would be filtered out by soil and plants, but in urban areas that bacteria is quickly swept into surface waters.

A new research method analyzing the DNA of fecal coliform bacteria can determine which type of animal the bacteria came from. A DNA study of bacteria in Tualatin Basin streams and stormwater sites found that birds are the most significant source of bacteria in that area.<sup>30</sup> Human behavior can contribute to the congregation of birds near waterways. Some cities are putting up signs asking residents not to feed ducks and geese.

Another major source of bacteria in some rivers is Combined Sewer Overflows. During storm events, these older systems found in some cities expel raw sewage directly into rivers because their pipes do not have enough room to accommodate both sewage and stormwater. The City of Portland is working aggressively to reduce Combined Sewer Overflows by building a "big pipe" and reducing the amount of stormwater that enters the stormdrain system by promoting downspout disconnects and green infrastructure.

## Hydrocarbons and vehicle byproducts

Vehicles contribute a number of pollutants to urban stormwater in addition to

metals and nitrogen. Engine coolants and antifreeze containing ethylene glycol and propylene glycol can be toxic and contribute to water quality impairments. Oil, grease, and other hydrocarbons related to vehicle use and maintenance also pollute urban runoff. They come from disposal of used oil and other fluids on the ground or into storm drains, spills of gasoline or oil, and leaks of oil and other fluids from vehicles. In addition, hydraulic oil is ubiquitous at industrial sites and is difficult for facilities to control at the source, contributing these hydrocarbons to stormwater. Runoff from residential car washing also contributes oil and grease to the stormwater system. The vehicle exhaust that is deposited on roads also contributes dioxins and polycyclic aromatic hydrocarbons (PAHs), highly toxic chemicals that persist in the environment. PAHs also leach from coal tar-based sealants used on paved roads and parking lots.

## High temperatures

In addition to carrying pollution and altering stream flows, stormwater may contribute to the unnaturally warm water temperatures found in many of Oregon's rivers. Because most rainfall occurs in the winter when river temperatures are cool, stormwater's direct impact on river temperatures is minor. Of greater concern is the fact that the impervious surfaces of urbanized areas reduce the amount of rainwater that recharges groundwater. This means there is less cool groundwater to supply streams and rivers in the warm summer months, which can have a significant impact on water temperatures and base flow levels.



## A TWO-PRONGED SOLUTION

The Stormwater Solutions Team identified two major approaches to reducing impacts of stormwater runoff:

1. Improving the way stormwater is managed by promoting green infrastructure and other best management practices
2. Reducing the sources of pollutants commonly found in stormwater

Excellent work toward these ends is already taking place in many of Oregon's cities and towns, especially those that have stormwater permits. The Stormwater Solutions Team seeks to promote and expand upon these efforts, to create a shift so that sustainable stormwater management and pollution prevention become standard practice throughout Oregon.

### SUSTAINABLE STORMWATER MANAGEMENT

Conventional stormwater systems with pipes, detention ponds and drywells manage stormwater as a waste product and were designed to convey water as quickly as possible away from developed areas; protecting water quality and stream health was not a priority when they were designed. The unintended consequences of conventional stormwater systems include increased runoff, higher flood potential, system overflows, and the transport of pollutants to streams, rivers, wetlands, and groundwater. Modern approaches to stormwater management slow the water down near its source, filter out pollutants, and allow the cleansed water to infiltrate into the soil and recharge groundwater supplies, maintaining the natural hydrologic regime of a watershed. The terms "green infrastructure" and "Low Impact Development" (LID) describe stormwater systems and site development practices designed to maintain or restore the natural, pre-developed ability of a site to absorb and filter stormwater.



A rain garden at Villebois, a 500-acre community currently under construction in Wilsonville

## Low Impact Development

According to the Low Impact Development Center: "LID is an innovative stormwater management approach with a basic principle that is modeled after nature: manage rainfall at the source using uniformly distributed decentralized micro-scale controls. LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source.

Techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and managing/treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small, cost-effective

landscape features located at the lot level. LID is a versatile approach that can be applied equally well to new development, urban retrofits, and redevelopment/revitalization projects. The LID approach includes five basic tools:<sup>31</sup>

1. encourage conservation measures (i.e., preserving natural areas)
2. promote impact minimization techniques such as impervious surface reduction
3. provide for strategic runoff timing by slowing flow using the landscape
4. use an array of integrated management practices to reduce and cleanse runoff
5. advocate pollution prevention measures to reduce the introduction of pollutants to the environment



Shallow, grassy swales like this one can be found in new neighborhoods in the City of Boardman, in eastern Oregon. They capture water from the street and the residence on a right of way that is designed to be indistinguishable from the front lawn. The sidewalks are angled to drain toward the swale, away from the street.

## Green Infrastructure

Green infrastructure is the term the U.S. Environmental Protection Agency (EPA) uses to describe a similar concept. According to the EPA, "Green infrastructure techniques utilize natural systems, or engineered systems that mimic natural landscapes, to capture, cleanse and reduce stormwater runoff using plants, soils and microbes. On the regional scale, green infrastructure consists of the interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities and wildlife habitat. On the local scale, green infrastructure consists of site-specific management practices (such as rain gardens, pervious pavements, and green roofs) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls."<sup>32</sup> In March 2007, EPA Assistant Administrator Ben Grumbles issued a statement of support for states using green infrastructure to manage stormwater and protect water quality (see appendix p. 52).

As you can see from the above definitions, the terms "Low Impact Development" and "green infrastructure" are used to describe essentially the same concept. In this report we also use the term "sustainable stormwater management" to encompass LID, green infrastructure, and other best management practices that reduce urban runoff pollution. Sustainable stormwater management practices are beginning to be used throughout Oregon and the Pacific Northwest. Following are a few illustrative examples.

### Bioretention: rain gardens and bioswales

Bioretention is the basic process at the heart of green infrastructure, and it can be applied in many different circumstances. Bioretention



Salem's Pringle Creek Community is one of Oregon's most low-impact residential developments. Thirty percent of the site is public open space, 80% of trees were saved, and the neighborhood has the largest pervious asphalt street system in the United States.



This rain garden at Aloha Huber Park Elementary School treats rainwater collected on the building's roof. Schools are excellent demonstration sites for rain gardens, which can provide hands-on learning opportunities for students.

is an engineered process to manage stormwater runoff using plants, soil and microbes to filter, infiltrate, store, and absorb runoff. Its application can be simple or complex, and it takes the form of swales, rain gardens, stormwater planters, vegetated parking strips, and planted curb

extensions. It is extremely versatile because it can be incorporated into landscaped areas with many design possibilities that may provide additional social and environmental benefits such as wildlife habitat, open space, traffic calming, reducing the heat island effect, and increased property values. Both lab and field studies have found that bioretention facilities effectively remove stormwater pollutants, particularly heavy metals; they are moderately effective at removing nitrogen and phosphorus.<sup>33,34</sup>

Maintenance of bioretention facilities is similar to that required of any landscaped area. Owners should remove debris, ensure that inlets and outlets are not blocked, and trim and replace plants and remove weeds as necessary. Chemical fertilizers and pesticides should not be used in stormwater facilities. The most critical aspect of maintenance is to inspect the facility on a regular basis to ensure that it is functioning well, and that it has not been filled in or altered.

### Green streets

Since streets often make up more than half of the impervious surface area in a city, using bioretention facilities to treat stormwater from streets can significantly reduce urban runoff. Streets with bioretention facilities are often called “green streets.” There are many different approaches to integrating these facilities into the right of way, depending on the needs of the site.

Bioretention can be a very cost-effective approach to managing stormwater from streets and parking lots. For example, when the Oregon Museum of Science and Industry (OMSI) developed its new location, the City of Portland asked them to redesign the site's parking lot to treat the 522,000 cubic feet of untreated stormwater runoff that was discharging directly to the Willamette River annually. They converted the existing landscaped islands to vegetated swales. OMSI saved about \$78,000 in construction costs by using swales instead of installing a traditional stormwater management system such as drywells.<sup>35</sup>

### Pervious pavement

Pervious pavement is a permeable pavement surface, often built with an underlying layer of stone or gravel that temporarily stores surface runoff before it infiltrates into the subsoil. Pervious pavement replaces traditional pavement, allowing stormwater to infiltrate and pollutants to be filtered out. One of the greatest advantages of pervious pavements is that they disperse stormwater instead of concentrating it, similar to a natural system. There are various types of pervious surfaces, including pervious asphalt, pervious concrete, and even grass or permeable pavers.

Pervious asphalt and concrete contain little or no “fines” or sand. By eliminating these smaller particles in the concrete or asphalt mix, voids are created that allow water to pass through. The result looks similar to a rice krispie treat. (see photo at right) Permeable pavers are interlocking concrete blocks where the voids are filled with sand or planted with grass to allow water to flow through.

In addition to allowing water to infiltrate, pervious pavements provide water quality treatment.



These street planters on SW 12th Avenue on the Portland State University Campus were designed to capture and infiltrate approximately 8,000 square feet of street runoff while still maintaining strong pedestrian circulation and on-street parking in a completely built-out urban environment.



Pervious pavement



Particles get captured in the pavement or in the top layers of the soil or gravel underneath the pavement as water trickles through. Studies of pervious asphalt, pervious concrete, and concrete pavers show that they remove 50-98% of suspended sediments and associated particulate lead, cadmium, copper and zinc.<sup>36,37,38</sup> In addition, pervious pavements degrade oil pollutants through the biochemical activity of bacteria and fungi that use the pavement and accumulated solids as a substrate. The oils are broken down and disperse safely into the atmosphere as carbon dioxide and water.<sup>39</sup> Studies have shown that 97-99% of applied motor oil is trapped in pervious pavements and biodegraded.<sup>40,41</sup>

Like all best management practices, pervious pavement should be combined with other practices to capitalize on each technology's benefits. For instance, a small facility using pervious pavement may only need several bioretention basins or a grass swale, rather than a large detention basin. This combined approach might prove less land-intensive and more cost-effective. Pervious pavements are commonly used in low-traffic parking lots, and they can sometimes be used in higher traffic areas. They are currently used as a top layer on some highways, to reduce hydroplaning. Pervious pavement may be inappropriate for areas where heavy accumulation or spills of pollutants may occur.

## Green roofs

A green roof, which may also be called an "ecorooft" or a "living roof", is a vegetated roof system. An ecorooft consists of a synthetic, waterproof membrane, a drainage layer, and a thin layer of soil or growing medium. Low-maintenance, drought-tolerant plants such as sedums, succulents, and certain grasses make up the vegetation that grows on ecoroofts. (see photo below right) They may require irrigation during the establishment period and possibly during drought conditions. An ecorooft can capture and

evaporate 10-100% of the precipitation that falls on it, and provides the additional benefits of cooling the building and providing habitat for insects and birds.

Green roofs can be located on flat or pitched roof structures at a slope up to 40% (or 5 in 12 pitch). They can be used on most types of commercial, multifamily, and light industrial structures, as well as single-family homes and garages. Although ecoroofts initially cost more to install than conventional roofs, they are competitive on a life-cycle basis because of reduced maintenance and replacement costs. As the ecorooft market develops, installation costs may decrease. The typical lifespan for an ecorooft is about 40 years, significantly longer than most conventional roofs. This is because the membranes are of good quality and the plants and growth medium protect the membrane from weathering.<sup>42</sup>



Sedums growing on a green roof

## Rainwater harvesting

Rainwater is a valuable resource that can be harvested. Although used throughout the world for many purposes, rainwater harvesting is lesser known in the Pacific Northwest. However, it is gaining traction as an important stormwater management tool and as a water conservation strategy. Rainwater storage systems vary from simple rain barrels to systems capable of storing tens of thousands of gallons. Homeowners can easily and inexpensively install rain barrels themselves and use the rainwater for irrigating lawn and garden areas. However, in many parts of Oregon rain barrels fill quickly to overflowing in the rainy season and their stored water is exhausted early in the dry season. While rain barrels provide an excellent introduction into



Rainwater harvesting tanks come in many shapes and sizes. This 550 gallon cistern in Eugene is elevated so that gravity provides water pressure for convenient garden irrigation.

the practice of rainwater harvesting, larger collection devices are more effective in Oregon climates.

Anyone can harvest up to 5,000 gallons of rainwater and use it for outdoor irrigation without a permit. Large cisterns holding 5,000 gallons or more require assurance that the system will be placed on stable soil and that its weight will not cause structural damage to foundations. A special permit may be required to use rainwater indoors for potable or non-potable purposes. Rainwater harvested for potable uses must be treated to drinking water standards.

Rainwater harvesting reduces stress on surface waters and groundwater by providing an alternative water source for human uses, and it mitigates high urban runoff volumes. It is conceivable that if rainwater were harvested on a massive scale it could alter the natural hydrology of a watershed, but at currently feasible levels of adoption rainwater harvesting is beneficial to water supplies and natural systems.

### Tree planting and retaining natural vegetation

Trees capture and hold rainfall in leaves and branches. They slow runoff flow and can decrease stormwater volume by 35% or more for small storms.<sup>43</sup> Mature trees also reduce noise levels, provide shade, filter airborne pollutants, capture carbon dioxide, provide wildlife habitat, and increase property values. Planting trees and protecting existing trees can reduce stormwater runoff. During construction it is critical to reduce soil compaction, which is the leading cause of the death or decline of mature

trees in developed areas.<sup>44</sup> While trees are a vital part of a healthy stormwater system, their leaves and needles can clog storm drains. Street sweeping can help reduce the accumulation of leaves.

### Site design

A development's initial design can reduce its impacts on nearby streams. Building narrower streets reduces impervious surface area. Clustering units together can protect open space and natural areas on another part of the site.

### Proprietary stormwater devices

In instances when green infrastructure solutions are not feasible, proprietary stormwater devices may be used to reduce the impacts of stormwater runoff. Private manufacturers have developed a wide variety of devices to detain and/or filter pollutants out of stormwater runoff. Some may be installed in existing stormdrains and pipes. They often include filters that must be regularly replaced in order to maintain effectiveness, which increases long-term costs. As with many other stormwater facilities, it can be difficult to ensure that proper maintenance occurs when the devices are used on private property.

### Encouraging stormwater retrofits

Retrofits of stormwater systems in already urbanized areas are most often installed when redevelopment is already occurring for some other reason. Otherwise, they can be difficult to fund and incentivize. The city of Portland is exploring the feasibility of establishing a market-based stormwater credit trading system to encourage stormwater retrofits of already developed private properties.



Oleson Woods is a multifamily complex in Washington County owned by Community Partners for Affordable Housing. The site was designed to preserve its mature Oregon White Oaks and Ponderosa Pines, as well as some wetlands.

## POLLUTION PREVENTION

Low Impact Development is a critically important tool in reducing urban runoff. At the same time, we must also reduce the amount of pollutants that enter stormwater in the first place. The Oregon Environmental Council worked with the Stormwater Solutions Team to conduct an online survey of government staff, stormwater engineers, landscape architects, developers and builders, and environmental advocates to identify barriers and solutions for sustainable stormwater management. Over 150 people participated in the non-scientific survey. See the appendix for detailed survey responses. Survey respondents identified the following four urban stormwater pollution sources as those most in need of additional attention:

1. *Oil and fluid leaks from vehicles.* Vehicles from time to time leak oil, grease, anti-freeze or other fluids on roads and parking lots, and those fluids are picked up by stormwater. These leaks could be very minor in the case of a leaking hose or major if the seals in the motor or transmission are leaking. Evidence of these leaks can often be seen during a rain event as a rainbow on the pavement or a grease spot in a parking space.
2. *Erosion from construction.* Erosion from construction sites continues to be a problem even though the Oregon Department of Environmental Quality's (DEQ) Construction General Permit (known as the 1200-C permit) has been in effect for six years. In addition, cities with stormwater permits are implementing construction programs in their communities (see Chapter 3, Regulatory Context). Education, inspection and enforcement are urgently needed to ensure that contractors install and maintain Best Management Practices (BMPs) to reduce sediment runoff from construction sites.
3. *Dumping wastes in storm drains.* While intentional or accidental spilling or dumping of wastes directly in stormdrains is infrequent, when it does happen, the impacts can be very harmful, sometimes resulting in fish kills.
4. *Urban use of pesticides and fertilizers.* Homeowners use up to 10 times more pesticides per acre on their lawns than farmers apply to their crops per acre. Excess application of pesticides and fertilizers washes into the stormwater system and degrades water quality. A number of educational programs exist to reduce the use of these chemicals, but they continue to contribute to stormwater pollution.

The Stormwater Solutions Team also noted that heavy metals, which enter stormwater from automobiles and roof runoff, are another important stormwater pollutant.

Following are some of the practices that can reduce stormwater pollution. Many local governments have educational programs to help reduce these pollutants, as a component of their municipal stormwater permit programs.

### Proper auto maintenance

When oil and other fluids leak from vehicles, they end up on streets and are washed into stormwater runoff. Keeping vehicles well maintained not only reduces air emissions, but it also improves water quality. There are few public education programs to promote better auto maintenance and reduce leaks. Most vehicle owners recognize the warning signs that their vehicle has a leak -- they have to add oil or fluid more frequently than normal, they see fluid spots collecting under their car, or their car smokes. But an education program that involves checking for leaks could help prompt them to do something about it. The barriers to correcting the problem are most likely convenience and cost. A successful public education

program might include offering vehicle owners discounts at auto shops for vehicle inspection services and/or repair of leaks.

Even when cars are properly maintained, pollutants from the exhaust and normal wear of parts such as tires and brake pads will continue to contaminate stormwater. Reducing those sources of pollution will require changing the way vehicles are built. In San Francisco, where copper impairs the waters of the San Francisco Bay, a study estimated that more than half the copper in urban runoff to the San Francisco Bay comes from brake pads. An organization called Sustainable Conservation has formed the “Brake Pad Partnership” and is conducting research that is expected to be completed in December 2007. If brake pad wear debris is found to impair water quality, industry manufactures have agreed to introduce new products voluntarily within five years.

### Car washes

Washing cars on the street sends soap, dirt, and oil into stormdrains. Car owners are encouraged to either wash their vehicles with biodegradable soap in an unpaved area, not on the street or in a driveway, or better yet, take their car to a commercial car wash. Many car washes recycle their water and all are required to pre-treat it before discharging it into the sewer system. Charity car washes are a pollution source that some jurisdictions are trying to control. Programs involve either having the charities sell coupons for commercial car washes, or offering car wash kits. The kits include a pump and hose to direct the wash water away from the storm drain and into a grassy area, sink, or other drain that directs the water to a sewage treatment plant. Implementing charity car wash kit programs requires consistent follow-up to ensure the kits are being used properly.

### Prevent construction erosion

The state’s construction stormwater permit program is designed to prevent erosion and sediment runoff from construction projects. There are a host of management practices that can be used to prevent erosion and control sediment runoff from construction projects to protect water quality. In Section VII of this report, the Stormwater Solutions Team makes some recommendations to improve the effectiveness of the construction permit program.

### Green landscaping

Runoff of fertilizers and pesticides from lawns, parks, and other landscaped areas makes its way into many urban streams and rivers. Practices that reduce water quality impacts of landscaping maintenance include:

- Grasscycling: leave lawn clippings on the grass, where they can break down and fertilize the lawn
- Use mature compost and other organic, slow-release fertilizers, which reduce nutrient loading to our streams
- Skip the weed and feed and other products that contain both herbicides and fertilizers. They unnecessarily apply herbicides to the entire lawn when they may only be needed in a few spots
- Water deeply but infrequently to promote a healthy lawn
- Aerate lawns to improve infiltration and reduce runoff
- Reduce lawn space and replace it with low-maintenance, native plants
- Use an alternative lawn, such as an “eco-lawn”, which is a mixture of grasses, flowers and herbs that provide an easy-to-maintain green space

Many local programs encourage people to reduce their use of chemicals on their lawns. Examples include:

- [www.healthylawns.org](http://www.healthylawns.org), a website developed by Oregon DEQ and partners to promote the message “Lawns can look great without chemicals” and demonstrate how to use natural lawn care alternatives
- Ecological Business Landscaper certification program, [www.ecobiz.org](http://www.ecobiz.org), which certifies professional landscaping companies that use environmentally friendly practices
- Naturescaping programs educate gardeners about landscaping with native plants
- Salmon-Safe certifies campuses and parks that use salmon-friendly maintenance practices

### Only water in storm drains

Many residents still do not realize that most storm drains connect directly to creeks or rivers without any treatment. Household hazardous waste programs, used oil recycling programs, storm drain marking, and basic educational programs help reduce intentional or unintentional spilling of pollutants into storm drains.

# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

## Don't feed the ducks

Birds can be a major source of fecal bacteria in waterways. Communities with high levels of avian bacteria need to take steps to discourage birds from congregating unnaturally near water bodies, such as discouraging people from feeding ducks and geese.

## Pick up dog waste

According to a study that used DNA testing to identify sources of bacteria, dog waste accounts for almost 15% of fecal bacteria in some streams.<sup>45</sup> The current solution is to ask pet owners to use plastic baggies to clean up after their dogs and dispose of the waste in the garbage. But all that waste ends up in the landfill, where it will sit for years in the absence of the oxygen it would need to decompose. Park crews in Eugene haul out at least 18 tons of canine fecal matter a year.<sup>46</sup> Better alternatives include taking the waste home and flushing it down the toilet (minus the plastic baggie), or developing a composting system or methane-generating system, both of which would require using only bio-degradable bags.

Until one of those alternatives becomes more feasible, many communities are encouraging residents to pick up after their pets and toss the waste in the garbage, which is a better option than leaving it to pollute streams and rivers. Social pressure can have a significant impact on promoting this behavior, especially in public places where people will see if you pick up after your dog or not. Providing baggies and garbage cans in heavily used parks for waste pick-up and disposal makes the task more convenient and reduces excuses. Creative programs such as Clean Water Services' "Canines for Clean Water" pledge make it fun for dog owners to participate by providing a free bandana with the campaign logo on it, and a pet photo



contest. This is a new program, and its effectiveness is not yet known. It helps people understand that pet waste has an impact on water quality, which many pet owners do not realize.

## Minimize industrial stormwater runoff

Industrial stormwater permits require facilities to utilize best management practices to control stormwater pollutants from their site to meet water quality benchmarks — target concentrations for pollutants such as suspended solids, oil, lead or zinc — that measure whether the management practices are effectively controlling stormwater pollution. The best management practices often involve source controls, such as covering exposed materials. Due to productivity pressures, cost barriers, the high amount of staff training required to effect consistent and successful source control, and the rate at which stormwater pollutants are swept off impervious surfaces, effective stormwater management by industry has been difficult to achieve. Site inspections with advice on when and where to use certain best management practices would be helpful. Allowing industry to incorporate low impact development strategies and on-site water management in certain low risk areas could reduce stormwater runoff and the size and cost of industrial stormwater controls.



Canines for Clean Water



# REGULATORY CONTEXT

A number of federal and state regulations impact the way Oregon towns and cities manage stormwater.

## **Federal Clean Water Act**

Stormwater that is discharged to surface waters is regulated by the Federal Clean Water Act (CWA), which is implemented in Oregon by the Department of Environmental Quality (DEQ) with guidance from the federal Environmental Protection Agency (EPA). The National Pollutant Discharge Elimination System (NPDES) program is the fundamental regulatory mechanism of the CWA. It requires anyone discharging a pollutant from a point source into the waters of the nation to obtain an NPDES permit. DEQ manages the NPDES permit program for stormwater runoff from certain municipalities, construction sites, and industrial facilities.

## **Municipal stormwater permits (MS4)**

In 1987, amendments to the CWA required the EPA to address discharges from a municipality's separate storm sewer systems (MS4). EPA's urban stormwater program implementation is designed to be phased in over several years. Phase I of the stormwater program, developed by the EPA in 1990, requires permits for stormwater discharges from medium and large MS4s located in incorporated cities or counties with populations of 100,000 or more. In 1995, DEQ began issuing Phase I MS4 NPDES stormwater permits. DEQ has issued six permits that cover 22 municipalities in Oregon and also issued a permit to the Oregon Department of Transportation. In 1999, EPA adopted rules to implement Phase II of the stormwater program for smaller municipalities in urbanized areas. DEQ has issued Phase II

# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

MS4 NPDES stormwater permits to 18 municipalities in Oregon. MS4 permittees are required to implement six “minimum control measures” to control stormwater pollution to the “maximum extent practicable.” The minimum control measures include:

- Public education and outreach on stormwater impacts
- Public involvement and participation
- Detection and elimination of illicit discharge
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations

## Construction stormwater permits (1200-C)

The 1200-C permit applies to construction activities that disturb one or more acres. In addition to obtaining a DEQ permit, projects within MS4 municipalities must also obtain a permit from their local municipality. As a result, these projects are subject to dual regulation by the state and local municipalities. To expedite the permitting process, some municipalities have entered into agreement with DEQ to administer the 1200-C permit on DEQ's behalf.

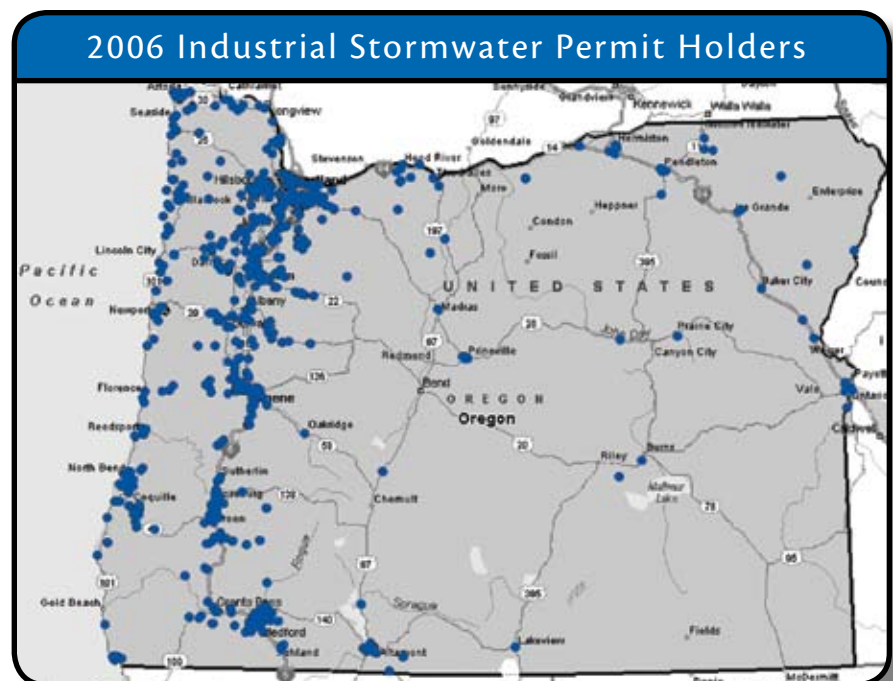
## Industrial stormwater permits (1200-Z and 1200-COLS)

The 1200-Z permit applies to stormwater runoff from a wide variety of industrial activities throughout the state. The 1200-COLS permit applies to stormwater runoff from industrial activities within the Columbia Slough Watershed. Because this waterbody is listed as impaired on the 303(d) list (see TMDLs below), industrial dischargers in the Columbia Slough watershed have received a watershed-based industrial stormwater permit with additional pollutant parameters and more stringent water quality benchmarks. As with the construction permits, some municipalities have entered into an agreement with DEQ to administer these permits on DEQ's behalf.

The construction and industrial permits require site operators to implement stormwater best management practices and ensure that stormwater runoff leaving their site does not cause a violation of instream water quality standards.

## Total Maximum Daily Loads (TMDLs)

Stormwater management is also influenced by Total Maximum Daily Load (TMDL) regulations. Under Section 303(d) of the Clean Water Act, DEQ is required to develop a list of water bodies that do not meet



Source: Map prepared by StormwaterRx using DEQ data.

water quality standards for parameters such as temperature, bacteria, mercury and numerous other pollutants, and submit an updated list to the EPA every two years. When a water body is placed on the 303(d) list, a TMDL must be developed to bring the water body back into compliance with water quality standards. A TMDL process determines the pollutants or stressors causing water quality impairments, identifies permissible loading capacities for the waterbody, and then, for each relevant pollutant, assigns load allocations to each of the different sources. When the TMDL process identifies urban stormwater as a source of pollutants, municipalities with MS4 permits are required to develop performance measures and benchmarks to track progress toward achieving the goals of the TMDL. In addition, smaller municipalities that are not required to obtain a MS4 permit must develop a TMDL implementation plan. Most cities in the state of Oregon lie within the watershed of a 303(d) listed stream. In addition, construction sites operating under a 1200-C permit that discharge stormwater to impaired streams that are listed for sediment or turbidity must implement additional best management practices to control erosion and sediment runoff to these streams and/or conduct stormwater turbidity monitoring.

MS4 permits and TMDLs are designed to be flexible, so that when local jurisdictions develop a stormwater management plan, they can identify the best management practices that are appropriate for their local conditions. As a result, local stormwater programs vary from city to city.

Some New England states are developing TMDLs for hydrology due to the widespread recognition that an altered hydrologic regime is one of the contributing factors to stream degradation.<sup>47</sup> Oregon DEQ only develops TMDLs for pollutants.

| Oregon Municipal Stormwater Permit Holders |              |           |   |
|--|--------------|-----------|---|
| CITIES:                                    |              | COUNTIES: | OTHER AGENCIES:                                     |
| Ashland                                    | Milwaukie    | Benton    | Clackamas County Service District No. 1             |
| Bend                                       | Oregon City  | Clackamas | Clean Water Services*                               |
| Corvallis                                  | Philomath    | Lane      | Oak Lodge Sanitary District                         |
| Eugene                                     | Portland     | Marion    | Oregon Department of Transportation                 |
| Fairview                                   | River Grove  | Multnomah | Port of Portland                                    |
| Gladstone                                  | Salem        | Polk      | Rogue Valley Sewer Services**                       |
| Gresham                                    | Springfield  |           | Surface Water Management Agency of Clackamas County |
| Happy Valley                               | Troutdale    |           |   |
| Johnson City                               | Turner       |           |   |
| Keizer                                     | West Linn    |           |   |
| Lake Oswego                                | Wilsonville  |           |   |
| Medford                                    | Wood Village |           |   |

\*Clean Water Services provides stormwater and wastewater services for the Tualatin River Watershed, which includes urban Washington County and parts of Multnomah and Clackamas County. This includes the cities of Beaverton, Tigard, Tualatin, Hillsboro, King City, Forest Grove, Sherwood, Cornelius, Banks, Gaston, Durham, and North Plains.

\*\*Rogue Valley Sewer Services provides stormwater services to a portion of Jackson County and the cities of Central Point, Phoenix, and Talent.

Based on data from the 2006 Annual Population Report prepared by Portland State University’s Population Research Center, 30% of the state’s population that lives in incorporated cities is not covered by a municipal stormwater permit.<sup>48</sup> Phase II permits are required in urbanized areas as determined by the U.S. Census, which means that a small town such as Turner (near Salem), population 1,645 is required to have a stormwater permit. Meanwhile, several cities with populations larger than 20,000 are not required to have stormwater permits (e.g., Albany, Grants Pass, McMinnville, Newberg, Redmond, Roseburg and Woodburn).



## **Federal Safe Drinking Water Act**

Surface water and groundwater are hydrologically linked. When stormwater is discharged below the ground in injection systems such as sumps, floor drains, trench drains and drywells, it is covered by the federal Safe Drinking Water Act (because groundwater is a source of drinking water). DEQ implements these regulations in Oregon via its Underground Injection Control (UIC) program. Many cities use injection systems to discharge stormwater from roads and publicly owned facilities. Private businesses may also use injection systems to dispose of stormwater runoff from parking lots or other impervious areas. These discharges may pollute groundwater if there is no pre-treatment such as natural or engineered filtration. As a result, owners must register their injection systems with DEQ. Depending on whether the injection systems meet certain requirements, they may be either authorized by rule or required to obtain a permit.

## **Federal Endangered Species Act**

Under section 4(d) of the Endangered Species Act, if an action will adversely impact a federally listed threatened or endangered species, then an incidental "take" permit from the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) is required. Numerous species are listed in parts of the state, such as Chinook salmon and steelhead trout. Stormwater Management Plans are a component of municipalities' efforts to avoid harming endangered species.

## **Oregon land use planning**

Every city and county is required to have a comprehensive plan and accompanying development ordinance to be in compliance with state land use planning goals, as determined by the state Land Conservation and Develop-

ment Commission (LCDC). Goals 5 and 6 have a direct connection to water quality.

Goal 5 is "to protect natural resources and conserve scenic and historic areas and open spaces." It requires jurisdictions to inventory wildlife habitat and open spaces, including riparian areas, and develop a plan for protecting them.

Goal 6 is "to maintain and improve the quality of the air, water and land resources of the state." Local governments have a wide degree of control over how to protect these resources in their community.

## **Oregon Groundwater Quality Protection Act**

According to this law, "The Legislative Assembly declares that it is the goal of the people of the State of Oregon to prevent contamination of Oregon's ground water resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's ground water resource for present and future uses." Programs developed under the Groundwater Quality Protection Act primarily focus on area-wide contamination resulting from non-point source pollution of groundwater. Oregon's law does the following:

- Establishes DEQ as the coordinating agency for groundwater management
- Spells out the procedure for establishing Maximum Measurable Levels (MML) of contaminants in Oregon's groundwater
- Establishes a groundwater monitoring and assessment program
- Defines a program to address areas where groundwater contamination is identified
- Requires DEQ to report to the Legislature in January of every odd-numbered year. These Biannual Groundwater Quality Reports to the Legislature provide a thorough review of groundwater conditions and program activities within the state

### Oregon drainage law

Oregon drainage law, which originates from common law or case law, has developed without legislative action, and it is embodied in the decisions of the courts. There are no Oregon Revised Statutes pertaining to drainage law.

Oregon has adopted the civil law doctrine of drainage. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water which naturally comes to his land from above, but he is entitled not to have the normal drainage changed or substantially increased. The lower landowner may not obstruct the run-off from the upper land, if the upper landowner is properly discharging the water.

For a landowner to drain water onto lands of another in the State of Oregon, two conditions must be satisfied initially: 1) the lands must contain a natural drainage course; and 2) the landowner must have acquired the right of drainage supported by consideration. In addition, three basic elements must be followed:

1. A landowner may not divert water onto adjoining land that would not otherwise have flowed there. "Divert water" includes but is not necessarily limited to: 1) water diverted from one drainage area to another; and 2) water collected and discharged which normally would infiltrate into the ground, pond, and/or evaporate
2. The upper landowner may not change the place where the water flows onto the lower owner's land (Most of the diversions not in compliance with this element result from grading and paving work and/or improvements to water collection systems)
3. The upper landowner may not accumulate large quantities of water, then release it, greatly accelerating the flow onto the lower owner's land. This does not mean that the upper landowner can not accelerate the flow of water at all; experience has found drainage to be improper only when acceleration and concentration of the water were substantially increased



# BARRIERS TO OVERCOME

As awareness grows about urban runoff’s negative impacts on groundwater, rivers and streams, stormwater management is changing in cities and towns in Oregon and throughout the country. As described in Chapter 3 of this report, many communities are taking steps to implement more sustainable stormwater management by promoting low impact development and working to reduce the pollution that enters our water via urban runoff. However, many barriers still exist that prevent or impede sustainable stormwater management from becoming standard practice.

The Stormwater Solutions Team sought to identify those barriers and develop recommendations for overcoming them. OEC worked with the team to conduct an online survey of government staff, stormwater engineers, landscape architects, developers, industrial facility representatives, and environmental advocates to identify barriers to sustainable stormwater management. Over 150 people participated in the non-scientific survey. See the appendix page 41 for detailed survey responses. Following is an overview of the most commonly identified barriers, including some anonymous quotes from the survey responses.

## **Limited land and site-specific challenges**

*“Many sustainable systems require a lot of valuable land.”*

*“Density can be problematic when it comes to having enough space for resources and effective stormwater management.”*

*“If land is available, there are poor soils for infiltration.”*

*“We need good, workable designs for our specific area.”*

Whereas traditional systems in urban areas convey stormwater via underground pipes, green infrastructure systems that allow stormwater to infiltrate into the ground on-site may require some land area. This can present a challenge when designing a new development or retrofitting existing facilities. It is in developers' financial interest to maximize the amount of buildable land, and they must meet certain density requirements. Setting aside space for stormwater facilities can sometimes compete with these other goals. Space limitations can also present a challenge when installing stormwater facilities in the right-of-way along public streets. There are multiple demands for space in the right of way, including stormwater treatment, bicycle lanes, sidewalks, utilities, parking and traffic lanes.

There are also significant differences in climate and geology across the state that can pose challenges to using green infrastructure. While much of the Portland metro area and the Willamette Valley have soils with favorable infiltration rates and precipitation that falls primarily in light showers, Washington County and Portland's West Hills have tight, clayey soils with low infiltration rates and many steep slopes. In Central Oregon, soils are porous with high infiltration rates, and a significant portion of the precipitation falls as winter snow. In some parts of the state, a high water table increases risks of groundwater contamination. Steep slopes with grades greater than 5% also pose a challenge that requires adapting green infrastructure practices to the site.

The challenges posed by space limitations and unique site characteristics can and have been overcome. Stormwater facilities, such as planter boxes, can be designed to fit into small spaces. They can also be integrated into the site design so that they serve multiple uses, such as a grassy swale that also meets landscaping or open space requirements. Center or shoulder medians and parking strips may be used as stormwater treatment areas for streets. Green infrastructure

projects have been effectively implemented on tight soils and steep slopes; amending the soil with compost and providing an overflow mechanism for large storms can help. Engineered filtration devices provide an alternative when there is not space for natural systems. Sharing information about the design of successful projects can help overcome these challenges.

### **Time is money**

*"A lot of LID techniques have to be customized for each site, which takes time, whereas a pipe does not."*

*"The process of building outside of current code is time-consuming and expensive."*

*"There is tremendous inconsistency of application from project to project within a jurisdiction and even more inconsistency between jurisdictions."*

*"Costs need to be documented to show that sustainable stormwater practices are cheaper than or at least competitive with traditional approaches."*

Implementing a practice that is not currently the norm naturally takes more time. For developers and business people, time is money. Delays in design and permitting can derail a project financially. When trying to implement sustainable stormwater management, developers often have to invest more in design consultants than they would for a conventional system. They may receive different answers from various staff within a local government about what they can and cannot do; they are expected to adapt to the various requirements of multiple jurisdictions within a region; and their attempts to do the right thing may be thwarted by permitting delays and redundant, unclear or conflicting requirements. In many cases, the actual costs of LID may be equal to or less than conventional gutter and pipe stormwater systems, especially when long-term performance is considered. But if a local government requires developers to install redundant conventional stormwater

systems in addition to LID, those cost savings cannot be realized and the developer will have a disincentive for using LID.

These barriers could be overcome by offering technical guidance for designing green infrastructure systems, priority processing of permits for LID projects, and improved consistency within and across local jurisdictions. Providing financial incentives and recognition to developers and property owners who implement LID can also help overcome these barriers. When local governments seek to promote green infrastructure, in addition to developing public education programs, they need to also ensure that their staff understand the program well and that their permitting system is conducive to making green infrastructure projects easier to implement than conventional systems that do not protect water quality.

## Barriers in codes and rules

*“Old techniques that do not achieve intended results should be phased out of use by permitting agencies.”*

*“Our standards mandate bad behavior.”*

*“The biggest challenge is getting the codes requiring new solutions in place.”*

*“Code review goes through an extensive process in cycles, and it takes a tremendous amount of effort and coordination to get everyone on the same page.”*

In some instances, “green” developers may be interested in using low impact approaches to stormwater management, but existing codes and rules at the local or state level get in the way. Many local governments simply have not yet taken the step of updating their development codes and ordinances to allow and promote green infrastructure. Codes may still require the installation of curbs and pipes to convey stormwater, and they sometimes do

not include provisions for permeable concrete or pavers, to name a few common examples of local code barriers. Some governments have conducted a review of their development codes, often employing the services of a private consultant to develop recommendations, and then deciding which of those changes to include in their code revisions.

Some people believe the state plumbing code also poses a challenge to installing green infrastructure and rainwater harvesting systems. However, these practices have been legally implemented in Oregon and the barrier lies primarily in how local jurisdictions interpret the state plumbing code.

## Lack of government staff capacity and resources

*“Small municipalities do not have the time and energy to keep their codes and requirements on the cutting edge.”*

*“There are not enough technical staff available for extended public outreach services.”*

*“We keep running out of funding once we start building improvements in a neighborhood.”*

*“Lack of money to improve streets. There isn't enough money to maintain the streets out there now.”*

*“Bring the funding and it will be done, no problem. No funding, big problem.”*

Updating development codes, learning about green infrastructure, educating builders and developers, educating the public about how they can reduce stormwater pollution, and inspecting and maintaining stormwater facilities all require government staffing and funding. Local governments and state agencies have limited resources for reducing stormwater's impacts. But these services need to be provided, or the public will continue to pay the greater

costs of restoring degraded streams, recovering endangered species such as salmon and steelhead, and cleaning up polluted water and river bottoms.

Some local governments, recognizing the costs involved in providing stormwater management services, have created a stormwater utility that is funded by a fee. In most cases the fee is small. The stormwater utility fee can become an incentive for on-site stormwater management if a fee reduction is offered. The City of Portland, for example, has an unusually high stormwater fee due to the high costs of installing the “Big Pipe” to reduce Combined Sewer Overflows. But the city offers a stormwater fee discount for on-site stormwater management through its “Clean River Rewards” program.

The Oregon Department of Environmental Quality oversees the state’s stormwater program. This agency has been underfunded and understaffed for several years, hampering its ability to review stormwater management plans, perform inspections and offer technical assistance, and coordinate programs related to stormwater in a logical and effective way. The outlook improved somewhat this year when the legislature increased funding for DEQ’s stormwater program, authorizing 14 new permanent staff and 5 new limited duration staff. The increase brought DEQ’s stormwater budget for the 2007-09 biennium up to \$2,680,000, with about half coming from fees and half from the general fund. This is still \$500,000 short of what DEQ requested to implement the stormwater program.

The legislature also approved a new fee to support Oregon’s Underground Injection Control program, adding six new positions to the one existing position. This will allow Oregon to have the basics of a functioning UIC program, rather than returning the program to the federal EPA, as DEQ had proposed last year due to lack of funding.

Oregon’s stormwater program is less than half the size of Washington’s, which has a budget of about \$5,440,000 for the 2007-09 biennium. In addition, the 2007 Washington State Legislature appropriated \$20 million for municipal stormwater projects. This fall, Washington cities may begin applying for the grants to implement Low Impact Development projects that protect hydrology and water quality. Oregon has no comparable program. Funding for this program came primarily from Washington’s Toxics Control Accounts, which contain funds generated by a Pollution Tax that was passed in 1988. The tax is imposed on the privilege of possession of hazardous substances in the state, at a rate of 0.7% of the wholesale value of the substance. The Toxics Control Accounts have grown in recent years due to increased gas prices.

### Maintenance

*“Our maintenance staff is already too busy.”*

*“The long-term maintenance and overall performance is not guaranteed.”*

Like conventional stormwater systems, green infrastructure facilities require some periodic maintenance. Maintenance requirements vary depending on the facility, and they may be as simple as weeding a vegetated swale and removing debris from curb cuts. It is important to ensure that the plants are healthy and the facility is functioning properly and not getting clogged. Conventional systems require maintenance as well. Pipes eventually need to be repaired or replaced, and stormdrains must be cleared of debris to prevent them from backing up. Limited resources can make maintenance of public facilities a challenge. The unique maintenance challenge posed by green infrastructure facilities is that because they are designed to be on-site, as close to the source as possible, they are often on private properties and it is difficult for public agencies to ensure that proper maintenance is occurring. Sometimes stormwater

facilities are even filled in or removed during landscaping projects by private owners who are not aware or don't care that the facility is an important part of a stormwater management system..

Many local governments are developing maintenance programs for green infrastructure facilities within their jurisdiction and determining the best way to provide that service. As more facilities are installed on private property, there is a need to educate private owners of green infrastructure facilities about their maintenance responsibilities, the benefits of their facility and how it functions.

## Resistance to change

*“Conservative public officials and production home builders are unwilling to deviate from the standard approach.”*

*“Some developers are reluctant to change their practices, but others are not.”*

*“City engineers will not deviate from the old ways.”*

*“No one wants to make a mistake that may affect public safety.”*

*“If the direction to change comes from the top, it's more likely to occur.”*

*“The end buyer, or homeowner often has a hard time accepting the idea of these facilities being near their property.”*

*“One challenge is changing the old system of thought that ‘if I can't see it, it is not my problem’.”*

Changing the standard way of doing something is difficult no matter what the issue is, and stormwater management is no exception. Among all the people involved in the process, including elected officials, planners, engineers, inspectors, developers, contractors, designers, customers and the general public, there are some individuals who embrace the shift toward more sustainable practices and others who either don't understand it or are resistant to change for one reason or another. Education, communication, and demonstration of effectiveness are the keys to building acceptance of the new way at all levels.



# RECOMMENDATIONS

Based on our research into the impacts of stormwater runoff, potential solutions, and existing barriers and challenges, the Stormwater Solutions Team developed a number of recommendations. They fall into two major categories.

1. **Stormwater management (SWM).** Improving the way stormwater is managed by promoting green infrastructure and other best management practices
2. **Pollution prevention (PP).** Reducing the sources of pollutants commonly found in stormwater

Within each category, recommendations include policy and programmatic changes (P); education, technical assistance and information-sharing recommendations (E); and technical research needs (R). The team identified some recommendations as higher priority than others, and estimated whether they are likely to be implemented in the short term or long term. A table summarizing all the Stormwater Solutions Team's recommendations is included in the appendix on page 47.

## SUSTAINABLE STORMWATER MANAGEMENT AND GREEN INFRASTRUCTURE

### POLICY AND PROGRAMMATIC RECOMMENDATIONS

**PRIORITY: Increased state support for local efforts to promote, incentivize and implement LID and rainwater harvesting, and remove barriers from codes, rules, and permitting processes. (SWM - P1)**

While many jurisdictions have already developed stormwater programs



and updated their codes to remove regulatory barriers to green infrastructure, most have not. They need funding and technical assistance to accomplish this task. The Oregon Department of Land Conservation and Development has developed a model development code for water quality, which is available at <http://www.oregon.gov/LCD/waterqualitygh.shtml>. Metro also has a model code available at <http://www.metro-region.org/article.cfm?ArticleID=15311>. Support for local stormwater work could include:

- Work with the Association of Clean Water Agencies (ACWA) and League of Oregon Cities to conduct independent code reviews and develop guidelines to promote green infrastructure.
- Seek an Executive Order from the Governor promoting green infrastructure. State-level acknowledgement of the importance of modernizing stormwater management to protect Oregon's waterways would be of great help. The state should encourage the use of LID in new developments, when properties are redeveloped, whenever possible on existing properties, and when installing or replacing public infrastructure (such as roads, stormwater conveyance systems and sumps).
- Seek state-level legislation to provide funding and technical assistance to promote green infrastructure, remove barriers, and provide incentives. (See next recommendation.)

**PRIORITY: Explore and develop sources of funding to support local efforts to update local development codes, develop stormwater programs, and implement and monitor LID projects.** (SWM - P2) Increasing the capacity of local jurisdictions will advance the implementation of many of the Stormwater Solutions Team's other recommendations. The State Revolving Fund could potentially be

used for these purposes. Washington State's legislature recently allocated \$20.2 million for competitive grants for municipal stormwater projects. Consider whether a similar program could be successful in Oregon. Funding could possibly be administered by OWEB, DEQ, or DLCD. One funding concept that merits further exploration is levying a tax or fee on the pollutants commonly found in stormwater, such as motor oil. In addition to generating funds for stormwater cleanup and retrofits, the fee would provide an incentive for reducing the use of these materials.

**PRIORITY: Improve collaboration among DEQ's stormwater, UIC and TMDL programs.** (SWM - P3) Stormwater management issues arise in a variety of DEQ's water quality programs. For example, Underground Injection Control Systems (UICs) may be used to discharge stormwater below the ground surface, which may trigger the need for a permit. Common examples are drywells, floor drains, trench drains, sumps, and perforated piping. As the use of green infrastructure and stormwater infiltration expands, it is sometimes unclear what is and is not considered a UIC, which can be problematic when designing stormwater management. In addition, for certain impaired waterbodies, stormwater management is also a component of TMDL development and implementation. DEQ recognizes the need for improved collaboration, and the increased funding the agency will receive this biennium should enable them to work on this project.

**PRIORITY: Explore adding provisions to water quality permits and regulations that promote innovations in stormwater management and green infrastructure and build the connection between flow, water quality, and overall stream health.** (SWM - P4) DEQ permits and regulations could do a better job at promoting Low Impact Development and addressing stormwater's impacts on hydrology as well as water quality.

**PRIORITY: Develop regional stormwater goals and manuals.** (SWM - P5) There is a need for greater consistency across jurisdictions at the regional level. The current system makes it difficult for developers to implement sustainable stormwater management because there is so much variation in requirements from one jurisdiction to another. This is especially true in the Portland metro area, where so many jurisdictions exist within one metropolitan area. Improved coordination could also reduce the need to ‘reinvent the wheel’ and duplicate efforts. Regional stormwater management goals and stormwater manuals should be developed that encourage BMPs appropriate for local conditions. Greater coordination is possible, as demonstrated by jurisdictions in Central Oregon that worked together to develop a regional stormwater manual. The State of Washington has one stormwater manual for Western Washington and another for Eastern Washington. DEQ can play a role in promoting regional coordination.

**PRIORITY: Increase funding for DEQ’s stormwater program to allow for the implementation and oversight of many of these recommendations.** (SWM - P6)

**PRIORITY: Develop incentives and programs to support the creation of stormwater programs in smaller communities (those with populations below 50,000, which are not required to have Phase II stormwater permits).** (SWM - P7)

**PRIORITY: Strengthen the compliance program for all stormwater permits, including industrial and construction stormwater permits.** (SWM - P8) This includes more rigorous and frequent inspections, providing technical assistance to contractors and industry on stormwater best management practices, ensuring that corrective actions are taken if violations occur, and proceeding with enforcement actions for significant violations and failure to make progress toward benchmarks.

**Explore and strengthen connections to water in Oregon’s land use laws and improve coordination between state agencies.** (SWM - P9) State Land Use Planning Goal 6 is about water, but it is not strongly implemented. If reconvened, the Oregon Task Force on Land Use Planning’s “Big Look” could provide opportunities to raise the profile of this goal. There is a need for increased coordination between DLCD, DEQ, and other agencies involved in green development. One idea to accomplish this, which would require further investigation, is to create an Oregon Office of Sustainability to help bridge those agencies, similar to Portland’s Office of Sustainability.

**Offer priority processing by local jurisdictions of plans for LID projects in order to speed up the permitting process and provide a greater incentive to use LID.** (SWM - 10) Provide simple forms and example designs to make it clear exactly what is required, and make sure all staff involved in the permitting and planning process are trained on stormwater and green infrastructure requirements, especially when code changes are made to allow and promote green infrastructure.

**Clarify that the state plumbing code does allow on-site stormwater management and rainwater harvesting, as long as the local government allows it.** (SWM - P11) Chapter 11 of Oregon’s plumbing code states that all roofs, paved areas, yards, courts, and court-yards shall be drained into a separate or combined storm sewer system, “or to some other place of disposal satisfactory to the Authority Having Jurisdiction.” While that language has permitted many local governments to promote on-site stormwater management by defining green infrastructure facilities in their local stormwater manuals as satisfactory places of disposal, agencies with less experience using green infrastructure sometimes cite the plumbing code as a barrier. The barrier lies in local interpretation, not in the state plumbing code itself, since the code makes no

statement about the use of green infrastructure. It leaves local governments on their own to determine what stormwater management practices are acceptable, which is good because the appropriate sizing and type of green infrastructure facilities depends on local soils and climatic conditions. However, this presents a challenge for governments that have little capacity to develop their own requirements. In addition, the state building codes division has developed code regarding harvesting rainwater for potable use, which takes effect only when adopted by the local jurisdiction. That code should be reviewed by rainwater harvesting experts to ensure that it protects public health and safety without being overly prescriptive and that the code makes it clear which requirements are necessary when rainwater is harvested for non-potable uses, such as irrigation.

**Create local fees to fund stormwater programs, and provide discounts and other incentives for on-site stormwater management.** (SWM - P12) We recommend that local governments use a stormwater fee to fund their stormwater programs, as several cities and service districts are already doing. This fee should provide a discount for properties that use on-site stormwater management to reduce their use of the public stormwater infrastructure. We also recommend that local governments use a Systems Development Charge (SDC) for stormwater and offer a discount and/or other incentives for on-site stormwater management. Portland provides a Floor Area Ratio (FAR) bonus for ecoroofs. This concept should be expanded to other high land value areas. In addition to the FAR bonus and discounts on stormwater fees and SDCs, identify other kinds of bonuses that could be offered as an incentive for using green infrastructure on private properties.

**Allow LID practices to receive credit toward stormwater treatment and detention, if applicable, in local stormwater requirements.** (SWM - P13) The detention and reten-

tion provided by rain gardens, ecoroofs, bioswales, and other LID systems should apply to the detention/retention otherwise required.

**Form local Stormwater Solutions Teams.** (SWM - P14) Local groups of stakeholders could be convened to identify and implement local policy changes to improve stormwater management.

**Incorporate stormwater criteria into the decision-making process for state allocation of transportation dollars.** (SWM - P15) Metro includes stormwater criteria in their process for allocating federal funding in the Portland area. Additional points are given to green streets projects in scoring/prioritizing them. Look into how these criteria could be included in funding decisions for transportation projects elsewhere in the state.

**Promote green infrastructure on industrial properties when appropriate.** (SWM - P16) In certain cases, green infrastructure practices would be an appropriate choice at industrial sites. In these instances, DEQ should provide technical assistance to promote using green infrastructure to manage stormwater. However there are concerns about groundwater contamination when high pollutant levels are involved.

**Conduct local government follow-up inspections of private and public stormwater facilities after one year and again every five years.** (SWM - P17) Document conditions in order to assess the effectiveness of maintenance regimes.

**Survey local jurisdictions about what they do to promote sustainable stormwater management and publish the survey results.** (SWM - P18) Such a survey could be conducted by ACWA or DEQ, with involvement of an outside organization such as OEC. This will help us learn more about what is and is not already being done, and help jurisdictions see how they compare with others. Using a

“report card” approach might help create some friendly competition between jurisdictions to encourage improvements.

**Look into requirements for federal re-development and housing programs, such as HOPE VI, to ensure they encourage LID.** (SWM - P19)

**Encourage local jurisdictions or regional collaborations to evaluate the benefits and costs of adopting a continuous rainfall simulation model for their stormwater programs.** (SWM - P20) This approach can more accurately predict stormwater facilities’ impact on the hydrological system than planning for one particular “design storm,” as is current practice. Washington uses two continuous rainfall simulation models for the east and west sides of the state, and they are closely tied to the stormwater manuals for Eastern and Western Washington. A few jurisdictions in the Portland area are developing their own continuous rainfall simulation models. Jurisdictions would need to consider how much environmental benefit they receive for adopting such a model in comparison to its cost.

EDUCATION, TECHNICAL ASSISTANCE AND INFORMATION-SHARING

**PRIORITY: Develop a comprehensive education and training program promoting sustainable stormwater management and LID in growing communities.** (SWM - E1) Audiences include public officials, agency staff, developers and builders, and designers. The training program should be adaptable to the individual needs of local communities. It involves several elements, which may be implemented in sequence, in combination or individually, depending on the individual needs of each community.

**First, select priority communities around the state.** The qualities to look for in priority communities include:

- Communities with a great deal of expected new development; areas that are already growing or are on the verge of growing. In such areas we can limit the impact of new development, whereas it is more difficult to retrofit urban areas once they are already built out. We can also prevent the impacts on aquatic life that result from introducing impervious surfaces into undeveloped areas. It may be necessary to conduct a study to identify these growing areas.
- Small communities (i.e., Phase II or smaller – population less than 50,000) with limited resources and government staff capacity, or other significant challenges to implementation of Low Impact Development.
- Communities with water bodies or groundwater that are impaired by stormwater runoff.
- Communities where there is a spark of interest: ensure that there are at least a few community members, watershed organizations, developers, elected officials or government staff who are interested in promoting LID and reducing stormwater runoff and could be partners in the education program.
- There may be a number of small communities in a region that could pool their resources together. It would be helpful if they have some experience working with each other, perhaps through watershed planning.

**Education Element 1.  
Kickoff Conference**

**In each community, host a conference with a national speaker to kick off the process and raise awareness.** Invite potential partner organizations, local governments and

elected officials, developers, stormwater practitioners, activist groups, media, etc. Facilitate discussion among stakeholders to help move toward ownership and buy-in by the necessary stakeholders. It is important to allow all concerns to be aired and discussed throughout the process so that a consensus can be achieved for the solution.

## Education Element 2. Train the Trainer Program

**Partner with OSU Extension, local watershed councils and SWCDs, and other interested local groups to train people to train others.** Develop materials in a series of modules that can be adapted to local needs and designed for specific audiences such as developers, government staff, practitioners, teachers, neighborhood leaders, students and the public. Local communities can choose the modules they need. The training modules could be available on a website with a clearinghouse of additional resources. Local governments will be top priority for trainings in the beginning, because local governments must first allow and support LID in order for developers and builders to implement it. Developers, engineers and architects who have experience with LID can play a role in educating local officials and staff. Consider including a visualization tool that shows build-out scenarios with and without LID to help decision-makers understand the impacts. Include LID case studies from other smaller communities and tours of LID projects. Metro's Green from the Ground Up seminars are a good model for workshops targeted to developers. Provide ongoing support to the trainers, such as an annual seminar. The trainers in each community may want to form a local Stormwater Solutions Team. They should use existing networks to organize trainings and offer continuing education credits for professionals. The trainers should receive a certification that is periodically updated.

Programs from elsewhere in the country that we can look to as models include:

- Georgia's Alliance for Quality Growth. <http://aqq.ecology.uga.edu/projects.html>. This program is focused on the land use planning level more than LID, but they have created a partnership of experts that assist communities as "train-the-trainers", and they have a set of modules and training courses that a community can choose from to address their specific needs
- Southeast Watershed Forum's Community Growth Readiness Initiative. <http://www.southeastwaterforum.org/training/growthreadiness.asp>. The train-the-trainer program was developed in Tennessee and replicable templates are being developed that can be applied in other regions of the country. It uses training and facilitation to promote wiser land use planning and watershed-friendly development.
- Connecticut's NEMO Program Commissioner Training. <http://nemo.uconn.edu/training/workshops.htm>. They provide a series of workshop modules communities can choose from, such as "Linking Land Use to Water Quality." The target audience is local decision makers, including elected officials and government staff.
- American Rivers is currently conducting research on the best messages to educate local officials about the connections between development and clean water, with the aim of promoting LID and building the political will to make stormwater a priority. Their research is in the Chesapeake Bay area, but some results will help inform Oregon efforts.
- The Center for Watershed Protection provides training and assistance to communities on subjects such as how to develop a local stormwater program, how to design and implement effective restoration programs, and a stormwater ordinance

roundtable process. Example projects and current training opportunities are shown on the website <http://www.cwp.org>.

**Education Element 3.  
Mentor Program**

**Pair up key government staff and/or elected officials in the selected communities with their colleagues in comparably sized communities that are more advanced in their implementation of LID.** Provide the mentors and mentees with opportunities to learn about each other’s challenges and successes via tours, conferences and other events.

**Education Element 4.  
Code Review Workshops**

**Once awareness has been raised, work with the local trainers to hold code review workshops with local governments to identify the changes that need to be made.** If possible, provide technical assistance and funding to help communities review and modify their codes, and train staff on permitting and planning for LID projects. Identify professionals in the community who can provide technical assistance to local governments. Help communities pool their resources together to hire stormwater professionals.

**In communities that have already updated their codes to promote LID, partner with government agencies and professional associations** such as the American Institute of Architects and the American Planning Association to provide courses and other resources to help designers, builders, and developers navigate the permitting system for LID projects. Provide continuing education credits.

**Education Element 5.  
Recognition**

**Develop a recognition program for green infrastructure.** Look for ways to incorporate

this program in with other recognition programs, such as Better Bricks, National Association of Homebuilders, LEED, Salmon-Safe and Earth Advantage. Also recognize elected officials who have demonstrated leadership. Invite leading LID builders and developers to speak at trainings; engage them in the train-the-trainer program.

Additional education-related recommendations include:

**PRIORITY: Compile information about long-term maintenance costs of low-impact stormwater facilities.** (SWM - E2) Compile information from owners of properties with low-impact stormwater facilities about required maintenance and costs. Compare that to maintenance costs for conventional stormwater facilities and distribute the findings to those making decisions on stormwater options (public officials, community staff, developers, builders, etc.).

**PRIORITY: Develop a stormwater management class or degree program at an Oregon Community College or University that blends landscape architecture and engineering.** (SWM - E3) The designers of tomorrow need to be educated in LID today.

**PRIORITY: Encourage green building certification programs require a minimum level of LID practices, not just optional points.** (SWM - E4) Convene certification programs such as LEED-ND, EarthAdvantage and Salmon-Safe to find overlaps regarding LID, and ensure that certified sites protect hydrology and water quality. Promote those programs that do successfully reduce urban runoff impacts.

**PRIORITY: Provide a simple owner’s manual or brochure for property owners on maintenance responsibilities and benefits of their on-site stormwater facility, and note the facility’s existence on the deed.** (SWM - E5) Partner with realtors to educate new

# STORMWATER SOLUTIONS Turning Oregon's Rain Back into a Resource

homeowners about stormwater facilities as amenities. Examples of manuals targeting homeowners and Home Owners Associations produced by the City of Portland are at <http://www.portlandonline.com/bes/index.cfm?c=34980>.

The table below characterizes the audiences this program would reach.

| Audiences  | What we want them to do  | Messages  |
|--|--|---|
| Elected officials  | Understand LID and lead the charge. Make this their pet issue. Charge their staff to remove barriers, promote LID, improve coordination.   | Leave a legacy for your community. Improve livability, put nature in neighborhoods (LID per se isn't the focus of the message). |
| Government staff   | Improve inter- and intra-agency coordination. Understand LID, how to approve permits for LID. Offer LID options to developers. Create codes that encourage LID and offer incentives. | Leave a legacy for your community. You play an important role.  |
| Builders, developers and industrial property owners  | Understand and use LID, and promote it within the industry. Make sure it's installed correctly.  | Green development is marketable, can save you money, and can make you an industry leader.                                       |
| Stormwater practitioners, e.g., landscapers and engineers  | Use LID and promote it within the industry. Make sure it's designed and installed correctly<br>Partner with industry associations.   | You can offer sustainable options to your clients and become a leader in the field of sustainable design.                       |
| Consumers <ul style="list-style-type: none"> <li>• Homeowners</li> <li>• Large landowners, including schools and homeowner associations</li> <li>• Engaged citizens</li> </ul> | Understand the connection between their property and surface and groundwater. Use water-friendly practices. Manage the stormwater facilities on your property.                       | We all live in a watershed. You can make a difference in keeping water clean. Leave a legacy.                                   |
|  | Use LID on their properties as models.   | Make your community commitment and leadership visible. Your landscape is an educational resource.                               |
|  | Become leaders on this issue.  | You can make a difference for clean water in your community.  |

**PRIORITY: Develop an online BMP clearinghouse. A central clearinghouse of information documenting LID best management practices is needed, including a cost/benefit analysis of LID practices, case studies, maintenance requirements, and effectiveness monitoring results.** (SWM - E6) When people get new information about the use of a BMP, they should be able to link that back to a common, statewide or regional website. There is a national website, [www.bmpdatabase.org](http://www.bmpdatabase.org), which includes effectiveness monitoring results, but does not include cost/benefit analyses or case studies and includes few local LID facilities. Take this information about the performance and effectiveness of LID facilities and translate it into easily accessible and digested reports for broad dissemination.

**PRIORITY: Install green stormwater facilities at schools, parks, hospitals and other visible properties.** (SWM - E7) Such facilities would provide an excellent educational opportunity. Green stormwater facilities on public and commercial properties should include signage explaining what they are and why they're there, their benefits and how to maintain them. Repeating the message over and over raises awareness.

**Assemble and provide "Best Practices" training and guidelines related to design, grading, infiltration, soils and plants for LID vegetated facilities.** (SWM - E8) Typically those in the construction industry, public inspectors, plan reviewers and stormwater engineers have not been given the training or skill development opportunities related to the best use and care of the vegetated components in these LID facilities. Develop training programs to give these audiences the tools they need to be successful in the implementation of their local programs and projects.

**Raise awareness within government agencies of how poor coordination and slow permitting processes are barriers to implementing LID practices, and encourage improvements.** (SWM - E9) Develop a presentation on a case study development, showing where builders get hung up in the process. Help convene cross-agency meetings to improve the process. We can facilitate a discussion, but change will require leadership from within.

**Support developer-led efforts to promote LID.** (SWM - E10) The National Homebuilders Association is working with local chapters to develop an incentive-driven green building standard focusing on builder education. Support and promote these kinds of proactive programs, and ensure that adequate emphasis is placed on mimicking the natural hydrology of the site.

**Provide market research to builders and developers interested in implementing LID.** (SWM - E11) In order to help demonstrate that LID is marketable, conduct a study of whether LID and greenbuiding properties sell faster or at a higher price and share that information broadly.

**Develop private-public partnerships to promote downspout disconnects where desirable.** (SWM - E12) In areas where disconnecting home downspouts is desirable, work with local hardware stores and/or large chains such as Home Depot to provide information about how to disconnect a downspout and install a raingarden (and sell the necessary materials).

**Develop guidelines for pervious pavement installation.** (SWM - E13) Research and provide examples of successful uses of pervious pavement (including concrete and asphalt), and develop guidelines that set parameters for materials and installation.

**Certify pervious pavement installation.** (SWM - E14) There are some certifications for installing pervious pavement. If the certifications became more standard and local jurisdictions required them, uneasiness about pervious pavement's effectiveness would be relieved.

#### TECHNICAL RESEARCH NEEDS

**Research is needed to inform the development of regional stormwater goals.** (SWM - R1) Because Oregon is very diverse, with significant variations in elevation, climate, topography, vegetation, soils and geology, the natural hydrologic regime, including natural rates of infiltration, runoff, and evapotranspiration, varies around the state. As we work to create development that mimics natural hydrology, it may be necessary to conduct research and studies to determine what that



looks like in different regions of the state. Potential research questions include: What is the hydrologic regime in different regions around the state, and what should hydrologic goals be for each region? Are there useful thresholds that can inform us about what degree of hydrological alteration is acceptable while still protecting the state's waters? Based on projected population growth across the state, which watersheds are expected to experience the greatest development pressures in the future?

**Develop cost/benefit and ecosystem services valuation data.** (SWM - R2) Costs of construction and ongoing maintenance are only one measure of cost/benefit. Much of the value of LID techniques is in the benefits that accrue to air quality, habitats, stream and floodplain resources, pedestrian facilities and bikeways, neighborhood and business districts, and community values. Quantify these benefits and share them with consumers, elected officials and practitioners so they can more accurately understand and value these techniques.

**Compile information about maintenance costs and long-term effectiveness of proprietary stormwater filtration devices.** (SWM - R3) Front-end installation costs for filtration devices may sometimes be lower than green infrastructure solutions. However, the filters need to be replaced periodically in order to maintain their effectiveness, which can be costly in the long run. When such filtration devices are installed on private property, they are usually not maintained properly because there is no incentive for doing so. The long-term costs and effectiveness need to be considered with adequate information when stormwater systems are being designed.

**Additional research is needed regarding long-term performance, maintenance requirements and costs for pervious asphalt and concrete.** (SWM - R4)

**Additional research is needed to address groundwater contamination concerns regarding the use of green infrastructure on industrial properties and in wellfield management areas.** (SWM - R5)

**Additional research is needed on plant materials, their suitability in different conditions around the state, and their water quality impacts.** (SWM - R6)

**Additional research is needed to demonstrate the effectiveness of green infrastructure BMPs in reducing flow, which should reduce the need for traditional stormwater infrastructure (e.g., gutter and pipe systems and large detention ponds).** (SWM - R7)

**Do a side-by-side comparison of the water quality and flow benefits from pervious pavement versus directing water from an impervious street to a vegetated swale.** (SWM - R8)

## POLLUTION PREVENTION

The Stormwater Solutions Team developed a number of educational recommendations, as well as some policy changes, to address the common sources of stormwater pollution.

### POLICY AND PROGRAMMATIC RECOMMENDATIONS

**PRIORITY: DEQ and local MS4 jurisdictions should ensure that builders doing construction on sites that are part of a common plan of development are implementing sediment and erosion control best management practices and obtaining necessary permits.** (PP-P1) Many construction projects for subdivisions result in the developer (the permittee) selling all or some of the lots to builders. These builders sometimes do not have knowledge about how to prevent erosion from the construction site, and the developer

may not have a mechanism for ensuring compliance with their construction stormwater permit. Having the builder obtain their own permits and developing transfer agreements between developers and homebuilders would ensure that builders prevent erosion from the construction site and meet state and local permit requirements.

**PRIORITY: Local jurisdictions should ensure that their public and private catch basins and storm drains are cleaned on a regular basis. (PP-P2)**

**Cities and counties should lead the way by reducing pesticide and herbicide use on their parks and public properties, and converting some areas to native or low maintenance landscaping as demonstration projects. (PP-P3)** This recommendation could be taken a step further by requiring public properties to be models for pesticide reduction by using Integrated Pest Management.

**Identify catch basins on parking lots and streets with heavy pollutant loads and install an additional filtration device or other BMP, in accordance with permit codes and standards. (PP-P4)**

**Local jurisdictions should ensure a system is in place to detect and respond to accidental or illicit spills in storm drains, and notify nearby property owners when an incident has occurred. (PP-P5)**

EDUCATIONAL PROGRAMS

There are a number of existing programs targeting stormwater pollution. We seek to build upon those existing programs and expand the best ones to areas where they have not yet been implemented. We recommend programs that work with residents and businesses to overcome barriers to changing their behaviors, in addition to broad educational efforts.

**PRIORITY: Expand and standardize stormwater courses for Designated Erosion and Sediment Inspectors. (PP - E1)** Many developers and builders do not fully understand the erosion and sediment control best management practices (BMPs) needed to comply with their 1200-C permit. They are required to designate an Erosion and Sediment Control Inspector knowledgeable in installing and maintaining BMPs. However, that person may not fully understand how to inspect and maintain these controls to prevent erosion from the site in accordance with the 1200C permit. Courses for Designated Erosion and Sediment Inspectors are currently offered by Clackamas Water Environment Services and Rogue Valley Sewer Services. Additional education courses that may include certifying participants in the installation and maintenance of BMPs should be expanded and standardized around the state to ensure that all Designated Erosion and Sediment Control Inspectors are knowledgeable.

**PRIORITY: Gather information from existing municipal construction programs and provide that information to smaller cities; encourage them to implement the programs most applicable to them. (PP - E2)** Currently, small cities that are not required to have a Phase I or II Permit are not required to provide any stormwater quality programs for construction sites. We recommend gathering information from the programs in Phase I and II cities that smaller cities could easily implement, that are cost effective, and have been determined by Phase I or II permittees to be effective. Provide that information to smaller cities and encourage them to implement the ones most applicable to their city – the “low hanging fruit.”

**PRIORITY: Provide training to building inspectors, watershed councils and other citizen groups about red flags to look for at construction sites. (PP - E3)** Since stormwater quality violations can happen often in a city,

additional help in observing and reporting these violations is welcome. Phase I and II permittees often encourage residents and others to call hotlines when they notice erosion, spills, dumping or other actions that may cause pollutants to enter the stormwater system. Signs with hotline numbers are sometimes posted at construction sites. This is a good step, but the public does not know what to look for. Cities should strongly encourage and train Building Inspectors to look for stormwater quality issues at construction sites and call the hotline to report concerns. Training could also be offered to members of watershed councils and other citizen groups. Tualatin Riverkeepers has developed a brochure for citizens on the correct implementation of construction BMPs.

**PRIORITY: Compile information about successful programs to reduce urban use of pesticides and fertilizers, and make that available in an accessible website. (PP - E4)** Because so many programs already exist, our recommendation is to gather information about the most effective programs and disseminate it, perhaps on an easily accessible website. The U.S. EPA has a “Nonpoint Source Outreach Toolbox” on its website, which includes samples of TV, radio and print advertising materials on numerous pollution prevention topics that relate to stormwater. What is needed is a clearinghouse of programs that are tailored to Oregon communities, and information about the effectiveness of incentive programs and various marketing approaches, not just advertising. There is a need for a range of educational programs, including naturescaping courses for greenthumbs, programs with simpler messages targeted at typical homeowners, certification programs such as the Eco-Biz program for professional landscaping firms and public agencies, and Salmon-Safe certification for commercial properties.

**PRIORITY: Promote less input-intensive alternatives to grass lawns, including native landscaping and “eco-lawns,” which use less water, need less mowing and thrive without fertilizers. (PP - E5)**

**PRIORITY: Study ways to reduce stormwater pollution from unregulated, semi-industrial businesses such as drive-throughs, stores with heavily used, large parking lots, garden centers, used tire centers, and gas stations. (PP - E6)**

**PRIORITY: Develop an education and incentive program to increase cleaning and maintenance of private stormdrains and catchbasins.** Gresham's Stormdrain Cleaning Assistance Program (SCAP) is one example. SCAP helps businesses with private catchbasins coordinate with private drain cleaning vendors. Normally, companies charge \$130 or more for a private service call for one drain. However, through this program, the average cost per business is \$35-\$65 per drain. The more businesses sign up for the program, the less expensive it is for each of them. The discounts offered in a program like this one could be used as an incentive to improve related practices, such as marking catchbasins, sweeping instead of washing pavement, and other measures depending on the business. (PP - E7)

**Develop educational programs to reduce automotive fluid leaks. (PP - E8)** Develop educational materials for auto owners and develop incentives for repairing leaks. Potential partners include oil change businesses such as Jiffy Lube, Eco-Biz certified auto shops, DEQ air emissions test stations, auto supply stores, and parking garages. Research successful programs from around the country.

**Educate business owners and managers about how to clean their parking lots without hosing them down. (PP - E9)**

**Encourage the Oregon Contractors Board to include in its erosion control certification a training on how to adapt an engineer's design to the site and make sure it's working. (PP - E10)**

**Continue to support, promote and expand household hazardous waste collection events in order to reduce dumping of pollutants in stormdrains. (PP - E11)**

**Study ways to reduce other sources of stormwater pollution, including zinc in moss killer and galvanized metal, and copper in flashing, downspouts and automotive brake pads.** (PP - E12)

**Expand stormdrain marking programs.** (PP - E13) Jurisdictions should work together to purchase materials in bulk and reduce costs. Stormdrain marking programs exist around the state, and these efforts sometimes rise and fall due to funding. There are several types of stormdrain markers, and each has its pros and cons:

- Stenciled markers only last two to three years, but they are inexpensive, can be applied by volunteers, and provide a community involvement opportunity.
- Plastic markers fastened with adhesive last longer and can be installed by volunteers, but they can come loose and lose their visibility over time due to scratches.
- Metal markers are available, but they cost approximately \$3 each. They need to be bolted down, so they may not be suitable for installation by volunteers.
- Thermoplastic markers are useful for high traffic areas because they are highly visible, but city/county maintenance staff must install them because they have to be heated to adhere to the pavement.

**Cities and other interested parties should work together and purchase large quantities of storm drain markers to reduce the price.** It makes sense to work with volunteer groups to stencil or install plastic markers on existing stormdrains, and require metal or thermoplastic markers as a component of all new storm drains.

### TECHNICAL RESEARCH NEEDS

**Explore PAH-free alternatives to tar-based parking lot sealants.** (PP - R1)

**Perform research to determine the effectiveness of optimized or enhanced street sweeping as a stormwater best management practice by itself or in conjunction with other BMPs under several land use scenarios.** (PP - R2)



# POTENTIAL FUNDING SOURCES

The following are some potential sources of funding for implementing the recommendations included in this report.

## **State Revolving Fund**

DEQ administers Oregon's Clean Water State Revolving Fund (CWSRF) to help public agencies finance water quality improvements. Congress appropriates funds to the EPA for the purpose of capitalizing the CWSRF program each year. The funds are allocated to all the states based on a pre-determined formula, and each state must contribute a minimum matching amount of 20% annually. The program provides low-cost loans for the planning, design and construction of various water pollution control activities, including stormwater control. Annually, the program has about \$50 million available for water quality improvements. While continuing to serve traditional municipality wastewater needs, the loan program is now expanding with additional loans and incentives to also address nonpoint source water pollution. Any public agency in Oregon is eligible for a CWSRF loan. The program is continuously open to new applications. All eligible proposed projects are ranked based upon their application information and entered on the program's Project Priority List. Points are assigned based on specific ranking criteria.

## **DEQ 319 Grants**

Grant funds are available through Section 319 of the Water Quality Act of 1987. Each year, DEQ identifies programmatic and

geographic targets, solicits project proposals, assembles a proposal package for EPA's review, develops contracts and agreements for disbursement of grant funds, oversees program implementation, and evaluates program accomplishments. State, local, tribal and federal governments, nonprofit organizations and institutions, including watershed councils and soil and water conservation districts are eligible to apply. Section 319 funds are intended for projects targeting non-point source pollution issues in priority watersheds, waterbodies and groundwater threatened by non-point source pollution. Priorities for funding projects are reviewed every year.

### **EPA Pollution Prevention Grants**

EPA has approximately \$4.5 million to support pollution prevention grants to States, Tribes, and Intertribal Consortia in FY 2007. The Pollution Prevention Grants Program supports State and Tribal technical assistance programs that help businesses and industries identify better environmental strategies and solutions for reducing or eliminating waste at the source.

### **Governor's Fund for the Environment**

This fund administered by the National Fish and Wildlife Foundation focuses on projects in the Willamette River Basin that support the implementation of the Governor's Willamette River Legacy Program. Eligible projects reduce pollution and protect and enhance fish, wildlife and habitat in the Willamette River Basin. The Foundation will award approximately \$300,000 in grants this year, using funds paid to maintain a sustained granting program to ben-

efit Oregon rivers and streams as a result of a settlement between the United States and an international shipping company that violated numerous federal pollution laws in 2005.

### **Oregon Watershed Enhancement Board (OWEB) Grants**

OWEB grants are available for watershed restoration, natural resource monitoring, outreach/education, and technical assistance to develop restoration projects. OWEB has funded a few stormwater or LID Projects that provide demonstrable benefits to watershed health, and stormwater education projects may be suitable for OWEB's outreach/education grant program.

### **Local stormwater utility fees and Systems Development Charges**

Some local governments use a stormwater utility fee attached to sewer bills to fund their stormwater programs. Systems Development Charges can also be used to ensure that new development helps pay for the stormwater facilities it requires. Discounts can be offered for on-site stormwater management.

### **Hazardous substance tax**

Both Washington and Oregon have hazardous substance taxes that were established in 1989. In Washington State the tax is imposed on the first in-state possessor of hazardous substances, including petroleum products, pesticides, and certain chemicals, at a rate of 0.7% of the wholesale value of the substance. More than 85% of the

# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

revenue in Washington's Toxics Control Accounts is based on petroleum products. The funds go into local and state Toxics Control Accounts to pay for a number of pollution prevention and hazardous waste cleanup programs, including \$20 million for stormwater programs this year. In Oregon, petroleum and crude oil are excluded from the hazardous substances fee, which is used to clean up contaminated sites where the responsible party is unknown, unwilling, or unable to undertake the cleanup. The Oregon fee is not used for stormwater projects. While the Oregon fee generates approximately \$5 million annually, the Washington tax generated more than \$48 million in 2006.



# APPENDICES

## APPENDIX I: STORMWATER SOLUTIONS SURVEY RESULTS

This non-scientific survey was developed by the Oregon Environmental Council with input from the Stormwater Solutions Team to assist the solutions team in developing recommendations to reduce impacts of urban stormwater runoff. The survey was conducted online using [surveymonkey.com](http://surveymonkey.com).<sup>\*</sup> 158 people responded by January 29, 2006. The survey was distributed via email to

- Oregon Association of Clean Water Agencies (ACWA)
- Oregon Home Builders Association
- Oregon Public Works Association
- American Society of Landscape Architects, Oregon Chapter
- Solutions Team Members and their networks

### 1. What cities and counties do you work in?

| Region                | Response Total | Percentage |
|-----------------------|----------------|------------|
| Greater Portland Area | 78             | 64%        |
| Willamette Valley     | 20             | 16.4%      |
| Southern Oregon       | 11             | 9%         |
| Central Oregon        | 8              | 6.6%       |
| Oregon Coast          | 4              | 3.3%       |
| Statewide             | 1              | .8%        |

<sup>\*</sup> In these survey results, we have included a compilation of responses to each question when possible. The full text of survey responses and a matrix summarizing barriers and solutions identified by survey respondents are available at [oeonline.org/rivers](http://oeonline.org/rivers).



# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

## 2. Do you work for a...?

Professions listed under "Other" included manufacturers of stormwater BMPs (7% of respondents), real estate, education, private contracting, advertising, automotive, design, engineering, finance and telecommunications.

| Organization                           | Response Total | Percentage |
|--|----------------|------------|
| Government Agency                      | 54             | 34.2%      |
| Developer or Builder                   | 45             | 28.5%      |
| Other                                  | 29             | 18.4%      |
| Private Consulting Firm or manufacture | 24             | 15.2%      |
| Non Profit                             | 6              | 3.8%       |

QUESTIONS 3 THROUGH 9 WERE ASKED ONLY OF GOVERNMENT EMPLOYEES.

## 3. Has your local government conducted a comprehensive review of its development codes for barriers to sustainable stormwater management and low impact development?

| Response     | Response Total | Percentage |
|--------------|----------------|------------|
| Yes          | 16             | 35.6%      |
| In progress  | 12             | 26.7%      |
| I don't know | 10             | 22.2%      |
| No           | 7              | 15.6%      |

## 4. If yes have the recommended changes been implemented?

| Response     | Response Total | Percentage |
|--------------|----------------|------------|
| Partially    | 12             | 33.3%      |
| No           | 10             | 27.8%      |
| I don't know | 9              | 25%        |
| Yes          | 5              | 13.9%      |

### If no, why not?

Most respondents said they were in the process of implementing them. Reasons cited for not adopting recommended code changes included:

- lack of understanding, awareness and education
- lack of political will
- barriers in state plumbing code for greywater reuse
- lack of resources including time and personnel
- strong opposition from the development industry

**5. How are your stormwater programs funded?**

| Response       | Response Total | Percentage |
|----------------|----------------|------------|
| Stormwater fee | 32             | 74.4%      |
| Other*         | 12             | 27.9%      |
| General fund   | 6              | 14%        |

\* Responses under “Other” included: system development charges, sewer and water fees, Limited Improvement District, street department, street and road tax, general fund. Some local governments are in the process of establishing stormwater funding sources.

**6. Does your agency have education programs to encourage residents and businesses to reduce urban runoff and the pollutants it carries?**

| Response   | Response Total | Percentage |
|------------|----------------|------------|
| Yes        | 32             | 78%        |
| No         | 8              | 19.5%      |
| Don't know | 1              | 2.4%       |

**7. Please briefly describe your programs including any incentives offered (i.e. coupons environmentally friendly products financial incentives etc.) If someone else is responsible for these programs please ask them to complete this survey as well.**

*Responses to this question are longer than space allows. The full text of survey responses and a matrix summarizing common themes are available at [oeonline.org/rivers](http://oeonline.org/rivers).*

**8. How would you rate the success of these programs?**

| Response                            | Response Total | Percentage |
|-------------------------------------|----------------|------------|
| Too early to tell                   | 13             | 40.6%      |
| Made a small reduction in pollution | 7              | 21.9%      |
| Didn't measure impact               | 7              | 21.9%      |
| Made a significant impact           | 4              | 12.5%      |
| No change                           | 1              | 3.1%       |

**9. What could help you improve the success of your educational programs to reduce urban runoff and the sources of pollutants commonly found in stormwater?**

*Responses to this question are longer than space allows. The full text of survey responses and a matrix summarizing common themes are available at [oeonline.org/rivers](http://oeonline.org/rivers).*

# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

| Response  | Response Total | Percentage |
|---|----------------|------------|
| MS4 stormwater permits  | 66             | 68%        |
| Other regulations (such as TMDLs, ESA, Safe Drinking Water Act) | 65             | 67%        |
| Other (please specify)  | 30             | 30%        |
| Public support  | 20             | 20.6%      |
| Interested developers   | 18             | 18.6%      |

## 10. What are the primary forces driving stormwater management in your community?

Responses listed under "Other" included: UIC rules; city regulations, city commitment, mayor, city council; City of Portland; industrial stormwater permits, construction stormwater permits; watershed management; public concern about water issues or rivers; Goal 5; lawsuits by environmental groups.

## 11. Do current codes and standards in your area (including planning codes, building codes, development codes, stormwater design standards, street design standards, and parking lot design standards) support sustainable stormwater management? Why or why not? Can you give examples? (Please be as specific as possible regarding jurisdiction, codes, and standards.)

Overall, 52 respondents (58%) said their codes mostly support sustainable stormwater management. 38 respondents (42%) said their codes do not support sustainable stormwater management.

| Cities        | Yes | No |
|---------------|-----|----|
| Ashland       | 1   | 0  |
| Beaverton     | 1   | 0  |
| Bend          | 2   | 3  |
| Central Point | 1   | 1  |
| Clackamas     | 2   | 2  |
| Corvallis     | 1   | 0  |
| Eugene        | 4   | 2  |
| Gresham       | 4   | 1  |
| Happy Valley  | 1   | 0  |
| Hillsboro     | 1   | 0  |
| Lake Oswego   | 2   | 2  |
| Madras        | 1   | 0  |
| Medford       | 1   | 0  |
| Newport       | 0   | 1  |
| Oregon City   | 1   | 0  |
| Portland      | 22  | 14 |
| Salem         | 0   | 4  |
| Sherwood      | 1   | 0  |
| Springfield   | 1   | 1  |
| Tigard        | 1   | 1  |
| Toledo        | 0   | 1  |
| Troutdale     | 1   | 0  |
| Tualatin      | 1   | 0  |
| Wilsonville   | 0   | 2  |
| Statewide     | 2   | 2  |
| Nationwide    | 0   | 1  |

**12. In your experience are sustainable stormwater management facilities more or less expensive to install and maintain than piped stormwater systems?**

| Response       | Response Total | Percentage |
|----------------|----------------|------------|
| More expensive | 41             | 39.8%      |
| Don't know     | 29             | 28.2%      |
| Less expensive | 17             | 16.5%      |
| About the same | 16             | 15.5%      |

Answers to this question broken out by profession:

| Profession          | More Expensive | Less Expensive | About the same | Don't know |
|---------------------|----------------|----------------|----------------|------------|
| Builders/Developers | 56%            | 8%             | 16%            | 20%        |
| Gov't agencies      | 32.4%          | 18.9%          | 16.2%          | 32.4%      |
| Private consultants | 29.4%          | 23.5%          | 17.6%          | 29.4%      |

**13. What are the greatest challenges to implementing sustainable stormwater management in new developments, already developed areas and on public streets?** (three separate questions). Please share any suggestions you have for overcoming these challenges including your successes and lessons learned.

**14. Describe any educational programs or tools you believe would aid in better understanding of why and how to implement sustainable stormwater practices and who the target audiences would be.**

*Responses to this question are longer than space allows. The full text of survey responses and a matrix summarizing common themes are available at [oeonline.org/rivers](http://oeonline.org/rivers).*

**15. Which water quality (and quantity) criteria are you most concerned about as they pertain to urban stormwater's impacts on receiving waters?** Please mark the top four criteria of most concern to you. *Responses under "other" included arsenic from native soils and pthalates.*

| Response                       | Response Total | Percentage |
|--------------------------------|----------------|------------|
| Sediment                       | 47             | 60.3%      |
| Flow (water velocity & volume) | 45             | 57.7%      |
| Temperature                    | 38             | 48.7%      |
| Oil and grease                 | 37             | 47.4%      |
| Nutrients (Phosphate Nitrogen) | 32             | 41%        |
| Pesticides                     | 29             | 37.2%      |
| Bacteria                       | 25             | 32.1%      |
| Mercury                        | 16             | 20.5%      |
| Other (please specify)         | 12             | 15.4%      |
| Copper                         | 11             | 14.1%      |
| Zinc                           | 11             | 14.1%      |
| Lead                           | 6              | 7.7%       |

**16. Which of these sources of pollution commonly found in stormwater do you think are most in need of additional attention?** Please mark the top four.

| Response   | Response Total | Percentage |
|--|----------------|------------|
| Oil and fluid leaks from vehicles                  | 49             | 60.3%      |
| Erosion from construction                          | 44             | 57.7%      |
| Dumping wastes in storm drains                     | 44             | 48.7%      |
| Urban use of pesticides and fertilizers            | 40             | 47.4%      |
| Other automotive pollution (from brake pads tires) | 28             | 37.2%      |
| Trash and debris                                   | 27             | 32.1%      |
| Pet waste  | 17             | 20.5%      |
| Car washing  | 16             | 15.4%      |
| Deicing chemicals                                  | 12             | 14.1%      |
| Other  | 10             | 14.1%      |
| Treated wooden utility poles                       | 9              | 7.7%       |

Responses under “Other” included galvanized metal; traction cinders; unidentified non-human bacteria sources other than pet waste; agriculture; medicines, platicizers and other emerging pollutants; erosion from unpaved surfaces; inadvertent spills.

Answers to this question broken out by profession:

| Profession          | Oil & Fluid Leaks from Vehicles | Erosion from Construction | Dumping waste in Storm Drains | Urban Pesticides and Fertilizers |
|---------------------|---------------------------------|---------------------------|-------------------------------|----------------------------------|
| Builders/Developers | 66.7%                           | 26.7%                     | 66.7%                         | 46.7%                            |
| Gov't agencies      | 51.4%                           | 74.3%                     | 48.6%                         | 57.1%                            |
| Private consultants | 83.3%                           | 33.3%                     | 50%                           | 50%                              |

**17. If you have any creative ideas for policy changes regulations or projects to address these pollution sources please share them.**

*Responses to this question are longer than space allows. The full text of survey responses and a matrix summarizing common themes are available at [oeonline.org/rivers](http://oeonline.org/rivers).*

**18. Do you have any other suggestions for policies programs or projects to reduce stormwater impacts in Oregon's urban areas?**

*Responses to this question are longer than space allows. The full text of survey responses and a matrix summarizing common themes are available at [oeonline.org/rivers](http://oeonline.org/rivers).*

## APPENDIX II: COMPLETE LIST OF RECOMMENDATIONS

### APPENDIX II: COMPLETE LIST OF RECOMMENDATIONS

| No.   | Summary of Recommendation  | Key Players   | Cost*  | Time**              |
|---|--|---|--------|---------------------|
| <b>STORMWATER MANAGEMENT &amp; GREEN INFRASTRUCTURE</b> |  |   |        |                     |
| Policy and Programmatic Recommendations                 |  |   |        |                     |
| SWM - P1  | PRIORITY: Increased state support for local efforts to promote, incentivize and implement LID and rainwater harvesting, and remove barriers from codes, rules, and permitting processes.   | ACWA, OEC, Governor, DEQ, DLCD, League of Oregon Cities, state legislature, regional councils | \$\$\$ | Long-term           |
| SWM - P2  | PRIORITY: Explore and develop sources of funding to support local efforts to update local development codes, develop stormwater programs, and implement and monitor LID projects.  | OWEB, DEQ, DLCD, higher ed., state legislature, OEC, regional councils                        | \$\$\$ | Long Term           |
| SWM - P3  | PRIORITY: Improve collaboration among DEQ's stormwater, UIC and TMDL programs.   | DEQ   |        | Short Term          |
| SWM - P4  | PRIORITY: Explore adding provisions to water quality permits and regulations that promote innovations in stormwater management and green infrastructure and build the connection between flow, water quality, and overall stream health. | DEQ   |        | Short and Long Term |
| SWM - P5  | PRIORITY: Develop regional stormwater goals and manuals.   | Local governments, regional councils, DEQ   |        | Long Term           |
| SWM - P6  | PRIORITY: Increase funding for DEQ's stormwater program.   | DEQ, state legislature  | \$\$   | Long Term           |
| SWM - P7  | PRIORITY: Develop incentives to support the creation of stormwater programs in smaller communities.  | DEQ, local government   | \$     | Long Term           |
| SWM - P8  | PRIORITY: Strengthen the compliance program for all stormwater permits, including industrial and construction stormwater permits.  | DEQ, local governments  | \$     | Short Term          |
| SWM - P9  | Explore and strengthen connections to water in Oregon's land use laws and improve coordination between state agencies.   | State agencies, Governor  |        | Long Term           |
| SWM - P10   | Offer priority processing by local jurisdictions of plans for LID projects in order to speed up the permitting process and provide a greater incentive to use LID.   | Local governments   |        | Long Term           |
| SWM - P11   | Clarify that the state plumbing code does allow on-site stormwater management and rainwater harvesting, as long as the local government allows it.   | Oregon Building Codes Division  |        | Long Term           |

\* A general estimate of high or low cost.

\*\* We believe short-term actions could be implemented in the next two years, while longer-term actions will require several additional years.

# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

| No.   | Summary of Recommendation   | Key Players  | Cost | Time       |
|---|---|--|------|------------|
| <b>STORMWATER MANAGEMENT &amp; GREEN INFRASTRUCTURE (cont.)</b> |   |  |      |            |
| <b>Policy and Programmatic Recommendations</b>                  |   |  |      |            |
| SWM - P12   | Create local fees to fund stormwater programs, and provide discounts and other incentives for on-site stormwater management.  | Local governments  | \$\$ | Long-term  |
| SWM - P13   | Allow LID practices to receive credit toward stormwater treatment and detention, if applicable, in local stormwater requirements.   | Local governments  |      | Long Term  |
| SWM - P14   | Form local Stormwater Solutions Teams   | Local governments, watershed councils, conservation groups, OEC, other partners  | \$   | Short Term |
| SWM - P15   | Incorporate stormwater criteria into the decision-making process for state allocation of transportation dollars.  | Oregon Department of Transportation  |      | Long Term  |
| SWM - P16   | Promote green infrastructure on industrial properties when appropriate.   | DEQ, local governments   |      | Short Term |
| SWM - P17   | Conduct local government follow-up inspections of private and public stormwater facilities that require maintenance after one year and again at least every five years.   | Local governments  | \$   | Short Term |
| SWM - P18   | Survey local jurisdictions about what they do to promote sustainable stormwater management and publish the survey results.  | ACWA, OEC, local governments, DEQ, regional councils   | \$   | Short Term |
| SWM - P19   | Look into requirements for federal redevelopment and housing programs, such as HOPE VI, to ensure they encourage LID.   | OEC, ACWA, other partners  |      | Short Term |
| SWM - P20   | Encourage local jurisdictions or regional collaborations to evaluate the benefits and costs of adopting a continuous rainfall simulation model for their stormwater programs.   | Local governments, regional councils   | \$   | Long Term  |
| <b>Education, Technical Assistance, Information Sharing</b>     |   |  |      |            |
| SWM - E1  | <b>PRIORITY:</b> Develop an educational program focused on growing communities with limited government resources or other barriers to implementing LID. Reach multiple audiences including government staff, elected officials, developers and builders, practitioners, and others. | OSU extension, community colleges, local governments, regional councils, watershed councils, soil and water conservation districts, OEC and other partners | \$\$ | Short Term |
| SWM - E2  | <b>PRIORITY:</b> Compile information about long-term maintenance costs of low-impact stormwater facilities.   | ACWA, local governments, regional councils   | \$   | Long Term  |
| SWM - E3  | <b>PRIORITY:</b> Develop a stormwater management degree program or class at an Oregon Community College or University that blends landscape architecture and engineering.   | Higher Education System  | \$   | Long Term  |
| SWM - E4  | <b>PRIORITY:</b> Encourage green building certification programs (LEED, Earth Advantage, Salmon Safe) to require a minimum level of LID practices, not just optional points, to ensure that certified sites protect hydrology and water quality.                                    | Green Building Council, Earth Advantage, Salmon Safe   |      | Long Term  |

APPENDIX II: FULL LIST OF RECOMMENDATIONS

| No.   | Summary of Recommendation   | Key Players  | Cost | Time       |
|---|---|--|------|------------|
| <b>STORMWATER MANAGEMENT &amp; GREEN INFRASTRUCTURE (cont.)</b>     |   |  |      |            |
| <b>Education, Technical Assistance, Information Sharing (cont.)</b> |   |  |      |            |
| SWM - E5  | PRIORITY: Provide a simple owner's manual or brochure for property owners on maintenance responsibilities and benefits of their onsite stormwater facility, and note its existence on the deed. | Realtors, local governments, homebuilders                              | \$   | Long-term  |
| SWM - E6  | PRIORITY: Create an online BMP clearing-house of information documenting LID BMPs, including cost/benefit analysis, case studies and effectiveness monitoring results.                          | ACWA, OEC, local governments, regional councils, national associations | \$   | Short-term |
| SWM - E7  | PRIORITY: Install green stormwater facilities at schools, parks, hospitals and other visible properties.  | Local governments, regional councils                                   | \$\$ | Long-term  |
| SWM - E8  | Assemble and provide "Best Practices" training and guidelines related to design, grading, infiltration, soils and plants for LID vegetated facilities.  | DEQ, local governments, ACWA, OEC, OSU Extension                       | \$   | Short-term |
| SWM - E9  | Raise awareness within government agencies of how poor coordination and slow permitting processes are barriers to implementing LID practices, and encourage improvements.                       | OEC, ACWA, local governments   |      | Short-term |
| SWM - E10   | Support developer-led efforts to promote LID.   | Homebuilders Association, OEC, regional councils, local governments    |      | Short-term |
| SWM - E11   | Provide market research to builders and developers interested in implementing LID.  | OEC, regional councils, local governments                              |      | Short-term |
| SWM - E12   | Develop private-public partnerships to promote downspout disconnects, where desirable.  | OEC, local governments, businesses                                     | \$   | Short-term |
| SWM - E13   | Develop guidelines for porous pavement installation.  | Local governments, Asphalt Paving Association                          |      | Short-term |
| SWM - E14   | Certify porous pavement installation.   | Asphalt Paving Association   | \$   | Long-term  |
| <b>Technical Research Needs</b>                                     |   |  |      |            |
| SWM - R1  | Research is needed to inform the development of regional stormwater goals.  |  |      |            |
| SWM - R2  | Develop cost/benefit and ecosystem services valuation data.   |  |      |            |
| SWM - R3  | Compile information about maintenance costs and long-term effectiveness of proprietary stormwater infiltration devices.   |  |      |            |
| SWM - R4  | Additional research is needed regarding long-term performance, maintenance requirements and costs for pervious asphalt and concrete.  |  |      |            |
| SWM - R5  | Additional research is needed to address groundwater contamination concerns regarding the use of green infrastructure on industrial properties and in wellfield management areas.               |  |      |            |
| SWM - R6  | Additional research is needed on plant materials, their suitability in different conditions around the state, and their water quality impacts.  |  |      |            |



# STORMWATER SOLUTIONS

Turning Oregon's Rain Back into a Resource

| No.   | Summary of Recommendation   | Key Players  | Cost | Time       |
|---|---|--|------|------------|
| <b>Technical Research Needs (cont.)</b>                     |   |  |      |            |
| SWM - R7  | Additional research is needed to demonstrate the effectiveness of green infrastructure BMPs in reducing flow, which should reduce the need for traditional stormwater infrastructure (e.g., gutter and pipe systems and large detention ponds). |  |      |            |
| SWM - R8  | Do a side-by-side comparison of the water quality and flow benefits from porous pavement versus directing water from the street to a swale with soil and plants.  |  |      |            |
| <b>POLLUTION PREVENTION</b>                                 |   |  |      |            |
| <b>Policy and Programmatic Recommendations</b>              |   |  |      |            |
| PP - P1   | Incorporate stormwater criteria into the decision-making process for state allocation of transportation dollars.  | DEQ, local jurisdictions, developers, home-builders  |      | Long Term  |
| PP - P2   | Promote green infrastructure on industrial properties when appropriate.   | Local jurisdictions  | \$   | Short Term |
| PP - P3   | Cities and counties should lead the way by reducing pesticide and herbicide use on their parks and public properties, and converting some areas to native or low maintenance landscaping as demonstration projects.                             | Local governments  | \$   | Short Term |
| PP - P4   | Identify catch basins on parking lots and streets with heavy pollutant loads and install an additional filtration device or other BMP, in accordance with permit codes and standards.   | Local governments  | \$\$ | Long Term  |
| PP - P5   | Local jurisdictions should ensure a system is in place to detect and respond to spills and dumping in storm drains, and notify nearby property owners when an incident occurs.  | Local governments  | \$   | Short Term |
| <b>Education, Technical Assistance, Information Sharing</b> |   |  |      |            |
| PP - E1   | <b>PRIORITY:</b> Expand and standardize stormwater courses for Designated Erosion and Sediment Inspectors.  | DEQ, homebuilders, General Contractors, local jurisdictions, educational partners                      |      |            |
| PP - E2   | <b>PRIORITY:</b> Gather information from municipal construction programs and provide that information to smaller cities; encourage them to implement the programs most applicable to them.  | Local jurisdictions, regional councils, ACWA, OEC  |      |            |
| PP - E3   | <b>PRIORITY:</b> Provide training to building inspectors, Watershed Councils and other citizen groups about red flags to look for at construction sites.  | Local jurisdictions, OEC and other educational partners, watershed councils, neighborhood associations |      |            |
| PP - E4   | <b>PRIORITY:</b> Compile information about successful programs to reduce urban use of pesticides and fertilizers and make that available on the web.  | ACWA, local jurisdictions, OEC, regional councils  |      |            |

## APPENDIX II: FULL LIST OF RECOMMENDATIONS

| No.   | Summary of Recommendation   | Key Players                                      | Cost | Time       |
|---|---|--|------|------------|
| <b>POLLUTION PREVENTION (cont.)</b>                                 |   |  |      |            |
| <b>Education, Technical Assistance, Information Sharing (cont.)</b> |   |  |      |            |
| PP - E5   | PRIORITY: Promote less input-intensive alternatives to grass lawns, including native landscaping and "eco-lawns", which use less water, need less mowing and thrive without fertilizers                                     | Local jurisdictions, OEC, regional councils      | \$   | Short Term |
| PP - E6   | PRIORITY: Study ways to reduce stormwater pollution from unregulated, semi-industrial businesses such as drive-throughs, stores with heavily used, large parking lots, garden centers, used tire centers, and gas stations. | Local jurisdictions, OEC, DEQ, regional councils | \$   | Long Term  |
| PP - E7   | PRIORITY: Develop an education and incentive program to increase cleaning/maintenance of private stormdrains and catchbasins.   | Local jurisdictions                              | \$   | Short Term |
| PP - E8   | Develop educational programs to reduce automotive fluid leaks.  | Local governments, OEC, regional councils        | \$   | Short Term |
| PP - E9   | Educate business owners and managers about how to clean their parking lots without hosing them down.  | Local governments, OEC                           | \$   | Short Term |
| PP - E10  | Encourage the Oregon Contractors Board to include in its erosion control certification a training on how to adapt an engineer's design to the site and make sure it's working.  | Oregon Contractors Board                         | \$   | Short Term |
| PP - E11  | Continue to support, promote and expand household hazardous waste collection events in order to reduce dumping of pollutants in stormdrains.  | Local governments, regional councils             | \$   | Short Term |
| PP - E12  | Study ways to reduce other sources of stormwater pollution, including zinc in moss killer and galvanized metal, and copper in flashing, downspouts and automotive brake pads.   | Local governments, DEQ, ACWA, OEC                | \$   | Long Term  |
| PP - E13  | Expand stormdrain marking programs.   | Local governments, regional councils             | \$   | Short Term |
| <b>Technical Research Needs</b>                                     |   |  |      |            |
| PP - R1   | Explore PAH-free alternatives to tar-based parking lot sealants.  |  |      |            |
| PP - R2   | Perform research to determine the effectiveness of optimized or enhanced street sweeping.   |  |      |            |



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

MAR 5 2007

OFFICE OF  
WATER

**MEMORANDUM**

**SUBJECT:** Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Nonpoint Source and other Water Programs

**FROM:** Benjamin H. Grumbles  
Assistant Administrator

A handwritten signature in black ink that reads "B H Grumbles".

**TO:** EPA Regional Administrators

Green infrastructure can be both a cost effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions. EPA Water Programs are in a pivotal position to exert leadership in the consistent and reliable implementation of green infrastructure approaches. This memo is to highlight opportunities for the Regions, States, and Headquarters efforts to increase the development and use of green infrastructure in water program implementation.

Several cities, searching for alternatives to traditional hardscape solutions to wet weather discharge problems, have initiated some green infrastructure approaches. The Natural Resources Defense Council (NRDC) has recently published a document with information and case studies on these efforts. I strongly support the use of green infrastructure approaches described in the NRDC report and I suggest you share the report with States and promote other tools for green infrastructure. *Rooftops to Rivers: Green strategies for controlling stormwater and combined sewer overflows* (NRDC, June 2006) is available at:  
<http://www.nrdc.org/water/pollution/rooftops/contents.asp>

Green infrastructure approaches essentially infiltrate, evapotranspire or reuse stormwater, with significant utilization of soils and vegetation rather than traditional hardscape collection, conveyance and storage structures. Common green infrastructure approaches include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips, reforestation, and protection and enhancement of riparian buffers and floodplains. Green infrastructure can be used where soil and vegetation can be worked into the landscape. It is most effective when supplemented with other decentralized storage and infiltration approaches, such as the use of permeable pavement, and rain barrels and cisterns to capture and re-use rainfall for watering plants or flushing toilets. These approaches can be used to keep rainwater out of the sewer system to reduce sewer overflows and to reduce the amount of untreated stormwater discharging to surface waters. Green infrastructure

facilitates or mimics natural processes that also recharge groundwater, preserve baseflows, moderate temperature impacts, and protect hydrologic and hydraulic stability.

Green infrastructure has a number of benefits:

- *Cleaner Water* – Vegetation and green space reduce the amount of stormwater runoff and, in combined systems, the volume of combined sewer overflows.
- *Enhanced Water Supplies* – Most green infiltration approaches result in stormwater percolation through the soil to recharge the groundwater and the base flow for streams.
- *Cleaner Air* – Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness.
- *Reduced Urban Temperatures* – Summer city temperatures can average 10°F higher than nearby suburban temperatures. High temperatures are linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air.
- *Increased Energy Efficiency* – Green space helps lower ambient temperatures and helps shade and insulate buildings, decreasing energy needed for heating and cooling.
- *Community Benefits* – Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas and can raise property values.
- *Cost Savings* - Green infrastructure may save capital costs on digging big tunnels and stormwater ponds, operations and maintenance expenses for treatment plants, pipes, and other hard infrastructure; energy costs for pumping water; and costs of wet weather treatment and of repairing stormwater and sewage pollution impacts, such as streambank restoration.

The Office of Water is working with a coalition of organizations, including the Natural Resources Defense Council, the National Association of Clean Water Agencies, and the Low Impact Development Center, to develop additional strategies for green infrastructure approaches to water quality challenges. As those strategies take shape, we will send you additional tools and information on implementing green infrastructure in our water programs.

I am pleased that EPA Regions and States are looking for opportunities to incorporate green infrastructure. We would be very interested in hearing about your efforts, and to the extent they can be applied elsewhere, assist in disseminating information and tools. If you have any questions, please contact me or have your staff call Jenny Molloy at (202) 564-1939 with any questions, comments, ideas or information on green infrastructure approaches.

cc: Water Division Directors  
OW Office Directors

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