Sustainable Site Development

Stormwater Practices

For New, Redevelopment and Infill Projects

November 2003

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

A River Renaissance Project

Portland receives about 37 inches of rain a year that falls on rooftops, roads, yards and parking lots. Every time it rains dirt and pollutants are washed into our streams and rivers. How we manage that runoff impacts our streams, our building designs and our pocketbooks. In 2011, the City of Portland will finish construction on a 20-year, $1 billion program to update sewer and stormwater infrastructure. Yet there is more to be done.

As Portland continues to develop, it is important that we accommodate growth and commerce while maintaining clean rivers and streams, air quality and livability. Our current urban practices and the growing amount of paved areas and roof tops (impervious surfaces) contribute to water pollution in our rivers and streams, increase flooding, degrade habitat for fish and wildlife, and raise air and water temperatures due to a loss of vegetation. The solution is to plan for the future and develop in a way that brings the function and values of trees, soil and open space back into our communities. If we develop today with long-term sustainability in mind, the generations that follow us can enjoy a vibrant city and clean and healthy rivers, without bearing the burden of our actions.

The following guiding principles are for anyone who is planning or designing new construction projects or making changes to existing development. Whether you are planning a 240-unit apartment complex, redeveloping an urban warehouse, adding a garage to your home, constructing a pump station, planning a town center, or building a public road, these principles will help meet the City's objectives for stormwater management, clean water, and healthy habitat for the people, fish and wildlife of our region.

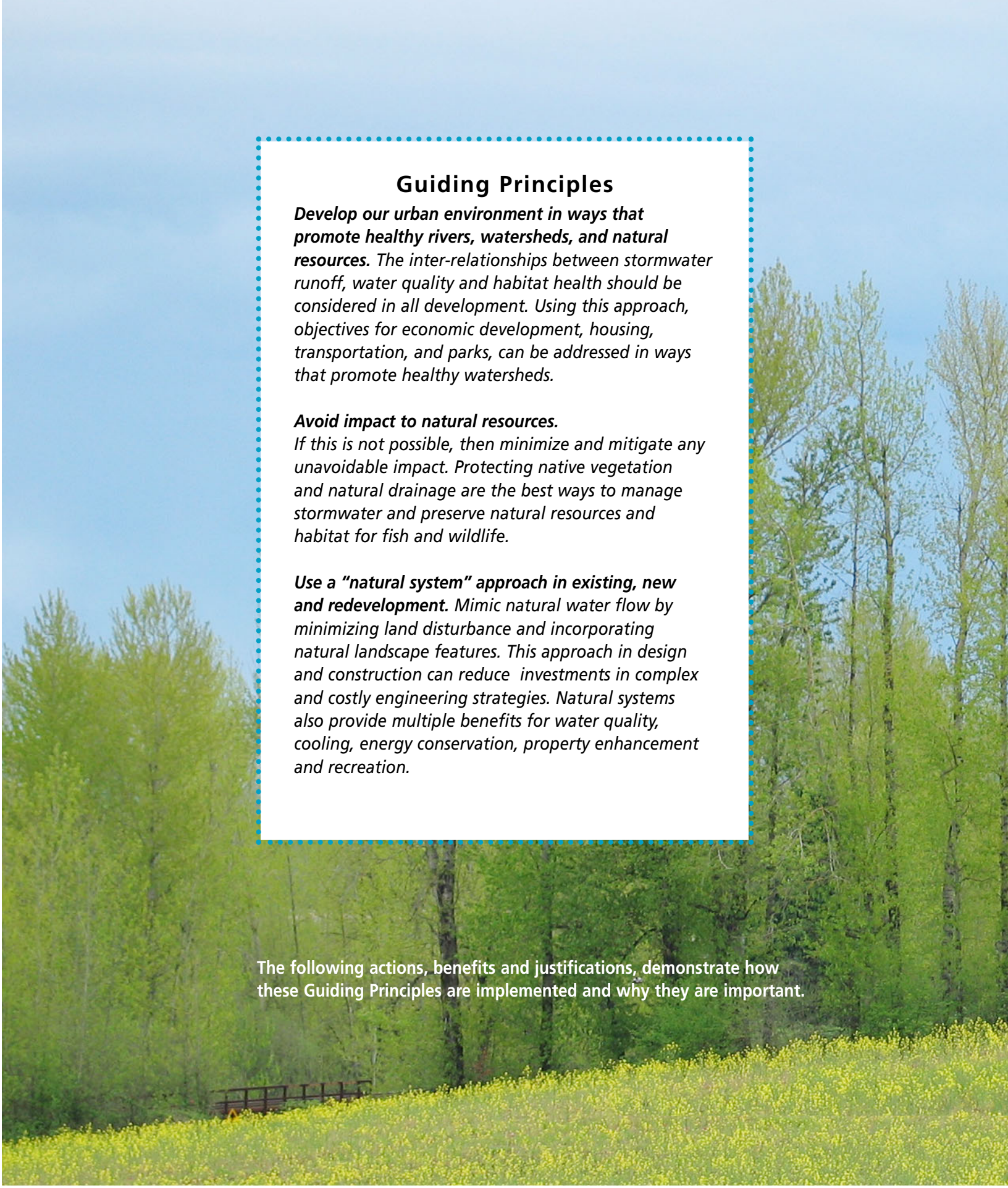
This document provides a guide to help meet City of Portland goals and regulations to develop projects that will focus on economic, environmental and sustainability goals. The following principles and actions tie together the common threads of Portland's Clean River Plan, River Renaissance Vision, the City's Framework for Integrated Management of Watershed Health, Stormwater Manual and various regional, state and federal regulations.

Please refer to City Code for specific regulatory requirements.

For more information

Bureau of Environmental Services
Sustainable Stormwater Management Program
503-823-7740
or visit www.cleanrivers-pdx.org

Commissioner Dan Saltzman
Director Dean Marriott



Guiding Principles

Develop our urban environment in ways that promote healthy rivers, watersheds, and natural resources. *The inter-relationships between stormwater runoff, water quality and habitat health should be considered in all development. Using this approach, objectives for economic development, housing, transportation, and parks, can be addressed in ways that promote healthy watersheds.*

Avoid impact to natural resources.
If this is not possible, then minimize and mitigate any unavoidable impact. Protecting native vegetation and natural drainage are the best ways to manage stormwater and preserve natural resources and habitat for fish and wildlife.

Use a "natural system" approach in existing, new and redevelopment. *Mimic natural water flow by minimizing land disturbance and incorporating natural landscape features. This approach in design and construction can reduce investments in complex and costly engineering strategies. Natural systems also provide multiple benefits for water quality, cooling, energy conservation, property enhancement and recreation.*

The following actions, benefits and justifications, demonstrate how these Guiding Principles are implemented and why they are important.

Hamilton ecoroof

action

1 Manage stormwater as close to the source as possible to reduce or eliminate the volume of water and pollutants leaving the site. Integrate stormwater in site development, building and landscape design.

benefit

Integrated landscaped techniques filter and clean stormwater runoff and recharge groundwater. Stormwater that is treated and managed on site reduces private and public infrastructure costs.

• Initial development costs and long-term maintenance needs can be reduced. • This approach helps reduce negative impacts on streams and combined sewers.

• When stormwater management is integrated into site design, stormwater can be a beneficial resource or a functional amenity and can enhance urban livability through the creation of water features and green spaces.

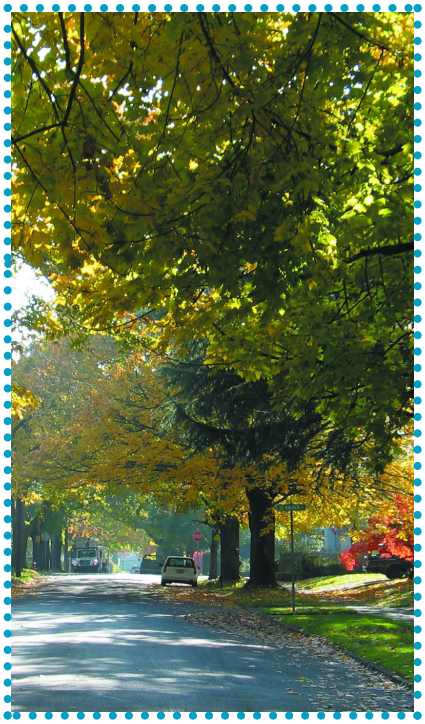
justification

- 80% to 90% of total rainfall in Portland arrives in small, frequently occurring storms. Rainfall from small storms can be easily managed at most sites by integrating stormwater with site and building design.
- The Oregon Museum of Science and Industry chose a stormwater design that allowed parking lot runoff to filter through swaled medians for treatment. They saved $78,000 by reducing the need for pipes, catch basins and manholes.
- When stormwater is managed on site in landscaped facilities, maintenance costs are comparable to maintenance costs of typical landscape areas.
- Integrated stormwater designs serve the community by conserving energy and natural resources.
- These integrated techniques are the preferred method for stormwater management in the City of Portland's Environmental Services Stormwater Manual.

Buckman Heights stormwater planters

action

2 Preserve, protect and plant trees and vegetation. Increase use of native trees and vegetation.



street tree canopy

benefit

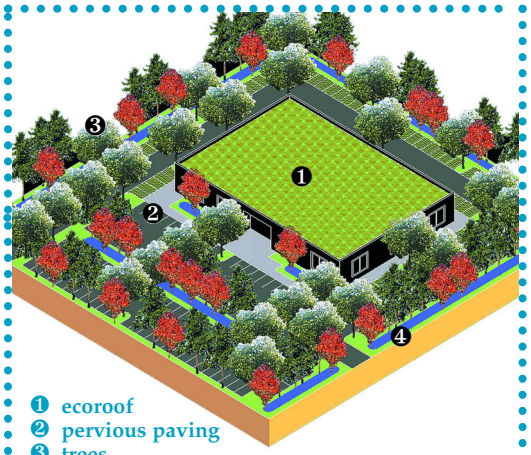
Trees and vegetation intercept rain, slowing and reducing stormwater runoff. The resulting runoff requires less treatment and minimizes downstream impacts. • Trees and vegetation absorb and filter pollutants from soil and water, shade and cool air and water and filter dust and airborne particles. • Trees and vegetation stabilize soils and prevent erosion, reduce wind velocity and insulate buildings. • Preserving, protecting and planting trees provides habitat for fish, birds, reptiles, mammals, insects and amphibians. • Planted areas provide mental and physical health benefits for people in the urban environment and can increase property values and marketability. • Native plants of the Pacific Northwest are well adapted to this environment, requiring little or no watering or maintenance. • Invasive non-native plants displace natives important to the ecological balance of an area. • Because native plants don't require pesticides or fertilizers the risk to human health, fish and wildlife from these chemicals is eliminated.

justification

- Mature canopy trees can block up to 90% of solar radiation. Three well-placed shade trees around a house can cut air conditioning energy needs by 10% - 50%.
- Roots loosen soil increasing rainfall infiltration which reduces overland flows.
- A study of a once forested area of the Puget Sound region concluded that if tree canopy lost since 1973 had not been lost, the region would have saved $95 million in air pollution services and $2.4 billion in stormwater containment services over the last 25 years.
- Trees dampen noise, provide a sense of place and stability and help reduce stress. Research at Texas A&M University has shown that most people relax mentally and physically when surrounded by gardens or parks.
- Mature trees add value to neighborhoods. Studies indicate people may pay as much as 20% more for a home landscaped with mature trees.
- A mature coniferous forest in the Northwest has been shown to retain up to one inch of rainfall before any runoff occurs.
- A Maryland study found that when lands were stripped of trees for construction 25,000-50,000 tons of sediment were released; this amounts to 500-1000 times more sediment than is released in a typical forested area.
- Mature and native trees reduce irrigation costs because they need less water.
- Corporate landowners can save an estimated $270-$640 per acre in annual maintenance costs when open areas are managed as natural areas rather than landscaped with exotic plants.

rosa nutkana

design of proposed stormwater facilities



action

3 Reduce impacts from impervious surfaces such as streets, parking lots, rooftops and other paved surfaces.

benefit

When impervious surface area is reduced, impacts to downstream areas are reduced. Impervious surfaces can increase the speed, volume and frequency of stormwater flows resulting in erosion and stream channel scour, down-cutting of stream channels, and washing out important habitat and aquatic life. • Less impervious surface reduces the volume of stormwater needing treatment and handling through the City's infrastructure. • Reduced impervious surface allows more groundwater recharge, and reduces pollutants and heat impacts to streams. • Replacing impervious surface with vegetation results in cleaner, cooler air, increased habitat and increased energy savings in the built environment. • Reduction in impervious area can result in reduced City stormwater fees.

justification

- Studies show that impervious land coverage greater than 10% degrades watershed conditions. In Portland, 49% of the land area is impervious.
- City of Portland monitoring demonstrates that ecoroofs can capture and evaporate an average of 69% of the rainfall. Runoff from peak intensities of large storms is reduced to less than 1/10 the runoff from a conventional roof.
- An exposed black roof can reach 190 degrees while an equivalent vegetated area under the same conditions may reach only 84 degrees.
- The City of Chicago estimates that an ecoroof can reduce energy costs by as much as .22 cents per square foot per year.

paved parking lot

same parking lot with stormwater swales

natural buffers along Johnson Creek

action

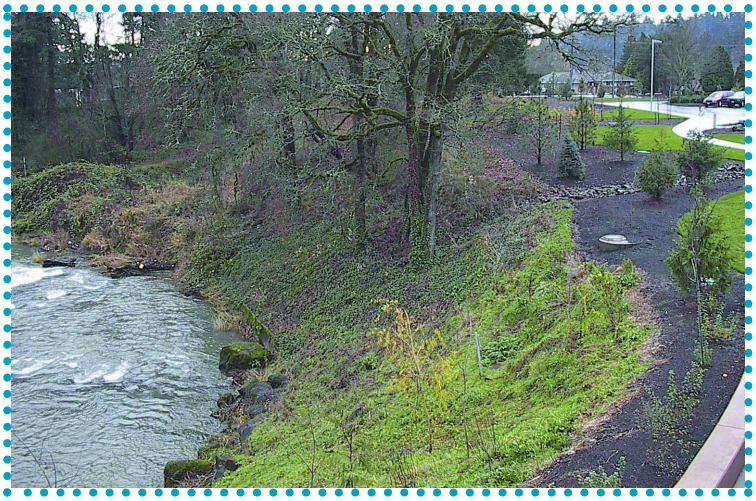
4 Avoid disruption along stream corridors. Create vegetative buffers.

benefit

Vegetated corridors filter pollutants, intercept rainfall and allow rain to infiltrate slowly to groundwater and streams. • Buffers accommodate the natural shifts and widening of streams which provide space for flood flows and protect nearby properties. • Buffers provide open space corridors and can increase property values. • Shading from trees and vegetation help cool stream temperatures and the urban environment. • Vegetated corridors provide food, shelter, protection and migration paths for aquatic and terrestrial wildlife. • Buffers protect and stabilize streambanks reducing the amount of soil that washes into fish spawning beds.

justification

- Research by the Center for Urban Water Resources at the University of Washington shows that urban development and disruption of riparian corridors are the two most detrimental impacts to steams.
- Stream corridor vegetation provides resistance to stream flow, slowing water velocities, and reducing erosion.
- The loss of riparian forests results in loss of large woody debris in urban streams. Large wood is important to fish because it traps sediment and creates pools that provide refuge and rearing habitat.
- In smaller streams riparian vegetation is a primary source of food for fish and wildlife, contributing up to 99 % of the energy (leaves, branches, twigs, bark and insects) in some systems and providing the building blocks for the aquatic food web.



restored buffer in an urban setting

- Riparian areas support more species than any other ecological community. In the Portland metropolitan region, approximately 45% of native wildlife species depend on riparian areas and up to 93% use riparian areas.
- Lack of bank vegetation can lead to channel widening, channel incision, and lowering of the water table.

Brookside flood storage and natural area

action

5 Avoid development in the floodplain and restore natural floodplain functions.

benefit

Avoiding floodplain development retains the natural functions of the floodplain and associated wetlands. • Retaining natural floodplain functions allows streams to flood without threatening public health and safety, reduces damage to surrounding property and provides safe harbor for fish and aquatic life during flood events. • Floodplain wetlands are important for water quality because of the ability of wetland vegetation to take up inorganic nutrients and chemical pollution. • Flooding is a restorative process essential for healthy stream ecosystems. • Floods clean out silts, dig deep pools for fish, bring in new food supplies and renew aquatic life.

justification

- Floodplain vegetation reduces velocities, redistributes flood flows and stabilizes banks.
- Functioning floodplains and wetlands provide temporary floodwater storage, decreasing downstream flood peaks.
- A topographically diverse floodplain supports a mosaic of plant communities and ecosystem functions.
- During periods of high water, fish and wildlife migrate from streams into the floodplain for refuge and food.
- When floodwaters recede, nutrients and organic matter from the floodplain are transported back to the river. The disconnection of the stream from its floodplain eliminates this natural function.

Johnson Creek flood conditions

streambank erosion control planting

action

6 Prevent and control erosion caused by construction and routine site development activities such as clearing and grading.

benefit

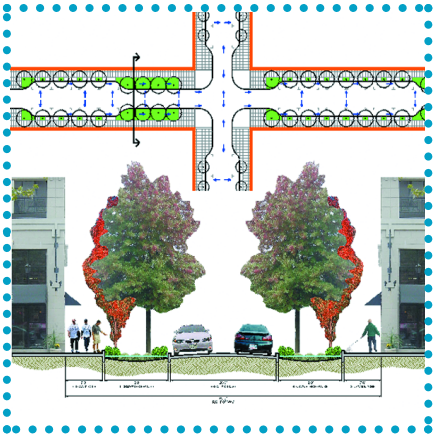
Erosion control preserves topsoil, increases plant survivability and reduces site development costs. • Erosion control reduces discharge of pollutants to streams and City infrastructure, landslides and property damage, City maintenance costs and damage to aquatic life and fish spawning gravels.

justification

- Sampling from a southeast Portland construction site revealed that the site released 4 times more sediment in one storm event than was released from an undeveloped site over the course of an entire year.
- The Environmental Protection Agency estimates that soil loss can be cut 50% simply by leaving a rough soil surface on disturbed sites. By using Best Management Practices such as straw mulch and silt fencing, sediment loads can be reduced by over 85% according to a Metropolitan Washington Council of Government study.
- The City of Portland's Environmental Services spends over $500,000 a year on disposal of materials removed from the City's culverts, sumps and sewer systems.

erosion controls at development

street swales with trees



action

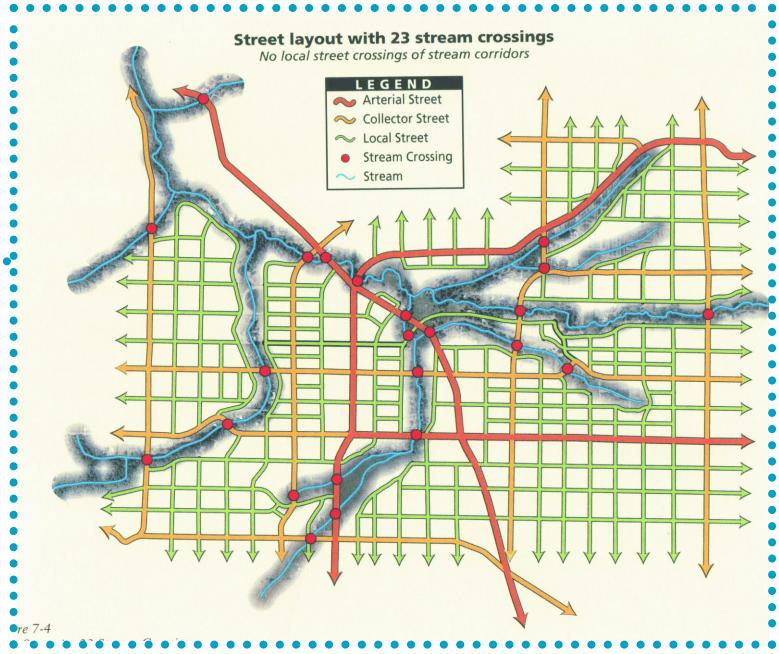
7 Locate and design streets to protect stream corridors and reduce high flows and polluted runoff.

benefit

Avoid stream crossings whenever possible. Use well designed street crossings over streams to accommodate flood flows and allow passage of large wood minimizing infrastructure maintenance costs. • These street crossings provide fish and wildlife passage within the safety of the stream corridor. • Green street design allows stormwater management within the right-of-way and provides environmental, aesthetic and cost benefits. • Green streets can infiltrate stormwater, reduce pollutant loads, and slow flows.

justification

- A Center for Urban Water Resources study shows that stream health decreases as road density increases. This decrease in stream health results in large part from polluted road runoff from ditches discharging directly to streams.
- Streets make up 25% of the City's total land area and account for 1/2 of the total impervious area. Street runoff carries sediments, nutrients, oil, grease, heavy metals, and toxins and increases water temperatures.
- Green street design can reduce impervious coverage by 11% when compared with a traditional street design. A Seattle green street design reduced the total volume of stormwater from a 2 year storm event by 98%.
- Green streets designed with natural drainage systems such as swales, generally cost 10 to 20% less than streets designed with traditional curbs, gutters, catch basins asphalt and sidewalks.



site planning to minimize stream crossings

action

8 Educate and enlist local agencies and the community in these Guiding Principles and Actions.

justification - benefit

Commitment to these Guiding Principles and Actions:

- Help meet City objectives for stormwater management, clean water and healthy habitat for fish and wildlife;
- Help meet City of Portland goals and regulations to develop projects that will be sustainable over time;
- Facilitate permit approvals;
- Provide long term cost savings to property owners; and
- Reduce public infrastructure costs.

reviewing a site design

adult education on water quality issues

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