Chesapeake Bay Program
A Watershed Partnership

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Backgrounder

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Developed lands provide a significant source of pollution to the waterways that flow into the Chesapeake Bay.

Nonpoint source pollution refers to pollution that stems from no clear single source, such as runoff that enters waterways from parking lots, farm fields and lawns.

Runoff from developed landscapes is a leading contributor of pollution in the Bay watershed. Key parts of the solution to this problem are better site design and use of on-site practices that limit runoff from developed land.

Ecologically-Based Design for Development: Reducing Impacts on Chesapeake Bay

The term "ecologically-based design" refers to a process of land use and development planning that minimizes adverse effects to the environment. It involves conserving natural areas and designing buildings and surrounding areas, such as parking lots, to reduce impervious cover and storm water pollution. Ecologically-based design incorporates onsite storm water management practices that maintain natural hydrologic functions. This approach involves actions at the site design level, which involves where and how a site is planned and designed. It also encompasses onsite practices that manage and mitigate the effects of storm water runoff.

Why Is It Important to Promote Ecologically-Based Designs?

Poorly designed development unnecessarily disturbs the landscape and creates significant amounts of impervious cover, which is surface area covered by roads, parking lots, houses, etc., that is impenetrable to water. When it rains, water is prevented from seeping into the ground and pollutants are washed directly into nearby waterways.

Poor development practices can cause:

Increased water volume, erosion and flash-flooding during storms – Rainfall on impervious surfaces is swiftly conveyed through natural channels and storm water pipes to waterways. This increased volume of water causes stream bank erosion and adds sediment to our waterways, degrading and destroying water quality and wildlife habitat. During storms, when runoff increases, the potential for flash flooding increases disproportionately.

Pollution – Runoff from impervious surfaces picks up pollutants, such as oil, pesticides, toxic metal particles, sediments, and trash. The runoff is then channeled directly into waterways, degrading water quality, increasing acidity and raising water temperatures.

Decreased biodiversity and degraded wildlife habitat – As pollutants, nutrients and sediment from development enter waterways, the numbers and types of species that can survive in this altered environment change significantly. Changes in water temperature and pH as well as decreased

dissolved oxygen in the water add stress to organisms and their habitats. According scientific studies on the impacts of impervious surfaces, even low levels of impervious surfaces can have dramatic impacts on surrounding waterbodies and the animals and plants that live in them. For example, scientists in Maryland found that brook trout are can no longer survive in streams that have watershed containging more than 2 percent of impervious surfaces. Wildlife habitat also is degraded or destroyed by environmentally insensitive development. Runoff from areas with impervious surfaces is dramatically higher than areas with undeveloped landscapes.

Decreased groundwater recharge – When storm water is rapidly conveyed to waterways, the water can not filter into the ground to recharge aquifers, or underground water sources. Reduced water levels in aquifers lead to lower sustained flows in streams and rivers and reduces drinking water supplies.

The amount of imperviousness in an area can predict how polluted or degraded a local stream or waterway will become. Studies have shown that as an area's imperviousness increases, water quality decreases.

How Do Ecologically-Based Designs Help to Maintain and Enhance Water Quality?

In the past storm water management systems were designed to control water volume; however more recently water quality and channel protection have been recognized as important goals. Efforts to mitigate storm water impacts on water quality can involve costly structures (such as storm water ponds) or expensive retrofits, which modify structures and infrastructure to improve design and replace malfunctioning parts. These traditional structures are often difficult to maintain, have varying degrees of effectiveness and do not relate to the natural hydrology of the site. As a result, problems often are simply transferred downstream.

An alternative to the traditional structural approach described above is to design a site to conserve its natural areas (particularly around the natural drainage system), minimize impervious cover and reduce storm water runoff and pollution. Reducing or preventing runoff is more cost-effective than treating storm water or the effects of polluted water after the fact.

Ecologically based designs can be achieved in several ways, including: 1) site location and design (for example, size, shape and layout of a developed site) and 2) site development practices (which allow water to infiltrate the ground at the site). These are more fully described in the following sections.

Site Location and Design

A first step in designing a project is to examine the site's physical characteristics to determine potential areas for development. Important considerations are how to maximize natural area conservation, reduce impervious cover, and allow for development approaches that will result in lower levels of runoff. In planning the development of a site, sensitive natural areas, including riparian buffers, mature forests, wetlands, steep slopes, erosion prone soils and wildlife habitat should be avoided. Instead, land that has already been developed or disturbed should be used. Once an appropriate location has been chosen, care should be taken to conserve its natural features, minimizing clearing and grading and preserving as many trees as possible.

Open space design involves reducing lot size in order to maximize open space while accommodating the allowable housing unit count. Various sources suggest that open space developments should set aside 30 to 80 percent of their land, ideally land that is contiguous and of high ecological value. Open space developments and traditional neighborhood design (in which homes are arranged in a village fashion) are development practices that reduce impervious cover. Other techniques include shortening the distances between homes and the street, reducing parking areas, decreasing street width and minimizing the length of streets and roads.

However, it is not enough simply to reduce impervious cover or retain natural vegetation. A new development should also maintain or restore its "open space" as a naturally functioning

ecosystem, thus providing important benefits such as water recharge and filtration, wildlife habitat, recreation, aesthetics and improved quality of life.

“In the Chesapeake Bay Watershed, a study compared compact and dispersed developments on tracts of land of the same size. Compact development consumed one-third as much land as a dispersed development consumed and included about half as much impervious surface. As a result, the compact development pattern resulted in 43 percent less runoff than the more dispersed development” (A Better Way to Grow CBF, p. 7).

In many urban areas one-half to two-thirds of the land area is devoted to transport-related imperviousness (e.g. roads and parking lots). One study found that "transportation-related land uses have the second-highest level of pollutant concentrations; only piped industrial sources were higher." (Stormwater Strategies: Community Responses to Runoff Pollution, NRDC, p. 34)

Despite the clear benefits of designing in an ecologically friendly manner, local codes and ordinances may impose limits on cluster development, shorter setbacks, road dimensions, and other designs that reduce runoff. In order to apply these practices, local codes may need to be revised.

Examples of overall design, as well as information on how to change local codes and ordinances can be found in the following documents: Center for Watershed Protection's Better Site Design: A Handbook for Changing Development Rules in Your Community, the Natural Lands Trust's Growing Greener; Putting Conservation into Local Codes and Conservation Design in the Chesapeake Bay Watershed.

Site Development Practices

After a site has been designed to minimize negative environmental impacts, additional practices may be used to treat any unavoidable storm water runoff. Techniques that allow water to infiltrate the ground at the site, instead of being conveyed offsite, should be used. These techniques are known as Low Impact Development (LID). The goals of LID techniques are to assist in restoring and maintaining a site’s natural hydrology. Examples of LID practices include bioretention areas, buffers, grassy swales and rain gardens.

These site-specific techniques can be applied to new developments. They can also be applied to more traditional development approaches and to existing developments as retrofits, in an effort to alleviate development practices that did not address water quality protection.

This fact sheet was created by the Chesapeake Bay Program in response to the *Chesapeake 2000* commitment to provide information to communities and local governments on the effects of land use and water quality. This fact sheet discusses the importance of using ecologically based designs to improve and maintain water quality and describes terms and approaches associated with storm water management. For a listing of resources and references to help you learn more about ecologically based-design, check out the fact sheet “Learn More About Ecologically-Based Design”.