Streamlines

A Newsletter for North Carolina Water Supply Watershed Administrators

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Site Planning for Water Quality

Site planning is the intentional thought given to the placement of uses onto the land *before* they are built. The process of site planning has been practiced since the earliest times when man studied the landscape for the best location for an agricultural field or primitive hut. The decision was based upon information gathered through observation and through experience gained from previous successes or failures. We continue today to face the challenge of siting our uses in the most beneficial manner which does not conflict with the balance of natural resources.

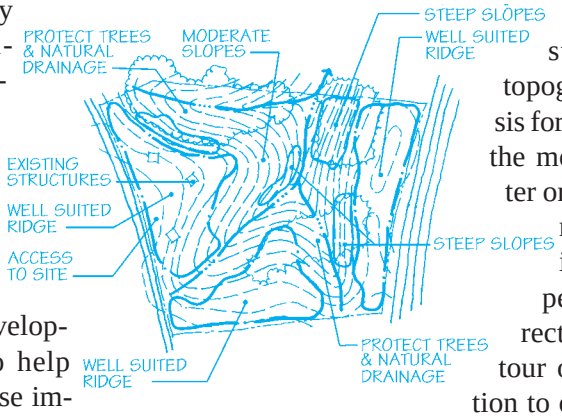
Among the most important natural resources we must protect are our surface waters which occur in the form of rivers, streams, lakes, ponds, bays, sounds, and wetlands. The use of our surface waters can be impaired by pollutants and sediments carried to them by stormwater runoff. When rainfall falls on undeveloped land, the natural vegetation covering the ground intercepts the individual drops and allows the rainwater to be gently returned to surface water and groundwater. When the natural vegetation and topography of the land are changed by development, the contours are smoothed and the landscape covered with hardened surfaces (e.g., rooftops, parking areas, etc.). This change results in decreased infiltration and increased runoff travelling at a higher velocity with increased erosive potential and greater ability to carry suspended and dissolved materials over much larger distances. These materials may ultimately be deposited into surface waters as non-point source pollution.

Individuals and local governments involved in the development of land have the potential to make a great impact in reducing the amount of pollutants which enter our surface waters through stormwater runoff. It is hoped that these groups will support statewide efforts to maintain and improve surface water quality by reducing non-point source impacts of runoff. The following text examines several techniques which can be used in the planning and development process to help reduce the adverse impacts on downstream water quality.

SITE INVENTORY / ANALYSIS

The earliest consideration for stormwater management in the design process should occur through gathering, mapping, and interpreting information about the site. In order to understand the relationship of the existing natural systems to the changes that will occur as a result of development, the existing site conditions must first be mapped onto a base map of the site. A base map depicts the two and three dimensional aspects of land and includes such components as the site boundary and topography which provide a basis for subsequent decisions about the project design.

Topography



An understanding of site topography is the basis for comprehending the movement of water on the site. Water runs downhill -- it will flow in a perpendicular direction from a contour of higher elevation to one of lower elevation. Contours which are spaced close together on a topographic map represent land which is steep; flatter land has contours spaced further apart. As land becomes steeper, runoff flows faster and has more energy to erode soil and to carry pollutants and sediments. For this reason, topography is useful to depict not only the direction of flow on a site, but also to gain an understanding of water velocity.

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Site Planning *(from page 1)*

It is very important to consider slope when designing a site plan for development. Developed areas with steeper slopes allow runoff to pass through more quickly, increasing the potential for downstream flooding and decreasing the chance for infiltration. Wherever possible, it is best to make land uses follow the contours of the site and leave steep slopes undisturbed. Following contours with land uses, instead of crossing them, will enable structures to fit into the land more naturally and require less grading. Since more of the natural earth is left intact, less vegetation will need to be disturbed. Also, the development will be more stable and less likely to erode.

Hydrology

The description of the drainage patterns and other features related to the activity of water on a site is known as the hydrology. Sometimes runoff collects into channels and is carried to streams or lakes; other times, the rainfall will not become runoff but will be absorbed or infiltrated into the ground. The drainage characteristics of a site are generally determined by the attributes of the land such as topography, soil types, and vegetation.

To gain an understanding of the surface hydrology of a site, its features can be mapped using symbols for streams, standing water, wetlands, infiltration areas, floodplains, and other existing conditions. Direction of flow and routing can be indicated with arrows. Even at the conceptual level of design, an effort should be made to increase the distance over which stormwater flows and slow it down so that pollutants and suspended materials are given a chance to filter out.

It should be a goal at the outset of the design to preserve and maintain the existing hydrology of a site. In a natural drainage system, the network of channels, depressions, floodplains, and infiltration areas has had time to become stabilized. When land is developed and the natural drainage patterns are changed, the surface flow must be accommodated in some manner. The curbing, catch basins, and pipes found in a typical development design replace natural channels in their ability to collect and carry flow quantity, but offer little in the control of water quality.

The most effective methods of stormwater runoff management incorporate a simulation of the functions which occur under natural conditions. Methods of this type serve to slow runoff velocity which reduces erosive potential, allows particulate and suspended materials to settle out, and encourages porous areas to absorb surface runoff.

A WATERSHED BASED APPROACH

Site planning for an individual parcel using an integrated approach involves the creation of a site specific management plan with a combination of preventive measures (site design, location of uses), source reduction practices (minimizing disturbance), and control measures (BMPs). An early step in design should be the preparation of a conceptual plan locating major building components and their accessory uses, vehicular and pedestrian circulation patterns, required elements such as set backs and buffers, and other features onto the base map of the site.

The conceptual plan is the most opportune part of the design process during which careful consideration and judgement can be used in the siting of buildings and features so that the final plan will result in a cost effective and efficient stormwater management system. Guidelines to help design for water quality include the following:

- minimize impervious surfaces
- cluster development in upland areas
- minimize disturbance of vegetation
- keep natural drainage patterns intact

"Save the Swales"

Swales, or wide shallow ditches used to temporarily store, route, or filter runoff, are a very effective and affordable stormwater treatment technique. By slowing runoff, swales give water enough time to soak into the soil, reducing runoff volume and pollutant loading. Vegetation in the swale acts as a natural filter, removing sediment, heavy metals, and hydrocarbons. Conventional curb and gutter drainage systems work well for quality control, but grassed swales serve the same purpose with the added benefit of protecting water quality. Swales are less expensive to construct, easier to maintain, and often require a smaller land area than other BMPs.

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Resources

Arendt, Randall. *Rural by Design: Maintaining Small Town Character*. American Planning Association: Chicago, IL, 1994.

Kunstler, James H. *Home from Nowhere*. Simon & Schuster: New York, 1998.

N.C. DENR - Division of Water Quality. *Stormwater Management Site Planning*. NC DWQ: Raleigh, NC, 1998.

Schueler, Thomas R. *Blueprint to Protect Coastal Water Quality*. The Center for Watershed Protection: Ellicott City, MD, 1995.

Schueler, Thomas R. *Site Planning for Urban Stream Protection*. The Center for Watershed Protection: Ellicott City, MD, 1995.

- use overland sheet flow
- route flow over longer distances
- keep runoff velocities low
- do not discharge runoff directly to surface waters
- use non-structural controls
- maximize on-site, off-line storage

Reduce Imperviousness

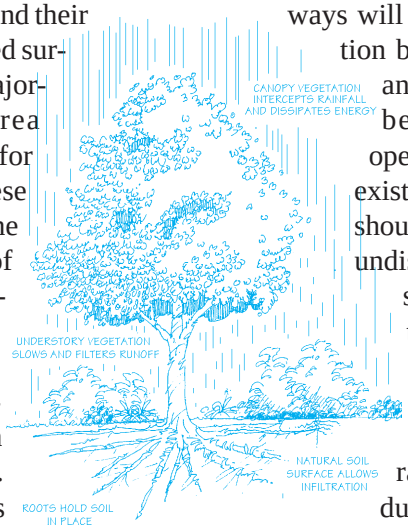
Many non-point sources of pollution in urban runoff are associated with impervious surfaces. Limiting the density of development allows a greater portion of a site to remain in a natural state; and since less of the site is built-upon, there will be fewer sources of pollutants to contribute to the flow. Buildings, transportation components, and their associated exterior paved surfaces account for the majority of impervious area found on a typical plan for development. Since these "built-upon" areas are the source of the majority of new runoff which is generated on a site, they offer the greatest opportunity to reduce the quantity of runoff through design modifications. The design of buildings can be modified to make more efficient use of space and disturb less land. Streets can be narrowed to a more reasonable yet functional width. Also, certain materials which are selected for exterior areas (e.g., wood decking) are more porous and can allow a greater amount of rainfall to infiltrate.

Cluster Development

One means of limiting development density is by clustering land uses into a smaller portion of the site and leaving a percentage of the project area as open space. Locating facilities away from surface waters and providing ample riparian buffers will help to control the quality of surface runoff entering waterways. An increased amount of open space also will allow for a greater amount of rainfall and runoff to be infiltrated. The efficiency of land use on a site may be improved by integrating stormwater management into the open space and landscape elements of a plan.

Vegetation

In order to reduce velocity and pollutant load, stormwater runoff generated by the impervious portions of the site should be routed through natural conveyances which will create longer travel times, provide some means of filtering or capturing pollutants, and allow for absorption of a portion of the runoff. Buffer strips of vegetation along waterways will help to prevent pollution by capturing pollutants and sediments in runoff before they enter the open water. In general, the existing vegetation on a site should be identified and left undisturbed wherever possible. Existing vegetation left intact helps protect water quality in the following ways:



- Areas left in a naturally vegetated state reduce the total amount of impervious surface area on a project thereby reducing the quantity of runoff generated and maintaining the natural porosity of soil.
- A vegetative canopy intercepts rainfall and disperses its erosive energy before reaching the ground.
- Intact root systems hold soil in place and reduce surface erosion.
- Vegetated areas can be used as buffers and natural filtering mechanisms if runoff is directed into these areas at a reasonable rate.

Use Overland Flow

The design of a stormwater system which is different from the standard solution of curb inlets, catch basins, and pipes presents a challenge. Over time, the use of enclosed piped systems has become an accepted solution to control localized flooding in many urban areas. Since the use of this type of system is well understood and can be engineered cost-effectively, it has been encouraged and even required in many areas. However, this methodology focuses on quantity control and ignores the quality aspect of stormwater. The use of grassed swales instead of pipes or lined ditches will allow runoff to be slowed and filtered as it is transported. Where space allows, a broader swale with regularly spaced check-dams should be used to keep velocities low and prevent erosion from occurring.

Storage devices such as wet detention ponds, dry detention ponds, stormwater wetlands, and bioretention areas are intended to hold runoff for a period of time and release it slowly back into the surface water system. During the time that runoff is being held, pollutants and sediments are given the opportunity to settle out or to be filtered by vegetation. An open channel stormwater drainage system incorporating BMPs may require more long-term care and maintenance, but will likely provide better treatment of the runoff, prevent downstream flooding to a greater extent, and may be more aesthetically pleasing as well.

¡ADIÓS AMIGOS!

This issue marks the end of Brent McDonald's tenure with the Division of Water Quality. Over the past two-and-a-half years, Brent has worn many hats as writer, designer, editor, and publisher of *Streamlines*; web site creator and maintainer; and office computer guru; along with his usual duties providing local government technical assistance in the water supply watershed protection program. Brent is leaving the N.C. Department of Environment and Natural Resources to pursue a teaching career in San Diego, California. The WSWP program wishes Brent good luck in his future endeavors. :-)

Look for *Streamlines* on the World Wide Web at URL:
http://h2o.enr.state.nc.us/wswp/SL/

What's Happening ?

May 3-6, 1998 – "Watershed '98 -- Watershed Management: Moving From Theory to Implementation." Denver, CO: Colorado Convention Center. For more information, contact the Water Environment Federation at (800) 666-0206.

May 12, 1998 – "1998 Update: The Clean Water Act." A Four Hour Satellite Seminar co-sponsored by the Water Environment Federation. For more information, contact the American Bar Association at (800) 285-2221.

May 15 & 20, 1998 – Training Workshops on the Neuse River Basin Riparian Buffer Area Rule. Raleigh: May 15. New Bern: May 20. For more information, contact the N.C. Division of Water Quality at (919) 733-5083, ext. 587.

May 17-22, 1998 – Conference of the Association of State Floodplain Managers. Flood hazard mitigation, watershed planning, etc. Milwaukee, WI. For more info, contact Diane Watson at (608) 274-0123, or e-mail: *asfpm@execpc.com*

May 20 & 21, 1998 – North Carolina Chapter of the American Planning Association (NCAPA) 1998 North Carolina Planning Conference. Greensboro, NC: Koury Convention Center. For more information, contact the Institute of Government at (919) 966-5381, or visit the web site at URL: *http://ncinfo.iog.unc.edu/planning/progapa.htm*

June 1, 1998 – Deadline for applications for the next funding cycle for the Clean Water Management Trust Fund (CWMTF). For more information, contact Steve Bevington of the CWMTF at (919) 830-3222.

June 24-26, 1998 – Municipal Stormwater Management. Nashville, TN. For more information, contact the American Society of Civil Engineers (ASCE) at 1-800-548-2723; fax: (703) 295-6144, or e-mail: *conted@asce.org*

July 5-9, 1998 – Balancing Resource Issues: Land, Water, and People. San Diego, CA. For more information, contact Charlie Persinger of the Soil and Water Conservation Society at (515) 289-2331, ext. 12, or e-mail: *charliep@swcs.org*

July 18-22, 1998 – The Urban and Regional Information Systems Association (URISA) 1998 Annual Conference and Exposition. Charlotte, NC. For more information, call URISA at (847) 824-6300, or e-mail: *info@urisa.org*

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