Chapter 13

Incentives, Market-Based Tools, and Private Efforts

A. Introduction

Kentucky communities need sustainable land use practices by private landowners, developers, businesses, and individuals, in order to achieve wet growth goals. Just as purely voluntary efforts are not adequate to prevent harm to water resources, purely regulatory efforts are also not adequate to ensure that land uses, development, and growth are aquatically sustainable. This chapter explores:

1. *incentives* to encourage or facilitate wet growth practices and sustainable land use;
2. *market-based tools* to stimulate wet growth practices and sustainable land use; and
3. *private efforts* to achieve wet growth and sustainable land use.

B. Incentives

Incentives are often use to encourage or in a sense reward a person into a desired action. If the payback or return is sufficient compensation for interested parties, there is the likelihood that there will be a higher number of participants in a program. There are several ways to incentivize sustainable land use and water quality and water conservation methods and practices. Although not all possible incentive programs can be explored in this handbook, this chapter describes incentives in land development codes, the incentives for the use of conservation easements, agricultural conservation programs' incentives, and water conservation incentives used by water supply utilities.

1. Land Development Codes and Ordinances

Local land development codes and ordinances can encourage or facilitate private landowners and developers to engage in land use practices that are more aquatically and ecologically protective than are required by the codes and ordinances. These incentives fall into four general categories:

- Transferable development rights (TDRs): The landowner or developer is restricted from developing the land in certain ways but may sell or transfer those rights to other landowners, who would then get additional development rights, such as additional permissible height, additional allowable densities, or reduced setback requirements, depending on the nature of the restriction and its accompanying TDR.
- Bonuses: The landowner or developer is given additional development opportunities that would exceed the restrictions normally applicable to development on that particular land, such as additional permissible height, additional allowable densities, narrower or no setback limitations, and the like.

- Relief from Requirements: The landowner or developer is excused from regulatory mandates, such as minimum numbers of parking spaces, landscaping requirements, stormwater hookup fees, and the like.
- Procedural Relief: The landowner or developer is entitled to a streamlined or fast-track permitting process or does not have to go through certain permit processes (i.e., a general permit is deemed to apply to the project, or the project is exempted from the permit requirement).

Each of these incentives would be contingent on the landowner or developer engaging in certain design, development, or land-use practices that substantially exceed any restrictions or requirements under applicable federal, state, or local laws or regulations. (Giving a landowner or developer an incentive to do something that is already required, even if by another regulatory entity, is merely a government give-away, and is not consistent with wet growth principles or with accountability to taxpayers and the public.) The specific incentivized design, development, and/or land-use practices would need to identified clearly and precisely in the code or ordinance provisions creating the incentive. The choices made about which behaviors to incentivize and how much and what type of incentives to award should be based on carefully planning, regulatory analysis, and choices about desired wet growth practices that exceed legal and regulatory requirements.

2. Conservation Easements

Conservation easements, which have been discussed in several places in this handbook, are essentially private land conservation for a variety of goals, including protection of water resources and natural ecosystems. They allow a landowner to continue to hold legal title to his or her land and to use it in any way that is consistent with the conservation easement, which is a grant of a property right in the land that permanently restricts its use for specified conservation purposes. Landowners have substantial tax incentives to donate conservation easements to qualified land trusts, particularly under federal tax laws. The value of a conservation easement can be quite substantial and can greatly reduce income, estate-and-gift, and property taxes, depending on a variety of factors. The I.R.S. closely scrutinizes gifts of conservation easements to ensure that actual conservation purposes are served in perpetuity and that they are valued properly and managed properly. Nonetheless, communities seeking to encourage land conservation in order to protect water quality, water supplies, or watersheds should consider land conservation efforts that use the financial benefits of conservation easements to landowners and make connections between owners of especially sensitive or aquatically valuable lands and qualified land trusts that could manage and sustain conservation interests in those lands.

Two experts on conservation easements have described the contributions that they can make to water resource protection:

> "A number of land trusts and other conservation organizations play an increasingly important role in drinking water source protection. . . . [However,] [l]and trusts routinely use conservation easements to address

water quality issues oriented less toward drinking water and more toward water quality or stream health in general. Provisions vary widely, but they are generally targeted at limiting non-point source pollution by restricting landowner activities. The conservation easements target impervious surfaces and urban runoff. But conservation easements may also target non-point source pollution for land use on undeveloped or partially developed lands. Here, conservation easements including an assortment of provisions, for example: establishing stream buffers and limiting certain agricultural or forest practices [e.g., restricting uses of pesticides and fertilizers, methods of timbering, or methods of farming that cause soil erosion], placing limitations on septic system location or manure handling, specifying how storm water is to be managed, and preventing alteration of stream banks, watercourses, or water bodies through drainage, damming, and the building of levees." (King and Fairfax 2005, pp. 1965-66)

3. Agriculture Conservation Programs

The Natural Resources Conservation Service (NRCS) has a conservation program specifically for farmers and ranchers that offer payments to offset costs and loss of income for conservation practices. The Environmental Quality Incentives Program (EQIP) provides both financial and technical assistance to farmers, ranchers, and other eligible parties with conservation practices on agricultural lands. EQIP program plans must comply with the NRCS technical standards specific to local land conditions (NRCS 2009b).

Payment through the EQIP program can be up to 75% of incurred costs of the conservation project and payback begins after the project's first year of completion and implementation for a period of up to 10 years. The costs may also include loss of income due to the conservation practice and/or activity. In addition, historically underserved producers (e.g., limited resource farmers/ranchers, beginning farmers/ranchers, socially disadvantaged producers) may be eligible for payments up to 90% of the estimated incurred costs and income foregone (NRCS 2009b).

The Kentucky Division of Conservation also has a cost share program that reimburses landowners up to 75% of the costs for implementing best management practices (BMPs) for reducing and preventing water pollution. To be eligible, land is limited to agricultural or silvicultural use; included are forestlands using proven silvicultural and agricultural resource principles (Kentucky Division of Conservation 2007).

The BMPs must follow the criteria set forth by the NRCS and local conservation districts and must be approved by the Soil and Water Conservation Commission. This cost-share assistance may be used in conjunction with either federal or local incentives providing that the total reimbursements are not in excess of 75% of the practice cost (Kentucky Division of Conservation 2007). Some BMPs for agricultural lands with livestock include:

- using animal waste as a fertilizer for agricultural land, which reduces the use of chemical fertilizers which can also cause pollution and allows management of the location, concentration, and runoff of manure;
- allowing only limited access at stream crossings (cattle should only have access to the stream when they are being transported form one part of the farm to another) (See Figure 10-7 in Chapter 10 for an example); and
- stabilizing streambanks to help restore the natural function of the stream corridor thus improving the water quality.

For example, in Fleming County, a local farmer sought the assistance of the NRCS after converting his dairy farm to a beef cattle operation. He acquired additional land that had been primarily used for silage and grain corn production. As such, these lands had no fencing and with only a pond and small stream serving as a water supply for his beef cattle. Since cattle do not stray more than 800 feet from their water supply when looking for food sources, it was likely that the cattle would forage in a small area of the farm. With the cattle having free access to the pond and stream and not straying far from it when looking for food, the end result would be a contaminated water supply and overgrazed forages. Seeking help from the NRCS, the Fleming County farmer applied for the EQIP to help offset the costs to implement practices to protect the water supply and land. Proposed plans included:

- tapping into the county's water for the cattle's drinking water supply and installing pipeline to connect to livestock water tanks strategically located throughout the grazing areas;
- excluding or limiting livestock access to the pond and streams; and
- rotating grazing and subdividing large fields for more efficient foraging.

Within the first year of the EQIP contract, the farmer was able to install about 6,500 feet of pipeline and eight livestock watering tanks and credits NRCS and the EQIP program for helping him to attain his goals (NRCS 2007b).

In addition to EQIP, the NRCS has two other federally funded cost-share programs that can be used to conserve lands for water quality. First, the Conservation Reserve Program (CRP) offers farmers both technical and financial assistance about how best to address soil, water, and related natural resource concerns on their property. CRP encourages the use of BMPs as well as helping farmers and agricultural landowners achieve their goals while adhering to federal and state environmental laws. The aim of CRP is a reduction in soil erosion and sedimentation in streams and lakes, which in turn leads to an improvement in water quality. This program can also be used to establish wildlife habitats and enhance both forest and wetland resources. Cost-sharing is provided when farmers and/or agricultural landowners replace highly erodible cropland or other unsustainable lands to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. For each term of the multi-year contract, farmers and/or agricultural landowners receive rent payments (NRCS 2009a).

Second, the Wildlife Habitat Incentive Program (WHIP) is directed at landowners who want to develop and improve wildlife habitat on agricultural land or nonindustrial

private forest land. Like EQIP, this program offers up to 75% cost-share assistance as well as technical advice on how to establish and improve fish and wildlife habitat. The cost-share agreement can last anywhere from 1 to 10 years after the final conservation practice is in operation (NRCS 2009c).

4. Water Conservation Incentives

Water utilities often offer incentives as a means to encourage their customers to participate in conservation programs. A reduction in consumer use eases demand from the water supply, reduces flows to wastewater treatment facilities and septic systems, and diminishes nonpoint pollution from lawns and impervious surfaces. Also, a reduction in the demand on supply will reduce the need for new equipment, infrastructure, which then results in a reduction in log-term costs to both the water utility and its customers. Some customers are willing to become active participants in conservation programs but find it difficult due to economic or financial barriers. Lack of knowledge, consideration of changes in lifestyle, or a genuine mistrust of water conservation technologies may also impede participation. By offering a variety of incentives, water utilities can help their customers change behavior and invest in equipment and appliances to conserve water (Fiske and Weiner 1994).

Water utilities with incentive programs often claim that "general awareness of the importance of water conservation is a key factor when encouraging program participation" (Fiske and Weiner 1994). An effective tool that essentially provides water customers tips on water conservation technologies and practices that would also save money is an audit. Audits can be performed for residential, commercial, and industrial customers, and also for large landscapes that are typical for public institutions, or customers using landscape meters or irrigated acreage. For accuracy, audits should only be performed by trained personnel or contracted professionals.

To have an effective water audit, water utilities would need to recruit a sufficient number of customers to participate and follow through on recommendations. Workshops to instruct customers how to implement conservation measure can accompany the audit process. In addition, requiring an audit as a prerequisite for incentives such as free devices, direct installation, leak repairs, rebates, vouchers, and funding is an excellent way to boost participation (Fiske and Weiner 1994).

Free giveaways often include plumbing-related devices that lower consumption. These might include faucet aerators, shower flow restrictors, low-flow showerheads, toilet tank displacement bags, and dye tablets for toilet tank leak detection. Water utilities might even offer installation for free or for a nominal fee.

Around the U.S, communities and water utilities have crafted rebate programs to incentivize customers to use less water. Examples of rebates include new, water-saving washing machines, high-efficiency and low-flow toilets, water-efficient HVAC and irrigation systems, replacing water thirsty lawns with native and adaptive plants, and one-time cash credits for proof of installation of water-efficient plumbing fixtures (Fiske and Weiner

1994; Hesperia, CA, http://www.cityofhesperia.us/article.cfm?id=86 and http://www.cityofhesperia.us/article.cfm?id=535; Boiling Springs, N.C., Water Conservation Incentive Program, http://www.boilingsprings.govoffice.com/index.asp?Type=B_BASIC&SEC=%7B31E1A141-C1B9-42F7-A96F-2B595B00A22E%7D; Solar Direct 2008). In North Carolina, the Town of Cary has adopted a water conservation program in response to increased demands on the Town's limited water resources. Its incentive program includes:

- affordable rain barrel kits along with a free build-your-own rain barrel workshop;
- a $150 rebate available to residential and business water customers for each new WaterSense[1] certified high-efficiency toilet;
- $500 Turf Buy Back for replacing a minimum of 1,000 square feet of turf with either a naturally landscaped area or warm season grass (Cary, N.C. Water Conservation Incentive Programs, http://www.townofcary.org/depts/pwdept/water/waterconservation/incentiveprograms/incentiveprograms.htm).[2]

The Town is able to fund these and other rebates due to "sound financial planning and growth" (M. Cefalo, personal communication, April 6, 2009).

Funding assistance programs are suitable for large scale water savings projects. Programs might be low-interest loans or matching funds. The South Florida Water Management District crafted the Water Savings Incentive Program (SIP) as a means to engage industrial, commercial, institutions, and even homeowners' associations in water conservation practices. By providing up to $75,000 of matching funds to both water providers and large users for installing water-efficient devices as well as adopting water-saving procedures, the District has realized a savings of more than 1 billion gallons of water since the program began in 2002. Successful projects have included upgrading and installing water-saving technology such as automatic flushing devices for hydrants, retrofitting or replacing indoor plumbing fixtures, using soil moisture and rain sensors, and large area "smart" irrigation system controls (SFWMD, Water Savings Incentive Program, https://my.sfwmd.gov/portal/page?_pageid=1874,4164497,1874_4166538&_dad=portal&_schema=PORTAL).

[1] The Town of Cary is a partner in EPA's WaterSense program. WaterSense represents products that meet criteria for water efficiency and performance and the WaterSense program relies on partners to educate and encourage consumers to purchase these products as a means to conserve water; see http://www.epa.gov/WaterSense/index.htm.

[2] Naturally landscaped areas save as much as 25% to 33% of the water used by traditional landscaping methods; warm season grasses require 21% less water during spring and summer (Cary, N.C. Water Conservation Incentive Programs, http://www.townofcary.org/depts/pwdept/water/waterconservation/incentiveprograms/incentiveprograms.htm).

C. Market-Based Tools

Clean water is clearly a benefit for everyone. However, the cost of pollution prevention most often lies on the landowner. Although cost-share and incentive programs have been effective tools in encouraging landowners to adopt and implement water conservation practices, it is important to seek other strategies to help landowners defray the costs. One evolving strategy for funding mechanisms for water quality and conservation efforts is the implementation of market-based tools. Market-based tools are "policy tools that encourage behavior through market signals rather than through explicit directives" (Whitten and Young 2003). This approach provides an incentive for landowners to incorporate pollution abatement into management decisions (U.S. EPA 2009).

In order to be effective, market-based tools rely on the assumption that there will be a fair amount of participants (buyers and sellers) with a healthy sales volume. Some of the types of transactions or forms that are best suited for environmental management are tradable permits, conservation auctions, and taxes and flat rate subsidies (Whitten and Young 2003; Knight 2005).
A market-based tool that has emerged in recent years is Water Quality Trading. With this, a farmer or agricultural landowner can get paid for implementing water conservation practices. Reducing nutrient (nitrogen and phosphorus) and sediment reduction earns water quality credits which can then be sold to wastewater treatment plants and some industries that cannot operate without restrictive permits that limit the amount of pollutants discharged into waterways; this exchange of credits has made it possible for the treatment plants to meet their regulatory requirements and provides ways for the industries the ability to invest in new technologies (Lal; U.S. EPA 2003; Conservation Technology Information Center 2006).

There are four principle parties that need to be involved when trading water quality credits. They are:

1. Sellers: most often farmers and other agricultural landowners but could also include waste treatment plants with extra credits;
2. Buyers: wastewater treatment plants;
3. Regulatory Agencies: the federal, state, or local agency that sets the trading policy and guidelines; and
4. Trading Facilitators: aggregators, consolidators, or central exchanges that facilitate trading transactions between buyers and sellers.

The Environmental Protection Agency (EPA) has established guidelines and policies in its *Trading Policy* paper regarding water quality trading and individual states have their own policies that are specifically written for their jurisdictions (Lal; U.S. EPA 2003).

An example from Ohio illustrates how water quality trading works. The Miami Conservancy District (MCD) of the Great Miami River Watershed in Ohio covers 4,000 square miles of which more than half of the land is used for agricultural purposes. Approximately 1.5 million people live in the area. The MCD's Water Conservation Sub-District (WCS) initiated the Great Miami River Watershed Water Quality Trading Program to lower the amount of phosphorus and nitrogen that was being washed into the receiving

waters downstream from the watershed. The local county proposed BMPs and conservation district staff worked with participating farmers and agricultural landowners to find ways to reduce the amount of nutrients discharged into the watershed. Since the program began in 2005, the levels of discharged nutrients from the agricultural lands have been lower than what the Ohio Department of Natural Resources and the EPA had originally predicted (Lal).

D. Private Efforts

Incentives and market-based tools are ineffective without the participation and commitment of land owners, water customers, businesses, and individuals. Furthermore, there are many other water quality and conservation measures that are readily available to consumers that require minimal investment. Most often the investment is time and a willingness to alter behaviors that affect water consumption and pollution prevention. Some of the methods and devices available include plumbing fixtures such as low-flow toilets, faucet aerators, appliances, rainwater collection, and water-conserving landscape and irrigation techniques. Changes in behavior or practices might include taking less time in the shower, running the dishwasher or washing machine only when there are full loads, and promptly repairing plumbing leaks (Flowers 2004).

What follows are tips and guidelines that lead to water quality, water efficiency, and water conservation for the private sector – both residential and business water consumers. In addition, water management practices are also provided for agricultural and development practices.

1. Water Customers' Indoor Water Conservation

High-efficiency appliances include clothes washers and dishwashers and should bear the EnergySTAR label. Front-loading clothes washing machines use 30 to 50% less water, use 50% to 60% less energy to run, require one-third less detergent, and create less wear and tear on clothes than the conventional top-loading models. Newer high-efficiency dishwashers use only 6–10 gallons per load as compared to 9–12 gallons per load used by older models and 20 gallons by hand-washing (Massachusetts Water Resources Authority 2006).

Water-efficient plumbing fixtures, devices, and leak detection for the home or office include low-flow/low-flush toilets, low-flow showerheads, and faucet aerators. Faucet aerators, which reduces splashing and flow by mixing air with the water, can actually reduce the amount of water coming through the faucet by 50 percent (Flowers 2004). Attentive leak detection and repair averts wasting water; dripping faucets account for up to 44 gallons water wasted per day and 3,520 gallons of water can run through a leaky toilet in one year (Flowers 2004).

2. Greywater

Wastewater generated from kitchen and bathroom sinks, bathtubs, showers, dishwashers, and washing machines is considered greywater. These wastewaters are diverted from being discharged in a sewer or septic system and can be recycled or reused for irrigation purposes. The exceptions would be kitchen sink water with food particles, especially from disposals, and laundry water used to wash soiled diapers.

There are several treatment methods for treating greywater, including:

- discharging directly onto the ground so that it is absorbed into the soil;
- draining into a mulch basin;
- diverted to a branched drain;
- draining to constructed wetlands; and
- diverted and treated in a solar greywater greenhouse.

The benefits of a greywater irrigation system are:

- reducing fresh water use;
- reducing strain on septic system or treatment plants;
- developing real estate not suitable for septic (including the use of composting toilets);
- recharging groundwater;
- supporting plant growth in areas lacking sufficient water;
- maintaining soil fertility; and
- enhancing water quality.

Precautions need to be taken when setting up a greywater recycling system as untreated greywater can become contaminated in a short time. Some jurisdictions may require permitting before a system can be implemented (LetsgoGreen.com, Greywater Recycling Basics, http://www.letsgogreen.com/greywater-recycling.html).

An example of several water conservation practices, including greywater use is Berea College's Ecovillage, which houses up to 100 students and their spouses and children. The water conservation design of the apartments include low-flow showerheads and faucets, low-flush toilets, rainwater from roofs that is used for landscape irrigation, and water from an ecological machine re-used in toilets. Ecological Machines or Living Machines are wastewater treatment systems that treat sewage and industrial waste naturally to reuse quality. These Machines are comprised of a series of tanks loaded with live plants, trees, grasses and algae, koi and goldfish, tiny freshwater shrimp, snails, and a diversity of microorganisms and bacteria that, as a different mini-ecosystem, is designed to eat or break down waste. It takes about 4 days to turn the dirty water crystal clear. This method of treating wastewater is chemical-free, odor-free and, when compared to conventional waste treatment, it costs less both financially and ecologically. The Ecovillage's goal for residential water consumption is 15.8 gallons of water used per day per person; this represents an overall decrease of 75% of water used when compared to the average amount of water used in other residential units on the campus. After the first year of operation, residential water consumption in the Ecovillage actually decreased 49%, with an average of 32 gallons of water used per day per person (Briggs and Olson 2005).

3. Water Customers' Outdoor Water Conservation

Landscaping, lawn maintenance, and swimming pools contribute extensively to the amount of water used externally, especially in the warm summer months. Nearly a third of outdoor water consumption is used for lawn care. In hot dry months, turf lawns require watering and this can average up to 180 gallons per application. One way to reduce the amount of watering is by planting trees, shrubs, and drought resistant plants that tend to absorb rainfall more efficiently than turfgrass. Watering should be scheduled for the early morning or evening hours when water is less likely to evaporate before soaking into the soils. Other methods to reduce evaporation are by mulching around the base of plantings (this alone can reduce evaporation by up to 70%) and also by not mowing lawns shorter than 2 centimeters (Flowers 2004).

BMPs for landscape water conservation are aimed to reduce landscape water use during the entire growing season (not just periods of drought). These BMPs are designed to be economical, practical, and sustainable and are a combination of what plants to use in the garden, watering methods, cultural and management practices, and a change in how we expect plants to perform during sub-optimal water conditions (University of Georgia Cooperative Extension 2007).

4. Landscapes

Before adding a new landscape or making changes in a current landscape design, careful thought should be given on how the landscape will be used, how it is going to look when completed, how to integrate the trees, shrubs, and plants that are established into the new design, the amount of water will be needed to maintain it (University of Georgia Cooperative Extension 2007). Key points to consider and follow when adopting a landscape design are:

- Choose plants that match the existing light conditions; they will be hardier and require less water. If a plant is listed as requiring full sun it will need 6 to 8 hours of full, direct sun. Even though a plant can grow with less light, plant form, leaf shape, and flowering habit will likely be affected resulting in plants with bigger leaves, spindly stems, and fewer flowers.
- Make sure that surface and soil drainage conditions go with plant moisture requirements. Select drought tolerant plants for dry areas. Though mounding soil to create raised beds improves soil drainage, a raised bed may not work if the drainage problem is caused by topography. When new soil is added, be sure to mix the two soils together to prevent drainage problems caused by layering effects.
- Choose plants that are suited for the temperature ranges of the area. A plant's water requirement depends on it tolerance to cold and heat and often plant labels recommend which U.S. cold hardiness and heat tolerance zone is best suitable for that particular tree, shrub, or plant. (The U.S. National Arboretum provides an interactive cool hardiness and heat tolerance zone

map on its website, www.usna.usda.gov/Hardzone/ushzmap.html.) Consider too the effects of a man-made environment on plants; radiant heat temperatures in large paved surfaces can easily rise well above the average air temperature of the area causing the transpiration rate to increase. This requires plants to need more water than normal.

- Choose plants that are best suited to the average rainfall of the area.
- Keep and maintain well-established plantings since these have extensive root systems and require less water than newly planted trees and shrubs.
- Space plants according to their mature size to reduce competition for water and space. Shrubs planted too close together require more water and maintenance, encourage moisture-related problems around foundations and crawl spaces by reducing air flow, and also are havens for insects and diseases. The traditional "green necklace" of plants wrapped around a building's foundation is the most commonly over-planted area.
- Concentrate seasonal color in small, highly visible areas to reduce overall water requirements. Since most annuals used in seasonal color displays are shallow-rooted plants and have high water requirements, locate flower beds where they will provide the greatest impact yet be close to available water sources. Using large containers placed in high impact locations that provide enough room for adequate root growth and by carefully selecting plants for container conditions can result in achieving high-impact color that requires less water than in-ground beds.
- Do not construct raised beds under trees as this can be harmful to tree roots and ultimately results in root competition for moisture. Large trees have extensive root systems that compete with adjacent plants for water and nutrients. Often, a raised bed is built under the tree by adding several inches of new soil over the existing grade which is quite harmful to the tree because it restricts the amount of oxygen and nutrients reaching the tree roots. When placed around the trunk, the raised bed may also promote wood decay. If the tree survives, its roots will eventually grow into the added soil and compete once again for water and nutrients.
- Arrange landscape plants in larger groupings in mulched areas with wide, curved bed lines to create a more natural or informal look. Do not build small, irregular-shaped island plantings in turfgrass areas as they are difficult to irrigate; turfgrass is a tough competitor for water and nutrients. When carefully selected and spaced properly, plants within mulched areas can be watered separately from adjacent turfgrass areas, thereby conserving water.
- Incorporate shade trees into the landscape to reduce evaporative water loss as they also provide shade, reduce stormwater runoff, stabilize soil, reduce evaporative water loss, and reduce summer air conditioning needs. Shade trees should be planted on the south and west sides of a building to block the sun and placed at least 20-30 feet away from the building, preventing future damage from falling limbs or brushing against the building.
- Divide the landscape into three water-use zones: high, moderate, and low and then choose and group plants according to their water needs and

drought tolerance. High water-use zones are highly visible areas of the landscape, such as the entrance to the property or building, where plants are irrigated as needed to promote optimum growth and aesthetic appearance. Moderate water-use zones, transition zones that bridge the high and low water-use zones, should have established plants that are watered only when they show signs of moisture stress. Low water-use zones are low impact areas or background areas viewed from a distance and should include beds of mulch or drought tolerant plants because they are not irrigated once established.

- Developing a landscape plan should come before designing the irrigation system. It stands to reason that planning for future irrigation upgrades are easier if done before installing the irrigation system itself. For instance, larger timers can be used to accommodate future zones, PVC sleeves can be placed under paved surfaces to provide easy access for future water lines, and control valves can be placed in an in-ground box adjacent to areas for future planting. The irrigation system should fit the landscape plan instead of dictating the landscape design.
- Consider the irrigation sprinkler patterns when designing turfgrass areas and planting beds. By designing turfgrass areas that match available sprinklers, problems such as watering sidewalks and streets, or accidentally watering adjacent mulched areas can be avoided.
- Arrange herbaceous plants and shrub according to height in order to take advantage of the upward angle of most irrigation sprinklers since large, tall plants located along the edge of a bed are more likely to block the stream of water, preventing the plants behind them from receiving the proper amount of water. Also, plantings adjacent to buildings often require sprinklers to be placed on risers in the back of the planting in order to prevent irrigation water from contacting the building; installing drip irrigation is the solution for this situation.
- Plants not suited to the existing site conditions and irrigation should be moved or eliminated altogether. Since some plants may require frequent watering to survive, while others are over-watered, it is unwise to design and install landscapes without regard to site conditions or water conservation practices, as this invites problems (University of Georgia Cooperative Extension 2007).

5. Rain Gardens

A biodiverse and attractive landscape project that in effect recharges the groundwater supply is a rain garden. Designed with a shallow depression that captures stormwater runoff from impervious surfaces such as rooftops, patios, driveways, and parking lots, rain gardens are a natural, organic way that allows water to filter pollutants before entering the storm water system (Croce 2009; Bluegrass Rain Garden Alliance, http://www.bluegrassraingardenalliance.org/).

6. Swimming Pools

Precautions can be made to mitigate water loss from backyard swimming pools. Using a pool cover can reduce evaporation (an average pool loses up to one inch of water per week from evaporation), and windbreaks lowers evaporation as well.

7. Builders and Developers

Building and development projects often lead to disturbances in the land and waterways that alters natural drainage by either reducing the ability to absorb stormwater runoff or removing natural features in exchange for increasing impervious surfaces that lead to an increase in the flow and intensity of stormwater runoff.

In some instances, builders and developers are mandated to employ stormwater treatment methods. Throughout Kentucky, any construction project that disturbs one or more acres of land is subject to Kentucky Pollutant Discharge Elimination System (KPDES) General Storm Water Permit requirements. These permit applications for storm water point discharges are reviewed and approved by the Kentucky Division of Water (DOW). The discharges include storm water runoff associated with industrial activity, construction activities, and stormwater runoff from municipal storm separate sewer systems (Kentucky Division of Water, Storm Water, http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/storm/). To help with the preparation of a stormwater point discharge plan, the DOW has several publications that not only walk the applicant through the erosion and sediment control process, but also explains planning and implementation of measures that reduce harmful water quality impacts from construction projects and other land-clearing activities. The storm point discharge permit, along with the free publications, *Kentucky Erosion Prevention and Sediment Control Field Guide* and *Kentucky Best Management Practices (BMPs) for Controlling Erosion, Sediment, and Pollutant Runoff from Construction Sites: Planning and Technical Specifications Manual*, can be obtained from the DOW's office in Frankfort or from its website at http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/storm/.

However, there are other creative and innovative measures that developers and builders can use to reduce the amount of storm water runoff and pollutants. Some methods involve construction strategies to reduce stormwater runoff and while others are design-oriented that protects and preserves open spaces, natural habitats, and other sensitive environmental resources. As discussed in Chapters 2, 3, and 7 of this handbook, these methods often actually save developers and builders money, while enhancing the value (and typically the price) of the developed properties.

a. Indoor water conservation: In addition to low-flow and high-efficiency toilets, faucets, showerheads, and landscape irrigation systems, indoor water conservation strategies may include tankless water heaters or demand (tankless or instantaneous) water heaters. These water heaters work by heating water directly instead of storing in a tank

resulting in the avoidance of standby heat loss and are ideal for supply hot water to locations in a building that are distant from a main hot water source.

b. Green roofs: A green roof "consist of plants being grown on roofs, thus replacing the vegetated footprint that was destroyed when the building was constructed" (Green Roof Research Program at Michigan State University, http://www.hrt.msu.edu/faculty/rowe/green_roof.htm). There are several benefits from having a green roof that include reducing stormwater runoff, better air quality, reducing urban heat island effects, preservation of habitat and biodiversity, aesthetics, local food production, and even recreation (Green Roofs for Healthy Cities, http://www.greenroofs.org/index.php?option=com_content&task=view&id=26&Itemid=40). Green roofs are often constructed using moveable, interlocking grids with plantings and growing materials that are placed or layered on a filtered drainage system. Sedums and other succulents are most often the plants of choice since these are drought resistant and able to withstand high temperatures. Studies have shown that some green roofs are capable of capturing 100% of rainfall during a rainstorm, and on average these roof-types retain about 80% of the rainfall (Rosenzweig et al. 2006).

In Kentucky, Sanitation District 1 in Ft. Wright added a green roof when expanding its administration building. Since this district's responsibilities include storm water management for Boone, Campbell, and Kenton counties in northern Kentucky, it was able to incorporate the instillation of the green roof as a working example of storm water BMP. The 3,600 square foot green roof is comprised of two inches of growing media and an additional two inches of granular drainage media and the plantings include ornamental grasses, chives and sedums. For research purposes, the District also has a 3,600 square foot conventional roof at its facility to act as a control for monitoring data. Using this data, the District expects to determine how effective the green roof performs as a stormwater management tool as well as the green roof's effectiveness from season to season. In addition, the District's green roof serves as an educational tool for children and adults alike. Public tours are provided and the region's school children benefit from outdoor environmental education projects (Green Roofs for Healthy Cities, http://www.greenroofs.org/minneapolis/index.php?page=sandistnoonewin).

c. Green parking: Another way to lessen the impact of development on stormwater runoff is through green parking. Green parking refers to "several techniques that applied together reduce the contribution of parking lots to total impervious cover" (U.S. EPA 2006). When employed properly and effectively green parking techniques reduces impervious cover, which in turn reduces the amount of stormwater runoff. Private developers can employ such green parking lot techniques as:

- minimizing the dimensions of parking lot spaces;
- utilizing alternative pavers in overflow parking areas; and
- using bioretention areas to treat stormwater.

Alternative pavers are in effect permeable surface materials that can be used for walkways, driveways, and parking lots instead of the traditional impervious asphalt and

concrete surfaces. The benefits are obvious: more permeable surfaces equates to less stormwater runoff. There are two categories of alternative pavers: 1) paving blocks, and 2) other permeable surfaces such as gravel, cobblestones, brick, natural stone, wood, and mulch. Paving blocks are grids, concrete or plastic, with gaps between them that allow for gravel or planted grass inside the holes to allow for infiltration. Sometimes the pavers have a gravel layer below it to keep the blocks from settling and also to allow for more infiltration. The amount and type of traffic affects the durability and efficiency of these pavers. For areas with high traffic volume, pavers should be limited to parking overflow areas. Pavers and other alternative surfaces are suitable for driveways and walkways in residential areas, but are not handicap accessible (U.S. EPA 2006).

A portion of the parking area at the Girl Scouts Program and Learning Center in Louisville is paved with pervious concrete. The Center is located on Lexington Road and the parking lot is adjacent to an area that leads to Beargrass Creek. Construction included applying an environmentally-safe, soybean oil-based water-repellent, called the "Bean", to the pervious concrete after placement. This helped to protect the surface, especially during the curing period. Manufactured in Indiana from Indiana soybeans, the Bean poses no threats to plants and animals (Concrete Products 2006).

d. Conservation subdivision design: Conservation Subdivision Design (CSD), also referred to as cluster development, is an alternative to the conventional subdivision layout. CSDs concentrate the home sites on a portion of the subdivision development parcel in order to preserve the remaining land as open space. This leads to a reduction in impervious surfaces, stormwater pollutants, construction costs, grading, and loss of natural areas. Uses for the open space may include preservation of existing natural features, restoration of natural conditions, and continued agricultural use and its ownership and overseers could be a homeowners association, the local municipality or County, the State, a land trust or other private conservation organization, or the original landowner. To ensure the common open space is protected from future development or more intense uses, conservation easements and deed restrictions should be incorporated in the development plans (SEWRPC, Conservation Subdivision Design, http://www.sewrpc.org/ca/conservationsubdivisions/; Stormwater Manager's Resource Center). The benefits of a CSD include:

- protected water quality;
- protected wildlife habitat;
- reduced infrastructure costs;
- reduced maintenance costs;
- reduced demand for publicly funded green space; and
- means for expanding public trails and greenways (Smart Communities Network).

As opposed to conventional subdivisions, the open space and natural resources within individual building lots in a CSD stand much better chances being maintained and preserved. If designed properly, natural features, as well as agricultural lands, can be protected by minimizing lot sizes, setbacks and frontage distances. Pollutant reductions,

including a 45% to 60% decline in nutrient exports from two conventional subdivisions after being redesigned as open space subdivisions, have been reported due to the significant drop in runoff from impervious surfaces. On average, a CSD has about a third less impervious cover than a conventional subdivision (SEWRPC, Conservation Subdivision Design, http://www.sewrpc.org/ca/conservationsubdivisions/; Stormwater Manager's Resource Center).

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