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Planning Information Sheet:

Influencing Water Quality with Comprehensive Planning and Ordinances

Metropolitan Design Center

Version 2.0

DESIGN FOR HEALTH is a collaboration between the University of Minnesota and Blue Cross and Blue Shield of Minnesota that serves to bridge the gap between the emerging research base on community design and healthy living with the every-day realities of local government planning.

UNIVERSITY OF MINNESOTA

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Overview

Design for Health's *Planning Information Sheets* series provides planners with useful information about opportunities to address important health issues through the comprehensive planning process and plan implementation. The series addresses a range of health issues that are relevant to many communities and can be efficiently and effectively integrated into local plans and policies. This information sheet provides insights for planners in understanding how water quality relates to health and points to innovative approaches to planning for water quality.

Key Points

- Most water-quality research focuses on ecological issues; as a result, the corresponding thresholds and planning strategies do not prioritize human health. In other words, what's good for the environment may not actually be what's good for human health. While they are interconnected, the Design for Health project focuses specifically on the link between water quality and human health, as opposed to looking at ecological issues. Two issues are key: access to clean drinking water and the ability to use streams, lakes and rivers for recreational purposes, such as swimming and fishing.

- Federal and state regulations have been effective in managing pollution problems from point sources. Agencies at all levels of government, however, remain concerned about nonpoint sources, such as agricultural and urban stormwater runoff, where land-use planning and design decisions play an important role.

- A key issue area that planners often consider is controlling the allowable amount of impervious surface. Paved surfaces and buildings reduce natural filtration and exacerbate runoff, which carries waste, fertilizer, sediment, and other pollutants directly or indirectly into surface and ground waters. While a primary focus is on the ecological impacts of runoff, it can also lead to health problems for humans, such as gastrointestinal illness (diarrhea, vomiting, cramps), pneumonia, increased risk of cancer, and other health concerns (EPA 2006c). Soil-runoff, for example, can lead to higher levels of turbidity, which is "associated with higher levels of disease-causing microorganisms, such as viruses, parasites and some bacteria" (EPA 2006c).

- Research, which focuses mostly on stream health as opposed to human health, shows that high levels of impervious surface leads to stream degradation; however, there are no conclusive thresholds, because there are too many variables to consider (Schueler 1995). One variable is whether or not a buffering system is in place. Here, research consistently supports a threshold of 15 to 80 m of distance between moving water and developed sites (Steedman 1998; Haycock and Muscutt 1995; Phillips 1989; Tufford 1998). It should be noted that these buffers are based on ecological health and not human health; these can provide a preliminary rationale, however, when making planning decisions.

- Water quality may be addressed in comprehensive planning in many ways. Approaches include: integrating water quality into traditional elements, such as environmental resources and conservation, public infrastructure, or parks and open space; developing supplemental plans, such as design landscape standards or local water-management plans; or creating separate maintenance and management plans for specific areas.

Industrial uses, such as gravel mining, have an obvious effect on water quality

- Specific strategies that planners can use to improve human health related to water quality include developing water-related landscape design standards, creating incentives for green roofs, encouraging rain gardens, re-working zoning regulations to include buffer thresholds, designing ordinances that encourage pervious pavement, and revising the development-review process to include an evaluation of impervious surfaces. While there may not be direct health impacts associated with the tools identified in this bullet, they fall into three categories: (1) reducing impervious surface, (2) increasing buffering and (3) promoting infiltration. These general approaches are represented in the literature as contributing to ground-and surface- water quality.

- Water quality is not an isolated issue; rather, it is tied to many other health topics covered in the DFH materials. For more information, see the table below.

Understanding Water Quality

Planners in transportation, land use, economic development, neighborhood development, public works, and parks and recreation make decisions every day that either directly or indirectly affect water quality. In this context, the Design for Health team specifically focuses on the link between water quality and human health in relation to land-use practices and community design. Readers interested in other aspects of water quality can consult numerous sources at www.designforhealth.net. We also recommend the NEMO (Nonpoint Education for Municipal Officials) Program as a starting point. Its Web site, nemo.uconn.edu/index.htm, provides a series of publications that addresses the relationship between land use and water quality. We focus on two issue areas: access to clean drinking water and the ability to use streams, lakes and rivers for recreational purposes, such as swimming and fishing. These issues are explored through three themes: polluted run-off, septic systems and toxins.

Design for Health Planning Information Sheets addressing Water Quality

DFH Planning Information Sheet:	**Topics covered related to accessibility:**	**Link:**
Influencing **Water Quality** with Comprehensive Planning and Ordinance	▪ Polluted run-off ▪ Decentralized wastewater treatment systems ▪ Toxic waste	http://www.designforhealth.net/techassistance/waterqualityissue.html
Promoting **Accessibility** with Comprehensive Planning and Ordinances	▪ Multimodal transportation systems ▪ Transit planning ▪ Specialized populations	http://www.designforhealth.net/techassistance/Accessibility.htm
Supporting **Physical Activity** through Comprehensive Planning and Ordinances	▪ Pedestrian and bicycle plans ▪ Community design	http://www.designforhealth.net/techassistance/physicalactivityissue.html

Polluted Run-off

As mentioned in the Key Question Series, water cleanliness is affected by both point and nonpoint sources of pollution. Here, we focus primarily on the relationship between land-use decisions and nonpoint-source pollution since point sources—such as factories or sewage treatment plants—are already regulated through federal and state standards. While there are certainly still point sources polluting waterways, water-quality assessments now point to nonpoint sources as the reason why most water-quality standards are not met (Randolph 2004, 393; EPA 2006a). Nonpoint-source pollution has a number of causes. Some problems occur when rain or irrigation systems overwhelm the existing treatment systems. Others are associated with agricultural runoff that collects fertilizers, soil particles and nutrients. Urban stormwater runoff is another source of water pollution, since there is no formal treatment system. As rainwater washes across impervious surfaces it picks up pollutants, such as sediment, litter, road salt, motor oil, pet and livestock waste, or hazardous particles from air pollution. These sources cause pathogens, sediment, debris, and toxic substances to move into surface- and ground-water without any natural or artificial filtration systems. This may lead to health problems, such as gastrointestinal illness (diarrhea, vomiting, nausea, cramps), pneumonia, anemia, circulatory problems, reproductive difficulties, kidney damage, liver problems, nerve damage, increased blood pressure, increased risks of cancer, and—in extreme cases—death (EPA 2006c).

Ann Forsyth

New kinds of porous or pervious pavers can allow water to infiltrate into the soil while still supporting heavy use

Decentralized Wastewater Treatment Systems (e.g. sewage systems, septic systems)

Drinking water can come from either ground-water sources (via wells) or surface-water sources (such as rivers, lakes and streams). Nationally, most water systems use a ground-water source (80 percent), but most people (66 percent) are served by a water system that uses surface water. This is because large metropolitan areas tend to rely on surface water, whereas small and rural areas tend to rely on ground water (EPA 2006a). On-site wastewater or septic systems are used by 23 percent of the homes in the United States (Randolph 2004, 341). To work effectively, the systems need appropriate soils, should be located appropriate distances from wells and water bodies; and need to be properly designed, installed and maintained (EPA 2006a). Other important characteristics are: topography, surface drainage, vegetation, and proximity to surface waters, wells, wetlands, rock outcrops, and property lines (Randolph 2004, 343).When these needs are not met, human health suffers. In 1996, the EPA estimated that 500 communities had public-health problems caused by failed septic systems and septic systems are listed as the third most common source of ground-water contamination (Randolph 2004, 342).

Minnesota, in fact, has one of the highest failure rates, with 50-70 percent of the systems failing (Randolph 2004, 343). Decentralized wastewater treatment systems also cause problems for surface waters if they are not located properly. The EPA recommends that in order to enhance management of decentralized wastewater treatment systems, state and local governments should develop a well thought-out strategy that considers a number of factors, including design options, site conditions, operation and maintenance requirements, periodic inspections, monitoring, and financial support (EPA 2005, 4). In 2005, the EPA published a handbook entitled, Managing Onsite and Clustered Decentralized Wastewater Treatment Systems: An Introduction to Management Tools and Information for Implementing EPA's Management Guidelines. It provides helpful information about how to do initial scoping, set goals and objectives, identify stakeholders, convene public meetings, assess and analyze existing conditions, develop a management program, and set up evaluation strategies. It offers a series of community examples related to implementation, program authority, financing, and program evaluation.

Toxic Wastes
Toxic wastes from point and nonpoint sources are detrimental to human health. They originate from industrial, commercial, and agricultural areas and can pollute surface water and ground water, which can make drinking water unhealthy and make it impossible to safely use surface waters recreationally for fishing and swimming (Design for Health 2007). As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program regulates point sources that discharge pollutants into waters of the United States (EPA 2006a). "Individual homes that are connected to a municipal system, use a septic system or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal and other facilities must obtain permits if their discharges go directly to surface waters" (EPA 2006a). Operators of industrial facilities or sites with activities included in one of these 11 categories must obtain coverage under an NPDES industrial stormwater permit (EPA 2006a):

- Facilities with effluent limitations
- Manufacturing
- Mineral, metal, oil and gas
- Hazardous waste, treatment, or disposal facilities
- Landfills
- Recycling facilities
- Steam electric plants
- Transportation facilities
- Treatment works
- Construction activity
- Light industrial activity

In most cases, the NPDES permit program is administered by authorized states. The federal and state regulations do a good job of monitoring and managing toxins that come from point sources; however, there are significant health problems associated with toxins that affect human health through nonpoint sources. Nonpoint sources are addressed above in the section on polluted runoff. For more information about NPDES, visit cfpub.epa.gov/dpdes/index.cfm. The site also lists a variety of case studies about how states are dealing with water-quality issues in relation to human health.

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High levels of nutrients can affect the quality of water in lakes and streams

Planning for Water Quality

There are a variety of urban-planning and design-related features that try to mitigate the causes of polluted drinking water and bodies of water through regulations on the use of septic systems, location of toxic wastes and other pollutants, and the level of runoff caused by urban development. In the next section, we look at a variety of policy and implementation strategies that are used to encourage the link between public health and water quality.

Polluted runoff
Polluted runoff is a complex issue because it is connected to a much larger conversation about watershed management that links environmental- and human-health concerns. Moreover, research, which focuses mostly on stream health as opposed to human health, shows that high levels of polluted runoff leads to stream degradation (Schueler 1995). Even though it is a multi-faceted issue, we do know that runoff causes problems for drinking water and for recreational surface waters; as a result, this section looks at a variety of ways that communities are handling runoff issues.

In its municipal code, the City of Santa Monica, California, includes a chapter on urban-runoff pollution, where the objective is to reduce both runoff volume and contamination from existing and future residential and non-residential development. Although polluted runoff is a regional planning issue, in that runoff from multiple southern California communities affects water quality in the Santa Monica Bay, policies at the local, regional and state level all contribute to improving water quality. The City of Santa Monica is particularly concerned with the runoff that enters the streets and eventually the Santa Monica Bay beaches through the storm drains. Each new development application must submit an Urban Runoff Mitigation Plan that "shall infiltrate or treat projected runoff for the new development by an amount equal to or greater than the volume of runoff produced from a storm event through incorporation of design elements" (City of Santa Monica No Date). The code also includes requirements for construction sites, "good housekeeping requirements" and a list of goals that the design strategies should achieve. They include:

- Increase permeable areas:

– Maximize the percentage of permeable surfaces and green space to allow more percolation of runoff into the ground. The use of porous materials for or near walkways will increase the amount of runoff seepage into the ground,

– Use natural drainage, detention ponds or infiltration pits so that runoff may collect and seep into the ground and reduce or prevent off-site flows,

– Divert and catch runoff through the use of swales, berms, green strip filters, gravel beds and French drains,

– Construct driveways and walkways from porous materials to allow increased percolation of runoff into the ground;

– Minimize the amount of runoff directed to impermeable areas and/or maximize stormwater storage for reuse:

– Install rain gutters and orient them towards permeable surfaces rather than driveways or nonpermeable surfaces so that runoff will penetrate into the ground instead of flowing offsite,

– Modify grades of property to divert flow to permeable areas and to minimize the amount of stormwater leaving the property,

– Use sediment traps to intercept runoff from drainage areas and hold or slowly release the runoff, with sediments held in the trap for later removal,

– Design curbs, berms or the like so as to avoid isolation of permeable or landscaped areas;

- Reduce parking lot pollution:

– All parking lots are required to have the capability to contain one inch of precipitation in a 24-hour period. Options to meet this requirement include use of green strip filters and porous pavement to capture and percolate runoff where possible, and use of oil and water separators or clarifiers to remove petroleum-based contaminants and other pollutants which are likely to accumulate,

– Direct runoff toward permeable areas and away from pollutant laden areas such as parking lots,

– Construct parking lots from porous materials.

Source: City of Santa Monica no date

New construction projects are also evaluated under a series of best-management practices identified within this code. One example in Article 7 states that, "Runoff, sediment and construction waste from construction sites and parking areas shall not leave the site" (9). Santa Monica is an example of how plan implementation is being used to regulate concerns about drinking water and recreational water.

In Minnesota, the Minneapolis Parks and Recreation Board releases a water resources report every year that summarizes its monitoring program; analyzes every lake, watershed, beach, river, and golf course within its jurisdiction; and offers suggestions for water-quality education. The report is a comprehensive technical reference and it is used by the City of Minneapolis in the development of its comprehensive plan. The monitoring section of the report includes information about the Lake Aesthetic and User Recreation Index (LAURI), which gives recreational users an easy-to-understand guide about whether or not they should use the lakes for fishing and/or swimming. The four categories include: aesthetic considerations (color and odor of water, garbage and debris), recreational interferences (aquatic plants), environmental quality (water clarity), and public health (E. coli measured at public swimming beaches) (Minneapolis Park and Recreation Board 2004, 11). The latter determines whether or not there is health risk present for swimmers, because this weekly testing of E.coli is a sign of fecal contamination that often comes from runoff problems (pet waste, water fowl, etc.) and it leads to an increased risk of gastrointestinal illness. This report is particularly useful, because it deals specifically with concerns about contaminated water that make it difficult for residents of Minneapolis to use its lakes, streams and rivers for recreational purposes.

The Local Surface Water Management Plan for the City of Minneapolis is a policy tool designed to combine management systems for sanitary sewers, storm drains and surface waters. The plan, which must also be approved by the regional governing body and the watershed district, contains sections on trends in water-resource management, categorization of systems, identification of regulatory responsibilities, goals and policies, assessment and inventory of resources, and plan implementation—all of which inform the City on how to balance aging infrastructure and regulatory mandates in order to encourage stormwater infiltration and reduce runoff (City of Minneapolis 2006, 6). The plan has been implemented through various City actions. The Public Works Department within the City of Minneapolis, for example, recently put in 90 grit chambers that are stormwater drainage system structures that remove sediment, trash and debris from storm runoff, so they are not deposited in receiving surface waters. "They were essentially large underground cement boxes with baffles, which allowed water to slow down. Once the process slows down, the sediments and heavier materials settle to the bottom of the box below the pipe entrance and exit" (City of Minneapolis 2006). This is a project that is being collaborated on by both the Public Works Department and the Parks and Recreation Board to help monitor the effectives of the chamber, since it stops working once it is full. These have typically been used on onsite public facilities, and the goal is to eventually make it a requirement for all private construction.

As mentioned previously, research has been conducted on the role that vegetated buffers can play in reducing the negative impacts that impervious surfaces have on stream health, which may lead to better drinking water and opportunities to fish and swim in lakes and rivers. Communities can either incorporate buffer thresholds into their existing landscape-design guidelines or imbed buffer thresholds into existing water-quality related ordinances. It is important to note that buffer thresholds to date focus on ecological-health needs and not human-health needs. This is not to say that buffers and landscaping are bad or that they have no impact on humans—it just means that we don't know what kind of impacts they do have.

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Rain gardens, such as this attractive one at Andrew Riverside International Peace Park, can be integrated into many paths and yards. Minneapolis

Researchers at the University of Georgia created a model stream-buffer ordinance that specifies a distance between moving water and developed land. The purpose of the ordinance is to protect water supplies, trap other pollutants in surface runoff, promote bank stabilization, protect wetlands, etc. The buffer zone restricts development and allows only limited land uses through the establishment of an overlay zone. The zoning language states (Wenger and Fowler 2000, 61):

> The Riparian Buffer Zone District (RBZ) is an overlay zone that encompasses all land within 100 ft [or width defined above] on either side of all streams, measured as a line extending from the stream bank. The RBZ must be maintained in a naturally vegetated state.

There are specific land uses that are prohibited within this area. They include (61): septic tanks, all types of impervious surfaces, buildings, landfills, mining, etc. The ordinance also lists definitions, permitted uses, minor variances, major variances, and additional water-supply watershed requirements. It is unclear whether or not any municipality has used this model ordinance.

Rain gardens are becoming an increasingly popular tool for dealing with polluted runoff that may contaminate drinking water, and it is in small, vegetated areas where rainwater is directed to be filtered by plants and soil. "Their location, size, and effectiveness depend on such things as the amount of rain that moves from a house/building, the number and location of downspouts, soil types and the plants used. The gardens are practical in landscaped areas along drives or walks, corner pieces to the yard and receiving areas for roof downspouts or sump pump hoses" (City of Maplewood 2006). Communities can take an active part in the design and development of rain gardens by offering incentives, technical assistance, educational materials, etc. Two suburban communities in Minnesota—Maplewood and Burnsville—are practicing this technique in concentrated areas in both new and old neighborhoods. Each advocates the use of rain gardens to combat polluted runoff from lawn fertilizers, pesticides, herbicides, yard wastes, sediment, and animal wastes—all of which seep into the ground- and surface-water, which leads to contaminated drinking water and the inability to use the lakes and streams for recreational purposes. Maplewood offers a list of extensive construction requirements and measurement methods, as well as other educational materials to help community members get their bearings. Burnsville set up a comparison study to monitor runoff in two comparable neighborhoods—one had rain gardens and one did not. One test showed that the street with gardens contributed to 90 percent less stormwater to the lake. While the rain gardens are not listed in zoning or landscaping ordinances, they are indirectly related to the comprehensive-plan goals for water quality.

Pervious surfaces are another way that drinking water is being treated. Permeable pavements are surfaces that allow water to pass through voids in the paving material and/or between paving units, while providing a stable, load-bearing surface. There are many types of pervious pavement, including plastic rings planted with grass; stone or concrete blocks with pore spaces backfilled with gravel or sand; porous asphalt; and porous concrete. Pervious pavement accepts only precipitation, not stormwater runoff (City of Portland 2004, 13). Many communities are beginning to incorporate plan implementation and policy frameworks that include pervious surfaces. The City of San Antonio, Texas, includes pervious surfaces within its plan implementation methods by including it within its parking and storage standards (Article 5, Division 6). In its code, it states that vehicle-parking areas can exceed their maximum number of spaces permitted if the additional spaces are designed as pervious pavement. It further identifies what kind of permeability rating the surface must have, as well as the necessary soil and slope conditions. It also includes maintenance standards by requiring the pavement to be "vacuum swept" and washed with a high-pressure hose at least four times a year (City of San Antonio 2006, 5-196).

The City of Seattle, Washington, has design guidelines that describe specifically where permeable pavers are allowed. This is listed as a strategy within the environmental element of its comprehensive plan. The design guidelines encourage permeable pavement by allowing it to act as a credit toward flow-control requirements. The standards list the three main categories of permeable pavements that are allowed, "based upon the reservoir base course, which provides stability for load-bearing surfaces and underground storage for runoff" (City of Seattle 2005a). They are:

- Permeable concrete or permeable asphalt pavement: similar to standard pavement, but the fine material (sand and finer) is reduced or eliminated in the mix. As a result, channels form between the aggregate in the pavement surface and allow water to infiltrate.
- Plastic grid systems: comes in rolls that are covered with soil and grass or gravel. The grid sections interlock and are pinned in place.
- Interlocking pavers: include cast-in-place or modular pre-cast blocks. The cast-in-place systems are reinforced concrete made with reusable forms. Pre-cast systems are either high-strength cement concrete or plastic blocks. Both systems have wide joints or openings that can be filled with soil and grass or gravel.

Source: City of Seattle 2005a

Seattle limits permeable pavements to non-street surfaces, such as sidewalks, driveways and parking pads. The table below outlines which materials are allowed for each street right-of-way component.The mandatory environmental element with the City comprehensive plan focuses more directly on ecological concerns rather than human health; however, the chapters on the natural-systems approach, aquatic areas, climate change, and source control all do affect human health. One of the policies within the section on natural systems is to, "Strive to increase the amount of permeable surface and vegetative cover in the city in order to mitigate the heat island effect of developed areas, control stormwater flows" (City of Seattle 2005b, 11). Seattle is a prime example for showcasing how policy and plan implementation work together.

The City of Portland, Oregon, in its Stormwater Management Manual, includes a section entitled, Pervious Pavement Operations and Maintenance Plan. The manual includes such topics as the required inspection timeline, how to treat surface materials, ways to deal with overflows or emergency spillways, identification of appropriate vegetation, and how to handle source control issues. The section on vegetation, for example, states (City of Portland No date, 10) that, "Vegetation and large shrubs/trees that limit access or interfere with porous pavement operation shall be pruned and fallen leaves and debris from deciduous plant foliage shall be raked and removed." Portland has also written

Table 1. Permeable Pavements in Street Right-of-Way

Component	Design Guidance—Approved Materials
Driveway, parking pad	Parking spaces and driveways, may use the gravel-pave technique, permeable concrete or permeable asphalt provided the City's loading requirements for driveways and long-term maintenance considerations are met. Refer to Standard Plan 430 and Standard Plan 431 for more information.
Sidewalk	Permeable asphalt and permeable concrete may be used for sidewalks provided the City's ADA requirements and long-term maintenance considerations are met.
Pathway	Permeable asphalt, permeable concrete, unit pavers and gravel-pave may be used for informal pathways.
Roadway	Roadway pavement shall continue to use standard non-permeable materials.

Source: City of Seattle 2005a

a case study about an example of a permeable-pavement project on Westmoreland Street. It is a test to see how well this kind of pavement works in a street, as opposed to just driveways and parking lots, by studying durability, maintenance requirements and drainage capacity (1). It is joint pilot project that includes Environmental Services, Portland Office of Transportation, and Portland Water Bureau. These pilot projects are popping up around the country as communities are looking for innovative ways to treat human and ecological health.

While this information sheet focuses specifically on techniques that local governments can use to address runoff issues in their communities, it should be noted that regional approaches are available and can be effective in addressing water quality issues at the watershed scale. For example, the Chesapeake Bay Program's Watershed Model estimates the sources and movement of pollutants from various locations in the watershed (Koroncai et al. 2003). In order to reduce pollution, Chesapeake Bay Program partner communities agreed to cuts in nutrients and sediment flowing into Chesapeake Bay and its tributaries, accomplished through local efforts to minimize agricultural runoff, managing animal waste, controlling erosion and sediment, buffering and a wide range of other measures (Chesapeake Bay Program 2007). Another example is the Minnehaha Creek Watershed District in the Twin Cities Metropolitan Area. As a regulatory agency, the watershed district has more authority than the Chesapeake Bay Program. The agency requires permits for many projects related to erosion control, floodplain alteration, wetland protection, dredging, shoreline improvement, water body crossings, and stormwater management (Minnehaha Creek Watershed District 2007).

Decentralized Wastewater Treatment Systems (e.g. sewage systems, septic systems)

In the EPA handbook on decentralizing wastewater treatment systems, there are a series of examples that cover a wide range of topics in relation to financing, plan implementation, stakeholder analysis, public education, etc. These case studies address the many technical, financial and participatory components that need to be addressed to successfully manage these systems, both from a governmental and an individual-home level. Three examples of case studies show how different communities are dealing with wastewater systems that have been either polluted or have the potential of polluting drinking and swimming water:

1. "Because of accelerated development in the Idaho panhandle and a rapid rise in nitrate concentrations in the Rathdrum Prairie Aquifer, the Panhandle Health District (PHD), which covers the state's five northernmost counties, developed a plan to implement an interim moratorium on new development served by conventional septic tank soil-absorption systems. The high-nitrate problem had been traced through ground water monitoring to wastewater systems in densely developed subdivisions. To gain support for the plan, the PHD made presentations that documented the problem and proposed solutions to school, civic and professional groups. The PHD then formed an ad hoc citizens' committee to develop and present suggested changes to the preliminary policy developed by the PHD. This committee included representatives from home builders, the U.S. Department of Agriculture's Natural Resources Conservation Service and two other affected federal agencies, farmers, planning boards, the state legislature, the League of Women Voters, and conservation/environmental organizations" (11).

2. "The Commonwealth of Massachusetts has developed three programs that help finance onsite systems and management programs. The loan program provides loans at below-market rates. Another program provides a tax credit of up to $4500 over three years to defray the cost of system repairs for a primary residence. Finally, the Comprehensive Community Septic Management Program provides funding for long-term community, regional or watershed-based solutions to system malfunctions in sensitive environmental areas. Low-interest management program loans of up to $100,000 are available" (46).

> 3. "Fairfax County, Virginia requires septic tank pumping every five years. System owners must provide the county health department with a written notification within 10 days of the pump-out. A receipt from the pump-out contractor, who must be licensed to handle septic-tank residuals, must supplement the notification" (50).
>
> Source: EPA 2006a

We recommend that communities refer to this comprehensive handbook when determining how to handle policy and plan-based implementation options for treatment systems.

The Minnesota Pollution Control Agency (MPCA) monitors the state's individual sewage-treatment systems (ISTS), which are known as septic systems as part of the federal requirements outlined by the EPA. The 1994 ISTS Act and its supplementary amendments directly connect public health with water quality as opposed to focusing solely on environmental considerations (MPCA 2006). The act requires that all new construction and replacement of ISTS "adequately protect the public health and the environment" (1994). It also establishes a method "to replace systems which pose an imminent threat to public health and safety (10-month upgrade) and systems that are failing to protect groundwater (upgrade per local requirements)" (1994).

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This rain garden also in Minneapolis, is part of a central open space in a housing development

As reflected in a passage of the 1994 ISTS Act, the objectives in regulating sewage treatment are to:

> - keep inadequately treated sewage away from human contact to prevent disease;
> - reduce levels of pathogenic bacteria discharged to the environment;
> - reasonably and cost-effectively prevent ground-water contamination;
> - develop clear direction for design, construction and maintenance of sewage-treatment facilities; and
> - strive for cost-effective methods of sewage treatment to maintain or improve property values.
>
> Source: MPCA 2006, 2

These examples show how the issue of water quality is not just a local one, but an issue that is coordinated at all levels of government. It is important to note that these systems are good ways of managing wastewater if they are properly designed, built and implemented. Local governments can actively play an important role in protecting drinking water by setting up systems to meet these three requirements.

Local plans can deal with decentralized wastewater treatment systems. For example, the mid-sized City of Lacey, Washington, located near Olympia, has integrated language into its comprehensive plan related to wastewater systems, including the extension of public systems and the use of septic tanks. This language, cited in the City's Wastewater Comprehensive Plan Update includes:

> - Preference normally should be given to providing adequate public facilities in settled areas, rather than extending new services to sparsely settled or undeveloped areas, and to serve the incorporated land before serving unincorporated areas. However, sewer extension shall be allowed to areas for purposes of ground water protection, surface water protection or the correction of identified existing residential, commercial or industrial need for sewer service.

- Residential and commercial development utilizing septic tanks for sewage disposal which have sanitary sewer laterals readily available should be required to hook up to sanitary sewer when the system fails, needs replacement or requires major repairs.

- A large portion of the Lacey growth area is in the designated McAllister Springs Geologically Sensitive area. Property located in this area should not develop at densities greater than one unit per five acres on septic tanks and drain fields. When such property is developed at one unit per five acres, it shall be done so in a clustered manner that will allow redevelopment at urban densities once sewer service is made available

Source: City of Lacey, WA 2005

One policy example comes from Bayfield County, Wisconsin. The county is located on the edge of Lake Superior, with a 2000 Census estimated population of 15,000. The County's sanitary permit requirements are tied to local soil conditions, which dictate the use of certain types of septic systems (e.g. conventional, mound, holding tank, aerobic treatment system) pending the results of a soil test.

Toxic Wastes
As indicated earlier, toxic wastes via point sources are heavily regulated by federal and state standards. For more information about how they are regulated, please visit www.epa.gov. At its Web site, the EPA recommends two specific examples of ground- and surface-water protection overlay districts to protect drinking water. The ground-water district emphasizes the connection between land uses and shallow aquifers, and it lists geographic zones, as well as what uses are encouraged and prohibited. Zone 1 (within 1000 feet (304 m) of the public well supply), for example, is referred to as the "Drinking Water Critical Impact Zone," and the encouraged uses are parks, greenways and publicly-owned recreational areas. Some of the prohibited uses include: gas stations, truck/bus terminals, junkyards, feed operations, storage tanks, dry cleaners, etc. It also recommends that abandoned wells should be properly plugged, so they don't become accidental conduits from contaminated pollutants that move from surface water into ground water.

The Reservoir Protection Overlay Zone (RPOZ) is "intended to ensure the adequate protection of current or potential public water supply reservoirs" (EPA 2006b). Rather than focusing on specific zones, this ordinance focuses on use regulations; for example, it prohibits storage, treatment, production, or disposal of federally-recognized hazardous materials. Like the overlay zone above, it does not allow dry cleaning, photo processing, service stations, or junkyards. This particular code also lists a series of review requirements for any site development proposal; these evaluative measures include:

- preventing nonpoint source pollution to the maximum extent possible, by taking into account site conditions, such as slope, soil type and erosivity, and vegetative cover;
- having sufficient management practices to remove or neutralize those pollutants that present a potential impact to the reservoir; and
- minimizing grading and removal of vegetation at a development and having erosion- and sediment-control measures in place and properly installed.

Source: EPA 2006b

Since point sources are regulated by both policy and plan implementation efforts, this means the conversations now center around nonpoint sources that harm humans through surface- and ground-water contamination. Examples of how communities are dealing with toxins are generally listed below in the thematic section about polluted runoff.

Final Thoughts

While federally-regulated water-quality standards were initially put in place to help human health, they have evolved to include great ecological protections. As a result, much of the research today focuses on the link between environmental concerns and water quality. Here, our attention is focused on human health in relation to drinking water and surface waters used for recreational purposes. We recommend a series of policy and plan implementation strategies that are mostly focused on polluted runoff, since most of the themes are regulated from the federal, state and regional levels. It is important to note that many of these strategies we recommend, such as buffering or pervious surfaces, are used for ecological health and indirectly for human health. This doesn't mean that they won't positively affect humans; it just means that we don't know how much good they will actually do.

For more information on the links between public health and planning, please visit www.designforhealth.com.

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