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PRACTICE SOURCE WATER PROTECTION

Overlay Zoning for Source Water Protection

By Matthew T. Allen

Land-use professionals and academics alike are keenly aware of the importance of water resources as a critical, foundational element of both the natural and built environments. As these spheres have become increasingly interwoven since the turn of the 20th century, water resources have come to be understood as part of a coupled natural-human system. This understanding has been predicated on the undeniable observation that humans and the natural environment influence each other at all scales—local, regional, and global (Konar et al 2019).

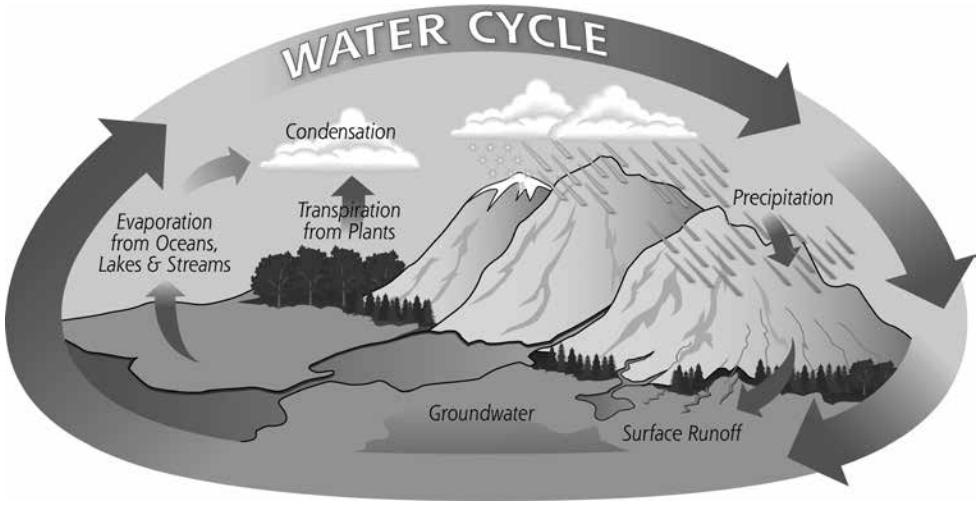
While water resources are impacted by human activity in many direct and indirect ways, land use and land cover changes—which is to say changes in the character of the landscape brought on by human activity and development—are especially notable. Deforestation and increases in impervious surfaces are known to greatly alter local hydrology. Affected watersheds suffer from flash floods throwing erosion and sedimentation regimes out of balance, resulting in habitat loss and limitations of water quantity and availability. Further, point and nonpoint pollution from the built environment stand to contaminate watersheds, undermining their ability to support nature and humans. Local impacts have been observed to combine and ramp up in scale as the edges of developed areas meet one another; in this way, large embayments, estuaries, and other coastal resources such as the Long Island Sound, Chesapeake Bay, and the Gulf of Mexico have experienced large die-offs of marine life due to hypoxia caused by anthropogenic contaminants (Rabalais 2017). The environmental, social, and economic costs of the degradation of water resources are monumental and untenable.

As air and water pollution came under increasing public and governmental attention in the middle of the 20th century, culminating in the ratification of the Clean Air and Clean Water Acts as well as the creation of the Environmental Protection Agency in the 1970s, point source pollution of water resources has debatably come under control (Russell 2004). However, nonpoint source pollution—an aggregate of many diffuse sources of contamination—has continued. Land-use professionals occupy a critical position; they can design and implement land-use regulations at the local level, where the benefits of amelioration can ramp up in scale just as the impacts of degradation have. Effective local land-use regulations broadly implemented can protect the hydrologic cycle, specifically the stage where water crosses landscapes as surface water or groundwater and is used by people and nature.

This edition of *Zoning Practice* will ask and answer a series of questions toward the goal of advancing an understanding of how land-use regulation—particularly zoning—can and should be used toward source water protection.

WHAT IS SOURCE WATER?

The hydrologic cycle is a continuous global physical process of water moving under the power of the sun's energy as well as gravity from the atmosphere, to the landscape, to the oceans, back to the atmosphere, and on again. When water precipitates out of the atmosphere and onto the landscape, about 70 percent returns directly to the atmosphere through evaporation and transpiration. The



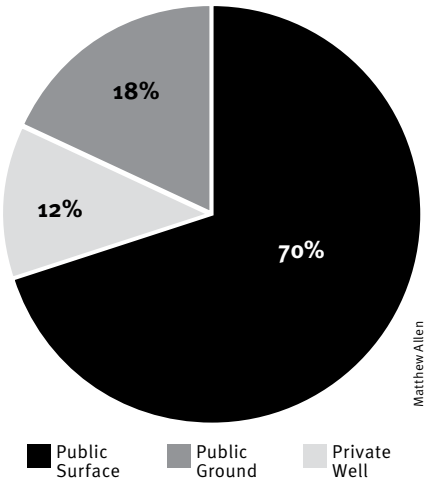
NASA (CC by 2.0, via Flickr)

A simplified representation of the water cycle.

30 percent that remains comprises surface water and groundwater; it is this relatively small portion of the hydrologic cycle that is used as "source water" by humans (Washington State Department of Ecology 2005).

While some source water resources are enormous—the Lake Mead reservoir and the Ogallala Aquifer are the largest surface water and groundwater resources in the United States, with maximum volumes of more than 32 billion cubic meters and four trillion cubic meters respectively (Maupin et al 2014)—most are relatively small and used at the local level. In the northeastern United States, most communities depend on local surface water and groundwater as source water, and the level of treatment required to make those sources potable and safe depends greatly on the level to which the resource is affected.

Many private residences depend on on-site wells. Although home wells typically must meet certain criteria for initial permitting, monitoring beyond instillation is generally not required by law and is up to the homeowner. In contrast, the Connecticut State Department of Health, like agencies in other states, requires operator certifications and ongoing reporting for public water systems (PWS) that range from wells servicing restaurants, schools, and churches to large reservoirs servicing cities with many thousands of users. According to the Connecticut Department of Public Health, regulated PWS fall into three categories: Community Water Systems, which serve at least 25 residents throughout the year; Nontransient, Noncommunity Systems, which serve a least 25 users six months of the year (schools, office buildings); and Transient, Noncommunity Systems, which service the public but do not meet the definition of the previous two categories (restaurants, parks). In Connecticut, 2,438 PWS service about three million people (more than 80 percent of the state's population) through almost 800,000 connections. While the vast majority of PWS in Connecticut are sourced by groundwater (2,349 of 2,438 systems, or more than 96 percent), they serve far fewer people than the systems sourced by surface water. In fact, the 89 PWS in Connecticut sourced by surface water serve in total almost 2.5 million people, or about 70 percent of the state's population.



Matthew Allen

About 70 percent of the population of Connecticut is serviced by a Public Water System (PWS) sourced by surface water, while 12 percent are serviced by a PWS sourced by groundwater and 18 percent are serviced by a private on-site well.

These trends generally mirror national ones; according to the U.S. Geological Survey, about 60 percent of the public water supply of the United States is sourced by surface water while about 40 percent is sourced by groundwater (Dieter et al 2018). This is important to note because surface water is generally more susceptible to land-use impacts than groundwater, though land use can also significantly impact groundwater.

WHY DOES SOURCE WATER NEED PROTECTION?

Since 1900 the population of the United States has increased more than 300 percent, from about 76 million to 330 million. Population density in the contiguous United States has increased as well, from about 10/km^2 to 40/km^2. Additionally, developments in transportation and changes in federal, state, and local policy have led to counterurbanization, where populations are dispersed from cities (Mitchell 2004). This has led to suburbanization and sprawl—low-density development that leads to inefficiencies in land use, including rampant deforestation of watersheds and increased impervious surfaces that greatly exacerbate nonpoint source pollution and alter landscape hydrology (Harbor et al 2000).

Myriad environmental, social, and economic impacts due to degradation of source water resources have been observed throughout the United States. According to the U.S. Environmental Protection Agency, source water contaminants from nonpoint source pollution include fertilizers (nutrients), insecticides, and herbicides from agricultural and residential sources; oil, grease, heavy metals, and other toxic chemicals from motor vehicles; and viruses, bacteria, protozoans, parasites, and nutrients from livestock and failing septic systems. These contaminants can cause disease and death in humans—especially expectant mothers and their babies, the elderly, and the infirm—in many direct and indirect ways. Additionally, water from source water resources costs more to monitor and treat; such economic challenges can exacerbate concerns or crises of public health and environment for communities.

Source water resources are vital for humans and nature. Impacts to the physical and chemical integrity of water resources can destroy habitat by altering local hydrology and geomorphology and introducing contaminants that directly harm native flora and fauna. In these ways local ecosystems can be thrown severely out of balance, sometimes irrevocably. Affected watersheds often become barren or overrun with invasive, nonnative species, making them dangerous and inappropriate for use as a source water resource as well as other uses (Harbor et al. 2000).

As natural resources continue to be encroached upon and overtaxed, it is imperative that land use be regulated and development reined in where it stands to impact source water the most. Further, to protect source water resources, public health, and the environment, it is also

imperative to inform and engage community stakeholders. Collective stewardship made up of people from different parts of a community is needed to realize safe, sustainable source water resources.

HOW CAN SOURCE WATER BE PROTECTED?

From the interdisciplinary field of sociohydrology, which seeks to combine physical and social sciences toward a holistic understanding of water resources, has emerged a concept known as Integrated Water Resources Management (Konar et al 2019). Integrated Water Resources Management is defined as a process that promotes the coordinated development and management of water, land, and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. It has further been emphasized that water should be managed in a watershed context under the principles of good governance and public participation (Rahaman & Varis 2005). The framework has been developed on an international scale, but it can be used just as well at the local level where zoning regulations are administered. Municipal or county government is especially conducive to the kind of integration prescribed by Integrated Water Resource Management.

Although the outright prohibition of development and all nonpassive land use within a source water resource's watershed would be most effective toward source water protection, in most developed areas water companies do not own their source water resource's watershed; as a result, they have limited if any authority over development and land use there. Typically, land-use regulation is delegated by states to local governments; accordingly, it is they who hold authority over the watersheds of source water resources when it comes to regulation of development and land use. However, conventional zoning—which divides a jurisdiction into zoning districts and establishes use and dimensional regulations for each—can actually contribute to the problem of nonpoint pollution by ignoring the impacts of nearby development. For example, if a lot has a stream running through the rear yard or encompasses part of an aquifer recharge area, a large minimum front setback required per dimensional regulations for the zoning district might force development toward that stream, resulting in possible degradation to its water quality (Russell 2004). However, such limitations of conventional zoning's ability to protect source water resources may be overcome with the implementation of overlay zones.

An overlay zone is a zoning district that is applied over previously established zoning districts, imposing further standards and criteria in addition to those of the underlying zoning district. Regarding source water protection, an overlay zone can be defined spatially not only by watershed boundaries but also by riparian corridors and/or aquifer recharge zones establishing protections exactly where they are needed.

One reason overlay zoning is a valuable tool for the protection of source water resources is that watersheds are confined by topography, and thus already delineated and defined (Russell 2004). The Continental Divide is a familiar example; the Rocky Mountains in the western United States serve as a hydrological dividing range where, in general, water that falls on the eastern side of the highest ridges ultimately flows to the Gulf of Mexico and Atlantic Ocean while that which falls to the west flows to the Pacific. All watersheds, no matter their size, have naturally defined physical boundaries that determine waterflow. Although boundaries of riparian zones for specific stream channels and aquifer recharge areas are not so readily defined by topography as those of watersheds are, they too may be defined by less obvious but long-established standards. The delineation of aquifer recharge areas, for example, requires inferences based upon the results of well tests, mapping of surface watersheds, and studies of soils and geology (Russell 2004); fortunately, such information is typically available from state or federal agencies. The boundaries of watersheds and aquifers that serve as source water resources may then be married to the special zoning district, the designated overlay zone.

Most communities adopt a comprehensive plan or master plan that ideally articulates a clear vision, reflects community consensus on all aspects of growth, and serves to guide future development. Many states require municipalities to have a comprehensive plan that must be periodically updated. Most include some mention of natural resources, conservation, and/or environmental protection. However, while in many cases such sections of a comprehensive plan might offer some mapping, survey, or description of source water resources within the subject jurisdiction and call for their general protection, they often fall short of prescribing specific regulatory measures. Overlay zoning for source water protection can help to fill that void and achieve congruence with the spirit of a proclaimed general consensus that source water resources are vital and ought to be protected, while offering an effective regulatory tool beyond what can be achieved through conventional zoning.

OVERLAY ZONING FOR SOURCE WATER PROTECTION IN GROTON, CONNECTICUT

Many communities have instituted overlay zoning to protect source water resources, though these schemes vary significantly in application and practice. This variation is a testament to the appropriateness of such regulation being done at the local level, where it can be tailor-made to adhere to the unique values and characteristics of a community. As opposed to rules handed down from a state capital that may be many miles away, community governance allows for more customization, stakeholder engagement, and transparency.

Groton, Connecticut, is a municipality of about 40,000 located on the state's southeastern shoreline. Like many communities of its size, zoning regulations were adopted in the middle of the 20th century and have been revised and updated over the years since. Within the town, Groton Utilities operates a treatment plant and distributes potable water to more than 30,000 people through more than 5,000 connections. The source water resource comprises five surface water reservoirs with a total watershed area

of 40.4 square kilometers—only 28 percent of which is owned by the water company (Groton Utilities 2019). Toward the protection of this and other existing and potential source water resources in Groton, a Water Resource Protection District was instituted as an overlay zoning district defined as all land over and upgradient of the current and future water supply resources as defined by watershed drainage boundaries (Town of Groton 2020). The intent of these regulations is offered in Section 6.4-1 of Groton's zoning regulations as follows:

> Creation of this district is essential to protect drinking water supply sources in the Town. . . As ground waters and surface waters have been shown to be easily, and in many cases, irrevocably contaminated by many common land uses, it is imperative that all reasonable controls over land use, waste disposal, and material storage be exercised within this district. This district is designed to protect existing and future water supply resources including extensive stratified drift aquifers, surface water reservoirs, and areas of future water supply. (Town of Groton 2020)

Town of Groton, Connecticut

Zoning map for the Town of Groton, Connecticut. The town's source water protection overlay zone is shown as shaded area.

The Water Resource Protection District requires all development, redevelopment, or expansion of permitted uses in the district to meet as a condition of approval prescribed general performance standards for erosion and sediment control, stormwater management, site design (including limits on impervious surfaces), and hazardous materials.

Further, many land uses that pose an elevated threat to source water resources are prohibited. Prohibited uses and activities include:

- Any industrial, commercial, or other enterprise in which the manufacture, use, storage, transport, process, or disposal of hazardous material is a principal activity
- Any discharge to the ground, watercourse, or wetlands of nonsanitary or significantly heated wastewater including industrial and commercial process wastewater
- Sewer plants, septic processing, and other waste treatment lagoons
- The application of sodium chloride for the removal of snow or ice on roads, parking areas, sidewalks, or any other surface
- Outdoor stockpiling of sodium chloride, calcium chloride, chemically treated abrasives, or other chemicals used for the removal of snow or ice on roads
- Stockpiling or disposal of snow or ice containing sodium chloride, calcium chloride, chemically treated abrasives or other chemicals used for the removal of snow or ice on roads which has been removed from highways and streets located outside of the District
- Heavy industrial, power plants
- Use of furniture strippers and chlorinated solvents
- Outside storage of hazardous materials as defined by the EPA
- Cemeteries
- Pest control services
- Airports; truck, bus, and heavy machinery storage; major vehicle service and repair; used car dealerships

Beyond prohibited uses and activities, many other agricultural, industrial, and transportation uses are conditionally permitted; for example, commercial agricultural uses are permitted with the condition that a 100-foot nondisturbance area buffering all surface waters and wetlands be maintained, and gas stations are permitted with the condition that a host of best management practices are incorporated (Town of Groton).

A potential problem for overlay zoning for source water protection (and zoning in general) is the question of preexisting nonconformities—uses that do not conform to zoning regulations but were legally established before their adoption. Typically, state enabling acts for zoning expressly exempt existing uses of property and stipulate that preexisting nonconforming status is forfeited only when abandoned. Additionally, relevant case law in many areas has raised the bar for abandonment to a point where neither change of ownership, suspension of use, nor anything less than an outright declaration of abandonment passes muster. Groton's Water Resource Protection District regulations allow some dispensation for preexisting nonconforming uses where such may be expanded, relocated, or altered under certain conditions; for example, Section 6.4-10.A allows for expansion of preexisting nonconforming uses with the conditions that 50 percent of the existing developed area is not exceeded, it is demonstrated that the proposed expansion does not pose more of a threat to the existing or future water supply source than does the existing nonconforming use, and others. Notwithstanding, preexisting nonconforming uses are more or less an issue for different communities heavily dependent upon the local context and development history of a given watershed.

WHAT RESOURCES ARE AVAILABLE TO BUILD CAPACITY?

A barrier for many communities that wish to institute zoning for source water protection is the lack of expertise and the financial resources to acquire and capitalize on that expertise. In addition to resources that may be available through state agencies or nonprofit organizations, the federal government, through the U.S. Department of Agriculture's Farm Service Agency, has provided funding and support for a national Source Water Protection Program. Administered through the National Rural Water Association—a nongovernmental water and wastewater utility organization based in Duncan, Oklahoma, with affiliates in all 50 states—the Source Water Protection Program is designed to provide communities with support toward the protection and sustainability of their source water resources.

The Source Water Protection Program is staffed by experienced water resource and land-use professionals who are available to communities in need at no cost. Each program year, professionals work with their colleagues from the Natural Resources Conservation Service, Farm Service Agency, and state environmental and public health officials to identify areas where source water protection is most needed. Once areas are identified, program professionals work with communities to create local teams made up of citizens, landowners, local government officials, and other stakeholders. These teams collaborate to create a source water protection plan to promote healthy watersheds and clean source water. Source water protection plans may supplement comprehensive plans as aforementioned and prescribe specific measures appropriate for the subject jurisdiction. Often, especially for communities located within more developed areas of the country, overlay zoning for source water protection is a central precept.

Of the numerous communities the Source Water Protection Program has assisted, a recent successful example is in the Town of Tiverton, Rhode Island. Nonquit Pond, a reservoir located within Tiverton but serving as a source water resource for the nearby larger community of Newport, was found to have elevated levels of nutrients and total organic carbon. The poor water quality in Nonquit Pond was a result of land-use impacts and necessitated costly intensive treatment in order to continue to be used as a source water resource. These impacts also undermined the ecology of Nonquit Pond, which is also a critical spawning habitat for anadromous fish. As a result of its hampered ability to support source water as well as ecological uses, Nonquit Pond was designated an "impaired water body" by the Rhode Island Department of Environmental Management.

A source water protection specialist was brought in to establish the Source Water Protection Program and assist the local government to create, adopt, and implement a source water protection plan for Nonquit Pond. The plan included a zoning overlay district bounded by the Nonquit Pond watershed that would bar certain land uses, require best management practices, and establish buffers around the pond and its main tributaries. Further, through cooperation with the Rhode Island Department of Environmental Management, the plan was tailored to help landowners and the local government qualify for other assistance programs from the Farm Service Agency, Environmental Protection Agency, and others. The *Nonquit Pond Source Water Protection Plan* will not only lead to an improvement in water quality for the source water resource but also help to restore local ecological function and be an impetus for other environmental improvements in the community.

CONCLUSION

Water resources in the United States have been severely impacted by unchecked development and unsustainable land-use practices. Public health at the community level has suffered due to these practices. Humans have always depended directly on water resources, but in modern times populations have exploded out across the landscape. Demand for larger and larger quantities of high-quality water as well as demand for the development of watersheds have combined to create water crises in communities across the country and the world.

Looking at this problem at the 2000 World Water Forum in the Netherlands, the Global Water Partnership—an international intergovernmental organization created to foster an integrated approach to water resources management and provide practical advice for sustainably managing water resources—observed that water crises are often crises of governance. The partnership identified as one of its highest priorities for local action the importance of developing a stronger culture around water governance. The notion of governance for water includes the ability to design public policies and institutional frameworks that are socially accepted

and mobilize social resources in support of them (Rogers and Hall 2003). Since the World Water Forum, both the peril to water resources and the need for active management at all levels to sustain current and future populations has only grown. These sentiments have been echoed repeatedly by many, including the United Nations, the World Summit on Sustainable Development, and countess water advocacy organizations across the world (Rogers and Hall 2003).

While the extent of the problem and associated challenges has been illuminated by those occupying lofty positions of international influence, it is important to see that the way forward hinges on local grassroots efforts. This goes to show that communities taking control of and responsibility for the natural resources on which they so greatly depend, through something as conceptually simple as overlay zoning, is in fact a powerful and hopeful pursuit.

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DOES YOUR CITY USE OVERLAY ZONING TO PROTECT SOURCE WATER?

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