Fact Sheet #5: Functions of Riparian Areas for Protecting Public & Private Water Supplies

[This fact sheet was prepared by *Russell Cohen, Rivers Advocate,* Division of Ecological Restoration, **Massachusetts Department of Fish and Game**. This document is intended for educational purposes only and does not necessarily represent the viewpoint of agencies and commissions having regulatory authority over riparian lands. Last updated: June 12, 2014.]

Why is it important for public and private water supply purposes to maintain and/or restore high water quality in our rivers and streams?

About half of Massachusetts' communities (166 out of 351 cities and towns), comprising 60% of the state's population, are dependent in whole or in part on surface water withdrawals as their primary source of drinking water supply. A few communities (including Lowell, Lawrence, Methuen and Billerica) obtain much if not most of their drinking water directly from rivers. Although the other communities utilize reservoirs, much of the water in these reservoirs is contributed by rivers and streams flowing or piped into them. In either case, pollution-generating activities on lands adjacent to these rivers may contribute to a degradation of water quality and harm public water supply systems.

What if our town, home, etc., is wholly supplied by well water?

Many public and a number of private wells are potentially threatened with contamination from pollutants getting into adjacent rivers, streams and other surface waters. Why is this the case? Contrary to popular belief, water withdrawn from many wells in Massachusetts does not exclusively originate from groundwater aquifers. In Massachusetts, groundwater and surface water are, for the most part, interconnected. For example, many if not most of the state's high-yield aquifers are located in areas with extensive stratified drift deposits (deposits of water-bearing sand and gravel that serve as major aquifers), often found directly underneath rivers and adjacent floodplains and uplands. Surface water can flow into the ground or vice versa in these areas, depending upon precipitation, streamflow and other factors. Many public water supply wells and a number of private wells are deliberately located in close proximity to rivers in order to tap into these stratified drift aquifers that are hydrologically connected to adjacent rivers, thereby maximizing yields (i.e., the volume of water available to be withdrawn by a well at that location).

As a result, water withdrawn from these streamside wells may include a significant proportion that is "pulled" (through a process called induced infiltration) out of adjacent rivers and streams and into the well. Another way of explaining this is that wells typically have a "zone of contribution", the area of land and subsurface from which water in a well originates. If a river or stream passes through this zone, then there is a significant possibility that some of this stream water will be induced to flow into an adjoining well. Hydrologists have determined that wells may induce infiltration from rivers and streams up to 1000 feet away, especially in periods of below-average precipitation. At least 400 public water supply wells in Massachusetts are located 400 feet or less from rivers, streams and other surface waters. What this means is that in order to protect such wells from contamination, it is necessary to protect the adjacent rivers and streams as well as the aquifer from contamination. In other words, as pollution-generating activities on riparian lands may contribute to a degradation of downstream water quality, it is important to minimize or eliminate these degrading activities on lands upstream of streamside wells as well as surface water withdrawal points.

Why should we be concerned about pollutants in rivers and streams contributing water to public water supplies if our community treats our source water before we use it?

Even if your water is treated before drinking, there are several reasons why it is still important to keep pollutants out of the source water as much as possible. First is the issue of cost. The more polluted the source water going into the treatment plant, the more communities, water districts, etc. will need to spend on disinfection (e.g. chlorination) and other treatment, and the greater likelihood that their water treatment plant facility will have to be upgraded to handle the additional pollutants. On the other hand, the cleaner the source water, the less money has to be spent on chlorine and other water treatment chemicals, with additional savings resulting from the reduced energy and manpower needed to operate treatment equipment. Protecting current sources from pollution is also easier and cheaper than losing them to contamination and then having to pay for developing a new water supply (if indeed there are any uncontaminated sources left in town) or having to purchase water elsewhere.

Second, and arguably more important, better source water quality has a public health benefit to water consumers. There are several types of pollutants - nitrates for example - that are particularly difficult and/or expensive to remove from drinking water. Studies have shown that *Giardia,* an intestinal parasite that is difficult to remove from source water (the Russian city of St. Petersburg's water system may be permanently contaminated with it) is ten times more common in water receiving urban pollution than water from protected forested watersheds.

Third, fish and other aquatic animals as well as humans may suffer from the consequences of having to add chemicals to source water in order to help render it safe for drinking. Degraded source waters may need to have disinfectants and algicides such as chlorine and copper sulfate added during the treatment process. These chemicals may pose no danger to humans, but are themselves (or via by-products) harmful to aquatic organisms once the water is discharged back into rivers and streams. Chlorine has another major problem: it combines with organic matter to produce chemicals called disinfectant byproducts (DBPs). The EPA has set drinking water standards of 80 ug/L(parts per billion) for one group of DBPs called trihalomethanes, and 60 ug/L for another DBP group called haloacetic acids, because of their potential to cause cancer.

How does the retention and/or establishment of a vegetated riparian area along rivers and streams help to protect public and private water supplies?

Naturally vegetated riparian areas along rivers and streams act as a living filter to intercept and absorb excess nutrients, sediment and other pollutants carried along in runoff from adjacent development as well as by the river itself. Several different and complementary processes within the vegetated riparian area collaborate to accomplish this. First, living, decaying and dead vegetation within the riparian area provides a multitude of barriers that slow down runoff from adjacent lands. Large woody debris (e.g. tree trunks and roots) extending or falling into the water accomplishes the same result for the stream itself. This slowdown enables a number of pollution-attenuating functions to occur. Much if not most of the runoff filters into the soil within the riparian area, where sediments are trapped and where excess nutrients, heavy metals and many other pollutants either adhere to or are taken up and sequestered in living plant tissue or are broken down into less harmful substances by soil bacteria and other microorganisms. A similar phenomenon occurs in the river itself, where sediments are held back by the large woody debris, which also provides ample surface area to support a large population of microbes that consume excess nutrients and other pollutants that have already gotten into the water.

Without the protection afforded by streamside forests, rivers and streams are vulnerable to being degraded by a host of pollutants, many of which pose specific problems relating to public and private water supplies. Excessive sediments carried into rivers by stormwater and other means harm water supplies by damaging water treatment pumps and other equipment, increasing treatment costs to remove the sediment, and reducing reservoir storage capacity. Sediment can also decrease river bottom infiltration, reducing the yield of nearby wells. In addition, chlorine is generally less effective as a water treatment disinfectant if the water has a high level of suspended sediment particles. Excessive nutrients (phosphates and nitrates) coming from fertilized lawns, golf courses and other sources harm water supplies by prompting excessive algae growth which can lead to odor and taste problems in drinking water, thereby increasing treatment costs. A related problem is that removing streamside forests leads to an increase in water temperature and sunlight, both of which can contribute to increased algae growth. Pesticides and herbicides running off and/or leaching into rivers from adjacent farms, yards, golf courses, etc. can be expensive and/or difficult to remove from drinking water, and those that are not effectively removed may pose carcinogenic or other health risks or cause the abandonment of the supply.

Metals coming from urban runoff have several adverse impacts. First, they increase the costs of treatment to remove the metals. Second, they also can form deposits in pipes, reducing their carrying capacity. Third, they can color water, leaving stains on fixtures and clothing. Last but not least, there is a possible human health hazard from toxic metals that may not be removed by prior treatment. Pathogens (viruses and bacteria), a common constituent of urban runoff as well as getting into rivers via malfunctioning sewer or septic systems, increasing public health risks while, once again, increasing treatment costs to render the water safe to drink. Lastly, removal of the shade provided by streamside forests increases stream temperature (and the smaller the stream, the greater the impact on stream temperature, because a smaller volume of water will heat up more easily than a larger one). This can lead to accelerated water supply pump/equipment corrosion while promoting algae growth, producing odors and bad taste, and creating a more favorable environment for pathogens.

In conclusion, nature itself has provided a very efficient, low-cost and low-maintenance water treatment mechanism in the form of naturally vegetated riparian areas. As the state's remaining inventory of relatively pristine waters continues to come under threat of contamination, we must consider all such water sources as potentially necessary for public or private water supply. Even if there are no current public or private surface or groundwater withdrawal points downstream from a particular riparian area proposed for development, such points may be necessary for water supply in the future. In the meantime, keeping these riparian areas naturally vegetated is a far more effective and less expensive way to safeguard safe drinking water over the long term than building elaborate facilities to treat increasingly polluted water.