

## Chapter 3

# Plan of Action

When NRDC first issued *Testing the Waters* in 1991, most beaches in the United States were rarely, if ever, monitored for pollution, and the public was usually not informed whether the beaches were safe for swimming. That situation has improved considerably due to years of public education and advocacy by NRDC and other public health and environmental organizations. While concerns about the adequacy of water quality standards and water quality test methods remain, the NRDC has largely shifted its focus to addressing the sources of beachwater pollution.

### CLEAN UP URBAN RUNOFF

Strategies for reducing contamination carried by stormwater runoff fall into three categories: stormwater reduction, stormwater treatment, and reduction of the sources of contamination in stormwater.

#### Stormwater Reduction: Green Infrastructure

Green infrastructure strategies employ a variety of technologies to reduce urban stormwater discharges to surface waters. These strategies, which are also often termed “low-impact development” or LID, act to restore natural hydrologic conditions by increasing the amount of permeable, usually vegetated areas that minimize the volume of stormwater discharges. Most often, these technologies retain and filter rainwater where it falls and let it soak back into the ground, rather than dumping it into waterways. Green infrastructure reduces pollutant flows and minimizes the need for more expensive traditional treatment by utilizing strategically placed rain gardens in yards, tree boxes along city sidewalks, green roofs that use absorbent vegetation on top of buildings, and permeable pavement. Green infrastructure also involves capturing and storing stormwater in rain barrels or cisterns and re-using it, most often for irrigation or other nonpotable uses. Many green infrastructure strategies have the added benefits of augmenting the water supply, providing wildlife habitat, minimizing greenhouse gas generation, and being aesthetically pleasing.<sup>1</sup>

**In addition to warning the public or closing our beaches when they are unsafe, we must address the sources of beachwater pollution.**

When surveyed for this year’s *Testing the Waters*, many states reported that green infrastructure is gaining traction as success stories mount. The American Recovery and Reinvestment Act of 2009 specifically directs clean water funding to environmentally innovative projects, including green infrastructure, and grant recipients are using funds to assist some cities to improve beachwater quality by implementing green infrastructure techniques. For example, in California, the City of Hermosa Beach was awarded nearly \$1.3 million in American Recovery and Reinvestment Act funds in 2010 to turn one of its major thoroughfares into a “green street.” The project includes a new storm drain system designed to prevent bacteria-laden runoff from ending up in beachwater that is listed as impaired because of high bacteria levels.<sup>2</sup> The City of Redondo Beach in California was awarded \$2.2 million in Recovery Act funds to protect coastal waters from urban stormwater by collecting rainwater for irrigation at a park and infiltrating excess water. This project will reduce discharges of bacteria in urban runoff to the city’s beaches.<sup>3</sup>

Green infrastructure techniques are being promoted in an effort to improve the water quality in Wreck Pond, a tidal pond in New Jersey that is high in fecal indicator bacteria and whose discharges are at least sometimes to blame for persistent water quality problems at beaches in the town of Sea Girt and Spring Lake. The Wreck Pond Regional Stormwater Management Planning Committee is working with Rutgers Cooperative Extension to install six showcase

rain gardens in the Wreck Pond watershed.<sup>4</sup> These gardens will encourage the use of rain gardens that will reduce the overall runoff, sediment, and pollutant loading into streams in the Wreck Pond watershed, which will in turn improve water quality at beaches downstream of the pond.

In many locations, current stormwater management cannot meet clean beachwater goals, and communities often struggle with the economic burden of repairing or expanding existing stormwater infrastructure. While retrofitting of existing development to reduce stormwater runoff can be cheaper and more effective than constructing traditional stormwater treatment facilities, the most economical time to implement green infrastructure strategies is during construction. Unless strong measures are taken to ensure that developers use sustainable practices such as on-site retention of stormwater, runoff from these areas will increasingly degrade coastal waters and pollute our beaches. Green infrastructure is an effective and innovative stormwater management approach that can be used to achieve more economically sustainable and environmentally sound solutions. NRDC recommends that green infrastructure requirements for all development and redevelopment (including road retrofit and renovation projects) be an element in every municipal stormwater permit.

A bill recently introduced in Congress, the Green Infrastructure for Clean Water Act (H.R. 4202 and S. 3561), aims to make green infrastructure and low-impact development techniques a national priority. The bill establishes institutional “Centers of Excellence” for green infrastructure that will provide critical research and information coordination services. It requires the Environmental Protection Agency to incorporate green infrastructure principles into its permitting and other programs more broadly than it has done in the past. Most importantly, the bill will provide communities with the financial and technical resources they need to implement green infrastructure and LID projects on the ground, improving the lives of their residents and the nation’s water quality. The Water Quality Investment Act of 2009 (H.R. 1262), which has been passed by the U.S. House of Representatives and is currently pending in the Senate, would authorize almost \$14 billion for the Clean Water State Revolving Fund over the next five years and provide critical assistance for various water quality improvement projects, including the use of green infrastructure.

### Stormwater Treatment

There are many means of treating stormwater to reduce bacterial contaminants, such as installing filters into outfall catch basins and using UV disinfection. In North Carolina, a \$1.1 million treatment unit for treating bacteria in a stormwater outfall began operating in Dare County in the fall of 2009. In this system, the stormwater enters a central chamber and is routed to an outfall at the beach after passing through filters lining the central chamber. The water quality from this unit will be monitored, and if the device is successful, more of these units will be installed statewide.<sup>5</sup>

A stormwater treatment system installed in Racine, Wisconsin, is pleasing to the eye in addition to being a very effective means of improving beachwater quality. In late 2000, a reengineering effort began on a stormwater outfall

**Figure 3-1. A Re-Engineered Stormwater Outfall in Racine, Wisconsin**



(a) Installation of a system for removal of solids from stormwater. The photo was taken in late 2000.



(b) The infiltration/evaporation basins after planting with native wetland species.



(c) The infiltration/evaporation basins as they appear today.

Source: Kinzelman, J., City of Racine Health Department, personal communication, July 2009.

that was affecting water quality at North Beach and Zoo Beach in Racine. The improved outfall includes a pretreatment system that removes solid wastes and oils from stormwater and then directs it to a series of infiltration/evaporation basins planted with native wetland species (see Figure 3-1). Under high flow situations caused by large storms (five-year or greater, meaning that there is less than a 20% likelihood that a storm this large would occur in any given year, excluding the first flush, which is held for treatment), stormwater bypasses the treatment structures and wetlands, discharging through a bypass outlet and into a plunge pool that also contains native vegetation before it is released into Lake Michigan. In addition to this stormwater treatment system, other strategies for improving water quality at these beaches were undertaken: the development of a series of dune ridges to intercept stormwater from the parking area, altered beach grooming practices that facilitate bacterial die-off in the sand through increased sun exposure, the placement of additional trash cans with liners so the trash can be emptied on an as-needed basis instead of overflowing and attracting seagulls, solar powered trash compactors, enacting a city ordinance and posting signs informing that feeding of seagulls is prohibited, and stenciling storm drains with the words “No dumping, drains to lake.”<sup>6</sup> During the summer of 2000, before these measures were taken, North Beach was under advisory for 62 days (more than half the time) and Zoo Beach for 39 days. Since then, the number of advisories has dropped dramatically. In the summer of 2009, two advisory days were issued at North Beach and six were issued at Zoo Beach. The average summer season *E. coli* count at North Beach decreased from 232 MPN/100 ml in 2000 to 2004 to 76 MPN/100 ml in 2005 to 2009.<sup>7</sup>

In some cases, sending urban runoff to sewage treatment plants is an effective means of improving beachwater quality. In dry weather, runoff occurs as a result of landscape irrigation, the draining of swimming pools, car washing, and various commercial activities. Even though it is much smaller in volume than stormwater runoff, dry weather runoff can be a significant source of beachwater contamination, especially along the coast of California, where it is dry during the summer when the beaches are most heavily used. Along the densely populated Santa Monica Bay in California, more than 20 low-flow diversion facilities have been constructed to route dry weather runoff through sanitary sewage treatment after trash and debris have been screened out.<sup>8</sup> Sanitary sewage treatment plants in this area have the capacity to treat dry weather runoff, but they cannot handle the huge volume of runoff that is generated during storms.

In Maine, as part of the Gooch’s Beach Seawall Reconstruction project, the stormwater system along Beach Avenue was modified to coincide with the Seawall Construction.<sup>9</sup> The town designed the system to allow for the implementation of a stormwater treatment device referred to as an Ultra Urban Filter. These devices were installed in four catch basins to provide treatment of stormwater by removing waterborne pollutants that have historically been allowed to discharge directly to the beach. This will provide treatment of approximately 920 feet of roadway and surrounding area.<sup>10</sup>

## Preventing Contamination

EPA regulations require cities and industrial and construction sites to obtain permits, develop stormwater management plans, and implement best management practices to control pollutants in stormwater runoff. However, only limited progress has been made to date. Vigorous implementation and enforcement and ambitious pollutant reduction goals are necessary to make this effort successful.

## ELIMINATE DISCHARGES OF HUMAN SEWAGE

Although the EPA’s combined sewer overflow policy has been in place since 1994, many of the roughly 772 communities nationwide that are served by combined stormwater and sewage systems have not yet begun implementation of a long-term plan to control combined sewer overflows and to include in such plans low-impact development approaches that provide more environmental benefits per dollar expended.<sup>11</sup>

Sanitary sewer overflows are illegal, yet the EPA has estimated that there are more than 23,000 sanitary sewer overflows every year into rivers, lakes, wetlands, and coastal waters.<sup>12</sup> The EPA needs to enhance its implementation and enforcement of this provision of the law. Also, the “ocean waiver” provision of the Clean Water Act gives the EPA administrator the authority to grant sewage treatment plants a waiver from secondary treatment requirements. The City of San Diego’s Point Loma Wastewater Treatment Plant has been granted such a waiver since 1995. The waiver was renewed in 2002 and again in 2010.<sup>13</sup> This waiver allows the treatment plant to discharge up to 240 million gallons a month of sewage that has not undergone secondary treatment through its ocean outfall.<sup>14</sup>

Coastal localities that have taken steps to reduce sewer overflows see beachwater quality benefits. Lakewalk Beach in Duluth, Minnesota used to have a number of advisory days every year due to sewage bypasses and overflows. The city installed a series of holding tanks, including one that holds a million gallons of wastewater, to reduce or eliminate sewage bypasses into Lake Superior and the St. Louis River. Water quality at Lakewalk Beach showed immediate improvement, with no beach advisory days in 2009.<sup>15</sup>

Installing holding tanks that allow sewage generated during high flow events to be treated is one way to prevent sewage overflows. Another way is to upgrade sewage treatment plants so that they can treat higher volumes of flow. However, there are hundreds of billions of dollars of documented needs for water and wastewater infrastructure in the United States, according to the EPA. Congress should assist state and local communities in meeting these levels by substantially increasing the federal resources available to meet clean water needs through the creation of a Clean Water Trust Fund or other dedicated source of clean water funding, and by increasing annual funding to the Clean Water and Safe Drinking Water State Revolving Funds. The Water Quality Investment Act/Water Infrastructure Financing Act (H.R. 1262/S. 1005), which has been passed by the U.S. House of Representatives and is currently pending in the Senate, would authorize between \$13.8 and \$16.8 billion for the Clean Water State Revolving Fund over the next five years and provide critical assistance for projects that repair and rebuild failing water and wastewater infrastructure. This funding includes support for green infrastructure and between \$1.8 and \$2.5 billion in authorized funds for grants to help communities address combined sewer overflows.

Sometimes significant sewage contamination of coastal waters occurs from multiple smaller sources. Many states find that elimination of malfunctioning septic systems improves their beachwater quality. Eliminating failing septic systems upstream of Fairview Beach in Virginia is such a success story. Microbial source tracking showed that the stormwater outfall at this beach had a persistent human signature, regardless of rainfall levels. The Virginia Department of Health and local officials located several apartments, homes, and trailers on old septic systems and connected them to the community sewer system. In 2009, the statewide fraction of advisories at Fairview Beach dropped compared to 2007 and 2008. Both 2007 and 2009 were wet years, but in 2009, the beach was under advisory half as many days as in 2007.<sup>16</sup>

Communities also need to spend smarter by linking water and sewer rates to water use and degradation, preserving and enhancing the use of wetlands and forests, and using soil and vegetation to reduce beachwater pollution. In a study of watersheds with at least 13.5% wetland coverage, for example, “periods of rainfall did not substantially increase the fecal coliform bacteria counts.”<sup>17</sup>

Finally, Congress is considering the Clean Coastal Environment and Public Health Act, which would reauthorize and increase the federal grants made available to states under the BEACH Act. This funding is crucial and should not only be authorized but should also be fully appropriated to provide states with the full support they need to tackle beachwater contamination and protect the public and the environment.

## **REDUCE AGRICULTURAL DISCHARGES AND AGRICULTURAL RUNOFF**

The EPA needs to plug the loopholes that allow industrial livestock operations to continue to discharge animal wastes into waterways. The EPA estimates that confined livestock produce about three times the amount of waste as people do nationwide; however, these facilities lack treatment facilities for livestock waste even remotely comparable to those that treat human sewage.<sup>18</sup> Moreover, many large feedlot operations historically avoided getting Clean Water Act permits, something made easier by lax federal regulation. The EPA needs to revise its rules to close the loopholes and require all large feedlots to keep animal waste out of waterways. Right now, the public is bearing the true cost of these feedlots because of their degradation of water quality.

## **IMPROVE COORDINATION BETWEEN SANITATION AND PUBLIC HEALTH OFFICIALS**

When a sewer overflow threatens beachwater quality, there needs to be immediate communication between those responsible for the overflow and those charged with protecting public health. The public has the right to know that an overflow or discharge has occurred and should be informed when it happens, not several days later, after beachwater monitoring

results have been analyzed and reported. To close these communication gaps and improve coordination between sanitation and public health officials, the Sewage Overflow Community Right-to-Know Act (H.R. 753/S. 937) should be passed. It would amend the Federal Water Pollution Control Act, directing owners or operators of sewage treatment plants to: 1) institute an alert system for sanitary sewer overflows, 2) notify the public of such overflows in areas where human health is potentially affected within 24 hours, 3) immediately notify public health authorities and other affected entities of certain kinds of overflows, and 4) provide specified reports to the administrator of the EPA or the state.<sup>19</sup> Improved monitoring, immediate reporting of overflows to public health authorities and to the general public, and prompt response to overflows to minimize human exposure and environmental harm are critical steps that need to be taken to close the communication gaps between those responsible for sewage and stormwater treatment and those charged with protecting public health. As noted above, NRDC also supports the Clean Coastal Environment and Public Health Act provision to direct public health officials to inform environmental agencies when they find a violation so that its source can be addressed.

## **IMPROVE BEACH INFRASTRUCTURE AND MAINTENANCE PRACTICES**

Often, manmade modifications and activities that are intended to make a beach more attractive or accessible to visitors backfire because they are conducive to poor water quality. Breakwaters, for example, make water less turbulent for swimmers, but they also reduce natural water circulation and trap polluted waters in areas where bathers congregate. Ironically, many “mother’s beaches” that are frequented by families with small children because of their quiet waters are prone to exceeding water quality standards. From a water quality standpoint, beach infrastructure that interferes with water exchange is undesirable.

The beaches in East San Pedro Bay along Long Beach, California, illustrate the impact that infrastructure designed to reduce waves can have on beaches. After considering a reconnaissance phase analysis, the Army Corps of Engineers has leant its support of further study concerning the reconfiguration of the 2.2-mile breakwater off the coast of this bay.<sup>20</sup> This World War II-era breakwater has been blamed for trapping water pollution from various sources, including the Los Angeles River, resulting in water quality exceedances at the beaches as well as wreaking ecological damage to the near-coast environment. The reconnaissance analysis estimated that the “maximum improvement scenario” for reconfiguring the breakwater could result in “increases of approximately \$52 million per year in local spending and economic activity, and nearly \$7 million per year in taxes and parking fees” because of the increased recreational value of the Long Beach shoreline.<sup>21</sup>

A beach amenity that can contribute to degradation of beachwater is parking lots. Parking lots are often constructed at the edge of beaches for ease of access, but pavement prevents water from soaking into the ground when it rains. Simple strategies like separating roads and parking lots from the beach with a strip of vegetation can prevent contaminated runoff from reaching the beachwater.

Waterfowl also contribute to pollution. Birds are attracted by food sources, including handouts from misguided visitors as well as trash left on beaches and in overflowing garbage cans. Where there are birds there is fecal contamination. Waterfowl congregate more freely when areas adjacent to beaches have been cleared of trees and bushes that would provide cover for predators. Frequently, parking lots at the beach are attractive to shoreline birds as well as people, and parking lot runoff washes fecal matter from the birds into the beachwater.

Beach maintenance strategies can have a huge impact on beachwater quality. Beachgoers might appreciate a long expanse of relatively flat and tightly packed sand, but sand harbors bacteria,<sup>22</sup> and beach grooming techniques that pack and level the sand can increase the density of bacteria in sand.<sup>23</sup> Switching to beach grooming techniques that deeply groom the sand without leveling it can have a positive impact on beachwater quality.<sup>24</sup>

## **IMPROVE BEACHWATER QUALITY STANDARDS AND USE FASTER DETECTION METHODS**

### **Water Quality Standards**

Current federal standards for recreational water quality are based on the concentration of fecal indicator bacteria, usually enterococcus and *E. coli*. They are called indicator bacteria because, although they may not be directly harmful

**Table 3-1. Beachwater Quality Standards Required by the BEACH Act**

Water Type	Indicator	Standard	
		For Multiple Samples <sup>a</sup>	For a Single Sample <sup>b</sup>
Marine	Enterococcus	35 per 100 ml	104 per 100 ml
Fresh	Enterococcus	33 per 100 ml	61 per 100 ml
	<i>E. coli</i>	126 per 100 ml	235 per 100 ml

EPA, Ambient Water Quality Criteria for Bacteria, EPA 440/5-84-002, 1986.

a Geometric mean of at least five samples over a 30-day period.

b For designated beach areas.

to humans, they indicate the likely presence of fecal contamination, are relatively easy to test for, and are typically found in the presence of harmful pathogens. Testing for the full range of pathogens found in beachwater is difficult, partly because if they are present they are at very low concentrations.

Under the Clean Water Act, the EPA is required to develop water quality criteria for pollutants based on their impact on human health and aquatic life. States then create limits, or standards, for these pollutants using the EPA's recommended water quality criteria or other criteria that the EPA deems as protective. In 1986, the EPA developed criteria for testing recreational waters using *E. coli* and enterococci bacteria as pathogen indicators in the Great Lakes (fresh) waters, and enterococci as indicators in marine and fresh waters, based on prior scientific research (see Table 3-1).

As of 2000, only 11 states had adopted the 1986 criteria. Recognizing the need for consistent water quality criteria at recreational beaches, Congress passed the Beach Environmental Assessment and Coastal Health (BEACH) Act in 2000, amending the Clean Water Act to improve beachwater quality monitoring programs and processes for notifying the public of health risks from contamination at beaches. Under the BEACH Act, states were pushed to adopt standards based on the EPA's 1986 criteria for pathogen indicators.<sup>25</sup> In addition, the EPA was required to complete studies on the human health effects of pathogens in coastal recreational waters and to develop new criteria and methods for detecting pathogens by 2005.<sup>26</sup> The EPA did not meet this deadline. As a result of a settlement of an enforcement action brought by NRDC four years ago to enforce the BEACH Act requirements, the EPA has conducted epidemiological studies and is now analyzing data from those studies and studies conducted by others in order to set new water quality criteria. It is also working to validate quantitative polymerase chain reaction (qPCR), a rapid test method.<sup>27</sup>

**If a family of four were to swim once a week in June, July, and August in ocean waters that just met the EPA's current bacteria standard, one member of the family would probably become ill.**

The gastrointestinal illness rates predicted by the fecal indicator bacteria concentrations set by the EPA in 1986 have been confirmed throughout the world.<sup>28</sup> However, the acceptable illness rate for full-body water contact that was used when setting the standards is high. Under the levels set by the EPA in the 1986 criteria, 19 out of 1,000 people swimming in ocean waters and 8 out of 1,000 swimmers in fresh waters just meeting these standards will become ill.<sup>29</sup> Put another way, if a family of four were to swim once a week in the summer (June, July, and August) in ocean waters that just meet the EPA's standard, one member of the family would probably become ill. The EPA is committed to a common level of risk protection in all waters of the United States that is at least as protective as the old standards as it prepares its new standards.<sup>30</sup> The new standards will probably be similar to the old standards in that they will have a standard for a short-term measure of water quality and a longer-term measure as well.

According to a 2007 report by the U.S. Government Accountability Office (GAO), the current water quality criteria have other significant limitations.<sup>31</sup> The GAO concluded that the current indicators may not identify all health risks. For instance, the standards were developed primarily to address the risk of contracting gastroenteritis but not necessarily to address rashes, earaches, pinkeye, respiratory infections, or very serious illnesses such as hepatitis and encephalitis (inflammation of the brain). An epidemiological study at four Great Lakes beaches noted that rates of gastrointestinal illness correlated with enterococcus levels, but other illnesses known to be associated with swimming did not.<sup>32</sup> New standards being developed by the EPA will focus on gastroenteritis, with other illnesses included if they are "significant and have indicators that reflect risk."<sup>33</sup>

The ability to test for pathogens instead of fecal indicator bacteria would strengthen the link between health standards and illness. While quantifying the concentrations of the multitude of pathogenic bacterial and viral species in recreational waters is difficult and expensive, the technologies for molecular methods are advancing and the possibility of directly detecting the relative presence of microbes has been demonstrated.<sup>34,35</sup> Molecular methods take advantage of the fact that fecal indicator bacteria and pathogens themselves have unique genetic sequences that can be detected. Quantitative polymerase chain reaction is an example of a molecular method for quantifying very small amounts of specific sequences of RNA or DNA. Because molecular methods do not involve culturing live cells, there is a possibility that water quality standards could be developed for species that are not easily cultured. However, most molecular methods, including qPCR, do not differentiate between live and dead cells, which is particularly problematic when measuring for water quality in waters that receive disinfected sewage. Also, molecular methods are susceptible to interference from chemicals, which could cause an underestimation of health risk.<sup>36</sup> The EPA is planning to develop its new standards based on fecal indicators, not on pathogens themselves.<sup>37</sup>

Another potential problem with the EPA's current beachwater quality standards is that the underlying epidemiological studies used to develop these standards were conducted primarily at beaches with exposure to human feces-dominated point-source contamination coming from pipes. In many coastal areas, diffuse, nonpoint sources—including urban runoff, septic system discharges, and animal waste—can be larger sources of pathogens in recreational waters. The EPA is now analyzing the results of studies at stormwater-impacted beaches to address this concern. Thus far, the agency has not found any data to support different criteria for different sources of fecal contamination.<sup>38</sup> In other words, it appears that illnesses from animal fecal sources occur at similar rates as illnesses from human sources of fecal contamination.

Geographic differences among water conditions, such as the amount of UV exposure and temperature, may affect the lifecycle of pathogens and their impact on human health. As a result, pathogens can behave differently in tropical waters than in temperate waters. The current standards fail to capture the variability in the potential for pathogens to re-grow, persist, and die off, or to address variability in indicator/illness relationships.<sup>39</sup>

Standards could include requirements for sampling locations and times. Recent studies establish that ambient concentrations of bacteria in dynamic aquatic environments can vary radically within short spatial and temporal scales.<sup>40</sup> Also, since human viruses are generally more resistant to sunlight than the indicator organisms that are measured, sampling is best conducted in the early morning hours.<sup>41</sup>

## **Faster Detection Methods**

Perhaps more important than any challenges associated with current fecal indicator bacteria standards is that current approved detection methods for fecal indicator bacteria require a long incubation period, usually producing results in 24 hours. This lag time between when pathogen-contaminated waters are sampled and when the public is notified creates a window of time where swimmers are exposed to contaminated water (see Figure 3-2). In addition, it results in beach closure days on days when the beachwater meets standards.

For several years, the EPA has been conducting research on the use of rapid test methods to determine beachwater quality, particularly using qPCR methods, including how the qPCR results correlate with other test methods of determining fecal indicator bacteria concentrations, whether qPCR detects all strains of fecal indicator bacteria, and whether the methods can be used to correlate the amount of indicator present with illness rates in swimmers.

The EPA included qPCR analysis as part of its freshwater epidemiological surveys conducted in the Great Lakes in 2004. The study concluded that the use of faster test methods for assessing recreational water quality would result in the ability to make decisions about beach closings and advisories on the day of sample collection and could thereby lower gastrointestinal illnesses in beach communities.<sup>42</sup>

Another promising rapid test method is immunomagnetic separation/adenosine triphosphate (IMS/ATP), which exploits the unique properties of the surfaces of target cells (e.g., enterococcus or *E. coli*) to capture and tag the cells and count their concentrations in a given sample. The use of IMS/ATP techniques for detecting microbes in surface waters has not been studied as much as the use of qPCR, but it is being used in epidemiological studies this year. One of the challenges of IMS/ATP is that strains of indicator bacteria for which antibodies do not yet exist are not detected.<sup>43</sup>

More epidemiological studies using rapid test methods have been conducted at beaches in California, Florida, and Puerto Rico, and the results of these studies are being analyzed. Many other locations have conducted or are conducting

**Figure 3-2. Lag Time Associated With Current Water Quality Monitoring and Public Notification Methods**



pilot tests of rapid test methods. For example, the City of Racine, Wisconsin, has been testing and piloting different rapid detection technologies since 2006.<sup>44</sup> In July of 2010, a pilot project was launched at several beaches in Orange County, California, in order to demonstrate the use of qPCR for making beachwater quality warning decisions on the same day a sample is taken. Traditional methods will be used to analyze the samples alongside qPCR analysis, but the qPCR results will be used to determine whether or not warnings about beachwater quality will be issued and signs posted at the pilot study beaches. This is the first use of a rapid test method for issuing beachwater quality notifications at coastal beaches in the United States.

Beachwater quality generally depends on many complex factors, but for some beaches, predictions of beachwater quality based on a few physical measurements of daily conditions can be fairly accurately calculated. Some states have taken advantage of this and have created computer beachwater quality models that rely on data from physical measurements such as rainfall levels, wind speed and direction, tides, wave heights, and currents. These models prepare rapid predictions of beachwater quality and allow for beaches to be closed or placed under advisory the day that bacterial levels are expected to be high, rather than 24 hours after samples with high bacteria concentrations are taken. The importance of predictive models in protecting public health was illustrated by one local beach manager who demonstrated that at his or her beach, advisories and closings based on monitoring results were issued inaccurately 100% of the time.<sup>45</sup> In other words, samples taken when the beach was under advisory or closure due to the previous day's monitoring results showed that the beachwater quality met standards on the days that the beach was under advisory or closure in every case.

Because the water quality at many beaches is adversely affected by stormwater runoff, another less sophisticated means of protecting public health is to preemptively close beaches or issue advisories when indicator bacteria levels are expected to be high after rainfall events. These preemptive rainfall advisories can be based on rainfall intensity or some other rain-related factor. States should always provide adequate warnings to swimmers when there has been a sewage spill.

## **INCREASE SOURCE IDENTIFICATION EFFORTS**

Information about sources of contamination is invaluable in terms of addressing poor water quality, but determining sources of contamination can take time, money, and expertise that beach managers do not have at their disposal. One simple way to identify sources is to conduct a sanitary survey. Beach sanitary surveys involve collecting information at the beach, and sometimes information about the surrounding watershed. Information collected at the beach may include data regarding discharge from any outfalls, the number of birds at the site, the amount of litter, and the presence of seaweed or algae. Information about the watershed may reflect land use, the use of residential septic tanks, and locations of wastewater treatment facilities. After a pilot study of sanitary surveys was conducted at 36 beaches in Wisconsin, the number of closing and advisory events attributed to unknown sources decreased from 84% to 24%.<sup>46</sup> Sanitary surveys

used to be associated mainly with drinking water and shellfish safety programs, but more and more states are conducting sanitary surveys of their recreational beaches, either annually or when exceedances are found.

In many cases, neither a visual survey nor an assessment of upstream sewage treatment plants or animal feedlots reveals the source of beachwater contamination. This is the case when many small or nonpoint sources are contributing to the contamination. Sometimes chemical markers (such as pharmaceuticals or their metabolites) are measured to determine whether a human sewage source is responsible for high bacteria counts. The presence of caffeine or optical whiteners used in laundry detergents is also used to determine whether contamination with human sewage has occurred.

There are many methods for identifying species responsible for fecal organisms present in water. Most microbial source tracking, as this process is called, relies on matching DNA or RNA “fingerprints” from bacterial strains found in contaminated beachwater with those of bacteria found in various animal hosts and human sewage. Quantitative PCR (qPCR) is an example of a laboratory technique used in microbial source tracking.

## **10 SIMPLE THINGS INDIVIDUALS CAN DO**

Everyone can help reduce beachwater pollution. For example, we can all take steps to reduce the amount of water sent to sewage treatment plants—which have the potential to overflow—and we can all play a part in reducing polluted runoff. Individuals can also make a difference by becoming educated and expressing their desire for clean, healthy water. Below are 10 simple actions individuals can take to improve our beachwater.

### **1. Be a good steward at the beach.**

If you bring a picnic to the beach, pick up your garbage, and do not feed the birds or other wildlife. Seagulls and other animals are attracted to the garbage and food waste that people often leave behind on the beach, and feeding them will only encourage their permanent presence there. Waste from wildlife is one of the three largest known sources of bacterial pollution and can lead to beach closures. Ask your local beach management agency to invest in secure garbage cans with tight-fitting lids. Make sure children not yet toilet trained are dressed in a swim diaper and rubber pants or a similar tight-fitting outer garment. An extra layer of protection in addition to a swim diaper is necessary to help prevent bacteria from entering the water.

### **2. Clean up after your pet.**

Don't leave pet waste on the ground. It could contain harmful bacteria and excess nutrients that can wash into storm drains and eventually pollute local waters. Flush it, bag it, or look for signs in public parks that direct pet owners to appropriate waste receptacles.

### **3. Conserve water.**

Extra water overwhelms sewage treatment plants and contributes to raw sewage overflows. Here are some ways you can reduce the amount of water you use at home:

- Scrape—don't rinse—dirty dishes before loading them into the dishwasher.
- Do not let water run unnecessarily when brushing your teeth or shaving.
- Install a water-saving toilet to conserve thousands of gallons annually.
- Install faucet aerators and a water-efficient showerhead to cut the amount of water you use and to save energy by reducing hot water use.

### **4. Direct runoff to the soil, not the street.**

Help keep stormwater from running off your property and into local waterways and the sewer system. Direct rain gutters and downspouts on your home to soil, grass, or gravel areas rather than blacktop, cement, or other hard surfaces. Learn about creating a rain garden or using rain barrels. Sweep your driveway and sidewalks instead of hosing them down.

## **5. Don't pour it down the drain.**

When you dump paint, oil, harsh cleansers, and other hazardous products down the drain, they can find their way into nearby bodies of water. Contact your local sanitation, public works, or environmental health department to find out about hazardous waste collection days and sites. Don't wash your car in the driveway or street; instead, do it at a car wash, where contaminated rinse water may be treated before being discharged to the sewage system.

## **6. Maintain your septic system.**

Have your septic tank cleaned out every three to five years. Such maintenance prolongs the life of your system and can help prevent groundwater and beachwater contamination.

## **7. Practice proper lawn and garden care.**

Use natural fertilizers such as compost on your garden, and minimize the use of chemical fertilizers, pesticides, and herbicides. To reduce the amount of polluted runoff, landscape with natural vegetation rather than lawns, which require fertilizers and herbicides. Do not allow water used to irrigate your landscaping to hit paved surfaces and run off.

## **8. Practice proper marine and recreational boating waste disposal.**

Dispose of your boat sewage at onshore sanitary facilities. Don't dump waste or trash overboard. Boating wastes discharged into coastal waters can be a significant cause of high pathogen concentrations.

## **9. Support local, state, and federal legislation that promotes the cleanup of pollution sources.**

Write to your representatives and senators and let them know you support strong beach legislation and clean water protections. Tell your local government to move forward quickly to address sewage overflows and stormwater. Make sure you tell officials that you are willing to pay for programs to monitor beaches and reduce runoff pollution.

## **10. Learn about the water quality at local beaches and choose your beach carefully.**

Go to NRDC's vacation beaches website ([www.nrdc.org/water/oceans/ttw/titinx.asp](http://www.nrdc.org/water/oceans/ttw/titinx.asp)), the EPA's Beach Advisory and Closing Online Notification website ([http://iaspub.epa.gov/waters10/beacon\\_national\\_page.main](http://iaspub.epa.gov/waters10/beacon_national_page.main)), or your local beach manager (usually the local public health authority), all of which have data on beach monitoring and notification policies and on closings and advisories. Also, to show your concern, ask the local beach manager the following questions: What are the sources of pollution affecting the waters where I swim? What sort of water quality monitoring is performed at these beaches? Are beaches always closed when monitoring shows that the bacterial standard is exceeded? What is the current status of these waters (are they closed or open?), and what warning signs can I look for? Whenever possible, swim at the beaches that your research shows have the cleanest waters or are carefully monitored with strict closure or advisory procedures in effect. Stay away from beaches with visible discharge pipes, and avoid swimming at urban beaches after a heavy rainfall.

For more ways you can prevent beachwater pollution visit NRDC's Your Oceans website (<http://oceans.nrdc.org/>)

## **NOTES**

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