Action Plan 3 Managing Stormwater Runoff and Promoting LID

Problem

Thousands of stormwater pipes and overland flows discharge contaminated runoff into Buzzards Bay and its tributaries. Connected to these pipes are tens of thousands of catch basins and hundreds of miles of pipes that convey numerous allowed and illicit pollution discharges. New development adds stormwater to this discharge network. These stormwater discharges pose many threats to the environment, not the least of which is the closure of shellfish beds and swimming beaches in Buzzards Bay. Federal permit programs that may require compliance with daily load limits for bacteria, and other requirements for municipal stormwater programs, could cost more than a $1 billion in the coming decades. These efforts, while costly and politically challenging, will dramatically reduce shellfish bed closures in Buzzards Bay and restore habitat in many areas to conditions not seen for decades[78].

The ongoing development and redevelopment of land in the Buzzards Bay watershed must be better managed and reprogrammed to minimize new impacts and mitigate existing problems caused by stormwater discharges. This new approach, called low impact development (LID), can restore hydrological balances in watersheds and reduce water quality impairments.

Goals

Goal 3.1. Prevent new or increased untreated stormwater flows to Buzzards Bay and contributing watershed areas that would adversely affect shellfishing areas, swimming beaches, water quality, and wetlands.

Goal 3.2. Correct existing stormwater runoff flows to Buzzards Bay and contributing watershed areas that are adversely affecting shellfishing areas, swimming beaches, water quality, and wetlands, or exceeding watershed total pollutant load limits.

Goal 3.3. Maintain and restore natural hydrologic conditions to provide base flow conditions to streams, wetlands, and estuaries.

Goal 3.4. To encourage low impact development (LID) techniques in new development and redevelopment, in order to minimize impacts from stormwater.

Objectives

Objective 3.1. To adopt and implement local and state stormwater LID laws and regulations.

Objective 3.2. To implement effective stormwater pollution remediation projects that include proper design, construction, operation, and maintenance.

Objective 3.3. To provide guidance and incentives for LID that reduces and re-uses stormwater runoff, and reduces the need for structural practices.

Objective 3.4. To improve compliance with federal, state, and local stormwater regulations and meet watershed total pollutant load limits.

Approaches

LID approaches are best implemented through local bylaws and ordinances that regulate subdivisions, and commercial development, through new municipal stormwater permit programs, and will require additional training of regulatory and technical assistance staff.

The elimination of water quality impairments caused by existing stormwater discharges is a major undertaking that will require actions and expenditures by all levels of government. EPA must enforce compliance with the Buzzards Bay pathogen TMDL through MS4 stormwater permits. DEP must upgrade state stormwater policy to include treatment standards for nitrogen and bacteria, and EEA must promote policies and regulations that foster low impact development techniques. The largest burden rests with municipalities, which will need to develop and implement meaningful stormwater management programs for themselves and the private sector supported by sound local laws, regulations, and policies.

Costs and Financing

LID approaches have modest costs for government to implement, and some approaches can even reduce development and long-term maintenance costs borne by residents. The most daunting costs will be to treat existing discharges causing degradation and to implement municipal stormwater programs that support these goals. This effort will likely cost more than $1 billion over several decades. The costs will likely be met through federal and state SRF loan programs, or through local financing like stormwater utilities.

Measuring Success

LID and stormwater goals will be tracked principally by programmatic actions such as the adoption of necessary laws and regulations. More importantly, documenting compliance with EPA stormwater permits and stormwater TMDLs including constructing stormwater treatment systems, or eliminating stormwater discharges, and implementing good housekeeping programs will be key measures. A key measure of success will be improvements to water quality, as evidenced by reductions in the extent or duration of shellfish closures.

[78] The success of these efforts will also partly depend on actions contained in Action Plan 1 Managing Nitrogen Sensitive Embayments, because of relationship between bacterial and nutrient discharges.

Background

Runoff from rainfall and snowmelt carries natural and human-derived pollutants into wetlands, lakes, streams, estuaries, and groundwater, which can affect water quality, habitat, and living resources. Pollutants associated with stormwater runoff may include bacteria, road salt, nutrients, pesticides, metals, and organic contaminants such as hydrocarbons. Stormwater also conveys sediments, atmospheric fallout, and other particles that cause siltation of aquatic and wetland habitats, increased turbidity, and declining water quality. Such sediment particles often serve as carriers of metals and organic contaminants that adsorb to particles.[79]

Stormwater also contributes floatable debris, resulting in littered shorelines and impacts on marine animals due to ingestion and entanglement. Stormwater pollutants can lead to swimming beach closures, loss of habitat and resources, and changes in species composition and diversity.

In coastal areas, excessive stormwater pollutants (primarily bacteria) can also result in shellfish bed closures. Chronic runoff of polluted stormwater to sensitive resources can result in aesthetic as well as economic impacts, such as those associated with the loss of commercial and recreational fisheries.

In the Buzzards Bay watershed, like other urbanized areas, water from melting snow and rain flowing off streets, parking lots, roofs, lawns, golf courses, agricultural land, and other pervious and impervious areas, carries contaminants to the bay and contributing streams, groundwater, and wetlands in the watershed. This stormwater enters surface waters via storm drain systems, including catch basins, pipes, road cuts, and via other overland flow.

Thousands of stormwater pipes like the one in Figure 50 discharge contaminated runoff in Buzzards Bay and its tributaries. The Buzzards Bay NEP's 2003 *Atlas of Stormwater Discharges in the Buzzards Bay Watershed* documented more than 2,000 pipes and nearly 600 road cuts that discharge to Buzzards Bay or to streams and wetlands near the coast in eight towns[80]. Table 21 and the map in Figure 51 summarize and show the locations of these discharges.

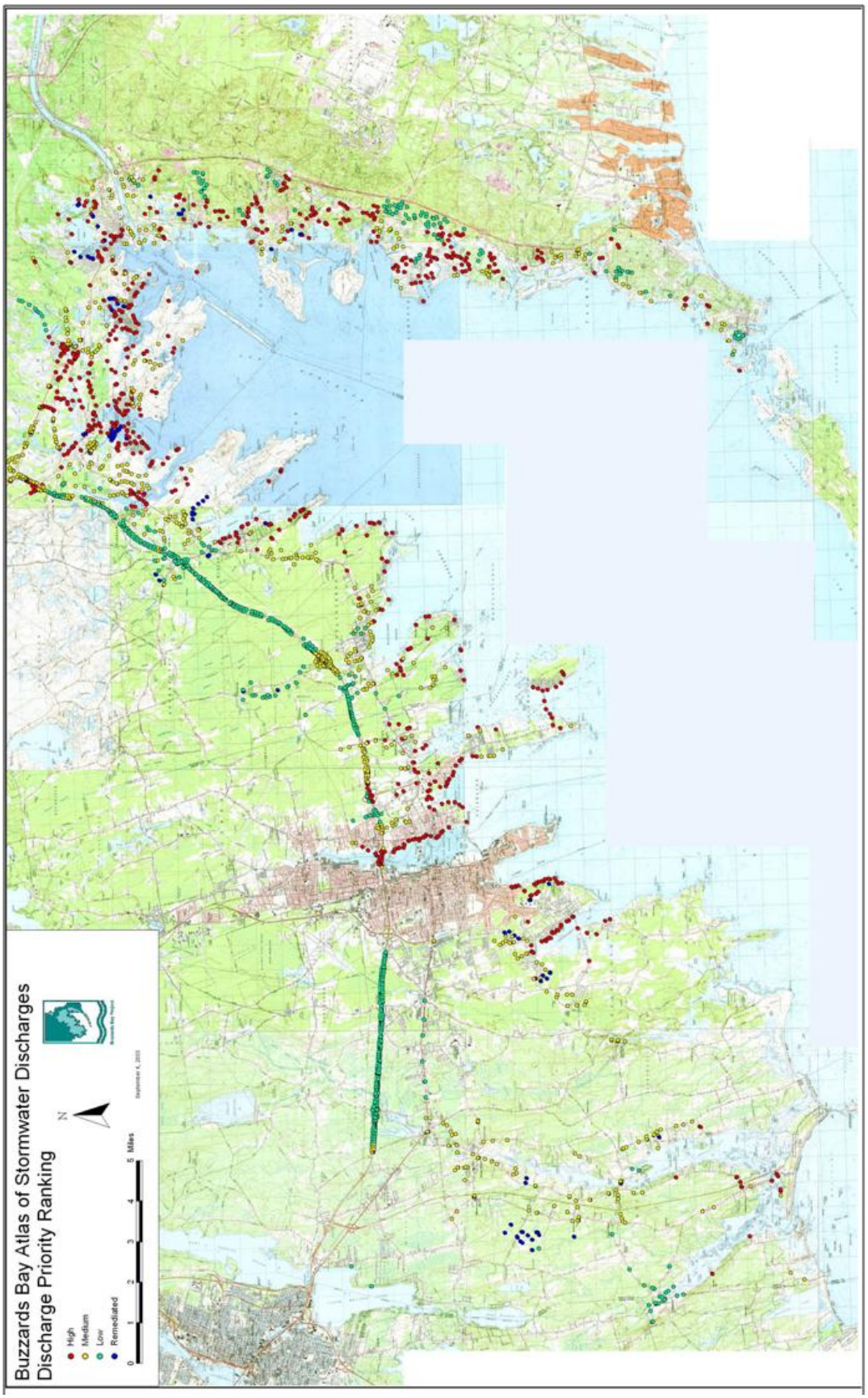
The atlas also mapped more than 12,000 catch basins, most of which were linked to the more than 2,600 discharges cited in Table 21. The actual number of catch basins associated with each discharge varied greatly, but most appeared to have only one or two catch basins draining various lengths of contributing roads and other impervious surfaces. More than 375 miles of road and pipe connected to these mapped discharges. The extent of water quality impairments in Buzzards Bay has been documented to a considerable degree in the Massachusetts DEP's Section 303(d) list. Twenty-two of the roughly 32 major Buzzards Bay embayments are listed as impaired due to fecal coliform bacteria (Figure 52).

Photo by Joe Costa.

Figure 50. A stormwater discharge pipe in Onset Bay.

[79] Good sources of general information on problems caused by stormwater pollution and management solutions are available from the Center for Watershed Protection website (www.cwp.org) and the U.S. EPA stormwater website cfpub.epa.gov/npdes/stormwater/swbasicinfo.cfm. For low impact development strategies in Massachusetts, the EEA website www.mass.gov/eea/waste-mgnt-recycling/water-resources/preserving-water-resources/partners-and-agencies/ should be reviewed.

[80] The study did not include the City of New Bedford, the Town of Acushnet, or the Town of Gosnold, part of the Elizabeth Island Chain. A description of this project is provided in subsequent pages of this action plan.



From Buzzards Bay NEP (2003).

Figure 51. Overview map of stormwater discharges documented in the *Atlas of Stormwater Discharges in the Buzzards Bay Watershed*.

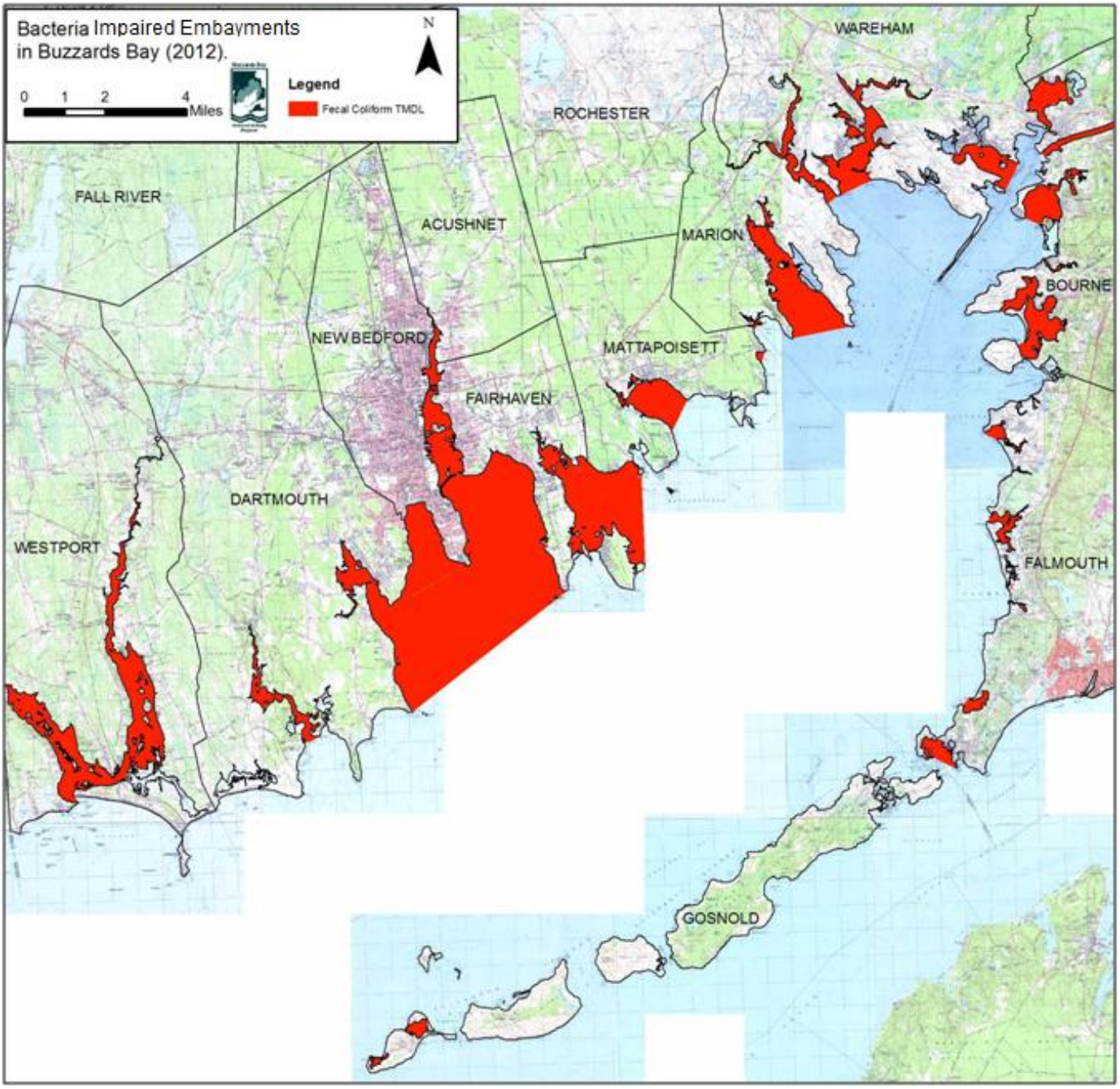


Figure 52. Buzzards Bay waters impaired by fecal coliform bacteria and having a TMDL.

Based on DEP's *Massachusetts Year 2012 Integrated List of Waters, Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act,* and a companion MassGIS coverage.

Further evidence of the scale of the problems caused by stormwater, or where stormwater is a contributing factor is illustrated by the distribution of shellfish bed closures in Buzzards Bay (see Figure 48 in Action Plan 2) and the temporary closures of swimming beaches in both fresh and salt water in the watershed. While some of these closures are related to municipal wastewater facility discharges, in most cases stormwater, conveying pollutants from various nonpoint sources, is the principal cause of the impairment.

Numerous studies in Massachusetts and nationwide have consistently pointed to stormwater as a major source of fecal coliform bacteria contributing to closures of swimming beaches and shellfish areas. Any stormwater pipe near a swimming beach represents a potential health risk and often contributes to floatable debris on beaches. On rare occasions, illegal sanitary hookups from septic systems to stormwater pipes have been found. However, many other "nonpoint" sources contribute to elevated fecal coliform levels in stormwater. These nonpoint sources include wildlife droppings, pet

Table 21. Summary of discharges by town showing numbers of basins tied to treatment system.

Municipality	Pipes	Road cuts	Total	UA Total(1)
Bourne	169	62	231	220
Dartmouth	255	168	423	412
Fairhaven	224	25	249	185
Falmouth	202	40	242	242
Marion	227	53	280	167
Mattapoisett	276	42	318	172
Wareham	592	118	710	513
Westport	88	85	173	12
Grand Total	2,033	593	2,626	1,923

(1) Taken from 2003 Buzzards Bay Atlas of Stormwater Discharges. "UA Total" equals number of discharges mapped in the National Pollutant Discharge Elimination System Stormwater Phase II urbanized areas. This permit program is further described in the background section of this action plan.

waste, overland run-off of manure from farms, and breakout from failed septic systems.

Every three years the Massachusetts Division of Marine Fisheries (DMF) completes sanitary surveys for shellfish areas in Buzzards Bay. These surveys contain a wealth of information on existing stormwater drains that are sources of fecal coliform bacteria and are causing or threatening to cause the closure of shellfish beds, as well as streams and rivers that have consistently elevated levels of coliforms. This information is in reports provided to all Buzzards Bay communities, and provides an excellent summary of potential pollution sources. However, due to limited funding, actual stormwater discharges during runoff events from pipes are usually not monitored for fecal coliforms, nor are upstream pollution sources identified in the rivers and streams contributing to high fecal coliform loads.

Prior to the late 1990s, the responsibility for controlling new storm drains was regulated largely at the local level through subdivision regulations and wetlands bylaws. Unfortunately, local regulations were inconsistent from one community to the next, and for the most part, municipalities did not adequately address management of the rate, volume, and quality of stormwater discharges. Management of all three parameters is now recognized as essential for improving or protecting water quality. In the late 1990s, however, the regulatory landscape expanded with additional state and federal authority to better address stormwater discharges to wetlands and surface waters. These changes coincided with increased local awareness and sophistication by local government pertaining to stormwater issues.

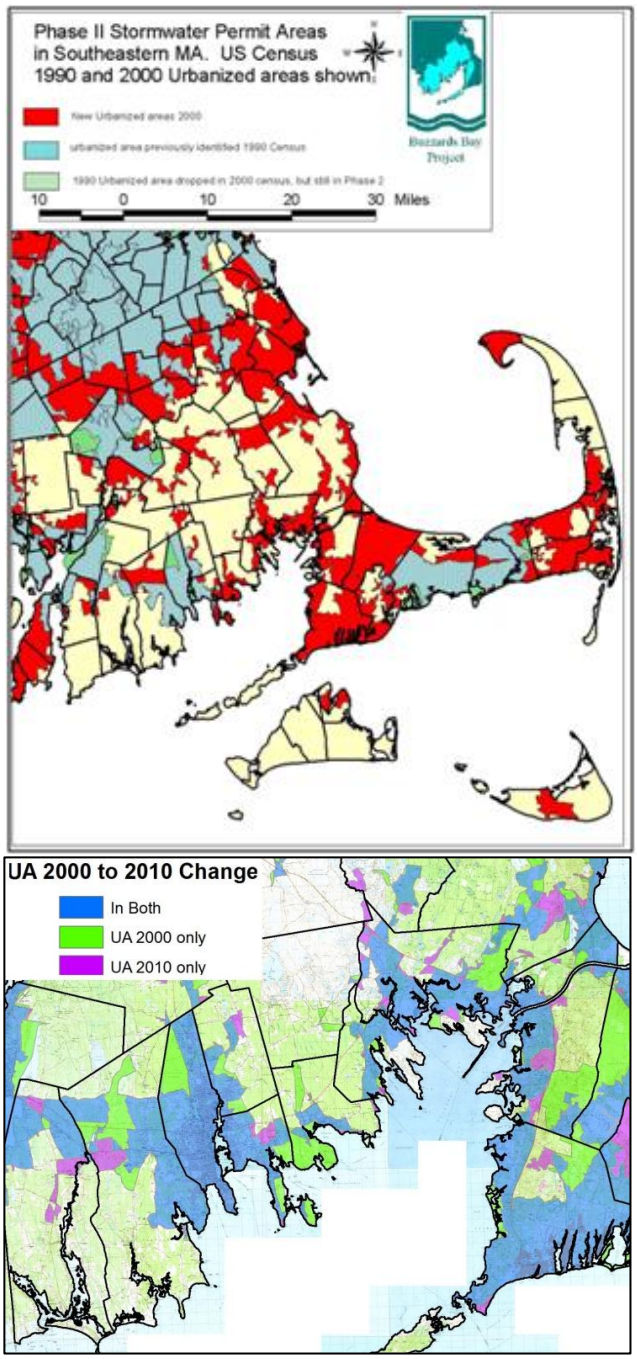


Figure 53. Top: Urbanized Areas (UAs) defined by the 2000 U.S. Census as compared to 1990. Bottom: Changes between the 2000 and 2010 urbanized areas.

As shown, the change in the definition of urbanized areas by the U.S. Census in 2000 resulted in a dramatic change in the jurisdictional area on the EPA NPDES Phase II Program for Municipal Small Storm Sewer Systems (MS4s). These changes in urbanized areas were more modest with the release of the 2010 Census, but still included some important new areas.

First, in 1990, implementation of Phase I of the National Pollution Discharge Elimination System (NPDES) program required the permitting of stormwater discharges from medium and large municipalities (municipalities

with a population of 100,000 or more) to waters of the U.S. In 1996, the Massachusetts Department of Environmental Protection (DEP) adopted Stormwater Standards and Policy, to be implemented primarily in association with the Wetlands Protection Act. This new policy prohibited "untreated stormwater discharges" to waters of the Commonwealth, required water quality treatment for runoff of up to 1-inch from impervious surfaces, identified appropriate "best management practices" (BMPs), required recharge of stormwater to balance the hydrologic budget and required operation and maintenance plans for stormwater facilities.

In 2008, DEP again updated the policies that met many of the goals identified in the Buzzards Bay CCMP. These new standards however, do not fully address water quality limits to waters that have bacteria or nitrogen TMDLs, thus additional revisions will be required as implementation of TMDLs commences by all levels of government.

In December 1999, EPA published the "Phase II Final Rule" for the NPDES program in the Federal Register. This rule expanded the coverage of the stormwater permit program to include stormwater discharges from, "certain regulated small municipal separate storm sewer systems (MS4s); and construction activities disturbing between 1 and 5 acres of land (i.e., small construction activities)." The rule also revised "he 'no exposure' exclusion and the temporary exemption for certain industrial activities."In plain English, the rule required municipalities located within "urbanized areas", as defined by the U.S. Census Bureau (Figure 53) to submit permit applications (Notices of Intent) by 2003 for their municipally owned stormwater discharges ("MS4s"), as well as "industrial facilities", waste transfer stations, landfills, and sewage treatment plants (separate from the wastewater discharge permit). Developers altering as little as 1 acre of land were also required to comply with the Phase II NPDES program beginning in 2003.

Perhaps even more significant than the adoption of the Phase II rule was the fact that the U.S. Census Bureau redefined "urbanized areas" for the 2000 Census (Figure 53, top). This redefinition greatly expanded the geographic extent of the federal definition of urbanized areas, particularly in the northeast U.S. Because the U.S. EPA had used the U.S. Census urbanized maps as the jurisdictional boundary for the Phase II program, the geographic area covered by the program now included at least a portion of nearly every municipality in eastern Massachusetts, including every Buzzards Bay watershed community. The urbanized areas defined by the U.S. Census changed again in 2010 (Figure 53, bottom), but the changes were less dramatic than the previous change.

While the geographic extent of the Phase II program may not seem appreciable for some municipalities, those areas covered essentially represent the existing moderately developed areas in each community, and more importantly triggers the requirement for management and regulatory actions in the municipalities as required in their permit.

Another regulatory program that has been moving forward in recent years is the DEP program to develop Total Maximum Daily Loads (TMDLs) in accordance with the Federal Clean Water Act to address pollutant loading to impaired water bodies throughout the state. Of particular relevance in Buzzards Bay is the recently published final Pathogen TMDL for the Buzzards Bay Watershed, developed jointly by DEP, U.S. EPA Region 1, and ENSR International. This TMDL has established a limit in the discharge concentration equivalent to the regulatory threshold for impaired waters. Thus, for stormwater discharges to waters closed to shellfishing, stormwater concentrations cannot exceed 14 fecal coliform per 100 ml. Adoption of this TMDL by the DEP has important implications for municipalities in addressing stormwater and pathogen sources, as well as for individual landowners with existing discharges. Various federal permits, such as those issued by the NPDES permit program, may require meeting the prescribed TMDL loading allocations, and associated water quality discharge standards. These TMDLs may also be implemented through other state regulatory mechanisms.

The Coastal Pollutant Remediation Grant Program at the MA CZM office has evolved into a positive funding mechanism for the remediation of nonpoint source pollution in Buzzards Bay and other coastal MA areas. For several years, the Buzzards Bay NEP had received funding through MA CZM from the MA legislature to address nonpoint pollution in the watershed. The Buzzards Bay NEP used this money to fund specific projects through a mini-grant program. This program was so successful that MA CZM adopted the program for the entire coastal zone in Massachusetts. These grants have been successful in fostering public education and addressing nonpoint pollution from roadways and other land uses through implementation of innovative stormwater practices. This program continues to this day.

Most development projects are designed and built using conventional development approaches, subdivision layouts and structural practices that encourage sprawl by maximizing road widths, parking areas and other impervious areas, and involve indiscriminate clearing and grading. The increase in impervious cover combined with soil compaction and removal of protective vegetation causes stormwater runoff to accelerate over land rather than infiltrate into the ground. The result is reduced groundwater recharge, increased flooding, increased downstream erosion, and other negative impacts on water resources, wetlands, and habitat. Cumulatively, these projects can add significant impacts to receiving waters including reduction of groundwater recharge and increased pollution such as nutrients and bacteria.

Photo credit: Modified from the Low Impact Development Center.

Figure 54. Conventional versus low impact development.

Although a significant portion of the Buzzards Bay watershed remains undeveloped, historically developed areas, including the industrial and port areas of New Bedford, Fairhaven, and Acushnet, and residential areas such as Wareham and Bourne, tend to reflect older zoning and development practices. Less densely developed or undeveloped areas of the Buzzards Bay watershed tend to be located further from coastal areas. Southeastern Massachusetts is favorably viewed as being within commuting distance of Boston and Providence, creating the need for new housing and businesses. Redevelopment in attractive coastal areas is continuing, along with new development inland. Some of the largest tracts of undeveloped land remaining in southeastern Massachusetts, comprising 6,000 acres of primarily forests and cranberries, are currently being planned for development.

Low-impact development (LID, Figure 54) offers an alternative approach in land development, an opportunity to develop land in a way that results in low impacts, and in some aspects, positive impacts. LID involves careful site planning and parcel level management strategies, including site and stormwater design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of origin. This strategy helps to achieve the goals of mimicking a site's pre-development hydrology, protecting native vegetation, maintaining natural water budgets capable of sustaining sensitive water resources, and keeping pollutants out of the stormwater stream before they can negatively affect downstream water resources.

As discussed by the Puget Sound Action Team (www.psp.wa.gov), LID is based on the premise that nature knows how to manage water and stormwater runoff best. Forests and other natural land covers are extremely effective in recharging groundwater. In these areas, most of the rainfall infiltrates into the ground, is absorbed by vegetation, or evaporates to the atmosphere with very little stormwater runoff generated. Development activities that clear forests and other natural areas, and replace them with impervious surfaces and storm drainpipes, alter the natural hydrology. These "hard" surfaces no longer allow rainfall to soak into the ground, resulting in an increase in surface runoff.

To counteract the effects of conventional development, stormwater storage facilities are often used to reduce flooding and treat stormwater-related pollution. These structures, however, are often maintenance intensive, unsightly, and costly to install. Rather than collecting and conveying stormwater runoff through storm drain pipes or other conveyances to a centralized stormwater facility, LID-minimizes the use of impervious surfaces and incorporates natural vegetation and small-scale treatment systems to treat and infiltrate stormwater runoff. This involves strategic placement of linked lot-level controls that address specific pollutants and stormwater travel times in drainage networks, flow rate, and volume issues.

Low impact development is defined by the Commonwealth's Executive Office of Energy and Environmental Affairs Smart Growth Toolkit as "an approach to environmentally friendly land use planning. It includes a suite of landscaping and design techniques that attempt to maintain the natural, pre-developed ability of a site to manage rainfall. LID techniques capture water onsite, filter it through vegetation, and let it soak into the ground where it can recharge the local water table rather than being lost as surface runoff. An important LID principle includes the idea that stormwater is not merely a waste product to be disposed of, but rather that rainwater is a resource."

Site planning using the LID approach starts with identifying critical environmental resource areas on, adjacent to, and down gradient of the site. Such resource areas can include drinking water protection areas, sensitive wildlife habitats, and buffers to wetlands, streams,

and estuaries. House sites and roads are then planned providing the maximum buffers to these resource areas. The site design reflects the site's natural runoff patterns, soil types, sensitive areas, and other key features and relies on those features to dictate the development pattern, rather than forcing a pre-conceived design upon an unwilling landscape. Refer to Action Plan 4: Improving Land Management and Smart Growth for more detailed discussion of site planning and design tools.

In LID developments, buildings are often clustered to protect natural areas by preserving open space. LID designs incorporate narrower roads and use permeable pavement for parking lots, driveways, and other impervious surfaces. Runoff from remaining impervious surfaces, such as rooftops, can be directed onto vegetated areas with porous soils. Roof gardens use soil and plants to absorb and evaporate water and slow runoff. Rooftop runoff can also be collected and reused. The proximity of the development to other developed areas (including village centers) can provide reduced costs associated with shared (neighborhood) wastewater treatment systems.

Some of the key goals of LID are as follows:

- Integrate stormwater management early in site planning activities;
- Mimic natural hydrologic functions;
- Focus on prevention rather than mitigation;
- Emphasize simple, nonstructural, low technology, and low cost methods;
- Manage stormwater as close to the source as possible;
- Distribute small-scale practices throughout the landscape;
- Rely on natural features and processes; and
- Create a multifunctional landscape.

The minimization of impervious areas is a key LID feature and directly ties into the protective goals of maintaining natural site hydrology, allowing for adequate groundwater recharge, and reducing pollution and erosion from stormwater runoff. Other common LID techniques include:

- Green rooftops that store and transpire precipitation before it can leave the rooftop surface;
- Rain gardens, rain barrels, cisterns, and other rainwater storage technologies that capture and store runoff for later use immediately after the runoff has exited roofs, driveways, or other impervious areas;
- Bioretention areas, constructed wetlands, and vegetated swales that transport, capture, store, infiltrate, and treat larger volumes of runoff while reducing the reliance on maintenance-intensive hard structures for stormwater management; and
- Better parking lot design, which divides large expanses of pavement into smaller sections where runoff can be managed and infiltrated in smaller quantities.

Table 22. Four key criteria for managing stormwater: "Reduce Runoff, Slow It Down, Spread It Out, Soak It In"

1. Peak rate flood control: The large, infrequent storms (e.g., 2, 10, 25 and 100-year) must be managed to avoid flooding and erosion impacts.

2. Channel protection: The bank-full event (1-year storm) must be managed to balance pre- and post-development runoff rates to avoid affecting stream banks and channels.

3. Recharge to groundwater: The goal of this criterion is to maintain the water balance at a site and within a watershed to the natural (pre-development) annual volume of recharge to groundwater after development occurs (in the post-development condition). Annual recharge (infiltration) depends on rainfall, runoff, and evapotranspiration during each rainfall event during a given year (See Figure 55), and simply put, these volumes are influenced by the combination of hydrologic soil groups (ability of a soil to infiltrate water), ground cover, and climate. For the Buzzards Bay watershed as a whole, the annual recharge volume is approximately 20 – 24 inches per year across the entire watershed. In order to get this volume of water back into the ground, the site designer must size stormwater infiltration practices to capture and infiltrate the first 0.6 inches of runoff from impervious surfaces. This will result in a cumulative total annual recharge volume approximating the natural annual recharge volume.

4. Water quality: The Massachusetts Stormwater Standards and Policy, established by DEP, requires that the first 0.5-inch (or 1.0-inch in critical areas) be effectively treated. This is based upon the so-called "first flush" principle where most pollutants are transported by smaller rainstorms during the first portion of larger events. While this is true for suspended solids, this principle is not directly applicable for bacteria and nitrogen. Therefore, the larger 1.0-inch design event is more applicable for the Buzzards Bay watershed.

An integration of LID principles and management practices allows for stormwater to be delayed (increased time of concentration) and infiltrated onsite, thereby reducing runoff volume and downstream flood damage (peak runoff control), and improving downstream water quality. The infiltration of stormwater provided by LID practices can result in more groundwater recharge than may have occurred under pre-development conditions, which in turn can help offset increasing water supply demand from other locations in the watershed. Finally, the hydrologic benefits of LID are also accompanied by an aesthetically pleasing landscape and neighborhood layout that manages stormwater more economically and with lower maintenance requirements than is generally the case with traditional stormwater management practices.

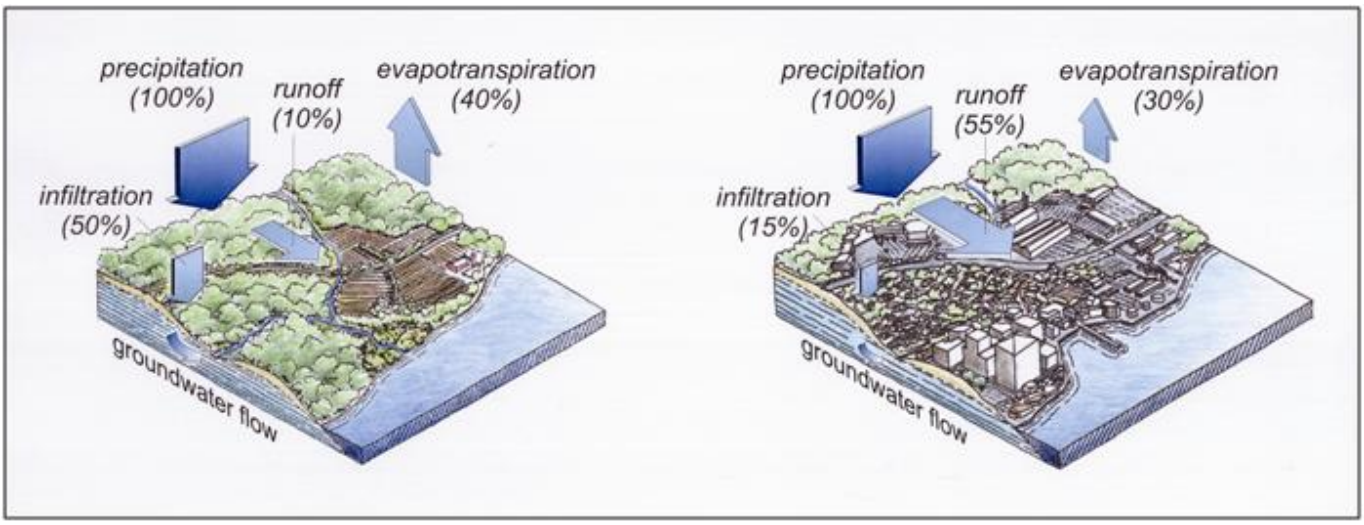


Figure 55. Graphical representation of degree of runoff in lightly developed watersheds as compared to urbanized watersheds.

Stormwater Management Design

Table 22 articulates some key principles of stormwater management design. Stormwater management is best accomplished as part of a holistic, integrated water management approach. Stormwater should not be viewed simply as problematic floodwaters that must be disposed, or only as a pollution source. Instead, stormwater should be considered a valuable resource part of the hydrologic cycle. This is recognized in those stormwater regulations that require stormwater to be recharged into the environment to approximate predevelopment hydrologic conditions. To achieve such a goal, stormwater runoff volumes, rates, and quality need to be managed to mimic natural conditions and pathways. Such actions can lead to the restoration of surface waters and wetlands.

Treated stormwater runoff from impervious surfaces can be "re-used" as an irrigation source, as an alternative non-potable water (non-drinking water) supply source and for groundwater recharge and base flow augmentation. From this standpoint, treated stormwater is a "resource" and not a 'wastewater" to be disposed of. Stormwater runoff from rooftops can be collected in rain barrels or cisterns and used for the irrigation of gardens and landscaped areas, reducing the need to use municipal drinking water for these purposes. It can also be infiltrated into the subsurface to recharge the groundwater system to restore drinking water supplies in some watersheds and to maintain critical (natural) freshwater base flow that may alleviate the impacts of withdrawal rates to streams, wetlands, and estuaries. Stormwater runoff can be managed to prevent water quality degradation of downstream resources.

An increase in impervious surfaces resulting from development decreases vegetation (Figure 55, as shown on right) and shifts the water balance from a more natural state (as shown on left), causing a significant increase in the volume of runoff and a decrease in infiltration and evaporation as a percentage of precipitation.

However, to balance the water budget for a watershed, stormwater recharge should also compensate for "consumptive" drinking water use by residences. These are primarily related to lawn and landscape irrigation, which result in water losses via additional evapotranspiration and runoff. This could be accomplished by either promoting the use of rainwater storage structures (e.g., rain barrels/cisterns) as an alternative irrigation source or by increasing the stormwater management recharge requirement from 0.6 inches to 1.0 inches of runoff. A broad range of best management practices (BMPs) has been developed to manage stormwater runoff. While some of these BMPs have been shown to be effective at removing at least 80% of the total suspended solids (TSS), the minimum required state and federal standard, only certain management practices are effective at treating fecal coliforms and nitrogen (two of the critical pollutants of concern for Buzzards Bay). These BMPs that treat both nitrogen and fecal coliforms are:

1. Filtration practices: sand filters, organic filters and infiltration systems (with proper pre-treatment) that trap bacteria.

2. Vegetated practices: bioretention areas, rain gardens, vegetated swales, and constructed wetlands that provide for nutrient uptake and/or nitrification-denitrification processes.

The proper design, construction, operation, and maintenance of <u>all</u> new stormwater BMPs are critical to their successful functioning. Without these elements, stormwater facilities provide only a false sense of security--they may appear to work because there is no flooding, but they may reduce little pollutant load in the stormwater that passes through them. Effective stormwater management also means that existing stormwater BMPs should be repaired, rebuilt, or retrofitted as needed, if they are observed to be malfunctioning, improperly

sized, or otherwise failing to meet the objectives of stormwater management. Sometimes water quality testing is needed to evaluate system effectiveness.

Accomplishments in Addressing Existing Stormwater Discharges

By far, the greatest amount of federal and state financial resources associated with Buzzards Bay NEP implementation efforts and technical assistance has been spent on the remediation of existing stormwater discharges. A key first step in remediation is locating the discharges and source areas.

In the 1990s, the Buzzards Bay NEP began gathering this type of information for municipalities. The seeds of the project began when the Buzzards Bay Action Committee, implemented a Buzzards Bay NEP funded catch basin and discharge pipe mapping project, using interns from the Massachusetts Maritime Academy. This information was eventually refined and improved upon by Buzzards Bay NEP staff with funding from the Massachusetts Highway Department, and in 2001, the Buzzards Bay NEP published an *Atlas of Stormwater Discharges in the Buzzards Bay Watershed* to serve as a tool for guiding remediation projects, as well as an educational tool[81] (see watershed overview map in Figure 51).

These discharges contribute to shellfish bed closures and water quality degradation throughout the bay watershed. A recent CZM project completed in 2006 evaluated the effectiveness of stormwater BMPs that were constructed using CPR funding and found that while these facilities have tremendous potential for pollutant remediation, maintenance was lacking at many facilities, compromising the effectiveness of these BMPs. The Buzzards Bay NEP staff continues to help local officials in the identification of funding sources and the development of successful projects. This allows the Buzzards Bay NEP and local communities to leverage estuary program funds far beyond their limits. The Buzzards Bay NEP currently estimates the cost of remediating discharges to impaired waters in order to comply with bacterial TMDLs and to implement municipal MS4 stormwater programs will exceed $1 billion dollars and take decades to achieve.

The Buzzards Bay NEP has been greatly assisted in this work through a partnership with the USDA Natural Resources Conservation Service in which NRCS staff works with the Buzzards Bay NEP in design and review of various forms of stormwater remediation facilities. These projects include such varied forms of stormwater BMPs as traditional stormwater infiltration structures, innovative constructed wetland systems, improved agricultural management practices, and urban sewer/stormwater cross connection remediation.

Improved Management of Stormwater in New Development

Preventing new untreated discharges to surface waters was one of the most important goals outlined in the 1991 Buzzards Bay CCMP. It was common sense considering the high cost of remediating existing discharges; it is simply true that an ounce of prevention is worth a pound of cure. At the time of completion of the 1991 Buzzards Bay CCMP, all of the towns surrounding Buzzards Bay had regulations on the books addressing the construction of new stormwater conveyance systems to control flooding or stormwater volume, consistent with state and federal flood control and roadway engineering standards. The stormwater drainage design was generally focused on addressing the site being drained rather than addressing any downstream impacts from stormwater runoff, and/or impacts on the hydrologic budget. Often these rules required that stormwater be delivered as quickly and as directly as possible to the nearest water body or wetland with little or no attention to the quality of the stormwater and its effect on water resources and shellfish habitat. Only if both stormwater quantity and quality are addressed can a town expect to prevent new problems with shellfish bed closures and water quality degradation. Another problem the Buzzards Bay NEP observed was that requirements among town boards were not consistent and sometimes even contradictory.

To address these problems, the Buzzards Bay NEP developed in 1996 a model regulation to manage stormwater ("Unified Rules and Regulations for Stormwater Management for use by Planning Boards, Boards of Health, and Conservation Commissions"). The Buzzards Bay NEP provided technical assistance and educational outreach to communities interested in adopting these standards. In the spring of 2006, the Buzzards Bay NEP published a revised set of unified standards to incorporate low impact development techniques, recharge, and more effective water quality and channel erosion protection measures. To date, these standards have been adopted by Acushnet (Stormwater Board), Rochester (Planning Board Subdivision Rules and Regulations), Marion (Planning Board Subdivision Rules and Regulations, Plan and Site Review), Fairhaven (Planning Board Subdivision Rules and Regulations), Westport (Planning Board and Board of Health), and Falmouth (Conservation Commission Rules and Regulations). Some of these towns subsequently revised the regulations to better meet their needs.

Major Issues

There appears to be a general lack of public knowledge and recognition of the importance of stormwater management and the impacts from poorly man-

[81] This project was financed by the Buzzards Bay NEP through its EPA funded Municipal Grant Program, by the Massachusetts Department of Environmental Protection through the federal Nonpoint Source Pollution (Clean Water Act Section 319) Program, and by the Massachusetts Office of Coastal Zone Management's (CZM) Coastal Pollutant Remediation (CPR) Program.

aged stormwater runoff on surrounding properties and downstream resources. Additionally, stormwater runoff is still generally viewed as a waste that should be disposed of rather than a resource that is integral to the water budget in terms of groundwater recharge and natural stream flows. This makes it difficult to implement local regulatory changes to address stormwater management, and it limits the support for making stormwater improvements within a community. In addition, stormwater management design for permitting purposes requires engineering skills and more recently, site planning skills. Therefore, it is becoming increasingly necessary to incorporate technical review and expertise on behalf of the local boards and commissions in the local permit process. Education of the public, local boards and commissions, municipal employees, as well as engineers and site planners, on matters of stormwater management and BMP design, is critical to ensure that stormwater management programs improve water quality.

Local stormwater management regulations and standards, NPDES Phase II permitting, and the DEP Stormwater Policy generally focus on new development and redevelopment, but do not focus on stormwater impacts from existing developments. Implementation of management measures to address water quality improvements through retrofits to existing development is generally not receiving much attention. However, with the adoption of the pathogen TMDL for Buzzards Bay, and the expected reissuance of MS4 NPDES permits expected in 2013[82], communities will need to begin new efforts to reduce stormwater from existing development, and bring these discharges into compliance with the stormwater discharge standards.

Implementation of an effective and comprehensive stormwater management program can be expensive. Despite recent economic problems, appreciable new areas will be developed in the next decade throughout the Buzzards Bay watershed, together with the evolution of more technical stormwater and water quality regulations, coordination and implementation of a stormwater management program in any given community will likely be expensive. Communities need to consider innovative mechanisms and models to fund a stormwater program, including technical oversight and engineering review, enforcement, and maintenance of stormwater practices.

The management solutions for controlling stormwater discharges range from simple to complex, inexpensive to costly, and can involve different levels of government as well as private landowners. In developed areas, structural controls may be expensive to implement and land for retention basins may be either prohibitively expensive or not available at all. The costs of installing stormwater BMPs are usually borne by the municipality and its residents, but benefits accrue to all users of the municipality's water resource. These benefits can include restored recreational opportunities, maintenance of land values due to the aesthetic appearance of receiving waters, and, of greatest relevance here, restored, or continued shellfishing opportunities.

Any town that is contemplating the construction of stormwater treatment facilities must consider all facets of the issue, including land acquisition, installation techniques, cost, treatment effectiveness, and maintenance requirements. Sampling data may be needed to determine the relative impact of each drain on water quality degradation. Before targeting a particular storm drain for action, the town should ensure that the problem is not emanating from septic systems or other illicit discharges that are "cross-connecting" with the drain.

The NPDES Phase II Program requires that communities (MS4s) covered by the program prepare and implement a stormwater management plan in accordance with a five-year schedule each community sets in an initial Notice of Intent. While U.S. EPA and DEP require that each MS4 file an annual report to provide an update on progress, and the reports are posted on the internet, there has been little other enforcement to ensure that communities are following the stormwater plan tasks and schedules[83]. At the same time, most communities are understaffed to meet all the responsibilities outlined in their NOIs. Communities need technical assistance to work efficiently and effectively to meet the Phase II NPDES requirements, and to address other water quality efforts such as the need for municipalities to implement programs to meet the pathogen TMDL for Buzzards Bay.

The Massachusetts Department of Transportation (Mass DOT, formerly, MassHighway) has, as one of its primary concerns, the construction and maintenance of safe roads. Until recently, this typically included the removal of stormwater from those roads as quickly as possible. Accordingly, resource protection and water quality considerations must be balanced with the Mass DOT primary mission of building safe roads. In January 2006 Mass DOT released an updated manual for the design of state roads, this manual, entitled *Project Development and Design Guidebook* features more emphasis on design flexibility, streamlined procedures, and improved collaboration between Mass DOT and the cities and towns it serves. Mass DOT also developed a *Stormwater Handbook for Roads and Bridges* (May 2004) and is required to meet NPDES Stormwater Phase II permit requirements for the storm sewer systems from the roads and facilities operated by Mass DOT. These new guidance manuals coupled with the regulatory requirement of Phase II will help foster a climate where Buzzards Bay towns will work collaboratively with Mass DOT to en-

[82] "EPA is expected to renotice the draft permit in the fall of 2012.

[83] After a hiatus, in 2011 and 2012, EPA issued letters of compliance and fines to more than two dozen municipalities, including two Buzzards Bay communities, for their failure to submit annual MS4 permit reports.

sure that water quality and quantity impacts are evaluated in a comprehensive manner for road and bridge planning, design and construction projects. The activities of town DPWs should receive the same attention.

Transportation planning should avoid siting new traffic corridors or hubs near sensitive receiving waters, and an alternatives analysis should identify sites that pose minimal or least impact due to stormwater runoff. Existing corridors/hubs near sensitive resources should be remediated.

Stormwater runoff from more than one town may be contributing to water quality degradation or shellfish bed closures in a specific embayment. Each contributing town must implement similar and equitable stormwater controls in order for the affected resource to be fully protected.

Most stormwater outfalls in Buzzards Bay are primarily wet weather discharges only. Those that have continuous dry weather flows might be an indication of illegal cross connections with sewer lines or septic systems. More likely, these dry weather discharges are a reflection of outdated and decrepit pipe systems that allow groundwater infiltration. In some communities, the discharge of sump pumps from basements is responsible for large portions of dry weather flow.

Federal implementation of the Phase II requirements cover all applicable areas of a regulated community, whereas state implementation of the DEP Stormwater Policy only covers activities within the jurisdiction of the Wetlands Protection Act (i.e., within a regulated resource area and/or a buffer to a regulated resource area). Municipalities implementing the Phase II program requirements will have the flexibility to implement a stormwater program across the entire municipal limits either in accordance with the provisions of the DEP Stormwater Policy or to a greater level as offered by the Buzzards Bay NEP Model Stormwater Bylaw, updated in the spring of 2011.

Currently, the state's stormwater management policy requires 80% TSS removal. Most commercial BMPs that meet this standard do little to remove fecal coliforms or nitrogen, which are impairing 22 Buzzards Bay embayments (303(d) listed). DEP needs to work cooperatively with U.S. EPA, EEA, and CZM to revise its 2008 Stormwater Standards and Policy to better address volume, quality, and rate of stormwater discharges. More specifically, the standards must require BMPs and performance standards that reduce fecal coliforms and other pollutants (such as nitrogen) in order to meet new TMDLs. DEP formed a Stormwater Advisory Committee that made some progress on this task, and made several recommendations to strengthen the recharge criteria and methods, incorporate new provisions for LID and redevelopment projects, and provide additional guidelines on BMP pollutant removal effectives. However, most of the recommended changes have not yet been implemented. The adoption of new standards will minimize environmental degradation, help to restore impaired waters, and reduce other ecological impacts of stormwater discharges, and improve the long-term success of the MS4 NPDES program.

Climate Change Adaptation

An increase in the average global temperature will likely lead to an overall increase in global precipitation, although some areas will likely receive less rain than today, and other areas will receive more rain (IPCC, 2007). For the northeast U.S., models predict a 7-14% increase of annual precipitation by the year 2100, mostly the result of increased rainfall in cooler months (EEA, 2011, Frumhoff et al., 2007). Furthermore, the frequency of larger rainfall events may also increase, as may storm intensity. Because stormwater collection and treatment systems may have lifespans over many decades, towns may wish to employ or require treatment designs to accommodate higher and more intense rainfall events. For stormwater treatment systems very close to shore, groundwater levels may raise as sea level rises. Infiltration systems near shore should be designed to accommodate at least a 1-foot rise in sea level.

Management Problems

Most elements of EPA's TMDL and MS4 stormwater permit program makes sense from a conceptual framework; however, the capacity of municipalities to comply with these programs seems to have been exceeded, both financially, and politically. The state's approach of gradually strengthening stormwater treatment requirements has helped, but has not kept pace with what is required to improve water quality and open shellfish beds or remove other impairments.

There are not enough State Revolving Fund (SRF) dollars to meet all current needs for required wastewater upgrades. To address seriously municipal stormwater needs and wastewater compliance with nitrogen TMDLs (Action Plan 1), SRF annual funding will need to increase many fold. In the end, because these are loans, municipalities can only maintain a certain debt load. U.S. EPA and DEP may eventually need to implement a debt-forgiveness program where individual municipal burdens are too great to sustain.

Eliminating water quality impairments caused by stormwater discharges is a major undertaking that will require actions and expenditures by all levels of government. EPA must ensure that towns meet the Buzzards Bay pathogen TMDL though improved compliance with municipal MS4 NPDES stormwater permits. At the same time, the federal government must not cut nonpoint pollution grants for municipalities to reduce pollutants to their stormwater networks, and must increase funding to the state revolving loan program to help municipalities. DEP must upgrade state stormwater policy to include

treatment standards for nitrogen and bacteria, and EEA must promote policies and regulations that foster low impact development techniques. The largest burden rests with municipalities, which will need to develop and implement meaningful stormwater management programs for themselves and the private sector supported by sound local laws, regulations, and policies.

As the Buzzards Bay watershed becomes increasingly developed, environmental impacts will also increase unless proactive measures are undertaken now. Conventional development may offer quick profits because the methods are well known and have been widely utilized; however, conventional development may not be the best way to protect sensitive resources. LID represents a sustainable approach to development that minimizes or eliminates impacts of development on water resources and habitat associated with Buzzards Bay. The key challenge is to encourage developers, planners, engineers and the public to utilize LID and other smart growth development approaches as the preferred alternative to conventional development.

A significant obstacle to the acceptance of LID principles is the perception that conventional development may be less expensive than LID and other methods of sustainable development. According to the Natural Resources Defense Council (www.nrdc.org/water), LID can often cost less than conventional stormwater management systems from both an installation and maintenance standpoint. LID design promotes reduced road surfaces and encourages less infrastructure underground (stormdrain pipes, catch basins, manholes). In addition, the associated vegetation also offers human quality of life benefits by greening the neighborhood, contributing to livability and aesthetics. This "greening" can enhance property values and marketability, and provide wildlife habitat along with pollution reduction and decreased flooding. Instituting change throughout the planning and development community will require showing that conventional development will cost Buzzards Bay communities more, in terms of environmental degradation and quality of life impacts, than the cost of changing over to sustainable development approaches. Figure 56 shows how the Buzzards Bay NEP sought to communicate these ideas a workshop series on LID.

Management Approaches

To address the stormwater problems identified in this action plan, a dual approach of setting higher stormwater treatment standards for new development and redevelopment, and for implementing an aggressive program to treat existing discharges that are causing water quality and habitat impairments is needed.

Stormwater Management Standards and Goals

With respect to stormwater treatment standards, DEP must work cooperatively with U.S. EPA, EEA and CZM to revise its 2008 Stormwater Standards and Policy to better address volume, quality, and rate of stormwater discharges, and to require reductions in fecal coliforms and other pollutants (such as nitrogen) to meet new TMDLs. This is an essential ingredient for towns to meet bacteria and nitrogen TMDLs, because many discharges are beyond their control. DEP may need to reconvene its Stormwater Advisory Committee to address this problem. The state's stormwater guidance must be updated to include the latest data on bacteria and nutrient removal by different types of BMPs. State and federal agencies, and regional planning entities like the Cape Cod Commission and SRPEDD, and the Buzzards Bay NEP can support these updates with training workshops, circuit riders, technical assistance staff, and GIS products. The Cape Cod Commission could also incorporate more stringent fecal coliform and nitrogen loading standards in their regulatory reviews of the stormwater management facilities associated with projects under their review.

USDA must update stormwater calculation programs like TR55 to include runoff coefficients for specific LID practices, with input from the EPA. This will set standards for commercial software packages and enable applicants to adopt certain LID approaches.

EPA's enforcement of existing MS4, MSGP, and Construction stormwater permits in the NPDES program has been inadequate. Currently two employees are working with 207 Massachusetts municipalities to address nonpoint source pollution, including local program review, permit compliance, and technical assistance. This level of support is not adequate to ensure the success of the program. The program is understaffed, and the agency must commit additional resources to the effort. Unless EPA takes action to ensure better compliance and tracking of these programs, little progress will be made. Even simple letter writing campaigns to notify industries not in compliance with the MSGP requirements can be an effective tool to promote action to implement stormwater remediation projects.

The state legislature should avoid exempting road and bridge projects from state wetlands permitting. The legislature continues this practice in the belief that it will streamline the permitting process, but it does nothing to streamline the federal permit process, and large projects often take considerable time, many times exempt from any local appeal process. Denying conservation commission involvement may just alienate the town. Although in these cases Mass DOT will still voluntarily meet with Conservation Commissions to resolve wetland issues, this does not always occur for exempted projects. Elimination of these exemptions will help Buzzards Bay communities to better protect sensitive wetlands from stormwater runoff from roads, and ensure that local needs are addressed.

With respect to restoring existing impairments to water quality and habitat, as defined under their MS4 per-

Figure 56. Posters developed by the Buzzards Bay NEP for a LID workshop.

mits, each Buzzards Bay community will need to implement best management and good housekeeping practices for stormwater networks. The highest priority should be given to stormwater networks contributing to shellfish bed closures or other impacts to wetlands, water quality, or other natural resources identified in bacteria TMDLs and MS4 permit stormwater plans. DPWs will be the lead in this effort, but most towns have established a stormwater management committee to help coordinate municipal board action and bylaw development, consistent with the town's stormwater management plan. It will be vital for conservation commissions, boards of health, and planning boards to adopt consistent stormwater regulations and policies, and that stormwater bylaws address projects not typically under review by municipalities like approval not required (ANR) projects.

Local Implementation

Most of the responsibility and costs for new stormwater management standards and requirements will fall to municipalities because the vast majority of stormwater discharges are associated with municipally owned stormwater drainage networks. There are considerable flexibilities in how municipalities might regulate and finance their expanded stormwater program obligations. For example, municipalities could establish a stormwater authority as authorized under the MGL Chapter 40, Section 1A and Chapter 83, Section 16. Alternatively, they could just expand existing programs and finance such efforts out of the general tax revenue base.

Whatever local management structure is implemented, an important process to support local stormwater management will be the continued development and expansion of GIS databases that map all stormwater discharges, catch basins, and drainage networks, BMPs, and maintenance (e.g., catch basin cleaning schedules) in existing stormwater networks. Currently few municipalities utilize GIS based stormwater management systems to track maintenance and repair of stormwater networks, despite the fact that the size of stormwater networks requires a computer-based management approach. Those municipalities may not have adopted these database

management approaches because of startup costs and training requirements.

Because local government has the greatest control over development and redevelopment, each Buzzards Bay municipality must adopt LID principles in their subdivision regulations and site plan review laws and regulations, or town-wide stormwater general bylaws. Because many kinds of development and redevelopment are not reviewed through these types of permits, a good general stormwater bylaw or ordinance will be a more comprehensive solution. Board of health and conservation commission regulations for stormwater treatment should be consistent with these other town requirements. In some cases, town meetings must approve new bylaws; in others, town boards already have authority to adopt regulations.

These LID laws and regulations should maximize infiltration of stormwater runoff to the greatest extent possible with a goal of capturing 95% of the stormwater volume. These local requirements could even contain an incentive (credit) system to encourage developers to minimize impacts by reducing impervious areas, disconnecting rooftops and driveways from street drainage, and maintaining naturally vegetated buffers to wetlands, streams, and marine waters.

Key state and local staff and municipal boards should become familiar with LID and other sustainable development practices, and should attend training workshops where applicable.

At least half the Buzzards Bay communities have participated in workshops and formally considered whether LID bylaws are appropriate in their town. Several towns are now adopting some LID measures in their regulations. At the state level, MEPA has been imposing new stormwater requirements on projects meeting the state project review threshold, and in 2010, the federal government, in an effort to lead by example, is requiring that 95% of stormwater be treated on site for any new or redeveloped federal properties.

The Buzzards Bay NEP should continue to promote adoption of municipal bylaws and regulations that support the principles of LID. Workshops should be coordinated with the BBAC. This is a high priority and should be a core element of the Buzzards Bay NEP's technical assistance program to manage stormwater. The Buzzards Bay NEP should work with BBAC and Buzzards Bay municipalities to assist with the adoption and implementation of the LID bylaws and unified stormwater regulations among town boards. Watershed protection groups will need to advocate for and support the passage of bylaws and regulations.

Once these local regulations are adopted, the Buzzards Bay NEP should continue to provide training in implementation of these regulations and the review of plans and stormwater calculations for compliance with these new local regulations, and to identify when professional engineering reviews are required.

State Responsibilities

At the state level, DEP is the most important agency in setting policy and requirements requiring LID techniques, particularly for projects that come before conservation commissions. While the state has initiated many important changes in the stormwater policies and regulations, more needs to be done to foster LID principles. A key need is to expand stormwater treatment requirements beyond the 80% TSS performance standard for stormwater discharges to impaired bathing beaches and shellfish areas, and ensure BMPs are put in place that remove bacteria as well.

MEPA should require the submission of an LID alternatives analysis for commercial and residential projects that meet MEPA thresholds (for land, rare species, wetlands, water, wastewater, transportation, and ACEC) for EIRs. These LID principles need to be more formally incorporated into the MEPA Regulations at 301 CMR 11.00. The MEPA office and EEA could have a Task Force to develop these recommendations for an LID alternatives analysis. The MEPA office should add changes to their website that promote LID as part of a preproject planning process, and MEPA should distribute appropriate guidance materials that encourage LID strategies prior to project submissions.

Agricultural Runoff

NRCS should continue their ongoing program to assist farmers to implement best management practices on agricultural lands in the Buzzards Bay area. In many Buzzards Bay watersheds, stormwater runoff from agricultural lands remains an important contributor to water quality and habitat degradation, and these impacts can be overcome. Presently there is inadequate follow up to ensure that farmers are adhering to their farm plans. Specifically, recommendations that are more detailed should be developed to minimize loading from nitrogen and phosphorous from fertilizers and fecal coliform where manure is used as a fertilizer. NRCS should work with DEP to develop updated guidance on understanding the exemptions and responsibilities afforded to agriculture under the MA Wetlands Protection Act. This information could be used to incorporate agriculture issues under the MA Stormwater Policy. Adequate staff and funding is needed to ensure that farmers have the resources and guidance to implement their farm plans.

Education and Training

Education and outreach is one of the most essential requirements for the success of this action plan. Currently there is general understanding and appreciation among decision makers of the problems with conventional development and the need for LID, and there is growing support for action. The main obstacle remains the inertia

of politicians and regulators to enact changes that may be viewed as burdensome to the private sector.

Effective outreach and information about LID techniques and approaches need to be provided to a wide audience. The recipients of this training include municipal staff and boards involved in policy and permitting of development. This includes planning boards, building inspectors, conservation commissions, zoning boards, boards of health, and others. Outreach should be provided to non-governmental entities, including developers, builders, engineering firms, homeowners and trade associations, and the public.

The Buzzards Bay NEP should continue to promote the adoption of its model municipal stormwater regulations to help towns adopt LID principles, and better comply with municipal MS4 stormwater permits and bacteria TMDLs. This is a core mission of the Buzzards Bay NEP, an essential step for municipalities to implement stormwater management plans in support of their MS4 permits, and to meet bacteria TMDLs. This means the municipalities must adopt regulations and standards that exceed the minimum standards under the state's Wetland Protection Act stormwater policies. The Buzzards Bay NEP will work with the BBAC to conduct periodic meetings and workshops on stormwater issues to create a forum to exchange approaches and ideas among watershed municipalities.

There are costs to government in implementing new stormwater performance standards, and there are real and sometimes perceived cost to the private sector creates that can create political obstacles to implementation. Sometimes incorrectly perceived costs can be overcome through outreach and education of the benefits of a program. All levels of government have a responsibility in this outreach and education, and non-governmental organizations like the Buzzards Bay Coalition can play an important role. Training workshops, outreach materials, demonstration projects, school and university projects, and media involvement are all parts of this communication strategy.

MA CZM could reestablish an LID Working Group to develop new strategies to reach out to coastal communities and educate this wide range of participants. CZM has provided leadership and guidance to coastal communities, and can reach out to them to promote LID techniques.

Regional planning and regulatory agencies like SRPEDD and the Cape Cod Commission should update their own regulations, or policies to meet LID principles, and continue to provide LID training, outreach, and education to municipalities and developers as well. The Cape Cod Commission should review its Regional Policy Plan and apply LID standards to projects under their regulatory review.

Trade associations that should be targeted in outreach efforts include the Cape Cod Homebuilders Association, Massachusetts Homebuilders Association, Massachusetts Association of Municipal Employees, American Planning Association, American Society of Civil Engineers, and other development and planning organizations. DEP, EEA, CZM, and Buzzards Bay NEP could provide "Train-the-Trainer" workshops to train association staff to ensure that the industry can provide LID training to their members.

The U.S. EPA should continue to promote LID through funding and partnership building, as part of nation-wide smart growth initiatives, and to encourage LID principles through in their regulatory programs. In Massachusetts, LID techniques should be encouraged through the EPA's MS4 stormwater permit program.

As noted in the stormwater action plan, NRCS, with input from the EPA, should incorporate LID hydrology into the TR-55 stormwater loading model used by engineers and regulators. This is important because TR55 and similar models are used by consultants and engineering firms as the basis of evaluating stormwater discharges for conformance to government stormwater regulations, it is essential that the program be updated to give proper runoff coefficients to LID BMPs to ensure those BMPs are given adequate consideration. NRCS can then develop the revised model using existing peer-reviewed data and design characteristics. Training and outreach by NRCS, EPA, local state agencies and LID experts will then be needed to teach engineers and reviewers how to use this model. EPA is an essential facilitator of this effort. Development of this model should be undertaken with assistance from engineering associations and research institutes to ensure its proper application to BMP designs and function. The effort could also be used to define the set of user-specified variables that will be needed in the model when incorporating LID BMPs in varied environments. Training and outreach will be needed in order to teach practitioners how to use this software.

Financial Approaches

The actual costs for changes to government regulations, laws, and policies are negligible. Some of these changes will increase initial development costs; others will reduce those costs. The costs of providing training will vary, but using private contractors, could range between $5K to $20K annually depending on workshop schedules, speakers fees and expenses, rental fees for facility, etc. Alternatively, existing government staff and agencies could shoulder these responsibilities.

Financing stormwater remediation to remove existing water quality impairments in Buzzards Bay is the most significant obstacle hindering implementing this action plan. Exacerbating the problem, EPA has continued to limit the use of 319 nonpoint source grant funds, and the state revolving loan program, often touted as a financial solution for municipal stormwater solutions, is becoming

increasingly burdened with municipal needs of sewer expansion and wastewater facility upgrades to meet nitrogen TMDLs.

The cost to Buzzards Bay towns to remediate existing discharges to comply with bacteria TMDLs and stormwater MS4 permits may exceed $1 billion dollars and take decades to achieve. All regional governmental organizations must provide towns with needed technical assistance to help comply with these water quality mandates. U.S. EPA, EEA, CZM and DEP, must commit additional funds to leverage local stormwater remediation projects. These programs should focus on watersheds of impaired embayments, including Phase II urbanized areas. A level of funding of $2 million annually directed to Buzzards Bay watershed can leverage continued progress to remediate important existing discharges. The state legislature and Congress must set aside these funds. However, the real burden of achieving these goals will fall to municipalities and the private sector. Government leverages private action at the time of permitting for development or redevelopment of projects. Remediation of existing municipal stormwater networks may require innovative approaches like stormwater utilities. Municipalities could utilize the State Clean Water Revolving Fund (SRF) loans to finance improvements to municipal stormwater networks. Unfortunately, the SRF program is overburdened with projects to upgrade wastewater facilities, so Congress would need to expand funding for the program. To save money on the cost of stormwater treatment projects, municipalities will need to coordinate stormwater remediation projects with road reconstruction and sewer expansion projects. Some of these actions will occur automatically if the state and federal governments change the performance standards in regulations defining stormwater treatment.

The costs to government to manage impacts from new development and redevelopment are negligible because government can adopt new performance standards that only incrementally add costs to development. Existing municipal and agency staff can develop and implement these new stormwater treatment standards mostly using existing staff, so the cost to government is negligible. Some municipalities have already adopted new bylaws with Buzzards Bay NEP assistance, and the level of technical assistance offered by the program will be defined by available funding.

Many of the elements of this action plan can be achieved by the passage of laws and promulgation of regulations. Because of the costs of stormwater treatment, and the perceptions of costs to the private sector, adoption of new laws and regulations can be challenging politically. The most daunting costs will be to ensure that municipal stormwater discharges meet bacteria TMDLs. Because of the large number of discharge pipes, and the costs to design and implement solutions for a single discharge pipe, the cost of meeting the bacteria TMDL will likely cost at least $1 billion and take decades.

To fund local stormwater restoration efforts, some municipalities have been considering adopting stormwater utilities. Potential funding for such an approach could be authorized under MGL Chapter 83, Section 16 ("Charge for use of sewers"). Municipalities may create such a stormwater management utility to raise fees to manage stormwater facilities that serve multiple residents and/or commercial properties. Such a stormwater utility is analogous to a sewer utility, and may include LID measures. A "water pollution abatement" district needs to be defined first, under MGL Chapter 40, Section 1A. Other funding sources include EEA Smart Growth Technical Assistance Grants and CZM CPR and NPS Grants.

The Buzzards Bay NEP should continue its grant program to support Buzzards Bay communities in eliminating or treating stormwater discharges. The Buzzards Bay NEP has particularly focused on helping communities adopt stormwater designs and site plans that can be used to obtain funding from other grant programs that have more funding for stormwater treatment construction, such as DEP's 319 grant program and CZM's CPR program. Municipalities can use funding from these programs to fund demonstration projects on municipal properties so that they can lead by example.

Monitoring Progress

Many of the actions needed to implement this action plan are programmatic, so success of programs can be measured by the adoption of embayment stormwater plans, the level of compliance with NPDES permit programs, and the adoption of new local regulations. Other tracking involves enumeration of the number of discharges treated, illicit discharges removed, and the percentage that have stormwater treatment solutions installed. The ultimate measure of success for this action plan will be number of acres of shellfish beds opened, or decreases in the number of beach days closed. Many of these elements can be evaluated through the MS4 permit process, and through the update and review of stormwater

With respect to meeting the goals of LID, workshops, adoption of bylaws and regulations, and meeting certain performance standards are measures easy to track. The long-term costs and benefits to the environment will take years to track and will be harder to measure, but the expected outcome will be less impacts of new development, and possible water quality improvements when the landscape is redeveloped and stormwater discharges are reduced through new stormwater treatment requirements.

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