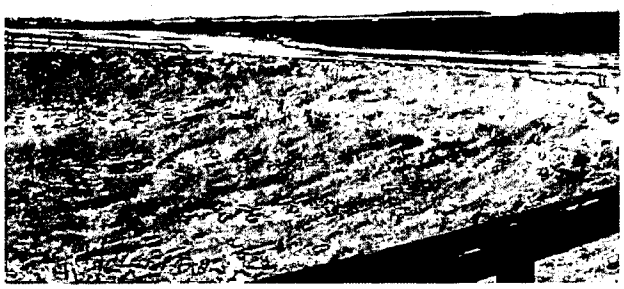

Beyond the Minimum: Stormwater Management in Ipswich, Massachusetts

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Cover Photographs: (top) Crane's Beach taken by group March 10, 2004; (middle) Town of Garner, NC, Engineering Department; (bottom) Ipswich, MA website (www.ipswichma.com)

Many thanks are due to the following for their helpful contributions to this project:

City of Bellevue, Washington
City of Eugene, Oregon
City of Gloucester, Massachusetts
City of Issaquah, Washington
Department of Public Works, City of Cambridge, Massachusetts
Eight Towns and the Bay
Ipswich Coastal Pollution Control Committee
Massachusetts Department of Conservation and Recreation
Massachusetts Department of Environmental Protection
Miami Valley Regional Planning Commission, Ohio
Natural Resources Conservation Service, Westford, Massachusetts Office
New Hampshire Department of Environmental Services, Water Quality Engineering Bureau
SEA Consultants, Inc.
Southeastern Regional Planning and Economic Development District (Massachusetts)
Town of Brookline, Massachusetts
Town of Garland, Texas

We extend special thanks to the numerous departments of the town of Ipswich, MA. We are extremely grateful to Glenn Gibbs and Kate Day of the Department of Planning for their support and guidance.

We also express thanks to our instructors Veronica Eady, Ann Rappaport and Rusty Russell for their feedback and assistance.

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Executive Summary

The natural landscape of Ipswich, Massachusetts yields a $1 million soft-shell clam industry and a citizenry devoted to the preservation of its scenic coastline of marshes, inlets, beaches, and bay. Stormwater pollution, pollution and sedimentation that reach water bodies via the flow of rain water and snowmelt, threatens these natural resources. One study found that nearly 50% of sedimentation reaching Ipswich Bay can be traced to single-family home development, which currently has no requirements for stormwater impact mitigation. Under an approaching deadline for implementation of Phase II of the Clean Water Act's National Pollution Discharge Elimination System (NPDES), cities and towns across the country must regulate stormwater for development disturbing one or more acres of land. The town of Ipswich is evaluating the possibility of going beyond this federal requirement in order to protect and restore its beloved natural environment.

Necessary for the nation's threatened waterways, stormwater regulation for developments impacting less than one acre has the inherent challenge of being effective while not creating a significant burden in costs or labor for the town or for individuals wishing to build a single-family home or construct an addition to their home. This project explored and evaluated the essential components of a bylaw for Ipswich to mitigate the effects of stormwater beyond the requirements of NPDES Phase II and produced a draft bylaw for consideration by the town.

Aspects of stormwater regulation including administration, enforcement, triggering events, fee structure, and the need for professionally approved plans for erosion and sediment control were all considered when drafting this bylaw, and research was done on existing stormwater bylaws on which to model the Ipswich bylaw.

The proposed bylaw suggests that any disturbance of land over 2,500 feet signals the need for sediment and erosion control plans to be submitted to the Department of Public Works in order to receive a building permit. These plans do not have to be stamped by a Professional

Engineer, to avoid placing additional burden on the landowner. The bylaw permits the DPW to require a stormwater management plan from a Professional Engineer in addition to the erosion and sediment control plan if the department feels it is warranted, such as in the case of steep slopes or proximity to ecologically sensitive areas. These plans would include all existing stormwater utilities; topographic features of the land; soil types; a description of all watercourses, impoundments, and wetlands on or adjacent to the site or into which stormwater flows; existing and proposed locations of all brooks, streams, drainage swales and the method of stabilization; and stormwater runoff calculations.

The bylaw also gives the town permission to collect application and review fees associated with the plans. This bylaw does not specify an amount for the fees, as this will be determined by the town, based upon the cost of review. A professional consultant may need to be retained for the review process, in which case the permit fee would cover this additional expense. Requiring a minimum of 60% of the sites' natural vegetation to remain intact is another component of the proposed bylaw. Vegetation is a natural method of keeping soils intact to prevent erosion and sedimentation, while slowing the flow of stormwater.

Finally, education is an integral part of ensuring compliance with this bylaw. Often property owners are unaware of the damage that can be caused by erosion on their property or by the runoff of stormwater from their land into a nearby stream. An information sheet covering the threat posed by stormwater will be distributed with any building permit application. Another effective way of promoting good stormwater management in the town is through the creation of a stormwater handbook to be distributed to developers, contractors, and property owners. This handbook would contain information about Best Management Practices for erosion and sediment control and for stormwater management, with information on how to implement them. This report provides suggestions for educating the public about this bylaw, and also provides information on additional stormwater management tools the town may want to consider along with the implementation of this bylaw.

1. INTRODUCTION

The Town of Ipswich is famous for its clams, its beaches, and its marshes. As with many prized natural treasures, these attractions are increasingly threatened by the accumulation of pollution and sediment stemming from development, automobiles, and other anthropogenic sources. Pollutants and sediment are conducted to Ipswich Bay through stormwater or snowmelt runoff. When rain falls or when snow melts, the water is either absorbed into the ground or runs along the surface until it reaches a water body. Paved surfaces, which are prevalent in developed communities such as Ipswich, swiftly conduct the water into the bay. Along the way, the water collects automobile exhaust, fertilizer from lawns, debris, and sediments. In areas where the land is disturbed for construction or other purposes, stormwater more easily picks up sediment because it is not secured by vegetation. This process contributes to both pollution of the bay and erosion of the land.

Federal laws require towns to address stormwater runoff for large-scale development under NPDES Phase II regulations, but there is no current requirement for small-scale development that disturbs less than one acre of land, including re-development projects and the construction of single-family homes. In addition, while state and local wetlands regulations address development in close proximity to wetlands or waterways, these regulations have no jurisdiction over other developments which may impact wetlands through runoff originating as far as several miles away, but which ultimately drains into wetland resource areas.

As it flows, stormwater collects pollutants from paved surfaces and sediment from construction sites and other disturbed surfaces, resulting in both erosion and pollution.

In Ipswich, the majority of development occurs as smaller scale projects. These are of concern to the town because its natural resources play such a significant role in the town's economy and culture. The Ipswich Coastal Pollution Control Committee estimated in a 1995 study that close to fifty percent of the sedimentation impacting Ipswich Bay originates from developments disturbing less than one acre of land and outside of the wetlands regulatory review jurisdiction, which are thus exempt from both the NPDES Phase II and wetlands regulations (personal communication, Wayne Castonguay, April 7, 2004). Therefore, NPDES Phase II does not come close to fully addressing this ongoing problem in the Town of Ipswich.

The focus of this project is to research and propose possibilities for mitigating the effect of stormwater runoff originating from smaller scale

development and re-development projects in the town of Ipswich. A condition of any proposed regulation was the avoidance of additional burdens of extra labor or costs to either the town or its citizens.

In discussing Ipswich's stormwater problem with town officials, it was apparent that sediment was by far the largest and most easily rectifiable problem generated by stormwater runoff. Sediment running into Ipswich Bay clogs the shellfishing beds resulting in closures, and transports pollutants to the bay. Through proper planning and the use of Best Management Practices, much of this sediment can be eliminated.

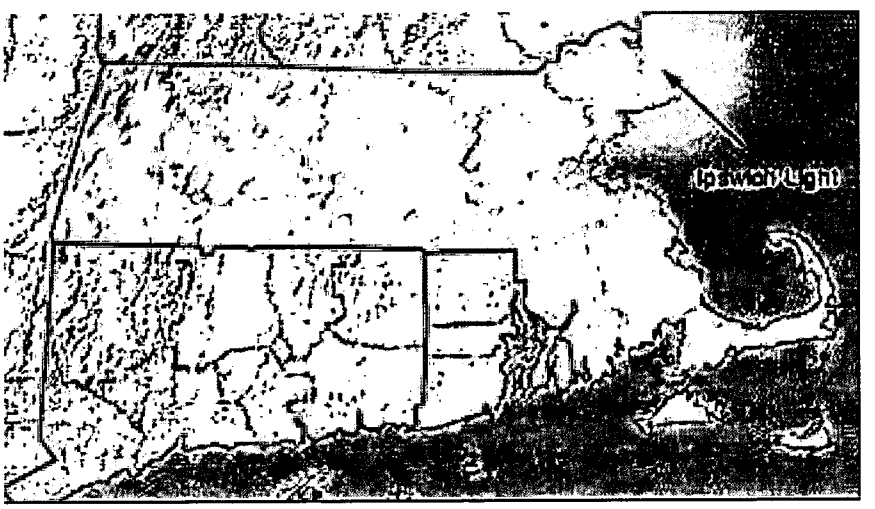
Given the importance of the town's natural resources and the impact of pollution and erosion caused by stormwater, more stringent stormwater regulations in Ipswich are sorely needed. Looking at this issue from a larger perspective, few towns across the country have implemented stormwater pollution controls which exceed those required by NPDES Phase II. This report will hopefully serve as a resource for other towns also wishing to take further steps to protect their own natural resources.

Sediment running into Ipswich Bay clogs the shellfishing beds resulting in closures. Through proper planning and the use of Best Management Practices, much of this sediment can be eliminated.

2. BACKGROUND

2.1. Field Projects

This report is the culmination of a semester's worth of work for the authors in a class called Field Projects: Planning and Practice. Field Projects is a required course for all masters degree candidates in the Urban and Environmental Policy and Planning (UEP) program at Tufts University. The intent of Field Projects is to give students practical experience in the field, while enriching the community by matching up students with a municipality or organization needing assistance with a project. The Ipswich team was asked to develop a regulatory mechanism addressing currently unregulated stormwater sources, without significantly increasing the workload of municipal officials or placing an undue burden on applicants. The scope of the project was narrowed to address the alteration of land too small in area to be subject to NPDES Phase II regulations. The team was successful in researching and creating an applicable bylaw that will be put before the Board of Selectmen. Hopefully, this bylaw will be effective at mitigating the problem of excess sediment and stormwater runoff in Ipswich.



New England Lighthouses, A Virtual Guide (www.lighthouse.cc)

2.2. Background

Ipswich lies roughly 28 miles north of Boston and covers approximately 33 square miles. The town includes a landscape of marshes, dunes, beaches, forests, fields, and farmlands. The Ipswich River runs through the center of town and carries fresh water to the Atlantic Ocean, creating diverse

ecosystems of marshes and estuaries where these water bodies come together. First settled by the son of Governor John Winthrop in 1633, the area's natural surroundings were ideal for citizens to earn a living by farming, fishing, building ships and trading. In 1868, the Ipswich Hosiery Mills opened, which attracted labor in the form of Scots, French Canadians, Poles, and Greeks. Still recognized as an old mill town, Ipswich has houses dating from the 1600's (Town of Ipswich, MA 2004). The combination of rich natural surroundings and authentic historical character create a real desire among the citizens of Ipswich to protect and preserve their unique town.

The ecosystems of Ipswich continue to provide an essential economic contribution to the town. "Ipswich clams", found Ipswich Bay, are famous, and a number of people in town make a living harvesting or processing shellfish. The tourism industry in Ipswich is based largely around its legendary clams, and Ipswich is home to a number of shellfish processing plants, which locate here because of the reputation of the Ipswich name and its association with shellfish. If pollution or other factors disrupted the shellfish ecosystem of Ipswich, the town could risk losing their reputation for producing the finest clams around. In addition, the shellfish industry in Ipswich is a $1 million industry and has a multiplier effect of up to six or seven, meaning that the shellfish industry generates as much as $6 to 7 million dollars for the Ipswich economy (Wayne Castonguay, personal communication, April 7, 2004).

The clam beds, however, are suffering. Fecal coliform bacteria, sediment (or total suspended solids), and metals are all carried to the clam beds through stormwater runoff and all are detrimental to the health of the clam beds. Data from 1991 show that thirty percent of the town's shellfish areas were permanently closed. While some of those beds are now being conditionally reopened, the majority of the beds are closed for a few days after a rainfall as little as a quarter of an inch (Lantagne 2003).

"Ipswich clams", found Ipswich Bay, are famous, and a number of people in town make a living harvesting or processing shellfish.

To protect its natural resources, Ipswich first adopted zoning and sewage programs to limit growth and ensure the quality of its environment in 1957 (Town of Ipswich, MA 2004). In 2001, the town changed the zoning of their Rural Residence district, a significant portion of the residential zoning districts, from one acre to two acres. The purpose of this change was to "promote the use of Open Space Preservation Zoning (OSPZ) as the preferred method for residential development outside the downtown area" (Town of Ipswich, MA 2001). In addition, roughly a third of the town has

been classified as "Existing Protected Land." Not all of this has been officially protected, but is recognized as areas that should be protected or incur development sensitive to its environment (Town of Ipswich, MA 2001). Because Ipswich does have significant tracts of developable land and because of its wealth of natural resources, regulation of stormwater is essential. Ipswich seeks to go beyond the requirements of federal law and figure out a way to improve the health of its clam beds, beaches, and marshes by passing regulations mitigating the damage from sites disturbing land of less than one acre in size.

A secondary concern for Ipswich and the surrounding communities is a loss of flow in the Ipswich River. This river has chronic low-flow problems in the summer and fall. A report created for the Ipswich River Watershed Association by the consulting firm Horsley & Witten, Inc. recommended that towns within the watershed infiltrate 150 percent of their stormwater runoff back into the groundwater, which feeds into the river, to replenish the river's flow (Horsley & Witten 2003). By focusing not only on the mitigation of sediment runoff but also on directing stormwater back into the ground, Ipswich can lead the way among the municipalities located in the watershed to restore this regional icon.

3. FEDERAL MANDATE FOR STORMWATER REGULATIONS

The United States has been enacting laws to protect and clean up its water since 1899 when the federal government created the Refuse Act. This prohibited the disposal of refuse into navigable waters without a federal permit. Since then, federal laws have become more comprehensive. The National Pollution Discharge Elimination System (NPDES) was created in 1972 as a subsection of the Clean Water Act (Section 402) in order to prohibit the discharges "of pollutants from any point source into the nation's waters except as allowed under an NPDES permit" (USEPA 2003). This helped to regulate point sources of pollution, such as open pipes feeding pollutants directly into a river, by setting limits on the amount of pollutants that could be discharged. In 1977, Congress amended the Clean Water Act to strengthen NPDES, in order to concentrate more on controlling toxic discharges. Ten years later, Congress passed the Water Quality Act that required increased monitoring and assessment of waterbodies (USEPA 2003).

Despite the passage of these laws, the nation's waters remained polluted. According to the 1996 National Water Quality Inventory, approximately 40 percent of surveyed water bodies still did not meet water quality standards (USEPA 2002). One of the leading causes of this pollution was polluted runoff (nonpoint source pollution). The EPA initiated Phase I of a stormwater program in 1990 in response to the 1987 amendments of the Clean Water Act (USEPA 2002). Phase I was enacted through the Clean Water Act, and it relies on NPDES permitting coverage. Phase I required the permitting of municipal separate storm sewer systems (MS4's) generally serving populations of 100,000 or more, construction activity disturbing sites of five acres or more, and ten categories of industrial activity.

According to the 1996 National Water Quality Inventory, approximately 40 percent of surveyed water bodies did not meet water quality standards (USEPA 2002). One of the leading causes of this pollution was stormwater pollution.

Phase II was published in 1999 and became effective in 2000. It expanded Phase I to require the permitting of operators of MS4's in urbanized areas and construction sites that disturb between one and five acres of land. In addition, municipalities must implement six minimum measures to reduce stormwater runoff. These measures are:

- public education and outreach on stormwater impacts
- public involvement and participation
- illicit discharge detection and elimination
- construction site stormwater runoff control

- post-construction stormwater management in new development and redevelopment
- pollution prevention and good housekeeping in municipal operations (USEPA 1999).

Ipswich is one of the many communities that fall under Phase II's jurisdiction. Ipswich is currently working to comply with Phase II, and the bylaw that we have created will go above and beyond what is mandated by Phase II.

For each minimum control measure, municipalities must select measurable goals and best management practices. They then must submit a notice of intent to apply for general permit coverage. The notice of intent must include the best management practices and measurable goals for each minimum control measure, a timeline for implementation of each measure, and specific individuals or groups responsible for implementation the measures. Notice of intent applications were due in March 2003 (USEPA 2003), and municipalities have five years to achieve compliance for all six measures.

There are two different systems for administrating NPDES permits in the US. Forty-five states run the programs themselves, while the EPA regional offices run five states. Massachusetts is a nondelegated state and its permits are issue jointly by the EPA New England (Region 1) and the Massachusetts Department of Environmental Protection (USEPA 2004). Enforcement is handled by the EPA, who has already charged three companies with stormwater construction site violations in Massachusetts (USEPA 2004). Violations are subject to fines of up to $25,000 per day, and sometimes more if the cases are repeated, negligent or knowing violations. Individuals or public interest groups may sue violators directly if regulatory agencies fail to enforce NPDES (River Network 2003). Ipswich is currently working with SEA Consulting of Cambridge, MA to meet the requirements of NPDES Phase II. Town officials decided they needed a second bylaw because the NPDES Phase II regulations for stormwater are not stringent enough. Ipswich Bay is severely impacted by stormwater runoff, primarily from sediment.

4. METHODS

4.1. Information Gathering

Creating the bylaw for the Town of Ipswich involved several stages of information gathering and consulting with other municipalities and organizations. The first step was to obtain as much information as possible about stormwater regulations at the state and federal level. This initial stage of research was conducted primarily via the Internet and by reading literature published on stormwater control, much of it in engineering textbooks. The EPA's NPDES Phase II regulations were thoroughly researched, as well as Massachusetts regulations pertaining to non-point source pollution. Current regulations and zoning in Ipswich were also examined in detail.

The next step was to contact other organizations with relevant information about stormwater regulations. This included the regional planning agencies – both Southeastern [Massachusetts] Regional Planning and Economic Development District (SRPEDD) and the Merrimack Valley Planning Commission - and non-governmental organizations. SRPEDD, the Mystic River Watershed Association, and the Cape Cod Groundwater Guardian Team provided model stormwater bylaws, while the Center for Watershed Protection provided information regarding all levels of stormwater and its regulation. Eight Towns and a Bay, a group concerned with the preservation of Ipswich Bay, contributed information about Low Impact Development techniques.

After gathering generic ordinance and stormwater information, bylaws specific to stormwater management were obtained. These formed the model for the Ipswich bylaw. As most municipalities' bylaws only follow the guidelines set forth by NPDES Phase II (and some do not even accomplish that), finding bylaws that included regulations to go beyond what is required by NPDES Phase II was a challenge. The search for bylaws was initially limited to towns with characteristics similar to Ipswich: coastal towns located in Massachusetts with a large percentage of wetlands. Finding such bylaws proved difficult. This forced the team to expand the search to include bylaws from any municipality in the country that specified regulations beyond the NPDES guidelines.

Some of the most progressive bylaws found were for Brookline, Pittsfield, and Westfield, Massachusetts, Eugene, Oregon, and Garland, Texas.

Bylaws that did not directly regulate stormwater, but accomplished many of the same goals (such as erosion and sediment control bylaws) were also reviewed.

4.2. Interviews

In addition to gathering information from the Internet and collecting bylaws, some research involved interviewing Ipswich town officials or others with knowledge of stormwater regulations. The interviews started with the Ipswich Planning Department. A strong relationship was fostered with this department at the launch of the project to ensure that the team's findings and ideas were aligned with the department's needs and goals. This was accomplished through several meetings over the phone and in person.

Other Ipswich town officials consulted were those who would be involved with the implementation of this plan—the head of the Department of Public Works and the Building Inspector. Individuals who had conducted research on stormwater in Ipswich in the past, such as Conservation Commission members and a member of the Trustees of Reservations in Ipswich, were also interviewed.

The team did not limit interviews to Ipswich officials. Other towns that had implemented stormwater bylaws that were more stringent than NPDES Phase II were contacted to learn whether these bylaws had been successful and what challenges those towns faced in implementing their bylaws. This process included meeting with various town engineers and public works officials.

During the kickoff meeting with the Ipswich Planning Department, it was learned that the town had retained SEA Consulting to create a stormwater bylaw. A meeting was held with SEA to discuss each group's respective roles in the creation of a bylaw to prevent duplication of efforts. As a result of both of these meetings, the team determined that working in conjunction with SEA to create a bylaw would provide the greatest benefit to Ipswich; SEA would create a bylaw to comply with NPDES Phase II regulations, and the Tufts Team would write an additional bylaw going beyond the minimum requirements outlined in NPDES Phase II that may eventually be incorporated into the bylaw written by SEA. It is at the ultimate discretion of the Town of Ipswich as to whether or not to combine the bylaws.

4.3. Findings

In searching for stormwater bylaws after which to model a bylaw for Ipswich, it became apparent that few municipalities have regulations beyond NPDES Phase II requirements. NPDES Phase II is relatively recent, and cities and towns have five years to become fully compliant with the new regulations; thus most municipalities are not yet in compliance.

There is significant variation among bylaws and ordinances in terms of:

- the minimum lot size triggering these regulations;
- activities requiring regulation;
- local government's requirements from developers or property owners;
- division of the local government overseeing the regulations.

A table in Appendix A.I. has a breakdown of the stormwater regulation requirements for each municipality researched. For example, the town of Westfield, MA requires a Stormwater Management Plan approved by a Professional Engineer (PE) for any construction activity disturbing more than 40,000 square feet, or any commercial or industrial structure that would result in more than 10,000 square feet of impervious surface. The city of Pittsfield, MA requires a Stormwater Control Plan stamped by a PE for any disturbance more than 5,000 square feet. Brookline, MA requires an Erosion and Sediment Control Plan for any land disturbance greater than 2,500 square feet. This plan must be designed by a civil engineer but does not require the stamp of a PE. Any land disturbance greater than 2,500 square feet that results in increased stormwater runoff requires a stormwater management plan approved by a PE in addition to the Erosion and Sediment Control Plan. Each of these bylaws or ordinances was administrated by the Department of Public Works, and in the case of Pittsfield and Brookline, are also in conjunction with the Conservation Commission. Several municipalities on Puget Sound in Washington required each development to maintain a minimum percentage of natural vegetation on the site to prevent erosion during construction.

5. STORMWATER

5.1. Why is this a problem?

According to the Massachusetts Department of Environmental Protection (DEP), "urban runoff and discharges from stormwater outfalls are the single largest source responsible for water quality problems in the Commonwealth's rivers, lakes, ponds, and marine waters" (Commonwealth of Massachusetts 1997). Rainfall and snowmelt are the primary vehicles for transporting pollutants to rivers, lakes, etc., and also to groundwater. Overland flow and storm sewers serve as a conduit for transporting pollutants. The discharge of this runoff, known as "non-point source pollution," is a leading cause of impairment to the nearly 40 percent of water bodies in the United States that do not meet federal water quality standards (Commonwealth of Massachusetts 1997).

Non-point source pollution wreaks havoc on water quality because it occurs virtually everywhere and it contains many pollutants. The primary constituents of non-point source pollution are:

- nutrients
- pathogens
- toxic metals and toxic organic compounds
- suspended solids (including sediment).

Each of these pollutants will now be examined in detail.

According to the Massachusetts Department of Environmental Protection (DEP), "urban runoff and discharges from stormwater outfalls are the single largest source responsible for water quality problems in the Commonwealth's rivers, lakes, ponds, and marine waters" (Commonwealth of Massachusetts 1997).

5.1.1. *Nutrients*

Although nutrients are essential for life, in the case of phosphorus and nitrogen, the problem is too much of a good thing. Naturally occurring water bodies contain phosphorus and nitrogen, but in limited quantities. When levels become elevated and the nutrients are no longer limited, it upsets the balance of the food chain in the receiving water body. As a result, some organisms that would have been previously restricted thrive with this abundance of nutrients, while other types of organisms suffer. Additionally, the increase in the microbial population of the water body increases the use of oxygen in the water, depleting it as a resource for plants and fish that need it. Sources of nutrients, such as nitrogen and phosphorus, include fertilizer and some types of detergents (Davis and Cornwell 1991, 263-264).

5.1.2. *Pathogens*

Contaminated runoff often contains pathogens, including bacteria and viruses. The most common source of this contaminant is from pet or human waste. Depending on the level of pathogens in the runoff, they can make the water unfit for drinking, fishing, or swimming. Bacterial contamination often results in the closure of shellfish beds. According to Davis and Cornwell, "certain shellfish can be toxic because they concentrate pathogenic organisms in their tissues, making the toxicity levels in the shellfish much greater than the levels in the surrounding water" (1991, 264). This is of particular concern for Ipswich considering the town's dependence on the shellfish beds. As previously discussed, 30 percent of the beds have been closed since 1991 because of fecal coliform, a type of bacteria always present in fecal wastes (Davis and Cornwell 1991, 145).

5.1.3. *Toxic metals and toxic organic compounds*

Two metals often found in urban runoff that threaten water quality are lead and zinc. The source of both of these metals is from automobiles. Although leaded gasoline is virtually obsolete, lead from automobile exhaust contributed significantly to water quality issues when it was readily used, and today it still originates from diesel-fueled vehicles. Zinc comes from tire wear. Much like pathogens, "many toxic compounds are concentrated in the food chain, making fish and shellfish unsafe for human consumption" (Davis and Cornwell 1991, 265).

In a study of waters in the lower San Francisco Bay, California area, half of the cadmium and zinc originated from tire wear. Brake pad wear contributed half of the copper in the Bay waters. Atmospheric deposition (mostly cars and trucks) accounted for another 25 percent of the copper found in the waters. Furthermore, copper is toxic to aquatic life in very low concentrations (Beach 2003).

Parking lots and high-use roads tend to contribute a disproportionate amount of the pollution in groundwater. A quarter of the metals and 64 percent of the petroleum hydrocarbons came from parking lots and major streets, which covered only six percent of the land area (Beach 2003).

5.1.4. *Suspended Solids*

Perhaps the biggest threat to the Town of Ipswich's water quality and to the shellfish beds as a result of uncontrolled runoff is from suspended solids, specifically sediment. The source of this contaminant is water and sometime wind erosion, as soil particles are dislodged and transported to surface waters. An increase in the sediments in the water can increase the turbidity,—"a cloudy condition in water due to suspended silt or organic matter" (Franklin, Hampden, Hampshire Conservation Districts 1997, 385)—which will impair the ability of plants to photosynthesize. Once the sediments settle to the bottom, they inhibit the transport of oxygen at the bottom of the water body, impeding the growth of both plants and animals. Sediment chokes out plants and suffocates fish eggs as the voids between rocks are filled with sediment (Davis and Cornwell 1991, 264). Much like excess nutrients, excess sediment encourages the growth of oxygen-consuming microorganisms, exacerbating the situation and making it difficult to sustain oxygen-dependent life (Hemond and Levy 2000, 100).

Fish species that are of particular concern for the Town of Ipswich are smelt, blueback herring, and white perch. These species all need clean, flowing water with a gravelly river bottom in order for proper development of the eggs they lay there (Lantagne 2003). Suspended solids settling into the voids in the gravel could have devastating consequences on the populations of these fish, in addition to choking out the shellfish beds on which Ipswich so heavily relies.

5.2. A Closer Look at Erosion

The key to reducing non-point source pollution is by preventing erosion at the source; that is, onsite sediment control. Prior to determining the steps to reduce erosion on site, one must understand how and why erosion occurs. This can be accomplished, in part, by examining the types of soil in Ipswich along with understanding basic hydrology.

Erosion is one of the most common natural phenomena on the planet and is responsible for carving landscapes and forming soil, but no soil phenomena is more destructive worldwide than soil erosion. Under normal conditions, approximately 0.1 to 0.2 tons/acre are eroded annually. When human activities make soil more susceptible to water and wind, rates increase, resulting in accelerated erosion. Accelerated erosion, particularly on croplands, is estimated to be 18 times faster than natural

conditions (Spiro and Stigliani 1996, 262-263). Each year in the United States, approximately four billion tons of soil are moved by soil erosion (two-thirds by water, one-third by wind); 1.7 billion tons of sediment is deposited each year in reservoirs, lowering their capacity to hold water for irrigation, industrial, and domestics uses. In terms of other non-point source pollutants, nearly 42 million tons of nitrogen, phosphorus, and potassium are removed by erosion. Fertilizers are used to add these nutrients back into the soil, which end up back in the water as pollution, creating a vicious cycle (Brady and Weil 1996, 563 – 567).

There are two types of costs associated with erosion: on-site and off-site costs. Brady and Weil describe on-site costs as those "incurred by the land owner at the site of erosion" (1996, 566). Total annual on-site costs in the United States have been estimated at $27 billion, based on "average wind and water erosion values for the entire country, and assigning appropriate costs for nutrient and water losses and for yield reductions due to erosion" (Brady and Weil 1996, 566).

Off-site costs "relate to the management and removal of sediment and excess water downstream" (Brady and Weil 1996, 566). The approximate value of these costs is $17 billion. This is based on the costs of "cleaning up and treating domestic water supplies, reducing water storage in reservoirs, dredging harbors and waterways, loss of wildlife habitat, widespread flooding and health costs" (Brady and Weil 1996, 566). This brings the total annual cost for erosion control in the United States to $44 billion.

The effects of erosion can be predicted by using two formulas, the Universal Soil-Loss Equation (USLE) and the Revised Universal Soil-Loss Equation (RUSLE) (pronounced "russell"). The USLE is A = RKLSCP, where:

A	predicted soil loss
R	climatic erosivity (rainfall and runoff)
K	soil erodibility
L	slope length
S	slope gradient or steepness
C	cover and management
P	erosion-control practice.

These factors determine the amount of water infiltrating the soil, the amount running off, and the manner and rate of removal. It has since been replaced by the more refined, computer based RUSLE. This formula

integrates site-specific information, such as soil type and hydrology. Many of these factors are inherent to the site, but cover and management (C) and erosion-control practices (P) can be impacted, reducing the predicted soil loss.

5.3. A Closer Look at Ipswich

According to the United States Department of Agriculture's (USDA) "Soil Survey of Essex County, Massachusetts, Southern Part," there are 90 different soil types in the Town of Ipswich. More than half of these soils are sandy loams with slopes ranging from 0 to 45 percent. Loams are "the textural-class name for soil having a moderate amount of sand, silt, and clay" (Brady and Weil 1996, 710). Sandy loams usually consist of 50 to 70 percent sand, 0 to 50 percent silt, and 15 to 20 percent clay (Brady and Weil 1996, 108). Most soils are some type of loam, so the high occurrence in Ipswich is not unusual.

Despite the preferable texture of these soils, a significant portion of the town's area is less than ideal for development. Approximately half of the land is wetland (Appendix A.II.) (MassGIS, 2004) and nearly one-quarter of the land has a slope greater than eight percent (Appendix A.III.). Wetlands are sensitive areas with stricter environmental controls; therefore, erosion in these areas is particularly detrimental. Slope is one of the factors in the USLE that contributes to soil loss. The steeper the slope, the larger the predicted soil loss.

Permeability and structure also impact soil's erodibility. The permeability of a soil is "the ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil" (Brady and Weil 1996, 715). In civil engineering, it is referred to as the hydraulic conductivity or coefficient of permeability and is further described as "the rate at which water can move through a permeable medium" (Fetter 2001, 555). For the soils in Ipswich, permeability ranges from less than 0.2 in/hr in poorly-drained, fine-grained soils (silts and clays) to 20 in/hr in well-drained, coarse-grained soils (sands) (USDA, 1984).

Despite the preferable texture of these soils, a significant portion of the town's area is less than ideal for development.

Soils that have higher permeabilities will be able to conduct water through them faster than those with low permeabilities; thus the threat of erosion is less with more permeable soils because there will be less runoff. However, permeability can be impacted by development or other human activity through compaction. Compaction is the densification of soil through

mechanical means, such as heavy equipment driving over it, or activities as simple as people walking over it (Holtz and Kovacs 1981, 110). Water will have a more difficult time passing through denser soil, thus runoff will increase.

Any USDA soil survey includes tables on the land's suitability for recreational development, construction materials, and water management, among other uses. Suitability for building site development is another of these tables (Appendix A.IV.). Development activities included in this table are:

- shallow excavations
- dwellings without basements
- dwellings with basements
- small commercial buildings
- local roads and streets
- lawns and landscaping

Nearly all of these activities in Southern Essex County are given a "severe" or "moderate" rating indicating the soil is not ideal for building site development. Wetness and slope are the primary reasons making this soil less than desirable (USDA 1984, 127 – 132).

Despite the fact that the soils in Ipswich are not ideal, development will still occur. One of the purposes of creating this bylaw is to ensure that the environmental impact that occurs as a result of land disturbing activities is minimized. Considering the soil types in the site plan is one step toward accomplishing this; considering surface water hydrology is another step.

5.4. A Closer Look at Hydrology

Hydrology is "the study of the waters of the earth, especially with relation to the effects of precipitation and evaporation upon the occurrence and character of water in streams, lakes, and on or below the land surface" (The Weather Channel 2004). In the case of site design, hydrology often concerns the flow overland and into receiving water bodies. Normal water flow in water bodies is called base flow. During periods between storms, base flow is a result of groundwater flowing out of stream banks into surface waters (Davis and Cornwell 1991, 54). Runoff events will result in an increase in flow. The goal of the site design process is to understand the impact of development on these flows.

Site development alters the natural drainage features of an area, increases peak discharge rates and volumes, and reduces recharge to streams and wetlands by increasing the size of impervious surfaces (Commonwealth of Massachusetts 1997). Structures that convey runoff from these sites, such as vegetated swales or grassed waterways, are designed based on the peak runoff rate from the site (based on a maximum expected rainfall rate).

The flow rate across these structures is dependent on the amount of runoff and the type of surface. Smoother surfaces will have less friction, and therefore a faster flow. Channel roughness leads to turbulence, which reduces the flow velocity (Fetter 2001, 59). The roughness of a channel's surface has been quantified through various methods for use in hydraulics. One of the most common and simplest applications of the runoff coefficient is the Rational Method to determine runoff from a site. Under this method, the peak runoff rate is $Q = 0.0028CiA$, where:

Q	peak runoff rate (m^3/s)
C	runoff coefficient
i	average rainfall intensity (mm/h)
A	area of watershed (ha)
0.0028	conversion factor, $m^3*h/mm*ha*s$

This method is usually limited to sites up to 13 km^2. For vegetated surfaces, the runoff coefficient is lowest for flat lawns (0.05 to 0.10) and highest for slopes greater than seven percent (0.25 to 0.35; about one-quarter of the land in Ipswich). Asphalt and concrete surfaces have runoff coefficients ranging from 0.70 to 0.95 (Davis and Cornwell 1991, 62 – 65). Appendix A.V. shows surface type and their runoff coefficients.

Higher flow water bodies, such as those running off from pavement and steep slopes, have more energy and are able to carry more pollutants. A significant portion of non-point source pollution occurs during runoff events and results in large flow rates that make treatment more difficult (Davis and Cornwell 1991, 263). This holds true particularly for sediment. The suspended sediment load varies with discharge and increases as discharge rises because the greater turbulence at high flow allows more sediment to be held in suspension (Hemond and Levy 2000, 93). This sediment will eventually settle out as velocities decrease, such as where the Ipswich River meets the Atlantic Ocean. At this point, the effects of sediment, such as impairment to fish and shellfish, will be observed.

5.5. Reducing the Risk

A comprehensive engineering analysis can be done at a site, taking into consideration the local soils and hydrology of the site. These can be used to create a site-specific stormwater management plan to reduce the environmental impact on a site. Treatment structures can be sized based on the history of the site and erosion controls can be implemented based on the risk calculated from the USLE or RUSLE. Erosion controls can be specified for a site using the "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas." This document is readily available from county Conservation Districts or the DEP. Design of stormwater retention structures is somewhat more difficult since computer simulations, such as Technical Release 55 (TR-55), are often used to calculate discharges and thus help to determine the size and location of these structures.

This manual describes dozens of erosion and sediment control practices, collectively known as best management practices (BMPs). Some of the more common erosion control practices that could be implemented on smaller construction sites addressed by this bylaw include: stabilized construction entrances, inlet protection, mulching and netting, and silt fences.

5.5.1. *Stabilized Construction Entrances*

A stabilized construction entrance has a six-inch deep bed, approximately 50 feet long, of crushed stone (one to two inch washed rock) leading from the construction site to the main road. This reduces the amount of mud and sediment tracked onto the main road from the tires of vehicles leaving the site; in turn, this prevents sediment from being washed off the road and into surface waters. These entrances are relatively inexpensive to install and maintain, yet improve the overall housekeeping of the site (Franklin, Hampden, Hampshire Conservation Districts 1997).

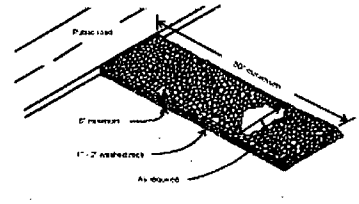


Figure 1. A stabilized construction entrance
(Franklin, Hampden, Hampshire Conservation Districts 1997, 77)

5.5.2. *Inlet Protection*

There are several methods used for inlet protection, but all involve filtering sediment before it enters catch basins - an underground basin combined with a storm sewer inlet to trap solids (Franklin, Hampden, Hampshire Conservation Districts 1997, 378) - or storm basins. This sediment could clog the drainage systems before they are even fully installed or vegetation is established. Typically, the inlet protection consists of filter fabric underneath the metal grate of the catchbasin or storm basin and either silt fence, crushed stone, or hay bales surrounding the basin to further filter and reduce the flow of sediment laden water (Franklin, Hampden, Hampshire Conservation Districts 1997).

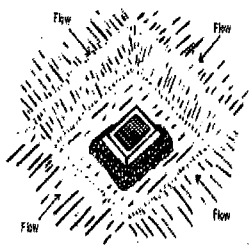


Figure 2. Inlet protection
(Franklin, Hampden, Hampshire Conservation Districts 1997, 108)

5.5.3. *Mulching and Netting*

Mulching and netting is the practice of protecting exposed surfaces with a cover of straw or other plant residue or using a geotechnical ("geotech") matting. This can protect soil from erosion by slowing the flow of water and also aiding in establishing vegetative growth when applied during the seeding process. Matting is typically used for steep slopes where the mulch would be likely to slide (unless used with a tackifier—a glue-like substance used to keep the mulch in place). The mulch does not need to be removed and if a vegetative-based mat, such as jute, is used, this can remain in place as well. Both are readily available and relatively affordable for small sites (Franklin, Hampden, Hampshire Conservation Districts 1997).

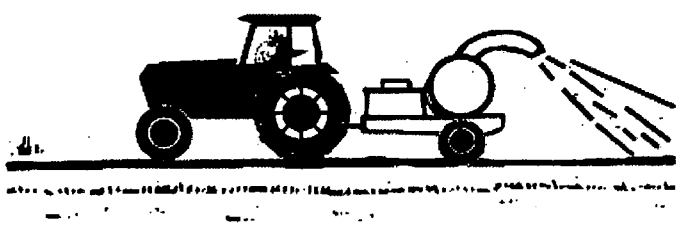


Figure 3. A tractor spreading mulch
(Franklin, Hampden, Hampshire Conservation Districts 1997, 127)

5.5.4. *Silt Fences*

Silt fences are perhaps the most commonly used erosion control method. Looking at practically any construction site, one can see what appears to be black plastic attached to stakes around the perimeter of the site - this is silt fencing. Silt fences consist of a geotech material attached to wooden stakes. Proper installation of silt fences involves the digging of a four-inch trench and burying the bottom of the silt fence in the trench. There is often a mark on the silt fence indicating the depth to which to entrench the fence. The silt fence works by allowing water to pass through but trapping sediment. It works quite well, but must be maintained on a regular basis by inspecting for sediment build-up, physical damage, or portions of the fences that are not "toed in" and thus would allow water and sediment to pass underneath (Franklin, Hampden, Hampshire Conservation Districts 1997).

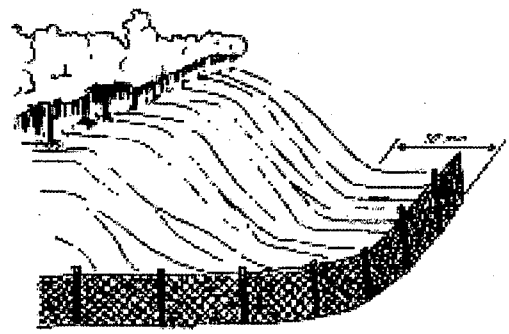


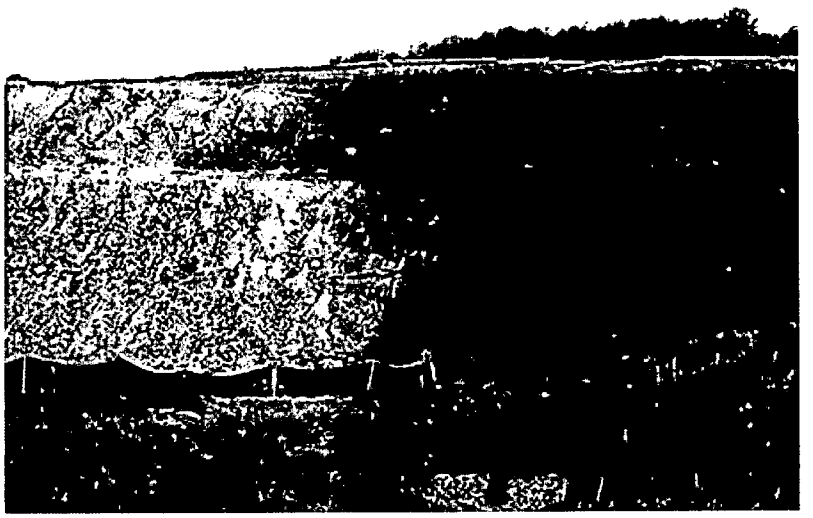
Figure 4. Silt fencing
(Franklin, Hampden, Hampshire Conservation Districts 1997, 163)

5.5.5. *Retaining Runoff*

Another method used to control erosion is by keeping the runoff onsite and allowing it to percolate into the ground. This can be accomplished by using structural BMPs that are designed to infiltrate retained water to the subsurface. The structures could be above grade or below grade (Town of Brookline 2003). Keeping the runoff on site would virtually eliminate off-site erosion, as discussed in section VI.ii. Additionally, this practice has been highly recommended by other Massachusetts municipalities, such as Brookline. The benefits of infiltration will be discussed in more detail in section 8.1., "Stormwater Infiltration."

Practices on small sites, such as covered by the bylaw, are specifically addressed in a section of the manual entitled, "Erosion and Sediment

Control Best Management Practices for Individual Homesites and Small Parcels." A sample sediment and erosion control plan is presented in Appendix A.VI. (Franklin, Hampden, Hampshire Conservation Districts 1997).



This is picture shows the contrast of using and not using best management practices.
International Erosion Control Association
(www.ieca.org)

6. WRITING THE BYLAW

A good bylaw is one that will be supported by the citizens, is easily understood, makes use of existing resources and processes in the town for new development, and effectively mitigates sediment runoff. New stormwater management regulations must not place a heavy burden on the town offices by significantly increasing the workload of any particular individual, and must also not represent a significant financial burden to the town. It is also important that these regulations do not place an unreasonable burden on property owners, financial or otherwise. There must also be a method for the town to finance any additional work they must do to implement this management plan.

From researching stormwater regulations in other towns and taking into account the needs of the Town of Ipswich, the team decided that the bylaw should address stormwater and sediment control for new development and alterations to existing development for any activity that will impact 2500 square feet or more of land. Prior to construction, the developer or property owner will be required to submit an erosion and sediment control plan and in some cases a stormwater management plan (contingent on the stormwater flows generated on site) to the town for the site being developed. This plan will include BMPs in place during construction, and also any measures taken on the property to reduce future stormwater runoff resulting from an increase in impervious surface.

6.1. Considerations in Drafting a Stormwater Bylaw

After meeting with several Ipswich town officials, some basic ideas were developed regarding how the town might be able to better regulate stormwater from sources currently unregulated by NPDES Phase II. As the primary concern is with the flow of sediment into Ipswich Bay, it made the most sense to draft a bylaw focusing on erosion and sediment control resulting from the construction of single-family homes and other small projects necessitating disturbing land that are not regulated by the current guidelines.

Based on the team's research, there are a number of different factors to be taken into consideration when creating a bylaw for the Town of Ipswich. Various options were presented to the Planning Department so they could

consider what would be most the feasible alternative for both the town and its citizens and what would ultimately best accomplish their goal.

6.1.1. *Permit requirements*

The town could choose to require stormwater management plans universally for developments larger than a certain size, or could choose to require plans only contingent on the location of the development, the slope of the development, or the sensitivity of the area to stormwater runoff.

6.1.2. *Stamped plans*

The town could choose to require all stormwater management plans to be stamped by a Professional Engineer, or require non-stamped plans for all projects. The town could also elect to require stamped plans only for developments in sensitive areas. On one hand, requiring stamped plans increases the likelihood that the plans will be properly done and effective; on the other, having engineered plans done can cost the applicant thousands of dollars.

6.1.3. *Minimum vegetation requirements*

Another consideration was whether to choose a minimum natural vegetation requirement on all land being disturbed. Keeping a certain percentage of the natural vegetation intact helps to prevent erosion, is essential for stormwater management, can eliminate the need for some additional stormwater management devices, adds scenic value to the property and to the town as a whole, and serves an important role in ecosystem function and wildlife habitat.

Keeping natural vegetation intact prevents erosion, can eliminate the need for additional stormwater management devices, adds scenic value to the property and to the town as a whole, and serves an important role in ecosystem function and wildlife habitat.

6.1.4. *Fee structure*

The town could create a stormwater utility fee to be assessed to all town taxpayers to cover the administrative costs of managing stormwater (discussed further in Section VIII.iii). They could assess a stormwater management fee to all building projects, which could either be a flat fee for all projects or could be based on the acreage of land disturbed. They could assess a fee only for major projects of a certain size, and no fee for smaller projects such as renovations or additions. They could also require a bond to

be paid at the beginning of the project, for release upon successful completion of the project.

6.1.5. *Approval/Review*

There are several departments within the town that could administrate the stormwater management program through reviewing and approving plans and through granting a building permit based on the submission of a stormwater management plan. This could be done through the Department of Public Works, through the Building Inspector, through the Planning Department, through the Conservation Commission, outsourced to an independent company, or managed through a separate department created just for this purpose. This process may involve more than one of these departments.

6.1.6. Enforcement

Similar to approval and review, several departments could enforce the bylaw. Potential enforcers include the Planning Department, the Conservation Commission, the Department of Public Works, the Building Inspector, a new department, or enforcement could be outsourced.

Ipswich, Massachusetts operates under the town meeting form of government. Under this model, changes to the town's bylaws are put before the town at a semi-annual town meeting. Proposals must pass by a majority vote and then be approved by the Attorney General's office to be enacted into law.

6.2. Passing a Bylaw in Ipswich

Ipswich, Massachusetts operates under the town meeting form of government. Under this model, changes to the town's bylaws or zoning regulations are put before the town at a semi-annual town meeting. Bylaws are the laws that govern the town, enforceable only through the town (as opposed to the county or state). In the case of the Clean Water Act's NPDES Phase II, the federal government mandated that all towns of have stormwater regulations in place. The regulations, though required by the federal government, are still created and enforced at the local level.

The Town of Ipswich has a Town Manager, a Board of Selectmen and Town Counsel. Proposed amendments, new bylaws, repeals of existing bylaws, or zoning changes can come from a Selectman, a town department, the board of appeals, regional planning agencies, or even a group of citizens (Commonwealth of Massachusetts 2003). With any proposal, the Town Manager first solicits the opinions of different town departments (Department of Public Works, Planning Department, and the Building

Inspector). If supportive, the departments come to consensus how the bylaw will be administered and by whom.

The proposal then goes before the Board of Selectmen, which consists of five elected officials, who decide by majority vote if the proposed change will be placed on warrant at the next town meeting. The town uses term "warrant" to refer to the list of items, called "Articles," that will go before the town at town meeting. If it passes, the Town Counsel then receives and reviews the bylaw. The town follows this with a warrant hearing. All articles on the warrant are considered at this hearing. The Selectmen then sign the warrant for all articles. (K. Day, personal communication, April 26, 2004).

At this point, the warrant must be published in the local newspaper 14 days before the town meeting. Citizens, town departments or other interested parties have an opportunity to ask questions and state their opinions on the proposed amendments, bylaws, and zoning changes at the town meeting (Commonwealth of Massachusetts 2003).

Changes to general bylaws must pass by majority vote at the meeting. Changes in zoning, however, must pass by a majority of two-thirds. Because of the requirement of two-thirds majority on zoning changes, some issues that might traditionally be addressed through a zoning change are sometimes creatively dealt with through changes to bylaws. For similar reasons, amendments to bylaws are often more easily supported than a whole new bylaw. However, several amendments to one existing bylaw may be also a thorny and complex task to rationalize before a town meeting (Commonwealth of Massachusetts 2004).

Limits exist for what kinds of bylaws a town can pass. Bylaws cannot be in conflict with each other or preempt state or federal law. To be defensible in court, the Commonwealth of Massachusetts requires that they must have a public hearing, publish a notice in the paper, and display notices in Town Hall.

If the bylaw is accepted by a majority of the citizens present at town meeting then the bylaw is sent to the office of the Attorney General of Massachusetts for review. If approved, the bylaw is effective the date of passage by town meeting. (Commonwealth of Massachusetts 2003).

6.3. The Completed Bylaw

After conducting extensive research on various bylaw options for the Town of Ipswich, a bylaw was drafted that pulls from various sources. The bylaw regulates the following:

- any disturbance of land of 2,500 square feet or greater;
- the removal of existing vegetation of more than 2,500 square feet;
- the storage of more than 100 cubic yards of excavate or fill

The bylaw shall be administered, implemented, and enforced by the Department of Public Works (DPW) and shall be triggered by the application for a building permit (See chart on page 29).When a developer or homeowner applies for a building permit through the office of the Building Inspector, receiving the building permit will be contingent on approval of a Land Disturbance Permit by the Department of Public Works. A Land Disturbance Permit requires the applicant to submit an Erosion and Sediment Control Plan to the DPW. The Erosion and Sediment Control Plan requires the applicant to inform the DPW of how they intend to meet the following objectives:

- minimize total area of disturbance;
- minimize peak rate of runoff;
- minimize soil erosion and control sedimentation;
- retain at least 60 percent of natural vegetation conditions over the site;
- maximize groundwater recharge;
- sequence activities to minimize simultaneous areas of disturbance.

It is not required that the Erosion and Sediment Control Plan be prepared by a Certified Professional Engineer, although preferably it will be created by a professional with experience in sediment control and stormwater management. At the discretion of the DPW, a Stormwater Management Plan may also be requested for larger developments, developments with a steeper slope, developments close to wetlands or other areas of natural significance, or any development likely to produce a significant amount of stormwater runoff. The Stormwater Management Plan requires the developer to provide information on how the impact of stormwater runoff will be minimized, and requires a map of:

- all existing stormwater utilities;
- topographic features of the land;
- soil types;
- description of all watercourses, impoundments, and wetlands on or adjacent to the site or into which stormwater flows;
- existing and proposed locations of all brooks, streams, drainage swales, and the method of stabilization;
- and stormwater runoff calculations.

The developers are encouraged but not required to meet with a staff member of the Department of Public Works prior to beginning work on the project to review the plans and their implementation.

The bylaw also mentions Low Impact Development as an alternative for developers to reduce erosion and stormwater runoff. This was included in the bylaw to encourage the use of Low Impact Development techniques within the Town of Ipswich, but there is no mechanism written into the bylaw to provide incentive for use of Low Impact Development techniques. For additional information on Low Impact Development, see 8.2.2. and Appendix A.VII.

6.4. Fees

The bylaw gives the town permission to collect application and review fees associated with the submittal of the application for a Land Disturbance Permit. This bylaw does not specify an amount for the fees, as the town will determine this, based upon the cost of review and administration. The DPW is also authorized to retain a Registered Professional Engineer or other professional consultant to advise the DPW on all aspects of the application. As the DPW is already contracting the engineering consulting firm SEA for assistance with implementing measures to comply with NPDES Phase II regulations, it may make logical sense for the town to contract SEA to review the Erosion and Sediment Control and Stormwater Management plans. Designating this is outside the scope of this particular report.

6.5. Enforcement

Enforcement of the new stormwater regulations will be administered through the Department of Public Works because they are in charge of implementing NPDES Phase II regulations. Enforcement is essential to the

success of the bylaw and must be taken seriously. Numerous case studies have found that stormwater regulations are only as good as their enforcement or contractors do not comply. Ipswich must make use of the powers given to it in the bylaw, such as stop work orders, withholding certificates of occupancy, and fines.

6.6. Rationale

The minimum land disturbance area of 2,500 square feet was chosen based on the bylaw for the town of Brookline, MA. In speaking with town officials, they had found this triggering size to be effective in regulating the majority of projects that are likely to impact stormwater runoff and increase sediment flow. The requirements for an Erosion and Sediment Control Plan and Stormwater Management Plan are modeled after the regulations in place in Brookline and a model stormwater bylaw produced by the Department of Conservation and Recreation in Massachusetts. The Department of Public Works was chosen as the agency to administer this program because the department is already working on stormwater management to comply with NPDES Phase II regulations, so involvement with these new regulations is a logical extension of their attempts to manage stormwater in Ipswich. Requiring a minimum of 60 percent of the site's natural vegetation to remain intact is based on the Cape Cod Commission's Model Land Clearing, Grading and Protection of Specimen Trees Bylaw (Cape Cod Commission 2003) and the bylaws of several municipalities along Puget Sound in Washington State, who adopted this standard as a measure to protect salmon spawning in streams in the area.

6.7. Limitations of Bylaw

One of the main limitations of the bylaw is the feasibility and extent of enforcement. If Ipswich does not have the funding or time to enforce the bylaw, it will not be effective. A staff person or consultant will need to visit sites to ensure the proper implementation of the Erosion and Sediment Control Plan and Stormwater Management Plan best management practices. Improperly installed erosion controls often prove to be ineffective. Another important limitation that must be considered is the effectiveness of accepting plans that have not been stamped by a Professional Engineer. Plans that are not stamped by a Professional Engineer are cheaper and easier for landowners to produce, but may not take into consideration the nuances of their particular site and project, or may not be as effective at stormwater mitigation.

7. STORMWATER MANAGEMENT AND LAND DISTURBANCE BYLAW

SECTION 1. PURPOSE

A. The harmful impacts of soil erosion and sedimentation are:

1. impairment of water quality and flow in lakes, ponds, streams, rivers, wetlands and groundwater;

2. contamination of drinking water supplies;

3. alteration or destruction of aquatic and wildlife habitat;

4. flooding; and,

5. overloading or clogging of municipal catch basins and storm drainage systems.

B. The objectives of this bylaw are to:

1. protect water resources;

2. require practices that eliminate soil erosion and sedimentation and control the volume and rate of stormwater runoff resulting from land disturbance activities;

3. promote infiltration and the recharge of groundwater;

4. ensure that soil erosion and sedimentation control measures and stormwater runoff control practices are incorporated into the site planning and design process and are implemented and maintained;

5. require practices to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality;

6. comply with state and federal statutes and regulations relating to stormwater discharges; and,

7. establish the Town of Ipswich's legal authority to ensure compliance with the provisions of this bylaw through inspection, monitoring, and enforcement.

SECTION 2. DEFINITIONS

ABUTTER: The owner(s) of land abutting the activity.

AGRICULTURE: The normal maintenance or improvement of land in agricultural or aquacultural use, as defined by the Massachusetts Wetlands Protection Act and its implementing regulations.

APPLICANT: Any person, individual, partnership, association, firm, company, corporation, trust, authority, agency, department, or political subdivision, of the Commonwealth or the Federal government to the extent permitted by law requesting a soil erosion and sediment control permit for proposed land-disturbance activity.

AUTHORIZED ENFORCEMENT AGENCY: The Department of Public Works (hereafter DPW), its employees or agents designated to enforce this bylaw.

BEST MANAGEMENT PRACTICE (BMP): An activity, procedure, restraint, or structural improvement that helps reduce the quantity or improve the quality of stormwater runoff.

CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL (CPESC): A certified specialist in soil erosion and sediment control. This certification program, sponsored by the Soil and Water Conservation Society in cooperation with the American Society of Agronomy, provides the public with evidence of professional qualifications.

CONSTRUCTION AND WASTE MATERIALS: Excess or discarded building or site materials, including but not limited to concrete truck washout, chemicals, litter and sanitary waste at a construction site that may adversely impact water quality.

CLEARING: Any activity that removes the vegetative surface cover.

EROSION: The wearing away of the land surface by natural or artificial forces such as wind, water, ice, gravity, or vehicle traffic and the subsequent detachment and transportation of soil particles.

EROSION AND SEDIMENTATION CONTROL PLAN: A document containing narrative, drawings and details developed by a qualified professional engineer (PE) or a Certified Professional in Erosion and Sedimentation Control (CPESC), which includes best management practices, or equivalent measures designed to control surface runoff, erosion and sedimentation during pre-construction and construction related land disturbance activities.

ESTIMATED HABITAT OF RARE WILDLIFE AND CERTIFIED VERNAL POOLS: Habitats delineated for state-protected rare wildlife and certified vernal pools for use with the Wetlands Protection Act Regulations (310 CMR 10.00) and the Forest Cutting Practices Act Regulations (304 CMR 11.00).

GRADING: Excavation or fill of material, including the resulting conditions thereof.

INFILTRATION: Replenishing groundwater with stormwater runoff.

LAND-DISTURBING ACTIVITY: Any activity that causes a change in the position or location of soil, sand, rock, gravel, or similar earth material.

LOW IMPACT DEVELOPMENT (LID): The use of innovative stormwater management practices that take advantage of natural conditions on the site to manage stormwater rather than clearing land for constructing new stormwater management devices.

MASSACHUSETTS ENDANGERED SPECIES ACT: (G.L. c. 131A) and its implementing regulations at (321 CMR 10.00) which prohibit the "taking" of any rare plant or animal species listed as Endangered, Threatened, or of Special Concern.

MASSACHUSETTS STORMWATER MANAGEMENT POLICY: The Policy issued by the Department of Environmental Protection, and as amended, that coordinates the requirements prescribed by state regulations promulgated under the authority of the Massachusetts Wetlands Protection Act G.L. c. 131 §. 40 and Massachusetts Clean Waters Act G.L.

c. 21, §. 23-56. The Policy addresses stormwater impacts through implementation of performance standards to reduce or prevent pollutants from reaching water bodies and control the quantity of runoff from a site.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) or municipal storm drain system: The system of conveyances designed or used for collecting or conveying stormwater, including any road with a drainage system, street, gutter, curb, inlet, piped storm drain, pumping facility, retention or detention basin, natural or man-made or altered drainage channel, reservoir, and other drainage structure that together comprise the storm drainage system owned or operated by the Town of Ipswich.

OWNER: A person with a legal or equitable interest in property.

PERSON: An individual, partnership, association, firm, company, trust, corporation, agency, authority, department or political subdivision of the Commonwealth or the federal government, to the extent permitted by law, and any officer, employee, or agent of such person.

PHASING: Clearing a parcel of land in distinct phases, with the stabilization of each phase completed before the clearing of the next.

PRE-CONSTRUCTION: All activity in preparation for construction.

PRIORITY HABITAT OF RARE SPECIES: Habitats delineated for rare plant and animal populations protected pursuant to the Massachusetts Endangered Species Act and its regulations.

RUNOFF: Rainfall, snowmelt, or irrigation water flowing over the ground surface.

SEDIMENT: Mineral or organic soil material that is transported by wind or water, from its origin to another location; the product of erosion processes.

SEDIMENTATION: The process or act of deposition of sediment.

SITE: Any lot or parcel of land or area of property where land-disturbing activities are, were, or will be performed.

SLOPE: The incline of a ground surface expressed as a ratio of horizontal distance to vertical distance.

SOIL: Any earth, sand, rock, gravel, or similar material.

STABILIZATION: The use, singly or in combination, of mechanical, structural, or vegetative methods, to prevent or retard erosion.

STORMWATER: Storm water runoff, snow melt runoff, and surface water runoff and drainage.

STRIP: Any activity which removes the vegetative ground surface cover, including tree removal, clearing, grubbing, and storage or removal of topsoil.

VERNAL POOLS: Temporary bodies of freshwater which provide critical habitat for a number of vertebrate and invertebrate wildlife species.

WATERCOURSE: A natural or man-man channel through which water flows or a stream of water, including a river, brook, or underground stream.

WETLAND RESOURCE AREA: Areas specified in the Massachusetts Wetlands Protection Act G.L. c. 131, § 40 and in the Town of Ipswich's wetland bylaw/ordinance.

WETLANDS: Tidal and non-tidal areas characterized by saturated or nearly saturated soils most of the year that are located between terrestrial (land-based) and aquatic (water-based) environments, including freshwater marshes around ponds and channels (rivers and streams), brackish and salt marshes; common names include marshes, swamps and bogs.

SECTION 3. AUTHORITY

This bylaw is adopted under authority granted by the Home Rule Amendment of the Massachusetts Constitution, the Home Rule statutes, and pursuant to the regulations of the federal Clean Water Act found at 40 CFR 122.34

SECTION 4. APPLICABILITY

This bylaw shall apply to all activities that result in disturbance of 2,500 square feet or more of land. Except as authorized by the Department of

Public Works in a Land Disturbance Permit or as otherwise provided in this bylaw, no person shall perform any activity that results in disturbance of more than 2,500 square feet of land or obtain a permit from the office of the Building Inspector pertaining to such activity.

SECTION 5. EXEMPTIONS

Normal maintenance and improvement of land in agricultural or aquacultural use, as defined by the Wetlands Protection Act regulation 310 CMR 10.4, are exempt. In addition, as authorized in the Phase II Small MS4 General Permit for Massachusetts, storm water discharges resulting from the above activities that are subject to jurisdiction under the Wetlands Protection Act and demonstrate compliance with the Massachusetts Storm Water Management Policy as reflected in an Order of Conditions issued by the Conservation Commission are exempt from compliance with this bylaw. If the project is subject to site plan review approval, these requirements are assumed to be met from provisions of this bylaw.

SECTION 6. RESPONSIBILITY FOR ADMINISTRATION

A. The Department of Public Works shall administer, implement and enforce this bylaw. Any powers granted to or duties imposed upon the DPW may be delegated in writing by the DPW to its employees or agents.

B. Waiver. The Department of Public Works may waive strict compliance with any requirement of this bylaw or the rules and regulations promulgated hereunder, where:

(1) such action is allowed by federal, state and local statutes and/or regulations,

(2) is in the public interest, and

(3) is not inconsistent with the purpose and intent of this bylaw.

C. Rules and Regulations. The Department of Public Works may adopt, and periodically amend rules and regulations to effectuate the purposes of this bylaw. Failure by the DPW to promulgate such rules and regulations shall not have the effect of suspending or invalidating this bylaw.

SECTION 7. PERMITS AND PROCEDURE

A. Application A completed application for a Land Disturbance Permit shall be filed with the Department of Public Works. Approval must be obtained prior to the commencement of land disturbing activity which meets or exceeds the following thresholds:

1. Any change of existing grade of more than 2500 sq. ft. or 25% of the lot, whichever is smaller.
2. Removal of existing vegetation or more than 2500 sq. ft. or 25% of the lot, whichever is smaller.
3. Storage of more than 100 cubic yards of excavate or fill.

The Land Disturbance Permit Application package shall include:

1. a completed Application Form with original signatures of all owners;

2. three (3) copies of the Erosion and Sediment Control Plan as specified in Section VII of this bylaw;

3. payment of the application and review fees; and,

4. one (1) copy each of the Application Form filed with the Town Clerk.

In addition, any project that will result in a significant increase in stormwater, that will in any way impact stream flow, or that in some other way will have an impact on stormwater as determined by the Department of Public Works, will be required to submit three (3) copies of a Stormwater Management Plan.

B. Entry. Filing an application for a permit grants the Department of Public Works or its agent, permission to enter the site to verify the information in the application and to inspect for compliance with permit conditions.

C. Other Boards. The Department of Public Works shall notify the Town Clerk of receipt of the application, and shall give one copy of the application package the Conservation Commission.

E. Information requests. The applicant shall submit all additional information requested by the DPW to issue a decision on the application.

F. Action by the Department of Public Works.

The DPW may:

1. Approve the Land Disturbance Permit Application and issue a permit if it finds that the proposed plan will protect water resources and meets the objectives and requirements of this bylaw;

2. Approve the Land Disturbance Permit Application and issue a permit with conditions, modifications or restrictions that the DPW determines are required to ensure that the project will protect water resources and meets the objectives and requirements of this bylaw;

3. Disapprove the Land Disturbance Permit Application and deny the permit if it finds that the proposed plan will not protect water resources or fails to meet the objectives and requirements of this bylaw.

G. Failure of the DPW to take final action upon an Application within the time specified above shall be deemed to be approval of said Application. Upon certification by the Town Clerk that the allowed time has passed without the DPW's action, the Land Disturbance Permit shall be issued by the Building Inspector.

H. Fee Structure. Each application must be accompanied by the appropriate application fee as established by the DPW. Applicants shall pay review fees as determined by the DPW sufficient to cover any expenses connected with the review of the Land Disturbance Permit Application before the review process commences. The DPW is authorized to retain a Registered Professional Engineer or other professional consultant to advise the DPW on any or all aspects of the Application.

I. Project Changes. The permittee, or their agent, must notify the DPW in writing of any change or alteration of a land-disturbing activity authorized

in a Land Disturbance Permit before any change or alteration occurs. If the DPW determines that the change or alteration is significant, based on the design requirements listed in Section 7.B. and accepted construction practices, the DPW may require that an amended Land Disturbance Permit application be filed. If any change or alteration from the Land Disturbance Permit occurs during any land disturbing activities, the DPW may require the installation of interim erosion and sedimentation control measures before approving the change or alteration.

SECTION 8. EROSION AND SEDIMENT CONTROL PLAN

A. The Erosion and Sediment Control Plan shall contain sufficient information to describe the nature and purpose of the proposed development, pertinent conditions of the site and the adjacent areas, and proposed erosion and sedimentation controls. The applicant shall submit such material as is necessary to show that the proposed development will comply with the design requirements listed in Section 7.B. below.

B. The **design objectives** of the Erosion and Sediment Control Plan are:

1. Minimize total area of disturbance;

2. Sequence activities to minimize simultaneous areas of disturbance;

3. Minimize peak rate of runoff in accordance with the Massachusetts Stormwater Policy;

4. Minimize soil erosion and control sedimentation during construction, provided that prevention of erosion is preferred over sedimentation control;

5. Retain at least 60 percent of natural vegetation conditions over the site;

6. Divert uncontaminated water around disturbed areas;

7. Maximize groundwater recharge;

8. Install, and maintain all Erosion and Sediment Control measures in accordance with the manufacturers specifications and good engineering practices;

9. Prevent off-site transport of sediment;

10. Protect and manage on and off-site material storage areas (overburden and stockpiles of dirt, borrow areas, or other areas used solely by the permitted project are considered a part of the project);

11. Comply with applicable Federal, State and local laws and regulations including waste disposal, sanitary sewer or septic system regulations, and air quality requirements, including dust control;

12. Prevent significant alteration of habitats mapped by the Massachusetts Natural Heritage & Endangered Species Program as Endangered, Threatened or Of Special Concern, Estimated Habitats of Rare Wildlife and Certified Vernal Pools, and Priority Habitats of Rare Species from the proposed activities;

13. Institute interim and permanent stabilization measures, which shall be instituted on a disturbed area as soon as practicable but no more than 14 days after construction activity has temporarily or permanently ceased on that portion of the site;

14. Properly manage on-site construction and waste materials; and

15. Prevent off-site vehicle tracking of sediments.

The plan should be prepared with the assistance of a Professional Engineer or other qualified personnel.

C. Erosion and Sedimentation Control Plan Content. The Plan shall contain the following information:

1. Names, addresses, and telephone numbers of the owner, applicant, and person(s) or firm(s) preparing the plan;

2. Location and description of natural features including watercourses and water bodies, wetland resource areas and all floodplain information, and existing vegetation including tree lines, canopy layer, shrub layer and ground cover, and trees;

3. Location of all existing and proposed building and impervious surfaces;

4. Surveyed property lines showing distances and monument locations, all existing and proposed easements, rights-of-way, and other encumbrances, the size of the entire parcel, and the delineation and number of square feet of the land area to be disturbed;

5. Location and details of erosion and sediment control measures with a narrative of the construction sequence/phasing of the project, including both operation and maintenance for structural and non-structural measures, interim grading, and material stockpiling areas;

6. Path and mechanism to divert uncontaminated water around disturbed areas, to the maximum extent practicable;

7. Location and description of and implementation schedule for temporary and permanent seeding, vegetative controls, and other stabilization measures;

8. Location of all existing and proposed stormwater utilities, including structures, pipes, swales, and detention basins;

9. A description of construction and waste materials expected to be stored on-site. The Plan shall include a description of controls to reduce pollutants from these materials, including storage practices to minimize exposure of the materials to stormwater, and spill prevention and response;

10. A description of provisions for phasing the project when the time necessary to complete the project is longer than the threshold set by the DPW;

11. Such other information as is required by the Department of Public Works.

SECTION 9. STORMWATER MANAGEMENT PLAN

In addition to the requirements for receipt of a Land Disturbance Permit as outlined in Section 6A, some projects may be required to submit a

stormwater management plan at the discretion of the Department of Public Works. The goals of the Stormwater Management Plan are:

1. to minimize stormwater runoff from any development;
2. to maximize infiltration for the purposes of recharging groundwater, including the use of stormwater retention and catchment;

3. to minimize nonpoint source pollution caused by stormwater runoff from development.

The application for a stormwater management permit shall consist of submittal of a Stormwater Management Plan to the Department of Public Works. This Stormwater Management Plan shall contain sufficient information for the DPW to evaluate the environmental impact, effectiveness, and acceptability of the measures proposed by the applicant for reducing adverse impacts from stormwater. The Stormwater Management Plan shall fully describe the project in drawings, and narrative. It shall include:

1. A locus map;
2. The existing zoning, and land use at the site;
3. The proposed land use;
4. The location(s) of existing and proposed easements;
5. The location of existing and proposed utilities;
6. The site's existing and proposed topography with contours at 2 foot intervals;
7. The existing site hydrology;
8. A description & delineation of existing stormwater conveyances, impoundments, and wetlands on or adjacent to the site or into which stormwater flows.
9. A delineation of 100-year flood plains, if applicable;
10. Estimated seasonal high groundwater elevation (November to April) in areas to be used for stormwater retention, detention, or infiltration;
11. Stormwater runoff calculations in accordance with the Department of Environmental Protection's Stormwater Management Policy;
12. The existing and proposed vegetation and ground surfaces with runoff coefficient for each;
13. A drainage area map showing pre and post construction watershed boundaries, drainage area and stormwater flow paths;

14. A description and drawings of all components of the proposed drainage system including:

    a. locations, cross sections, and profiles of all brooks, streams, drainage swales and their method of stabilization;
    b. all measures for the detention, retention or infiltration of water;
    c. all measures for the protection of water quality;
    d. the structural details for all components of the proposed drainage systems and stormwater management facilities;
    e. notes on drawings specifying materials to be used, construction specifications, and typicals, and
    f. expected hydrology with supporting calculations.

15. Timing, schedules, and sequence of development including clearing, stripping, rough grading, construction, final grading, and vegetative stabilization;
16. A maintenance schedule for the period of construction, and
17. Any other information requested by the DPW.

SECTION 10. LOW IMPACT DEVELOPMENT

Whenever possible, the Town of Ipswich recommends the use of Low Impact Development techniques for the regulation of stormwater on development sites. These techniques make use of the natural features of the landscape and natural vegetation for increasing on-site stormwater retention. In many cases these Low Impact Development techniques are less expensive than traditional stormwater management practices. In addition to limiting erosion and the transportation of sediment, each Stormwater Management Plan should have as its goal the infiltration of a maximum amount of stormwater for the purposes of recharging groundwater, including the use of stormwater retention and catchment devices used for on-site infiltration.

SECTION 11. INSPECTION AND SITE SUPERVISION

A. Pre-construction Meeting

Prior to starting clearing, excavation, construction, or land disturbing activity the applicant, the applicant's technical representative, the general contractor or any other person with authority to make changes to the project, are encouraged to meet with the Director of Public Works to review the permitted plans and their implementation.

B. Board Inspection

The DPW or its designated agent shall make inspections as hereinafter required and shall either approve that portion of the work completed or shall notify the permittee wherein the work fails to comply with the land disturbance permit as approved. The Permit and associated plans for grading, stripping, excavating, and filling work, bearing the signature of approval of the DPW, shall be maintained at the site during the progress of the work. In order to obtain inspections, the permittee shall notify the DPW at least two (2) working days before each of the following events:

1. Erosion and sediment control measures are in place and stabilized;

2. Site Clearing has been substantially completed;

3. Rough Grading has been substantially completed;

4. Final Grading has been substantially completed;

5. Close of the Construction Season; and

6. Final Landscaping (permanent stabilization) and project final completion.

C. Performance Standards

A construction project shall be considered in conformance with this section if soils or other eroded matter has been prevented from being deposited onto adjacent properties, rights-of-ways, public storm drainage system, or wetland or watercourse. The design, testing, installation, and maintenance of erosion and sediment control operations and facilities shall adhere to the standards and specifications contained in the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas dated March 1997 or the latest edition thereof.

D. Access Permission

To the extent permitted by state law, or if authorized by the owner or other party in control of the property, the Department of Public Works, its agents, officers, and employees may enter upon privately owned property

for the purpose of performing their duties under this bylaw and may make or cause to be made such examinations, surveys or sampling as the DPW deems reasonably necessary to determine compliance with the permit.

SECTION 12. CERTIFICATE OF OCCUPANCY

The Department of Public Works shall not give its consent to the issuance of a Certificate of Occupancy by the Building Inspector's office until the work required under this bylaw has been completed to the satisfaction of the DPW.

SECTION 13. ENFORCEMENT

A. The DPW or an authorized agent of the DPW shall enforce this bylaw, regulations, orders, violation notices, and enforcement orders, and may pursue all civil and criminal remedies for such violations.

B. Orders

1. The DPW or an authorized agent of the DPW may issue a written order to enforce the provisions of this bylaw or the regulations thereunder, which may include:

   a) a requirement to cease and desist from the land-disturbing activity until there is compliance with the bylaw and provisions of the land-disturbance permit;

   b) maintenance, installation or performance of additional erosion and sediment control measures;

   c) monitoring, analyses, and reporting

   d) remediation of erosion and sedimentation resulting directly or indirectly from the land-disturbing activity.

2. If the enforcing person determines that abatement or remediation of erosion and sedimentation is required, the order shall set forth a deadline by which such abatement or remediation must be completed. Said order shall further advise that, should the

violator or property owner fail to abate or perform remediation within the specified deadline, the town may, at its option, undertake such work, and the property owner shall reimburse the town's expenses.

3. Within thirty (30) days after completing all measures necessary to abate the violation or to perform remediation, the violator and the property owner shall be notified of the costs incurred by the town, including administrative costs. The violator or property owner may file a written protest objecting to the amount or basis of costs with the DPW within thirty (30) days of receipt of the notification of the costs incurred. If the amount due is not received by the expiration of the time in which to file a protest or within thirty (30) days following a decision of the DPW affirming or reducing the costs, or from a final decision of a court of competent jurisdiction, the costs shall become a special assessment against the property owner and shall constitute a lien on the owner's property for the amount of said costs. Interest shall begin to accrue on any unpaid costs at the statutory rate, as provided in G.L. Ch. 59, § 57, after the thirty-first day following the day on which the costs were due.

C. **Criminal Penalty** Any person who violates any provision of this bylaw, regulation, order or permit issued there under, shall be punished by a fine of not more than $___.__. Each day or part thereof that such violation occurs or continues shall constitute a separate offense

D. **Non-Criminal Disposition** As an alternative to criminal prosecution or civil action, the [city or town] may elect to utilize the non-criminal disposition procedure set forth in G.L. Ch.. 40, §21D and the *insert citation town enabling vote/bylaw (if applicable)* of the Town of Ipswich, in which case the *insert title or other authorized agent* of the Town of Ipswich shall be the enforcing person. The penalty for the 1st violation shall be $___. The penalty for the 2nd violation shall be $____. The penalty for the 3rd and subsequent violations shall be $ ___.__. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.

E. **Appeals** The decisions or orders of the DPW shall be final. Further relief shall be to a court of competent jurisdiction.

F. **Remedies Not Exclusive** The remedies listed in this bylaw are not exclusive of any other remedies available under **any** applicable federal, state or local law.

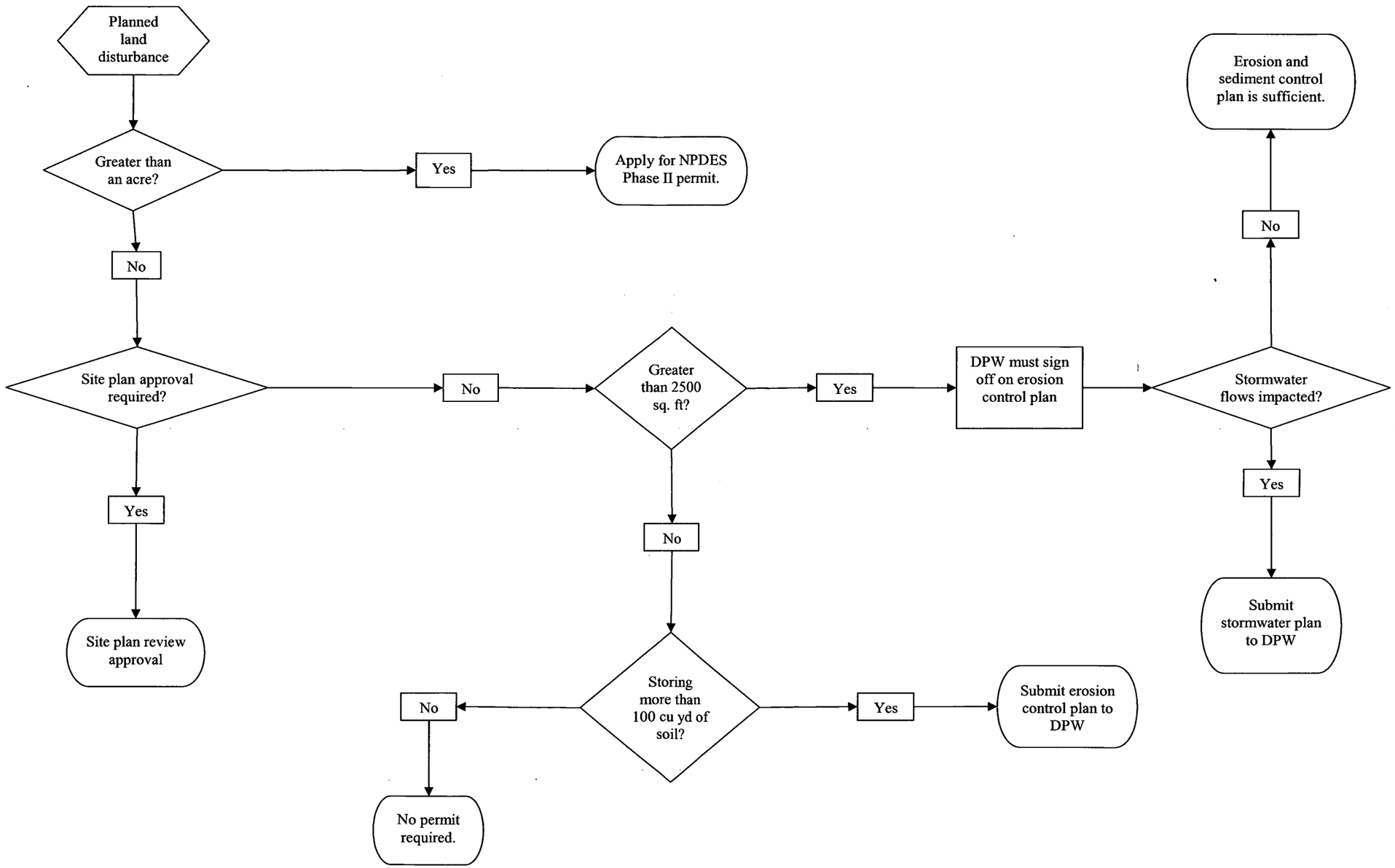
SECTION 14. CERTIFICATE OF COMPLETION

The issuing authority will issue a letter certifying completion upon receipt and approval of the final reports and/or upon otherwise determining that all work of the permit has been satisfactorily completed in conformance with this bylaw.

SECTION 15. SEVERABILITY

If any provision, paragraph, sentence, or clause of this bylaw shall be held invalid for any reason, all other provisions shall continue in full force and effect.

Permitting and Approval Process for Land Disturbances in Ipswich, MA



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8. ALTERNATIVES / ADDITONAL RECOMMENDATIONS

8.1 Alternatives

8.1.1 *Overlays with Stricter Protections for Most Sensitive Land*

Overlays are a tool used in zoning where a zone is "placed on the zoning map 'over' traditional zoning districts" (Mandelker and Payne 2002). Applying overlays to land that is particularly ecologically sensitive is one common way to use an overlay zone. Ipswich contains three areas that are distinguished from regular zoning. These areas are:

1) the banks of permanent streams extending 200 feet
2) the edge of wetlands extending 100 feet, and
3) areas of critical and environmental concern such as the coastal marshes of Ipswich.

The Conservation Commission of Ipswich has full oversight for any structure built in these areas. Current Massachusetts law requires the Conservation Commission to evaluate stormwater management plans for land disturbance greater than one acre but the Conservation Commission of Ipswich requires and evaluates all stormwater management plans for any new development on land that falls under their jurisdiction (D. Standley, personal communication, April 7, 2004).

Given that these overlays exist, and that nearly all of Ipswich rests on wetlands, or land having characteristics of wetlands, making different overlays with different standards would not advance the protection of the water resources of the town. With the exception of the current area overseen by the Conservation Commission, it is recommended that all of Ipswich be covered under one stormwater management regulation. However, overlays may be an effective stormwater management tool for other municipalities considering similar regulations.

8.1.2. *Stormwater Management Utility Fee*

Several hundred towns around the country have a stormwater management utility. These towns charge residents a fee for stormwater management along with their other utility fees. The money collected is used for maintaining stormwater management devices and for administrating the stormwater management program within the town.

Generally, all single family homes are charged a single rate a pre-determined number of times each year, which is an amount based on the required budget of the agency in town responsible for stormwater management. Other property is charged a fee, usually determined by the area of the property or the area of impervious surface multiplied by a base rate. While not practicable at present time, the town may want to consider the possibility of initiating a stormwater management utility fee collected from its citizens. Everyone benefits from a reduction in stormwater through cleaner beaches, thriving shellfish beds, and a healthier environment, and the stormwater utility fee is a way for the town to provide for the costs associated with stormwater management.

8.2. Additional Stormwater Managment

8.2.1. *Stormwater Infiltration*

As mentioned earlier, Ipswich lies along the Ipswich River, considered to be one of the most endangered rivers in the United States because of a continuing loss of flow. The Ipswich River is fed mostly by groundwater, and most of this groundwater is drawn from the river for public use before the river reaches its destination in Ipswich Bay. In a report produced by the consulting firm Horsley & Witten, Inc. for the Ipswich River Watershed Association (Horsley & Witten, Inc. 1999), they recommend that all cities and towns in the Ipswich River Watershed adopt a policy of infiltrating 150 percent of their stormwater. To date no municipality has attempted this; Ipswich has the opportunity through adopting a progressive stormwater regulation to lead the way on restoring the Ipswich River. Thus stormwater management in Ipswich should be focused not only on sediment remediation but also on stormwater infiltration on-site, rather than directing stormwater offsite into the municipal sewer system or other drainage system. The goal of infiltrating 150 percent of stormwater means not only infiltrating all stormwater runoff produced on a site but also capturing rainwater from roof runoff and in infiltration basins to direct the water back into the ground before it has evaporated or is lost to transpiration by plants. Infiltration can be accomplished through a number of BMPs, including the use of Low Impact Development techniques.

The Ipswich River is considered to be one of the most endangered rivers in the U.S. because of a continuing loss of flow. Using Low Impact Development techniques, Ipswich can allow for more rainwater to restore the groundwater resources instead of being diverted to storm water sewers.

8.2.2. *Low Impact Development*

Low Impact Development (LID) is the use of existing vegetation and slopes and other natural features of the land to manage stormwater runoff. Rather

than clearing large amounts of land and then later installing devices to manage stormwater created by the alteration of the land, LID techniques use more natural systems such as rain gardens, rooftop rainwater collection systems, vegetative swales, and bioretention areas, as well as utilizing the natural slope of the land, to infiltrate stormwater on-site. These techniques are often more effective and generally less expensive than traditional BMPs used for stormwater management. By promoting the use of LID techniques, the Town of Ipswich will be not only effectively preventing the transportation of sediment into wetland areas and into the Ipswich Bay, but will also be contributing to the infiltration of stormwater into the groundwater system, and thus working towards the restoration of the Ipswich River.

While LID techniques should not be a required component of land clearing permits, the town should strongly recommend the use of these devices on all lots involved with development or renovation. The town should also consider providing incentives to developers or home owners for the use of Low Impact Development on their property, such as a reduction or waiver of the permit fee, or in allowing the submission of a LID plan in lieu of an Erosion and Sediment Control Plan stamped by a Professional Engineer. For additional information on Low Impact Development techniques, see Appendix A.XII.

8.2.3. *Stormwater Education*

Educating the public about the benefits of proper stormwater management is a critical component of introducing a successful bylaw. Often property owners are unaware of the damage that might be caused by erosion on their property or by the runoff of stormwater from their land into a nearby stream. Education is essential to creating compliance within the town. Ipswich has already started an outreach program to educate its citizens about the problem of stormwater runoff. In addition to this outreach campaign, they should work to educate property owners, developers, and contractors about proper stormwater management techniques.

One method of contributing to the knowledge of those individuals who will be involved with land disturbance is through posting information in the Building Inspector's office. It is important that these individuals are aware of the new bylaw before they apply for their building permit, as typically the application will come near the end of the process of planning for a new development. In some cases, such as the storage of excavate or

fill on a lot, the land owner may not need to apply for a building permit, in which case the town is unlikely to be informed about the activity. Educating people about the process of applying for a Land Disturbance Permit will hopefully inform some of these individuals who might otherwise remain unaware of their obligation. To ensure compliance and avoid unhappy citizens, the town should be sure to give its citizens plenty of notice about this new bylaw.

Another effective way of promoting good stormwater management in the town is through the creation of a stormwater handbook to be distributed to developers, contractors, and property owners. This handbook would contain information about Best Management Practices for erosion and sediment control and for stormwater management, with information on how to implement them. The handbook would also contain information about Low Impact Development techniques, which these individuals may find to be more cost effective than traditional stormwater BMPs, and more effective at reducing stormwater. The goal of this handbook will be to allow the contractors and property owners to implement some BMPs on their own without requiring the assistance of a Professional Engineer, which can be costly and burdensome to the property owner. The stormwater management handbook would also provide information on why stormwater management is so important to the Town of Ipswich, and where the reader can find more information about stormwater. Issuing this handbook concurrently with the implementation of the bylaw would hopefully provide for a smoother transition and ensure compliance with the new law.

9. CONCLUSION

By adopting this bylaw and its associated recommendations, the Town of Ipswich will be able to significantly reduce the impact of stormwater runoff and erosion on the natural environment. In combination with the NPDES Phase II regulations, these recommendations will greatly reduce the amount of sediment carried by stormwater runoff into the Ipswich Bay and other nearby wetlands, improving these areas as a wildlife habitat, as a scenic and recreational area, and largely restoring the health of the Ipswich shellfish beds, a vital commercial and cultural resource to the town. Additionally, infiltrating stormwater into the groundwater table and back into the Ipswich River will have the benefit of improving the health of the Ipswich River, another important resource for the town. Using techniques that preserve vegetation on the land being developed has the added bonus of preserving the town's scenic qualities and serves as a wildlife habitat as well.

Another significant implication of this bylaw is that it will allow the Town of Ipswich to be at the forefront of conservation efforts and stormwater remediation. Ipswich will serve as a model for other municipalities within the watershed to adopt similar measures to reduce their own impact on the environment and on the Ipswich River and Ipswich Bay. Ipswich will most certainly benefit from the adoption of similar regulations by its neighbors, and being a leader provides the incentive for other neighboring towns to do so.

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APPENDICES

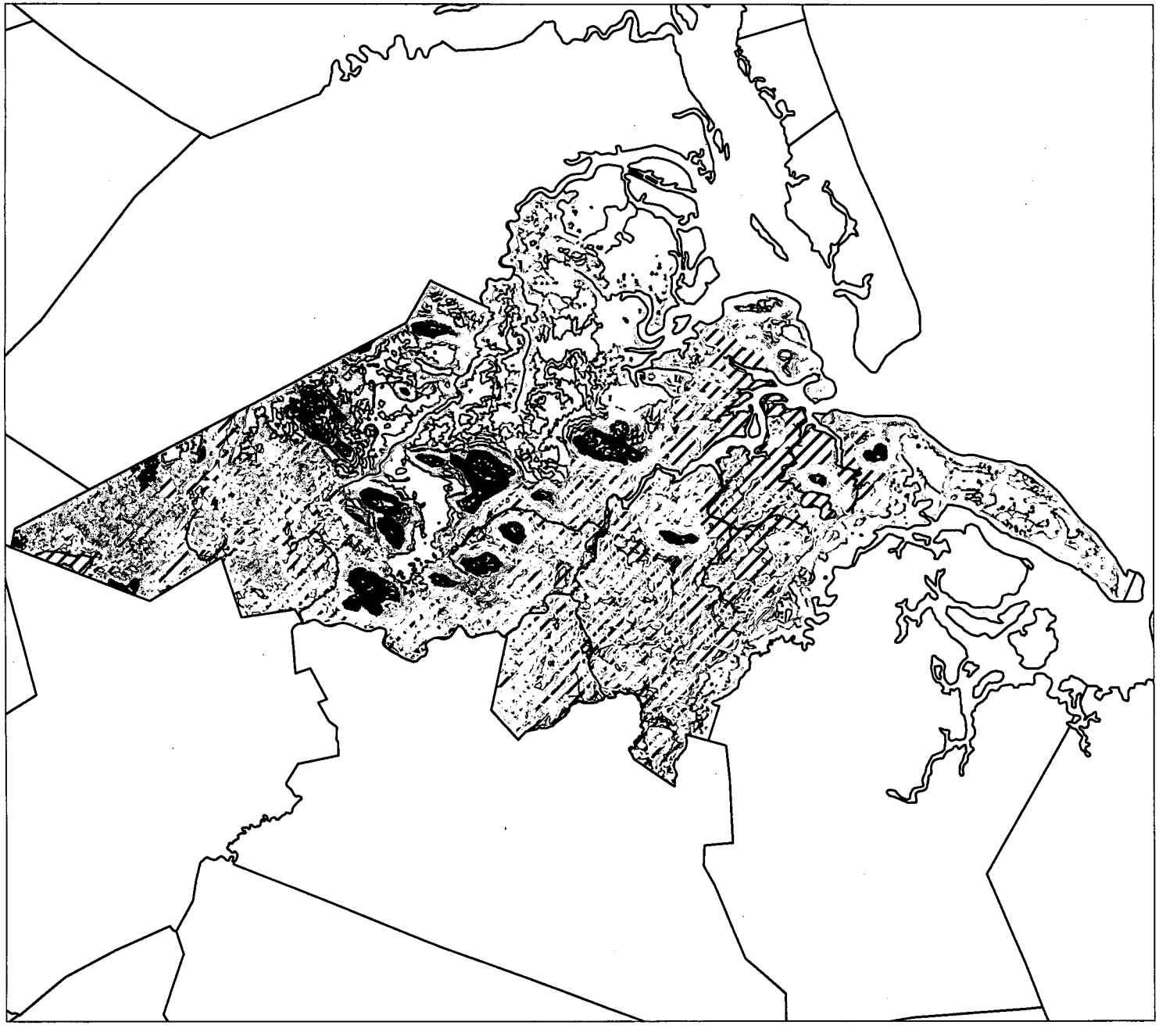
APPENDIX A
Items Referenced in Report

I. Stormwater regulation requirements for municipalities researched
II. Map of Ipswich: elevation and surface waters
III. Map of Ipswich soils: based on slope
IV. Table of suitability for building site development
V. Surface type and runoff coefficients
VI. Sample sediment and erosion control plan
VII. Low-impact development brochure

Summary of Stormwater Ordinances

	Westfield	Pittsfield	Brookline	Eugene, OR	Garland, TX	Hatfield, MA
Qualifying Area/Activities	Multi-family residential developments w/4 or more units	Construction activity 5000+ sq.ft. as long as the amount of impervious cover created does not exceed 1000 sq.ft.	Change in grade of 2500 sq. ft. or 25% of the lot whichever is smaller	Outcome based approach. All construction activity in city limits regulated, regardless of whether permit needed.	5,000 square feet to one acre-erosion control plan employing appropriate bmps.	Any development creating 10,000 or more square feet of new impervious surfaces
	New commercial, industrial, and institutional structures 5000+ sq.ft. floor area, 10,000 sq.ft. impervious surface, or 10 or more parking spaces		Removal of existing vegetation of more than 2500 sq. ft. or 25%...	In sensitive areas, the following need permits: highly erodable soil, slopes of 10% or greater or directly draining to a water feature-- if it is a disturbance of 500 square feet or greater.		Any project disturbing five acres or more of soil, with the exception of agriculture
	Redevelopment or additions to existing commercial, industrial, and institutional uses which result in an additional impervious surface area or gross floor area of greater than 5,000 square feet, or which results in an increase of 10 or more parking spaces.		Storage of more than 100 cubic yd of excavate or fill			
	Subdivisions and construction activities of any kind disturbing greater than 40,000 square feet;		Minor Significance -- <20,000 sq. ft. or 100 - 1300 cy fill.			
	Development or redevelopment involving multiple separate activities in discontinuous locations or on different schedules if the activities are part of a larger common plan of development that all together disturbs one or more acres.		Significant Impact -- >20,000 sf or >1300 cy of fill			
			Major Impact -- >1 acre			
Enforcement	DPW	DPW and Conservation Commission	DPW or authonzed agent	Public Works- Erosion Prevention Specialist		Planning Board
Application Requirements	Approved by a PE	Approved by a PE	Erosion and Sediment Control Plan ("ESCP") ONLY if SW flows are not impacted	Application with site map and plan of bmps.	Erosion control plan employing appropriate bmps.	Stormwater Mgt Plan will serve as bases for all subsequent construction
	SW management plan (includes erosion and sediment control)	SW management plan (includes erosion and sediment control)	ESCP has to be designed by a civil engineer, but does not have to be a PE	Does not need PE approval	Not required to be sealed.	Plan must include supporting computations and drawings with sufficient information describing the manner, location, and type of measure win which stormwater runoff will be managed for entire development.
			SW management plan and ESCP required for:			Must include 15 things (see by-law)
			1. Any land disturbance activity greater than 2500 sq. ft. which would result in an increased amount of SW runoff from the property to public/private property or resource areas.	Detailed construction schedule for wet weather season.		ZEO must inspect property before approval: 1)Initial inspection 2) Erosion Control Inspection 3) Construction Inspection 4) After Development Inspection
			2. Any activity which would increase the flow to the municipal storm or sanitary sewer systems			Plan must meet described performance standards and be consisistent with by-law
			3. Any activity which would alter or modify an existing drainage system			Must get OK from abutting neighbors if water will runoff onto their property
			SW Management plan need PE stamp			
Review and Approval	DPW City Engineer provides comments to DPW	DPW and Conservation Commission	Engineering Division of the DPW Con Com (major projects only; *won't apply for our purposes*)	Public Works Engineering Erosion Prevention	Engineering Department	Con Com receives copy of permit and has 35 days to comment. Planning Board cannot approve permit until 35 days has passed or they've received comments from Con Com, whichever is first. ZOE, Board of Health, DPW, Building inspector also have 35 days to comment.
Fee Structure	Based on amount of land to be disturbed	Non-refundable permit review fee				
		Performance or security bond--Total estimated construction cost of the storm water management practices approved under the permit, plus 25%. Released in full only upon submission of "as built plans" and written certification by a registered PE.		Fees assessed on all construction activity, even non-permitted sites. Non permitted residential = $60, Permitted new residential = $250, Permitted residential addition = $150. Other fees may apply.	No fees. Garland has a stormwater utility that funds it.	Planning Board may require from developer a cash bond, irrevocable letter of credit or other means of security before building permit is issued. Bond is released after final inspection
	Established by Board of Public Works Fee credited to the Utility Enterprise Fund					
Penalties	1. Written notice of violation to owner 2. Stop work order	Written notice of violation to property owner Stop Work Order	Stop Work Order issued in writing to applicant Fine, if damages occur	Strong enforcement.		
	3. Criminal and Civil Penalties (City enforced)--$300/day/violation	Civil and Criminal Penalties (flat fine and/or imprisonment)	Fines for non-compliance, no damages: $100 1st offense, $200 2nd offense, $300 3rd and subsequent offenses			Any portion not complying shall be promptly corrected or the applicant will be subject to 1. bonding provisions and/or 2. enforcement provisions Lab expenses at owners request to verify adequacy of material and compaction. DPW will make corrections within 30 days and applicant will pay DPW for their work
	DPW enforced penalties: $100 1st offense, $200 2nd offense, $300 3rd and subsequent offenses	Restoration of lands		Stop work orders, orders to correct, and civil penalties		
	Restoration of lands Holds on Occupancy Permits	Holds on Occupation Permits				
Waiver Qualifications		Not likely to impair attainment of the objectives of the ordinance	Certain aspects of SW Management Plan can be waived for minor projects only. Generally won't require the submission of an operation and maintenance plan.			
		Alternative minimum requirements for on-site SW discharge have been established and approved by the city				
		SW being managed by off-site facility				
		DPW and Con Com determine meeting minimum on-site requirements is not feasible				
		IF MINIMUM REQUIREMENTS ARE WAIVED, APPLICANT MUST MEET ONE OF THE MITIGATION MEASURES				

Ipswich: Elevation and Surface Waters



Ponds and Streams

Elevation (feet)

0 - 29

30 - 68

69 - 108

109 - 157

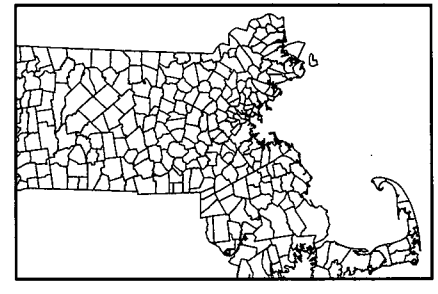
158 - 255

Wetlands

0 0.5 1 2 3 4

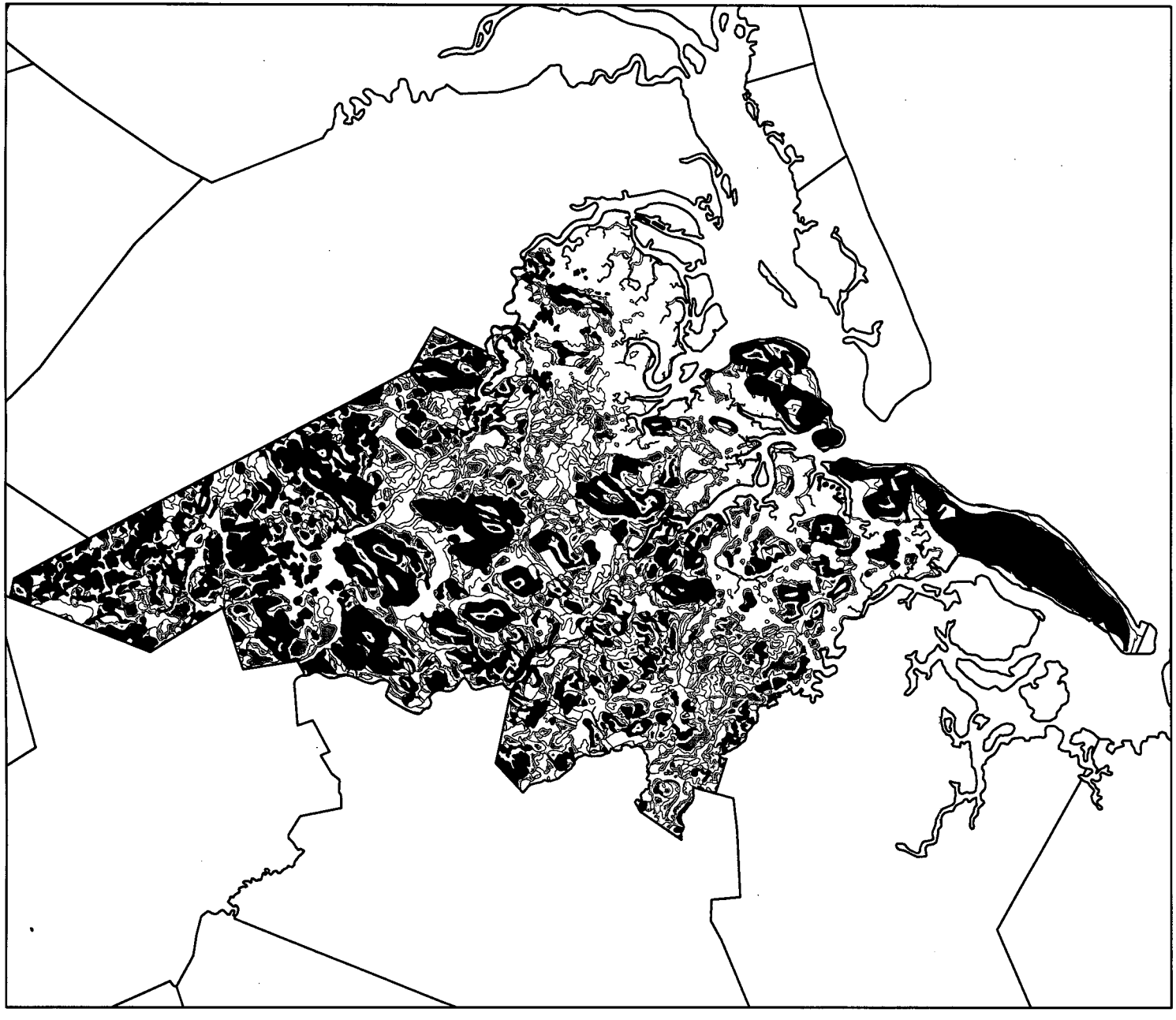
Miles

N



Source: MassGIS,
http://www.mass.gov/mgis

Ipswich Soils: Based on slope



Ipswich Soils
Percent Slope

- 0
- 0 - 3
- 3 - 8
- 8 -15
- 15 - 25
- 25 - 45

0 0.5 1 2 3 4
Miles

N

Source: MassGIS,
http://www.mass.gov/mgis

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AnB---- Annisquam	Severe: large stones.	Severe: large stones.	Severe: wetness, large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
AnC---- Annisquam	Severe: large stones.	Severe: large stones.	Severe: wetness, large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: large stones.
AnD---- Annisquam	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, wetness, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.
Ba*. Beaches						
BeB---- Belgrade	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Severe: frost action.	Moderate: wetness.
BuA, BuB---- Boxford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
BuC---- Boxford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Severe: low strength, frost action.	Moderate: wetness, slope.
BxB*: Boxford----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Urban land.						
CaB---- Canton	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight----	Slight.
CaC---- Canton	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
CbB---- Canton	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight----	Moderate: large stones.
CbC---- Canton	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, slope.
CbD---- Canton	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
CcB---- Canton	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight----	Moderate: large stones.
CcC---- Canton	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, slope.
CcD, CcE---- Canton	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ChC*: Canton----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dsellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
ChC*: Urban land.						
CrC*: Chatfield	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock, frost action.	Moderate: small stones, large stones, slope.
Hollis	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: thin layer.
Rock outcrop.						
CrD*: Chatfield	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hollis	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, thin layer.
Rock outcrop.						
De Deerfield	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: frost action, wetness.	Moderate: wetness.
Du*. Dumps						
ElA Elmridge	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Moderate: wetness.
ElB Elmridge	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Severe: low strength, frost action.	Moderate: wetness.
FF. Fluvaquents						
Fm Freetown	Severe: wetness, excess humus.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength, frost action.	Severe: wetness, excess humus.
Fp Freetown	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding, excess humus.
HfA Hinckley	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: small stones, droughty.
HfB Hinckley	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: small stones, droughty.
HfC Hinckley	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: small stones, droughty.
HfD, HfE Hinckley	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HuC*: Hollis	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: thin layer.
Urban land.						
Rock outcrop.						
Iw*: Ipswich	Severe: ponding, excess humus.	Severe: ponding, flooding, low strength.	Severe: ponding, flooding, low strength.	Severe: ponding, flooding, low strength.	Severe: ponding, low strength, flooding.	Severe: ponding, excess salt, excess sulfur.
Westbrook	Severe: excess humus, ponding, flooding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding, low strength.	Severe: excess salt, excess sulfur, ponding.
Ma Maybid	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, low strength, frost action.	Severe: ponding.
MeA Melrose	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
MeB Melrose	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
MmA Merrimac	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
MmB Merrimac	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
MmC Merrimac	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
MmD Merrimac	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MnB*: Merrimac	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
Urban land.						
MoB Montauk	Moderate: dense layer, wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, slope.	Moderate: wetness, frost action.	Slight.
MoC Montauk	Moderate: dense layer, wetness, slope.	Moderate: wetness, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness, slope, frost action.	Moderate: slope.
MsB Montauk	Moderate: dense layer, wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, slope.	Moderate: wetness, frost action.	Moderate: small stones, large stones.
MsC Montauk	Moderate: dense layer, wetness, slope.	Moderate: wetness, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness, slope, frost action.	Moderate: small stones, large stones, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MsD---- Montauk	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MxC---- Montauk	Moderate: dense layer, wetness, slope.	Moderate: wetness, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness, slope, frost action.	Moderate: small stones, large stones, slope.
MxD---- Montauk	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
NnA---- Ninigret	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: frost action, wetness.	Moderate: wetness.
NnB---- Ninigret	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Moderate: frost action, wetness.	Moderate: wetness.
PaB---- Paxton	Moderate: dense layer, wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: frost action, wetness.	Slight.
PaC---- Paxton	Moderate: slope, dense layer, wetness.	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Moderate: slope, frost action, wetness.	Moderate: slope.
PaD---- Paxton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PbB---- Paxton	Moderate: dense layer, wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: frost action, wetness.	Moderate: large stones.
PbC---- Paxton	Moderate: slope, dense layer, wetness.	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Moderate: slope, frost action, wetness.	Moderate: slope, large stones.
PbD---- Paxton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PcE*: Paxton----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Montauk----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PdC*: Paxton----	Moderate: slope, dense layer, wetness.	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Moderate: slope, frost action, wetness.	Moderate: slope.
Urban land.						
Pe---- Pipestone	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Pg*. Pits						
PlB---- Pollux	Slight----	Slight----	Slight----	Moderate: slope.	Moderate: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PoB---------- Poquonock	Moderate: dense layer, wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, slope.	Moderate: wetness.	Moderate: large stones.
PoC---------- Poquonock	Moderate: dense layer, wetness, slope.	Moderate: wetness, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness, slope.	Moderate: large stones, slope.
PoD---------- Poquonock	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Qu*. Quarries						
RdA, RlA, RlB----- Ridgebury	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Rx*: Rock outcrop.						
Hollis----------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, thin layer.
Sb---------- Scarboro	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
ScA---------- Scitico	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
SgB---------- Scituate	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Moderate: frost action, wetness.	Moderate: wetness.
ShB---------- Scituate	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: frost action, wetness.	Moderate: small stones, large stones.
ShC---------- Scituate	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope, frost action.	Moderate: slope, small stones, large stones.
SmB---------- Scituate	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: frost action, wetness.	Moderate: small stones, large stones.
SoB---------- Scituate	Severe: large stones, wetness.	Severe: large stones.	Severe: wetness, large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
SoC---------- Scituate	Severe: large stones, wetness.	Severe: large stones.	Severe: wetness, large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: large stones.
SpA, SpB---------- Shaker	Severe too clayey, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
SrA---------- Sudbury	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SrB---------- Sudbury	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Moderate: wetness, frost action.	Slight.
Ss---------- Swansea	Severe: wetness, excess humus, cutbanks cave.	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness, low strength.	Severe: wetness, low strength, frost action.	Severe: wetness, excess humus.
UAC. Udipsamments						
UD. Udorthents						
Ur*. Urban land						
WaA, WaB---------- Walpole	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
We---------- Wareham	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Wf---------- Whately Variant	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Wh---------- Whitman	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: frost action, ponding.	Severe: large stones, ponding.
WnA---------- Windsor	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
WnB---------- Windsor	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
WnC---------- Windsor	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
WnD---------- Windsor	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
WrB---------- Woodbridge	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Severe: frost action.	Moderate: wetness.
WrC---------- Woodbridge	Severe: wetness.	Moderate: slope, wetness.	Severe: wetness.	Severe: slope.	Severe: frost action.	Moderate: slope, wetness.
WsB---------- Woodbridge	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: slope, wetness.	Severe: frost action.	Moderate: large stones, wetness.
WsC---------- Woodbridge	Severe: wetness.	Moderate: slope, wetness.	Severe: wetness.	Severe: slope.	Severe: frost action.	Moderate: slope, large stones, wetness.
WsD---------- Woodbridge	Severe: slope, wetness.	Severe: slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope, frost action.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

Appendix A.V.

Selected runoff coefficients	
Description of area or character of surface	*Runoff coefficient*
Business	
Downtown	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	
Single-family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light	0.50 to 0.80
Heavy	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30
Pavement	
Asphaltic and concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, sandy soil	
Flat, 2 percent	0.05 to 0.10
Average, 2 to 7 percent	0.10 to 0.15
Steep, 7 percent	0.15 to 0.20
Lawns, heavy soil	
Flat, 2 percent	0.13 to 0.17
Average, 2 to 7 percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35

Sample

EROSION AND SEDIMENTATION CONTROL PLAN ABC INDUSTRIES, INC. ANYTOWN, MASSACHUSETTS JULY 1995

Table of Contents

Narrative

Project Description

The purpose of the project is to construct two large commercial buildings with associated paved roads and parking area. Another building will be added in the future. Approximately 6 acres will be disturbed during this construction period. The site consists of a total of 11.1 acres and is located in ANYTOWN, Massachusetts.

Site Description

The site has rolling topography with slopes generally 4 to 6 percent. Slopes steeper to 10 to 20 percent in the northwest portion of the property where a small healed-over gully serves as the principal drainageway for the site. The site is now covered with woody vegetation, predominantly white pines, 15 to 20 feet high. There is no evidence of significant erosion under present site conditions. The old drainage gully indicates severe erosion potential and receives flow from 5 acres of woods off-site. There is one large oak tree, located in the western central portion of the property, and a buffer area, fronting Terri Road, that will be protected during construction.

Adjacent Property

Land use in the vicinity is commercial/industrial. The land immediately to the west and south has been developed for industrial use. Areas to the north and east are undeveloped and heavily wooded, primarily in white pine. Hocutt Creek, the off-site outlet for runoff discharge, is presently a well stabilized, gently-flowing perennial stream. Sediment control measures will be taken to prevent damage to Hocutt Creek. Approximately 5 acres of wooded area to the east contribute runoff into the construction area.

Soils

The soil in the project area is mapped as Paxton (see Natural Resources Conservation Service, soil survey for your town) fine sandy loam in B and C slope classes. Paxton soils are considered moderately well to somewhat poorly drained with permeability rates greater than 6 inches/hour at the surface but less than 0.1 inches/hour in the subsoil. The subsurface is pale brown sandy loam, 6 inches thick. The subsoil consists of a pale brown and brownish yellow sandy clay loam ranging to light gray clay, 36 inches thick. Below 36 inches is a layer of fine sandy loam to 77 inches. The soil erodibility (K factor; see soil survey for an explanation) ranges from 0.20 at the surface to 0.37 in the subsoil.

Due to the slow permeability of the subsoil that will be exposed during grading, a surface wetness problem with high runoff is anticipated following significant rainfall events. No groundwater problem is expected. The tight clay in the subsoil will make vegetation difficult to establish. Some topsoil exists on-site and will be stockpiled for landscaping.

Planned Erosion and Sedimentation Control Practices

Sediment Basin

A sediment basin will be constructed in the northwest corner of the property. All water from disturbed areas, about 6 acres, will be directed to the basin before leaving the site. (NOTE: The undisturbed areas to the east and north could have been diverted, but this was not proposed because it would have required clearing to the property line to build the diversion and the required outlet structure.)

Construction Entrance

A temporary gravel construction entrance will be installed near the north-west corner of the property. During wet weather it may be necessary to wash vehicle tires at this location. The entrance will be graded so that runoff water will be directed to an inlet protection structure and away from the steep fill area to the north.

Block and Gravel Inlet Protection

A temporary block and gravel inlet protection device will be installed at the drop inlet located on the south side of the construction entrance. Runoff from the device will be directed into the sediment basin. (NOTE: The presence of this device reduces the sediment load on the sediment basin and provides sediment protection for the pipe. In addition, sediment removal at this point is more convenient than from the basin.)

Temporary Diversions

Temporary diversions will be constructed above the 3:1 cut slopes south of Buildings A and B to prevent surface runoff from eroding these banks. (NOTE: Sediment-free water may be diverted away from the project sediment basin.) A temporary diversion will be constructed near the middle of the disturbed area to break up this long, potentially erosive slope should the grading operation be temporarily discontinued. A temporary diversion will be constructed along the top edge of the fill slope at the end of each day during the filling operation to protect the fill slope. This temporary diversion will outlet to the existing undisturbed channel near the north edge of the construction site and/or to the temporary inlet protection device at the construction entrance as the fill elevation increases.

Level Spreader

A level spreader will serve as the outlet for the diversion east of Building A and south of Building B. The area below the spreader is relatively smooth and heavily vegetated with a slope of approximately 4 percent.

Tree Preservation and Protection

A minimum 2 foot high protective fence will be erected around the large oak tree at the dripline to prevent damage during construction. Sediment fence materials may be used for this purpose.

Land Grading

Heavy grading will be required on approximately 6 acres. The flatter slope after grading will reduce the overall erosion potential of the site. The buildings will be located on the higher cut areas, and the access road and open landscaped areas will be located on fill areas.

All cut slopes will be 3:1 or flatter to avoid instability due to wetness, provide fill material, give an open area around the buildings, and allow vegetated slopes to be mowed. Cut slopes will be fine graded immediately after rough grading; the surface will be disked and vegetated according to the Vegetation Plan.

Fill slopes will be 2:1 with fill depths as much as 12 to 15 feet. Fill will be placed in layers not to exceed 9 inches in depth and compacted.

The fill slope in the north portion of the property is the most vulnerable area to erosion on the site. Temporary diversions will be maintained at the top of this fill slope at all times, and the filling operation will be graded to prevent overflow to the north. Filling will be done as a continuous operation until final grade is reached.

The paved road located on the fill will be sloped to the south and will function as a permanent diversion. The area adjacent to the roads and parking area will be graded to conduct runoff to the road culverts. Runoff water from the buildings will be guttered to the vegetated channels. The finished slope face to the north will not be back-bladed. The top 2 to 6 inches will be left in a loose and roughened condition. Plantings will be protected with mulch, as specified in the Vegetation Plan.

A minimum 15 foot undisturbed buffer will be maintained around the perimeter of the disturbed area. (NOTE: This will reduce water and wind erosion, help contain sediment, reduce dust, and reduce final landscaping costs.)

Temporary Sediment Trap

A small sediment trap will be constructed at the intersection of the existing road ditch and channel number 3 to protect the road ditch. Approximately 2 acres of disturbed area will drain into this trap.

Sediment Fence

A sediment fence will be constructed around the topsoil stockpile and along the channel berm adjacent to the deep cut area, as necessary to prevent sediment from entering the channels.

Sod Drop Inlet Protection

Permanent sod drop inlet protection will replace the temporary block and gravel structure when the contributing drainage area has been permanently seeded and mulched.

Grassed Waterway

Grassed waterways with temporary straw-net liners will be constructed around Buildings A and B to collect and convey site water to the project's sediment basin.

Should the disturbed areas adjoining the channels not be stabilized at the time the channels are vegetated, a sediment fence will be installed adjacent to the channel to prevent channel siltation.

Riprap-Lined Waterways

A riprap channel will be constructed in the old gully along the north side of the property starting in the northwest corner after all other construction is complete. This channel will replace the old gully as the principal outlet from the site.

Construction Road Stabilization

As soon as final grade is reached on the entrance road, the subgrade will be sloped to drain to the south and stabilized with a 6 inch course of ¾ inch stone. The parking area and its entrance road will also be stabilized with ¾ inch stone to prevent erosion and dust during the construction of the buildings and prior to paving.

Outlet Stabilization

A riprap apron will be located at the outlet of the three culverts to prevent scour.

Surface Roughening

The 3:1 cut slopes will be lightly roughened by disking just prior to vegetating, and the surface 4 to 6 inches of the 2:1 fill slopes will be left in a loose condition and grooved on the contour.

Surface stabilization

Surface stabilization will be accomplished with vegetation and mulch as specified in the Vegetation Plan. One large oak tree southwest of Building A and a buffer area between the parking lot and Terri Road will be preserved. Roadway and parking lot base courses will be installed as soon as finished grade is reached.

Dust control

Dust control is not expected to be a problem due to the small area of exposure, the undisturbed perimeter of trees around the site, and the relatively short time of exposure (not to exceed 9 months). Should excessive dust be generated, it will be controlled by sprinkling.

Construction Schedule

1. Obtain plan approval and other applicable permits.
2. Flag the work limits and mark the oak tree and buffer area for protection.
3. Hold a pre-construction conference at least one week prior to starting construction.
4. Install the sediment basin as the first construction activity.
5. Install the storm drain with the block and gravel inlet protection at the construction entrance/exit.
6. Install the temporary gravel construction entrance/exit.
7. Construct the temporary diversions above the proposed building sites. Install the level spreader and sediment trap and vegetate disturbed areas.
8. Complete site clearing except for the old gully in the northwest portion of the site. This area will be cleared during the last construction phase for the installation of the riprap channel.
9. Clear the waste disposal area in the northeast corner of the property, only as needed.
10. Rough grade site, stockpile topsoil, construct channels, install culverts and outlet protection, and install sediment fence as needed. Maintain diversions along the top of the fill slope daily.
11. Finish the slopes around the buildings as soon as rough grading is complete. Leave the surface slightly roughened and vegetate and mulch as soon as possible.
12. Complete the final grading for roads and parking and stabilize with gravel.
13. Complete the final grading for the buildings.
14. Complete the final grading of grounds, topsoil critical areas, and permanently vegetate, landscape, and mulch.
15. Install the riprap outlet channel and extend riprap to pipe outlet under entrance road.
16. After the site is stabilized, remove all temporary measures and install permanent vegetation on the disturbed areas.
17. Estimated time before final stabilization is 9 months.

Maintenance Plan

1. All erosion and sediment control practices will be checked for stability and operation following every runoff-producing rainfall but in no case less than once every week. Any needed repairs will be made immediately to maintain all practices as designed.
2. The sediment basin will be cleaned out when the level of sediment reaches 2 feet below the top of the riser. Gravel will be cleaned or replaced when the sediment pool no longer drains properly.
3. Sediment will be removed from the sediment trap and block and gravel inlet protection device when storage capacity has been approximately 50 percent filled. Gravel will be cleaned or replaced when the sediment pool no longer drains properly.
4. Sediment will be removed from behind the sediment fence when it becomes about ½ foot deep at the fence. The sediment fence will be repaired as necessary to maintain a barrier.
5. All seeded areas will be fertilized, reseeded as necessary, and mulched according to specifications in the Vegetation Plan to maintain a vigorous, dense vegetative cover.

Note: The appropriate official from Anytown, Massachusetts should conduct regular (weekly or bi-weekly) inspections of the site and control measures to ensure proper functioning. Orders should be issued if any conservation practice is observed to be malfunctioning or incorrectly built.

References

Massachusetts Department of Environmental Protection, Office of Watershed Management, Nonpoint Source Program, ***Massachusetts Nonpoint Source Management***, Boston, Massachusetts, June, 1993.

What if you could...

...preserve environmental quality...reduce infrastructure construction and maintenance costs

...enhance community awareness.....and lower development costs?

You can, if you apply the principles of ...

LOW-IMPACT DEVELOPMENT

Low-Impact Development (LID) presents a new philosophy in site development and environmental protection. LID is not a growth management program. LID does not rely on density restrictions or clustering. **Instead.....LID focuses on how the developed area of a site is planned and designed to minimize hydrologic impacts.** LID uses a variety of site design and pollution prevention techniques to create a hydrologically functional and environmentally sensitive landscape.

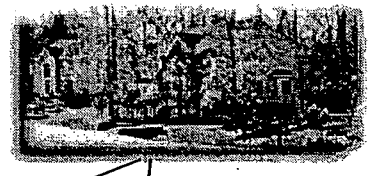
What are the benefits?

Environmental

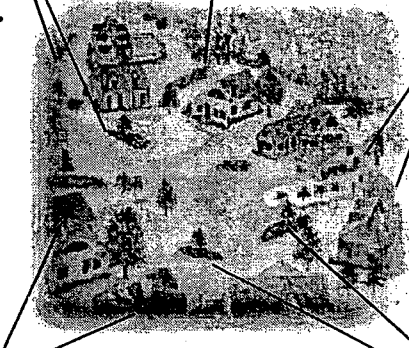
- Reduced wetland impacts & associated impact fees
- Multiple regulatory credits for environmental protection
- Reduced downstream erosion
- Improved groundwater recharge
- Reduced uplands habitat impacts

Low-Impact Development, St. Mary's County, MD

Runoff Retention Using On-lot Bioretention;
Runoff Detention Using Modified Open Drainage Swale



Forest Conservation Through Site Fingerprinting Reduced; Imperviousness Through Narrow Road Widths; Open Drainage Swales



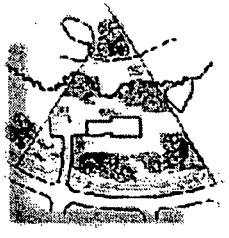
Runoff Retention Using Rainbarrel

Costs

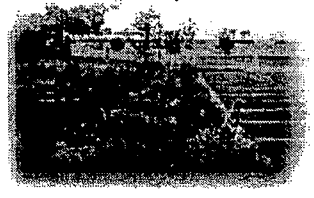
- Development cost savings as much as $5,000 per lot
- Reduced site infrastructure and associated costs
- Reduced infrastructure maintenance costs
- Potential gains in lot yields

Other

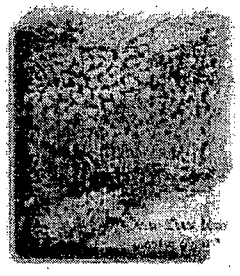
- Improved site aesthetics
- Enhanced public awareness
- Applicability to retrofit/urban revitalization areas
- Potential for reduced taxes & fees
- Potential increases in property values



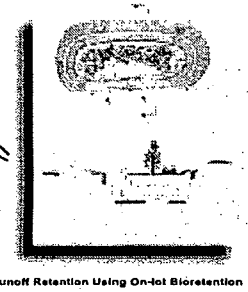
Plan View Schematic of Low-Impact Development Residential Lot



Low-Impact Development for Commercial Property, Prince George's County, MD



Public Participation Through Homeowner BMP Maintenance



Runoff Retention Using On-lot Bioretention

SERVICES

- ❑ **Training** to Federal, State, local and private groups on the development and application of LID technologies and related technical areas
- ❑ **Technical assistance** and guidance to state and local agencies interested in developing standards and guidance manuals
- ❑ **Development of strategies** for effective use of infrastructure and rehabilitation of urban and rural watersheds
- ❑ **Planning, Analysis and Design** of solutions to CSO, SSO, NPDES and TMDL program requirements including monitoring and watershed assessment.
- ❑ **Civil Site Design** services to developers and consulting firms interested in applying LID technology to their development site.

.PBSJ.com)

LOW-IMPACT DEVELOPMENT CENTER

Balancing growth with environmental protection

CENTER MATERIAL NOW AVAILABLE:

LOW IMPACT DEVELOPMENT DESIGN MANUAL (November, 1997)

This manual was prepared for the Prince George's County, MD, Department of Environmental Resources. Members of the Center served as key personnel in the development of this document which involved a very broad and significant effort including input from Federal and state agencies as well as a countywide interagency and interdisciplinary task force. The manual provides guidance on the following topics:

- ✓ **LID Hydrologic Analysis**
- ✓ **LID Site Planning**
- ✓ **LID Site BMP's**
- ✓ **LID Model Permit Processing**
- **Residential and Commercial Case Studies**
- ✓ **LID Model Public Outreach Program**

DESIGN MANUAL FOR USE OF BIORETENTION IN STORMWATER MANAGEMENT (June 1993)

This manual was prepared for the Prince George's County, MD, Department of Environmental Resources. Members of the Center served as key personnel in the development of this manual which provides guidance on the following areas:

- ✓ **The Bioretention Concept**
- ✓ **Grading Plan**
- ✓ **Planting Plan**
- ✓ **Soil, Mulch and Plant Materials Guidelines**
- ✓ **Maintenance Guidelines**
- ✓ **Peak Runoff Control and Pollutant Reduction**

For More Information: **The Low-Impact Development Center**
5010 Sunnyside Ave. • Suite 200 • Beltsville, Maryland 20705
Phone: (301) 982-5559 • Fax: (301) 982 1994 • www.lowimpactdevelopment.org

This brochure developed and produced for the Low Impact Development Center by PBSJ *(visit our website at.http:llwww*

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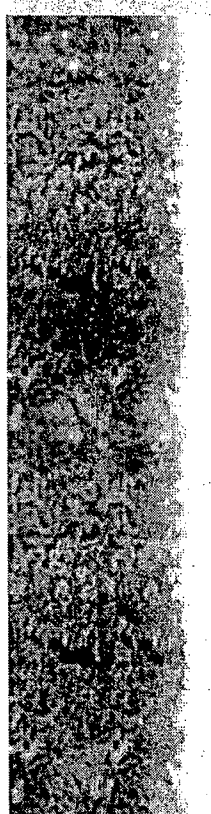


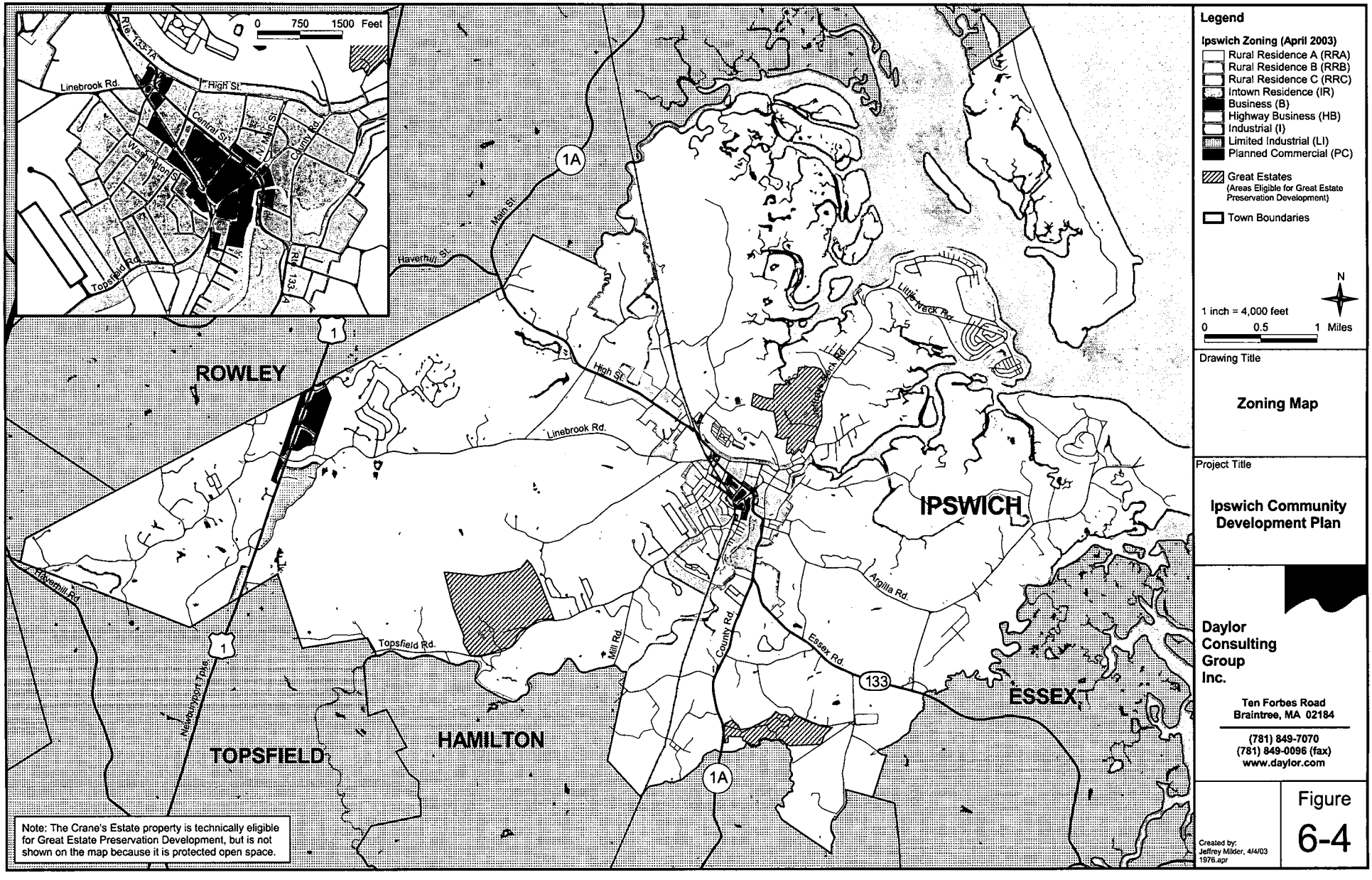
What is Low Impact Development? Low Impact Development is a new low cost effective alternative stormwater control technology. It combines resource conservation, a hydrologically functional site design with pollution prevention measures to reduce development impacts to better replicate natural watershed hydrology and water quality. Through a variety of small-scale site design techniques, Low-Impact Development controls runoff discharge, volume, frequency and quality to mimic predevelopment runoff conditions. This unique micro-management source control concept is quite different from conventional end of pipe treatment or conservation techniques.

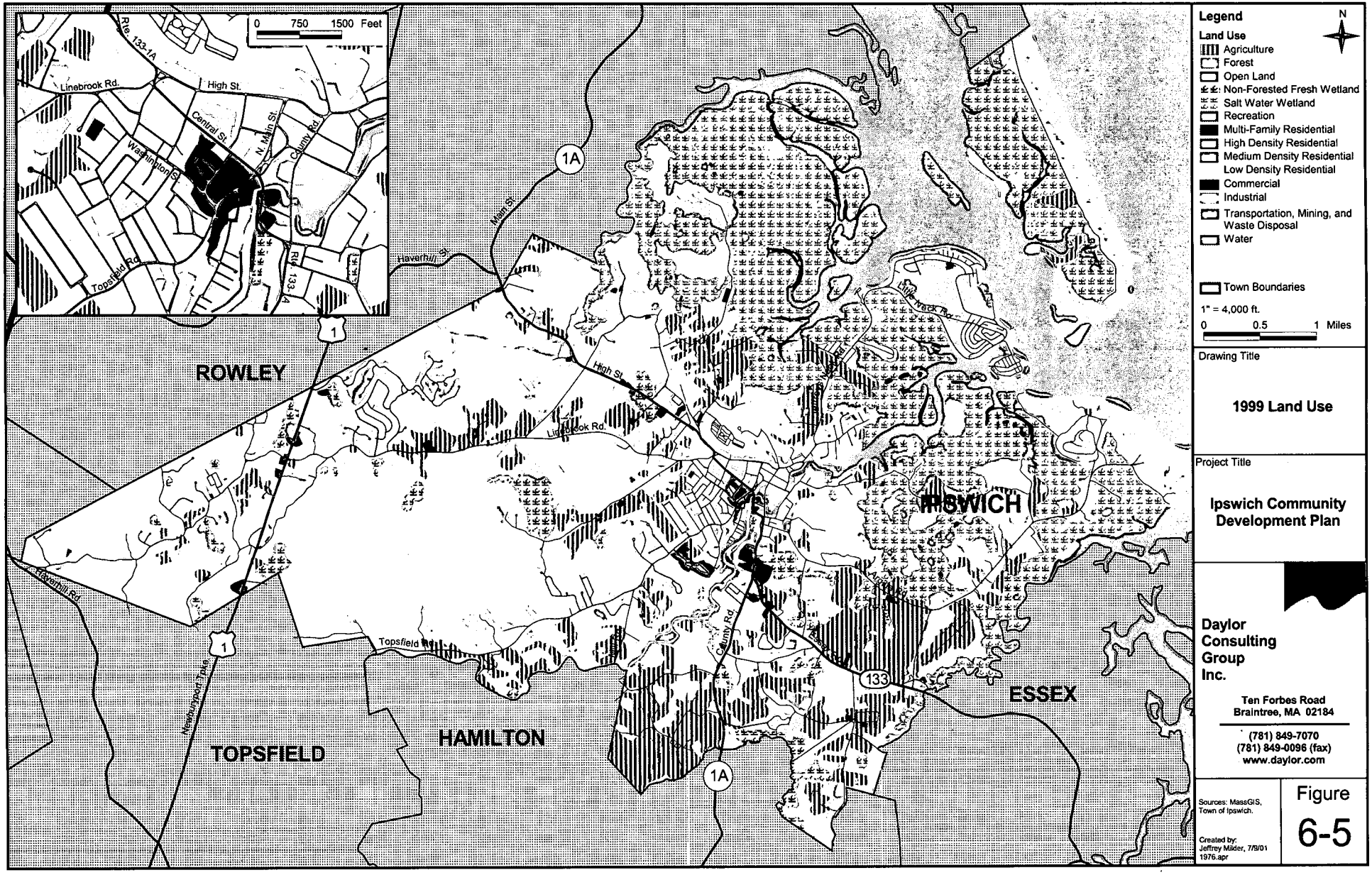
The **Low-Impact Development Center** is a non-profit organization formed in 1998 to serve as a technical clearinghouse for information and issues related to Low Impact Development (LID), and to facilitate research, education, and strategies for the implementation of LID technology. This technology is based on site specific approaches to maintain watershed viability by maintaining each site's hydrologic regime. The Center's mission includes research, development of models, stormwater management regulations and ordinances, ecosystem monitoring plans, and development of public outreach and environmental protection strategies. This is done with an interdisciplinary approach that includes researchers, public officials, citizen groups, and practitioners so that practical solutions can be achieved.

Members of the Center have been instrumental in the development of LID technology in the Mid- Atlantic Region (Prince George's County, MD, LID Design Manual) and are currently working on the development of the National Manual for LID technology which is being prepared for the US Environmental Protection Agency. Other current and future activities include the development of manuals for other regions of the Country and international applications, monitoring of LID case studies, and application of LID technologies to solving CSO and SSO problems.

APPENDIX B
Additional maps of Ipswich, Massachusetts

I. Map: Zoning Map of Ipswich, MA
II. Map: Land Use Map of Ipswich, MA


0 750 1500 Feet
Rte. 133/1A
Linebrook Rd.
High St.
Central St.
N. Main St.
Washington St.
Columbia Rd.
Topsfield Rd.
Rte. 133
Haverhill St.
Main St.
1A
1
ROWLEY
High St.
Linebrook Rd.
Little Neck Rd.
Little Neck Rd.
IPSWICH
Argilla Rd.
Haverhill Rd.
Topsfield Rd.
Mill Rd.
County Rd.
Essex Rd.
133
ESSEX
Newburyport Tpke.
TOPSFIELD
HAMILTON
1A
Note: The Crane's Estate property is technically eligible for Great Estate Preservation Development, but is not shown on the map because it is protected open space.
Legend
Ipswich Zoning (April 2003)
Rural Residence A (RRA)
Rural Residence B (RRB)
Rural Residence C (RRC)
Intown Residence (IR)
Business (B)
Highway Business (HB)
Industrial (I)
Limited Industrial (LI)
Planned Commercial (PC)
Great Estates
(Areas Eligible for Great Estate Preservation Development)
Town Boundaries
N
1 inch = 4,000 feet
0 0.5 1 Miles
Drawing Title
Zoning Map
Project Title
Ipswich Community Development Plan
Daylor Consulting Group Inc.
Ten Forbes Road
Braintree, MA 02184
(781) 849-7070
(781) 849-0096 (fax)
www.daylor.com
Created by:
Jeffrey Milder, 4/4/03
1976.apr
Figure
6-4


0 750 1500 Feet
Rte. 133-1A
Linebrook Rd.
High St.
Central St.
Washington St.
N. Main St.
County Rd.
Topsfield Rd.
Rte. 133-A
ROWLEY
1A
Main St.
Haverhill St.
1
High St.
Linebrook Rd.
Little Neck Rd.
IPSWICH
Haverhill Rd.
Topsfield Rd.
County Rd.
133
ESSEX
Newburyport Turnpike
TOPSFIELD
HAMILTON
1A
Legend
N
Land Use
Agriculture
Forest
Open Land
Non-Forested Fresh Wetland
Salt Water Wetland
Recreation
Multi-Family Residential
High Density Residential
Medium Density Residential
Low Density Residential
Commercial
Industrial
Transportation, Mining, and Waste Disposal
Water
Town Boundaries
1" = 4,000 ft.
0 0.5 1 Miles
Drawing Title
1999 Land Use
Project Title
Ipswich Community Development Plan
Daylor Consulting Group Inc.
Ten Forbes Road
Braintree, MA 02184
(781) 849-7070
(781) 849-0096 (fax)
www.daylor.com
Sources: MassGIS, Town of Ipswich.
Created by: Jeffrey Milder, 7/9/01
1976.apr
Figure
6-5

APPENDIX C
Resources

I. Town of Brookline, Massachusetts; Building Department Referral Stormwater Management and/or Land Disturbing Activities

II. Helpful websites

Rec'd 3/10/04

TOWN of BROOKLINE

Massachusetts

Brookline - FAST
Refer Planning

BUILDING DEPARTMENT REFERRAL TO DPW
STORM WATER MANAGEMENT AND/OR LAND DISTURBING ACTIVITIES
{Article 8.25 of By-Laws of Town of Brookline}

Address of Project: _____ Referral Date: _____

Applicant (Print Clearly): _____
(Contact Person for Information and Questions)

Address: _____

Telephone Numbers(Office): _____ Cell phone Number: _____
Fax: _____ Email: _____

Description of Proposed Project:

_____

_____

(For example: new house, addition, tennis court, garage, retaining walls, patios, driveway, swimming pool, filling in land, cutting grades, or change in grades, etc)

Name Address and Phone Number of Civil Engineer, Land Surveyor or Landscape Architect: _____

Date of Drawings: _____
Drawings must be submitted with complete proposal and scope of work.

Additional drawings and information may be necessary to document your proposal.

Referred By: _____ (Building Inspectors Name)

Received by Building Department	Approved by DPW - Engineering Division

THIS IS NOT A BUILDING PERMIT APPLICATION.

Appendix C.II.

Helpful Websites

For general stormwater information:
The Center for Watershed Protection: http://www.cwp.org
The Environmental Protection Agency: http://www.epa.gov
Massachusetts Department of Environmental Protection: http://www.mass.gov/dep

For more information on model stormwater bylaws:
Cape Cod Groundwater Guardian Team: http://www.capecodgroundwater.org/bylaws.htm

For the electronic version of "Erosion and Sedimentation Control Guidelines: a guide for planners, designers, and municipal officials:"
Massachusetts DEP: http://mass.gov/dep/brp/stormwtr/stormpub.htm

For more about the Ipswich River:
Ipswich River Watershed Association: http://www.ipswichriver.org/
Watershed management plan: http://www.horsleywitten.com/ipswich.html

For more information on Low Impact Development Techniques:
EPA: http://www.epa.gov/owow/nps/lid/
Urban Design Tools: http://www.lid-stormwater.net/intro/sitemap.htm

APPENDIX D
Required Documents

I. Memorandum of Understanding
II. IRB Exemption Form

MEMORANDUM OF UNDERSTANDING BETWEEN THE STUDENT GROUP FROM THE DEPARTMENT OF URBAN AND ENVIRONMENTAL POLICY AND PLANNING PROGRAM AT TUFTS UNIVERSITY AND THE TOWN OF IPSWICH PLANNING AND DEVELOPMENT DEPARTMENT.

This document describes the scope of work, products (deliverables), timeline, and work processes agreed to by the parties for the satisfactory completion of the project.

Client

Glenn Gibbs, Planning Director for the Town of Ipswich
Town Hall Building
25 Green Street
Ipswich, MA 01938
[redacted]

Project Goal
To develop a regulatory mechanism to address unregulated storm water sources, without significantly increasing the workload of municipal officials or placing an undue burden on applicants. Unregulated storm water sources refer to sources that do not fall under any existing local regulations or regulatory authority, such as single-home development, connection to existing storm drain systems, and road resurfacing.

Methods
The Tufts Team will research other municipal initiatives aimed at addressing the identified problem, in order to determine the best option. Most research will be done online and by interviewing and soliciting information from municipal officials from various towns. The team will meet with the Public Works Director, Conservation Agent, Town Planner, and others to develop a full understanding of the issues.

Products/Deliverables
The Tufts Team will produce a well-researched and organized report that includes several options and an explanation of the proposed approach and why it was chosen. The Team will also draft a bylaw concerning the issue. As well, the Team will present their findings to relevant Town officials and board and commission members.

Timeline

Task	Target Completion Date
Initial meeting with client	February 12, 2004
Memorandum of Understanding completed	February 12, 2004
Research Mass. and Ipswich regulations and existing unregulated storm water bylaws	February
Summarize results. Provide initial recommendations to client for comment. Include outline for bylaw.	March 3, 2004 – noon mtg w/ Ipswich
Client provides written interim evaluation report of the team's progress	March 8, 2004
Spring Break	Week of March 21, 2004
Present report and recommendations to town officials in Ipswich	April 16, 2004
Final revisions to all products	April
Deliver final report to client	April 28, 2004

Work Processes and Communication
The Tufts Team will report exclusively to Glenn Gibbs and contact with town boards, committees, etc. will be through Mr. Gibbs or Ms. Day.

This Memorandum of Understanding can be revised and renegotiated with the agreement of all members of the Tufts Team and the Client.

Consideration and Expenses
Each team member expects to spend approximately ten hours per week on this project. No payment is expected from the Town of Ipswich.

Tufts Ipswich Team Members
Andrea Bowman [redacted]
Dara Olmsted
Sarah Smith
Kelley Whitmore

Glenn O'Neil 2/12/04
Client Signature Date

Dara Olmsted 2/12/04
Tufts Team Representative Signature Date

2/18/04
TUFTS FACULTY REPRESENTATIVE

Date: Mon, 05 Apr 2004 08:47:13 -0400

From: "Ted Liszczak" <theodore.liszczak@tufts.edu> Add to Address Book

To: "Kelley Whitmore" <kelley_whitmore@yahoo.com>

Subject: Your IRB Protocol

Kelley,
Thank you for you IRB forms. Your project "Potential solutions for the Town of Ipswich for storm water pollution created by disturbances of land under one acre" is exempt from IRB review. It falls under category (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected
or appointed public officials or candidates for public office; or (ii) Federal statute(s) require(s) without exception that the confidentiality
of the personally identifiable information will be maintained throughout
the research and thereafter. If I may be of any further assistance, please contact me.
Sincerely,

--
Theodore M. Liszczak
Associate Director, Grants & Contracts Admin.
Office of the Associate Provost for Research
Ballou Hall, Room 107, Medford, MA. 02155
Phone: 617-627-5187, Fax: 617-627-3673

BIOGRAPHIES OF THE AUTHORS

Andrea Bowman is a first-year Master's degree candidate in the joint Urban and Environmental Policy and Planning and Civil Engineering programs at Tufts University. She received a B.S. from the University of Maine in Natural Resources. Her primary focus is soil and waste management.

Dara Olmsted is a first-year Master's degree candidate in Urban and Environmental Policy and Planning at Tufts University. She received her B.A. from Harvard University in Social Anthropology. She is interested in water resources and sustainable development.

Sarah Smith is a first-year Master's degree candidate in Urban and Environmental Policy and Planning at Tufts University. She received her B.A. from Hamilton College in French. Her main focus is marine environmental policy.

Kelley Whitmore is a first-year Master's candidate student in Urban and Environmental Policy and Planning at Tufts University. She received her B.A. from the University of South Carolina in Public Relations. She is concentrating on sustainable development.