Progress Report

Tri-Community Working Group

August 2005

Table of Contents

List of Appendices

Glossary of Terms

ABBS – Alewife Brook Branch Sewer

Acre-Foot – the volume of water that is one foot deep and covers one acre of land

CFS – cubic feet per second of flow

CSO – combined sewer overflow

DCR – Department of Conservation and Recreation, formerly the Metropolitan District Commission

DEM – Department of Environmental Management, currently part of the Department of Conservation and Recreation

I/I – Infiltration and Inflow

MDC – Metropolitan District Commission, currently part of the Department of Conservation and Recreation

MEPA – Massachusetts Environmental Policy Act

MGD – million gallons per day

MWRA – Massachusetts Water Resource Authority

NGVD – National Geodetic Vertical Datum

Executive Summary

This progress report provides a summary of the information presented to and gathered by the tri-community working group for the purpose of understanding the flooding issues attributed to the Alewife Brook and the municipal sewer systems of Arlington, Belmont, and Cambridge. The working group is comprised of municipal employees of Arlington, Belmont, and Cambridge as well as concerned residents (Appendix B).

For two years the working group has facilitated the dialogue between residents impacted by flooding and municipal engineers and planners dedicated to solving the adverse impacts. The main areas of discussion included surface flooding, sewage overflows, public policy, and personal responsibility. Each section of this report summarizes the information as discussed and provides a series of proposed next steps.

Surface Flooding

The discussion of surface flooding included local and regional watershed characterization, local hydraulics of the Alewife Brook, and open discussions of recent flood events. The working group agreed that next steps should include collecting accurate hydrological data, exploring stormwater storage alternatives including but not limited to low-impact development alternatives, and a general need for maintenance of the existing municipal sewer systems.

Sewage Overflows

The discussion of sewage overflows included the relationship between the municipal sewer systems and the Massachusetts Water Resource Authority collection system, the causes of sewer overflows, and current engineering efforts. The working group agreed that next steps should include the evaluation of sewer systems upgrades including but not limited to increasing the pumping capacity of the interceptor system and a general need to work regionally.

Public Policy and Personal Responsibility

The discussion of public policy and personal responsibility included homeowner advice on flood prevention and backflow prevention and community responsibilities. The working group agreed that next steps should include educating the public on stormwater issues and preventative actions and the general need to work regionally.

Section 1: Background

Evolution of the Tri-Community Working Group

In early 2002, The Mystic River Watershed Association, the Department of Environmental Protection and officials from Arlington, Belmont and Cambridge began meeting together to consider collaborative approaches to Alewife sub-watershed issues. As the dialogue advanced, the group began to focus particularly on the issue of flooding. By the fall of 2002 an informal working group convened to openly discuss flooding issues. The group was formed out of a shared concern for the serious impact that surface flooding and sewage backflows have in Arlington, Belmont and Cambridge. The group also recognized that both citizen activists and officials would play an important part in the political resolution of major flooding issues. Accordingly, the group's conversations have been open to all interested persons. Our goal has been to make as many people as possible that are active on Alewife issues aware of our conversations. A summary of the Mathematics of Flooding and a list of those who received our regular mailing are provided in Appendices A and B respectively.

Goal of the Tri-Community Working Group

The primary goal of the tri-community working group was to develop a consensus among actively concerned parties as to:

- What we know about the causes of surface flooding;
- What we know about the causes of sewage backflow;
- What we do not know about these issues;
- What actions should be taken based on what we do and do not know; and
- What are the priorities for further investigation.

The term surface flooding describes stormwater overflowing out of the banks of the Alewife Brook and into surrounding neighborhoods; and the term sewage backflow describes sewage rising out of plumbing fixtures and flooding basements in homes. The discussion also included the relationship between the two problems.

The discussions were focused on the areas prone to flooding within the Alewife Brook sub-watershed: East Arlington, North Cambridge, and the Winn Brook area in Belmont.

Progression of the Tri-Community Working Group

Based on the conversations we had in the Fall and Winter of 2002, we determined that a public symposium, assembling the expertise of state and federal agencies would be helpful. The following agencies participated: Federal Emergency Management Agency, the Department of Conservation and Recreation (formerly Metropolitan District Commission) and the Massachusetts Water Resources Authority. Our meetings in early 2003 were focused on planning for that symposium, which was held on April 22, 2003.

The symposium answered many questions and raised more. It served to underline both the urgency of the flooding problem and the extent of public confusion about basic factual issues. We worked through the summer of 2003 in group meetings with the presenting agencies to sort through complexities and apparent conflicts in the information available. Through the fall, we met without additional presenters to work towards an objective synthesis of "what we know and what we don't know" and to make appropriate priorities for further investigation. This report summarizes the information. Appendix C provides a list of the presenters.

In addition to the larger group meetings, town engineers conducted several off-line meetings to compare notes and develop materials that were then discussed with the larger group. An engineering working group comprised of Arlington, Belmont, and Cambridge met and continue to meet to share information and techniques.

To date, the tri-community working group meetings have not been formal, and no votes have been taken. Definition of voting authority seemed unnecessary given that the fundamental goal of the group was to develop a consensus. However, one product of the group's efforts has been the pending creation of a Tri-community Environmental Joint Powers Entity. The three communities hope that this agreement will serve as a useful vehicle when funding becomes necessary to further the goals of the group. Prior to instituting the joint powers agreement, the Executive Office of Environmental Affairs must approve the draft and a public meeting must be held.

Section 2: Surface Flooding

Surface flooding describes overflowing stormwater, and can be a serious safety issue during large storm events. Safety concerns are exacerbated by the potential presence of sewage and groundwater toxins.

Introduction

During the course of the working group's meetings, we heard from residents and groups whose property and quality of life have been impacted by serious flooding events. Residents of Arlington, Belmont and Cambridge chronicled the long and difficult history of flooding. The residents wanted to know the causes of flooding. In addition, residents voiced concerns regarding the presence of sewage in the floodwaters; residents wanted more information on the impacts these large flood events have on public health and how to prevent those impacts.

In order to address the questions raised by the community, the working group investigated the functionality of the Alewife Brook sub-watershed and the relationship between the Alewife Brook, the MWRA interceptor sewers, and the municipal sewer systems. This section provides a summary of those findings.

Reasons for Arterial Flooding in the Alewife

Surface flooding in the Alewife Brook sub-watershed is caused when the demand for stormwater conveyance exceeds the capacity of the system. In general terms, the Alewife is like a bathtub with a slow drain. During extreme storm events, stormwater enters the tub faster than it can drain and causes the tub to overflow. The proclivity to flood can be explained by analyzing a variety of local and regional parameters that characterize the Alewife Brook, the Alewife Basin and the Mystic River Watershed. These parameters include but are not limited to geographic size, topography, soil characteristics, urbanization (extent of development), capacity of conveyance channels, and constrictions.

Watershed Characterization

The Alewife Brook sub-watershed includes approximately 8 square miles of land in Belmont, Arlington, Cambridge and Somerville; and constitutes approximately 10% of the greater Mystic River watershed. The shape of the sub-watershed is essentially that of a bowl. The steeper sloped areas of the system characterize the western, eastern and southern fringes, and the central area is predominantly flat. The system has very little topographic relief; the primary relief point is the Alewife Brook.

In addition to topography, the principal natural hydrologic features of the watershed include various ponds: Spy Pond, Little Pond, Blair Pond, and Clay Pit Pond. At one time Fresh Pond in Cambridge was hydrologically connected to the system, but it is now divorced from the watershed and is used principally as a water supply reservoir for the City of Cambridge. Spy Pond in Arlington covers an area in excess of 100 acres and flows toward Little Pond in a culvert. Little Pond in Belmont is at the upstream end of the Little River and is 18 acres in extent. Clay Pit Pond in Belmont flows toward Blair Pond in Cambridge via Wellington Brook, which is partially in a culvert. Blair Pond is connected to Little Pond/Little River by the continuation of Wellington Brook.

Urbanization of the sub-watershed communities has fundamentally changed the natural hydrologic characteristics of the area. Natural detention and storage of stormwater has been largely eliminated and replaced by impervious surfaces with constructed drainage systems. It is important to note that the Alewife Brook area has always experienced flooding, even prior to the development of the contributing municipalities. Subsurface investigations have revealed a relatively shallow layer of clay around the Brook. This clay layer presents an impenetrable barrier for infiltration and also causes the ground water table to be high.

It should also be noted that the extent of development has increased the demand on the constructed drainage system. Movement of peak stormwater discharges through the system is limited by the conveyance rate and capacity of the trunk line pipes. As a result of flat topography and limited conveyance capacity, ponding and flooding problems occur throughout the municipal system. These areas may not have experienced flooding in the earlier history of this watershed. In summary, the natural flashiness of the system is exacerbated by the extent to which the area has been urbanized over the past century. This has resulted in fundamentally altering the natural runoff characteristics of the system. Thus, during large storm events, more significant flooding is experienced along the Brook itself, as well as upstream of those areas where the constructed drainage systems are inadequate to provide conveyance for the peak discharges.

Alewife Brook Hydraulics

At the base of our bowl shaped sub-watershed is the Alewife Brook. The Alewife Brook system extends from Little Pond to the confluence with the Mystic River. The Brook is approximately 2 1/3 miles long and drops only 3 feet in bed elevation along its length. In other words the average slope of the channel is approximately 1:4,000. The steepest section is between the Alewife MBTA Station and the Mystic River.

In addition to the urbanized nature of the catchment and the flatness of the channel, the capacity of the Alewife Brook system is further impacted by a loss in its cross sectional area due to silt deposition. Survey work conducted by the City of Cambridge in 2000 showed that almost 1 foot of sediment has accumulated in the channel between the MBTA Station and the Massachusetts Avenue Bridge when compared with a 1981 survey prepared by Camp Dresser and McKee (CDM) for the Metropolitan District Commission (MDC), now called the Department of Conservation and Recreation (DCR). This sedimentation problem is noticeably evident in Blair Pond as well.

Characterizing the conveyance limitations of the Alewife Brook would not be complete without exploring the potential constrictions posed by the numerous bridges and channel crossings. The narrowest and most restrictive bridges are the Route 2 bridge, the Massachusetts Avenue bridge and the Broadway bridge. Another restriction in the system is the railroad and MWRA interceptor crossing of the Wellington Brook downstream of Blair Pond.

When bridges are being designed today, they are designed to allow unobstructed conveyance of the 100-year storm event. In the case of the Alewife Brook, the current 100-year flood elevation is estimated to be 8.2 feet NGVD. The height of the Route 2 and the Massachusetts Avenue bridges are 5.68 NGVD and 7.53 NGVD respectively. These bridges were designed prior to the establishment of this design standard and therefore represent constrictions below the presently established design standards.

The MDC commissioned CDM to undertake a study of the Mystic River Hydrology and Hydraulics, which included the Alewife Brook in 1981. The consultants concluded that there would be only a 0.4-foot headloss between the upstream side of the Massachusetts Avenue Bridge and the downstream side of the Broadway Bridge during a 50-year storm event. CDM further concluded that there may be occasions when the widening of these bridges would exacerbate flooding upstream of the bridges, given the magnitude of the stormwater backflow contributed by the Mystic River.

The railroad and MWRA interceptor crossing of the Wellington Brook is a significant restrictor to large flows from Blanchard Road and the Clay Pit systems in Belmont. There is evidence that this restriction causes blockages and back ups of the Wellington Brook system as it flows to the Little River. The result is serious flooding in the Hittinger Street area of Belmont and areas adjacent to Blanchard Road in Cambridge. In addition, debris accumulation, such as that which was recently removed at the Craddock Locks by the MDC, can contribute to back ups in the river system.

The flooding experienced by people living near the Brook will vary depending on the duration and intensity of the particular rainfall event. Alewife Brook is a flashy catchment, and responds quickly to intense rainfall events. Therefore, during intense short duration events, the flooding experienced along Alewife Brook is typically a result of inadequate conveyance capacity in the Brook. The Mystic River is a system that exhibits a slower response. During a longer duration event, the Alewife Brook is further impacted by the tailwater of the Mystic River.

Direct abutters to the Brook, residents of the Sunnyside neighborhood and near Lafayette Street and Boulevard Road in East Arlington, experience frequent flooding. Existing drainpipes behind the East Arlington Sunnyside neighborhood appear to exacerbate the flooding problems. The backflow of water through the pipes creates a pond that forms at the low point on the downstream end of Sunnyside's back alley, prohibiting access and use of the alley (an easement of private property) and all the rear private parking spaces and rear entries to houses. The edge of the bank acts as a berm between this pond and Brook and is the only visible land at times, before the entire bank overflows. Back flow preventors on each pipe outlet may stop the backflow of water and the excessive ponding.

It is important to note that the Amelia Earhart Dam is believed to have adequate pumping capacity. The Dam, constructed in 1981, is capable of pumping 4,200 cubic feet per second with three pumps working together, operated as recommended by CDM's 1981 Comprehensive Flood Study, the dam is capable of reducing 50-year flood event flood levels by almost one foot in Alewife Brook.

Recent Flooding History

There exist a variety of different flood measurements from a variety of different sources concerning the magnitude of the recent events along the Little River and Alewife Brook. Those interested have had to rely on hearsay, video evidence, debris surveys and photographs taken at various stages during the events, rather than that information typically used by hydrologists, scientists and engineers when studying storm and flood events. Typically, hydrologists use spatially and temporarily varied rainfall information together with stage (elevation), and stage – discharge relationship information to develop a profile of a river system. That profile provides information relating to rainfall – runoff relationships, the flashiness of a river, and the statistical distribution that best describes flood frequency. This information is needed to inform risk analysis when considering development and system changes within the watershed.

There have been three major flood events since the mid 1990s: the October 1996 storm, the June 1998 storm, and the March 2001 storm. The three events were distinctly different from a rainfall intensity/distribution perspective. The October 20-21st 1996 event was a long duration event of medium intensity. During the initial stages of that storm as measured at Logan Airport, the average intensity was approximately 0.4 in/hr. After 7 hours, this reduced to approximately 0.2 in/hr for a further 19 hours, amounting to approximately 8 inches of rainfall over a two-day period. The June 13th 1998 storm followed a particularly wet late spring. A total of almost 7 inches fell over two days, the majority of that falling over the late morning and afternoon hours of Saturday June 13th. The March 21-22nd storm of 2001 occurred when over 3 inches of rain fell when a saturated snow covered watershed with the consequence of creating a significantly higher volume and rate of runoff than typical. Unfortunately, the primary source of rainfall information heretofore has been Logan Airport in Boston. However, stations at Cambridge Public Works, Somerville Public Works and Cambridge Water Department, thus providing more spatially diverse sources of information, now supplement that station. Beyond these sources, satellite tracking can further supplement and, with appropriate goodness-of-fit techniques, more accurately depict rainfall as it moves through the area.

There has been considerable controversy and disagreement among the various interested parties concerning flood elevations associated with these storm events along the Alewife Brook. The US Army Corps conducted field debris surveys after the October 1996 storm. The Corps itself expressed concern about the accuracy of this information. The Alewife Neighbors Inc. engaged Bruce Jacobs to investigate flooding after the events of 1996 and 1998. He referenced and also questioned the US Army Corps survey of the 1996 flood. The MDC engaged CDM to update and reexamine flooding along the Alewife Brook in 2002. The City of Cambridge, as part of its sewer separation and stormwater management efforts, has spent considerable energies since 1998 measuring and examining the rainfall and runoff within and along the watershed. This investigation included measuring and examining the rainfall and runoff within and along the watershed based on metered data as gauged from gauging stations upstream of the T station footbridge on the Little River (since 2001) and upstream of the Massachusetts Avenue bridge on the Alewife Brook (since 1998). In addition, Steve Kaiser independently monitored these storms, and his estimates provide further information concerning the relative magnitudes of historic flood events along the river, more details are provided in Appendices D, E, and F.

At the end of October/November 1996 the Army Corps reconnaissance teams recorded debris levels along the Alewife Brook. Only three marks were recorded in their subsequent report to FEMA. They indicated a discrepancy between the upstream and downstream elevations when compared with an expected return period perspective. The elevations and discharge estimates were 8.86 and 8.97 NGVD within the Arthur D Little Complex with an estimated discharge of 575 cfs, while the downstream debris elevation recorded at Bicentennial Park in Arlington immediately adjacent to Massachusetts Avenue Bridge was 5.65 NGVD, and this elevation was consistent with a flow of approximately 300 cfs.

Steve Kaiser using contour maps and his own records of the event of October/November 1996 states that the water level within Arthur D Little property was approximately elevation 7.0 feet NGVD for this 50-year storm event. The MDC report prepared by CDM generated river elevations using the SWMM hydraulic model also predicted elevation at 7.0 feet NGVD.

For the 1998 event, Steve Kaiser indicated that his estimation of the peak elevation was 6.3feet NGVD at Massachusetts Avenue and 6.5feet NGVD upstream of Route 2. No other surveys were conducted during that storm. After this event, the City of Cambridge installed a gauge immediately upstream of the Massachusetts Avenue Bridge so as to further monitor the river during large storm events. During survey work conducted in association with the City of Cambridge CAM004 sewer separation project, two residents in the Lafayette Street area of Arlington pointed out their recollections of the maximum elevations of floodwaters during the 1998 storm event. These elevations were computed as 7.2-feet and 7.6-feet NGVD. Concern was voiced as to the accuracy of that survey and of the reference USGS datum used. This was subsequently checked as a first order USGS datum point and furthermore another survey by a professional surveyor, employed by the City of Cambridge, validated this datum when closed with a survey to an adjacent datum point.

Finally, in March 2001, the City gauge recorded a stage elevation of 5.28 feet NGVD upstream of the Mass Avenue Bridge, while Steve Kaiser recorded an elevation of 6.2 feet at the same location, with a corresponding Route 2 flood elevation of 6.4 feet NGVD. The MDC SWMM model in this instance computed elevations of 3.58 feet NGVD and 4.78 feet NGVD at Mass Ave and Route 2 respectively.

The City of Cambridge has since installed another meter at the Pedestrian Bridge upstream of Route 2 so as to better establish elevations at this location and better understand the hydraulics within these reaches of the river.

Next Steps

Hydrological Data: Metering and Gauging Information

Members of the working group have been vocal about the lack of useful data relating to historical storms along the Little River/Alewife Brook. There is no continuous water elevation monitoring data except for that which the City of Cambridge has recently begun to gather. The Town of Belmont gathered stage information at Little Pond for a considerable period of time by manually measuring depth during large storm events. However, due to personnel constraints in recent years, collecting data has become increasingly more difficult. Similarly, there is very limited information on the local rainfall history in the Alewife watershed. People generally tend to depend on Logan Airport data, which might be very different from rainfall timing, intensity and extent at Alewife. At present, there is no central repository for hydrological data that relates to the Alewife Brook. Thus, estimates for large return period storms may not be completely reliable. Our statement that the 100-year flood event stage elevation in Cambridge adjacent to the Alewife Brook is 8.2 feet NGVD, is based on ungauged catchment hydraulic analysis. Therefore, the standard error associated with the estimate is relatively large.

Some members of the tri-community working group also questioned the accuracy of the finding in the CDM report described above. These members are concerned that the headloss is likely to be greater due to the reduction in width of the Alewife channel at the Broadway Bridge (33 feet to 12.5 feet) and the Massachusetts Avenue Bridge (33 feet to 14 feet). Additional data is needed to develop a well-calibrated model to fully examine the impacts of these restrictions.

Any improvements that convey more water beyond the bridges may exacerbate flooding conditions downstream of the restrictions. Data needs include flow metering, brook level and rainfall information. In addition, given the significant impact of the Mystic River tailwater on the Alewife Brook during long duration storm events, any inlet restrictions removed by widening of the various bridges should be weighed against the dampening effect caused by the Mystic River and potential to move flooding to other locations. Particular attention should be given to the area surrounding the neighborhoods of East Arlington, where people have experienced hardship as a result of current flooding conditions.

To address the need for better data, the tri-community working group is proposing to support and seek funds to undertake a monitoring program to measure flow and elevations of the Alewife Brook. The objectives of the study would be to:

- Conduct an authoritative elevation survey
- Install water elevation gauges at key locations
- Provide visible markings to facilitate volunteer flood elevation observations
- Create a mixed municipal and volunteer operation to monitor flood measurements
- Create a publicly accessible repository of measurements to support analysis.

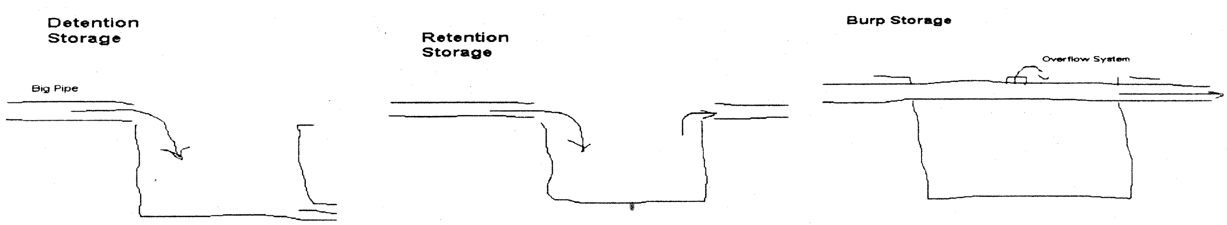
Storage Alternatives

Considerable time was spent within the tri-community working group, as well as, in separate meetings among engineers representing the three towns discussing alternative flood protection storage options along the Brook and within the broader Alewife catchment area. There are a variety of different ways to store water within a watershed, and the storage method employed depends on the reason for storing water in the first place. These methods are referred to as Detention, Burp and Retention storage.

Occasionally people store water for water conservation purposes, on other occasions water is stored so as to allow the most polluted first portion of runoff to be captured and allow the particulate matter to settle out, thus removing the majority of those first flush pollutants. In the case of the Alewife watershed our primary concern is to prevent flooding, and the storage objective is to store that portion of the storm that will cause the most flood damage; the peak discharge portion of the storm.

Some storage areas are more effective in preventing flooding than others, because of the type of storage provided as well as the size of the storage area. Simply creating more areas where water collects does not necessarily reduce flooding at the peak of a storm, if those areas are full of water before a storm begins or would fill with water before the peak of the storm. Detention and Burp storage are sensitive to the peak of the storm and thus have the greatest impact on flooding conditions during the critical point of the storm. Generally, the most efficient types of flood storage are referred to as detention and burp type storage systems because they are sensitive to the peal of the storm. Retention storage is storage that is filled during the initial phases of a storm, prior to the threat of flooding and of little benefit to address flooding.

Detention storage devices will allow water to continue to run through the device but with a smaller outlet capacity than inlet capacity. The difference in the flows is then captured/stored to hold the difference in inflow and outflow over a period of time. Burp storage is similar to detention storage but the storage system is off-line and will only be utilized when the conveyance capacity of the pipe system or open channel is surcharged or overtopped at which time the burp storage system will begin to fill and it will only allow water back into the system after the event has passed.



One proposal to provide storage is to lower Spy Pond and Clay Pit Pond in advance of a rainfall event, similar to the protocol used in lowering the level of the Mystic at the Dam prior to the onset of a predicted heavy rainfall. Both of these ponds would provide temporary storage, the effectiveness of which would depend on the extent to which the ponds were lowered prior to the onset of an event, the inflow into the system, and the degree to which the outflow was controlled. Considerable storage is potentially available in Spy Pond. Lowering the level of Spy Pond by one foot prior to a storm would generate approximately 32.5 million gallons of retention storage. Substantial storage quantities could also be achieved in Clay Pit Pond, which would assist in relieving flooding both upstream and downstream. Belmont High School, Hittinger Street and Blanchard Road areas would benefit most from lowering the elevation at Clay Pit Pond prior to a storm event. Considerable efforts would be required to determine the appropriate drawdown levels and outflows, as well as the recharge, water quality and ecological issues involved.

Interest was also articulated by some members of the tri-community working group concerning the provision of storage at the former MDC Skating Rink in Belmont, the ADL Parking Lot in Cambridge, and in other open or under-utilized spaces. Appendix G presents a preliminary list of potential storage locations in the Alewife area, prepared for the former MDC.

Of the options considered, lowering Spy Pond and Clay Pit Pond prior to a storm event appear to have the greatest potential for detention storage. Options involving storage at the former MDC Skating Rink, the ADL Parking Lot, and other underutilized spaces may possibly provide additional flood storage.

The tri-community working group proposes to seek funds to obtain better flow and pond measurements to evaluate and model the effectiveness of using Spy Pond and Clay Pit Pond for storage during large storms.

Low Impact Development Alternatives

In many locations throughout the Country and in many parts of Europe where water quality and quantity issues are of similar importance, communities have begun to embrace Low Impact Developments (LIDs). LIDs are alternative strategies of incorporating hydraulic, hydrologic and bio-technological strategies on a micro scale to address development and redevelopment impacts on water quality and runoff problems. These strategies require a more holistic approach to water and a commitment on the part of neighborhoods to connect with their watersheds and accept different streetscapes and landscapes, which are more sympathetic to the overall health of the watershed.

The techniques address temporary storage, sediment control, and regeneration of groundwater, and phytoremdiation. They can be incorporated in new and re development projects as well as in street, and drainage reconstruction and remediation projects. Techniques include swales, bio swales, rain gardens, green roofs etc., as well as a myriad of other methodologies for slowing water down, cleaning it and controlling it in natural ways so as to minimize harm to it and its harm to property and homes. LIDs are discussed further in Section 4.

Maintenance

It is imperative that the various agencies responsible for the maintenance of local and regional drainage systems implement comprehensive routine, capital and emergency maintenance programs. Municipal maintenance programs should at a minimum ensure that drainage systems are structurally sound and that conveyance capacities are not diminished by sediment, debris and obstructions. In addition, each municipality has the responsibility to ensure that municipal catch basins are cleaned frequently, that their major drainage arteries are frequently and systematically checked to ensure that no blockages or potential blockages exist, and that no inappropriate materials are being conveyed into the Brook or its tributaries. Each community should identify all potential blockage locations and have them checked frequently. Adequate resources need to be available to provide immediate relief in the event a blockage occurs.

Similarly, it is the responsibility of the Department of Conservation and Recreation to ensure that all of the various bridges, locks, dams and pumps are properly operated, maintained, and kept free from constrictions. Routine, structural, mechanical and maintenance inspections of all of the various structures and channel elements of the river should be conducted and recorded. Again, it is critical that appropriate emergency provisions are in place to be able to address and alleviate potentially serious flooding problems due to mechanical failures and obstruction of flows.

All of the communities in the Boston metropolitan area have problems with old stormwater and sanitary sewer infrastructure. Past expenditures to repair and replace pipes have generally not been sufficient to prevent deterioration of the sewer infrastructure. The federal stormwater regulations are requiring that all municipalities investigate and, where necessary, repair their sewers to reduce pollution of surface waters. These efforts should have positive effects on flooding and/or on the level of contamination in floodwaters. Some actions that are already being taken to address inadequate sewers are discussed in the next section.

Each community should consider a long-term capital maintenance program, to address existing problems and to maintain their systems over time. For example, over the long term, a municipality might plan to repair or replace 5 percent of its sewers each year, resulting in a complete repair/replacement of its system every 20 years. It is important that residents be aware of the need for substantial investments in sewer infrastructure, and supports these efforts in their budget decisions.

Other Flood Reduction Alternatives - Not Embraced

In considering the various possibilities to improve the situation for people living adjacent to the Little River/Alewife Brook some other typical flood protection alternatives that merit discussion, but were not embraced by the group include: construction of flood protection berms or levees, widening of the conveyance channel, and dredging the existing channel.

Berms

Berms and levees have a long history of use throughout the United States and Mainland Europe. The practice provides for the construction of levees and berms adjacent to properties of value thus protecting them from inundation during flood events. As a consequence of building the berms you allow more water to be conveyed through the open channel system. In the best-case scenario you protect low lying areas and make more use of downstream and upstream channels where there is additional underutilized capacity. Similarly, where areas of less value exist, you protect the high value areas with berms and allow more significant flooding in the adjacent low-lying areas within the watershed along the rivers. Unfortunately, in the case of the Alewife Brook, given the extent of development and the nature of the flood plain in the area, constructing a berm along the brook will cause flooding in some other area along the brook/watershed.

Initially, the MWRA and Cambridge in their sewer separation project for the CAM004 area proposed a berm in Arlington immediately upstream and to the west of Massachusetts Avenue. However, because of regulatory and hydraulic reasons this proposal was ultimately rejected. If the berm were constructed the Wetland Protection Act regulations would require the replacement of an equivalent amount of lost flood plain within the same hydraulic reach along the Alewife Brook as was lost due to the berm construction. Furthermore, construction of the berm could potentially increase the peak, rate of conveyance, bank erosion, and/or increase the extent of the flood as a result of a reduced cross sectional area available for conveyance.

Some working group participants that a berm could be constructed between the Sunnyside area in Arlington and the Alewife Brook have also expressed interest. In this situation it is believed that the compensatory storage necessary to meet the Wetlands Protection Act requirements could be found in the MDC playing fields at Dilboy Field.

Channel widening

Widening the river channel would allow more floodwater to be conveyed through the Alewife Brook. However, the existence of the various bridges along the Alewife Brook and the conditions of the downstream receiving waters need to be considered. Widening of the Alewife Brook channel would only be able to provide some temporary additional storage. Flow capacity would still be limited by the various bridge constrictions. If the bridge constriction issue were solved we would now be conveying a larger peak discharge to the Mystic River and thus potentially change flood elevations in that river.

Dredging

Dredging is also a tool used to enlarge and improve conveyance in river systems. However, in the instance of the Alewife Brook, dredging the channel would be of limited benefit because the Amelia Earhart Dam ultimately controls the system. Before the onset of a flood event any additional channel area provided by the dredging would already be occupied with water and thus not available for flood storage/attenuation.

Section 3: Sewage Overflows

Introduction

Interactions between the stormwater drainage system and the sanitary sewers contribute to contamination of Alewife Brook and other water bodies by sewage. This is a significant problem especially during floods, because residents may be exposed to the contaminated floodwaters. Section 4 of this report makes recommendations on how residents can protect themselves from contact with polluted floodwaters. This section discusses efforts to reduce contamination of the waters.

In general, there is adequate capacity to convey sewage in all of the sanitary sewers, but the amount of stormwater in the sanitary sewers combined with the sewage may exceed the system capacity, causing backups and overflows of contaminated stormwater into Alewife Brook. In addition, pipes that are in poor repair result in inflow and infiltration (I/I). Infiltration refers to groundwater seeping into sewer pipes, and inflow refers to stormwater runoff pouring into sewer pipes. Infiltration may occur during dry weather as well as during storms whereas inflow occurs primarily during storms. The nature of interactions between the stormwater and the sanitary sewer systems depends on whether there is a combined or a separate system. In a combined system, stormwater and sewage are transported in the same pipes. A separate system has separate sanitary and stormwater sewers, which are often located next to each other.

Arlington, Belmont and Cambridge contribute to the Massachusetts Water Resources Authority (MWRA) sewage collection system. Belmont and Arlington have separate sewer and stormwater systems, while Cambridge is one of five communities in the Metropolitan area that has a combined sewer system, contributing both sanitary waste and stormwater flows to the MWRA's interceptor pipe system. The MWRA large diameter interceptor trunk pipelines flow primarily by gravity in the Alewife area. The interceptors extend from the Belmont - Cambridge border north of Blair Pond and run parallel and along the southern bank of the Alewife Reservation to the MBTA station. There they connect with lines conveying flow in MWRA pipes that start at the Alewife Rotary (at the Ground Round in Cambridge). From the MBTA station the lines continue in a northerly direction along the Alewife Brook until they reach the confluence of the Alewife Brook with the Mystic River. Here the system connects with MWRA's 18" Lexington interceptor lines and flow is lifted through the MWRA Alewife pump station and is then conveyed by gravity in large gauge pipes adjacent to the Mystic River until it gets down into the greater Boston Harbor basin and eventually to the Deer Island treatment facility.

There are eight combined sewer overflow structures (CSOs) located in the City of Cambridge that provide relief to local combined sewers and the MWRA's interceptor systems during wet weather events. Six of these belong to Cambridge; one belongs to the MWRA, and one to the City of Somerville. CSOs discharge untreated sanitary waste mixed with stormwater into the Alewife Brook during larger or more intense rainfall events. Currently there are approximately 13 CSO events and approximately 22 million gallons of combined sewage discharged into the Brook during the average year as indicated by the MWRA system hydraulic model.

A goal of the tri-community working group is to assess the hydraulic connectivity between the river and the sewer pipe lines and to determine the causes for sewer surcharge conditions on streets and in basements in the Winn Brook area of Belmont, New Street and Bay State Road areas in Cambridge, and Boulevard Road and the Sunnyside areas in East Arlington, as well as, other low lying areas in the three communities. The analysis for the revised Long Term CSO Control Plan for Alewife Brook proposed by the MWRA was reviewed through the MEPA process. While not the focus of the tri-community working group, it is important to acknowledge the significance of combined sewage contamination in floodwaters resulting from Combined Sewer Overflows and the consequent potential impact on those who live within the floodplain.

Sewage Overflows on Streets and in Basements

During certain storm events, residents in low lying areas of Arlington, Belmont and Cambridge experience sewage rising up through plumbing fixtures in their basements, and in some locations sanitary manholes overflowing onto adjacent roadways. To understand this phenomenon, the tri-community working group explored the relationship between the various sewer systems and their hydraulic connectivity, most particularly when it rains. Detailed presentations were made to the group by the MWRA and the City of Cambridge. The MWRA presentation concentrated on the nature of the MWRA infrastructure in the area, level of service issues, and the degree to which the MWRA sees opportunities in the immediate future for improving service levels to the communities. The City of Cambridge presentation concentrated primarily on further evaluations of the Cambridge combined sewer system. The evolution focused particularly on those areas other than the Fresh Pond/Concord Avenue/Huron Avenue area (CAM004) that was already evaluated as part of the MEPA process for the MWRA's revised Facilities Plan. The City of Cambridge, working with the Charles River Watershed Association, also presented a hydraulic modeling analysis demonstrating the ineffectiveness of rain barrels on private property as combined sewer overflow (CSO) and flood control devices.

The following information was presented and discussed:

- Sewer surcharging occurs in the MWRA system during rain events as small as a 3-month storm. CSOs are required on the system to relieve the system so that it doesn't back up into people's basements.
- Many local sewer systems can't handle 1-year 6-hour storm conditions due to inflow.
- Where there's a separated system, the MWRA tries to provide an acceptable level of service for a 1-year 6-hour storm.
- Potential system capacity improvements being implemented or are under review by the MWRA include:
  - Removal of Tannery Brook from the MWRA interceptor (under review). This system carries CSOs from combined systems upstream in Somerville that would require sewer separation.
  - Cleaning of the system (completed)
  - Increasing the capacity of the MWRA pump station from 60 mgd to 75 mgd (under review) **Note:** 60 mgd is 5 times the average daily flow through the Alewife pump station.
- MWRA made a commitment to reevaluate their existing system to ensure they are working as efficiently as possible and will evaluate the potential to increase the Alewife Pump station capacity beyond 75-mgd and to provide further cleaning of the system to ensure the conveyance of the maximum possible discharge.
- MWRA will provide their new hydraulic model to individual communities to allow independent analysis of the relationship between the community and the MWRA system.
- Rain barrels have no meaningful flood reduction benefit or CSO reduction benefit, because they fill up early in a storm and cannot store additional water at the peak of the storm event.
- Sewer separation of the CAM002 (North Massachusetts Avenue) area would require retention storage to ensure that post-peak discharge conditions to the Alewife Brook does not exceed pre-peak discharge conditions.
- In addition to CSO structures providing relief to the interceptor and combined sewer systems, CSOs allow two way hydraulic communications between the interceptors, the municipal systems and the river. During significant events river water can be conveyed back into the sewer systems through the CSO regulators. As a result, sewer surcharge conditions may not necessarily be due to inadequate conveyance capacity, but rather it could be due to river system inundation of the local and regional sewer systems. This occurrence of river inundation of the sewer systems requires further review prior to taking measures to keep this from happening. The primary concern voiced here being the elimination of the additional conveyance capacity presently afforded runoff through the interceptor system and the consequent adverse impact on river elevations as a result of the elimination of this interceptor sewer capacity to the river.
- Elevation of the Belmont sewer pipes in the Winn brook area is very close to the elevation of the connection to the MWRA interceptor system. Therefore, these flat pipes have difficulty pushing flow through when the MWRA system is surcharged.

The tri-community working group agreed to work with the MWRA to further evaluate the relationship between the sewer and river systems as it impacts Belmont residents in the Winn Brook area and the other low lying properties in the three communities.

Questions remain as to the extent to which inflow and infiltration removal alone will resolve the surcharge situation in the community system. The MWRA Flood Forum presentation suggested that, during a rainfall event in the Spring of 2000, the flow increase in the sewer system in Belmont in the area adjacent to Winn Brook was in the order of 4 times dry weather flow. In reviewing the profile of the Alewife Brook interceptors during the one-year event simulation, it is noteworthy that in a number of locations the hydraulic grade line is within two feet of the ground surface. One possible relief mechanism that could be reviewed when other optimization options are being considered by the MWRA is the placement of a sanitary pump station along the MWRA Belmont lines. In order to make this attractive as an option, the inflow percentage should be aggressively reduced, thus reducing the size and expense and location obstacles associated with siting a pump station.

Better metering of sanitary systems is necessary in order to support analysis of proposals mentioned above, to identify local problems, and to identify potential benefits to opening CSOs sooner. Cambridge currently meters the flows in their sanitary systems. To help gather data, Cambridge installed two flow meters, one in Arlington and one in Belmont for 6 weeks. Results from these meters indicate that inflow and wet flows in the interceptor have an adverse impact on service levels. However, given the limited duration of the metering and the lack of significant storm events during the metering, it is impossible to reach firm conclusions from this effort. Arlington and Belmont would benefit from initiating a local metering program in their system. The metering data would allow both Arlington and Belmont to better query the MWRA model with specific input from their communities.

Current Efforts to Remove Inflow and Infiltration

To address existing Inflow/Infiltration problems in the sanitary systems, the town of Arlington has recently replaced 255 linear feet (lf) of 8" sanitary sewer, 100 LF of 15" stormwater drains, relined of 420 LF of 18" stormwater drains, cleaned 575 LF of 8" sanitary sewer, joint tested 192 units of 8" sewer, and sealed 153 units on streets in east Arlington.

The Town of Belmont has had a longstanding program of removing I/I. Their current contract includes construction of approximately 5,825 linear feet of new 10-inch, 12-inch and 15-inch PVC and RCP storm drains and appurtenant catch basin and drain manhole structures; installation of approximately 7,340 linear feet of 6-inch drain service laterals connecting to new or existing storm drains; replacement of up to 3,390 linear feet of 6-inch sanitary service laterals; disconnecting existing sump pumps from sanitary sewers and connecting to new drain service; capping existing open pipes; installing a sump and approximately 90 sump pumps in private homes and connect to new drain service; and appurtenant restoration work.

The City of Cambridge is predominately a combined sewer community. Cambridge is working with the MWRA to separate a portion of the combined sewer area in Alewife, which will eliminate a significant contribution of stormwater from the MWRA interceptor system. Sewer separation is proposed to begin in 2005 in the CAM004 and the CAM400 areas. In areas that are currently separated, Cambridge has eliminated 16 common manholes in the Alewife area that convey stormwater to the sanitary system when it rains. Another 3 common manholes are scheduled for separation during 2004 and another 21 are in the design phase. Cambridge is also involved in a multi-phased stormwater management project around the Fresh Pond golf course that involves cleaning and lining existing stormwater lines and the design of storage swales and other options to limit the extent of flooding.

Next Steps

The tri-community group should make a formal request to the MWRA regarding specific system optimization and evaluation measures, such as:

- Evaluate the impacts to the sewer systems, river elevations and system operations of installing flap gates on CSO structures to eliminate river inundation of the sewer system.
- Incorporate Alewife Brook elevations into sewer system modeling to better reflect river flow into the interceptor system.
- Evaluate increasing the Alewife Pump station capacity beyond 75 mgd
- Provide cleaning and inspection of the interceptor system on a regular basis to ensure conveyance of the maximum possible discharge.
- Evaluate the impacts from the proposed MWR003 modulating gate on the low lying areas in the Hittinger Street/Winn Brook area of Belmont to ensure protection of this area.
- Evaluate the placement of a sanitary pump station along the MWRA Belmont lines to reduce surcharging in low-lying areas in Belmont.
- Clarification as to the condition of the two siphons under the Wellington Brook and assurances that they are constructed in such a way so as not to unduly increase head loss.

- Report back to the communities on the status of MWRA's review to remove Tannery Brook from the MWRA interceptor.

The engineering departments of the tri-communities should continue to work together and share information, specifically:

- Each community should continue to reduce inflow and infiltration in their sanitary system and inspect and clean their systems to ensure conveyance of maximum possible discharge.
- The engineers should continue to meet on a semi-annual basis to discuss current efforts, system information and proposed future efforts within the watershed.
- Arlington and Belmont should develop a sanitary sewer-metering program and install meters within their communities.
- Maintain communications with MWRA as they proceed with their modeling efforts.
- Ensure that MWRA cleans and inspects their system on a regular basis.

Section 4: Public Policy and Personal Responsibility

Introduction

As previous chapters make clear, there are no simple or easy answers to the problems of flooding in the Alewife. A variety of players have to make both short-term and long-term changes in their actions to reduce the problems presented by flooding. Many of the actions involving engineering and floodplain management have been discussed in previous chapters. This chapter discusses what residents can do, both to protect them from flooding and to reduce their own contribution to flooding. The chapter also discusses actions communities can take to educate their residents about the problems and hazards associated with flooding. Finally, this chapter discusses actions communities as a whole can take to reduce flooding or to prevent increased flooding in the future, through their land use and development policies.

The following matrix lists the kinds of actions both homeowners and municipalities need to take to deal with flooding:

	Homeowner	Community
Reduce Stormwater Runoff	X	X
Maintain/Increase Capacity of Sewers	X	X
Increase Stormwater Storage	X	X
Reduce Pollutants in Stormwater	X	X
Reduce Basement Flooding and Backflow	X	X
Prevent Exposure to Contaminated Floodwater	X	X

Homeowner Self-Help

There are a variety of things residents, as potential victims of flooding, can do to reduce the damages caused by floods. Essentially, these include reducing the potential for flooding of basements, reducing the potential for sewage backflow into home plumbing, and reducing exposure to contaminated floodwater should flooding occur. This section provides a brief overview of the self-help actions residents can take. Appendices H through K provide more detailed information.

Actions to Prevent Basement Flooding

FEMA's *Homeowner's Guide to Retrofitting* (June 1998) provides information on a variety of ways to retrofit your house to prevent flooding damage – all the way from moving your house or elevating it above the flood level to waterproofing your basement and installing check valves. See Appendix I for information on obtaining this guide.

Waterproofing or sealing cracks in the foundation. Commercial firms will waterproof your basement. Waterproofing can be done from the inside or from the outside. A persistent and able do-it-yourselfer can do this by digging a trench around the outside of the house and applying suitable waterproofing materials. This takes a good deal of time and effort, however.

Some residents use sealers for inside leaks that may have been there for quite some time, or holes that suddenly burst open (usually at the base of the cellar wall where pipes enter or at the base of the bulkhead stairs). These projects may seal the leak, but could also simply divert the leak for a persistent problem.

FEMA's *Homeowner's Guide to Retrofitting* provides information on more extensive waterproofing methods, as well as cautions about when waterproofing could increase risks of damage to your basement walls.

Direct downspout drainage away from the home. It is important to have runoff drain away from basement walls, by using drainpipes that are curved out at the bottom and by landscaping to drain away from the house. Extensions can be connected to the drainpipes to move water further from the house, or they can drain into a piece of gutter or purchased units that fit under the bottom of the drainpipe, carrying water away from the house. Runoff from the downspouts can also be directed to an underground dry well. (See the discussion below.)

Install sump pumps. Many local residents have sump pumps in their basements. In the Alewife sub-watershed, particularly, residents may have two and even three sump pumps. The capacity needed depends on the height of the water table and the elevation of the site. These pumps pump out water that collects in the low part of the basement. Be sure to pump the water away from the house and do not pump water directly into the storm drains, since this adds to amount of stormwater in the system.

Actions to Prevent Sewage Backflows

Install check or shut off valves. These valves are set in the building sewer line close to where it exits the structure. Wastewater is allowed to flow out of the house, but cannot reverse itself when the municipal sewer system is surcharging and flow back into the house. You must have approval from the local Department of Public Works before installing such a valve.

Raise or remove basement plumbing fixtures. Some homes have toilet fixtures, sinks and washing machines in the basement that may back up during rainstorms due to backflow from sewers. Toilets can sometimes be plugged with a heavy weight, but it is preferable to raise the fixtures to a higher level or to remove them entirely if they are not absolutely necessary fixtures.

Actions to Avoid Damages and Public Health Risks Limit valuables at risk. Residents who know their homes are subject to basement flooding should be careful to store valuables in a dry place. Even a small amount of moisture can be damaging to unprotected articles and materials. Storing things in heavy plastic bags or hooking up and using a dehumidifier will help to keep things somewhat dryer, but are unlikely to prevent damage during flood events. Long-term storage, even in a relatively dry basement, can cause mustiness. Carpets on the floor that tolerate water do not dry underneath. Residents might also want to move their washer and dryer and hot water heater upstairs, to avoid damage to this equipment during floods.

Raise the basement floor level. Creating a false basement can isolate living areas from floodwaters. More extensive work to elevate the entire structure is described in FEMA's *Homeowner's Guide to Retrofitting*. (See Appendix I)

Avoid contact with contaminated floodwaters. Floodwaters can contain a variety of contaminants from sewage, including disease-causing agents (pathogens including bacteria and viruses), toxic metals, and toxic organics. In general you should avoid direct contact with floodwaters – keep children from wading, and wear boots, eyewear and gloves when cleaning up.

Clean and disinfect areas that are exposed to flooding. You will need to clean and disinfect any areas that are exposed to floodwater, inside and possibly outside. Guidelines for cleaning up provided by the Mass. Department of Environmental Protection and the Mass. Department of Public Health are provided in Appendix H and are also available at http://www.state.ma.us/dep/brp/stormwtr/files/flooding.htm. These guidelines discuss methods for cleaning up inside and out, as well as prevention measures.

Obtain flood insurance. Your homeowners insurance probably does not cover flood damage. Some private insurers offer flood insurance. In addition, the National Flood Insurance program (NFIP) provides federally backed insurance, sold through private insurance agents and companies, with standard coverage and rates. If you are located in a Special Flood Hazard Area (SFHA) shown on a FEMA Flood Insurance Rate Map, you may be required to buy flood insurance as a condition of having a mortgage, to receive a home improvement loan from a federally-regulated lender, or to obtain federal disaster assistance. FEMA is currently updating the Flood Insurance Rate Map for the Alewife area.

The Federal Emergency Management Agency (FEMA) administers the NFIP. This program provides for insurance as a protection against flood losses to property owners in participating communities. Rates vary depending on whether residences are located in or out of the floodplain, and (for new or substantially improved houses) their elevation in relation to expected flood levels. You can obtain a policy through your insurance company or agent. Don't wait until a flood is coming to purchase your policy. It normally takes 30 days after purchase for a flood insurance policy to go into effect. For more information about the NFIP and flood insurance, contact your insurance company or agent or call the NFIP at 1-888-FLOOD29.

Homeowner Responsibilities

Residents' management of their own properties can make a significant difference in the amount of stormwater runoff that contributes to flooding. This includes both properties located in flood-prone areas and properties located in steep areas that experience little or no flooding but that contribute substantial runoff to lower-lying communities.

Actions to Reduce Runoff

Avoid channeling stormwater into the sanitary sewers or the stormwater system. Do not direct water removed by sump pumps into the sewer system, e.g. by connecting into internal drains, or by discharging water into catchbasins. Instead, try to direct stormwater into areas where it will drain into (infiltrate) the soil away from buildings.

Increase On-Site Stormwater Storage. Rain barrels, dry wells, vegetated swales, and rain gardens are all methods for holding stormwater on-site. Their effectiveness varies, and some methods may not be practical in areas where the groundwater table is high or where the soils are impervious (e.g., clay soils).

Arlington and Cambridge have programs that help residents purchase rain barrels. Studies have shown that use of rain barrels does not reduce flooding, because the barrels fill up before the peak of a storm. Use of rain barrels does conserve water, which can be used for garden irrigation purposes, at the same time saving on sewer and water charges because the water does not go through the house meter.

A dry well is constructed by digging a hole in the yard (more than one if necessary), and filling the hole with various-sized rocks and sand. The downspout is directed to the dry well through a small trench that is cut and covered. (You have to make sure you have good soil above the dry well or your lawn in that area might suffer.) Homeowners can construct small dry wells; help may be needed for larger dry wells. Dry wells retain water on-site and increase infiltration to the soil.

Rain gardens are depressed planted areas that collect and infiltrate stormwater. Research has shown that, even in densely developed areas, small rain gardens can absorb enough water to make a difference in runoff.

Add a rain garden to your yard. A rain garden is a small depression that captures and infiltrates or detains rainwater. They are generally planted with native species that are wet- and dry-weather tolerant. Rain gardens have been very effective in areas with permeable soils, as demonstrated by a pilot project in Maplewood, MN. Depending on where you live, they may not infiltrate, as much rainwater in the Alewife area where the soils are very compact and the groundwater level is high, but would still help to store rainwater and slow the rate of runoff.

Reduce impervious surfaces. Homeowners contribute to expansion of impervious surfaces by paving and enlarging asphalt driveways, and eliminating lawns. If you don't want to mow a lawn, consider a low-maintenance lawn cover instead of paving.

Improve the permeability of your soil, by aerating and incorporating compost.

Replace your asphalt driveway with a permeable cover. You can use gravel or stone in your driveway, or one of a number of new materials that create a firm surface that allows water to pass through. It is important that there is sufficient depth from the surface to groundwater, to ensure that pollutants in stormwater are removed before they reach the groundwater.

Avoid Contaminating Stormwater

Protect catch basins. Most catch basins convey stormwater to rivers. Catch basins should be protected and not used to dispose of contaminates or wastes.

Pick up after your pets. Do not leave pet wastes in the street to wash into the catch basins/storm drain system.

Limit or eliminate use of fertilizers and pesticides. Testing soils to determine what is needed before applying any fertilizers, and using a variety of integrated pest management methods, can significantly reduce runoff of nutrients and pesticides in stormwater.

Ensure that your sanitary pipes do not connect internally to the storm drains. Internal roof leaders are common in flat-roof triple-decker residences, and it may be difficult, expensive, or even impossible to separate pipes in these buildings. Even there, though, it may be possible to disconnect basement wastewater pipes from the storm drain.

Never pour toxic materials down household drains or into stormdrains. Recycle used oil and discard household and lawn care chemicals, paints and varnishes at hazardous waste collection facilities.

Protect rivers and streams from contaminants conveyed through catch basins. Most catch basins convey stormwater to streams and rivers.

Community Responsibilities

Municipalities play a major role in actions related to flooding, as discussed in earlier chapters. This section discusses four additional ways in which municipal governments should address flooding problems: (1) by educating their residents about the various self-help options and responsibilities and the potential health risks from exposure to floodwaters; (2) by improving the sewer infrastructure to reduce bacteria contamination in floodwaters; (3) by increasing storage of stormwater in the region; and (4) by exercising their land use responsibilities in ways that reduce stormwater runoff over time. In many cases, these activities can be done most cost-effectively at a regional level. The Tri-community Joint Powers Agreement provides a mechanism for Arlington, Belmont and Cambridge to work together more effectively to identify effective regional solutions. At a minimum, the Tri-community process promotes better communication about actions in one municipality that will affect the residents of another.

Educate citizens about self-help options and responsibilities.

The municipalities should consider a variety of methods for distributing information presented in this report on residents' self-help options and responsibilities related to flooding and stormwater. The Phase II NPDES Stormwater Regulations require all three municipalities to conduct public education related to stormwater. It would make sense to make information on flooding available at the same time. Outreach should include enclosures with tax bills or other community-wide mailings, public access TV, newspaper articles, public forums, and town websites.

In addition to general information about flooding, residents need specific warnings when there is high risk of exposure to contaminated floodwaters. Cambridge is required under the current variance to the state's water quality standards for its CSOs to issue public notices when a specific marker CSO has activated. Currently, those notices are posted on the Cambridge website, and emailed to the Mystic River Watershed Association (MyRWA) and to Departments of Public Health in Arlington, Belmont, Cambridge, and Somerville. More work is needed to get this information out to residents in a timely fashion – for example, through public access TV announcements, posting of signs and leafleting in particularly vulnerable neighborhoods. During the recreational season (April through September), residents can also be encouraged to check the EMPACT project website (http://www.mysticriveronline.org). This website provides warnings when bacteria levels in Alewife Brook and other water bodies – whether from CSOs or from other sources – are expected to exceed boating and swimming standards, based on recent rainfall events.

Improve Sewer Infrastructure

The three communities need to investigate and remediate inflow & infiltration and illegal connections in their sewer systems, to reduce the amount of sewage reaching Alewife Brook, its tributaries and floodwaters. Much of this work is already underway, as described in Section 3. These efforts are costly, may take a number of years to complete, and will require continued effort to detect and address new problems as they arise.

Increase Storage Capacity

Actions that the communities might collaborate on include the following:

- Assessing the cumulative impact of potential new developments and redevelopments on runoff and the need for floodwater storage, as well as on wastewater demands on the sewer systems;
- Assessing the amount of storage capacity needed to control moderate flooding, in light of the plans for regional land uses; and
- Identifying and investigating stormwater storage options that might achieve the target.

Possible options for storage, including drawing down Clay Pit and Spy Ponds prior to storms, were discussed in Section 2. Other options for increasing storage might include:

- Preserving land as open space, through purchase, conservation restrictions, and other means;
- Creating stormwater basins or constructed wetlands, like that being proposed by Cambridge for the Alewife Reservation as part of the CSO separation plan; and
- Creating underground storage capacity in tanks or pipes.

Reduce Runoff through Stormwater Management and Redevelopment

Land use can have a significant impact on flooding: the greater the increase in impervious surfaces, the greater portion of rainfall and snowmelt that runs off instead of infiltrating to groundwater. More impervious surface results in higher peaks and "flashier" hydrology – both of which can cause flooding. Land use planning and regulation can reduce the impact of development and redevelopment on stormwater pollution and flooding, without necessarily reducing overall density or property tax revenues to the towns. In fact, redevelopment of already developed land offers an opportunity to correct past mistakes by reducing imperviousness of already developed sites. However, these benefits will not occur automatically, and require that the individual municipalities make stormwater management an important component of their permitting process.

Massachusetts' home rule structure makes municipalities the most important players in determining land use patterns. Local zoning and planning boards set and enforce provisions that determine what can be built where and how developments must be designed. Local Conservation Commissions have authority over development and other activities near wetlands (including rivers, lakes, ponds and streams.) Lack of regional planning in Massachusetts has often hindered comprehensive and cost-effective approaches to regional environmental problems such as flooding. The tri-community working group is an effort to provide more effective regional planning in the case of flooding. To further reduce flooding, and even preventing the problem from getting worse, may require changes in municipal land use and development policies, and may require further regional cooperation in planning.

Currently, a number of new developments and redevelopment projects are being considered which if not designed properly can add substantially to the amount of impervious surface, runoff, sewage contamination of Alewife Brook, and flooding. Appendix L provides a list of prospective developments in the Alewife Brook sub-basin. This list, drawn from public sources, is not intended to be exhaustive, but it does present a picture of the major development proposals that could go forward in the next few years. This list can help communities evaluate long-term prospects for additional runoff and demands for sewer service in the region.

The municipalities should consider adopting "Smart Growth" and "Low Impact Development" principles in all future developments. Smart Growth and Low Impact Development (LID) are both concepts that promote land use practices that protect the environment:

- Smart Growth advocates argue, among other things, for redeveloping already developed sites rather than building on undeveloped parcels, and for concentrating development in areas with existing infrastructure and access to public transit.
- Low Impact Development advocates promote site and building designs that minimize environmental impacts where development does occur.

Both concepts have relevance to community efforts to reduce flooding.

The municipalities could also adopt local by-laws, ordinances or design guidelines that require stormwater runoff controls for any development or redevelopment project that affects the Alewife area. These include developments located near the flood-prone areas, as well as, areas that contribute runoff to lower-lying areas.

Given the severe flooding problems in the Alewife basin, the Mystic River Watershed Association (MyRWA) argued that the municipal standards for developments and redevelopments in the basin should exceed the current Massachusetts Stormwater Guidelines. These guidelines require no increase in peak runoff, but do not prevent substantial increases in total runoff. MyRWA recommends a more stringent standard, for example, detaining enough stormwater volume to prevent property damages from the peak runoff or requiring a reduction in total pollutant load relative to pre-development conditions.

Appendix A: Mathematics of Flooding (Q&A)
by Will Brownsberger

What is this Appendix about?

The purpose of this Appendix is to define some of the key quantities that determine flood levels in the Alewife area and to consider what, if anything, they suggest about solutions to flooding.

How was this document prepared?

This draft was prepared by Will Brownsberger based on the collection of flooding study documents that Steve Kaiser assembled. Steve reviewed it and gave helpful comments, but the mistakes are all Will's.

What is the Alewife area?

More precisely, we mean the Alewife sub-watershed – the area drained by Alewife Brook. It is part of the Mystic River Watershed. It includes much of Belmont and parts of Arlington, Cambridge and Somerville. It includes the lowlands between Fresh Pond and Route 2 and along the Alewife Brook. Most of these lowlands lie in Cambridge and in East Arlington.

How big is the Alewife sub-watershed?

It is approximately **5300 acres**. The Mystic River Watershed as whole is 39,600 acres.

What are normal water levels in the Alewife Brook?

In normal weather conditions, the water levels from Little Pond in Belmont all the way out to the Amelia Earhart Dam at the mouth of the Mystic are roughly flat. They vary seasonally by a foot or two, but are **maintained at a level of approximately mid-tide in Boston Harbor** by the operation of the dam. The mid-tide level is defined as zero on a scale called NGVD ("National Geodetic Vertical Datum"). The MDC uses a different scale based on ebb tide in Boston Harbor less one hundred feet. Low tide is about 5.65 feet below the NGVD so the water level in the basin between the dam and Little Pond is maintained at about "105 MDC base."

How high do water levels rise in major floods?

This is a highly controversial question because it affects land values and political perceptions of the consequences of development projects. However, the high water levels in Little Pond (and generally upstream from the Route 2 bridge) appear to **rise roughly 8 feet above NGVD in the "100-year flood**." The experts differ. The maximum may be as much as a foot less or it may be a few inches more.

How high does the water need to be to begin to cause problems?

Elevations are hard to measure perfectly. The data is imperfect, but some suggest that a rise of **roughly 3 feet above NGVD** begins to create street flooding in the lowest lying neighborhoods. At about 5 feet NGVD (level depends on gates set along the stream) storm water can pour directly into the ABC conduit, raising water levels in the conduit and creating a certainty of sewage backups. At 8 feet NGVD, the Alewife Brook Parkway is under several feet (2-4) of water.

How often do major floods occur?

The recurrence of major floods varies. The short answer is **too often**, recently. We have had 3 floods over 6.5 feet NGVD in the past 7 years (2001, 1998, 1996), but only a total of 5 in the last 50 years (1984 and 1955 are the additional floods).

What determines when major floods occur in the Alewife area?

Flood levels in the basin are determined logically by the net flow (rain in less flow out) and the capacity in the basin, in other words by:

- precipitation,
- by how much of the precipitation runs off into the basin (as opposed to being absorbed by the upland soils) and by whether snowmelt is added to the precipitation,
- by the storage capacity of the basin (the low-lying areas along Little River and Alewife Brook), and
- by the rate of flow out of the Alewife Brook and by the water level in the Mystic itself (which may limit the rate water can exit Alewife Brook).

What are typical recurrence levels for different amounts of rainfall?

Boston Area Precipitation Extremes for Return Periods from 2 to 100 Years (MDC's recent Hydrology Study)

Frequency of Event	Precipitation in inches during given period		
(years)		our	ur
2			
5			
10			
25			
50			
100			

How many cubic feet of water does an inch of rain on the Alewife watershed represent?

19.2 million cubic feet, computed as 5,300 acres x 43,560 square-feet/acre x 1/12.

So, combining that computation with preceding table, every two years or so, we get storms that drop roughly 60 million cubic feet of water 24 hours?

Right – 3.2 x 19.2 million. Every 10 years, we get storms that drop almost 100 million cubic feet in 24 hours. Every 100 years, we get storms that drop 160 million cubic feet in 24 hours.

Alright, well how much water can the watershed hold?

If, by that, one means storage of water in the basin formed by the river channels and the flood plain, the answer, of course depends on how high the water has risen. At full flood depth – 8 feet, NGVD -- storage up stream of the Route 2 culvert is 26 million cubic feet. Including storage between Route 2 and the Mystic, there are perhaps 40 million cubic feet at full flood depth (although we lack a good number on this). At 3 feet NGVD, the approximate level at which surface flooding begins to occur, total storage is only 2 or 3 million cubic feet. Recall that normal levels are close to 0 NGVD.

Hold on, so that means that the bad one hour storm we get every two years drops 10 times as much water as the basin can hold without beginning to flood?

Right. Every couple of years, we have a one hour storm that drops 1.1 inches or rain, over 20 million cubic feet of water – 10 times the 2 or 3 million cubic foot capacity of the basin filled to 3 feet NGVD. Roughly enough water, in fact, to fill the basin to 7 feet NGVD, a severe flood.

So you mean a good hard day of rain like we see every few years could fill the basin to severe flood levels several times over?

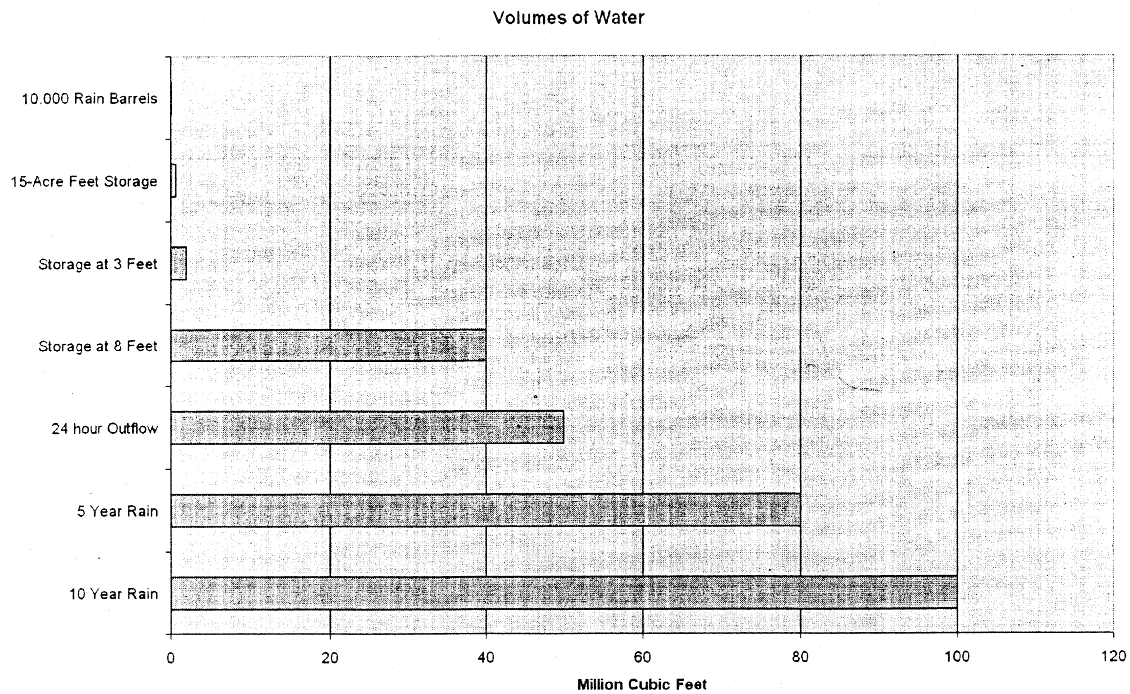
Right. Every five years, we get a 4-inch 24-hour rainfall. That's almost 80 million cubic feet of water, twice the capacity of the basin at the highest flood levels. Every 10 years, we get a 5 inch 24-hour rainfall, totaling 100 million cubic feet.

OK, but what you are leaving out is the fact that water is constantly running out of the basin.

True, so let's fold it in. *There are no good measurements of flow out of the basin,* but modeled flows at the junction of the Alewife and the Mystic are in the ballpark of 400 to 600 cubic feet per second depending on water elevation – roughly 30 million to 50 million cubic feet per 24 hour period.

But wait, that still would mean an 8-foot super-flood every ten years, wouldn't it?

It would. If that 5-inch 24-hour rainfall drops 100 million cubic feet, that's 50 million cubic feet more than the watershed can drain in the same period (50 million cubic feet). 50 million cubic feet is much more than the flood plain can store at 8 feet of depth.



And didn't I hear something about backwater conditions in the Mystic River?

Yes, it does appear that in some conditions, water levels in the Mystic can rise dramatically as a result of heavy flows from upstream. The pumps at the Amelia Earhart dam appear to be roughly equal to the 4300 cubic feet per second maximum flow of the Mystic. But, there needs to be a bit of a slope in the Mystic Channel to maintain that flow. So, water levels may rise to over 5 feet above normal at the confluence of the Mystic and the Alewife. Older estimates (CDM 1982) put the rise even higher, but these estimates predated the installation of major pumps at the dam and also predated recent clearance by the MDC of debris at the old Craddock locks.

So these backwater conditions could make things even worse.

Generally, high tailwater in the Mystic may operate to reduce the outflow from the Alewife, but we have no measurements of this. High tailwater, in itself, increases the cross-section of the flow and could help flow, but the flow numbers we are using above are already high.

So why don't we have worse floods more often -- what's still missing?

Run-off rates – the rates at which rain falling over the watershed makes its way down to the lower basin. Run-off rates are very hard to model and very dependent on changing conditions. Soil all over the watershed has the potential to absorb and store water. An inch rain of over 6 hours on dried summer soils may sink in completely. An inch of rain on exposed bedrock or on soils covered by a sheet of hardened ice will flow quickly into the basin. Slopes make a big difference too. And, of course, increased development and impervious surface area accelerate runoff. The tricky fact is that the more it rains, the more of the rain ends up running-off as soils saturate; some soils saturate faster than others. Modeling of run-off rates is the hardest part of flood modeling and engineers rely on standard models which may or may not accurately reflect prevailing conditions in the Alewife watershed at any given time.

If run-off rates are highly variable and also hard to model and they make all the difference in whether or not we have flooding, then how confident can we be about modeled projections of flood levels?

Not very. That's right. In the absence of good measurement, we can't put that picture together with much confidence. In March 2001, we had a deep flood with only a 3 inch storm, because of surface conditions.

So, what do we do?

We should put instruments in critical locations to continually measure river flows and levels. We need more hard numbers to validate the models.

Great, but I still want some answers about what we should be doing to make a difference.

Fair enough, let's go through some of the common questions and see what we know.

First, how much can we gain by improving upstream retention through rain barrels?

If a rain barrel holds 50 gallons, it holds about 6.7 cubic feet of water. So, 10,000 rain-barrels would hold roughly 67,000 cubic feet of water. In even modest rainstorms, we are talking about flows on the order of 1,000 times greater. As another comparison point, the average household uses 63,000 gallons of water per year, according to the MWRA.

However, Steve Kaiser points out that the amount that could be stored in a more ambitious rain-barrel program compares favorably to the amounts that could be stored in some governmental storage basin proposals.

Well, how about controls on development?

What do you mean, development in the flood plain or development above the flood plain?

Well start with development above the floodplain – you said run-off rates are a big issue.

Yes, high-ground development is a big part of why we are where we are today. An interesting research question would be to see when most of the development occurred in different parts of the watershed. Also, it would be helpful to know how much of the undeveloped areas are not already under under permanent conservation protection.

According to some sources, development in Belmont was more or less complete in 1950. Relevant neighborhoods in Arlington and Cambridge were also mostly developed. Even development upstream in the Mystic, which surged in the 60's and 70's is now fairly mature, except for areas so for up in the watershed that they probably will not affect our problems – water takes a long time to flow from there and passes through major retention areas.

Can we improve controls on run-off from new development?

This is also a question that needs further study. It may be that the regulatory framework is adequate or it may not. Certainly, new major projects today are already required to be run-off neutral or even to reduce run-off with detention and retention devices.

Can we reverse the effects of existing development?

Interesting question. Also needs further study. Another interesting homework item for someone in the group would be to understand the contributions to runoff from different categories of surface in the watershed – roads, lawns, roof-tops, parking lots, etc. However, the biggest factor accelerating runoff in the Alewife basin may be the steep hills in Belmont and Arlington – even in 1900, the engineer Freeman referred to it as a "quick and flashy" basin.

How about development in the floodplain or the reverse – additions of storage to the floodplain?

Clearly floodplain storage makes some difference. It makes sense to fight incremental loss of floodplain storage. We need better modeling consensus on how storage trades off against flow rates. It may be that since the watershed storage volume is so much smaller than the amounts entering and exiting it in severe storm conditions, modest percentage increases or decreases in storage do not make much difference in maximum flood levels – rather, they may briefly delay or accelerate the rise of flood waters to whatever equilibrium high water level they will rise to in the course of the flood.

What about removing constrictions that reduce the flow out of the Mystic and the Alewife?

Clearly, the removal of debris from the Craddock locks, thanks to the latest MDC study, may have made a difference. The study says additional clearance won't help much, but the first draft of it said it would. The final draft better reflects available data, but the change illustrates the critical lack of good information for evaluating options.

Appendix B: List of Work Group Participants

The following is the list of persons receiving regular e-mails regarding the proceedings of the group. Not all of these persons have attended regularly, although most have attended at least one meeting. They have not necessarily reviewed and do not necessarily endorse the contents of this report.

Alice Wolf, State Representative
Ann Norton
Anne Paulsen, State Representative
Aram Hollman, Alewife Coalition
Anne Marie Mahoney, Belmont Selectman
Carolyn Mieth, Alewife Coalition
Catherine Woodbury, Cambridge Department of Public Works
Cori Beckwith, Arlington Conservation Commission
Daniel Driscoll, Department of Conservation and Recreation
David White
Elizabeth Karpati
Elsie Fiore, Arlington Town Meeting Member
Gene Benson, Arlington Conservation Commission
Grace Perez, Mystic River Watershed Association
Henrietta Davis, Cambridge City Councilor
Jane Howard
Jennifer Wright, Cambridge Conservation Commission
Jim Marzilli, State Representative
Jim Graves, Belmont Citizen's Forum
John Sanchez
Joyce Munro, Belmont Assistant Town Administrator
Julia Bowdoin, Cambridge City Manager's Office
Kathleen Dias, Arlington Selectman
Kristin Anderson, Sunnyside Neighborhood Representative
Lee Smith, Belmont Town Counsel
Mark D'Andrea, Belmont Citizen's Forum
Mel Kleckner, Belmont Town Administrator
Miriam Anderson, Executive Office of Environmental Affairs
Nancy Hammett, Mystic River Watershed Association
Nancy Breen
Owen O'Riordan, Cambridge Department of Public Works
Paul Solomon, Belmont Selectman
Paul Kirshen
Peter Castanino, Belmont Department of Public Works
Ralph Jones
Richard M. Vogel, Tufts University Hydrology Professor
Richard Zingarelli
Roger Frymire
Ron Santosuosso, Arlington Department of Public Works
Steve Kaiser
Sue Bass, Belmont Citizens Forum
Tom Gatzunis
Will Brownsberger, Belmont Selectman
William Eykamp

Appendix C: List of Presenters

Symposium Presenters

David Kubiak, Massachusetts Water Resource Authority
Michael Galvin, Department of Conservation and Recreation
Richard Laramie, Camp Dresser and McKee
Marcia Greenblatt, ENSR
William Pisano, Montgomery Watson Harza
Dan Driscoll, Department of Conservation and Recreation
Robert France, Associate Professor Harvard School of Design
Nancy Hammett, Mystic River Watershed Association
Richard Vogel, Professor Tufts University
Stephen Kaiser, Cambridge Resident
Roger Frymire, Cambridge Resident

Presenters at Group Meetings

June 10, 2003 -	Stephen Kaiser
June 24, 2003 -	Michael Galvin
July 22, 2003 -	Miriam Anderson, Executive Office of Environmental Affairs Aram Hollman and Carolyn Mieth, Alewife Coalition Mystic River Watershed Association
September 9, 2003 -	Owen O'Riordan, Cambridge Department of Public Works William Pisano and Len Sekula, Montgomery Watson Harza
September 30, 2003 -	David Kubiak

Appendix D: Flood Elevation Analysis by Stephen Kaiser

APPENDIX on FLOOD ELEVATIONS by S. Kaiser

In the past 8 years, there have been four major floods at Alewife : one was a 50-year flood, two were 25-year floods, and one was a 10-year flood. In those eight years there have been no government reports on flooding at Alewife, and the only photos taken were by citizens. I was the only person making flood elevation measurements during all four storms.

The best flood measurements ever made at Alewife were taken during the spring of 1936. The nation was in the midst of a prolonged depression, and the new Governor James Michael Curley wished to create jobs. Curley was up for re-election (he lost) but used the catastrophic floods of March 1936 to record flood elevations on every Massachusetts river and brook. An army of surveyors and observers swept over the state, recording the high water scum lines on bridges and barns, and translating the results into page after page of tabular data, as well as stream profiles. The results were published in the September 1936 in a 200-page document, "High Water Data : Flood of March 1936 in Massachusetts," by the Mass Geodetic Survey/Mass Dept. of Public Works. This report is the Gutenberg Bible for hydrologists.

The 1936 report contained six measurements along Alewife Brook -- all at bridges and culverts, with elevations in the range of 5.4 to 5.7 feet NGVD elevation -- what we today might identify as a 10-year flood. There were also two measurements on Little River, two on Winn's Brook and three on Wellington Brook. In addition, there were 15 different measurements along Mill Brook in Arlington. All measurements were listed, explained, referenced and attributed. As far as I know, never before or since has such a thorough document been prepared in Massachusetts.

During the past 75 years, measurement of flood levels has been irregular and often undocumented. The only exception is the town of Belmont, which has maintained a program of flood elevation measurement at Little Pond fairly continuously since 1928. The first town engineer held the position for about 30 years. The second town engineer held the position from 1926 to 1972, and he instituted the regular flood measurements at Little Pond.

What is the flood of record at Alewife? Not everyone agrees. Some people claim it is the flood of October 1996, while others say it was the hurricane of 1955. For 1996, we had two measurements : 7.1 feet and 8.9 feet. I have seen three measurements for 1955 : 6.9 feet, 7.4 feet and 7.8 feet. The fact that the data has not been sorted out for accuracy after all these years is at least very embarrassing.

The best way to understand the 1955 flood is by a comparison with the other major flood at Alewife : October 1996. In this fall storm, there are three source of flood measurements. The Army Corps made three individual measurements -- two near ADL with elevations of almost 9 feet. Their third measurement near Mass Avenue reported as 5.6 feet suggested an unprecedented drop of 3 1/2 feet within a distance of about 2,000 feet along Alewife Brook. The Army Corps did indicate that there were inconsistencies in the data, but these measurements are the only flood measurements made at Alewife in 1996 by any government agency. Even Belmont had no measurements for Little Pond or Little River. Cambridge, Arlington, MDC, DEM, Mass DPW, and USGS were all silent. Only the Army Corps produced a written document on the 1996 flood, with Alewife included as one element in a comprehensive study of New England flooding.

The differences between 1955 and 1996 measurements were significant. In 1955, we had a hurricane with 12 inches of rain and no Earhart Dam to lower the level of the Mystic Basin, yet it produced (according to Belmont) a flood level of only 6.9 feet. By contrast the 1996 storm with 8 inches of rain and with the protection of the Earhart Dam resulted in a flood depth of 9 feet. Clearly the data are illogical and inconsistent. If anything, one would have expected the 1955 flood to be the higher of the two and thus the flood of record.

The best decision as I see it is to select the 1955 flood elevation as 7.8 feet, rather than Belmont's 6.9 feet, and to select the 1996 flood as 7.1 feet, not 9.0 feet. CDM has effectively accepted the 7.1 foot mark in its revised flood report of January/ February 2003, and abandoned its earlier acceptance of the Army Corps figures. Further verification comes from the Mugar's consultant who used a photograph in East Arlington to calculate a flood elevation of 6.9 feet for the 1996 flood.

For the 1998 flood, I made the only flood measurements, recording 6.5 feet at ADL. There were no government or consultant calculations of flood levels.

Starting in late 1998, the City of Cambridge installed a continuous brook elevation recorder, so that data was electronically kept on water levels during both dry periods and floods. Thus for the March 2001 flood, there were three flood measurements, one by Cambridge above Mass Avenue, and two by me -- one at ADL and the other at the intersection of Herbert Road and Lafayette Street. I measured 6.4 feet at ADL and 6.0 feet at Herbert Road. Cambridge recorded a peak elevation of 5.3 feet. Here again we did not have good agreement on flood elevations.

The 2001 flood caused the closure of both Route 2 and Alewife Brook Parkway due to flooding of the pavement. According to the 1962 Maguire report, the parkway has two low points, at elevations 5.7 and 6.8. With Cambridge's claim for a flood level of 5.3 feet, the water would never have come over the parkway, let alone shut the road down from water depths of 8 to 10 inches. I conclude that the Cambridge meter continues to be in error by about one foot, reading too low.

The 3-day rainstorm of March 31 to April 2, 2004 produced 6 inches of rain on Boston, and resulted peak flood levels of 5.4 feet. Alewife Brook Parkway was never flooded or closed, although Route 2 outbound had local drainage problems which caused the closure of one outbound lane.

If there are errors in my measurements, they may be slightly on the low side -- if there were any pavement resurfacing where I made my measurements. My elevations were based on a 1974 topographic map and any repaving in the last quarter century would have meant that the elevations I measured should be raised by the thickness of the repaving. This thickness should be added to all of my measurements from 1996 to 2004, as originally made as 7.0, 6.5, 6.4 and 5.4 feet.

The best way to resolve this matter is to send out a survey crew to measure and verify the pavement elevations at Herbert Road and at the ADL access road. For my measurements, the discussion of errors is fortunately focused on inches, unlike the Cambridge and Belmont data where the errors appear to be measured in feet.

The only other document which comes close to the 1936 flood report in excellence of quality is the 1974 Maguire report prepared for the Town of Arlington on Mill Brook. From my review of various bibliographies, it appears that this report was a unique product of its era : an open, thorough and complete document on flooding, with details on past storms, channel conditions, stream profiles, and elevation references.
I would not hesitate for a moment to take the 1936 report and the 1974 Arlington study -- placing them together as a package for any consultant and any agency or developer to see that this indeed is the way to do a good flood report.

==

THE REASONS WHY THE ALEWIFE AREA HAS FLOODS

Storm water flooding at Alewife can be a serious problem in both moderate and large storms. Some homes can have flood waters at the front step in a 5-year storm. Other homes are not flooded at the surface level but instead suffer from flooded basements. Flooding on private property can be localized (having no direct connection with flooding along Little River and Alewife Brook) or it can be part of the flood lake ("Lake Alewife") which is created when Little River and Alewife Brook overtop their banks and create a large continuously flooded area.

During dry weather, the Alewife Brook streambed is very flat with minimal water motion. Little Pond is only a foot higher than the Mystic River basin six miles away. The upper parts of the Watershed, especially Belmont Hill and Arlington Heights, are quite steep and the water drains rapidly to the flat bottom of the drainage "bathtub." Flood waters accumulate in the low-lying areas of the watershed, and are slow to move downstream because of the narrow mile-long constriction posed by Medford Center. Here the river rushes more rapidly in a storm, and the amount of storm water can be 100 times the dry weather flow – much more than normal.

In a large storm that would create a 50- to 100-year flood, the only way for the water to get out of the Alewife Basin is to rise up and push its way out. The brook must rise four feet just to move the water through Medford. It needs another 2 to 3 feet to push its way through Belmont, Cambridge, Arlington and Somerville. Altogether Little Pond must rise 6 to 7 feet as it temporarily stores the storm water and also forces large amounts of water to flow downstream. Even at flood time, this is a drop of only one foot over the distance of a mile. Most of this drop occurs through a series of bridges which cross Alewife Brook, and at most of them, the water drops only 3- to 5-inches from the upstream side of the bridge to the downstream side. The brook culvert under Route 2 now appears to be the largest constriction, with a drop of about 7-inches.

Over the past century, the Alewife area has been extensively developed, with farmlands paved over. Flood storage has been lost and a greater proportion of any rainfall is now running off into street drains and into streams. Some committee members believe that the Alewife area has become entirely developed and there will be no future increase in runoff. Others contend that past trends towards more runoff will continue into the future, with major floods rising about 7 inches for every 20-years' worth of development.

The single most effective flood control program in the past century has been the Earhart Dam, constructed in 1965 and fitted with large pumps in the late 1970s. The combination of sluicing water out of the basin at low tide and pumping water into the harbor during high tide means that the effects of tidal action can be only beneficial and that high tide problems of the past can be overcome. Dropping the level of the Mystic Basin in anticipation of major storms also is a way to draw down the river levels and encourage more flow through the Medford Center area. However, the water cannot be drawn down too far, because of the concerns about boaters in the basin and aquatic habitat needs of the brook itself. Shallow streams are less inviting to fish.

It appears that the effect of creating the Mystic Basin and the Earhart Dam has produced about a one-foot flood benefit at Alewife. In other words, if we did not have the dam, flood levels in the past decade could have been a foot higher than they actually were. So why has the flooding situation not gotten better? The answer is that urbanization in the last century has increased runoff and subsequent flooding, and more than counterbalanced the benefits of the dam.

Development and natural events of the past century have produced a realization that severe flooding can come from both summer hurricanes and heavy rainstorms, as well as moderate wintertime rain on snow-covered ground or frozen soil. Freeman assumed that summer runoff in a largely rural watershed was only 10%, while in today's highly developed watershed, the runoff is closer to 60% or 70%. After the winter flood of March 1936 swept up the Connecticut River Valley, the Northeast experienced a series of summer floods which took the form of the warm hurricanes and changed the hydrologist's way of thinking : the September 1938 and August 1955 hurricanes, as well as the heavy rains of May/June 1984, October 1996 and June 1998. The worst winter flood occurred in February 1886 (the "Stony Brook Flood"), but recent examples at Alewife were March 1972, January 1979, and March 2001.

Flooding conditions can be made less severe by providing for flood storage anywhere in the watershed, upstream or downstream of Alewife, within the floodplain itself, and in upland areas. The general rule applied by state regulators is that any increase in flood water released to Alewife Brook must be fully mitigated or compensated for. In other words, if a project takes away flood storage or increases run-off into the brook, an equal amount of flood storage must be created elsewhere.

For example, Cambridge is seeking to implement a program of flood control which would mean no severe street and neighborhood flooding in a 10-year storm. Examples of such programs would be in the New Street area near Danehy Field and areas within residential areas near Fresh Pond. Using improved drainage pipe and collection systems, as well as pump stations, flooding in medium storms can be limited in Cambridge neighborhoods, but the water must be transferred somewhere -- and the repository is Alewife Brook.

==

Belmont lists these major floods :

August 1955	6.91 feet NGVD
January 1979	5.88 feet
October 1962	5.48 feet
January 1978	5.14 feet
June 1982	4.78 feet
July 1980	4.68 feet
September 1954	4.58 feet
January 1979	4.48 feet

A simple practical rule of thumb for Alewife is that during the warm seasons, each one inch of rain causes the brook to rise one foot.

100-year Flood Elevation	8.2 feet
50-year Flood Elevation	7.3 feet
25-year Flood Elevation	6.5 feet
10-year Flood Elevation	5.6 feet
5-year Flood Elevation	4.8 feet
2-year Flood Elevation	3.8 feet
1-year Flood Elevation	3.3 feet
3-month Flood Elevation	2.5 feet

Our rainfall measurements are quite good. The Committee has data on Boston rainfall going back over 130 years, with a listing of the 500 heaviest rain storms and CD-ROMS with an entire daily chronology of rainfall from 1872 to 2003. The rainfall frequency is :

A 100-year rainfall storm	6.6 inches in one day.
A 50-year rainfall storm	6.2 inches in one day.
A 25-year rainfall storm	5.6 inches in one day.
A 20-year rainfall storm	5.3 inches in one day.
A 10-year rainfall storm	4.4 inches in one day.
A 5-year rainfall storm	3.5 inches in one day.
A 2-year rainfall storm	2.8 inches in one day.
A 1-year rainfall storm	2.3 inches in one day.
A 3-month rainfall storm	1.5 inches in one day.

Fecal Coliform Bacteria Counts in Units per 100 milliliters

Class B Water Quality standard - swimming	200
Class B Water Quality standard - boating	1,000
Current Dry Weather bacteria count at Mass Avenue	1,300
Current Peak of a one year storm at Mass Avenue	100,000
Current non-CSO contribution, peak of 1 year storm	10,000
Future condition with partial CSO program, same storm	70,000

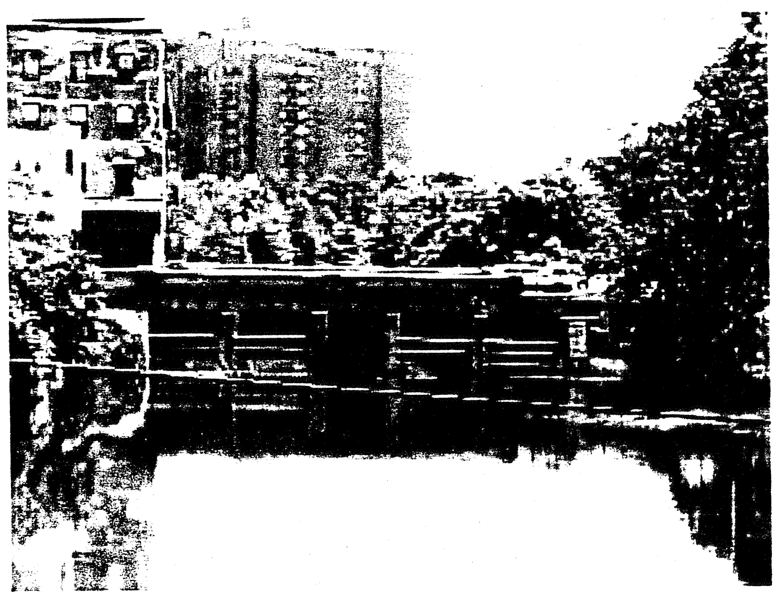
Appendix E: Commonwealth of Massachusetts Department of Conservation and Recreation Flooding Report with Comments by Stephen Kaiser

Metropolitan District Commission

Mystic River Hydrologic and Hydraulic Study Report

MDC Contract No. P83-1250-S2A

January 31, 2003



Executive Summary

General

This report on a hydrologic and hydraulic study of the Mystic River watershed is one component of a Metropolitan District Commission (MDC) project to plan rehabilitation or replacement of the Upper Mystic Lake Dam. This report assesses flooding and identifies flood reduction measures along the Mystic River and its Alewife Brook tributary. It updates numerous previous studies, and follows the occurrence of three recent major floods in the area in October 1996, June 1998, and March 2001.

Numerous studies have been conducted since the early 1900s examining the hydrology of the Mystic River Basin. Some of these have examined the complete watershed, while others have focused on areas with chronic flooding or water quality problems such as Alewife Brook or the Aberjona River. This study follows and makes use of the analysis and findings of the recently completed Aberjona River Flood Study (CDM, 1999) The recommendations from that study are contained in Appendix E. The focus of the study described in this report is on the Mystic River watershed from the Mystic Lakes, including the Upper Mystic Lake Dam, downstream to the Wellington Bridge above the confluence with the Malden River and the downstream limit of the freshwater basin at Amelia Earhart Dam.

Analysis

For this study, all prior studies and the currently available drawings and mapping were collected and reviewed to obtain the necessary data for the analysis. An updated computer model of the Mystic River basin study area was constructed and used to assess hydraulic conditions at the dam along the downstream waterways. The widely used and accepted Storm Water Management Model (SWMM) was used in this analysis. SWMM is a dynamic continuous simulation rainfall-runoff model designed for urban areas. SWMM was developed for the United States Environmental Protection Agency (USEPA) from 1969-1971 by researchers at University of Florida, CDM, and Metcalf and Eddy, Inc. The model has been expanded, refined, and verified many times since by consulting engineers and a variety of academic institutions.

A large storm in October, 1996 caused heavy rainfall in the area and very high flows over a two to three day period. An actual time history of the Aberjona River discharges during this storm was available for the USGS gaging station located just upstream of the Upper Mystic Lake. A number of high-water elevations were also recorded during this event. This storm was selected and consistently used as the basis for our modeling in both the Aberjona and Mystic River hydrologic and hydrology studies because it occurred relatively recently, is well-remembered, caused significant flood damage and has the best available data for it.

The October 20, 1996 Storm was characterized by a long duration of moderately heavy wide-spread rainfall. Approximately 10.1 inches of rain fell over a 41-hour period in the Mystic and Aberjona watershed. The peak 24-hour rainfall of 8.4 inches has an estimated recurrence interval of approximately 100-years, making it among the largest recorded storms in this area.

The peak Aberjona River flow of 1,150 cfs at the USGS gage on the river was also among the highest recorded for the 58 years of record at this gage. Based on this gaging record, the USGS determined that the return period for the October, 1996 peak flow is approximately 50 years (i.e., a storm of that magnitude is expected to occur once every 50 years on average).

Findings

The findings of this study may be summarized briefly as follows. The findings are further described in Section 6 of the report.

Upper Mystic Lake and Dam

- Analysis of the Upper Mystic Lake shows that the current dam and outlet works configuration does not provide sufficient storage to attenuate large stormwater inflows.
- Investigation of changes in the outlet works that would provide a lower initial lake level at the beginning of a large storm showed that this could be an effective means for maintaining lower flood levels in and around the lake without causing adverse increases in the rate of flow and therefore the potential to increase flooding in areas downstream of the dam.
- The specifics of any such improvements for flood control as well as dam safety are being investigated in Phase II of this project and will be described in subsequent reports.

Mystic River

- Evaluation of the structures and flood profiles along the Mystic River from the Lower Mystic Lake to the Amelia Earhart Dam did not identify any constrictions causing high headloss and excessively elevated flood profiles.
- Reports of very significant headlosses at the Cradock Bridge on Main Street in Medford Center could not be replicated by the hydraulic modeling based on the 1980 design drawings for the demolition of the old Cradock Dam and Locks. As a result divers we sent out to investigate the subsurface conditions found the flow section to be significantly constricted with accumulated subsurface debris.
- The MDC is in the process of having this debris removed to greatly reduce the losses associated with this structure and return this structure to its intended flow capacity.
- The Mystic River was found to have no other significant flow constrictions that warrant improvement.

Alewife Brook

- Evaluation of the structures and flood profiles along the Little River/Alewife Brook tributary from Little Pond to its confluence with the Mystic River identified a narrow, shallow channel with several restrictive bridge crossings as contributing to the recurrent flooding problems that occur along this waterway.

- The most restrictive of these were identified as the old bridges at Broadway and Massachusetts Avenue with bridge opening widths of 12.5 feet and 14 feet respectively compared with opening widths of 30 feet or more for the other structures along the brook.

- However, it was determined that the combined head loss attributable to these bridges is only 0.4 feet, or about 5 inches, for a severe storm such as the one that occurred during October, 1996.

- Widening of the Mass. Ave. and Broadway bridges would be desirable to have a more consistent, unrestrictive flow path along the entire length of Alewife Brook. While this improvement would result in some slight improvement in the severity and frequency of flooding upstream of the bridges along Alewife Brook and the Little River, the costs of reconstructing the bridges would likely exceed the expected economic benefit of their improvement.

- The planning level cost estimates are $2,000,000 for widening the Massachusetts Avenue Bridge, and $1,500,000 for widening the Broadway Bridge.

- Based on these costs, the costs of reconstructing the bridges at Massachusetts Avenue and Broadway would likely exceed the economic benefit achieved and cannot be recommended on a flood-control basis alone.

APPENDIX ***DCR Report of February 2003***

3-page executive summary from DCR report.

Additional SK comments :

The MDC/DCR report of February 2003 as prepared by CDM is a significant improvement over the earlier September 2002 draft. For the 50-year storm of October 1996, the elevation drop from one side of the Mass Ave bridge to the other now becomes 5 inches, which compares with a similar value at Broadway and 7 inches at the Route 2 culvert. The new report used a flood elevation of 7.0 NGVD as the calibration point in 1996, and avoided the admitted flawed and inconsistent measurements of the Army Corps for this storm. The Army Corps reported a 3-foot drop through the Route 2 area of Alewife Brook, and this concept was carried over into the initial CDM report. This error was corrected in the new MDC/DCR edition of January/February 2003.

The new report is generally consistent with the 1981 flood study for Alewife, also prepared by CDM. However, the recent analysis considers only a 50-year storm and does not preview any other storms or flood measurements. Replacement of bridges on Alewife Brook could not need cost-benefit criteria for funding. As a result, the report recommends no structural proposals to decrease upstream flooding or increase downstream flooding.

Appendix F: Alewife Rainfall and Flooding Summary by Stephen Kaiser

ALEWIFE RAINFALL AND FLOODING SUMMARY

TABLE 1 Flood measurements near Route 2 and Mass Avenue

RAINFALL	October 1996	June 1998	March 2001	April 2004
at Logan Airport	(National Weather Service)			
Rain in one day	6.1 inches	5.7 inches	2.6 inches	4.3 inches
Rain in 2 days	7.9 inches	6.8 inches	3.0 inches	5.6 inches
Prior rain	2.3 inches 11 days before	1/2 inch 10 days before	frozen ground and melting snow	very dry

FLOOD LEVELS Upstream of Route 2 / Near ADL — All elevations in feet, NGVD

Measured by	1996	1998	2001	2004
by Army Corps	8.9 feet	-	-	-
DCR Measure	-	-	-	-
CDM Computer Model	7.0 feet	5.9 feet (uncalibrated)	4.8 feet (uncalibrated)	-
by MWRA or DEP	-	-	-	-
by ARLINGTON	6.9 feet (Mugar)	-	-	-
by BELMONT	st flood was 1955 Hurricane = 6.9 feet)			-
by CAMBRIDGE	-	-	-	-
by S. Kaiser by Sunnyside neighbors	7.0 feet (15 inches)	6.5 feet (10 inches)	6.4 feet (10 inches)	5.4 feet in basements

FLOOD LEVELS Upstream of Mass Avenue — All elevations in feet, NGVD

Measured by	1996	1998	2001	2004
by Army Corps	5.65 feet	-	-	-
DCR Measure	-	-	-	-
CDM Computer Model	6.3 feet	4.1 feet (uncalibrated)	3.6 feet (uncalibrated)	-
by MWRA or DEP	-	-	-	-
by ARLINGTON	-	-	-	-
by BELMONT	-	-	-	-
by CAMBRIDGE	-	-	5.3 feet	-
by S. Kaiser by Sunnyside neighbors	6.6 feet (15 inches)	6.3 feet (10 inches)	6.0 feet (10 inches)	5.0 feet in basements
by Lafayette neighbors	-	7.2, 7.6 feet	-	-
Flood Rating by FEMA Criteria	50-year event	25-year event	25-year event	5 to 10 year event

FLOOD IMPACTS	1996	1998	2001	2004
Route 2 Closed	2 lanes	2 lanes	4 lanes	1 lane
Parkway Closed	4 lanes	4 lanes	4 lanes	none
Basements Flooded	Yes	Yes	Yes	Yes
Number of Basements flooded	unknown	unknown	unknown	unknown

Appendix G: Potential Flood Storage Enhancements: Alewife Reservation prepared by The Bioengineering Group on behalf of the Department of Conservation and Recreation

DRAFT
Potential Flood Storage Enhancements
Alewife Reservation & Alewife Brook
Prepared by The Biioengineering Group, Inc.
January 2004

Parcel	Proposed Action	TBG Method for Estimating Existing FSV	In 100-yr Floodplain (8.28' NGVD)	Existing							Potential		Potential Gain in FSV (ac-ft)***
				Min. El.	Max. El.	Avg. El.*	Area** (sf)	Area** (acres)	FSV*** (CY)	FSV*** (ac-ft)	Avg. El.	FSV*** (ac-ft)	
Former MDC Ice Rink	Excavate, berm, and install flood gates, maximize upland habitat with inundation-tolerant plants	DTM for existing	No	4.4	12.5	8.4	187,974	4.3	4,269	2.6	5.0	17.3	14.6
Belmont Uplands	New development with slight increase in FSV	take directly from developer's plan and numbers	partially	~1	~21	NA	NA	15.6	NA	NA	NA	NA	0.5
Little River b/w Perch Pond & Rt. 2 Access Rd. Bridge	Dredge an avg. of ~ 1.0', restoring natural channel profile	rough estimate based on average dredging depth of 1.0' over river area	NA	less than 0.0'			213,108	4.9	NA	TBD	TBD	TBD	4.9
Cambridge Stormwater Wetland	Excavate and install stormwater wetland basin and compensatory wetlands	take directly from project plans and numbers	partially	2	13	NA	NA	3.0	NA	51.5	1.0	58.7	7.2
Acorn Office Park	Remove existing buildings along riverfront portion, convert to conservation easement	rough estimate based on calculated area and elevations from plan	Yes	4	7.5	5.5	174,000	4.0	NA	9.5	5.5	14.0	4.5
ADL Parking Lot	Acquire, then create wetland for habitat, education, and flood control	DTM for existing	Yes	2.7	13	2.8	265,000	6.1	61,248	38.0	2.0	42.6	4.6
Cattail Marsh	Acquire outer areas, restore wetland, enhance for flood control by excavating to GW; potential USACE involvement	rough estimate based on calculated area and elevations from plan	Yes	1.4	2.8	2.2	133,000	3.1	NA	20.8	1.5	22.9	2.1
Dilboy Field parking lot	Excavate down to gain flood storage, connect to Little River	DTM for existing	partially	6.8	10.5	8.0	78,824	1.8	2,812	1.7	6.0	5.4	3.7
Blair Pond	Dredge to remove accumulated soft sediments (to > 10' depth, est. 15,000 CY); potential USACE involvement	based on the 1999 Blair Pond Master Plan estimate of 15,000 CY soft sediment volume	Yes	between -5.0' & +10' contours			57,000	1.3	NA	Unknown	Unk.	Unk.	9.3
Mugar Parcel	Acquire & then utilize as upland preserve?	Not enough info	partially	between 5' and 15' contours			775,000	17.8	NA	TBD	TBD	TBD	TBD
Sum All Parcels										**124.1**		**160.8**	**51**

NOTES:
All elevations in ft NGVD
*Avg. Elev. = Average elevation for area based on observing 1-ft contours
**Area: Area of region as delineated in AutoCAD plan; ownership of some areas not resolved, some areas need to be acquired by MDC for this area to be possible.
*** FSV: Flood Storage Volume to 9.0'
TBD: To be determined

Appendix H: Commonwealth of Massachusetts Department of Environmental Protection and Department of Public Health, *Flooding and Sewage Backups: Home Care Guide*

Appendix

Massachusetts Department of Environmental Protection
Massachusetts Department of Public Health

Flooding and Sewage Back-ups: Home Care Guide

Background/Introduction

This document has been jointly prepared by the Massachusetts Department of Public Health Division of Community Sanitation (DPH), and the Massachusetts Department of Environmental Protection (DEP) and is intended to provide guidance to the general public relative to managing pathogen risks from direct contact with floodwaters and/or sewage backups.

> ***It is important to note that during and following flooding events, dangerous and even life-threatening hazards may exist, and the public is strongly urged to contact local and state emergency management officials for instructions on the procedures or actions necessary to safely avoid injury during these conditions.***

This document *is not* intended to directly address these public safety issues (such as risks from accidental electrocution from flooded basements or downed power lines). Additional information on the public safety hazards associated with floodwaters can be found at the Massachusetts Department of Public Health, Red Cross and Federal Emergency Management Agency and Massachusetts Emergency Management Agency websites.

Pathogens are disease-causing agents, which can be in the form of bacteria, viruses, mold spores, or protozoans, and which are normally present in large numbers in sewage wastes. The nature and extent of potential pathogen risks of sewer backups and floodwaters will depend in large part on the potential contaminants expected to be in the waters. In general, the greater the extent of the sewage component, the more likely the potential for adverse impacts, and the more important the proper cleanup of the materials that have come into direct contact with the contaminated waters. The severity of the health threat therefore depends on the source of the water and the extent of penetration into the building environment. The extent of penetration is dependent on the porosity of contaminated materials, the quantity of floodwater, and the amount of time the water remains in contact with materials. Even floodwater or stormwater which has not been directly impacted by sewage discharges is likely to contain a wide variety of microbiological organisms (e.g., from animal wastes, street runoff, etc.) and must be properly managed. Some of these pathogens, such as mold spores, can even establish an ecological niche and present a health risk from chronic exposure for some time after the event. Preventive measures, and proper cleanup procedures are essential in mitigating the risk of infection; this guidance is intended to assist the public in these actions.

DEP and DPH recognize that flood conditions can occur in any watershed during severe wet weather events. The potential for, and extent of, flooding depends on many factors, including: topography, flood storage capacity, the extent and location of development, infrastructure constraints, and, of course, on the severity of the storm event. DEP, through implementation of its Combined Sewer Overflow Abatement program and Sanitary Sewer Overflow Abatement program, continues to require infrastructure improvements to mitigate the potential for untreated wastewater to be discharged during wet weather events. DEP also has implemented a Stormwater Policy which provides for performance measures to control stormwater pollution and peak flow rates for projects subject to the Wetlands Protection Act, Infiltration/Inflow Control Guidelines and Illicit Connection Initiative (sewers connected to separate stormdrain systems). While these programs are important in managing the risks from exposure to floodwaters, some risk will always remain, especially for low-lying properties during and following extreme storm events. As such, DEP has collaborated with DPH to develop guidance for the public who may be at risk to flood conditions. This Guidance includes suggested actions before and after flood events to minimize the public health risk and property damage. In all cases where flood conditions are expected or occur, the public should always remain in close contact with public safety officials as well.

Prevention:

If a home is located in an area subject to periodic flooding (such as in a floodplain) or where sewage backups have occurred, the homeowner should implement "all feasible measures" to prevent/minimize the nature and extent of impacts from such situations. Such actions can be preventive or pro-active.

Preventive actions include:

1. waterproofing the building foundation and/or sealing cracks in foundation floor or walls;
2. installation of a check valve or shut-off valve on the building sewer

close to where it enters the structure, which will protect your home from sewage back-ups due to surcharging conditions in the municipal sewerage system (***you must*** check with the proper sewer authority prior to taking this action!!); and

3. raising or removing any sink, toilet, washing machine, etc. in the basement that may be subject to backups when the sewer system surcharges.

Pro-active measures include:

1. purchasing or installing a pump (e.g. sump pump) to pump out water that collects in the low point of the basement or structure;
2. ensure that building gutter downspouts and drains are directed away from the foundation and toward low points away from the home;
3. to the extent possible, keep furniture and valuables above flood levels where flooding has previously occurred; and
4. if minor flooding occurs, follow the water to its point-of-entry and seal cracks or defects to the extent possible.

Remember, an ounce of prevention is worth more than a pound of cure. Flood insurance is also vitally important where properties are known to be in floodplains or flood prone areas. More information on prevention and flood insurance is available on the FEMA website.

Cleanup of Internal Areas

Once the flood waters have receded and the property can be accessed safely, cleanup operations should commence - ***Remember to check with local emergency management officials before returning to a property affected by flooding!*** The most important steps are to restore the environment to a dry state and salvage any valuable property. The longer that water/waste are allowed to remain in your home or on your property, the greater the potential for illness and irreparable damage to your home, its contents, and environs. *Where they may be operated safely, use of pumps and dehumidifiers will be helpful in restoring dry conditions.* In any flood cleanup project regardless of the source, ***one should assume that pathogens are present and take appropriate precautions.***

The survival of pathogens depends on a number of factors: location (indoors vs. outdoors), season, type of surface contaminated, whether disinfectants are used, and also on environmental conditions such as humidity, temperature, and sunlight. Sunlight (UV radiation) reduces the survival rate of pathogens with numbers decreasing rapidly with increasing exposure to UV radiation. Mild temperatures and higher humidity in external situations result in longer survival times.

Prior to undertaking cleanup efforts, take proper precautions:

- Always wear protective gloves, eyewear, and boots. Rain gear is also advisable.
- Avoid direct contact with sewage material, and be particularly careful of your face and eyes. Goggles are recommended when using a hose and/or any chemicals.
- Protect all cuts and scrapes. Immediately wash and disinfect any wound that comes in contact with sewage.

The following steps should be taken to mitigate the microbial risk from a building contaminated with sewage:

· Any excess water should be removed from the property by pumps, wet vacs, or mopping. Dehumidifiers and active ventilation should also be used when available.

- All solid waste should be collected and disposed.
- All upholstered furniture and mattresses should be discarded, other contaminated furniture should be removed and cleaned or discarded.
- The affected areas should be washed with a detergent solution to remove sewage-related contamination, then disinfected and allowed to dry.

Sort damaged contents to be repaired or discarded. Use the following guide relative to discarding of household material and furnishings.

Usually Discard	**Always Discard**
Foam rubber	Food
Large carpets	Cosmetics
Books and paper products	Medicines and medical supplies
	Stuffed animals
	Toys
	Mattresses and pillows
	Upholstered couches and chairs
	Carpet padding
	Cardboard

BE CAREFUL

- Assume anything touched by sewage is contaminated.
- Clean and disinfect everything sewage has touched.
- Always wear protective rubber gloves, eyewear, and boots and be especially careful if you have cuts or open sores.

- Wash, disinfect, or discard any clothing and supplies immediately after use.

Disinfection

Disinfectants are typically chemical agents that reduce significant numbers of pathogens to levels below those expected to cause disease. Cleaning and disinfection are two different processes. Cleaning removes the dirt. The processes of disinfection and decontamination are important to ensure the elimination of pathogens and organisms that were contained in the sewage or that grew during the period of contamination. Even concrete can be colonized and broken down by microorganisms if it is allowed to remain wet and contaminated by organic matter. Many household products are capable of disinfecting surfaces and should be used in accordance with manufacturer's label directions. A household bleach solution is also an effective disinfection agent, and can be made by combining one quarter cup of household bleach to one gallon of water. Bleach should never be used directly without dilution since, in this concentrated form, the bleach can cause severe skin and respiratory hazards.

To prepare surfaces for disinfection, wash surfaces first with warm soapy water and rinse surface. Apply the disinfectant solution to all areas of the affected surface, and allow for sufficient contact and drying time.

When proceeding with cleanup operations, remember that those individuals whose immune systems are in some way compromised or who are otherwise susceptible due to age, medication, or underlying illness, are considered to be at greater risk of contracting infections than those individuals who are healthy.

If you decide you that you need professional help:

- Look under "Carpet Cleaning", "Fire Restoration", or "Mold Abatement" in the telephone book. If you hire cleanup or repair contractors, be sure they are qualified to perform the job. Always check references and ask whether they are insured. Certification for these companies is not currently required or available in Massachusetts.
- Contact your local emergency management officials, to determine if there are resources available for assistance, or to get referrals for qualified contractors.

More detailed information on cleaning up after a flood event can also be found on the Red Cross website.

Cleanup of External Areas

The majority of the microbial population from sewage flooding onto lawns, tarmac and paved areas will be inactivated within several days due to exposure to UV radiation from sunlight. A disinfectant can be used on tarmac and paved areas. Contamination on grass could be left to degrade naturally. Typically, bacterial numbers on turf are reduced to background levels expected in the environment within 13 days, but can extend to 20 days on soil and sand in the autumn and spring. Generally, the least absorbent or pervious surfaces absorb the least sewer and bacterial concentrations and return to background levels the quickest.

References/Other Sources of Information

Protecting Your Home from Flooding, FEMA, 1994
Repairing Your Flooded Home, FEMA-234, 1992
Flood Emergency and Residential Repair Handbook, FIA-13, 1986
Retrofitting Flood-Prone Residential Structures, FEMA-114, 1986
Protecting Building Utilities from Flood Damage, FEMA-348, 1999

To obtain copies of these and other FEMA documents, call FEMA Publications at 1-800-480-2520 Information is also available on the World Wide Web at http://www.fema.gov.

Other Internet Links

Red Cross - Repairing Your Flooded Home
FEMA - Preparation & Prevention
FEMA - Floods
MEMA - What is a Flood?
MA Department of Public Health - Storm Fact Sheet

Disclaimer:

The information provided is based on research and input from experienced professionals. The reader must assume responsibility for adapting this information to local conditions. This document should be used as a guide and is not intended to replace the advice and guidance of experienced professionals and public health officials who are able to view a home and assess the needs of the particular situation.

It is important to note that during and following flooding events, dangerous and even life-threatening hazards may exist, and the public is strongly urged to contact local and state emergency management officials for instructions on the procedures or actions necessary to safely avoid injury during these conditions.

Emergency Procedures for Flooded Homes

Caution! Flooding can cause electrocution and other hazards.

- Avoid any downed power lines.
- Turn off your electricity until your house is dried out.
- Do not use appliances or motors that have gotten wet.
- Check for gas leaks.
- Follow FEMA and Red Cross guidelines to avoid hazards, and call your Department of Public Health for help.

Caution! Floodwaters may be contaminated by sewage and street runoff. Clean and disinfect everything that gets wet.

Cleaning up inside:

- Wear rubber gloves, eyewear and boots.
- Cover any cuts or open sores.
- Wash *and* disinfect or discard any clothing and supplies immediately after use.
- Keep the pregnant women, children and people who are ill away from flooded areas.
- Discard: Food, Cosmetics, Medicines and medical supplies, Stuffed animals and toys, Mattresses and pillows, Upholstered couches and chairs, Carpet padding & large carpets, Cardboard, Foam rubber, Books and paper products
- Wash the affected areas with detergent solution. Then disinfect and allow to dry.

Cleaning up outside:

Sunlight will kill bacteria from contaminated floodwater within a few days. Disinfect tarmac and paved areas, or avoid contact for several days. Avoid contact with soil, sand, and landscaped areas.

Emergency contacts:

Arlington:
Public Health [phone #]
Public Works [phone #]

Belmont:
Public Health [phone #]
Public Works [phone #]

Cambridge:
Public Health [phone #]
Public Works [phone #]

Resources:

MA Department of Environmental Protection and MA Department of Public Health, "Flooding and Sewage Back-ups: Home Care Guide", http://www.state.ma.us/dep/brp/stormwtr/files/flooding.htm

FEMA and the Red Cross, "Repairing Your Flooded Home," http://www.redcross.org/static/file_cont333_lang0_150.pdf

MA Department of Public Health, "Storm Fact Sheet", http://www.state.ma.us/dph/dcs/stormfct.htm

Appendix I: United Stated Federal Emergency Management Agency Homeowner Advice on Flood Prevention

Appendix

The Federal Emergency Management Agency (FEMA) has a number of publications that provide useful information on preventing and recovering from a flood. This appendix includes excerpts from several FEMA publications.

FEMA's *Homeowner's Guide to Retrofitting* (June 1998) provides information on a ways to retrofit your house to prevent flooding damage –including elevating your house, wet floodproofing (allowing floodwater into the lower floor of your house, with protection for other areas), moving your house to a less floodprone location, dry floodproofing (waterproofing, using a sump pump, and installing check valves), and constructing levees or floodwalls.) The guide is available for downloading from http://www.fema.gov/hazards/floods/lib312.shtm, and a copy is available for viewing at the Mystic River Watershed Association's office.

Other useful publications can be obtained on FEMA's website, at http://www.fema.gov/library/prepandprev.shtm, or by calling 1-800-480-2520. The following is a list of FEMA publications available on-line as of February 2004.

Flood Insurance

General Publications

- Answers to Questions about the NFIP
- Avoiding Flood Damage: A Checklist for Homeowners -- 178 KB
- Coping with a Flood - Before, During & After
- Flood: Are you Protected from the Next Disaster?
- How the NFIP Works
- How You Can Benefit from the New ICC Endorsement
- Myths & Facts
- Nothing Could Dampen the Joy of Home Ownership
- Preferred Risk Policy
- Things You Should Know About Flood Insurance
- Tips on Handling Your Flood Insurance Claim
- Top 10 Facts Every Consumer Needs to Know About the NFIP
- What You Need to Know About Federal Disaster Assistance & National Flood Insurance
- Who is at Risk for Flooding?
- Why You Should Have a Preferred Risk Policy
- Your Homeowners Insurance Doesn't Cover Floods
- Flood Zone Determination Companies
- National Flood Insurance Program (NFIP) Program Description -- 621 KB

- Nada Podria Arruinar el disfrute de su Hoger
- Su Seguro de Vivienda de residencia no cubre Inundaciones...

Floodplain Management

- Above the Flood: Elevating Your Floodprone House
- Addressing Your Community's Flood Problems
- After a Flood: The First Steps
- Alluvial Fans: Hazards and Management
- Answers to Questions About Substantially Damaged Buildings
- Answers to Questions About the National Flood Insurance Program
- A Report - Mitigation of Flood and Erosion Damage to Residential Buildings in Coastal Areas
- A Unified National Program for Floodplain Management
- Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas
- Code Capability Report and Appendices A-F
- Design Guidelines for Flood Damage Reduction
- Engineering Principles and Practices of Retrofitting Floodprone Residential Structures
- Elevated Residential Structures
- Engineering Principles and Practices of Retrofitting Floodprone Residential Structures
- Federal Programs Offering Non-structural Flood Recovery and Floodplain Management Alternatives
- Flood Insurance Program Community Status Book
- Floodplain Management Bulletin 1-98 - Use of Flood Insurance Study FIS Data As Available Data
- Floodplain Management in the United States: An Assessment Report Summary and Volume 2: Full Report
- Floodproofing Non-Residential Structures
- Hazard Mitigation Grant Program Desk Reference
- Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding
- Managing Floodplain Development in Approximate Zone A Areas - A Guide for Obtaining and Developing Base (100 yr) Flood Elevations
- Manufactured Home Installation in Flood Hazard Areas
- National Flood Insurance Program - Community Rating System (CRS) Coordinator's Manual
- Protecting Building Utilities from Flood Damage
- Protecting Floodplain Resources - A Guidebook for Communities
- Protecting Building Utilities from Flood Damage: Principles and Practices for Design and Construction of Flood Resistant Utility Systems.
- Property Acquisition Handbook for Local Communities
- Repairing Your Flooded Home
- Reducing Flood Losses through International Code Series
- Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials
- Report of the Floodplain Management Forum
- Technical Bulletins

[Return to Mitigation Division - Insurance & Mitigation Resources]

State & Local Official Publications

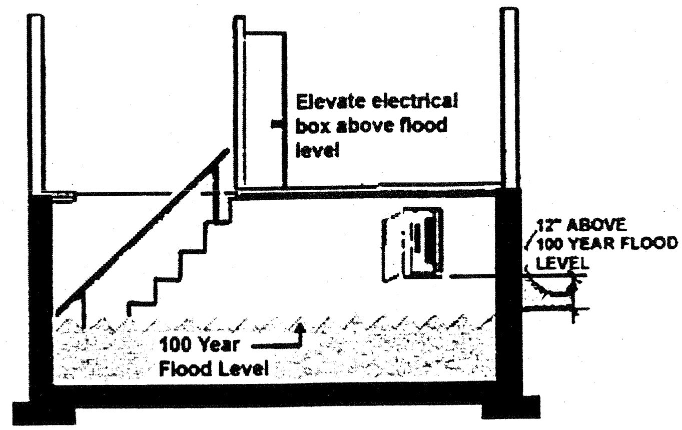
- Federal Programs Offering Non-Structural Flood Recovery and Floodplain Management Alternatives -- 381 KB
- Hazard Mitigation Grant Program Desk Reference
- Managing Floodplain Development in Approximate Zone A Areas

- Managing Floodplain Development through the NFIP, student manual
- Property Acquisition Handbook for Local Communities
- Reducing Flood Losses through International Code Series
- Reducing Risk: Information for Communities
- Federal Programs Offering Non-Structural Flood Recovery and Floodplain Management Alternatives -- 381 KB
- NFIP Bulletins
- NFIP Study Guide
- Report of the Floodplain Management Forum

The following guidelines are a compilation of materials provided on the FEMA website.

PROTECTING YOUR HOME FROM FUTURE FLOOD DAMAGE

You can reduce the risk of future flood damage to your property by taking common-sense steps when making repairs to your home or property. These steps are known as hazard mitigation. Mitigation techniques can be designed for your home to minimize the effects of floodwaters on your property and your family.



Many Mitigation Measures Are Low-Cost

Mitigation measures don't have to be expensive. If you live in a flood hazard area, there are many low-cost measures that you can take to reduce your risk from future flooding.

Heating and hot-water systems, washers and dryers can be elevated on a platform at least 12 inches above the flood level. Electrical panels and utilities also should be relocated to an area above the flood level. If the space is not high enough to allow elevation of the utility, the utility may be moved to an upper floor or attic space.

Other measures include building a floodwall around basement windows to protect the basement from low-level flooding and anchoring fuel tanks to prevent them from floating and over-turning.

Before any alterations or repairs are made, contact your local building official to obtain any necessary permits.

Sewer Backflow Valves

Install Sewer Backflow Valves

In some floodprone areas, flooding can cause sewage from sanitary sewer lines to back up into houses through drain pipes. These backups not only cause damage that is difficult to repair but also create health hazards.

A good way to protect your house from sewage backups is to install backflow valves, which are designed to block drain pipes temporarily and prevent flow into the house. Backflow valves are available in a variety of designs that range from the simple to the complex. The figure shows a gate valve, one of the more complex designs. It provides a strong seal, but must be operated by hand. So the effectiveness of a gate valve will depend on how much warning you have of impending flooding. Among the simpler valves are a flap or check valves, which open to allow flow out of the house but close when the flow reverses. These valves operate automatically but do not provide as strong a seal as a gate valve.

Tips

Keep these points in mind if you have backflow valves installed:

- Changes to the plumbing in your house must be done by a licensed plumber or contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.
- Some valves incorporate the advantages of both flap and gate valves into a single design. Your plumber or contractor can advise you on the relative advantages and disadvantages of the various types of backflow valves.
- Valves should be installed on all pipes that leave the house or that are connected to equipment that is below the potential flood level. So valves may be needed on washing machine drain lines,

laundry sinks, fuel oil lines, rain downspouts, and sump pumps, as well as sewer/septic connections.

- If you have a sump pump, it may be connected to underground drain lines, which may be difficult to seal off.

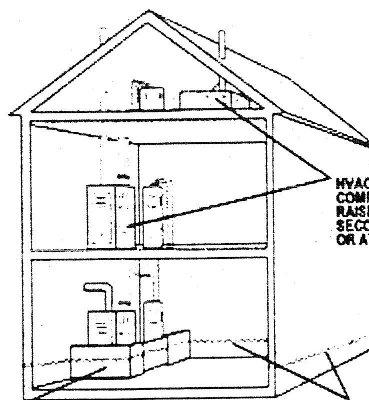
Estimated Cost

Having a plumber or contractor install one backflow valve will cost you about $525 for a combined gate/flap valve or about $375 for a flap valve. These figures include the cost of excavation and back-filling.

Heating, Ventilating, and Air Conditioning Equipment

Raise or Floodproof HVAC Equipment

Heating, ventilating, and cooling (HVAC) equipment, such as a furnace or hot water heater, can be damaged extensively if it is inundated by flood waters. The amount of damage will depend partly on the depth of flooding and the amount of time the equipment remains under water. Often, the damage is so great that the only solution is replacement.



In floodprone houses, a good way to protect HVAC equipment is to move it from the basement or lower level of the house to an upper floor or even to the attic. A less desirable method is to leave the equipment where it is and build a concrete or masonry block floodwall around it. Both of these methods require the skills of a professional contractor. Relocation can involve plumbing and electrical changes, and floodwalls must be adequately designed and constructed so that they are strong enough and high enough to provide the necessary level of protection.

Tips

Keep these points in mind when you have your HVAC equipment raised or floodproofed:

- Changes to the plumbing, electrical system, and ventilating ductwork in your house must be done by a licensed contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.

- If you are having your existing furnace or hot water heater repaired or replaced, consider having it relocated at the same time. It will probably be cheaper to combine these projects than to carry them out at different times.

- Similarly, if you have decided to raise your HVAC equipment, consider upgrading to a more energy-efficient unit at the same time. Upgrading can not only save you money on your heating and cooling bills, it may also make you eligible for a rebate from your utility companies.

- f you decide to protect your HVAC equipment with a floodwall, remember that you will need enough space in the enclosed area for system repairs and routine maintenance. Also, depend-ing on its height, the wall may have to be equipped with an opening that provides access to the enclosed area. Any opening will have to be equipped with a gate that can be closed to prevent flood waters from entering.

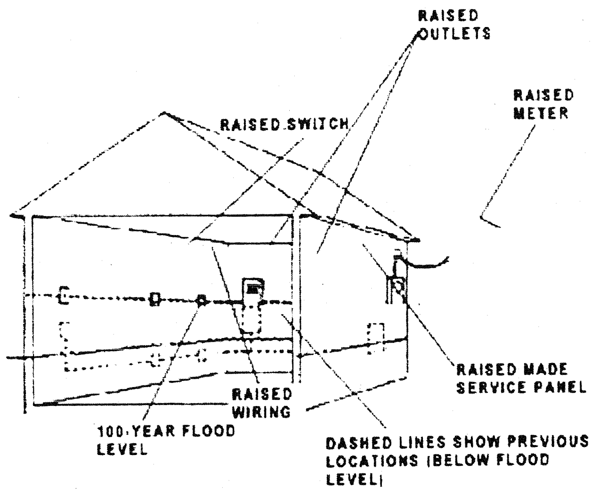
Estimated Cost

Having your furnace and hot water heater moved to a higher floor or to the attic will cost about $ 1,500. The cost of a floodwall will depend partly on its height and length. A 3-foot-high wall with a perimeter length of 35 feet would cost about $1,000.

Raise Electrical System Components

Electrical system components, including service panels (fuse and circuit breaker boxes), meters, switches, and outlets, are easily damaged by flood water. If they are inundated for even short periods, they will probably have to be replaced. Another serious problem is the potential for fires caused by short circuits in flooded systems. Raising electrical system components helps you avoid those problems. Also, having an undamaged, operating electrical system after a flood will help you clean up, make repairs, and return to your home with fewer delays.

As shown in the figure, all components of the electrical system, including the wiring, should be raised at least 1 foot above the 100-year flood level. In an existing house, this work will require the removal of some interior wall sheathing (drywall, for example). If you are repairing a flood-damaged house or building a new house, elevating the electrical system will be easier.



Tips

Keep these points in mind when you have your electrical system components raised:

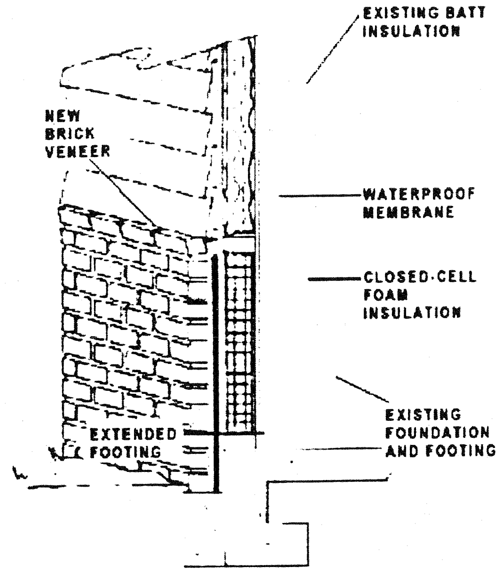
- Electrical system modifications must be done by a licensed contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.
- Your contractor should check with the local power company about the maximum height that the electric meter can be raised.
- If your house is equipped with an old-style fuse box or low-amperage service, you may want to consider upgrading to a modern circuit breaker system and higher-amperage service, especially if you have large appliances or other electrical equipment that draws a lot of power.

Estimated Cost

Raising the electrical service panel, meter, and all of the outlets, switches, and wiring in a 1,000-square-foot, single-floor house will cost about $1,500 to $2,000. If this work is performed during the repair of a damaged house or construction of a new house, the cost may be much lower.

Exterior Walls

Add Waterproof Veneer to Exterior Walls



Even in areas where flood waters are less than 2 feet deep, a house can be severely damaged if water reaches the interior. The damage to walls and floors can be expensive to repair, and the house may be uninhabitable while repairs are underway.

One way to protect a house from shallow flooding is to add a waterproof veneer to the exterior walls and seal all openings, including doors, to prevent the entry of water. As shown in the figure, the veneer can consist of a layer of brick backed by a waterproof membrane. Before the veneer is applied, the siding is removed and replaced with exterior grade plywood sheathing. If necessary, the existing foundation footing is extended to support the brick. Also, because the wall will be exposed to flood water, changes are made to the interior walls as well so that they will resist moisture damage. In the area below the flood level, standard batt insulation is replaced with washable closed-cell foam insulation, and any wood blocking added inside the wall cavity is made of exterior grade lumber.

Tips

Keep these points in mind when you have a waterproof veneer added to the exterior walls of your house:

- Adding a waterproof veneer is appropriate in areas where the flood depth is less than 2 feet. When flood depths exceed 2 feet, the pressure on waterproofed walls increases greatly, usually beyond the strength of the walls. If greater flood depths are expected, consult with a licensed civil or structural engineer before using this method.
- Changes to the foundation of your house must be done by a licensed contractor, who will en-sure that the work is done correctly and according to all applicable codes. This is important for your safety.
- If your house is being remodeled or repaired, consider having the veneer added as part of the remodeling or repair work. It will probably be cheaper to combine these projects than to carry them out separately.
- If your house has brick walls, you can still use this method. The new brick veneer and water-proof membrane are added over the existing brick.
- If your house is flooded by groundwater entering through the floor, this method will not be effective.

Estimated Cost

If you have a contractor add a waterproof brick veneer to your house, you can expect to pay about $10 per square foot of exterior wall. For example, a 3-foot-high brick veneer on a house measuring 60 feet by 30 feet would cover about 540 square feet and would cost about $5,400. This figure does not include the cost of sealing doors and other openings or extending the foundation.

Appendix J: National Disaster Coalition Repairing Your Flooded Home

Appendi› .

National Disaster Education Coalition, "Repairing Your Flooded Home"

(available as a .pdf file at
http://www.redcross.org/services/disaster/0,1082,0_570_,00.html#after)

Your home and its contents may look beyond hope, but many of your belongings can be restored. If you do things right, your flooded home can be cleaned up, dried out, rebuilt, and reoccupied sooner than you think.

Play it safe. The dangers are not over when the water goes down. Your home's foundation may have been weakened, the electrical system may have shorted out, and floodwaters may have left behind things that could make you sick. When in doubt, throw it out. Don't risk injury or infection.

Ask for help. Many people can do a lot of the clean up and repairs discussed in this book. But if you have technical questions or do not feel comfortable doing something, get professional help. If there is a federal disaster declaration, a telephone "hotline" will often be publicized to provide information about public, private, and voluntary agency programs to help you recover from the flood.

Floodproof. It is very likely that your home will be flooded again someday. You can save a lot of money by floodproofing as you repair and rebuild. See Step 8. You should also prepare for the next flood by buying flood insurance and writing a flood response plan.

Table of Contents

Step 9. Prepare for the Next Flood
Protect yourself from the next flood with flood insurance, a flood response plan, and community flood protection programs. This step also includes sources to go to for additional assistance.

Hard copies of this information in book form are available from your local Red Cross chapter or by writing:

FEMA
P. O. Box 2012
Jessup, MD 20794-2012

Production This book was prepared for the Federal Emergency Management Agency under Contract Number EMW-89-C-3024 and EMW-91-K-3738.

FEMA and the American Red Cross gratefully acknowledge the thoughtful assistance provided by the many individuals who reviewed this book. Reviewers included repair and reconstruction contractors, mental health professionals, sociologists, researchers, disaster assistance specialists, insurance experts, underwriters, structural engineers, public health agents, floodplain managers, emergency managers, education specialists, editorial experts, and graphic designers.

What to Do After a Flood or Flash Flood

- **Seek necessary medical care at the nearest hospital or clinic.** Contaminated flood waters lead to a greater possibility of infection. Severe injuries will require medical attention.
- **Help a neighbor who may require special assistance--infants, elderly people, and people with disabilities.** Elderly people and people with disabilities may require additional assistance. People who care for them or who have large families may need additional assistance in emergency situations.
- **Avoid disaster areas.** Your presence might hamper rescue and other emergency operations, and put you at further risk from the residual effects of floods, such as contaminated waters, crumbled roads, landslides, mudflows, and other hazards.
- **Continue to listen to a NOAA Weather Radio or local radio or television stations and return home only when authorities indicate it is safe to do so.** Flood dangers do not end when the water begins to recede; there may be flood-related hazards within your community, which you could hear about from local broadcasts.
- **Stay out of any building if flood waters remain around the building.** Flood waters often undermine foundations, causing sinking, floors can crack or break and buildings can collapse.
- **Avoid entering ANY building (home, business, or other) before local officials have said it is safe to do so.** Buildings may have hidden damage that makes them unsafe. Gas leaks or electric or waterline damage can create additional problems.
- **Report broken utility lines to the appropriate authorities.** Reporting potential hazards will get the utilities turned off as quickly as possible, preventing further hazard and injury. Check with your utility company now about where broken lines should be reported.
- **Avoid smoking inside buildings.** Smoking in confined areas can cause fires.

- **When entering buildings, use extreme caution.** Building damage may have occurred where you least expect it. Watch carefully every step you take.
    - **Wear sturdy shoes.** The most common injury following a disaster is cut feet.
    - **Use battery-powered lanterns or flashlights when examining buildings.** Battery-powered lighting is the safest and easiest, preventing fire hazard for the user, occupants, and building.
    - **Examine walls, floors, doors, staircases, and windows to make sure that the building is not in danger of collapsing.**
    - **Inspect foundations for cracks or other damage.** Cracks and damage to a foundation can render a building uninhabitable.
    - **Look for fire hazards.** There may be broken or leaking gas lines, flooded electrical circuits, or submerged furnaces or electrical appliances. Flammable or explosive materials may travel from upstream. Fire is the most frequent hazard following floods.
    - **Check for gas leaks.** If you smell gas or hear a blowing or hissing noise, open a window and quickly leave the building. Turn off the gas at the outside main valve if you can and call the gas company from a neighbor's home. If you turn off the gas for any reason, it must be turned back on by a professional.
    - **Look for electrical system damage.** If you see sparks or broken or frayed wires, or if you smell burning insulation, turn off the electricity at the main fuse box or circuit breaker. If you have to step in water to get to the fuse box or circuit breaker, call an electrician first for advice. Electrical equipment should be checked and dried before being returned to service.
    - **Check for sewage and waterline damage.** If you suspect sewage lines are damaged, avoid using the toilets and call a plumber. If water pipes are damaged, contact the water company and avoid using water from the tap. You can obtain safe water from undamaged water heaters or by melting ice cubes.
    - **Watch out for animals, especially poisonous snakes, that may have come into buildings with the flood waters. Use a stick to poke through debris.** Flood waters flush snakes and many animals out of their homes.
    - **Watch for loose plaster, drywall, and ceilings that could fall.**
    - **Take pictures of the damage, both of the building and its contents, for insurance claims.**
- After returning home:
    - **Throw away food that has come in contact with flood waters.** Some canned foods may be salvageable. If the cans are dented or damaged, throw them away. Food contaminated by flood waters can cause severe infections.
    - **If water is of questionable purity, boil or add bleach, and distill drinking water before using.** (See information on water treatment under the "Disaster Supplies Kit" section.) Wells inundated by flood waters should be pumped out and the water tested for purity before drinking. If in doubt, call your local public health authority. Ill health effects often occur when people drink water contaminated with bacteria and germs.
    - **Pump out flooded basements gradually (about one-third of the water per day) to avoid structural damage.** If the water is pumped completely in a short period of time, pressure from water-saturated soil on the outside could cause basement walls to collapse.
    - **Service damaged septic tanks, cesspools, pits, and leaching systems as soon as possible.** Damaged sewage systems are health hazards.

Produced by the National Disaster Education Coalition: American Red Cross, FEMA, IAEM, IBHS, NFPA, NWS, USDA/CSREES, and USGS

Appendix K: Massachusetts Department of Public Health, Division of Community Sanitation, Storm Fact Sheet

Appendix

Massachusetts Department of Public Health
Division of Community Sanitation

Storm Fact Sheet

Flooding

If a person must come into contact with the floodwater they should take the following general precautions:

- Keep all children and pets out of the floodwater.
- Check in on elderly or chronically ill neighbors to make sure that they are safe.
- Wear waterproof boots, gloves, eye protection and clothes that are either water resistant or disposable.
- Make sure all gas and electric utilities to the affected area are turned off by appropriate persons before you enter.
- Keep contact time with flood waters to a minimum and avoid splashing. It is especially important to keep the water out of mouth, eyes and nose.
- If there has been personal exposure to the flood waters, bathe or shower thoroughly with soap and water and wash all contaminated clothing in hot water and a detergent.
- Make sure tetanus immunization is up to date for any person who is exposed to flood waters. For most adults, having received a tetanus booster within the past 10 years is adequate. For children, parents should check with their pediatrician to make sure the tetanus vaccination is up to date.
- General use of immune globulin (IG) injections for hepatitis A is not being recommended. However, individuals should consult with their primary health care provider if they have significant underlying health problems or are immunocompromised (e.g., on steroid therapy, chemotherapy for cancer, has HIV or some other disease that weakens the immune system).
- Health care providers should be contacted if an individual becomes ill with fever, nausea, vomiting or diarrhea after exposure to possibly contaminated flood waters.

Wells

If the area over a well is under flood water, the recommended procedure for disinfecting is:

1. pour a solution of three gallons of water and one pint of 3% to 6% commercial bleach directly into the well,
2. open all faucets until there is an odor of chlorine apparent and then close all faucets for ten hours to allow the bleach to kill bacteria present in the pipes, storage tank or well,
3. open all faucets and let the water run until the odor and taste of bleach have disappeared,
4. have a sample of water, taken 24 hours after disinfecting, tested at a certified laboratory to determine that the water is suitable for use.

Note: This procedure results in a high level of chorine so the water should not be used for drinking, cooking, or watering livestock until the chlorine odor and taste is no longer apparent. Use of bottled water or boiling water is suggested if citizens are unsure of the purity of their water supply.

Homes and buildings

Flooded buildings should be pumped out and disinfected. After the water is pumped out, solid wastes should be disposed of in a functioning sewage disposal system or sealed in plastic bags for ultimate disposal in an approved landfill. All flooded floor and wall surfaces should be washed with a solution of two capfuls of household bleach for each gallon of water. Any household articles affected by floodwaters should be washed with the same solution. Carpeting, mattresses and upholstered furniture should be disposed of or cleaned and disinfected by a professional cleaner.

Yards

Yards that have been contaminated by flooded sewage systems should be disinfected by a liberal application of lime. Children and animals should be kept away from limed areas until the lime is no longer visible.

Power Failure/Food Safety

Heavy rain can mean a disruption in electrical and gas service and the availability of potable water. When power goes off in the refrigerator, you can normally expect food inside to stay safely cold for 4 to 6 hours, depending on how warm your kitchen is. Here are some additional guidelines:

- Add a block of ice to the refrigerator if the electricity is off longer than 4-6 hours. As this ice melts, the water may saturate food packages. Keep packages out of the water as it drains.
- High protein foods (dairy products, meat, fish, and poultry) should be consumed as soon as possible if power is not restored immediately. They cannot be stored safely at room temperature.
- Fruits and vegetables can be kept safely at room temperature until there are obvious signs of spoilage.
- A fully stocked freezer will keep food frozen 2 days if the door remains closed. A half-full freezer can keep foods frozen about one day.
- If you are purchasing perishable foods from a market in an area that has been affected by power outages, make sure that the cold foods have been kept below 45 degrees F. and that hot foods have been kept above 140 degrees F.

Generally, do not eat any food that has come in contact with floodwater, especially root and garden vegetables. Citrus fruits should be washed well, sanitized in a chlorine solution and peeled before eating. Apples and other fruits should also be cooked before eating. Carefully examine all canned and bottled goods, these are usually not affected but should be washed thoroughly with approved drinking water and a mild disinfecting solution and rinsed prior to opening and use. Canned or powdered milk may be substituted for fresh milk.

Injury Prevention
Hazards of floods continue to exist after the water recedes as workers, volunteers and homeowners begin to clean up. There are many hazards besides drowning which may cause serious injury. Some basic cautions should be taken as follows.

Electrical hazards: When entering flooded areas, be aware of electrical hazards. Don't touch any electrical equipment unless you are absolutely sure it is properly grounded or that the power is off. Also, don't operate any electrical equipment that is not specifically designed for use in wet locations. The water in which you are standing will provide a path for the electricity if you touch any equipment that is not properly grounded. That path will go through you too.

Never handle a downed power line. If clearing or other work must be performed near a downed power line, contact the utility company. Extreme caution is necessary when moving ladders and other equipment near overhead power lines to avoid inadvertent contact.

*Carbon Monoxide:*Flood cleanup activities may involve the use of gasoline- or diesel-powered pumps, generators, and pressure washers. Because these devices release carbon monoxide, a deadly, colorless, odorless gas, operate all gasoline-powered devices outdoors and *never bring them indoors*.

Back Injuries: Get help to move heavy objects. Working on slippery surfaces can also cause injuries. Make sure you have a firm footing before lifting. Make sure you have a clear path for carrying heavy objects.

Heavy Equipment: Never operate equipment that you have not been adequately trained to use. When crews are working around heavy equipment, site control is critical. During an emergency, people will not pay attention to back-up alarms. Do not work around heavy equipment unless it is absolutely necessary. Have as few pedestrians in the area as possible.

Structural Instability: Never assume that water-damaged structures or ground are stable. Soil is also easily destabilized in wet conditions and may collapse without warning.

Additional questions about proper disinfection procedures and other potential health problems related to the storm can be directed to the local Board of Health in each city or town.

Appendix L: Proposed and Potential Developments in the Alewife Area by the Mystic River Watershed Association

Proposed and Potential Developments in the Alewife Area

Site	City/Town	Description	Area	# Parking Spaces	Sewage	EOEA #	Status
Mugar Property	Arlington	300,000 sf office	17 acres (most in 100 yr floodplain)	1,150	22,500 gpd	12307	Scoped by MEPA, no Draft EIR yet
O'Neill (Belmont Uplands)	Belmont (part in Cambridge)	original: 245,000 sf office revised: 250 units residential (300,000 sf)	12 acres	original: 750 revised: 500	50,000 gpd	12376	Final EIR for office park completed summer 2003 No EIR filed yet for residential project
McLean Hospital	Belmont	111 condos, 480 elderly units, 150,000 sf R&D, 50,000 hospital expansion Total = 800,000 sf	238 acres	2,700	126,000 gpd	12408	EIR completed 2002
Concord-Alewife Development Plan	Cambridge	1.3 mill sf office, 1.3 mill sf housing, 175,000 sf retail Total = 2.8 mill sf	275 acres	~3,000	400,000 gpd		No MEPA filing yet.
Martignetti	Cambridge	347 units or 416,000 sf (proposed 2001) plus 125,000 sf office	8 acres (most in 100 yr floodplain, some wetlands)	416 residential 310 to replace 200 for office	~85,000 gpd		No MEPA filing yet
Bullfinch (ADL site)	Cambridge	900,000 sf office (to replace existing bldgs, now about 100,000 sf)	40 acres	1,050 (to replace 750)	70,000 gpd		No MEPA filing yet
Alewife Center (Grace site)	Cambridge	1,050,000 office, hotel and retail (1988 proposal) 150,000 sf retail, 250 units, 150,000 sf hotel, 87,000 sf office (1996 proposal)	20 acres	2,400 (1988)	150,000 gpd (1988) 120,000 gpd (1996)	5869 (1988)	Notice of project change withdrawn with no MEPA action. On hold; undergoing 21E review.
TOTALS		6,825,000 sf	almost 1 sq. mile (of 7 sq miles in the Alewife sub-watershed)	11,525	908,000 gpd		

Compiled by Steve Kaiser.

Appendix M: Bibliography

BIBLIOGRAPHY

1904 .... "Report on Improvement of the Upper Mystic River and Alewife Brook by Means of Tide Gates and Large Drainage Channels," by John Freeman, for the Metropolitan Park Commission.

1936 .... "High Water Data : Flood of March 1936 in Massachusetts," by the Mass Geodetic Survey/Mass DPW WPA Project 165-14-6085

1955 ... "Hurricane Rains and Floods of August 1955 Carolinas to New England," Technical Paper No. 26, Weather Bureau, U.S. Department of Commerce

1962 .... "Mystic River Basin Report," by C. A. Maguire, prepared for the MDC

1974 "Mill Brook Hydrological Flood Plain Study for the Town of Arlington," by C.A. Maguire for Town of Arlington, Redevelopment Board and Conservation Commission.

1974 ... Moore Survey & Mapping Corporation, *Photogrammatic Maps*, scale 1:480 Conto ur interval = 1 foot : Route 2, Arlington and Cambridge for Mass DPW

1979 .... "Special Problem Report" to FEMA "Unresolved Discrepancies" by C-E Maguire, Inc. #250186 Feb. 8, 1979

1981 ... "Mystic River Comprehensive Hydrology Study : Final Report" by Camp Dresser & McKee for the MDC (April and July, September)

1981 .... Town of Belmont : "Flood Insurance Study" by FEMA

1982 .... Town of Arlington : "Flood Insurance Study" by FEMA and Camp, Dresser & McKee

1982 .... Cambridge : "Flood Insurance Study" by FEMA and CE Maguire. Data revised for Alewife Brook by Research Analysis, Inc.

1984 ... "Draft Environmental Impact Report" New Office Facility for Arthur D. Little by Jason Cortell & Assoc.

1987 ... "Route 2/Alewife Brook Parkway Project : Draft EIS/R" FHWA and Mass Dept. of Public Works, prepared by Fay Spofford & Thorndike

1997 ... "October 1996 Flood : regional Analysis - Massachusetts and New Hampshire" by U.S. Army Corps of Engineers .... "High Water Mark Report for storm Event of October 20-21, 1996," prepared for FEMA by U.S. Army Corps

1998 ... "The Flood of June 1998 in Massachusetts and Rhode Island," by U.S. Geological Survey, National Weather Service and NOAA

2001 ... "Notice of Project Change : Long Term CSO Control Plan for Alewife Brook," by Mass. Water Resources and Cambridge Public Works

2002 ... "Survey of Reports and Data on Rainfall and Flooding for the Alewife Brook Area of Arlington, Belmont and Cambridge," by Stephen Kaiser for Coalition for Alewife and Association of Cambridge Neighborhoods, First Edition

2002 .... "Mystic Flood Control Study" by CDM for MDC, Initial Draft (September)

2003 ... "Mystic Flood Control Study" by CDM for MDC, Revised (January/February)

2003 .... Citizen *photos* of flooding 1996, 1998, 2001 and 2004 by Elsie Fiore, Steve Kaiser and Sunnyside Neighbors

2003 ... "Survey of Reports and Data on Rainfall and Flooding for the Alewife Brook Area of Arlington, Belmont and Cambridge," by Stephen Kaiser for Coalition for Alewife and Association of Cambridge Neighborhoods, Second Edition

2003 .... "Response to Comments," Long Term CSO Control Plan for Alewife Brook," by Mass. Water Resources

2003 .... "Final variance Report," Long Term CSO Control Plan for Alewife Brook," by Mass. Water Resources and Cambridge Public Works

2003 .... 26 Flooding *memos* by S. Kaiser

Appendix N: Joint Powers Agreement (*Executed March 4, 2005*)

ENVIRONMENTAL JOINT POWERS AGREEMENT

A-B-C STORMWATER FLOODING BOARD

WHEREAS, the undersigned political subdivisions of the Town of Arlington, the Town of Belmont and the City of Cambridge Massachusetts, (hereinafter referred to individually by name or collectively as the "Communities"), all of such entities being public agencies as defined in Massachusetts General Laws, Chapter 21A, section 20, hereby desire to enter into this "Environmental Joint Powers Agreement" (the "Agreement") pursuant to said Chapter 21A, section 20;

WHEREAS, all of the Communities are committed to developing a consensus approach to the management, protection, and enhancement of natural resources and the environment and to reducing or eliminating any adverse effects of flooding and other hazards emanating from stormwater flow in the Little River and Alewife Brook areas (the "Watershed") and desire to enter into a joint powers agreement and form a Board to address such issues;

NOW, THEREFORE, IN CONSIDERATION OF THE MUTUAL COVENANTS AND UNDERTAKINGS HEREIN, THE COMMUNITIES AGREE AS FOLLOWS:

1. **Authorizing Statutes:** This Agreement is entered into pursuant to M.G.L., c. 21A, §20, as amended, and creates the A-B-C STORMWATER FLOODING BOARD (the "Board").

2. **Purpose:** The purpose of this Agreement is for the Communities to work jointly and cooperatively to identify and implement cost effective solutions to reduce or eliminate any adverse effects of flooding and other hazards in the Watershed pursuant to M.G.L. c. 21A, §20. The Communities agree that Arlington, Belmont and Cambridge should address such hazard reduction jointly because the independent hazard reduction actions of one Community can affect one or more of the other Communities in the Watershed.

3. **Creation of the Board and Division of Responsibilities:**

a) The Board shall consist of one (1) member for each of the Communities entering into this Agreement. Each member is to be appointed by the individual Communities to the Agreement in the manner selected by each community. Each Community shall be represented on the Board as follows:

1. Town of Arlington	-	one member with one vote
2. Town of Belmont	-	one member with one vote
3. City of Cambridge	-	one member with one vote

b) Each party to the Agreement shall, in addition to the appointment of its primary representative member, appoint at least one alternate member to the Board, who in the absence or incapacity of the primary member may be designated to act ("Designated Alternate") and shall act in place of the primary member. The Designated Alternate member shall have all the powers, duties and responsibilities of the primary member when serving as a member of the Board. Designated

Alternate members may attend all meetings of the Board but may not participate in deliberations of the Board or vote, except as a Designated Alternate member of the Board.

c) Each primary member or Designated Alternate member shall be entitled to one vote.

d) At the first official meeting of the Board the members shall elect a chairman, vice chairman, and treasurer/clerk who each shall serve for one (1) year or until their successors are duly elected and qualified.

e) The Board shall not conduct business unless a quorum consisting of all members or Designated Alternate members of the Board are present.

4. **Administration.**
a) The Board shall conduct its meetings, where applicable, under Robert's Rules of Order, as revised.

b) The Board shall meet in compliance with the Open Meeting Law of the Commonwealth of Massachusetts.

c) The Board shall coordinate the activities of the Communities under the Agreement, but only to the extent of and in accordance with the powers otherwise granted by law to one or more of the Communities.

5. **Estimated Costs and Methods of Financing.**
a) No Community shall be required to provide any funding to the Board, or pay any assessments for any administrative and contractual costs of this Agreement unless and until such funding or payment of assessments is specifically authorized by the Board and by the lawful appropriating agency of the member Community.

b) The Board, except as otherwise provided by law, is entitled to receive and expend public and private funds to defray the operational, administrative, and contractual costs of this Agreement, including, but not limited to salaries, wages, transportation and administrative overhead.

c) The Board shall adopt budget and accounting procedures that will result in the strict accountability of all receipts and disbursements.

6. **Financial Administration:** The Board shall account for the source and amount of all contributions made to the Board. The Board shall keep accurate records of all transactions of the Board. The Board shall maintain the records and keep them open for inspection and audit at all reasonable times by any member of the Board or for inspection and audit by any person designated by the governing body of any member Community who may be appointed to conduct such inspection and audit. Books and records of the Board shall be subject to inspection and copying pursuant to applicable federal and state statutes and regulations, including the Public Records Law, M.G.L. c. 4, §7(26), and c. 66, §10.

7. **Distribution of Assets:** In the event of dissolution of the Board for any reason, or termination of this Agreement by all the Communities or otherwise by law or equity, the unencumbered assets of the Board shall be equally distributed to the cities and towns who are Communities under this Agreement, after deduction for all legitimate expenses incurred pursuant to this Agreement. However, in the event that a Community provides funding to the Board in an amount which is not equal to the amount contributed by any other Community, upon dissolution, distributions shall be made to the Communities in proportion to their respective contributions.

8. **Termination:** Any party to this Agreement may cease to be a party to it and withdraw by written notification to the Board, which shall terminate this Agreement and cause the distribution of assets to the Communities pursuant to Paragraph 7, above.

9. **Limitation:** This Agreement shall not be construed to:

a) Amend, repeal or otherwise alter the authority or jurisdiction of, or establish, any public agency.

b) Confer any management authority over funds, land, or natural resources beyond the authority exercised by the participating Communities under appropriate laws and regulations.

c) Authorize legislatively appropriated funds to be expended for the purposes of this Agreement, or to be transferred or have the effect of being transferred from one appropriation to another, except as authorized by law.

d) Amend, repeal or otherwise alter the authority of the Department of Environmental Protection, Commonwealth of Massachusetts, to undertake or order actions pursuant to M.G.L. c. 21E, nor otherwise to require said department to participate in a joint powers agreement if the commissioner thereof determines that such participation would conflict with the purposes of said Chapter 21E.

10. **Liability:** Nothing in this agreement shall be construed to create liability on the part of any public agency for, the act or omission of another public agency.

11. **Severability**: If any part of this Agreement is adjudged illegal or invalid, such illegal or invalid part shall not be a part of this Agreement, shall be severed herefrom, and the adjudication shall not affect the validity of the of the remainder of the Agreement, in whole or any other part.

12. **Effective Date:** This Agreement shall not become effective until:

a. All of the Communities have executed the Agreement pursuant to official authorization in accordance with their local charter.

b. The Secretary of Environmental Affairs has held a public hearing concerning this Agreement and submitted the Secretary's approval in writing to the Clerks of the Senate and House of Representatives and any and all other requirements of law are met.

13. **Amendment:** This Agreement may be amended with the approval of the Secretary of Environmental Affairs and the consent of all of the duly authorized members voting; however, no amendment shall be valid or binding on a member Community which provides for the requirement of a member Community to provide any funding to the agency or pay any assessments for any operational administrative and contractual costs of this Agreement unless such funding or payment of assessments is specifically authorized by the lawful appropriating agency of the member Community.

14. **Governing Law:** This Agreement is governed by and interpreted under the laws of the Commonwealth of Massachusetts.

15. **Duration of the Agreement:** This term of this Agreement shall not exceed five years from its effective date without express approval as required under M. G. L., c. 21A, §20.

16. **Entire Agreement:** It is understood and agreed that the entire Agreement of the member Communities is contained herein and that this Agreement supersedes all other agreements and negotiations between the member Communities relating to the subject matter herein as well as any previous agreements previously in effect between the member Communities.

IN WITNESS THEREOF, Each of the undersigned local government's duly authorized representatives have set their signatures as set forth below to become one of the Communities hereunder.

Town of Arlington Diane M. Mahon - Board of Selectmen

By John W Hurd this 31st day of January, 2005

~~Print~~ Name CHARLES LYONS Title SELECTMAN

Print Name Kathleen Kiely Dias Title Board of Selectmen

Town of Belmont

By Paul Solomon this 10th day of January, 2005
PAUL SOLOMON

Print Name William N. Brownsberger Title Selectman
William N. Brownsberger

Print Name Angelo R. Firenze Title Selectman
ANGELO R. FIRENZE

City of Cambridge

By Robert W. Healy this 4th day of March, 2005

Print Name Robert W. Healy Title City Manager

Print Name ______________________ Title ______________________

Appendix O: Responses to Draft Progress Report

September 15, 2004

William N. Brownsberger
Chair, Tri-Community Working Group
Town Hall
455 Concord Ave.
Belmont, MA 02478-2573

Subject: MWRA Comments on Draft Progress Report

Dear Mr. Brownsberger:

MWRA staff have reviewed the June 2004 Draft Progress Report of the Tri-Community Working Group ("TCWG"), regarding flooding and sewage back-ups in the Alewife Brook subwatershed, and offer the following comments.

The report does a commendable job of compiling information and data from a variety of sources related to the flooding problems along Alewife Brook. The report identifies certain system optimization and evaluation measures that the TCWG would like MWRA to undertake. Many of them, such as the optimization of pumping capacity at our Alewife Brook pump station, are already underway, while others are planned. MWRA expects to be able to provide additional information to the TCWG about its sewer system as planned work proceeds and as the results of work that must be undertaken by Cambridge, Somerville and MWRA pursuant to conditions in the recently issued CSO variance extension become available.

Glossary of Terms

- For CFS and MGD, suggest adding the following conversion: 1 MGD = 1.547 CFS
- For I/I, suggest adding "groundwater and storm runoff that enters the sanitary sewer system"
- MWRA – Massachusetts Water Resources Authority (please correct all references)

Section 2: Surface Flooding

- A map of the watershed and key water bodies (e.g. Fresh Pond, Little River, Alewife Brook) would be helpful. It may also be interesting to compare two maps, one showing current topography and water resources and another showing these features prior to the Metropolitan Park Commission improvements and the isolation of Fresh Pond.

- Page 2-5, Reasons for Arterial Flooding in the Alewife: The reasons for flooding and the extent of flooding in various storms involves complicated hydrologic and hydraulic influences that define the conveyance and detention capacities of each section of the Alewife. While a complicated explanation may not be necessary or advisable, the analogy to the bath tub with a slow drain may mislead the readers early in their review into thinking that there is one bottleneck or even a small set of bottlenecks that could be relieved to solve the flooding problems. Instead, the problems involve a system of flows and capacities that require a systematic solution comprising a set of various runoff, conveyance and flood control measures. At a minimum, change the text to read "In general and very simplistic terms,…"

- Page 2-2, third full paragraph: change "conveyance rate and capacity of the trunk line pipes" to "conveyance capacity of the pipes, especially the larger pipes in the downstream sections of the drainage systems."

- Page 2-3 into 2-4: change "railroad and MWRA interceptor crossing of the Wellington Brook" to "railroad crossing of the Wellington Brook." The MWRA interceptors that cross under the brook are unrelated to the railroad crossing that includes culverts lying in the brook. Furthermore, while the interceptor crossing does not impede brook flow in any way, the draft report text implies that the interceptors are part of a restriction. MWRA has two active interceptors crossing under Wellington Brook: Section 81 Belmont Relief Sewer and Section 179 Alewife Brook Conduit - Belmont Branch. Section 81 is a 30" pipe with a transition to three 16" barrels to cross under the brook. Section 179 is a 36" pipe that transitions to an inverted siphon to cross under the brook. Neither one of these pipes interferes with brook flow. MWRA crew have, on occasion during inspections, removed large amounts of debris from the brook where it enters a three-barrel culvert supporting the train tracks. The railroad culverts and the debris that can collect in front of them appear to be a potential restriction to brook flow. Again, we ask that the reference to MWRA interceptors contributing to brook restrictions be removed.

Section 3: Sewage Overflows

- This section of the report should summarize the efforts to be undertaken by Somerville, Cambridge and MWRA pursuant to the three-year Alewife/Upper Mystic River CSO variance extension issued by DEP on September 1, 2004 (copy attached). Conditions in the variance extension may also warrant some changes to the text in the draft report, particularly related to Somerville's Tannery Brook and Cambridge's efforts to evaluate additional sewer separation.

- Page 3-1, second paragraph, second sentence: change to "In addition, all sewer pipes, especially if old or in disrepair, are susceptible to infiltration and inflow." All sewer pipes, especially the laterals that pick up flows from each home and building, are prone to significant quantities of infiltration and inflow, regardless of age, unless they are specially designed to be extremely water tight. The draft text may imply to the reader that infiltration and inflow could be avoided if systems were maintained. Well maintained systems control or minimize I/I, but don't preclude it.

- Page 3-1, last paragraph, beginning with third sentence: suggest revising description of MWRA system, as follows:

  MWRA's interceptor system comprises two, large diameter, gravity-flow pipes that parallel Alewife Brook. One pipe begins at the Belmont-Cambridge border north of Blair Pond and runs along the southern bank of the Alewife Reservation to the MBTA station. There, it joins the other MWRA pipe, which originates near the Alewife Rotary (at the Ground Round in Cambridge). From the MBTA station, the parallel lines continue in a northerly direction along the Alewife Brook until they reach the confluence of the Alewife Brook with the Mystic River. Here, an 18" MWRA interceptor serving parts of Lexington and Arlington ties into the system, and all flows discharge into the wet well of MWRA's Alewife Brook pump station. The pump station lifts the flows into larger pipes that convey flows to MWRA's Chelsea Creek Headworks and eventually to Deer Island for treatment.

- Page 3-2, first full paragraph: the noted CSO activation frequency (13 discharges/ year) and annual volume (22 million gallons) are from Table 7-3 in MWRA's Final Alewife Variance Report. These numbers represent an interim implementation condition that does not yet exist. For instance, this condition includes planned work not yet completed to upsize connections between the Cambridge system and the MWRA interceptors. The discharges today are likely closer to the "Existing Conditions" values, which are 25 discharges/year and 33.4 million gallons.

- Page 3-3, fourth bullet, first sub-bullet: change to "Ongoing Somerville studies to evaluate the feasibility of removing Tannery Brook flows from the MWRA interceptor." Somerville, not MWRA, is conducting the studies with the objective of taking Tannery Brook off the MWRA system.

- Page 3-4, second paragraph, fourth sentence: change to "One possible relief mechanism that could be reviewed is the use of one or more sanitary pump stations to convey Belmont flows into the MWRA system against a surcharged condition." The draft report suggests that adding an MWRA pump station to lift Belmont flows could be a cost-effective means of relieving sewer flooding problems in Belmont.

It is unclear whether the Belmont problems are system-wide or occur in certain areas, such as the Winn Brook neighborhood. The hydraulic conveyance condition of the Belmont sewer system is also unclear. Sewer flooding problems may be more appropriately solved with local solutions, such as a much smaller pump station serving only the Winn Brook neighborhood. Also, the draft report suggests that removing I/I could reduce the size of a pump station, but it is unclear whether large enough quantities of I/I in the Belmont system can be removed cost-effectively. The best means of reducing the size of a pump station would be to locate it where the area it serves and, therefore, the flows are minimized.

- Page 3-5, **Next Steps**, 6th bullet: Consideration of pumping stations to protect specific, low lying neighborhoods in Belmont should be undertaken by the Town of Belmont. See related comment, immediately above. Also, change the last MWRA-related bullet to read "Track the status of Somerville's studies regarding removal of Tannery Brook flows from the MWRA interceptor."

<u>Appendix L</u>

- The reference to MWRA in the title of this appendix does not appear to be relevant or appropriate.

Please do not hesitate to contact me, at 617-788-4394 or david.kubiak@mwra.state.ma.us, if you have any questions about our comments or need additional information.

Very truly yours,

David A. Kubiak, P.E.
Sr. Program Manager, CSO

cc: Catherine Daly-Woodbury, Cambridge DPW
Ralph Wallace, MWRA
John McLaughlin, MWRA
Stephanie Moura, MWRA

September 6, 2004

Re: Progress Report Tri-Community Working Group

General comments:

The organizers and writers of this report are to be congratulated for their compilation of a diverse set of data and also in their integration of this material into a readable and tightly focused document. Well done!

The tri-community working group and their supervisors are to be particularly commended for their efforts in getting to, and remaining at, the table through this process. A pessimist might grumble and say "what took you so long," whereas an optimist would intone "great, now keep at it."

The mixing of technical wisdom with on-the-ground field experience rings through the volume and will help to insure that it gets the attention it deserves. As does the latitude in allowing local activists and arm-chair pundits to present their, occasionally conflicting, interpretations.

Specific comments:

Pg.

2-2 It is critically important, for obvious reasons, to take every opportunity to state (and restate) that in the absence of any or all development in the watershed, that certain locations will always "flood." I placed that word in quotation marks because "flooding" is most frequently interpreted as a human derived pejorative term for something that many rivers simply do naturally. It needs to be made very clear that in normal state of what hydrologists refer to as "dynamic equilibrium" that rivers will overflow their banks; i.e. that is how wetlands and riparian forests are created and maintained. I think it critical to mention that although homes in the area might suffer from too much water for short durations, the Alewife Reservation wetlands in terms of their biotic health suffer from too little water for much of the time; i.e. urban rivers like the Alewife suffer from feast or famine in terms of water: too much at a few times and too little for most of the time – both a result of the impervious coverage etc. And perhaps a little bit more of an historical perspective (i.e. the Great Swamp) could be inserted at the appropriate location in the report.

2-2 Be careful what you call the Alewife Brook as opposed to the Little River.

2-3 Although defined in an appendix, always explain all acronyms first time mentioned in text; i.e. NDVD, etc.

2-3, 2-4 The issue of topographically produced flashiness in the watershed is explained well (though, it must be said a little more clearly in the wonderful appendix than here), that of the backflow problem might need some additional sentences to flesh it out a bit more.

2-7 Description of mathematical modeling is clear, and honesty in mention of the limitation of useful data is good.

2-9 I recognize that the major focus of the report is on the topic of *quantity* of water; however, I believe that discussion of the roles of various BMPs on the *quality* of water is apt to include; e.g. retention basins are generally regarded as being superior to detention basins in terms of improving water quality.

2-10 How would dredging Blair Pond and the river help with flooding? i.e. I know it is discussed later but some mention near here would also be beneficial.

2-10 Good intro description of LID.

Section-3 This is about the right amount of detail that needs to be devoted to the CSO topic.

4-1 "There are no simple or easy answers to the problems of flooding in the Alewife" – good admission of the truth and a warning for those searching for a stormwater panacea.

4-4, 4-5 Do we have any idea about how effective on-site seepage is? i.e. you mention several times that rain barrels do not offer any real benefits to stormwater storage, but what do we know about LID rain gardens etc.? given the clayey nature of much of the soil in the basin. It reads a bit confusing to the homeowner.

4-5 OK, so rain barrels can't hold enough water to make a difference in terms of flood amount (and possibly flood peak timing), but do they not have some benefits in terms of water quality in the whole basin? Is there any info on this from elsewhere, for example? Also, given that 2 of the last 3 summers were declared a drought up and down the East Coast, mention should be prominently made that use of rain barrels will help alleviate water shortages for lawn watering etc.

4-7 Spell out what NPDES stands for and why it is so important.

4-8 I think that the section on increasing storage capacity needs to be expanded, particularly in light of the plans for building the wetland basin in the Reservation. Perhaps direct readers (through a discussion) to the basin at Dannehy Park or the plans for one near Fresh Pond as models within the watershed. Also, perhaps refer to the new stormwater treatment wetland built at Long Lake in Littleton, MA as an example of what to aspire to; i.e. both function and form addressed together. Can we get some estimates about what the storage volumes might be at the locations you mention as possible future target sites?

4-8, 4-9 Finally, I realize that the bits about future development will be perhaps the most provocative of the report (more so, of course, for tax searching city councilors than the general public who already lives there). As it is, I feel that the committee may be playing it too safe (impressions of muzzling from higher ups will be the take home message left by some members of the public). As it reads now, this last section does a good job of speaking about the general benefits from Smart Growth or LID, but shies away saying anything of particular utility to the Alewife watershed, even if it is only in the hypothetical nature at this early stage; i.e. should by-laws be enacted to insist on LID approaches; should off-site runoff be taxed should mention be made of the controversial idea that at sometime (in the future, or in the past) about when enough is enough? - i.e. an absolute limit to growth? etc. None of these are easy answers but even the fielding of the topics as possible questions to be discussed on the tri-community level would be a positive statement and help to deflect criticism by some of the more vociferous members of the public (e.g. don't posit the topic as I've done here in terms of "shoulds" but simply list as some ideas in an arsenal of approaches that have been tried elsewhere). Presently, those members of the public could accuse this report of having a hypocritical imbalance in that many more pages are devoted to how individual homeowners can help flooding etc. whereas nowhere near the same coverage is given to how the municipalities can also help in terms of doing a much better job of regulating new development. And in terms of that new development, further mention I think needs to be made about how the adaptive re-use and redevelopment of sites is a far better approach in terms of watershed health than sprawl into undeveloped sites.

Appendix A is fabulous! And the others offer useful background material that is important to include in the final report.

In conclusion, let me reiterate my congratulations on bringing this important report together in a readable fashion. The only thing I might add (perhaps as another appendix or at the end of the main text) is a section that is more forward-looking in its review of possible future actions that might be taken or at least topics that might be explored (I know you do this here and there in the text, but a summary would be helpful, especially if you can rank the actions/explorations based on cost or best guess likelihood to alleviate flooding).

Dr. Robert France
Harvard University

Wright, Jennifer

From: Cori Beckwith [cbeckwith@town.arlington.ma.us]
Sent: Monday, September 27, 2004 10:49 AM
To: Will Brownsberger
Subject: my review of Progress Report

Hi Will,
I've finally finished my reading of the report. It was very well done. I only have typos and small clarifying questions. I'll just forward them to you in this email.
One new Conservation Commissioner, who lives in the floodplain too, is reviewing this as well and he might have more substantial comments that we'll forward as soon as we get them.

Not sure I can get there tomorrow night I might have an afternoon appointment that will run through.

Page1 - Background, Evolution: The DEM (Miriam)also started this group with MyWRA (Grace) and DEP (Kwabena) but really wanted the three towns to take the ball from them. They didn't want this group to be a state-run group.

Page 20 - middle paragraph, discussion is not too simplistic for homeowners.

- last paragraph, the Ground Round is not there anymore, so identify this rotary in some other manner (ask Cambridge).

Page 21 - last paragraph, "The evolution focused particularly"...should be "The evaluation focused particularly"

Page 22. Rain barrels...and "cannot" store additional...
- second to last bullet, the last sentence, add "and the consequent impact on river elevation (increases flooding) as a result..."

Page 27 Explain topic of Construct a flood barrier

page 28 - Actions to avoid damage...
This section can include smaller steps like just installing appliances on bricks or small platforms to raise the appliances enough off floor so that water can to sheet across the basement floor to sump holes/pumps and decrease the change of water inundating the elements/pilot lights/electrical components of the appliances.

Do you also want to include discussions of flood proof construction in this document? There are Federal building codes on this, Miriam forwarded these to me before she left.

Thanks, Cori

Cori Beckwith, Administrator
Arlington Conservation Commission
781-316-3012

Appendix P: Follow-up Letters Sent on behalf of the Working Group

ABC ***Tri-Community Working Group***

February 11, 2005

Mr. Frederick A. Laskey, Executive Director
Massachusetts Water Resources Authority
Charlestown Navy Yard
100 First Avenue
Boston, MA 02129

Re: Invitation to *Tri-Community Working Group* Meeting

Dear Mr. Laskey:

The T*ri-Community Working Group* is composed of representatives from the communities of Arlington, Belmont and Cambridge with the common goal of sharing knowledge and developing a regional understanding of flooding and sewer backup issues, which transcend community boundaries and center on the Little River/Alewife Brook drainage basin. The working group has worked for two years facilitating dialogue between residents, engineers and planners dedicated to solving these issues, including several meetings and presentations by MWRA representatives. A *draft* Progress Report was issued by the working group in June of 2004 and a community meeting was held on November 16, 2004 to discuss the report's findings and recommendations. A copy of the Progress Report can be viewed on the Cambridge DPW website at http://www.cambridgema.gov/TheWorks/departments/engnr/pdfs/tricommunityupdate.pdf. The Progress Report identifies several "Next Steps" that involve action, coordination and assistance from the MWRA.

Summarized below are the recommendations included in the June 2004 report specific to MWRA regarding system optimization and evaluation measures:

- Evaluate the impacts to the sewer systems, river elevations and system operations of installing flap gates on CSO structures to eliminate river inundation of the sewer system.
- Incorporate Alewife Brook elevations into sewer system modeling to better reflect river flow into the interceptor system.
- Evaluate increasing the Alewife Pump station capacity beyond 75 mgd.
- Provide cleaning and inspection of the interceptor system on a regular basis to ensure conveyance of the maximum possible discharge.

- Evaluate the impacts from the proposed MWR003 modulating gate on the low lying areas in the Hittinger Street/Winn Brook area of Belmont to ensure protection of this area.
- Evaluate the placement of a sanitary pump station along the MWRA Belmont lines to reduce surcharging in low-lying areas in Belmont.
- Clarify the condition of the two siphons under Wellington Brook and provide assurances that they are constructed in such a way so as not to unduly increase head loss.
- Report back to the communities on the status of MWRA's review to remove Tannery Brook from the MWRA interceptor.

On behalf of the *Tri-Community Working Group*, I would like to invite you and/or your representative to either meet with us to discuss implementation of these recommendations, or provide us with a response to the recommendations as stated.

Our next scheduled meeting is March 1, 2005 at 6:30PM in the Selectmen's 2d Floor conference room in Arlington Town Hall. We could accommodate your visit at that meeting, or, if you would prefer, at a later date.

We believe that by implementing the above system optimization measures and other actions on the part of the local communities we can jointly identify the most effective solutions to the sanitary sewer surcharging problems that have beleaguered the communities surrounding Little River/Alewife Brook drainage basin.

Thank you for your consideration of this matter. I look forward to hearing from you. My phone number is 617-489-2612 and my e-mail is will@brownsberger.us.

Very truly yours,

William U. Brownsberger

Will Brownsberger, Selectman, Belmont
Acting Chairman
Tri-Community Working Group

Office of the Selectmen
Belmont Town Hall
455 Concord Avenue
Belmont, MA 02478

ABC ***Tri-Community Working Group***

August 2, 2005

Mr. Stephen R. Pritchard, Acting Commissioner
Massachusetts Department or Conservation and Recreation
251 Causeway Street
Boston, MA 02114

Re: ***Tri-Community Working Group***

Dear Mr. Pritchard:

The *Tri-Community Working Group* is composed of representatives from the communities of Arlington, Belmont and Cambridge with the common goal of sharing knowledge and developing a regional understanding of flooding and sewer backup issues, which transcend community boundaries and center on the Little River/Alewife Brook drainage basin. The working group has worked for two years facilitating dialogue between residents, engineers and planners dedicated to solving these issues, including several meetings with DCR representatives.

A *draft* Progress Report was completed by the working group in June 2004 and a community meeting was held in November 2004 to discuss the report's findings and recommendations. A copy of the Progress Report was forwarded to Michael Galvin, DCR Engineer and Dan Driscoll, DCR Senior Planner back in June 2004 and can be viewed on the Cambridge DPW website at http://www.cambridgema.gov/TheWorks/departments/engnr/pdfs/tricommunityupdate.pdf. The Progress Report identifies several "Next Steps" that could be achieved through action, coordination and assistance from the DCR. This letter outlines the "Next Steps" and requests your cooperation in moving forward to resolving the regional flooding and sewer issues.

Recommendations included in the June 2004 report involving DCR areas of cooperation fall into two sections:

- Hydraulic Information
- Channel Maintenance

Hydraulic Information

Engineers in our group appreciate the cooperation from DCR's Engineering and Dam operations personnel to date in gathering hydraulic information needed to understand the scope of Alewife flooding. Further analysis of possible causes and solutions to Alewife flooding may require additional data and access to current, historic, and draft

- An increasing depth reduction has been noted between Route 2 and Massachusetts Avenue.
- The Little River from Perch Pond to Route 2 lacks a channel and is steadily widening as the banks erode.
- Blair Pond has been nearly completely filled with sediment.
- The parkland soil beside the culverted section of Alewife Brook between Route 2 and Henderson Street is slowly 'flowing' over the culvert walls where occasional high waters wash it into the Brook.
- Sand from road operations is washing into the Brook both through storm drains and overland where storm drains are full or clogged.

Of these channel maintenance topics, debris removal is our top priority. We hope DCR will regularly inspect problem areas for incipient debris dams to ensure constrictions do not become dams to floodwaters.

On behalf of the *Tri-Community Working Group*, I would like to invite you and/or your representative to either meet with us to discuss implementation of these topics, or provide us with a contact person or people who can facilitate the gathering of information and scheduling of maintenance activities.

Thank you for your consideration of this matter. I look forward to hearing from you. My phone number is 617-489-2612 and my e-mail is will@willbrownsberger.com.

Very truly yours,

William U. Brownsberger

Will Brownsberger, Selectman, Belmont
Acting Chairman
Tri-Community Working Group

Office of the Selectmen
Belmont Town Hall
455 Concord Avenue
Belmont, MA 02478

ABC *Tri-Community Working Group*

August 3, 2005

Mr. Brian Sullivan, Town Manger
Town Hall
730 Massachusetts Avenue
Arlington, MA 02476

Re: *Tri-Community Working Group*
Progress Report Recommendations

Dear Mr. Sullivan:

The *Tri-Community Working Group* is composed of representatives from the communities of Arlington, Belmont and Cambridge with the common goal of sharing knowledge and developing a regional understanding of flooding and sewer backup issues, which transcend community boundaries and center on the Little River/Alewife Brook drainage basin. The working group has worked for over two years facilitating dialogue between residents, engineers and planners dedicated to solving these issues. As you know the Town of Arlington has been represented at these meetings by Selectwoman Kathleen Kiely Dias, staff (John Sanchez, Ron Santosuosso and Cori Beckwith), and interested residents. In addition, a separate group of municipal engineers and staff have also met to share information and work collaboratively on issues related to the *Tri-Community Working Group's* effort.

A *draft* Progress Report was issued by the working group in June of 2004 and a community meeting was held on November 16, 2004 to discuss the report's findings and recommendations. The working group has continued to meet to finalize the report and to implement recommended actions in the Report. One product of the group's efforts was the creation of an Environmental Joint Powers Entity to serve as a useful vehicle when funding becomes necessary to further the goals of the group. We are pleased to announce that the Massachusetts Executive Office of Environmental Affairs approved the Environmental Joint Powers Agreement (EJPA) in January 2005. The EJPA authorized the creation of the ABC Stormwater Flooding Board, which is

comprised of a representative from each of the three communities of Arlington, Belmont and Cambridge. With equal participation from the communities the ABC Stormwater Flooding Board entered into an agreement with the United States Geological Survey (USGS) to install, operate and maintain a stream gauging station on the Alewife Brook. This station will provide real time information on how the Alewife Brook reacts during rain events and will provide the working group with valuable information in our quest to understand and address flooding along the Alewife. Look for the station information under the Mystic River Basin at the following web page:
http://waterdata.usgs.gov/ma/nwis/current/?type=flow.

The Progress Report also identifies several "Next Steps" that involve action, coordination and assistance from the Town of Arlington. Summarized below are the recommendations included in the June 2004 report specific to each of the three communities of Arlington, Belmont and Cambridge regarding sanitary and drainage system maintenance and flood awareness and prevention measures:

- Implement a long-term comprehensive routine, capital and emergency maintenance program to:
    - Ensure that drainage systems are frequently and systematically checked, cleaned and repaired to make certain that they are structurally sound and are free of sediment, debris and blockages,
    - Ensure that no inappropriate materials are being conveyed into the Alewife Brook via local drainage systems,
    - Identify locations prone to blockages and have them checked frequently, and
    - Make adequate resources available to provide immediate relief in the event of a system blockage.
- The Engineering Departments of the various communities should continue to work together and share information, specifically:
    - Each community should continue to reduce inflow and infiltration in their sanitary system and inspect, clean and repair their systems to ensure conveyance of maximum possible discharge,
    - Engineers should continue to meet on a semi-annual basis to discuss current efforts, system information and proposed future efforts within the watershed,
    - Each community should have a sanitary sewer metering program and install meters within their communities,
    - Maintain communications with MWRA as they proceed with their modeling efforts, and

  - Ensure that MWRA cleans and inspects their system on a regular basis.
- Address flooding problems, specifically by:
  - Educating residents about the various self-help options, their responsibilities and the potential health risks from exposure to floodwaters,
  - Collaborating with the other tri-community municipalities on opportunities to increase floodwater storage opportunities, and
  - Reducing stormwater runoff in the Alewife area through stormwater management and redevelopment through consideration of Smart Growth and Low Impact Development principles for future developments, and adoption of design guidelines or local by-laws or ordinances that require stormwater runoff controls.

On behalf of the *Tri-Community Working Group*, I would like to invite you and/or your representative to either meet with us to discuss implementation of these recommendations, or provide us with a response to the recommendations as stated.

We believe that by implementing the above system maintenance and flood prevention and awareness measures, we can effectively begin to address water quality and quantity issues that have beleaguered the communities surrounding Little River/Alewife Brook drainage basin.

Thank you for your consideration of this matter. I look forward to hearing from you.

Very truly yours,

Will Brownsberger, Selectman, Belmont
Chairman, *Tri-Community Working Group*, and
Chairman, ABC Stormwater Flooding Board

Office of the Selectmen
Belmont Town Hall
455 Concord Avenue
Belmont, MA 02478

cc: Arlington Board of Selectmen

ABC *Tri-Community Working Group*

August 3, 2005

Mr. Tom Younger, Town Administrator
Town Hall
455 Concord Avenue
Belmont, MA 02478

Re: *Tri-Community Working Group*
Progress Report Recommendations

Dear Mr. Younger:

The *Tri-Community Working Group* is composed of representatives from the communities of Arlington, Belmont and Cambridge with the common goal of sharing knowledge and developing a regional understanding of flooding and sewer backup issues, which transcend community boundaries and center on the Little River/Alewife Brook drainage basin. The working group has worked for over two years facilitating dialogue between residents, engineers and planners dedicated to solving these issues. As you know the Town of Belmont has been represented at these meetings by staff [Peter Castanino and Tom Gatzunis (prior to his departure)], interested residents, and myself. In addition, a separate group of municipal engineers and staff have also met to share information and work collaboratively on issues related to the *Tri-Community Working Group*'s effort.

A *draft* Progress Report was issued by the working group in June of 2004 and a community meeting was held on November 16, 2004 to discuss the report's findings and recommendations. A copy of the Progress Report can be viewed on the Belmont website at
http://www.town.belmont.ma.us/Public_Documents/BelmontMA_Documents/index.

The working group has continued to meet to finalize the report and to implement recommended actions in the Report. One product of the group's efforts was the creation of an Environmental Joint Powers Entity to serve as a useful vehicle when funding becomes necessary to further the goals of the group. We are pleased to announce that the Massachusetts Executive Office of Environmental Affairs approved the Environmental Joint Powers Agreement (EJPA) in January 2005. The EJPA authorized the creation of the ABC Stormwater Flooding

Board, which is comprised of a representative from each of the three communities of Arlington, Belmont and Cambridge. With equal participation from the communities the ABC Stormwater Flooding Board entered into an agreement with the United States Geological Survey (USGS) to install, operate and maintain a stream gauging station on the Alewife Brook. This station will provide real time information on how the Alewife Brook reacts during rain events and will provide the working group with valuable information in our quest to understand and address flooding along the Alewife. Look for the station information under the Mystic River Basin at the following web page: http://waterdata.usgs.gov/ma/nwis/current/?type=flow.

The Progress Report also identifies several "Next Steps" that involve action, coordination and assistance from the Town of Belmont. Summarized below are the recommendations included in the June 2004 report specific to each of the three communities of Arlington, Belmont and Cambridge regarding sanitary and drainage system maintenance and flood awareness and prevention measures:

- Implement a long-term comprehensive routine, capital and emergency maintenance program to:
  - Ensure that drainage systems are frequently and systematically checked, cleaned and repaired to make certain that they are structurally sound and are free of sediment, debris and blockages,
  - Ensure that no inappropriate materials are being conveyed into the Alewife Brook via local drainage systems,
  - Identify locations prone to blockages and have them checked frequently, and
  - Make adequate resources available to provide immediate relief in the event of a system blockage.
- The Engineering Departments of the various communities should continue to work together and share information, specifically:
  - Each community should continue to reduce inflow and infiltration in their sanitary system and inspect, clean and repair their systems to ensure conveyance of maximum possible discharge,
  - Engineers should continue to meet on a semi-annual basis to discuss current efforts, system information and proposed future efforts within the watershed,
  - Each community should have a sanitary sewer metering program and install meters within their communities,
  - Maintain communications with MWRA as they proceed with their modeling efforts, and
  - Ensure that MWRA cleans and inspects their system on a regular basis.

- Address flooding problems, specifically by:
    - Educating residents about the various self-help options, their responsibilities and the potential health risks from exposure to floodwaters,
    - Collaborating with the other tri-community municipalities on opportunities to increase floodwater storage opportunities, and
    - Reducing stormwater runoff in the Alewife area through stormwater management and redevelopment through consideration of Smart Growth and Low Impact Development principles for future developments, and adoption of design guidelines or local by-laws or ordinances that require stormwater runoff controls.

On behalf of the *Tri-Community Working Group*, I would like to invite you and/or your representative to either meet with us to discuss implementation of these recommendations, or provide us with a response to the recommendations as stated.

We believe that by implementing the above system maintenance and flood prevention and awareness measures, we can effectively begin to address water quality and quantity issues that have beleaguered the communities surrounding Little River/Alewife Brook drainage basin.

Thank you for your consideration of this matter. I look forward to hearing from you.

Very truly yours,

Will Brownsberger, Selectman, Belmont
Chairman, *Tri-Community Working Group*, and
Chairman, ABC Stormwater Flooding Board

Office of the Selectmen
Belmont Town Hall
455 Concord Avenue
Belmont, MA 02478

cc: Belmont Board of Selectmen

ABC *Tri-Community Working Group*

August 3, 2005

Mr. Robert W. Healy, City Manager
City Hall
795 Massachusetts Avenue
Cambridge, MA 02139

Re: *Tri-Community Working Group*
Progress Report Recommendations

Dear Mr. Healy:

The *Tri-Community Working Group* is composed of representatives from the communities of Arlington, Belmont and Cambridge with the common goal of sharing knowledge and developing a regional understanding of flooding and sewer backup issues, which transcend community boundaries and center on the Little River/Alewife Brook drainage basin. The working group has worked for over two years facilitating dialogue between residents, engineers and planners dedicated to solving these issues, including several meetings and presentations by Cambridge staff and consultants. As you know the City of Cambridge has been represented at these meetings by staff (Owen O'Riordan, Jennifer Wright and Catherine Daly Woodbury) and interested residents. In addition, a separate group of municipal engineers and staff have also met to share information and work collaboratively on issues related to the *Tri-Community Working Group's* effort.

A *draft* Progress Report was issued by the working group in June of 2004 and a community meeting was held on November 16, 2004 to discuss the report's findings and recommendations. A copy of the Progress Report can be viewed on the Cambridge DPW website at http://www.cambridgema.gov/TheWorks/departments/engnr/pdfs/tricommunityupdate.pdf.

The working group has continued to meet to finalize the report and to implement recommended actions in the Report. One product of the group's efforts was the creation of an Environmental Joint Powers Entity to serve as a useful vehicle when funding becomes necessary to further the goals of the group. We are pleased to announce that the Massachusetts Executive Office of Environmental Affairs approved the Environmental Joint Powers Agreement (EJPA) in January

2005. The EJPA authorized the creation of the ABC Stormwater Flooding Board, which is comprised of a representative from each of the three communities of Arlington, Belmont and Cambridge. With equal participation from the communities the ABC Stormwater Flooding Board entered into an agreement with the United States Geological Survey (USGS) to install, operate and maintain a stream gauging station on the Alewife Brook. This station will provide real time information on how the Alewife Brook reacts during rain events and will provide the working group with valuable information in our quest to understand and address flooding along the Alewife. Look for the station information under the Mystic River Basin at the following web page: http://waterdata.usgs.gov/ma/nwis/current/?type=flow.

The Progress Report also identifies several "Next Steps" that involve action, coordination and assistance from the City of Cambridge. Summarized below are the recommendations included in the June 2004 report specific to each of the three communities of Arlington, Belmont and Cambridge regarding sanitary and drainage system maintenance and flood awareness and prevention measures:

- Implement a long-term comprehensive routine, capital and emergency maintenance program to:
    - Ensure that drainage systems are frequently and systematically checked, cleaned and repaired to make certain that they are structurally sound and are free of sediment, debris and blockages,
    - Ensure that no inappropriate materials are being conveyed into the Alewife Brook via local drainage systems,
    - Identify locations prone to blockages and have them checked frequently, and
    - Make adequate resources available to provide immediate relief in the event of a system blockage.
- The Engineering Departments of the various communities should continue to work together and share information, specifically:
    - Each community should continue to reduce inflow and infiltration in their sanitary system and inspect, clean and repair their systems to ensure conveyance of maximum possible discharge,
    - Engineers should continue to meet on a semi-annual basis to discuss current efforts, system information and proposed future efforts within the watershed,
    - Each community should have a sanitary sewer metering program and install meters within their communities,
    - Maintain communications with MWRA as they proceed with their modeling efforts, and
    - Ensure that MWRA cleans and inspects their system on a regular basis.

- Address flooding problems, specifically by:
    - Educating residents about the various self-help options, their responsibilities and the potential health risks from exposure to floodwaters,
    - Collaborating with the other tri-community municipalities on opportunities to increase floodwater storage opportunities, and
    - Reducing stormwater runoff in the Alewife area through stormwater management and redevelopment through consideration of Smart Growth and Low Impact Development principles for future developments, and adoption of design guidelines or local by-laws or ordinances that require stormwater runoff controls.

On behalf of the *Tri-Community Working Group*, I would like to invite you and/or your representative to either meet with us to discuss implementation of these recommendations, or provide us with a response to the recommendations as stated.

We believe that by implementing the above system maintenance and flood prevention and awareness measures, we can effectively begin to address water quality and quantity issues that have beleaguered the communities surrounding Little River/Alewife Brook drainage basin.

Thank you for your consideration of this matter. I look forward to hearing from you.

Very truly yours,

Will Brownsberger, Selectman, Belmont
Chairman, *Tri-Community Working Group*, and
Chairman, ABC Stormwater Flooding Board

Office of the Selectmen
Belmont Town Hall
455 Concord Avenue
Belmont, MA 02478

cc: Michael A. Sullivan, Mayor
Cambridge City Council