Progress Report

Tri-Community Working Group

June 2004 – DRAFT FOR COMMENT

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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, evaluating certain stormwater storage sites, exploring low-impact development approaches, and maintaining channels to prevent obstructions which may exacerbate flooding.

Sewage Overflows

The discussion of sewage overflows (including backflows) included the causes of sewer overflows, current engineering efforts and the interactions among river flooding, the municipal sewer systems and the Massachusetts Water Resource Authority collection system. The working group identified a number of potential regional sewer system upgrades that merit detailed evaluation.

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