STORM DRAIN STUDY

LEITHA DRIVE AND HARDY POND DRAINAGE AREA STUDY

WALTHAM, MA
NOVEMBER 2010

Coler & Colantonio, Inc. Project # 27-38

DRAFT

Submitted To:

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ENGINEERS AND SCIENTISTS

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Section 1

Narrative

1.1 INTRODUCTION

Hardy Pond lies in the Northwestern portion of the City of Waltham within Middlesex County in the Commonwealth of Massachusetts. The Hardy pond watershed encompasses 1,015 acres and lies to the east of Interstate 95. A major roadway in the greater Boston area, Route 2, passes through the watershed (see Figure 1). The watershed encompasses land in both the Town of Lexington and the City of Waltham.

Over the last century a significant amount of development has occurred within the Hardy Pond watershed which has in turn created areas of concern within the watershed with regards to stormwater management. The system that now surcharges in the back yards of Leitha drive during severe storm events was once a free flowing channel into Hardy Pond from Lexington. As it exists today, flows from Lexington are conveyed southerly through an armored channel engineered to accommodate development in the Hardy Pond area around 1974, and into a culvert system that dates back to the 1930's where Hardy Pond Discharges in an easterly direction. The system does not appear to have been updated to accommodate the increase in impervious area from development upstream since that time. The undersized system has created a situation in which the frequency of flooding events has increased in recent years.

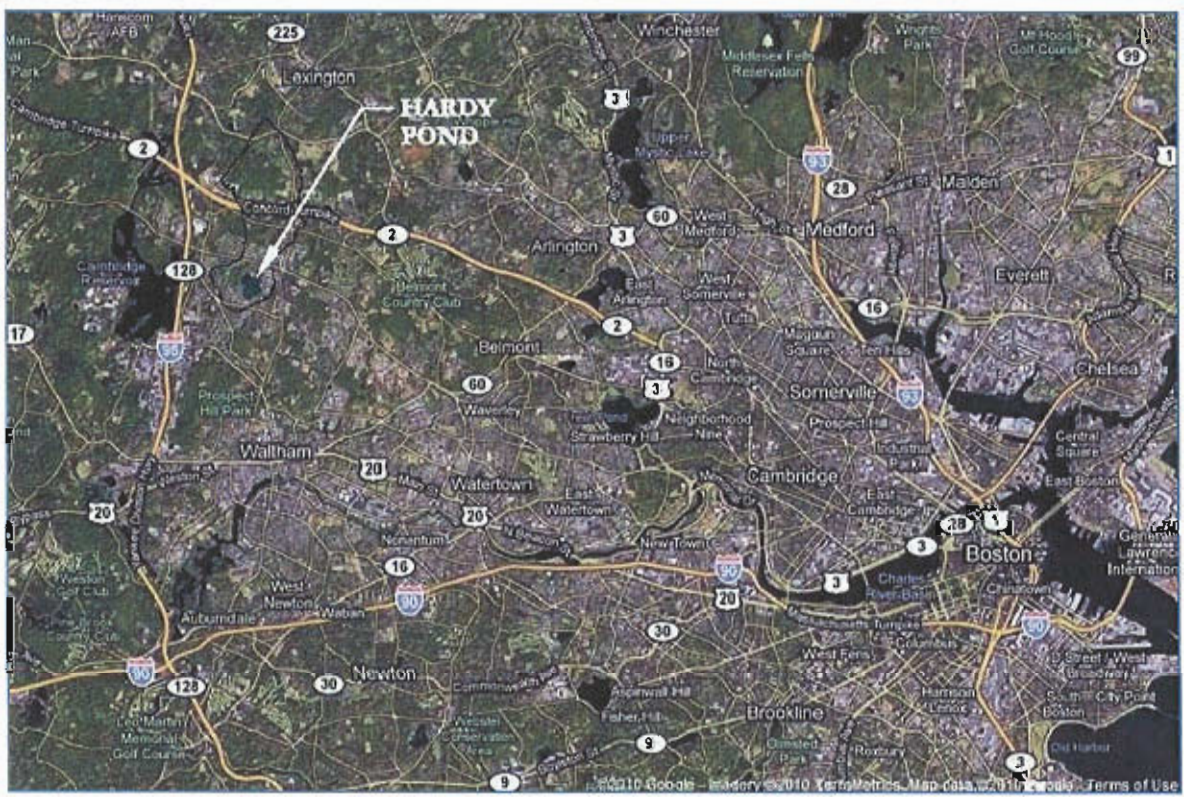

Figure 1: Hardy Pond Location in Relation to the Greater Boston Area

Coler and Colantonio, Inc. has been tasked with performing a preliminary hydrologic analysis of the Hardy Pond drainage area, particularly in the area of the drainage system continuous with the Leitha

Drive swale where frequent flooding events have occurred in recent years. In an effort to better understand the reasons for the frequency of flooding and to generate options to help improve the situation, a variety of references have been compiled to create a hydrologic model of existing conditions for four storm events, utilizing HydroCAD. We have considered many solution options during the development of this report. For purposes of this report we have narrowed down the options to those we believe have the best potential for balancing improving hydraulic conditions, technical feasibility, construction costs and minimizing the impacts to private properties to include minimizing the need for new easements. As you will see, the solution options focus on increasing conveyance capacity to Hardy Pond and maximizing upstream storage capacity in the Lexington Wetland. In this report you will find a detailed description of the existing conditions for the area followed by the proposed improvement options for your consideration.

1.2 EXISTING CONDITIONS

1.2.1 Hardy Pond Area

The overall Hardy Pond watershed area is approximately 1,015 acres (see figure 2). The watershed has a variety of land uses including everything from major highways, residential, wetlands, forests, industrial, and commercial. Additionally, the watershed has soil types with characteristics covering the entire hydrologic soil group spectrum, from soils with very low infiltration rates and high runoff rates to soils with very high infiltration rates and low runoff rates. For the purpose of this study, we have divided the watershed into five subcatchment areas. Four of which are tributary to the formal drainage conveyance system downstream of the Leitha Drive swale, and the fifth comprises the rest of the drainage systems and overland flow tributary to Hardy Pond (see figure 3).

It is clear from the storm events of March 2010 that flooding is a major concern in the area of Hardy Pond (see photo 1). Site visits to inspect the Chester Brook channel downstream of Hardy pond have posed some maintenance concerns as well.

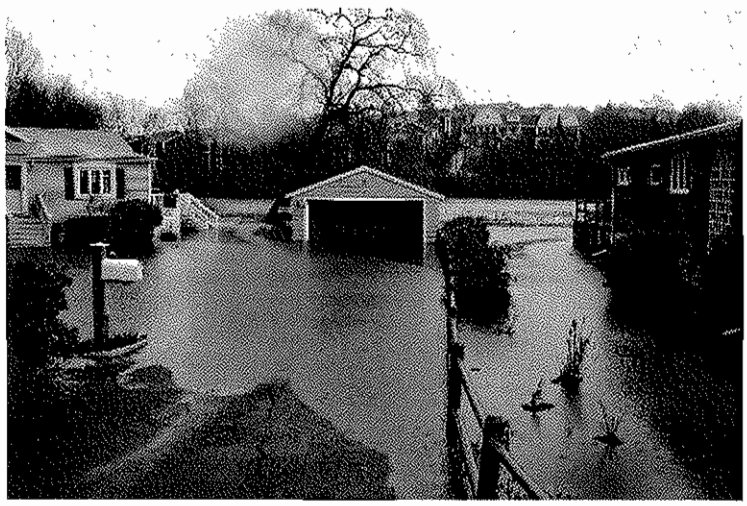

Photo 1: Flooding at a property along Hardy Pond, C&C March 2010

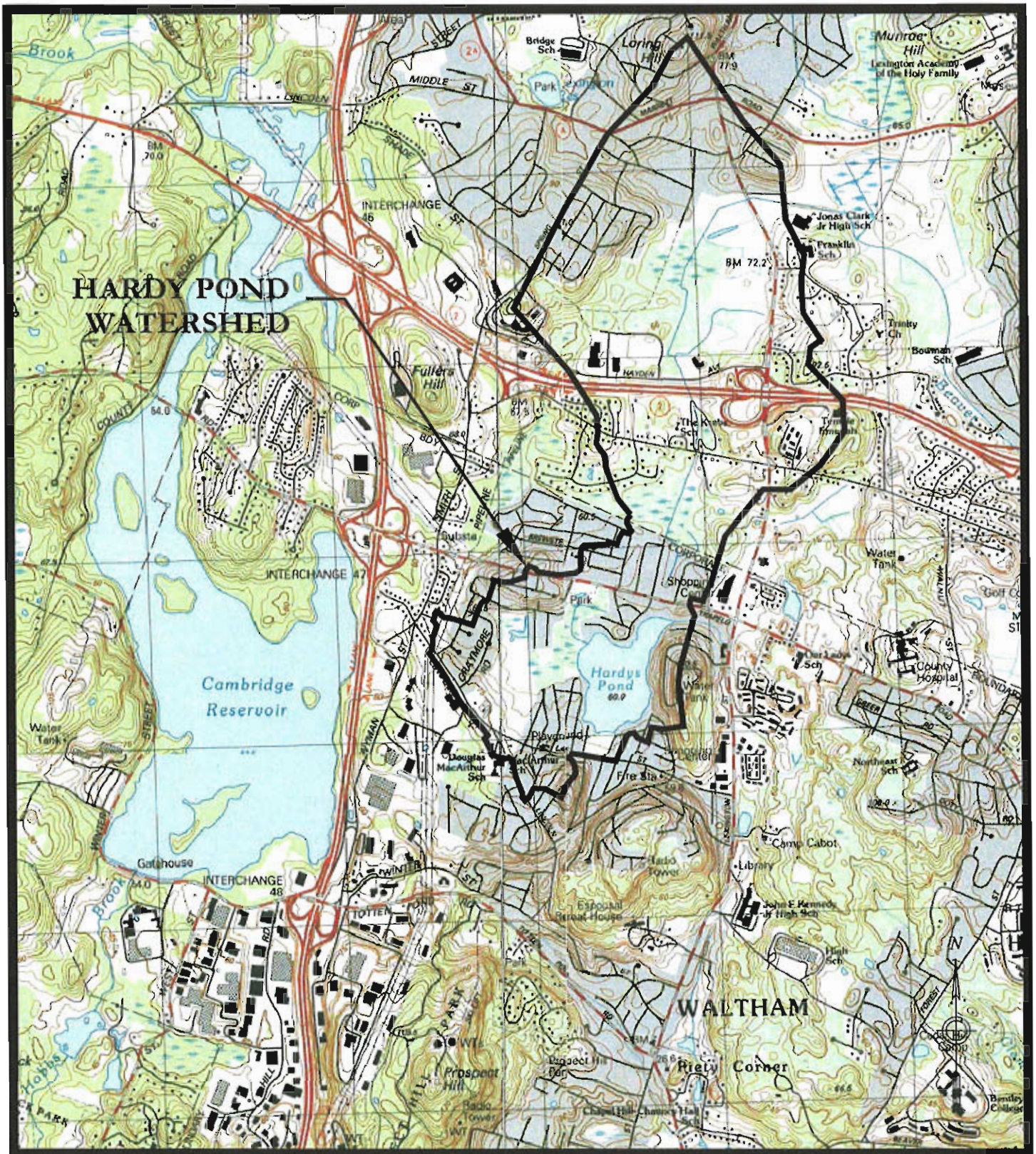

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FIGURE 2: HARDY POND WATERSHED - USGS

SCALE: 1"=2,400'

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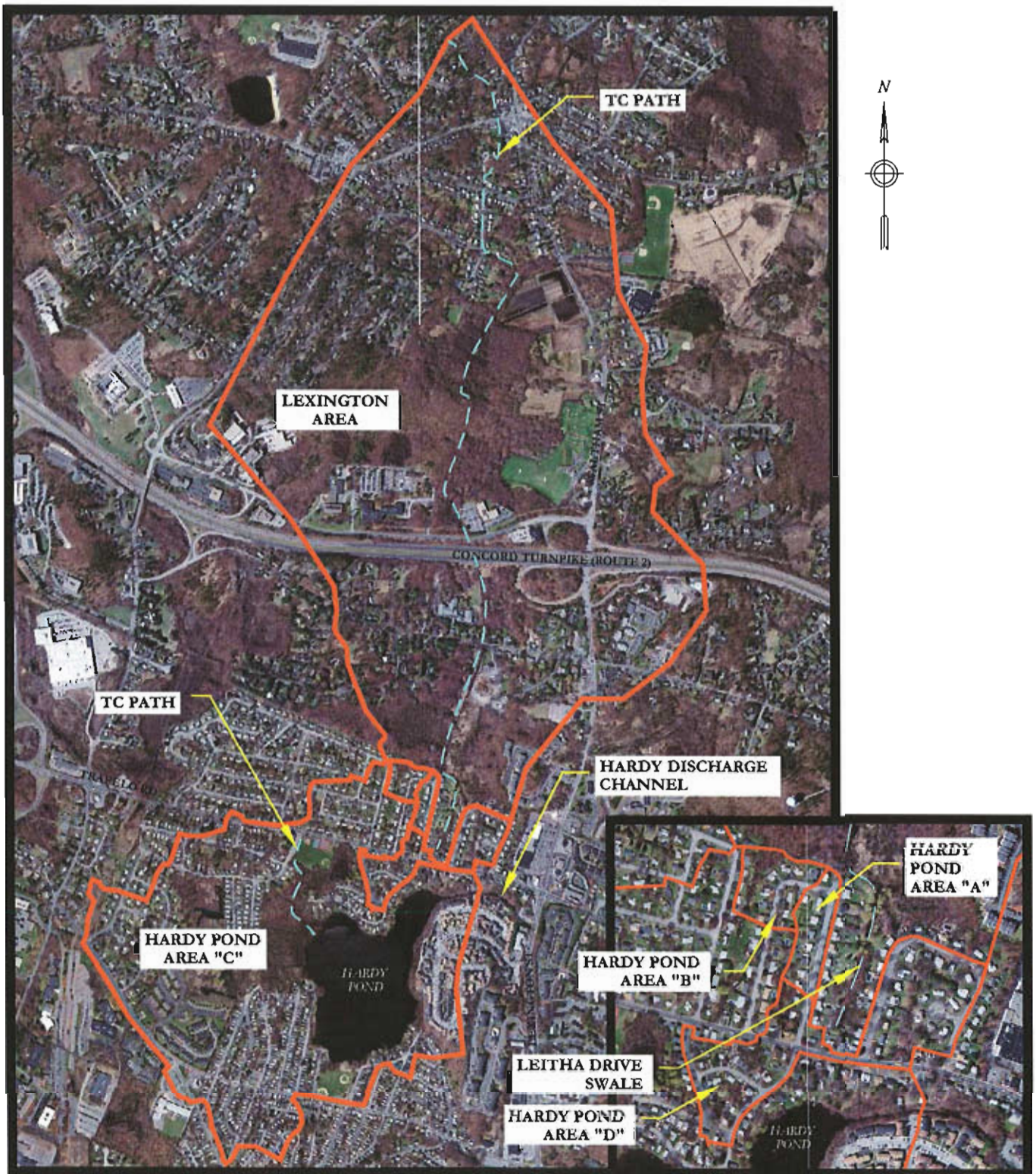
WALTHAM, MA



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HARDY POND DRAINAGE AREA STUDY
WALTHAM, MA

FIGURE 3: HARDY POND WATERSHED - AERIAL

MAIN SCALE: 1"=1,600'
INSET SCALE: 1"=800'

We observed that Hardy Pond discharges to Chester Brook in the northeast corner of the pond which extends easterly adjacent to the Stearns Hill Road development and heads southerly along Lexington Road and ultimately flows toward the Charles River. The easterly portion of Chester Brook was observed to have standing water with little to no flow. We encountered a concrete control structure (a rectangular weir) at the outfall from the pond to the Brook (see photo 2). Compared to known outlet elevations and water surface elevation at the time of the site visit we estimated that the weir elevation is set at an approximate elevation of 194.5'. We observed that the water surface elevation was approximately 13" above the control elevation which indicates to us that there are likely other conditions downstream that are controlling the current water surface elevation.

Photo 2: Hardy Pond Control Structure, C&C September 2010

Photo 3: Stagnant Water Downstream of Control Structure, C&C September 2010

Our site walks identified that Chester Brook shows some signs of side bank erosion and sedimentation (see photo 4) in the channel that is reducing the available cross section for conveyance in low flow conditions. We also observed two areas where large stones have been placed across the channel to create walkway paths. A worn path leads to and from each crossing, indicating these paths are frequently utilized by pedestrians. These crossings have effectively created a damming effect and are restricting flow (see photo 5).

Photo 4: Sedimentation in Chester Brook, C&C September 2010

Photo 5: Improvised Stream Crossings in Chester Brook, C&C September 2010

Downstream of Hardy Pond Chester Brook diverts from its easterly path with a sharp bend and heads southerly along Lexington Road. It passed through two driveway culvert crossings. The first crossing is a private way for a small apartment development and consists

of a single 5' to 6' diameter corrugated metal culvert. Runoff in the channel appeared to pass freely through the culvert during low flow conditions. The second crossing, approximately 800' downstream is the driveway entrance to Windsor Village at Stearns Hill Road. This crossing was observed to contain two 36" corrugated metal culverts that appear to be deformed under the weight of the overlying roadway and impeded by sediment (see photo 6). Additionally, they appear to be undersized when compared to the upstream crossing and could be contributing to the restriction of flow from Hardy Pond. Site visits in March 2010 confirmed this is a major point of hydraulic constriction (see photos 7 and 8) for discharge from Hardy Pond. Repair and/or replacement of this crossing will improve the flooding of Hardy Pond. A Notice of Intent for work at this crossing was filed with the City September 24, 2010 by Thompson Farland for Windsor Property Management.

Photo 6: Stream Crossing at Stearns Hill Road, C&C September 2010

Photo 7 (Left): Upstream of Stearns Hill Road after rain event, C&C March 2010

Photo 8 (Right): Downstream of Stearns Hill Road after rain event, note that the flow seems to be stagnated in one pipe despite the fact that there is substantial head accumulated on the upstream end of the pipe, C&C March 2010

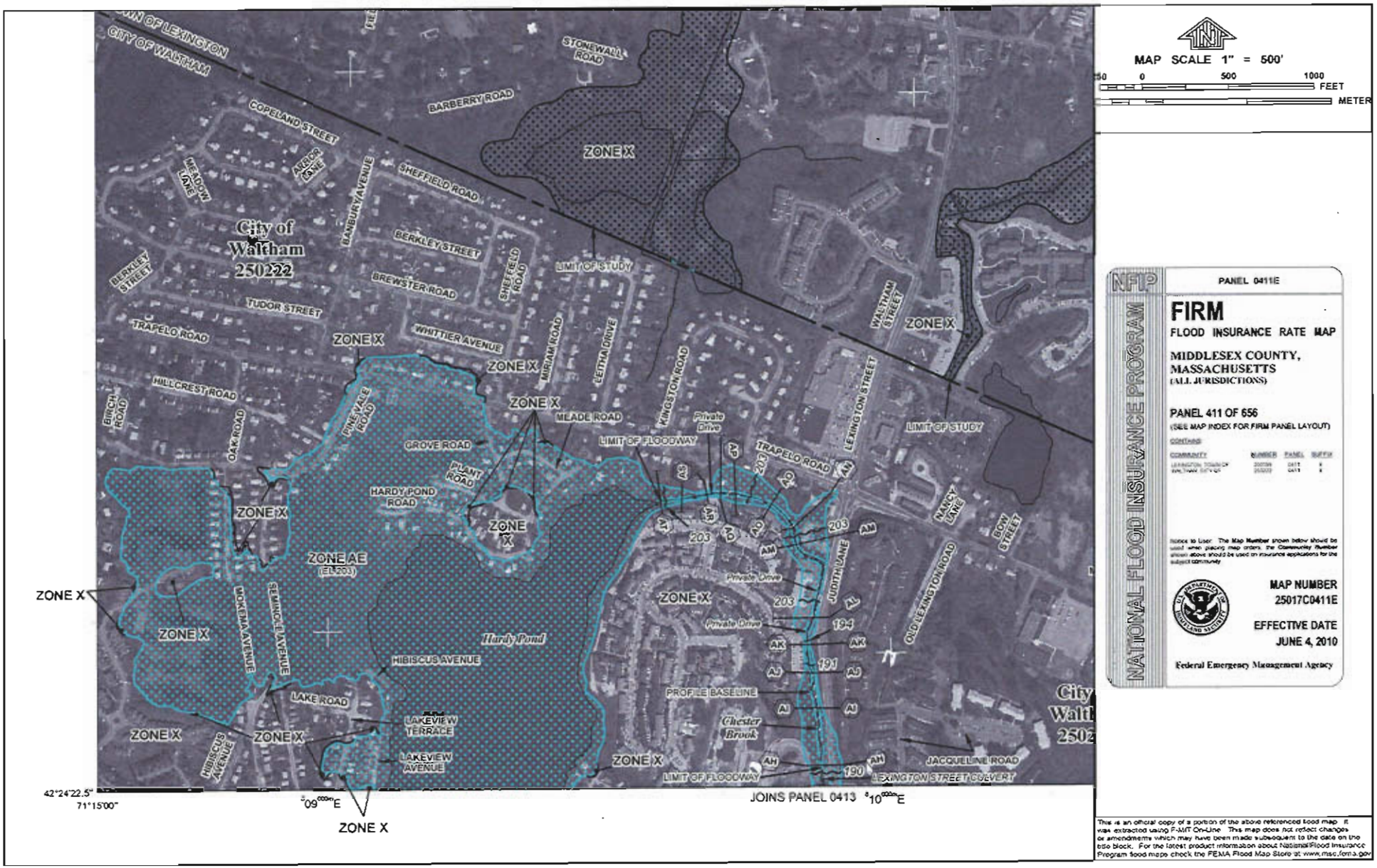
1.2.2 Leitha Drive Area

As mentioned previously, severe storms in March of 2010 have heightened the interest in addressing flooding concerns, especially in the Leitha Drive area of the Hardy Pond watershed. A swale flows to the east of Leitha Drive and conveys a large tributary area of approximately 702 acres from the north, primarily from the Town of Lexington. This flow is funneled to the Leitha Drive swale by overland flow and a channel in the Lexington wetland to the north. At the southerly end of the Leitha Drive swale flows are collected by a 48" corrugated metal pipe (see Photo 9). A small vortex is seen at the location of the pipe inlet.

Photo 9: 48" CMP at Leitha Drive swale flooding during March storms, C&C March 2010

It is our belief that the Leitha Drive area was missed in recent FEMA studies and likely should have been included in the 100 year flood plain delineation. The Leitha Drive swale is undouhtedly hydraulically continuous with the flood plain associated with Hardy Pond as well as the flood plain delineated in Lexington. As such, our analysis indicates that is not feasible to completely mitigate flooding in the area for a storm as large as the 100 year storm, however the options discussed later in this report will address improvements that will provide relief to the maximum practical extent (see attached FIRM map).

On a dry day in September of 2010 the inlet of the pipe was observed to be filled with at least 8" of debris (sand, boulders, etc.) and there is evidence of deterioration of the structure of the pipe, as seen in Photos 10 and 11 respectively. As a first measure, this pipe should be cleaned to improve conveyance from the Leitha Drive swale. After cleaning the pipe the condition can be more accurately assessed and full or partial replacement may be considered.



MAP SCALE 1" = 500'

500 0 500 1000 FEET

METER

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0411E

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 411 OF 656
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LEXINGTON, TOWN OF	250099	0411	E
WALTHAM, CITY OF	250222	0411	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
25017C0411E

EFFECTIVE DATE
JUNE 4, 2010

Federal Emergency Management Agency

Photos 10 & 11: 48" Corrugated Metal Pipe inlet at Leitha Drive Swale Terminus
C&C September 2010

The 48" metal pipe conveys flow approximately 180 feet from the Lexington subcatchment to the 36"x42" RCP box culvert in Leitha Drive which extends southerly across Trapelo Road, down Hardy Pond Road and ultimately discharges into Hardy Pond. Additional residential drainage infrastructure in watershed subcatchment areas titled Hardy Pond A, B, and D total an additional 24 acres and contribute flow to the 36"x42" RCP box directly downstream of the Leitha Drive conveyance pipe. The land use is primarily residential though there are some small contributing wooded areas as well.

From the junction of the 48" CMP and the 36"x42" RCP box flows are conveyed approximately 750 feet at an average slope of 0.1% to the outlet at Hardy Pond (see photo 12). An additional watershed subcatchment area titled Hardy Pond C also contributes flows to Hardy Pond. Hardy Pond C is approximately 289 acres, with land uses including residential, commercial, industrial, woods and wetlands.

Photo 12: 36"x42" Reinforced Concrete Pipe outlet to Hardy Pond,
C&C September 2010

1.2.3 Hydrologic Modeling Methodology

The HydroCAD Stormwater Modeling System computer program, version 7.10, by Applied Microcomputer Systems, Inc. was used to develop stormwater runoff rates and volumes for the various subcatchment areas to establish base flow conditions for the existing conveyance system. We then updated the existing conditions model to test various possible improvements and their effect on the watershed. We paid particular attention to the peak rate of runoff approaching the existing 48" culvert behind the homes along Leitha Drive and the resulting peak water surface elevations of the subcatchment. It is important to note that this analysis relies on non precise data as the basis for analysis including USGS 3 meter contours, 2' contour topography in the city of Waltham, GIS database information on soil types and land use, as well as aerial photographs to determine surface conditions. Thus the primary use for the model is to gauge the relative improvement in upstream hydraulic stage conditions when the various options/solutions are applied in the model.

This drainage analysis was developed utilizing a Type III, 24-hour storm as developed by the Soil Conservation Service (SCS). The following basic steps were employed in the procedure:

1. The watershed subcatchment areas are delineated according to the most recent USGS Quads, Waltham's 2-foot contour data and information on existing drain infrastructure, provided by Waltham.

2. The hydrologic soil group for the various soil types is evaluated and combined with land use and land cover information for each subcatchment area to determine an approximate Curve Number (CN). Both of these datasets, soil group and land use/cover, are available from the MassGIS database.

3. The Time of Concentration (TC) was determined by identifying the longest hydraulic flow path across each subcatchment area and evaluating the slopes and land cover associated with it. Based upon the TC, the storm is divided into bursts of equal duration. For each burst, the SCS runoff equation and the average CN are used to determine the portion of that burst that will appear as runoff.

4. A unit hydrograph representing the runoff resulting from one inch of precipitation excess generated uniformly over the watershed in combination with the TC is used to determine how the runoff from a burst is distributed over time. The result is a runoff hydrograph for a single burst.

5. Individual hydrographs are added together for all bursts in the storm yielding the complete runoff hydrograph for each storm.

Design points were chosen at down gradient points in the subcatchment areas to compare development conditions for each of the following SCS Type III 24-hour design storm events. Based upon published rainfall frequency atlas data, rainfall depths for the various design storms are estimated as follows:

Storm Frequency (Years)	Rainfall Depth (Inches)
2	3.10
10	4.50
25	5.30
100	6.70

The hydrologic routing is accomplished utilizing the Simultaneous Method that evaluates the stage-discharge and storage-indication curves at each time step based upon the current elevation of any downstream nodes. This allows the routing to respond to ongoing tail water changes rather than assuming static tail water conditions. However this approach makes it difficult to model changes in elevation during the storm event to Hardy Pond itself without more detailed outlet information and additional downstream survey data beyond the current scope of this study. We have assumed a free discharge after the control structure in order to focus the analysis and solutions on the upstream collection and conveyance system. This approach also assumes that addressing the downstream constraints is a key component to any other suggested improvements proposed.

1.2.4 Existing Hydrology Model

The Leitha Drive swale is hydraulically continuous with the Lexington Watershed and was modeled in HydroCAD using "custom stage volume" areas at known elevations from field survey and Waltham GIS, but the vast majority of the storage data was interpolated using USGS topographic mapping as no detailed topographic information was provided by the Town of Lexington. Including custom stage volume information enabled us to be able to identify an approximate peak water surface elevation that may occur for a given storm event in the rear of the lots on the east side of Leitha Drive. This output gave us a key comparison point for the various options within this study.

In the existing conditions model, the 48" CMP is actually modeled as a 42" to compensate for the level of sediment that is currently blocking the pipe. This blockage constricts the ability for water to leave the Leitha Drive swale. The model conveys Lexington Area flows from the Leitha Drive swale through 184 LF of 42" CMP. Hardy Pond Areas A, B, and D are added to the Lexington flows and conveyed through 744 LF of 36"x42" RCP Box culvert. At an elevation of 195.9, the Box culvert outlets into Hardy Pond. See figure 5 for a schematic.

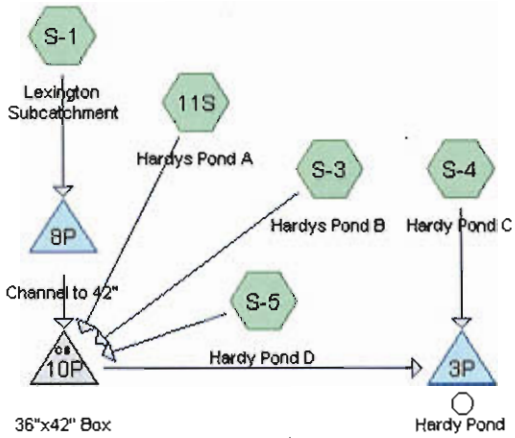


Figure 4: HydroCAD Existing Conditions

The water surface elevation varies in the Leitha Drive Swale. This is depicted in Table 1 for each storm event. Simply cleaning the 48" CMP and effectively returning it to its full cross sectional area, reduces the accumulation of water in Leitha Drive.

Table 1: Peak Water Surface Elevation by Storm Event in the Leitha Drive Swale Under Existing Conditions

	Existing Conditions	Remove Sediment
Peak Elev. 2 year	202.39	202.25
Peak Elev. 10 year	203.86	203.67
Peak Elev. 25 year	204.64	204.42
Peak Elev. 100 year	205.96	205.71

1.3 OPTIONS ANALYSIS

With the existing conditions modeled as described above we have analyzed the stormwater conveyance system from Leitha Drive's swale to Hardy pond. Our approach assumes that the FEMA 100-year flood plain elevation for Hardy Pond of 203' is accurate. This is backed up by the record flooding event which produced flood stages close to this elevation. Thus, the potential improvement options we have analyzed focused on providing reasonable hydraulic relief for the 25 year and all smaller storm events.

1.3.1 Maintenance

Before pursuing construction of any of the following proposed options we recommend the maintenance related tasks be considered (see Figure 5).

1. We recommend that the City clean and inspect the existing 48" CMP conveyance pipe between the Leitha Drive swale and the 36"x42" RCP box culvert. We estimate the cost for both cleanings to be about $3,000.

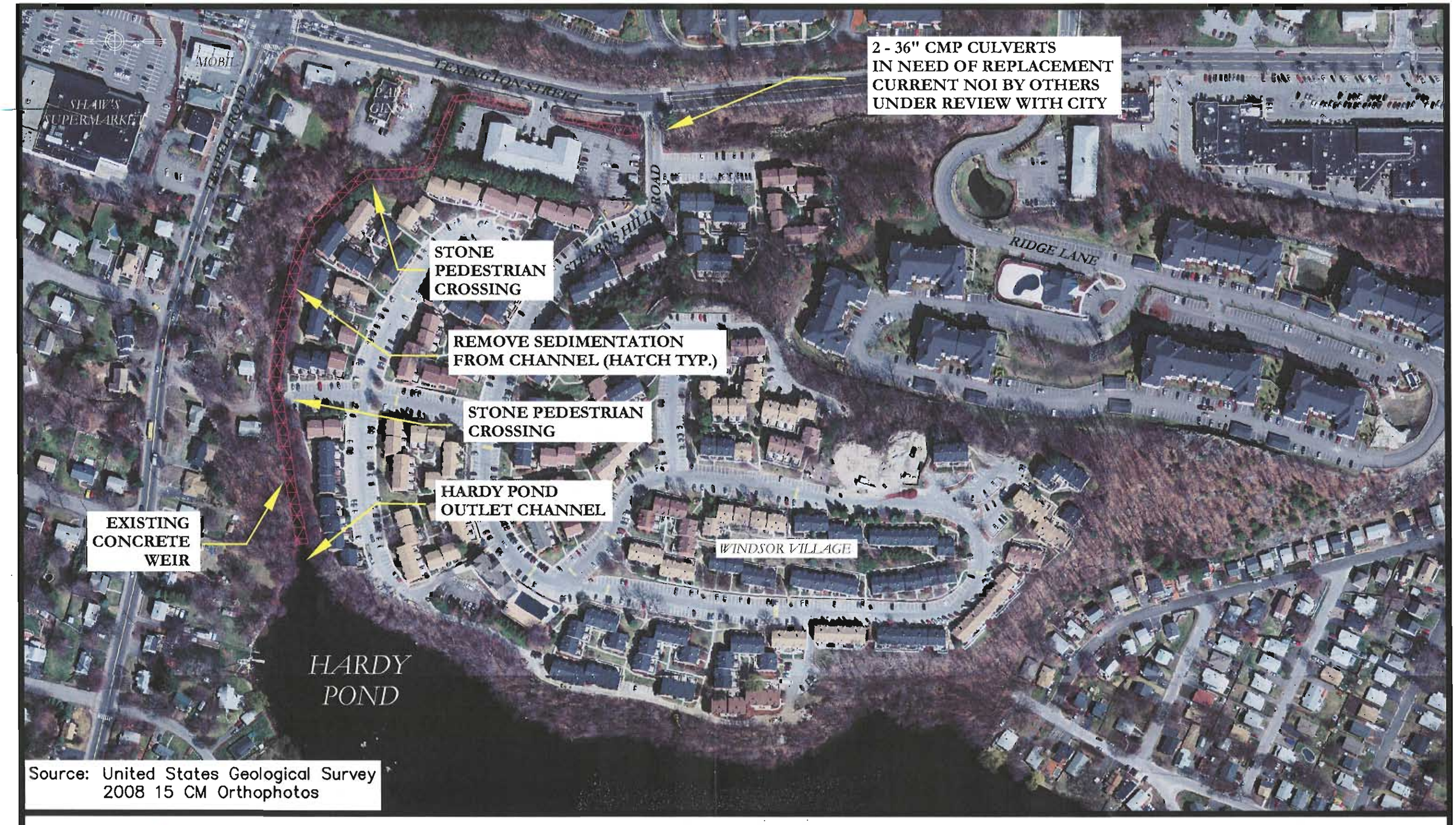
2. Visual inspections at the inlet, as seen in Photo 11 (p. 10), noted some degradation of the 48" CMP along the sediment line. Should this pipe need to be replaced after cleaning, we estimate the approximate cost to be $55,000 for the entire 185 LF of pipe. This assumes RCP pipe and an allotment for site restoration.

   Completing pipe replacement is not anticipated to create any permanent wetland impacts, the chief challenge will likely be coordination with private property owners. Two permit filings would likely be needed for the construction in these locations. A Notice of Intent with the local conservation commission (which generally takes 2 months for review and approval) would likely be the first. The second permit would be an Army Corps of Engineers Programmatic General Permit that would take about a week to file (§404 Inland Waters and Wetlands- Category I). This is simply a notification to the USACE of the impending work as required by their regulations.

   Inspections during a rain event in March of 2010, as seen in Photo 8 (p. 7), provided evidence that one of the 36" CMP culverts at Stearns Hill Road may be completely blocked or crushed. Additionally, both pipes appear to have deformed and replacement is likely the best option for improving conveyance in this area. This road is the only access point to the Windsor Village development and likely contains a great deal of the sites utilities and would have to remain open for access to and from the development. A notice of Intent submitted September 24, 2010 describes a planned upsizing and replacement of this stream crossing by Windsor Village. We feel this work is an essential component to improving the flooding in this area.

3. We recommend removal of sedimentation accumulation and obstructions within Chester Brook and restoration of the full channel cross section. This maintenance task was also recommended in the Chester Brook Master Plan (Rizzo, 2002).

   This action would likely require additional permits for work affecting wetlands, and within stream banks. We would recommend having a pre-application meeting with the Army Corps of Engineers, DEP and the Waltham Conservation Commission before fully pursuing this option. We would expect costs for this work would be around $280,000 and require cooperation from adjacent property owners. Ideal locations to access the Brook would require permission to access private properties such as the Windsor Village development, or Papa Gino's parking lot.



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HARDY POND DRAINAGE AREA STUDY
WALTHAM, MA

FIGURE 5:
MAINTENANCE

SCALE: 1"=200'

1.3.2 Option 1

The goal of this option is to increase capacity and thus conveyance downstream of the Leitha Drive Swale. See Figure 6 for a schematic illustration. Flows will still accumulate in the swale, however the extent of the flooding should be reduced. This option involves constructing a new inlet and headwall adjacent to the existing 48" CMP that will essentially double the conveyance capacity from the Leitha Drive Swale. We would recommend installing a 48" pipe from the end of the drainage channel, southerly along the sewerage and drainage easement for the existing 21" drainage pipe (possibly interconnecting with this system if utility conflicts occur), then in as direct a path as possible to Hardy Pond. See Table 3 for comparison of existing conditions to the proposed system. This option would decrease the water surface elevation in the swale by almost one foot for the 25-year, 24 hour Type 3 storm event.

This option would require construction of:

- An inlet structure (headwall)
- 690 LF of 48" pipe
- 4 new manholes (one at each bend and one near the intersection of Trapelo Road)
- An outlet structure (headwall)

We would anticipate construction costs for this Option 1 to be approximately $360,000. Additional costs are anticipated to obtain permanent drainage easements on 5 private properties (Map 14 Lots 5, 6, 7, 8, and 9), the possibility for utility conflicts exist in Trapelo Road, traffic management in Trapelo Road and filing of environmental permits. We also anticipate that a Notice of Intent application with the Waltham Conservation Commission, a USACE-Category 1 Notification and NPDES general construction permit would be required for the work. Also we believe that the new outfall to Hardy Pond may trigger further review by DEP possibly in the form of a Chapter 91 license as well as MEPA review for the new outfall. We would suggest that a pre-application meeting be scheduled with the Waltham Conservation Commission, the USACE and DEP to present the options and try to minimize the permitting effort needed for this work.

Source: United States Geological Survey
2008 15 CM Orthophotos

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FIGURE 6: OPTION 1

SCALE: 1"=200'

1.3.3 Option 2

The goal of this option is to reduce the volume of runoff that enters the Leitha Drive swale from upstream through construction of a berm with an undersized culvert and redirecting flow to a parallel system constructed in Leitha Drive. This option includes constructing a 48" conveyance pipe in Leitha Drive from the dead end on the north end of the road (adjacent the conservation land) and would tie directly into the existing Hardy Pond Road 36"x42" culvert.

Additionally, a 375 LF berm with a top elevation of 204.0 would be constructed across two backyards (Map 8 Lot 2 and Lot 13) perpendicular to the swale at Leitha Drive. For a schematic of this option see figure 7. A 24" culvert would pass through the berm in the existing location of the swale, and at an invert to match the existing swale (approximately elevation 200.0). This option would reduce the flow entering the Leitha Drive Swale and provide an alternate route for flows from the Lexington subcatchment area. The water surface elevation in the swale for the 25-year storm would decrease by 1.65 feet for this option.

This option would require construction of:

- An inlet structure
- 740 LF of 48" pipe
- 3 new manholes (at the points where we connect to existing catchbasins and downstream pipes)
- 20 LF of 24" culvert
- 375 LF of Berm (with 2:1 side slopes estimate 1,000 CY of material)

We would anticipate construction costs for Option 2 to be approximately $480,000. Additional costs are anticipated to obtain permanent drainage access easements on two (2) private properties.

This option poses challenges from a permitting perspective. This option would create permanent impacts to existing wetlands that would be close to, if not over, the 5,000 square foot threshold for approval by the Waltham Conservation Commission. These permanent impacts would require mitigation and it is not clear where or if a suitable location exists to perform wetland mitigation. In addition, temporary impacts would be necessary for construction access and permanent access. Permanent drainage maintenance access would be needed through two existing residential properties to inspect, maintain and repair the berm in the future. There is a strong possibility that, DCR may consider the berm a dam as it will detain more than 15 acre feet of volume immediately upstream of it during significant storm events. As this is a grey area (given that the design would incorporate a culvert) a pre-application meeting with DEP and USACE would be key to determining the viability of this option.

Source: United States Geological Survey
2008 15 CM Orthophotos

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FIGURE 7: OPTION 2

SCALE: 1"=200'

Table 3: Water Surface Elevations in Leitha Drive Swale by Storm Event
(NOTE: houses approximately at elevation 204.0 and
Channel approximately at elevation 200.0)

	Existing Conditions	Remove Sediment	Option 1	Option 2	Option 3
2 year	202.39	202.27	201.70	199.30	201.79
10 year	203.86	203.68	202.97	199.79	203.01
25 year	204.64	204.42	203.68	202.99	203.70
100 year	205.96	205.70	204.86	205.05	204.88

1.3.4 Option 3

The goal of this option is to reduce the volume of runoff that enters the Leitha Drive swale by redirecting it to a parallel system to be constructed in Leitha Drive. The third option we will discuss is similar to Option 2. However, in this case, the berm would not be constructed. No permanent easements would be required, all construction would occur within Leitha Drive. This option would propose constructing a 48" pipe in Leitha Drive from the dead end to the junction of the existing Hardy Pond Road 36"x42" culvert. Water surface elevations in the swale would be decreased by approximately one (1) foot for the 25 year storm.

This option would require construction of:

- An inlet structure
- 740 LF of 48" pipe
- 3 new manholes (at the points where we connect to existing catchbasins and downstream pipes)
- Regrading to direct the swale to the new 48" inlet

We would anticipate construction costs for Option 3 to be approximately $315,000.

We anticipate that a Notice of Intent application with the Waltham Conservation Commission, a USACE-Cat 1 Notification and NPDES general construction permit would be required for the work. Again, we would recommend pre-application meetings be held with the Waltham Conservation Commission, DEP and the USACE to determine the fill extent of the permitting requirements for this option.

1.4 CONCLUSION

From our Analysis, it is clear that the flow being conveyed through the Leitha Drive swale is more than the capacity of the current piped collection and conveyance system can handle for storm events above the 2 year storm. It is our opinion that the best outcome for this area is achieved by implementing a combination of the solution options utilizing a phased construction approach. The first phase would include addressing current maintenance concerns. The second phase would address conveyance capacity in the Leitha Drive area and the third phase would address conveyance capacity issues downstream of the Leitha Drive area. If sufficient funds remain, and flooding conditions persist construction of the berm across the Leitha Drive swale or filling of the rear yards could then be accomplished as a fourth phase. See the general outline of the proposed work plan below.

Phase 1: Maintenance Phase

- Remove sediment from the 48" culvert at Leitha Drive Swale
- Remove sediment from twin 36" pipes at Windsor Village
- Replace 48" at Leitha Drive as necessary
- Replace twin 36" pipes at Windsor Village
- Remove obstructions from Chester Brook

Phase 2:

- Construct Option 3, 48" pipe in Leitha Drive

Phase 3:

- Construct Option 1, New 48" pipe from Leitha Drive swale to Hardy Pond

Phase 4:

- Construct Option 2 berm or bring up the elevations of rear yards abutting the Leitha Drive swale

We thank the City for the opportunity to serve you on this project. We are more than happy to meet with you at any time to review this report and the solution options at your convenience.

1.5 REFERENCES

1. Detailed survey provided by Coler and Colantonio Survey staff, 2010.
2. 2' contour GIS data provided by the City of Waltham
3. Historic USGS maps of the area dating back to 1903
4. Record design plans dating back to 1933 (provided by the City Engineer)
5. Topographic plans of the area with 2-foot contour intervals (provided by the City Engineer)
6. FEMA FIRM maps of the areas in Waltham and Lexington
7. A previous analysis performed by Mr. Charles E. Fuller, P.E. (memo and attachments dated March 7, 2006)
8. "Sizing Drainage Ditch, Rear of #19 to #77" by Beal dated July 12, 1974.
9. "Stormwater Master Plan Chester Brook and West Chester Brook," Rizzo Associates; October 10, 2002.
10. "Notice of Intent: Site Plan Windsor Village at Waltham," Thompson Farland; September 24, 2010.
11. E-mails and internet sources provided by residents of the area photographically capturing flood conditions east of Leitha Drive, along Hardy Pond Road and along Trapelo Road.
12. Commonwealth of Massachusetts, Department of Environmental Protection, Stormwater Management Standards Handbook. Volumes 1-3 February 2008 (DEP Stormwater Management Policy 2008).
13. Commonwealth of Massachusetts, Department of Environmental Protection. 310 CMR 10.00: Massachusetts Wetlands Protection Act Regulations. 2008.
14. Commonwealth of Massachusetts, Department of Conservation and Recreation. 302 CMR 10.00: Dam Safety.

Section 2

Hydrology Model Using HydroCAD