COMMITTEE OF THE WHOLE – FEBRUARY 6, 2006

AUGUST 19, 2005 RAINSTORM

Recommendations

The Commissioner of Engineering and Public Works in consultation with the Commissioner of Finance and Corporate Services recommends:

1. That Staff continue to be proactive in the review, updating and implementation of sound engineering design standards, policies and practices in close consultation and cooperation with the Toronto Region Conservation Authority, the Ministry of Environment, the Ministry of Natural Resources and the Department of Oceans and Fisheries.

2. That priority be placed on completing the following projects and studies, as approved in the 2006 Capital Budget;

    i. Stormwater Management Retrofit Study
    ii. Stormwater Management Criteria Study
    iii. Sediment and Erosion Control Study
    iv. Sewage Flow Monitoring Program
    v. City-Wide Drainage Study
    vi. Storm Pond Sedimentation Removal (various locations).

3. That Staff continue to explore and subsequently report back to Council on funding alternatives and approaches to secure future sustainable funding for;

    i. unexpected storm damage to roads and infrastructure as a result of flooding or other types of severe natural weather occurrences,
    ii. an enhanced level of cleaning and maintenance of the City's stormwater management pond facilities and catchbasins, and
    iii. a Downspout Disconnection Program.

4. That Staff prepare educational material on the sources of basement flooding, the benefits of downspout disconnection and illegal sewer connections, in support of initiating a formal educational program where this material may be disseminated to residents via the;

    i. Corporate Internet Website,
    ii. Vaughan Page in the Vaughan Citizen,
    iii. Public Works Department's Waste Collection Schedule mailings,
    iv. Hydro and water bill mailings,
    v. Tax bill mailings, and
    vi. Display Boards posted during National Public Works Week.

5. That following the completion of the proposed 2006 Capital Budget projects noted above, consideration be given to the development of a Flood Emergency Response Plan in close cooperation with the City's Manager of Emergency Planning.

Economic Impact

The immediate budgetary impacts resulting from the adoption of this report have been considered as part of the 2006 Capital Budget deliberation process. The total capital costs required to complete the priority projects and studies relating to the August 19th, 2005 rainstorm as approved in the 2006 Capital Budget is approximately $1.1 million.

There will be future impacts on staffing resources required to process and administer the recommendations made.

Future educational programs as well as potential programs to develop a Flood Emergency Response Plan will require future budget deliberations in order to be implemented.

Purpose

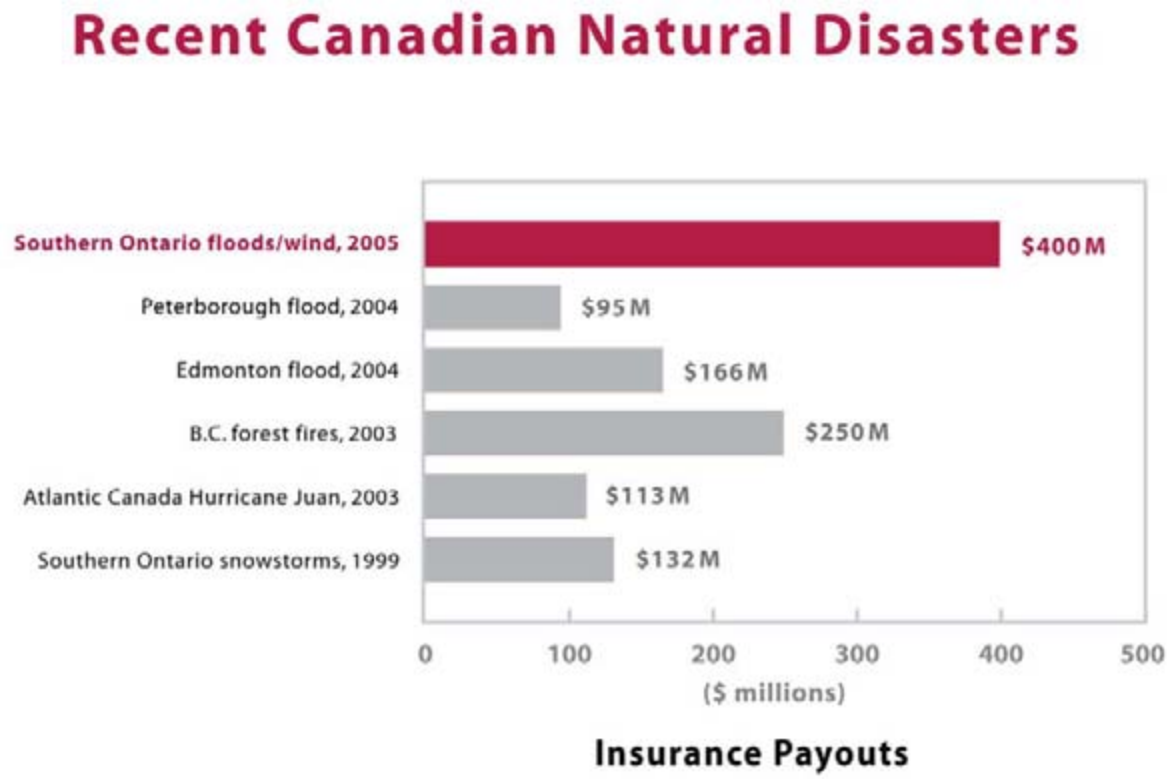
The purpose of this report is to affirm the details of the August 19th, 2005 rainstorm event and to recommend future initiatives to proactively and more effectively manage such natural occurrences.

Background – Analysis and Options

On August 19th, 2005, the City of Vaughan, as well as surrounding municipalities from Stratford to Pickering experienced a rainstorm event that caused considerable flooding resulting in significant damage to both private and public property. The same storm system also spawned two tornadoes in the Fergus area.

According to the Insurance Bureau of Canada representing more than 90% of the insurance industry for non-government home, car and business insurance in Canada, the expected pay out to help Southern Ontario recover from the August 19th storm will reach $400 million. Insurance companies are reporting a huge volume of claims, in the order of 15,000 and growing. The vast majority of claims are for sewer back-up coverage, which is typically purchased as an addition to a homeowner's policy. There have also been a number of auto claims and many businesses were damaged. Figure 1 below provides a comparison of total insurance payouts from recent Canadian natural disasters.

FIGURE 1



Source: http://www.insurance-canada.ca/consinfohome/IBC-Ontario-storm-509.php

The Ministry of Municipal Affairs and Housing (MMAH) governs a relief program known as the Ontario Disaster Relief Assistance Program (ODRAP).

ODRAP provides assistance when damages are so extensive that they exceed the financial resources of the affected individuals, the municipality and the community at large. ODRAP is usually activated in cases where there is extensive private damage to essential property not covered by insurance and/or there is damage to public infrastructure exceeding the funding resources of the municipality.

MMAH has stated that the intent of ODRAP is to provide financial assistance in extraordinary situations, where disasters are of such a magnitude that they are beyond the local municipality's ability to manage and thus warrant provincial assistance. The program does not take the place of private insurance coverage.

A memorandum from the City's Manager of Emergency Planning was issued on January 24, 2006 to the Mayor and Members of Council stating that the severe rainstorm of August 19th, 2005 did not meet the provincial guidelines on which to declare an emergency.

Stormwater Management

Since the 1980's, the Toronto Region Conservation Authority (TRCA) and many area municipalities within the Region of York, including the City of Vaughan, have addressed the impact of urbanization on the environment, through the use of stormwater management. When land is converted from open space/agricultural use to residential/employment use, it often results in increased water levels in ditches, sewers, streams, and creeks and ultimately the Don and Humber Rivers (the receiving rivers to the City of Vaughan), during periods of rainfall and snow melt. As water is unable to run into the ground (due to concrete, asphalt pavements and buildings) the new sewers and roads move the water to our streams more quickly. Stormwater management involves storing the portion of the "additional" water (referred to as storm water runoff) in designated holding areas or ponds, and releasing this water at a reduced rate, typically equal to the rate prior to development. Stormwater management has since evolved to include water quality and temperature impacts, source control, and retrofitting facilities that do not meet current design standards.

Stormwater management was born out of the detrimental and fatal effects of a storm that left thousands of people homeless and caused extensive damage to municipal and private infrastructure including roads, buildings and houses. In 1954, Hurricane Hazel caused the most severe flooding in the Southern Ontario area in recorded history, dumping approximately 212 millimeters of rain in the Toronto Region within 36 hours. This storm jump-started the Conservation Authorities' Flood Control Program. The intent of the program was to transfer the liability of low lying flood susceptible or flood plain land from private hands to the Authorities' and to acquire lands necessary for the construction of flood protection works. In addition, a province-wide flood plain planning policy was initiated through the Conservation Authorities Act. Regulations were implemented to restrict future development and land use in flood hazard areas.

The TRCA and the City of Vaughan in conjunction with the Ministry of Environment, Ministry of Natural Resources and Department of Fisheries and Oceans implement sound engineering design standards, policies and practices to manage the change in hydrologic and hydrogeologic conditions as a result of land use changes through urban development. Hydrologic models and criteria are utilized to accommodate and mitigate post-development runoff to pre-development levels.

Storm Water Engineering Design Standards and Criteria

One of the key engineering design parameters used in the determination of post-development urban runoff from precipitation or rainfall, and the subsequent design of municipal storm sewer

systems, is the development of synthetic design rainstorm events. These synthetic design storm events are unlike actual recorded historical events such as Hurricane Hazel. Their development is based on probable or statistical rainfall depths and durations based on rainfall data collected within a local geographical area such as the GTA.

The three key parameters required to establish a specific synthetic design storm event include intensity, duration and frequency. These parameters are typically referred to as the IDF (intensity, duration and frequency) curve for a specific rainfall event. Intensity is the rate of rainfall as referenced to a time unit. The normal unit of measurement is millimeters per hour (mm/hr). Duration is the length of time in which the rainfall event occurred, usually measured in seconds, minutes and hours. Frequency refers to the probability of reoccurrence or return period of a specific rainfall event of a specified depth, intensity and duration. Frequency is normally reported in years (i.e., the rainfall event is expected to occur at least once in a certain number of years). Frequency or return period estimates are based on a long term statistical analysis and there is absolutely no guarantee that a 10-Year Return Period Storm Event (10-Year Storm) cannot happen in two consecutive years, weeks or even days. It is only a statistical estimate.

In accordance with the Engineering Department's Design Criteria and Standard Drawings Manual, a comprehensive Stormwater Management (SWM) plan including a drainage report must be submitted to the City for review in conjunction with any development application. This provides an integrated means of dealing with the many impacts of urban development on water quantity and quality, erosion and sedimentation and the hydrologic cycle (preservation of groundwater resources). The preparation of a stormwater management plan is based on an approved Master Drainage Plan and TRCA initiatives where the criteria is established by the City and the TRCA. The guidelines for the design of stormwater management facilities in the City are considered supplemental to the latest version of the Ministry of Environment Stormwater Management Practices, Planning and Design Manual.

The design of a stormwater management system is divided into the following two main categories: the minor system and the major system. The minor system includes all belowground storm sewer piping and appurtenances such as catchbasins typically buried below city streets. It is designed to accommodate runoff generated by a 5-Year Storm event. In theory, when a storm event more intense than this occurs, the underground storm sewer pipes are not designed to carry the increased flows from this kind of storm and therefore, the major system kicks in. The major system component includes the aboveground overland flow of water within the roadway and boulevards of a municipal right-of-way. The major system design also includes stormwater management ponds and other overland flow routes through municipal property. The overland flow route (major system) is designed to accommodate runoff generated by a 100-Year Storm event.

The above noted criteria represents commonly accepted municipal engineering design standards and practices by all jurisdictions within the Province of Ontario.

Analysis of the August 19th, 2005 Storm Event

A review and subsequent analysis of the precipitation intensities and total rainfall data recorded by twelve rain gauge stations in the field and operational during the August 19th rainstorm, was completed for the City by Clarifica Consulting. Attachment No. 1 geographically identifies the location of the rain gauge stations and the respective total rainfall volume in millimeters recorded at each station. The highest recorded total rainfall volume was 122.6 millimeters (4.83 inches) at rain gauge station number 1 located at York University.

The intensity, duration and frequency analysis concluded that approximately 85% of the entire area of the City of Vaughan experienced 100-Year Storm conditions or worse. Seven of the twelve IDF curves generated for each rain gauge station exceeded the current synthetic 100-Year Storm IDF curve typically used in the GTA. Attachment No. 2 identifies the estimated boundary throughout the City that experienced 100-Year Storm conditions or worse.

Since the City uses the 5-Year and 100-Year Storm design criteria for the minor and major system drainage design respectively, a significant amount of overland flow within city streets and overall system flooding would be expected from the August 19th, 2005 rainstorm. As a result of the high rainfall intensities over a short duration period, flooding damage did occur at various locations throughout the City.

Summary of Flooding Damage

Based on the analysis of the August 19th rainstorm prepared by Clarifica Consulting, it has been noted that most of the high intensities and volumes of precipitation occurred near the middle and south side of the City. The majority of complaints received by Staff were from older areas of the City reflecting the highest intensities of rainfall, which traversed the City roughly along the Langstaff Road corridor. A location summary of private property flooding complaints received and municipal flooding damage experienced is presented in Attachments No. 3 and No. 4 respectively.

It has been noted that the majority of flooding complaints received were in the older residential neighbourhoods of Woodbridge and Thornhill where existing storm drainage systems pre-date the City's current design criteria. Specifically in the Thornhill area, inlet control devices on catchbasins were implemented and required to accommodate post development storm water flows discharging to the Concord and Centre Street Trunk Sewers due to existing restrictions in the downstream systems. This would have contributed to additional overland flow and subsequent flooding problems in the area during the August 19th storm.

Overall, the flooding related calls and damage resulting from the August 19th rainstorm is summarized below.

Public Works Dispatch received approximately 160 flooding related calls. The majority of complaints were deferred to the individuals' home insurance company. As a priority Staff responded to basement flooding calls due to sewer back-ups where residents indicated that raw sewage was present.

The Clerks Department received numerous notice letters for potential damage claims and continues to address these with the City's insurance company.

The Fire Department responded to and/or followed up with a total of 172 calls.

The majority of calls to Public Works and to the Fire Department were flooding related.

The types of flooding damage sustained to public property included:

- erosion to watercourse banks causing collapse, fencing damage, Terrafix blocks and gabion baskets damage and rip rap washouts
- roadway pavement structure washouts
- broken storm sewer inlet grates
- damaged manholes and fences

A telephone survey was conducted of neighboring municipalities including Toronto, Markham, Richmond Hill and Brampton in order to evaluate the extent of flood damage. Similar types of flooding complaints and damages were received by all neighboring municipalities contacted. The City of Toronto alone is dealing with approximately 1,600 basement flooding issues related to the August 19th rainstorm. As a result, the City of Toronto has reinstated their Basement Flooding Protection Subsidy Program as described below.

City of Toronto Basement Flooding Protection Subsidy Program

The City of Toronto's basement flooding protection subsidy program was reinstated to help residents who experienced basement flooding and to prevent future flooding. The program offers eligible residential homeowners a subsidy to install flood-prevention devices, such as backwater valves and sump-pumps on the internal plumbing of their homes. Subsidies are based on a maximum of $3,200 per residential unit and are available to those that qualify on a first come first serve basis, to assist in covering the costs for such preventative items as back water valves and sump pumps.

To be eligible for any of the subsidies, the homeowner's rainwater roof-leaders must be disconnected from the sewer system and one or more detailed quotation(s) from licensed plumber(s) must be obtained. It is important to note that, the City of Toronto as compared to the City of Vaughan, has older infrastructure such as combined sewers (sanitary sewage and stormwater sharing the same pipe) therefore requiring additional mitigative devices on the service connections to reduce the property owners' flooding risk.

Potential Sources of Basement Flooding

In understanding the sources of basement flooding, it is important to keep in mind the fundamental difference between a sanitary and storm sewer system. The sanitary sewer carries wastewater (sewage) from all plumbing fixtures and basement floor drains (i.e. toilets, sinks, laundry, etc.) and eventually leads to a sewage treatment plant. Storm sewers collect storm runoff or storm water from catchbasins located in roads, parking lots and rear yards, and weeping tiles (foundation drains) and carry these flows into nearby stormwater management facilities which eventually outlet to natural watercourses.

However, water can enter a residential basement for a number of reasons. Basement flooding is most likely to occur during a heavy rainfall event such as on August 19th, 2005. The main causes of basement flooding include the following:

- leaks in basement walls, windows or doors
- poor lot drainage
- failure of the foundation drain system
- overflowing of eaves troughs
- blocked storm sewer lateral connections between the house and the main storm sewer in the street
- a back-up of water in the storm sewer system or a combination of wastewater and rainwater from the sanitary sewer system
- cross connections (a sanitary lateral connected to a storm sewer or vice versa)
- illegal basement walkouts with improper grading
- illegal basement bathrooms / kitchens connected to the storm sewer instead of the sanitary sewer system
- failure of sump pumps in areas where they are required to pump foundation drain water
- connection of eaves trough downspouts to the sanitary sewer connection
- overland flow exceeding the capacity of the designed storm system
- re-directing downspouts to the road drainage system

Attachment No. 5 schematically illustrates the potential sources of basement flooding as described above. It is important to note that the majority of the above noted sources of basement flooding are due to situations and/or alterations made directly by individual homeowners on private property. Further, mitigating these sources will only reduce the risk of basement flooding and not necessarily eliminate it altogether.

On-Going Engineering and Public Works Initiatives

On-going 2006 Capital Budget funded programs and studies related to stormwater management engineering design standards, policies and procedures review, will allow for future flooding mitigation from events such as the August 19th, 2005 rainstorm, by establishing improved City-wide policies related to:

- stormwater management facility retrofit requirements,
- updated stormwater management design criteria,
- sedimentation and erosion control, and
- infiltration and inflow, based on sewage flow monitoring.

One of the key 2006 Capital Budget studies required to substantiate and potentially mitigate future instances of flooding and related concerns received by residents (as identified on Attachments No. 3 and No, 4) is the completion of the City-wide Drainage Study.

This study will include a comprehensive investigation of existing drainage conditions throughout older subdivisions in the Woodbridge, Maple, Thornhill and Concord areas, with recommendations on mitigative measures to address on-going drainage and flooding issues in these areas.

Further, Staff is currently implementing the recommendations and maintenance priorities of the Stormwater Management Inventory and Maintenance Study completed by Clarifica Consulting in 2004. As a result, the required maintenance of assumed SWM facilities is being prioritized and included in yearly Capital Budget deliberations.

As a result, it is recommended that priority be placed on completing the following projects and studies, as approved in the 2006 Capital Budget;

- Stormwater Management Retrofit Study
- Stormwater Management Criteria Study
- Sedimentation and Erosion Control Study
- Sewage Flow Monitoring Program
- City-Wide Drainage Study
- Storm Pond Sedimentation Removal (various locations)

In addition, Engineering Services has initiated a comprehensive piped infrastructure data capture project to be completed this year. This will create a detailed Geographic Information System (GIS) database of the City's existing sewer and watermain infrastructure. This database will become essential to improve the City's capabilities to store and analyze critical flooding related data and to develop a comprehensive Flood Emergency Response Plan.

Potential Future Engineering and Public Works Initiatives

Following the completion of the City-wide Drainage Study, it may be appropriate that the following initiatives and programs be implemented.

Annual Catch Basin and SWM Pond Cleaning Program

Currently, the Public Works Department has an annual catchbasin cleaning program. The current level of funding, however, does not allow the City to clean every catch basin on an annual basis. To mitigate concerns and/or legal challenges concerning the City's catchbasin maintenance program and its potential contribution to flooding, sufficient funding for future Operating Budgets, to ensure a higher level of service for catchbasin cleaning is required.

There are currently 52 assumed stormwater management ponds throughout the City, with an estimated additional 30 ponds that will be constructed and assumed in the near future. In 2003 a study was implemented in order to assess the current conditions and prioritize the on-going maintenance of these ponds. The City of Vaughan is one of the first municipalities within the TRCA's jurisdictional watersheds to implement such a study.

The cleaning and maintenance budget requirements for a limited number of existing SWM facilities have been included in the current 2006 Capital Budget. Funding for this work will be from taxation. However, increased sustainable funding for an enhanced level of cleaning and maintenance of the City's stormwater management pond facilities and catchbasins will be required in the future.

Downspout (Rainwater Roof Leader) Disconnection Program

In some areas, residents have connected their rainwater roof leaders into the City's sanitary or storm sewer systems directly, or indirectly to the street curbs and subsequent pavement overland flow system. In cases of significant rainfall, this extra water can contribute to the surcharging of the sewer system, which may result in basement flooding. In order to mitigate the potential for surcharging as a result of roof leaders being connected to the sewer system, summer students could be hired to conduct a door-to-door inventory of homes in severely flooded areas. If they find homes where the roof leaders do not discharge onto the ground, as required, they would leave an educational brochure concerning the impact this has on the City's sewer system, as well as the impact it may have on their own property such as basement flooding. A detailed list of locations would be compiled, and those houses would be re-visited the following year to determine if any action had been taken to disconnect these roof leaders from the City's sewer system. This program could be developed and implemented subject to the availability of future funding.

Illegal Sewer Connections Information Brochure

Basement flooding can also be the result of illegal connections being made to the City's sewer system. In cases where the homeowner takes it upon himself/herself to construct a bathroom and/or kitchen in the basement of a house that does not have approved roughed-in connections, there is a danger that the homeowner may connect these fixtures to the wrong sewer. Toilets, sinks, showers etc. must all be connected to the sanitary sewer system. An improper connection made to a storm sewer will not only lead to raw sewage entering the storm drainage system, but it may also result in storm water entering the house in heavy rainfalls through these illegal connections. A smoke or dye-testing program would help identify illegal connections of this type. However, an educational/information brochure could be prepared and circulated to all residents. This may be a more effective means to correct and mitigate this concern.

Flood Emergency Response Plan

As a follow-up to the current proposed City-Wide Drainage Study in the 2006 Capital Budget, the development of a flood emergency response plan identifying areas susceptible to severe flooding and defining concrete steps to mitigate the risk for property damage and/or public safety would be appropriate. The plan would also include a review of potential flooding and hazards in tableland areas and within stream corridors. Some of this information is readily available from the TRCA and would also be analyzed as part of the plan development. Input from the City's Manager of Emergency Planning should also be included as part of this plan development.

A key component of this plan should address procedures relating to the on-going communication of key information to Council, senior management and affected residents during any emergency situation.

Relationship to Vaughan Vision 2007

In accordance with the strategic corporate priorities related to service delivery excellence in serving our citizens (A-1, A-2 and A-3) as established by Vaughan Vision 2007, the recommendations of this report will assist in improving community safety through design, prevention, enforcement and education.

Conclusion

The intensity, duration and frequency analysis of the August 19th, 2005 rainstorm concluded that approximately 85% of the entire area of the City experienced 100-Year Storm conditions or worse.

Since the City uses the 5-Year and 100-Year Storm design criteria for the minor and major system drainage design respectively (a commonly accepted design standard within the Province of Ontario), a significant amount of overland flow within city streets and overall system flooding would be expected. As a result of the high rainfall intensities over a short duration period, flooding damage did occur at various locations throughout the City.

Accordingly, it is noted that the on-going and future initiatives identified herein will allow the City to remain proactive and more effectively manage future natural occurrences such as the August 19, 2005 rainstorm. Any mitigative measures implemented within the City will no doubt reduce the potential risk and associated damage resulting from natural occurrences, however, they will by no means eliminate the risk completely.

Attachments

1. Total Rainfall Volumes and Rain Gauge Station Locations
2. 100-Year Storm Event Boundaries
3. Private Property Flooding Complaints General Area Map
4. Municipal Flooding Damage General Area Map
5. Potential Sources of Basement Flooding

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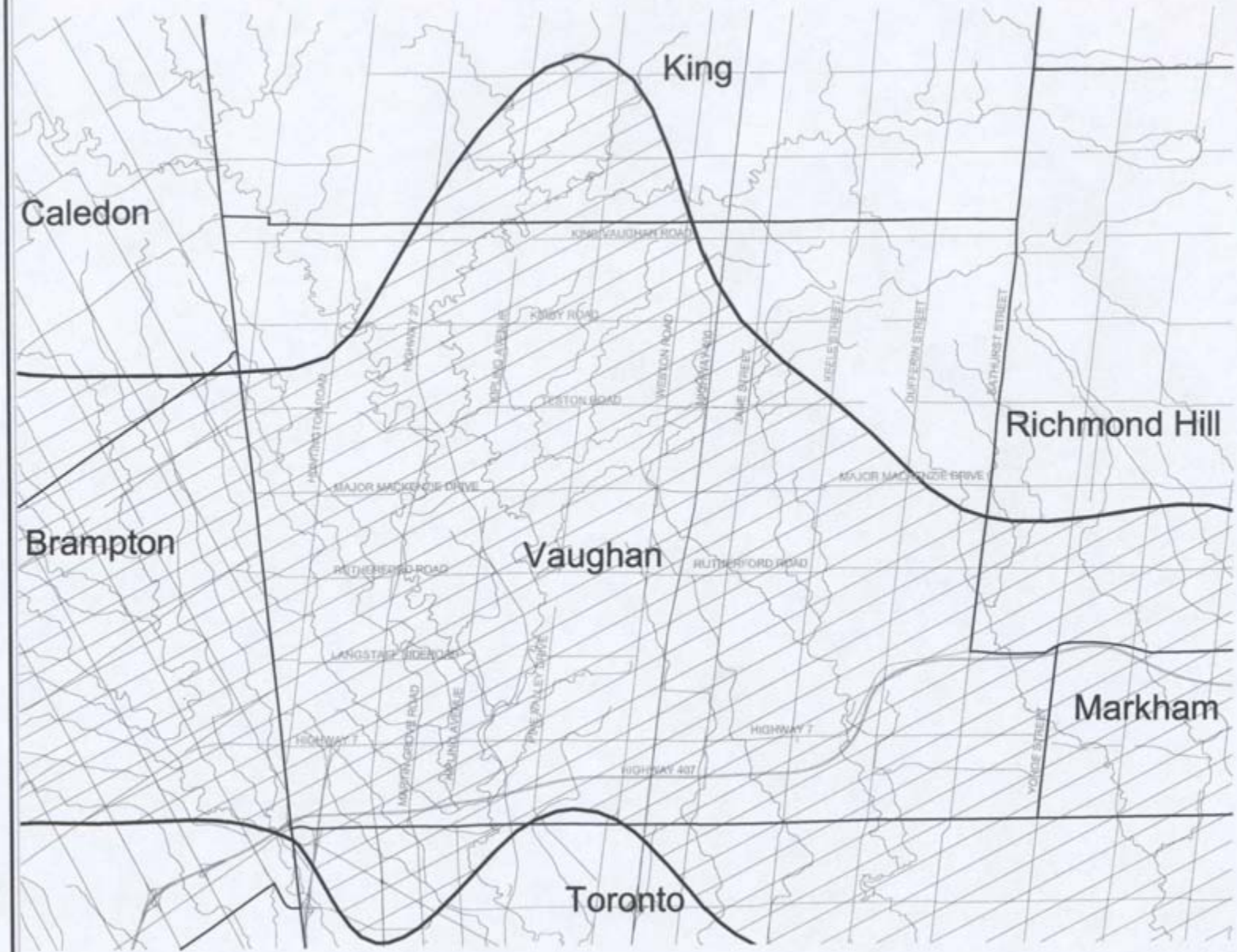
ATTACHMENT No. 1

TOTAL RAINFALL VOLUMES AND RAIN GAUGE STATION LOCATIONS

N.T.S.

CITY OF VAUGHAN - ENGINEERING PLANNING & STUDIES

ATTACHMENT No. 2



LEGEND

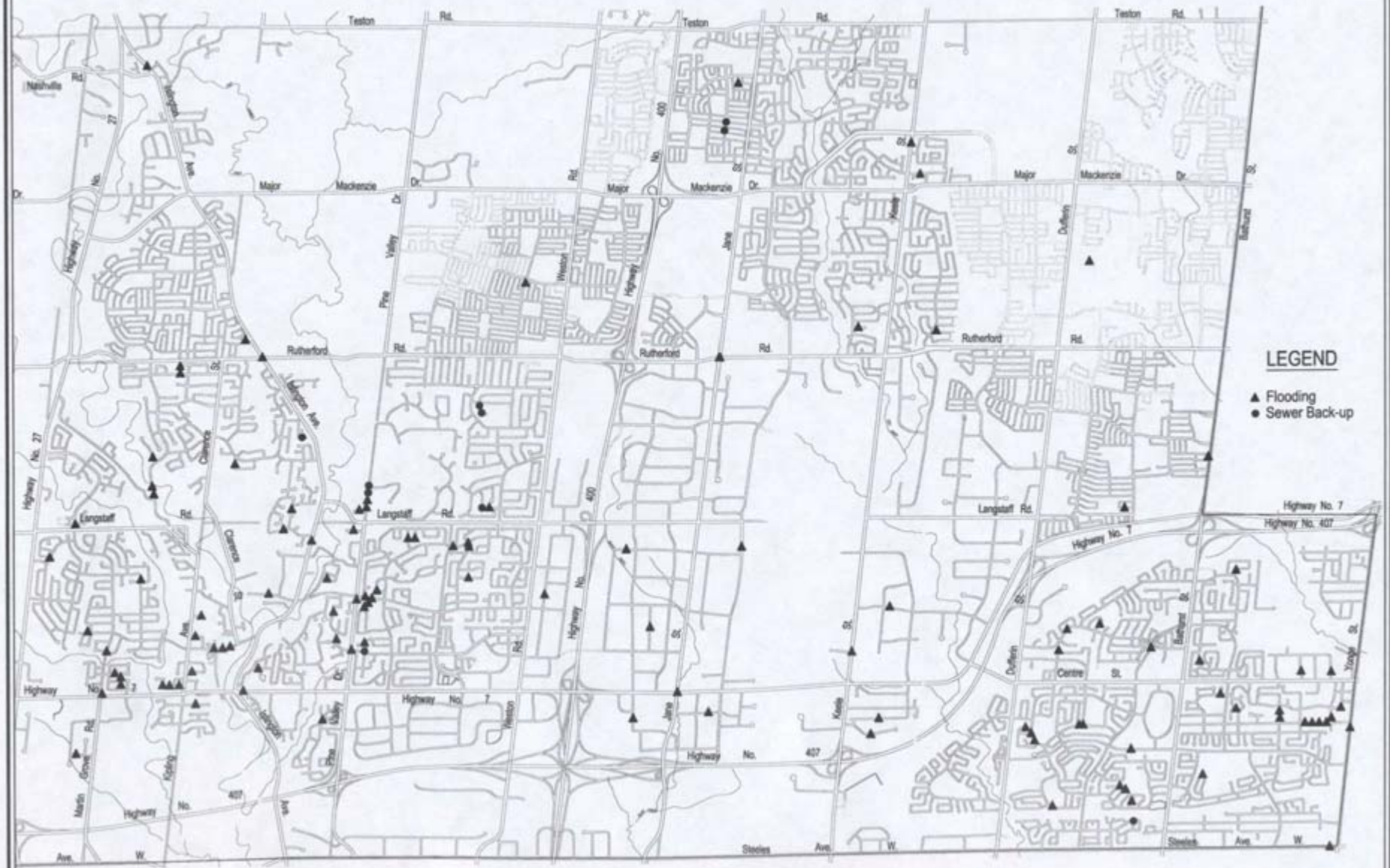
- 100 - Year Storm Boundary
- Roads
- Rivers
- Municipal Boundary
- 100 - Year Storm Conditions Exceeded

100-YEAR STORM EVENT BOUNDARIES

N.T.S.

CITY OF VAUGHAN - ENGINEERING PLANNING & STUDIES

ATTACHMENT No. 3



PRIVATE PROPERTY
FLOODING COMPLAINTS
GENERAL AREA MAP

N.T.S.

CITY OF VAUGHAN - ENGINEERING PLANNING & STUDIES

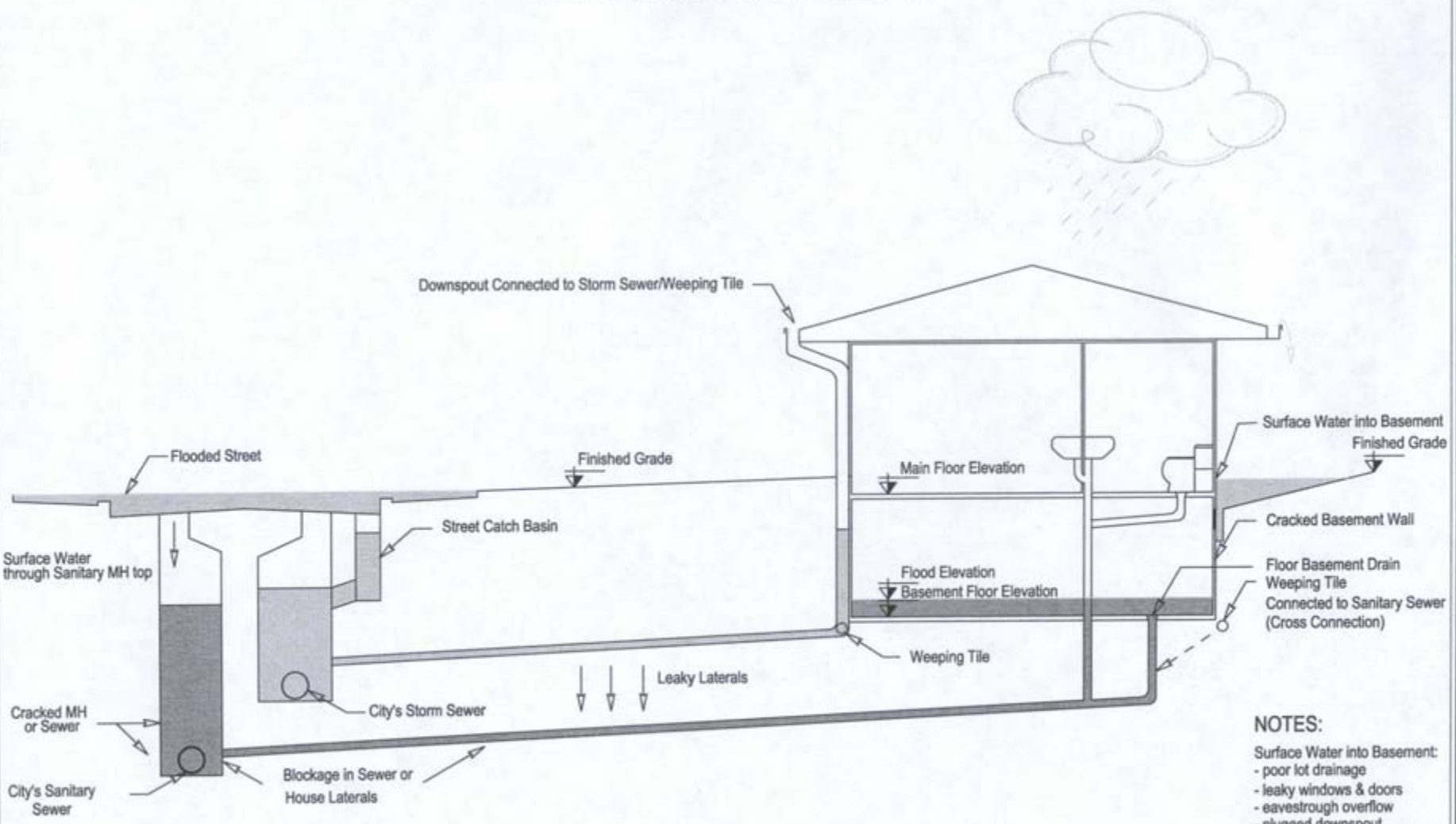
ATTACHMENT No. 4

MUNICIPAL FLOODING DAMAGE
GENERAL AREA MAP

N.T.S.

CITY OF VAUGHAN - ENGINEERING PLANNING & STUDIES

ATTACHMENT No. 5



NOTES:

Surface Water into Basement:
- poor lot drainage
- leaky windows & doors
- eavestrough overflow
- plugged downspout
- reverse slope driveway

LEGEND

Storm Sewer

Sanitary Sewer

N.T.S.

POTENTIAL SOURCES OF BASEMENT FLOODING

CITY OF VAUGHAN - ENGINEERING PLANNING & STUDIES