THE CORPORATION OF THE
TOWN OF TECUMSEH

Public Works & Environmental Services
Report No. 40/16

TO:	Mayor and Members of Council
FROM:	Daniel Piescic, Director Public Works & Environmental Services
DATE:	November 10, 2016
DATE TO COUNCIL:	November 22, 2016
SUBJECT:	Rainfall Event of September 29, 2016

RECOMMENDATIONS

It is recommended that:

1. Public Works and Environmental Services Report No. 40/16, Rainfall Event of September 29, 2016, be received as information.

BACKGROUND

September 29, 2016 Rainfall
On September 29, 2016, an unprecedented and extraordinary rainfall event of unusual intensity and duration occurred in Windsor, Tecumseh and Lakeshore. The rain storm was centered over the Town of Tecumseh and Wards 1, 2 and 3 bore the brunt of the storm. Using data from an independent rain gauge monitored by Weather Underground, and located near Revland Street in Tecumseh, it was observed that:

- 220 mm of rain fell in 24 hours between 6:00 pm September 28 and 6:00 pm September 29
- 195 mm of rain fell in the 12 hours between 12:00 midnight and 12:00 noon on September 29.
- 175 mm of rain fell in the six (6) hours between 6:00 am and 12:00 noon on September 29.
- 110 mm of rain fell in two (2) hours during an intense period of the storm, between 8:00 am and 10:00 am on September 29.

Figures 1 and 2 illustrate the pattern of rainfall accumulation, and the intensity and rate of accumulation of rainfall, respectively.

A rainfall event is typically classified according to its frequency of occurrence. Classifying the event considers various factors such as the duration and intensity of the rainfall, as well as the amount of accumulation. Rainfall frequency return periods are typically established through statistical review. The average rainfall intensity over a given time can also provide the return period, noting that a short duration and high intensity rainfall can be characteristic of a 1:100 flood, as can be a longer rainfall event with moderate rainfall intensity. The September 28 and 29, 2016, rain fall event, where approximately 220 mm of rain fell in a 24 hour period, and 110 mm fell in two (2) hours during the morning of September 29, was a very severe, intense and infrequent storm. Using the Environment Canada rainfall data for the Windsor A Weather Station, a 1:100 year storm would result in 108 mm of rain in a 24 hour period. Based on that comparison, unofficially this storm far exceeded the 1:100 year

storm. To our knowledge, this rainfall was the largest 24 hour rainfall event ever recorded in the Town of Tecumseh.

The heavy rains on September 28 and 29 saturated the soil and the resultant storm water runoff inundated the storm sewer system as the frequency of the rainfall event exceeded the design frequency of the Town's storm sewer system. As the storm sewer system could no longer accept more storm water, no additional runoff could enter the street catch basins and street flooding occurred. With storm water sitting on the roadway and other low-lying ground surfaces, there was increased opportunity for storm water to enter the sanitary sewer system. The resulting large inflow of runoff water overwhelmed the Town's storm water and wastewater systems' normal operating capacities, which in turn, caused the both systems to surcharge. The combination of surcharged sewer systems and the inability of some residences to protect themselves from the high water levels due to failed, or overwhelmed sump pumps and/or a lack of backwater valves, resulted in many flooded basements.

On September 29 and on several days following, more than 1,300 residents reported via telephone, or via the flood survey posted on the Tecumseh website, that they had basement flooding occur at their properties. The reported number of flooded basements may be an underestimate as not all residents opted to report whether they experienced basement flooding. The attached map, titled "Locations of Reported Basement Flooding" illustrates the distribution of reported basement flooding.

The Town's storm water and wastewater systems were both fully functional at all times before, during and after the storm. In addition, all eight (8) of the Town's storm water pump stations and all four (4) of the wastewater pump stations were fully operational and were capable of operating at maximum capacity at all times. Furthermore, as is standard operating procedure, crews from both Public Works & Environmental Services and Parks & Recreation Services Departments were on-site at the storm water pump stations and flooded roadways, and OCWA personnel were at the wastewater pump stations to ensure no issues occurred and the pumps continued to operate. Heavy equipment was used, where necessary, to clear debris from trash grates leading to the pump stations to ensure proper flow into the pump stations.

The Insurance Bureau of Canada reports that this rainfall event resulted in significant property damage and that insurance claims to date in the Windsor, Tecumseh and Lakeshore area have exceeded $108 million.

The Mayors of Windsor and Tecumseh declared emergencies on Thursday, September 29, 2016. On Monday, October 3, 2016, the Ontario Minister of Municipal Affairs visited Windsor and Tecumseh and announced the Province had activated the Disaster Recovery Assistance Program.

COMMENTS

Two Separate Sewer Systems

The Town of Tecumseh utilizes storm water and wastewater collection systems and they are separate sewer systems.

The Town's wastewater collection system consists of underground wastewater sewer pipes and four (4) wastewater pump stations that collect wastewater and convey it to treatment plants in Windsor for treatment. Storm water is collected and conveyed to Lake St. Clair via the Town's storm sewer system and eight storm water pumping stations.

Storm Sewer Collection System

The Town's storm sewer system within Wards 1, 2 and 3 collects storm water for ultimate discharge to Lake St. Clair. Several pump stations exist along Riverside Drive that lift the storm water from the storm

sewers to the lake. The pump stations are equipped with standby power generators in case of power outages.

The design of the storm sewers is based on the frequency of a particular storm event and is referred to as a 1 in "x" number of year's event. The lower the number "x", the more frequent the event and the smaller the rainfall volume. The result is a smaller storm sewer. The larger the number "x", the less frequent the event and the larger the rainfall volume and larger size storm sewer. Pump stations are similarly designed.

Much of the pre 1984 storm sewer systems in the Town were designed to a 1:2 year rainfall event. The Ministry of the Environment and Climate Change (MOECC) last updated its design guidelines in 1984 and recommended the return frequency for storm sewer design be 1:2 or 1:5 year rainfall event. Much of the storm sewer systems in the Town post 1984 are designed to either one of those two rainfall events depending on which former municipality the storm sewer is situated. It is important to repeat that the September 29 storm far exceeded the 1:100 year rainfall let alone a 1:2 year or 1:5 year rain fall event. A storm sewer system designed for a two or five year storm event cannot be expected to contain a storm event far greater than a 1:100 year event such as occurred on September 29, 2016 without some road and ground surface flooding. That rain fall was the largest 24 hour rainfall event ever recorded in the Town.

Rainwater is collected into the storm system by catch basins and inlets in the roadway and by private drain connections (PDCs) that can typically include sump pumps that drain foundation drains. Portions of the Town have roof leaders or downspouts connected to the PDCs as well. When the rainfall exceeds the normal operating capacity of the storm sewers, the rainwater backs up in the storm sewer system, filling it and rising up onto the roadway. These back-ups occur when a rainfall event exceeds the design rainfall event frequency. Often, the run-off water can be temporarily accommodated in the roadway until the storm passes and the sewer system can effectively convey the rainwater away.

While street flooding is normally considered a bad thing, it is more desirable to have water temporarily pond in the roadways than to have rainwater enter basements or the wastewater collection system.

It is very important to note that most Canadian municipalities design and construct their local municipal storm water systems to handle either a 1:2 year or 1:5 year rain fall. No Ontario municipality designs their storm water system to handle the rainfall event that occurred on September 29, 2016. To do so would result in enormous diameter storm water pipes and huge pumping station capacities which would be unaffordable to construct.

Wastewater Collection System

The Town's wastewater collection system consists of two components, the collection sewers and the wastewater pumping stations. Wastewater consists of dry weather flow and wet weather flow. The wastewater is collected for treatment at wastewater treatment plants located in Windsor.

The Tecumseh wastewater collection system was designed following MOECC guidelines and based on a per capita usage (dry weather flow) and nominal extraneous flow (wet weather flow) calculation.

Dry weather flow is the sewage (or sanitary as it is sometimes referred to) from buildings and consists of water used in showers, toilets, sinks and floor drains.

Wet weather flows are extraneous flows that inadvertently enter the sanitary collection system. It is also referred to as inflow and filtration (I&I).

Infiltration is typically described as any extra water that enters sanitary sewer pipes from the surrounding soil. Infiltration water can enter the sewer pipes through leaky pipe joints, cracks in pipes leaky manholes and other similar type defects.

Inflow is typically described as any extra water flowing into the sanitary collection system from above ground sources and is usually a result of rainfall activity and can enter the sanitary system by sheet flow of water over leaky manhole covers and uncovered cleanouts or through private property rain downspouts or cellar, yard, area or foundation drains illegally connected to the sanitary sewer system. Based on observations made in studies carried out by the Town and on observations of data from monitors that the Town has placed in the Towns sanitary sewers, the pattern of wet weather flow has revealed that the majority of inflow into the sanitary sewer system is occurring on private properties.

Any extra water from inflow and infiltration is unwanted and is the primary cause of sanitary sewers becoming overwhelmed and resulting in the surcharging of the sanitary sewer system. Surcharged sanitary sewers can then cause the mixture of sewage and extra storm water to rise up through floor drains, shower drains and other plumbing fixtures and thereby enter the basements.

Basement Flooding Questionnaire
Town staff set up an on-line questionnaire to determine the extent of the basement flooding. In addition, phone calls from residents were also received providing similar information. Over 1,300 responses were recorded. The attached map shows the distribution of the reports of flooding.

Widespread basement flooding was experienced throughout Wards 1, 2 and 3 of the Town. Many of the respondents to the questionnaire indicated that the water had entered their basement through the floor drain which provides a direct connection to the sanitary sewer system. Some respondents indicated the water entered their basement through their sump pump pit and that the water was sometimes "dirty" and sometimes clear.

Responses also indicated that street flooding had occurred throughout Wards 1, 2 and 3 with the heaviest flooding being in low lying areas.

Previous History of Basement Flooding
The Town has had a history of basement flooding during severe rainfall events. The highest frequency of basement flooding appears to have been concentrated in the former Village of St. Clair Beach, with the next highest frequency occurring in the former Town of Tecumseh. The sanitary sewers in the Tecumseh Hamlet have surcharged during severe rainfall events and resulted in some basement flooding. The following is a list of recorded rainfall events that resulted in basement flooding in 2013 and prior years.

Date of Event	Total Rainfall Amount	Comments
September 1981	89.0 mm	Basement flooding reported in St. Clair Beach(SCB), Old Tecumseh and Tecumseh Hamlet
July 1983	82.0 mm	Basement flooding reported in SCB
February 1985	34.6 mm*	Basement flooding reported in SCB
February 1990	70.6 mm	Basement flooding reported in SCB
June 2010	89.8 mm	Basement flooding reported in SCB, Old Tecumseh and Tecumseh Hamlet
September 2011	86.0 mm	Basement flooding reported in SCB
July 2013	70 mm (in 4hrs)	Basement flooding reported in Tecumseh Hamlet

*Rainfall recorded at Windsor Airport-actual rainfall in SCB likely much higher

As a result of significant rainfall events that occurred on June 5 and 6, 2010, and September 9 and 10, 2011, widespread basement flooding was experienced by residents in Wards 1 and 2 of the Town. The unusually large amount of storm water run-off overwhelmed the Town's wastewater systems' normal operating capacity, which in turn, caused the sewers to surcharge resulting in flooded basements.

A significant rainfall event occurred on July 16, 2013, and widespread basement flooding was experienced by residents in Ward 3 of the Town. The resulting unusually large amount of storm water run-off overwhelmed the Town's wastewater systems' normal operating capacity, which in turn, caused the sewers to surcharge resulting in flooded basements

Causes of Basement Flooding
Water can enter basements in several ways and for many reasons and is most likely to occur during periods of heavy rainfall, or when snow is melting rapidly during a thaw. Some of the ways are listed below and are illustrated in Figure 3:

- Storm water overwhelming the capacity of the sump pump, causing backup from the sump
- Sump pump failures due to power outages, overuse or other malfunctions
- A blocked connection between the residence and the main sewer in the street
- A back-up of wastewater (or a combination of wastewater and rainwater) through the sanitary sewer system (via floor drain, cleanout etc.)
- Poor grading around the house
- Through cracks, holes etc. in basement walls or floors
- Overland flow through openings in the residence

A backup of wastewater in the sanitary sewer system (from a combination of wastewater and rainwater) is one of the most damaging ways that flooding of a basement can occur. It is caused by an excessive amount of inflow of storm water into the sanitary sewer system and thereby causing the system to be overwhelmed and surcharged which results in wastewater rising up into basements. This is illustrated in Figure 4. Unwanted storm water can enter into the sanitary sewer system by various ways including:

- Infiltration into leaky sewers on both the public right-of-way and on private properties
- Inflow into sanitary manholes located in flooded roadways or low-lying areas
- Inflow through cross connections of roof downspouts to sanitary sewer
- Inflow through cross connections in homes (floor drains and foundation drains)
- foundation drains being directly connected to the sanitary sewer

A backup of storm water from the sump pump is also one of the most damaging ways that flooding of a basement can occur. It is caused by storm water overwhelming the capacity of the sump pump, sump pump failures due to power outages, overuse or other malfunctions and aggravated by poor grading around the house.

It is difficult to determine the exact cause of every home's flooding as not all homes within the flooding areas were subject to basement flooding or the same underlying cause. Protecting each home from basement flooding is the best defence. Information is available on our website and administration will continue to highlight the opportunities and methods for homeowners to protect their residences from flooding.

Town Actions and Improvements Made to Date

1. Since the early 1980s, several studies, reports and remediation programmes were prepared and implemented to investigate the causes of the flooding and reduce the extent of basement flooding.

2. Flood reduction program work was undertaken in the 1990s in response to widespread basement flooding within the former Village of St. Clair Beach. The program included a regular sewer inspection and cleaning program, the upgrading of the Hayes sanitary pump station and a building standards by-law that provided specific measures to control and mitigate inflow to the sanitary sewer system. These standards included the elimination of roof eaves trough downspout leaders to the sanitary sewers, lot drainage and grading requirements and basement sump pump pit discharge details for new developments. The program was somewhat successful as the frequency of sanitary sewer basement flooding had somewhat reduced.

3. In response to the 2010 flooding event, the Town engaged Dillon Consulting Limited to provide a complete assessment of the Town's Wastewater Collection System and in 2011 Council approved a ten year plan at an estimated cost of **$10 million** to implement four main areas of improvement to reduce the risk of basement flooding as follows:

   a) Improvements to reduce extraneous flows;
   b) Partnering with homeowners to manage risk;
   c) Assessment and management of public infrastructure;
   d) Storm drainage improvements

   As of November 2016, much of the ten year plan has been implemented. The elimination of extraneous flows from the sanitary system is still ongoing and will likely continue for a number of years. The majority of the inflow is occurring on private property and will also require action by property owners to reduce the inflow.

4. A flood prevention by-law was approved to make backflow valves and sump pump overflows mandatory for new home construction. A policy for mandatory disconnection of rain water leaders and improper cross connections was also developed.

5. In 2012, Council implemented a voluntary subsidy program to assist homeowners (single family, duplex homes and row houses) with the cost of the installation of a new backwater valve and the disconnection of foundation drains from the sanitary sewer system. The eligibility for the program was backdated to June 2010. The program provides for a subsidy of up to a maximum of 80% of the cost of the installation of a new backwater valve, up to a maximum of $800 and a subsidy of a maximum of 50% of the cost of the disconnection of foundation drains from the sanitary sewer system, up to a maximum of $1,060. Since the program implementation and prior to September 29, 2016 only 17 residences have applied for the subsidy for the backwater valve and none have applied for the disconnection of foundation drain subsidy. Since September 29, 2016 approximately 180 residences have applied for the subsidy for the backwater valve which will result in providing over **$144,000** to residents to install backwater valves in their residences.

6. As part of the ten year plan, in 2011, Council approved a project to investigate (via flow monitoring and hydraulic modelling) the capacity of the Lakewood (Hayes) Sanitary Pump Station and the sewer collection pipes in the effort to optimize the Town's sanitary sewer collection system and reduce the risk of basement flooding in the area served by the Little River trunk sanitary sewer (Wards 1 and 2).

   Based on the results of the flow monitoring and hydraulic modelling, the Lakewood (Hayes) Pump Station and Storage Facility project was implemented in 2014. The project included constructing a new pump station with increased discharge capacity, decommissioning of the existing facility at Hayes Avenue, and a system storage capacity to temporarily store peak wet weather flows. The storage facility consisted of 450 metres of 2.25 metre diameter pipe

providing 1800 cubic metres of wet weather flow storage capacity to mitigate basement flooding in Wards 1 and 2. This project was implemented at a cost of **$4.3 million**.

7. In 2009, Council approved the reconstruction of the Brighton Storm Water Pumping Station and related storm sewers to improve the service level of the storm sewer system for the drainage area served by the Brighton Pump Station. The implementation of this project improved the capacity of the existing station to 2.23 cubic metres per second. This project was implemented at a cost of **$5.6 million**.

8. In 2012, Council approved the recommendation that authorized administration to proceed with a program to outfit the Town's existing storm water pumping stations with back-up power generation. All eight pump stations in the Town can now operate on back-up generators in the event of power failure. This project was implemented at a cost of **$1.1 million**.

9. In 2012, Council approved the recommendation that all newly constructed single family dwellings, semi-detached dwellings and townhouse dwellings in the Town of Tecumseh have backwater valves installed in accordance with the Ontario Building Code; that all lot grading plans and sanitary sewer private drain connection sheets for new residential developments shall be required to include details and notes on the installation of backwater valves; and that general information related to the benefits of an maintenance of backwater valves, sump pumps and lot grading be made available to builders and homeowners through the Town of Tecumseh and in brochures available at Tecumseh Town Hall.

10. In 2013, Council approved the reconstruction of the East Town Line Drain Storm Water Pump Station at the foot of Manning Road and related storm sewers to improve the service level of the storm sewer system for the drainage area served by the East Town Line Drain Pump Station. The implementation of this project improved the capacity of the existing station from 1.9 to 7.5 cubic metres per second. This project was implemented at a cost of **$8.6 million**.

11. In 2014, Council approved the relocation of a portion of the East Town Line Drain from the west side of Manning Road into Lakewood Park from Hayes Avenue to Riverside Drive. The implementation of this project improved the conveyance capacity and storage capacity of the East Town Line Drain along this location and will accommodate the proposed road improvements to Manning Road which will then improve the road side safety of Manning Road. This project was implemented at a cost of **$0.7 million**

12. In 2014, the Town implemented a new standard for new residential subdivisions that all plumbing fixtures in basements must be drained via a sewage ejector pump to the sanitary building sewer. All plumbing fixtures on the first floor level and above may be drained by gravity pipes to the building sewer. This system virtually ensures that basement flooding will not occur from surcharging of the Towns sanitary sewer system. It also eliminates any likelihood of cross connections of storm water into the sanitary system.

13. Information has also been provided on the Town's website, on a continuing basis, on how to flood proof a residence.

These actions, implemented by the Town to date, were intended to prevent basement flooding from surcharged sanitary sewers by providing sufficient protection from rainfall events of up to 80 mm in 24 hours.

Proposed Future Town Actions

Although considerable action has been taken to date by the Town to reduce the risk of basement flooding more work is planned.

Future Wastewater System Actions

1. The Town is currently in the midst of preparing an update to the Water/Wastewater Master Plan. This plan will result in recommendations for infrastructure improvements to support existing development and future infrastructure expansions for future development. The updated Master Plan is anticipated to be completed by June 2017.

2. As part of the ten year action plan, the Town has placed rain water shields in sanitary manhole covers in low lying areas of Wards 1 and 2. This prevents the entry of rainwater into the sanitary system during heavy rains. The placement of rain water shields in all remaining manhole covers is intended to take place.

3. As part of the ten year action plan, the Town will continue its program of reducing I&I of storm water into the Town owned portions of the sanitary system. Excess I&I is the root cause of surcharging of the sanitary system leading to basement flooding. However, past studies by the Town have revealed that the majority of inflow into the sanitary system is occurring on private properties. Accordingly, there is also an opportunity for private property owners to assist in the reduction of unwanted inflow sources from their property. In October 2016, the Town applied for two grants totalling $3 million from the senior levels of government to assist with the reduction of I&I. It is intended that a portion of these funds be used to assist property owners in reducing I&I from the sanitary system.

4. As part of the ten year action plan, a second wet weather flow storage facility is proposed to be constructed along Riverside Drive to temporarily store excess inflow during severe rainfall events. The project includes constructing a new storage facility consisting of 400 metres of 1.5 metre diameter pipe (replacing the existing 400 mm diameter pipe) along Riverside Drive between Pentilly Road and Kensington Boulevard providing 700 cubic metres of wet weather flow storage capacity to mitigate basement flooding in Ward 2.

5. The Town will continue to provide a voluntary subsidy program to assist homeowners (single family, duplex homes and row houses) with the cost of the installation of a new backwater valve and the disconnection of foundation drains from the sanitary sewer system. The program provides for a subsidy of up to a maximum of 80% of the cost of the installation of a new backwater valve, up to a maximum of $800 and a subsidy of a maximum of 50% of the cost of the disconnection of foundation drains from the sanitary sewer system, up to a maximum of $1,060.

6. The Town will continue to investigate and evaluate the current wastewater system and potential improvements that can be made to ensure storm water inflow is managed effectively during major storm events.

7. The Town will also continue to provide information to residents in person and on the Town's website on how to implement flood protection measures for residences.

Future Stormwater System Actions

1. The Town has partnered with the Essex Region Conservation Authority and surrounding municipalities to update the Region's Intensity-Duration-Frequency (IDF) curves. An IDF curve is a key storm water management design tool used to produce a design rainfall event of a particular intensity and duration for various return periods, which is applied when designing storm water infrastructure. An update to this curve is required to take into account the effects of climate change. This work is in progress but more work is needed to finalize the updated curves for practical use by engineering practitioners.

2. The Town will continue its program of neighbourhood local improvements, which includes upgrading local storm sewers and storm outlets.

3. The Town's storm water infrastructure network is supported through eight storm water pumping stations, which are primarily located near the shore of Lake St. Clair within Wards 1, 2 and 3.

   The Town's storm water infrastructure has performed reasonably well in handling rainfall events up to and including 90 mm of rain in a 24 hour period. However, the 220 mm of rain that fell in the 24 hours of September 28 & 29, 2016, overwhelmed the Town's storm water infrastructure. This was to be expected as no local municipal storm water system is designed to handle a storm of that magnitude. That being said, it is intended that an investigation be undertaken to determine if there any improvements that can be reasonably made to the Town's storm water infrastructure.

   Accordingly, in the Public Works & Environmental Services 2017 Capital Works Plan, Council will be requested to approve a proposed Storm Water Master Plan which will focus on an analysis of the Town's urban storm infrastructure within the existing eight (8) storm pumping station service areas.

   This analysis will review how the Town's storm water infrastructure functions during minor rainfall events (i.e. what can be contained within the storm sewer network), and major rainfall events (what would follow overland flood routes). The storm pumping stations will also be reviewed to determine if any modifications or improvements are required based on any of the recommended storm sewer network improvements (i.e. capacity upgrades).

   The Master Plan will also look for efficiencies which may be possible to make in the storm sewer network, and whether a consolidation of storm pumping stations is feasible. The Master Plan will follow the Municipal Class Environmental Assessment (EA) process, and is equivalent to the same steps that a Schedule 'B' EA would follow. This will provide the Town with the necessary analysis/study under the Municipal Class EA process to complete future improvements reconstruct and/or decommission storm pumping stations without having to complete a separate Schedule 'B' EA at a later date.

Comment
While the past and proposed future modifications and infrastructure improvements by the Town will not guarantee that a basement flooding event will never again occur, the cumulative effect of such actions will serve to eventually reduce the impact of severe rainfall events and lessen the extent of any basement flooding associated with heavy rain events.

Recommended Actions for Homeowners to Take to Reduce the Risk of Basement Flooding
While the Town has undertaken studies to address extraneous flows into the sanitary sewer collection system and has implemented many improvements to both the sanitary and storm water systems, there is also an opportunity for private property owners to implement protective measures to reduce the risk of basement flooding and to eliminate sources of extraneous flows into the sanitary system.

The Town has also endeavoured to raise awareness of the availability of resources on the Town's website and elsewhere and has encouraged property owners to take measures to reduce the chance of basement flooding.

However, severe weather events and/or other related factors that lead to basement flooding are difficult to predict. Municipal planning cannot account for every potential scenario and in some cases, weather

events can simply overwhelm the infrastructure. This is why residents and businesses should ensure their property is ready to handle whatever nature throws at it.

Although there was widespread basement flooding reported throughout Wards 1, 2 and 3 of the Town during the September 29, 2016, severe rainfall event, there were many homes that, in fact, did not experience basement flooding. These included homes that were surrounded by other homes that did experience flooded basements. Of course some of the homes did not have flooded basements because they had no basement or their basement was very shallow. However, it is our opinion that the remaining homes did not suffer basement flooding because they all had proper flood protection measures in place including a backwater valve. Several residents did comment that they had a backwater valve installed but had not maintained it and as a result encountered flooding. Flood protection measures are discussed below.

Adopting flood protection measures is an important tool in protecting a residence. The following are effective measures that property owners can implement to reduce the risk of flooding in basements:

1. Ensure ground and pavement surfaces around the residence slope away from the building and toward a suitable storm water outlet in order to prevent water from running toward the foundation walls.

2. Ensure sump pumps are properly installed and maintained and have an adequate pumping rate. Sump pump discharge pipes should also drain away from the residence to prevent water from running back toward the foundation wall and down to the foundation drains.

3. Remove any cross connection between the sump pump, sanitary pipes or floor drain.

4. Ensure a mainline backwater valve is installed where sanitary pipes leave the house. If you have a backwater valve installed, have it checked and cleaned regularly to ensure it is working properly. As a back-up measure to a mainline backwater valve there are also floor drain back water valves available that can be installed directly in floor drains in addition to the mainline backwater valve. As an alternative to the backwater valve, a sewage ejector pump may be utilized to drain the plumbing fixtures on the basement level.

5. Ensure all roof leader downspouts are disconnected from the underground storm piping (where it is safe to do so) and that they discharge away from the foundation of the home.

6. Ensure there are no cracks in the storm water drain piping around the home to prevent water from running back into the weeping tiles and thereby overwhelming the sump pump.

7. Ensure that all eaves troughs are cleaned out and if you have basement windows that the window wells have protective covers over them.

8. Ensure there are no cracks or holes in the basement walls or floors that may allow water to enter the basement.

9. If possible, provide a backup power supply to the sump pump.

The following links provide information on how to reduce the risk of basement flooding:

Handbook for Reducing Basement Flooding
(http://www.tecumseh.ca/sites/default/files/Handbook_for_Reducing_Basement_Flooding_0.pdf)

Protect Your Home from Basement Flooding
(http://www.tecumseh.ca/sites/default/files/Protect%20Your%20Home%20from%20Basement%20Flooding.pdf)

Information for Residents on Stormwater Management
(http://www.tecumseh.ca/sites/default/files/Information%20Report%20for%20Residents%20-%20Tecumseh%20Stormwater%20Management.pdf

Additional information will be shared on the Town's website and app, as well as social media to direct residents to information on how they can reduce the risk of flooding on their properties.

Concluding Comments
While past and proposed future modifications and infrastructure improvements by the Town are significant, they alone will not guarantee that a basement flooding event will never again occur. The cumulative effect of such actions will serve to eventually reduce the impact of severe rainfall events and lessen the extent of any basement flooding associated with heavy rain events.

The effects of climate change will likely have further negative impacts on municipal sewage systems and the Town will continue to strive to manage the ever intensifying climactic events as they evolve.

There are, however, measures that property owners can and should take to reduce the risk of basement flooding. We encourage all residents to review ways to protect their properties from the impacts of severe weather and implement the suggested improvements.

CONSULTATIONS

Financial Services
Information & Communication Services

FINANCIAL IMPLICATIONS

As a consequence of the flooding that occurred on September 29, 2016, the Town incurred unanticipated and unbudgeted expenses in dealing with the aftermath of the flooding. Some of the significant costs are as follows:

Town staff overtime for flood debris collection	$27,000
Flood debris collection by Windsor Disposal Services	$85,000
Flood debris collection by Contractors (estimated)	$30,000
Flood debris disposal tipping fees	$40,000
Subsidy for Backwater Valve	$144,000
Total expenses	**$326,000**

No recoveries are expected to offset this cost; consequentially Administration will consider funding options as part of the year-end financial variance analysis.

LINK TO STRATEGIC PRIORITIES

No.	2015-16 Strategic Priorities	Applicable
1.	Make the Town of Tecumseh an even better place to live, work and invest through a shared vision for our residents and newcomers.	✓
2.	Ensure that the Town of Tecumseh's current and future growth is built upon the principles of sustainability and strategic decision-making.	✓
3.	Integrate the principles of health and wellness into all of the Town of Tecumseh's plans and priorities.	✓
4.	Steward the Town's "continuous improvement" approach to municipal service delivery to residents and businesses.	✓
5.	Demonstrate the Town's leadership role in the community by promoting good governance and community engagement, by bringing together organizations serving the Town and the region to pursue common goals.	

COMMUNICATIONS

Not applicable ☒

Website ☐ Social Media ☐ News Release ☐ Local Newspaper ☐

This report has been reviewed by senior Administration as indicated below and recommended for submission by the CAO.

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Reviewed by:

Luc Gagnon, CMA, CA, BMath
Director Financial Services & Treasurer

Recommended by:

for Tony Haddad, MSA, CMO, CPFA
Chief Administrative Officer

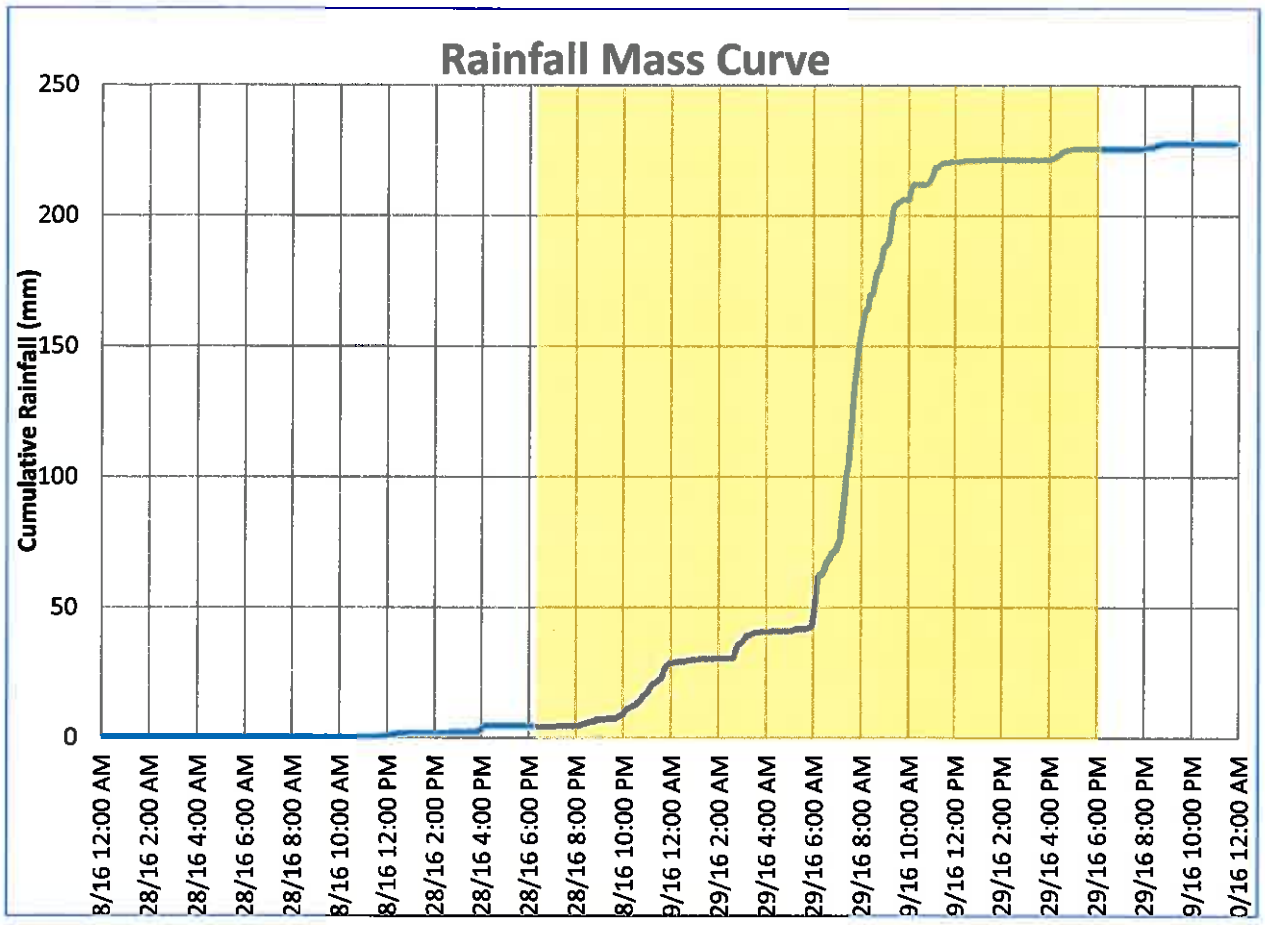
Attachments:

1. Figure 1: Rainfall Accumulation, Rainfall Event of September 28 & 29, 2016
2. Figure 2: Rainfall Increment and Intensity, Rainfall Event of September 28 & 29, 2016
3. Map: Locations of Reported Basement Flooding
4. Figure 3: How Flooding can Occur in a Home: Infiltration Flooding, Overland Flooding and Sewer Backup
5. Figure 4: How Sewer Backup can Enter a Home

DP

FIGURE 1

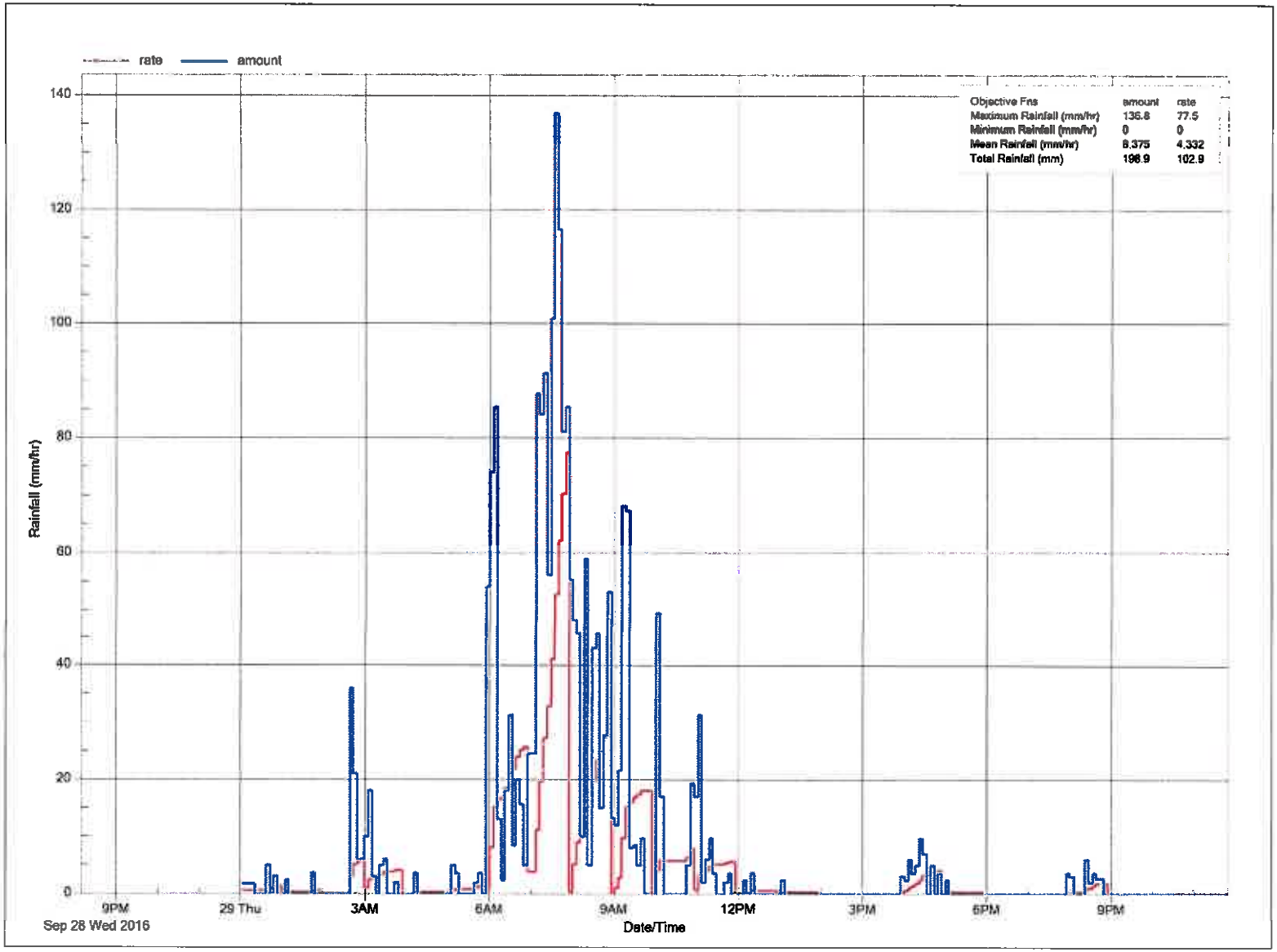
Rainfall Accumulation
Rainfall Event of September 28 & 29, 2016



Source: Weather Underground

FIGURE 2

Rainfall Increment and Intensity
Rainfall Event of September 28 & 29, 2016



MAP 1

Locations of Reported Basement Flooding

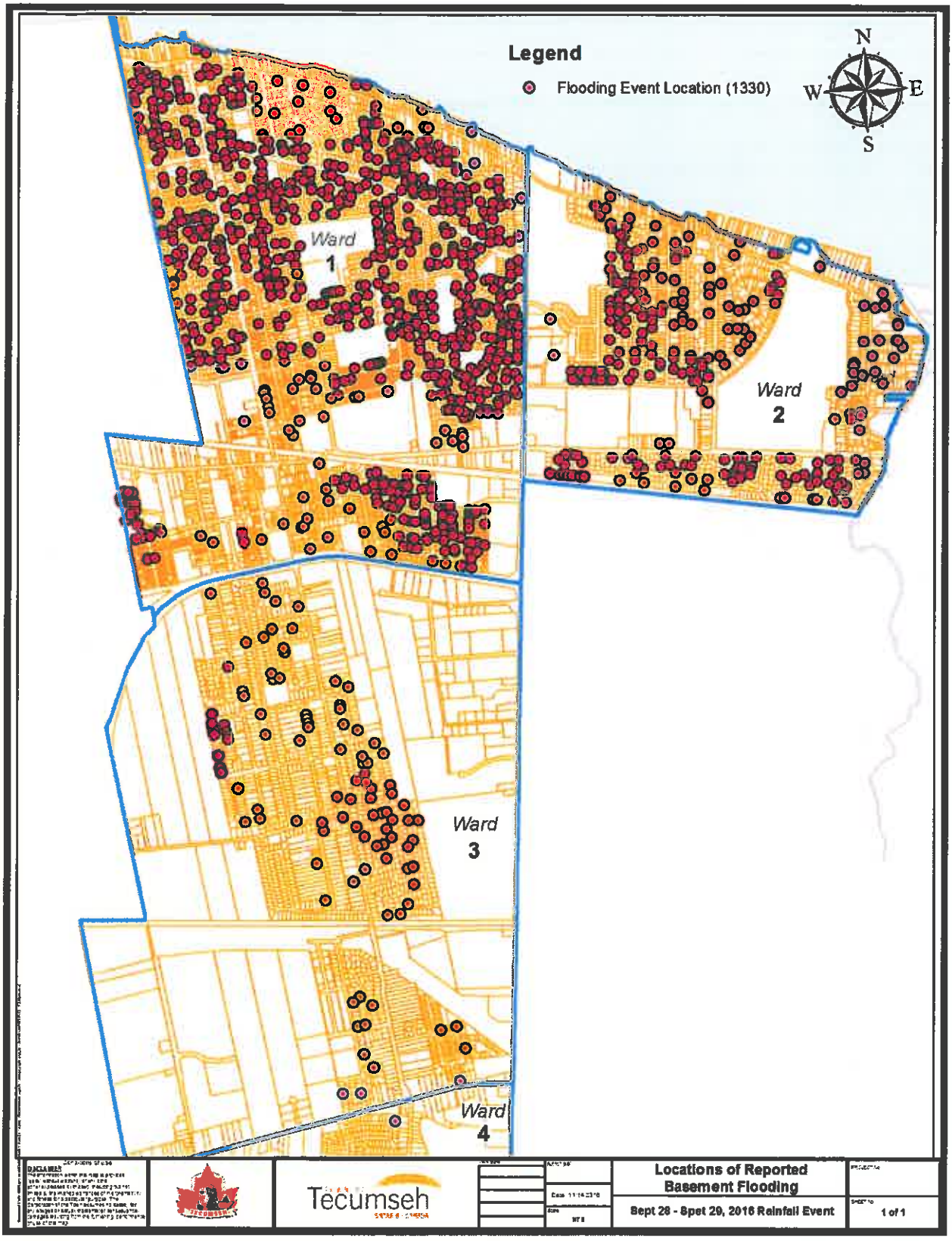
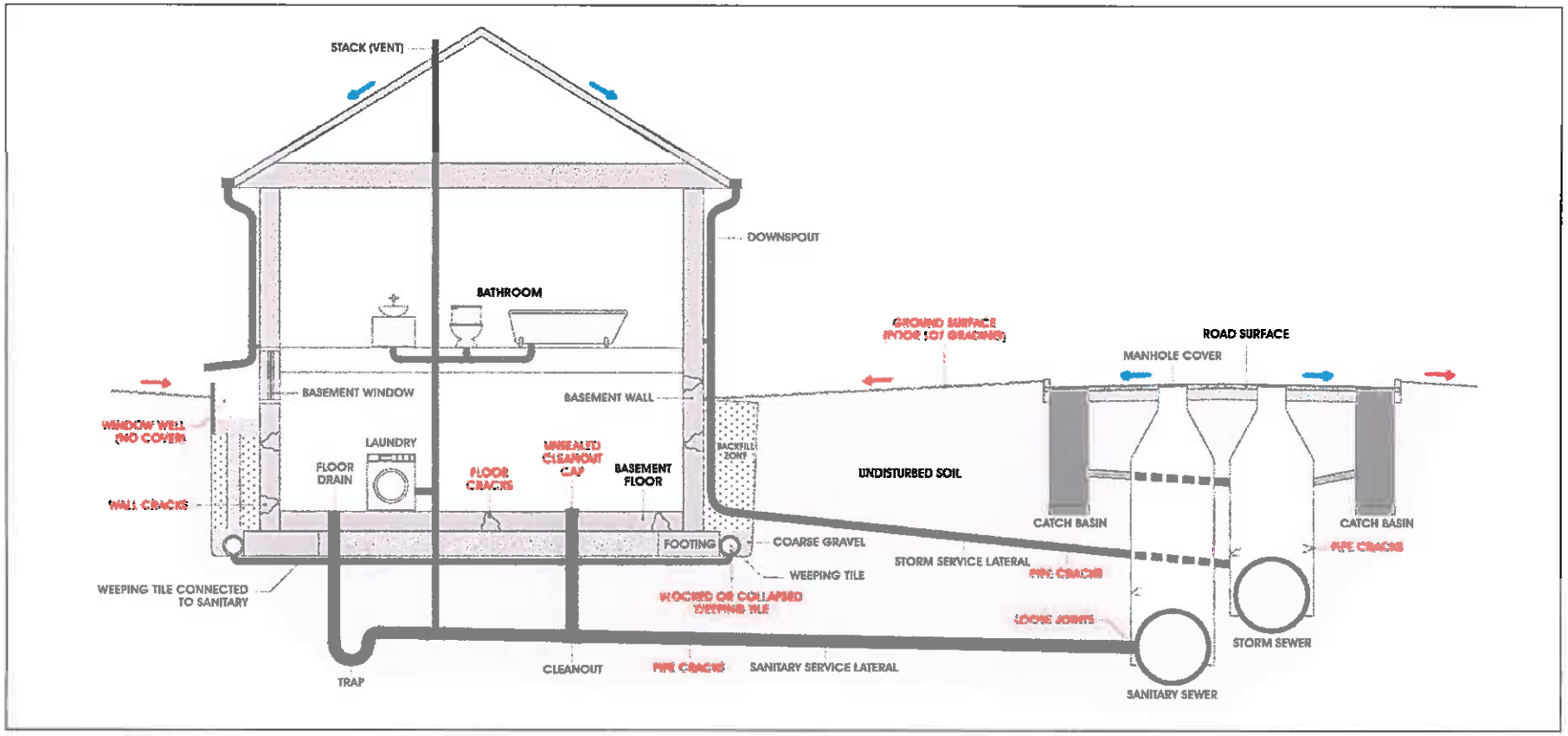


FIGURE 3

How Flooding can occur in a Home: Infiltration Flooding, Overland Flooding and Sewer Backup

Some Conditions that can lead to Basement Flooding



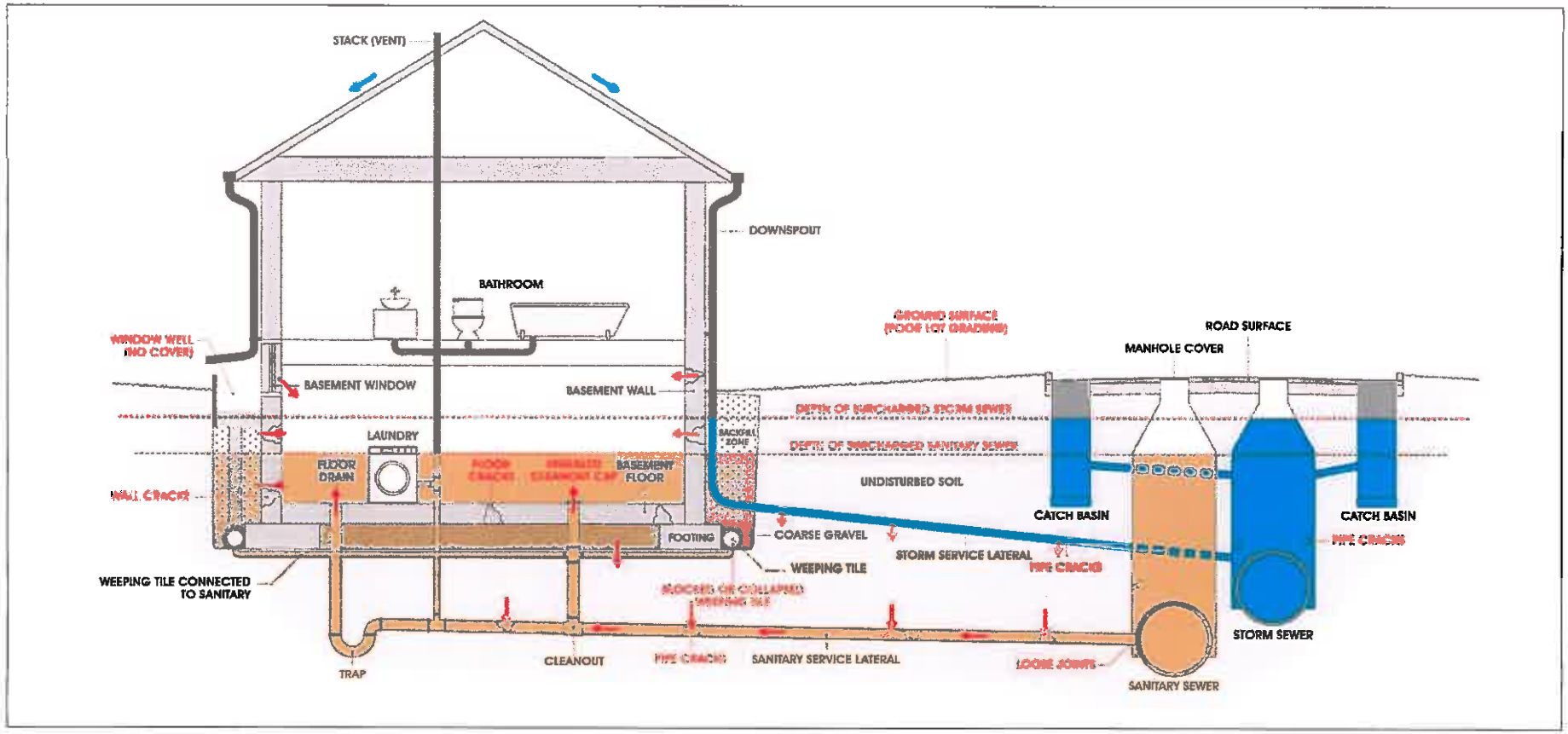
What to look for in this diagram

This diagram shows a home that is at risk of basement flooding from infiltration flooding, overland flooding and sewer backup. In this diagram:

- The cracks in the foundation wall and basement floor are unsealed.
- Downspouts are connected to the municipal sewer system or are discharging too close to the foundation.
- The yard is improperly graded and sloped toward the home.
- The weeping tiles are connected to the sanitary sewer lateral.
- The weeping tiles have not been maintained and are damaged.
- There is no backwater valve in place.
- The sewer laterals have not been maintained, are cracked and have loose joints.
- The storm sewer lateral has not been severed and is prone to exfiltration.
- The backfill area beside the foundation wall is uncapped.
- The sewer cleanout is uncapped and unsealed.
- There is no window well cover in place.

FIGURE 4

How Sewer Backup can Enter a Home



What to look for in this diagram

This diagram shows how sewer backup can enter a home. In this diagram:

- The sanitary sewer is surcharging and pushing sewage back into the home through the sanitary sewer lateral.
- Sewage is entering the basement through plumbing fixtures, including the basement floor drain and the unsealed sewer cleanout.
- Because the weeping tiles are connected to the sanitary sewer, sewage has been forced into the weeping tiles and is infiltrating into the basement through cracks in the basement walls.
- In this instance, the municipal storm sewer is also surcharging, and forcing storm sewage into the home's storm sewer lateral. High pressure storm sewage is exfiltrating from the storm sewer lateral and entering the sanitary sewer lateral, thereby increasing the amount of sewage that enters the basement.
- The home's sanitary sewer lateral is also in disrepair, and water is entering through cracks and loose joints.