

Appendix 1-4
Inflow and Infiltration Control Study (January 2005)

Town of Tecumseh Inflow and Infiltration Control Study

Prepared for
Town of Tecumseh

January 2005



CH2MHILL

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8. Conclusions and Recommendations

8.1 Existing System Analysis

The Town of Tecumseh sanitary sewer system has been analyzed under dry weather and wet weather conditions. The following conclusions have been summarized based on these analyses.

8.1.1 Dry Weather Condition Conclusions

The overall conclusions for the Town of Tecumseh sanitary sewer system during dry weather condition can be summarized as follows:

- The sewage conveyed, during dry weather conditions, to the LRPCP is 15% to 23% of the maximum flow rate available to Tecumseh in its present agreement with Windsor, 934.4 L/s (33 cfs).
- The sanitary sewers are generally flowing less than half full under dry weather conditions.
- The domestic flow per capita is approximately 229 L/cap/day. This is approximately 76% of the sanitary sewer design value of 300 L/cap/day.
- The dry weather infiltration varies during the year and also spatially. This is largely due to the elevation of the groundwater table as it undergoes seasonal variation.

Specific conclusions during dry weather conditions for the areas of Tecumseh, St. Clair Beach and Tecumseh Hamlet, within the Town of Tecumseh can be summarized as follows:

Tecumseh

- The sanitary sewers operate at less than half full during dry weather conditions with the exception of the sanitary sewer on Lesperance Road north of Cedarwood Drive. This section of sewer operates under surcharge conditions during dry weather. However, the sewer is located at a low elevation and the flow is therefore greater than 3 metres below ground surface.
- Flow spikes in the St. Pierre Street sanitary sewer were noted from the Family Tradition processing plant. The flow spikes are intermittent and unpredictable with respect to time and quantity.
- The dry weather infiltration rate is approximately 6,000 L/ha.day, which is approximately 35% of the sanitary sewer infiltration design value.

St. Clair Beach

The sanitary sewers operate at less than half full during dry weather conditions.

- The Clovelly Road area in St. Clair Beach is noted to have the highest dry weather infiltration rate of approximately 11,900 L/ha/d. This rate is approaching the sanitary sewer design criteria for infiltration of 16,415 L/ha/d. The dry weather infiltration for the Clovelly Road area is approximately 90% higher than the average

dry weather infiltration from the other 5 monitored areas. The Clovelly Road area experiences a high dry weather infiltration flow due to its low elevation with respect to the Lake St, Clair water elevation. Also, prior to sanitary sewer construction within the area, the area was serviced by private septic tanks/tile drain system and improper disconnection of the old septic tank/tile drain systems to the private sanitary services may exist resulting in the high dry weather infiltration values from the area.

- The other two areas monitored within St. Clair Beach, have a dry weather infiltration rate of approximately 6,000 L/ha.day, which is approximately 35% of the sanitary sewer infiltration design criteria.

Tecumseh Hamlet

- The sanitary sewers operate at less than half full during dry weather conditions.
- The dry weather infiltration rate for the area is approximately 6,500 L/ha.day, which is approximately 40% of the sanitary sewer infiltration design criteria.

8.1.2 Dry Weather Condition Recommendations

The Clovelly Road area of St. Clair Beach is noted to experience a high infiltration rate during dry weather condition. The remaining areas within the Town experience a lower level of dry weather infiltration. Reduction of the dry weather infiltration would assist in lowering the overall flow contribution from the Town of Tecumseh to the LRPCP. The other component in flow reduction during dry weather condition is the reduction of domestic flows through the process of water conservation.

The recommendations for the control of excess flows during dry weather conditions are summarized as follows:

- It is recommended that dry weather infiltration, in the Clovelly Road area, be identified through monitoring/field testing and sources disconnected/remedied where possible in order to regain necessary conveyance capacity.
- Disconnection of the old septic tank/tile drain systems within the Clovelly Road area should be verified and any improper disconnection, such as tile drains hydraulically connected to the sanitary service, be corrected.
- To reduce the domestic sewage flow, it is recommended that public education be provided for water conservation and awareness of the sewer use by-laws. It is noted that from water studies for residential area (excluding industrial usage), the average day water reduction is in the range of 5% to 15% with the application of water conservation.

8.1.3 Wet Weather Condition Conclusions

The overall conclusions for the Town of Tecumseh sanitary sewer system during wet weather condition can be summarized as follows:

- Wet weather I/I for the Town ranges from half the sanitary sewer design criteria for infiltration to greater than two times the sanitary sewer design criteria for infiltration.
- Model calibration for the wet weather condition identified the slow infiltration parameters to be more predominant than the direct inflow parameters. This indicates

that wet weather I/I are likely attributed to the connection of foundation drains, and defects in sewer pipe.

- Experience has shown that the flow allotment for the Town of 0.934 m³/s (33 cfs) is approached and occasionally exceeded. It has been simulated that a 1:5 year return storm will result in the peak flow of 1.0058 m³/s (35.5 cfs) to the LRPCP from the Town.
- Sections of the sewer system operates under surcharge conditions for events equal to or greater than a 1:5 year return storm and flow controls are required to reduce the surcharge to an acceptable level.

Specific conclusions during wet weather conditions for the areas of Tecumseh, St. Clair Beach and Tecumseh Hamlet within the Town of Tecumseh can be summarized as follows:

Tecumseh

- The wet weather I/I for the area varies from 10,000 L/ha.day to 29,000 L/ha.day depending on the storm pattern and antecedent conditions while the sanitary sewer design criteria for the Town of Tecumseh allows an infiltration value of 16,410 L/ha.day.
- The sanitary sewer along Lesperance Road operates under surcharge conditions during a 1:5 year return storm. The surcharge varies from 150% to 200% of the pipe capacity.
- The majority of the remaining sanitary sewers within the area operate at capacity during the 1:5 year return storm.
- For the 1:5 year return storm, 50% of the sewers operate with the sewage level greater than 3 metres below ground surface while the remaining 50% operate with sewage levels between 1.5 metres to 3 metres below ground surface.
- It has been reported that foundation drains within Tecumseh are connected to the storm sewer. Therefore foundation drain flows within this drainage area should have no impact on the sanitary sewer flows.

St Clair Beach

- The wet weather I/I for the area varies from 8,000 L/ha.day to 33,000 L/ha.day depending on the storm pattern and antecedent conditions while the sanitary sewer design criteria for the Town of Tecumseh allows an infiltration value of 16,410 L/ha.day.
- The Clovelly Road area consistently has a lower wet weather I/I. This is the opposite of the monitored dry weather data, which identified the area to have the highest dry weather infiltration rate. This indicates that although high ground water is contributing to the dry weather infiltration, direct connections such as roof leaders do not exist to any great extent.
- Pentilly Road area consistently saw the highest instantaneous I/I flow volumes during wet weather events. This occurred even though the average I/I volume over the event was similar to other locations. This observation would indicate that directly connected sources, such as roof leaders or backyard drains, are connected causing the rapid response.
- It has been reported that the foundation drains within the St. Clair Beach area are connected to the sanitary sewer. This will have an impact on the sanitary wet weather flows within the area. It is noted that foundation drain disconnection is a

difficult program to implement due to the cost and inconvenience impacts on the private home owner. However, if opportunities arise for foundation drains to be disconnected such as redevelopment, private sewer service improvements, etc., the foundation drains should be disconnected from the sanitary sewer and reconnected to the storm sewer system, preferably by means of a sump pump.

- The local trunk sewer along Riverside Drive, Arlington Boulevard and Hayes Avenue operates at 100% full during the 1:5 year return storm while the sanitary sewer through the Lakewood Country Club operates at 150% capacity.
- Over 95% of the sewers within the area operate with the sewage level being within 1.5 metres to 3 metres below ground surface for the 1:5 year return storm.
- The simulated flow from the 1:5 year return storm for the St. Clair Beach area is 0.204m³/s which is 104% of the peak flow allotment for the St. Clair Beach area to the LRPCP.

Tecumseh Hamlet

- The wet weather I/I for the area varies from 21,000 L/ha.day to 34,000 L/ha.day depending on the storm pattern and antecedent conditions while the sanitary sewer design criteria for the Town of Tecumseh allows an infiltration value of 16,410 L/ha.day.
- The highest wet weather I/I has been monitored consistently within the Intersection Road monitoring station, which was selected to represent the Tecumseh Hamlet area. It has been reported that the foundation drains within the Tecumseh Hamlet area are connected to the storm sewer or have a sump pump that discharges to ground surface. This area has predominantly been developed post 1990 when the Ontario Building Code was revised to require that all foundation drains be connected to the storm drainage system. Due to the unaccountable wet weather high I/I flow within the area, a potential source is the illegal connection of sump pump discharges to the sanitary sewer as modified by the private home owner.
- The Trunk sewer on Lesperance Road from County Road 22 to Gouin Street operates up to 150% of capacity with a small section near the Parshall Flume operating at up to 250% of capacity for the 1:5 year return storm. While the remaining trunk sewer along St Anne Street operates at 100% or full capacity.
- Although the sewer operates significantly over capacity, the surcharge level is greater than 3 metres below ground surface for the 1:5 year return storm due to the sewer's burial depth.
- The simulated flow from a 1:5 year return storm for the Tecumseh Hamlet area is 0.255 m³/s or 158% of the peak flow allotment for the Tecumseh Hamlet to the LRPCP.

8.1.4 Wet Weather Conditions Recommendations

Flow reduction during wet weather conditions can be achieved by identifying and removing the points of I/I entering the sewer system. This process is accomplished by detailed flow monitoring, smoke and dye testing of the local sewers, closed circuit television (CCTV) inspection and subsequent disconnection of foundation drains and other illegal direct storm connections. Based on the results of the flow monitoring program for this

study, the first priority area for more detailed investigation is Tecumseh Hamlet and the second priority area is St. Clair Beach.

The recommendations for the control of excess flows during wet weather conditions are summarized as follows:

- It is recommended that a comprehensive program to control I/I be undertaken initially in the Tecumseh Hamlet and St Clair Beach areas. This program should consist of initially monitoring flows during wet and dry weather events and then systematically removing the sources of I/I. Obvious sources of inflow like roof leaders, and back yard drains should be examined and removed from discharging to the sanitary sewer. Proper lot grading and the determination of the condition of the sewerage system and repairs would be the next step. The impact of each of these improvements can be monitored over time. Should the obvious sources of I/I be impossible or impractical to eliminate, Tecumseh will be faced with the prospect of having to construct storage balancing facilities such that the flow contribution to the LRPCP under wet weather conditions with additional flow from future development will not exceed the flow contribution agreement with the City of Windsor.
- It is recommended that a comprehensive flow-monitoring program be implemented to identify the locations and sources of I/I and remove such flows. The monitoring program should commence at the monitoring stations carried out for this study and then proceed upstream within the sewer shed to systematically identify areas and then specific connections so that extraneous flows can be systematically removed.
- It is recommended that the foundation drains connected to the sanitary sewer within the St. Clair Beach area be disconnected as the opportunities arise. The opportunities may consist of redevelopments, new storm sewers construction within the area to provide a storm service to individual houses, etc. Direct foundation drain connections to the storm sewer should however be avoided to prevent potential basement flooding due to storm sewer surcharges.
- It is recommended that sump pumps discharge within the Tecumseh Hamlet area be investigated and confirmed that they have not been directly or indirectly connected to the sanitary sewer system.

8.2 System Relief Conclusions and Recommendations

8.2.1 System Relief Conclusions

The Town of Tecumseh sanitary sewer system wet weather flow analysis indicates that for storm events that are more frequent than a 1:5 year return storm, the system is operating with minimal surcharge and generates a flow somewhat less than the agreed flow to the LRPCP. Storm events equal to and/or greater than the 1:5 year return storm will result in sanitary sewer system surcharge and direct overflows to the receiving waters with possible basement flooding.

Based on the model simulation for a 1:5 year return storm, Tecumseh Hamlet contributes 158% of its allotment flow, St. Clair Beach contributes 104% of its allotment flow and Tecumseh contributes 95% of its allotment flow for a total flow of 1.006 m³/s to the LRPCP.

The wet weather flow from the 1:5 year return storm is 108% of the overall allotment flow of 0.934 m³/s to the LRPCP from the Town of Tecumseh.

The overall conclusions from the sanitary sewer system wet weather flow analysis are summarized as follows:

- It has been determined that the existing sewer system has ample capacity during dry weather conditions but exceeds the allotted treatment flow capacity during wet weather flow conditions (1:5 year return storm condition). Wet weather flow control is therefore required to proceed along with development.
- The LRPCP treatment capacity is more than ample for the treatment of dry weather flows. During wet weather flow conditions however, the LRPCP is overtaxed and flows from the Town of Tecumseh exceed the agreed upon flow contribution to the LRPCP. A combination of I/I removal and storage for throttling of wet weather flows to the plant would be a more appropriate alternative to plant expansion to accommodate flows from future development.
- It has been simulated that predominant sources of I/I are from moderate and slow infiltration sources such as foundation drains and defective sewer pipes. Due to the difficulty of disconnecting foundation drains from the sanitary sewer, a small wet weather flow reduction is anticipated with the implementation of I/I controls. A level of infiltration control to the foundation drains can be achieved by implementing positive surface drainage away from structures having foundation drains and the roof leaders discharging a minimum of 1.5 metres away from the building wall. Additional improvements will be experienced with foundation drain disconnections within the St. Clair Beach area as opportunities arise. Similar improvements will be noted within the Tecumseh Hamlet area with the identification and removal of sump pump discharges directly or indirectly connected to the sanitary sewer.
- Reductions of 60% inflow and 20% slow infiltration as an average for the whole Town are considered reasonable to achieve. The 20% reduction of slow infiltration has been arrived at considering that the majority of the infiltration is due to foundation drain connections that will be difficult to disconnect.

Specific conclusions to provide system relief for the three areas; Tecumseh, St. Clair Beach and Tecumseh Hamlet are summarized as follows:

Tecumseh

- The trunk sewers in Tecumseh are surcharged due to the contributing flows from St. Clair Beach and Tecumseh Hamlet. Flow reduction from St. Clair Beach and Tecumseh Hamlet will relieve the trunk sewers in Tecumseh.
- Flow attenuation at the Cedarwood Road pumping station by means of storage would be effective in reducing the peak flow during wet weather condition to achieve the flow contributing agreement between the Town of Tecumseh and City of Windsor.
- The feasible level of I/I reduction within the developed area of Tecumseh will provide limited flow relief and will not be sufficient on its own to achieve the agreement flow to the LRPCP during wet weather condition.

St. Clair Beach

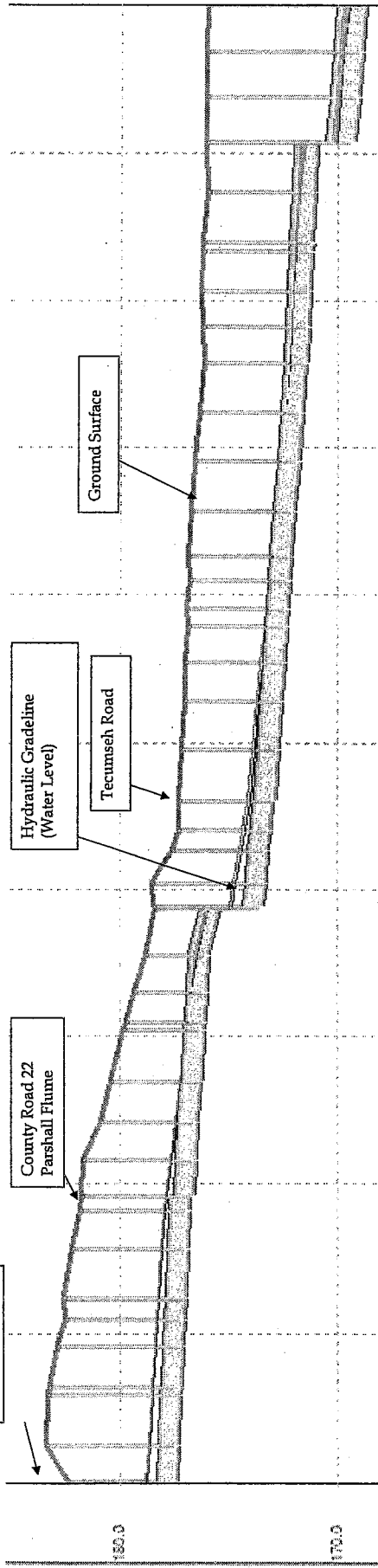
- For the 1:5 year return storm, St. Clair Beach is contributing 104% of its allotment flow to the LRPCP.
- Flow reduction by means of a feasible level of I/I removal will assist in providing flow relief but will not resolve the sewer surcharge conditions during wet weather conditions.
- Flow attenuation at the Lakewood pumping station by means of storage is effective in reducing the surcharge of the trunk sewer through the Lakewood Country Club and also relieves the trunk sewer surcharge in Tecumseh.

Tecumseh Hamlet

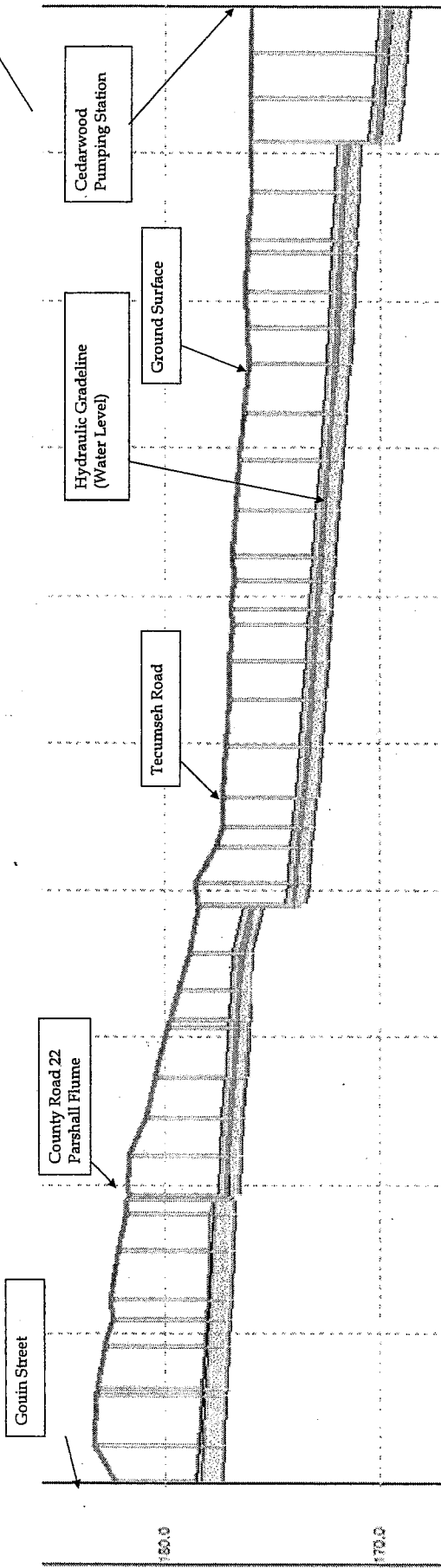
- The I/I flow monitored during wet weather conditions in Tecumseh Hamlet is consistently higher than the design standard and contributes approximately 158% of its allotment flow under these conditions.
- Even though a small reduction in peak flow is anticipated from what is considered a feasible level of I/I reduction, the reduction will be sufficient to provide capacity for immediate development to proceed within the Tecumseh Hamlet community. Development of 600 homes, within the Tecumseh Hamlet community, with I/I control program will result in no overall flow increase and may result in lower peak flows if I/I control program is very aggressive within Tecumseh Hamlet.
- A relief sewer from the Lesperance Road Parshall Flume to the Windsor-Tecumseh trunk sewer will provide hydraulic relief in the system downstream of County Road 22 but the total peak flow will still exceed the Town's present allotted flow to the LRPCP. Figure 8-1 provides the hydraulic gradelines comparison within the Lesperance Road trunk sanitary sewer for existing condition and with the diversion relief sewer in place.
- During the preparation of this report, negotiations have been ongoing with the Town of Tecumseh and the City of Windsor to negotiate a revised agreement for additional flow allotment for new development south of County Road 22 and the newly annexed land by the City of Windsor. A new sewer for this additional allotted flow to the LRPCP would be on the alignment of Banwell Road. The relief sewer from the Lesperance Road Parshall Flume would then connect to this new sewer.
- Storage at Lesperance Road Parshall Flume would provide sewer hydraulic relief downstream in Tecumseh but the peak flow to the LRPCP would not be significantly reduced unless storage is also provided at the Cedarwood Road pumping station.
- A relief sewer from the Lesperance Road Parshall Flume to the Windsor - Tecumseh trunk sewer along the Banwell Road alignment with storage at the Cedarwood Road pumping station would provide approximately equivalent flow control as that of the three storage facilities located at Lakewood pumping station, Lesperance Road Parshall Flume and at Cedarwood Road Pumping station. Storage at the Cedarwood Road pumping station would be required pending the new flow agreement presently being negotiated between the Town and the City.
- The relief sewer alternative has more flexibility for future development if the sewer over sizing is considered at this time in order to provide conveyance capacity for the immediate requirements, conveyance for future development and also possible

Figure 8-1 - Profile of Lesperance Road Trunk Sanitary Sewer

Existing Wet Weather Flow Lesperance Rd Trunk Sewer Gouin Street to the Cedarwood Pumping Station



Wet Weather Flow Lesperance Rd Trunk Sewer Gouin Street to the Cedarwood Pumping Station - Diversion of Flow at the Parshall Flume



- inline storage to balance the flow and meet the agreed flow contribution to LRPCP from the Town.

8.2.2 System Relief Recommendations

It is required that wet weather flows are reduced to be in compliance with the present flow allotment agreement between the Town of Tecumseh and the City of Windsor for storm events equal to or greater than the 1:5 year return storm. The recommendations to achieve this objective and as concluded from the sanitary sewer system wet weather flow analysis are summarized as follows:

- It is recommended that I/I control program be implemented such that immediate development of 600 homes within the Tecumseh Hamlet community can proceed. The I/I control program consists of flow monitoring, smoke testing and dye testing; removal of identified I/I sources and public education as outlined earlier.
- It is recommended that flow throttling of wet weather flows be applied to meet the agreed flows to the LRPCP from the Town and also provide sufficient capacity to accommodate future development. The flow throttling will consist of storage at three locations (Lakewood pumping station - 2,550 m³, Lesperance Road Parshall Flume - 2,470 m³, and Cedarwood Road pumping station - 2,750 m³ with flow restriction of 0.849 m³/s from the pumping station). Alternatively, a relief sewer with storage at the Cedarwood Road pumping station (8,250 m³) will provide system hydraulic relief, control wet weather flows to an acceptable level and provide spare conveyance/treatment capacity for further development. The preferred alternative will be based on site availability for storage implementation.
- It is recommended that discussions with the City of Windsor continue for a comprehensive wastewater agreement for the servicing of lands within the Town of Tecumseh and adjacent lands within the City of Windsor to the LRPCP. The proposed relief sewer could provide servicing for developments within the two municipalities and provide hydraulic relief within the existing Lesperance Road trunk sewer. The alternative of a relief sewer with storage provides future flexibility for development by providing immediate hydraulic relief and trunk sewer infrastructure for future development.

8.3 Implementation Plan

The implementation plan is an integrated plan for the three communities; Tecumseh, St. Clair Beach and Tecumseh Hamlet. A number of components are common to all three communities and implementation of other components will either have an impact on the adjacent community or alternatives in one community will negate an alternative in another community. The implementation plan, in consideration of the above conclusions and recommendations for the three communities within the Town, consists of the following:

- Town to acquire two to three flow monitors (portable, velocity-area type) to carry out a flow monitoring program for the Town. Town staff is required to be trained in the use of the flow monitors with respect to area identification for installation, installation procedures, operation and maintenance of the equipment and data interpretation.

- Disconnection of foundation drains to the sanitary sewer system, a source of wide spread infiltration to the sanitary sewer, will be difficult and disruptive. Surface area influencing contributory flow to the foundation drains should be properly graded away from the structure walls. The surface area of influence to foundation drain contribution is considered to be approximately 1.5 to 3 metres from structure walls depending on type of soil. This area should have a 3% slope away from the structure walls. Similarly, roof leaders should discharge away from this area of influence by extending the downspout 1.5 to 2 meters from the structure wall. This control is on private property, for the majority of structures, and public education of the benefits of site/private grading to the overall community and the individual household should be implemented.
- A CCTV inspection program for all sewers should be implemented such that all sewers are inspected on a 5 year to 10 year cycle.
- Flows from new development should be monitored for pre-development and post-development conditions to confirm flows from new development meet requirements.
- An acceptable flow for dry and wet weather conditions for the overall new development should be considered prior to the subdivision infrastructure acceptance.
- The first area of priority for monitoring is the Tecumseh Hamlet area commencing at the same monitoring station that was used for this study. Monitoring of this area is required to confirm study findings and identify sources of I/I for remediation. Working upstream within the sewer shed with additional monitoring will help to identify both specific areas and illegal connections to address. Potential sources of I/I are illegal connection of foundation drain sump pumps indirectly or directly connected to the sanitary sewer, illegal storm drain connections and illegal roof leader connections.
- The second area of priority for monitoring is the southeast area of St. Clair Beach commencing at the same monitoring station as was used for this study. Similar to the Tecumseh Hamlet, this is to confirm study findings and using a similar approach as described above, identify and remove source of direct inflow within this area. Smoke testing and dye testing should be carried out in the St. Clair Beach area to identify directly connected sources such as roof leader and/or backyard drain. Disconnection of foundation drain from the sanitary sewer should be carried out as opportunities arise.
- Development of 600 homes in the Tecumseh Hamlet area could proceed in parallel with the flow monitoring program within Tecumseh Hamlet to identify and remove sources of I/I.
- Extensive development within the Town will require wet weather flow management to ensure flow to LRPCP does not exceed the agreement flow of 0.934 m³/s (33 cfs). A relief sewer from Lesperance Road and County Road 22 to the Tecumseh-Windsor trunk sewer along the alignment of Banwell Road to the LRPCP will be required to provide hydraulic relief for the trunk sewer along Lesperance Road and connecting sewers. In addition, to maintain the flows from the Town within the allotted flow of 0.934 m³/s (33 cfs), a storage volume of 8,250 m³ will be required in the vicinity of the Cedarwood Road pumping station. This will also provide a spare treatment capacity for the development of 138 hectares having a population of 6,200 persons.

- Discussions should continue with the Town of Tecumseh and the City of Windsor for a comprehensive wastewater agreement for the servicing of new developments within the Town of Tecumseh and adjacent lands within the City of Windsor to the LRPCP.
- An equivalent alternative to the relief pipe and storage program is the installation of storage at Lesperance Road Parshall Flume (2,470 m³), storage at Lakewood pumping station (2,550 m³), and storage at Cedarwood Road pumping station (2,750 m³). This storage may be considered only if the Lesperance Road/County Road 22 relief sewer does not proceed.

8.4 Post Study Developments

Subsequent to completion of this study, the negotiations between the Town of Tecumseh and the City of Windsor have achieved favourable conclusions for both parties with an agreement to provide conveyance to and treatment capacity increase at the LRPCP to account for flow relief to the Lesperance Road trunk sanitary sewer and provide treatment capacity for future development in Tecumseh and the City of Windsor. The agreement includes a jointly developed trunk sanitary sewer along Banwell Road to the CN tracks, thence westerly along the CN tracks and thence northerly to the east side of the LRPCP with expansion of the LRPCP to accommodate the future flows from developments south of Tecumseh Hamlet and the southeasterly area of the City of Windsor. The relief sewer will have sufficient capacity to intercept flows from Tecumseh Hamlet south of County Road 22 to provide hydraulic relief to the Lesperance Road trunk sanitary sewer. The relief sewer will also be constructed at sufficient depth to provide the opportunity to eliminate the existing Sylvestre pumping station and St. Alphonse pumping station.

With the implementation of the Banwell Road relief sewer and acceptance of the new flow allotment agreement between the Town of Tecumseh and City of Windsor, storage at the Cedarwood pumping station will no longer be required to meet the old flow allotment flow of 934.4 L/s (33 cfs) from the Town of Tecumseh to the LRPCP. This new flow agreement and conveyance sewer development however, will have no impact or improvements to the St Clair Beach sewer conveyance system.