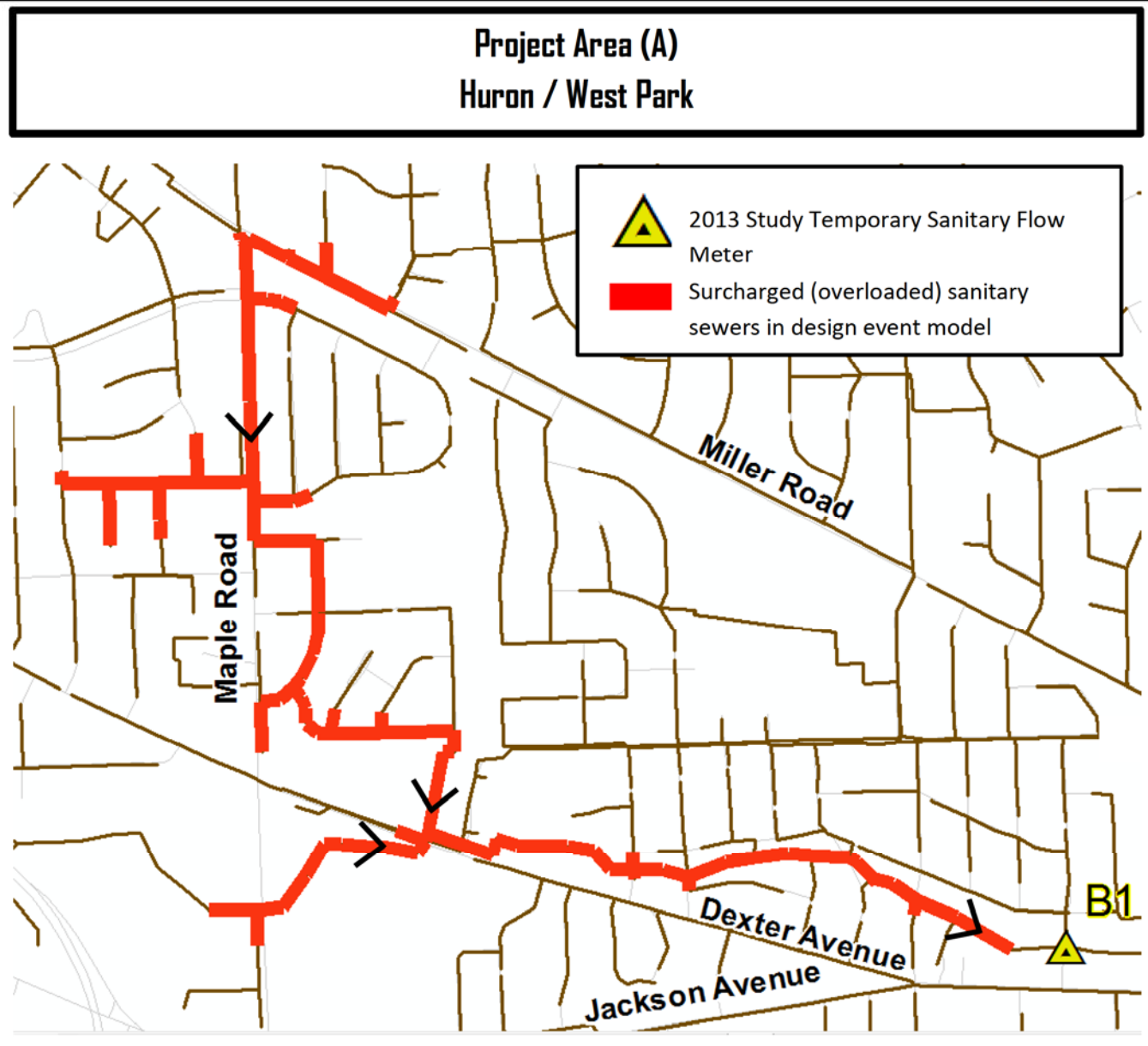




Appendix A
Collection System Action Plans



Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (B1) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Sanitary model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

- 1- Sanitary sewer model shows sanitary flows that exceed the sanitary sewer pipe capacities as identified in the adjacent figure, resulting in modeled surcharging as high as ~15 ft. above the sanitary sewer bottom.
- 2- The City had previously recognized this as a problem area and constructed a relief sanitary sewer downstream of meter B1. Further work was planned but extent of improvements needed was yet to be identified.
- 3- The City complaint data (sanitary sewer backup report) does not show reported sanitary backups in this area.

Therefore, we do not have high confidence in the surcharging identified by the sanitary sewer model and recommend action items listed below before making significant capital investments.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

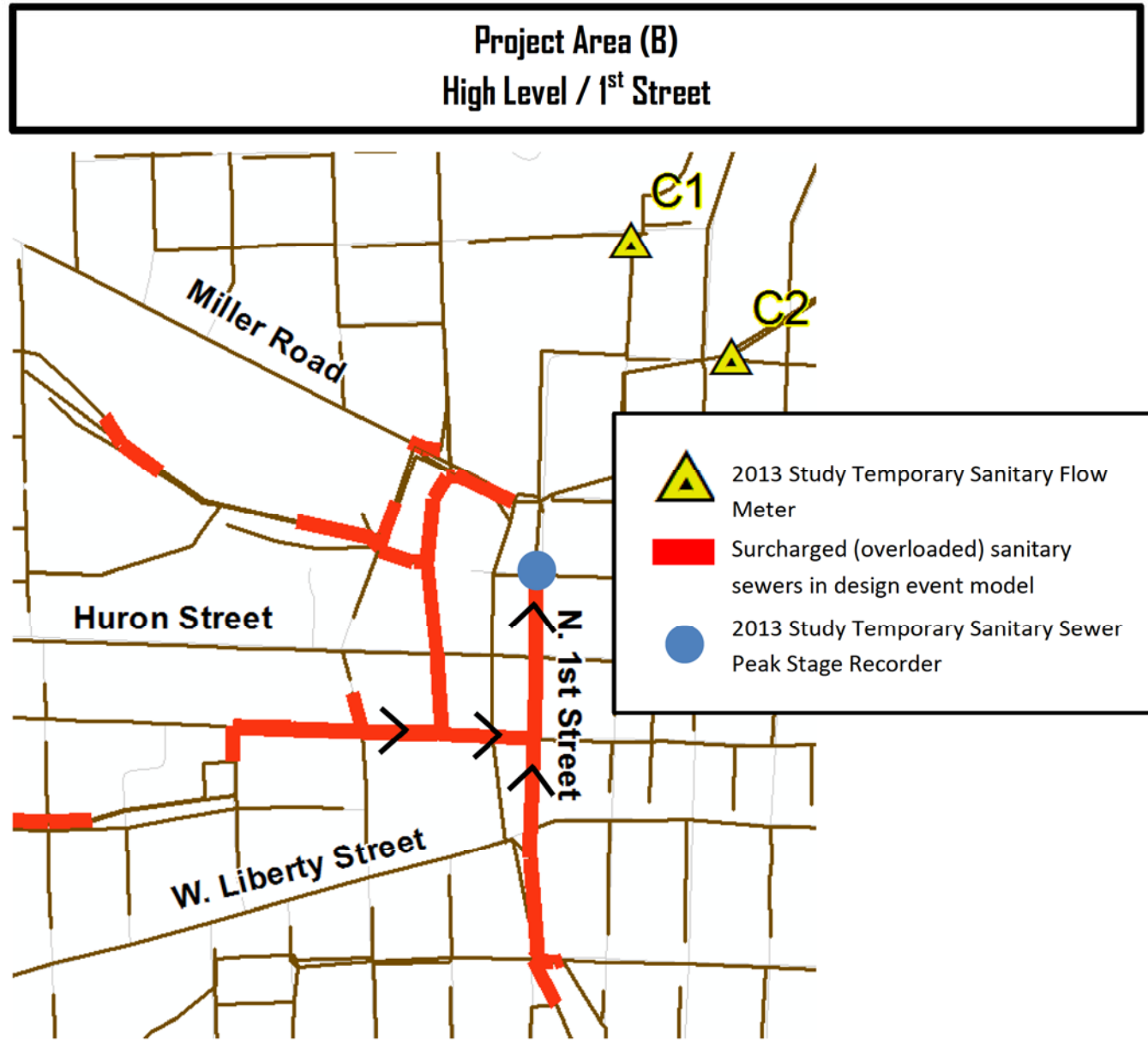
1. Identify locations for additional temporary sanitary metering and other data collection (e.g. video inspection) in order to better understand actual sanitary system performance.
2. Perform temporary sanitary flow metering and data collection.
3. Revise sanitary model based on findings.
4. Re-run sanitary model for design event to identify deficiencies.

Expected Outcome

1. Sanitary flow metering and data collection report.
2. Revised sanitary sewer model.
3. Proposed plan to address sanitary sewer deficiencies, including capital improvements to be included in the City's capital improvement plan.

- **Estimated investigation cost:** less than \$100,000
- **Estimated timeline to complete:** approximately 8 months

CAC COMMENTS:



Sanitary Model Background

- Existing sanitary model was calibrated to downstream sanitary flow meter (C1/C2) as well as peak stage recorder (shown in figure). Sanitary flow distribution upstream of these meters in the current model is as identified in previous (2002) model.
- Model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

- Sanitary model calibration efforts show that very high hydraulic losses, i.e. blockages, needed to be applied in order to make the sanitary model match peak stage recorder (PSR) data (location of PSR is shown on map). These losses, i.e. blockages, are much higher than suggested by engineering standards.
- Design event sanitary sewer model calibrated to the PSR shows flows that exceed the sanitary pipe capacities, resulting in modeled surcharging as high as ~8 ft. above sanitary sewer bottom.
- The City had previously recognized this as a problem area. Further work was planned but extent of improvements needed was yet to be identified.

Therefore, it is believed that further investigations are needed to resolve the unusual hydraulic losses before making significant capital investments.

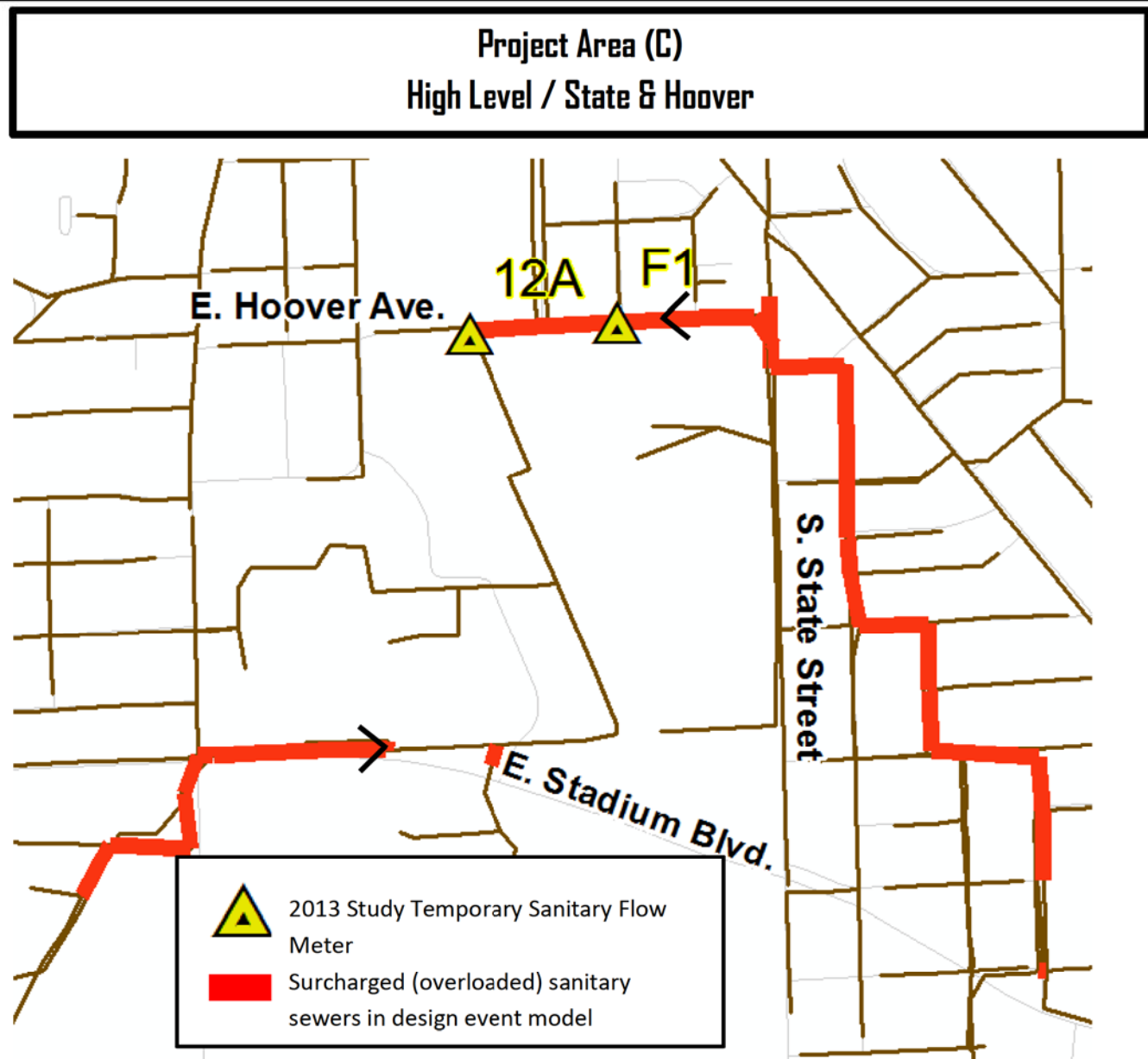
Suggested Action Plan for Further Investigation

Tasks Associated with Project	Expected Outcome
<ol style="list-style-type: none"> Install branch flow meters to verify the flows in this area. Televise and physically inspect sanitary pipes and manholes. Perform field sanitary flow testing if feasible by directing water from a hydrant into the sanitary sewer. Organize a wet weather mobilization team to measure sanitary depths during storm events. Perform continuous sanitary depth and flow meter monitoring at key locations, if needed. 	<ol style="list-style-type: none"> Identification of obvious physical obstructions (e.g. root blockages) or, if not present, in the sanitary sewer. Perform further field investigation in order to identify sanitary structures and conditions resulting in unexpectedly high sanitary depths in this area.

- Estimated investigation cost:** Less than \$100,000
- Estimated timeline to complete:** 12 months

CAC COMMENTS:

- The 18" sanitary sewer, set west of First St., runs north from Washington St directly under what is known as the Atrium Office building (315 W Huron).
- Examine the results of the stormwater model calibration study to determine if stormwater flooding might be contributing to issues in this area.



Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (F1/12A) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

- 1- Sanitary sewer model calibration efforts show that very high hydraulic losses needed to be applied in order to make the model match sanitary flow meter data. These losses are much higher than suggested by engineering standards.
- 2- Design event sanitary sewer model calibrated to the downstream sanitary flow meter shows flows that exceed the sanitary pipe capacities, resulting in modeled surcharging as high as ~8 ft. above sewer bottom.
- 3- The City had previously recognized this as a problem area. Further work was planned but extent of improvements needed was yet to be identified.
- 4- This is a known Sanitary Sewer Overflow (SSO) area - upstream of meter F1.

Therefore, it is believed that further investigations are needed to resolve the unusual hydraulic losses before making significant capital investments.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

1. Televis and physical inspect sanitary pipes and manholes.
2. Perform field sanitary flow testing if feasible by directing water from a hydrant into the sanitary sewer.
3. Organize a wet weather mobilization team to measure sanitary depths during storm events.
4. Perform continuous sanitary depth and flow meter monitoring at key locations, if needed.

Expected Outcome



1. Identification of obvious physical obstructions (e.g. root blockages) or, if not present, in the sanitary sewer.
2. Perform further field investigation in order to identify sanitary structures and conditions resulting in unexpectedly high sanitary depths in this area.

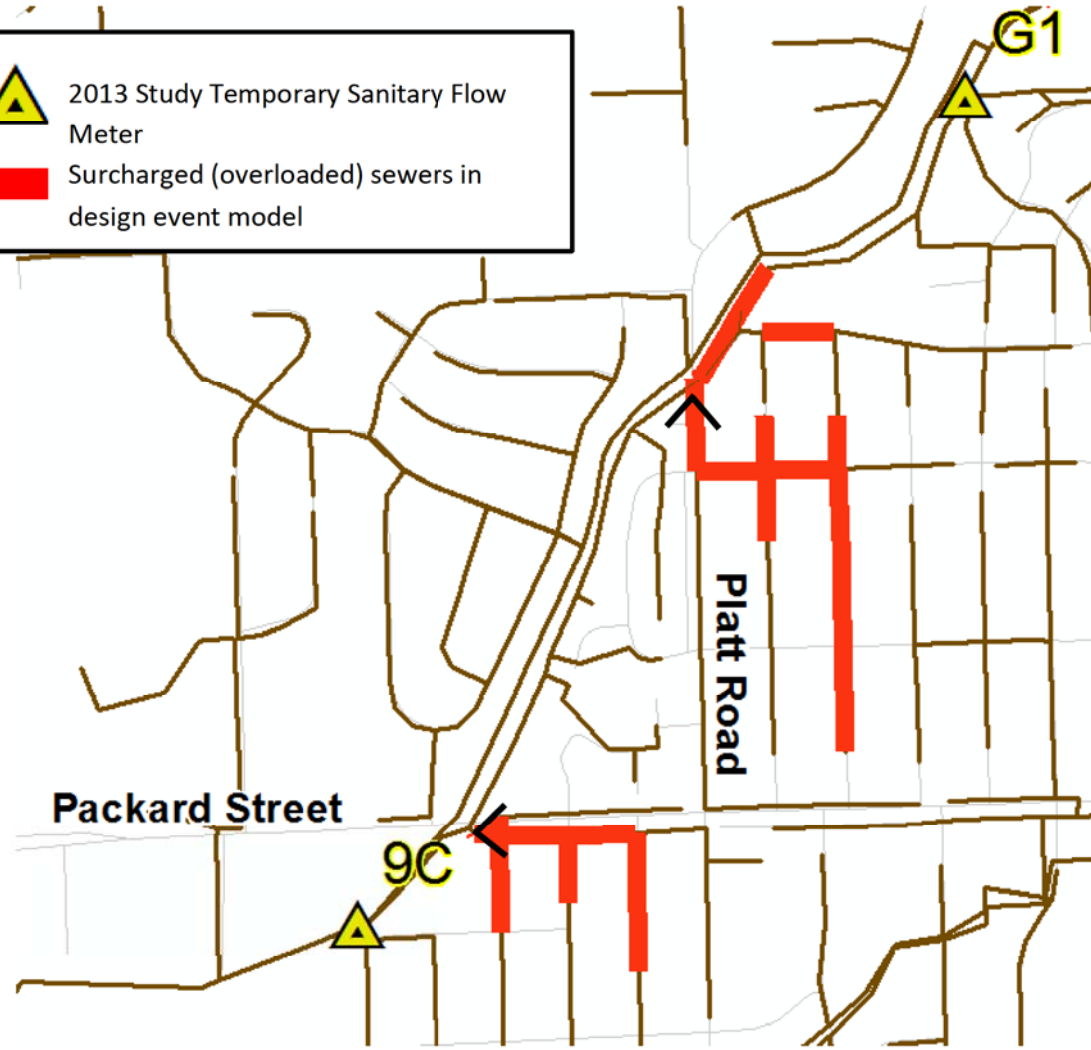
- **Estimated investigation cost:** Less than \$100,000
- **Estimated timeline to complete:** 12 months

CAC COMMENTS:

1. Consider monitoring the sanitary depth downstream to understand where the sanitary back-ups begin.

**Project Area (D)
Pittsfield Valley**

 2013 Study Temporary Sanitary Flow Meter
 Surcharged (overloaded) sewers in design event model



Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (G1) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Sanitary model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

- 1- Sanitary model shows sanitary flows that exceed the sanitary pipe capacities as identified in the adjacent figure, resulting in modeled surcharging as high as ~11 ft. above sanitary sewer bottom.
- 2- The City had previously recognized this as a problem area as this area includes sanitary backup complaints.
- 3- This area is suspected of having high footing drain flows that maybe overloading the sanitary system. The area was not directly metered and so actual sanitary flows are not known. Sanitary model results are based on assumed sanitary flow distribution.

Therefore, it is believed that further investigations are needed before making significant capital investments (i.e., storage, relief sewer, sanitary flow source removal, including FDD).

Suggested Action Plan for Further Investigation

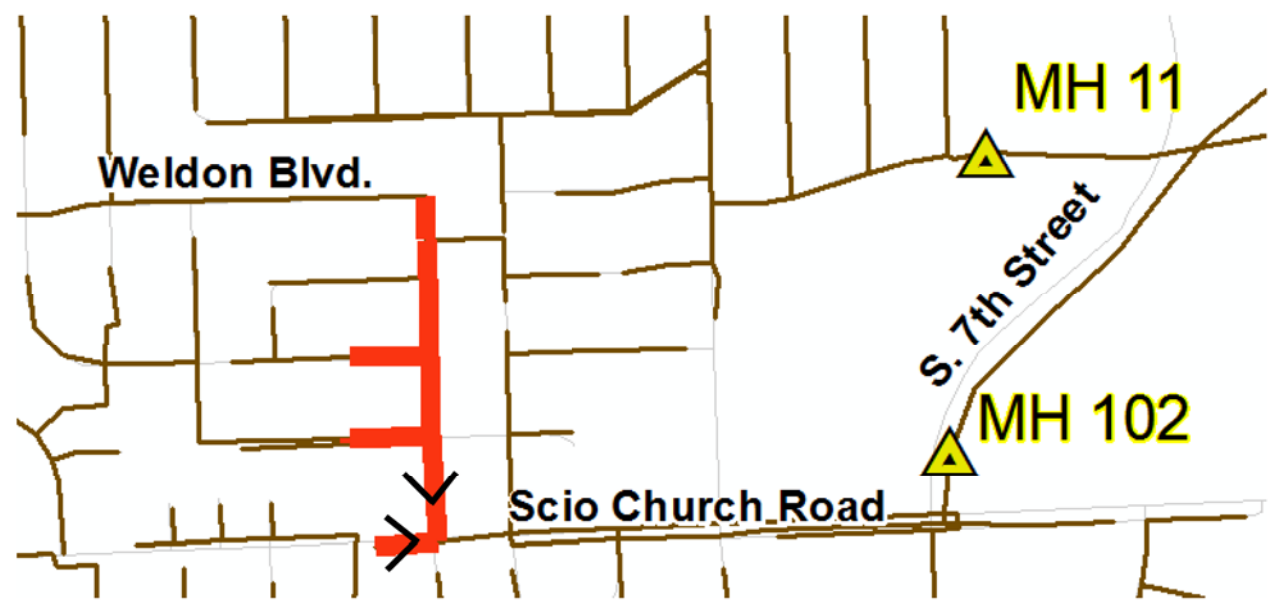
Tasks Associated with Project	Expected Outcome
<ol style="list-style-type: none"> 1. Ensure that all sanitary manhole pick holes are plugged before flow metering 2. Perform sanitary metering to understand sanitary flow magnitude and source. 3. Survey home owners to understand extent and cause of sanitary sewer basement backups. 4. Determination of cause of sanitary backups (i.e. is it high sanitary flows, system capacity constraints, or local, homeowner system issues). 	<ol style="list-style-type: none"> 1. Sanitary flow metering, data collection, and survey results report. 2. Revised sanitary sewer model. 3. Proposed plan to address sanitary deficiencies, including capital improvements to be included in the City's capital improvement plan to address identified sanitary sewer deficiencies.


- **Estimated inspection cost:** less than \$100,000
- **Estimated timeline to complete:** approximately 8 months


CAC COMMENTS:

1. Consider sealed and gasketed sanitary manhole lids.

**Project Area (E)
Glen Leven**



 2013 Study Temporary Sanitary Flow Meter

 Surcharged (overloaded) sanitary sewers in design event model

Sanitary Model Background

- Existing sanitary sewer model was calibrated to downstream sanitary meter (MH11/MH102) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
- Sanitary model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

- Sanitary model shows sanitary flows that exceed the sanitary pipe capacities for approximately 1,800 ft., resulting in modeled surcharging as high as ~3 ft. above sanitary sewer bottom.
 - This is one of the high-priority footing drain disconnection areas (Glen Leven).
 - Sanitary metering data analysis indicated that footing drain disconnection was less effective in this area than in the other high-priority areas.
 - High flows from inflow & infiltration into the sanitary system still exist in this district, either from remaining footing drains or other inflow & infiltration sources.
- Therefore, it is believed that further investigations are needed before making significant capital investments.

Suggested Action Plan for Further Investigation

<u>Tasks Associated with Project</u>	<u>Expected Outcome</u>
<ol style="list-style-type: none"> Determine sanitary surcharge level that impacts basements. Develop a scope and cost for sanitary sewer evaluation survey (SSES), inclusive of televising, sanitary manhole inspection, smoke testing, and temporary sanitary flow monitoring. Prepare a preliminary cost estimate for a sanitary relief sewer. Perform cost effectiveness evaluation between construction of relief vs further I/I removal. 	<ol style="list-style-type: none"> Evaluation results of whether sanitary surcharge is acceptable. Cost estimates for SSES, I&I removal, and construction of relief sanitary sewer. Recommendation for how to proceed based on cost estimates and community values.

- Estimated investigation cost:** Less than \$20,000
- Estimated timeline to complete:** 3 months

CAC COMMENTS:

- What is our level of confidence in the model in this area, and the prediction of 3-feet of surcharge? *OHM indicated high confidence.*
- There were some concerns expressed by OHM about the flow split between the two meters on this area. Does that affect the confidence? *No. The meter data was used to distribute the sanitary flow in the model.*
- Should the City consider some "free board" above the three feet of surcharge to provide some cushion before basements are impacted? *CAC recommends two feet.*