



CITY OF MELROSE

DEPARTMENT OF PUBLIC WORKS
*Administration & Engineering—Water—Sewer—Facilities
Park & Forestry—Highway—Sanitation—Cemetery—Fleet*

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MEMORANDUM

To: Mayor Gail Infurna

From: John Scenna, Director of Public Works

cc. Robert Van Campen, Deputy Mayor & City Solicitor
Elena Proakis Ellis, P.E., City Engineer, Peter Pietrantonio, Operations Manager DPW

Date: July 12, 2019

Re: Summary of Weston & Sampson Brazil Street Incident Review

As part of the immediate response to the June 20, 2019 sewer backup on Brazil St., the city retained Weston & Sampson of Reading, MA to perform an independent evaluation. They were asked to evaluate the existing conditions of the sewer and service connections, to review video taken of the system immediately after said blockage, to provide an opinion as to the cause, and to present recommendations for improvements to the sewer going forward.

Weston & Sampson reviewed the inspection video of the sewer created by Wayne's Drains on the day of the event, used historic data and documentation of existing sewer infrastructure, and reviewed first-hand accounts provided by Melrose DPW staff members who were present during the incident. Below is a brief summary of findings. Additional, more detailed information and photos of existing conditions can be found in the attached draft report.

Weston and Sampson ultimately concluded the Brazil St. sewer incident was likely the result of a combination of the following factors:

- Roots and debris obstruction which created a surcharged condition within pipes in the system;
- Significant presence of grease in the 6-inch sewer main and individual sewer service connections;
- Poor condition of the individual sewer service connections which likely allowed large amounts of liquid sewage and waste to continuously accumulate overtime in the sewer service connections.

Regarding Sewer Conditions Weston & Sampson found:

- **Prior to June 20, the sewer was in "fair/poor" condition** due to the roots, large amounts of grease and debris, surcharged conditions (when a sewer overfills with wastewater due to clogs or overflow), and a significant number of cracks.
- **The sewer service connections were likely surcharged prior to any work performed by the City.** Roots, debris, and grease accumulated and caused a major blockage in the sewer. As a result, the existing 6-inch sewer upstream of the blockage was likely surcharged prior to any work performed by the City as evidenced by staining and grease/debris along the sides and top of the pipe.
- **The existing capacities of the individual service connections were reduced due to the large amounts of grease observed in each service connection.** Many of the homes along Brazil Street were contributing significant amounts of grease over an extensive period of time into the City sewer as indicated by the photos in the full report .
- **The sewers in Brazil Street were installed in 1906 using 6-inch vitrified clay pipe (standard at the time) and the service connections appear to be 4-inches in diameter.** Today's industry guidelines require 8in minimum for mainline sewer pipe and 6in for service connection pipe. With smaller diameter sewers, any type of debris or solids that accumulate could significantly reduce the area inside the pipe and directly impede the flow of wastewater.

Regarding the city's work to clear the blockage, Weston & Sampson found:

- **The City's procedure of increasing the flow and pressure of the jet hose when the obstruction was encountered is typical protocol when cleaning sewers.** When there are known roots or grease clogs however, different equipment can be used, such as a nozzle with a cutting instrument.
- **After the blockage was clear, wastewater most likely flowed downstream at a velocity greater than 6 mph, which may have caused wastewater to be forced back up the service connections and into the homes.** According to City record drawings, the existing 6-inch sewer pipe upstream of the incident was installed with a slope of over 11%. Based on this slope, the velocity of the wastewater in this pipe while flowing full would be approximately 9 feet per second or approximately 6 miles per hour. When the City cleared the obstruction, it is likely that the wastewater flowed downstream at even higher velocities due to the buildup of pressure in the sewer behind the obstruction—possibly forcing wastewater back up the service connections and into the homes.

We will continue to work with our DPW Engineering Office and Weston & Sampson to begin to review and put in place some of the recommendations within this report.

MEMORANDUM

TO: John Scenna, Director of Public Works – Melrose, MA

FROM: John C. Potts, P.E.

DATE: July 12, 2019

SUBJECT: Melrose, MA – Brazil Street Sewer Review and Evaluation

At the request of the City of Melrose, MA (the City), Weston & Sampson Engineers, Inc. has prepared this memorandum after review of the sewer issue that occurred on Brazil Street on Thursday, June 20th, 2019. The purpose of the memorandum is to present an evaluation of the existing conditions of the sewer and sewer service connections, provide an opinion as to the cause of the issue, and present recommendations for improvements to the sewer.

BACKGROUND

On June 20th, 2019, City personnel responded to a call of water seeping out of the ground at a water main gate box in Brazil Street which led them to investigate the sanitary sewer. The existing sanitary sewer along Brazil Street is a 6-inch diameter, vitrified clay (VC) pipe. According to City record drawings, it was originally installed in 1906. Initial investigations found the sewer flowing at sewer manhole (SMH) 0+00 located in the intersection of Washington Street and Brazil Street. Investigations by the City then found the sewer manhole located in front of #24 Brazil Street (SMH 2+80) to be filled (or surcharged) with wastewater which indicated that something in the 6-inch VC mainline sewer was causing it to back up. There are seven (7) homes (#5, #9, #12, #13, #17-19, #18, and #24) on Brazil Street connected to the existing 6-inch VC sewer between SMH 0+00 and SMH 2+80. See Figure 1 at the end of this memorandum for a copy of the City record drawing which depicts the existing sewer, properties and approximate service connection locations.

City personnel inserted a jet hose into the 6-inch sewer in Brazil Street from SMH 0+00 to clean the existing pipe. At approximately 34-feet upstream of SMH 0+00 (Station (STA) 0+34), as shown on Figure 1, the City encountered an obstruction which prohibited the jet hose from proceeding forward. In an attempt to clear the obstruction, the flow and pressure from the jet hose was increased, which is typical protocol for such an operation and conditions. Shortly thereafter, the residents of #9 Brazil Street and #12 Brazil Street reported their toilets and plumbing overflowing and wastewater pouring into their homes. The City immediately ceased all operations. #13 Brazil Street and #18 Brazil Street were also impacted during the work.

Following the overflows, the City hired Wayne's Drains of Burlington, MA to conduct a closed-circuit television (CCTV) inspection of the existing 6-inch VC sewer in Brazil Street.

EXISTING CONDITIONS AND CONCLUSIONS**Existing Condition of the 6-inch VC Sewer Main –**

Weston & Sampson reviewed the CCTV inspection video of the Brazil Street sewer from SMH 0+00 to SMH 2+80 completed and provided to the City by Wayne's Drains on June 20th. CCTV inspection began at SMH 0+00 at the intersection of Washington Street and Brazil Street and continued upstream from this manhole. The following paragraphs present a summary of the existing conditions of the sewer based on the observations of the CCTV inspection video. All station designations in the following paragraphs indicate the location in feet upstream of SMH 0+00 (i.e. – STA 0+25 is 25-feet upstream of SMH 0+00).

At STA 0+11, there appears to be a "capped" (or sealed off) service connection stub with large amounts of grease (see Photo #1).

Photo #1 – STA 0+11

At STA 0+25 and STA 0+30, root intrusion was present at the sewer pipe joints (see Photos #2 and #3)

Photo #2 – STA 0+25

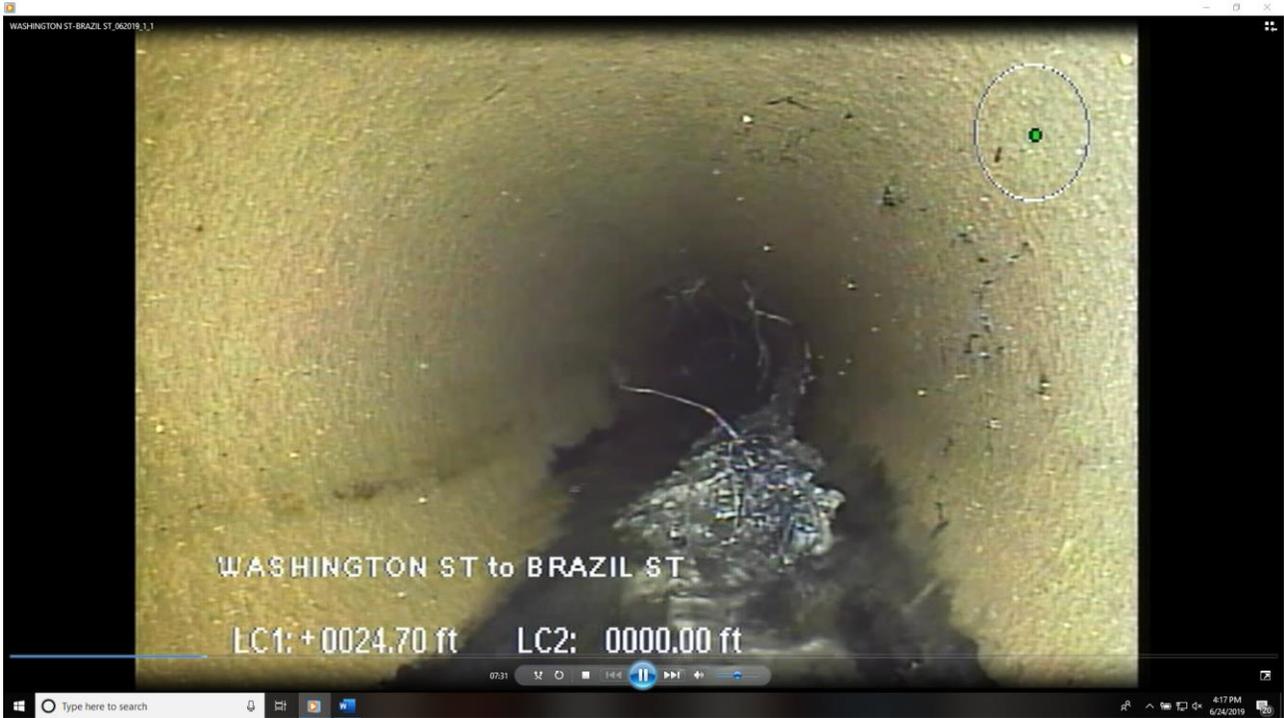


Photo #3 – STA 0+30



As previously stated, the City encountered an obstruction at approximate STA 0+34 during their jetting operations on June 20th. As shown below in Photo #4, large amounts of roots and debris were still present at STA 0+34 following the jetting operation.

Photo #4 – STA 0+34



There was also another “capped” service connection behind the roots shown in Photo #4 at STA 0+35 which was also completely filled with roots. As shown in Photo #4, a small amount of wastewater is flowing past the cluster of roots as indicated by the discolored water at the right side of the photograph. These roots were the obstruction encountered by the City personnel during their jetting operations on June 20th. In order to clear the obstruction, the flow and pressure from the jet hose were increased which allowed the jetting procedure to continue and to allow wastewater to flow better downstream toward SMH 0+00.

Based on our review of the CCTV inspection video, it appears that the existing 6-inch VC sewer pipe was completely filled (or surcharged) with wastewater behind the roots that were encountered at STA 0+34 as shown in Photo #4. Large amounts of grease and debris were seen in the video at the top of the pipe and along the sides of the pipe which are indicative of the pipe being full. The amount of grease and debris also indicate that this pipe was likely surcharged for enough time to allow for collection and deposition of grease and debris. Grease and debris appear to have collected in the roots as well, which further solidified the obstruction, surcharged the sewer behind it, and limited the normal flow of wastewater from Brazil Street.

The following photos show the condition of the sewer behind the root obstruction found at STA 0+34.

Photo #5 – STA 0+38



Photo #6 – STA 0+40



Photo #7 – STA 0+41



Photo #8 – STA 0+55



Photo #9 – STA 0+56



Photo #10 – STA 0+59



Photo #11 – STA 0+63



Photo #12 – STA 0+70



In addition to the grease and debris present in the previous photos, “black staining” can be seen along the sides and near the top of the pipe. Such staining is indicative of wastewater flows being at this level for long periods of time. It appears to be a systemic problem in the existing Brazil Street sewer and not one that recently developed.

All seven (7) of the active service connections to the homes along Brazil Street are located upstream of the root obstruction at STA 0+34. The following table lists the properties and the approximate location of the service connections along the sewer mainline.

**Table 1
Service Connections and Locations**

Property	Approximate Location
#5 Brazil Street	STA 0+50
#9 Brazil Street	STA 1+20
#12 Brazil Street	STA 1+37
#13 Brazil Street	STA 1+54
#18 Brazil Street	STA 2+05
#17-19 Brazil Street	STA 2+56
#24 Brazil Street	STA 2+73

As previously stated herein, the existing 6-inch sewer was likely surcharged with wastewater behind the “mass of roots, grease and debris” at STA 0+34 prior to any work performed by the City on June 20th. It is also likely that some of the service connections listed above in Table 1 were also either full or partially full of wastewater before the City jetted the existing pipe on June 20th. Once the obstruction was cleared by the City, the plumbing in the following homes were impacted - #9, #12, #13 and #18, with #9 and #12 being impacted the most. It should be noted that while the service connection to #5 Brazil Street was closest to the obstruction, it did not experience any issues on June 20th since the entrance to the service connection from the 6-inch mainline was filled with roots and grease (see Photo #13).

Photo #13 – #5 Brazil Street Service Connection (STA 0+50)



The following photos show the service connection to the #9 Brazil Street as observed from the 6-inch main.

Photo #14 – #9 Brazil Street Service Connection (STA 1+20)

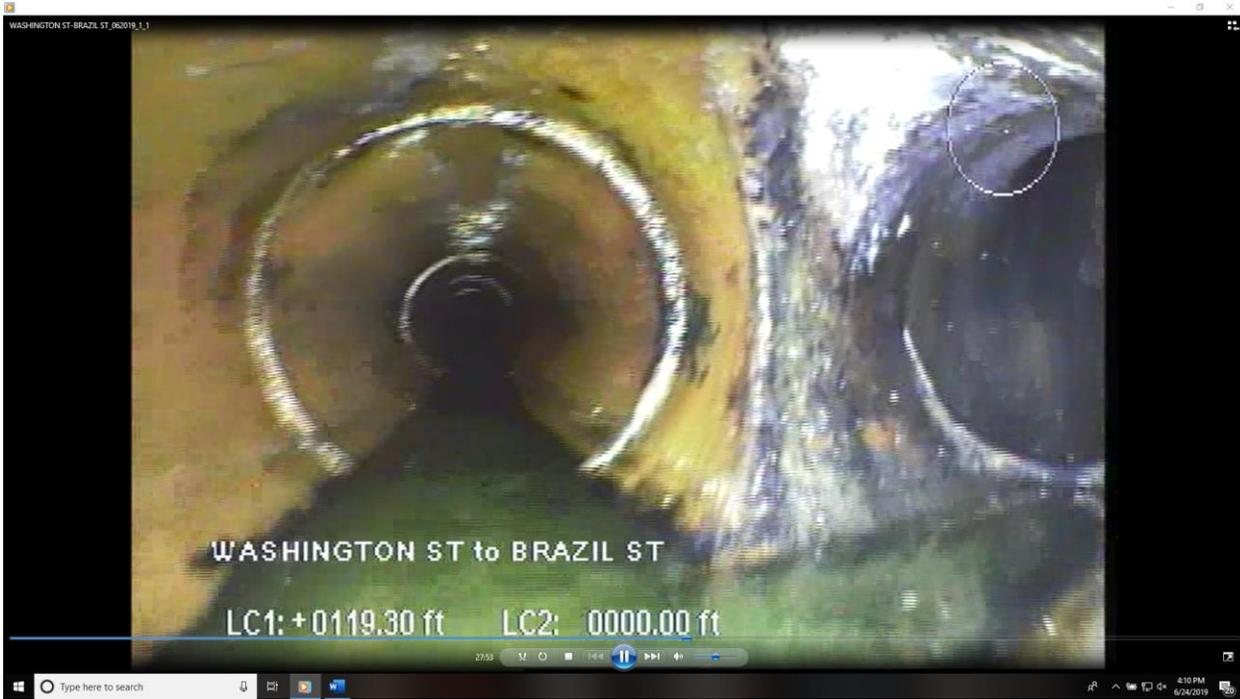
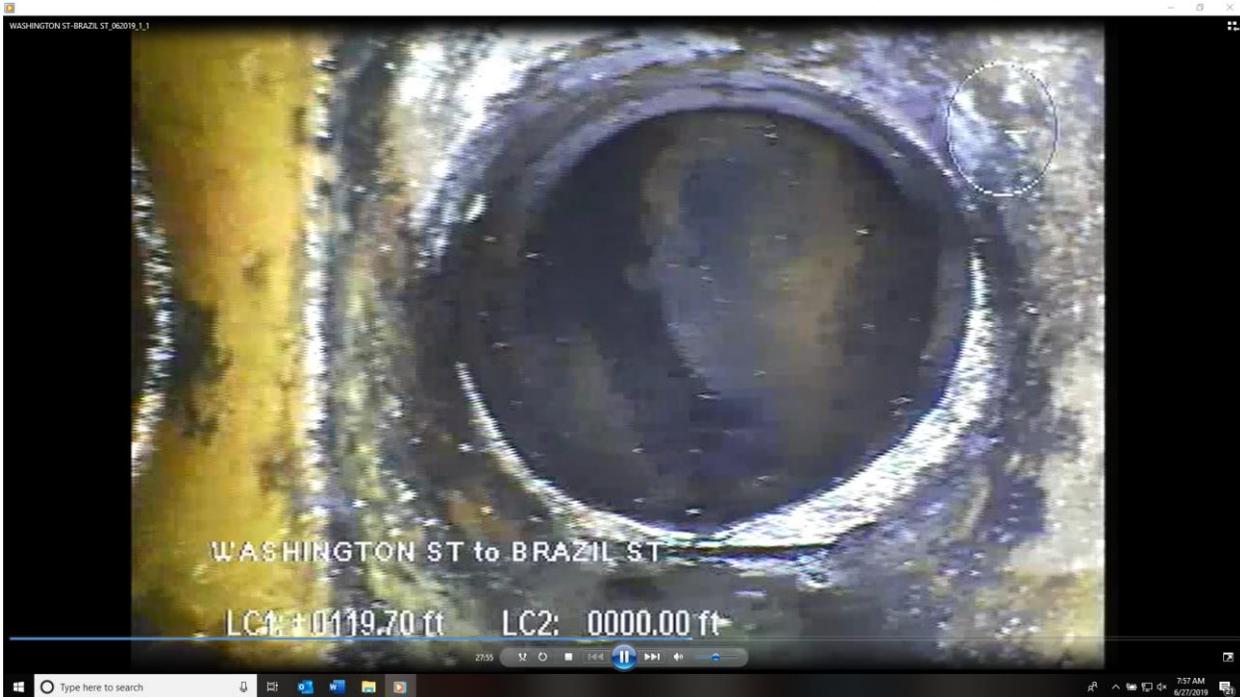


Photo #15 – #9 Brazil Street Service Connection (STA 1+20)



Grease or Indications of grease and surcharging (black staining) were also present in the service connections from #12, #13, and #18 as shown in the following photographs as observed from the 6-inch sewer main.

Photo #16 – #12 Brazil Street Service Connection (STA 1+37)



Photo #17 – #13 Brazil Street Service Connection (STA 1+54)

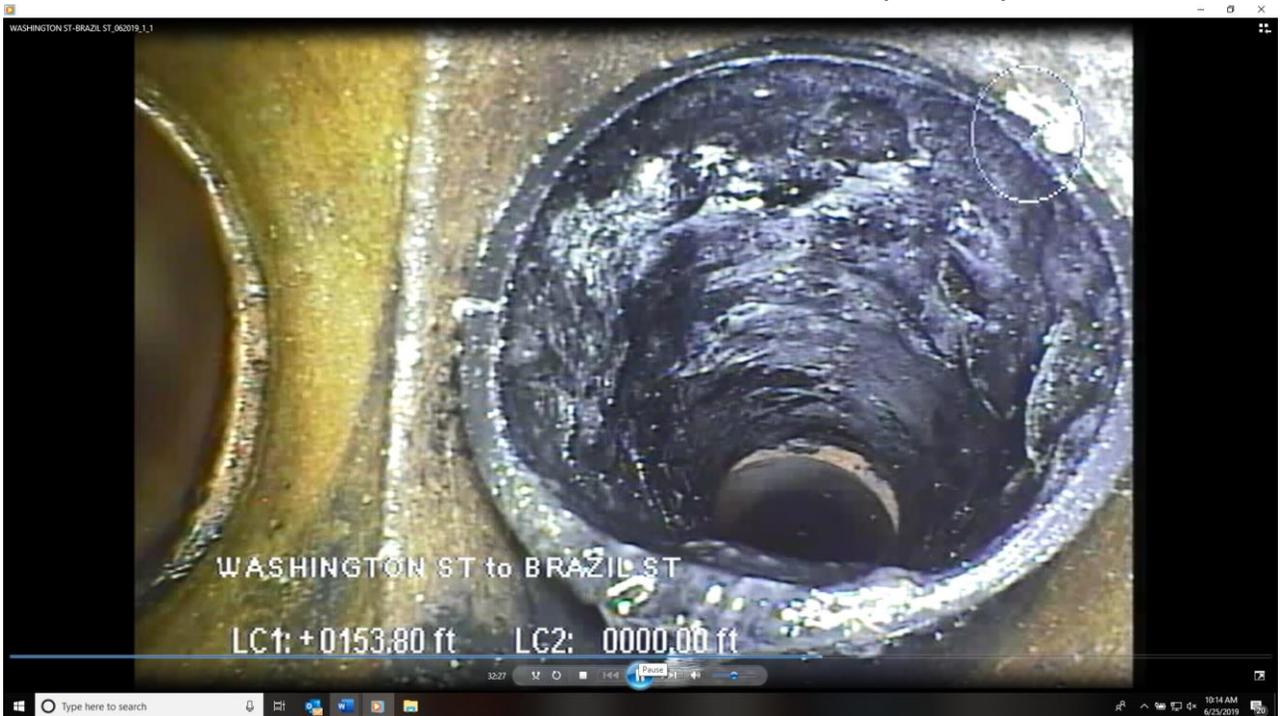
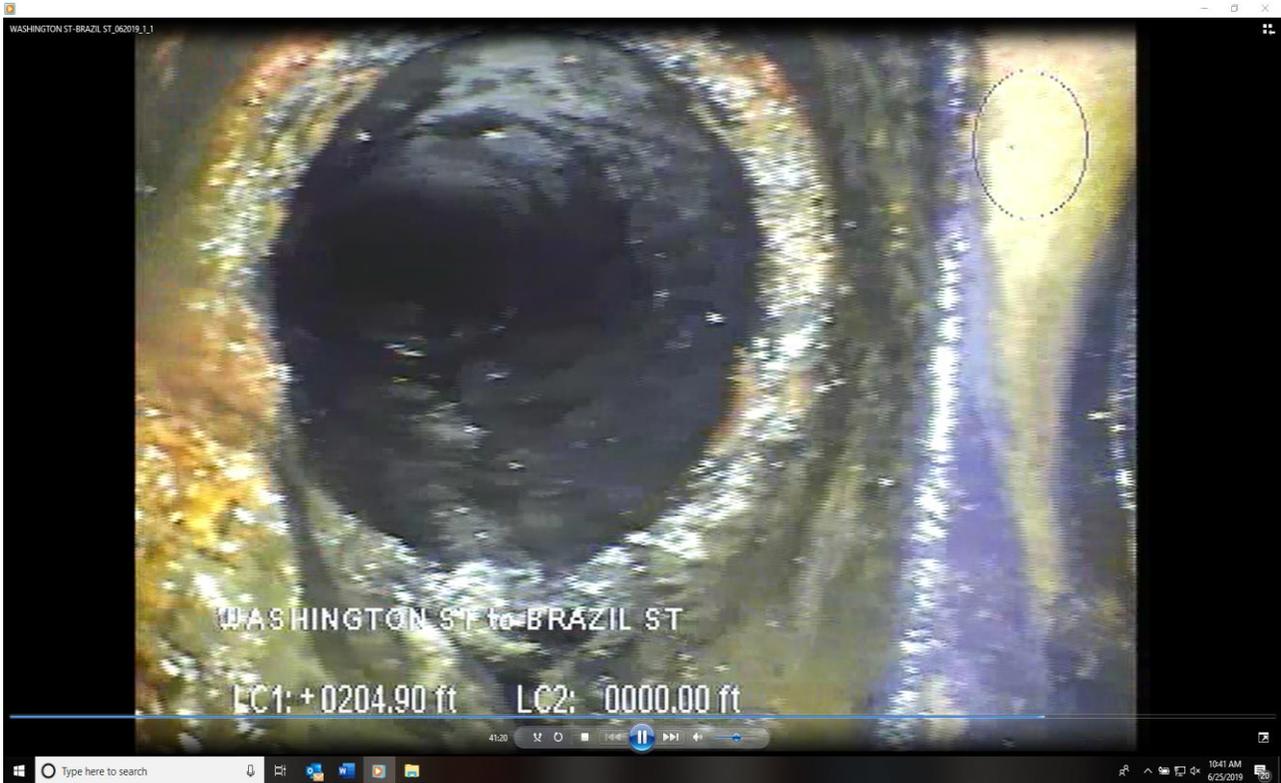


Photo #18 – #18 Brazil Street Service Connection (STA 2+05)



Evidence of pipe surcharging as far upstream as SMH 2+80 in Brazil Street can also be seen in the following photographs. Debris was observed at the top of the pipe and within the existing services.

Photo #19 – STA 2+53



Photo #20 – #17-19 Brazil Street Service Connection (STA 2+56)



Photo #21 – #24 Brazil Street Service Connection (STA 2+72)



In addition to the roots, grease and pipe surcharging, numerous structural issues were found during the CCTV inspection of the existing Brazil Street sewer. A total of 19 locations were identified with one or more of the following structural issues:

- Broken sections of pipe with large voids (see Photo #22 for an example)
- Spiral cracks and fractures (see Photo #23 for an example)
- Longitudinal cracks and fractures (see Photo #24 for an example)

Photo #22 – Broken pipe at STA 0+06

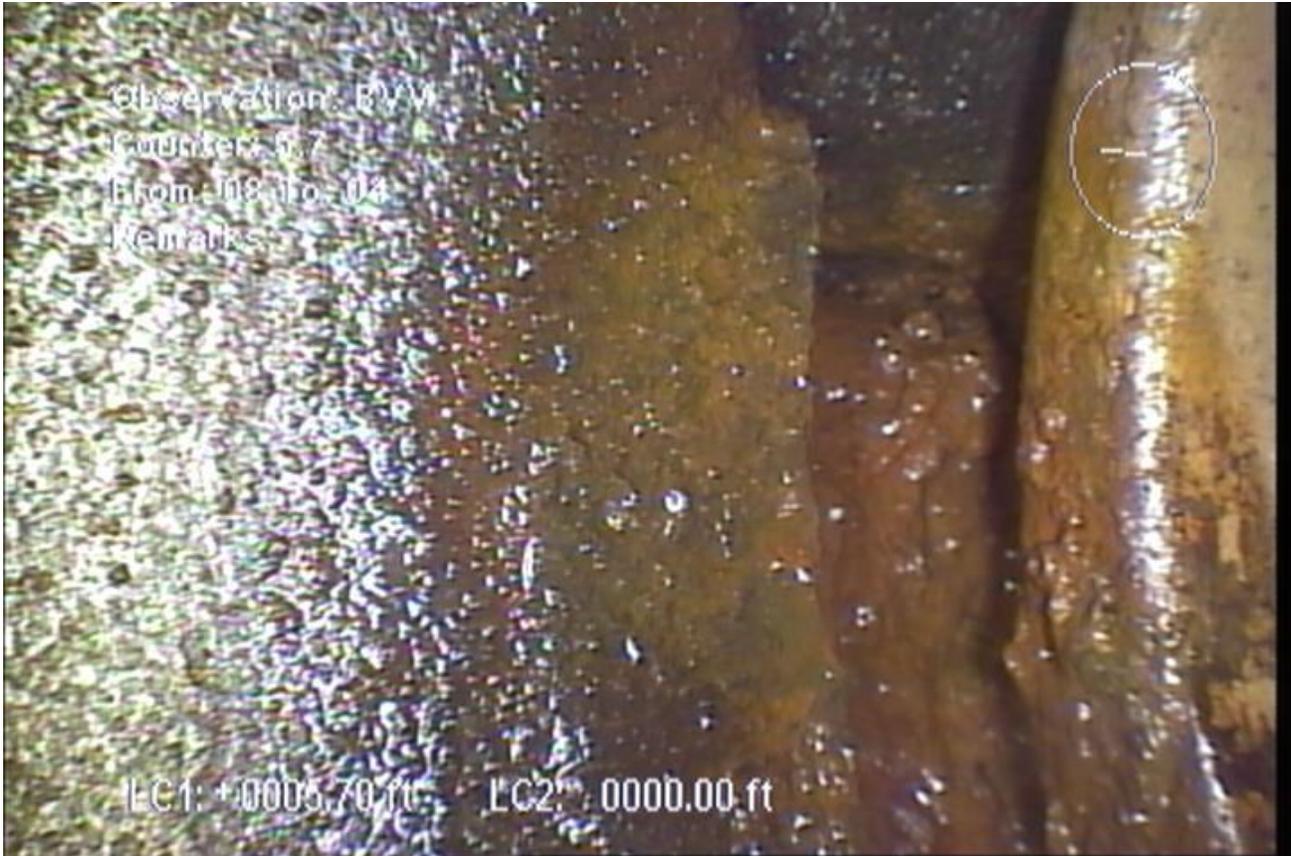


Photo #23 – Spiral crack at STA 1+31

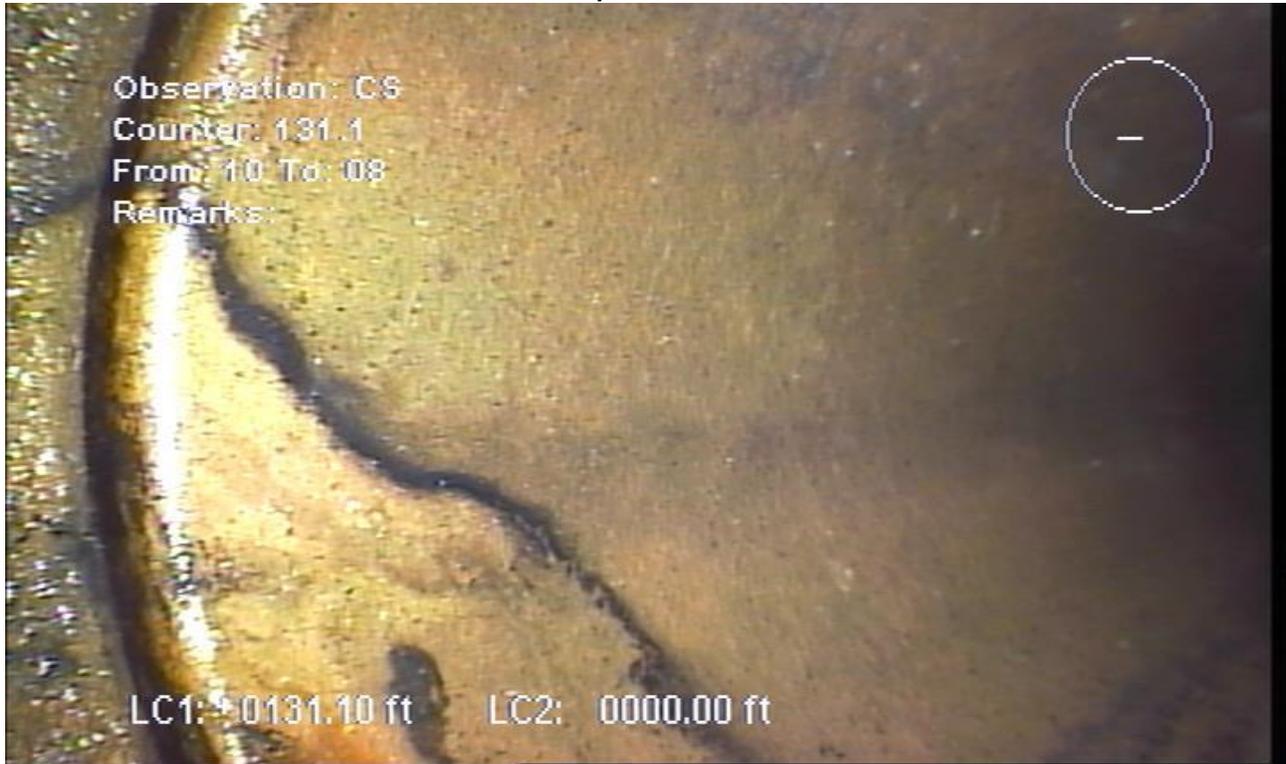


Photo #24 – Longitudinal crack at STA 1+58



Existing Conditions of the Impacted Residential Service Connections –

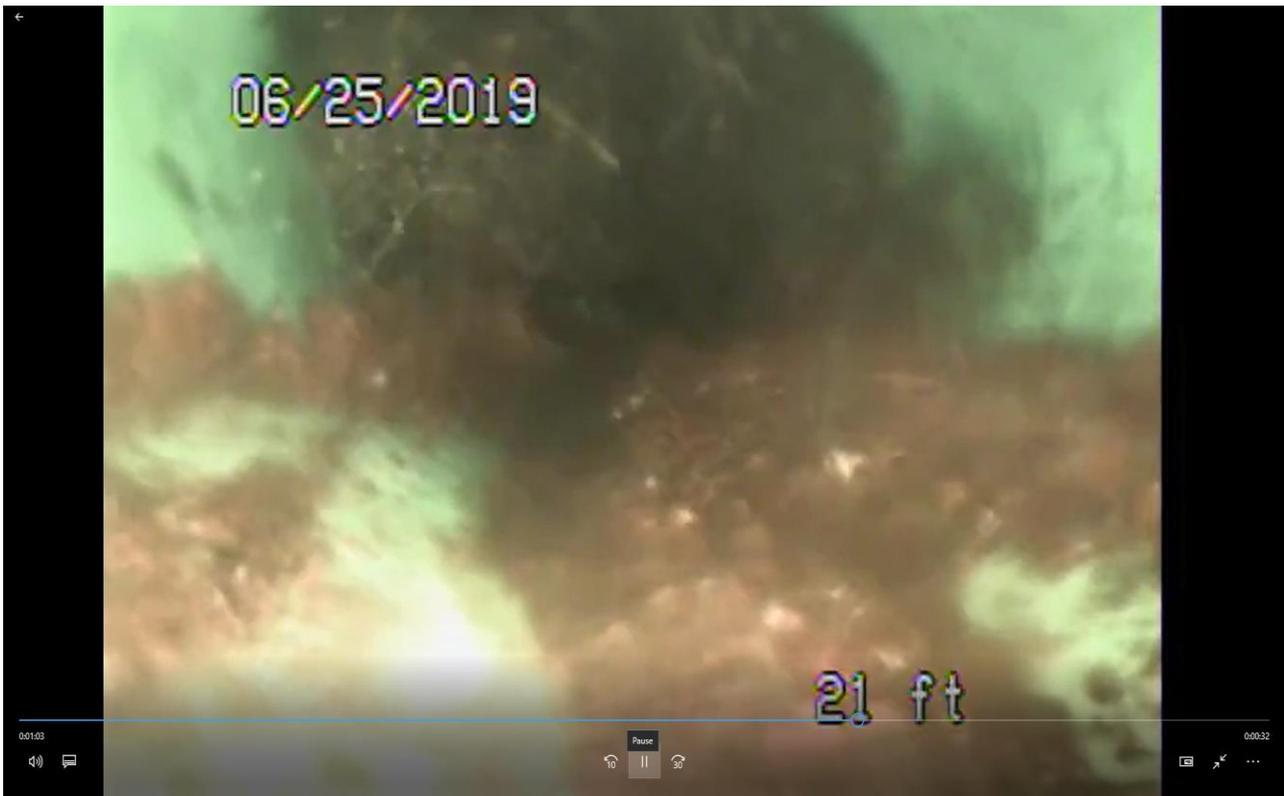
The City also hired Wayne’s Drains to conduct inspections of the existing service connections from #5, #9, #12, #13, and #18 Brazil Street using a push camera. The video inspections were performed on June 25th, 2019 except #13 Brazil Street, which was conducted on June 27th. Inspections were conducted from inside the individual houses and toward the 6-inch VC sewer main in the street. All of the service connections appear to be 4-inch in diameter according to the City’s existing tie cards for each property.

The following paragraphs present a summary of the existing conditions of the sewer service connections based on the observations of the push camera videos. All station designations in the following paragraphs indicate the location in feet downstream of the houses (i.e. – STA 0+00 begins at each house).

#5 Brazil Street

At STA 0+21, the push camera encountered a mass of roots and a build up of waste and was unable to continue to the 6-inch sewer main (see Photo #25 below).

Photo #25 – #5 Brazil Street – STA 0+21



The service connection from #5 was almost completely filled with roots and grease where it enters the sewer main in the street (see Photo #13). Therefore, it is possible that this service connection is filled with roots, debris, etc. from STA 0+21 to the mainline (approximately 17-feet). It should be noted that according to the City’s tie card for this property, the service connection was replaced using polyvinyl chloride (PVC) pipe in June 2011.

#9 Brazil Street

The service connection from #9 Brazil Street is approximately 58-feet in length from the house to the mainline. Small deposits of grease begin to appear 3- to 4-feet into the push camera inspection. The service connection has large amounts of grease throughout its entire length as evidenced by the following photographs.

Photo #26 – #9 Brazil Street – STA 0+24



Photo #27 – #9 Brazil Street – STA 0+32



Photo #28 – #9 Brazil Street – STA 0+34



Photo #29 – #9 Brazil Street – STA 0+38



Photo #30 – #9 Brazil Street – STA 0+40



#12 Brazil Street

The service connection from #12 Brazil Street is approximately 64-feet in length from the house to the mainline. The service connection has large amounts of grease throughout its entire length as evidenced by the following photographs.

Photo #31 – #12 Brazil Street – STA 0+39



Photo #32 – #12 Brazil Street – STA 0+40



Photo #33 – #12 Brazil Street – STA 0+51



Photo #34 – #12 Brazil Street – STA 0+56



Photo #35 – #12 Brazil Street – STA 0+56



#13 Brazil Street

The service connection from #13 Brazil Street has heavy pockets of grease from the house to approximately STA 0+48. A broken section of pipe was found at STA 0+41 where the bottom of the pipe appeared to be rotted out and prevented the push camera from continuing with the inspection to the mainline in the street. Despite the broken pipe, flow was continuing to the 6-inch VC sewer main. The following photographs depict the existing condition of this service connection.

Photo #36 – #13 Brazil Street – STA 0+20

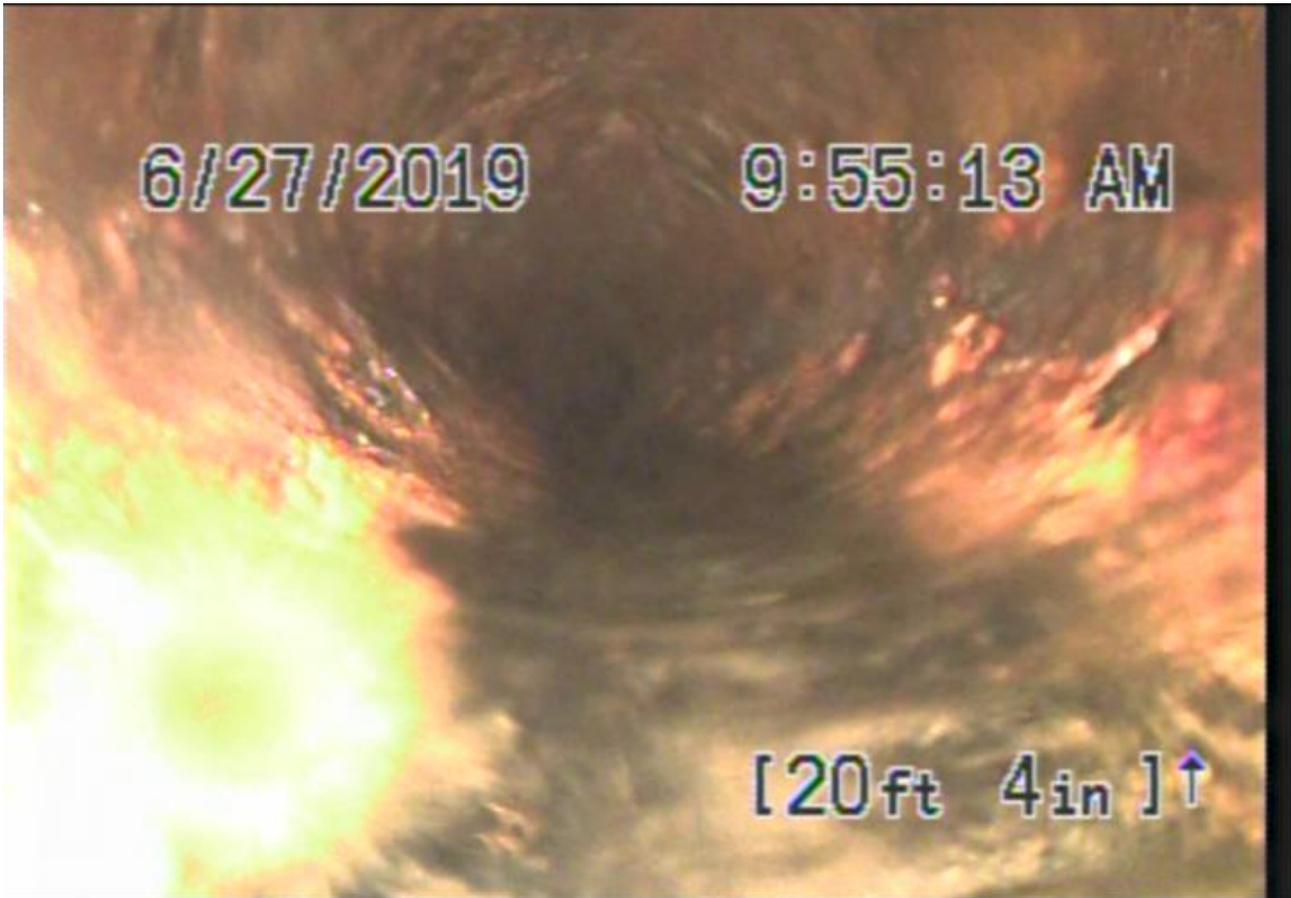


Photo #37 – #13 Brazil Street – STA 0+34



Photo #38 – #13 Brazil Street – STA 0+41



Photo #39 – #13 Brazil Street – STA 0+41

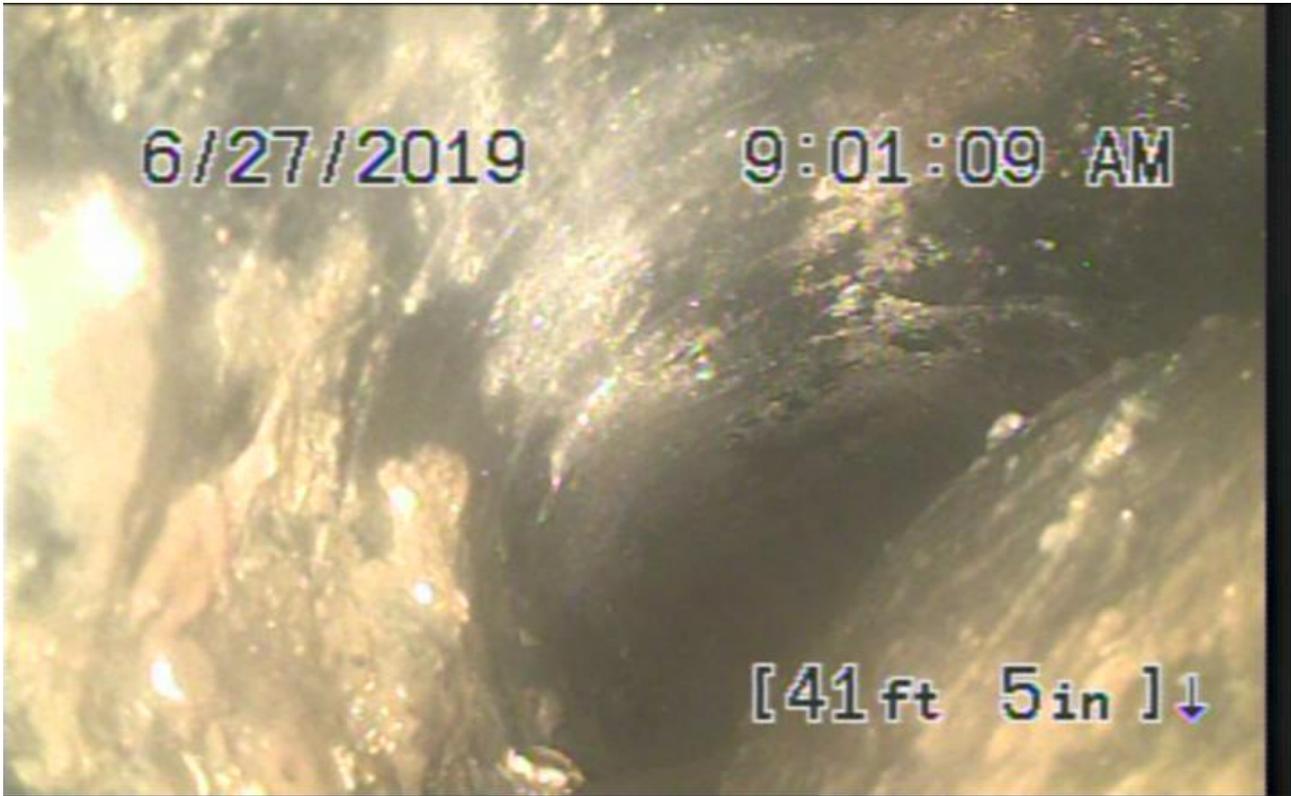


Photo #40 – #13 Brazil Street – STA 0+4



#18 Brazil Street

The service connection from #18 Brazil Street is approximately 62-feet in length from the house to the mainline. The service connection has grease throughout its entire length as evidenced by the following photographs.

Photo #41 – #18 Brazil Street – STA 0+04



Photo #42 – #18 Brazil Street – STA 0+09



Photo #43 – #18 Brazil Street – STA 0+13



Photo #44 – #18 Brazil Street – STA 0+32



Photo #45 – #18 Brazil Street – STA 0+56



Conclusions –

Based on the review of the CCTV inspection videos and discussions with City personnel, Weston & Sampson offers the following conclusions regarding the sewer incident that occurred on Brazil Street on June 20th, 2019.

- Prior to the events of the June 20th, the existing 6-inch sewer in Brazil Street was in “fair/poor” condition due to the roots, large amounts of grease and debris, surcharged conditions, and a significant number of cracks.
- Roots, debris, and grease accumulated and caused a major blockage in the existing 6-inch VC sewer at STA 0+34. As a result, the existing 6-inch sewer upstream of the blockage was likely surcharged (completely full) as it was on June 20th prior to any work performed by the City as evidenced by staining and grease/debris along the sides and top of the pipe.
- The sewer service connections were likely surcharged prior to any work performed by the City. It was not clear how far toward the houses that the surcharging was present in the individual sewer service connections.
- Many of the homes along Brazil Street were contributing significant amounts of grease over an extensive period of time into the City sewer as indicated by the photos included herein of the sewer service laterals. The existing capacities of the individual service connections was reduced due to the large amounts of grease observed in each service connection.
- In accordance with today’s industry guidelines, the minimum diameter for mainline sewer pipe is 8-inches and for service connection pipe is 6-inches. The sewers in Brazil Street were installed in 1906

using 6-inch VC pipe and the service connections appear to be 4-inches in diameter. With smaller diameter sewers such as 6-inch, any type of debris or solids that accumulate could significantly reduce the area inside the pipe and directly impede the flow of wastewater.

- According to City record drawings, the existing 6-inch sewer pipe upstream of SMH 2+80 was installed with a slope of over 11%. Based on this slope, the velocity of the wastewater in this pipe while flowing full would be approximately 9 feet per second (fps) or approximately 6 miles per hour (mph). It was not clear how far upstream of SMH 2+80 that surcharged pipe conditions were present at the time of the City's work on June 20th. When the City cleared the obstruction at STA 0+34, it is likely that the wastewater flowed downstream at even higher velocities due to the build up of pressure in the sewer behind the obstruction and could have caused wastewater to be forced back up the service connections and into the homes.
- The City's procedure of increasing the flow and pressure of the jet hose when the obstruction was encountered at STA 0+34 is typical protocol when cleaning sewers. Had the City been aware of the roots and grease, different equipment may have been used, such as a nozzle with a cutting instrument, to clear the obstruction.
- The sewer incident that occurred on Brazil Street on June 20th, 2019 was the likely result of a combination of the following elements:
 - Roots and debris obstruction found at STA 0+34 which created a surcharged condition
 - Significant presence of grease in the 6-inch sewer main and individual sewer service connections
 - Poor condition of the observed sewer service connections which likely allowed large amounts of liquid sewage and waste to continuously accumulate over time in the sewer service connections.

RECOMMENDATIONS FOR IMPROVEMENTS

Based on the events that occurred on June 20th and review of the CCTV inspection video, Weston & Sampson recommends the following course of action and improvements.

- The remaining 6-inch VC sewer in Brazil Street upstream of SMH 2+80 should be CCTV inspected.
- At a minimum, the existing 6-inch VC sewer pipe should be removed and replaced with 8-inch polyvinyl chloride (PVC) sewer pipe in Brazil Street between SMH 0+00 and SMH 2+80. Unified Contracting, Inc. is currently under contract with the City to perform open-cut sewer repairs. If Unified Contracting, Inc. was willing to perform this 280-foot sewer replacement work, the total cost including trench paving and a 15% construction contingency would be approximately \$150,000, based on their current unit prices.
- Depending on the results of the additional recommended CCTV inspection and due to the current size of the existing sewer in Brazil Street, removal and replacement of the existing sewer beyond SMH 2+80 should also be considered.