# CW 2145 - Sewer and Manhole Inspection

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CW 2145 - **SEWER AND MANHOLE INSPECTION**

1. **DESCRIPTION**

1.1 **General**

1.1.1 This specification covers inspection of sewers and manholes using internal video equipment for the purposes of assessing thoroughness of cleaning, observing and recording structural and service defects and construction features and to verify new sewer construction prior to acceptance.

1.2 **Referenced Standard Construction Specifications**

1.2.1 CW 2140 - Sewer and Manhole Cleaning

3. **CONSTRUCTION METHODS**

3.1 **Inspection Unit**

3.1.1 Sewer and manhole inspection units are to consist of a self-contained vehicle with separate areas for viewing and storage complete with the following equipment as a minimum.

1. Cellular telephone and suitable communication system linking all crew members.

2. Fans and blowers capable of removing fog that may be present in sewers at the time of the inspection.

3. Video cameras, lighting, cables and power source.

4. Video monitor, videocassette recorder and digital video recorder.

5. Computer system with video capture card or dedicated unit and other related equipment.

3.2 **Video Inspection Equipment**

3.2.1 Sewer inspection equipment is to consist of the following.

1. Video camera capable of panning 360° and tilting 270° with optimum picture quality provided by focus and iris adjustment. Focal range to be adjustable from 100 millimetres to infinity.

2. Adjustable light source to allow an even distribution of light around the sewer or manhole perimeter without loss of contrast, flare out of picture, or shadowing. Ensure lighting illuminates the sewer or manhole ahead of the camera to be able to determine general condition, features and upcoming defects.

3. Video overlay equipment capable of superimposing a minimum of 15 lines with up to 30 characters per line of alphanumeric information onto the video recording.

4. Equipment shall be capable of continuously capturing digital video from first generation recordings with no frame loss, regardless of the progression of the inspection.

5. Equipment shall be used to acquire continuous digital video images of the sewer for the entire length being inspected.
Manhole inspections are to be performed using digital panoramic inspection system such as the IBAK PANORAMO SI or equivalent meeting the following criteria:

.1 The inspection camera system must be 100% digital. Any analog or NTSC video camera will be deemed unacceptable.

.2 The inspection camera system must have two independently or simultaneously controlled digital cameras, one facing in the downward direction and one facing in the upward direction. Each camera must have a minimum of 185 degree field of view.

.3 The inspection camera system must provide sufficient illumination of the interior of the manhole to obtain proper exposure without introducing any motion blur. The light shall be positioned to distribute the light evenly onto the structure walls. The lighting must be able to illuminate manholes without the need of any auxiliary lighting.

.4 The inspection system shall produce individual images or frames with no more than 0.001 inches (0.025mm) of movement during image or frame exposure to produce crisp, clear images.

.5 The inspection camera must provide a minimum of 3000 line of vertical resolution in the side view and a minimum of 500 lines in the perspective view.

.6 Contractor is responsible for reviewing collected data, coding observations, however the City must have the ability to view the digital film file in the way that the contractor can view them, including full control of the virtual pan and tilt.

.7 The digital film files must include an unfolded view of the manhole with a minimum of 3000 lines of vertical resolution.

.8 The inspection system must descend to the lowest point within the manhole chamber to a depth that will facilitate accurate perpendicular weir wall measurements' using the software’s measuring tools to occur.

.9 The digital film files must include the capability to produce a three dimensional representation of the manhole structure. This data shall be used to perform geometric measurements. This file shall be exportable to common CAD programs for further analysis.

.10 The digital file files must include a distortion-free virtual pan and tilt allowing the review of the manhole structure from any angle from any depth. The virtual pan and tilt must be able to view 360 degrees in any direction. The virtual pan and tilt must consist of views from the top and bottom camera, any virtual pan and tilts that artificially create this view from a single camera will be deemed unacceptable due to distorted images on the direct side view.

.11 The virtual pan and tilt and unfolded views must be able to be viewable by the City with all the required software included.

.12 All chambers that exhibit weir wall or spill pipe weir levels as observed within the field or identified, but not limited to control structures or manholes identified by the Contract Administrator, must be measured from manhole rim to weir crest where possible and detailed within the Inspection Comments field. Chambers exhibiting weir walls with no coded depth observations shall be rejected.

3.3 Video Camera Transport Equipment

.1 Video camera transport equipment to consist of the following.
.1 Self-propelled rubber tired or crawler tractor capable of passing over minor surface imperfections including but not limited to broken joints and solid debris up to 40 millimetres in height.

.2 Mount camera to float or skid and tow through sewers where the condition of the sewer prevents the use of a tractor. Obtain the Contract Administrator’s approval before using a float or skid. Position the towing equipment to not impede the view of the sewer from the camera and ensure the float or skid is stable to provide a smooth progression and steady video recording.

.3 Transport and cable capable of inspecting a minimum of 200 metres of sewer from a single access point and the complete inspection of the sewer from the start manhole to the finish manhole.

.4 Transport equipment must be capable of allowing for adjustable camera height.

.5 A device for manhole inspections that will securely orient the camera with the 12:00 video position facing north and capable of moving the camera through the entire vertical length of the manhole.

3.4 Operator Qualifications for Inspection and Condition Coding

.1 Ensure each operator is fully trained in all aspects of sewer and manhole inspections and capable of making accurate observations and recording all conditions that may be encountered in the sewers and manholes.

.2 Perform condition coding using operators who can demonstrate proficiency coding in accordance with the requirements of the WRC “Manual of Sewer Condition Classification 3rd Edition”.

3.5 Sewer Condition Coding

.1 Perform sewer condition coding in accordance with the requirements of the WRC Manual of Sewer Condition Classification 3rd Edition.

.2 Record place names in accordance with Clause 3.9.4 of this specification.

3.6 Manhole Condition Coding

.1 Perform manhole condition coding in general accordance with Section 3.4 of this specification and with the following additional requirements. Record place names in accordance with Clause 3.9.4 of this specification.

.1 Header Description:

Manhole Street: e.g. BERRY ST @ WELLINGTON AA
Location Description: e.g. INTERSECTION
Manhole Asset Number: e.g. S-MH000001
Measured Distance: e.g. 3.6 m
12:00 Reference Position: e.g. N
Measured Riser Diameter: e.g. 750mm

.2 Defect Coding - at inspection rod readings in accordance with WRC condition code standards.

.3 Construction Features - note in comments at rod readings where they occur:
.4 Frame and Cover

- Location code e.g. A
- Grade elevation e.g. FCB, 100
- Condition e.g. B

.5 Risers

- Material e.g. CO
- Condition e.g. CL, CL, SSM

.6 Reducer and Base

- Material e.g. CO
- Condition e.g. NOD

.7 Benching

- Material e.g. CO
- Condition e.g. DES, IR

.8 Steps

- Material e.g. HS
- Condition e.g. B

.9 Atmosphere

- e.g. LEL

.2 In addition to the WRc condition code standards the following codes will be applicable to manhole inspections.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Code</th>
<th>Applicable To</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAILS CARBON MONOXIDE TEST</td>
<td>COF</td>
<td>ATMOSPHERE</td>
</tr>
<tr>
<td>PASSES CARBON MONOXIDE TEST</td>
<td>COP</td>
<td>ATMOSPHERE</td>
</tr>
<tr>
<td>FAILS EXPLOSIVE TEST</td>
<td>LELF</td>
<td>ATMOSPHERE</td>
</tr>
<tr>
<td>PASSES EXPLOSIVE TEST</td>
<td>LELP</td>
<td>ATMOSPHERE</td>
</tr>
<tr>
<td>FAILS OXYGEN TEST</td>
<td>OF</td>
<td>ATMOSPHERE</td>
</tr>
<tr>
<td>PASSES OXYGEN TEST</td>
<td>OP</td>
<td>ATMOSPHERE</td>
</tr>
<tr>
<td>COVER CRACKED</td>
<td>COC</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>COVER SURFACE SPALLING/CORROSION</td>
<td>COSS</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>FRAME CRACKED</td>
<td>FRC</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>FRAME CRACKED MULTIPLE</td>
<td>FRCM</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>FRAME DISPLACED LARGE (&gt;50MM)</td>
<td>FRDL</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>FRAME DISPLACED MEDIUM (0-50MM)</td>
<td>FRDM</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>FRAME SURFACE SPALLING/CORROSION</td>
<td>FRSS</td>
<td>FRAME/COVER</td>
</tr>
<tr>
<td>NO OBSERVED DEFECT</td>
<td>NOD</td>
<td>ALL</td>
</tr>
<tr>
<td>STEPS APPEAR SAFE</td>
<td>SAS</td>
<td>STEPS</td>
</tr>
<tr>
<td>STEPS APPEAR UNSAFE</td>
<td>SAU</td>
<td>STEPS</td>
</tr>
<tr>
<td>STEPS MISSING</td>
<td>SM</td>
<td>STEPS</td>
</tr>
<tr>
<td>HORSESHOE STEPS</td>
<td>HS</td>
<td>STEPS</td>
</tr>
<tr>
<td>ALUMINUM STEPS</td>
<td>AS</td>
<td>STEPS</td>
</tr>
<tr>
<td>STEEL STEPS</td>
<td>SS</td>
<td>STEPS</td>
</tr>
</tbody>
</table>

3.7 Coding Accuracy

.1 Coding accuracy will be a function of the number of defects or construction features not recorded or omitted and the correctness of the coding and classification recorded. Coding accuracy is to satisfy the following requirements:

.1 Header accuracy - 95%.
.2 Detail accuracy - 85%.

.2 Implement a formal coding accuracy verification system before starting the Work.
.3 Verify coding accuracy on a random basis on a minimum of 10% of the inspection reports. Submit coding accuracy checks with the corresponding video recording.

.4 Perform a minimum of two accuracy verifications for each operator for each week working and submit the results to the Contract Administrator for review. Operators failing to meet the accuracy requirements on two occasions will not be permitted to code on the remainder of the Contract until they can demonstrate to the Contract Administrator that they can code in accordance with the requirements of the WRc Manual of Sewer Condition Classification 3rd Edition.

.5 Re-code inspections not satisfying the accuracy requirements and verify the accuracy of the inspection immediately proceeding and following the non-compliant inspection. Repeat the process until the proceeding and subsequent inspections meet the accuracy requirements.

### 3.8 Recording Resolution

.1 Provide a minimum of 400 lines of resolution around the periphery of the picture for digital MPEG video playback.

.2 Confirm recording resolution if requested by the Contract Administrator by recording a RETMA type resolution chart as follows.

.1 Set up camera and accessories for the recording to simulate an actual inspection i.e. video signal routed through the cable reel, video overlay system, etc.

.2 Record camera being introduced and reaching its final position for the test.

.3 Resolution chart is to fill the monitor screen;

.4 Resolution chart is to be illuminated evenly and uniformly without reflection and illumination source is to accurately simulate the lighting used in the sewer inspections.

.5 Record test for a minimum of 30 seconds.

.6 Identify the camera on the recording;

.7 Perform the test at the start of a tape or digital recording.

### 3.9 Screen Information on Video Recordings

.1 Clearly display in legible letters for 30 seconds on the monitor and video recording at the start of each inspection a video overlay system containing the following alpha-numeric information. Enter this information before beginning the inspection.

| line 1: | Contract ID | e.g. | CITY OF WINNIPEG, 709-2002 |
| line 2: | Street Name | e.g. | NASSAU ST N |
| line 3: | Start MH to Finish MH Names | e.g. | MH AT WELLINGTON AV to 1st MH S OF WELLINGTON AV |
| line 4: | Sewer Size (diameter or HxW) | e.g. | 450 mm |
| line 5: | Sewer Asset Number | e.g. | S-MA0000001 |
| line 6: | Start MH Asset Number | e.g. | S-MA0000001 |
| line 7: | Finish MH Asset Number | e.g. | S-MA0000002 |
| line 8: | Contractor Name | e.g. | XYZ LTD |
| line 9: | Date and Time of Inspection | e.g. | 08/17/2000-14:15 |
| line 10: | Direction of Inspection | e.g. | WITH FLOW |
line 11: Start MH to Finish MH  
Steel Tape Measured Distance e.g. 127.39 m

line 12: Cable Calibration Distance e.g. 1.5 m

.2 Clearly display in legible letters on the periphery of the monitor and video recording the following information during the inspection. Arrange the information to minimize interference with the inspection image:

bottom centre: automatic update of the camera’s distance from the centre of the start manhole e.g. 15.3 m

top centre: Street Name & Sewer Asset e.g. BERRY ST(S-MA0000001)
top left: Start MH Asset e.g. S-MH0000001
top right: Finish MH Asset e.g. S-MH0000002

.3 Use the following naming convention when entering street and place names in sewer and manhole inspection records.

<table>
<thead>
<tr>
<th>Term</th>
<th>Naming Convention</th>
<th>Term</th>
<th>Naming Convention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street</td>
<td>ST</td>
<td>First</td>
<td>1ST</td>
</tr>
<tr>
<td>Avenue</td>
<td>AV</td>
<td>Second</td>
<td>2ND</td>
</tr>
<tr>
<td>Boulevard</td>
<td>BV</td>
<td>Third</td>
<td>3RD</td>
</tr>
<tr>
<td>Road</td>
<td>RD</td>
<td>Fourth</td>
<td>4TH</td>
</tr>
<tr>
<td>Bay</td>
<td>BY</td>
<td>Fifth</td>
<td>5TH</td>
</tr>
<tr>
<td>Crescent</td>
<td>CR</td>
<td>Sixth</td>
<td>6TH</td>
</tr>
<tr>
<td>Lane</td>
<td>LN</td>
<td>North of</td>
<td>N OF</td>
</tr>
<tr>
<td>Drive</td>
<td>DR</td>
<td>South of</td>
<td>S OF</td>
</tr>
<tr>
<td>Place</td>
<td>PL</td>
<td>East of</td>
<td>E OF</td>
</tr>
<tr>
<td>Way</td>
<td>WY</td>
<td>West of</td>
<td>W OF</td>
</tr>
<tr>
<td>Cove</td>
<td>CV</td>
<td>North Property Line NPL</td>
<td></td>
</tr>
<tr>
<td>Highway</td>
<td>HW</td>
<td>South Property Line SPL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>East Property Line EPL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>West Property Line WPL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Centre Line CL</td>
<td></td>
</tr>
</tbody>
</table>

.4 Use uppercase lettering for all street/place naming and location descriptions. Reference street locations relative to the direction of flow where possible. Reference sewer location using street name and start/end manhole locations as follows:

.1 Street/Place

Enter the street name, followed by a Naming Convention, if required, in brackets noting its location within the right of way, e.g. OAK ST (N OF CL).

.2 Location/Description

Enter location of start manhole relative to closest upstream Cross Street, followed by “TO”, followed by location of end manhole relative to closest upstream Cross Street, e.g. 3RD MH N OF CORYDON AV TO 4TH MH N OF CORYDON AV.

3.10 **Analog Format Video Recordings**

.1 Analog format video recordings on VHS tape will not be acceptable.

3.11 **Digital Format Video Recordings**
.1 Capture the inspections in digital format in colour from the live video source on archival grade digital versatile discs, DVD-R format to the following minimum requirements. Adjust requirements as required to achieve 400 lines of resolution specified in clause 3.8 of this Specification.

- 1 XDVD MPEG-2 or MPEG-4 format (MPEG-4 preferred).
- 2 Picture Size: NTSC 720 x 480 @ 29.97 frames per second.
- 3 Data/Bit Rate: 6.0 M-bits/sec.

.2 Obtain digital video inspections from first generation recordings using video capture equipment capable of capture with no frame loss.

.3 Digital video inspections can to be saved to a hard-drive and later transferred to recordable digital versatile disc, DVD-R media for submission.

.4 Submit one complete single digital file for each inspection. Produce the final file in one of the following ways.

- 1 Capture the original recording continuously using a computer system and video capture card regardless of the progress of the inspection. Edit the original raw digital file before submission to remove the pauses where inspection progress is not continuous. or

- 2 Capture the original recording intermittently using a computer system and video capture card. Edit the original raw digital file before submission to form one continuous file. or

- 3 Capture original recording with specialized video recording equipment capable of pausing and resuming live recording to produce a single file for submission.

- 4 Edit digital videos using non-linear video editing software. Do not recompress edited digital files.

.5 For manholes, provide file names within the 360Player.exe software in alpha numeric order. For sewers, provide file names containing up to a maximum of 64 characters for each digital video file in accordance with the following.

- 1 TenderNo_E<entity no>_F<from entity no>_T<to entity no>_StreetName_M<measured len>_I<inspected len>_DS or US<inspection dir>_L<Letter designating inspection sequence>.MPG

  Eg. 910-2000_S-MA0000001_FS-MH0000001_TS-MH0000002_BERRY_M100.0_I39.2_US_B.MPG (indicates that this is the second or “B” partial inspection of this entity, 39.2 m long)

.6 Submit digital files of the original video inspections to the Contract Administrator on recordable digital versatile discs, DVD-R format in 5.2 millimetre slim-line clear “jewel cases” capable of displaying a summary sheet containing the information listed in Section 3.14 of this specification.

.7 Ensure the entire inspection of a particular sewer or manhole is contained on the same DVD-R disc. Record reverse set-up inspections of a sewer immediately after the original inspection where possible.

### 3.12 Sample Inspection Report

.1 Submit a sample inspection report, digital MPEG DVD-R video recording and corresponding magnetic data file of an actual sewer and manhole inspection performed by each camera that will be used to the Contract Administrator for review at least 2 weeks before beginning the
inspection work.

.2 Clearly identify the camera make, model and serial number on each video. Demonstrate the resolution of each camera using the recording resolution in Section 3.8 of this specification.

.3 Use the report submission accepted by the Contract Administrator as a benchmark for subsequent inspection report submissions.

.4 No inspection work is to be performed until the sample inspection report has been accepted by the Contract Administrator.

3.13 Sewer and Manhole Inspection Reports

.1 Provide on a weekly basis for the previous week’s work sewer and manhole inspection reports in digital format on a CD-R.

.2 Provide the digital inspection reports in a format that will allow direct uploading into to the City’s Sewer Management System (SMS). The Contract Administrator will provide a data entry utility (SMS Contractor Module) at no cost if required.

.3 The Contractor shall maintain backup copies of all digital video and inspection data submissions for the duration of the Warranty Period as stated in C13 or as directed by the Contract Administrator.

3.14 Video Inspection Labelling

.1 Label inspection reports, diskettes and DVD discs with the following information.

- Contract Name: e.g. The City of Winnipeg, Bid Opportunity No. 910-2000
- Sewer Asset Number(s): e.g. Sewer Asset Numbers – S-MA0000001, etc.
- Submission ID: e.g. Sewers Inspected Week of 08/24/2000 - 1 of 5

.2 Label DVD-R discs with a marker or using other acceptable means certified by the manufacturer as being compatible with the DVD-R disc material. Do not apply stick-on labels to DVD-R discs.

.3 Provide a typed summary sheet in DVD-R disc cases containing the following information.

<table>
<thead>
<tr>
<th>Entity Asset</th>
<th>From MH</th>
<th>To MH</th>
<th>Street Name</th>
<th>Inspection Direction</th>
<th>Measured Length</th>
<th>Inspection Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-MA0000001</td>
<td>S-MH0000001</td>
<td>S-MH0000002</td>
<td>BERRY ST</td>
<td>U/S</td>
<td>100.0 m</td>
<td>39.2 m</td>
</tr>
</tbody>
</table>

3.15 Camera Position and Speed

.1 Position the centre of the camera lens in the vertical centre of circular and egg shaped sewers and manhole risers or as directed by the Contract Administrator.

.2 Ensure camera speed does not exceed 9 metres/minute during sewer and manhole inspections.

3.16 Sewer and Manhole Measurements

.1 Measure the distance between the centre of the start and finish manholes on the ground surface above the sewer to the nearest 0.01 of a metre using a steel tape or other approved methods before beginning the sewer inspection. The centre of the manhole will be based on the centre of the manhole cover regardless of the manhole configuration.

.2 Measure the vertical distance from the sewer invert to the manhole frame to the nearest 0.01 of
a metre with a steel tape before beginning the sewer or manhole inspection.

.3 Provide a remote reading counter to measure the distance to the nearest 0.10 metre the video camera has travelled within the sewer from the centre of the start manhole during the sewer inspection.

.4 Distance measurement within the sewer to be accurate to within 0.5% of the above ground steel tape measurement between start and finish manhole centres.

3.17 **Sewer and Manhole Inspections**

.1 Notify the Contract Administrator of the locations where sewer and manhole inspections will be performed one full day before starting inspection work at that location.

.2 Perform sewer and manhole inspections after cleaning (where applicable) is completed and sample inspection report has been accepted unless directed otherwise by the Contract Administrator.

.3 Use the flusher continuously during inspection and implement flow control measures in accordance with Section 3.13 of CW 2140 where required to ensure the following.

   .1 The entire cross section of the sewer is visible and no debris is present during the sewer inspection.

   .2 The manhole invert is completely visible and no debris is present during the manhole inspection.

.4 Evacuate fog from the sewer and manhole before beginning inspections and keep the sewer and manhole clear of fog during the entire inspection.

.5 Keep the camera lens clean during the entire sewer and manhole inspection.

.6 Ensure the picture is in focus and there is adequate, even lighting free of shadows and glare ahead of the sewer pipe or manhole riser at all times to be able to determine general condition, features and upcoming defects. Provide better lighting as directed by the Contract Administrator.

.7 Perform sewer inspections in accordance with the following.

   .1 With the direction of flow unless a reverse set up is required.

   .2 From the centre of the start manhole to the centre of the finish manhole.

   .3 Begin inspections generally with the upstream sewer in the system and proceed downstream in a consecutive manner.

   .4 Schedule inspection of downstream sewers to be done after the contributing upstream sewers have been cleaned.

   .5 Ensure the face of the start manhole is clearly visible at the start of the sewer inspection.

   .6 Record the distance from the center of the manhole to the cable calibration location at the start of the inspection and adjust the distance reading so that zero is at the center of the start manhole. This distance is known as the cable calibration distance. The cable calibration location is the intersection point between the camera’s widest horizontal viewing angle and the pipe’s side periphery (03 and 09 o’clock) when the camera is level and looking forward.
All defects are to be circumferentially located based on the side periphery only.

.7 Indicate on the monitor screen accurate automatic distance measurement that begins to move immediately as the camera moves. Ensure measurement is accurate from the cable calibration point to the centre of the finish manhole.

.8 Stop the camera and position to provide a steady 2 second perpendicular view of connections, junctions, major branches and major defects including deformed sewers, displaced bricks, holes, large displaced joints, missing bricks, missing mortar, obstructions, and large open joints.

.8 Perform manhole inspections in accordance with the following.

.1 From the top to the bottom of the manhole.

.2 From the manhole frame to the center line elevation of the exiting sewer.

.3 Ensure the frame of the manhole is clearly visible at the start of the inspection.

.4 Block ambient light during the inspection to minimize problems related to lens flare and poor contrast.

.5 Inspect the manhole to the lowest depth that will facilitate accurate perpendicular measurements using the software’s measuring tools.

.9 Re-perform sewer and manhole inspections where the Contract Administrator has determined the tolerance requirements for camera position and speed and internal distance measurement requirements in Section 3.15 and 3.16 of this specification have not been satisfied.

3.18 Reverse Set-Up Inspection

.1 Perform a reverse set-up inspection when a blockage in the sewer prevents completion of the inspection from the upstream manhole. Move the equipment to the downstream manhole and attempt to complete the inspection of the entire sewer to the upstream manhole.

3.19 Incomplete Inspections

.1 Immediately advise the Contract Administrator when a complete sewer or manhole inspection cannot be completed due to collapse, excessive deformation, intruding connections, obstructions or large displaced joints. Jointly decide with the Contract Administrator one of the following alternatives.

.1 Abandon the inspection. or

.2 Re-perform the inspection subsequent to one of the following actions.

.1 Performing solid debris cutting.

.2 Removing intruding connections.

.3 Modifying the camera setup position or method of transport.

.4 Completion of external or emergency repairs.

.2 Note in a log the sewer or manhole ID number, steel tape measurement, upstream and downstream length or manhole length inspected, length of missing video and the reason the
inspection could not be completed and review with the Contract Administrator on a weekly basis.

3.20 Acceptance of Inspections

.1 The Contract Administrator will review inspection reports, video recordings, and magnetic data files to ensure compliance with the specifications within 10 working days of submission based on an inspection rate of 1,000m per day, unless otherwise indicated by the Contract Administrator. The review period will be proportionately extended for inspection rates greater than 1,000m per day. The Contract Administrator may adjust the frequency of reviews based on the results of previous reviews.

.2 Re-perform sewer and manhole inspections where the Contract Administrator has determined the requirements of the specification have not been satisfied.

.3 Correct non-compliant inspection submissions and resubmit the corrected inspections to the Contract Administrator within 5 working days.

.4 Repeat the process until the inspection submissions are accepted by the Contract Administrator.

3.21 Removal of Equipment that becomes stuck in a Sewer

.1 Advise the Contract Administrator immediately if equipment becomes stuck in a sewer. Attempt to remove equipment that is stuck using whatever means are necessary for at least 4 hours. Advise the Contract Administrator if the equipment cannot be freed after 4 hours and mark the position on the surface over the sewer where the equipment is stuck.

.2 The Contract Administrator will arrange to have an excavation made to the top of the sewer where the equipment is stuck within 48 hours of notification the equipment cannot be freed.

.3 Be present during the excavation and once the top of the sewer is exposed and the excavation is secured, do one of the following.

   .1 Remove the top of the sewer pipe and retrieve the equipment stuck in the sewer or;

   .2 Defer removal of the top of the sewer and retrieval of the stuck equipment to the excavation contractor. Damages caused to the stuck equipment will not be the responsibility of the excavation contractor. No claim for equipment damages will be made against the excavation contractor.

.4 The Contract Administrator will arrange to have the sewer repaired after removal of the equipment that was stuck.

.5 Clean and remove backfill and debris that may have entered the sewer during removal of the equipment and subsequent repair of the sewer.

3.22 Observed Failures During Sewer and Manhole Inspections

.1 Capture photograph or digital images and notify the Contract Administrator immediately where a flow disparity, clear water infiltration, hole or missing bricks, collapse, void or deformation > 10% is observed during the sewer or manhole inspection. Provide the captured images to the Contract Administrator at the end of each work day.

.2 Place barricades around the location above the sewer or manhole where a void is visible or suspected to be outside of the sewer pipe or manhole and immediately notify the Contract Administrator. Notify the City of Winnipeg, Emergency Services at 986-2626 after normal working hours if the Contract Administrator cannot be reached.
.3 The Contract Administrator will arrange for emergency sewer or manhole repairs to be performed if required as soon as possible if the inspection cannot be completed or the sewer or manhole condition poses an immediate operational or safety concern such as a complete collapse.

.4 Emergency sewer or manhole repairs will be prioritized if more than one emergency repair arises at the same time.

.5 Carry out inspection of other sewers not affected by the emergency repair and complete inspection of the sewer when notified by the Contract Administrator the emergency repair has been completed.

.6 Repeat cleaning of the sewer in accordance with CW 2140 if required to remove backfill and debris that may have entered the sewer during emergency repairs.

4. MEASUREMENT AND PAYMENT

4.1 Inspection Coding

.1 Inspection coding will be included with sewer and manhole inspection.

4.2 Inspection Reports

.1 Sample inspection reports and inspection reports will be included with sewer and manhole inspections.

.2 Correction and re-submission of non-compliant submissions will be at own expense.

4.3 Video Recordings

.1 Digital video recordings will be included with sewer and manhole inspection.

4.4 Sewer Inspections

.1 Sewer inspections will be measured on a length basis for each size and type of sewer and paid for at the Contract Unit Price for “Sewer Inspection”. Length to be paid for will be the total length of sewer inspected in accordance with this specification, accepted and measured by the Contract Administrator.

.2 Measurement will be made horizontally at grade above the center line of the sewer from centre to centre of manholes or from centre of the start manhole to the point of abandoned inspection as confirmed by the steel tape measurement.

.3 The diameter of non-circular sewers will be taken as the largest dimension.

.4 Payment will not be made until the required report submissions are accepted by the Contract Administrator.

.5 Payment will not be made for inspections re-performed where the Contract Administrator has determined the requirements of the specification have not been satisfied.

4.5 Manhole Inspections

.1 Manhole inspection will be measured on a unit basis and paid for at the Contract Unit Price for “Manhole Inspection”. Number of units to be paid for will be the total number of manholes
inspected in accordance with this specification, accepted and measured by the Contract Administrator.

.2 Payment will not be made until the required report submissions are accepted by the Contract Administrator.

.3 Payment will not be made for inspections re-performed where the Contract Administrator has determined the requirements of the specification have not been satisfied.

4.6 **Reverse Set Up - Inspection**

.1 Reverse set-up inspection will be measured on a unit basis and paid for at the Contract Unit Price for "Reverse Set-Up Inspection". Number of units to be paid for will be the total number of reverse set-up inspections performed in accordance with this specification, accepted and measured by the Contract Administrator.

4.7 **Removal of Equipment That Becomes Stuck in a Sewer**

.1 The City will pay costs for excavating down to the top of the sewer pipe, repairing the sewer after inspection equipment is removed, backfilling the excavation and restoring the surface.

.2 Removal of the top of the sewer pipe and the inspection equipment that was stuck in the sewer will be at own expense.

.3 Cleaning and removing backfill and debris that may have entered the sewer during removal of the equipment and repair of the sewer will be measured and paid for in accordance with Clause 4.1.3 of CW 2140.

.4 No payment or extra time will be given for equipment downtime and attempted equipment retrieval.

4.8 **Flow Control**

.1 Flow control will be included with sewer inspection.