This is a supplement to the *Standard Specification for Municipal Services* specific to the requirements of HRWC.

PART 1 GENERAL

1.1 Work Included

.1 This SECTION refers to those portion of the work that are unique to the requirements for inspecting new and existing Wastewater, Stormwater and Combined Systems by closed circuit television (CCTV). This includes mains, service connections, manholes and culverts, which are all wholly referred to in this section as *pipe*. This SECTION must be referenced to and interpreted simultaneously with all other SECTIONS pertinent to the works described herein.

1.2 Related Sections

.1	Wastewater Mains	SECTION 33 31 00.
.2	Force Mains	SECTION 33 34 00.
.3	Manholes, Catch Basins and Structures	SECTION 33 39 00.
.4	Stormwater Mains & Culverts	SECTION 33 40 00.

1.3 Reference Standards

.1	NASSCO	Pipeline Assessment and Certification Program

1.4 Submission of Certification

.1 Submit to HRWC, at least one week prior to the start of the CCTV inspection operations, a copy of the CCTV operator's current certifications relevant to the work to be done:

.1 NASSCO Lateral Assessment Certification Program (LACP) certificate.

.2 NASSCO Manhole Assessment Certification Program (MACP) certificate.

.3 NASSCO Pipeline Assessment Certification Program (PACP) certificate.

1.5 Work Regulations

.1 Work to conform to all applicable legislation, including the Occupational Health and Safety Act of Nova Scotia. Confirm training compliance in the following:

.1 Confined space rescue.

.2 Confined space entry.

.3 Ventilation.

.4 Atmospheric monitoring.

.5 Self-contained breathing apparatus.

.6 Personal protective equipment.

.2 Provide written confirmation to the HRWC that workers have knowledge of confined space entry practices and equipment required for confined space entry.

1.6 Scheduling of Work

.1 Contractors are to coordinate with HRWC to minimize service interruption to affected HRWC customers. This would include scheduling work in off peak hours.

.2 Maintain existing flow during inspection survey unless flow reduction measures required per 3.7 of this SECTION.

.3 Refer to HRM Traffic Control Manual Supplement.

PART 2 PRODUCTS

2.1 Equipment

.1 Provide a survey vehicle capable of:

.1 Viewing and control are to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation to be provided to enable one person in addition to the operator to clearly view the monitor screen.

.2 All equipment utilized within the pipe to be stored outside the viewing, recording and control area.

.3 Electrical power for the CCTV system to be self-contained. External power sources from public or private sources not permitted.

.2 Provide survey equipment, with cables, capable of:

.1 Survey unit to be a self-propelled rubber tired or crawler type with a means of transporting the CCTV camera in a stable condition through the pipe. Survey unit to be capable of passing over minor surface imperfections including but not limited to broken joints and debris up to 100 mm in height.

.2 Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from the pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipe are to be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment. Survey unit to be capable of inspecting 200 metres from a single access point.

.3 Where conditions do not suit tractor deployment, provide a float or skid for mounting camera equipment and towing through the pipe. Situations requiring float or skid mounted inspections to be approved by HRWC in advance. Positioning shall not impede view of camera and stability must be achieved to ensure steady video recording.

.4 Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipe condition and header reference information.

.3 Provide a pipe camera capable of:

.1 Self-contained, self-leveling, pan and tilt waterproof camera, capable of panning the pipe at 360° with tilt capability of 270°. Able to operating in corrosive environment, with a lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipe perimeter without the loss of contrast of flare out or picture shadowing.

.2 Live picture to be visible with no interference and capable of registering a minimum number of 420 lines of resolution at the periphery.

.3 Provide remote focus and iris adjustment capabilities to allow optimum picture quality. The focus and iris adjustment will provide a focal range from 150 mm in front of the camera's lens to infinity. The distance along the pipe in focus from the initial point of observation to a minimum of twice the vertical height of the pipe.

.4 Provide camera capable of inspecting Service Connections 100mm to 200mm diameter and cameras capable of inspecting pipes 150 mm to 1200 mm diameter.

.5 Provide a backup camera, in good working condition, at the inspection site.

.6 Hemispherical head or fisheye lens type camera are not permitted.

.4 Provide a access point (manhole/catch basins etc.) camera capable of:

.1 Self-contained, self-leveling, pan and tilt waterproof camera, capable of panning the 360° pipe-manhole junction (pipe circumference) for pipes from 200 mm to 3000 mm, without raising or lowering the boom. Able to operating in corrosive environment, with a lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipe perimeter without the loss of contrast of flare out or picture shadowing.

.2 Live picture to be visible with no interference and capable of registering a minimum number of 420 lines of resolution at the periphery.

.3 Provide remote focus and iris adjustment capabilities to allow optimum picture quality. The focus and iris adjustment will provide a focal range from 150 mm in front of the camera's lens to infinity. The distance along the pipe in focus from the initial point of observation to a minimum of twice the vertical height of the pipe.

.4 Capability of inspecting manholes and structures of minimum 600 mm diameter.

.5 Telescopic boom must be capable of lowering the camera to a depth of at least 10 metres inside the manhole.

.6 The camera will be lowered down the manhole at a rate not exceeding 3 metres / minute. The camera will inspect the entire 360 degrees of manhole surface. For each structural and service anomaly detected, the operator will precisely focus on the defect and record a steady image for a period of 5 to 10 seconds.

.7 The camera shall be positioned below the chimney of the manhole and focused to provide a wide angle view of the entire manhole depth. The camera will be rotated through 360 degrees at a rate not exceeding 3 degrees per second.

.8 An optic telephoto lens capable of managing pixelization so that magnification does not degrade the farthest image.

.9 Detachable from the mobile unit for inspection of difficult locations using a tripod.

.10 Hemispherical head or fisheye lens type camera are not permitted.

.5 Digital video playback to be MPEG-4 standard.

PART 3 EXECUTION

3.1 Site Coding Sheets

.1 Each pipeline length to be recorded according to the NASSCO. Any variation from the manual to be noted in the survey report.

.2 Standard coding according to latest version of NASSCO methods (PACP, MACP Level 1, LACP):

3.2 Recording Resolution

.1 Minimum recorded video resolution shall be 420 lines with a National Television Standards Committee (NTSC) size of 720 x 480 at 29.97 frames per second.

.2 Record all digital videos at MPEG-4 standard.

.3 At the beginning of each file, perform a recoding resolution test with use of a Marconi or RETMA resolution chart.

3.3 Digital Images

.1 Overlay on digital images the following data in alpha-numeric form such that it will not interfere with the defect condition reported:

.1 Report/job number

.2 Metre reading position (all dimensions and chainages to be metric)

.3 Manhole / pipe length reference number (from – to)

.4 Digital image number

.5 PACP, MACP Level 1, LACP condition, defect, and observation code

.6 Date of survey (yyyy.mm.dd)

.2 Capture digital image and alpha-numeric data as a digital image in a JPEG file format with report reference number.

.3 Coordinate digital images with the written report by reference number.

3.4 Camera Position

.1 Position camera lens centrally in the pipe with a positioning tolerance of 10% off the vertical centerline axis of the pipe. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measure from the invert.

.2 Position camera lens looking along the longitudinal axis of pipe except when viewing service connections or panning defects.

.3 Where the camera moves from one pipe diameter size to another pipe diameter size, ensure the camera position is reset so it is in the centre of the pipe.

3.5 Camera Travel Speed

.1 Travelling speed of the camera in the pipe to be as follows:

.1 0.1 m/s for pipe of diameter less than 200 mm.

.2 0.15 m/s for diameters 200 mm a larger, not exceeding 310mm.

.3 0.2 m/s for diameters exceeding 310 mm.

3.6 Flushing & Cleaning

.1 Flush and clean pipes immediately prior to CCTV inspection survey unless otherwise specified.

3.7 Flow Reduction

.1 Reduce flow in pipe to approximately 1/3 pipe diameter to allow CCTV inspection by combination of the following.

.2 Schedule work for off peak flow times.

.3 Plug or block flow at upstream manhole.

.1 Plug designed to either block all flow or impede flow to the approximate 1/3 pipe diameter.

.2 Obtain the HRWC's approval prior to plugging or impeding any flow.

.3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipe.

.4 Temporary bypass pump flow around inspection section when required, as specified in contact documents. Plug to be flow through with hoses and pipe of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain the HRWC's approval prior to setting up temporary bypass pump system.

3.8 CCTV Inspection

.1 CCTV operator to be NASSCO certified.

.2 Prior to commencement of the inspection surveys, submit sample of inspection report, digital video to HRWC for review. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent report submissions.

.3 Flow in the pipe not to exceed approximately 1/3 of the pipe diameter. Notify the HRWC of excessive flows, video using flow reduction method per 3.7 of the SECTION.

.4 Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.

.5 Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.

.6 Inspection procedure – Mains:

.1 Set zero chainage at face of every manhole or on entrance into pipe or start of pipe culvert.

.2 At the start of each inspection, record the mandatory information outlined in the NASSCO method (PACP, MACP Level 1, LACP) and the following additional information – pipe inspections:

.1 Manhole (from-to) / pipe length reference numbers/asset ID.

.2 Pipe dimensions.

.3 Pipe material.

.4 Type or used of pipe.

.5 Date of survey (yyyy.mm.dd)

.6 Road name / location.

.7 Direction of travel of survey equipment (upstream or downstream)

.8 Inspection (report) number.

.9 Weather conditions.

.3 Data generator to continuously electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following information during each run:

.1 Automatic update of the camera's metre position from adjusted zero.

.2 Manhole/pipe length reference numbers.

.3 Type of use of pipe.

.4 The unique inspection /report number of the run.

.5 Display digital information such that it will not interfere with the video image on the screen.

.4 Arrange the information to minimize interference with the inspection image (defect code and description should appear on the screen while 'coding' for at least five (5) seconds).

.5 Illuminate approximately two (2) metres ahead of the camera to minimize reflective glare. Adjust and distribute lighting according to the size of the pipe to provide a clear picture of the entire periphery of the pipe without loss of contrast.

.6 Perform pipe inspection one (1) pipeline section at a time from manhole to manhole by moving the camera through pipeline preferably in direction of flow along the axis of the pipe and record general construction, structural condition, and evidence of inflow, infiltration or surcharging together with the location of the defect.

.7 Pan each service connection at 90° such that the camera looks down the centerline of the service connection, pause for a minimum five (5) seconds and note condition of the joint and pipe with maximum one (1) metre tolerance measured from centerline of reference manhole.

.8 Pan each feature, defect, and joint, pause for a minimum five (5) seconds and note condition of the joint and pipe with maximum one (1) metre tolerance measured from centerline of reference manhole.

.9 Provide reverse set up of the equipment if during the initial inspection, the camera equipment cannot pass through the entire segment due to an obstruction; if second set up results in an obstruction, the inspection shall be considered incomplete and shall be marked "survey abandoned".

.10 Immediately notify HRWC of any blockage or obstruction that will not allow the passage of survey equipment.

.11 Prior to restarting survey await instructions from the HRWC on removal of obstruction. Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by the HRWC.

.7 Inspection procedure – Access Points (manhole/catch basins etc.)

.1 At the start of each inspection, record the mandatory information outlined in the NASSCO method (MACP Level 1) and the following additional information – manhole inspections:

.1 Manhole ID.

.2 Potential for runoff.

.3 Wall diameter.

.4 Wall by size.

.2 For manhole inspections, commence the inspection so that the frame of the manhole is clearly visible at the start of the inspection.

.3 Inspect manholes for general construction, structural condition, and evidence of inflow, infiltration or surcharging together with the ground level condition within a two (2) metre radius of the manhole cover.

.4 Inspect each component of the manhole consistent with MACP Level 1 inspection to establish a complete inventory, identify defects, and update existing records. Inspections shall include:

.1 Cover. Inspect the cover before and after removal from the frame and on both sides of the cover. Inspection includes cover diameter, type, condition, fit with frame and measurement above or below grade.

.2 Frame. The frame may have a grade rings used to adjust the chimney height to the finish grade of the road. Inspection includes frame and riser material, type, condition, and evidence of infiltration.

.3 Chimney. The chimney section is used to reduce the diameter of the manhole structure to the diameter of the cover or adjuster (riser) section. The inspection shall include chimney wall type, shape, condition and evidence of infiltration.

.4 Wall. Inspection includes wall condition, evidence of infiltration and number of steps (if present).

.5 Benching. The benching is to be sufficiently clean to enable the inspection. The method of construction will influence the defects observed (cracks, leaking construction joints, roots). Inspection includes the benching and invert type, condition, deposits, and any evidence of infiltration.

.6 Channel. The channel conveys the flows from one or more pipes through the manhole to the outlet pipe. In some cases, no channel will be observed. Inspection includes, channel yes/no, channel material, type and exposure.

.7 Manhole Steps. Identifies the number of manhole steps present and includes step number, step material. Observations of infiltration should be included.

.8 Pipe Connections. Identifies all pipe connections at the manhole and their locations. Inspection includes number of connections, position, frame to invert, direction, material, shape, diam 1 (pipe diameter/height), diam 2 (pipe width), pipe condition, seal condition, special condition (pipe type). Include observations of infiltration.

.5 Measure and record the upstream and downstream pipe invert depths (manhole lid to pipe invert) when access is possible with vertical accuracy for an invert at ± 50 mm.

.8 Inspection procedure – Service Connections:

.1 Provide references for the video that clearly display ‘From’ and ‘To’ (pipeline to terminus at street line or structure) and travel distance in metres on the periphery of the screen and arrange the information to minimize interference with the inspection image (defect code and description should appear on the screen while ‘coding’ for at least five (5) seconds).

.2 Provide accuracy for distance measurement in the pipeline to within 0.5% of the above ground measurement.

.3 Inspect continuous defects using the pan and tilt feature at intervals that will provide a representation of and fully display and identify that defect.

.4 Advise HRWC of service connections that are inaccessible and proceed to next service connection in that pipeline section.

.5 Position service connection camera launcher at the service connection location using pipeline cameras.

.6 Inspect service connections from inside of the pipeline only up into the service connections (inspections are not permitted from cleanouts, excavations, or other access points, unless authorized by HRWC) and record general construction, structural condition, and evidence of inflow, infiltration or surcharging together with the location of the service connection.

.1 Flag service connections displaying continuous clear water flow.

.7 Adjust lighting as needed according to the size of the pipe to provide a clear picture of the entire periphery of the pipe for all conditions encountered.

.8 Distribute lighting evenly around the perimeter of the pipe to prevent loss of contrast.

.9 At the start of each inspection, record the mandatory information outlined in the NASSCO method (PACP, MACP Level 2, PACP) and the following additional information – service connection inspections:

.1 Service connection ID (start and end point of inspection along service connection, direction of travel (upstream, downstream))

.2 Upstream MH

.3 Downstream MH

.4 Pipe use (purpose of service connection)

.5 Length surveyed

.6 Purpose

3.9 Inspection Report

.1 Submit reports to the HRWC within 10 working days of the completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.

.2 Provide report that includes the location of each fault, defect, and service connection with distance measured from the centerline of reference manhole and clock position referenced to the axis of pipe, and report shall include pictures of significant defects (severely deteriorated pipe, severely protruding service connection, locations of severe inflow and infiltration flows, or any other relevant information), and technical recommendations based on the inspection observations.

.3 Provide an inspection report and video for each pipe section inspected.

.4 For each inspected manhole and pipe inspected (referenced to the property address and corresponding pipe) provide:

.1 MPEG file.

.2 Digital images in JPEG format.

.3 Inspection reports in searchable PDF format.

.4 Handwritten inspection logs or field maps prepared during inspection.

.5 Provide a PACP database in MDB format.

.5 File naming convention:

.1 “Street_pipeID_yyyy_mm_dd_incremental_number (1, 2, 3, etc…)” with the corresponding file extension (.MPEG, .JPG/.JPEG, .PDF, .MDB, .SHP).

.2 “Street_mhID_yyyy_mm_dd_incremental_number (1, 2, 3, etc…)” with the corresponding file extension (.MPEG, .JPG/.JPEG, .PDF, .MDB, .SHP).

.3 “Street_ServiceConnetionID_yyyy_mm_dd_incremental_number (1, 2, 3, etc…)” with the corresponding file extension (.MPEG, .JPG/.JPEG, .PDF, .MDB, .SHP).

.6 Retain a copy of all inspection records including video files, photographs, database, reports, shape files (and any other relevant associated records) for a minimum period of three (3) years after completion of the inspection work.

.7 Submit all inspection records and deliverables electronically. If using FTP site, notify HRWC via email that information has been submitted