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- 1.0 GENERAL**
- .1 These specifications outline the requirements for conducting underground infrastructure upgrades to the storm and sanitary systems on Granville Island in Vancouver, BC. These specifications must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
 - .2 In general, the works are to be constructed to the requirements as specified in the MMCD Master Municipal Specifications and Standard Detail Drawings (2009 Platinum Edition).
- 1.1 MMCD Reference Standards**
- .1 Temporary Facilities Sec. 01 53 01
 - .2 Aggregates & Granular Materials Sec. 31 05 17
 - .3 Excavating Trenching & Backfill Sec. 31 23 01
 - .4 CCTV Inspection of Pipelines Sec. 33 01 30.1
 - .5 Cleaning of Sewers Sec. 33 01 30.2
 - .6 Sanitary Sewers Sec. 33 30 01
 - .7 Storm Sewers Sec. 33 40 01
 - .8 Manholes and Catchbasins Sec. 33 44 01
- 1.2 Supplemental Reference Standards**
- .1 Traffic Regulations Sec. 01 55 00.1S
 - .2 CCTV Sewer Inspection Sec. 33 01 30.1S
 - .3 Sewer Cleaning Sec. 33 01 30.2S
 - .4 Cured-in-Place-Pipe Lining Sec. 33 05 24S
 - .5 Trenchless Point Repairs Sec. 33.05.25S
 - .6 Chemical Grouting Sec. 33 05 30.1S
- 1.3 Scheduling of Work**
- .1 Submit a detailed construction schedule prior to commencing works.
 - .2 No construction shall be permitted from December 2, 2013 through January 3, 2014.
 - .3 The contractor may postpone the start date for construction to early January 2014.
- 2.0 MEASUREMENT AND PAYMENT**
- 2.1 Mobilization & Demobilization**
- .1 Payment for all works associated with mobilization and demobilization will be paid as a lump sum. 50% of the lump sum payment will be made at the time of the first invoice after works have commenced. The remaining 50% will be paid upon fully demobilizing and completion of the contract works.

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| 2.2 | CCTV Inspection | .1 Refer to Supplemental Specification 33 01 30.1S |
| 2.3 | Sewer Cleaning | .1 Refer to Supplemental Specification 33 01 30.2S. |
| 2.4 | CIPP Lining | .1 Refer to Supplemental Specification 33 05 24S. |
| 2.5 | Root Cutting | .1 Measurement for payment of root cutting will be made on an hourly basis as described in the Form of Tender and in accordance with Supplementary Specifications – Sewer Cleaning Section 33 01 30.2S. |
| 2.6 | Trim Connections | .1 Measurement for payment of removal of intruding connections will be paid at the unit price as described in the Form of Tender. This shall include the supply of all equipment and labour to remotely remove intruding connections comprised of PVC, vitrified clay, concrete, asbestos cement and cast iron. |
| 2.7 | External Point Repair | .1 Payment for external point repairs will be made as a lump sum payment as shown on the contract drawings. Payment for includes saw cutting pavement and/or concrete slabs and/or paver removal, trench excavation, disposal of surplus excavated materials, supply and installation of all pipe, fittings and related materials, bedding, imported backfill, cleaning and flushing, testing, all surface restoration, and all other work and materials necessary to complete the point repair. |
| 2.8 | Trenchless Point Repair | .1 Refer to Supplemental Specification 33 05 25.1S. |
| 2.9 | Chemical Grouting | .1 Refer to Supplemental Specification 33 05 30.1S. |
| 2.10 | Air Testing | .1 Refer to Supplemental Specification 33 05 30.1S. |
| 3.0 | PRODUCTS | .1 Refer to the applicable MMCD Reference Standard Section or Supplemental Sections. |
| 4.0 | EXECUTION | .1 Refer to the applicable MMCD Reference Standard Section |

END OF SECTION

1.0 GENERAL

- .1 Section 01 55 00.1S addresses the specific requirements for traffic management during the Granville Island Underground Infrastructure Upgrade project. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the work described herein.

The Prime Contractor is responsible for all traffic management associated with the project.

- .2 The Contractor shall submit a full Traffic Management Plan (TMP) to the CMHC for approval for all work on Granville Island. The TMP is to include traffic control plans, a public information plan, an implementation plan, and an incident management plan. Specific traffic control plans are required for all stages of construction for daytime business hours, evenings and after work periods. Applications shall be submitted a minimum of 10 working days prior to commencing work.

The public information plan is to address static and changeable message signage required to inform drivers of lane closures and expected delays. Communications with local tenants will be coordinated by the CHMC and should be referenced in the public information plan within the TMP document.

- .3 Construction hours shall conform to the City of Vancouver Noise Bylaws. The Contractor is required to obtain approval for all work outside of the standard construction hours.
- .4 All traffic management is to conform to the latest edition of the *BC Ministry of Transportation and Infrastructure Traffic Management Manual for Work on Roadways*.
- .5 The Contractor shall appoint Traffic Control Personnel to set up, maintain, and remove temporary traffic control devices and provide traffic control services as and when required (and permitted). Personnel shall be certified to appropriate WorkSafe BC standards. The Contractor's implementation plan shall identify the roles, qualifications, responsibilities and contact information for all personnel associated with construction traffic management.
- .6 On street parking will not be permitted within the work zone. Contractor to make arrangements with the CMHC for parking regulation changes as necessary.

**2.0 TRAFFIC
MANAGEMENT
REQUIREMENTS**

- .1 A minimum of one travel lanes shall be maintained at all times.
- .2 Pedestrian sidewalk access to businesses shall be maintained at all times during business hours. The contractor shall plan work so that works do not interfere with business accesses. In addition, sidewalk continuity shall be maintained through the work zone at all times.

Where hazards exist, modoloc fencing shall be used to provide safety to pedestrians on the sidewalk. In addition, handicap ramps and traffic control personnel shall be provided as and when required during construction to assist and/or escort pedestrians around active work zones.
- .3 The Contractor will be required to provide construction signage three (3) working days in advance of starting work - to inform users of construction and anticipated delays / alternate routes. Approximate locations and potential messaging shall be included in the traffic control plans for daytime, evening, and after work periods.
- .4 The Contractor and Contract Administrator shall monitor all temporary advisory signage to ensure correct operation and adjust if necessary. When signs related to traffic control personnel or specific work activities are not required at the end of a shift, they shall be covered or removed.

END OF SECTION

- 1 GENERAL**
- .1 Section 33 01 30.1S refers to those portion of the work that are unique to the requirements for inspecting new and existing sanitary, storm and combined sewer pipe and pipe culverts by closed circuit television. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein. These specifications are supplemental and do not appear in the Platinum edition of MMCD.
- 1.1 Related Work**
- .1 Traffic Regulation Section 01 55 00.1S
.2 Cleaning of Sewers Section 33 01 30.2
- 1.2 References**
- .1 These specifications must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Reference standards, specification or publications.
- .1 Water Research Centre (WRc) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.
- .3 Nomenclature
- .1 CCTV Closed Circuit Television
.2 JPEG Joint Photographic Experts Group
.3 MPEG Movie Photographic Experts Group
- 1.3 Work Regulations**
- .1 Work to conform to all applicable regulations of WorkSafe BC. Confirm training compliance in the following:
- .1 Confined space entry
.2 Ventilation
.3 Atmospheric monitoring
.4 Personal protective equipment
- .2 Provide written confirmation to the Contract Administrator that workers have knowledge of confined space entry practices and of equipment required for confined space entry.

- 1.4 Scheduling of Work**
- .1 Schedule work to minimize interruptions to existing services.
 - .2 Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11)
- 1.5 Measurement for Payment**
- .1 All units of measurement for payment will be as specified herein unless shown otherwise in Form of Tender
 - .2 CCTV pipeline inspection will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
 - .3 Measurement will be determined by calibrated electronic measure along the sewer from the inside wall of manhole to inside wall of manhole or end to end of sewer pipe for all sections except where a blockage or obstruction occurs.
 - .4 For sections of pipe where a blockage or obstruction occurs, measurement will be from the start of inspection (inside wall of manhole) to the point of abandonment of survey.
 - .5 For sections of pipe with the WRc. condition code CU (camera underwater) that has a continuous distance greater than five (5) metres, the measurement above will be reduced by the distance in excess of the five metres.
 - .6 *Separate payment will not be made for flow control, with the exception of bypass pumping. Payment for bypass pumping as required and only where approved by the Contract Administrator will be made on a per occurrence basis (refer to Clause 3.11.4)*
- 2.0 PRODUCTS**
- 2.1 Equipment**
- .1 Survey Vehicle to contain a separate area for viewing, recording and controlling the CCTV operation.
 - .1 Viewing and control area 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 pipeline to be stored outside the viewing, recording and control area.
 - .3 Vehicle to be equipped with a telephone for communication with the Contract Administrator for the duration of the work.

- .4 Electrical power for the system to be self contained. External power sources from public or private sources not permitted.
- .2 Survey Equipment to have sufficient cables to view the lengths of pipe as specified.
 - .1 Survey unit to be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
 - .2 Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
 - .3 Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.
- .3 Camera to be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - .1 Camera to be "Pan & Tilt" and have the capability of panning the pipe at 360° with tilt capability of 270°.
 - .2 Live picture to be visible with no interference and capable of registering a minimum number of 400 lines of resolution at the periphery.
 - .3 Focus and iris adjustment to allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - .4 Camera to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.

.4 Digital video files shall be MPEG2 and conform to the following requirements:

.1 Picture Size: NTSC 704 x 480 at 29.97 frames per second.

2.2 Materials

.1 Digital video files to be stored on portable hard drives.

.2 Photographs to be colour, minimum image size 90mm x 70mm and reproduced on premium glossy ink jet paper when required, as specified in the Contract Documents.

3.0 EXECUTION

3.1 CCTV Inspection

.1 CCTV operator to have received training by NAAPI or NASSCO.

.2 Submit sample of inspection reports, video in DVD format together with corresponding digital data file for review within one week of receipt of notice to proceed with contract. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent inspection report submissions.

.3 No inspection surveys to be carried out under this contract until an acceptable sample inspection report has been approved by the Contract Administrator.

.4 Flow in the pipeline not to exceed approximately 20% of the pipe diameter. Notify Contract Administrator of excessive flows, inspect using flow reduction method (See Clause 3.11).

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

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

.7 Inspections video image to be produced in MPEG2 format in either one or a combination of the following methods:

.1 Create separate digital file for each individual Manhole to manhole inspection report. Identify each report title on the DVD menu.

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

- .9 Report and record on full length of pipeline from inside face to inside face between manhole or outlet end of pipes and from one end of pipe culvert to the other.
- .10 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- .11 Data generator to electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information prior to the start of each run:
 - .1 Manhole(from-to) / pipe length reference numbers.
 - .2 Pipeline dimensions
 - .3 Pipe material (ie vitrified clay, concrete, pvc etc.)
 - .4 Type or use of pipe (ie sanitary, storm or combined sewer)
 - .5 Date of survey (yyyy.mm.dd)
 - .6 Road name/location
 - .7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
 - .8 Inspection (report) number
- .12 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 minimum information during each run:
 - .1 Automatic update of the camera's metre reading position from adjusted zero.
 - .2 Manhole/pipe length reference numbers.
 - .3 Type or use of pipe (ie sanitary, storm or combined sewer)
 - .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.

- .13 Stop camera at each defect, change of condition of pipe and service connection to record defect in accordance with WRc codes.
 - .14 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
 - .15 Immediately notify Contract Administrator of any blockage or obstruction that will not allow passage of survey equipment.
 - .16 Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by Contract Administrator.
- 3.2 Recording Resolution**
- .1 At the beginning of each video tape, day of inspection or when a substitute camera is introduced perform necessary checks to ensure recording resolution satisfies these specifications.
- 3.3 Site Coding Sheets**
- .1 Each pipeline length to be recorded according to the MSCC. Any variation from the manual to be noted in the survey report.
 - .2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - .1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day)
 - .2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds)
 - .3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC
- 3.4 Camera Position**
- .1 Position camera lens centrally in the pipeline with a positioning tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.
 - .2 Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.
- 3.5 Camera Travel Speed**
- .1 Travelling speed of the camera in the pipeline to be as follows:

- .1 6m/min for pipeline of diameter less than 200mm.
 - .2 9m/min for diameters 200mm and larger but not exceeding 310 mm: and
 - .3 12 m/s for diameters exceeding 310 mm.
- 3.6 Camera Position Chainage Device**
- .1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera
 - .1 Chainage information to be transmitted electronically to control area and displayed on the monitor.
 - .2 Chainage device to be accurate to within 0.3 m up to the first 50 m and within $\pm 1\%$ for lengths exceeding 50 m.
 - .3 Chainage tolerance to be checked at the start of contract and a minimum of once every two weeks there after or every 5000 m of pipeline inspected, whichever is greater.
 - .4 Provide audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.
- 3.7 Photographs and/or Digital Images**
- .1 Photograph all major defects as defined by condition codes: B, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X
 - .2 Overlay on photographs 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 (chainage)
 - .3 Manhole/pipe length reference numbers (from - to)
 - .4 Photograph number
 - .5 WRc. condition defect code
 - .6 Date of survey (yyyy.mm.dd)
 - .3 Capture photograph and alpha-numeric data as a digital image in a JPEG. format if required, as specified in contract documents.

- .4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.
- 3.8 Inspection Reporting
Hard copies &
Digital format**
- .1 Submit reports to Contract Administrator within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
- .2 Present machine printed (hard copy) and computer generated data base reports according to the MSCC format.
- .1 Each binder to commence with an index of all survey inspection reports contained within.
- .2 Hard copy reports to be presented in tabular form in accordance with WRc MSCC
- .3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the contract documents.
- .4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
- .5 Digital information to be presented in tabular configuration in accordance with the CMHC standard file format in Microsoft ACCESS (.MDB) (see attached CMHC standard file format).
- .6 Provide CD ROM of digital photographs. Disk to be labelled with photo and contract numbers.
- .7 Include CMHC supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
- .3 Present report in 215 mm x 280 mm three ring (D type) binder. DVD's containing relevant CCTV inspections surveys to be included in the binder.
- .4 Attach computer disks in three hole plastic diskette sheet holder in back of binder.
- .5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
- .6 All dimensions and chainages in the reports to be metric.

- 3.9 Cleaning** .1 Clean pipelines to Supplementary Specifications Section 33 01 30.2 immediately prior to CCTV inspection survey, unless otherwise specified in the contract documents.
- 3.10 Root Cutting & Removal** .1 Remove roots to Section 33 01 30.2 for condition codes RM where required, to allow for CCTV equipment to pass.
- 3.11 Flow Reduction** .1 Reduce flow in pipeline to approximately 20% of 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 plug all flow or impede flow (*“flow through”* plug) to the approximate 20% of pipe diameter.
- .2 Obtain Contract Administrator’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 pipeline.
- .4 Temporary bypass pump flow around inspection section when Contractor demonstrates that off peak inspection, plugging and /or the use of sewer cleaning equipment cannot effectively reduce flow levels to specified levels. Bypass pump plugs to be flow through with hoses and pump 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 Contract Administrator’s approval prior to setting up temporary bypass pump system.
- 3.12 Coding Accuracy** .1 Coding accuracy to be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:
- .1 header accuracy 95%
- .2 detail accuracy 85%
- .2 Contractor to implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the Contractor on a random basis on a minimum of 10% of the inspection reports. Contract Administrator to be entitled to review the accuracy verification system and results and be present when

the assessments are being conducted.

- .3 A minimum of two accuracy verifications to be performed for each operator for each working week. Coding not satisfying the accuracy requirements to be re-coded and the accuracy of the inspection report immediately proceeding and following the non compliant inspection to be verified. Process to be repeated until the proceeding and subsequent inspections meet accuracy requirements.

END OF SECTION

- 1.0 GENERAL** .1 Section 33 01 30.2S refers to those portion of the work that are unique to the requirements for cleaning of new and existing sanitary, storm and combined sewer pipe and pipe culverts.
- 1.1 Related Work** .1 Traffic Regulation - Section 01 55 00.1S
.2 CCTV Pipeline Inspection Section 33 01 30.1S
- 1.2 References** .1 This section must be referenced to and interpreted simultaneously with all other sections of the Master Municipal Specifications pertinent to the works described herein.
- 1.3 Material Certification** .1 All materials to conform to this specification, to the latest edition of the appropriate specifications of the American Society for Testing and Materials (ASTM) or other standards expressly specified. All provisions in ASTM and other specified standards pertaining to materials, workmanship, finish, inspection and rejection form part of these specifications as far as they are applicable and providing that they are not inconsistent with this specification. This specification takes precedence over the ASTM specifications in case of a discrepancy or conflict. Materials incorporated into the Work but not specifically covered in the specifications are to be obtained from the Contract Administrator prior to installation.
- 1.4 Work Regulations** .1 Work to conform to all applicable regulations of Work Safe BC Confirm training compliance in the following:
- .1 Confined space entry procedures
 - .2 Atmospheric monitoring and ventilation methods
 - .3 Personal protective equipment
 - .4 Interpretation of Material Safety Data Sheets (MSDS)
- 1.5 Terminology** .1 Flushing is defined as a maximum of three (3) passes of high pressure jetting equipment to allow for passage of CCTV or other forms of inspection equipment.
- .2 Cleaning is defined as the removal of all debris by means of high pressure jetting equipment including: gravel, sand, rocks (to 300mm in diameter), grease and other deleterious material
- 1.6 Submissions** .1 Submit the following information seven (7) days prior to the commencement of work;
- .1 Provide schedule and sequence of flushing or cleaning activities
 - .2 Provide written confirmation to the Engineer that workers have

knowledge of confined space entry practices and of equipment required for confined space entry

1.7 Scheduling

- .1 Schedule work to minimize interruptions to existing services.
- .2 Hours of work to comply with noise restriction bylaw unless granted exemption.
- .3 Maintain existing flow during sewer cleaning and debris removal unless directed otherwise in contract document.

1.8 Measurement For Payment

- .1 All units of measurement for payment will be as specified herein unless shown in the Form of Tender.
- .2 Sewer cleaning and sewer flushing will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
- .3 Measurement for sewer flushing and debris removal to be determined from plan distances and periodically confirmed by surface measured distances with a calibrated measuring devise.
- .4 Measurement for sewer cleaning and debris removal to be determined from plan distances and periodically confirmed by surface measured distances with a calibrated measuring devise
- .5 Manhole cleaning will be made at a per unit rate as described in the Form of Tender.
- .6 Root cutting will be measured in hours. Payment will be made at the unit price bid in Form of Tender. Measurement will be determined from the difference in time between when the cutting tool is engaged at the face of the manhole to when it exits on completion of the root removal process.
- .7 Grease cutting and removal will be measured in hours. Payment will be made at the unit price bid in Form of Tender. Measurement will be determined from the difference in time between when the cutting tool is engaged at the face of the manhole to when it exits on completion of the grease removal process.
- .8 Debris disposal is considered incidental to associated cleaning and flushing work. No separate payment will be made for debris disposal.

2.0 PRODUCTS

2.1 Equipment

- .1 High velocity cleaning equipment to be capable of providing a minimum flow of 200 litres per minute (60 GPM) at 140 bar (2000 psi). Cleaning nozzle to be hydraulically or hydro-dynamically propelled and capable of producing a scouring action from 15 to 45 degrees. A variety of ancillary equipment and nozzles to be available including; standard flushing nozzles, high efficiency , spinning jet and plough jet to address all anticipated debris conditions. The equipment to include a water tank, pumps and hydraulically driven hose reel. Equipment to include a wash down gun for cleaning manholes and an approved back flow preventing device for water tank filling.
- .2 Debris removal equipment to consist of a vacuum pump complete with positive displacement pumps or fans producing a minimum of 700 l/s air movement. Equipment to be capable of removing debris at a minimum of 4.5 metres vertical head. Suction hose to be a minimum of 150 mm diameter. Debris tank to be water tight and capable of returning the liquid portion of the debris to the sewer.
- .3 Debris cutting equipment to be an accessory or attachment to hydraulic cleaning equipment. Equipment to be capable of removing heavy roots and solid debris such as encrustation and grease.
- .4 Backflow prevention valves for the purpose of drawing water from hydrants to have air gap and must be pre-approved by the Water Utility Operations Department.
- .5 All water used in the flushing or cleaning of storm sewers shall comply with BC Environmental Management Act and corresponding Municipal Sewage Regulation and be subject to de-chlorination with ascorbic acid or similar approved product prior to use.

3.0 EXECUTION

3.1 Clean or Flush

- .1 Clean or flush all pipelines as specified in contract documents. Notify Engineer immediately in the event that roots, grease or unusual quantities of debris is observed after three passes.
- .2 Notify all affected residence connected to the sanitary sewers in writing of proposed sewer cleaning and CCTV inspection process

as specified in the contract documents. Notice to be distributed two (2) working days in advance of flushing. Notice to include Contractor's name and contact information.

- .3 Begin cleaning or flushing from the upstream sewer in the system and proceed downstream. Under no circumstances is the sewer cleaning or flushing process to proceed downstream until all contributing upstream sewers have been cleaned. Sewers to be cleaned or flushed in the direction of flow.
- .4 A manhole to be washed down with high pressure wand AFTER manhole inspection has been completed.
- .5 Remove debris by vacuum pumping at each manhole. Do not pass debris from manhole to manhole.
- .6 Dispose of debris at an approved landfill site
- .7 Comply with applicable Provincial and Municipal environmental laws in regard to the decanting of accumulated waste water with respect to spills and discharge of contaminants.
- .8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate of a maximum of 8 litres per second.
- .9 Dechlorinate all water used for cleaning and flushing storm sewers prior to discharge from tanker in accordance with Section 8 (1) of the Municipal Sewage Regulation

3.3 Root Removal

- .1 Inform Contract Administrator prior to undertaking any root cutting or grease removal where cutting equipment is required.
- .2 Run root cutter through entire section of pipeline from manhole to manhole or end of pipe to end of pipe
- .3 Select root cutting device or grease removal nozzle of appropriately size and configuration for the diameter of the pipeline.

END OF SECTION

1.0 GENERAL

- 1.1 Description**
- .1 Section 33 05 24S refers to those portions of the work that are unique to the supply and installation of Cured-In-Place-Pipe liner for circular sewer main rehabilitation up to and including 1000mm diameter. This section must be referenced and interpreted simultaneously with all other sections pertinent to the works described herein. This supplemental specification supersedes section 33.05.24, Cured In Place Pipe Liners, of the Platinum Edition of the MMCD, Vol. II.
- 1.2 Related Work**
- .1 Traffic Regulation – Section 01 55 00.1 S
- .2 CCTV Pipeline Inspection Section 33 01 30.1.
- .3 Sewer Cleaning Section 33 01 30.2.
- 1.3 References**
- .1 Reference standards, specification or publications.
- .1 ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Material.
- .2 ASTM D2990 Standard Test Method for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
- .3 ASTM D5813 Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems.
- .4 ASTM E1252 Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis.
- .5 ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
- .6 ASTM F1743 Standard Practice for the Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
- .7 ASTM F2019 Standard Practice for the Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP).

- 1.4 Material Certification** .1 All materials to conform to this specification, to the latest edition of the appropriate specifications of the American Society for Testing and Materials (ASTM) or other standards expressly specified. All provisions in ASTM and other specified standards pertaining to materials, workmanship, finish, inspection and rejection form part of these specifications as far as they are applicable and providing that they are not inconsistent with this specification. This specification takes precedence over the ASTM specifications in case of a discrepancy or conflict. Materials incorporated into the Work but not specifically covered in the specifications are to be obtained from the Contract Administrator prior to installation.
- 1.5 Work Regulations** .1 Work to conform to all applicable regulations of Work Safe BC Confirm training compliance in the following:
- .1 Confined space entry procedures.
 - .2 Atmospheric monitoring and ventilation methods.
 - .3 Personal protective equipment.
 - .4 Interpretation of Material Safety Data Sheets (MSDS).
- 1.6 Submissions** .1 The Contractor shall submit the following information at the time of tender submission:
- .1 Description of proposed lining product including the name of the manufacturer of the tube and resin together with relevant references to applicable ASTM procedures for product manufacture and product installation.
 - .2 Independent third party test data supporting values for long-term modulus of elasticity of proposed CIPP composite material in accordance with ASTM D2990. These tests must include a description of the composite verifying the type of resin, carrier material and corresponding reference numbers.
 - .3 Infrared Spectroscopy report (graph) of proposed resin in accordance with ASTM E1252.
 - .4 Structural design calculations for liner thickness based on ASTM F1216-09 Appendix XI.

- .5 Statement of compliance confirming that the liner will be installed in strict adherence to the appropriate ASTM Standard Practice. Alternatively provide concise statement of items of deviation from the Standard Practice.
 - .6 Provide three (3) references for similar CIPP projects carried out in the past three years. References to include: The name of the municipality for which the liner installations were completed, contact name and telephone numbers of project manager.
 - .7 Statement as to whether the intended installation and curing method is for hydrostatic head, steam/pressure or Ultra-violet ray. Provide brief description of associated equipment.
 - .8 Resume of experience for the wet-out supervisor and on-site lining superintendent.
- .2 Contractor to submit the following information at least ten (10) days prior to initiation of rehabilitation work:
- .1 Calculated values for maximum inversion head and curing head and maximum allowable tensile strength for each section of CIPP liner.
 - .2 Resin curing schedule including anticipated temperature and cure times for the various stages of installation reflecting the proposed resin system, liner length, thickness and diameter.
 - .3 Resin volume calculations for each section of liner.
 - .4 Written confirmation of safety training for field crews.
 - .5 Site sketch indicating proposed layout of bypass pumping system.
 - .6 Project schedule detailing a work plan time-line.
 - .7 Traffic management plan.
 - .8 Certificate of Calibration for the time / temperature monitors conducted within the past 18 months of the beginning of the contract.
- .3 No CIPP liner installation shall take place prior to review and written acceptance of the aforementioned submissions by the Contract Administrator.

- 1.7 Material Samples**
- .1 Provide one (1) restrained sample for each liner installed for mains up to 400mm diameter. Sample to measure minimum of 450 mm in length and formed in suitable circular pipe mould. For sewer mains greater than 400mm diameter the contractor will extract a field sample from the lined main as directed by the engineer.
 - .2 Provide one (1) control sample of uncatalyzed resin direct from manufacturer to testing agency.
 - .3 Provide three (3) 200 ml samples of uncatalyzed resin direct from resin drum at time of wet-out as directed by the Contract Administrator.
- 1.8 Scheduling**
- .1 Schedule work to minimize interruptions to existing services.
 - .2 Hours of work to comply with noise restriction bylaw unless granted exemption from governing authority.
- 1.9 Measurement for Payment**
- .1 All units of measurement for payment will be as specified herein unless shown in the Form of Tender.
 - .2 Measurement for payment of by-pass pumping system will be on a lump sum basis for the completed project as described in the Form of Tender. This shall include the supply and installation of the temporary by-pass pumping system including pumps, piping, hoses, controls, power supply, standby power/pump supply, transfer switch, by-pass of all designated connections to the main, fuel and maintenance cost, security fencing and other appurtenances and services required to establish and maintain the system for the duration of the project.
 - .3 Measurement for payment for sewer cleaning will be on a per linear metre basis as described in the Form of Tender and in accordance with Supplementary Specifications – Sewer Cleaning Section 33 01 30.2.
 - .4 Measurement for payment of root cutting will be made on an hourly basis as described in the Form of Tender and in accordance with Supplementary Specifications – Sewer Cleaning Section 33 01 30.2.
 - .5 Measurement for payment of Pre-installation CCTV inspection will be on a linear metre basis as described in the Form of Tender and in accordance with Supplementary Specifications – Sewer Cleaning – Section 33 01 30.1.
 - .6 Measurement for payment of removal of intruding connections will be paid at the unit price as described in the Form of Tender. This shall include the supply of all equipment and labour to

remotely remove intruding connections comprised of PVC, vitrified clay, concrete, asbestos cement and cast iron.

- .7 Measurement for payment for sewer lining will be on a linear metre basis for respective pipe diameters described in the Form of Tender. The length will be based on linear metres indicated on the Contract Drawings and confirmed in the field by CCTV inspection measurement or above ground measurement unless otherwise agreed upon in writing by the Engineer.
- .8 Measurement for payment of service connection re-instatement will be paid at the unit price as described in the Form of Tender. This shall include the supply of all equipment and labour to remotely re-instate designated service connections.
- .9 Measurement of payment for Measurement for payment of Post-installation CCTV inspection will be on a linear metre basis as described in the Form of Tender and in accordance with Supplementary Specifications – Sewer Cleaning – Section 33 01 30.1.

1.10 Inspection and Testing

- .1 Contractor to provide Engineer free access to inspect the materials and wet-out procedures and render all assistance including installation of the Engineer's testing equipment (thermistor cables) and confined space entry equipment to facilitate physical inspection of finished liner.
- .2 Contractor to provide Engineer 48 hours advance notice of wet-out operation. The wet-out shall not commence without the owners designated inspector in attendance unless waived in writing by the Contract Administrator.
- .3 Physical property values used in submitted structural calculations must be met prior to release of progress and final payments. Failure to achieve these values will require the re-submission of calculations using the physical properties determined by independent laboratory test results as per ASTM D 790.
 - .1 The material testing laboratory will be selected by the Contract Administrator. No other material tests results conducted by other than the designated material testing facility will be considered

- .2 The minimal values for Flexural Strength and Flexural Modulus shall be in accordance with Table 1 of the corresponding ASTM Standard Practice for each liner technology. Failure to achieve these values may incur payment penalties.
- .3 Digital copy of the Time and Temperature (and where applicable pressure) curing logs to be presented within 72 hours of liner installation and prior to release of interim payments.

2.0 PRODUCTS

2.1 Liner Technology

- .1 The liner material shall be such that it will restore the structural integrity of the pipe and eliminate the potential for infiltrating ground water and exfiltration of contents. The completed liner shall contain only materials capable of withstanding the effects of conventional sanitary and storm sewage, the gases produced there from, grits and other materials normally transported in sanitary and storm sewage pipelines.
- .2 The following liner technologies only are acceptable under these specifications:
 - .1 Cured-in-place (Felt liners) Inversion Method –ASTM F1216- 09 *Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of Resin-Impregnated Tube*. This Standard Practice is deemed to be a specification. No deviation from this Standard Practice will be accepted without the express written permission of the Contract Administrator.
 - .2 Cured-in-place (Felt liners) Pull-in-place Method – ASTM F1743-08 *Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)*. The Title of Section 6 “Installation Recommendation” is replaced by the term “Specified Method of Installation”. No deviation from this Standard Practice will be accepted without the express written permission of the Contract Administrator.

.3 Cured-in-place (Glass Reinforced Plastic) Pull-in-place Method – ASTM F2019 -03 *Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)* The Title of Section 6 “Installation Recommendation” is replaced by the term “Specified Method of Installation”. No deviation from this Standard Practice will be accepted without the express written permission of the Contract Administrator.

2.2 Liner Material

- .1 Minimum material requirements for CIPP liners to conform to ASTM D5813.
- .2 All liner tube shall be made of virgin material. No rework except that obtained from the manufacturer’s own production of the same formulation shall be used.
- .3 Liner material to have a minimum tensile strength of 5 MPa (750 psi) in both longitudinal and transverse directions when tested in accordance with the requirements of ASTM D 1682 Test Methods for Breaking Load and Elongation of Textile Fabrics or ASTM D 5035.

2.3 Resin

- .1 The following resins are permitted under the terms of this contract:
 - .1 Premium polyester resins that do not contain a styrene monomer;
 - .2 Vinyl Ester resins that do not contain a styrene monomer;
 - .3 Epoxy resin.
- .2 Resin used for impregnation to be consistent with the product identified in the ASTM D2990 testing performed by the resin manufacturer and submitted at the time of tender. If no long-term testing is available than the short-term Modulus of Elasticity to be discounted by 50%.
- .3 Volume of resin to be consistent with the volume calculations submissions in accordance with ASTM F1216-09, Section 7.2 *Resin Impregnation* including an allowance between 5% to 10% for change in resin volume due to polymerization and migration.

2.4 Workmanship and Finish

- .1 The finished CIPP liner shall conform to Clause 6.2 *Workmanship* of ASTM D5813.
- .2 The Contractor shall field measure the internal circumference of the sewers to determine the exact size of liner so that the liner is tight to

the wall of the existing pipe and the surface finish is free of pleats, folds or creases.

- .3 Physical dimensions of the liner shall conform to Clause 6.3 *Dimensions* of ASTM D5813.

2.5 Liner Design

- .1 Liner thickness calculations shall assume that all sections of sewer main to be rehabilitated are considered to be “*Fully Deteriorated Gravity Pipe Condition*”. Designs will be based on the modified AWWA formula as detailed in Appendix XI of ASTM F1216-09 edition with the following minimum design assumptions:
- .1 The total external pressure on the pipe shall include an allowance for an AASHTO HS20 concentrated live load.
 - .2 The minimum soil density utilized in computation of dead load shall be 1920 kg/m^3 .
 - .3 The height of the water above the pipe shall be based on the assumption that the groundwater table is 1.0 metre below the ground surface elevation.
 - .4 The ovality reduction factor shall be based on a minimum value of 3% unless a greater value is specified or warranted based on the Contractor’s observation of the CCTV inspection, remote measuring method or physical measurement.
 - .5 The modulus of soil reaction ($E's$) shall be assumed to be 6900 kPa unless a higher or lower value is specified in these documents.
 - .6 The minimum factor of safety (N) to be utilized in the fully deteriorated design analysis shall be 2.
- .2 The long-term value for the flexural strength (E_L) shall satisfy the following:
- .1 The projected value at 50 years of continuous application of the load based on the specific resin and fabric composite proposed for use as established by ASTM D2990.
 - .3 A design check using Manning’s formula shall be performed to confirm that the rehabilitated section will have a hydraulic capacity equal to or greater than the existing pipeline. The assumed value for Manning’s “ n ” for the CIPP section shall be 0.011.
 - .4 Liner design calculations signed and sealed by a Professional Engineer or holder of an Engineering License under APEG BC.

- 2.6 Sealing Material** .1 Approved sealing material between host pipe and liner shall be an epoxy grout or alternative products approved by the Contract Administrator.
- 3.0 Execution**
- 3.1 Resin Impregnation (Wet-Out)** .1 Quality Control: Record and document all resin:catalyst ratios and weights of chemical components employed for each batch (barrel) of resin mixed.
- .2 Contractor to conduct gel tests (time to hardness) for each batch of resin mixed and record results of each test sample.
- .3 All documentation related to quality control of resin:catalyst ratios shall be made available for to the Contract Administrator upon request.
- 3.2 Bypass Pumping** .1 Contractor to provide notice of work to residents minimum 1 week prior to commencing (date on letter).
- .2 Contractor shall install temporary bypass pumping system around the designated sewer sections in accordance with pre-submitted arrangement.
- .3 Pumps and bypass lines shall be of adequate capacity to accommodate pre-determined flows as specified in the contract documents.
- .4 Contractor to take all necessary precautions to prevent spills to the environment or back-up of sewerage onto private property. In the event of a spill the Contractor shall be responsible for immediate clean-up operation and remediation of damaged property.
- .5 Contractor shall report any spills and back-ups to Engineer immediately.
- 3.3 Preparation** .1 Flush and clean sewer main of all debris, roots and ponding water before liner installation. Cleaning of sewers to be carried out in accordance with Standard Supplemental Specification for "Cleaning of Sewers" Section 33 01 30.2.
- .2 Remove intruding portions of service connections to within 5 mm of the mainline pipe wall. Finished surface of intruding connection to be left smooth to avoid damage to liner material.

- .3 Conduct pre-installation CCTV inspection in accordance with Standard Supplementary Specifications for CCTV inspection of Sewers - Section 33 01 30.1.
- .4 Pre-measure and document the location of all service connections within the main. Record distance, clock position and diameter of connection.
- .5 Notify Contract Administrator of any unforeseen obstructions or anomalies observed in the pre-installation CCTV inspection.
- .6 Notify effected property owners 24 hours in advance of disruption of service. Information notice to be pre-approved by Contract Administrator.

3.4 Liner Installation

- .1 Install liner in accordance with applicable ASTM standard as referenced in Section 1.2 *References* of this specification.
- .2 Pull-in type liners shall have a calibrated dynamometer fitted to the winch. The pulling tension shall not exceed fifty (50%) of the tensile strength of the liner.
- .3 Liners inverted by means of water column shall comply strictly with Items 7.4.1 of ASTM F 1216-09 have sufficient head to cause the impregnated tube to invert to point of termination and hold the tube tight to the pipe wall in a continuous operation. Monitor inversion head to ensure tensile stresses values are not exceeded.
- .4 Liners inverted by means of air pressure to comply strictly with Items 7.4.2 and 7.4.3 of ASTM F 1216-09 and the following parameters;
 - .1 Liner to be installed within the minimum and maximum installation pressure (heads) as recommended by the tube manufacturer.
 - .2 The advancement of the liner will be controlled with the aid of a hold-back rope or tape to ensure a tight fit to the host pipe at all times in order to displace air pockets and residual water. The rate of advancement shall not exceed 0.5m per second.

- .3 Continuous pressure shall be maintained within the tube throughout the complete inversion, curing and cool-down cycle without falling below the minimum allowable pressure at anytime during the process. ***Should the pressure deviate from within the range of the minimum and maximum pressures, the installed tube shall be removed from the existing conduit.***
 - .5 Install temperature and pressure gauges to monitor both upstream and downstream ends of liner.
 - .6 Thermistors cables to be located between host pipe wall and inserted liner. Thermistors shall be connected to data logger and time/temperature (where applicable pressure) data gathered at a sampling rate designated by the Contract Administrator.
 - .7 The curing and cool-down process to follow the ASTM Standard Practice under which the liner is installed. Specifically the curing process will follow the resin manufactures recommendation to achieve; initial cure, followed by a period ***of not less than two (2) full hours*** of post-cure at the manufacturer's recommended temperature. Cool-down will take place at no greater rate of one (1) degree °F per thirty (30) seconds until such time as the designated cool-down target temperature is achieved.
 - .8 No deviation of the criteria set-out under Item .7 of this Section (curing and cool-down) will be acceptable without the express written consent of the Contract Administrator. Such requests by the contractor will be submitted in writing seven (7) days prior to the intended lining date.
 - .9 Present curing data to the Contract Administrator following each liner installation.
- 3.5 Field Cured Samples**
- .1 Install pipe mould or equivalent to form representative restrained sample at either upstream or downstream manhole. For pipe sizes of 450mm or less, the sample should be held in place by a suitable heat sink such as sandbags. For larger pipe sizes, plate samples will be provided or a sample of the in-situ CIPP liner shall be extracted from the new liner subject to approval by the Contract Administrator. The Contractor shall use an approved resin material to repair the location where the sample was extracted.
 - .2 Remove CIPP pipe samples and present to Contract Administrator immediately following each liner installation.

- 3.6 Service Reconnection**
- .1 Reconnect all designated service connection as specified in the contract documents and in accordance with Contract Drawings.
 - .2 Service connection re-opening to be carried out by remotely operated cutting equipment in tandem with articulating CCTV inspection camera.
 - .3 Brush finish each re-opened connection with wire brush attachment to eliminate uneven edges and leave smooth finish.
- 3.7 Termination at Manholes**
- .1 Liner terminal points at manholes to be tight fitting and tapered to eliminate impediments to flow.
 - .2 Seal annular space between host pipe and liner with approved sealant to eliminate water tracking.
- 3.8 Post Installation CCTV Inspection**
- .1 Conduct the following two CCTV inspection surveys:
 - (i) a preliminary post installation CCTV inspection immediately after the removal of the surplus head and tail sections of liner and prior to returning the sewer to service;
 - (ii) a full CCTV post-installation within 48 hours in accordance with Sections 33 01 30.1. Submit copy of inspection report to Engineer.
- 3.9 Acceptance**
- .1 Acceptance of each CIPP liner will be determined based on the following:
 - .1 Material tests of field cured samples shall have the minimum values as stated in ASTM F1216-09 – Section 7 – Table 1 (CIPP Structural Properties) and meet the claimed physical material properties used in the submitted structural calculations.
 - .2 Review of resin volume impregnation records.
 - .3 Installation and curing logs including:
 - .1 Installation, curing and cool-down heads.
 - .2 Curing temperatures and pressures for compliance with applicable ASTM standards.
 - .4 Review of post installation CCTV inspections reports.
 - .2 Penalties may be assigned to each liner which fail to meet acceptable standards.

END OF SECTION

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- 1.0 GENERAL** .1 Section 33 05 30S refers to those portions of the work that are unique to the requirements for grouting of cracks, joints and laterals in sanitary pipe. This section must be referenced and interpreted simultaneously with all other sections pertinent to the works described herein. These specifications are supplemental and do not appear in the Platinum edition of MMCD.
- 1.1 Related Work**
- .1 Traffic Regulation Section 01 55 00.1S
 - .2 CCTV Pipeline Inspection Section 33 01 30.1S
 - .3 Sewer Cleaning Section 33 01 30.2
- 1.2 References**
- .1 Reference standards, specification or publications.
 - .1 ASTM F2304-03 Standard Practice for Rehabilitation of Sewers Using Chemical Grouting
 - .2 Guide to Successful Chemical Grouting – North American Grout Marketing Association
 - .3 ASTM F2454-05 Standard Practice for Sealing Lateral Connections and lines from the mainline Sewer Systems by Lateral Packer Method, Using Chemical Grouting
- 1.3 Material Certification** .1 All materials to conform to this specification, to the latest edition of the appropriate specifications of the American Society for Testing and Materials (ASTM) or other standards expressly specified. All provisions in ASTM and other specified standards pertaining to materials, workmanship, finish, inspection and rejection form part of these specifications as far as they are applicable and providing that they are not inconsistent with this specification. This specification takes precedence over the ASTM specifications in case of a discrepancy or conflict. Materials incorporated into the Work but not specifically covered in the specifications are to be obtained from the Contract Administrator prior to installation.
- 1.4 Work Regulations**
- .1 Work to conform to all applicable regulations of Work Safe BC Confirm training compliance in the following:
 - .1 Confined space entry procedures
 - .2 Atmospheric monitoring and ventilation methods
 - .3 Personal protective equipment
 - .4 Interpretation of Material Safety Data Sheets (MSDS)
 - .2 Comply with MSDS for the particular chemicals used in the grouting process. The following minimum safety equipment to be worn when mixing acrylamide based grouts;

- .1 Respiratory Protection: Half-face respirator with organic vapour cartridges;
 - .2 Ventilation: local exhaust around mixing area
 - .3 Protective clothing: rubber gloves, long-sleeved shirt, long pants
 - .4 Eye protection: goggles
 - .5 Additional requirements as stipulated by the applicable MSDS
- 1.5 Submissions**
- .1 The Contractor shall submit the following information at the time of tender submission:
 - .1 Description of proposed Chemical Grouting technology, grouting material and additives together with relevant references to applicable ASTM procedures for product installation.
 - .2 Copy of the relevant Material Safety Data Sheet for chemical grout and applicable additives.
 - .2 Contractor to submit the following information seven days prior to initiation of rehabilitation work:
 - .1 Traffic management plan
 - .2 Project schedule detailing a work plan time-line
 - .3 Site sketch indicating proposed layout of bypass pumping system.
 - .4 Written confirmation of safety training for field crews.
- 1.7 Scheduling**
- .1 Schedule work to minimize interruptions to existing services.
 - .2 Hours of work to comply with noise restriction bylaw unless granted exemption
- 1.8 Measurement For Payment**
- .1 All units of measurement for payment will be as specified herein unless shown in the Form of Tender.
 - .2 Measurement for payment for sewer cleaning will be on a per linear metre basis as described in the Form of Tender and in accordance with Supplementary Specifications - Sewer Cleaning Section 33 01 30.2S.
 - .3 Measurement for payment of root cutting will be made on an hourly basis as described in the Form of Tender and in accordance with Supplementary Specifications – Sewer Cleaning Section 02736S.

- .4 Measurement for payment of pre-rehabilitation CCTV inspection will be on a linear metre basis as described in the Form of Tender and in accordance with Supplementary Specifications – CCTV Inspection of Sewers - Section 33 01 30.1S.
- .5 Measurement for payment of removal of intruding connections will be paid at the unit price as described in the Form of Tender. This shall include the supply of all equipment and labour to remotely remove intruding connections comprised of PVC, vitrified clay, concrete, asbestos cement and cast iron.
- .6 Measurement for payment for joint testing will be measured on a unit basis (each). Payment will include supply of all labour, equipment, material, equipment tests, written and digital reports and all other work necessary to complete the pressure testing of each joint as described in the Form of Tender.
- .7 Measurement for payment of joint grouting will be measured on a unit basis (each). Payment will include supply of all labour, equipment, materials, mixing, grouting, joint seal verification and all other work necessary to complete the pipeline sealing as described in the Form of Tender.
- .8 Measurement of payment for post-installation CCTV inspection will be on a linear metre basis as described in the Form of Tender and in accordance with Supplementary Specifications - Sewer Cleaning - Section 33 01 30.2S.

1.9 Inspection and Testing

- .1 Contractor to provide Contract Administrator free access to inspect the materials, equipment and grouting procedure.
- .2 Contractor to provide Contract Administrator 48 hours advance notice of grouting operation including material mixing.
- .3 Contractor to maintain written log of grout gel times, equipment barrel tests, and intermediate pipe tests in accordance with procedures described in Section 11 of ASTM F 2304 -03 for mainline joint grouting
 - .1 Testing log to be maintain on a daily basis and made available for inspection by Contract Administrator.
- .4 Contractor to maintain written log of grout gel times, equipment barrel tests in accordance with procedures of ASTM F 2454-05 for sealing lateral connections.

2.0 PRODUCTS

2.1 Equipment

- .1 Joint grouting equipment to consist of closed circuit television camera, working in tandem with a joint testing device (packer) with inflatable bladders, and test monitoring equipment.
- .2 Equipment to provide means of introducing a controlled test medium, under pressure, into the void area created by expanded ends of the joint testing device.
- .3 Packers to be “*low void, flow through*” permitting some flow to pass through the center of the device and minimise the quantity of residual grout material.
- .4 Equipment to be capable of continually measuring the pressure within the void space created by the packer. Void pressure to be measured at the void space.
 - .1 Equipment to be capable of transmitting void pressure to the monitoring equipment by means of a transducer to the operating control compartment.
 - .2 Alternatively, pressure may be monitored by means of video image of the pressure gauge mounted on the packer and connected to the void space. Video image and gauge face to be adequately illuminated, clear of deleterious material and provide a clear and unobstructed view of the gauge pressure reading.
- .5 Viewing and control area to be above ground and 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 operator and Contract Administrator to clearly view the monitor screen and monitor grouting operation.
- .6 Lateral sealing packers to be capable of sealing 100mm and 150mm diameter laterals and sealing lengths of 1.0m in length from the mainline pipe.
- .7 Each unit to carry sufficient numbers of guides and rollers such that, when testing and grouting, all cables are supported away from pipe and manhole edges.
- .8 Vehicle to be equipped with a mobile telephone for communication with the Contract Administrator for the duration of the contract work.

**2.2 Grouting
Material**

- .1 Material requirements for Chemical grouts and additives to conform to ASTM F 2304 -10 Sections 6 and 7.
 - .1 Chemical sealant must be able to react and perform in the presence of ground water.

- .2 The resulting chemical grout formation must be capable of preventing the passage of infiltrating ground water and exfiltrating sewage.
- .3 Sealant material must not be biodegradable
- .4 The cured sealant material shall be chemically stable and resistant to the concentrations of acids, alkalis, and organics found in typical wastewater sewers.
- .5 Acrylamide and acrylic based grouts to have a controllable reaction time from 10 seconds to 1 hour.

- .2 The following materials are approved for use under these specifications:

- .1 Acrylamide Base Gel

- .1 A minimum of **12%** acrylamide base material by weight to be used in the total sealant mix. A higher concentration (%) of acrylamide base material may be requested by the Contract Administrator in order to increase strength or offset dilution during injection in areas of high infiltration

- .2 Acrylic Base Gel

- .1 A minimum of **12%** acrylic base material by weight to be used in the total sealant mix. A higher concentration (%) of acrylamide base material may be requested by the Contract Administrator in order to increase strength or offset dilution during injection in areas of high infiltration

- .3 Urethane Base Gel

- .1 The mix ratio for urethane prepolymer to be 1 part of urethane prepolymer to 8 parts of water (11% prepolymer).

2.5 Optional Additives

- .1 Additives that enhance the grout strength, reduce grout shrinkage protect against low temperature, increase viscosity, help fill large voids or inhibit root growth maybe used subject to approval of Contract Administrator.

3.0 EXECUTION

3.1 Preparation

- .1 Clean sewer in accordance with Standard Supplementary Specifications for “Flushing and Cleaning of Sewers and Culverts” Section 02736S
- .2 Conduct pre-installation CCTV inspection in accordance with Standard

Supplementary Specifications for CCTV inspection of Sewers - Section 02735S

- .3 Remove intruding portions of service connections to within 5mm of the mainline pipe wall. Finished surface of intruding connection to be left smooth to avoid damage to grouting equipment.
- .4 Notify Contract Administrator of any unforeseen obstructions or anomalies observed in the pre-installation CCTV inspection.
- .5 Notify effected property owners 24 hours in advance of disruption of service. Information notice to be pre-approved by Contract Administrator

3.2 Flow Control

- .1 Maximum depth of flow in sewer during testing and sealing work not to exceed the following:

150mm to 300mm pipe	25% of pipe diameter
300mm to 610mm pipe	30% of pipe diameter
685mm and up	35% of pipe diameter

- .2 Flow Control to be achieved by the following means:
 - .1 Schedule work for off peak flow times;
 - .2 Plug or block flows at upstream manhole.
 - .1 Obtain Contract Administrator's approval prior to plugging or impeding flow
 - .2 Plug to be flow-through type with control valve to allow for gradual release of sewage with surge or surcharging downstream main.
 - .3 Pumping and Bypassing
 - .1 Temporary bypass pump flow around section when required, as specified in contract documents. Flow to be pumped to downstream manhole on same system or run as work is to take place.
 - .2 Plug to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free.
 - .3 Flow to be pumped to downstream manhole on same system or run as work location.
 - .4 Obtain Contract Administrator's approval prior to setting

up temporary bypass pump system.

3.3 Grout Preparation

- .1 Follow manufacturer's instructions for the mixing and safety procedures. The total percent grout mix concentration shall be a minimum of **12%**. Any changes to this percent of mix shall be approved by the Contract Administrator.
- .2 Adjust gel time to compensate for changes in temperature in grout components, tanks and hoses. The addition of water to extend gel time is not acceptable unless the resulting base tank grout material exceeds 24% by weight for solution grouts.
- .3 Monitor grout component tanks for equal volume of draw down. If unequal volumes are noted, repeat above ground pump test and if necessary correct defective equipment.
- .4 Gel times shall be calculated using the following formula unless contractor experience and / or field conditions dictate otherwise. Once mutually established any alterations of the gel time formula shall be approved by the Contract Administrator

$$Gel\ Time = \left(\frac{Volume\ of\ Pipe\ / \ Packer\ Void\ Space\ (gal)}{Pumping\ Rate\ (gpm)} \right) \left(\frac{60\ sec}{1\ min} \right) + 20\ sec (+/-\ 5\ sec)$$

- .5 The temperature of the grout mixing water and catalyst water shall not be less than 4.5°C (40°F). Preheat water to meet minimum temperature of 4.5°C (40°F) prior to mixing grout. Maintain temperature of grout tank and catalyst tank above 4.5°C (40°F) overnight or during other inactive work periods.

3.4 Control Testing

- .1 Control Test – Conduct above ground control test in accordance with ASTM F2304 -10 Section 11.4.1 (Barrel Test) as requested by the Contract Administrator. Insert packer into a test cylinder and perform pressure test. The observed pressure shall be within +/- 3 kPa (1/2 psi) of the 48-69 kPa (7-10 psi) pressure applied to the test gauge to pass successfully. Release the air trapped in the void. The void pressure should drop to within +/- 3 kPa (1/2 psi) to pass successfully.
- .2 Intermediate Test – Conduct in-pipe Intermediate Test in accordance with ASTM F2304 -10 Section 11.4.2 as requested by the Contract Administrator.
- .3 Conduct a Pump Test at the end of the hoses to demonstrate equal proportions of grout and catalyst.

- .4 Gel set times – Conduct the following gel set tests and record results:
 - .1 Obtain sample from the ends of the packer hose after recycling to tanks prior to insertion of equipment into each sewer main and record gel times and temperatures.
 - .2 Obtain comparative sample from holding tanks at beginning of each working day and immediately after the preparation of each new batch of grout. Record gel times and temperatures.
 - .3 Conduct gel test and record gel times when the temperature in the tanks or ambient temperature changes by more than 5.5°C (10F) during the working day.

3.5 Joint Testing

- .1 All joints within sewer to be pressure tested.
- .2 Contractor to maintain log of joint locations that cannot be tested due to pipe configuration or other impediments.
- .3 Test each pipe joint on an individual basis with an air pressure test or water leakage test in accordance with ASTM F 2304-03 Section 11.6.2 *Air/Liquid Test Procedure*.
 - .1 Air test to equal 11kPa per one metre of pipe bury (0.5 psi per one foot) to a maximum of 69 kPa (approx.10 psi).
 - .2 In the presence of water table, air test to equal 20kPa (3 psi) in excess of the external hydraulic pressure to a maximum of 69 kPa (approx.10 psi).
- .4 Observe void pressure for 15 seconds.
 - .1 A pressure drop of less than 7 kPa (1 psi), then the joint will be considered as having passed.
 - .2 Additional pressure decay within the 15 second period, the joint will be considered as having failed.

3.6 Joint Sealing

- .1 Seal joints in accordance with procedures described under STM F2304 -10 Section 12.
- .2 Seal all joints that fail the leak test as prescribed under section 3.4 of this specification.
- .3 Seal all joints that show signs of visible active leakage.
- .4 No joint shall be considered sealed unless, while under continual pressure, an attempt is made to pump grout to “refusal”

- .1 Refusal shall mean that a minimum of 1.25 litres of chemical grout has been pump into the joint per 25mm diameter pipe size.
 - .2 Typical consumption rates indicated below:
 - 200 mm = 10.0 litres
 - 250 mm = 12.5 litres
 - 300 mm = 15.0 litres
 - 375 mm = 18.75 litres
 - .5 Deflate packer after sealing, allow grout to set for a minimum of 30 seconds. Re-inflate packer and repeat Joint Testing procedure as per Section 3.4 of this specification.
- 3.7 Testing of Laterals**
- .1 All laterals in the line to be tested unless specifically excluded by the Contract Administrator.
 - .2 Contractor to perform initial above-ground equipment test as described in Section 11.3.4 of ASTM F2454-05 in the presents of the Contract Administrator
 - .3 Test pressure for each lateral test to be 20Kpa (3psi.) higher than groundwater pressure up to a maximum of 40Kpa (6psi)
 - .4 Observe air pressure for a period of 15 seconds. Laterals exhibiting a pressure drop of 2psi or less are deemed to have passed the air test. Decay in pressure of more than 2psi will constitute a failed air test.
- 3.7 Grouting of Laterals**
- .1 Seal laterals with approved chemical grout that fail the air test described in Section 3.6 Test of Laterals in accordance with Section 12 of ASTM F2454-05
- 3.8 Residual Grout**
- .1 Remove residual sealing material from the joint and surrounding pipe walls by means of hydraulic flushing equipment. The sealed joint to be left smooth and flush with existing pipe surface.
- 3.9 Grouting Reports**
- .1 Maintain documented record of test and grouting procedure including the following data:
 - .1 Identification of the manhole section tested and grouted
 - .2 Type of pipe material
 - .3 Diameter of pipe
 - .4 Length of pipe sections between joints
 - .5 Depth of pipe to surface
 - .6 Test pressure used and duration of test, and
 - .7 Statement indicating the pass/fail test result for each joint tested
 - .8 Location (stationing) of each joint tested and location of nay joints not tested with an explanation for not testing.

- .9 The volume of grout material used to seal each joint
 - .10 The volume of grout placed per MH to MH section
 - .11 The gel times as recorded per Section 3.3.3 of this specification
 - .12 The test pressure after sealing and the duration of test
 - .13 Barrel test results
 - .14 The type of grouting material used and their respective quantities
- .2 Present hardcopy and digital copy of testing log together with corresponding joint testing and grouting record for each section of sewer main within 10 days of completion of grouting.
 - .3 Present report in 215 mm x 280 mm three ring (D type) binder complete with identification labels
 - .1 Each binder to commence with an index of all sewer sections rehabilitated with chemical grout.
- 4.0 Post Installation
CCTV Inspection**
- .1 Conduct post installation CCTV inspection within 7 days of chemical grouting in accordance with Sections 33 01 30.1S.
 - .2 Submit copy of inspection report to Contract Administrator.

END OF SECTION

- 1.0 GENERAL** .1 Section 33.05.25S refers to those portions of the work that are unique to the requirements for the rehabilitation of localized defects in existing sanitary, storm and combined sewer pipe and pipe culverts. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.1 Related Work**
- .1 Traffic Regulation Section 01 55 00.1S
 - .2 Cleaning of Sewers Section 33 01 30.2
 - .3 CCTV Inspection Section 33 01 30.1S
- 1.2 Work Regulations**
- .1 Work to conform to all applicable regulations of WorkSafe BC. Confirm training compliance in the following:
 - .1 Confined space entry procedures.
 - .2 Atmospheric monitoring and ventilation methods.
 - .3 Personal protective equipment.
 - .4 Interpretation of Material Safety Data Sheets (MSDS).
 - .2 Provide written confirmation to the Contract Administrator that workers have knowledge of confined space entry practices and of equipment required for confined space entry.
 - .3 Comply with the Material Safety Data Sheet for the particular chemicals used in the preparation of the CIPP repair material. In particular where dictated, personnel safety equipment shall be worn when mixing the chemical resins or when physical contact with the chemical material is a possibility.
- 1.3 Shop Drawings (Submissions)**
- .1 The following shop drawings are required in accordance General Conditions Section 5.0, "Shop Drawings", subsection 5.2 "Submission of *Shop Drawings*". ***These calculations are not required at the time of tender but will be requested upon award of contract.***
 - .1 A design submission detailing all liner thickness computations in accordance with these specifications sealed by a Professional Engineer of holder of an Engineering License under APEG BC.
 - .2 For design purposes assume the depth of bury of each sanitary sewer is 3.0m.

- .3 Independent third party verification of the flexural strength of the composite fabric tube and resin system(s) proposed for use based on ASTM D790 or ASTM D2990.
- .4 An operations protocol outlining the following:
 - .1 Resin impregnation (“wet-out”) protocol.
 - .2 Documentation that the resin proposed for use has not exceeded it’s shelf life as recommended by the manufacturer of the resin.
 - .3 The volume of resin to be impregnated for each 1.0 m of repair for each diameter of pipe including allowance for polymerization and migration into cracks and joints of the host pipe.
- .5 Curing Schedule including recommended duration and pressure required to effect a proper cure of the resin and fabric tube composite.

1.4 Measurement for Payment

- .1 All units of measurement for payment will be specified herein unless shown in the Form of Tender.
- .2 Measurement for payment for sewer cleaning will be on a per linear metre basis as described in the Form of Tender and in accordance with Cleaning of Sewers – Section 33 01 30.2
- .3 Measurement for payment of Pre-installation CCTV inspection will be on a linear metre basis as described in the Form of Tender and in accordance with CCTV Inspection of Pipelines 33 01 30.1..
- .4 Measurement for payment of removal of intruding connections will be paid at the unit price as described in the Form of Tender. This shall include the supply of all equipment and labour to remotely remove intruding connections comprised of PVC, vitrified clay, concrete, asbestos cement and cast iron.
- .5 Measurement for payment for the localized trenchless point repair will be made on a lump sum basis for the respective locations described in the Form of Tender. The length to be paid for shall be the total number of linear metres described in the Form of Tender.
- .6 Measurement for payment of service connection re-instatement will be paid at the unit price as described in the Form of Tender. This shall include the supply of all equipment and labour to remotely re-instate designated service connections.

- .7 Measurement for payment of Post-installation CCTV inspection will be on a linear metre basis as described in the Form of Tender and in accordance with CCTV Inspection of Pipelines – Section 33 01 30.1.

2.0 PRODUCTS

2.1 Materials

- .1 Minimum material requirements for CIPP trenchless point repairs to conform to ASTM D5813 “Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe”.
- .2 Premium polyester resins that do not contain a styrene monomer;
- .3 Vinyl Ester resins that do not contain a styrene monomer;
- .4 Epoxy resin.
- .5 Resin used for impregnation to be consistent with the product identified in the ASTM D2990 testing performed by the resin manufacturer and submitted at the time of tender. If no long-term testing is available than the short-term Modulus of Elasticity to be discounted by 50%.
- .6 Volume of resin to be consistent with the volume calculations submissions in accordance with ASTM F1216, Section 7.2 *Resin Impregnation* including an allowance between 5% to 10% for change in resin volume due to polymerization and migration.

2.2 Workmanship

- .1 The finished CIPP point repair shall conform to Clause 6.2 of ASTM D5813.

2.3 Physical Samples

- .1 Two (2) test samples to be prepared in 0.5 metre lengths of PVC pipe provided by contractor.
- .1 One (1) sample of 150 mm diameter.
- .2 One (1) sample of 200 mm diameter.

2.4 Repair Dimensions

- .1 The minimum length of trenchless point repair at each location as described in the Form of Tender and the associated drawings but in no circumstances should it be less than 0.3m into the adjacent pipe on each side of the damaged pipe section.

3.0 EXECUTION

- 3.1 Cleaning** .1 Flush and Clean pipelines as per Section 33 01 30.2 immediately prior to installation of repair system.
- 3.2 Root Cutting** .1 Remove roots as per section 33 01 30.2 as required to ensure quality installation.
- 3.3 By-pass Pumping** .1 Temporary bypass pump flow around all sections prior to the installation of repair, as specified in contract documents. Plug to be flow through with hoses and pump 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. Obtain Contract Administrator's approval prior to setting up temporary bypass pump system.
- .2 Alternative to by-pass pumping maybe considered under exceptional circumstances with the following options, subject to Contract Administrator's approval.
- .1 Schedule work for off peak flow times. Flows levels to be maintained at less than 5 % of pipe diameter.
- .2 Plug or block flow at upstream manhole. Plug designed to either plug all flow or impede flow to a maximum of 5% pipe diameter.
- .3 Obtain Contract Administrator's approval prior to plugging or impeding any flow.
- .4 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.
- 3.4 CCTV Inspection** .1 Perform full length, manhole to manhole, pre-repair CCTV inspection of each sewer main to be repaired in accordance with CCTV Inspection of Pipelines, Section 33 01 30.1.
- .2 Perform full length, manhole to manhole post-repair CCTV inspection of each sewer main and trenchless repair in accordance with CCTV Inspection of Pipelines, Section 33 01 30.1. Post lining inspection to confirm the fit and finish of the repair section including the transition areas between repair and host pipe.
- .3 Present both pre and post repair CCTV inspection reports in sequence as per Clause 3.8 of Section CCTV Inspection of Pipelines, Section 33 01 30.1.

- 3.5 Dimension check** .1 Verify all host pipe diameters via physical check and confirmation in the field for each section of sewer main scheduled for repair.
- 3.6 Test Samples** .1 Prepare and cure the representative samples identically to the protocol for the preparation and installation of the trenchless point repair in the sewer main. Additionally, the sample shall be held in place by a suitable heat sink such as sandbags.
- .2 Prepare test samples and cure as instructed in presence of the Contract Administrator.
- 3.7 Owner's Inspection** .1 Owner' representative to be present at all of the following stages of Trenchless Technology point repair preparation and installation:
- .1 Impregnation of fabric with resin for test samples.
- .2 Termination of curing procedure for test samples.
- .2 All work associated with the installation of the Trenchless point repair systems to take place in the presence of the Contract Administrator unless waived in writing.
- 3.8 Installation** .1 Install Trenchless Point Repair system in accordance with manufacture's instructions and shop drawings (submissions) (Clause 1.3 of this document).
- 3.9 Criteria for Acceptance** .1 The following criteria will be considered as a minimum standard for pre-acceptance:
- .1 Repair material to be free of any folds and creases.
- .2 Transition between repair material and host pipe to be smooth, free of any excess resin or other appendages that could impact the hydraulic performance of the pipe.
- 4.0 DESIGN REQUIREMENTS**
- 4.1 Design Objectives** .1 The design objectives for carrying out trenchless point repairs by CIPP methods include:
- .1 Maximize the structural enhancement of the point repair system by provision of a close-fit liner with minimal annulus between the liner and the host pipe.
- .2 Provide minimal impact or increase to the hydraulic capacity of the rehabilitated sewer.

- .3 Provide a smooth transition between the point repair and the host pipe to prevent the build-up of solids and minimize wear on the point repair system due to routine sewer cleaning and maintenance activities.
 - .4 Mitigate infiltration and exfiltration at the point of repair.
 - .5 Minimize sewer service disruption as a result of the repair.
- 4.2 Point Repair Liner Design**
- .1 Calculations will assume that all sections of sewer main to be rehabilitated are considered to be “*Fully Deteriorated*”. Designs will be based on the modified AWWA formula as detailed in Appendix XI of ASTM F1216 latest edition.
 - .2 The following minimum design assumptions shall be employed:
 - .1 The total external pressure on the pipe shall include an allowance for an AASHTO HS20 concentrated live load.
 - .2 The minimum soil density utilized in computation of dead load shall be 1920 kg/m³.
 - .3 The height of the water above the pipe shall be based on the assumption that the groundwater table is 1.0 metre below the ground surface elevation.
 - .4 The ovality reduction factor shall be based on a minimum value of 3% unless a greater value is specified or warranted based on the Contractor’s observation of the CCTV inspection.
 - .5 The long-term value for the flexural strength (E_L) shall be deemed to be:
 - .1 The projected value at 50 years of continuous application of the load based on the specific resin and felt composite proposed for use as established by ASTM D2990 – Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics, or, in the case of having no ASTM D2990 values.
 - .2 25% of the flexural strength value as established by ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

- .6 The modulus of soil reaction (E's) shall be assumed to be 6900kPa unless a higher or lower value is specified.
- .7 The minimum factor of safety (N) to be utilized in the fully deteriorated design analysis shall be 2.
- .8 A design check using Manning's formula shall be performed to confirm that the rehabilitated section will have a hydraulic capacity equal to or greater than the existing pipeline The assumed value for Manning's "n" for the CIPP section shall be 0.011.

END OF SECTION

Canada Mortgage and Housing Corporation
Standard CCTV Digital File Format – Header Table

HEADER TABLE

NAAPI FIELD NAME	DATA TYPE	FIELD PROPERTIES	FIELD NAME
ID	AutoNumber		
SURVEYEDBY	Text	12	
CONTRACTNUMBER	Text	8	
JOBNUMBER	Text	10	
CATCHMENT	Text	10	
DIVISION	Number	Byte	
DISTRICT	Text	3	
PIPELENGTHREF	Text	11	
DATE	Date/Time		
TIME	Date/Time		
LOCATION	Text	50	
STARTMANHOLE	Text	10	
SDEPTH	Text	4	
SCOVER	Number	Single	
SINVERT	Number	Single	
FINISHMANHOLE	Text	10	
FDEPTH	Text	4	
FCOVER	Number	Single	
FINVERT	Number	Single	
USESEWER	Text	1	
DIRECTION	Text	1	
SIZE1	Number	Integer	
SIZE2	Number	Integer	
SHAPE	Text	1	
MATERIAL	Text	3	
LINING	Text	3	
PIPELENGTH	Number	Single	
TOTALLENGTH	Number	Single	
YEARLAID	Text	4	
VIDEONUMBER	Text	5	
COMMENTS	Text	50	
PURPOSE	Text	1	
SEWERCATEGORY	Text	1	
PRECLEANING	Text	1	
WEATHER	Text	1	
LOCATIONCODE	Text	1	
FURTHERDETAILS	Text	48	

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Standard CCTV Digital File Format – Header Table
CONDITION DETAILS TABLE

FIELD NAME	DATA TYPE	FIELD PROPERTIES	CITY OF..... FIELD NAME
ID	AutoNumber	Long integer	
VIDEONUMBER	Date/Time	hh:nn:ss	
PHOTOGRAPHNUMBER	Number	Integer	
DISTANCE	Number	Single	
CONTINOUSDEFECT	Text	2	
CODE	Text	4	
DIAMETER_DIMENSION	Number	Integer	
CLOCKFROM	Number	Integer, "00"	
CLOCKTO	Number	Integer, "00"	
PERCENTAGE	Number	Byte	
INTRUSION	Number	Integer	
JOBNUMBER	Text	10	
REMARKS	Text	34	