SECTION 02752

Internal Sewer Condition Assessment

PART 1 – GENERAL

1.01 SCOPE

A. It is the intent of this contract to assess the internal structural and service condition of sewers prior to preconditioning or rehabilitation. Assessment will be performed using pan and tilt color camera-CCTV. In those circumstances where depth of flow is too great for CCTV, sonar or a combination of sonar and CCTV shall be used.

B. It is also the intent of this contract to inspect individual sewer lines that have been preconditioned to further assess condition and record findings.

C. It is the responsibility of the Contractor to comply with OSHA regulations, the City of Atlanta's Safety Guidelines, and the City of Atlanta's Confined Space Guidelines as applicable. The Contractor shall provide written documentation that all workers have received the training required under these regulations and guidelines.

D. The form of internal condition assessment that is required as part of this Contract as follows:

1. Sewer inspection – Viewing the sewer ("pull-through") pursuant to investigative work possibly incorporating a radio-sonde transmitter for locating purposes and/or following other operational activity including:

    a. Locating manhole(s) and/or lateral(s) with or without radio-sonde

    b. Sewer preconditioning and cleaning activities

    c. Sewer rehabilitation, including point repairs

    d. Such other similar purposes as may be required by the engineer

    e. Sewer inspection shall be carried out manually or with the aid of CCTV and/or sonar equipment, to assess overall condition. No detailed data logging is required, but a report containing header information only is required.

3. Service lateral inspection – Assess and document the internal condition of all Connections and Junctions pursuant to investigative work and/or following other operational activity including:

    a. Locating lateral(s) with or without radio-sonde

    b. Sewer preconditioning and cleaning activities

    c. Service lateral rehabilitation, including point repairs

d. Such other similar purposes as may be required by the Engineer

e. Service lateral inspection shall be carried out manually or with the aid of CCTV and/or Sonar equipment, if required by one of the four conditions above, to assess overall condition. No detailed data logging is required, but a report containing header information only is required.

1.02 SUBMITTALS

A. The Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

Type of Submittal	Time/Frequency of Submittal
Experience Record of Contractor and/or Subcontractor(s)	**With the Bid Documents**
Listing of CCTV and SONAR Equipment	In accordance with Section 01300 - Submittals
2 Copies of CCTV and SONAR findings (2 hard copies of fully detailed logs incorporating a summary statistical breakdown of defects and main findings, 2 electronic discs of fully detailed logs and CD-ROMS of video output)	One week After Completion of Section
Daily Logs and Progress Reports	Daily
Confined Space Entry Logs	Bi-Weekly
External Hard Drive containing CCTV video, photos, and detailed logs	Prior to Contract Close-out

B. Daily reports shall be provided via e-mail to the designated engineer. Daily reports shall be provided no later than 5:00PM on the second day following the survey. Weekly reports shall be provided no later than 5:00PM on the first Monday following the week of the survey.

C. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract. The Contractor shall include in his daily record, reference to:

1. Delays: e.g. Dense traffic, lack of information, sickness, labor or equipment shortage

2. Weather: conditions, e.g. rain, etc.

3. Equipment: on site, e.g. specialist cleaning, by-pass equipment, etc.

4. Submittals: to the designated engineer representative

5. Personnel: on site by name, e.g., all labor, Specialist Services, etc.

6. Accident: report, e.g. all injuries, vehicles, etc.

7. Incident: report, e.g. damage to property, property owner complaint, etc.

8. Major defects encountered, including collapsed pipe, if any: e.g. cave-ins, sink holes, etc.

9. Visitors: on site

D. The designated Engineer on site shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Engineer may at his discretion, for which the Contractor must receive direction in writing, an exception to this requirement for weekly submission of progress rather than for daily submission.

1.03 REQUIREMENTS AND EXTENT OF INSPECTION

A. The Contractor shall inspect pipelines with color pan and tilt CCTV imagery and sonar and or combined color pan and tilt CCTV/Sonar (TISCIT) as specified so as to record all relevant features and to confirm their structural and service condition. Inspections of pipelines shall be carried out in accordance with the reporting format determined by the Engineer. A sample report sheet is attached to this specification (Attachment B) and includes the recording of both target total length of sewer inspected between manholes as well as actual length inspected.

B. All CCTV/sonar operator(s) responsible for direct reporting of sewer condition shall have a minimum of 3 years previous experience in surveying, processing, and interpretation of data associated with CCTV and sonar inspections. The Contractor shall provide the designated Engineer with written documentation that all CCTV and sonar survey operators meet these experience requirements which shall include a list of projects undertaken as well as client name and telephone number for reference.

C. All approved Contractors will be required to provide certification that they have undergone training prior to undertaking internal condition assessment work in the City of Atlanta. Material, Shape and Lining Coding used throughout the project

will conform to the attached listing (Attachment C). General inspection logging requirements are also included with this Section (Attachment D). Training will be carried out at the Contractor expense. No charge will be levied for the training, which is expected to last two days.

D. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the Contract.

1.04 INSPECTION UNITS

The Contractor shall provide sufficient inspection units and all relevant ancillary equipment, including standby units in the event of breakdown, in order to complete all sewer and manhole inspections as specified.

1.05 INSPECTION VEHICLE

A. The inspection vehicle shall comprise two totally separate areas. One of these, designated as the viewing area, shall be insulated against noise and extremes in temperature, include the provision for air conditioning, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the specification. Seating accommodation shall be provided by the Contractor to enable two people, in addition to the operator, to view clearly the on-site monitor, which shall display the inspection as it proceeds.

B. The working area shall be reserved for equipment, both operational and stored, and no equipment utilized within the sewer shall be allowed to be stored in the viewing area.

C. The Contractor shall allow in the rates and provide at no additional cost, a vehicle when required by the City, together with a driver, to assist with visual reconnaissance surveys and/or inspections. The vehicle shall be suitable for carrying the survey team and laborers and shall be equipped with the following:

1. Equipment for easing and lifting manhole covers.

2. Sewer safety equipment.

3. Road safety equipment.

4. Protective clothing for the survey/inspection teams comprising coveralls, boots, gloves, hard hat etc.

1.06 CCTV INSPECTION AND OPERATIONAL EQUIPMENT REQUIREMENTS

A. The inspecting equipment shall be capable of inspecting a length of sewer at least 1500 ft. when entry onto the sewer may be obtained at each end and up to 100 ft. by rodding or up to 750 ft. where a self propelled unit is used, where entry is possible at one end only. The Contractor shall maintain this equipment in full working order and shall satisfy the designated Engineer at the commencement of each working shift that all items of equipment have been provided and are in full working order.

B. Each inspection unit shall contain a means of transporting the CCTV camera and/or sonar equipment in a stable condition through the sewer under survey and/or inspection. Such equipment shall ensure the maintained location of the CCTV camera or sonar equipment when used independently on or near to the central axis of a circular shaped sewer when required in the prime position.

C. Where the CCTV camera and/or Sonar head are towed by winch and bond through the sewer, all winches shall be stable with either lockable or ratcheted drums. All bonds shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera and/or Sonar equipment. All winches shall be inherently stable under loaded conditions.

D. Each unit shall carry sufficient numbers of guides and rollers such that, when surveying or inspecting, all bonds are supported away from pipe and manhole structures and all CCTV/Sonar cables and/or lines used to measure the CCTV camera's/sonar head location within the sewer are maintained in a taut manner and set at right angles where possible, to run through or over the measuring equipment.

E. Each unit shall carry a range of flow control plugs or diaphragms for use in controlling the flow during the inspection. A minimum of one item of each size of plug or diaphragm ranging from 6 inches to 2 feet diameter inclusive shall be carried.

F. Each inspection unit shall have on call equipment available to carry out the flushing, rodding and jetting of sewers as and when such procedures are deemed to be necessary.

1.07 FIELD SUPERVISION BY CONTRACTOR

The Contractor shall maintain on site at all times a competent field supervisor in charge of the inspection, see item 3.1 below. The field supervisor shall be approved in writing by the designated Engineer prior to commencement of Work. Any change of supervision must also be approved in writing by the designated Engineer prior to the change. The field supervisor shall be responsible for the safety of all site workers and site conditions as well as ensuring that all work is conducted in conformance with these specifications and to the level of quality specified.

1.08 APPLICATION OF INSPECTION TYPE

The following guidelines concerning the use of CCTV and sonar shall be followed, subject to the review and approval of the designated Engineer:

1. Generally CCTV alone shall be used for internal condition assessment where the depth of flow of sewage is less than 25% of overall sewer diameter at the start of the survey. The Contractor will make an informed decision to continue should the depth of flow increase beyond the 25% level but no greater than 40% of overall sewer diameter at any time throughout the length.

2. Generally CCTV combined with sonar shall be used for internal condition assessment where depth of flow of sewage varies from 25% to 75% of overall sewer diameter for sewers greater than 24-inches in diameter. Where the sewer is less than 24-inches in diameter and depth of flow of sewage exceeds 25% and is less than 75% of overall sewer diameter the designated Engineer shall instruct Contractor to either: (a) continue using CCTV (where depth of flow is only marginally greater than 25% of overall diameter) or (b) use sonar (by damming or plugging the sewer so that depth of flow exceeds 75% of overall diameter).

3. Generally sonar alone shall be used where depth of flow in the sewer exceeds 75% of overall diameter and the level of the flow will be artificially increased, without the risk of flooding, to ensure that the pipe is completely surcharged.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 CLEANING PRIOR TO INTERNAL CONDITION INSPECTION

A. Where required by the City and only when instructed in writing, the Contractor shall clean the sewer prior to internal condition inspection. Cleaning shall be carried out in conformance with Section 02511 – Preconditioning and Cleaning of Manholes and Sewers.

3.02 SEWER CLEANING UNITS AND EQUIPMENT

A. The Contractor shall provide sufficient sewer cleaning units and equipment, including standby units in the event of breakdown, in order to complete cleaning operations as specified.

3.03 CCTV/SONAR – GENERAL

A. CCTV Camera/Sonar Head Prime Position: The CCTV camera/sonar head shall be positioned to reduce the risk of picture distortion. In circular sewers the CCTV camera lens and/or sonar head shall be positioned centrally (i.e. in prime position) within the sewer. In non- circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera lens/sonar head shall be positioned looking along the axis of the sewer when in prime position. A positioning tolerance of ± 10% of the vertical sewer dimension shall be allowed when the camera is in prime position.

B. CCTV Camera/Sonar Head Speed: The speed of the CCTV camera in the sewer shall be limited to 8 inches per second for surveys to enable all details to be extracted from the ultimate CD-ROM recording. Similar or slightly higher speed as agreed by the designated Engineer shall be provided for inspections. The speed of scanning sonar shall be limited to 4 inches per second.

C. CCTV Color Camera: The Contractor shall provide a color pan and tilt camera(s) to facilitate the survey and inspection of all laterals, including defects such as hydrogen sulfide corrosion in the soffit of sewers and benching or walls of manholes over and above the standard defects that require reporting, where required by the designated Engineer. These will be carried out as part of the normal CCTV assessment as the survey or inspection proceeds when instructed by the designated Engineer. A 360˚ rotational scan indicating general condition must be implemented at every 50 feet interval (min.) along sewers, and at manholes and any salient, specified, defect features. The tilt arc must not be less than 225°.

D. Linear Measurement:

1. The CCTV/Sonar monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the footage of the camera or center point of the transducer, whichever unit is being metered, from the cable calibration point. The relative positions of the two center points should also be noted.

2. The Contractor shall use a suitable metering device, which enables the cable length to be accurately measured; this shall be accurate to ±1% or 3 inches whichever is the greater.

3. The Contractor shall demonstrate compliance with the tolerance in Sub-clause 3.7 D.2 is being complied with, using one or both of the following methods in conjunction with a linear measurement audit form which shall be completed each day during the survey:

    a. Use of a cable calibration device

b. Tape measurement of the surface between manholes

A quality control form will be completed and submitted by the Contractor depicting the level of accuracy achieved.

4. If the Contractor fails to meet the required standard of accuracy, the designated Engineer shall instruct the Contractor to provide a new device to measure the footage. The designated Engineer retains the right to instruct the Contractor in writing, to re-survey those lengths of sewer first inspected with the original measuring device using the new measuring device.

E. Data Display, Recording and Start of Inspection:

1. At the start of each sewer length being inspected and each reverse set-up, the length of pipeline from zero footage, the entrance to the pipe, up to the cable calibration point shall be recorded and reported in order to obtain a full record of the sewer length. Only one survey shall be indicated in the final report. All reverse set-ups, blind manholes, and buried manholes shall be logged on a separate log. Video digits shall be recorded so that every recorded feature has a correct tape elapsed time stamp. Each log shall make reference to a start (ST) and finish (FH) manhole unless abandonment took place because of blockage. Manhole number shall be indicated in the remark's column of the detail report. Inspections must not extend over 2 CD-ROMs.

2. The footage reading entered on to the data display at the cable calibration point must allow for the distance from the start of the inspection to the cable calibration point such that the footage at the start of the survey is zero.

3. In the case of inspecting through a manhole where a new header sheet must be completed, the footage shall be set at zero with the camera focused on the outgoing pipe entrance.

4. At the start of each manhole length a data generator shall electronically generate and clearly display on the viewing monitor and subsequently on the CD-ROM recording a record of data in alpha-numeric form containing the following minimum information:

   a. Automatic update of the camera's footage position in the sewer line from adjusted zero

   b. Sewer dimensions

   c. Manhole/pipe length reference numbers

   d. Date of inspection

   e. Road name/location

f. Direction of inspection

g. Time of start of inspection

h. Sewer use (S-Sanitary Sewer, C-Combined Sewer, etc)

i. Material of construction of the pipe

5. The size and position of the data display shall be such as not to interfere with the main subject of the picture.

6. Once the survey of the pipeline is under way, the following minimum information shall be continually displayed:

   a. Automatic update of the camera's footage position in the sewer line from adjusted zero (see Sub-clause E4)

   b. Sewer dimensions in inches

   c. Manhole or pipe length reference number (PLR). General convention allows upstream manhole number to be designated PLR

   d. Direction of survey, i.e., downstream or upstream

7. Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of the test tape or other device approved by the Contractor. Satisfactory performance of the camera shall be demonstrated by the recording of the appropriate test device at the commencement of each day for a minimum period of 30 seconds.

8. Footage and corresponding time elapsed video digit shall be given throughout inspection for all construction features encountered unless otherwise agreed.

9. Where silt encountered is greater than 10 percent of the diameter of the pipe, the depth of silt shall be measured and recorded at approximately 50-foot intervals.

10. CD-ROM capacity shall be adequate to record two hours of video inspection. Recording of a single segment shall not extend over more than one CD-ROM. No unrecorded gaps shall be left in the recording of a segment between surveys/inspections as the original video tape.

11. Only segments between manholes on the same sewer reach or basin shall be included on one CD-ROM. There shall be no “split surveys” or “split-basins” between CD-ROMs.

12. All continuous defects shall incorporate a start and finish abbreviation in the log report

F. Coding: Material, Shape, and Lining Coding, and conventions used throughout the project will be provided by the designated Engineer. See Attachments to this Section. The CCTV Contractor must ensure that all operators conform to the detailed requirements of the reporting procedure concerning feature description and feature definition as well as the Sewer1.Dat computer file format attached. An example Sewer1.Dat Data File has also been provided in Attachment E.

3.04 CCTV AND SONAR SURVEY DATA SPECIFICATION

A. CCTV Reporting:

1. No later than fourteen days following the completion of a pipeline inspection, Contractor shall submit to the Engineer two hard copies of all details, i.e. typed "Full English" reports including two floppy diskettes containing the data transfer file and two CD-ROM's shall be submitted to the designated Engineer. The supplied data and information shall remain the property of the City.

2 The report shall be computer validated using AMPS/EXAMINER software, or equivalent approved by the designated Engineer, and presented on two floppy diskettes to provide a summary listing of the number and type of features including defects found for each section of pipeline. The report format is shown in the attached specimen report. This specimen report sheet shall be accurately and fully adopted in style, format and in detail.

3. When requested, the Contractor shall provide hard copy output or manually completed site coding sheets at the time of the inspection and shall forward copies of these sheets to the designated Engineer, preferably each day, but at least every other day, together with a daily report on progress.

4. Inspection reports shall contain all header information. A summary observation shall be included as a comment in the header indicating the general condition of the segment for which the inspection was required. The detailed section of the report will include coding for the for the start (ST), manhole (MH), water level (WL), finish manhole (MH) where appropriate, and finish (FH) or survey abandoned (SA) as appropriate, together with all the supplemental information otherwise required for the "survey".

B. Site Coding Sheets: Each sewer length, i.e. the length of sewer between two consecutive manholes, shall be entered on a separate coding sheet or entered separately electronically. Thus where a Contractor elects to "pull through" a manhole during a CCTV and/or Sonar inspection a new coding sheet shall be started at the manhole "pulled or walked through" and the footage re-set to zero on the coding sheet. Where a length of sewer between consecutive manholes is inspected from each end (due to an obstruction) two coding sheets should be used. Where a length of sewer between two consecutive manholes cannot be inspected or

attempted for practical reasons a (complete header) coded sheet shall be made out defining the reason for abandonment. At uncharted manholes a new coding sheet must be started and the footage re-set to zero.

C. Measurement Units: All dimensions shall be in feet and inches. Measurement of sewers shall be to the nearest inch.

D. CCTV Photographs:

1. Photographs shall be taken of all defective laterals and pipeline defects where requested in writing. Where a defect is continuous or repeated the photographs shall be taken at the beginning of the defect and at not less than 10 foot intervals thereafter. Where photographs are not otherwise required a general condition photograph shall be taken not more than 50 feet after the previous photograph.

2. CCTV Photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment.

3. Photographs must be durable and 3"x5" size and shall be supplied in a suitable album or storage drawer the standard of which shall be to the satisfaction of the designated Engineer.

4. Still photographs shall be durable and clearly identified in relation to the photograph number (cross referenced to the site survey sheet) street location, sewer dimensions, manhole start and finish numbers, survey direction, footage and date when the photograph was taken.

5. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 14 point, and be type printed in upper case.

6. The annotation shall be positioned so as not to interfere with the subject of the photograph.

7. The Contractor shall provide color photographs using digital camera or such other mutually agreed upon hard copy color image together with electronic copy.

E. Control Sample Photographs and/or CD-ROMs: The designated Engineer may issue a written instruction to the Contractor to provide a sample of the photographs and/or CCTV/Sonar video taken during the contract period which the Contractor shall provide within 5 working days of receiving the written instruction.

3.05 SERVICE LATERAL INSPECTION DATA SPECIFICATION

A. For service line inspections launched from the mainline during a mainline inspection:

1. Contractors will assess and document the internal condition of all Connections and Junctions using the previously described procedures, with the exception of ending abandoned service line inspections launched from the mainline. Use "GOA" to note abandonment.

2. A number will be entered into the "Photo No." field that represents a sequential numbering of the services found. The services will be numbered 01, 02, 03, etc. When the inspection is a reverse setup and the number of services has not exceeded 50, the numbering shall begin with 51 on the reverse. (It is unlikely that there will be more than 50 services on the first survey that is abandoned, however, should this occur, numbering shall continue on the reverse with the same sequence begun on the first survey.)

3. The end of the inspection of the service line at the property line shall be entered "GO" (General Observation code), along with the service line number in the "Photo No." column, and the distance to the end of the survey in the "Remarks" column. The "Distance" will also be the same as for the Connection or Junction. When a survey is abandoned, the code "GOA" shall be used and the reason for the abandonment stated in the "Remarks" column.

4. Measurements shall be taken from the wall of the mainline pipe.

B. For service line inspections conducted from a cleanout (or as a <u>separate</u> inspection launched from the mainline), the inspection shall be recorded as a normal mainline inspection with the following exceptions:

1. When the mainline is inspected or surveyed, all services shall be numbered using a number in the "Photo No." field, as explained above.

2. The "Start Manhole" shall be entered as the upstream manhole followed by "_01", "_02", etc. Where the "_01" corresponds to the service number assigned when the mainline was surveyed.

3. The upstream manhole shall be entered as the PLR.

4. The "Address" shall be the address of the house connected by the service line.

5. If the inspection begins at a cleanout, the "Direction" is entered as "D". If the inspection begins from the mainline, the "Direction" is entered as "U".

6. "=Service Line=" shall be entered in the "Location Details" field.

3.06 CCTV/SONAR PERFORMANCE

A. Color CCTV/Sonar: All CCTV and/or Sonar work shall use color CCTV/sonar reproduction.

B. CCTV Picture Quality:

1. An approved test device shall be provided and be available on site throughout the Contract, enabling the tests specified in this clause to be checked.

2. The test card shall be Marconi Regulation Chart No. 1 or its approved derivatives with a color bar, clearly differentiating between colors, with no tinting, to show the following: White, Yellow, Cyan, Green, Magenta, Red, Blue, and Black.

3. At the start of each and every working shift, the camera shall be positioned centrally and at right angles to the test card at a distance where the full test card just fills the monitor screen. The Contractor shall ensure that the edges of the test card castellations coincide with the edges of the horizontal and vertical scan (raster). The card shall be illuminated evenly and uniformly without any reflection. The illumination shall be to the same color temperature as the color temperature of the lighting that recorded for subsequent use by the designated Engineer, the recording time to be at least 30 seconds. The type of camera used is to be identified on the test recording. The recording must show the camera being introduced into the test device and reaching its stop position. Other test devices may be used subject to approval by the designated Engineer. Test recordings shall also include the time and date of the recording. Test recordings shall be delivered to the Engineer on a weekly basis. The test recordings may be delivered on VHS tape or CD-ROM.

4. The electronic systems, television camera and monitor shall be of such quality as to enable the following to be achieved:

C. Shades of Gray: The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five clearly recognizable stages.

D. Color: With the monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no tint.

E. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole of picture. The center circle shall appear round and have the correct height/width relationship (± 5%).

F. Resolution: The live picture must be clearly visible with no interference and capable of registering a minimum number of TV lines/pictures height lines. The resolution shall be checked with the monitor color turned down. In the case of tube cameras this shall be 600 lines.

G. Color Constancy: To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color constancy, generally no variation in illumination shall take place during the survey.

1. The Contractor shall note that the designated Engineer may periodically check both the live and picture color consistency against the color bar. Any differences will require re-survey of the new length or lengths affected, at the Contractor's expense.

H. CD-ROM Labeling:

1. . CD-ROM playback imaging shall be linked to electronic out put of alpha-numeric data so that if necessary direct interrogation of database can take place with simultaneous viewing of CCTV/sonar images.

2. Each CD-ROM disc shall be labeled by reference to the header record for the survey section completed together with the following information:

    a. Client Name: "City of Atlanta"

    b. Project Name

    c. Contractor's Name

    d. Contractor's logo is optional

    e. Survey date(s)

    f. Survey Method: "CCTV – Internal Sewer Condition Assessment"

    g. CD Volume Label – "XXXXXXYYZZTT", where:

        i. XXXXXX is the Sewershed abbreviation, as provided by the City

        ii. YY is the Company abbreviation, as provided by the City

        iii. ZZ is the unique crew leader initials

        iv. TT is a sequence number maintained for the crew leader

h. Video Filename(s): Alphanumeric using any convention. Filename is to be included in the header field as specified. Filename is limited to 5 characters (e.g. "00001" to "00004")

I. CCTV Focus/Iris/Illumination: The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated. The adjustment of focus and iris shall provide a minimum focal range from 6 inches 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. The illumination must allow an even distribution of the light around the sewer perimeter without the loss of contrast picture, flare out or shadowing.

J. Sonar Survey Requirements:

1. Rates shall allow for:

   a. Complete structural and service assessment to the equivalent standard as that obtained through conventional CCTV imagery

   b. The means of attenuating flow, where necessary, to facilitate appraisal of the full sewer cross section

   c. Measurement of flow depth and silt depth.

2. Rates shall allow for continuous output on conventional annotated CD-ROM format of all sewers surveyed, supported by complete defect code sheets. Additionally, silt levels shall be assessed as a percentage depth of sewers at 25 foot intervals for each pipeline surveyed. To facilitate this requirement, and in addition, to assist in diametrical measurement particularly where a sewer is deformed and/or where a sewer has suffered hydrogen sulfide corrosion; screen graphic facilities shall be made available to enable measurements to be taken in any position across the diametrical profile of the sewer as the sonar survey proceeds and where specifically directed by the designated Engineer.

3. Where combined CCTV and Sonar imagery is required the output shall display combined CCTV and Sonar images of the sewer being surveyed. The sonar image shall be superimposed on the real CCTV image as a combined operation.

4. Rates shall allow for a comprehensive final report on the findings concerning major defects, including fractures, displaced joints, deformation, corrosion and lateral intrusions, as well as dominant surface features, including encrustation and silt depths.

5. The monitor display resolution shall be a minimum of 512 x 512 pixels. The color palette shall have a minimum of 16 colors with text.

6. The picture update speed shall not compromise compliance with Sub-clause A (1) or result in unsatisfactory picture resolution.

7. The range of resolution shall be ± 1/10 inch.

8. The maximum beam width of sonar energy pulse shall be no greater than 2 degrees from the center of the transducer.

9. The transducer shall be of the continuous scanning type.

K. Contractor's Data Quality Control Procedure:

1. The Contractor shall operate a quality control system, to be approved by the designated Engineer, which will effectively gauge the accuracy of all survey reports produced by the operator.

2. The system shall be such that the accuracy of reporting is a function particularly of:

   a. The number of faults not recorded (omissions).

   b. The correctness of the coding and classification of each fault recorded.

3. The minimum levels of accuracy to be attained under the various survey headings are as follows:

   a. Header Accuracy 95%

   b. Detail Accuracy 85%

L. The Contractor’s data quality control program shall include routine outside auditing of the work completed by a qualified subcontractor. The qualified subcontractor shall meet the minimum specified Contract requirements for the performance of the work and shall be approved in writing by the Engineer. The accuracy of the Contractor’s data shall be based on the percentage of the data confirmed correct by the subcontractor. The minimum acceptable accuracy of the data shall be 85%. The general sequence of the auditing shall be as follows:

1. The Engineer shall randomly select one day per month, typically in the first week of the month, and the work performed during this day shall be reviewed and/or repeated by the qualified subcontractor.

2. If the work is greater than or equal to 85% accurate, no further outside auditing will be required for the month unless requested by the Engineer at

his sole discretion. The cost for this audit is included in the allowances specified in the Bid Form.

3. If the work is less than 85% accurate, the Contractor shall at his own expense repeat and/or correct the work and have the work re-audited by the qualified subcontractor.

4. If this work is still less than 85% accurate, the Contractor shall repeat and/or correct and have the work re-audited, at his own expense, until the work is greater than or equal to 85% accurate.

5. When this re-audited work is found to be greater than or equal to 85% accurate, the Contractor shall have the work of another randomly selected day in the same month reviewed and/or repeated by the qualified subcontractor at the Contractor's own expense.

6. Steps 2 through 5 shall be repeated at the Contractor's own expense until the selected day is 85% accurate on the initial audit.

7. The occurrence of five randomly selected days not achieving 85% accuracy on initial subcontractor review will constitute cause for dismissal.

8. If the Contractor successfully meets the 85% accuracy requirement for the initial randomly selected day for two consecutive months (Step 2 above), the Contractor may subsequently audit one day every other month. The Contractor may continue auditing one day every other month until the initial randomly selected day does not meet 85% accuracy, at which time it must resume auditing one day every month.

3.07 COLLAPSED SEWERS/DEFECTIVE MANHOLES

A. Any sewer found with greater than 10% deformation (i.e. collapsed or near to collapse) must be reported to the designated Engineer immediately for remedial action. In the event of emergency phone (404)- 546-3700.

B. Any manhole found broken, cracked, with missing covers or surcharged, must be reported to the designated Engineer immediately for remedial action. In the event of emergency phone (404)- 546-3700.

C. Any sewer found where the existing conditions pose a threat of personal injury to the public, such as a collapsed sewer with attendant depression to roadway, must be protected by the Contractor until the Engineer arrives at the job site. In the event of emergency phone (404)-546-3700.

D. Any manhole found where the existing conditions pose a threat of personal injury to the public, such as broken, cracked or missing covers or covers found in traveled portions of any sidewalk or roadway must be protected by the Contractor until the Engineer arrives at the job site. In the event of emergency phone (404)-546-3700.

3.08 TRAFFIC CONTROL

Refer to Specification Section 01550 Traffic Regulations for requirements.

ATTACHMENT A

DEFINITIONS

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DEFINITIONS

Notes:

- Features that are visible in the sewer during surveys/inspections and other key items are defined below.
- Sewer defects are categorized under the following headings: Structural, Service, Protective Lining, and Constructional.
- Normal parts of speech abbreviations apply (e.g., (n) for noun, (v) for verb, etc.)

Sewer Defects - Structural

Angular Joints: Adjacent conduit sections are angularly displaced at the joint.

Break: Pieces of the sewer conduit are noticeably displaced, differentially, and some pieces could be missing. A broken sewer is the most structurally serious defect. A hole in the fabric of the sewer is also classified as broken. A chipped sewer wall is not coded as broken, but should be entered into the "general comments" section of the coding sheet as such.

Crack: Crack line visible on the sewer wall, with the pieces of the wall still in place. The crack may be either longitudinal (i.e., following the longitudinal axis of the sewer), circumferential (i.e., around the periphery of the sewer), or spiral (i.e. helically around the sewer). Cracks are not themselves serious defects, but are indicative of the initial stages of sewer deterioration. Multiple cracks are a combination of both longitudinal and circumferential cracks.

Collapse: Structural integrity of the sewer conduit has been completely lost and deformation is greater than 10 percent. Percentage loss of cross-section is estimated to the nearest 5 percent.

Corrosion: The destruction of a cementitious or metal wastewater component and its material properties, because of a reaction with its surroundings (the sewage environment). Corrosion is usually a defect observable specifically in the soffit, and generally above the springings of the sewer conduit and in the proximity of force main discharges. Four levels of corrosion are identifiable:

- *Light Corrosion* is characterized by a slightly depressed pH (<6.0), and a concrete surface that can be penetrated with a sharp instrument under moderate hand pressure with the removal of some concrete material. The original concrete surface is fully recognizable and aggregate may or may not be exposed.

- *Moderate Corrosion* is characterized by some concrete loss with aggregate slightly exposed, but the original concrete surface is still distinguishable. The surface may have a thin covering of pasty material that is easily penetrated. There is generally a depressed wall pH (<5.0).

- *Severe Corrosion* is characterized by significant measurable concrete loss or active corrosion. Aggregate and, occasionally, reinforcing steel is exposed. The original concrete surface is not distinguishable. The surface is covered with soft, pasty corrosion products where active scouring is not present. There is generally a depressed wall pH (<0.3) indicating active corrosion.

- *Extreme Corrosion* is characterized by corrosion so extensive that the wall of the sewer has been completely corroded and earth can be observed behind the sewer wall.

Normal pH ranges (around 6.0) are applicable. A normal concrete surface is defined as that which cannot be penetrated or removed by a sharp instrument under moderate hand pressure. The surface of the concrete may have biological growth (slime build) and moisture but the concrete is normal and aggregate is not exposed.

Deformation: A measure of the vertical and horizontal reduction or change in cross-section of a sewer as a result of self-weight or external forces. Three levels of deformation are normally reported. These are:

- 0-5 percent deformation is acceptable, may not need structural upgrading, and normally may require periodic monitoring.

- 5-10 percent deformation requires some form of structural enhancement, possibly a lining;

- >10 percent deformation is a collapse condition and the sewer needs replacing.

Brick sewers may have some irregular or misshapen cross-sections built into the original sewer. Plastic pipes can deform without structural defects. Normally a built-in deformation of 6 percent is allowable in plastic sewers.

For inspection purposes, deformation is normally recorded to the nearest 5 percent.

Fracture: Wall of sewer visibly separated along the length and/or circumference of the sewer with the pieces of the sewer wall in place. The fracture may be either longitudinal (i.e., following the longitudinal axis of the sewer), circumferential (i.e., around the periphery of the sewer, or spiral (i.e. helically around the sewer). The sewer may be seen to suffer from some distortion. The defect is indicative of the secondary stage of sewer deterioration and constitutes a more serious problem than a crack. Multiple fractures are a combination of both longitudinal and circumferential fractures.

Offset (Displaced) Joint: Adjacent conduit sections are not concentric at the joint. Displacements are recorded as a fraction of the wall thickness of the conduit (t) as follows:

- *slight* - < t
- *medium* - 1 < t < 1.5
- *large* - > 1.5 t

Separated (Open) Joint: Adjacent conduit sections are open at the joint. Displacements are recorded as a fraction of the wall thickness of the conduit (t) as follows:

- *slight* - < t
- *medium* - 1 < t, 1.5
- *large* - 1.5 t

Surface Damage: Surface of sewer conduit is damaged by spalling, wear, erosion, or any other deleterious mechanism other than corrosion (see **Corrosion**).

Sewer Defects - Service

Debris: Obstructions in a sewer line, excluding items mechanically attached to the line such as protruding service connections, protruding pipe and joint materials. Percentage loss is normally given to the nearest 5 percent. (See also Silt)

- Debris is normally identified by the following characteristics:
- *Debris.* Pebbles, pieces of concrete, wood chippings, sticks, brick, and other extraneous material that could cause turbulence and/or reduction in hydraulic capacity
- *Ragging*. Paper and sanitary products

Encrustation: Mineral deposits left on the wall or joint of a sewer by the effect of infiltrating groundwater containing dissolved salts. Normally described as being light, medium, or heavy, and characterized by loss of percentage cross-sectional area, thus:

- light - < 5 percent
- medium - > 5 loss < 20 percent
- heavy > 20 percent loss

Ground Water Infiltration: Water entering sewers and manholes via defective joints and connections, broken pipes, fractured manholes, etc., due to the effects of a high ground water table. Various levels of ground water infiltration are identified, namely as follows:

- Weeper - The slow ingress of infiltration through sewer/manhole joints or structural defects, identified by glistening effect of the water under the influence of survey lighting apparatus

- Dripper - Infiltration characteristically dripping into the wastewater system through sewer/ manhole joints or structural defects

- Runner - Infiltration running into the wastewater system through sewer/manhole joints or structural defects

- Gusher - Infiltration rapidly entering the wastewater system under hydrostatic pressure through sewer/manhole joints or structural defects

Line Deviation: Vertical or horizontal divergence of alignment of sewer conduit line encountered during inspection, also known as "change in direction" or "change in alignment."

Obstruction:An obstruction in the sewer conduit resulting in stoppage of the inspection or survey. Obstructions can be:

- *General*, e.g., shopping cart, ball, or rock
- *Mechanical*, e.g., water main installed through sewer
- *Structural*, e.g., support mechanism such as a pile or tie back anchor
- *Strata*, e.g., rock or stone which has become dislodged and fallen onto the invert

Roots: Intrusion of roots through defects in sewer conduits, laterals, or manholes. Described as fine, medium, or tap roots, depending on severity as follows:

- *Fine roots:* slender or thin fibrous roots that partially result in a reduction in flow capacity
- *Medium roots:* mass of fine roots less than 50% of the area of the pipe
- *Tap roots:* individual root strands more than 1/2 inch thick.
- Ball roots: mass of roots more than 50% of the area of the pipe

Silt: Any and all solid or semi-solid materials, including fine and granular material such as sand, grit, gravel and rock, as well as grease, sludge, slime, debris or any other loose material or encrustation lodged in the manhole or sewer.

Water Level: The depth of water at the observed point in the sewer conduit, in percentage to nearest 5 percent.

Sewer Defects - Protective Lining

Blister: A concentrated swelling of the *protective coating* over the host conduit.

Bulge: A concentrated swelling of the *protective liner* over the host conduit.

Degradation: Break down by biological action of the protective liner, protective coating, or host conduit.

Delamination: Separation of internal layers of the protective lining material. Loss of internal bonding, chemical or mechanical.

Detached: Extensive separation of the protective lining material or protective coating from the host conduit.

Missing: Where the sewer conduit has no protective coating or protective lining through the sewer conduit as indicated on as-built drawings, or on job files.

Tear: When the protective lining has become torn.

Weld Failure: The opening up of the weld between adjacent pieces of protective lining due to physical or chemical breakdown.

Wrinkle: The incorporation of a longitudinal or circumferential fold, typically in a CIPP lining due to stretching or excessive material. Normally the wrinkle should not exceed more than 1 percent of diameter for protective linings equal to or greater than 24 inches, and more than 2 percent of diameter for protective linings in sewers less than 24 inches. (Establish using 3-dimensional templates or similar.)

Sewers - Construction

Battens: Anchoring strips used to attach PE, PVC, or HDPE liners to the host sewer conduit (the sewer being treated) or annulus grout. Battens are normally made of plastic or stainless steel.

Buried Manhole: A manhole on a sewer, which is not visible at ground surface. A buried manhole may or may not be designated for assessment.

Chimney: The cylindrical, variable height access portion of the manhole structure. The chimney extends from the top of the corbel above the manhole chamber to the base of the manhole frame, and is used for adjusting the finished level of the manhole frame.

Coal Tar Epoxy:A chemically cured, two component coal tar coating which has been in use since the 1950's. In order to be successful as a coating, the surface preparation has to be of a very high order that is difficult, if not impossible, to achieve in the context of sewer conduits.

Connection: A sewer tap including break-in/hammer tap or saddle connection, of lateral sewer to another sewer.

Construction Exit: A stone-stabilized pad located at any point where traffic will be leaving a construction site to a public right-of-way, street, alley, sidewalk, or parking area.

Corbel or Cone: That portion of a manhole structure that slopes upward and inward from the barrel of the manhole to the frame diameter or required chimney (access shaft). Corbel refers to the oversailing brickwork that supports the cover and frame. Cone refers to a precast section.

Critical Path Method (CPM): A planning and scheduling technique involving the charting of all events and operations to be encountered in completing a given process, rendered in a form permitting determination of the relative significance of each event and establishing the optimum sequence and duration of operations.

Crown: The external elevation at the top of the sewer conduit (see also **Invert, Soffit**).

Cured-in-Place (CIPP): A pipe rehabilitation system in which the flexible lining (either epoxy resin or polyester resin) impregnated felt is water or air inverted or winched and inverted into an existing sewer and subsequently heat cured. The reformed pipe fits snugly into, and follows closely, the contours of the existing (host) pipe. The work also involves the reconnection of the existing sewer service property connections and television inspection of the lined pipeline.

Designated Manhole (s): Manholes identified by Engineer to be assessed.

Drop Pipe: The pipe that vertically connects the upstream sewer conduit to the invert of the through flow channel in a manhole. The drop pipe is strapped to the inside of the manhole, or surrounded in concrete if immediately outside the manhole.

Float: Float or slack time associated with one chain of activities is defined as the amount of time between earliest start date and latest start date or between earliest finish date and latest finish date for such activities, as calculated as part of the accepted Schedule Submittal.

Flow bypass: The transfer of flow from an upstream section or segment of sewer to the same sewer downstream (generally downstream of the section being rehabilitated) via temporary piping. Generally flow bypass and diversion pumping may be described as the efficient and effective installation and operation of bulkheads, plugs, hoses, piping, and pumps to maintain sewage flow and prevent backup, spillage, flooding or overflow.

Flow diversion: The transfer of sewage from an upstream section or segment of the originating sewer to another sewer. The flow is generally not returned to the originating sewer but may in some cases be transferred to another service area. Generally flow bypass and diversion pumping may be described as the efficient and effective installation and operation of bulkheads, plugs, hoses, piping, and pumps to maintain sewage flow and prevent backup, spillage, flooding or overflow.

Fold and Form Pipe: A pipe rehabilitation system in which the plastic pipe (either PVC or HDPE) is manufactured in folded shape of reduced cross-sectional area and is pulled into an existing sewer and subsequently expanded with pressure and heat. The reformed pipe fits snugly into and follows closely the contours of the existing (host) pipe.

HDPE Liner: The high density polyethylene (HDPE) pipe or sheeting that is used to renovate sewer conduits subject to structural and corrosive defects.

Hobas Pipe: Proprietary Glass Fiber Pipe used for sewer conduit renovation purposes.

Invert: The internal elevation at the bottom of the sewer (see also **Soffit, Crown**).

Joints: The means of connecting sectional lengths of sewer pipe into a continuous (flexible jointed or articulated) sewer line using various types of jointing materials. The number of joints depends on the lengths of the pipe sections used in the specific sewer construction work. See pipe manufactures catalogue.

Junction: A factory-made tap.

Junction Box: A subsurface structure normally constructed in reinforced concrete in which two or more sewer conduits meet.

Lateral: Building or house service connection to sewer or sewer to sewer connection.

Lining: (n) Also termed "insitu lining," is an internal lining material applied to the wall of an existing sewer for structural and/or protective reasons. (v) Active renovation (i.e., by insertion) of a prefabricated lining into an existing sewer.

Manhole: A subsurface structure in which two or more pipes meet, with person access from the ground surface.

Manhole Structure: Reference to and all activities relevant to manhole structures throughout the text shall also be taken to include junction boxes, inspection chambers, drop shafts, sumps, and all other auxiliary structures appurtenant to the sewerage system.

Mapped Manhole: A manhole that appears on the City's sewer system map. A mapped manhole may or may not be designated for assessment.

Cured-In-Place Pipe (CIPP): A system by which a burster unit splits the existing pipe while simultaneously installing a new polyethylene pipe. The new pipe may be of the same size or larger size. The work also involves the reconnection of the existing sewer service property connections and television inspection of the polyethylene pipe.

***Raised manhole**: A manhole in which the cover and frame are above normal levels above ground, i.e., more than 30-inches above ground level. A raised manhole may or may not be designated for assessment.*

Schedule of Record: The Schedule of Record will be the Official Project Schedule for this Contract. All updates and/or revisions relating to coordinating the Work, scheduling the Work, monitoring the Work, reviewing the progress payment requests, evaluating time extension requests, and all other objectives shall be made to this Schedule. No other schedule will be recognized for this Contract.

Sewer Inspection: Viewing the sewer pre- or post preconditioning and/or pre-or post rehabilitation with the aid of CCTV and/or sonar equipment, and/or manually, to assess overall condition. No data logging is required.

Sewer Survey: Viewing the sewer with the aid of CCTV and/or sonar equipment, and/or manually, to assess internal structural and/or service condition as well as assess the structural and/or service condition of laterals. Data logging is required.

Soffit: The internal elevation at the top of the sewer (see also **Crown, Invert**).

Stream crossing: A temporary structure installed across a perenial or nonperenial stream or watercourse for use by construction equipment. Stream crossing shall be in accordance to detail in the Contract Arawings and the Georgia Erosion and Sedimentation Act of 1975 and its amendments.

Tap (Connection): Factory tap, break-in/hammer tap or saddle connection of lateral sewer to another sewer.

Through Flow Channel: The channel that passes sewage directly through the (concrete) manhole base from the upstream sewer to the downstream sewer, also called the manhole invert.

T-Lock: HDPE sheeting used specifically for protecting sewer conduits against corrosion.

***Unburied Manhole**: A manhole on a sewer to be assessed formerly buried below ground surface. An unburied manhole may or may not be designated for assessment*

Unmapped Manhole: A manhole not included on the City's sewer system map. An unmapped manhole is also known as an uncharted manhole.

Wet Well: The wet side or inlet side of a wastewater pumping station.

Sewers - General

Abrasion: Hydraulic wear or scour on the wall of a sewer, through-flow channel or manhole wall.

Above Ground Sewer (Aerial Sewer): An unburied sewer (generally a sanitary sewer), supported on piers, pedestals or bents to provide a suitable grade line.

Aggressive: A property of the sewage conveyed that results in accelerated corrosion of the conveying sewer conduit.

Building Sewer: The conduit that connects building wastewater sources to the public or street sewer, including lines serving homes, public buildings, commercial establishments and industry structures. Referred to also as house sewer, building connection, service connection or lateral connection.

Cleaning: Techniques used to clean sewer lines either hydraulically or mechanically. *Hydraulic cleaning* involves using water, such as water pumped at a high velocity spray and water flowing by gravity or head pressure. Devices include high-velocity jet cleaners, cleaning balls (or pigs) and hinged-disc cleaners. *Mechanical cleaning* includes methods utilizing rodding machines, bucket machines, kites, winch-pulled brushes and wheelbarrows with spades.

Collector Sewer: A sewer located in the public way that collects wastewater discharges through building sewers, and conducts such flows to larger interceptor sewers, lift stations and treatment works.

Combined Sewer: A sewer that is designed to serve as both a sanitary sewer and a storm sewer.

Conduit: A pipe or other opening, buried or above ground, for conveying hydraulic traffic, pipelines, cables or other utilities.

Core Area: That essential part of a sewer network containing critical sewers and other sewers where hydraulic problems are likely to be most severe, and that require detailed definition within a flow simulation model.

Corrosion Rate: The rate (usually an average) at which corrosion of a component of the wastewater network progresses; expressed as though it were linear in units of mdd (millimeters per square decimeter day) for weight change, or mpy (millimeters per year) for thickness changes.

Corrosion Resistance: Ability of a material to withstand corrosion within the wastewater network.

Creep: The dimensional change, with time, of a sewer renovation material (lining) under continuously applied stress after the initial elastic deformation.

Critical Sewers: The major sewers in a wastewater network that would exhibit the most significant consequences in the event of structural collapse.

Critical Soils: Appraisal of the nature of soils surrounding sewers. Soils of *High-Criticality* are composed of silts and sands. Those of *Medium-Criticality* consist of low plasticity clays and gravel. Soils of *Low-Criticality* consist of medium to high plasticity clays and all clays where the sewer was constructed in tunnel.

Deflection: Reduction in vertical diameter and/or distortion in shape of a conduit as a result of self-weight or external forces.

Degradation: Breakdown in chemical resilience of a plastic product.

Effluent: Outflow or discharge from a sewer or wastewater treatment product.

Elastic Modulus: Characteristic of the stress build-up associated with a given strain in a conduit or lining (see also **Flexural Modulus**). Typically a feature of the strength characteristics of lining materials in sewers.

Elongation: The increase in length of a material stressed in tension.

Embrittlement: Loss of ductility of a material, resulting from a chemical or physical change.

Environmental Stress Crackling: The visible manifestation of a material's susceptibility to crack under the influence of specific chemical or mechanical stresses.

Epoxy: Resin formed by the reaction of bisphenol and epichlorohydrin.

Erosion: Deterioration of the surface of a component of the wastewater system resulting from the action of harder material suspended in sewage on the wastewater component.

Exfiltration: The leakage or egress of sewage from the wastewater system into the surrounding area, usually the ground, through leaks in pipes, joints, manholes, or other sewer system structures and components; the reverse of infiltration.

External Structural Condition: Appraisal of a length of sewer between manholes in to identified external forces (e.g., from traffic load if less than 4 feet below highway; ground water pressure if below the water table, etc.) and nature of ground (e.g., soil criticality, chemical inertness, etc.).

Flexural Modulus: The slope of the elastic strain curve defined by flexural load versus resultant strain. A high flexural modulus indicates a stiffer material.

Flexural Strength: The strength of a material in bending expressed as the tensile stress of the outermost fibers at the instant of failure.

Flow Attenuation: The process of reducing the peak flow rate in a sewer system by redistributing the same volume of flow over a longer period.

General Corrosion: Uniform corrosion, usually a phenomenon observed above the flow line in the sewer.

Ground Water Table (Level): Upper surface of the zone of saturation in permeable strata. Of special relevance to sewer survey or inspection if immediately above or below the sewer. The sewer is more susceptible to ground water infiltration if above the sewer. (See also **Ground Water Infiltration**).

Grout: (1) A fluid mixture typically consisting of cement, water and sand that can be poured or pumped easily. (2) Chemical mixtures that have the capability of stopping water infiltration through small holes and cracks in sewers and manholes.

Grouting: (1) The joining together of loose particles of soil in such manner that the soil so joined becomes a solid mass impervious to water. (2) The process of introducing (typically by pumping) a cement and water grout into the annular space between a host pipe and a slipline pipe.

Header: All reference data at the head of the coding sheet, other than sewer condition data, attaching to the sewer being inspected.

Hydraulic Gradient: An imaginary line through the points to which water would arise in a series of vertical tubes connected to the sewer.

Hydrogen Sulfide Corrosion: Hydrogen sulfide corrosion is the attack of cementitious materials caused by the microbiological conversion of sulfates within sewage to gaseous sulfides and then to sulfuric acid. The corrosion causes a reduction in the sewer wall thickness and a loss of structural integrity.

Infiltration: See **Ground Water Infiltration.**

Infiltration/Inflow (I/I): Pertaining to the study and understanding of the undesirable ingress of infiltration and inflow into the wastewater system.

Inflow: The rain-induced water entering the sewerage or wastewater system from areas not intended to drain to the sewerage or wastewater system. Inflow is thus distinguished from infiltration. (See also **Ground Water Infiltration**).

Interceptor Sewer: A sewer that receives flow from collector sewers and conveys the wastewater to treatment facilities.

Internal Condition Grade (ICG): The relative state of the internal service or structural performance of the sewer in relation to specified criteria. In broad structural terms, it is a measure of the sewer's probability to collapse.

Internal Sewer Service Condition: The ability of a length of sewer between manholes to perform its intended function of conveying sewage, determined by the degree of non-structural defects within the sewer.

Man Entry Sewers: Those sewers considered to be large enough for safe manual (physical) inspection, survey and work activities (e.g., manual renovation and repair). Generally considered to be greater than 1,000 millimeters (around 40 inches) in size. Safety considerations are important before contemplating and undertaking such a survey.

Manholes Length, Section or Segment: The length of sewer between two adjacent manholes.

Non-Man Entry Sewers: Those sewers considered to be too small for manual inspection, survey and work activities (e.g., renovation and repair). Generally considered to be less than 1,000 millimeters (around 40 inches) in size. Normally, these sewers are inspected and surveyed using CCTV, and repairs are carried out robotically.

Non-uniform Corrosion: Corrosion that attacks small, localized areas of the sewer, usually resulting in material loss. Characteristic of poorly made non-uniform concrete.

Overflow: (a) The excess water that flows over the ordinary limits of the sewer, manhole, or containment structure. (v) An outlet, pipe, or receptacle for excess water.

Oxidation: Loss of electrons, as when metal goes from the metallic state to the corroded state.

PH: A measure of the acidity or alkalinity of sewage, expressed as the logarithm, base 10, of the inverse of the hydrogen ion concentration (the weight of the hydrogen ions multiplied by the activity coefficient, which is close to unity in most fresh waters and in other waters of relatively low ionic strength). Most aqueous solutions have pH values in the range 0-14, with pure water (which is neutral) having a pH value of 7. Values above or below 7 indicate alkalinity or acidity, respectively.

Pipeline: An alternative definition of a length of sewer that exists as a single branch within the wastewater network. It consists of many pipes and extends from manhole to manhole.

Pipe Sealing: Sealing of existing circumferential pipe crack or pipe joint using grouting materials under air pressure.

Pipe Repair: Repair of fracture, break or longitudinal crack or fracture in a pipeline by manual (in Man entry sewers) or robotic (in Non-man entry sewers) structural repair techniques.

Pitting: Localized corrosion resulting in deeper penetration of the concrete surface in only a few spots.

Pitting Factor: Depth of the deepest pit divided by the average penetration calculated from weight loss.

Sanitary Sewer: A sewer intended to carry only sanitary or sanitary and industrial wastewater from residences, commercial buildings, industrial parks, and institutions.

Scaling: Thin layer of deposit or remnant of sewer material observed during the course of inspection/ survey.

Serviceability of the Sewer or Sewer System: Continued service life with high degree of confidence that failure will not occur during its long-term service.

Sewer: An underground conduit designed to carry wastewater. A sewer can take the form of a pipe or tunnel and can be of many shapes (e.g., circular, ovoid, u-shaped, rectangular, oval, etc.) and materials (e.g., concrete, asbestos cement, truss, clayware, brick, steel, cast iron, etc.). Sewers convey either storm water or wastewater.

Sewer Infiltration: See **Infiltration.**

Sewer Inflow: See **Inflow.**

Sewer Inspection: Viewing the sewer primarily with the aid of sewer CCTV equipment, and or manually, to assess overall condition. No data logging is required. Inspection is normally carried out as an adjunct to other activities in the sewer such as preparatory cleaning or pre/post renovation measures. (See also **Sewer Survey**).

Sewer Structural Condition: Assessment of the structural integrity of the sewer.

Sewer Service Condition: Assessment of the service condition of the sewer, reflecting the sewer conduit's capacity, potential for blockage, and water tightness.

Sewer Springings: The imaginary points on the wall of the sewer at the ends of the horizontal diameter. Normally considered to be the position where the arch, or top half, of the sewer commences.

Sewer Survey: Viewing and appraising the sewer with the aid of:

Internally:

- *Sewer CCTV equipment*, and/or manually to assess internal structural and/or service condition of the sewer (as well as assess the structural and/or service condition and location of laterals). Data logging is required and the depth of flow is not more than 25 percent of the vertical dimension of the sewer;

- *Sewer profiling equipment*, to establish the dimensional configuration of the sewer (including percentage deformation). Flow is normally bypassed;

- *Sonar equipment*, when the sewer is flooded or partially flooded to assess internal structural and/or service condition of the sewer (as well as assess the structural and/or service condition and location of laterals). Data logging is required, though not with the same resolution as with CCTV;

- *A combination of sonar and CCTV equipment,* when the depth of flow is between 25 percent and 75 percent in sewers larger than 18 inches; and/or

- *Thermographic sensor-equipment*, to determine the position of laterals in lined sewers.

Externally:

- Ground probing radar antennae, to assess external conditions (e.g., voids) immediately relating to the sewer;

- Seismic resonance testing equipment, to assess stratification and nature of the ground between the ground surface and the sewer; and/or

- Such other equipment that provides insights into the nature of the sewer and its surrounding conditions.

A sewer survey normally forms the basis of an engineering interpretation of the internal condition of the sewer (see also **Sewer Inspection**).

Springing: See also **Sewer Springing**.

Standard Dimension Ratio (SDR): Ratio of the pipe diameter to wall thickness.

Surcharge: Occurs and is witnessed when the sewer flow exceeds the hydraulic capacity of the sewer line.

Uniform Corrosion: Corrosion that results in an equal amount of material loss over an entire sewer surface

ATTACHMENT B

INTERNAL SEWER CONDITION ASSESSMENT SAMPLE REPORTS

(For use with City of Atlanta Database)

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SURVEY REPORT — Page Number : 167

Date : 02 05 2000 Time : 10:28

Contractor	Contract No	Job No	Drainage Area	Div	Dist	Pipe L. Ref
ASI/DG	ASG/0001	0	0	0	000	23250201501X

Location	Place Name
BERKELE STREET	MCDANIEL BASIN

Start Manhole No. : 23250201001 Depth : 08.0 Total Length : 365.0
Finish Manhole No. : 23250201501 Depth : 09.0 Suyed Length : 280.7

Use	Direction	Size	Shape	Material	Lining	Yr Laid	Pipe L
COMBINED	UPSTREAM	8in	CIRC.	V. CLAY		Z	3.00

CD-ROM No	V. Model	Comments
00016		-

Purpose	Weather	Location	Further Information
	DRY		-

DETAIL — Page Number : 167

Digit Ph.	Dist	CD	Code	Other Details
0136	0.0		ST	Start of Survey [0065]
0280	0.0		MH	Manhole 23250201001
0560	0.0		WL	Water Level is now 05%
0163	30.2		JN	Junction. 6in at 03o/c FW
0180	41.6		JDM	Joint Displaced Medium
0186	43.3		JN	Junction. 6in at 09o/c SW
0200	54.6		OJM	Open Joint Medium
0203	56.3		JN	Junction. 6in at 09o/c SW
0226	79.0		JN	Junction. 6in at 03o/c FW?
0236	83.2		JN	Junction. 6in at 09o/c FW
0260	106.5		JN	Junction. 6in at 02o/c FW?
0270	108.5		JN	Junction. 6in at 09o/c FW
0286	120.9		CNI	Conn. Intruding by 1in. 6in Dia at 12o/c FW
0303	135.4		CL	Longitudinal Crack at 12o/c
0310	136.0		CNI	Conn. Intruding by 1in. 6in Dia at 12o/c FW?
0326	147.2		JN	Junction. 6in at 03o/c FW
0333	149.8		JN	Junction. 6in at 09o/c SW
0346	157.5		JN	Junction. 6in at 03o/c SW
0366	175.9		JN	Junction. 6in at 10o/c SW
0376	181.0		JN	Junction. 6in at 02o/c FW?
0386	184.9		JN	Junction. 6in at 10o/c SW
0780	184.9	S1	DES	Debris Silt. 05% loss
0416	209.3		JN	Junction. 6in at 10o/c FW?
0840	209.3	F1	DES	Debris Silt. 05% loss
0433	218.9		JN	Junction. 6in at 02o/c SW
0453	234.2		JN	Junction. 6in at 10o/c SW
0470	244.8		FCJ	Circumferential Fracture at Joint at 03 to 05o/c
0483	254.7		JN	Junction. 6in at 02o/c FW?
0970	254.7	S2	DES	Debris Silt. 05% loss
1940	254.7	S3	RF	Fine Roots
0490	257.5		JN	Junction. 6in at 09o/c SW
0513	279.5	C2	DES	Debris Silt. 50% loss
0520	280.6		JN	Junction. 6in at 02o/c SW

DETAIL CONTINUED ON NEXT PAGE For Page Number : 167

```
<CONTINUATION PAGE>  <Page Number :  167>
Location                          Place Name
BERKELE STREET                    MCDANIEL BASIN

Start  Manhole No. : 23250201001  Depth : 08.0   Total Length : 365.0
Finish Manhole No. : 23250201501  Depth : 09.0   Suyed Length : 280.7

<DETAIL CONTINUED>  <Page Number :  167>
Digit Ph.  Dist CD Code Other Details

0523       280.7 F2 DES  Debris Silt. 50% loss
1050       280.7 F3 RF   Fine Roots
0523       280.7    SA   Survey Abandoned  DUE TO SURVEY OVERLAP

<SUMMARY>  <Page Number :  167>
St Mh No.  : 23250201001  Fh Mh No. : 23250201501  Suyed Length : 280.7

SOME MAJOR defects in this length :   Deformations :  NO

          Mult/Long/Circ Heavy/Medium  Gusher/Runner Mass
Breaks/Holes  Fractures   Encrustation  Infiltration  Roots Obstructions
  NO                          NO            NO          NO       NO
                CIRC
     Faulty Junctions/Connections : YES
<END OF SUMMARY>
```

SURVEY REPORT — Page Number : 170

Date : 02 05 2000 Time : 17:20

Contractor	Contract No	Job No	Drainage Area	Div	Dist	Pipe L. Ref
ASI/DG	ASG/0001	0	0	0	000	23250200401X

Location	Place Name
MCDANIEL STREET	MCDANIEL BASIN

Start Manhole No. : 23250201901 Depth : 09.6 Total Length : 085.8
Finish Manhole No. : 23250200401 Depth : 08.0 Suyed Length : 085.8

Use	Direction	Size	Shape	Material	Lining	Yr Laid	Pipe L
COMBINED	UPSTREAM	12in	CIRC.	V. CLAY		2	3.00

CD-ROM No	V. Model	Comments
00016		-

Purpose	Weather	Location	Further Information
	.DRY		-

DETAIL — Page Number : 170

Digit Ph.	Dist	CD	Code	Other Details
0683	0.0		ST	Start of Survey [0341]
1370	0.0		MH	Manhole 23250201901
1940	0.0		WL	Water Level is now 05%
0683	0.0	S1	DEG	Debris Grease at 07o/c to 05o/c. 05% loss
0693	13.9		JDM	Joint Displaced Medium
0700	18.3		OB	Obstruction. 05% loss STONE
0710	26.3	S2	DES	Debris Silt. 05% loss
0720	35.4		CXI	Conn Defect/Intr. by 3in. 6in Dia. At 10o/c SW
1440	35.4		JN	Junction. 6in at 02o/c CAPPED OFF
0736	40.5		JN	Junction. 6in at 02o/c CAPPED OFF
0750	46.6	C2	DES	Debris Silt. 15% loss
0766	60.9		JN	Junction. 6in at 10o/c CAPPED OFF
0783	73.7		JX	Junction. Defective. 6in Dia at 02o/c SW
1570	73.7		B	Break. From 11o/c to 01o/c
0796	81.1		JN	Junction. 6in at 10o/c
0800	85.8	F1	DEG	Debris Grease at 07o/c to 05o/c. 05% loss
1600	85.8	F2	DES	Debris Silt. 15% loss
2400	85.8		MH	Manhole 23250200401
0800	85.8		FH	Finish of Survey.

SUMMARY — Page Number : 170

St Mh No. : 23250201901 Fh Mh No. : 23250200401 Suyed Length : 085.8

SOME MAJOR defects in this length : Deformations : NO

Breaks/Holes	Mult/Long/Circ Fractures	Heavy/Medium Encrustation	Gusher/Runner Infiltration	Mass Roots	Obstructions
YES	NO	NO	NO	NO	YES

Faulty Junctions/Connections : YES

END OF SUMMARY

< SURVEY REPORT > < Page Number : 184 >

Date : 02 07 2000 Time : 14:52

Contractor	Contract No	Job No	Drainage Area	Div	Dist	Pipe L. Ref
ASI/DG	ASG/0001	0	0	0	000	23350305601X

Location	Place Name
GAULT STREET	BOULEVARD BASIN

Start Manhole No. : 23350305601 Depth : 22.0 Total Length : 501.2
Finish Manhole No. : 23350315501 Depth : 00.0 Suyed Length : 501.2

Use	Direction	Size	Shape	Material	Lining	Yr Laid	Pipe L
COMBINED	D/STREAM	12in	CIRC.	V. CLAY		2	3.00

CD-ROM No	V. Model	Comments
00017		-

Purpose	Weather	Location	Further Information
	DRY		-

< DETAIL > < Page Number : 184 >

Digit Ph.	Dist	CD	Code	Other Details
0786	0.0		ST	Start of Survey [0392]
1580	0.0		MH	Manhole 23350305601
2360	0.0		WL	Water Level is now 05%
0790	6.0	S1	EMJ	Encrust Med at Jnt. 15% loss at 07o/c to 05o/c CLOCKS VARY
0800	12.9		EHJ	Encrust Heavy at Jnt. 25% loss at 12o/c to 05o/c
0810	15.3		IDJ	Infiltration Dripping at Joint at 11o/c to 12o/c
0816	18.6		EHJ	Encrust Heavy at Jnt. 25% loss at 01o/c to 05o/c
0823	24.7		CL	Longitudinal Crack at 12o/c
0830	31.5		FL	Longitudinal Fracture at 12o/c
0840	43.2		EHJ	Encrust Heavy at Jnt. 30% loss at 07o/c to 05o/c
0846	46.3		EHJ	Encrust Heavy at Jnt. 25% loss at 07o/c to 05o/c
1700	46.3	S2	IDJ	Infiltration Dripping at Joint at 12o/c
2600	46.3		RFJ	Fine Roots at Joint
0856	50.9		EHJ	Encrust Heavy at Jnt. 50% loss at 09o/c to 03o/c OBSCURING VISION
0920	87.5	F2	IDJ	Infiltration Dripping at Joint at 12o/c
0956	147.1		IDJ	Infiltration Dripping at Joint at 12o/c
0966	161.0		EHJ	Encrust Heavy at Jnt. 25% loss at 09o/c to 03o/c
1940	161.0		IDJ	Infiltration Dripping at Joint at 11o/c
3080	161.0		RFJ	Fine Roots at Joint
0973	166.5		EHJ	Encrust Heavy at Jnt. 25% loss at 08o/c to 12o/c
0983	171.1		IDJ	Infiltration Dripping at Joint at 11o/c
0996	194.7		IDJ	Infiltration Dripping at Joint at 11o/c
1003	202.4		IDJ	Infiltration Dripping at Joint at 01o/c
1016	213.7		BJ	Break at Joint. From 06o/c to 08o/c
1026	217.6		IDJ	Infiltration Dripping at Joint at 11o/c to 12o/c
1033	225.2		IDJ	Infiltration Dripping at Joint at 01o/c
1050	252.9	F1	EMJ	Encrust Med at Jnt. 15% loss at 07o/c to 05o/c CLOCKS VARY
1300	252.9	S3	ELJ	Encrust Light at Joint at 07o/c to 05o/c CLOCKS VARY
1066	286.4		IDJ	Infiltration Dripping at Joint at 12o/c
1073	296.2		RMJ	Mass Roots at Joint. 30% loss
1350	296.2		IDJ	Infiltration Dripping at Joint at 02o/c

DETAIL CONTINUED ON NEXT PAGE For Page Number : 184

< CONTINUATION PAGE > < Page Number : 184 >

Location	Place Name
GAULT STREET	BOULEVARD BASIN

Start Manhole No. : 23350305601 Depth : 22.0 Total Length : 501.2
Finish Manhole No. : 23350315501 Depth : 00.0 Suyed Length : 501.2

< DETAIL CONTINUED > < Page Number : 184 >

Digit Ph.	Dist	CD	Code	Other Details
1086	304.2		RMJ	Mass Roots at Joint. 10% loss
1113	349.6		RMJ	Mass Roots at Joint. 65% loss
1130	367.7		RMJ	Mass Roots at Joint. 05% loss
1133	370.7		RMJ	Mass Roots at Joint. 60% loss
1146	375.8		RMJ	Mass Roots at Joint. 05% loss
1150	377.8	S4	RFJ	Fine Roots at Joint
1186	441.6		BJ	Break at Joint. From 09o/c to 12o/c
1193	442.7		B	Break. From 11o/c to 01o/c
1200	444.8		B	Break. From 11o/c to 01o/c REPAIRED
1206	446.3		CCJ	Circumferential Crack at Joint at 07o/c to 09o/c
1213	448.5		B	Break. From 10o/c to 01o/c REPAIRED
1220	451.8		B	Break. From 11o/c to 01o/c REPAIRED
1230	454.7		B	Break. From 10o/c to 12o/c REPAIRED
1240	457.2		B	Break. From 10o/c to 12o/c REPAIRED
1250	460.3		B	Break. From 09o/c to 01o/c REPAIRED
1256	462.1		B	Break. From 10o/c to 01o/c REPAIRED
1266	471.9		B	Break. From 11o/c to 02o/c REPAIRED
1273	478.5		RMJ	Mass Roots at Joint. 25% loss
1750	478.5		RTJ	Tap Roots at Joint
1346	485.1		RMJ	Mass Roots at Joint. 25% loss
1360	492.7	S5	DES	Debris Silt. 10% loss
1370	501.2	F3	ELJ	Encrust Light at Joint at 07o/c to 05o/c CLOCKS VARY
1940	501.2	F4	RFJ	Fine Roots at Joint
3080	501.2	F5	DES	Debris Silt. 10% loss
3760	501.2		MH	Manhole 23350315501
1370	501.2		FH	Finish of Survey.

< SUMMARY > < Page Number : 184 >

St Mh No. : 23350305601 Fh Mh No. : 23350315501 Suyed Length : 501.2

SOME MAJOR defects in this length : Deformations : NO

Breaks/Holes	Mult/Long/Circ Fractures	Heavy/Medium Encrustation	Gusher/Runner Infiltration	Mass Roots	Obstructions
YES	LONG	HEAVY MEDIUM	NO	MASS	NO

Faulty Junctions/Connections : NO

< END OF SUMMARY >

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ATTACHMENT C

DEFECT, MATERIAL, SHAPE, AND LINING CODES

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DEFECT CODES SORTED ALPHABETICALLY

CONT. DEFECT	CODE	DEFINITION	DIAMETER	CLOCK AT	CLOCK TO	PERCENT / INTRUSION	REMARKS
Optional	**B**	Broken pipe	N/A	Req'd	Optional	N/A	Optional
N/A	**BR**	Branch major	Req'd	Optional	N/A	N/A	Optional
Optional	**CC**	Crack circumferential	N/A	Req'd	Req'd	N/A	Optional
Optional	**CL**	Crack longitudinal	N/A	Req'd	N/A	N/A	Optional
Optional	**CM**	Cracks multiple	N/A	Req'd	Req'd	N/A	Optional
N/A	**CN**	Connection	Req'd	Req'd	N/A	N/A	Enter Connection Material
N/A	**CNA**	Connection abandoned '	Req'd	Req'd	N/A	N/A	Optional
N/A	**CNI**	Connection, intruding	Req'd	Req'd	N/A	Intr - inches	Enter Connection Material
N/A	**CXA**	Connection, defective abandoned	Req'd	Req'd	N/A	Intr - inches	Enter Connection Material
Optional	**CU**	Camera underwater	N/A	N/A	N/A	%	Optional
N/A	**CX**	Connection defective	Req'd	Req'd	N/A	N/A	Enter Connection Material
N/A	**CXI**	Connection defective, intruding	Req'd	Req'd	N/A	Intr - inches	Enter Connection Material
Optional	**D**	Deformed sewer	N/A	N/A	N/A	%	Optional
Optional	**DB**	Displaced bricks	N/A	Req'd	Optional	N/A	Optional
N/A	**DC**	Dimension of sewer changes	Req'd	N/A	N/A	N/A	Optional
Optional	**DE(J)**	Debris (non-silt/grease)	N/A	N/A	N/A	%	Optional
Optional	**DEG(J)**	Debris grease	N/A	Req'd	Req'd	%	Optional
Optional	**DES(J)**	Debris silt	N/A	N/A	N/A	%	Optional
Optional	**DH**	Deformed sewer, horizontal (brick sewers only)	N/A	N/A	N/A	%	Optional
Optional	**DI**	Dropped invert (brick sewer only)	N/A	N/A	N/A	N/A	Gap ... inches
Optional	**DV**	Deformed sewer, vertical	N/A	N/A	N/A	%	Optional
Optional	**EH(J)**	Encrustation heavy	N/A	Req'd	Req'd	%	Optional
Optional	**EL(J)**	Encrustation light	N/A	Req'd	Req'd	%	Optional
Optional	**EM(J)**	Encrustation medium	N/A	Req'd	Req'd	%	Optional
Optional	**ESH**	Scale heavy	N/A	Req'd	Req'd	%	Optional
Optional	**ESL**	Scale light	N/A	Req'd	Req'd	%	Optional

Optional	**ESM**	Scale medium	N/A	Req'd	Req'd	%	Optional
Optional	**FC**	Fracture circumferential	N/A	Req'd	Req'd	N/A	Optional
N/A	**FH**	Finish Survey	N/A	N/A	N/A	N/A	Enter Finish MH Label
Optional	**FL**	Fracture longitudinal	N/A	Req'd	N/A	N/A	Optional
Optional	**FM**	Fractures multiple	N/A	Req'd	Req'd	N/A	Optional
N/A	**GO**	General observation at this point	N/A	N/A	N/A	N/A	Enter reason for general observation
N/A	**GOA**	General observation Abandonment of a Service Line Survey/Inspection	N/A	N/A	N/A	N/A	Enter reason for general abandonment and "D="
N/A	**GP**	General photograph number	N/A	N/A	N/A	N/A	Enter reason for general photograph
N/A	**H**	Hole in sewer	N/A	Req'd	Req'd	N/A	Indicate size of hole
Optional	**ID(J)**	Infiltration dripper	N/A	Req'd	Optional	N/A	Optional
Optional	**IG(J)**	Infiltration gusher	N/A	Req'd	Optional	N/A	Optional
Optional	**IR(J)**	Infiltration runner	N/A	Req'd	Optional	N/A	Optional
Optional	**IS(J)**	Infiltration seeper	N/A	Req'd	Optional	N/A	Optional
Optional	**JDL**	Joint displaced large	N/A	N/A	N/A	N/A	Optional
Optional	**JDM**	Joint displaced medium	N/A	N/A	N/A	N/A	Optional
N/A	**JN**	Junction	Req'd	Req'd	N/A	N/A	Enter Junction Material
N/A	**JNA**	Junction, abandoned	Req'd	Req'd	N/A	N/A	Optional
N/A	**JX**	Junction defective	Req'd	Req'd	N/A	N/A	Enter Junction Material and Defect Type
N/A	**JXA**	Junction defective abandoned	Req'd	Req'd	N/A	N/A	Enter Junction Material and Defect Type
N/A	**LC**	Lining of sewer changes/starts/finishes	N/A	N/A	N/A	N/A	Enter new lining or material code
N/A	**LD**	Line of sewer deviates down	N/A	N/A	N/A	N/A	Optional
Optional	**LL**	Line of sewer deviates left	N/A	N/A	N/A	N/A	Optional
Optional	**LN**	Lining defect	N/A	Req'd	Req'd	N/A	Optional
Optional	**LR**	Line of sewer deviates right	N/A	N/A	N/A	N/A	Optional
N/A	**LU**	Line of sewer deviates up	N/A	N/A	N/A	N/A	Optional
Optional	**MB**	Missing bricks	N/A	Req'd	Req'd	N/A	Indicate size of hole
N/A	**MC**	Material of sewer changes at this point	N/A	N/A	N/A	N/A	Enter new material
N/A	**MH**	Manhole/node	N/A	N/A	N/A	N/A	Enter the Start or Finish MH

							Label
Optional	**MM**	Mortar missing medium	N/A	Req'd	Req'd	N/A	Optional
Optional	**MS**	Mortar missing surface	N/A	Req'd	Req'd	N/A	Optional
Optional	**MT**	Mortar missing total	N/A	Req'd	Req'd	N/A	Optional
Optional	**OB(J)**	Obstruction	N/A	N/A	N/A	%	Enter the type of obstruction
Optional	**OJL**	Open joint large	N/A	N/A	N/A	N/A	Optional
Optional	**OJM**	Open joint medium	N/A	N/A	N/A	N/A	Optional
N/A	**PC**	Pipe Joint Length changes	N/A	N/A	N/A	N/A	Enter new pipe joint length, in feet
Optional	**RF(J)**	Roots fine (at joint)	N/A	Req'd	Req'd	N/A	Optional
Optional	**RM(J)**	Roots mass (at joint)	N/A	Req'd	Req'd	%	Optional
Optional	**RT(J)**	Roots tap (at joint)	N/A	Req'd	Req'd	N/A	Optional
N/A	**SA**	Survey abandoned	N/A	N/A	N/A	N/A	Enter Reason for abandoned survey
N/A	**SC**	Shape of sewer changes at this point	N/A	N/A	N/A	N/A	Enter code for new shape / other pertinent comments
Optional	**SSL**	Surface damage, spalling large	N/A	Req'd	Req'd	N/A	Optional
Optional	**SSM**	Surface damage, spalling medium	N/A	Req'd	Req'd	N/A	Optional
Optional	**SSS**	Surface damage, spalling slight	N/A	Req'd	Req'd	N/A	Optional
N/A	**ST**	Start of survey	N/A	N/A	N/A	N/A	Optional
Optional	**SWL**	Surface damage, wear large	N/A	Req'd	Req'd	N/A	Optional
Optional	**SWM**	Surface damage, wear medium	N/A	Req'd	Req'd	N/A	Optional
Optional	**SWS**	Surface damage, wear slight at	N/A	Req'd	Req'd	N/A	Optional
Optional	**V**	Vermin	N/A	N/A	N/A	N/A	Optional
Optional	**WL**	Water level	N/A	N/A	N/A	%	Optional
Optional	**X**	Sewer collapsed	N/A	N/A	N/A	%	Optional

DEFECT CODES SORTED BY TYPE

Pipe Material Codes:

AK	Alkathene
AC	Asbestos Cement
BR	Brick
CI	Cast Iron
SI	Spun Grey Iron
CMP	Corrugated Metal Pipe
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CO	Concrete
CC	Box Culvert
DI	Ductile Iron
GRC	Glass Reinforced Concrete
GRP	Fiberglass
PSC	Plastic / Steel Composition
PE	Polyethylene
PLP	PVC Fold & Form
PVC	PVC
RCP	Reinforced Concrete
RPM	Reinforced Plastic Matrix (Truss)
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
WOD	Wood
PF	Pitch Fiber (Orangeburg)
MA	Masonry
XXX	Other (Comment)
ZZZ	Not Known

Pipe Shape Codes:

A	Arched,
B	Barrel (Beer Barrel)
C	Circular
E	Egg Shape
H	Horseshoe
O	Oval
R	Rectangular
S	Square
T	Trapezoidal

U	U Shape w/ Flat Top
X	Other (Comments)

Pipe Liner Codes:

BL	Bitumin,
CPP	Cure In Place
CL	Cement,
IS	Soft Inversion,
PL	Plastic,
RL	Resin Liner,
XXX	Other,
ZZZ	Not Known

Pipe Use Codes:

C	Combined
F	Foul (Sanitary)
S	Surface Water
T	Trade Effluent
W	Watercourse (Culvert)
X	Other (Comment)
Z	Not Known

Purpose Codes:

A	Specific problems on sewer system related to structural or service condition
B	Specific problems on sewer system related to infiltration
C	Assessment of complete remedial or renovation works
D	Pre-adoption - normally new sewers for adoption
E	Pre-acceptance - new sewers (direct contract) constructed by sewerage undertakers
F	Sample survey to determine asset condition
G	Associated with future capital scheme including Drainage Area Planning
H	Resurvey for any reason
X	Other (state in Comments)
Z	Not Known

Location:

A	Main Road Urban
B	Main Road Rural
C	Lightly Traveled Road
D	Foot Path / Road Shoulder
E	Field
F	Garden
G	Woodlands

X	Difficult Access

Weather Codes:

1	Dry
2	Heavy Rain
3	Light Rain
4	Showers
5	Snow

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ATTACHMENT D

GENERAL INSPECTION LOGGING REQUIREMENTS

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General reporting notes – **Header Information**
(to be read in conjunction with other related documentation, i.e. Clients Instructions or the Manual of Sewer Condition Classification):

- The Inspection company and the Inspectors name must be entered on the Header.
- The Date and accurate time of the inspection must also be recorded.
- Pipe sizes and shapes must also be recorded.
- **Recheck the accuracy of the Manhole Numbers and Road Names (for Road Names, i.e. 4711 Peachtree Street NE) as these are the "keys" to the whole inspection.**
- The Depth of the Start and Finish Manhole must be entered, but as a minimum, the Start Manhole depth is essential.
- A Total Length from center to center of manholes (Total Length Field) must be entered, either derived from the footage to the finish manhole (when the inspection successfully reaches the finish manhole) or estimated either from the Plan or by striding the length. It is fully understood that, in the case of an SA, the Total Footage is an estimate, **but it must not be the same as the Inspected length if SA**.
  If the Finish manhole cannot be found then enter a sensible footage (nominally 300 feet as an example) and NOT the footage of the abandonment. If the Total Length is estimated then just enter the text "Tot Length?" in Comments.
- If a Buried or Unmappped manhole is encountered then the Inspection report MUST finish with the MH / FH codes, and a new Inspection must be started. In the case of an unnumbered manhole being found, the numbering of the Manhole MUST be as advised by the client prior to the start of the Inspection/Contract.
  Do not just make up a number. Update the map by marking the position of the Unmapped Manhole in red and writing its number in red.
- If the inspection is abandoned from one direction and inspected from the other direction then the inspection from the first direction must by finished using SA (**plus a reason for the Inspection being Abandoned, SA)** and a new Header must be started for the "Reverse Inspection". Note the reverse inspection by entering a "Y" in the proper field on line 1.
- If the inspection is not going to be carried out from the other Manhole, in the case of an SA, then a Header sheet MUST still be completed as if the inspection was to take place, with the reason for failing to carry out the inspection. **See the separate "No Access Instructions" appended to these guidelines.**
- Determine, prior to starting the contract, from Specification Section 02752, what text (data) must be displayed on the monitor (hence recorded). At the start of each inspection as much information as possibly needs to be recorded.

- **If using VHS tape, the video recorder MUST be set to SP and NOT EP or LP for the best quality** to be achieved especially if the Video is going to be encoded onto CD-ROM

General reporting notes – Detail Information

- The first three lines of each set of inspection details **must** have the codes ST, MH, and WL. **The Manhole Number must be entered in the Remarks column against the MH code** (this is essential as a number of Data Interrogation packages stores the Header and Detail records separately which are "connected" by an Index. To ensure data integrity, a QC check can be run against the Detail information to confirm that the correct Details are against the relevant Header).

  i.e.:

V Digit	Dist	Code	Remarks
02305	0.0	ST	
	0.0	MH	SJ34255521
	0.0	WL	10

- Each line of Detail must have the video digit (V Digit) entered against each code, presented in the following way:
  - The video digits must conform to the National elapsed time based standards (time into the tape) for Video Tape recorders:
    - Always have digits (hmmss).
    - Always right justified and zero filled.
    - The following elapsed time format MUST be adhered to, i.e.:

      02305 is:

      0 = Number of hours (Zero hours).

      23 = Number of minutes (23 minutes).

      0 = Units of 10 seconds each (0 seconds)

      5 **=** Units of seconds (5 seconds).
    - Other examples:

      00324 = 3 minutes and 24 seconds into the tape.

      15039 = 1 hour, 50 minutes and 39 seconds into the tape.

      24516 = 2 hours, 45minutes and 16 seconds into the tape.

  This method locates the position of the defect/feature into the tape to within a few seconds, which is more than adequate.

- **The final detail line for each inspection MUST end with a Termination code, either SA (Survey Abandoned) or FH (Survey Finished).**

  i.e.

24511	**76.0**	**F1FL**	**12**
24511	**76.0**	**RMJ**	**30**
24511	**76.0**	**SA**	**DUE TO ROOTS MASS (or DUE TO RMJ)**

---------- or ----------

14956	**97.3**	**D**	**10**
15032	**102.9**	**MH**	**SJ35513464**
15032	**102.9**	**FH**	

Each* Inspection *Report MUST only contain one Inspection hence, in the case of a Survey Abandonment or a buried or unmappped manhole being encountered, a new Header and Detail must be completed.
The above are essential for the Validation of the data to take place and to tie the data in with Mapping systems.
General reporting notes – Detail Information (Cont'd)

When a defect or feature is encountered, the camera must be stopped just prior to the defect/feature so that it can be clearly seen.

- The defect/feature must be recorded for a sufficient time to enable the engineer to assess the observation without recourse to using the "pause" facility.
- A video digit must be entered against the defect/feature in the format of time elapsed into video tape. The format is :h:mm:ss (explained above).
- If the defect spans for more than 3 feet or is repetitive over a number of joints (i.e. ELJ, Encrustation Light at Joint) then a Start Flag (S1, S2 etc, sequentially up to S9 then SA, SB --- SZ! can be used) can be entered against the code at the start footage. When the defect finishes the appropriate Finish Flag is inserted against the defect at the finish footage and the same Flag number is used to finish the defect off (S1 MUST finish with an F1 and so on). This aids the Rig Manager in reporting repeating defects without having to enter the code at every joint footage or every 3 feet.
  Note: The defect that has the start flag against it can change its position (i.e. a FL or CL) but not its magnitude (i.e. you cannot start with a CL and finish with a FL. You must "close", or finish, the defect with the appropriate Finish Flag and then start the new defect with an UNUSED (in the current inspection) Start Flag.
- If the inspection was abandoned (SA), then a reason for the abandonment MUST be entered in the Remarks column against the SA code. The description of the reason for the SA should contain the appropriate defect code that has caused the abandonment (i.e. If due to an intruding connection then the end of the report would read:

11025	342.8	CNI	04	11	02	
11025	342.8	SA				DUE TO CNI

- If you are unsure of the defect magnitude (an FL or CL, for instance) then enter the worst code of the two, with its support information, and then in Remarks enter: CL ??

  i.e. 00327 301.2 FL 11 CL??

- All defects and features MUST have the relevant support data (i.e. JN/CN must have sizes and positions. See Defect Code list for details)

General Inspection Logging Requirements

(to be read in conjunction with other related documentation, i.e. Manual of Sewer Condition Classification):

The first three lines of each set of survey details **must** have the codes ST, MH, and WL (WL is optional but is important to the City of Atlanta as it directly relates to the sewer flow level at a certain time of day).

The Manhole Number must be entered in the Remarks column against the MH code (this is essential as a number of Data Interrogation packages stores the Header and Detail records separately which are "connected" by an Index. To ensure data integrity, a QC check can be run against the Detail information to confirm that the correct Details are against the relevant Header).
i. e.:

0D10230 0.0 ST
0D1 0.0 MH SJ34255521
0D1 0.0 WL 10

Each line of Detail (or as a minimum the first and last Detail lines) must have the video digit entered against each code, presented in the following way:
– The video digits must conform to the National elapsed time based standards (time into the tape) for Video Tape recorders:

- Always four digits (hmms, where s = units of 10 seconds).
- Always right justified and zero filled.
- The following elapsed time format MUST be adhered to, i.e.:

0230
0 = Number of hours (Zero hours).
23 = Number of minutes (23 minutes).
0 = Units of 10 seconds each (0 seconds).

Other examples:
0032 = 3 minutes and 20 seconds into the tape.
0244 = 24 minutes and 40 seconds into the tape.
1503 = 1 hour, 50 minutes and 30 seconds into the tape.
2451 = 2 hours, 45minutes and 10 seconds into the tape.

The final detail line for each survey must end with a Termination code, either SA or FH.

i.e.
0D1 89.0 RMJ 30
0D1 89.0F1JDS
0D10410 89.0 SA DUE TO ROOTS MASS
---------- or ----------
0D1 33.0 D 10
0D1 34.9 MH SJ35513464

0D10670 34.9 FH

Each Survey Report MUST only contain one survey hence, in the case of Survey Abandonment or a buried or uncharted manhole being encountered, a new Header and Detail must be completed. The above are essential for the Validation of the data to take place

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DRAFT
CITY OF ATLANTA – INTERNAL CONDITION ASSESSMENT LOG

CD Volume Label	Contractor/Inspector	Basin Number	Sub Basin Number	Reverse	Spare	PLR

Date (mmddyy)	Time	Address (Street Number, NSEW, Name, Type, NSEW, Apt #)						Outfall / Trunk Name

Start Manhole	Start Depth	Start Cover	Start Invert	Finish Manhole	Finish Depth	Finish Cover	Finish Invert

Use	Direction	Size 1 Dia/Hght	Size 2 Width	Shape	Material /	Lining	Pipe Length	Total Length	Year Laid

Video Name	Spare	Comments

Purpose	Weather	Location	Location Details	Category Code	Pre-Cleaned

Video No.	Photo.No./S VC.No	Distance	Cont. Defect	Code	Diameter	Circumferential Clock At	Circumferential Clock To	Percent / Intrusion	Remarks

CD Volume Label	Contractor/Inspector	Date	Time	PLR

Video No.	Photo No.	Distance	Cont. Defect	Code	Diameter	Circumferential Clock At	Circumferential Clock To	Percent / Intrusion	Remarks

ATTACHMENT E

SERVICE LATERAL DOCUMENTATION

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Launch From Main:

CD Volume Label	Contractor/Inspector	Basin Number	Sub Basin Number	Reverse	Spare	PLR
PTO1XXAGCT01	AG CT	PTC	01			23260112301

Date (mmddyy)	Time	Address (Street Number, NSEW, Name, Type, NSEW, Apt #)						Outfall / Trunk Name
90502	1245	1234		PEACHTREE	RD	NE		

Start Manhole	Start Depth	Start Cover	Start Invert	Finish Manhole	Finish Depth	Finish Cover	Finish Invert
23260112301	6.00			23260123401	6.00		

Use	Direction	Size 1 Dia/Hght	Size 2 Width	Shape	Material / Lining	Pipe Length	Total Length	Year Laid
F	D	8		C	CO	3	70.3	

Video Name	Spare	Comments
00000		

Purpose	Weather	Location	Location Details	Category Code	Pre-Cleaned
B	1	B			N

Video No.	Photo/Svc No.	Distance	Cont. Defect	Code	Diameter	Circumferential Clock At	Circumferential Clock To	Percent / Intrusion	Remarks
10020		0.0		ST					
10020		0.0		MH					23260112301
10110	01	22.1		JN	4	12			INSPECTION FROM CLEANOUT
10202	02	35.2		CN	4	11			SVC INSPECT
11030	03	50.6		CN	4	09			SVC INSPECT
11655		70.3		MH					23260123401
11655		70.3		FH					

From Clean Out:

CD Volume Label	Contractor/Inspector	Basin Number	Sub Basin Number	Reverse	Spare	PLR
CCO1XXCECN01	CE CN	CMC	01			23260112301

Date (mmddyy)	Time	Address (Street Number, NSEW, Name, Type, NSEW, Apt #)						Outfall / Trunk Name
90502	1245	1268		PEACHTREE	RD	NE		

Start Manhole	Start Depth	Start Cover	Start Invert	Finish Manhole	Finish Depth	Finish Cover	Finish Invert
23260112301_01	6.00			23260123401	6.00		

Use	Direction	Size 1 Dia/Hght	Size 2 Width	Shape	Material /	Lining	Pipe Length	Total Length	Year Laid
F	D	4		C	VC		3	55	

Video Name	Spare	Comments
00001		

Purpose	Weather	Location	Location Details	Category Code	Pre-Cleaned
B	1	F	=SERVICE LINE=		N

Video No.	Photo/Svc No.	Distance	Cont. Defect	Code	Diameter	Circumferential Clock At	Circumferential Clock To	Percent / Intrusion	Remarks
10020		0.0		ST					
10020		0.0		MH					23260112301_01 (CO)
10320		55		FH					MAIN LINE REACHED

ATTACHMENT F

SEWER1.DAT DATA SPECIFICATION
AND
EXAMPLE OF SEWER1.DAT DATA FILE

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CCTV data transfer: Sewer1.Dat Description and Inspection Guidelines

Overview:

The Sewer1.dat Inspection data transfer format has been in existence since 1984. Sewer1.dat has been developed because the technology available now means that longer lengths are being inspected resulting in the need for higher "numbers" being achieved and longer manhole identifiers are becoming the "norm". Sewer1.dat reflects these needs.

Sewer1.dat is an "open architecture" format and was devised by a UK Government body called WRc to ensure that inspection data could be transferred between many applications and that no one contractor or software supplier had monopoly on inspection data input/interrogation software.

Sewer1.dat format basis is derived from the site data input form found in the Manual of Sewer Condition Classification Ver. 2 and 3. without the guideline boxes. Copies of the Manual are easily available. The form has been further customized for the City of Atlanta's specific needs following the same general format.

There are at least 15 specialist software programs around worldwide that accepts this format, and can be imported into ACCESS, Dbase V (with the Sewer1.dat fields properly defined within such applications) and Geographical Information Systems.
The specification for the format is "free issue" and devoid of "control characters" that can be found in some bespoke applications/data transfer specs.

A number of companies offer a free service to Contractors who wish to export to the Sewer1.dat format from their data handling software to test the correctness of the format and offer advice when necessary.

To ensure that the data transfer file format is correct the following points are to be adhered to:

- Some Field labels are available for the Contractor's use for their own purpose. These are labeled "Spare".
- The file is to be in a standard ASCII text format (i.e. no control characters) therefore each line in the file should be terminated by an ASCII carriage return/linefeed combination i.e. ASCII code 13 followed by ASCII code 10 (the default termination on most text generating programs).
- *The maximum line length must not exceed 81 characters including the ASCII termination code, except for Line 1 where the contractor can have their own reference after the 80th character. Other information could be added after the last character in each line (except for Line 1) if the software that the data is going into is set up to import this extra data. Line 2, for instance, the position from character 64 to 81 is unused.*

- Decimal points must not be in any header field. The Format describes the mask of the field; the Actual Format shows how it should have been originally recorded/reported.
- Each Header line must start with a three character identifier "1H*n*", *n* being between 1 and 6. The “1” before the “H” denotes that it is a Sewer1.dat specification.
- Each Detail line must start with a three character identifier "1D1". The “1” before the “D” denotes that it is a Sewer1.dat specification.
- Decimal points must be in Detail footage.
- N = Numeric ONLY field. If the Format is unspecified then Alpha Numeric characters are acceptable.

DATA TRANSFER SPECIFICATION

		Start Position	Number of Characters	Format/Actual Format ----------Or Notes--------
Line 1	"1H1"	1	3	Line Identifier
	CD Volume Label	4	12	As per City Guidelines
	Contractor/Inspector	16	8	*----------Ditto---------
	Basin Number	24	10	*i.e. PTC or PTC-PRC
	Sub Basin Number	34	10	*i.e. 32/33/34
	Reverse		44	1Indicate Y if reverse setup
	Spare	45	3	For Contractors Use
	PLR	48	17	Upstream Mh No. + X or Y

*** Specific format and Information supplied by City of Atlanta**

Line 2	"1H2"	1	3	Line Identifier
	Date	4	8	MMDDYYYY
	Time	12	4	hhmm
	Road Name	16	30	Where Upstream Mh is.**
	Place Name	46	20	Local name

**** Specific format and Instructions for completion to be supplied by City of Atlanta**

Line 3	"1H3"	1	3	Line Identifier
	Start Manhole	4	16	
	Start Depth	20	5	(NNNNN) (nnn.nn)
	Start Cover	25	6	(NNNNNN)(nnnn.nn)
	Start Invert	31	6	(NNNNNN)(nnnn.nn)
	Finish Manhole	37 (was 38)	16	
	Finish Depth	53	5	(NNNNN)(nnn.nn)
	Finish Cover	58	6	(NNNNNN)(nnnn.nn)
	Finish Invert	64	6	(NNNNNN)(nnnn.nn)

Line 4	"1H4"	1	3	Line Identifier
	Use	4	1	
	Direction	5	1	Direction of inspection U/D
	Size 1	6	4	(NNNN)(nnnn)
	Size 2	10	4	(NNNN)(nnnn)
	Shape	14	1	
	Material	15	3	
	Lining	18	3	
	Pipe Length	21	4	(NNNN)(nnn.n)
	Total Length	25	5	(NNNNN)***(nnnn.n)
	Year Laid	30	4	

***** Distance between the St. and Fh. Manholes, NOT inspected length unless the inspection was completed where it would be the same as the Inspected length.**

Line 5	"1H5"	1	3	Line Identifier

	Video Name	4	5	e.g. 00000, 00001, etc.
	Spare	9	10	
	Comments	19	40	
Line 6	"1H6"	1	3	Line Identifier
	Purpose	4	1	
	Weather	5	1	
	Location	6	1	
	Location Details	7	50	
	Category Code	57	1	
	Pre-Cleaned	58	1	
Details	"1D1"	1	3	Line Identifier
	Video Digit.	4	5	(NNNNN)(nnnnn)
	Photo/Svc No. (see Note 2.)	9	4	(NNNN)(nnnn)
	Distance	13	6	(NNNN.N)(nnnn.n)
	CD	19	2	Cont. Defect column
	Code	21	5	
	Diameter	26	4	(NNNN)(nnnn)
	Clock At	30	2	(NN)(nn)
	Clock To	32	2	(NN)(nn)
	***Percentage %**	34	2	(NN)(nn)
	***Intrusion**	34	4	(NNNN)(nnnn)
	Remarks	38	30	

***Note:** The position from character 29 to 32 is a shared field in that there is no defect or feature that would have both Percentage and Intrusion, hence if a Percentage the Start position would be 29 for two characters (99% max), and if an Intrusion the Start position would also be 29 but zero filled (20 inches would be 0020, for instance).

Note 2. In addition to the standard use as described in the Manual of Sewer Condition Classification, this field will also be used to number service connections/junctions in accordance with the attached clarification on CCTV Inspection of Private Service Connections and Junctions.

Example of Sewer1.Dat Data File on Diskette

```
1H1CC02BXCECN02CECN    CMC       02B          13930201601
1H20829200209162731 BLACK FOREST TR SW
1H313930201601    00915          13930201701    01427
1H4FD0008    CCO    004001881
1H5C0003
1H6B1B                          N
1D100027    0000.0  ST
1D100057    0000.0  MH      MANHOLE 13930201601
1D100113    0000.0  WL      05
1D100532    0002.3  JN      000603      MATERIAL CO
1D100942    0005.1  JN      000609      MATERIAL CO
1D101253    0046.0  ELJ     070805
1D101427    0049.6  B       0304
1D101511    0051.4  JN      000603      MATERIAL CO
1D101619    0052.7  JDM     0105
1D101759    0068.5  FL      12
1D101924    0076.2  ELJ     010205
1D102056    0095.9  ELJ     030505
1D102214    0098.8  CX      000611      MATERIAL CO
1D102345    0105.1  JNA     000609      MATERIAL CO
1D102607    0138.3  FL      12
1D102713    0148.3  FL      12
1D102816    0159.6  JN      000603      MATERIAL CO
1D103002    0182.2  JX      000609      MATERIAL CO
1D103127    0188.1  MH      MANHOLE 13930201701
1D103151    0188.1  FH
```

****END OF SECTION****