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SECTION 1 – INTRODUCTION

This manual documents the general procedures and codes required to perform closed-circuit television inspection (CCTV) for the Santa Ana Watershed Project Authority (SAWPA) which owns and operates the Santa Ana Regional Interceptor (SARI) pipeline in conjunction with sub-authorities, Western Municipal Water District (WMWD) and the Inland Empire Utilities Agency (IEUA).

The intent of this manual is to describe the collection and documentation of CCTV data procedures required to be followed by SAWPA employees, WMWD, IEUA, CCTV specialty contractors, CCTV operators, maintenance managers, engineers, construction inspectors, and construction contractors.

1.1 MANUAL CONTENTS

This manual includes general procedures for performing CCTV of Reaches I through V of the SARI pipelines and its laterals. It includes information regarding mobilization for CCTV, data collection process and standards, the data to be collected, and codes to be used. These sections are presented in generic rather than equipment-specific terms.

1.2 IMPORTANCE OF TELEVISION INSPECTION

SAWPA has a primary responsibility to protect and maintain its facilities and to prevent sewage spills that could create public health hazards or damage to the environment. CCTV provides information about the condition of the pipes so they can be properly maintained, identify critical repair/rehabilitation needs and prioritize these repairs, establish rehabilitation budgets and projects, system improvements, spot repairs, and large-scale projects. CCTV is also used to verify the quality of preventative maintenance cleanings, new pipe construction and pipeline rehabilitation.

1.3 STANDARD PROCEDURES AND CODES

It is important for all CCTVs to be completed to a uniform standard of performance. The use of uniform codes to describe conditions and defects allows the reviewer to gain a good understanding of the condition of a pipe merely by looking at the CCTV report for the pipe. All CCTV performed by CCTV contractors must be performed using the standards and coding system described in this manual, and be delivered in compact disc (CD or digital video disc (DVD) format.

1.4 GENERAL INFORMATION AND DEFINITIONS

Camera Set and End Points: The location at which the camera footage counter is set (typically about 8 feet into the pipe from the manhole) should be recorded using the SET code. The footage locations of observations made prior to the camera set point should be estimated by the operator. The point where the camera footage counter is stopped (typically at the end of the pipe at the manhole wall) should be recorded using the END code, and the

footage at the ending manhole centerline should be recorded as the END footage plus half the diameter of the manhole.

Clock Position: A clock position must be recorded for all taps, drops, or blind tee connections (see explanation of clock positions later in this section).

Data Entry Direction: Data should be entered in ascending footage in the direction of camera travel as the inspection proceeds from the starting manhole. The first entry of each pipe segment should be at the centerline of the manhole (MH) at footage location 0.0.

Defect Panning: When a defect or other feature is encountered in a pipe, it should be recorded at the footage indicated on the footage counter. Progress of the camera should be slowed and stopped for a minimum of 15 seconds or as needed so that the observation can be panned with the camera, the data recorded, narration made, and a still picture captured, if required.

Direction of CCTV: The direction of camera travel should be in the direction of flow in the pipe unless there are access problems that require a reverse set-up, or the camera cannot pass through the pipe from end-to-end in the direction of flow.

End Point: The end point of the segment is the centerline of the manhole (or other structure) at the opposite end of the pipe segment from the starting manhole.

Interruption of Progress: If the camera becomes stuck in a pipe or otherwise cannot progress, the cause of the interruption should be evaluated and corrected. If the camera cannot pass, a reverse setup should be used to complete the CCTV of the pipe segment. If cleaning the pipe is required before the CCTV can be resumed, recording of CCTV observations should continue at 0.1 foot beyond the position where the CCTV was interrupted. A comment regarding the cleaning procedures should be included in the data record. The CCTV contractor should notify SAWPA immediately if a blockage cannot be cleaned using normal hydroflushing or rodding methods.

Manhole: The point of entry into the sewer system is referred to as a manhole (MH). Sanitary sewer manholes are type-coded SS-MH.

Manhole “Scanning”: Data recording for a setup should begin at the street level and include scanning the manhole for observations before the pipe inspection is started. Any observations in the manhole should be recorded at footage 0.0 of the pipe being inspected. If a CCTV setup passes through a manhole, the manhole should be scanned from the pipe with the manhole location and start of the new pipe segment recorded at the centerline of the manhole.

Node: A node is a sewer manhole or other sanitary sewer structure, displayed as a point on a utility map and assigned a structure identification number (ID#). Manhole ID numbers are given by SAWPA and stored as part of the SARI GIS.

Photo Capture: Still picture images should be collected for all severe defects, broken or collapsed pipe, medium and severe corrosion or ovality problems, and for any defects coded as Other. Still pictures should also be captured at 100-foot intervals along the pipe segment to document the typical condition of the pipe.

Pipe Segment: A pipe segment is the section of mainline between two nodes displayed as a line on a utility map and assigned a structure ID#. Sewer pipe ID#'s are coded by upstreamMH#_downstreamMH#.

Reverse Set-up: CCTV performed against the flow due to an upstream manhole access problem, restricted mainline access, or because an obstruction prevents the camera passing. Reverse setups for convenience are not acceptable. All CCTV observation locations are to be recorded based on the direction of camera travel.

Setting “Zero” Point for Camera: The zero point of the CCTV is the centerline of the manhole where the camera is inserted. The footage counter should be set accordingly by adding the footage from the centerline of the manhole to the edge of the manhole, the camera length, and the camera focal length.

Taps: Sewer service lines join mainlines at taps. There are four types of taps: factory tees, factory wyes, cored taps, and hammer taps. Any of the types should be recorded as a sewer service connection (TAP). However, a plugged service line should be recorded as a dead tap (DT), rather than a TAP. In addition, any protrusion of a cored tap or hammer tap should also be recorded as a protruding tap (PT) and given an appropriate severity rating.

Taps in Manhole: Taps connecting directly into the starting manhole of the CCTV should be recorded at footage location 0.0 along with appropriate clock position (see below).

CCTV of Multiple Segments: It may be necessary to perform CCTV on several consecutive pipe segments with one set-up. If this is the case, each segment should be considered a separate data report.

Water Level: Water level should be the first item of information to be entered after the manhole information. After this initial entry, water level is only entered again for changes in the water level. Enter the water level using the coding which designates depth in relation to the inside pipe diameter.

SECTION 2 – MOBILIZATION

This section describes the general data collection process. It includes basic information on pre-inspection activities including mobilization and site assessment, and describes CCTV performance standards, including general information and definitions, quality standards, record keeping requirements, digital data formatting, appropriate screen text information and narration, and special CCTV procedures.

The CCTV operator and field crew should refer to the following documents describing procedures for activities related to CCTV:

- Standard Specification for Public Works Construction (Greenbook), latest edition
 - Traffic and Access (Section 7-10.1, 2006 ed.)
 - Street Closures, Detours, Barricades (Section 7-10.3, 2006 ed.)
 - Safety Orders (Section 7-10.4.1, 2006 ed.)
 - Confined Spaces (Section 7-10.4.4, 2006 ed.)
 - Cleaning & Preliminary Inspection (Section 500.1.1.4, 2006 ed.)
 - Television Inspection (Section 500.1.1.5, 2006 ed.)

- Health and safety procedures
- General mobilization/demobilization procedures
- CALTRANS STANDARD for traffic control procedures
- Procedures for plugging pipes, flow diversion, and bypass pumping
- Equipment owner's manuals (for equipment operation, maintenance, and troubleshooting)
- Software user's manuals (for software operation, maintenance, and troubleshooting)

2.1 MOBILIZATION AND SITE ASSESSMENT

Pre-inspection activities include all activities required to mobilize for the field and set up equipment before actually performing the CCTV, as well as assessing the requirements for working at the project site. The following sections summarize the standards required by SAWPA. The information provided in this manual is intended to supplement any contractual requirements that bind a contractor performing this work for SAWPA.

Access to Property: Property owners must be notified if access to property is required. CCTV contractors must follow SAWPA prescribed easement access procedures for the project being performed.

Traffic Control: Traffic control is normally required to perform CCTV. CALTRANS STANDARD must be followed at all times. Flashing lights must be used for all night work.

Atmospheric Testing: Atmospheric Testing must be performed even if entry into the manhole is not planned. This prevents personnel leaning over the manhole from being overcome by noxious gasses and allows emergency confined space entry if necessary. If the gas detector alarm sounds, contact a supervisor immediately.

Plugging or Bypassing: Plugging or bypassing of flow is NOT to be performed by CCTV contractors without prior approval of SAWPA.

NOTE: If the safety of field personnel or the public, or safe use of field equipment is threatened at any time during the CCTV process, the field activities should be stopped and the site secured. If SAWPA, IEUA, or WMWD field personnel are performing the CCTV, the supervisor should be notified immediately. If a CCTV contractor is performing the CCTV, the prime contractor and SAWPA's project manager should be notified immediately.

SECTION 3 – DATA COLLECTION/PERFORMANCE STANDARDS

3.1 CCTV PERFORMANCE

CCTV performance includes the following:

- Consistent use of standard forms and codes
- Uniform compliance with setup and inspection procedures
- Quality picture and audible records
- Suitable camera speed, lighting, and panning
- Accuracy when recording file names and electronic data

3.2 *CCTV QUALITY STANDARDS*

Counter Calibration: The footage counter for the camera must be calibrated at least every two weeks during CCTV operations. The footage counter must be accurate to 0.5 feet per 100 feet. The calibration is performed by checking the cable counter against a measured length of 400 feet. The date of last calibration should be recorded for every CCTV report.

Verification of Map Length: If the map length (as indicated by the written distance shown on sewer maps) and the CCTV field length for a pipe segment differ by more than 2 feet, the field length should be verified by measuring between the centerlines of the manholes using a measuring tape or wheel.

Lighting: Lighting in the pipe should be such that the pipe is illuminated and there is a minimum amount of glare. Lighting should be adjusted as needed according to the size of the pipe to provide a clear picture of the entire periphery of the pipe for all conditions encountered. Illumination sensitivity should be 3 lux or less.

Flow Level: The flow level requirements for CCTV vary depending on the type of inspection being performed. Generally, the more pipe visible, the more data that is obtained. The following standards apply to various types of CCTV. Lower percentages of visible pipe wall may be inspected only with the approval of SAWPA.

Maintenance: At least 75-percent of the circumference of the pipe wall must be visible except in areas with sags or obstructions, in which case cleaning and dewatering (plugging) may be required to expose the required amount of pipe wall.

Condition Assessment: At least 75-percent of the circumference of the pipe wall must be visible. Certain types of condition assessment projects may require a greater amount of visibility.

Pre- and Post- Rehabilitation: At least 75-percent of the circumference of the pipe wall must be visible.

New Pipe Construction: Nearly 100 percent of the circumference of the pipe wall circumference must be visible. A small amount of water will be introduced for purposes of sag identification. In some cases, nighttime work may be required in order to obtain appropriately low flow levels for CCTV. If maximum pipe wall visibility is critical for the specific project and sufficiently low flow levels cannot be obtained even at night, flow plugging and/or bypass pumping may be required. Plugging should only be performed by SAWPA, IEUA, or WMWD employees or under the direction and approval of SAWPA.

Camera Travel Speed: The camera travel speed should be a uniform rate of no more than 30-feet per minute. The camera speed should be slower when recording features and defects.

Clarity: All video and still picture images must be clear and sharp. The camera operation should adjust focus, iris, zoom, and lighting as needed to obtain a satisfactory image. The recorded image from the CCTV camera must be free of fog or haze in the pipe. If the camera lens becomes obscured with condensation, grease, scum, or debris, the camera should be removed from the pipe, cleaned, and reinserted to continue inspecting the pipe. For increased clarity, the contractor should also try adjusting the iris, focus and zoom of the camera.

3.3 RECORD KEEPING

CCTV Field Log: A field log is to be used by the CCTV crew to track daily work. This log should be submitted with the completed fieldwork at the end of the day or when data is delivered. Submittals should be given to the agency responsible for the inspection. All inspection logs shall be filed and submitted to SAWPA annually.

Catalogue Number for CD/DVDs:

CD/DVD Labels: All CD/DVDs must be properly identified with

- Project number and/or name (if applicable)
- Name of responsible Agency
- Contractor name, address, and phone number
- Date of inspection(s)
- Pipe segments listed by upstream MH# to downstream MH# (followed by R if reverse set-up)

3.4 DIGITAL DATA FORMAT

CCTV Video: The full CCTV video must be captured in MPEG-1 format. Files should be named in accordance with the following convention: *Upstream MH#-MH#-mmdyyy-F/R.mpg*

Digital video files are to be copied onto CD/DVD and grouped in a logical manner (e.g. by Reach and area of inspection). CCTV contractors must provide two copies of each CD/DVD.

Still Picture Captures: Still images should be captured for all observed defects with a severe rating and/or as directed by SAWPA. In addition, still images should be captured for every 100 feet to illustrate the typical condition of the pipe. Still images should be in jpeg format at least 640 x 480 resolution and should utilize the same file naming convention as described for the digital video files with the addition of the footage location on the image. Therefore, the file naming convention is: *UpstreamMH#-Downstream MH#-mmdyyy-F/R-xxx.jpg* where xxx is the footage location of the defect or observation (to the nearest foot).

Still image files are to be copied onto the same CD or DVD as the corresponding video file for the pipe segment.

Site and CCTV Observations: All inspection (header) information and pipe features and defects observed during CCTV must be recorded and captured in a digital database format using the coding system described in Section 5 of this manual. Various software may be used to capture the data depending on how each CCTV vehicle and/or contractor is equipped. CCTV contractors must provide the data in a format as specified by SAWPA that will permit unloading to SAWPA's computerized maintenance management system.

3.5 SCREEN TEXT

Start-up Screen Text: Immediately before the insertion of the camera into the manhole, the following information must be provided as text on the video recording. This text should be displayed for approximately 15 seconds or for the duration of the Start-up Narration, whichever is longer. If an inspection is being performed on consecutive pipe segments with the same setup, this information must be provided at the start of each pipe segment.

- Upstream and downstream node numbers
- Direction of camera travel
- Purpose of CCTV
- Location
- Date and time of day
- Job number
- CCTV company of Agency staff
- Operator's name

Running Screen Text: During CCTV, the running screen must include the following information. The display of this information must in no way obscure the central focus of the pipe being inspected.

- Running footage (distance traveled)
- Pipe ID (Upstream MH#-DownstreamMH#)

End Screen Text: The end point of the inspected pipe segment should be indicated with screen text for approximately 15 seconds. The ending screen text should indicate:

- Ending footage
- Date and time of day
- Upstream MH#-DownstreamMH# of inspected pipe segment

3.6 NARRATION

Language and Background Noise: The CCTV video recordings are part of SAWPAs permanent records and should not contain inappropriate language, idle chatter, background noise, and discussions between the operator and other crew members.

Start-up Narration: A voice narration must be included in the video recording. This narration must include the following information at the beginning of each pipe segment:

- Type (mainline or lateral) and purpose of inspection
- Upstream and downstream MH#s
- Direction of camera travel
- Location
- Date
- Pipe size
- Pipe material
- CCTV company or Agency staff (IEUA, WMWD, SAWPA)
- Operator name

Running Narration: All observations along the length of the pipe must also be narrated, with a description of the observation and clock position, if applicable. For example:

- Tap at 10 o'clock at 56 feet; factory wye
- Severe roots at 23 feet, all around crown of pipe
- Medium scaling deposits at flowline starting at 45 feet. End at 94 feet.

End Narration: At the conclusion of the inspection of a pipe segment, the operator should state the final CCTV footage and indicate that the CCTV inspection of a pipe segment is complete.

3.7 SPECIAL CCTV PROCEDURES

Buried Manholes: If the CCTV crew encounters a buried manhole, they should notify the responsible Agency (IEUA or WMWD) that the manhole needs to be exposed. CCTV may proceed through the buried manhole, however a new file should be started, treating the CCTV inspection as a separate pipe segment from the initial pipe segment, coding the new MH as NEWMH. If it is not possible to CCTV through the manhole, the crew should notify the responsible Agency that the manhole needs to be exposed in order to complete the assigned CCTV.

Flow Control: As noted above, flow plugging and/or bypass pumping is to be performed by SAWPA or the responsible Agency's employees, or under the direct supervision and approval of SAWPA or the responsible Agency. CCTV contractors requiring flow control services must contact the responsible Agency for assistance.

Pre-Rehabilitation CCTV: Pre-Rehabilitation CCTV may be performed immediately before construction or a repair or rehabilitation project. The purpose of this CCTV is to

locate gross defects that are to be corrected or might interfere with the rehabilitation project. This CCTV is for the use of the construction contractor and does not require the same level of defect identification maintenance or condition assessment CCTV.

Large diameter pipe: Large diameter pipes often require special procedures for flow control, lighting, and camera travel. Often self-propelled camera rigs are not suited for large diameter pipes. The camera must be floated down the pipe on a raft or boogie board. Only CCTV crews with the appropriate equipment and training to perform large diameter pipe inspection should do so.

SECTION 4 – STANDARDIZED CCTV CODES

This section covers the information and standard formats and codes required for completion of the CCTV.

4.1 GENERAL GUIDELINES

The following guidelines must be followed when completing the header section of the CCTV form:

- Unless specifically required, do not enter units or abbreviations for measurements.
- Enter all alphabetic entries in all capital letters.
- Enter all decimal entries to one decimal place, unless otherwise directed in these instructions.
- If the CCTV extends through a manhole and spans more than one pipe segment, a new header form must be completed at the start of each subsequent pipe segment.
- If a reverse set-up is required because the CCTV in the downstream direction could not be completed due to an obstruction, a new header form must be completed at the start of the reverse set-up CCTV.

4.2 REQUIRED HEADER INFORMATION

The header information contains the date and time of CCTV and information about the inspection location, conditions at the time of CCTV, operator conducting the CCTV, reason for the CCTV, and pertinent data about the pipe being inspected. The header is completed in the field to provide as much information as possible about the inspection work.

4.3 CONTINUOUS DEFECTS

Continuous defects are those defects or observations that extend more than one foot from beginning to end. A continuous defect can be any one of the following code types:

- Cracked pipe (CP) – typically longitudinal or spiral cracks

- Corrosion (C)
- Grease (G)
- Sediment or solids (S)
- Water level (W)
- Out of round (OV)
- Horizontal bend (BH)

A “start” of continuous defect should be recorded at the footage location where the defect or observations begin, and a “stop” should be recorded at the footage location where the defect or observation ends. Water level and grease should also be coded as continuous observations, with a “start” at footage 0.0 and corresponding “stop” and “start” entries at each change in water level or grease rating. Note: Defects that occur at regular intervals along the sewer length (ie. at each joint) but are not truly continuous should be recorded as individual observations at each location where they occur. Examples include roots at joints, open or displaced joints, and circumferential fractures occurring at joints.

The general procedure for coding continuous defects is as follows:

1. At the first occurrence of a continuous defect, record it in the usual manner (defect code plus severity rating).
2. If it is immediately noticed that the defect continues for more than one foot, also record a “start” of continuous defect.
3. If the defect is not initially observed to be more than one foot in length, but as the inspection proceeds it is still present, go back to the initial entry of the defect code and record a “start” of the continuous defect.
4. No further action is necessary until the end of the continuous defect is reached.
5. When the end of the defect is reached, re-enter the same defect code and severity as at the start of the defect and record a “stop” of the continuous defect.

Note: If a continuous defect changes in severity (e.g. from light to medium corrosion), record a “stop” and then a “start” of the same defect code with a different severity rating. This also applies to recording changed in water level.

Other guidelines for coding continuous defects:

- If the camera becomes submerged, end all continuous defects at the footage that the camera goes under water, and then record the start of a “WS” water level observation. If a continuous defect is still observed after the camera re-emerges, then record a new “start” of the continuous defect at the footage where the “WS” water level stops. An exception would be if the camera is under water for only a very short length and the defect appears to be continuous throughout the length of pipe in which the camera was submerged. In this case, it is not necessary to stop the continuous defect during the submergence.

- To revise continuous defect entries that cannot be immediately corrected, make a note in the comments column to recheck the defect, (e.g. Recheck CPM between footage 205.1 and 225.8).
- Start and stop labels should be verified for all continuous defects. The defect code and severity must be identical to the code at the start and stop entries. Continuous defects must be ended at the end of each pipe segment or at the point where the CCTV was terminated (e.g. in the case of an obstruction that prevents the camera from passing).
- Any other features or defects observed at the same location as the start or end of a continuous defect or within the footage spanned by the continuous defect must be entered in the usual manner separately from the continuous defect.

SECTION 5 – CLOCK POSITION

All blind tee (TEE) and service line connection (TAP) observations must also include a clock position indicating the relative position of the pipe or service line connection.

Clock Position in Pipes: The clock position for blind tees or taps into pipes is based on the camera pointing in the direction of travel, with “12 o’clock” at the crown (top) of the pipe. The clock numbers (1, 2, 3, etc.) go in a circle in a clockwise direction (from right to left) around the circumference of the pipe. For example, a sewer service discharging into the left-hand side of the mainline pipe (based on camera travel direction) about 30 degrees above the springline (horizontal centerline) of the pipe would be in the 10 o’clock position.

Clock Position in Manholes: The clock position for taps into manholes is based on the direction of CCTV of the associated pipe. When looking into the manhole from the surface, “12 o’clock” is the location of the pipe to be inspected. The clock numbers (1, 2, 3, etc.) go in a clockwise circle around the circumference of the manhole chamber. For example, a sewer service discharging into a manhole on the right side of the manhole (when facing in the direction of the camera travel in the pipe) and at right angles to the pipe being inspected, would be at the “3 o’clock” position.