

Accreditation Organisations:



Particular Specification For Manhole Internal Condition Survey (MHICS) 2020 Edition Version 1.1



Publisher:



UTILITY TRAINING INSTITUTE (UTI)
A trade name of UTI (International) Ltd. 管綫學院

Foreword

It's been 25 years since the disastrous landslip that occurred in Kwun Lung Lau on Hong Kong Island on 23 July, 1994. Since 1995, the Government of HKSAR has awarded hundreds of millions of dollars in contracts related to detection of leakage from buried water carrying services (BWCS) both on slopes and on the roads throughout the territory. As expected, this sequence of events generated an increasingly large pool of "Utility Specialists (US)", with most working almost independently, devoid of any standardized surveying methods, quality requirements (on survey results) and the "registration" of operation professionals in the market before the establishment of HKIUS in 2002.

In view of the availability of the multitude of method statements, specifications, training manuals, and the contracts documents produced for the vast number of underground utility survey contracts (by government and private projects), the following sections try to provide a comprehensive set of particular specification, by addressing the following topics in general and where the abbreviation can be found in the Appendix:

- (1) Utility Services Information to be Investigated
- (2) Level of Accuracies
- (3) Types of Deliverables and Schedules
- (4) Requirements for Deliverables

You are welcome to take reference to this Particular Specification for your contract and in case you need further information, please refer to relevant manuals or publications by HKIUS/IIUS or send an e-mail to info@hkius.org.hk or call Ir. Dr. King Wong

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B1 Introduction

Manholes, being one of the most common access structures to conduits, are a significant asset for the entrance of conduit maintenance. The word “manhole” implies that these access structures are large enough for entry of personnel.

Manhole Internal Condition Survey (MHICS) provides information on the features and defects of the manholes like whether there are defects on the covers, shafts, chambers, pipes, benchings, etc. or excessive infiltration/ inflow. It also provides information for system maintenance. With information on the manhole condition and other abnormalities as compared with the designer records constantly, remedial actions can be taken in time and in turn prevent potential landslips or road collapse.

Safety are particularly important for MHICS because it may involve entry into confined space which with potential high risks. Besides, special attentions shall be paid on record taking, as there are specific systems for recording different information like the coding system, numbering system and referencing system.

Besides, a complete set with industry norm survey standards and record system are the keys to success. A solid record management system is also crucial to good performance.

In recent years, 3D manhole scanners and pole cameras are introduced, providing alternative solutions to Manhole inspection, visual, geometry and measurable data collection without man entry.

B2 Personnel Requirements

In order to maintain the Utility Profession's requirements for the consistency, reliability and accuracy of reports, inspection shall be performed by a properly trained and accredited personnel:

- Operational works shall be conducted by Operative/ Manager Member of HKIUS (管綫專業監理員/師) (CCE- CCTV&ME) (at least 3 years' post-training experience) or AMHKIUS (助理管綫專業監理員)(at least 2 years' post training experience) with supervision by OMHKIUS,
- The whole operation shall be supervised by OMHKIUS/ MHKIUS/ FHKIUS.
- Report and survey result checking shall be completed by Manager/ Fellow Member of HKIUS (管綫專業監理師),
- And receive endorsement from Recognized Professional Utility Specialist (RPUS) (管綫專業監察師) where necessary or instructed.

Personnel responsible for recording, identifying and classifying defects, features and other observations for the purpose of report preparation shall hold a certified qualification issued by a Registered Training Organization (RTO), such as Utility Training Institute (UTI) or The Hong Kong Polytechnic University or equivalent, which are approved by HKIUS.

A certified qualification shall be either:

- (1) Degree/ Higher Degree, or
- (2) Diploma/ Professional Diploma, or
- (3) Professional Certificate, or
- (4) Accredited by Hong Kong Accreditation Services (HKAS), or
- (5) Equivalent approved by HKIUS in Utility Surveying and Management or related subject awarded by a RTO.

Note*: (1), (2) and (3) shall be of Surveying/ Engineering/ Applied Science with specialization in underground-utility (UU) survey(s) with practical on-site training.

In addition, a minimum of 3-year post-training experience will be necessary for a person to become competent. Besides, qualified personnel are required to attend refreshment course in every 3 years to strengthen and enhance their knowledge.

All works carried out within sewers, manholes, inspection openings or other confined spaces shall be performed in accordance with the requirements for works stipulated in Cap. 59AE Factories and industrial Undertakings (Confined Space) Regulation and Cap. 509 Occupational Safety and Health Ordinance, as well as any additional precautions that may be specified by the asset owner.

Note**: Designated Certified Workers (DCW) and Designated Competent Person (DCP) are required for DSD's confined space works inspection and risk assessment report preparation. For details on requirements of DCW and DCP, please refer to "*Safety Manual*" published by DSD (2018).

For comprehensive information, please refer to the Appendix B – **Requirements for Personnel Carrying Out Inspection** in this Particular Specification.

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B3 Statutory Requirements

This Section outlines the legislations in force that are relevant to Manhole Internal Condition Survey. The Utility Specialists are responsible to comply with the relevant ordinance or regulations listed below.

Cap. 28 Land (Miscellaneous Provision Ordinance)

Cap. 59AE Factories and Industrial Undertakings (Confined Spaces) Regulation

Cap. 358 Water Pollution Control Ordinance

Cap. 374 Road Traffic Ordinance

Cap. 446 Land Drainage Ordinance

Cap. 509 Occupational Safety and Health Ordinance

For detailed information, please refer to the latest verified legislation in Hong Kong at the website of Hong Kong e-Legislation <https://www.elegislation.gov.hk/>.

B4 Survey Equipment

B4.1 General Equipment

The Utility Specialists shall equip the team undertaking the manhole internal condition survey work for manhole condition evaluation with the following:

- (1) Equipment for easing and lifting manhole covers;
- (2) Sewer or other confined space facilities safety equipment;
- (3) Road safety equipment.

B4.2 Equipment for confined space

All works carried out within sewers, manholes or other confined spaces shall be performed in accordance with the requirements for works in the vicinity of Confined Space and Occupational Health and Safety Legislations, as well as any additional precautions that may be specified by the asset owner.

B4.3 Personal Protective Equipment (PPE)

It is a statutory requirement for Utility Specialists to provide guidance, instruction, training and supervision for operators to use PPE properly and to ensure that they have sufficient knowledge in usage, maintenance, replacement schedule and limitations of PPE. The Utility Specialists shall provide sufficient PPE and ensure that they are readily available.

In general MHICS works, PPE shall include but not limited to the following:

- (1) Steel toe cap, rubber safety boots
- (2) Safety helmet
- (3) Safety vest (reflective at night)
- (4) Safety goggles/Anti-glare glasses
- (5) Harness and fall arrester
- (6) Gloves
- (7) Ear muffs / Ear plugs (if applicable)
- (8) Handy gas detector

Note that other PPE shall be provided depending on the method of survey works, the specific site conditions after completion of risk assessment under safety procedures.

B4.4 MHIC Survey Equipment**B4.4.1 Photography and video equipment**

To capture images/ videos of the manholes, the following equipment is required:

- (1) Still Cameras/ video cameras;
- (2) Pole mounted cameras (if instructed);
- (3) Cameras with counter wheel (if instructed);
- (4) Combined photographic equipment and measurement device e.g. scanning equipment (if instructed).

The above instrument are preferably to be rugged, water proof and shock proof. Additional accessories such as tripods and camera stabilizers can be added to the instrument to improve the video quality.

B4.4.2 Topographic survey equipment

To gather data about location and elevation of the edges/ corners of manholes, the following equipment is required:

- (1) Total station
- (2) Prism
- (3) Tripods
- (4) GNSS survey instrument (if instructed)

B5 Survey Procedures

This Section outlines the general survey procedures for Manhole Internal Condition Survey. The Utility Specialists are expected to use their professional judgement and experience for MHICS.

For detailed information, please refer to the latest version of Work Procedure and Method Statement published by UTI.

B5.1 Planning for the Inspection

B5.1.1 Desk study

Obtaining all information available regarding the asset from the asset owner (usually the client)

Including extra details in order to enhance readability for whom might concern, the extra details should include:

- (1) A map indicates geo-information of the asset
- (2) The locality
- (3) Information of manholes (size, material and present condition)
- (4) Date of construction
- (5) Depth of manholes, surface and invert levels
- (6) Coordinates of manholes or other nodes
- (7) System name or descriptor
- (8) Name of qualified operators and checkers and name of specialist firm

B5.1.2 Preparation for Master Programme and Progress Schedule

Before execution of any works, The Utility Specialists shall prepare a Survey Progress Schedule agreed by the Client. Any survey work without confirmation with the Client for execution may be considered as invalid.

B5.1.3 Site reconnaissance survey

The Utility Specialist shall conduct a reconnaissance survey at each slope/ site before commencement of works. The survey shall cover the full survey extent as confirmed on the Layout Plans. The reconnaissance survey shall identify:

- (1) The full extent of the assets (manholes, pipes, catch-pits and other ancillaries) located within the survey extents
- (2) Any other manholes, pipes, catch-pits and other related ancillaries.
- (3) For pipelines extending beyond the survey extent the closest upstream and downstream manholes outside the survey extent.

- (4) Any salient features which may impede the execution of the surveys
- (5) Any additional features not shown on the base mapping or the Layout Plans, and/or revisions required to match existing conditions on-site.

It is the Utility Specialists' responsibility to ascertain the ownership of manholes and pipes based on site survey information together with the latest available information from various sources.

The Utility Specialists shall ensure that all reconnaissance surveys, manhole surveys, pipeline investigations and all other surveys are carried-out under the supervision of an operative/professional member of HKIUS (O/M/FHKIUS) or otherwise agreed with the client. Any surveys carried-out without the supervision, or any data from such surveys, shall not be accepted and any such surveys will be required to be repeated under the supervision at no extra cost to the Contract.

The Utility Specialists shall make arrangements for the client's staff to access survey sites not accessible by contract vehicles, including, but not limited to, survey sites in outlying islands, at no extra cost to the Contract for all reconnaissance surveys, manhole surveys, pipeline investigations and other surveys instructed by the Client or his representative.

The Utility Specialists shall provide all necessary justification as to the positions of all drainage and sewerage assets located within or adjacent to the survey extents, to the satisfaction of the Client or his representative.

The Utility Specialists shall submit a detailed method statement for undertaking the Reconnaissance surveys in advance of undertaking any Reconnaissance surveys. A method statement is not required for each slope or survey extent, however where there is significant difference in the scope of the Reconnaissance Survey the Utility Specialists may be required to produce a series of tailor-made method statements.

B5.1.4 Risk Assessments and Safety Plans

The Utility Specialists shall conduct risk assessment to identify high risks or hazards particular to that site and react with corresponding safety plan before issuing Permit to Work. Typical high risk works/ environment of-MHICS are included but not limited to the followings as shown in *Table 1*:

Table 1 Typical items for Risk Assessment of MHICS and corresponding safety precautions

Tasks/ environment with high risk	Corresponding safety precautions
Heavy traffic	Apply for Temporary Traffic Arrangements (TTA) for traffic diversion
Man-Entry to Confined Space	Safety precautions for confined space
Hazardous/ flammable gases	Gas testing Provide masks or BA if required

Work on-slope	Safety harness/ fall arrestor
Work at height	Working Platform Safety harness with fall arrestor
Insufficient lighting	Head torches
Water level > 1.5 m	Certified Divers

B5.1.5 Special considerations for confined spaces requirements

The Utility Specialists shall submit separately detailed method statement of the procedures to be adopted whenever men are required to work in confined spaces, in accordance with the latest Cap.59 Factories and Industrial Undertakings (Confined Spaces) Ordinance 1989 (amended year 2000) or any other revision. The Utility Specialists shall take special note of the recent amendments which require a risk assessment to be carried out under this ordinance as part of the safety procedures. Evidence shall be required in order to confirm that all personnel have attended the appropriate courses for this type of work e.g. DCW (certified workers for drainage works), DCP (competent persons for drainage works). The approval by the Client or his representatives of this method statement shall not relieve the Utility Specialists of his responsibility for ensuring the safety of his personnel.

B5.2 Testing and calibration of MHICS equipment

To ensure both the camera and the control unit are in good conditions, the following testing and calibration procedures shall be performed before inspection on each working day: (1) monitor test; (2) camera test; and (3) measurement device testing

B5.3 Procedures of Manhole Internal Condition Survey by different survey methods

B5.3.1 MHICS by man entry

In general situation, man-entry survey is not preferred. Man-entry techniques are usually adopted when the size of the manhole is large enough for man access and where it is difficult to carry out a MHICS due to the existence of complicated structures such as multiple platforms and large sized chambers. The general survey procedures are as follows:

- (1) Gas detection and other safety precautions
- (2) Measure and record the features and dimensions of the manhole;
- (3) Sketch the (83) Location Sketch and (84) Plan of Manhole;
- (4) Fill in all fields in Form C1 for level 1 surveys; and both Form C1 &2 for level 2 surveys;
- (5) Take manhole photographs as specified in section 0of this Particular Specification;
- (6) Finish survey or survey abandoned with reason noted in (80) Remarks.

B5.3.2 MHICS using pole mounted cameras/ manhole cameras/ combined photographic equipment and scanning equipment (if instructed)

- (1) Gas detection and other safety precautions;
- (2) Measure and record the features and dimensions of the manhole cover and manhole opening on ground;
- (3) Install the 3D Scanner or pole mounted camera to a tripod for a stabilize imagery/ video data acquisition or hand held for sites with difficult accessibility;
- (4) Extend the control rod and insert the scanner or pole camera into the manhole and start Scanning or video taking;
- (5) Monitor scan or video taking with the control unit, tablet, laptop or smartphone according to the instrument used;
- (6) Fill in all fields in Form C1 for level 1 surveys; and both Form C1 &2 for level 2 surveys;
- (7) Take manhole photographs as specified in section 0of this Particular Specification;
- (8) Finish survey or survey abandoned with reason noted in (80) Remarks.

B5.4 Other Inspections related to MHICS

MHICS shall be performed and coordinated with other related inspections (if instructed by the client) to increase the efficiency and reduce data duplication. Typical inspections conducted conjointly with MHICS include but not limited to:

- (1) CCTV Inspection,
Flow Monitoring Surveys,
Smoke/Dye/ Electronic method Connectivity testing
Water testing.

B5.5 Abandonment and rescheduling of manhole surveys

Abandonment of the survey of a manhole may be considered by the Utility Specialists subject to the agreement of the Client or his representative in any or a combination of the following circumstances:

- (1) Risk to Utility Specialists' equipment,
- (2) Inability to locate the manhole,
- (3) Inability to gain access to the manhole once located,
- (4) Risk to Utility Specialists' operations due to unsafe condition of manhole,
- (5) Inability to survey from the manhole due to blockage, silt or high water level
- (6) Inability to gain access to the manhole due to possession of the site by a third party.

In case (1), (2), (3), and (4) the Utility Specialists shall, if possible, take photographs of the situation causing abandonment, mostly due to physical obstructions, abandon the survey of the manhole. The Utility Specialists shall report the matter to the Client or his representative and report the same in the survey report.

In case (5) the Utility Specialists shall report the matter to the Client or his representative's as soon as possible and report the same in the survey report. The Utility Specialists shall carry out cleaning works ventilation, flow control or other measures as necessary to complete the survey. **Cleansing works, flow control or other non-standard measures** shall be paid under a separated item.

In case (6) the Utility Specialists shall first reschedule his works to minimize the effects of the possession of a site by a third party. Arrangements shall be made to revisit the site in order to complete the survey. The Utility Specialists shall report the matter to the Client or his representative's as soon as possible and report the same in the survey report.

B5.6 Documentation and Data Management

During the Manhole Internal Condition Survey, the following details should be recorded:

- (1) Photo No.
- (2) Video No. (if inspection videos were taken)
- (3) Depth (Distance in meters from the start point)
- (4) Code of defects/ observations (if observed)
- (5) Location of defect/ observations (if observed)
- (6) Intrusion (if observed)
- (7) Remarks

B5.6.1 Form C1 – DCAMS Manhole Record Form

During the MHICS, all fields (including header and codes) on **Form C1 – DCAMS Manhole Record Form** shall be filled. The operator shall record observations or notes on **field (78) Remarks** for details of the operation which requires attention and cannot be covered by any fields. For example, general remarks, the site restrictions or other challenges which affects the quality of the survey.

B5.6.2 Form C2 – DCAMS Manhole Internal Condition Assessment Coding Form – Site Coding Sheet

Despite the Form 1 as mentioned in the previous sub-section B5.6.1, the operator shall complete **Form C2 – DCAMS Manhole Internal Condition Assessment Coding Form – Site Coding Sheet** for all level 2 inspections.

The inspected results shall examined by Utility Specialists in office by viewing inspection data. The Utility Specialist shall also input the inspection data into the MHICS Module under DCAMS of IDMS or any other equivalent computerized data management system.

Sample forms are attached in:

0 DCAMS Manhole Record Form (Filled); Appendix C – Sample DCAMS – Manhole Internal Condition Assessment Coding Form - Site Coding Sheet (filled); Appendix D – Sample DCAMS – Manhole Internal Condition Assessment Coding Form (filled);

of this particular specification.

The blank forms can be downloaded from <http://www.uti.hk/publications/projectforms/> for free.

B5.6.3 Photographs/ Video prints

B5.6.3.1. Location photos of the manhole

The Utility Specialists shall record the location of the manholes at ground level using a still camera or capturing video prints from the location videos. The following are the requirements for location photos:

- (1) Surrounding features for determination of the location and orientation of the manholes;
- (2) Related ground features of the manholes;
- (3) Photo board recording the information of the manholes ().

B5.6.3.2. Photos of the manhole cover

The Utility Specialists shall record the conditions of the manhole cover and cover frame with the photo board. Photos are preferably taken prior the manhole cover is removed from the frame, in order to record the level difference above or below the ground surface level (if any).

B5.6.3.2. Internal condition photos of the manholes

The following defects or observations shall be recorded as internal condition photos:

- (A) All incoming / outgoing pipes and other connections to the manhole;
- (B) Continuous defects: at the beginning of the defect ;
- (C) Structural conditions at each meterage depth:
 - (1) Crack
 - (2) Fracture
 - (3) Broken
 - (4) Deformed
 - (5) Collapse
 - (6) Displaced joint
 - (7) Surface damage
 - (8) Mortar missing
 - (9) Displaced bricks
 - (10) Missing bricks
- (D) Service Defects at each meterage depths:
 - (1) Roots
 - (2) Infiltration
 - (3) Exfiltration
 - (4) Attached deposits
 - (5) Settled deposits
 - (6) Ingress of soil
 - (7) Obstruction
- (E) Construction Features;
- (F) Miscellaneous Features;
- (G) Any other appropriate features.

As defined in the WRc/WAA “Manual of Sewer Condition classification”, 5th Edition 2013 or the UTI’s MHCEC2019, “Manhole Condition Evaluation Codes” 1st Edition, 2019 or its latest version

The Photographs/video prints shall be under good condition and in proper adjustment, which detail information like defects and conduit internal condition can be clearly identified in relation to the location (minimum requirement manhole start and finish numbers or prescribed manhole reference numbers), survey direction, depth, photo print number, and date when the print was taken. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 5mm, and be type printed. The annotation shall be so positioned as not to interfere with the subject of the print.

B5.6.3.4. General photos

If no special condition of manhole is found, photographs or video prints shall be captured not more than 5m after the previous photograph or print in the manhole as general photograph.

Other photographs including but not limited to the following shall be taken:

- (1) Instrument setup,
- (2) Survey progress,
- (3) Evidence of challenge encountered.

B5.6.4 Videos

Video is a typical medium to record the conditions of manholes. Digital videos can be recorded and serves the assessment and documentation of the manholes with or without man-entry. The video shall be recorded under adequate illumination, good condition and in proper adjustment, which detailed information like defects and conduit internal condition shall be clearly identified in relation to the orientations (e.g. define the manhole corners or wall numbers) and depth measurements.

To ensure visually detailed results, the video quality shall be supported with high-resolution and wide range zooming cameras and sufficient illumination.

The annotation shall be so positioned as not to interfere with the subject. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 5mm, and be type printed. For the detailed annotations requirements during video playback, please refer to section 6.2 of this Particular Specification.

Typical type of videos includes:

- (1) Inspection videos using pole mounted cameras, waterproof type cameras or manhole inspection robots/systems (if instructed);
- (2) Inspection videos taken by the inspector using still camera (if the survey is conducted with man-entry);
- (3) Location video of the Manhole/ access structure (non-mandatory)

B5.6.5 Reference system

All relevant assets (manholes, catch pits, gullies etc.) shall be referenced as below by the Utility Specialists.

The Utility Specialists shall ensure that each new manhole has a unique reference and is not duplicated in the original datasets provided at the start of the project. The Utility Specialists shall also maintain consistent references for each asset (i.e. an asset shall not be given two different numbers). Where appropriate pipeline assets shall be referred to by the upstream node number plus an appropriate suffix starting from X, Y, Z, Z1 etc. For example, 382133001X and 382133001Y are the first 2 outgoing pipes from the upstream manhole GVMH282133001.

B5.6.5.1. Manhole Number (Site)

The Manhole Number (Site) is designed for the ease of on-site numbering for operators, aiming to distinguish manholes surveyed within a site. This numbering system consists of 4 characters in 2 parts:

- (1) The 1-character alphabetical prefix indicating the function (F for foul and S for Storm)
- (2) A 3-digit, 0-filled site reference number starting from 001 to 409 for foul manholes; 501 to 999 for storm manholes existing within the 100-meter grid.

The Manhole Number (Site) are arranged by the operators on site, according to the site conditions; usually assigned from upstream to downstream.

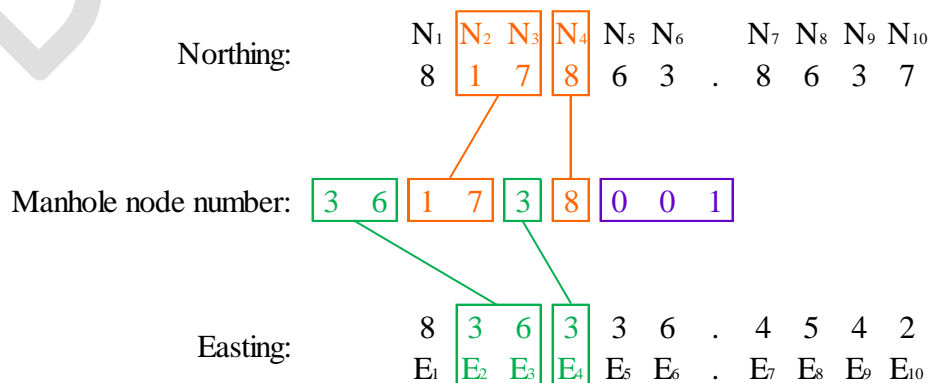
B5.6.5.2. Manhole Node Number

9-digit grid reference number with an accuracy of **±50m**:

- (1) A 4-digit reference number (E₂E₃N₂N₃) from HK 1:000 Topographic Map;
- (2) A 2-digit reference number from the 100-meter grid coordinate (E₄N₄)
- (3) A 3-digit registration number in sequential order of the manhole recorded in IDMS starting from 001 – 499 for Foul and 501 – 999 for Storm within the 100-meter grid.

The registration number are arranged automatically by the DCAMS system, the logical sequence assign manholes by XY-coordinates (ascending order of x-value and y-value) automatically.

For example, the first Manhole Node Number of a foul manhole located at 836336.4542, 817863.8637 shall be 361767001

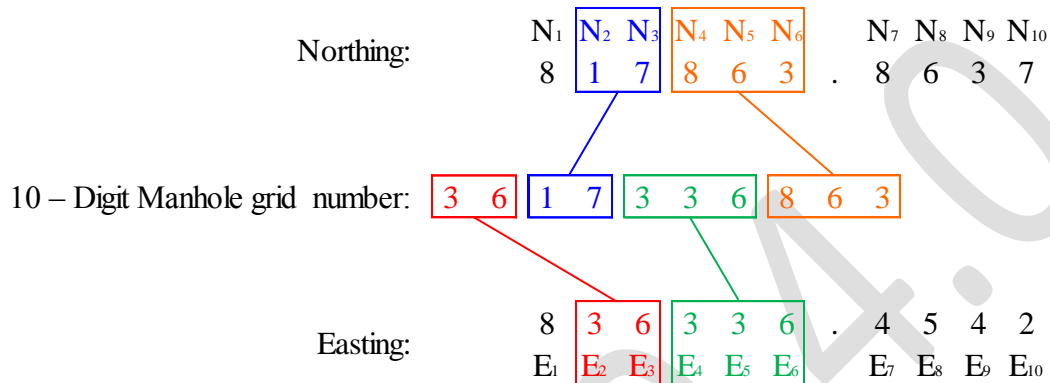


B5.6.5.3. Manhole Grid Reference Number

10 – digit grid reference number with an accuracy of ±0.5m:

- (1) A 4-digit reference number (E₂E₃N₂N₃) from HK 1:000 Topographic Map;
- (2) A 6-digit reference number from the 100-meter grid coordinate (E₄E₅E₆N₄N₅N₆);

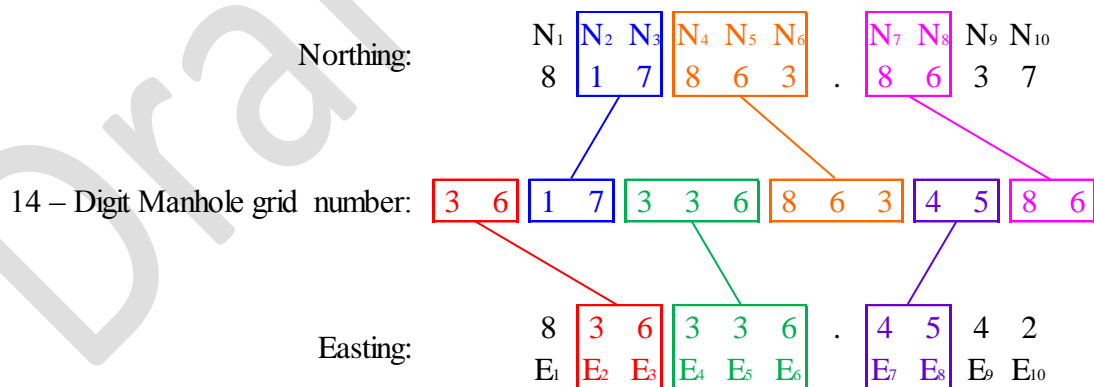
For example, the first Manhole Grid Number of a manhole located at 836336.4542, 817863.8637 shall be 3617336863.



14 – digit grid reference number with an accuracy of ±0.005m:

- (1) A 4-digit reference number (E₂E₃N₂N₃) from HK 1:000 Topographic Map;
- (2) A 10-digit reference number from the 100-meter grid coordinate (E₄E₅E₆N₄N₅N₆E₇E₈N₇N₈).

For example, the first Manhole Grid Number of a manhole located at 836336.4542, 817863.8637 shall be 36173368634586.

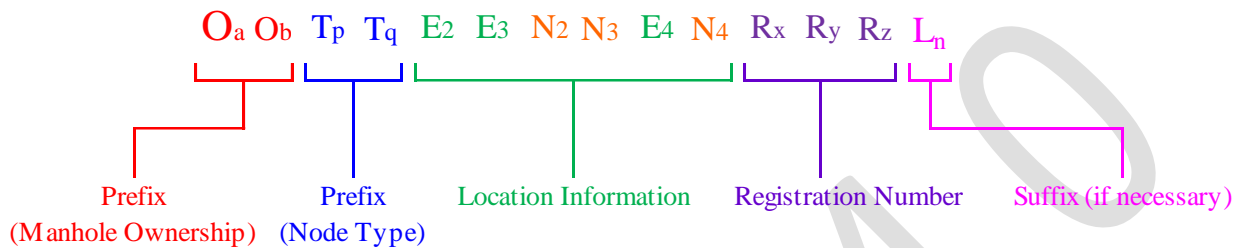


B5.6.5.4. IDMS Manhole Reference Number

The IDMS Manhole Reference Number is a unique feature identifier consisting of 3 parts:

- (1) A 4-alphabetical prefix indicating the ownership of the manhole and its node type;
- (2) Manhole Node Number
- (3) A 1-alphabetical suffix assigned in alphabetical order only if there are more than one manhole covers for the same manhole chamber.

General IDMS Manhole Reference Number:



Where:

Prefix indicating the ownership information of the manhole: OaOb

Prefix indicating the type of node: TpTq

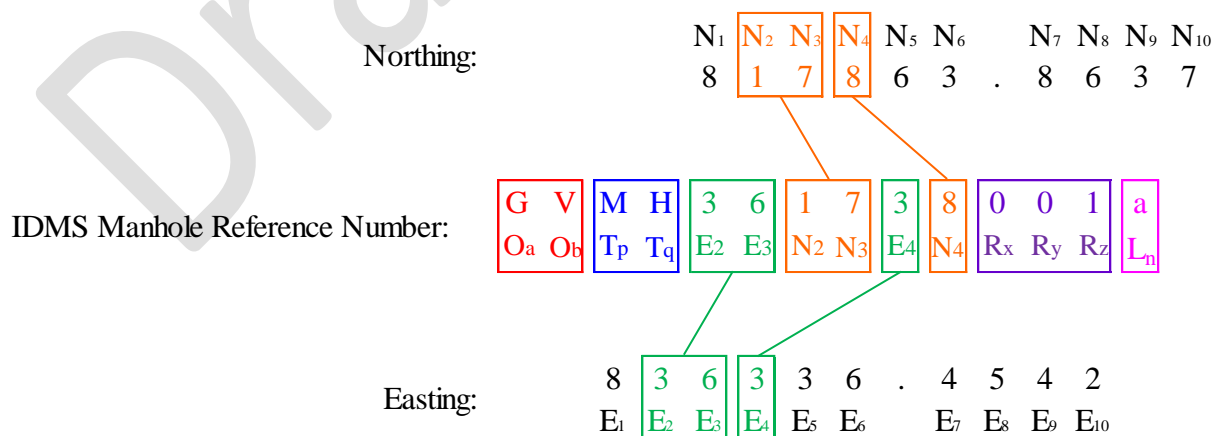
X-Coordinate of Manhole = E₁E₂E₃E₄E₅E₆E₇E₈...E_n

Y-Coordinate of Manhole = N₁N₂N₃E₄N₅N₆N₇N₈...N_n

Sequential Manhole Registration Number: R_xR_yR_z

Suffix for identical of manhole covers for the same manhole camber L_n

For example, the IDMS Manhole Reference Number of a government owned foul manhole first restricted at within the 100-meter grid, locating at 836336.4542, 817863.8637, shall be GVMH361738001. If that manhole has more than one cover on top of the same chamber, a suffix will be assigned.



The registration numbers are arranged automatically by the DCAMS system. The numbering arrangement follows the ascending order of the x- coordinates within the 100-meter grid; if more than one manhole are along the identical x-axis; manholes will be arrange according to their y-coordinates.

The following figure shows an example of the numbering arrangements for IDMS Manhole Reference Number.

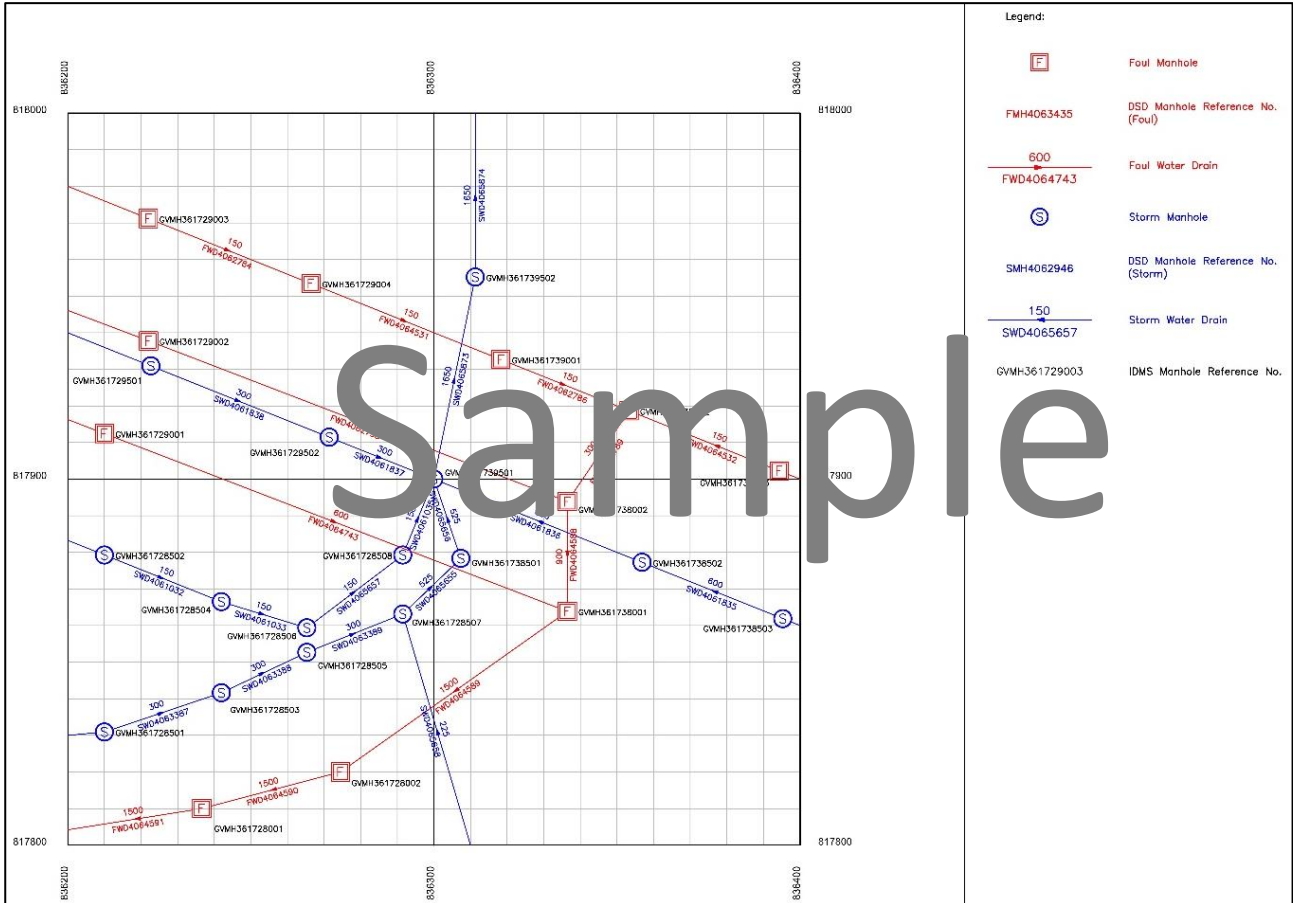


Figure 1 Sample Arrangement of Auto-generated IDMS Manhole Reference Number

B5.6.5.5. DSD Manhole Reference Number

The DSD Manhole Reference Number is referring to the feature reference number on Drainage Record Plan. It consists of 2 parts:

- (1) A 3-alphabetical prefix indicating the type of features
- (2) The asset are categorized by their class and each prefix indicates one type of feature.
- (3) Table 2 shows the manhole reference number on Drainage Record Plan.

Table 2 List of manhole reference number on Drainage Record Plan

Type of Feature	Prefix
Storm water manhole	SMH

Sewage manhole	FMH
Sewer Manhole-Unspecified	FUH
Storm Manhole-Unspecified	SUH
Combined system manhole	CMH
Terminal manhole-storm drain	SLH
Terminal manhole -sewer	FLH
Catch pit	SCH
Special manhole- storm drain	SPH
Tapping point -storm drain	SSH
Sand / silt trap	FSH
Special manhole - sewer	STH
Tapping point-sewer	FTH
Interface valve chamber (for vacuum sewer)	FIH
Sewage chamber	FCH
Storm Chamber	SBH
Overflow-sewer	FOH
Overflow-combined system	COH
Oil / petrol interceptor	FPH
DWF Interceptor	SDH
Inlet-storm drain	SIH
Valve-sewage	FVH

- (4) For the full list for all types of features in the Drainage Record Plan, please refer to Appendix F – Full List of DSD Feature Reference Number of this Particular Specification.
- (5) A 7-digit reference number assigned in sequential order by each division for a new feature. The digit number will not be delete even when the corresponding feature is removed from the system.

Table 3 7-digit number reserved for 3 District Divisions

Divisions	Number
Mainland North Division	10000000-39999999
Mainland South Division	40000000-69999999
Hong Kong and Islands Division	70000000-99999999

For detailed information on IDMS referencing system and Manhole Grid Reference No., please refer to the latest version of Method Statement for Manhole Internal Condition Survey and Manhole Condition Evaluation Codes published by UTI.

Draft V.0.4.0

B6. Requirements of Survey Deliverables

B6.1. Accuracy of Survey Requirements

The standard of accuracy required in the Survey and the completion of Form 1 and Form 2 shall be as follows:

- (1) All textual information shall be correct;

All measurements shall be accurate within the following tolerances and confidence levels (*Table 4*):

Table 4 Accuracy requirement for Manhole Internal Condition Survey (MHICS)

Level 級別	Purpose 目的	Tolerance (mm) 公差 (毫米)	Confidence Level 置信水平
I	Grid	1000mm	95%
	Location	300mm	95%
I	Relative Levels	20mm	90%
II		10mm	
I	Pipe size	20mm	90%
II		10mm	
I	Others	50mm	90%

B6.1.1. Grid/ Location

Grid references shall be supplied in Hong Kong 1980 Grid format which requires Input Coordinate system (inSys), Northing (n) and Easting (e), while Output Coordinate system (outSys), Height (h) and Format of Geographical Coordinates for outSys (outUnit).

B6.1.2. Relative Levels

Elevations shall be referenced to Survey Bench Marks, the location and values of which are obtainable from the Lands Department of the Hong Kong Government.

B6.1.3. Pipe size

The sizes of all connecting pipes to the manhole surveyed shall be measured with a tolerance of 10mm and 20mm depending on the quality level required with a confidence level of 90%.

B6.1.4. Others

The dimension of the others, i.e. non-circular shape manhole, shall be measured with a tolerance of 50mm; its confidence level shall reaches 90%.

B6.2. Data Display during Video Playback

At the start of each manhole being surveyed, the location of the zero meterage depth shall be the ground level. The cable calibration point (zero meterage depth) shall be recorded and reported in order to obtain a full record of the manhole depth.

The meter reading entered onto the data display at the cable calibration point must allow for the distance from the start of the survey to the cable calibration point such that the meterage at the start of the survey is zero.

The Crew Leader (the qualified person with training equivalent to OM/FHKIUS (CCE (CCTV & ME))) shall ensure that the meterage counter starts to register immediately when the operator pull the cable and push the camera into the manhole.

At the start of each manhole depth a data generator shall electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha numeric form containing the following minimum information:

The following items shall be included in the data display:

- (1) Project number and Site number
- (2) Location (building/ street number, estate/ road name, area, district)
- (3) Dimensions of the manhole cover, shaft and chamber (H. x W. in mm) & material
- (4) Manhole reference numbers
- (6) Function of manhole (Storm/ Foul/ Combined System).
- (7) Company & Name of qualified operator or HKIUS membership
- (8) Date of survey (ISO8601 format: YYYY-MM-DD).
- (9) Time of start of survey (HH:MM:SS).

The size and position of the data display shall be such as not to interfere with the main subject of the picture. The colour of the text shall be optimally visible and distinguishable from the background.

Once the survey of the manhole length is under way, the following minimum information shall be continually displayed:

Automatic update of the cable's meterage position in the manhole from "adjusted zero".

- (1) Manhole dimensions & material.
- (2) Manhole reference numbers.
- (3) Function of manhole (Storm/ Foul/ Combined System).
- (4) Company & Name of qualified operator or HKIUS membership

The Utility Specialist shall demonstrate the correct adjustment of the recording apparatus and monitor by use of the test tape or other device approved by the client's representative. The Utility Specialist shall then demonstrate satisfactory performance of the camera by the recording of the appropriate test device at the commencement of each day for a minimum period of 15 seconds.

All video recording media shall be supplied by the Utility Specialist/Contractor and shall be best quality high grade (HG) new and unused prior to recording and shall be of DVD/CDR/MP4/AVI format as agreed with client.

When recording the conditions of the drain, DVD/CDR/MP4 the storage device with the format as specified above shall have an adequate storage for a running time of not less than 1 hours.

Before report submission, CCTV survey video records shall also be converted to CD-ROM or DVD-ROM in digital formats as stated in Clause A4 of this particular specification.

B6.3. Submission of Survey Data and Results

B6.3.1. General Requirements

The Utility Specialists shall check the information to be submitted by M/FHKIUS(MHICS) and submit his validated Survey Information within 7 working days of the survey (or surveys). The submission shall comply with all requirements Discrbed in B8 Quality Assurance and Quality Control of this Particular Specification.

The standard required survey information includes but not limited to the following:

- (1) Location plan including all assets with connectivity delineated
- (2) A computerized record of all the defects and features required to be reported as detailed in this particular specification. All fields of the the forms recommended as the following:
 - DCAMS – Manhole record cards and validation check (sheets)
 - DCAMS – Manhole Condition Assessment Coding Forms
- (3) Corresponding IDMS electronic data (or any equivalent computerized program)
- (4) Manhole Photographs (including location photographs, manhole cover photographs, internal photographs and images of the location of defects)

The following additional survey information can be provided if subjected to the instructions and payment by the Client:

- (1) Inspection Videos
 - 3D measurable point cloud and 3D models

If errors are found to exceed the tolerances indicated in B6.1, the Client or his Representative shall instruct the Utility Specialists to return and re-survey the manhole at his own expense.

B6.3.2. Presentation of Drawings

B6.3.2.1. Location Plans

Location plans should be drawn with the manhole or spot level check location referenced to at least two fixed structures shown on the 1:1000 (Lands Information Centre) base mapping survey sheets or referring to GPM. The sketch shall show the manhole layout, including the distance and direction of offset from the manhole cover to the centre line of flow in the main pipe. Lamp posts, traffic lights or

similar features shall be acceptable as Fixed Structures in case buildings are not found within 50m from the survey extent. If existing buildings are taken as the fixed structures, the building names and numbers should be highlighted in the sketches. If village houses are taken as the fixed structures, the house number should be identified and indicated in the sketches.

The Utility Specialists shall only carry out survey works to locate buried manholes when a written instruction has been given by the Client or his representative upon the request of the Utility Specialists. The Utility Specialists shall report the findings of the buried manholes to the Client or his representative upon completion of the investigation in an approved format accepted by the Client or his representative's.

The Location Plan shall indicate the location of the manholes with the corresponding manhole reference numbers. Unless specified by the Engineer, the Location Plan shall be plotted in 1:100 scale fitted in A1 drawings or 1:200 scale fitted in A3 drawings on the specified grid and datum approved by the Engineer. The layout shall be either landscape or portrait, considering the area of interest and the requirements from the client. Margins shall be left along the four edges. The title block shall include but not limited to the followings:

- (1) The project name and project reference number
- (2) The site location and the site reference number/ works order
- (3) The drawing title, version and drawing number
- (4) Name of client, consultant and contractor (if applicable)
- (5) The sheet Designation of the basemap
- (6) Legend
- (7) The names of the Utility Specialists who prepare and approve the plan
- (8) Paper size and corresponding scale
- (9) Date of survey and date of the drawing is drawn
- (10) Remarks
- (11) Number of sheets

Other sketches and schematic drawings are not bounded by the above requirements. For example, the sketch of internal connections of manhole shall include all measurements of connections, flow direction, feature reference number but it is not mandatory to be in scale.

B6.3.2.2. Annotation for Location Sketches of buried manholes

The Utility Specialists shall only carry out survey works to locate buried manholes when a written instruction has been given by the Client or his representative upon the request of the Utility Specialists.

The Utility Specialists shall report the findings of the buried manholes to the Client or his representative upon completion of the investigation in an approved format accepted by the Client or his representative's.

B6.3.3. DCAMS – Manhole record cards and validation check sheets

The Utility Specialists shall obtain all relevant data to complete the record cards. In particular, the Utility Specialists shall complete the final MH record card by drawing the MH location Plan and the MH general arrangement plan with slope/road reference and manhole number on each page.

To ensure data integrity, consistency checks shall be completed. Consistency check sheets shall be generated automatically using Drainage Condition Assessment & Management Systems (DCAMS), a module under IDMS (or any other equivalent), to ensure no duplications, misconnections or intersections of utilities (such as invert level, direction/backflow check, manhole materials and pipe size etc.) If the surveyed results failed to reach the tolerance, they shall be corrected and re-examed until they reach the accuracy required. Utility data with contractitions shall be validated and updated. The Utility Specialists shall be aware that not all failures in consistency checks are errors. (For example, manhole covers are usually made with the same materials within the same batch inside a catchment area, however, it is possible that alterations or replacements exist throughout time.) Validation is a must to secure the accuracy of up-to-date data.

Intruding utilities located in manholes identified during the course of the surveys are to be commented in the remarks section of the manhole record card. In addition, the Utility Specialists must indicate on the layout or other sketch the position and size of the utility. A sample of Manhole Record Card and Consistency Check Sheets are included in Appendix C and F respectively.

B6.3.4. DCAMS – Manhole Condition Assessment Coding Forms

For Level II surveys, it is required to complete all fields on the DCAMS – Manhole Record Card and Manhole Condition Assessment Coding Form. Manhole condition coding form shall be appropriately checked by Professional Member of M/FHKIUS (管綫專業監理師/(院士)) with the standard coding definitions stated in the latest version of Manual of Manhole Internal Condition Survey accredited by International Institute of Utility Specialists (IIUS) or Manual of Sewer Condition Classification published by Water Research Centre (WRC). A sample of Manholes Condition Assessment Coding Form is included in Appendix D

B6.3.5. Electronic data of database files

The utility specialists shall provide the structured and organized data files and log files which stores the survey data when instructed by the Client. These data shall be logically divided into filegroups and data files.

B6.3.6. Manhole Photographs

The Utility Specialists shall provide a minimum of two photographs for each manhole as shown in *Appendix E – Sample Photograph Sheet of Manhole Internal Condition Survey*. One photograph should show the general location of the manhole with respect to the road, slopes or buildings in the vicinity. The second photograph shall be a general view of the inside of the manhole. The manhole reference number shall be required to be shown on each photograph. The Utility Specialists may use a photoboard placed in the manhole or paint on the road surface to indicate the manhole reference number.

Where photographs are submitted in digital ‘*.jpeg’ format with a minimum resolution of 2 million pixels shall be provided. Samples shall be submitted to the Client or his representative’s in advance.

The utility specialist shall take additional photographs to highlight a defect or special feature. The Utility Specialists shall report to the Client or his representative’s in a summary report on slope/ site by slope/ site basis for such occurrence on a weekly basis. The Client or his representative’s shall spot-check and confirm the acceptance of such additional photographs prior to payment being made at the appropriate rate in the Bill of Quantities. The Utility Specialists shall include these accepted additional photographs in producing the relevant slope/site reports.

B6.3.7. Inspection Videos (non-mandatory)

The internal condition of manholes can be recorded by pole mounted cameras, waterproof type cameras or manhole inspection robots/systems. Digital videos can be recorded and serves the assessment and documentation of the manholes without man-entry. Defects such as fine cracks or offsets shall be examined by Utility Specialists in office by viewing inspection data. To ensure visually detailed results, the video quality shall be supported with high-resolution and wide range zooming cameras and sufficient illumination.

The inspection videos shall be submitted in '*.avi' or '*.mpg' format on a CDR or DVD attached in the Appendix of the final report if subject to the Clients' instructions. The minimum video resolution and frame rate shall be agreed with the Client in the contract. Samples shall be submitted to the Client or his representative's in advance.

B6.3.8. 3D measurable point cloud and 3D models (non-mandatory; applicable when 3D scanning or pole cameras in used)

The geometry of the manhole can be captured by laser scanners through dense measurable color point cloud. It can also be reconstructed by transforming multispectral images into dense measurable meshes and 3D point clouds generated by integration of photometric and geometric information. Automatic measurements of manhole features (such as depth of invert, shaft/chamber dimensions) can be remotely completed instead of traditional manual measurements on site which usually consists of man entry. The acquired detailed measurements can be annotated on 2D unfold view of internal side walls or 3D models which can be visualized and imported into a wide range of 3D viewers. 3D Models shall be generated if 3D Manhole scanners or pole cameras were used to capture images of the manhole internal condition if required by the client. Further Manhole condition management such as structural soundness evaluation can be conducted.

The following deliverables shall be submitted only if instructed and paid by the Client:

- Point Cloud in Polygon File Format (.PLY)
- 3D CAD Model (.DXF)
- Surface Model (.STL)
- Virtual Model (.OBJ)
- Unfolded View of the internal wall(s) (.JPEG)
- Orthomosaic images of the location of manhole (.JPEG)

The above deliverables and corresponding file formats are general suggestions. Specific requirements may differ from the aim of project and the 3D Viewer used by the Clients. The Utility Specialists shall seek approval from the Clients or his representative on this matter in the contract. Samples shall be provided to the Client prior to payment if instructed.

B6.4. Requirement of data files and data format

B6.4.1. File format of Photographs/ video prints

High quality colour video prints or photographs of a size not smaller than standard 3R (89mm x 127mm) in dimension in the digital format of JPEG, PNG, TIF, GIF, WMF or others formats specified by asset owner.

B6.4.2. File format of Videos (if any)

Survey videos are not mandatory but can be provided if instructed by the client. If required, the survey videos shall be capable of a minimum resolution of 1 Megapixel and at a frame rate approved by the Engineer.

The Utility Specialist shall prepare the CCTV survey's video record in one of the following digital formats: MPEG VIDEO (.mpg), AVI VIDEO (.avi), QUICK TIME FILE (.mov) or other formats agreed by the client for recording in the computer system.

The videos shall be stored in:

- (1) A CD-Rom encoded to the MPEG 1 format
- (2) A DVD-Rom encoded to MPEG 2 format or AVI format
- (3) Other media and/ or other format specified by asset owners

B6.5. Report

B6.5.1. Survey report

(Extracted From PS-MHICS (2011))

The Utility Survey Specialist shall examine, analyse, process and interpret the investigation results and incorporate findings in a report. The report shall consist of the followings:

- (1) Introduction
 - a. Project name and Location
 - b. Site appreciation
- (2) Details of Investigation
 - a. Date of Investigation
 - b. Detailed description of the investigation procedure adopted
 - c. All equipment used for the investigation
 - d. Identification of supervisor and equipment operators carrying out the investigation
- (3) Work Procedures
- (4) Investigation results
 - a. Summary of buried utilities
 - b. Report on examination, analysis and interpretation of the investigation results
 - c. Identification of utilities, chambers, manholes and relevant surface installations
 - d. Records of on-site verification of data handled by qualified person responsible for the report
 - e. Report on difficulties encountered
- (5) Appendices
 - a. Floppy diskettes or CDR for the digital data files of qualitative and numeric data about the underground assets found;
 - b. Engineering Drawings (updated) showing the types and location of various underground assets;

- c. Survey Photographs - 3R colored photographs (prints and negatives/digital copy in JPEG format)

The Utility Specialist shall supply the Survey Report as described fully as in the above. This report shall include all results with a detailed discussion and accompanying plans. It shall be prepared and signed by a qualified person who shall hold one of the following qualifications:

- (1) RPUS or MHKIUS (MHICS) with two years local post qualification experience ;
- (2) MICE, or MHKIE or MHKIS with 10 years experiences, each year 35 hours CPD training, and 14hours refreshment training every 3 years.

B6.5.2. Operator's report

The operator shall provide a report on the measurements, depths, positions and characteristics of reportable features including defects and features mentioned in MHCEC 2019; MSCC 2013 or any other equivalent code or manual.

The report shall include all the mandatory details together with such other informative details as specified by the asset owner.

The operator's report shall be written, printed or in the form of digital format.

B6.5.3. Photographs and video prints

All photographs and video prints shall be attached in Appendix DCAMS – Manhole Internal Condition Survey – Photograph Sheet (Form D). High quality colour video prints, are required for the CCTV survey. The video prints shall be a minimum of 3R size 89 x 127mm. All photographs or prints relating to one manhole shall be kept together and in ascending order by depth, shallowest at the front, deepest at the back.

B6.5.4. Videos (non-mandatory)

Upon the request of the client, videos taken by Manhole Camera could be included in the report.

B7. Deliverables and Schedule

The Utility Specialist shall supply for the Site preliminary digital data and paper check plots including a draft technical report with control results within one (1) week after the programmed completion of the works for the Site. The client's representative may direct the Contractor to submit preliminary report of the Site during the execution of investigation, the utility specialist shall submit the reports within 1 week after the client's representative has given such written instruction at no additional costs.

The client's representative shall return a copy of preliminary data with comments and correction progressively within one week of receipt of preliminary data. The Contractor shall incorporate the Engineer's comments on the preliminary data within the preparation of his Final Survey report.

The Utility Specialist shall submit a Final Report for the investigation within 4 weeks after the completion date of the Works.

B7.1. Preliminary Stage

- (1) One set of preliminary digital data.
- (2) One set of paper copy of drawings.
- (3) Control results, including simple description of permanent ground markers.
- (4) One copy of brief technical report checked by MHKIUS (MHICS) and endorsed by RPUS when required.
- (5) One set of photographs.
- (6) One set of scan files, 3D model or video (if instructed).

B7.2. Interim Stage (where necessary)

- (1) One set of interim digital data.
- (2) One set of paper drawings plotted in 1:100 scale fitted in A1 drawings or 1:200 scale fitted in A3 drawings
- (3) One copy of interim technical report drafted by MHKIUS (MHICS) and checked by RPUS.

B7.3. Final Stage

2 copies of Final Report checked by MHKIUS (MHICS) and endorsed by RPUS when required which is a compilation of all deliverables required under interim stage to incorporate all comments provided by the Engineer.

B8. Quality Control and Quality assurance

B8.1. Quality Control of MHICS

The accuracy of the coding system is highly reliant on the skills and experiences of the Utility Specialist (A/O/M/FHKIUS) who carries out the inspection and produces the report. A quality control system to continuously monitor the standard of coding is therefore required.

The Quality Control Procedures and the level of accuracy required shall be agreed with the client prior to the commencement of any contract.

The quality control system shall measure the accuracy and completeness of reporting and in particular:

- (1) The number of defects/ features not recorded (omissions)
- (2) The correctness of the coding and classification of each defeat/ feature recorded in terms of :
- (3) Depth of defects/ observations
- (4) Position of defect (from...to or at... o'clock)
- (5) Percentage value (to the nearest 5% increment)
- (6) Dimensions and other depth values

Reports may fail due to inaccuracies in either the Header or Observation Sections.

B8.2. Methodology

On completion of the survey of each 100 manholes (or the whole catchment area if number of manholes is less than 100) or other similar structures the Utility Specialists shall supply completed computer generated manhole record cards (IDMS-DCAMS) and a copy of the relevant portion of the map in respect of those manholes or other structures and notify in writing to the Client or his representative's that in the opinion of the Utility Specialists the records are ready for a site check to be carried out. The Client or his representative shall either reject the batch of data or arrange for a site check as specified below within 2 weeks of the written notification.

Prior to the supply of data to the Client or his representative, the Utility Specialists shall carry out his own validation test on all data according to the requirements as outlined in his method statement on data validation, which shall be approved by the Client or his representative's in advance of any surveys.

Specialists shall be required to comply that 5% of the manholes or minimum 1 manhole to be resurveyed shall be randomly selected by the client or his representatives and checked against the results obtained by the utility specialists in the initial survey in office; 1% of the manholes or minimum 1 manhole shall be checked on site. The resurvey shall include the re-proving of all associated pipework lengths. The Utility Specialists shall supply a survey team to carry out the resurvey under the supervision of the Client or his representative's, and a person appointed by the Utility Specialists as his representative.

The resurvey shall be deemed to have failed if any item of manhole measurement falls outside the tolerances stated in this PS. Notwithstanding any of the foregoing if in the opinion of the Client or his representative's the other data on the manhole record sheets are sufficiently defective then the survey shall be deemed to have failed the quality control check and the Client or his representative is entitled to reject the data.

If the results of the resurvey are accepted by the Client or his representative, the Utility Specialists shall be entitled to payment for the resurvey at the rates included in the Bill of Quantities.

If the results of the resurvey are considered to be unacceptable to the Client or his representative, the Utility Specialists shall resurvey that portion of the work which failed to meet the tolerances stated in PS at his own expense and he shall not be paid for the work involved in that check. When he is satisfied that the previously failed work has been corrected he shall inform the Client or his representative and a further resurvey shall be carried out in accordance with the above procedure on five of the remaining 95 manholes. Quality control checks shall be repeated at the Utility Specialists' expense until the Client or his representative's is satisfied that this portion of the work has met the requirements of the check as stated in PS. The Utility Specialists shall then be paid for the resurvey of which results were accepted by the Client or his representative.

Self-assessment of survey data for Utility Specialists

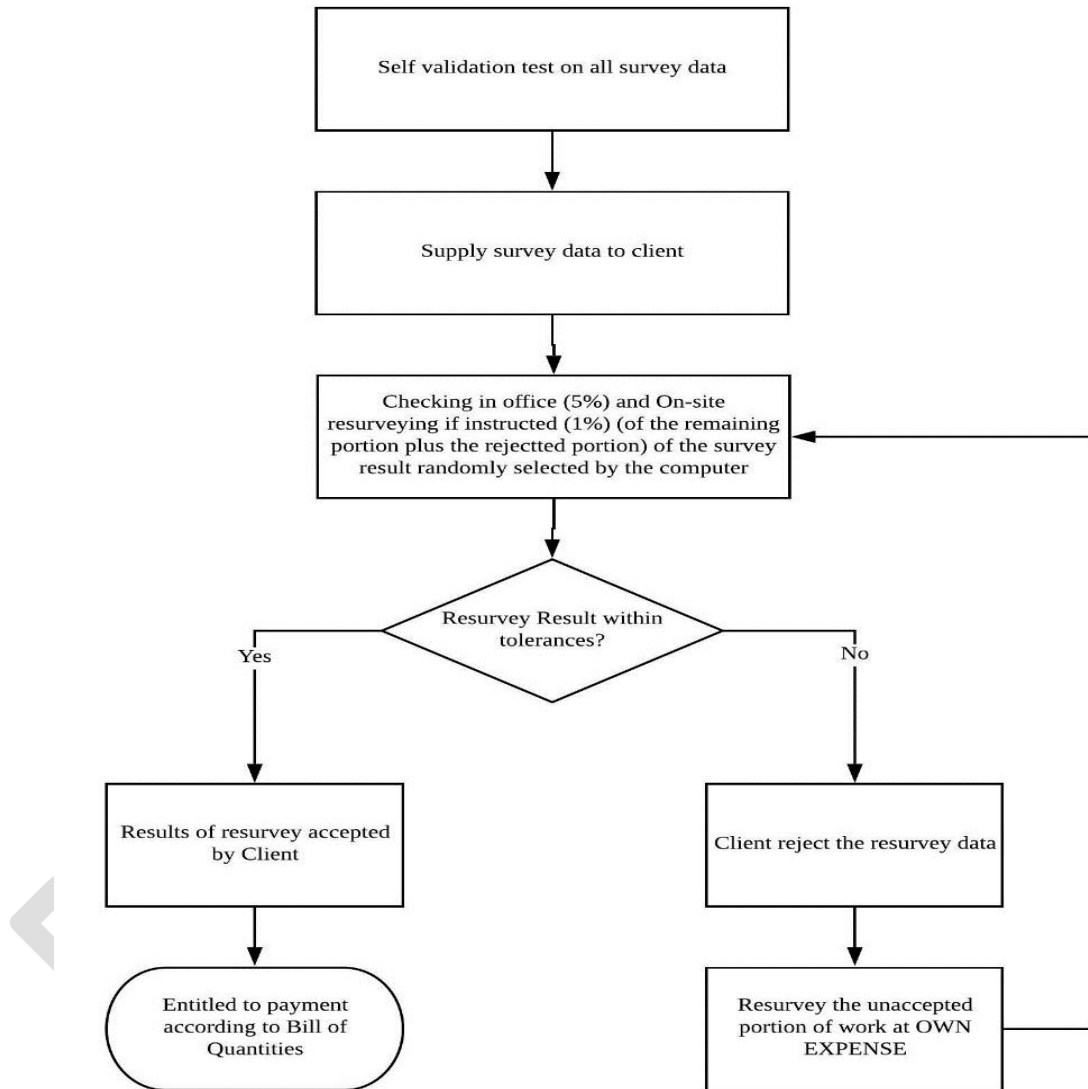


Figure 2 Summarized procedures for an example of self-assessment of the survey data

B8.3. Quality Control for operator

Each Utility Specialist shall maintain a record of his survey results and accuracy rating to be inspected by the client in accordance with the quality requirements as contained in the WRC's

Manual of Sewer Condition Classification 5th Edition or the UTI's MHCEC 2019 "Manhole Condition Evaluation Codes" 1st Edition, 2019 or its latest version.

The ongoing accuracy of the specialist (confidence level) should be calculated by taking the mean of each 5 percentage results (each 5 representing one control unit).

Both the individual survey percentages and the mean results should be entered on to the Specialist's Accuracy Graph. This graph should have 2 boundaries:

- (1) Specified mean – The level of accuracy expected
- (2) Specified tolerance – The level to which the accuracy can fall before specified action is taken

Any Specialist whose particular report is scored below the tolerance, the report has to be reviewed and re-submitted until achieving the HKIUS requirement.

For the separate survey level which means the particular specialist's accuracy for his each survey or inspection. It should be recorded and submitted by particular specialist's supervisor who shall be RPUS or O/M/FHKIUS.

The on-going accuracy of a particular utility specialist's for each year (confidence level) is an accumulated mean of the specialist's accuracy. It represents how much confidence the utility specialist can provide to client.

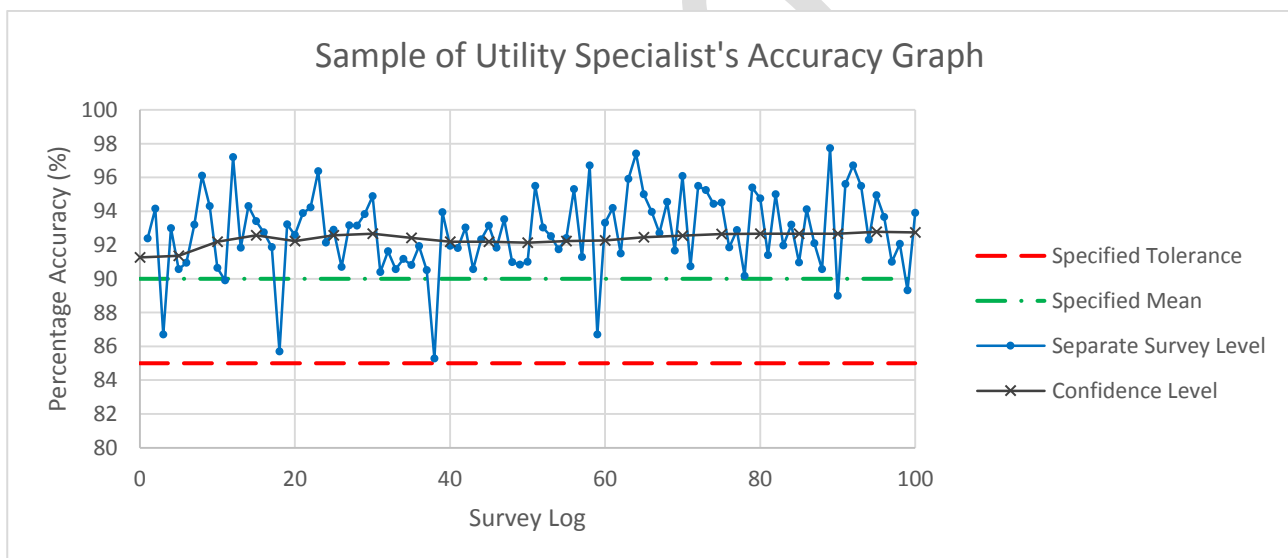


Figure 3 Sample of the utility specialist's accuracy graph

B8.4. Interpretation of Results

In case a report of any surveyed manholes which fail to achieve the specified standard, it should be recoded and the report of that manhole resubmitted.

In addition the coding of the manholes completed immediately before and after the failed length should also be subjected to rechecking as part of an additional quality control check.

If there are any failed reports in this additional check, these should be recoded and resubmitted. Should any failure occur in the increased sample the selection should be increased by a further five lengths before and after, as above, until the required accuracy is achieved.

The ongoing accuracy of the specialist (the confidence level) should be calculated by taking the mean of each 5 percentage results (each 5 representing control units).

B8.5. Computerized Program of Drainage Condition Assessment and Management – MHICS Module

B8.5.1. Data management system (EXTRACTED FROM 2011 VERSION)

The Utility Specialists shall provide a method statement to the Client or his representative's outlining his proposed data management system to be implemented as part of the project.

Data requirement can be referred to IDMS Manhole Record Form and Data Consistency Checks (*DCAMS Manhole Record Form (Filled)*; *Appendix D – Sample DCAMS – Manhole Internal Condition Assessment Coding Form (filled)* and *Sample Consistency Check Report* in this particular specification). Further details may refer to the latest version of the Manhole Condition Evaluation Codes (MHCEC) published by UTI which is accredited by IIUS.

The method statement for the Utility Specialists data management system shall include but not limited to the following :

- (1) Method for managing the sewerage data in different formats (e.g. DCAMS)
- (2) Method for performing connectivity and inconsistency validation checks on the imported data (ie. Checks for missing or inconsistent data as detailed in the specification)
- (3) Method for managing Examiner or DCAMS (*.dat) format CCTV data and validating the data
- (4) Method of managing any GIS base data (if used)
- (5) Method of managing laser scanning data (if used) and digital images
- (6) Method of managing / updating drawings (including slope polygons and survey extents) management of data associated with any drawings reporting of results and data to the Client or his representative's and client.

The Utility Specialists shall host and maintain all checked data on a secured database to be accessed by Client or his representative, this shall include but not limited to the following information:

- (1) Daily Reports
 - (A) Reconnaissance survey information
 - (B) Manhole survey information
 - (C) Pipeline survey information
 - (D) Other on site surveys/activities (eg. Cleaning)
 - (E) Number of survey crews/staff deployed
 - (F) No of CCTV camera sets deployed
 - (G) Name of qualified crew leader on site (O/M/FHKIUS(MHICS))

Planning/ programme activities

- (H) Contract programme showing updated progress on each survey
- (I) Planning of Temporary Traffic Arrangements
- (J) Rescheduling of surveys due to site access conflicts.

The costs associated with the implementation of such a database system shall be deemed to have been included in the rates included in the Contract.

The Client or his representative may also operate a data management system. The Utility Specialists shall be responsible for interfacing with this system by ensuring:

- (1) only validated data is issued to the Client or his representative's in the required format (IDMS, DCAMS or Examiner)
- (2) validation reports shall accompany each data submission.

The Utility Specialists shall be responsible for ensuring that all datasets submitted shall be in the correct format for input into the Client or his representative's data management system.

B8.5.2. Platforms and target users of Computerized Program of Drainage Condition Assessment and Management

The Utility Specialists shall use a computerized Program to systemise the conduit condition codes, scores/ grades of conduits and control the quality of survey data. The program shall include 3 levels of quality control and data validation targeting at different users:

Table 5 Platforms of the computerized program for Drainage Condition Assessment and Management

Level	Platform	Targeted users
1	Data Entry	<ul style="list-style-type: none"> - Contractors – Crews - Site inspector - Site Supervisor
2	Examiner	<ul style="list-style-type: none"> - Engineers - Contractor's Checker - Supervisor - Architect
3	Management	<ul style="list-style-type: none"> - Senior Engineering Manger - Supervisor - Architect - Project Managert

In Data Processing Platform, video or photos are inputted with corresponding coding by O/M HKIUS. Computerized coding can reduce human errors on data record and input. Comprehensive grading and scoring system which is compatible to Sewerage Risk Management (SRM), Manual of Sewer Condition Classification (MSCC) published by WRC and Manhole Condition Evaluation Codes (MHCEC) published by HKIUS. The related scores and grades are calculated automatically to avoid manual errors. Inspection reports, Defect Grade Description Report and Structural Condition Survey Report are generated and handed to the Engineer for accuracy checking.

The Engineers examine the data handed by operators in the Examiner Platform. The operation performances are checked and a corresponding Tracking Report is generated which compatible to the requirement is specified in section 0of this PS.

The Senior Engineering Manager validate the data in the Management Platform and prepare the Repair Analysis Report to provide professional advices to clients on rehabilitations, maintenance and management of the assets. The user can check the results of different conduit condition evaluation of the same conduit, e.g. manage the condition of the same conduit over years/ before and after repair/ rehabilitation.

B.8.6. Non-compliance: Manhole Internal Condition Survey

The Manhole Internal Condition Survey result for a site shall be considered as not complying with the specified requirements if:

- (1) The number of defects/ features not recorded (omissions);
- (2) The correctness of the coding and classification of each defeat/ feature recorded in terms of :
- (3) Location of defect (Depth);
- (4) Position of defect (from...to or at... o'clock);
- (5) Percentage value (to the nearest 5% increment); and
- (6) Dimensions, depth values, position or level;

of any defects/ observations reported in the preliminary stage deliverables does not comply with the requirements of Manhole Internal Condition Evaluation Codes, 1st Edition, UTI, 2019 or its latest version.

If the utility investigation result for a particular site does not comply with the specified requirements, the Contractor shall re-execute utility investigation in the area within a week from receiving notification by the Engineer. The Utility Specialist shall submit the investigation result as deliverables defined in Section 0 in this particular specification within 2 weeks from receiving notification.

If the utility investigation result again fails to comply with the specified requirements, the Utility Survey Specialist shall repeat the work specified until the result complies with the specified requirements. The costs for re-execution of utility investigation shall be borne by the Utility Specialist.

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Water Research Centre, (2004). Manual of Sewer Condition Classification (MSCC) (4th ed). U.K.: WRC Publications.

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Appendices**Appendix A – Abbreviations**

Company/ Organization	
Code	Description
BD	Buildings Department, HKSARG
CCEC	Conduit Condition Evaluation Codes
CEDD	Civil Engineering and Development, HKSARG
DSD	Drainage Services Department, HKSARG
EMSD	Electrical and Mechanical Services Department, HKSARG
EPD	Environmental Protection Department, HKSARG
HA	Hong Kong Housing Authority, HKSARG
HKIUS	Hong Kong Institute of Utility Specialists, HKSARG
HKURC	Hong Kong Utility Research Centre
HyD	Highways Department, HKSARG
IIUS	International Institute of Utility Specialists
LandsD	Lands Department, HKSARG
LD	Labour Department, HKSARG
PolyU	The Hong Kong Polytechnic University
UTI	Utility Training Institute
WRc	Water Research Centre

Company/ Organization	
WSAA	Water Services Association Australia
WSD	Water Supplies Department, HKSARG
WTI	Water Training Institute

Others	
Code	Description
%	Percentage
AVI	Audio Video Interleave (Video Format)
BIM	Building Information Model
BMP	Bitmap (Picture Format)
BWCS	Buried Water Carrying Service
CAD	Computer Aided Design
CCE	Conduit Condition Evaluation
CCE(CCTV & ME)	Conduit Condition Evaluation(Closed Circuit Television & Man- Entry)

Others	
CCES	Conduit Condition Evaluation Specialists
CCTV	Closed Circuit Television
CD	Compact Disc
CL	Cover Level
COP	Code of practice
CP	Competent Person
CSV	Comma-separated values (file format)
DAT	Intersystems Caché database file
DCAMS	Drainage Condition Assessment Management System
DN	Nominal Diameter
DP	Design Pressure
DVD	Digital Versatile Disc
DXF	Drawing Exchange Format
e.g.	Exempli Gratia
EPR	Environmental Protection Requirements
etc.	et cetera
FPS	Frames per second
GIS	Geographic Information System

Others	
GL	Ground Level
H	Height
HPWJ	High Pressure Water Jetting
hr	Hour
Hz	Hertz
ICG	Internal Condition Grade
ID	Internal Diameter
IDMS	Integrated Data Management System
IFC	Industry Foundation Class
IL	Invert Level
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group (Picture Format)
kHz	Kilo- Hertz
kPa	Kilopascal
m	Meter(s)
MDB	Access Database (File Format)
ME	Man Entry
MHICS	Manhole Internal Condition Survey

Others	
mm	Millimetre(s)
Mpa	Megapascal
MPEG	Motion Picture Experts Group (Video Format)
MS	Method Statement
MSCC	Manual of Sewer Condition Classification, UK
OBJ	Object file (file format)
OHSAS	Occupational Health and Safety Assessment Series
PDF	Portable Document Format (File Format)
PLY	Polygon File Format (File Format)
PPE	Personal Protective Equipment
pptx	PowerPoint Open XML Presentation (File Format)
ppm	Parts per million
PS	Particular Specification
psi	Pound Per Square Inch
PTW	Permit to Work
QA/ QC	Quality Assurance/ Quality Control
Ref.	Reference
RMSE	Root Mean Square Error

Others	
RPUS	Recognized Professional Utility Specialist
RTO	Recognized Training Organization
SCG	Service Condition Grades
SD	Secure Digital
SOPs	Safe Operator Procedures
SPF	Sun Protection Factor
SPG	Structural Performance Grade
SRM	Sewer Rehabilitation Manual
STP	System Test Pressure
TTA	Temporary Traffic Arrangement
US	Utility Specialist
W	Width
WLD	Water Leakage Detection
WO	Works Order
WP	Work Procedure
XLSX	Microsoft Excel Open XML Format Spreadsheet file (File format)

Appendix B – Requirements for Personnel Carrying Out Inspection

Training and Experience Requirements for Personnel Carrying Out Inspection (MEIKUS standard, 2020)			
Title	Role	Minimum Training Requirement	Minimum Years of Practical Experience
Project Leader	Responsible for contract administration and preparation, checking and certifying of reports for compliance with the technical specification.	<ul style="list-style-type: none"> > At least 35 hours of CPD every year > At least 14 hours for refreshment training in every three years > Relevant training in RTO (e.g. PolyU, UTT) for surveys and data collection > Has attended training courses of 84 hrs or trade test for relevant survey /detection methods, and Possesses a valid technical specification training certificate for relevant survey / detection methods used 	10 years in contract administration, preferably in works related to the inspection, survey and in data management.
Deputy Project Leader	Responsible for assisting project leader and acting the post of project leader when project leader temporary not with the team.	<ul style="list-style-type: none"> > At least 35 hours of CPD every year > At least 14 hours for refreshment training in every three years > Relevant training in RTO (e.g. PolyU, UTT) for surveys and data collection > Has attended training courses of 84 hrs or trade test for relevant survey /detection methods, and Possesses a valid training certificate for relevant survey /detection methods used 	10 years in contract administration, preferably in works related to the inspection, survey and in data management.
Team Leader	Responsible for works arrangement and data processing including checking of raw data for quality and consistency.	<ul style="list-style-type: none"> > At least 35 hours of CPD every year > At least 14 hours for refreshment training in every three years > Relevant training in RTO (e.g. PolyU, UTT) for surveys and data collection > Has attended training courses of 84 hrs or trade test for relevant survey /detection methods, and Possesses a valid training certificate for relevant survey /detection methods used 	5 years in works related to the inspection, survey and in data management.
Crew Leader	Responsible for supervising the field works and site safety.	<ul style="list-style-type: none"> > At least 35 hours of CPD every year > At least 14 hours for refreshment training in every three years > Relevant training in RTO (e.g. PolyU, UTT) for surveys and data collection > Has attended training courses of 84 hrs or trade test for relevant survey /detection methods, and Possesses a valid training certificate for relevant survey /detection methods used 	3 years in works related to the inspection, survey and in data collection.
Operators	Responsible for operating equipment and carrying out inspection and survey.	<ul style="list-style-type: none"> > At least 35 hours of CPD every year > At least 14 hours for refreshment training in every three years > Relevant training in RTO (e.g. PolyU, UTT) for surveys and data collection > Has attended training courses of 84 hrs or trade test for relevant survey /detection methods, and Possesses a valid training certificate for relevant survey /detection methods used 	2 years in works related to the inspection, survey and in data collection.
			Qualification
			Either: M/F/H/K/J/S, R/P/S plus CP, CW, DCP, DCW or ME/K/E / R/P/E, plus CP, CW, DCP, DCW or equivalent and relevant training in RTO (e.g. PolyU, UTT) for surveys and data management Either: M/F/H/K/J/S, R/P/S plus CP, CW, DCP, DCW or ME/K/E / R/P/E, plus CP, CW, DCP, DCW or equivalent and relevant training in RTO (e.g. PolyU, UTT) for surveys and data management M /F/H/K/J/S, R/P/S, CP, CW, DCP, DCW or equivalent O / ME/K/J/S, CP, CW, DCP, DCW or equivalent A/M/E/K/J/S, CP, CW, DCP, DCW or equivalent

DCAMS Manhole Record Form (Filled)

IDMS - DCAMS Manhole Internal Condition Assessment Coding Form - Site Coding Sheet



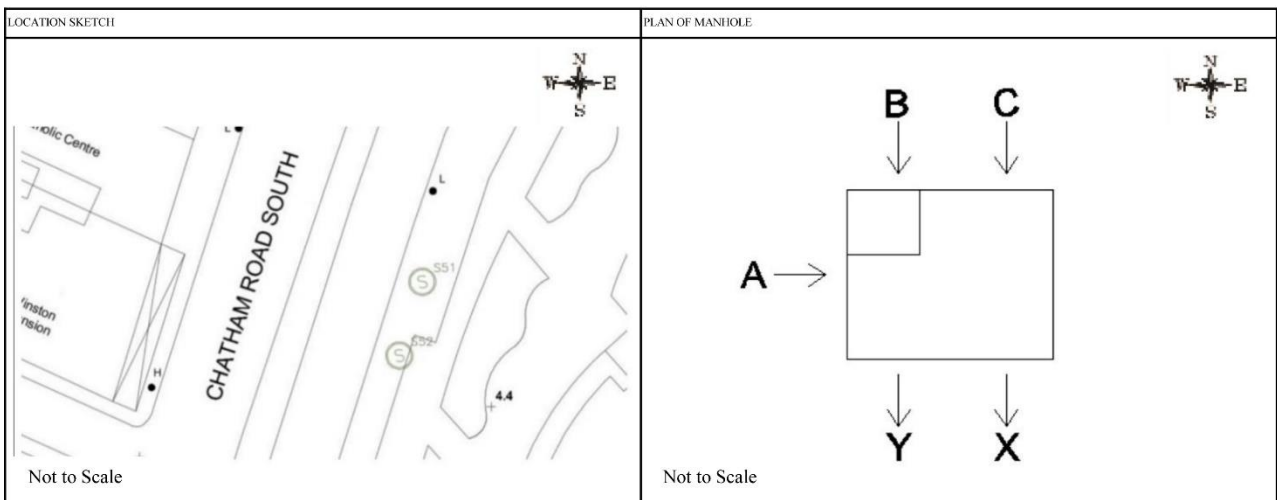
NODE REF.	S501										
GRID REF	X: 836267 Y: 818130	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GVMH361821501	MANHOLE GRID REF.	3618 267 130	WITH RISK ASSESSMENT	Y		
DRAINAGE RECOED CODE	11NW25C	CLIENT	DSD	WO NO.	Site DN/12	DSD REF.	/	WITH PERMIT TO WORK	Y		
SURVEYED BY	C.Y.LEE	LOCATION	Hong Kong Museum Of History, Chatham Road South, Tsim Sha Tsui East, Kowloon							WITH TRAFFIC PERMIT	Y
SURVEYED DATE	13/6/2018	YEAR LAID (YYYY)	Z	STATUS	PU	FUNCTION	S	NODE TYPE	M		

COVER SHAPE	D	HINGED	N	LOCK	N	DUTY	H	COVER SIZE (dia./H) (mm) (W) (mm)	900 x 750	TOXIC ATMOSPHERE	N		
SHAFT SIDE ENTRY	N	REGULAR COURSE	0	LADDERS	0	LNDSG	0	SHAFT SIZE	900 x 750	EVIDENCE OF VERMIN	N		
CHAMBER SOFFIT	S	STEPS	1	CHAMBER SIZE	3150 x 16740	CONSTRUCT CODE	I						
DEPTH OF FLOW (mm)	200	DEPTH OF SILT (mm)	100	HEIGHT SURCH (mm)	0	MANHOLE DEPTH (m)	2.53	COVER LEVEL (mPD)	4.24	DEPTH OF SHAFT (m)	0.65	DEPTH OF CHAMBER (m)	0.38

	UPSTREAM REF.	PIPE SHPE	PIPE SIZE (dia./H) (mm)		BACKDROP (mm)	PIPE MATERIAL	LINING	PIPE DEPTH (m)	NVERT LRVEL (mPD)	PHOTO NO.	FOR OFFICE USE		
			(W)(mm)	(D)(mm)							WALL NO.	LOCATION (m)	
INCOMING PIPES	A	GNA	R	240	x	1250	-	CO	N	2.50	1.74	S501-P05	
	B	GNB	C	1200	x	-	-	CO	N	2.50	1.74	S501-P06	
	C	GNC	C	1500	x	-	-	CO	N	2.50	1.74	S501-P07	
	D				x								
	E				x								
	F				x								
	G				x								
OUTGOING PIPES	X	GNX	C	1800	x	-	-	CO	N	2.53	1.71	S501-P08	
	Y	GNY	R	1500	x	1880	-	CO	N	2.53	1.71	S501-P08	
	Z				x								
DOWNSTREAM REF									COND	Y/N	CRITY	A/B/C	

CONDITIONS (Y if attention required)	COVER	N	IRON/ LADDER	N	SHAFT	N	CHAMBER	N	BENCHING	N	OTHER	N
PHOTO NO.												

UTR	N	LOCATION PHOTO	S501-P01-P02	REMARKS								
UTL	N											
UTGA	N											
UTS	N	INTERNAL PHOTO	S501-P04-P08	RECORD PLAN DIFFERENCE	N	Y (if attention required)						
JETTING	N			COVER TYPE								
ON-SLOPE	N	WATER DEPTH (UTS)	-	STANDARD	LARGE	MULTIPLE COVER	DOUBLE TRIANGULAR	WITH DECORATION COVER	OTHERS ()			
SLOPE NO.:	-											



NODE TYPE: A: Catch Pit; B: Hydrobrake; C: Cascade; D: Dual Function Manhole; E: Ejector; F: Outfall; G: Ghost; H: Hatchbox; I: Inlet; J: Junction (Saddle); K: Combined; L: Lamphole; M: Manhole; N: Dead End; O: Oil Interceptor; P: Pumping station; Q: Transition; R: Rodding eye; S: Soukaway; T: Vent Column; U: Unspecified; V: Storm overflow; W: Treatment Works; X: Unreliable; Y: Gully; Z: Ghost in rising main

Appendix C – Sample DCAMS – Manhole Internal Condition Assessment Coding Form - Site Coding Sheet (filled)

IDMS - DCAMS Manhole Internal Condition Assessment Coding Form - Site Coding Sheet



UTILITY TRAINING INSTITUTE (UTI)
a trade name of UtilityINFO (Training) Ltd. 管綫學院

NODE REF.	S501									
GRID REF. X: 836 207 Y: 818 133	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GM/MH 361821501	MANHOLE GRID REF.	3618207130	WITH RISK ASSESSMENT	Y		
DRAINAGE RECOED CODE	11NW25C	CLIENT	DSD	WO NO.		DSD REF.		WITH PERMIT TO WORK	Y	
SURVEYED BY	C.Y. LEE	LOCATION	HONG KONG MUSEUM OF HISTORY, CHATHAM RD S. > 7 ST, KOWLOON						WITH TRAFFIC PERMIT	Y
SURVEYED DATE	13/06/2018	YEAR LAID (YYYY)	Z	STATUS	PV	FUNCTION	S	NODE TYPE	M	

COVER	SHAPE	D	HINGED	N	LOCK	N	DUTY	H	COVER SIZE	(dia) (H) (mm) (W) (mm)	900 x 750	TOXIC ATMOSPHERE	N
SHAFT	SIDE ENTRY	N	REGULAR COURSE	0	LADDERS	0	LNDGS	0	SHAFT SIZE	900 x 750	EVIDENCE OF VERMIN	N	
CHAMBER	SOFFIT	S	STEPS	1					CHAMBER SIZE	3150 x 16740	CONSTRUCT CODE	2	
DEPTH OF FLOW (mm)	200	DEPTH OF SILT (mm)	100	HEIGHT SURCH (mm)	0	MANHOLE DEPTH (m)	2.53	COVER LEVEL (mPD)	4.24	DEPTH OF SHAFT (m)	0.65	DEPTH OF CHAMBER (m)	0.38

Video No.	Photo No.	Depth (Meters)	Location	Common Defects	Type	Desc.	Dia of IJ/CX (mm) (H x W)	NUMBERS				Remarks																													
								Clock		Intrusion etc (mm)																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40		
M001	P04	0.00	FWY	ST																																					
	P05	2.33	FWY	WL																																					
	P05	2.50	FWY	BF																																					
	P05	2.50	FWY	PJRI			240 x 1250																																		
	P06	2.50	FWY	PJCI			1200																																		
	P07	2.50	FWY	PJCI			1500																																		
	P08	2.53	FWY	PJCO			1800																																		
	P08	2.53	FWY	PJRO			1500 x 1880																																		
		2.53	FWY	FW																																					

Weather Code	1-Dry	2-Heavy Rain	3-Light Rain	4-Showers
Permit to Work for Confined Space				
Potential Hazardous Gases:	O ₂	CO	LEL	H ₂ S
Safe Range Reading:	19.5%-23%	<25ppm	<10%	<10 ppm
Readings:				
Name of CSW & Card No.:				
Name of CP:				
Signed by Team Leader (CP)				
	Time:		Date:	

NODE TYPE: A: Catch Pit; B: Hydrobrake; C: Cascade; D: Dual Function Manhole; E: Ejector; F: Outfall; G: Ghost; H: Hatchbox; I: Inlet; J: Junction (Saddle); K: Combined; L: Lamphole; M: Manhole; N: Dead End; O: Oil Interceptor; P: Pumping station; Q: Transition; R: Rodding eye; S: Sockaway; T: Vent Column; U: Unspecified; V: Storm overflow; W: Treatment Works; X: Unreliable; Y: Gully; Z: Ghost in rising main

Appendix D – Sample DCAMS – Manhole Internal Condition Assessment Coding Form (filled)

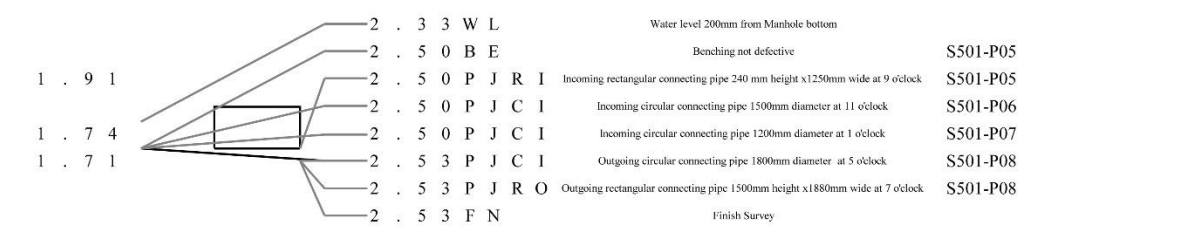
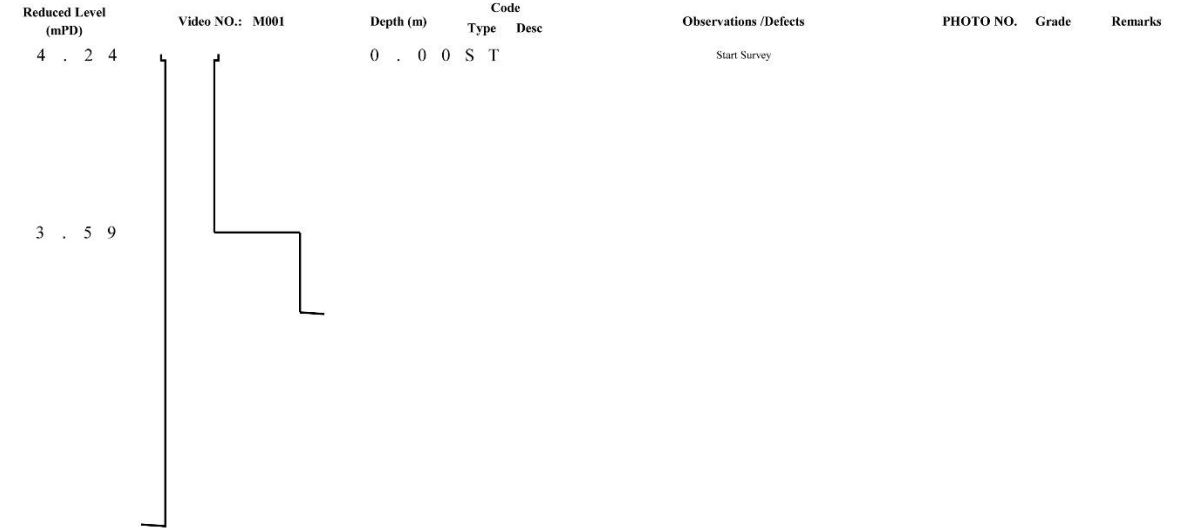
IDMS - DCAMS Manhole Internal Condition Assessment Coding Form



NODE REF.	S501									
GRID REF. X:	836267	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GVMH361821501	MANHOLE GRID REF.	3618 267 130	WITH RISK ASSESSMENT	Y	
GRID REF. Y:	818130	CLIENT	DSD	WO NO.	Site DN/12	DSD REF.	/	WITH PERMIT TO WORK	Y	
DRAINAGE RECORDED CODE	11NW25C	LOCATION	Hong Kong Museum Of History, Chatham Road South, Tsim Sha Tsui East, Kowloon						WITH TRAFFIC PERMIT	Y
SURVEYED BY	C.Y.LEE	(BUILDING)	(ESTATE/ROAD)	(AREA)	(DISTRICT)					
SURVEYED DATE	13/6/2018	YEAR LAID (YYYY)	Z	STATUS	PU	FUNCTION	S	NODE TYPE	M	

COVER SHAPE	D	HINGED	N	LOCK	N	DUTY	H	COVER SIZE (dia./H) (mm) (W) (mm)	900 x 750	TOXIC ATMOSPHERE	N		
SHAFT SIDE ENTRY	N	REGULAR COURSE	0	LADDERS	0	INDGS	0	SHAFT SIZE	900 x 750	EVIDENCE OF VERMIN	N		
CHAMBER SOFFIT	S	STEPS	1	CHAMBER SIZE	3150 x 16740	CONSTRUCT CODE	I						
DEPTH OF FLOW (mm)	200	DEPTH OF SILT (mm)	100	HEIGHT SURCH (mm)	0	MANHOLE DEPTH (m)	2.53	COVER LEVEL (mPD)	4.24	DEPTH OF SHAFT (m)	0.65	DEPTH OF CHAMBER (m)	0.38

	UPSTREAM REF.	PIPE SHAPE	PIPE SIZE (dia./H) (mm)		BACKDROP (mm)	PIPE MATERIAL	LINING	PIPE DEPTH (m)	NVERT L RVEL (mPD)	PHOTO NO.	FOR OFFICE USE			
			(mm)	(mm)							WALL NO.	LOCATION (m)		
INCOMING PIPES	A	GNA	R	240	x	1250	-	CO	N	2.50	1.74	S501-P05		
	B	GNB	C	1200	x	-	-	CO	N	2.50	1.74	S501-P06		
	C	GNC	C	1500	x	-	-	CO	N	2.50	1.74	-		
	D				x									
	E				x									
	F				x									
	G				x									
	H				x									
OUTGOING PIPES	DOWNSTREAM REF										COND	Y/N	CRITY	A/B/C
	X	GNX	C	1800	x	-	-	CO	N	2.53	1.71	-		
	Y	GNV	R	1500	x	1880	-	CO	N	2.53	1.71	-		
Z				x										



NODE TYPE: A: Catch Pit; B: Hydrobrake; C: Cascade; D: Dual Function Manhole; E: Ejector; F: Outfall; G: Ghost; H: Hatchbox; I: Inlet; J: Junction (Saddle); K: Combined; L: Lamphole; M: Manhole; N: Dead End; O: Oil Interceptor; P: Pumping station; Q: Transition; R: Rodding eye; S: Soakaway; T: Vent Column; U: Unspecified; V: Storm overflow; W: Treatment Works; X: Unreliable; Y: Gully; Z: Ghost in rising main

Sample Consistency Check Report

Node Ref.	Deviation Description
HK31135505	Non-existent node ref - upstream A 31135504
HK31135506	Invalid node type - "U"
HK31135506	D/S pipe size < U/S - max. in 450 out - 225
HK31135506	Non-existent node ref - upstream A GN. A
HK31135506	Non-existent node ref - upstream A GN. B
HK31135516	Incon. Node/grid ref. HK31134416/ HK31113
HK31135516	No cover level
HK31135516	No cover size
HK31135516	Non-existent node ref - No upstream ref.
HK31135516	No D/S manhole ref.
HK32132038	Non-existent node ref - No upstream ref.
HK32132044	Invalid node type - "U"
HK32132044	D/S pipe size < U/S - max. in 370 out - 300
HK32132044	No cover size
HK32132044	Non-existent node ref - upstream A GN. A
HK32132044	Non-existent node ref - upstream A GN. B
HK32132044	Non-existent node ref - Downstream X 32132045
HK32132044	Incon. Invert levels 97.44 / 97.51

SUMMARY	Number	Percentage
Invalid node ref -	0	0.00%
Invalid grid ref -	0	0.00%
Incon. Node/grid ref -	8	3.67%
Invalid status -	0	0.00%
Invalid function -	0	0.00%
Invalid node type -	13	5.96%
No D/S manhole ref -	8	3.67%
Non-existent node ref -	121	55.50%
Wrong U/S ref in	0	0.00%
Backfall from node	0	0.00%
Incon. D/S data -	0	0.00%
U/S & D/S refs same -	0	0.00%
Incon. Invert levels	5	2.29%
Invalid cover shape -	0	0.00%
Invalid cover duty -	0	0.00%
No cover size	22	10.09%
No cover level	9	4.13%
No shaft size	0	0.00%
No shaft depth -	0	0.00%
No pipe depth -	10	4.59%
Invalid pipe shape	0	0.00%
Invalid soffit code	0	0.00%
No chamber size	12	5.50%

No chamber depth -	0	0.00%
Invalid const. code	0	0.00%
Incon. D/S function -	0	0.00%
Low fall to/from node	0	0.00%
Invalid pipe mat. -	0	0.00%
Invalid lining mat. -	0	0.00%
No pipe size -	0	0.00%
Invalid crit. code -	8	3.67%
D/S pipe size < U/S -	2	0.92%
U/S & D/S refs same as node	0	0.00%

Total number 218

Total nodes checked 62

Total nodes with inconsistencies 50 80.65%

Appendix E – Sample Photograph Sheet of Manhole Internal Condition Survey

*Manhole Internal Condition Survey -
Photograph Sheet*



UTILITY TRAINING INSTITUTE (UTI)
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NODE REF.	S501									
GRID REF	X: 836267	SURVEYED BY	C.Y.LEE	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GVMH361821501	MANHOLE GRID REF.	3618 267 130	
DRAINAGE RECOED CODE	11NW25C	SURVEYED DATE	13/6/2018	CLIENT	DSD	WO NO.	Site DN/12	DSD REF.	/	

	Photograph No.:	S501-P01
	Location:	Chatham Road South
	Description :	Manhole Location
	Remarks:	

	Photograph No.:	S501-P02
	Location:	Chatham Road South
	Description :	Manhole Location
	Remarks:	

**Manhole Internal Condition Survey -
Photograph Sheet**



UTILITY TRAINING INSTITUTE (UTI)
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NODE REF.	S501									
GRID REF	X: 836267 Y: 818130	SURVEYED BY	C.Y.LEE	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GVMH361821501	MANHOLE GRID REF.	3618 267 130	
DRAINAGE RECOED CODE	11NW25C	SURVEYED DATE	13/6/2018	CLIENT	DSD	WO NO.	Site DN/12	DSD REF.	/	



Photograph No.:	S501-P03
Location:	Chatham Road South
Description :	Manhole Cover
Remarks:	



Photograph No.:	S501-P04
Location:	Chatham Road South
Description :	Manhole Condition
Remarks:	

**Manhole Internal Condition Survey -
Photograph Sheet**



UTILITY TRAINING INSTITUTE (UTI)
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NODE REF.	S501									
GRID REF	X: Y:	836267 818130	SURVEYED BY	C.Y.LEE	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GVMH361821501	MANHOLE GRID REF.	3618 267 130
DRAINAGE RECOED CODE	11NW25C	SURVEYED DATE	13/6/2018	CLIENT	DSD	WO NO.	Site DN/12	DSD REF.	/	

	Photograph No.: <p style="text-align: center;">S501-P05</p>
	Location: <p style="text-align: center;">Chatham Road South</p>
	Description : <p style="text-align: center;">Manhole Condition</p>
	Remarks:



	Photograph No.: <p style="text-align: center;">S501-P06</p>
	Location: <p style="text-align: center;">Chatham Road South</p>
	Description : <p style="text-align: center;">Manhole Condition</p>
	Remarks:


**Manhole Internal Condition Survey -
Photograph Sheet**



UTILITY TRAINING INSTITUTE (UTI)
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NODE REF.	S501									
GRID REF	X: Y:	836267 818130	SURVEYED BY	C.Y.LEE	PROJECT NO.	Y18-P-028-999	IDMS MANHOLE REF. NO.	GVMH361821501	MANHOLE GRID REF.	3618 267 130
DRAINAGE RECOED CODE	11NW25C	SURVEYED DATE	13/6/2018	CLIENT	DSD	WO NO.	Site DN/12	DSD REF.	/	

	Photograph No.: <p style="text-align: center;">S501-P07</p>
	Location: <p style="text-align: center;">Chatham Road South</p>
	Description : <p style="text-align: center;">Manhole Condition</p>
	Remarks:

	Photograph No.: <p style="text-align: center;">S501-P08</p>
	Location: <p style="text-align: center;">Chatham Road South</p>
	Description : <p style="text-align: center;">Manhole Condition</p>
	Remarks:

Appendix F – Full List of DSD Feature Reference Number*Table 6 List of feature reference Number on Drainage Record Plan*

Class	ID	Type of Feature	Prefix
Pipe	1	Storm drain	SWD
	2	Sewer	FWD
	3	Combined system drain	CWD
	4	Multiple pipes-storm drain	SMD
	5	Multiple pipes-sewer	FMD
	6	Gully pipe	SGD
	7	Inverted siphon-storm drain	SSD
	8	Inverted siphon- sewer	FSD
	9	Vacuum sewer	FVD
	N1	Vacuum Storm	SVD
	10	Sewage rising main	FRD
	N2	Storm rising main	SRD
	N3	Multiple Storm rising main	SPD
	N4	Multiple Sewer rising main	FPD
Manhole / Chamber	11	Storm water manhole	SMH
	12	Sewage manhole	FMH
	N4	Sewer Manhole-Unspecified	FUH
	N5	Storm Manhole-Unspecified	SUH
	13	Combined system manhole	CMH
	14	Terminal manhole-storm drain	SLH
	15	Terminal manhole -sewer	FLH
	16	Catch pit	SCH
	17	Special manhole- storm drain	SPH

Class	ID	Type of Feature	Prefix
	18	Tapping point -storm drain	SSH
	19	Sand / silt trap	FSH
	20	Special manhole - sewer	STH
	21	Tapping point-sewer	FTH
	22	Interface valve chamber (for vacuum sewer)	FIH
	23	Sewage chamber	FCH
	N6	Storm Chamber	SBH
	24	Overflow-sewer	FOH
	25	Overflow-combined system	COH
	26	Oil / petrol interceptor	FPH
	27	DWF Interceptor	SDH
	28	Inlet-storm drain	SIH
	29	Valve-sewage	FVH
Gully	30	Gully	SUG
	31	Special gully	SSG
	32	Gully sump	SMG
Outfall	33	Storm water outlet	SOF
	34	Sewage outlet outfall	FOF
	35	Combined system outfall	COF
	36	Sewage submarine	FSF
	37	Outlet- storm drain	SNF
Ghost/ Junction	38	Ghost /Junction-storm drain	FGJ
	39	Ghost / Junction sewer	SBB
	N7	Storm Y-Junction	FBB
	N8	Sewer Y-Junction	SCB

Class	ID	Type of Feature	Prefix
	N9	Combine Y-Junction	CGJ
Boundary	40	Storm water culvert (boundary)	SBB
	41	Sewage culvert (boundary)	SBB
	42	Channel/Nullah (storm water boundary)	FBB
	43	Storm water tunnel (boundary)	SCB
	44	Sewage tunnel (boundary)	STB
	N10	Drainage Reserve	FTB
	N11	Zone of Influence	XRB
	N12	Lot Boundary	XZB
	N13	District Boundary	XLB
	N14	Catchment	XDB
	N15	Service Extent	ZMA
	N16	Engineered Channel Boundary	ZEA
	N17	Flood Pond	SCB
	N18	Boulder Fence	XFB
	N19	District Council Boundary	XBB
	N20	Village Boundary	XIB
	N21	Leach Field	ZHA
	N22	Road	ZRA
	N23	Contract	ZOA
	N24	Incident	ZEA
	N25	Spot Level	ZVA
Path	45	Culvert (sewage, path)	FBP
	46	Tunnel (sewage, path)	FTP
	47	Cascade (path)	SAP

Class	ID	Type of Feature	Prefix
	48	Culvert (storm water. path)	SBP
	49	Channel (storm water, path)	SCP
	50	Decked Nullah (path)	SDP
	51	Surface channel (storm water, path)	SHP
	N26	Surface-Channel Half Channel Nullah (path)	SFP
	52	Nullah (path)	SNP
	53	Stepped channel (path)	SNP
	54	Tunnel (storm water, path)	SSP
	55	U channel (path)	STP
	56	Dry weather flow channel (path)	SUP
Structure	57	Screening plant (structure)	XWP
	58	Sewage treatment plant (structure)	XSS
	59	Storage pond (structure)	XTS
	60	Imhoff tank (structure)	XFS
	61	Pumping station (structure)	XIS
	62	Soakaway (structure)	XPS
	63	Protective bund (structure)	XAS
	64	Septic tank (structure)	XBS
	65	Unspecified (structure)	XCS
Hstructure	66	Orifice (Hstructure)	XUS
	67	Weir (Hstructure)	XAY
	68	Compound orifice (Hstructure)	XWY
	69	Fabric-dam (Hstructure)	XCY
	70	Dam (Hstructure)	XDY
	71	Stilling basin Hstructure	XEY

Class	ID	Type of Feature	Prefix
	72	Energy dissipator (Hstructure)	XFY
	73	Fish pass (Hstructure)	XGY
	74	Hydrobrake (Hstructure)	XJY
	75	Contributing area (Hstructure)	XKY
	76	Bar Screen (Hstructure)	XBY
	77	Stop log (Hstructure)	XLY
	78	Stop log shaft (Hstructure)	XSX
	79	Unspecified (Hstructure)	XUY
	N27	H-Structure –Valve	XVY
	N28	H-Structure -Sluice Gate	XNY
	N29	H-Structure Unspecified	XUY
Asset/ Miscellaneous	80	Desilting opening	ZDA
	81	Inspection opening	ZIA
	82	Balancing hole for culvert	ZBA
	83	Machine access	ZMA
	84	Maintenance access	ZAA
	85	Maintenance tunnel	ZTA
	86	River	ZRA
	87	Slope (nature Stream)	ZSA
	88	Pipe bridge	ZPA
	89	Water gauge	ZWA
	90	Railing	ZLA
	91	Fencing	ZFA
	92	Concrete parapet	ZCA
	93	Bank	ZKA

Class	ID	Type of Feature	Prefix
	94	Nullah bed	ZNA
	95	Dummy	ZUA

Draft V.0.4.0