

Guide to Manhole Internal Condition Survey



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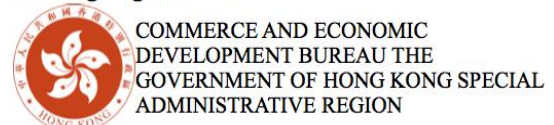


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FOREWORD

After the disastrous landslide of 1994 occurred in Kwun Lung Lau on Hong Kong Island, the Government has paid more attention on utility maintenance with particular emphasis on leakage detection of buried water carrying services on both slopes and roads. The Government has increased resources and imposed additional legislation on the detection of underground utilities. As a direct result, the utility profession has been developing rapidly, and over the last decade, the number of “Utility Specialists” (管綫專業監理師) has grown as the Government’s requirements for Competent Persons to carry out the investigations has been implemented, in addition, Recognized Professional Utility Specialist (RPUS) (管綫專業監察師) has been recognized in recent years. However, lack of standard surveying methods, centralized monitoring systems and organized management, have lead to unsatisfactory investigation results.

In order to address these issues, Hong Kong Institute of Utility Specialists (HKIUS) (香港管綫專業學會), targeting the promotion of knowledge and good practice in the utility profession, collaborated with Hong Kong Utility Research Centre (HKURC) (香港管綫管理研究中心) and supported by the funding from the Professional Services Development Assistance Scheme (PSDAS) of HKSAR, published a series of guide books and pamphlets in 12 disciplines of the utility profession in order to set standards for the practitioners to follow. As part of HKIUS continual effort to enhance the professionalism of the utility profession, it is the intention of the series that the quality of the survey can be raised and that utility related incidents can be avoided by performing high quality utility practices. Hopefully, the resulting benefits can extend to the general public.

This issue provides good practice of Manhole Internal Condition Survey (MHICS) (沙井狀況評估). It states the whole process and specification of conducting MHICS from planning to finishing stages and intended to be used by all personnel involved in the works.



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1. INTRODUCTION

Manholes are windows to the underground drainage and sewerage system. The decay of manholes may affect the flow of drain or even causes damages to the underground utilities. Manholes may be destroyed by erosion from surface runoff and underground water intrusion, corrosion from liquids and gases, wearing from heavy traffic loads and general depreciation from age. Manhole Internal Condition Survey (MHICS) (沙井狀況評估) provides information on the features and defects of the manholes like whether there are excessive infiltration and inflow. These extraneous flows affect the sewer system hydraulically and sanitarily. It also provides information for system maintenance. With information on the manhole condition constantly, remedial actions can be taken in time and in turn prevent potential landslips. Besides, the locations and structures of the manholes may affect the design and construction of the drainage works investigation of manhole provides detailed information as references to the planning of drainage works.

For manhole inspection, safety are particularly important 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 numbering system and referencing system. Therefore, standardized requirements and sufficient information are needed for manhole inspection. Hong Kong Institute of Utility Specialists (HKIUS) (香港管綫專業學會), aimed at maintaining a healthy underground drainage system and safe working environment, prepared guidelines to provide a standardized process of conducting manhole internal condition survey in order to promote a good practice for the practitioners. Noted that such standards are for reference only, any other standards or requirements are acceptable as long as stated in the contract or there are mutual agreement between the Contractor and the Engineer/ Client.

2. OBJECTIVE AND SCOPE

A manhole provides access for performing maintenance works to the buried utilities. The purpose of this guide is to provide recommendations on good practice of the methods and specification of Manhole Internal Condition Survey to enhance the quality of the survey. Conducting manhole internal condition survey provides comprehensive information regarding the manholes including their locations, features and conditions. However, a survey usually involves investigation of a large number of manholes that means a large amount of data is being processed. And so, contradicting and incorrect data are not uncommon. This document provides standardized processes and recommends the use of systematized information recording system. It aimed at providing guidelines for the practitioners to follow to improve the quality of the survey.

Another purpose of this guide is to promote a safe working environment especially working in the confined spaces as man-entry into confined spaces may be needed in manhole inspection.

This guide provides information on the whole process and specification of conducting manhole internal condition survey from planning to finishing stages. Nevertheless, users of this guide shall refer to relevant documents for further information on safety that are not covered in details. It must be stressed that the guidelines given in this guide are in no way exhaustive, and professional judgment must be employed in all cases.

This guide is intended to be used by all personnel who are involved in the planning, commencement and supervision of manhole internal condition survey, including contractors, utility companies, consultants, government departments and other parties concerned.

3. PRE-SURVEY PREPARATION

Before commencement of the survey, the Utility Specialist shall conduct reconnaissance survey at each site to have an overview of the proposed manhole survey. Personal and environmental safety precautions shall be taken comprehensively to prevent accidents. To ensure the professionalism and safety issues of the survey, accredited personnel shall be appointed to carry out the inspection.

3.1 Reconnaissance Survey (初步勘察)

The Utility Specialist shall conduct a reconnaissance survey at each site before commencement of works. The survey shall cover the full survey extent as confirmed on the Layout Plans. The survey ensures the feasibility of the initial planning and provides more information regarding the site so that the survey can run more smoothly. The reconnaissance survey shall identify the followings:

- (1) The full extent of the assets (manholes, pipes, catch-pits and other ancillaries) located within the survey extent and see if there are assets that are not shown on the Layout Plans.
- (2) The closest upstream and downstream manholes outside the survey extent for pipelines extending beyond the survey extent.
- (3) Any salient features, which may impede the execution of the surveys.
- (4) Any additional features not shown on the Layout Plans, and/ or revisions to match existing conditions on-site.

Besides, the Utility Specialist shall establish the ownership of the assets identified within the survey extent with the latest available information from various sources.

It is important to note that the Utility Specialist shall ensure the whole process of all surveys including reconnaissance survey, manhole survey and pipeline investigations are carried out by or under the supervision of the Competent Person. Otherwise, the data of the survey shall not be accepted and repeated survey shall be carried out under supervision with any additional cost. The definition of Competent Person is stated in section 3.3.

3.2 Safety Precautions

Sufficient safety precautions shall be taken to minimize the possibilities of incidents and injuries. Both employers and employees have the responsibility to maintain a safe working environment. Generally, the person in charge (who is supposed to be a Competent Person) shall ensure detailed working procedures and safety plan have been drawn up and the workmen are instructed according to such plans. All safety equipment such as sewer safety, road safety and personal protective equipments shall be supplied in sufficient quantity and in full working order. Close supervision shall also be imposed during the commencement of works to ensure everything is in correct manner.

As manholes may contain explosive or inflammable gases, smoking, naked lights or fires must NOT be permitted near the manholes and only flame/ explosion proof equipment shall be used inside the chamber to prevent any fire-induced explosions or accidents.

3.3 Statutory Requirement

The Workplace Health and Safety Regulations of Hong Kong specify several requirements for personnel involved in works, some of the requirements are stated in relevant ordinances or regulations such as road traffic control, excavation safety, dangerous substance, noise at work, etc.

It is important to follow relevant ordinances stated on the Occupational Safety and Health Council (<http://www.oshc.org.hk>) before commencement of work.

Also, operators shall use personal protective equipment (PPE) and shall have sufficient knowledge in both usage and maintenance of the equipment. Besides equipment, they shall always use caution and common sense all the times. PPE shall include:

- Steel toe cap, rubber safety boots
- Safety helmet
- Safety vest (reflective at night)
- Safety goggles/Anti-glare glasses
- Breathing apparatus/Disposable respirator
- Harness and Fall arrester
- Gloves
- Ear muffs / ear plugs
- Handy gas detector
- Audio-visual alarm
- Resuscitator

In works for the Water Supplies, the Drainage Services or other government departments, appropriate steps shall be taken to minimize or eliminate any potential risks for injuring the public. Appropriate temporary traffic arrangement (TTA) shall also be made to prevent accidents. The TTA shall comply with the Road Traffic (Traffic Control) Regulations (Cap. 374G), at all times. In case where excavation is required, the work area has to be properly supervised by a Competent Person (CP), under Electricity Supply Lines (Protection) Regulation (Cap. 406H). The access for "essential services", e.g., police, fire service and ambulance, has to be retained. Access to other public services, such as bus stops, footpaths, etc, shall also be maintained and supervised.

If excavations are required, no dirt, excess spoil or any other materials shall be left in the water channel and polluting the drainage system. Sediment control procedures can be referred to the Environmental Protection Department (<http://www.epd.gov.hk>).

3.4 Confined Space

Though entering the manhole is not recommended for investigation, it is often used in the manhole internal condition survey. Manhole is a confined space that is potentially hazardous. According to the Factories and Industrial Undertakings (Confined Spaces) Regulation, confined space (密閉空間) means any place in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk, and without limiting the generality of the foregoing, includes any chamber, tank, vat, pit, well, sewer, tunnel, pipe, flue, boiler, pressure receiver, hatch, caisson, shaft or silo in which such risk arises.

A series steps shall be followed before commencement of works. The first step is to identify whether the workplace is a confined space or not, then competent person and certified worker shall carry out risk assessment, in order to control and minimize the risk. The contractor shall perform safety precautions according to the potential dangers that mentioned in the risk assessment report. The permit-to-work can then be issued with a working period. When the period expired, risk assessment shall be carried out once again. Also, emergency procedures shall be planned before working so that they can react promptly when unpredicted situation occurs.

Before entering the manhole, sufficient period of time shall be given to allow ventilation. Then, lower the gas detection apparatus into the manhole to check if it is safe to enter, even the result shows it is a safe condition; do not enter if there is peculiar smell.

When working in the manhole, the workmen shall wear full range of protective clothing and a safety harness with lifeline. He shall also check the gas detector for any lethal gases frequently. There shall be a top man arranged outside the manhole to keep in touch and communicate with the man work underground. The workman shall obey the instructions given by the top man.

In case of emergency, the injured man shall be brought out of the manhole as soon as possible. First aid shall be given immediately. Whether further medical assistance is needed shall depend on the seriousness of the injuries. If the workman collapsed, any other person who is with him shall signal the top man and leave the manhole as quickly as possible unless they can drag the casualty clear at once. Whenever there is no breathing apparatus, no further rescue shall be made and dial 999 immediately for assistance.

When finished the inspection, ensure all men worked underground have returned to the surface and all manhole covers have been replaced properly.

For further information on the regulations and steps of working in the confined space, please refer to the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap 59 AE) which can be accessed via homepage of Occupational Health and Safety Council at www.oshc.org.hk or the “Code of Practice for Safety and Health at Work in Confined Spaces” prepared by the Labour Department. The code of practice can be accessed via its website at www.labour.gov.hk.

3.5 Personnel Requirement

In order to maintain the Utility Profession's requirements for the consistency, reliability and accuracy of reports, CCTV inspection shall be performed by properly trained and accredited personnel. Accredited personnel shall hold a certified qualification issued by a Registered Training Organisation (RTO), such as Utility Training Institute or The Hong Kong Polytechnic University or equivalent.

In addition, a minimum of 3 years 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 refresh and enhance their knowledge.

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 & Safety Legislations, as well as any additional precautions that may be specified by the asset owner.

Table of personnel requirement

Training and Experience Requirements for Personnel Carrying Out Inspection (HKIUS standard, 2011)			
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, UTI) for surveys and data collection ➤ Has attended training courses 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.
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, UTI) for surveys and data collection ➤ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used 	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and 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, UTI) for surveys and data collection ➤ Has attended training courses 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, UTI) for surveys and data collection ➤ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used 	D/MHKIUS, CP, CW
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, UTI) for surveys and data collection ➤ Has attended training courses 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.

4. SURVEY FIELD RECORD

Field record is a crucial part of the Survey as the information collected on site would be the basis of further analysis and actions. It is important to note that information obtained from the site shall be recorded on site immediately and properly for the sake of accuracy, as it would be difficult to recall the data after leaving the site.

4.1 Manhole Card Completion

The manhole record card shall be filled with the information of the inspected manhole. Basic information includes location, measurements and features of the compartments of the manhole, details of the incoming and outgoing pipes, and two sketched illustrating the situation of the manhole. More importantly, defects of the manhole shall also be noted and any clues of infiltration and exfiltration shall be observed. Defects of manhole may affect the hygiene of the surroundings or the structure of the surrounding soil.

All fields of the card shall be filled properly. The node reference and grid reference shall be determined according to the manhole referencing system which will be mentioned in section 4.1.3, the manhole reference number of a manhole must not be duplicated with that of another manhole as no two manholes are located at the same place. And so as the upstream and downstream node references, they shall not be the same. Note that different codes are used to describe the features of the manholes, correct codes shall be filled in the card. Normally, the invert levels of the outgoing pipes shall not be higher than that of the incoming pipes. Other conditions and circumstances (e.g. intruding utilities, reason of survey abandoned, etc.) shall be marked clearly in the remarks column.

4.2 Site Standard Measurement

The result of measurement can vary due to different definition and conception of the operator. For example, operators may take different starting point to measure. Therefore, principles are established to set definition for measurements. The operator shall measure the manhole according to the following rules.

For measuring pipe size, the internal diameter shall be measured. The wall thickness of the pipe is excluded. A caliper can be used to take the measurement. Instead of measuring the top/bottom, a horizontal reading shall be taken.

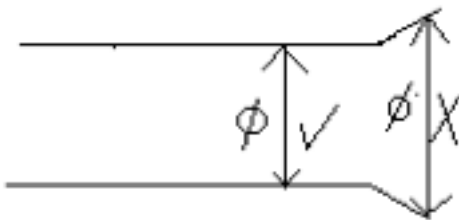


Fig.4.1 Pipe size measurement.

Some standard pipe sizes can be taken as reference for easy measuring and reading.

Standard Pipe Size (mm)			
80	225	750	1800
100	300	900	2100
150	375	1050	
	450	1200	
	525	1350	
	600	1500	
		1650	

Fig. 4.2 Standard pipe size.

Pipes may not be always in regular shapes. For non-regular pipe shape, major dimensions (width and height) of the pipe shall be measured as shown in Fig.4.2.

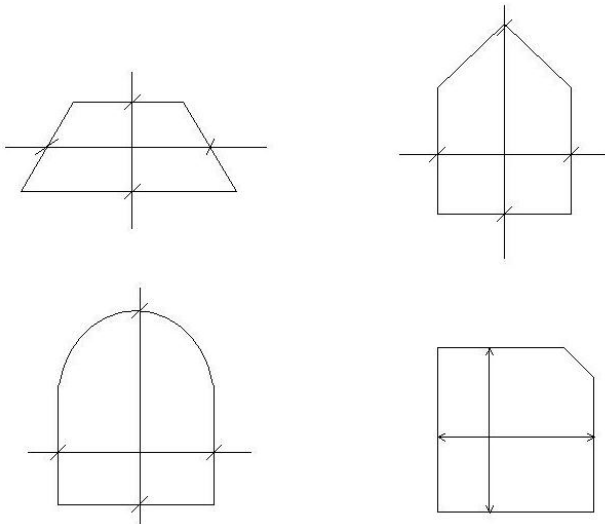


Fig.4.3 Major dimensions are measured when the pipe shapes are irregular.

When measuring the depth of manhole, the starting point shall be the lowest point of the manhole cover. The operator shall first mark X at the lowest point of the manhole cover. Also mark T at the position of the pipe on the manhole cover. If the pipe is out of the area of the manhole cover, mark T at the corner of the cover. Note that oil-based paint/ spray or other similar means shall be used instead of water-based paint.

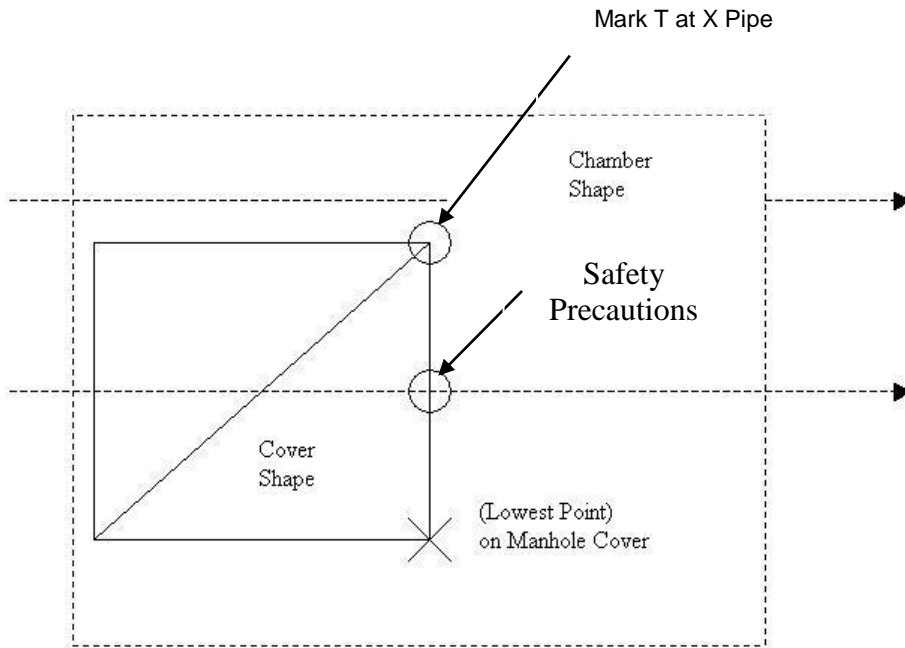


Fig. 4.4 Markings on manhole cover.

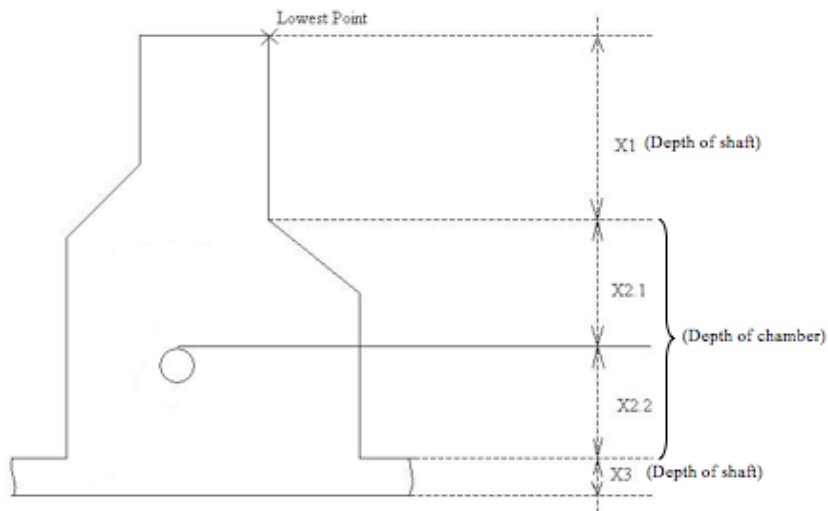


Fig. 4.5 Measure manhole depth.

The manhole depth shall be the sum of the depth of shaft, chamber and diameter of the pipe. That is $X1+X2.1+X2.2+X3$ referring to Fig. 4.5.

4.3 Dimensional Requirement

It is important to take the measurements and fill the manhole card carefully in order to minimize errors. The standard of accuracy required in the survey and completion of manhole record card shall be as follows:

- (1) All textual information shall be correct;
- (2) All measurements shall be accurate within the following tolerances:

Grid References	± 1m
Location Measurement	± 300mm
Levels	± 25 mm
Relative levels of pipe inverts within the chamber	± 20 mm
Pipe sizes	± 20 mm
Box-culverts	± 20 mm
All other dimensions	± 50 mm

Levels shall be referred to Survey Bench Marks, the location and values of which are obtainable from the Lands Department and the Grid Reference shall be supplied in Hong Kong 1980 Grid Reference.

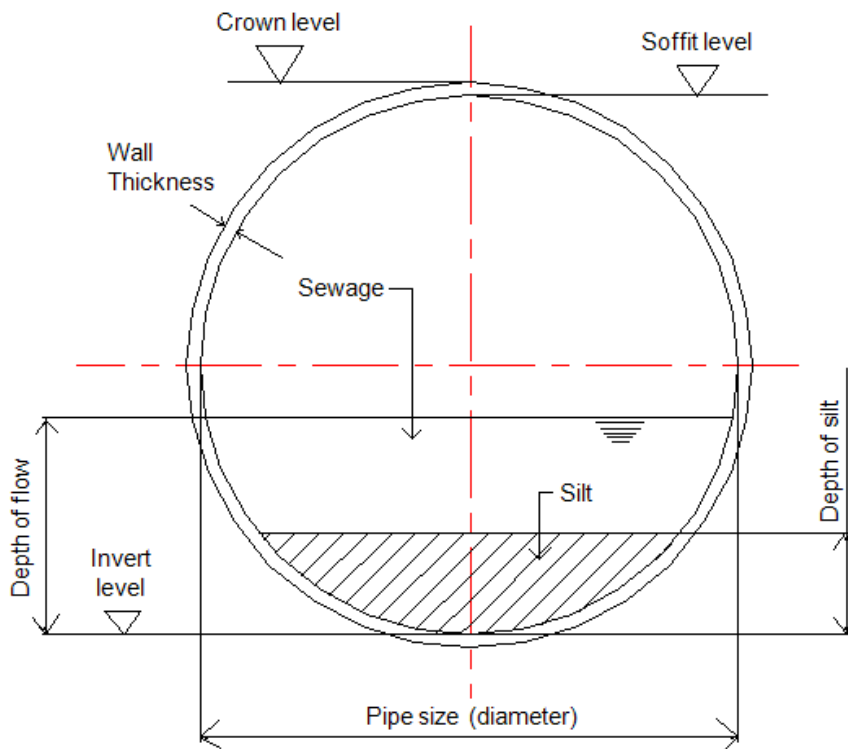


Fig.4.6 Pipe dimensions

4.4 Referencing System

All assets (manhole, lamp holes and ancillaries) shall be referenced properly with the compliance of the referencing system. There are two references to identify the manhole, the Node Reference and the Grid Reference. The Node Reference (refer to Manual of Sewer Condition Classification 2004 (WRC)) indicates its location in 100 meter grid coordinate, the sequence of manhole in the grid and the function of the manhole. There must be a 10-character reference where the first six characters are the number of 1:1000 Topographic Map reference, the 7th character and the 8th character indicates the 100 m easting and northing quadrant respectively and the last two digits indicates the node/ point number in that quadrant. An example is used to illustrate the system.

The Referencing system is divided into three parts:

The reference number of 1:1000 Topographical Map.

e.g. 838135 (easting) and 821236 (northing) = HK3821

100 Meter Grid Co-ordinate

e.g. 838135 (e) and 821236 (n) =12

Manhole Reference Point Number

Each manhole or node is numbered consecutively as 01, 02, 03...etc. with number 1-49 for foul and 51-99 for storm.

i.e. The first Foul Manhole shall be referenced as HK3821 12 01 and;

The first Storm Manhole shall be referenced as HK3821 12 51.

For the Grid Reference (refer to IDMS manhole numbering system), it indicates the exact position of the node on the Topographical Map. There must be a 12-character grid reference where the first six characters are the 1:1000 Topographic Map reference, the following three characters represent the easting and last three characters the northing. An example is used to illustrate the system.

The Grid Referencing System consists of two parts:

The reference number of 1:1000 Topographical Map.

e.g. 838135 (easting) and 821236 (northing) = HK3821

Last three digits of the easting and northing of the grid reference

e.g. 838135 (e) and 821236 (n) = 135236

i.e. The Grid Reference shall be HK3821 135 236

* Base maps shall be the latest published version of the 1:1000 B1000 series Digital Topographic Maps published by Lands Department.

4.5 Manhole Survey Sketches

In order to get a clearer picture of the location of the manhole, sketches about the manhole are required in the manhole record card. Two sketches shall be included, the Location Sketches and Plan of Manhole.

Location Sketches shall be drawn with the manhole referenced at least two reliable fixed structures shown on the 1:1000 base mapping survey sheets. The sketch shall show the manhole layout, including the distance and direction of offset from the main pipe. Note that lampposts, traffic lights

or the similar shall not be acceptable as the reliable fixed structures. If existing buildings are taken as the fixed structures, the building names and numbers shall be highlighted in the sketches. If village house are taken as the fixed structures, the house number shall be identified and indicated in the sketches.

To ensure the accuracy of the manhole location, there shall be three points taken from those reliable fixed structures as reference points when indicating the location of the manhole. The distance between the three reference points and the manhole shall also be stated.

Plan of Manhole shall have the incoming pipes and outgoing pipes indicated with their flow direction. The pipe shall be labeled according to the numbering system which will be discussed in the next sub-section. If there is any utility intruding the manhole, the position and size of the intruding utility shall be noted.

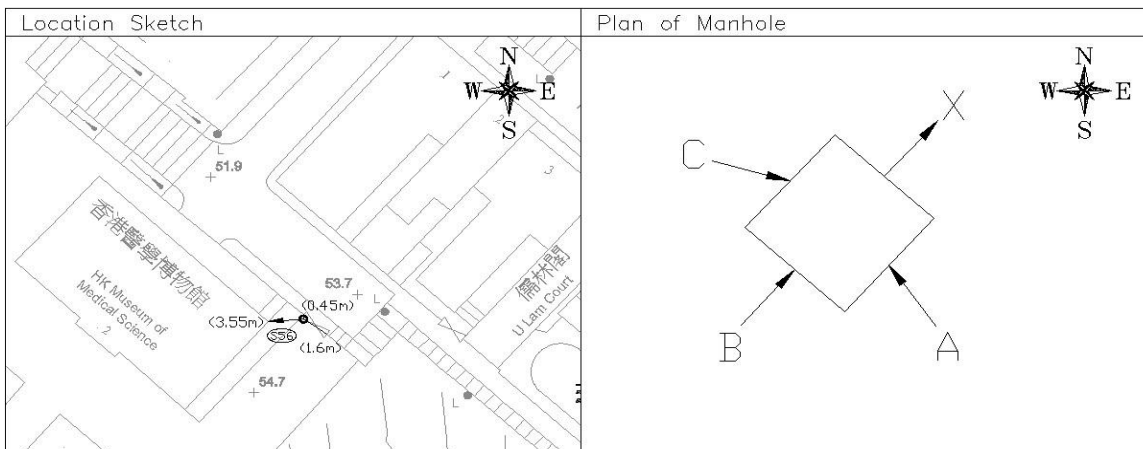


Fig.4.7 Location Sketch and Plan of Manhole in Manhole Record Card.

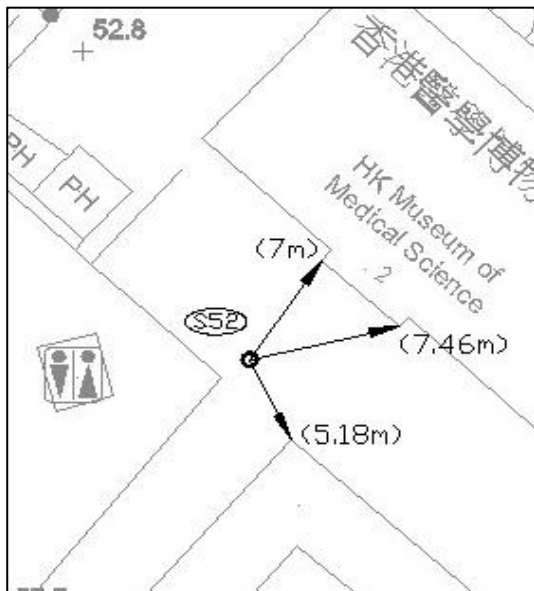


Fig.4.8 Three points measurement

Numbering System

The incoming and outgoing pipes shall be labeled according to the numbering system. Pipes are usually named in alphabetical order from the incoming pipes in clockwise basis. The following is an example of the pipe numbering system.

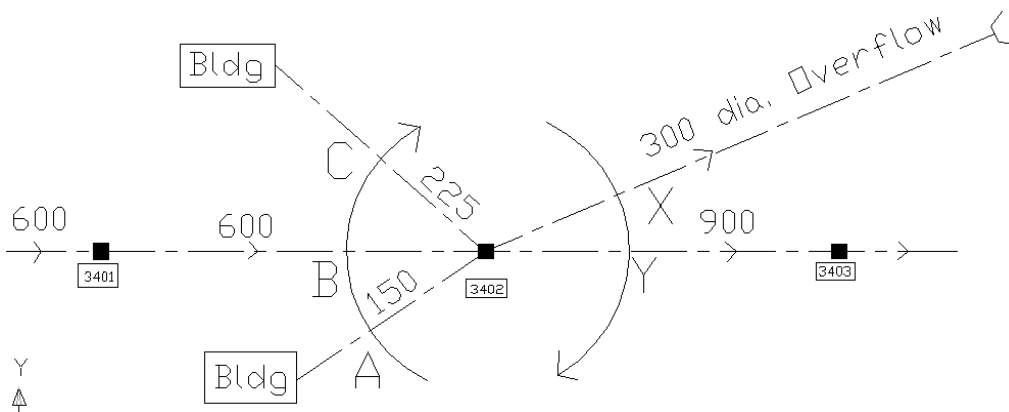


Fig.4.9 Numbering system

As shown in Fig. 4.9, A, B, C represent the incoming pipes and X, Y represent the outgoing pipes. 150, 225, 300, 600 and 900 is the diameter of the pipes. Flow direction and function of the sewer are also shown.

If special conditions are encountered, the Utility Specialist shall consult the Engineer or Client before taking any action. The Utility Specialist shall investigate the following items unless written instruction is given by the Client.

Connecting points without manholes

Where sewers and drains connect without a manhole, the connection point shall be numbered as if a manhole is present. The connection point is the actual point of connection physically located. This shall apply to the first manhole outside the survey extent, which is required to be located but not fully investigated.

Buried Manholes

Manholes can be buried or covered by road paving or other structures. This causes the manhole invisible or inaccessible. The Utility Specialist shall only carry out survey works to locate the buried manholes when requested by the Client.

4.6 Manhole photographs

The Utility Specialist shall provide a minimum of two photographs for each manhole as shown in Appendix B. Manhole location photo shall show the general location of the manhole with respect to the roads, slopes or buildings in the vicinity. The second photograph, manhole internal photo, shall be a general view of the inside of manhole. When taking photos, the photos are better to face North, and put compass direction (N, E, S, W) on manhole card to clarify. The manhole reference number shall be shown on each photograph. The Utility Specialist may place a blackboard near the manhole or paint on the road surface to indicate the manhole reference number. In the report, photograph number, location of manhole, manhole reference, description and remarks (if any), shall be clearly indicated.

If any notable defect or special condition is observed, photograph shall be taken to highlight it according to the opinion of the Utility Specialist. Defects may include broken/collapsed parts, intruding roots/ other pipes, etc. Special conditions may include high flow level or high water level, unable to survey (UTS)/ unable to raise (UTR) / unable to gain access (UTGA)/ unable to locate

(UTL), before high pressure water jetting and after jetting, etc. Those features shall be put in the remark section.

4.7 Abandonment of survey

In some circumstances, investigation of the manholes may be abandoned in opinion of the Utility Specialist. When any one of those situations is encountered, the situation shall be reported to the client as soon as possible and report the same in the survey report. The circumstances include:

- (1) Risk to the Utility Specialists or the equipment.
- (2) Inability to locate the manhole.
- (3) Inability to gain access to the manhole once located.
- (4) Inability to survey from the manhole due to blockage, silt or high water level.

In the above case, take photographs of the situation causing abandonment if possible. In case of dirty, the Utility Specialist shall carry out cleaning works, flow control or other measures may be required to complete the survey. Client's permission/ agreement shall be gained before taking any action.

If the team cannot access the site in which the manhole is owned by the third party, the Utility Specialist shall first reschedule his work to minimize the effects of the possession of the site, and then revisit the site as well as liaise with any third parties in order to complete the survey. The operators shall ensure works are carried out where permitted.

4.8 Deliverables

Utility Specialist shall prepare documents in preliminary, interim and final stages for each site for client's reference.

In preliminary stage, the following items shall be provided:

- (1) One set of prelimin
- (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; any digital data;
- (5) One set of photographs.

In interim stage, the following shall be supplied:

- (1) One set of interim digital data;
- (2) Paper drawings in 1:100 scale;
- (3) One copy of interim technical report.

For the final stage, the following items shall be prepared:

- (1) 2 copies of Final Report compiling of all deliverables and comments provided by the Engineers;
- (2) All reports shall be prepared by Competent Person on site and be checked by Recognized Professional Utility Specialist (RPUS) (管綫監察師) before submission.

Preliminary report shall be ready within one week after completion of the programmed completion of the works. However, the operator may need to submit the report within one week upon client's request even during the execution of investigation. In response, the client shall return a commented report to the operator within one week. After completing the works, the Utility Specialist has four weeks' time to complete and submit the final report to the client.

5. POST-SURVEY DATA PROCESSING

After inspection, Manhole Record Card shall be completed to state the features and defects (if any) of the inspected manhole. Photographs and a copy of digital data files generated by computer software shall also be submitted to the client.

5.1 Data Storage and Quality Control

For quality control, the Utility Specialist shall carry out validation test on all data according to the requirements as outlined in his method statement on data validation that has approved by the client before the commencement of any survey. Usually, a site check comprising a resurvey of 5% of each batch of 100 manholes submitted by the Utility Specialist is required and those 5% shall be selected in random basis.

If any item of manhole measurement falls outside the tolerance stated in section 4.1.2, the survey shall be regarded as failed. The failed portion of the work is subject to resurvey at the Utility Specialist own expense and he shall not be paid for the work involved in that quality check. A further quality control check shall be carried out in accordance of the above procedure on the remaining 95 manholes. Quality control check shall be repeated at the Utility Specialist's expense until the requirements are reached.

5.2 Manhole Recording Programmes

The manhole record card is used to account for the inspection result. However, the paper record is difficult to manipulate and check the accuracy. An alternative method to keep record is making use of the computerized Manhole Recording Programmes like the EGSSView and the Integrated Data Management System (IDMS). They store manhole record card data in computerized form. They allow the data to be arranged more systematically and are capable of checking the data consistency. The reporting facilities allow complex searches of the sewerage database to be carried out. The systems provide a method of collecting, processing and checking sewer survey data, creating sewer overlay drawings and maintaining a complete record of sewer assets. The data can be entered into the system on site directly or transferred from the manhole record card.

Computer programmes create overlay drawings. They can plot manholes and their connecting pipes on the map according to the information entered. Details like manhole reference, pipe diameter and function of the pipe are also shown in the plan for easy reference.

For data storage, each batch of manhole records submitted shall be assigned a unique survey filename. Each computer programme may store the data in different format. The data stored shall be able to be retrieved and searched later on despite the format.

For quality control, computer software can check the consistency and accuracy of the data. This option is used to check the consistency of node data and to produce relevant inconsistency reports. Any duplication or intersection can also be checked. There are groups of different types of consistency checks. They are listed as follows:

- Consistency of node/grid reference
- Status, function, node type codes
- Existence downstream reference
- Identical up & downstream nodes
- Existence of: Upstream reference Level

Existence of: Cover shape & depth
Existence of: Shaft size & depth
Existence of: Chamber soffit & construction
Existence of: Pipe size, shape, depth & material
Existence of: Consistency of downstream data
Existence of: Consistency of invert levels
Existence of: Fall to downstream node
Existence of: Downstream pipe length
Existence of: Criticality codes
Existence of: Maximum size tolerance
Existence of: Minimum gradient
Existence of: Maximum pipe length
Existence of: Ignorance of UTR/UTL/UTS/UTGA nodes

The first four checks (a-d) are normally sufficient to ensure that the sewer network is capable of being plotted because the programme will check the connectivity from one node to the next. The next seven checks (e-k) are to ensure that the data is capable of analyzing as a database because checks are made on data coding. The last group of checks (l-r) is geared towards the use of the data for engineering analysis and final reports. The very last check (s) allows the user to specify whether nodes with UTR, UTL, UTS or UTGA in the remarks field are to be included in the consistency check.

Report of consistency check can then be generated. If the report fails to reach the tolerance, they shall be corrected and re-examined until they reach the required accuracy. The consistency report of the pass result shall be handed to the client together with the MHICS report.

This guide is not intended to illustrate the whole computer programme. For the practical steps and other functions of the programme, Please take reference to the user Manual of EGSView and IDMS Manual proposed by UtilityINFO. Ltd. They provide step-by-step instructions regarding the operations of the programmes.

5.2 Rehabilitation

The rehabilitation work shall be determined by the Engineer or Client. The purposes of rehabilitation are repair structural defects, satisfy maintenance requirements and eliminate inflow and infiltration. Different rehabilitation methods are available for problems of different nature and extent. Priority for rehabilitation works shall be set according to the severity and urgency of the problems, works shall be planned and carried out on schedule.

After the investigation and rehabilitation (if applicable), it is important to note that all manholes are subjected to resurvey periodically no matter the condition of the manhole is good or bad.

Initial preparation

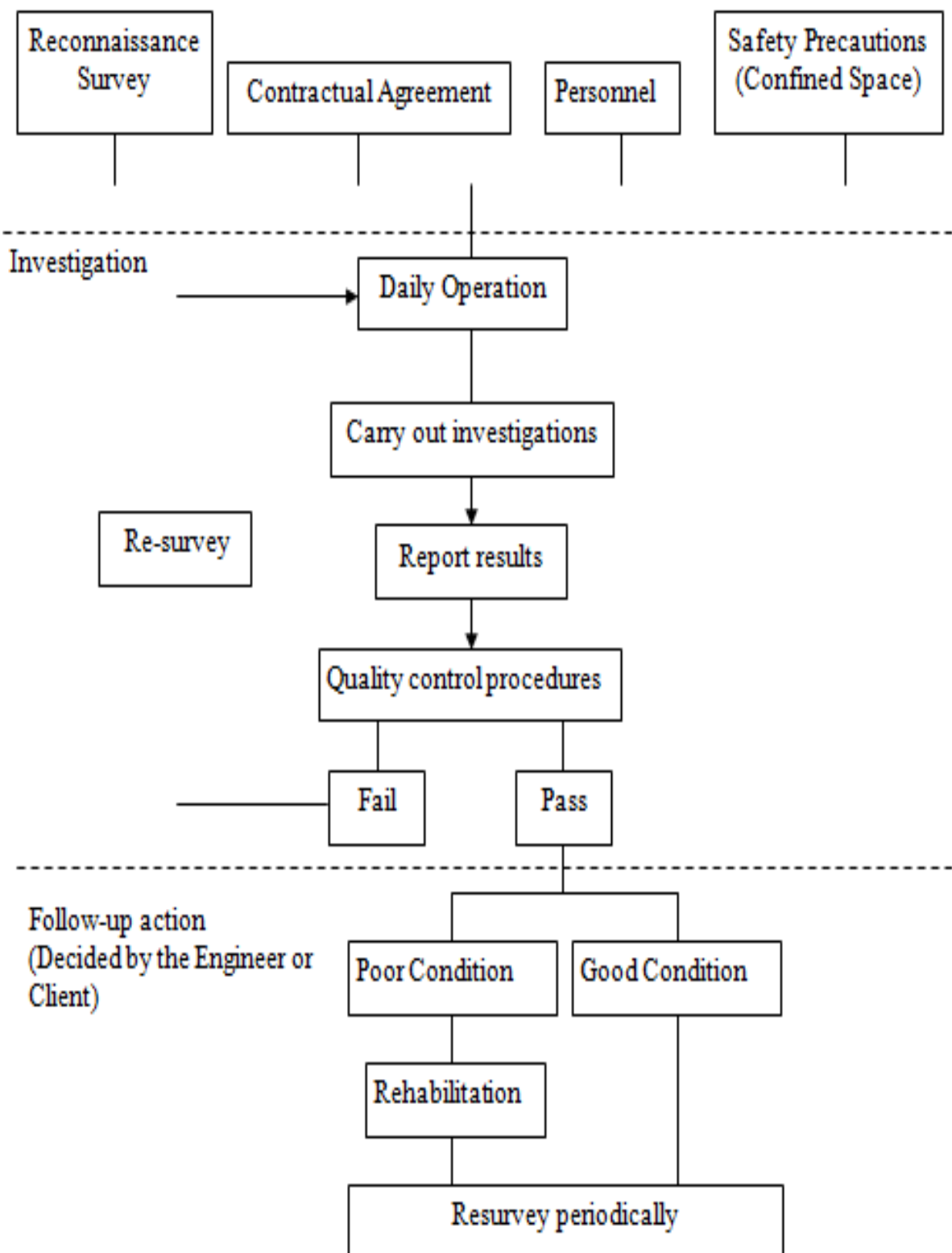


Fig. 5.1 Flow chart of conducting Manhole Internal Condition Survey and the follow-up actions.

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Appendix A: Abbreviations

Company/ Organization	
Code	Description
BD	Buildings Department, HKSARG
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
HKURC	Hong Kong Utility Research Centre
HyD	Highways Department, HKSARG
LandsD	Lands Department, HKSARG
LD	Labour Department, HKSARG
PolyU	The Hong Kong Polytechnic University
UTI	Utility Training Institute
WRc	Water Research Centre
WSAA	Water Services Association Australia
WSD	Water Supplies Department, HKSARG
WTI	Water Training Institute
Others	
Code	Description
%	Percentage
BMP	Bitmap (Picture Format)
BWCS	Buried Water Carrying Service
CCE	Conduit Condition Evaluation
CCE(CCTV & ME)	Conduit Condition Evaluation(Closed Circuit Television & Man- Entry)

Company/ Organization	
CCES	Conduit Condition Evaluation Specialists
CCTV	Closed Circuit Television
CD	Compact Disc
CL	Cover Level
COP	Code of practice
CP	Competent Person
DN	Nominal Diameter
DP	Design Pressure
DVD	Digital Versatile Disc
e.g.	Exempli Gratia
GIS	Geo-Information System
EPR	Environmental Protection Requirements
etc.	et cetera
GL	Ground Level
H	Height
HKCCEC	Hong Kong Conduit Condition Evaluation Codes
HPWJ	High Pressure Water Jetting
hr	Hour
Hz	Hertz
ICG	Internal Condition Grade
ID	Internal Diameter
IDMS	Integrated Data Management System
IL	Invert Level
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group (Picture Format)
kHz	Kilo- Hertz
kPa	Kilopascal

Company/ Organization	
m	Meter(s)
ME	Man Entry
MHICS	Manhole Internal Condition Survey
mm	Millimetre(s)
Mpa	Megapascal
MPEG	Motion Picture Experts Group (Video Format)
MS	Method Statement
MSCC	Manual of Sewer Condition Classification, UK
OHSAS	Occupational Health and Safety Assessment Series
PPE	Personal Protective Equipment
ppm	Parts per million
PS	Particular Specification
PSI	Pound Per Square Inch
QA/ QC	Quality Assurance/ Quality Control
Ref.	Reference
RMSE	Root Mean Square Error
RPUS	Recognized Professional Utility Specialist
RTO	Recognized Training Organization
SCG	Service Condition Grades
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
VHS	Video High Speed

Company/ Organization	
W	Width
WLD	Water Leakage Detection
WO	Works Order
WP	Work Procedure

Appendix B: Sample Photographs of Manhole Covers



Fig. A.1 Storm Cover



Fig. A.2 Foul Cover



Fig. A.3 Gully Cover



Fig. A.4 Rodeye Cover



Fig. A.5 Multiple Cover

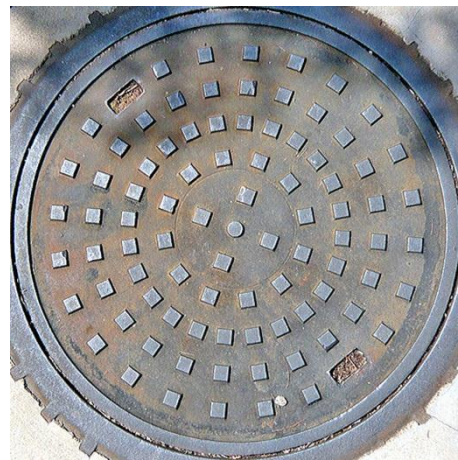


Fig. A.6 Private Cover

Photos are adapted from HKCCEC 2009 (UTI).

Appendix C: Typical Manhole Structures

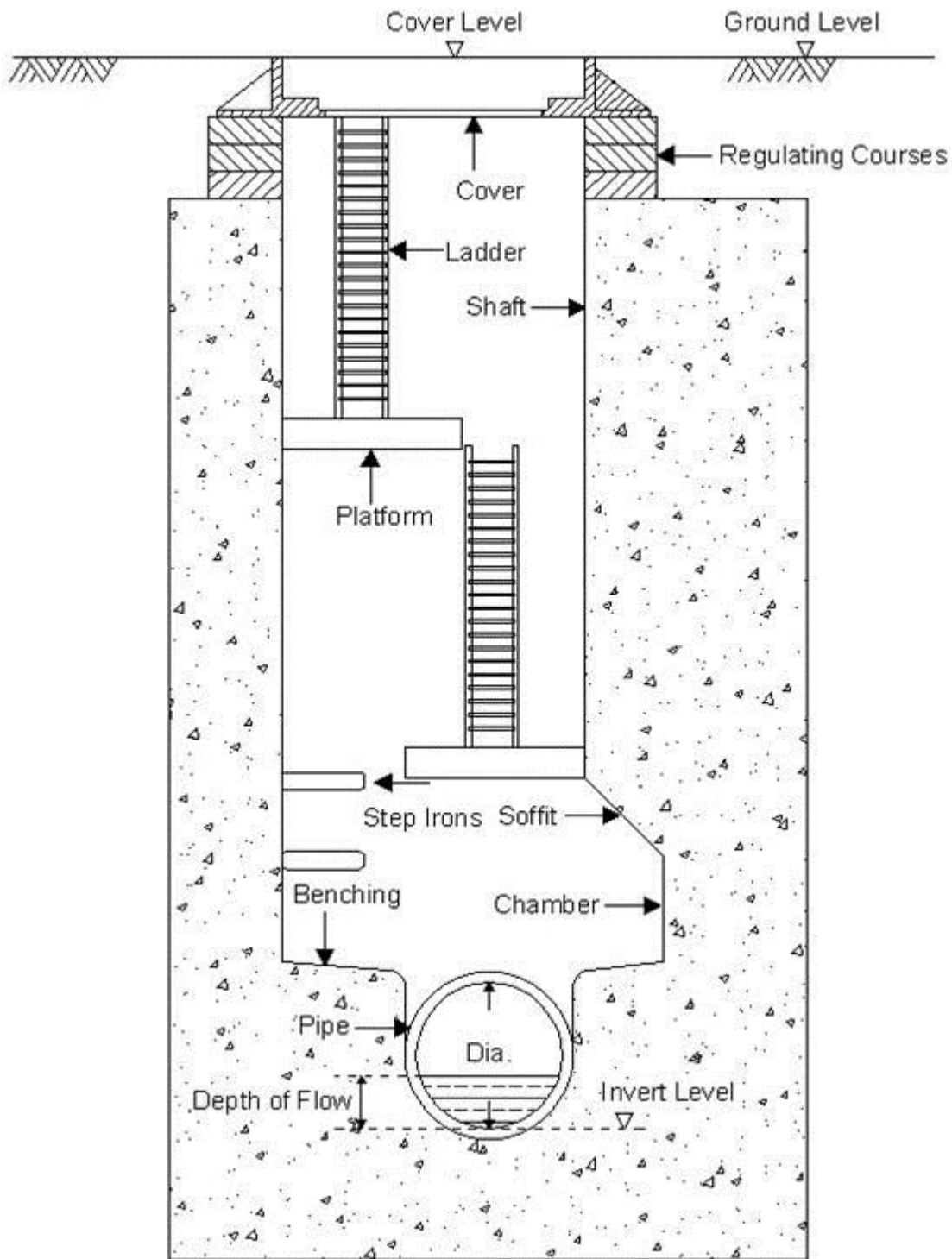


Fig. B.1 Typical Manhole Detail A.

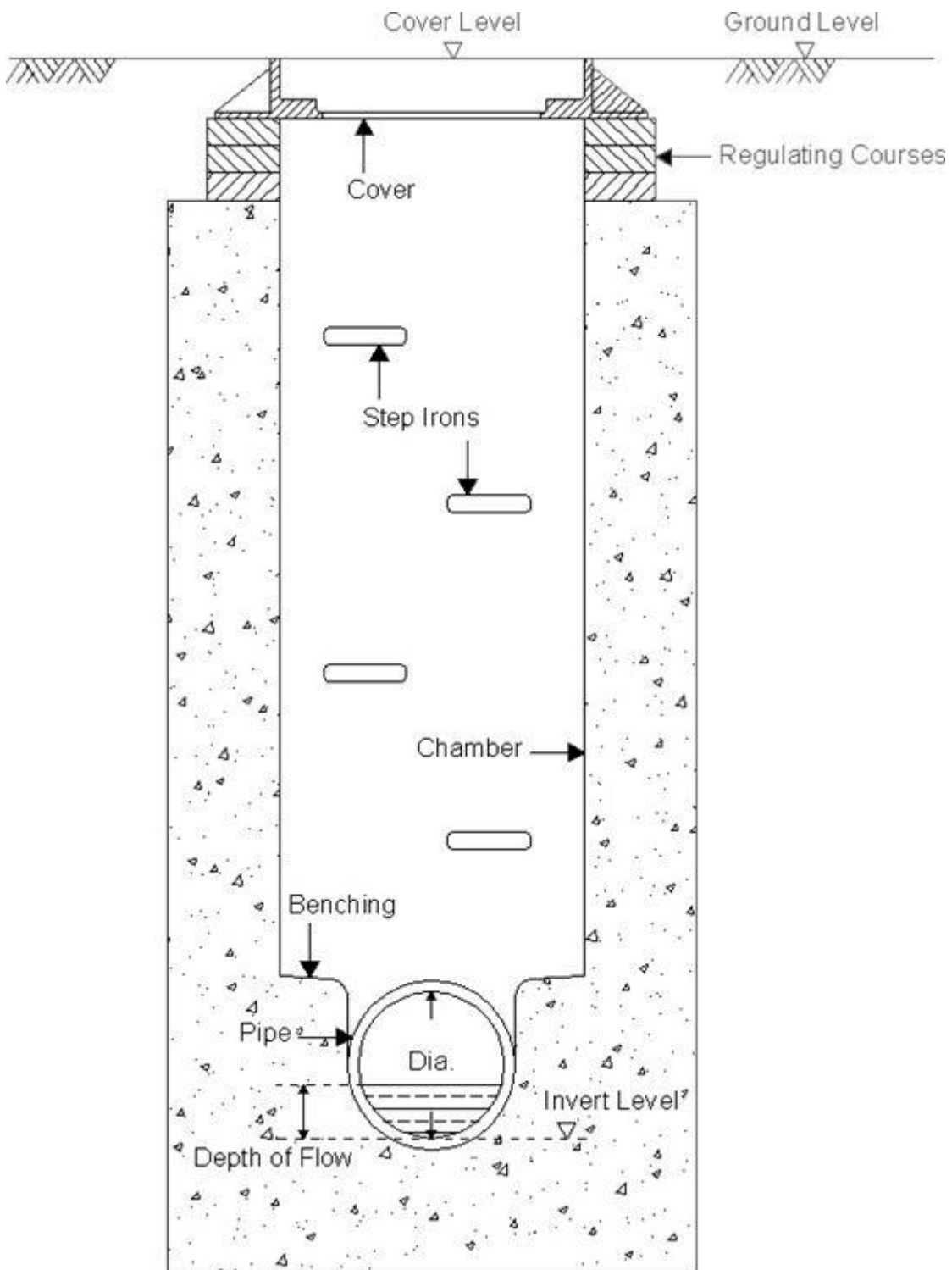


Fig. B.2 Typical Manhole Detail B.

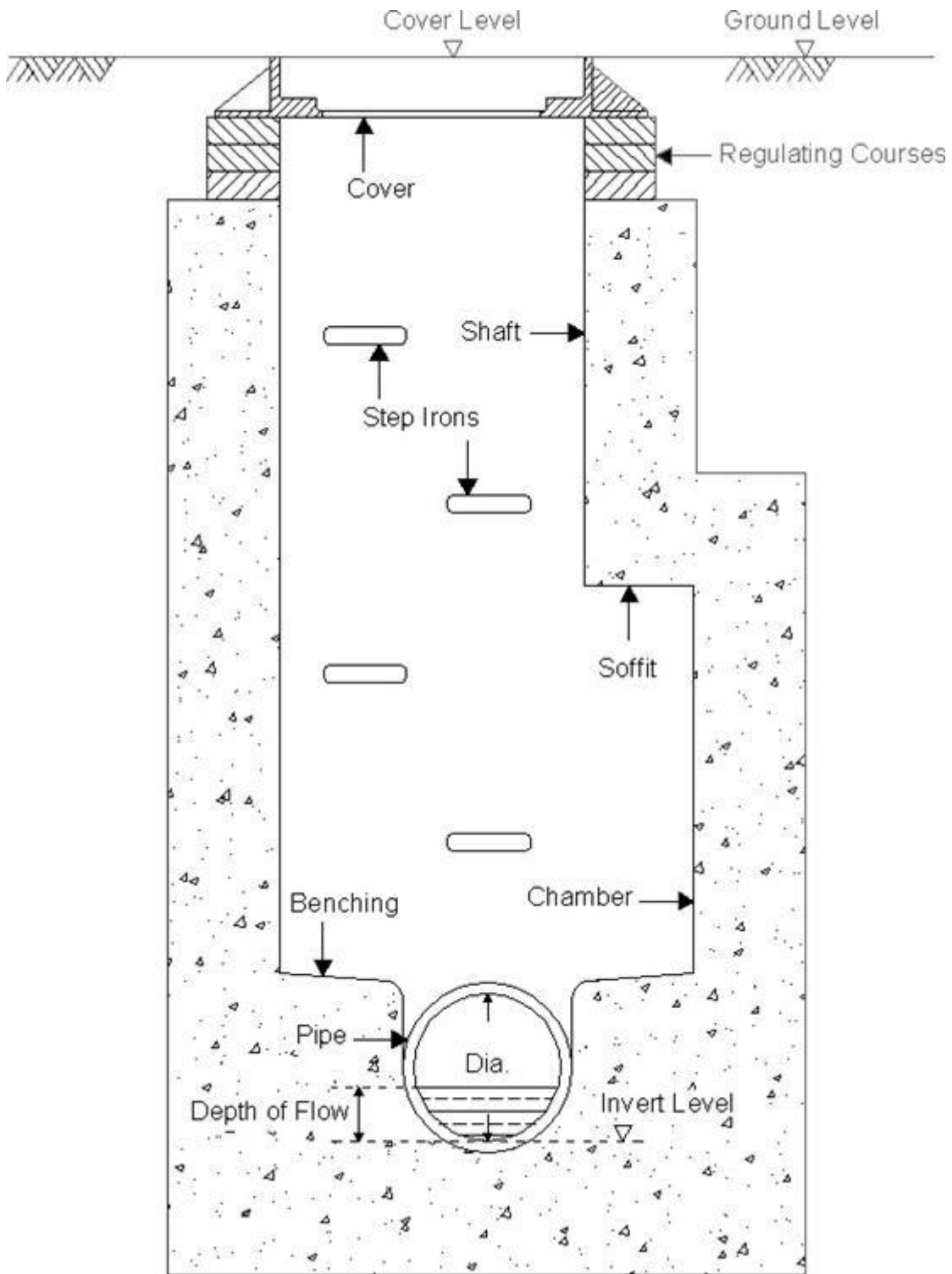



Fig. B.3 Typical Manhole Detail C.

Drawings are adapted from HKCCEC 2009 (UTI).

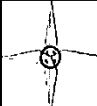
Appendix D: Sample Manhole Record Forms
B3 IDMS Manhole Record Form

 香港管綫專業學會 Hong Kong Institute of Utility Specialists		IDMS Manhole Record Form							
PROJECT NO.	MANHOLE ID	FIELD NO.:	NODE REF.						
WO NO.	DSD REF.		GRID REF.						
LOCATION			DRAINAGE AREA CODE						
YEAR LAID (YYYY)	STATUS		SURVEYED BY						
	HINGED Y / N	FUNCTION	SURVEY DATE (DD/MM/YYYY)						
	REGULAR COURSES	LOCK Y / N							
	STEPS	DEPTH	COVER SIZE (dia.) (mm)						
		LADDERS	SHAFT SIZE						
			CHAMBER SIZE						
			TOXIC ATMOSPHERE Y / N						
			EVIDENCE OF VERMIN Y / N						
			CONSTRUCT CODE						
COVER	SHAPE								
SHAFT	SIDE ENTRY Y / N								
CHAMBER	SOFFIT								
DEPTH OF FLOW (mm)	DEPTH OF SILT (mm)	HEIGHT SURCH (mm)	COVER LEVEL (mPD)						
UPSTREAM REF.	PIPE SHAPE	PIPE SIZE (dia. \ H) (mm)	BACKDROP (mm)						
		(W) (mm)	PIPE MATERIAL						
			LINING						
			PIPE DEPTH						
			INVERT LEVEL (m)						
INCOMING PIPES	A		X						
	B		X						
	C		X						
	D		X						
	E		X						
	F		X						
	G		X						
	H		X						
	DOWNSTREAM REF.	COND	Y / N						
		CRITY	A / B / C						
OUTGOING PIPES	X		X						
	Y		X						
CONDITIONS (Y if attention required)	COVER Y / N	IRON LADDER Y / N	SHAFT Y / N						
	CHAMBER Y / N	BENCHING Y / N	OTHER Y / N						
PHOTO NO.									
UTR	Y / N	LOCATION PHOTO	REMARKS						
UTL	Y / N	INTERNAL PHOTO							
UTGA	Y / N		RECORD PLAN DIFFERENCE Y / N (Y if attention required)						
UTS	Y / N								
JETTING	Y / N	MH DEPTH	COVER TYPE						
ON-SLOPE	Y / N	WATER DEPTH (UTS)	STANDARD						
SLOPE NO.:			LARGE						
			MULTIPLE COVER						
			DOUBLE TRIANGULAR						
			WITH DECORATION COVER						
			OTHERS: ()						
Location Sketch		Plan of MH							
<table border="1"> <tr> <td>With Risk Assessment</td> <td>Y / N</td> </tr> <tr> <td>With Permit to Work</td> <td>Y / N</td> </tr> <tr> <td>With Traffic Permit</td> <td>Y / N</td> </tr> </table>		With Risk Assessment	Y / N	With Permit to Work	Y / N	With Traffic Permit	Y / N	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	
With Risk Assessment	Y / N								
With Permit to Work	Y / N								
With Traffic Permit	Y / N								

Form Title: Manhole Record Form

Form No.: PM02
Revision 1 (Jun 2011)

A4. IDMS Manhole Record Form (Filled)



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

IDMS Manhole Record Form

(6) PROJECT NO.	Y10-BS-LG-P-004-002		(8) IDMS MANHOLE ID	GVMH1535420001		(1) NODR REF	F4201 (F01)			
(7) WO NO.	-		(4) DSD REF	-		(2) GRID REF	N 815428.4975 E 835212.6195			
(10) LOCATION	One Pacific Place		(12) STATUS	PR	(13) FUNCTION	F	(14) NODR TYPE	M		
(11) YEAR LAID (YYYY)	Z	(15) SHAPE	S	(16) HINGED	N	(17) LOCK	N	(18) DUTY	HI	
COVER SHAFT CHAMBER	(20) SIDE ENTRY	N	(21) REGULAR COURSES	0	(22) DEPTH	510	(19) COVER SIZE (dia) (mm)	780 X 780	(29) TOXIC ATMOSPHERE	N
	(4) SOFFIT	S	(25) STEPS	3	(26) LADDERS	0	(23) SHAFT SIZE	740 X 740	(30) EVIDENCE OF VERMIN	N
	(32) DEPTH OF FLOW (mm)	20	(33) DEPTH OF SILT (mm)	0	(34) HEIGHT SURCH (mm)	0	CHAMBER SIZE (mm)	1340 X 2210	CONSTRUCT CODE (31)	I
		(5) SURVEYED BY	H. S. Leung				(5) SURVEY DATE (DDMMYY)	2/9/2010		

	(36) UPSTREAM REF.	(37) PIPE SHAPE	(38) PIPE SIZE (dia. 100) (mm)	(39) BACKDROP (mm)	(40) PIPE MATERIAL	(41) LINING	(42) PIPE DEPTH	(43) INVERT LEVEL (m)
	INCOMING PIPES	A	F03	C	150	X	CI	1.94
	B	GN (BUILDING)	C	300	X	CI	1.81	3.20
	C	GN (BUILDING)	C	225	X	CI	1.84	3.17
	D				X			
	E				X			
	F				X			
	G				X			
	H				X			
OUTGOING PIPES	X	F02	C	375	X	CI	2.00	3.01
	Y				X			

(46) COVER	N	(47) IRON LADDER	Y	(48) SHAFT	N	(49) CHAMBER	N	(50) BENCHING	Y	(51) OTHER	N
(52) PHOTO NO.	F01-P5&6			F01-P7&8							

(53) ITR	N	(59) LOCATION PHOTO	F01-P1&2	(63) REMARKS	3 steps were found broken and crack was found at the benching.
(54) ITR	N	(60) INTERNAL PHOTO	F01-P3&4		
(55) ITR	N	(61) INVERT	2.00	(64) RECORD PLAN DIFFERENCE	N
(56) ITR	N	(62) WATER DEPTH (UTS)		(65) COVER TYPE	

(66) Location Sketch	(67) Plan of Manhole
----------------------	----------------------

(68) Wash Risk Assessment	Y	<small> NODE TYPE: A: Catch Pit; B: Hydrobrake; C: Cascade; D: Dual Function Manhole; E: Ejector; F: Overflow; G: Ghost; H: Backbar; I: Inlet; J: Junction/Saddle; K: Combined; L: Lampole; M: Manhole; N: Lead End; O: Oil Interceptor; P: Pumping station; Q: Transition; R: Roding off; S: Sockaway; T: Vent Column; U: Unseal/Gek; V: Storm Overflow; W: Treatment works; X: Unserviceable; Y: Gully; Z: Ghost in rising main </small>
(69) Wash Permit to Work	Y	
(70) Wash Traffic Permit	N	

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Guideline Amendment Form

Please fill in the following form if any error or mistake is found in this manual. We thank for your support and appreciate your continuous help in improving this manual.

Discipline*	Page No.	Description of Existing Content	Suggested Amendment

- * A. Conduit Condition Evaluation (CCTV and ME Survey)
 B. Manhole Internal Condition Survey
 C. Utility Survey (Pipe Cable Locator Survey, PCL)
 D. Water Leakage Detection and Control
 E. Advanced Leakage Detection of Buried Water Carrying Services Affecting Slopes
 F. Pipe Rehabilitation by Trenchless Technology
 G. GPR(Ground Penetrating Radar) Survey
 H. Flow Study in Drainage Conduit (流量監控)
 I. Pipe Condition Surveys by other non-destructive methods
 J. Data Management for Utility Records
 K. Utility Management
 L. Safety

Please fill in your contact information in case follow up is needed.

First Name: _____ Second Name: _____ Last Name: _____

Title: _____

Organization: _____

#Telephone No.: _____ #Email Address: _____

#Address: _____

Please fill in one or more contact information in the blanks provided
 This amendment form is available at: www.uti.hk

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M H I C S

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Professional Service Development Assistance Scheme (PSDAS)
Professional Guide Notes and Pamphlet for utility professionals in Hong Kong
Project ref: Y09-HKIUS-P02-PSDAS