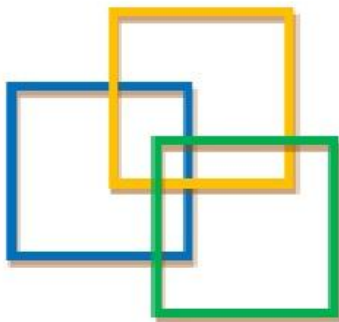




Hong Kong Institute of Utility Specialists  
Non – profit Making Organization

# Work Procedure For Utility Mapping By Non- Destructive Methods



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## **Foreword**

Since the disastrous landslip that occurred in Kwun Lung Lau on Hong Kong Island on 23 July, 1994. Since 1995, the Government of HKSAR is investing tens 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 new profession in the Hong Kong market, Utility Specialists (US). Most of the Utility Specialist working almost independently, devoid of any standardized surveying methods and quality requirements (on survey results). No formal registration system was in place for Utility Specialist in the industry as recognized operational personnel in the market before the establishment of HKIUS in 2002.

In addition to the above, HKIUS consider it is the best to have a standardized work procedure for the industry to execute survey works and report under a standardized guideline. By consolidating all various method statements, specifications, training manuals, and the contracts documents produced for the vast number of underground utility survey contracts (government and private projects) available in the market, a comprehensive and standardized work procedure is produced. The standardized work procedure basically addressing the following topics in general:

- (1) Planning and Preparation on Utility Services Information to be investigated
- (2) Requirement of Personnel and Equipment for the Investigation Works
- (3) Level of Accuracies
- (4) Scheduling and Reporting
- (5) Requirement of Deliverables in report format.

Such work procedure provides a straight forward and easy to follow to enable anyone from Client to Contractors and all Utility Specialist to understand. From here HKIUS unify all utility specialists in the Hong Kong market and become world class professionals.

You are welcome to take reference to this Particular Specification for your contract and in case you need further information, please send an e-mail to [info@hkius.org.hk](mailto:info@hkius.org.hk) or call Ir Dr. King Wong.



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Mr, Zico Kai Yip KWOK  
(郭啟業先生)  
President, HKIUS (2010-11)  
April, 2011

If any error or mistake is found in this work procedure, please kindly contact us.

Tel: (+852)2690 3899      Fax: (+852)2618 4500      Email: [info@uti.hk](mailto:info@uti.hk)

## Utility Mapping (By Non-Destructive Methods)

### 1. Work procedures of Utility Survey (by Pipe/Cable Locator) 工作程序 - 管綫測量(管綫探測儀)

Note: The working procedures is mainly for ease of site operation checking, details shall refer to relevant method statement submitted separately

注意: 此工作程序主要為地盤施工的檢查帶來方便，詳情請參閱另外提交的工作說明

#### **1. Calibration, Planning and Preparation**

Steps 步驟	Part 1. Calibration, Planning and Preparation 第一部份 較準，計劃和準備工作	Completed by 檢測者
1	Check Record Plans, Traffic Permit and other information. 檢查圖則，交通許可及其他資料。	
2	Boundary Definition and Visual Inspections for valves, chambers and pits of different utilities. 確認測量範圍及觀察不同管綫的沙井及閘門。	
3	Carry out safety arrangements including PTW, TTA, PPE. 執行安全措施，包括工作許可證(PTW)、臨時交通安排、個人保護措施等。	

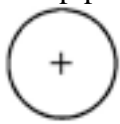
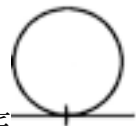
#### **2. Operation**

Steps 步驟	Part 2. Operation 第二部份 操作程序	Completed by 檢測者
1	Operation should be carried out by OMHKIUS(with at least 3 years experience) or AMHKIUS (with at least 2 years experience). The whole operation must be supervised by OMHKIUS. 操作員應為管綫專業監理員(最少三年經驗)或助理管綫專業監理員(最少兩年經驗)。整個探測過程必須由管綫專業監理員監督。	
2	For power lines, tune to 'Power Mode' to do sweeping for live cables. 調至無源探測模式的「Power Mode」以檢測有源電纜。	
3	Further sweep the rest of the area. 進一步掃查其餘的地方。	

Steps 步驟	Part 2. Operation 第二部份 操作程序	Completed by 檢測者
4	<p>When there is a signal detected, mark the location by spray paint or other means (refer to Fig.2).</p> <p>當探測到訊號，用噴漆或其他方法作標記（參考圖二）。</p>	
5	<p>Tune the receiver to 'Radio Mode' and sweep for Radio Signal reflected from Radio Frequency.</p> <p>將接受器調至無源探測模式的「Radio Mode」，掃查由無線電頻率反射的無線電訊號。</p>	
6	<p>Once detection completed, place the transmitter onto one of the marked points and turn on the transmitter and select an appropriate frequency.</p> <p>探測完成後，將發射器置於標記點，啟動發射器，選擇合適的頻率。</p>	
7	<p>For gas/water pipes or other pipes with connection point, connect the signal lead to an accessible point safely by connection method and turn on the transmitter.</p> <p>若是煤氣喉／水喉或其他可接駁金屬管綫，安全地連接訊號夾至其接觸點，啟動發射器。</p>	
8	<p>Tune the receiver to the same frequency and start to search for the signal.</p> <p>將接收器的頻率調至與發射器相同的頻率，開始搜尋訊號。</p>	
9	<p>Mark further points along the routing and record the depth in location where signal is steady.</p> <p>沿著管道的路線繼續做標記，在訊號穩定的位置記錄深度。</p>	
10	<p>Search the area to check if the signal has coupled to any nearby lines within the arm radius, or radius of 3-5 meters if necessary.</p> <p>在目標電纜的約一手臂或半徑約三至五米範圍內，檢查訊號有否被鄰近電纜吸收。</p>	

Steps 步驟	Part 2. Operation 第二部份 操作程序	Completed by 檢測者
11	<p>Measure the current on the target line and on any other lines located within the arm radius (or 3-5 meters radius). Check the current value is higher on the target line than on any other nearby lines or not.</p> <p>量度目標電纜及其手臂(或半徑三至五米)範圍內的鄰近電纜的電流值，檢查目標電纜的電流值是否高於其他鄰近電纜。</p>	
12	<p>Check current value on the target line and on other nearby lines.</p> <p>檢查目標管綫及鄰近管綫的電流值。</p>	
13	<p>QA/QC check on site by verifying some of the located alignment and check with existing records again. Determine which information is correct on site if there are differences with the records.</p> <p>即場作品質監控，驗證一些已標記的路由並與現時的紀錄作對比，如與圖則有差異，需即場決定哪個是正確的資料。</p>	
14	<p>Use total station to produce site records.</p> <p>以全站儀作現場紀錄。</p>	
15	<p>Final check and complete daily report.</p> <p>作最後檢查並完成日常報告。</p>	
16	<p>Clean and tidy up equipments and site.</p> <p>收拾、清潔儀器及現場。</p>	
17	<p>Submit site data materials to report team.</p> <p>將現場搜集的資料交給報告組。</p>	

## 2.1 Accuracy Requirements

Accuracy Requirements 準確性要求	Standard /Tolerance 標準／公差
Depth of metallic lines by locator 金屬管綫深度	Centre of pipes/ cable  喉中
Depth of non-metallic lines by sonde or direct measurement 非金屬管綫深度或直接量度的深度	Bottom of duct  喉底
Cable ducts 電纜槽	Mark on the drawing with outer cables shown on each side 在圖上標記每邊位於最外面的電纜
Buried utility depth 管綫深度	± 165 mm or 0.1d (at least 90% of results shall reach the standard) ± 165 毫米 or 0.1d (最少九成的結果需符合以上標準)

## 3. Report

Steps 步驟	Part 3. Report 第三部份 報告	Completed by 檢測者
1	Process raw data from site. 整理現場搜集的資料。	
2	Check site records against existing Record Plans. 核對現場紀錄及原有紀錄圖則。	
3	Use the total station result to edit drawings by IDMS. 根據全站儀的結果，使用綜合資料管理系統編輯繪圖。	
4	Create technical report with site records, photographs, signature and proposed trial pit location (if necessary). 製作技術報告包括現場紀錄、相片、簽名及建議挖掘試孔位置（如有需要）。	

Steps 步驟	Part 3. Report 第三部份 報告	Completed by 檢測者
5	<p>QA/QC before reporting by MHKIUS (at least 5 year experience).</p> <p>報告前由管綫專業監理師進行品質監控程序（最少五年經驗）。</p>	
6	<p>Report should consist of the followings: 報告需包含以下項目：</p> <p>Survey report – name and certificate number of competent person, mandatory information, survey result, recommendation. 檢測報告－合資格人士的名稱及證明書號碼、基本資料、測量結果、建議。</p> <p>Site photographs. 現場相片</p> <p>Information of equipments used. 所用儀器的資料</p> <p>Utility survey drawing – alignment, depth, diameter, direction (drainage services), type of the services, location of manholes and other related surface installations. 管綫測量繪圖－設施的路由、深度、直徑、方向（渠務設施）及種類、沙井及其他地面設施的位置。</p> <p>Report to be confirmed by RPUS. 報告需由管綫專業監察師（至少八年經驗）監定。</p>	

#### 4. Final Verification

Steps 步驟	Part 4. Final Verification (if requested by the client) 第四部份. 最後驗證 (如客戶要求)	Completed by 檢測者
1	<p>If clients request, 5% samples of the whole project and 1% samples taken on site will be picked up randomly for audit. 如客戶要求，工程報告中的 5% 樣本及工地中的 1% 樣本會被抽出作抽樣檢查。</p>	
2	<p>Samples will be checked by the competent person from another group from the same company or competent person from third party as client request. 樣本將會由同一公司中另一組合資格人仕或獨立組織中的合資格人仕作出檢查核對。</p>	

Steps 步驟	Part 4. Final Verification (if requested by the client) 第四部份. 最後驗證 (如客戶要求)	Completed by 檢測者
3	The utility survey drawing for final report will then be reviewed and updated after audit. 在抽樣檢查完成後，管線成果圖會作出更新並加入最後報告中。	



Fig. 1 Tracing the alignment  
圖一. 追蹤路由



Fig. 2 Site marking  
圖二. 現場標記



## **2. Work procedures of Ground Penetrating Radar Survey 工作程序-探地雷達檢測**

Note: The working procedures is mainly for ease of site operation checking, details shall refer to relevant method statement submitted separately, a separate item shall be paid for GPR survey.

注意: 此工作程序主要為地盤施工的檢查帶來方便，詳情請參閱另外提交的工作說明,使用地雷達檢測需支付額外的款項。

### **1. Calibration, Planning and Preparation**

Steps 步驟	Calibration, Planning and Preparation 較準，計劃和準備工作	Completed by 檢測者
1	Study record drawing and previous survey result/information. 閱覽圖則及以前的探測結果／資料。	
2	Site investigation. 對探測範圍作初步調查。	
3	Safety precautions – PTW, TTA, PPE. 執行安全措施，包括工作許可(PTW)、臨時交通安排、個人保護措施等。	
4	Check and charge the GPR. 檢查並為雷達充電。	

### **2. Operation**

Steps 步驟	Part 2. Operation 第二部份. 操作程序	Completed by 檢測者
1	Define site boundary. 規劃探測範圍。	
2	On site calibration. 即場較準儀器。	
3	Design traverse pattern and mark on site. 設計探測路線，在現場作標記。	
4	Set parameters of GPR, such as gain, range, sample per trace, etc. 設定雷達參數，如增益、測距、每次掃描採樣等。	

Steps 步驟	Part 2. Operation 第二部份. 操作程序	Completed by 檢測者
5	<p>Calibrate dielectric constant of site materials at several locations. 在數個地點為地下物料作介電常數較準。</p>	
6	<p>Mark the start and end point of each GPR traverse so that topographic survey can be followed the coordinate and level of the GPR traverse. 標記雷達探測路線的起點和終點，則路線的座標和高度可根據地形測量得知。</p>	
7	<p>General GPR survey (approximately 4m x 4m) (as find necessary by team leader). 進行一般探地雷達探測（約四米乘四米）(如組長認為有需要)。</p>	
8	<p>Specific GPR survey (pattern design on site) – according to the prepared list of unreliable and informed on site by Locator Operator. 進行指定探地雷探測（現場設計探測路線）－按事前預備的「不可靠」管綫名單及管綫探測儀操作員的指示。</p>	
9	<p>Record the surface installation, pipe alignment and depth. 紀錄地面設施、管綫路由及深度。</p>	
10	<p>Fill in the GPR record form with potential anomalies by OM/HKIUS. 由管綫專業監理員填寫探地雷達紀錄表格，紀錄潛在異常情況。</p>	
11	<p>Clean and tidy up equipment and site. 收拾、清潔儀器及還原現場。</p>	
12	<p>Hand raw data materials to report team. 將現場搜集的資料交給報告組。</p>	


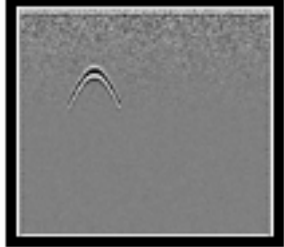
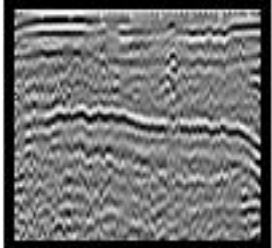
### 3. Report

Steps 步驟	Report 報告	Completed by 檢測者
1	Process raw data from site. 整理現場搜集的資料。	
2	Download data and store in assigned folder with site no. 從雷達下載資料並儲存於指定位置。	
3	Data analysis. 分析數據。	
4	QA/QC before reporting by MHKIUS (at least 5 years experience). 報告前由管綫專業監理師(最少五年經驗)進行品質監控程序。	
5	The report shall consists of the followings 報告需包含以下項目 Survey report - mandatory information, result of investigation. 探測報告－背景資料、探測結果。 Site location plan. 現場規劃圖。 Survey result drawing. 探測結果繪圖。 GPR radargram (refer to Fig.2 & Fig.3). 探地雷達的剖面圖(參考圖二及圖三)。 Site photographs. 現場相片。 Information of equipment used. 所用儀器的資料。	

### 4. Final Verification

Steps 步驟	Part 4. Final Verification (if requested by the client) 第四部份. 最後驗證 (如客戶要求)	Completed by 檢測者
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Steps 步驟	Part 4. Final Verification (if requested by the client) 第四部份. 最後驗證 (如客戶要求)	Completed by 檢測者
2	Samples will be checked by the competent person from another group from the same company or competent person from third party as client request. 樣本將會由同一公司中另一組合資格人仕或獨立組織中的合資格人仕作出檢查核對。	
3	The utility survey drawing for final report will then be reviewed and updated after audit. 在抽樣檢查完成後，管線成果圖會作出更新並加入最後報告中。	

	
<p>Fig.1 Principle of GPR 圖一. 探地雷達的原理</p>	<p>Fig.2 GPR radargram showing a pipe perpendicular to the GPR. 圖二. 探地雷達剖面圖，顯示管道與雷達垂直</p>
	
<p>Fig. 3 GPR radargram showing pipes parallel to the GPR. 圖三. 探地雷達剖面，顯示管道與雷達平行</p>	