Appendix H1

Marine Archaeological Investigation Report

Installation of Submarine Gas Pipelines
and Associated Facilities from
To Kwa Wan to North Point for Former Kai Tak Airport
Development

Consultancy Services for Feasibility Study and Detailed Design

Marine Archaeological Investigation

May 2010

The Hong Kong and China Gas Company Limited

Mott MacDonald

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1. Summary

A Marine Archaeological Investigation (MAI) was carried out for the installation of submarine pipelines and associated facilities from To Kwa Wan to North Point. The study was undertaken by SDA Marine Limited as sub consultant to Mott MacDonald.

The methodology follows the Guidelines issued by the Antiquities and Monuments Office (AMO). The aim of the study was to assess the archaeological potential of the seabed 100m either side of the proposed pipeline alignment. The MAI consisted of a Baseline Review, Geophysical Survey and Diver Seabed Inspection.

Previous Marine Archaeological Studies undertaken adjacent to, and in the vicinity of, the proposed pipeline have established high archaeological potential based on recorded historical activity. It is the only place in Hong Kong where historical relics have been retrieved from the seabed. In 1957, a Ming Dynasty (1368-1644) cannon was discovered during dredging for the original Kai Tak airport.

The geophysical survey was carried out as part of the site investigation for the pipeline but the data was of sufficiently high quality to be re-used for the archaeological assessment.

The Baseline Review and original geophysical survey was completed in July 2008. The results of the geophysical survey data indicated the presence of thirteen sonar contacts within the total study area. Six of these contacts were within 50m of the centreline of the proposed alignment and would therefore be directly impacted by it.

However, it was subsequently decided that 200-300m of the alignment will be changed at the To Kwa Wan side. In order to ensure 100% seabed coverage, additional geophysical survey was carried out in November 2008. The additional survey did not locate any additional sonar contacts.

When the geophysical survey data from both phases was plotted against the revised alignment it was found that only 3 sonar contacts were within 50m of the alignment. The other sonar contact will not be impacted by the excavation of the trench for the submarine gas pipelines.

In January 2009 a diver inspection of the 3 sonar contacts was carried out. Each contact was successfully located and inspected. Each of them was quickly identified as modern debris and a mooring block. An additional inspection was made of 2 further sonar contacts which were between 50m and 60m of the proposed centreline of the alignment as a precautionary measure. Both were found to be part of a mound of dumped building materials. It is therefore concluded that none of the sonar contacts were underwater cultural heritage resources. There will therefore be no negative impact from the construction of the gas mains at these locations.

However, some sections of the geophysical survey were affected by 'gas masking' which prevented 100% seabed coverage. It is therefore recommended that a monitoring brief is conducted in these areas.

2. Introduction

An existing submarine pipeline carries gas from Ma Tau Kok to North Point. Its alignment runs close to the runway of the former Kai Tak Airport. As part of the redevelopment of the Kai Tak area, it is proposed to replace the existing gas pipeline with one further from the former runway. This report presents the results of a Marine Archaeological Investigation carried out along the proposed alignment of the replacement pipeline.

The MAI was completed by Sarah Heaver of SDA Marine Ltd, HK. This company has been working in Hong Kong since 1998 and completed 81 MAI projects, which have been approved by the AMO.

3. Legislative Framework for Marine Archaeological Investigations in Hong Kong

Legislation, Standards, Guidelines and Criteria relevant to the consideration of underwater cultural heritage impacts under this study include the following:

- Antiquities and Monuments Ordinance
- Environmental Impact Assessment Ordinance
- Technical Memorandum on Environmental Impact Assessment Process.
- Guidelines for Marine Archaeological Investigation

3.1 Antiquities and Monuments Ordinance

Historical buildings and ancient structures may receive legal protection in Hong Kong under the Antiquities and Monuments Ordinance. In this case, the Antiquities Authority may, after consulting the Antiquities Advisory Board and with the approval of the Chief Executive and the publication of the notice in government gazette, legally declare a place to be protected. Once it is protected under the Ordinance, any restoration, repair, maintenance or any other related works to the monument requires a permit under Section 6 of the Ordinance.

The discovery of an Antiquity, as defined in the Ordinance must be reported to the Antiquities Authority (the Authority), or a designated person. The Ordinance also provides that, the ownership of every relic discovered in Hong Kong after the commencement of this Ordinance shall vest in the Government from the moment of discovery.

No archaeological excavation may be carried out by any person, other than the Authority and the designated person, without a licence issued by the Authority. A licence will only be issued if the Authority is satisfied that the applicant has sufficient scientific training or experience to enable him to carry out the excavation and search satisfactorily, is able to conduct, or arrange for, a proper scientific study of any antiquities discovered as a result of the excavation and search and has sufficient staff and financial support.

Once declared a site of public interest, no person may undertake acts which are prohibited under the Ordinance, such as to demolish or carry on building or other works, unless a permit is obtained from the Antiquities Authority.

The Ordinance defines an antiquity as a relic (a moveable object made before 1800) and a place, building, site or structure erected, formed or built by human agency before the year 1800. Archaeological sites are classified as follows:

- ***Declared Monuments*** – those that are gazetted in accordance with Cap. 53 by the Antiquities Authority and are to be protected and conserved at all costs;

- ***Recorded Archaeological Sites*** – those which are considered to be of significant value but which are not yet declared as monuments and should be either protected, or if found not possible to protect these sites mitigation measures should be proposed and implemented to preserved the archaeological resources.

It should also be noted that the discovery of an antiquity under any circumstances must be reported to the authority, i.e. the Secretary for Development or designated person. The authority may require that the antiquity or suspected antiquity is identified to the authority and that any person who has discovered an antiquity or suspected antiquity should take all reasonable measures to protect it.

3.2 The Environmental Impact Assessment Ordinance

Since the introduction of the 1998 Environmental Impact Assessment (EIA) Ordinance CAP. 499, S16, (EPD, 1998), the Antiquities and Monuments Office (AMO) have the power to request a MAI for developments affecting the seabed. Its purpose is to avoid, minimise and control the adverse impact on the environment of designated projects, through the application of the EIA process and the Environmental Permit (EP) system. The EIA Ordinance stipulates that consideration must be given to issues associated with cultural heritage and archaeology as part of the EIA process. Annexes 10 and 19 of the EIA Technical Memoranda (TM) outline the criteria for evaluating the impacts on sites of cultural heritage and guidelines for impact assessment, respectively.

The EIA TM identifies a general presumption in favour of the protection and conservation and requires impacts upon sites of cultural heritage to be ‘kept to a minimum’. There is no quantitative standard for determining relative importance but in general sites of unique, archaeological, historical or architectural value should be considered as highly significant.

3.3 Technical Memorandum on Environmental Impact Assessment Process

The general criteria and guidelines for evaluating and assessing impacts to Sites of Cultural Heritage are listed in Annexes 10 and 19 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). It is stated in Annex 10 that all adverse impacts to Sites of Cultural Heritage should be kept to an absolute minimum and that the general presumption of impact assessment should be in favour of the protection and conservation of all Sites of Cultural Heritage. Annex 19 provides the details of scope and methodology for undertaking Cultural Heritage Impact Assessment, including baseline study, impact assessment and mitigation measures.

3.4 Guidelines for Marine Archaeological Investigation

The AMO have issued Guidelines for Marine Archaeological Investigation (MAI) which detail the standard practice, procedures and methodology which must be undertaken in determining the marine archaeological potential, presence of archaeological artefacts and defining suitable mitigation measures.

4. Methodology

4.1 Marine Archaeological review

All previous Marine Archaeological Investigation studies in the vicinity of the current project were reviewed for relevant data. The following six reports were studied:

1. August 2000: Marine Archaeological Investigation. SDA Marine Ltd. SE Kowloon Reclamation. Environmental Management Ltd;

2. 2. December, 2001: Marine Archaeological Investigation at SEKD – Final Report, prepared by IGGE under CED Contract GE/2001/20, Works Order No. GE2001/20/04 Geophysical surveys;

3. 3. March 2002: Marine Archaeological Investigation prepared by SDA Marine Ltd under Agreement CE 32/99 for Environmental Management Ltd;

4. September 2002: Marine Archaeological Investigation, Field investigation; prepared by Cosmos Coroneos under Agreement CE32/99 for Archaeo-Environments Ltd HK;

5. March 07.KDO 01/2006. Site Investigation and Contamination Assessment at Remaining Area of Former Kai Tak Airport and Proposed Cruise Terminal. Marine Archaeological Investigation prepared by SDA Marine Ltd.

6. August 07 Agreement No. CE 35/2006(CE) Kai Tak Development Engineering Study cum Design and Construction of Advance Works– Investigation, Design and Construction. Initial EIA Report. Marine Archaeological Investigation prepared by SDA Marine Ltd.

4.2 Baseline Review

A baseline review was undertaken to compile a comprehensive inventory of cultural heritage resources of the Study Area. The Review established the historical profile and potential for cultural heritage sites and included:

- Marine charts records held in British Library and National Maritime Museum Library in London;
- Publications on local historical, architectural, anthropological, archaeological and other cultural studies;
- Unpublished papers, records, archival and historical documents held in local libraries and other government departments.

4.3 Archive Search

All archives holding information on shipwrecks in Hong Kong were explored for relevant data.

4.4 Geophysical Survey

The geophysical survey was carried out by EGS (Asia) Ltd on the instructions of Gammon Construction Limited. The survey data were passed to SDA Marine Ltd for the archaeological assessment.

4.4.1 Objectives of the Survey

The marine geophysical survey was carried out as part of the ground investigation for the replacement gas pipeline. The objectives of the survey were:

- To map sea bed bathymetry
- To map the texture and features on the sea bed
- To map the underlying significant geological horizons
- To locate the position of the existing utilities

Although the survey was designed to meet the requirements of the engineering site investigation the data was sufficiently detailed to be re-used for the archaeological assessment.

4.4.2 Survey Period and Location of Survey Area

The survey was carried completed in two stages. The first phase was completed during the period of 4th – 6th May 2008 and additional data was collected on 4th November 2008. The survey area covered by both work phases is set out below.

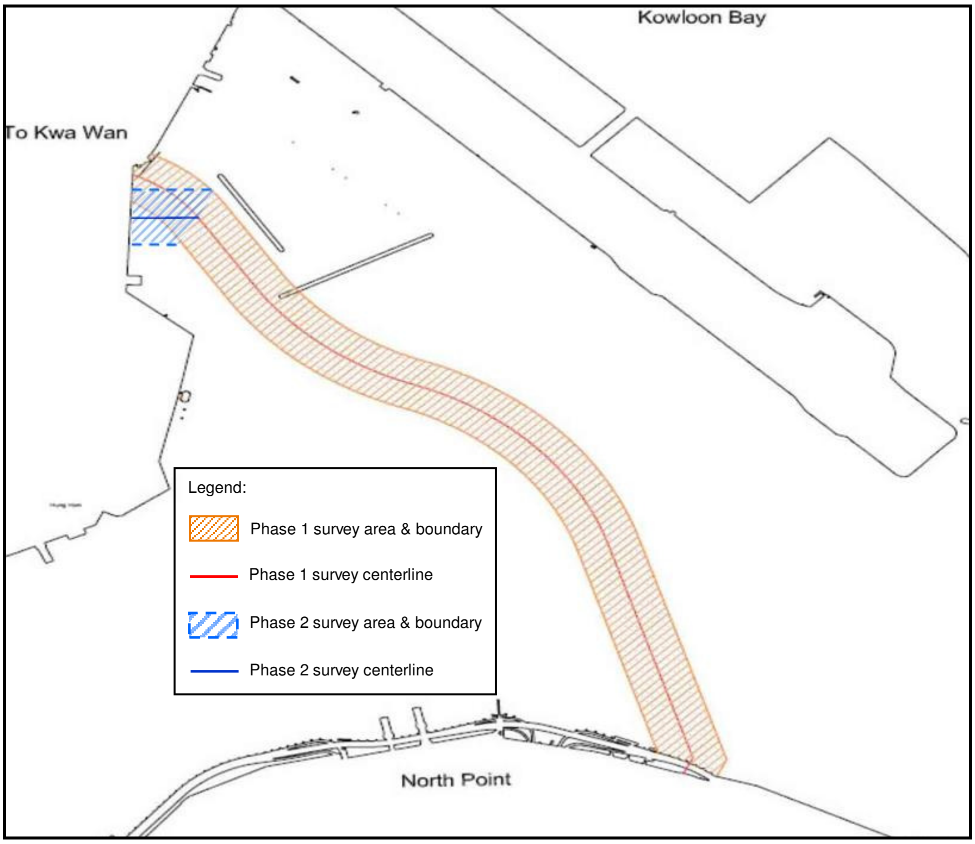


Figure 4.1: Study area and survey corridor

4.4.3 Site Description

The site is situated between Ma Tau Kok Public Pier in Kowloon Bay and North Point on Hong Kong Island. The survey area is busy with marine traffic. Breakwaters protect the To Kwa Wan typhoon shelter, one of these breakwaters projects into the survey corridor.

	
The survey area is always busy from marine traffic	A breakwater projects into the survey area.

Figure 4.2: Photographs of the study area

4.4.4 Equipment

The following equipment was mobilised onboard the commercially licensed survey vessel.

Equipment	Qty	EGS Serial No.
C-Nav GcGPS	1	GPS74A
The EGS computerised navigation package v1.12 and PC	1	D735
Knudsen 320M echo sounder	1	ESD20
The Elac Seabeam 1180 multibeam system	1	SWA02
Swath PC	1	D394
272-TD system with digital tow fish	1	SSS26
EGS boomer and hydrophone	1	SPP13
EGS TVG console	1	TVG13
Waverley recorder	1	GPR14
TSS gyro compass	1	GYR05
Valeport velocity profiler	1	SVP12
TSS DMS 3-05 heave motion compensator (Swath)	1	HMC13A
TSS 320B heave motion compensator (SBES)	1	HMC02
2m Gravity Corer	1	n/a
Van Veen Grab Sampler	1	n/a
Generators, spares	Various	n/a

4.4.5 Location Control, Operating system

4.4.5.1 Horizontal

Basic Method

The survey vessel was located with a globally corrected Global Positioning System (GcGPS) unit called C-Nav, for which no shore based differential correction transmitter is required. The system provides corrected positions to an accuracy of +/- 0.3m without the need for a shore-based transmitting system.

4.4.6 Computerised Navigation

The EGS computerized navigation system was added to the positioning system to control the steering of the boat along the traverses specified, and to log all horizontal and vertical control data.

This system provides the user with a dynamic analogue and digital screen display on which the following are continuously updated:

- Skewed grid set parallel to the desired line direction
- Boat position
- Water depth
- Date and Time
- GcGPS diagnostics enabling quality control

4.4.7 Calibration, Accuracy and Quality Assurance

The positioning system was calibrated by checking the co-ordinates displayed by the navigation system at the previously co-ordinated point located at the Yau Ma Tei typhoon shelter.

Carrying out the above quality assurance checking procedure ensured an accuracy of +/-1m or better. The results of these checks are presented as Appendix A of this report.

4.4.8 Location of Tidal Measurements

Tidal levels were recorded at the EGS tide gauge in Central. The measured tide levels were used to reduce bathymetric data to Principal Datum, Hong Kong (PD).

4.4.9 Datums

This survey was carried out relative to Hong Kong Principal Datum. For reference, Chart Datum is 0.15m below Principal Datum (Reference: Hydrographic Office, Marine Department, Government of the HKSAR, 2005, Charts for Local Vessels). Mean Sea Level at Quarry Bay, adjacent to this survey area, is 1.39m above Chart Datum (Reference: UK Hydrographic Office, 2008, Admiralty Tide Tables).

4.4.10 Operating System on Board the Survey Vessels and in the Office

EGS has developed the C-View operating and interpretation software package. This system was installed on survey vessels and in the office, to carry out the following functions:

OPERATIONS DURING SURVEYING

The system provided screen displays on up to three monitors for seismic profiling and side scan systems

Full operating systems coverage was provided, to enable the best survey records to be obtained

All raw data was logged digitally

SUB-BOTTOM AND SIDE SCAN SONAR INTERPRETATION

This was carried out in the office; interpretation on the screen was then directed straight to Autocad without the need for further re-digitizing

4.4.11 Swath (Multibeam) Bathymetry

Seabed level observations were made with a multibeam echo sounder (MBES) system with the transducers mounted over the starboard side of the survey vessel. The DGPS antenna was mounted directly above the transducers and as such the swath transducer acted as the datum for the survey vessel.

The swath system is a multibeam echo sounder. Instead of transmitting a single vertical pulse, which provides a record of water column thickness beneath the vessel track, the swath measures the same type of data over a 'fan' on both sides of the vessel.

4.4.12 Calibration

For errors to be avoided, the MBES system requires careful calibrations. A significant (potential) source of error relates to the speed of sound in water; the MBES system requires the speed of sound be measured through the water column, and for these data to be entered into a file which is accessed by the MBES acquisition and processing software. In addition, due to the fact that the speed of sound can vary significantly near the sea surface, a speed velocity probe is installed at MBES transducer so that measurements are recorded at all times during the survey and the corresponding corrections can be made within the MBES system in real-time.

In addition, a patch test is required to calibrate system components, as follows:

4.4.12.1 Navigation Delay

A survey line is set exactly over a well-defined feature, such as a rock outcrop, a significant slope or a man-made structure. The line is run twice in the same direction, once at the slowest possible speed and once at the highest speed

4.4.12.2 Pitch Offset

A survey line is set exactly over a well-defined feature. The line is run in opposite directions at the same speed

4.4.12.3 Roll Offset

A survey line is set over an area with a flat and featureless seabed. The line is run in opposite direction at the same speed

4.4.12.4 Yaw (Heading) Offset

Two parallel lines are set to either side of a well-defined feature with the feature positioned in the middle of the two lines. The off-track distance between the feature and the lines are selected according to water depth and the fan width of the MBES system, so that the feature will be detected at the outer part of sounding “fan”. The lines are run in the same direction at the same speed; once passing the feature to Port and once to Starboard.

By applying appropriate algorithms to match the apparent differences in the positions of the selected feature and the seabed topography measured in the individual calibration line, these calibration factors can be determined and are entered into the acquisition system to correct the seabed level measurements in real-time.

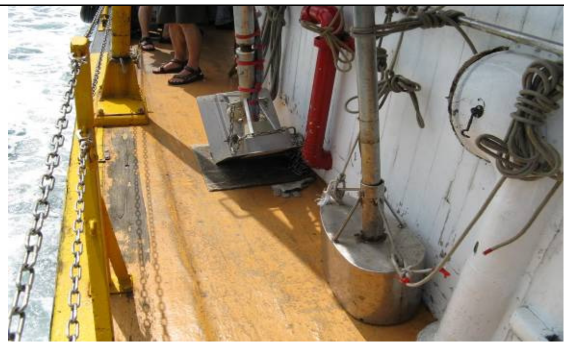
	
Illustrations of swath bathymetry systems	The Transducer of Elac Seabeam 1180 Swath System (upper) and single beam echo sounder (lower)

Figure 4.3: Swath Bathymetry System

4.4.13 Side Scan Sonar Survey

Prior to the commencement of survey the side scan sonar system was wet tested to confirm that the system was working correctly. The side scan sonar tow fish was towed from the stern of the survey vessel, at a depth of around 5m beneath the sea surface, depending on the water depth.

The recording parameters for the side scan survey were as follows:
- Vessel speed: 1.5 – 1.8 m/sec
- Fix interval: 8 seconds
- Source frequency: 100 kHz
- Pulse length: 25 µs
- Gain setting: Manually controlled
- Slant range: 75m

All data was logged to the C-View SDMP where two channels (100kHz port and starboard) were simultaneously recorded with navigation, fix, vessel heading, cable out angle and length, fish heading, water depth.

Detailed log sheets were recorded with unique survey line number, start fix and end fix of each survey line, roll number, range, frequency and cable out value and angle. The corresponding C-View data file name was also recorded in these log sheets.

272-TD was used in the Side Scan Sonar survey

Figure 4.4: Side Scan Sonar fish

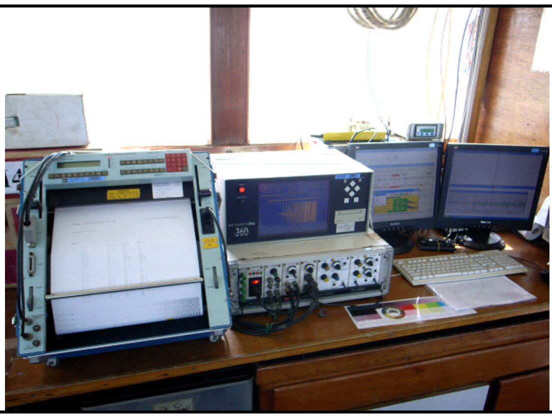
4.4.14 Seismic Reflection Survey

Prior to the commencement of survey the EGS boomer was wet tested to ensure the system was working correctly.

The EGS boomer was towed from the stern of the survey vessel, at a distance such that noise from the survey vessel was kept to a minimum.

The recording parameters for the seismic reflection survey were as follows:

- Vessel Speed: 1.5 – 1.8 m/sec
- Fix Interval: 8 seconds
- Out put power: +/- 500 volts
- Sweep: 80ms (paper)
- Delay: 0ms
- Gain setting: Manually controlled



The two monitors on the right were displaying seismic profiling and side scan sonar digital data using C-View and the systems on the left were the signal processor and analogue data printer.

Figure 4.5: Onboard display for geophysical survey equipment

4.4.15 Site Safety

Safety was in accordance with the EGS Safety Manual, which is significantly based on industry requirements as set out in the 'Marine Geophysical Operations Safety Manual' (International Association of Geophysical Contractors, Ninth Edition, 2004).

4.4.16 Quality Assurance

Quality was assured by adopting the measures set out in the EGS ISO9001 Quality Handbook.

4.4.17 Reduction of Observations and Interpretation

4.4.17.1 Swath (Multibeam) Data

Tidal correction and simple filter are applied before the data sets are edited manually. Judgment is required at this stage, to identify small features which are real reflections from low-level noise; for guidance, two or more mutually consistent soundings which are higher or lower than the general sea bed level would be accepted, especially if the same anomalous soundings are present on separate survey traverses.

Gridded sounding selection is widely used for engineering purposes. The selection procedures for this project are as follows:

- The processed data were gridded on to a 1m spacing dataset and a 2.5m spacing dataset. During the gridding process, median sounding values were used.
- These gridded data were then plotted at a spacing of 6mm at the charting scale, to provide a sounding plan for the whole area surveyed.
- This gridded plot was then contoured using the 2.5m spacing dataset and coloured using 'C-View Bathy' processing and charting software, to provide the sounding plans.

4.4.17.2 Side Scan Sonar Data

Processing and interpretation of side scan sonar data was carried out using the C-View interpretation software. All features were individually marked or grouped into regions using on screen digitising. All offsets and laybacks were applied to the C-View system. The subsequently generated interpretation files were then imported to the Auto CAD environment on a line by line basis where the interpretation was reconciled and a detailed check was performed.

The interpretation of the side scan sonar records sought to identify the following features on the seabed:

- Indicators for the presence of intact or broken up shipwrecks
- Isolated objects which could have archaeological potential
- Areas of disturbed seabed attributed to anchoring or trawling
- Large area of debris or dumped materials
- Higher reflectivity areas attributed to gravel or sandy materials
- Lower reflectivity areas attributed to relatively clean or undisturbed marine sediments
- Any other significant sonar contacts

4.4.17.3 Seismic Data

The quality of the seismic records is marginally acceptable, because the data was adversely affected by the presence of material on the seabed which was masking the seismic data. The extent of the masking is shown on Chart Figures 3.1 & 3.2.

4.4.17.4 Interpretation of the Geological Succession

The interpretation of the seismic records has sought to quantify the following elements of the offshore geological succession:

Formation	Event
Sea bed	N/A
Marine Deposits of Holocene age (Hang Hau Formation)	The base of these deposits occurred during the last ice age
Alluvium (Chek Lap Kok Formation; mainly coarse sediments with gravels)	Accumulation of sediments during glacial/inter-glacial cycles during the Pleistocene

The seismic horizons were selected for interpretation in accordance with the list above and drawn on the digital data using C-View packages during preliminary interpretation.

All the geological horizons' levels were corrected to HKPD and plotted with the tide- and datum- reduced seabed presented in the alignment chart.

4.4.17.5 Coverage

Survey lines were planned as follows:

- Swath (Multibeam Echo Sounding survey) Various spacing depending on water depth, and infill lines at landing areas
- Side Scan Sonar Survey 25m spacing along the proposed route
- Seismic 25m spacing along the proposed route and

- cross-lines of 100m intervals

4.5 Diving inspection

The underwater inspection was carried out in January 2009. The aim of the underwater inspection was to provide detailed information on the unidentified targets identified during the geophysical survey.

The Differential Global Positioning System (DGPS) fixes obtained during the geophysical survey were used to re-locate each target.

Figure 4.6: Dive Team using hand held GPS to relocate each target.

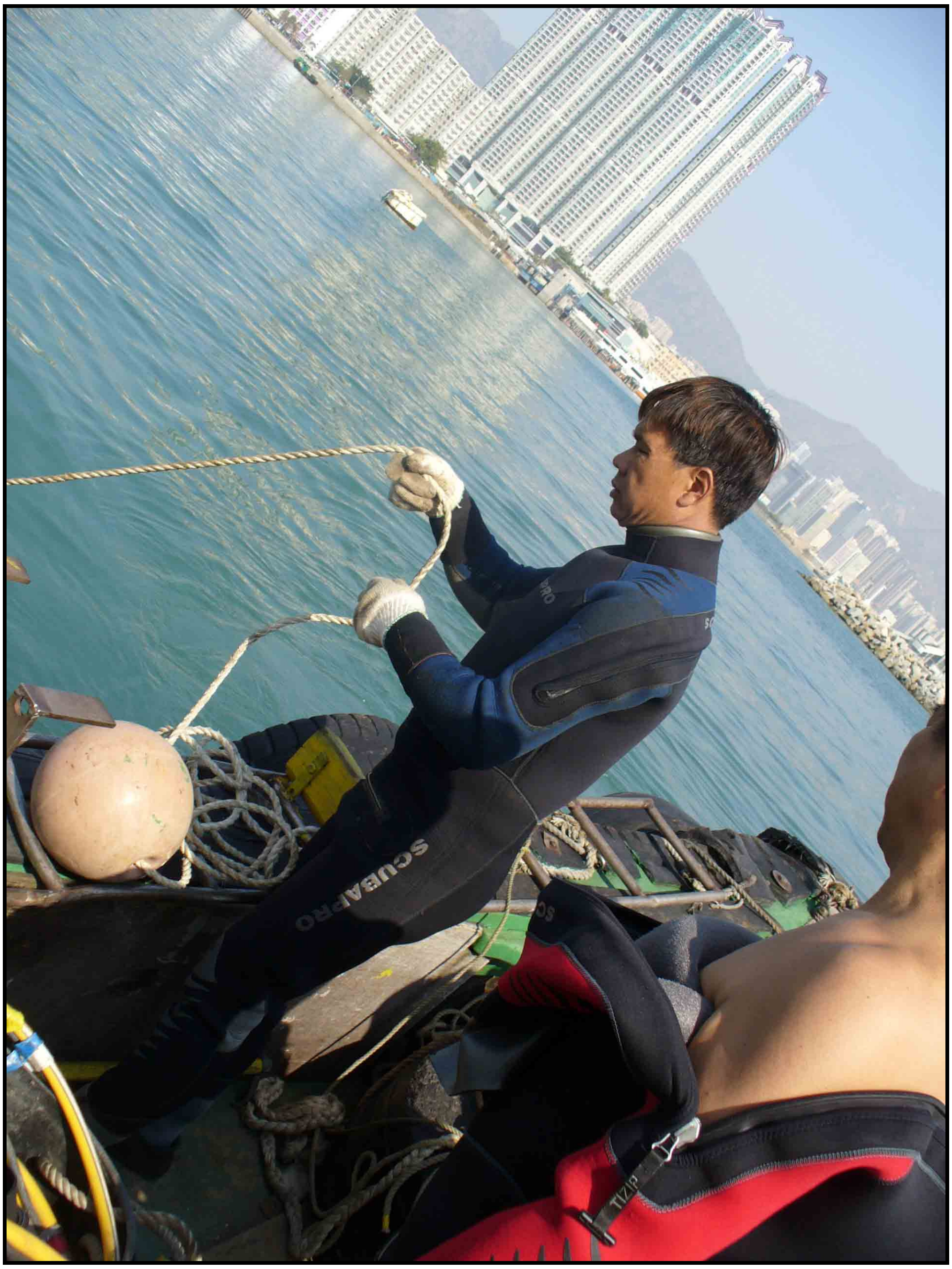


Figure 4.7: Diver positioning sinker to use as the centre point for the target search

A 25-kg metal sinker was placed on the seabed at the fix point and a 5m, 15m and 20m radius sector search conducted. The principle of the search is that the diver extends the line to the set length and searches radially about the centre point. If any objects are present, the line will snag everything within the circumference of the search area. This approach ensured 100% seabed coverage even through water visibility was restricted. In addition, the diver used a hand held metal rod of 1.5m length to probe the seabed every 2m. The aim of the probe was to locate buried objects and establish the density of the seabed sediments.

A marine archaeologist and a team of three commercial divers were used to conduct the investigation. All the divers hold HSE qualifications and all diving was conducted with strict safety considerations. Diving operations were carried out from a sampan. Each diver used surface supplied air and through water communications thereby enabling verbal contact with the dive supervisor at all times. A video recording was made of each anomaly using the Osprey Electronics SeaHawk system. The supervisor and marine archaeologist were able to monitor the progress of the diver at all times and view his activity on the on board monitor. The through water communications enabled communication with and direction of the diver at all times.

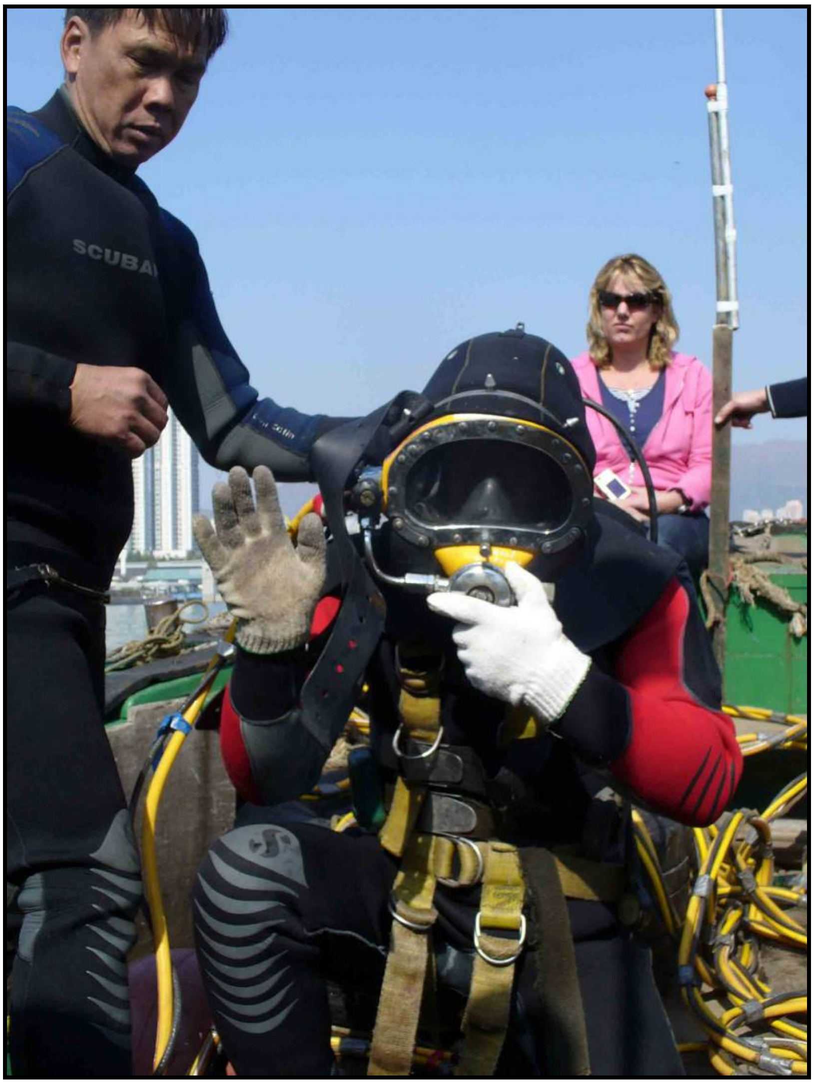


Figure 4.8: Diver using surface supplied air and through water communications.

Figure 4.9: The dive supervisor and marine archaeologist monitor and direct the diver

5. Results

5.1 Marine Archaeological Review

None of the six investigations located archaeological material on the seabed but confirmed the high archaeological potential of the study area. Each of these reports also indicated the evidence for seabed disturbance from recent activities such as trawling and dumping of debris.

5.2 Baseline Review

5.2.1 Shipwreck Data

Practically nothing is known about the archaeological potential of the seabed deposits in Hong Kong. The only marine archaeological discovery is that of a late Sung/early Ming Dynasty (1368-1644) boat uncovered during the construction of the High Island Reservoir, near Sai Kung (Frost, 1974). Since then, no other historic shipwreck has been found. However, this is probably because there were no dedicated marine archaeological surveys until the introduction of the 1998 EIA Ordinance.

Formation of archaeological sites underwater is mainly due to shipwrecks (Muckelroy, 1978). Since these are random and haphazard events it is difficult to predict their exact location if there are no written references. The aim of this review is to examine the evidence for maritime activity within the study area to predict the potential for shipwrecks.

5.2.2 Physical Evidence

In November 1957 a cannon was dredged from Kowloon Bay during construction of the Kai Tak runway (Eather, 1996). The cannon was cast in the 4th year of the Wing Uk Reign of the Ming Dynasty (1368-1644). It bears the following inscription:

> '*Commissioned by Choi Governor of Waiboi and created by Ting Hoi General of Imperial Command – To by Imperial Command appointed Governor General of Kwanung and Kwangsi Provinces Fan, General Officer Commanding Kwantung and Guardian of the Imperial Heir. Colonel Siu Lei-Yan directed the casting for Ho Hing Cheung, Commander of the Ordinance Depot, Sixth Moon of the Fourth Year of Wing Lik. Weight 500 catties.*'

The chance discovery of this cannon is very significant and suggests that there may be other similar cultural resources on the seabed within the study area.

5.2.3 Archive Search

The UK Hydrographic Office (UKHO), Taunton holds a database of surveyed shipwrecks in Hong Kong, including many not shown on Admiralty Charts. The database does not contain any records of shipwrecks within the study area. However, the Hydrographic Office only charts wrecks which are a potential hazard to navigation. It is therefore possible that there are other wrecks within the study area which are partially or totally buried and thus not recorded.

5.2.4 South East Kowloon and Nearby Waters in Pre-British Times

The first reference to the sea passage and waters in what later became called Victoria Harbour are found in the Cheng Ho navigation map of the China coast dated c.1425 AD. This map is believed to be based on the earlier Mau K'un map executed from 1422-1430 AD by his grandson Mau Yuen-I. This map was published in a book called Mo Pei Chi (Notes on Military Preparation), published in 1621 (Empson, 1992). The map indicates the routes taken by vessels of a 15th century Imperial Chinese fleet under the command of Admiral Cheng Ho.

Kowloon waters are also charted in a coastal map of Kwangtung appearing in a book by Ying Ka called Chong Ng Chung Tuk Kwan Mun Chi, first published in 1553. The map was later reprinted in 1581. There are references to Kowloon waters in a 1723 map of Kwang Tung produced by Chiang Ting Sik in his book called Ku Kam to Shu Chap Shing. It is again positioned in "Map of the entire coastline" by Chan Lun Kwing in his book Hoi Kwok Man Kin Luk (A Record of the Countries of the Sea), printed in Ngai Hoi Chu Chan in 1744 (Figure 10).

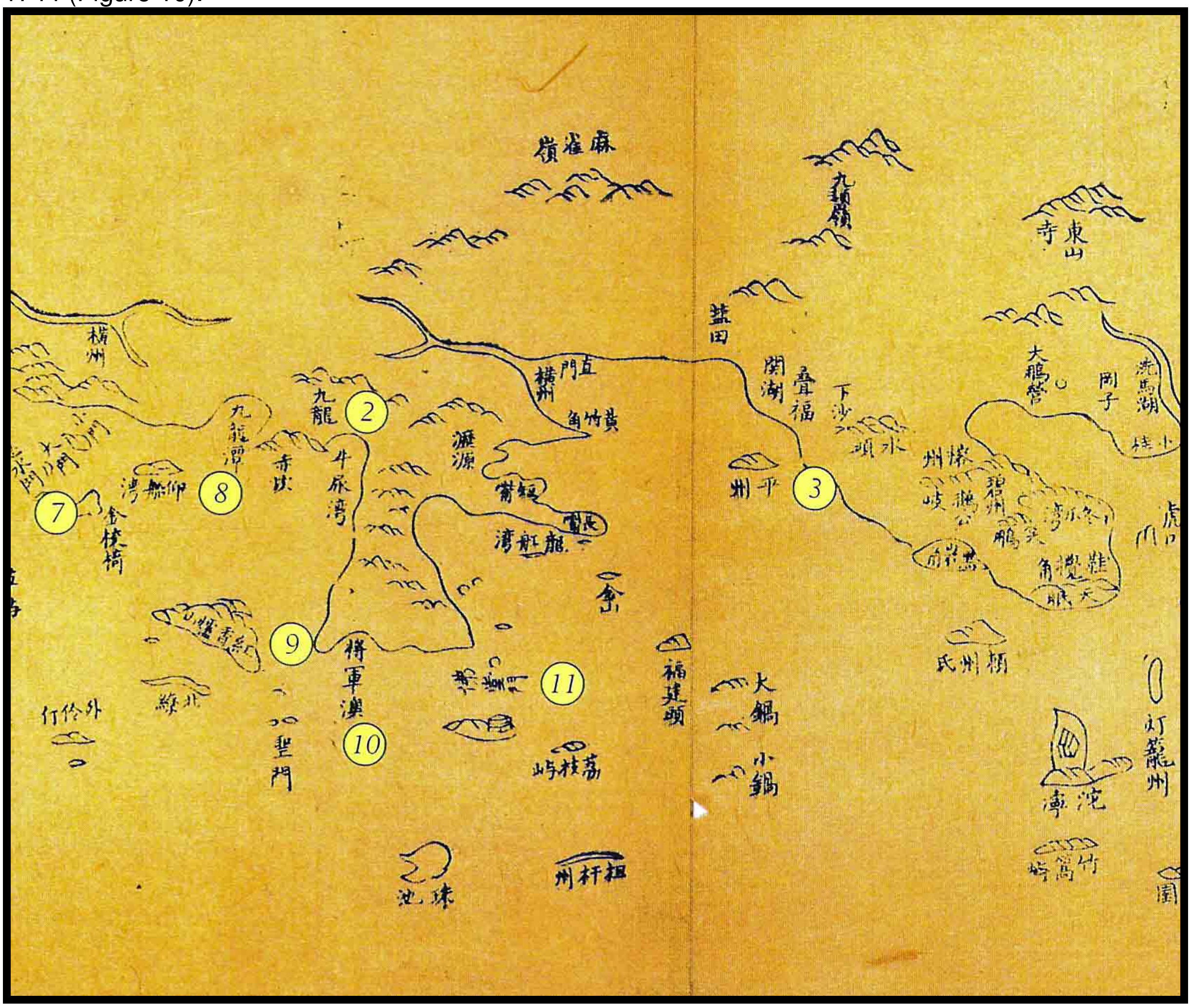


Figure 5.1: Section of the Map of the Entire Coastline by Chan Lun Kwing in Hoi Kwok Man Kin Luk (Record of the Countries of the Sea) printed by Ngai Hoi Chu Chan in 1744.

Key to place names:

2 Kowloon
3 Ping Chau
7 Kap Shui Mun
8 Ngong Shue Chau (Stonecutters Island)
9 Red Incence Burner Hill (Hong Kong Island)
10 Tseung Kwan O
11 Fat Ton Mun

The Kang Hsi Emperor commissioned the Jesuit Fathers to undertake a detailed map of China, which was reprinted in part in 1737. The Jesuit map relies heavily on pre-existing Chinese maps of the coast. Hong Kong waters are charted in this map, found in Nouvelle Atlas de la Chine, published in Paris in 1737.

A further reference appears in the San On Yuen Chi, a cartogram from the directory of San On County (Figure 5). Another Chinese map of Kwangtung Province, dated from 1820, reportedly the work of a Taoist priest, charts Hong Kong harbour. One of the more detailed regional maps is the Kwang Tung Ting Shang Shui To, by Chan Chi Sze c.1840. A good subsequent Chinese map recording the South Eastern waters of Victoria Harbour is of San On District, in the 1864 edition of the San On Gazetteer.

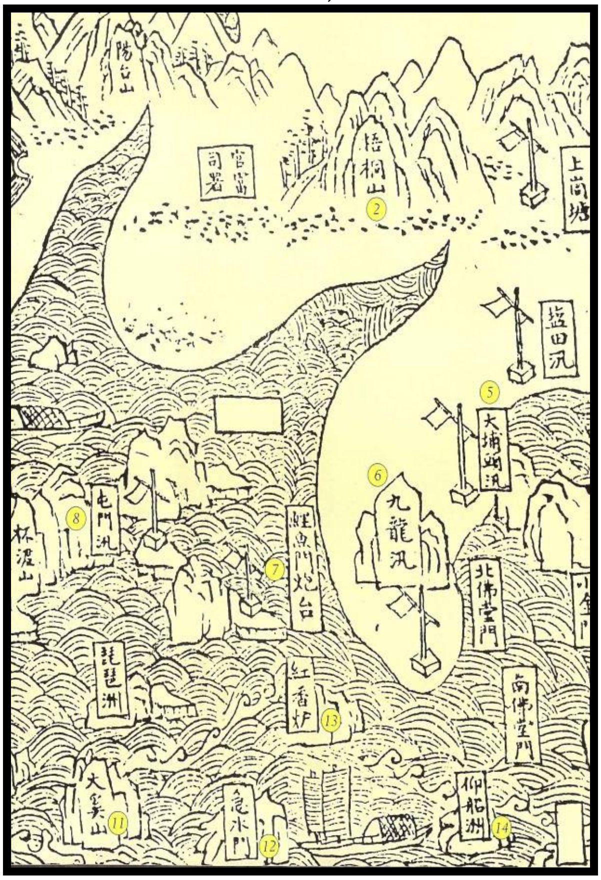


Figure 5.2: 1819 San On Yuen cartogram from the Directory of San On County

Key to play names:

2	Wung Tung City
5	Tai Po Tai (Tai Po)
6	Kowloon
7	Lei Yue Mun
8	Tuen Mun
11	Tai Hai/Kai Shan (Lantau)
12	Kap Shui Mun
13	Red Incence Burner (Hong Kong)
14	Ngong Shuen Chan (Stonecutters Island)

The first map which clearly depicts Hong Kong harbour in detail is an 1810 marine chart (Figure 12). These maps are particularly important as they indicate that Kowloon Bay was established as a known coastal settlement from the 15th century.

Figure 5.3: Marine Chart prepared for the East India Company by Daniel Ross and Philip Maughan, Lieutenants of the Bombay Marine.

5.2.5 Opium War Period

In the prelude to the First Anglo-Chinese (Opium) War the entire British community resident at Macao embarked and sailed to Hong Kong harbour. This was because the Governor of Macao, owing to pressure from the Chinese authorities, could no longer guarantee their safety. They arrived in Hong Kong waters on 26th August 1839, and once there lived on board ship for several months, mainly in Kowloon Bay. On The 30th August, H.M.S. Volage under the command of Captain Smith arrived on the scene. On 4th September 1839, having failed in peaceable efforts to obtain supplies from nearby villages, Captain Charles Elliot opened fire from H.M.S Volage on the Chinese war-junks anchored off Kowloon City. The junks were there for the express purpose of obliging the local inhabitants to take back food-stuffs that had already been bought and paid for. It is not recorded whether or not he inflicted serious damage on the Chinese vessels (Sayer, 1975).

5.2.6 1841-1860

On the signing of the Treaty of Chuen-pi in 1841, H.M.S. Sulphur, commanded by Captain Sir Edward Belcher, was commissioned to undertake a hydrographic survey of Hong Kong Island and the surrounding waters. Produced in the meticulous style typical of the Royal Navy, this chart is remarkable for its accuracy and detail. It takes into account depth soundings in a number of areas, which still form the basis of charts in unchanged areas (Figure 13).

The area which is today considered South East Kowloon remained outside British jurisdiction following the cession of Kowloon peninsula, south of what is now Boundary Street, following the Second Anglo-Chinese (Arrow) War in 1860. Large areas remained agricultural or semi-agricultural until relatively recent times, with the predominately Hakka and former stonecutter's settlement of Ngau Tau Kok only being cleared for development.

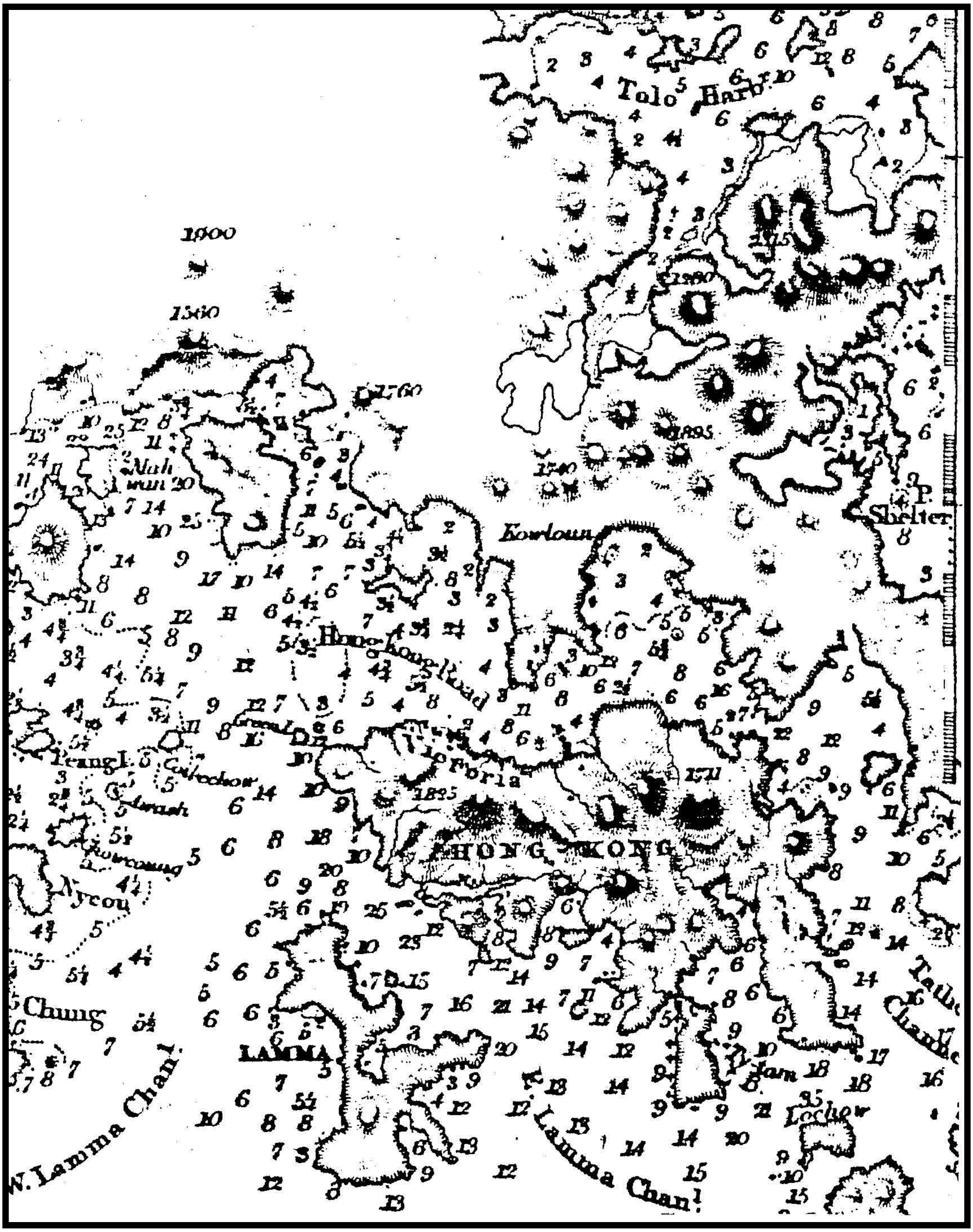


Figure 5.4: British Admiralty Chart 1853

5.2.7 Kowloon Walled City

At the beginning of the Ching Dynasty there was no walled city. It is recorded that in 1668 there was an outpost called the Kowloon Outpost which had 30 guards (Yuen-chung, 1990). Fourteen years later when China was considered quite peaceful the number of guards was reduced to ten and the post was demoted to guard station. It was expanded again in 1811 to become the Kowloon Fort. It was assigned a garrison of 48 men under a sergeant and a corporal.

After Hong Kong Island was ceded in perpetuity to Great Britain following the Treaty of Nanking in 1842, the Ching Government moved to greatly strengthen the hitherto quite sketchy fortifications in the Kowloon area. In 1847, a walled city was built on the shore of Kowloon Bay, later known as the Kowloon Walled City. It was garrisoned by a full battalion, with a usual complement of 795 men (Lui, 1990). The Walled City was located to the immediate north-west of a small Chinese settlement known as Kau Loung Gai. This town, which could be considered in some respects to comprise the suburbs of Kowloon City, was frequently condemned during the 1890's as an obstacle to law and order. Worthy Hong Kong citizens seeking "rectification" of the colony's boundaries constantly referred to it as an evil that should be overcome.

One of its main industries was gambling, and the tables were a favourite haunt of many prominent Hong Kong residents. Special steam-launches, operating well into the night, provided a free passenger service to gamblers from Hong Kong Island across the harbour, and complimentary coffee and cigars were handed out en route. Representations by the Hong Kong authorities to the viceroy at Canton and to Peking eventually succeeded in having the establishments closed down.

In November 1894, the General Officer Commanding Major-General Digby Barker noted the potential danger to Hong Kong from the large junk traffic associated with Kowloon City that frequented the waters of South East Kowloon and of the periodic visits by the Chinese fleet to its own waters in Kowloon Bay. The Colonial Defence Committee reported in 1896 the need to maintain a considerable military force on the mainland to protect the defence works and stores from pilferage by Kowloon City residents. No specific complaints were at this time made by Hong Kong against the fort, but the town was identified as a source of potentially dangerous criminal activity.

To the Imperial Chinese Government, the fort was an important centre of civil and military administration for that part of San On County since the Deputy Magistrate, with limited powers of arrest and detention and certain Army officers resided there. The British in Hong Kong found the "Kowloon Mandarin" a useful person to have in residence nearby, for he was in constant correspondence with the Hong Kong Police. The military commander had a garrison of more than 500 men and was said to exercise jurisdiction over the 200 civilians living within the walls.

In 1898, the Walled City was about a quarter of a mile from the seashore, although subsequent reclamations have placed it much further inland. Its fortified stone wall was built between 1843 and 1847 with an average height of 13 feet and an average width at the top of 15 feet. In the rough shape of a parallelogram, it enclosed an area of 6.5 acres. Inside were several public buildings, a well-regarded school, two temples and a number of quite substantial residences along the main streets. In contrast, the "suburbs" contained numerous small factories, shops and gambling dens along its narrow, evil-smelling roadways. Other landmarks were a defence wall rising to the top of the hill overlooking the city, a substantial stone pier where the road from the Walled City met the sea and a rest house for travellers.

Figure 5.5: Kowloon City pier in the 1890s. It was subsequently buried beneath the western end of the terminal building for Kai Tak airport.

In 1841, at least one Chinese fort on Kowloon peninsula was destroyed by British forces. It is probable that construction of the Kowloon City wall was started as a specific response to the British presence on neighbouring Hong Kong Island. After the cession of Kowloon in 1860, the population of the Walled City grew in terms of population and importance. Hong Kong residents distrusted Chinese officials and objected strenuously to the very existence of the fort and its suburban area. Whereas to the Imperial Chinese Government in Peking, the Walled City was a government installation, a visible symbol of Imperial control constructed for the very purpose of discouraging British interference in the region (Wesley-Smith, 1990).

After 1898, one of the first tasks of the Public Works Department in the New Territories was the repair of the Kowloon City pier. Timber work was repaired at a cost of almost $6000 and the work was completed in 1900. At this time it was agreed that:

> *'Chinese officials stationed here shall continue to exercise jurisdiction, except so far as may be inconsistent with the military requirements for the defence of Hong Kong. Within the remainder of the newly leased Territory, Great Britain shall have sole jurisdiction…. It is further agreed that the existing landing place, near the Kowloon City shall be reserved for the convenience of Chinese man of war, merchant and passenger vessels, which may come and go and lie there at their pleasure; and for the convenience of movement and people within the city'* (Yuen-chung, 1990).

It can be assumed from the above that at this time Kowloon Bay was a thriving maritime community. However, a year later the situation changed. There was unrest in the New Territories and the British asked for help from the Ching Government and six hundred soldiers were sent to assist. The British however, made a very big mistake and thought that the soldiers were sent to assist the uprising. They proceeded to invade the walled city on 19th May 1899 and drove away the imperial officials and the garrison of three hundred soldiers. This ended the Ching military occupation of the Kowloon Walled City.

It was not long before the landing place disappeared when the reclamation of part of Kowloon Bay commenced. The Kai Tak Land Investment Company began development of the area in 1917, and in the 1920's most of the reclaimed land was taken over for construction of the airfield. It was no longer possible for Chinese vessels or Kowloon Walled City residents to use the pier which had existed since before 1898 (Wesley-Smith, 1990).

5.2.8 Kowloon Battery

The Kowloon Battery was located outside the southern gate of the Kowloon Walled City. It was constructed in the 16th year of the Jia Qing reign (1811) during the Qing Dynasty (Kwok-Kin, 1997).

The Battery took a square form with walls measuring 103.23 meters long and 3.66 meters high. There were 42 battlements, each of them standing 1 meter high. The top of the wall facing the sea was 4.33 meters wide, while that at the rear was 1.67 metres wide. The Battery had ten barracks and eight cannon, and was manned by a captain and forty two soldiers. It was abandoned in the 24th year of the Guang Xu reign (1898). The Battery was demolished due to redevelopment in the area. Today, no more remains can be traced.

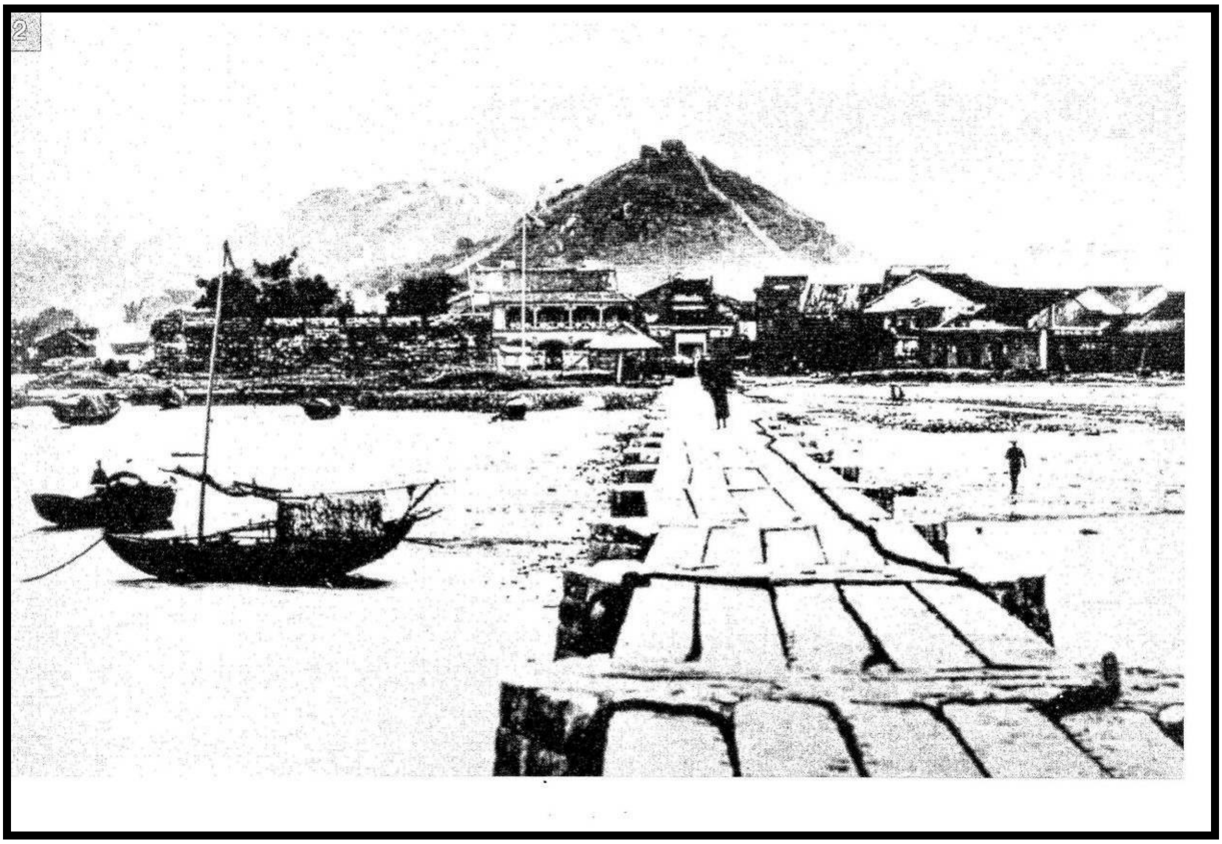


Figure 5.6: A distant view of the Kowloon Walled City as seen from the Longjin Pier, circa 1910. The photograph also shows the Kowloon Battery on the left.

5.2.9 The Kowloon City Execution Ground

The traditional execution ground for criminals ordered for execution at Kowloon City was an almost enclosed courtyard on the western side of the Kowloon City market, to the south of the Walled City. Occasionally, however, another site was used. This was a peninsula of land south of the city, opening to the bay on the east, and a creek to the west. This peninsula was used because it lay immediately adjacent to the 1860-1898 border, and was used for executions which were of interest to Hong Kong as well as to the Kowloon City authorities, especially of pirates captured in joint Anglo-Chinese Anti-Pirate operations. The site was used as the execution ground because the site could easily be cut off by a cordon of soldiers across the neck of the peninsula, thereby making access to the site subject to the control of the authorities. This execution ground lies within the Kai Tak site, under the western end of the Terminal Building (exactly under the area which was the Waiting Area for people awaiting arrivals).

In 1860, when the new border was set out, the southern tip of this peninsula fell within the new British Kowloon. The execution ground used the area immediately adjacent to the border, just North of the border-fence, but still within the peninsula.

Figure 5.7: A photograph of an execution of pirates which took place in 1891

Figure 16 shows the execution actually in progress, is taken from the north, and shows the border fence immediately behind the last pirate shown. The European officials shown are there because this group of pirates (who had murdered many people on the ships they had captured) were caught by a joint Anglo-Chinese Anti-Pirate agreement. It was considered doubtful that the pirates would receive sufficiently harsh punishment if they were brought to trial in Hong Kong, and so they were returned to the sub-Magistrate at Kowloon City, to be tried there, since some of their crimes had been committed in Chinese waters. The Magistrate invited the naval and police officers from Hong Kong, who had caught the gang, to witness the execution as his guests. This was seen, on both sides of the then border, to be a clear sign of the good relations between the two authorities at this date. Gruesome as these photos may be, nonetheless, the presence of the execution ground within the Kai Tak Development Area is a significant historical heritage factor.

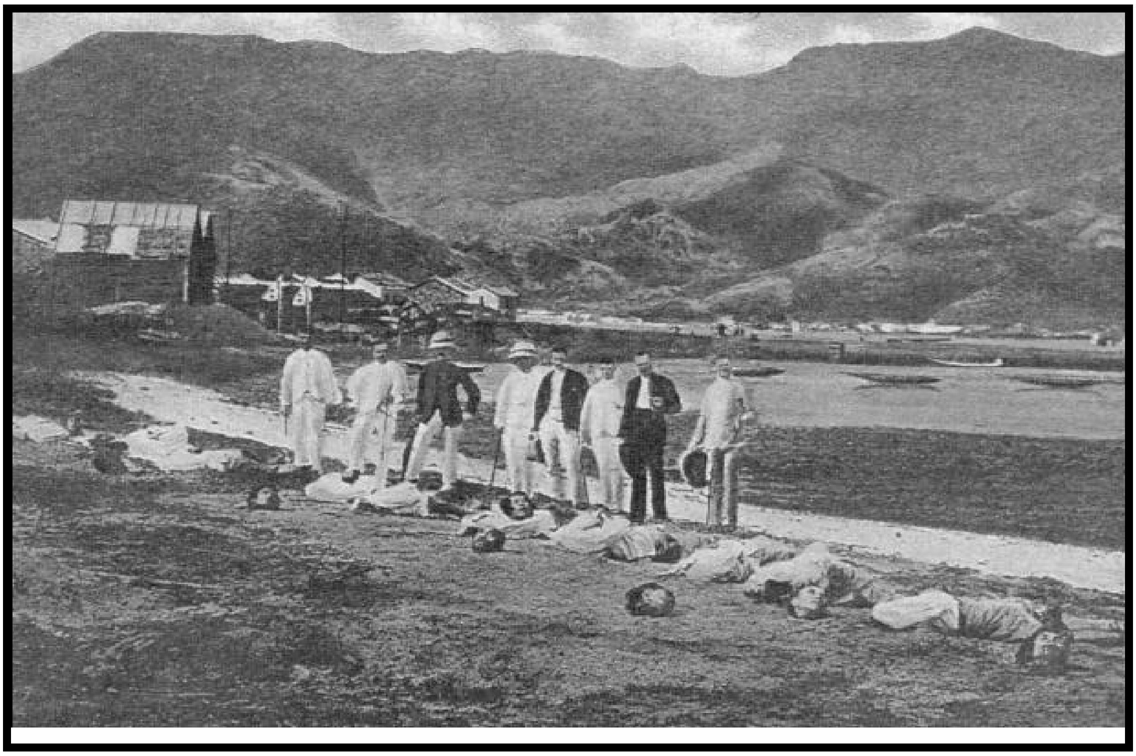


Figure 5.8: Execution of Pirates at the Kowloon City Execution Ground, 1891.

5.2.10 Kai Tak Airport and Extensions and the Sung Wong T'oi

The famous stone boulder, meaning Sung Emperor's Terrace formerly stood in a small park near Kowloon City. The stone commemorates the passage through the Hong Kong region of the last Emperor of the Southern Song Dynasty in the eleventh century AD. The park was proposed by Dr. Ho Kai in 1898 (Choa, 1986). Its original location is now roughly where the former Aero Club premises stood, on Sung Wong T'oi Road. The Sung Wong T'oi was cut down and the ground levelled to make way for extensions to Kai Tak Airfield during the Pacific War. Working parties of allied prisoners of war were drawn from the nearby camps at Shamshuipo (for British, Canadian, HKVDC and other European prisoners), and Ma Tau Chung and Ma Tau Wai (for the Indian Army). The remaining walls of Kowloon Walled City were demolished in 1943 and the material used as fill for the airfield extension. Consequently, the exact boundaries of the Walled City became impossible to accurately determine after the end of the Pacific War (Wesley-Smith, 1990).

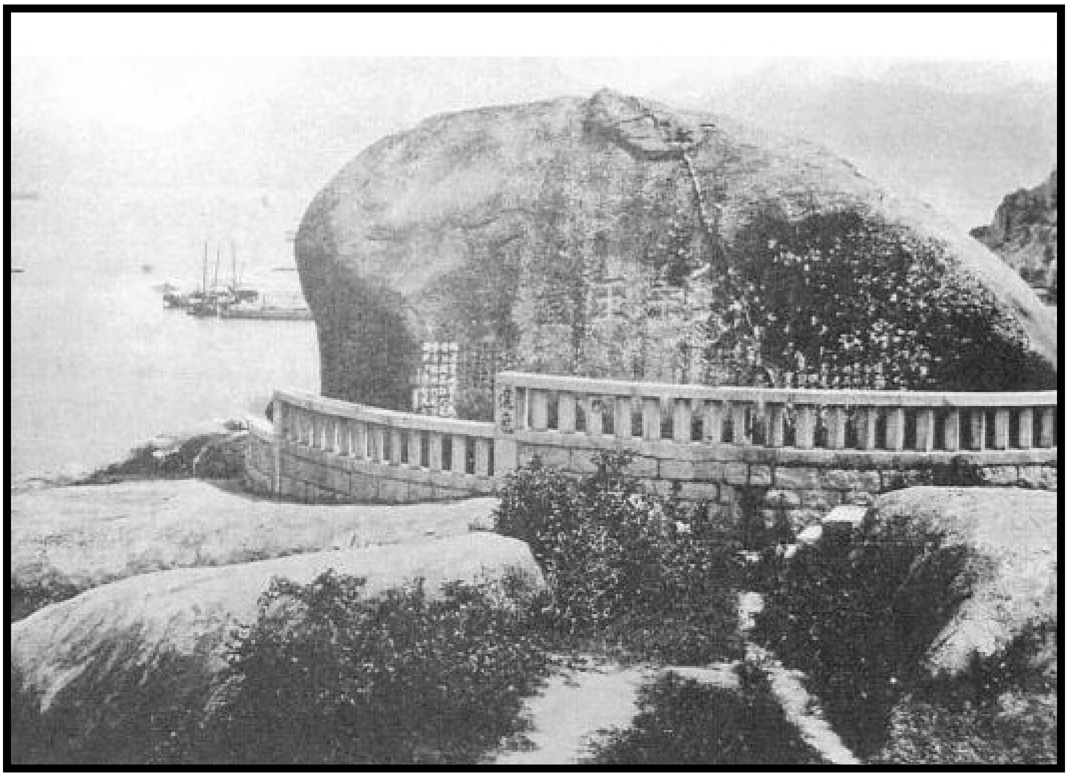


Figure 5.9: The Sung Wong To Rock from the North

A pre-Song Watchtower is believed to have stood a little to the left of the picture. The boy-Emperor Ching and his entourage looked out to sea from here at some point during their residence at Kowloon City in 1277. The junks in the middle distance are anchored at the piers at Ma Tau Kok which served the quarries there. The Rock and the hill on which it stands today lie under the landward end of the runway.

The airfield at Kai Tak was subsequently extended out into Kowloon Bay in an ambitious project that commenced in 1956. The Kai Tak extension called for a 795-foot wide reclaimed promontory, 16 feet above sea level on which an 8,340 runway would be built with prepared over-runs of 300 feet at the South East seaward end and approximately 750 feet at the northward end. Completion was scheduled for late 1958. Work started in January 1956 with nearby hills being levelled and the resulting fill being dumped into the sea. The first aircraft landed on 31 August 1958 (Dunnaway, 1999).

5.2.11 Villages in South East Kowloon

There were several villages along the eastern coast of South East Kowloon, including Lei Yue Mun, Cha Kwo Leng, Ngau Tau Kok and Yau Tong. These were also known locally as the "*Four Hills*" and all were actively involved in stone-quarrying. An official report of 1912 states that: "*The New Territories are very rich in granite which appears chiefly in the form of granite boulders on the hillsides. By far he most important quarries are those which stretch eastward along the north of Kowloon Bay as far as Lyeemun. They extend over about 100 acres and are leased to contractors for an average Crown Rent of $15,000. From these is supplied most of the granite now used in Hong Kong.*"

These quarries had been working long before the British occupation of the New Territories. As early as 1810, masons from South East Kowloon were persuaded by one of the Tangs of Kam Tin to cut stone for use in the construction of a fort at Kowloon at a discounted rate as a contribution to the defence of the area against pirates (Hayes, 1977).

5.3 Geophysical survey results

The geophysical survey data are presented in charts. Two drawings are needed to cover the whole of the survey area. The north western part of the route has a suffix “1” and the south eastern portion has suffix “2” The results have been presented as follows:

5.3.1 Drawings

Chart Figures 1.1 & 1.2	Hydrophone Track Plot
Chart Figures 2.1 & 2.2	Colour Contoured Swath Bathymetry Plan
Chart Figures 3.1 & 3.2	Contoured Levels at Base of Marine Deposits
Chart Figures 4.1 & 4.2	Contoured Levels on Top of Rock in any State of Decomposition
Chart Figures 5.1 & 5.2	Contoured Levels on Top of Presumed Moderately Decomposed Rock
Chart Figures 6.1 & 6.2	Contoured Isopachs of Marine Deposits
Chart Figures 7.1 & 7.2	Seabed Features

5.3.2 Colour Contoured Swath Bathymetry

As shown on the drawings, the seabed generally varied between 0.3m PD and –13.4m PD within the survey area. The deepest water was in the main fairway just north of the Hong Kong Island coastline. The seabed shoaled slightly along the route towards the northwest, crossed an anchorage that has been dredged to allow access for deep-draught vessels. From the anchorage, the seabed continues to shoal gently towards the To Kwa Wan Typhoon Shelter.

5.3.3 Geological Profile along the Pipeline Route

The shallow geology within the HKSAR is well documented, charted and understood. Within the survey area the shallow geology comprises an upper unit of Holocene marine deposits known as the Hang Hau Formation, which in turn overlies older deposits of the Chek Lap Kok Formations. Below this unit lies rock in any state of decomposition (Grade IV/V rock) and presumed moderately decomposed rock (Grade III rock) observed generally >10m beneath the top of Grade IV/V rock. Geological profiles along the proposed pipe route were interpreted accordingly and presented in Chart Figures 3 to 6.

Within the study area, the surficial sediments are assigned to the Quaternary Hung Hau Formation.

The formation consists of relatively homogenous very soft to soft, greenish grey silty clay (Fyfe et al., 1997) and has a high moisture content. Therefore, the Hang Hau Formation sediments potentially provide an excellent substrate for the preservation of archaeological material. Additionally, the soft nature of the sediments would make it possible for archaeological material to be buried within the formation, where it would have greater protection than if it were exposed on the seabed. Across the whole of the study area there is between 12-18m of Hang Hau Formation. This would provide an excellent preservation environment for archaeological remains.

In addition to this natural geological sequence, human influences could be observed on the seismic records. The two main anthropomorphic features were dumped material and sewage:

- As described in Section 5.3.4 below, dumped material is scattered across the seabed along the whole route. Some of this sinks to shallow depth into the natural Holocene sediments. The dumped material can be recognized as irregular scattering of the seismic signal close to the main seabed reflection, usually correlating with features seen on the side scan sonar records.

- Sewage has been discharged into this part of the harbour for decades. The denser organic material sinks to the seabed where it continues to decompose slowly. One of the decomposition products is methane, which forms into tiny gas bubbles trapped in the organic-rich material. The gas bubbles are excellent reflectors of seismic energy, so the signal is reflected and scattered from this seabed layer. Depending on the severity of the masking, it is difficult or not possible to identify reflections from deeper geological horizons. This effect is known as "masking", as the geological information is masked by the sewage close to the seabed. The worst affected areas have been shown on Chart Figures 3.1, 4.1, 5.1 and 6.1.

Examples of the seismic sequence as interpreted are shown below.

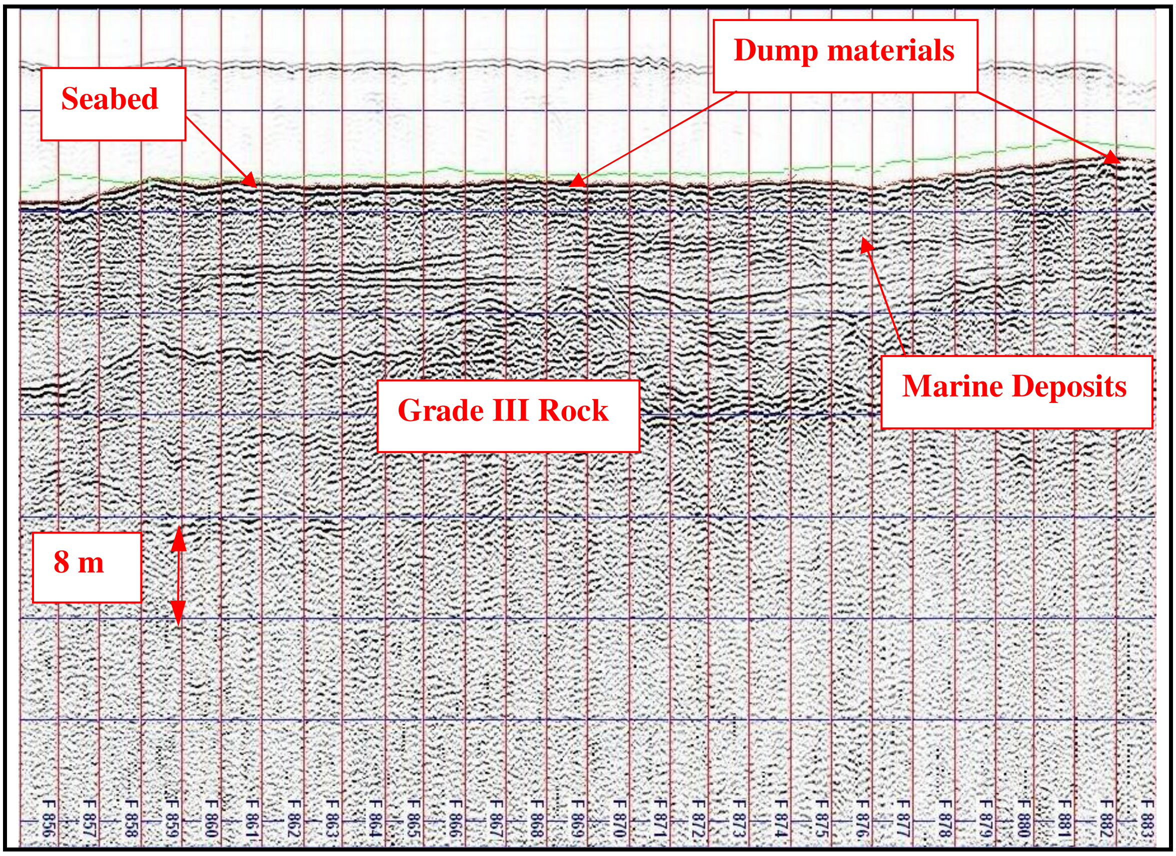


Figure 5.10: Data example of seismic record which shows dumped materials on seabed and the geological sequence

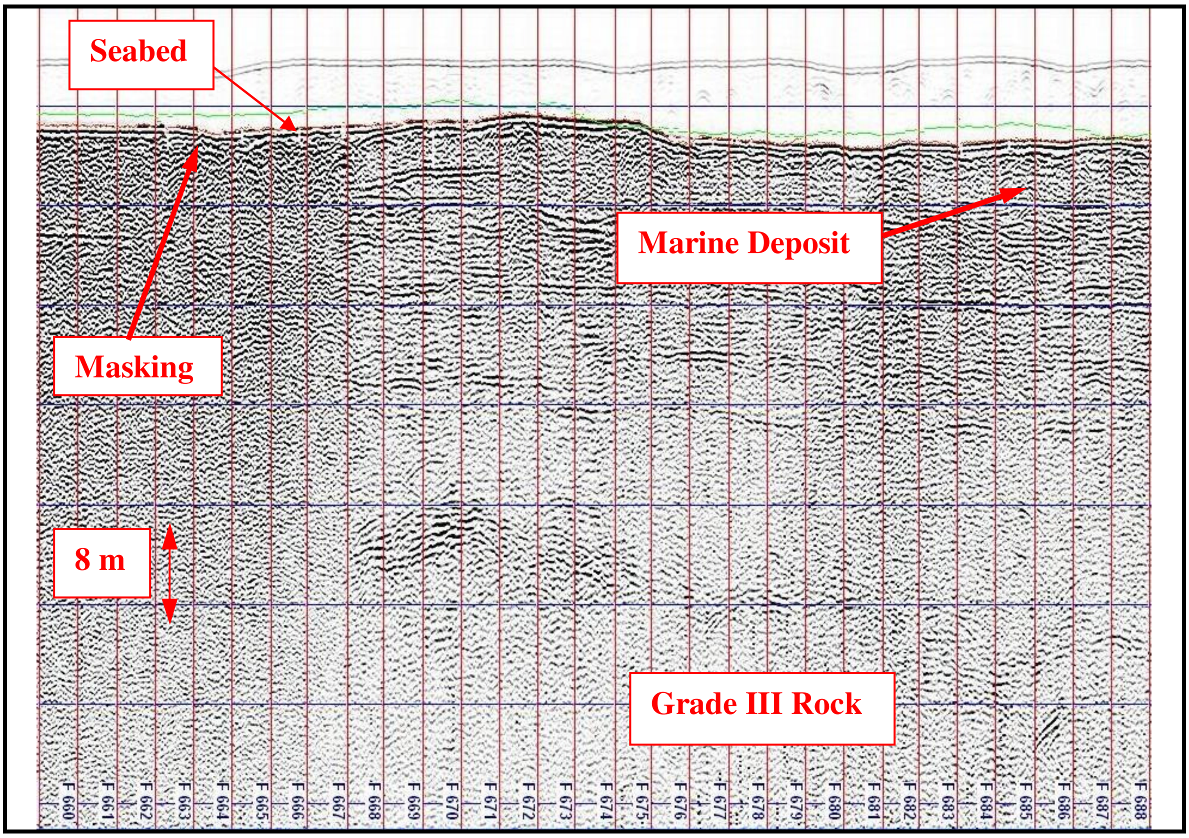


Figure 5.11: Data example of seismic record which shows a masking area

5.3.4 Seabed Features

5.3.4.1 Characteristics of the Sea Bed in the Study Area

The natural seabed comprises sand and gravel in the main fairway near Hong Kong Island, grading to finer sediments in the approaches to the To Kwa Wan typhoon shelter. The main anthropogenic features were:

- Rock forming the breakwaters protecting the To Kwa Wan typhoon shelter, with rope or chain trailing into the water and continuing a short distance across the seabed sediments.
- There is scattered debris and dumped material along the whole route. Only the most prominent features have been identified individually.
- Numerous anchor scars to the north of the main fairway. As the tidal currents flood and ebb, anchored vessels rotate around a fixed anchor point. When the vessel swings round, it pulls the anchor chains across the seabed leaving a distinctive scar in the seabed sediments.
- A few trawl scars, where fishing nets have been pulled across the seabed.
- In the north western half of the corridor, there were large patches of the seabed which reflected the sonar signal strongly. The cause could not be identified with certainty, so they have been annotated on the plans as “high reflectivity seabed”. However, combined with the seismic evidence, it appears plausible that they are accumulations of sewage decomposing on the seabed.

5.3.5 Sonar Contacts

Interpretation of the first phase of side scan sonar data identified 13 significant sonar contacts. On further analysis two of these (SC001 & SC003) appeared to be different components of the same contact as seen in Figure 5.15 below. There are therefore only 12 sonar contacts. Of these, 3 lie within 50m of the proposed alignment and will impacted by the dredging.

All of these contacts are anthropogenic in origin and could have archaeological potential. The details and data for each contact are listed below:

Contact Number	Easting Northing	Water Depth (m)	Dimensions (m)	Distance to proposed pipeline A1 (m)	Description
WH2_SC001	838,088 819,317	7.2	25.2 x 0.5 x 0.7	58.5	unidentified
WH2_SC002	838,074 819,311	7.7	6.9 x 1.8 x 0.5	**43.5**	unidentified
WH2_SC003	838,089 819,318	7.2	25.2 x 0.5 x 0.7	59.9	unidentified
WH2_SC004	838,030 819,337	5.7	2.2 x 2.5 x 2.5	**30.7**	unidentified
WH2_SC005	838,034 819,248	7.6	10.0 x 1.1 x 0.3	**24.4**	unidentified
WH2_SC006	837,958 819,243	7.8	6.6 x 1.5 x 0.7	66.6	unidentified
WH2_SC007	837,987 819,416	6.8	1.9 x 0.7 x 1.1	107.4	unidentified
WH2_SC008	837,938 819,439	5.8	5.0 x 0.4 x 0.3	128.3	unidentified
WH2_SC009	837,900 819,450	4.4	5.8 x 0.4 x 0.5	137.7	unidentified
WH2_SC010	838,287 818,732	11.4	7.5 x 8.7 x 4.0	130.0	unidentified
WH2_SC011	838,476 818,857	8.6	3.7 x 0.5 x 0.4	88.1	unidentified
WH2_SC012	839,418 817,417	12.6	3.3 x 0.7 x 1.7	87.8	unidentified
WH2_SC013	839,215 818,359	10.4	2.2 x 2.3 x 0.9	75.9	unidentified

On the EGS Seabed Features Chart Figures (7.2 & 7.2) 11 of the sonar contacts have been classified as *debris* while two remain *unidentified*. Within a busy shipping area, in water depths of 10-13m, with evidence of recent seabed disturbance, the survey classification of *debris* is understandable and logical. However, from an archaeological perspective these targets could be contemporary debris from modern vessels or artefacts of historical significance. While the former is more likely, the latter cannot be ruled out without proper ground truthing.

The second phase of geophysical survey in 2008 did not locate any additional targets. Each target was plotted in relation to the revised pipeline route and three were located less than 50m from the centreline. SC001 and SC003 are actually sections of the same feature. Although they were more than 50m away from the centreline a diving inspection was conducted as a precautionary measure.

5.3.6 Side Scan Sonar Data indicating Seabed Characteristics

Examples of the side scan images indicating seabed features are provided below:

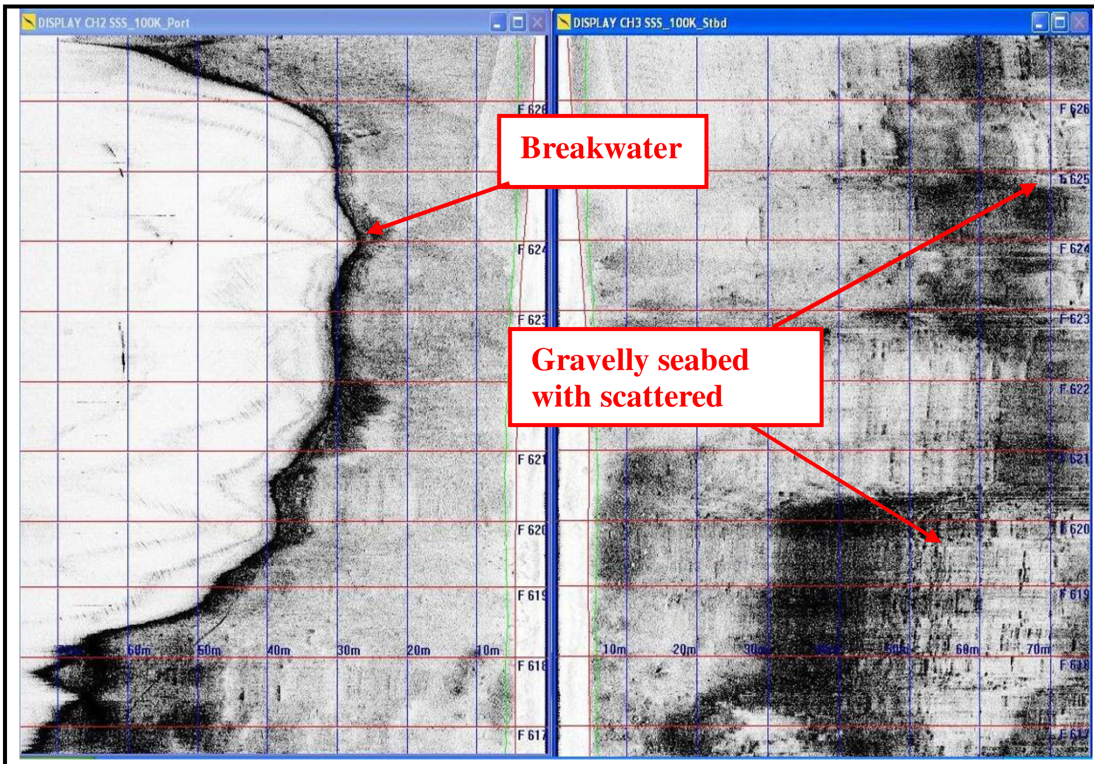


Figure 5.12: Side scan sonar data example of centerline, near To Kwa Wan breakwater

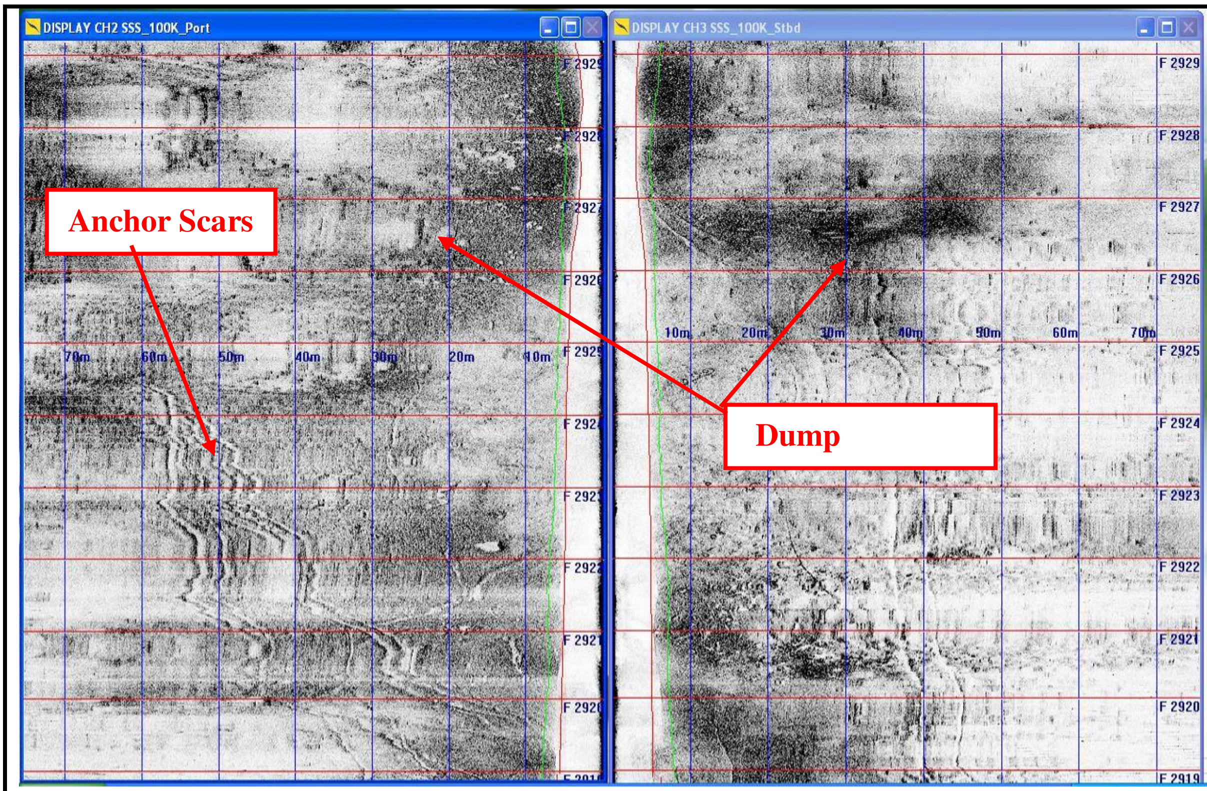


Figure 5.13: Side scan sonar data example of dumped materials and anchor scars.

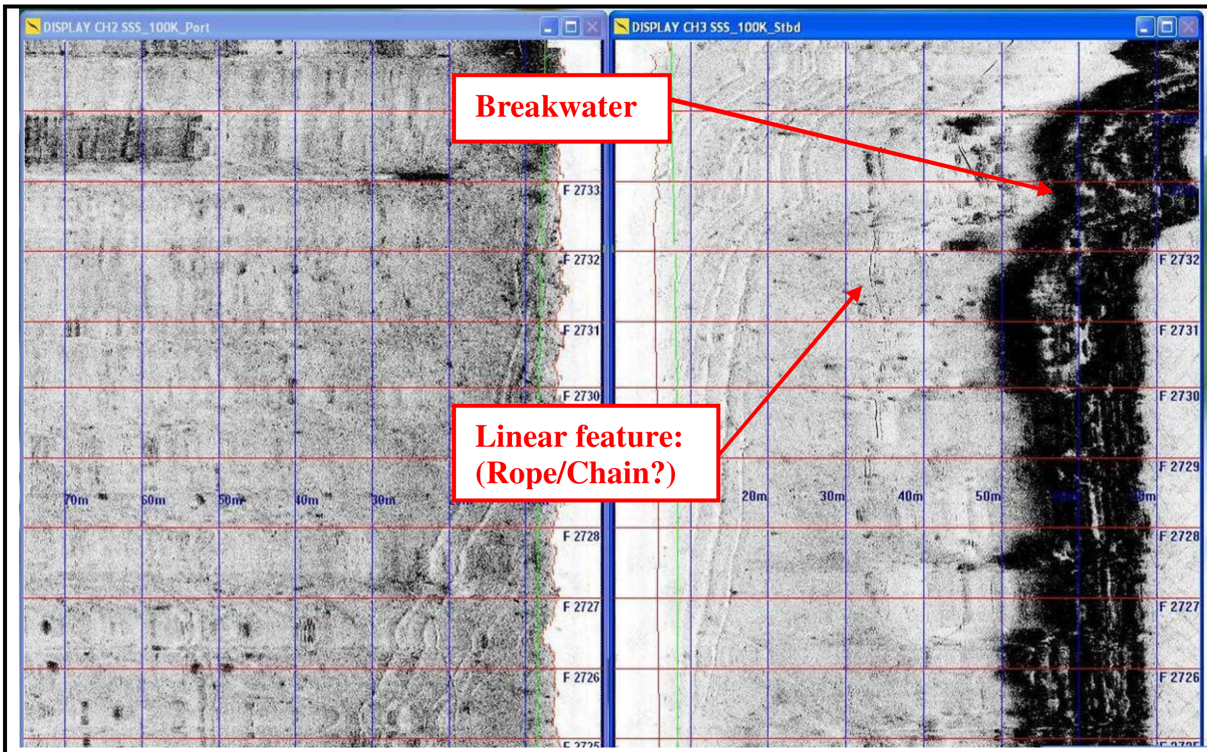


Figure 5.14: Side scan sonar data example of possible rope/chain near To Kwa Wan breakwater

Copies of the side scan sonar data showing each of the 13 sonar contacts.

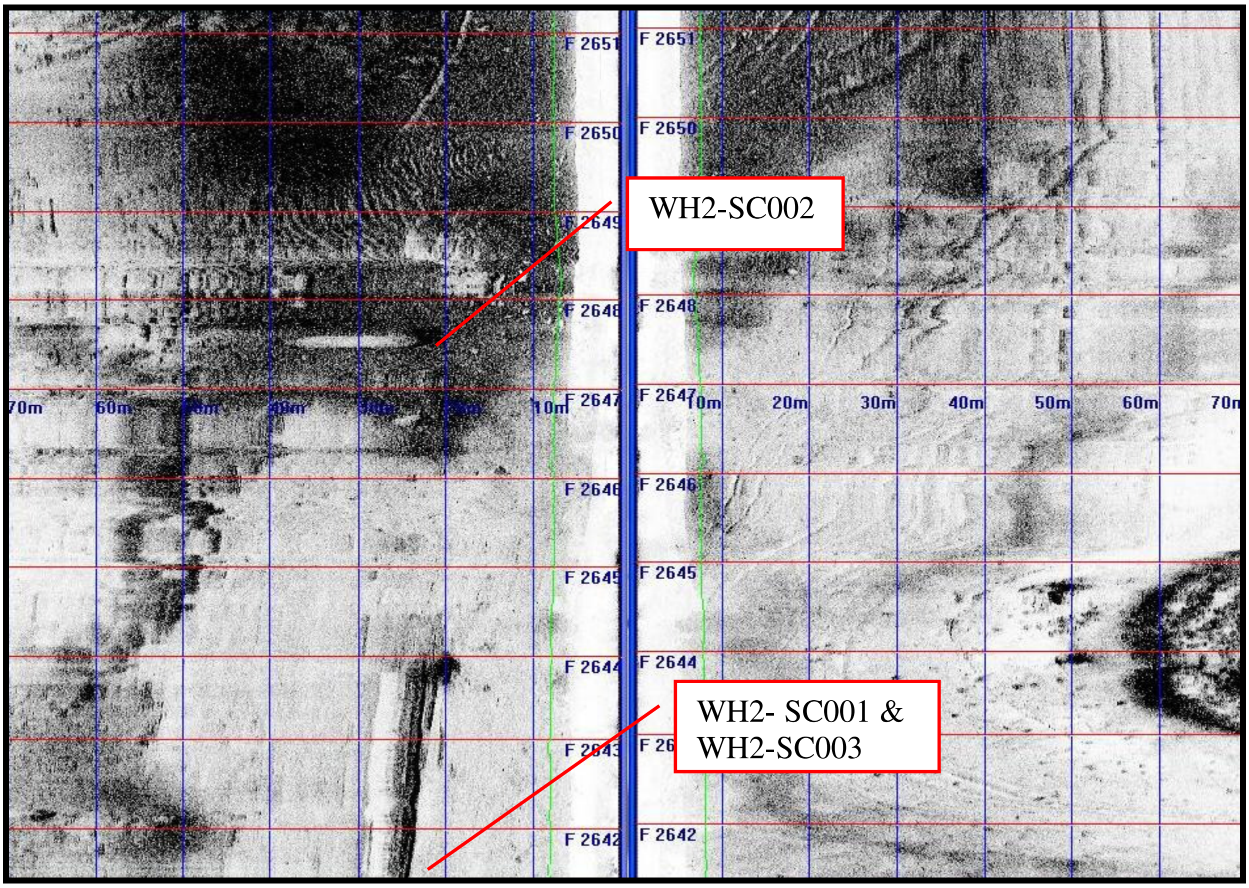


Figure 5.15: Side scan sonar data showing WH2_SC001, WH2_SC002 & WH2_SC003

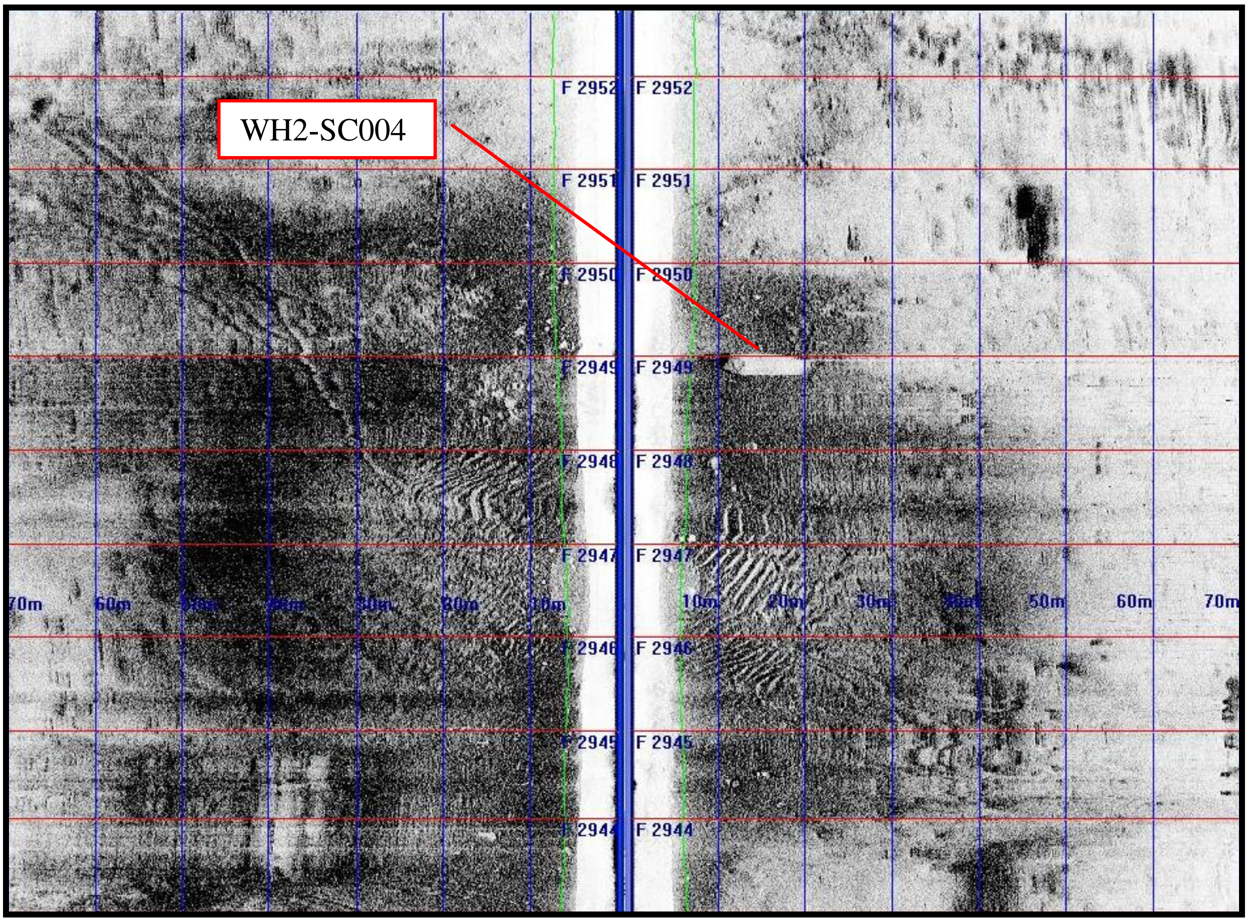


Figure 5.16: Side scan sonar data showing WH2_SC004

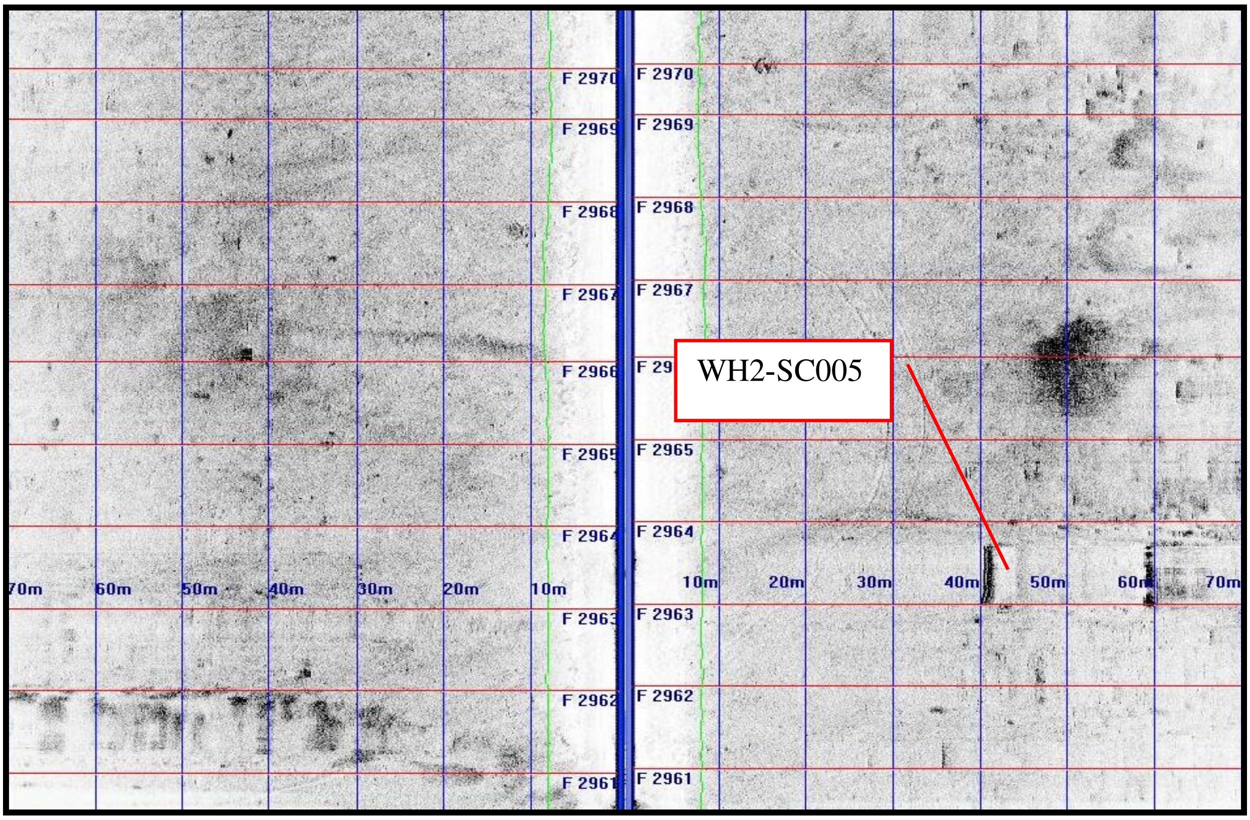


Figure 5.17: Side scan sonar data showing WH2_SC005

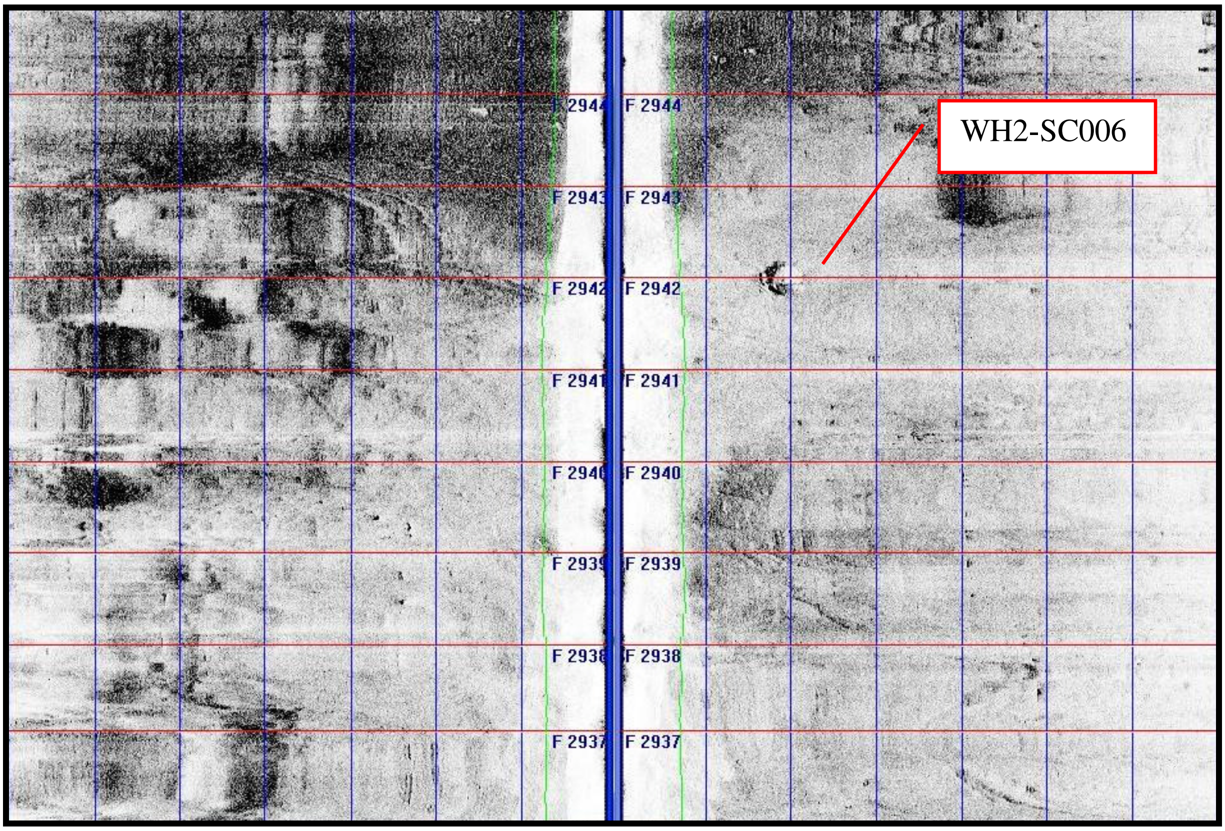


Figure 5.18: Side scan sonar data showing WH2_SC006

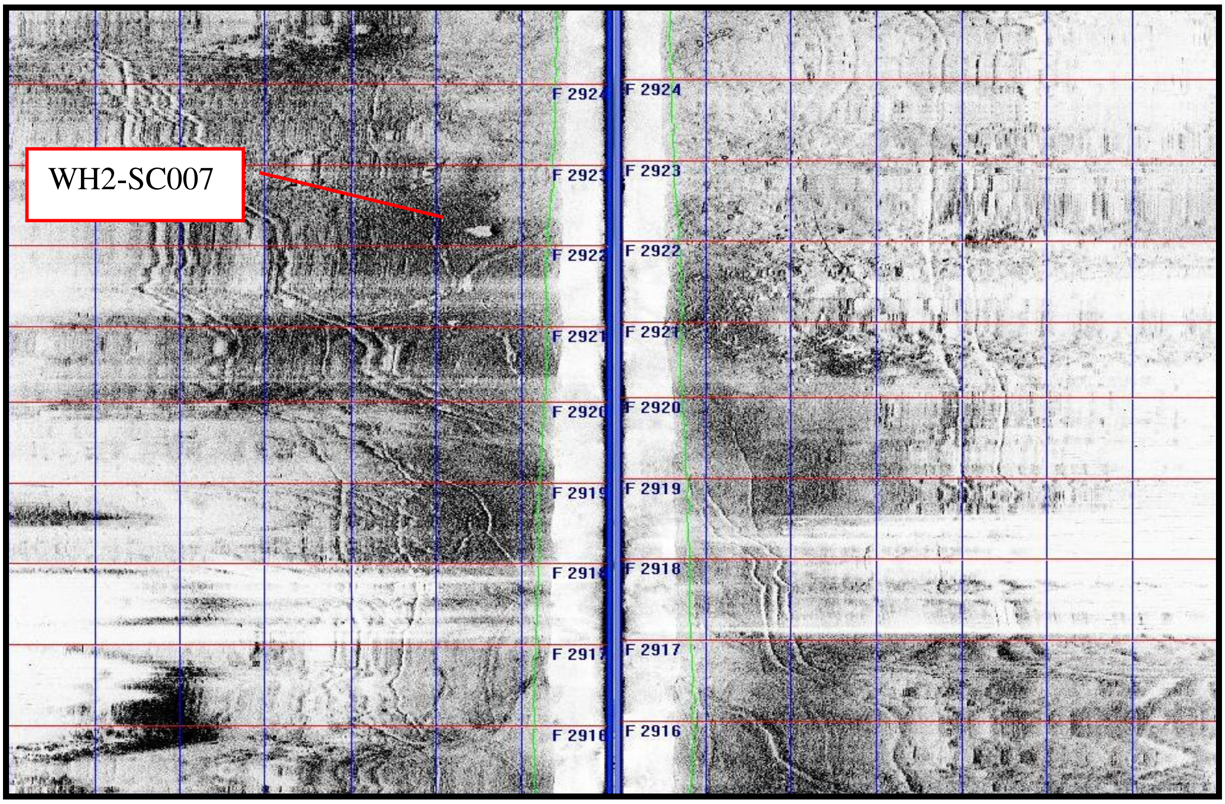


Figure 5.19: Side scan sonar data showing WH2_SC007

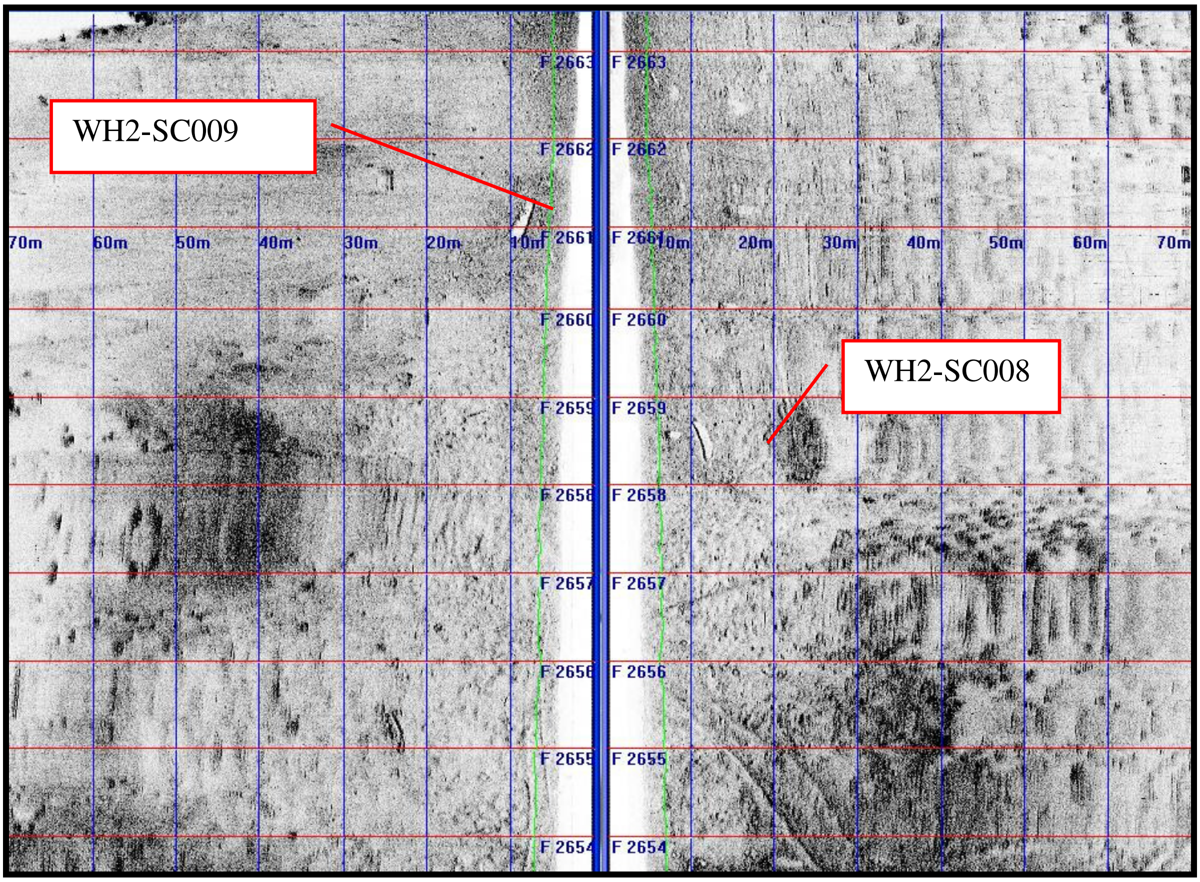


Figure 5.20: Side scan sonar data showing WH2_SC008 & WH2_SC009

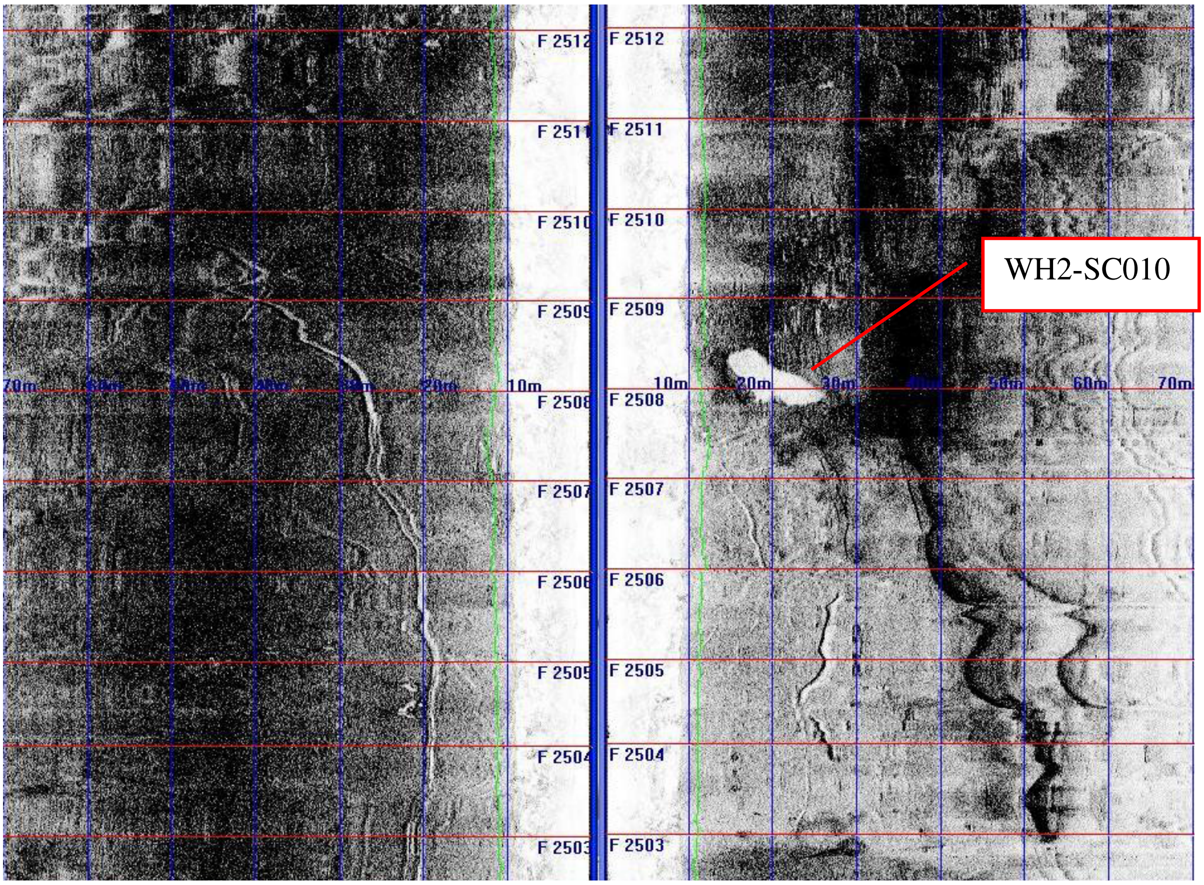


Figure 5.21: Side scan sonar data showing WH2_SC010

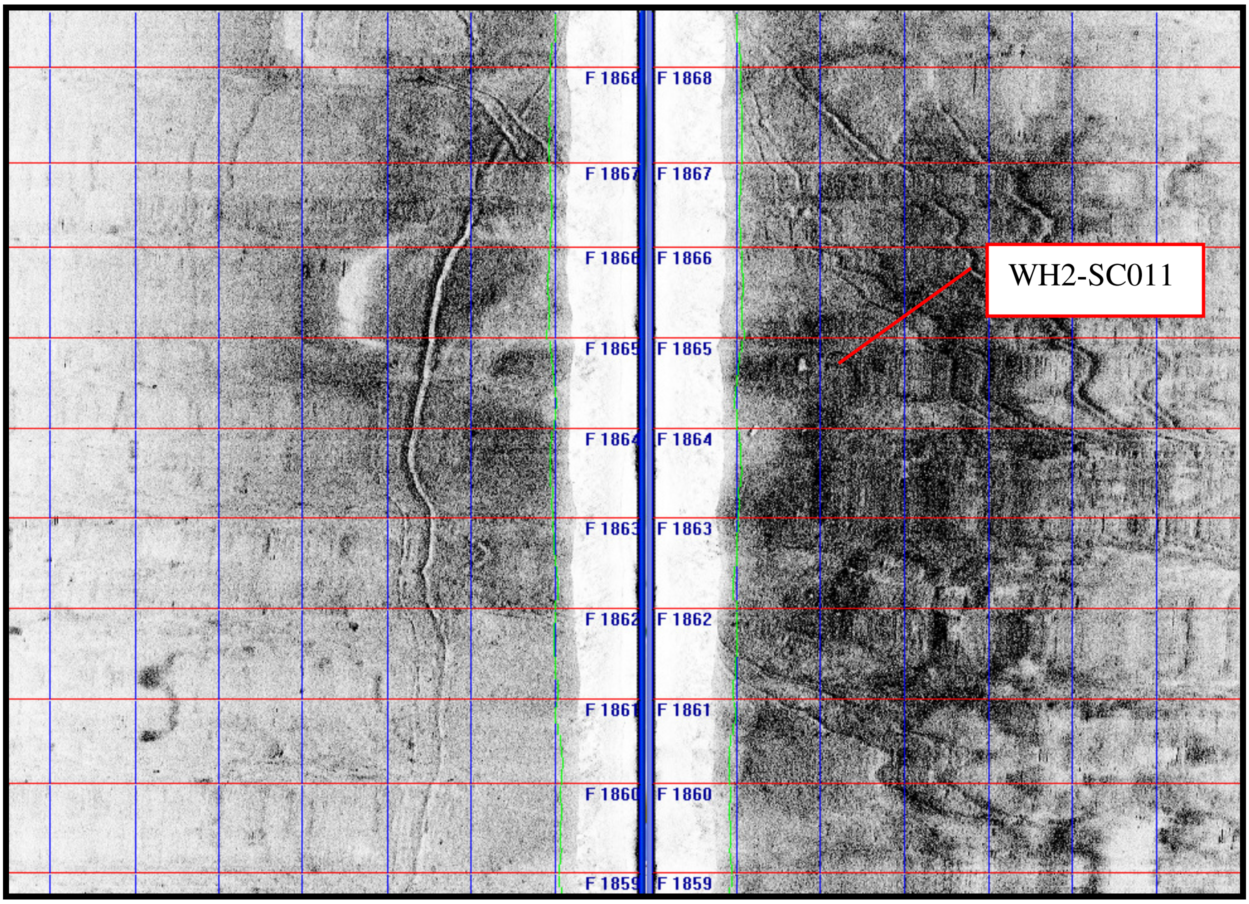


Figure 5.22: Side scan sonar data showing WH2_SC0011

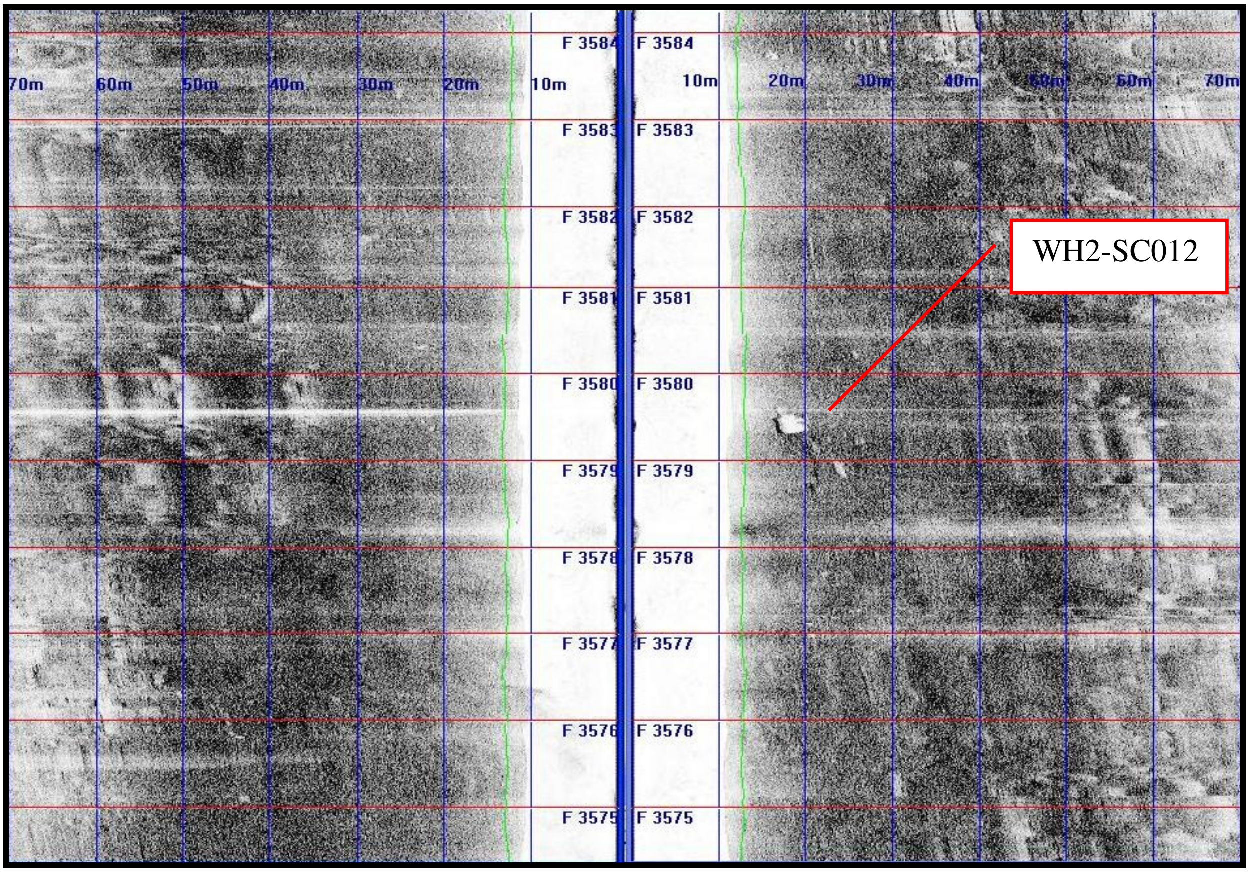


Figure 5.23: Side scan sonar data showing WH2_SC0012

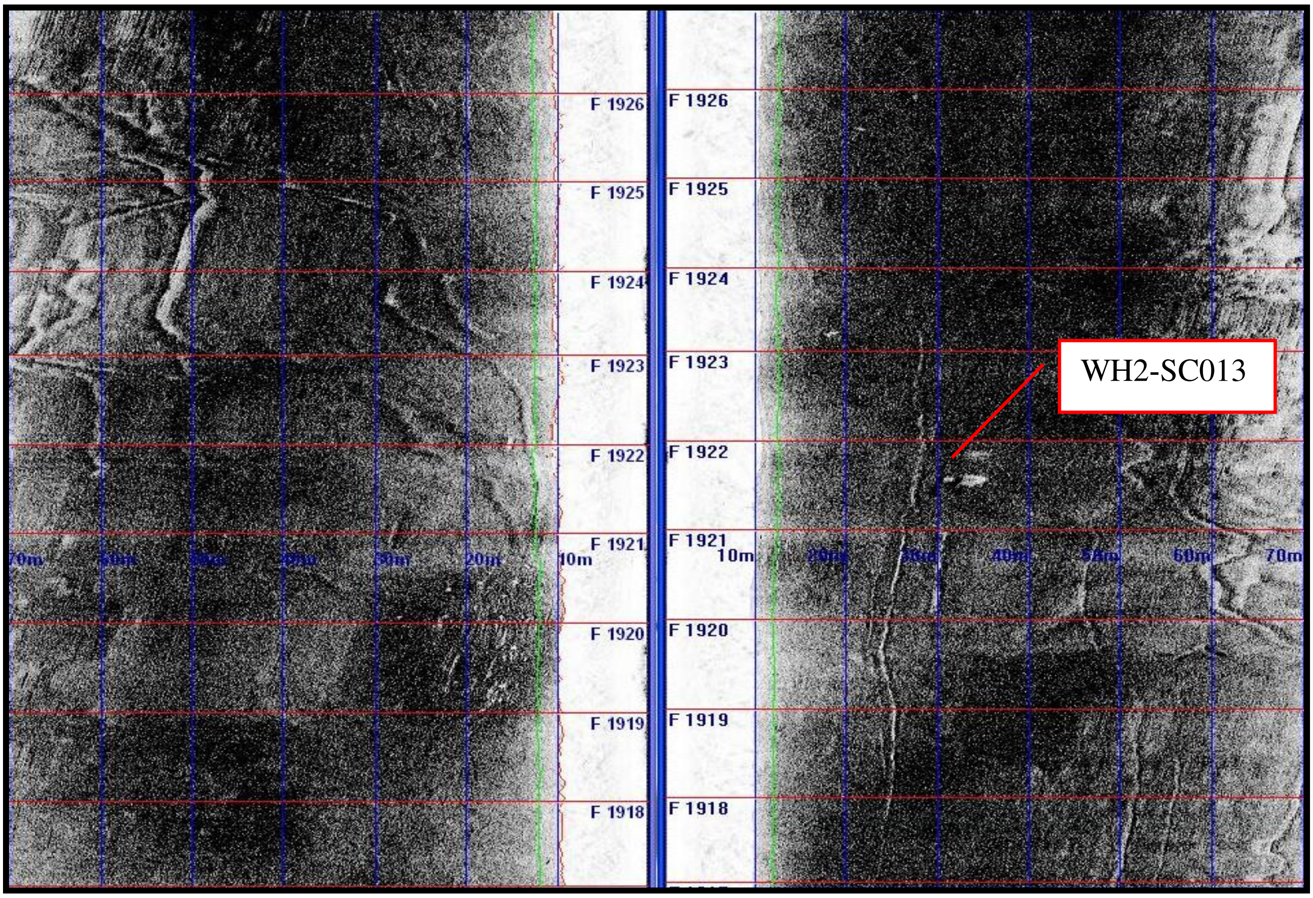


Figure 5.24: Side scan sonar data showing WH2_SC0013

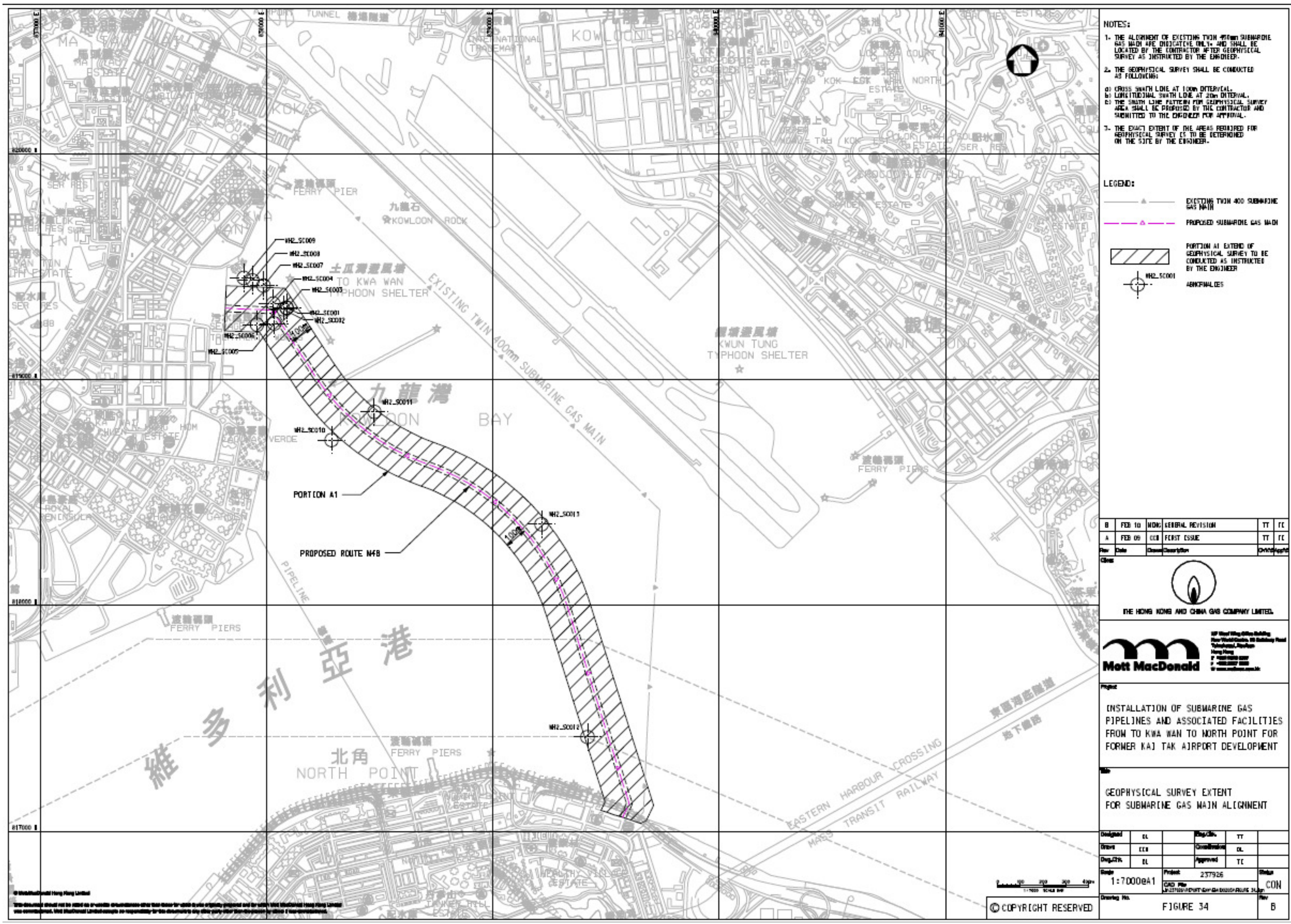


Figure 5.25: Position of the thirteen sonar contacts in relation to the final pipeline alignment

5.3.7 Accuracy

The following estimates of accuracy apply:

- Sea bed levels +/- 0.15m
- Sea bed features +/- 3m
- Base of marine deposits +/- 1m
- Top of rock in any state of decomposition +/- 2m
- Top of presumed grade III rock +/- 3m

5.4 Diving inspection

5.4.1 WH2_SC002

The diver located the sonar target 4m from the sinker. It was identified as modern fishing debris including degraded metal as seen in the photograph below. The probe was able to penetrate the seabed to a depth of 0.8m but did not locate any additional buried material.

Figure 5.26: Modern fishing equipment and metal debris on the seabed.

The diver located the target .5m from the sinker. It comprised a large pile of rope which must have fallen from an anchored vessel. The diver was able to move the rope sufficiently to look under and around the rope but did not locate any material with archaeological potential. The probe was able to penetrate the seabed to a depth of 1.2m but did not locate any additional buried material.

Figure 5.27: Abandoned rope on the seabed.

Figure 5.28: Abandoned rope on the seabed.

5.4.2 WH2_SC004

The diver located the target 2.4m from the sinker. It was identified as a modern mooring block with chain still intact as seen in the photograph below. The probe was able to penetrate the seabed to a depth of 0.9m but did not locate any additional buried material.

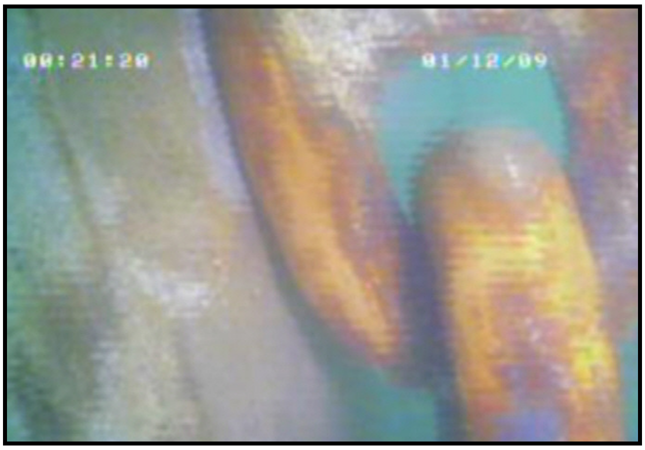


Figure 5.29: Chain from a modern mooring block.

5.4.3 WH2_SC005

The diver located the target 3.2m from the sinker and it was identified as a cluster of modern debris including concrete blocks and metal as seen in the photographs below. The probe was able to penetrate the seabed to a depth of 0.75m but did not locate any additional buried material.

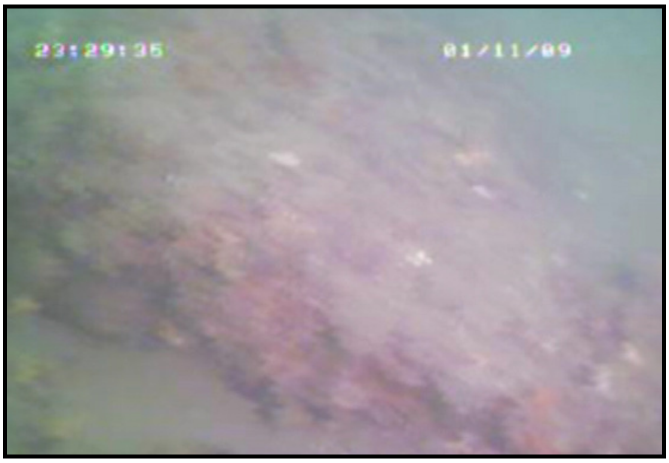


Figure 5.30: Block of modern concrete with marine growth.

Figure 5.31: Modern debris.

5.4.4 WH2_SC001 & SC003

The sinker was placed at a mid point between the two sonar contacts. A large scatter of concrete boulders and modern debris were located scattered across the seabed. The diver was able to look underneath the boulders but there was no evidence for archaeological remains. The probe was able to penetrate 80cm into the seabed sediments but no buried objects were found.

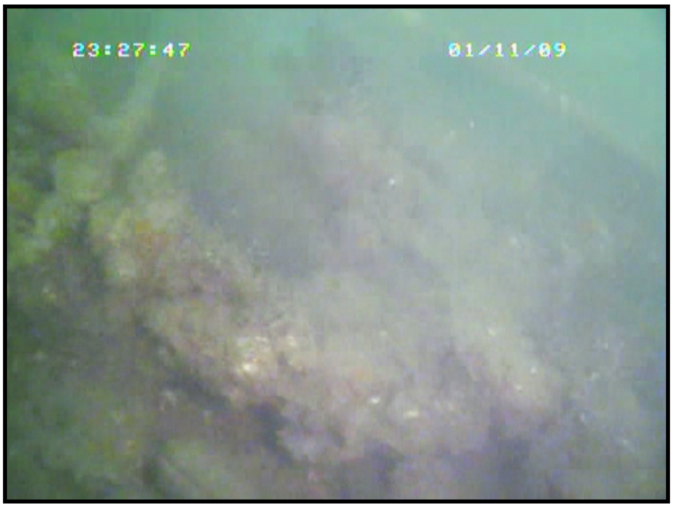


Figure 5.32: Modern Concrete Debris with marine growth

6. Impact of the Pipeline Installation on the Seabed

Two 450mm submarine pipelines will be installed between To Kwa Wan (TKW) and North Point across Victoria Harbour with two proposed gas stations to be built on land at the two ends. Construction of the new submarine gas pipelines will require dredging a trench to a depth of 6 – 9 m and 29 – 49m across.

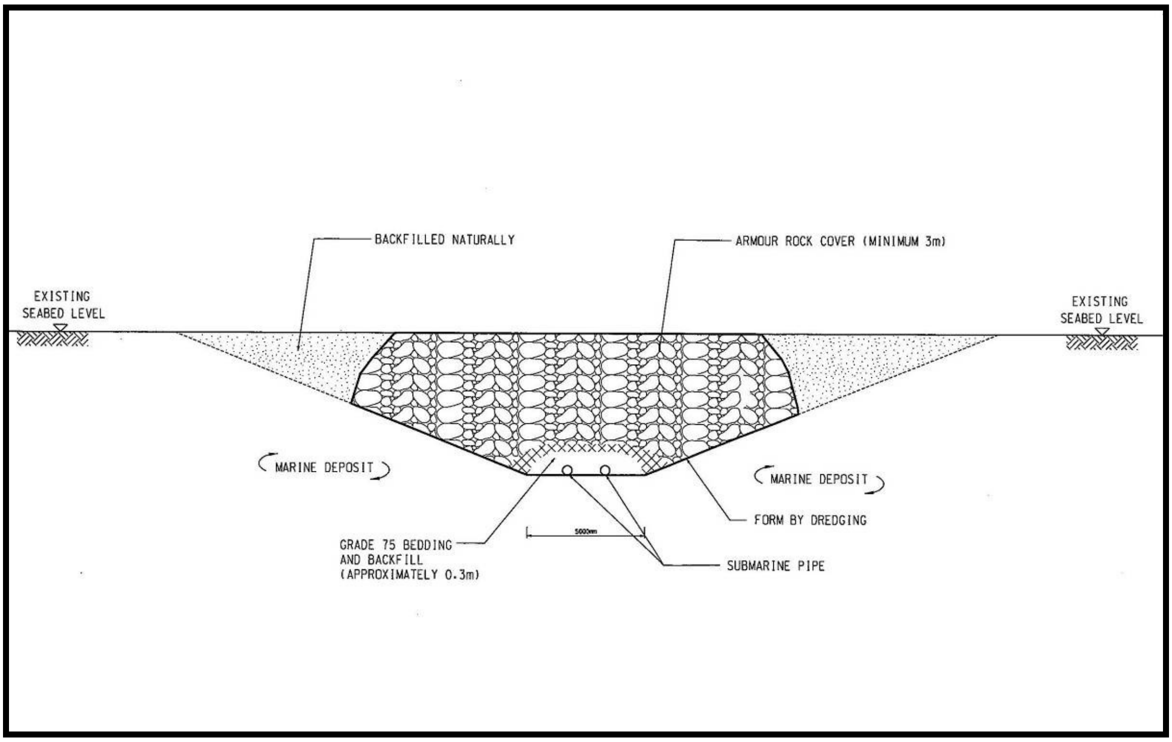


Figure 6.1: Section across the pipeline.

Once the pipelines have been installed the trench will be backfilling and rock-dumping. The rock backfilling would be conducted by manoeuvrable barges.

The immense volume of dredging would result in the damage or destruction of any submerged cultural resources, if present on the seabed. The dredging will be carried out by grab dredger.

7. Conclusion

7.1 Identification of Cultural Heritage Impact

The MAI did not locate any submerged cultural heritage. However gas masking prevented 100% geophysical survey coverage. There are therefore some sections of the study area for which it was not possible to make an assessment.

7.2 Assessment of Cultural Heritage Impact

In areas where there was 100% geophysical survey coverage, there were no underwater archaeological resources identified and there will be no underwater cultural heritage impact.

It is not possible to provide an assessment for areas where there was no geophysical survey data.

7.3 Mitigation of Adverse Environmental Impact

There is no need for any mitigation measures or further action at the areas with 100% geophysical survey coverage.

It is not possible to provide an assessment for areas where there was no geophysical survey data.

7.4 Evaluation of Residual Cultural Heritage Impact

There will be no residual underwater cultural heritage impact in the areas with 100% geophysical survey coverage.

It is not possible to provide an assessment for areas where there was no geophysical survey data.

7.5 Environmental Monitoring and Audit

It is recommended that a monitoring brief is conducted during dredging at the locations where there is no geophysical survey data due to ‘gas masking’. The detailed requirements and locations are set out in Appendix H2.

8. References

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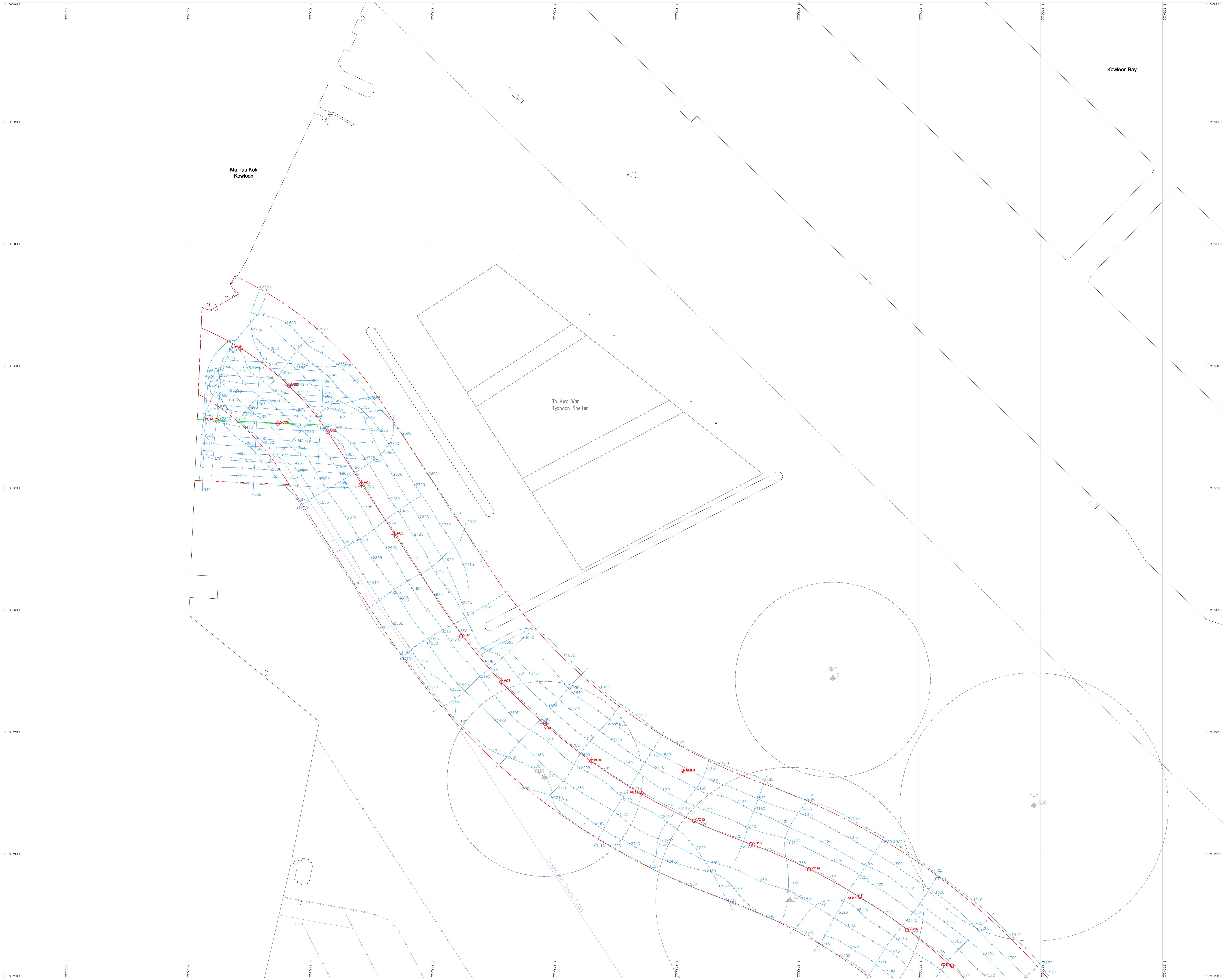

Legend :

- Hydrophone track with fix positions
- Survey boundary
- Previous RPL
- Current RPL
- Existing pipeline
- MDH1 Drillhole from client
- VC31 Vibro core from client

Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 1.1

Drawing Title :

HYDROPHONE TRACK PLOT

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	23/5/2008	Agnes Siu	Joe Lam	Matthew Lai	Survey Report
1	23/7/2008	Agnes Siu	Joe Lam	Matthew Lai	Final Report
2	14/11/2008	Agnes Siu	Joe Lam	Margie Chen	Rev. Final Rpt

METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client :

Contractor :

AP/RSE :

Surveyor :

EARTH SCIENCES & SURVEYING

EGS (ASIA) LIMITED
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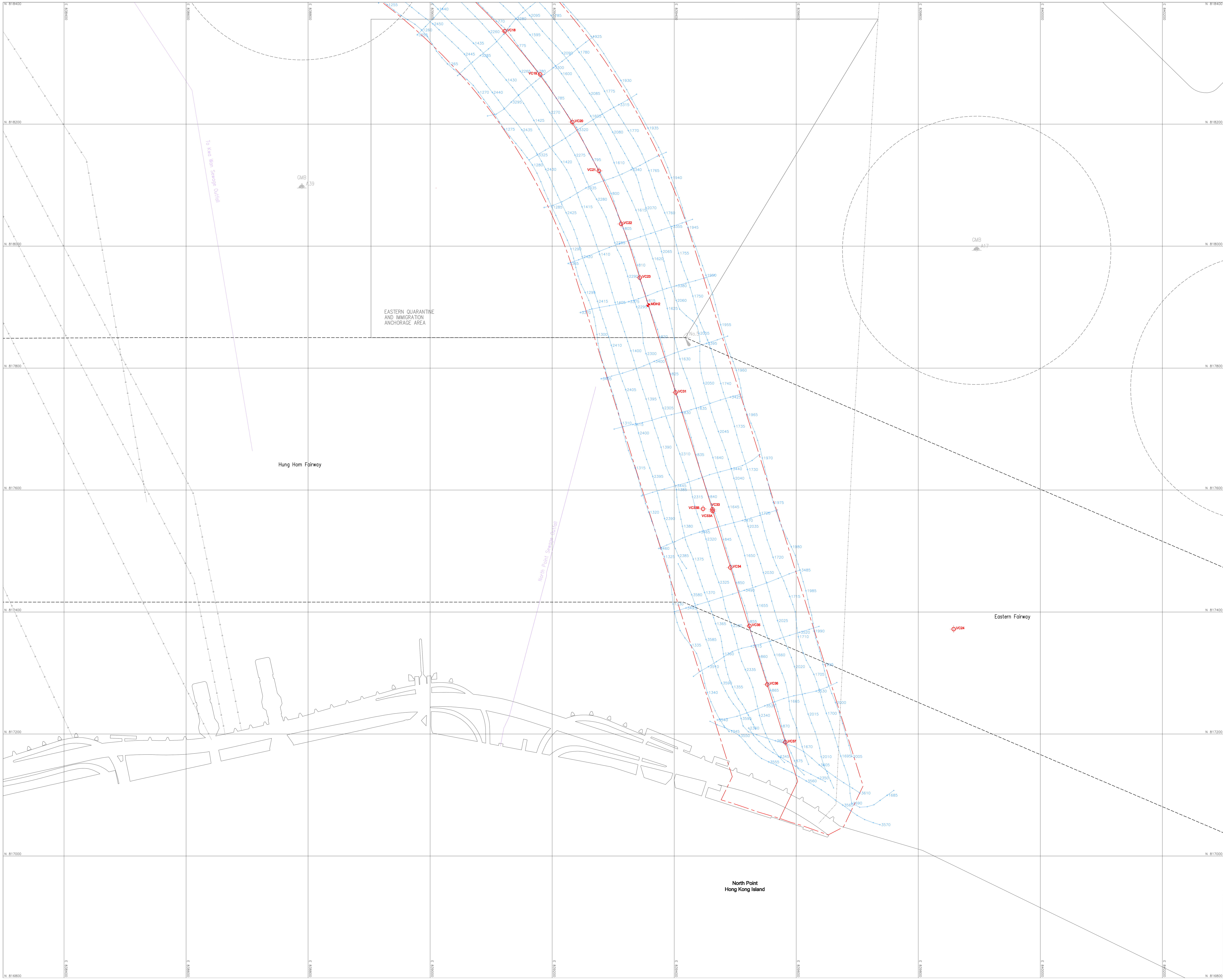
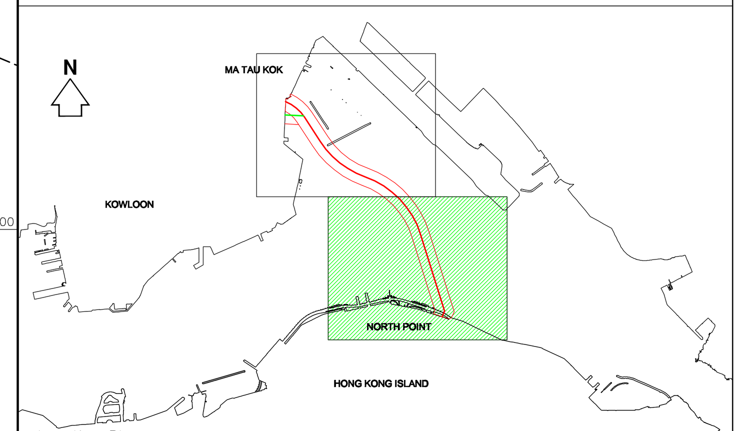
JOB NO. : HK211508



Legend :

- Hydrophone track with fix positions
- Survey boundary
- Previous RPL
- Current RPL
- Existing pipeline
- MDH1 Drillhole from client
- VC31 Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 1.2

Drawing Title :

HYDROPHONE TRACK PLOT

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

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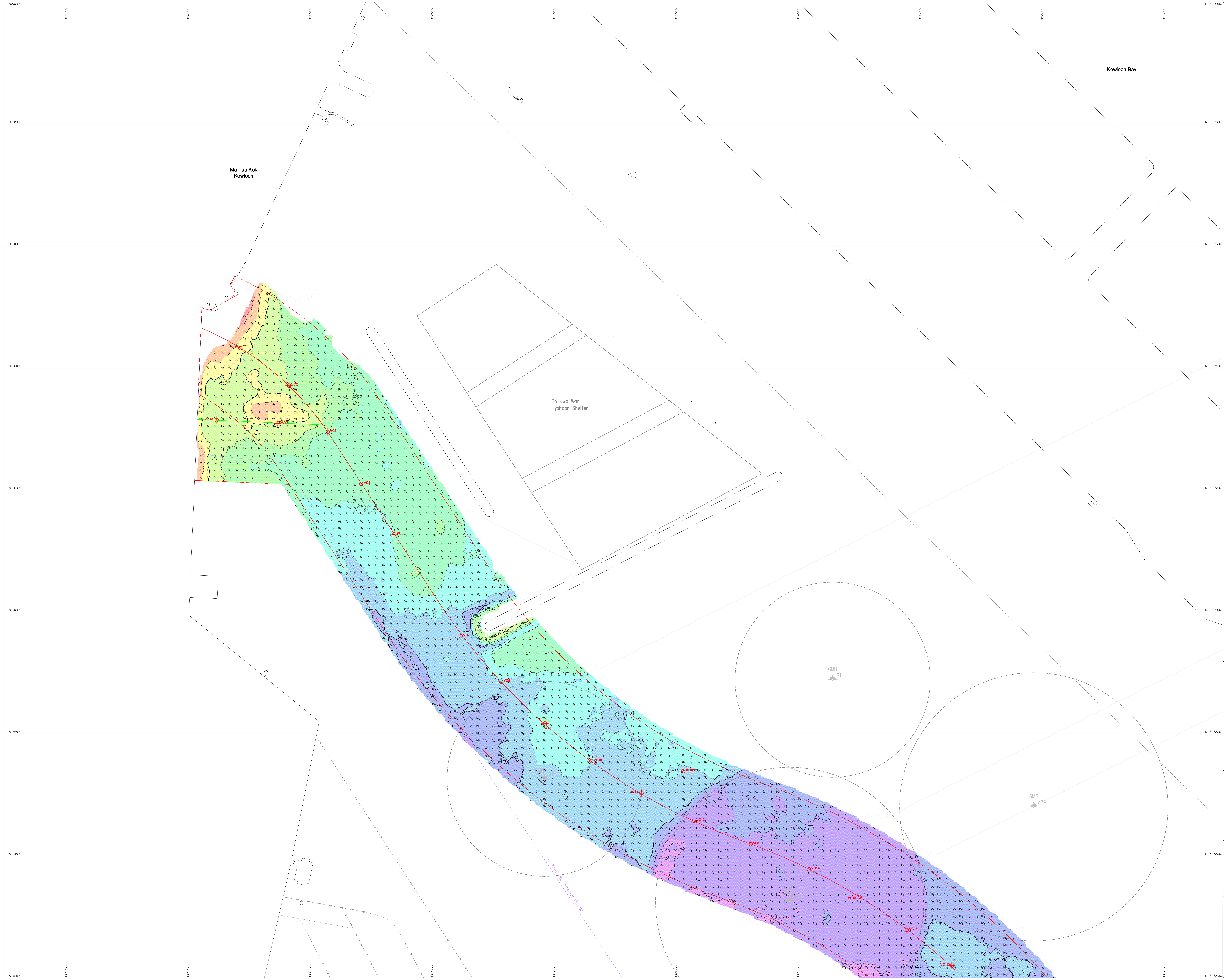
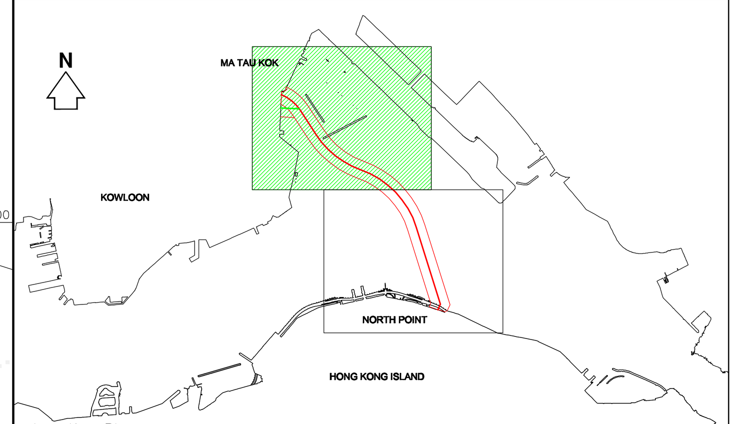


Legend :

5.5	Gridded data in metres below Hong Kong Principal Datum
	Contour at 1 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client

Metres below HKPD

2 4 6 8 10 12 14



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 2.1

Drawing Title :

COLOUR CONTOURED SWATH BATHYMETRY PLAN

Notes :
1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : Elac 1180 Swath System
   Knudsen 320M Echo Sounder
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

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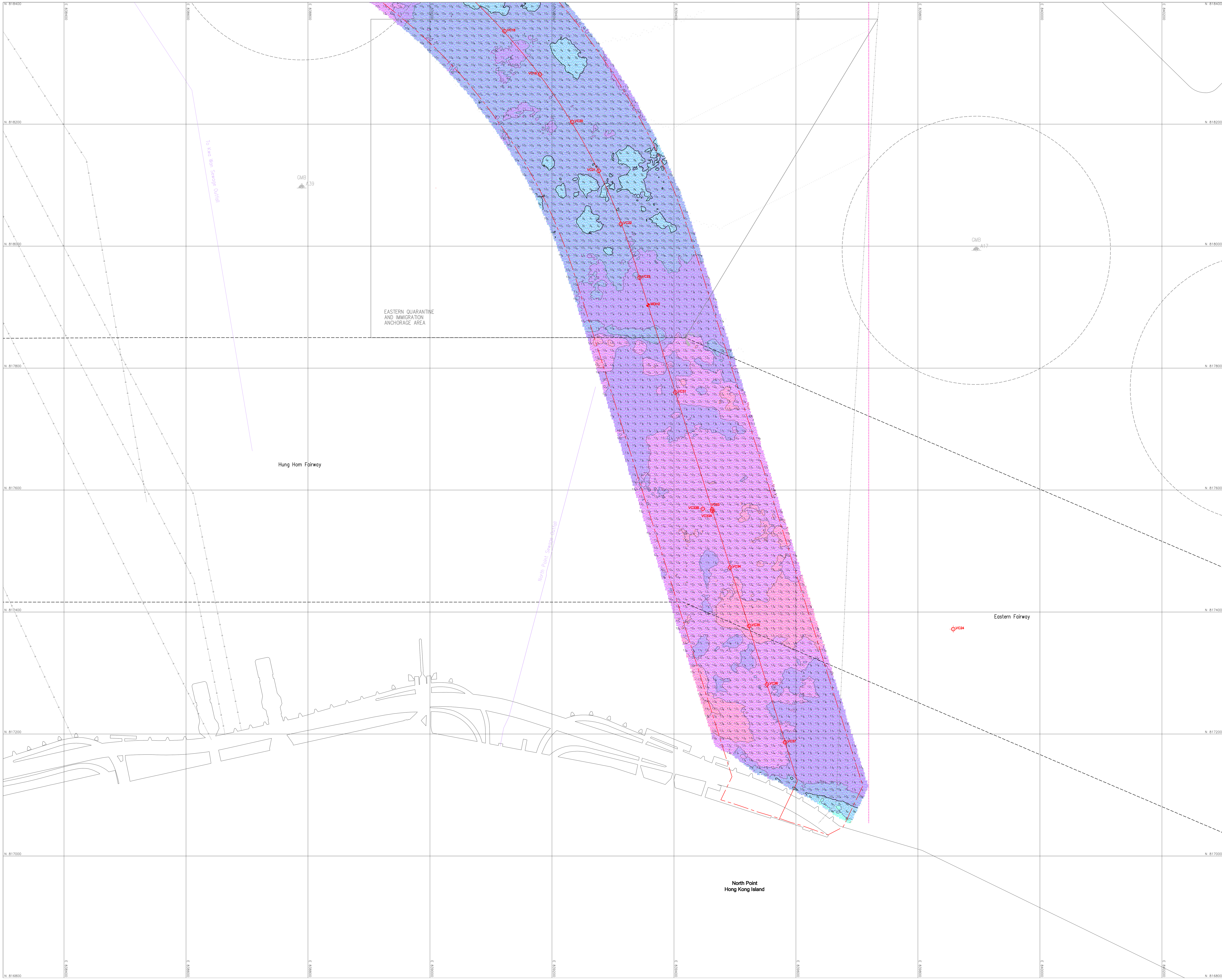
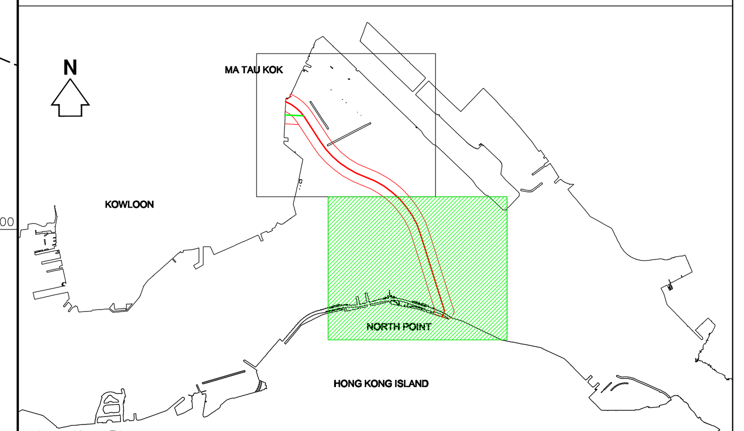


Legend :

- 5·5 — Gridded data in metres below Hong Kong Principal Datum
- Contour at 1 metre interval
- Survey boundary
- Previous RPL
- Current RPL
- Existing pipeline
- MDH1 — Drillhole from client
- VC31 — Vibro core from client

Metres below HKPD

2 4 6 8 10 12 14



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 2.2

Drawing Title :

COLOUR CONTOURED SWATH BATHYMETRY PLAN

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : Elac 1180 Swath System
   Knudsen 320M Echo Sounder
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

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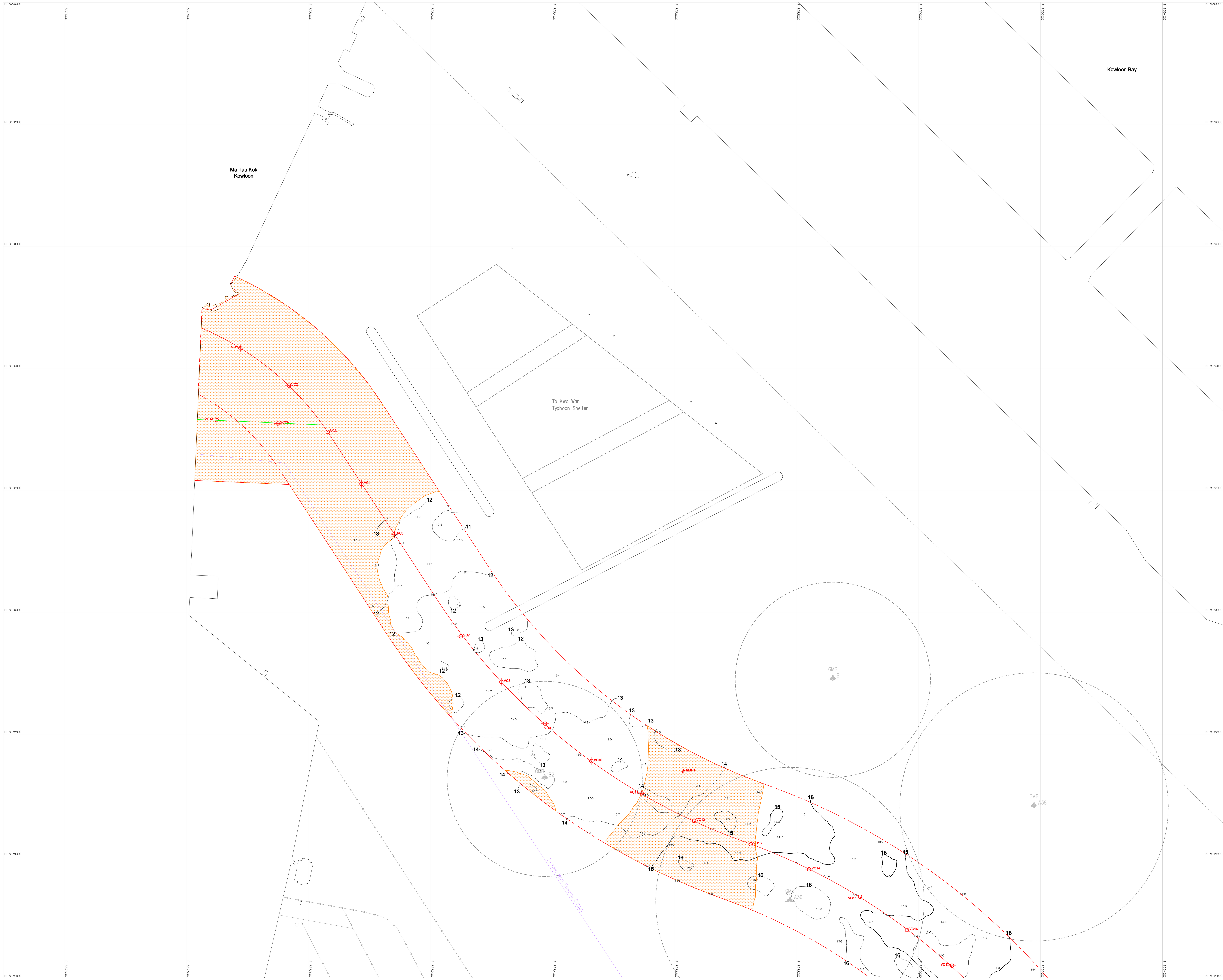

Legend :

- 5·5 — Spot value in metres below Hong Kong Principal Datum
- Contour at 1 metre interval
- Survey boundary
- Previous RPL
- Current RPL
- Existing pipeline
- MDH1 — Drillhole from client
- VC31 — Vibro core from client
- Masked zone

Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 3.1

Drawing Title :

CONTOURED LEVELS AT BASE OF MARINE DEPOSITS

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

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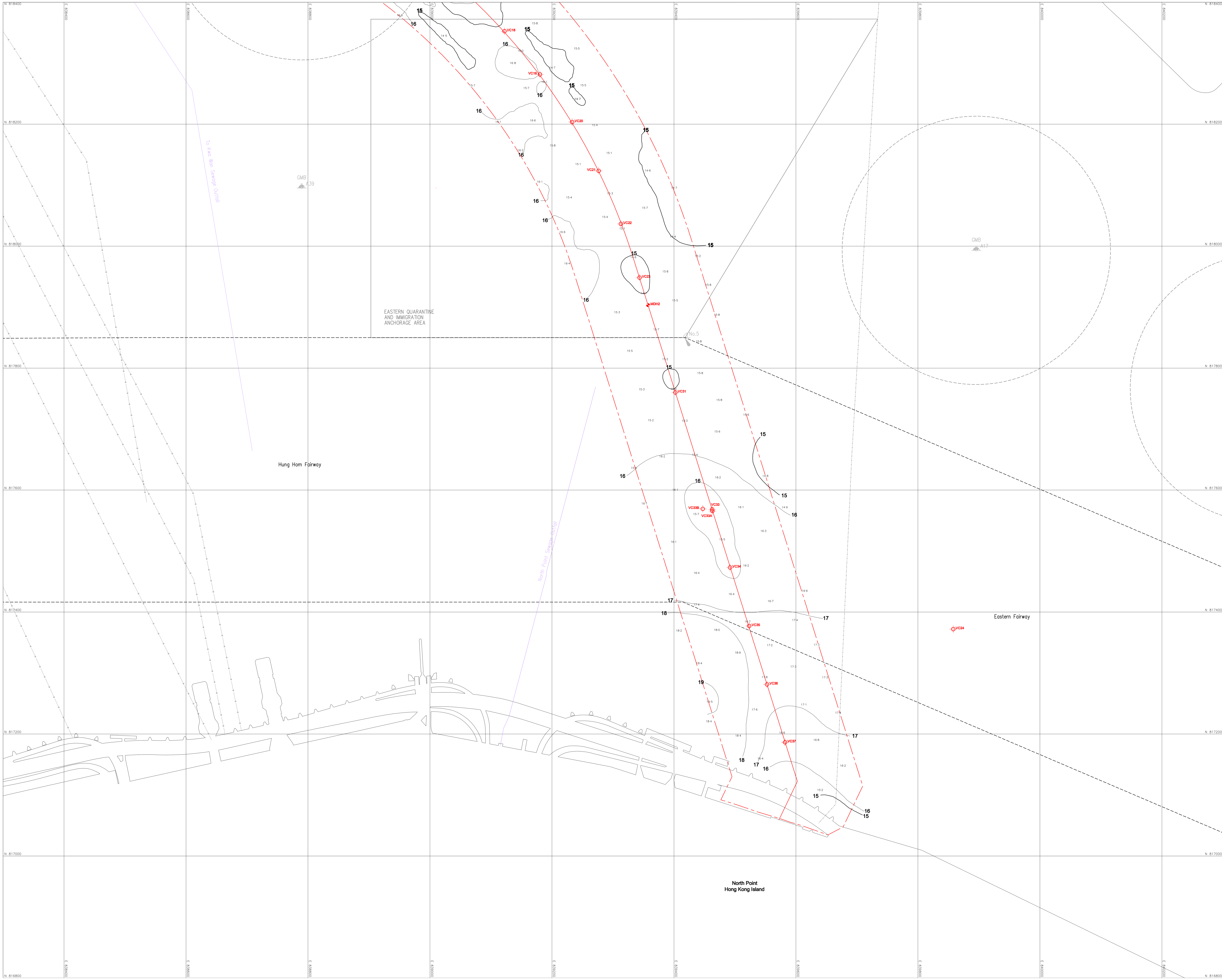
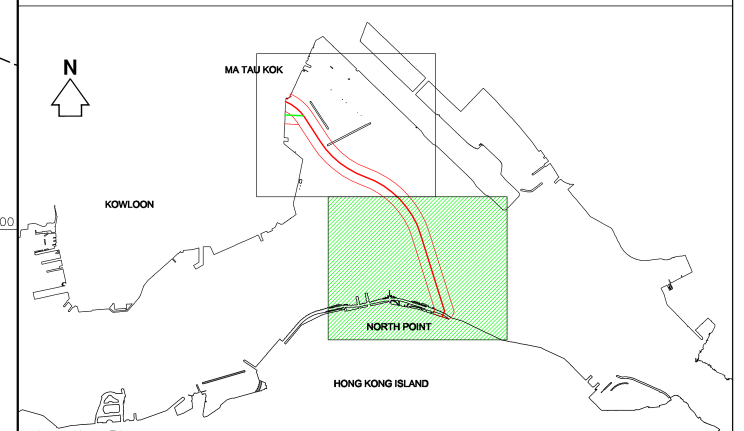


Legend :

5·5	Spot value in metres below Hong Kong Principal Datum
	Contour at 1 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 3.2

Drawing Title :

CONTOURED LEVELS AT BASE OF MARINE DEPOSITS

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : Towngas 煤氣

Contractor : Gammon

AP/RSE : Mott MacDonald

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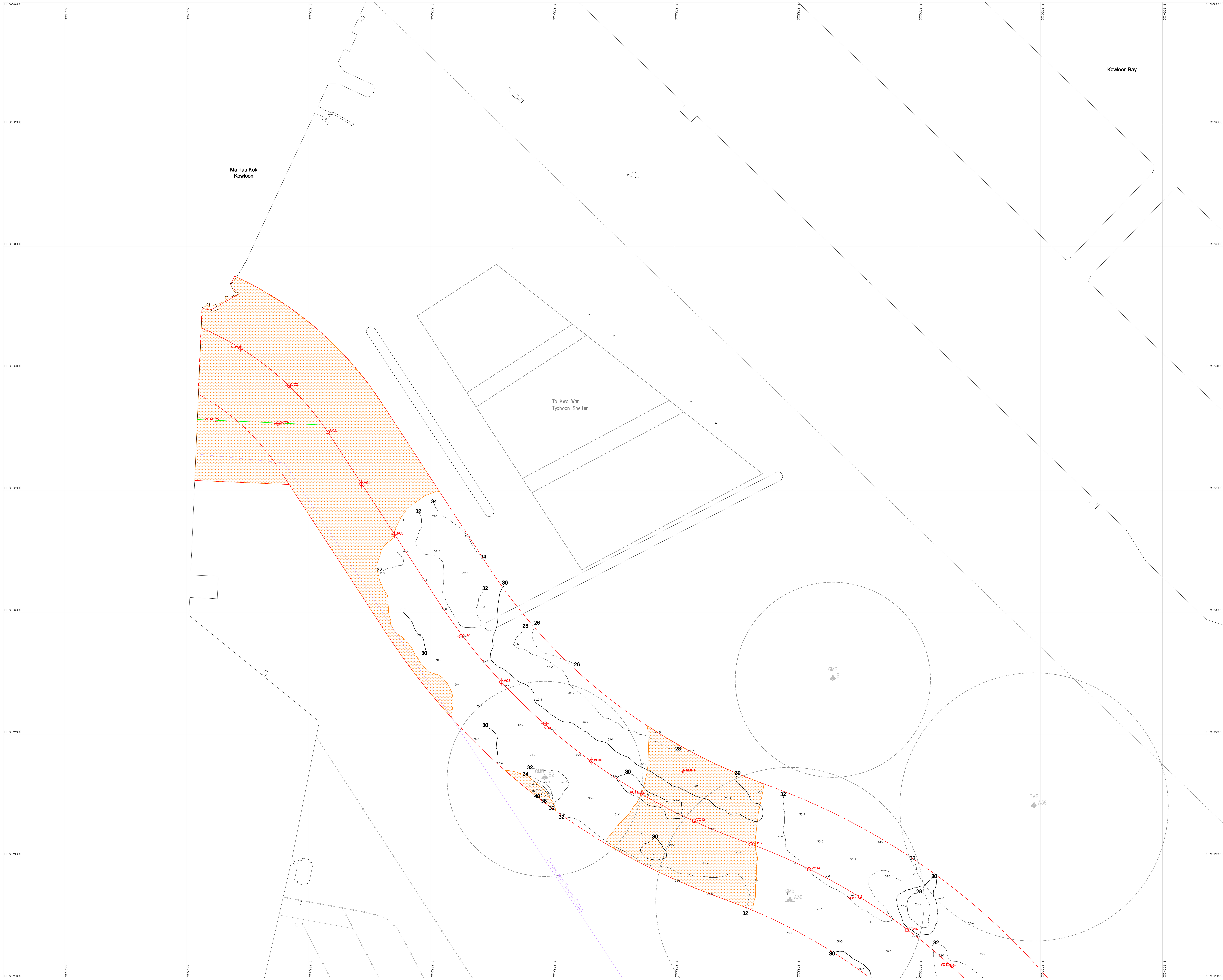
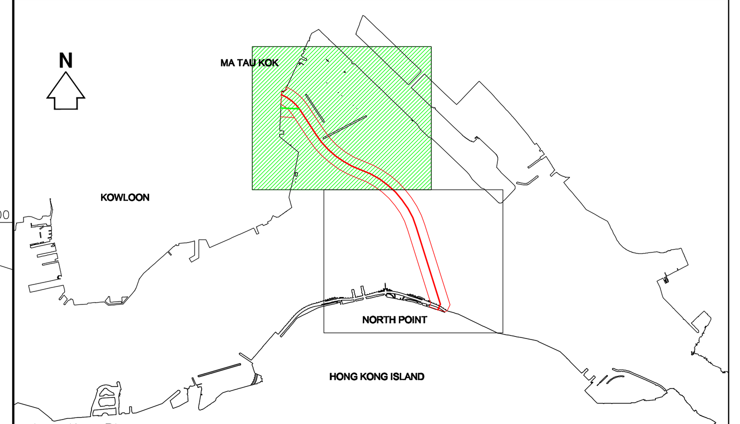


Legend :

15·5	Spot value in metres below Hong Kong Principal Datum
	Contour at 2 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client
	Masked zone



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 4.1

Drawing Title :

CONTOURED LEVELS ON TOP OF ROCK IN ANY STATE OF DECOMPOSITION

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

Surveyor : EGS

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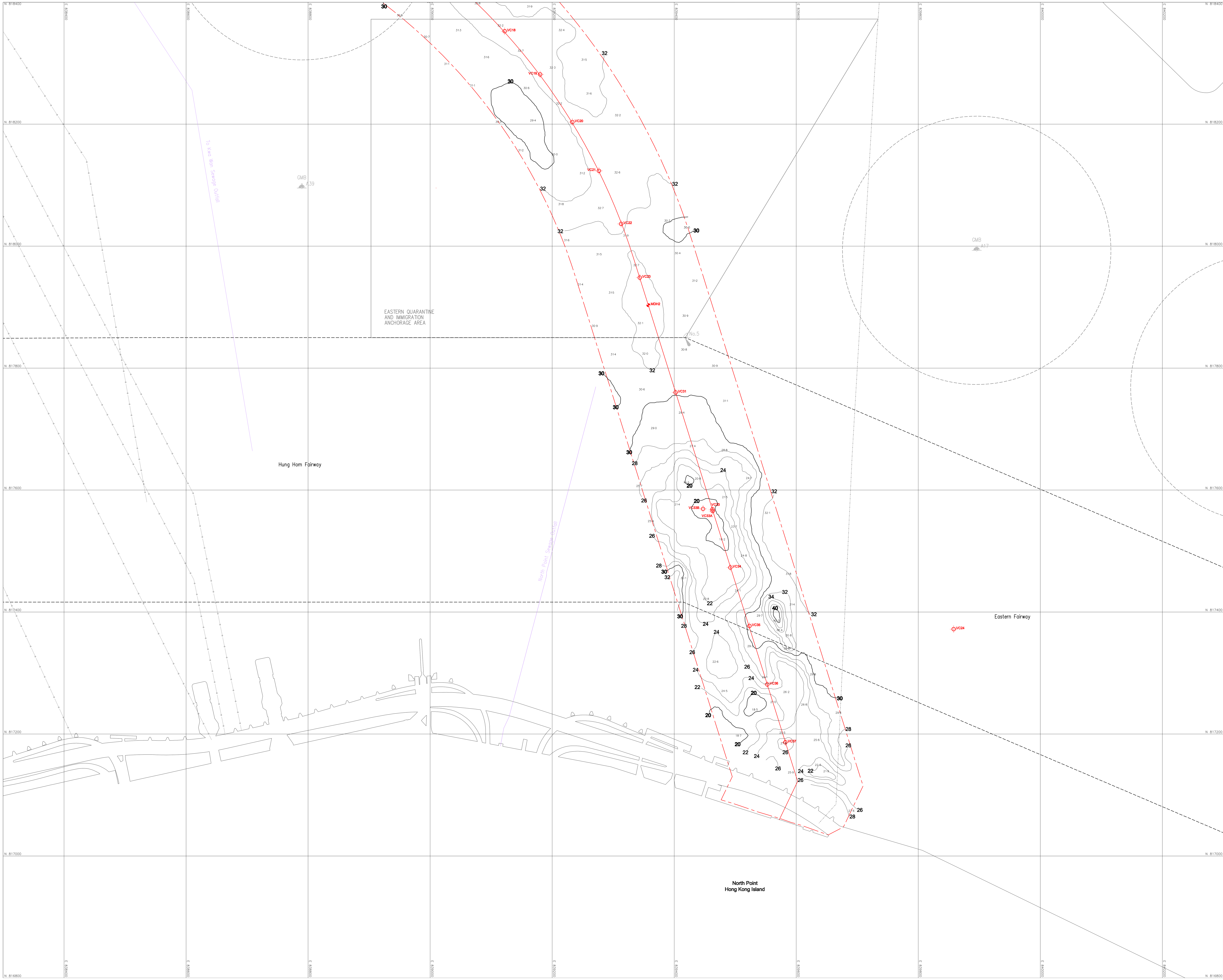
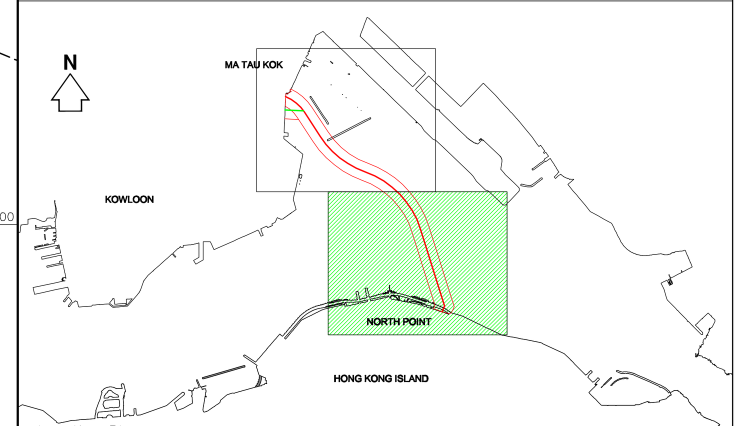


Legend :

15.5	Spot value in metres below Hong Kong Principal Datum
	Contour at 2 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 4.2

Drawing Title :

CONTOURED LEVELS ON TOP OF ROCK IN ANY STATE OF DECOMPOSITION

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

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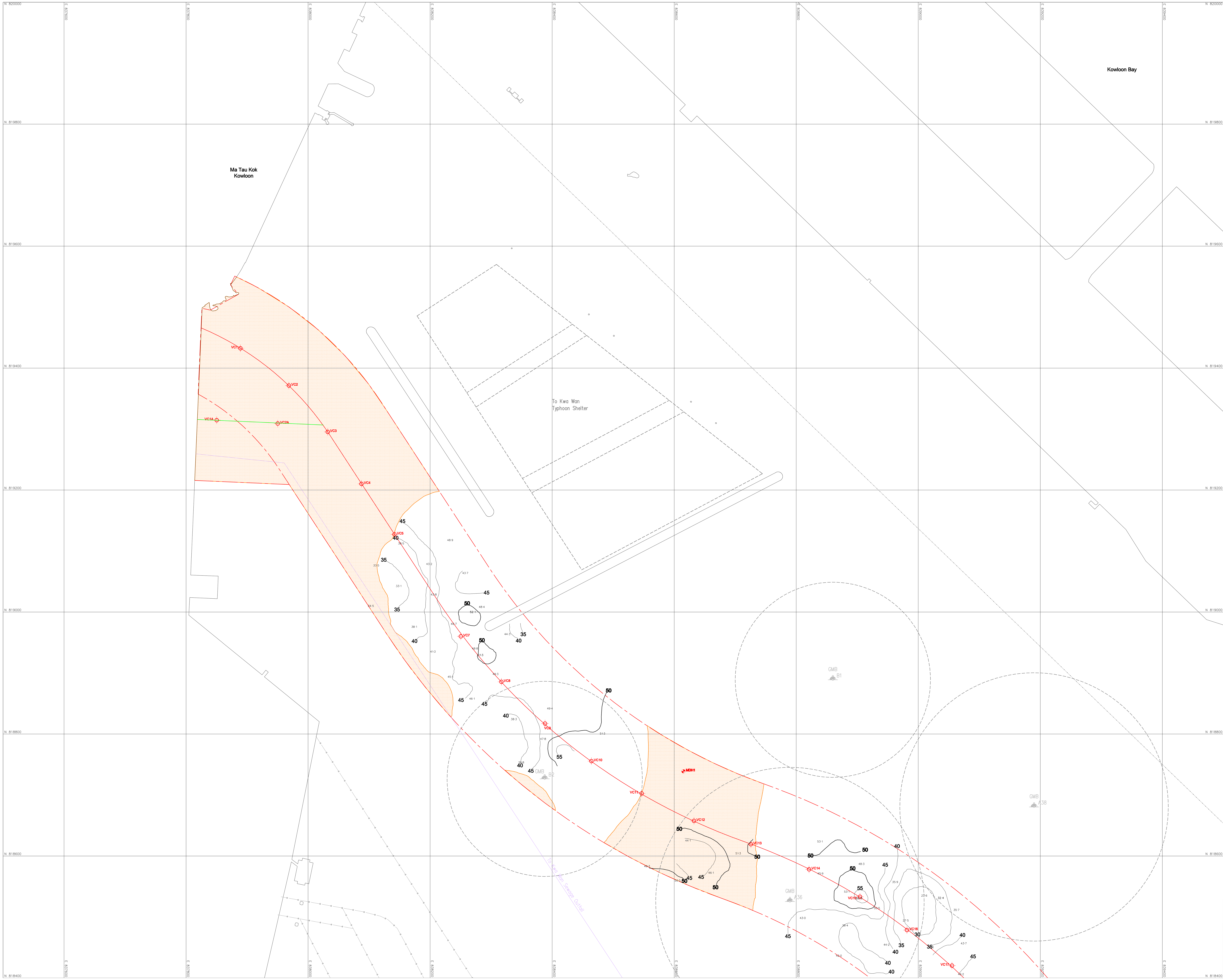
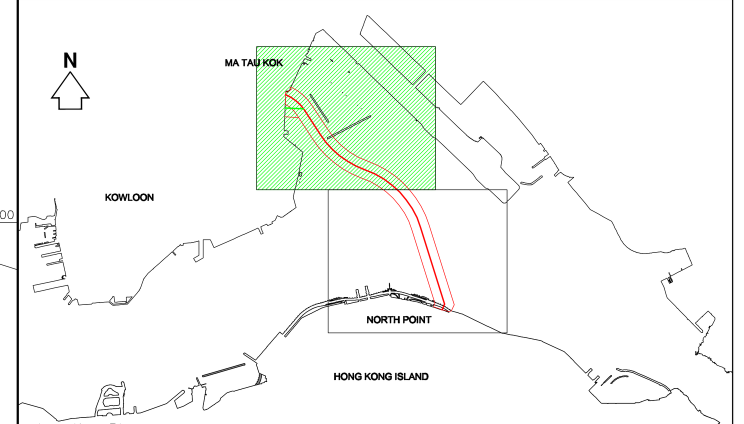
JOB NO. : HK211508



Legend :

25·5	Spot value in metres below Hong Kong Principal Datum
	Contour at 5 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client
	Masked zone



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 5.1

Drawing Title :

CONTOURED LEVELS ON TOP OF PRESUMED MODERATELY DECOMPOSED ROCK

Notes :
1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	23/5/2008	Agnes Siu	Joe Lam	Matthew Lai	Survey Report
1	23/7/2008	Agnes Siu	Joe Lam	Matthew Lai	Final Report
2	14/11/2008	Agnes Siu	Joe Lam	Margie Chen	Rev. Final Rpt

METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

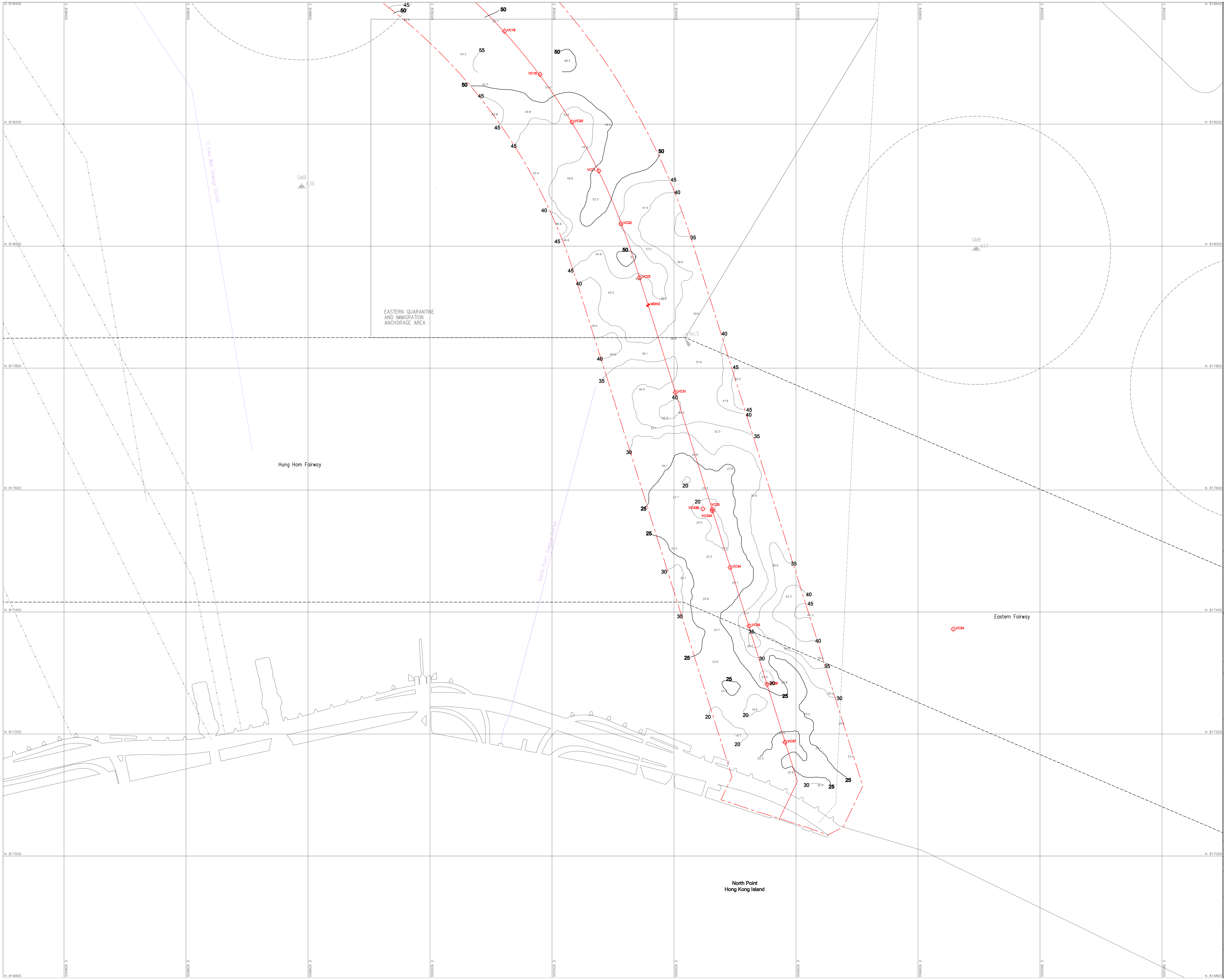
Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

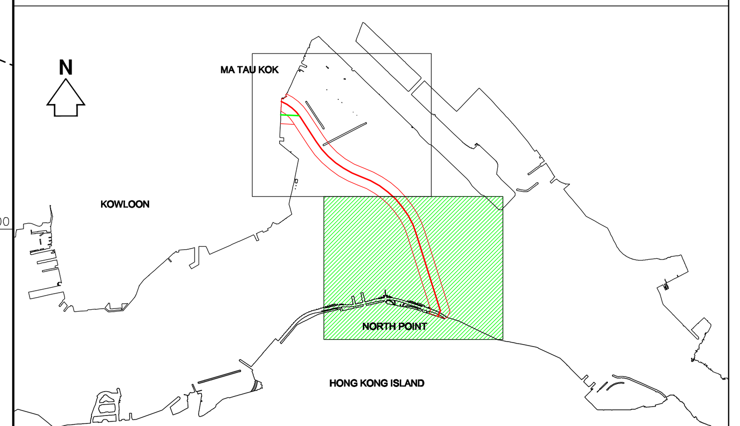
Surveyor : EGS (ASIA) LIMITED
9/F SOUTH, SOMERSET HOUSE, TAIKOO PLACE, 979 KING'S ROAD, QUARRY BAY, HONG KONG
Tel: (852) 28948622
Fax: (852) 25763590
Web: www.egssurvey.com
EARTH SCIENCES & SURVEYING

JOB NO. : HK211508



Legend :

25·5	Spot value in metres below Hong Kong Principal Datum
	Contour at 5 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 5.2

Drawing Title :

CONTOURED LEVELS ON TOP OF PRESUMED MODERATELY DECOMPOSED ROCK

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
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1	23/7/2008	Agnes Siu	Joe Lam	Matthew Lai	Final Report
2	14/11/2008	Agnes Siu	Joe Lam	Margie Chen	Rev. Final Rpt

METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

Surveyor : EGS (ASIA) LIMITED
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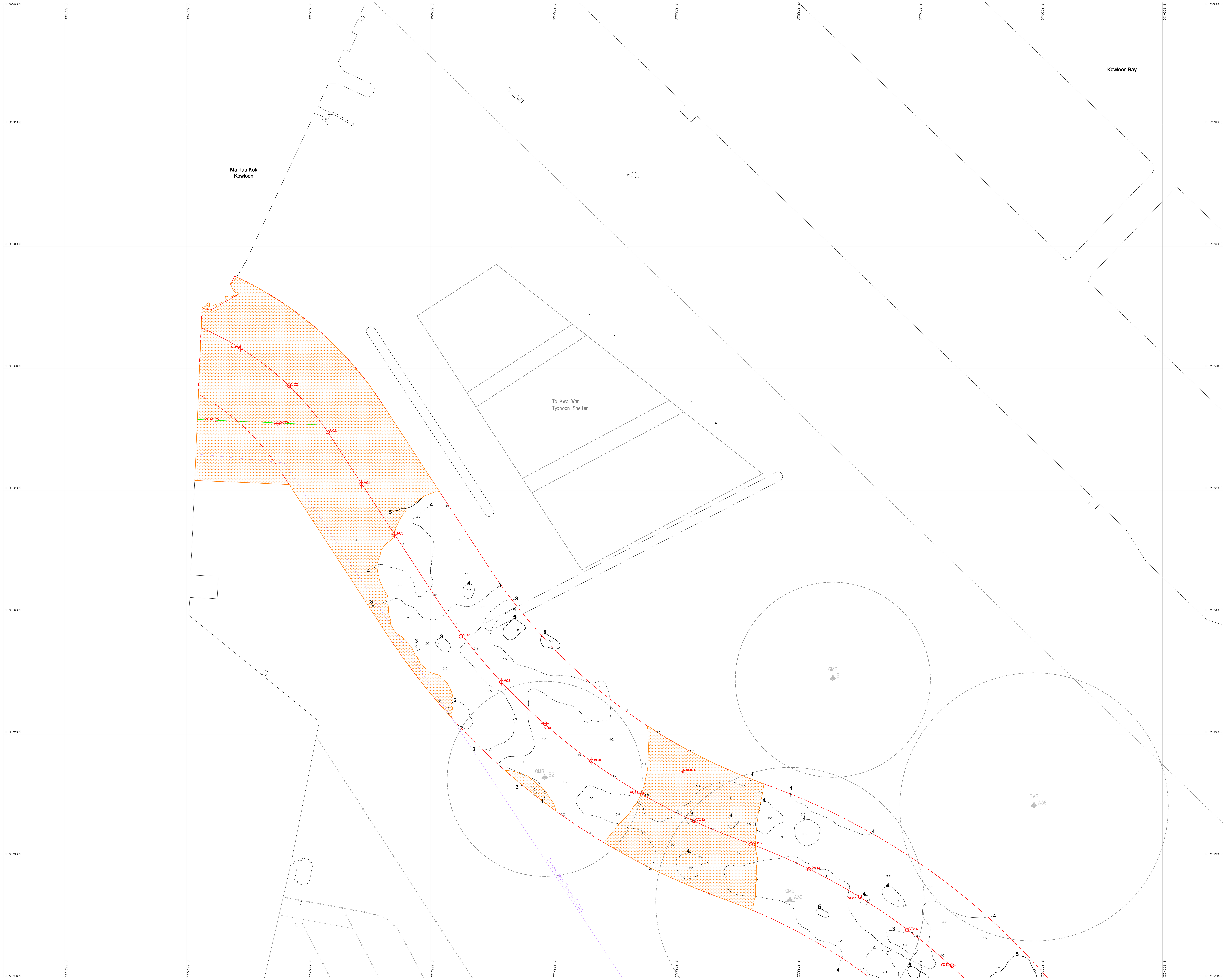

Legend :

5·5	Isopachs value in metres
	Contour at 1 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client
	Masked zone

Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 6.1

Drawing Title :

CONTOURED ISOPACHS OF MARINE DEPOSITS

Notes :
1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C-Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

Surveyor : EGS (ASIA) LIMITED
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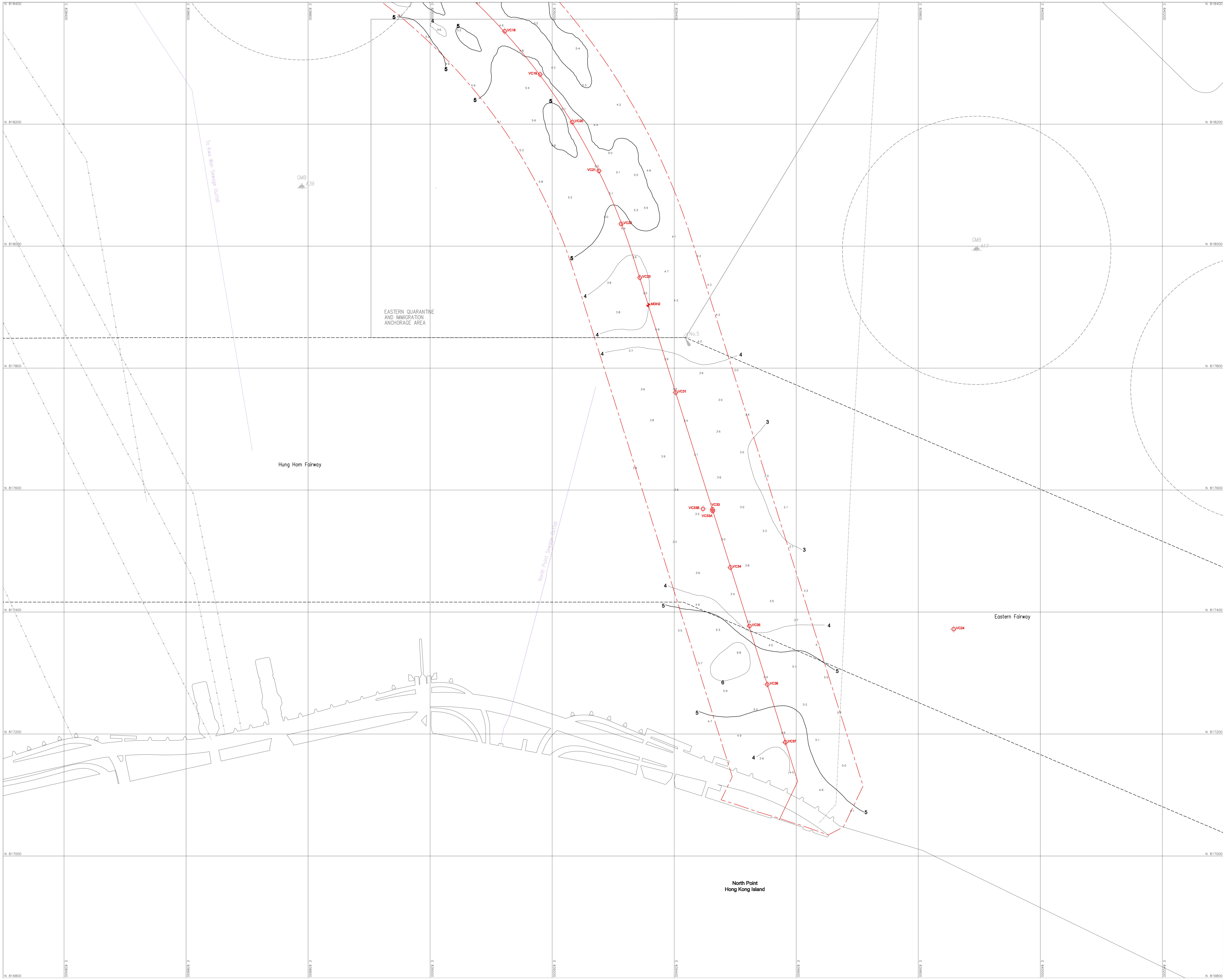
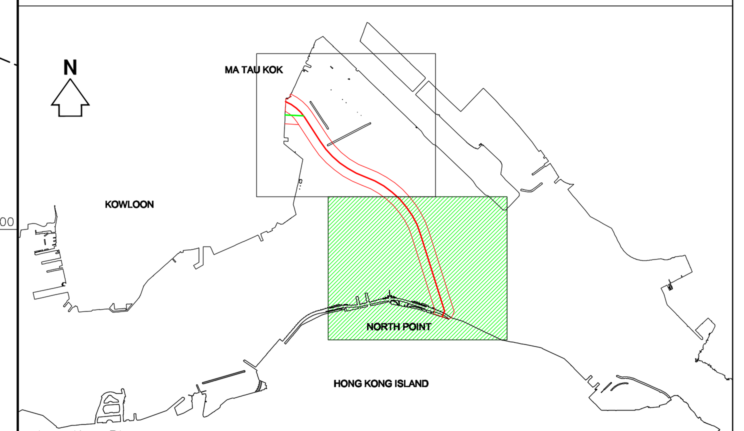


Legend :

5·5	Isopachs value in metres
	Contour at 1 metre interval
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 6.2

Drawing Title :

CONTOURED ISOPACHS OF MARINE DEPOSITS

Notes :

1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : EGS Seismic Profiler
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	23/5/2008	Agnes Siu	Joe Lam	Matthew Lai	Survey Report
1	23/7/2008	Agnes Siu	Joe Lam	Matthew Lai	Final Report
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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : 煤氣 Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

Surveyor : EGS (ASIA) LIMITED
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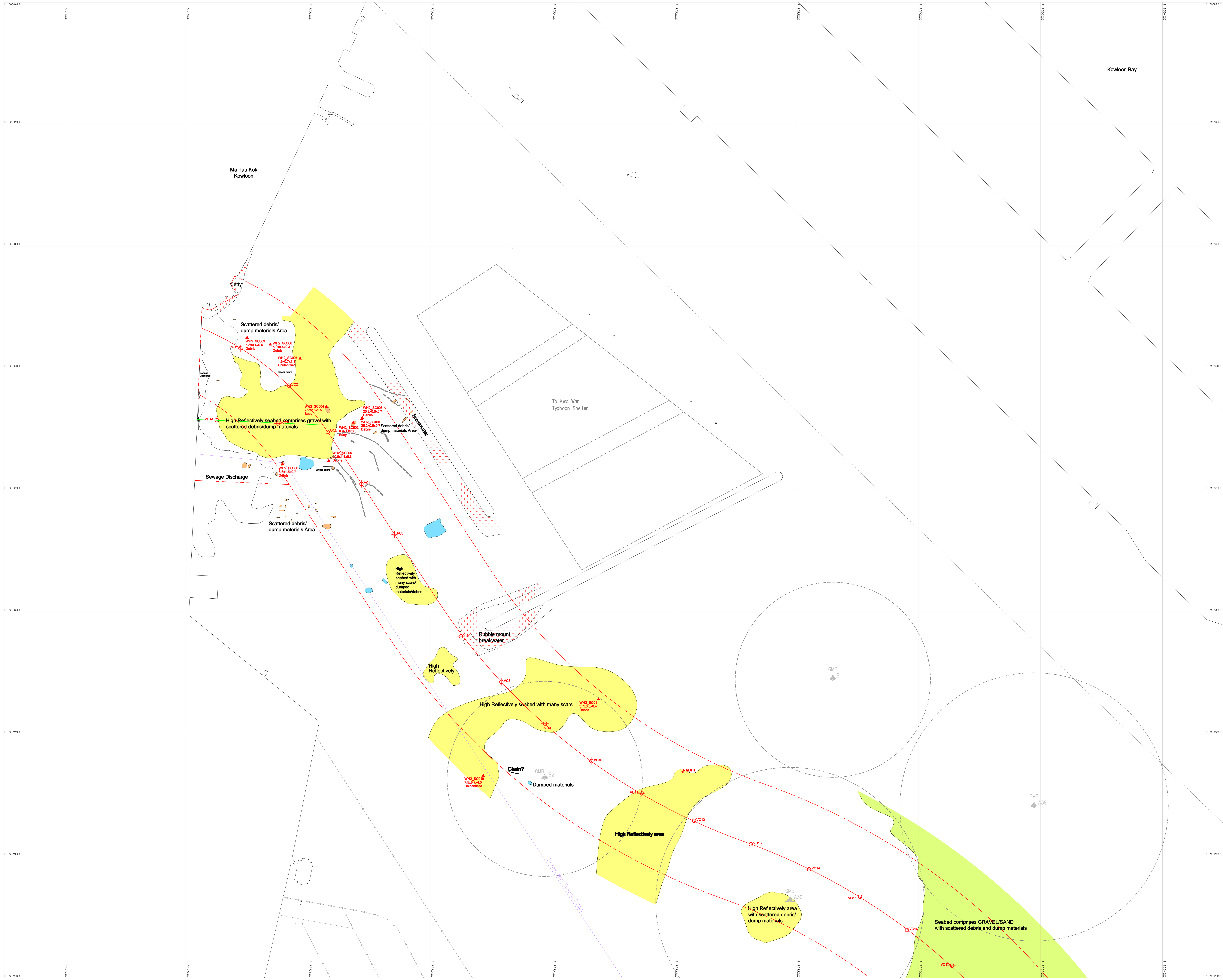
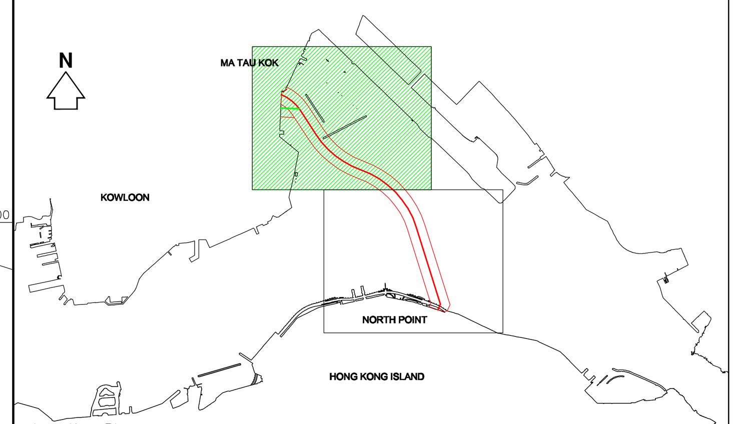


Legend :

	Debris
	Breakwater
	Dumped materials
	High Reflectively area
	Seabed comprises GRAVEL/SAND with scattered debris and dump materials
	Scar
WH2_SC010 7.5x8.7x4.0 Unidentified	Isolated sonar contact with reference number (length x width x height in metres where measurable)
	Survey boundary
	Previous RPL
	Current RPL
	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 7.1

Drawing Title :

SEABED FEATURES

Notes :
1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : Klein 3000 Side Scan Sonar System
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	23/5/2008	Agnes Siu	Joe Lam	Matthew Lai	Survey Report
1	23/7/2008	Agnes Siu	Joe Lam	Matthew Lai	Final Report
2	14/11/2008	Agnes Siu	Joe Lam	Margie Chen	Rev. Final Rpt

METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

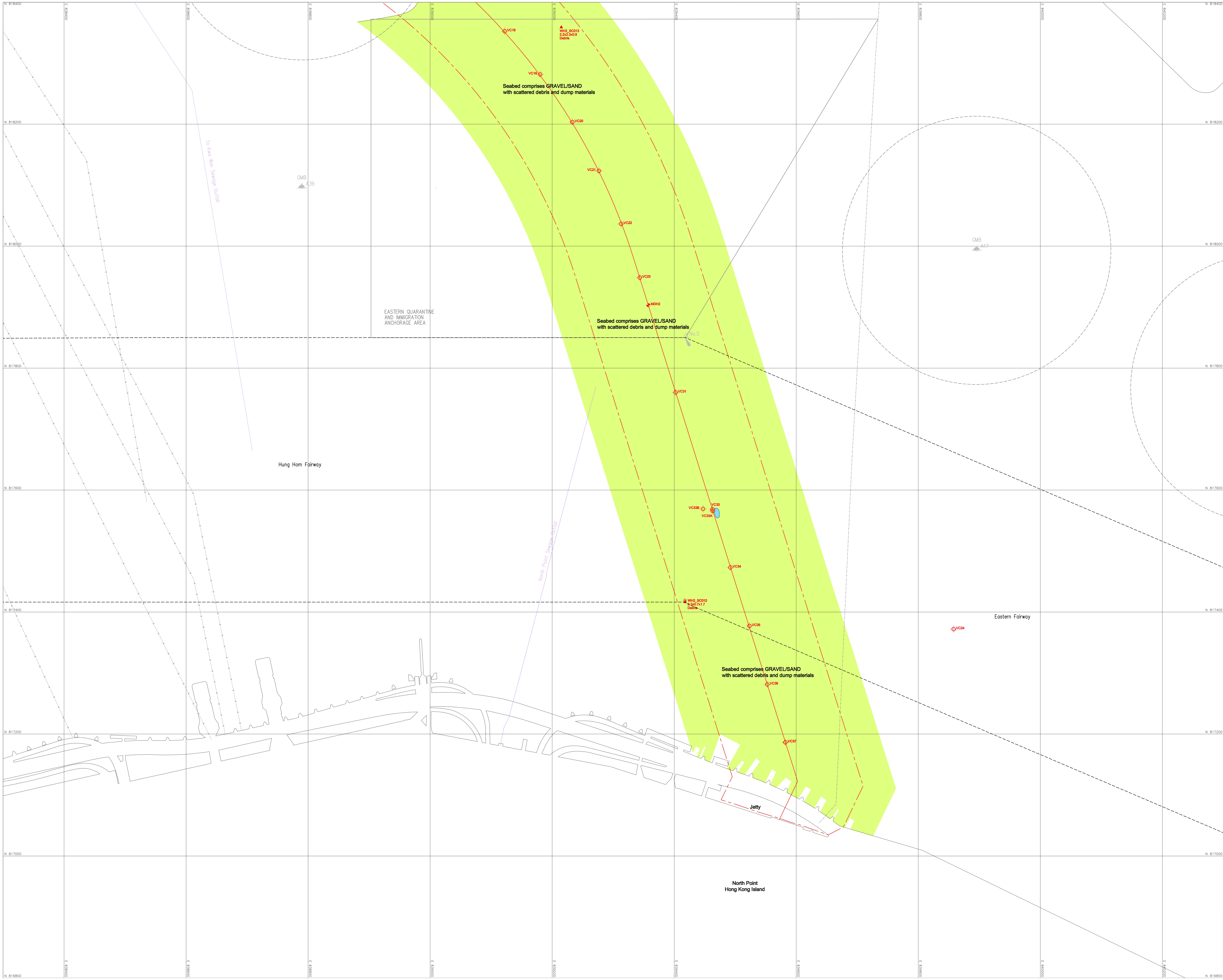
Client : Towngas

Contractor : Gammon

AP/RSE : Mott MacDonald

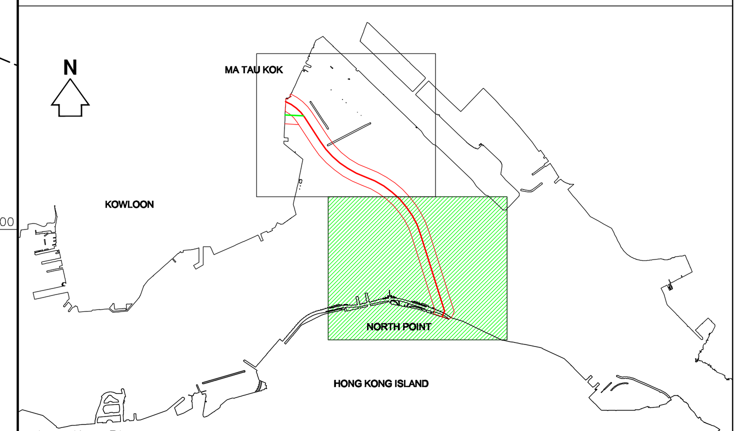
Surveyor : EGS (ASIA) LIMITED

JOB NO. : HK211508



Legend :

(orange fill)	Debris
(red crosses)	Breakwater
(blue fill)	Dumped materials
(yellow fill)	High Reflectively area
(green fill)	Seabed comprises GRAVEL/SAND with scattered debris and dump materials
(grey dashed line)	Scar
▲ WH2_SC010 7.5x8.7x4.0 Unidentified	Isolated sonar contact with reference number (length x width x height in metres where measurable)
(red dash line)	Survey boundary
(red line)	Previous RPL
(green line)	Current RPL
(grey line with markers)	Existing pipeline
MDH1	Drillhole from client
VC31	Vibro core from client



Location Plan

Project :

INSTALLATION OF SUBMARINE GAS PIPELINES AND ASSOCIATED FAILITIES FROM TO KWA WAN TO NORTH POINT FOR FORMER KAI TAK AIRPORT DEVELOPMENT

FIGURE NUMBER : 7.2

Drawing Title :

SEABED FEATURES

Notes :
1. Survey Date : 5–6th May 2008 & 4th November 2008
2. Survey Grid : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS (Globally corrected GPS)
5. Equipment : Klein 3000 Side Scan Sonar System
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department

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METRIC SCALE 1:2,000

100 80 60 40 20 0 100 200

Client : Towngas 煤氣

Contractor : Gammon

AP/RSE : Mott MacDonald

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