Appendix 15-1

Utilities Survey Report

Murphy GEOSPATIAL

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Utility Survey Report

Project Name – Kilshane Block Valve

Project Number – 54172

Client – Fingleton White & Co Ltd

Document Register

Rev	Date	Prepared by	Role	Checked by	Role	Revision Reason
00	15/02/24	IC	Cad Technician	DS	Quality Manager	First issue

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1 Introduction

1.1 Terms of Reference

Location: **Kilshane Road**

Client: **Fingleton White & Co Ltd**

Utility Survey Date start: **15/01/2024**

This report should be viewed with the following drawings: **MGS54172_U.dwg**

This document is the technical report for this investigation; it therefore supersedes any previous reports whether written or oral.

1.2 Background/Purpose of Investigation

Murphy Geospatial were requested to carry out a full GPR & utility survey on behalf of Fingleton White & Co Ltd. The intention of this survey is to detect, locate and record all existing Utilities and highlight any anomalies in the required areas for upcoming works.

1.3 Objective of project

The objective of the survey was to locate the position and depth of all existing underground utilities using a combination of non-intrusive survey techniques. As the main investigative techniques used are largely non-destructive, the findings given in this report are based on indirect measurements and the interpretation of acoustic, electrical and electromagnetic signals. The findings represent the best professional opinions of the authors, based on our experience and the results of non-intrusive pipe location carried out elsewhere on similar materials and projects.

1.4 Site aerial view

Survey area outlined in yellow.

1.5 Key Personnel

Project Manager: **Aidan Doherty**

Responsible for the management of the overall project.

Senior Surveyor: **Marcis Jirgensons**

Lead surveyor responsible for the site work.

Safety Advisor: **Dermot Guiney**

Responsible for safety inductions (internal requirements only) and advising on safe working practices.

Production Manager: **Zuzana Knotkova**

Responsible for processing of the dataset and production of the final deliverables.

Quality Manager: **Daniel Stempien**

Responsible for processing and quality assessment of data

1.6 Specifications and International Standards

All survey works were carried out in accordance with the following guidelines and standards:

- European GPR Association - Policy on the Use of GPR in Utility Detection
- American Society of Civil Engineers- Standard Guideline for the collection and depiction of existing subsurface utility data.
- Radio detection- abc & xyz of locating buried pipes and cables.
- PAS128: 2014 – Publicly Available Specification 128 2014

2 Survey Report

2.1 Survey Restrictions

Due to unsuitable ground conditions (overgrown vegetation / uneven surface), some parts of the site couldn't be scanned with GPR radar and EML scan was carried out where possible only – please refer to the drawing.

2.2 Field Data Survey

Field data was surveyed in ITM (OSGM15) coordinate system. All levels are related to Malin Head Datum. Survey results were overlaid on topographical background.

2.3 Traffic Management

A traffic management plan was implemented for the survey works on the public roads.

2.4 Methodology

2.4.1 Underground Utility & GPR Survey

Murphy Geospatial detect conductive services with the use of the Radio detection RD8100 receivers and transmitters which use very low electromagnetic frequencies to detect the services utilising the following methods:-

Direct Connection – This technique incorporates the use of a signal generator which is capable of generating sine waves at very low frequencies, typically 8 kHz or 33 kHz which can be applied to a metallic service. The service acts like an aerial and conducts the transmitted signal, which can then be detected on the surface using the receiver.

This is the most accurate method of locating a buried service and is applied in the first instance where access to pipes and cables is possible.

Signal Clamp – The signal clamp will be used to trace buried LV and HV cables. The signal will be applied via a clamp which is placed around the cable at a point the service enters or exits the ground.

Induction – Where a direct signal cannot be applied, the transmitter is used to radiate an indirect signal actively. The transmitter has a built-in aerial, which is capable of transmitting

an electromagnetic field into the ground which conducts along the pipe or cable and can be detected on the surface using a receiver.

Passive – In Passive mode, the receiver is used without the transmitter to detect signals, which are generated by power cables or from distant radio transmitters, which constantly induce a signal into metallic services.

This method should only be used once both Direct Connection and Induction methods have been exhausted.

2.4.2 GPR Methodology:

A number of different GPR grids were set out over the site. Data field files were collected with a multi frequency array antenna system to give maximum depth penetration whilst maintaining a high resolution at both shallow and deep depths. Full calibration was carried out at the start scan with constant quality monitoring during acquisition and frequent recalibration checks were carried out where necessary.

Depth readings from GPR rely on multiplying the measured two-way travel time by the velocity of the radio signals passing through the materials under investigation. As the surface and subsurface of the site changes, frequent recalibration of the subsurface velocities results in an accurate calculation of depths and thicknesses of located features relative to the surface.

Post site processing then took place in the office, using specialised software, GPR Slice. A number of processing stages were involved, including start time correction, amplitude gain adjustments, Gaussian filtering, dynamic correction and noise removal. Once the raw data was processed individual targets were identified on each survey line and linear features mapped out over the survey areas. These GPR results are then incorporated into Autocad for final processing.

2.5 Equipment Used

- Radiodetection RD8200 EML kit
- Dual-Frequency GPR GSSI Utility Scan DF
- Sonde & Copper Flex
- Trimble S5 Total Station
- Trimble R12 GPS & Trimble TSC5 Controller

2.6 Surveyors Involved

Marcis Jirgensons, Aljosa Idrizov

2.7 Works Programme

Site Works Commenced on 15/01/2024

Delivery of drawings – 15/02/2024

2.8 Software Used for Processing

Autodesk Civil 3D 2020

AutoCAD 2020

GPR Slice V7.0

GeoPal

Microsoft Office

2.9 Quality Assurance Site Procedures

Equipment used was calibrated and tested in line with manufacturer guidelines. Calibration certificates can be provided on request.

Distance & angle checks were carried out on site regularly. Specialised software was used to verify accuracy of all measurements taken on site throughout the survey.

2.10 Findings

2.10.1 Drainage

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
On the West side, storm network was located running from manhole 5 to offsite manhole and collecting nearby gullies present in this area. Other storm network was located on the East side at manholes 13, 17, 18 and 20. Please note that due to silted pipes or chambers connections for some of these lines and for some of the gullies present on site couldn't be fully verified – please refer to the drawing. Foul sewer network was located on the West side running through manholes 12, 8 and manhole offsite.	B1P / B2P	M2P

2.10.2 Water Mains/Fire Mains

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
Due to the non-metallic nature of the pipes, no proper signal was obtained from water main which according to records drawings is running on the East side of survey area. No signal was also obtained from sluice valves and air valve found within area. Due to the signal being absorbed by the pipe material rather than reflected back to the radar antenna, GPR results were not conclusive for water main pipes in this area. Pipe, which was shown on the records drawings but which couldn't be located and verified on site was shown marked with 'records'' note and it is recommended to treat its location as indicative only. Please note that water main records drawings don't show any water pipes in western part of the area, however air valve and sluice valves present there are the evidence of water network in this area which couldn't be located.	B4	M2P

2.10.3 Electricity, HV, LV, Street lighting, Traffic

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
MV/LV electrical network was located by EML techniques, crossing the survey area on the West side. Due to limited access (overgrown/private area) connection for one of these lines couldn't be fully verified – please refer to the drawing. ESB connections which were shown on records drawing but which couldn't be located and verified on site were marked with 'records' note and it is recommended to treat their location as indicative only. Public lighting and CCTV network was also located and traced on the West side of the site crossing the survey area and feeding the lamp posts/CCTV pole present in this area – please refer to the drawing. No evidence of any traffic cables was found on site.	B1P / B2P (located) B4 (records)	M2P

2.10.4 Eir, Enet, UPC (Virgin), BT and other Comms

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
Eir, Virgin, BT, Enet and Aurora lines were located and traced on site by EML and GPR techniques running through various chambers. Please note that due to no signal given by some of these services or silted chambers, connections for some of these lines couldn't be fully verified – please refer to the drawing. BT, Enet and Aurora connections and manholes which were shown on records drawings, but which couldn't be located and verified on site were marked with 'records' note and it is recommended to treat their location as indicative only.	B1P / B2P (located) B4 (records)	M2P

2.10.5 Gas, Oil & Fuel mains

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
HP gas main pipes were located on the West side of the site by EML techniques crossing the survey area and running offsite – please refer to the drawing. No signal was detected for the gas valves located at manholes 7 8 and 10 or from gas valve located nearby manhole 7.	B2P	M2P

2.10.6 Unknown Cables/Empty Ducts and Services

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
Unknown empty duct was located at manhole 9 but due to the presence of silt, its connection couldn't be fully verified. Unidentified service (possible Gas pipe) was located at manhole 8 running through the service channel towards nearby concrete pad. Other unidentified service was located in the field area but due to signal interference its connection couldn't be fully verified – please refer to the drawing.	B2P	M2P

2.10.7 GPR data conclusion

Comments
Generally, the depth of investigation from GPR does not exceed 2.0 metres in this area. As well as all the confirmed utility services which have been identified, there are unidentified features shown as GPR Anomalies. These features may be the result of services which are running through the sites, abandoned services, natural geological features or land drains amongst other things.

2.11 Manhole and pit schedules

Each manhole/inspection cover within the survey area was opened and the contents documented. These measurements are recorded on a digital manhole description sheet using Geopal applications. The manholes were individually numbered. All depths recorded inside the chamber were by disto, measuring tape or leveling staff. Details included:

- Cover Levels
- Invert levels
- Service Type
- Service Material
- Pipe sizes
- Chamber dimensions
- Direction of flow
- Photographs
- Siltation, stagnant water, or any other notable observations

After completing manhole investigation each manhole sheets was exported to Excel format and submitted together with final drawing and GPR report as a part of final deliverables.

2.12 Recommendations

Services which are shown on service records drawings, but which couldn't be located and verified on site and services which couldn't be traced due to no signal being obtained or signal being lost during the trace will require further investigation.

It is recommended to carry out slit trenching investigation in this area which would allow identifying location and depths of these untraceable services.

Drainage pipes which could not be traced, will require further investigation. It is recommended to jet wash those pipes and carry out CCTV investigation works which would allow to identify connection points for these pipes.

Manhole which could not be opened and inspected (marked as UTO) will require further investigation. Also, manholes which are shown on service records drawings, but which could not be found or verified on site will require further investigation.

3 Pas Detection Methods and Quality Level Tables

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-Processing	Location Accuracy		Supporting Data
				Horizontal 1)	Vertical 2)	
D	Desktop utility records search	QL-D	-	Undefined	Undefined	-
C	Site reconnaissance	QL-C	-	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar).
B	Detection 3)	QL-B4	-	Undefined	Undefined	A utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route.
		QL-B3	No	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used
		QL-B3P	Yes			
		QL-B2	No	±250 mm or ±40% of detected depth whichever is greater	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. 4)
		QL-B2P	Yes			
		QL-B1	No	±150 mm or ±15% of detected depth whichever is greater	±15% of detected depth	Horizontal and vertical location of the utility detected by multiple geophysical techniques used. 5)
		QL-B1P	Yes			
A	Verification	QL-A	-	±50 mm	±25 mm	Horizontal and vertical location of the top and/or bottom of the utility.

1) Horizontal location is to the centreline of the utility.
2) Vertical location is to the top of the utility.
3) For detection, it is a requirement that a minimum of GPR and EML techniques are used (see 8.2.1.1.2).
4) Electronic depth readings using EML equipment are not normally sufficient to achieve a QL-B2 or higher.
5) Some utilities can only be detected by one of the existing detection techniques. As a consequence, such utilities cannot be classified as a QL-B1.

Method 1) (to be determined in consultation with the client)	Survey Grid/Search Resolution 2)				Quality Levels achievable	Typical Application (informative)
	EML 3)	GPR		Other Techniques 4)		
		General	Post-Processing			
M1	Orthogonal search transect at ≤10 m intervals and when following a utility trace, search transects at ≤5 m intervals	Use as applicable	No	≤5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of an undeveloped area
M1P			Yes		B1P, B2P, B3P	
M2	Orthogonal search transect at ≤5 m intervals and when following a utility trace, search transects at ≤2 m intervals	Either: a) ≤2 m orthogonal; or b) high density array 5)	No	≤2 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a suburban area or where the utility services cross a boundary of a survey area
M2P			Yes		B1P, B2P, B3P	
M3	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤1 m intervals	Either: a) ≤1 m orthogonal; or b) high density array 5)	No	≤1 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a busy urban area or for clearance surveys prior to operations such as borehole/drilling/fencing/tree planting
M3P			Yes		B1P, B2P, B3P	
M4	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤0.5 m intervals	Either: a) ≤0.5 m orthogonal; or b) high density array 5)	No	≤0.5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a congested city area
M4P			Yes		B1P, B2P, B3P	

NOTE 1 In general the effort increases from M1 to M4 and the addition of post-processing. For areas with a greater density of utilities or areas considered high risk by the client, a detection method that has a higher level of effort should be selected.

NOTE 2 "P" indicates off-site post-processing has been included.

1) It is a requirement that a minimum of GPR and EML techniques are used.
2) The tolerance for orthogonal transect centres and survey grids shall be ±0.1 m.
3) It is a requirement that passive EML is deployed over the whole survey area and that where an active EML method can be used, it is used.
4) The transect centre depends on technique used.
5) A high density array comprises 100 mm or closer antenna separation.

4 Disclaimers

The survey aims to map all existing utilities and sub-surface structures and provide information with respect to pipe size, material type and drainage connectivity. However, GPR surveying is limited by the following guidelines and it may not be possible to accurately survey, define and locate all services and sub-surface features. Survey Results are representative of the date and time of survey only.

- Locational accuracy is determined by referring to the manufacturers guidelines for the detectors used.
- Existing record information showing underground services is often incomplete and unknown accuracy; therefore, it should be regarded only as an indication.
- In ideal conditions these spatial accuracies for the underground utilities are +/- 5% for the RD8100 and +/- 10% of depth for the GPR to 2.5m deep. However, variations within the subsurface may alter this estimated accuracy.
- Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.
- GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying.
- Due to the attenuation of the radar signal with depth, resolution is restricted, hence making identification of anomalies difficult with increasing depth.
- The depth penetration and quality of the data depends on the ground conditions on the site. Poor data may be a result of areas with high conductivity. Also, high reflective materials close to the surface i.e. rebar may hide deeper anomalies.
- It is not always possible to trace the entire length of each underground service.
- It is always our intention to use the Utility providers' details, if supplied prior to survey commencement as a guide for location purposes. However, should we not be able to locate those guided services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore shown “Taken from Records” on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.
- Unless otherwise stated, all services and sub-surface structures shown on Murphy Geospatial plan drawings have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to run straight.
- Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run in close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.
- Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other

utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate.

- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

No allowance has been made within our quotation, unless otherwise stated, for the location and mapping of undeclared services. Failure to detect or fully map any declared service will be recorded within the notes accompanying our final drawings.

Where technically possible, depth indications will be given. These should be used for guidance only and wherever critical accuracy is required these should be confirmed by the Client by undertaking trial excavations or similar. Bends, lateral service connections, or the close proximity of other services and local magnetic, atmospheric or ground conditions, could in certain situations influence the accuracy of the plan and depth indication facility. Depths will not be provided unless we are reasonably confident of their validity.

Where Murphy Geospatial issues a CAD drawn utility service plan, this should be read in conjunction with all available public utility records etc. As part of our exhaustive Quality Control procedures, Murphy Geospatial endeavour to add relevant Public Utility record information onto the final issue drawing. An allowance should be made for the width of services, particularly where these are laid in bands or are of significant size etc. For clarification or appropriate easement bands, we would recommend that direct contact is made with the Asset Owner or Statutory Undertaker.

We exclude the following, except where otherwise specified and possible to do so:

- All private service connections, (including water or gas fittings where no through flow of applied signal is possible).
- Pot ended or disconnected cables or terminated short lengths of pipe.
- Internal building services
- Fibre optic cables (except where laid with a standard communications cable or built in tracer wire or similar conductor system) or can be clearly located using ground penetrating radar.
- Small diameter cables less than 17mm diameter, or pipes less than 38mm diameter.
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 10 minute effort using standard heavy duty lifting apparatus.
- Services positioned directly below other pipes or cables etc (i.e. masking signal) - intrusive verification options available on request.
- Deep non-metallic pipes, ducts or culverts (unless probing or Pipe Track 3d is specified as part of the fully invasive survey option).

- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this would significantly increase the scope of work, survey cost and also cause possible disruption to occupants.

Service provider utility drawings may not be up to date or give sufficient coverage of all areas surveyed, as such extra precaution should be taken when excavation works are carried out on site and it is recommended to contact service providers before commencing any excavation works within surveyed areas.

All work carried out by Murphy Geospatial conforms to the guidelines set out by The Survey Association (TSA).

5 GNI Gas Pipeline Disclaimer

Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie.

6 General GPR Limitations

GPR surveying is limited by the following guidelines		Minimizing GPR Limitations
Depth and size of Utility	In good ground conditions and within the depth range of two metres the ability to detect a utility will reduce in diameter by 1mm for each 10mm of depth. i.e. a 200mm pipe can be detected at 2m and a 50mm pipe at 0.5m but a 25mm plastic water service pipe to a house cannot be detected at 1.2m with radar	Murphy Geospatial incorporated Radio Detection surveys in areas where GPR was found to be ineffective.
Shadowing	This can happen where shallow buried utilities hide or mask deeper buried utilities below.	Murphy Geospatial use mutli frequency radar systems to reduce the effect of shadowing.
Soil Condition	GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying. The depth penetration and quality of the data depends on the ground conditions on site. Poor data maybe a result of areas with high conductivity	Murphy Geospatial calibrate our GPR Systems for varying soil types on each project.
Plan Accuracies	Plan accuracies of the order of + or – 150mm maybe achieved but this figure will depend on the depth of the service below ground level.	Murphy Geospatial incorporated Radio Detection surveys in areas where GPR was found to be ineffective.
Utility location	Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.	Murphy Geospatial utility surveyors are all qualified and certified to locate underground services.
Existing Utility Records	Existing record information showing underground services is often incomplete and unknown accuracy; therefore, it should be regarded only as an indication.	It is always our intention to use the Utility provider's details, if supplied prior to survey commencement, as a guide for location purposes. However, should we not be able to locate those guided services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore

		shown “Taken From Records” on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.
Loss of Signal	It is not always possible to trace the entire length of each underground service.	Murphy Geospatial will indicate on the drawing if a service trace is lost.
Utility Congestion	Where similar services run on close proximity, separation maybe impossible.	Murphy Geospatial incorporated Radio Detection surveys in areas where GPR was found to be ineffective.
Pipe Material	Successful tracing of non-metallic pipes maybe limited due to material construction of the pipe.	Murphy Geospatial incorporate Radio Detection/ Manhole& PWG surveys in areas where GPR was found to be ineffective.

The American Society of Civil Engineers in their ‘Standard Guidance for the collection and depiction of existing subsurface utility data’ has a useful rule of thumb for GPR which in, metric values, can be summarised as: ‘In good ground conditions and within the depth range of two metres the ability to detect a utility will reduce in diameter by 1mm for each 10mm of depth. i.e. a 200mm pipe can be detected at 2m and a 50mm pipe at 0.5m but a 25mm plastic water service pipe to a house cannot be detected at 1.2m with radar’.