Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report 2024

Appendix A16.1: Electromagnetic Compatibility Survey Plan

BARRY TRANSPORTATION
egis GROUP
egis

Project Ireland 2040
Building Ireland's Future

Table of Contents

SECTION 1: Introduction and objectives

1.1 Context

Luas Finglas is the proposed new northern extension of the Luas Green Line from its current terminus in Broombridge to a new terminus in Charlestown, near the N2-M50 interchange, it is approximately 4km long, with 4 new stops, two new substations, two main bridges, and a new extension to Broombridge depot. The general environment of the new line runs through a combination of industrial areas, residential areas, street running, green field areas and an interface with an existing railway line.

This EMC Survey Plan follows on from the EMC Desktop Survey and identifies proposed measurement locations for required EMC survey measurements, which were identified during a route walk on 05/09/22.

1.2 Scope

The scope is limited to the proposed route of the new Luas Finglas extension and immediate surrounding area and identifies suitable measurement locations for three specific EMC survey measurements:

- Electric and Magnetic field measurements under the HV power line running parallel and crossing the proposed tramway route.
- Radiated emission measurements in accordance with EN 50121-2:2017, with and extended frequency measurement range from 9kHz to 6GHz at four identified site locations.
- Ground resistivity measurements at the location of the two new substation sites.

1.3 Background to the EMC Survey

Electrical or magnetic interference can stop electrical or electronic equipment from working correctly. EMC is the ability of equipment or a system to function satisfactorily in its electromagnetic environment, without introducing intolerable electromagnetic disturbances to anything in that environment. The goal of EMC is the correct operation, in the same electromagnetic environment, of different equipment which use electromagnetic phenomena, and the avoidance of any interference effects.

In order to achieve EMC, two aspects need to be considered;

- Emission issues are related to the generation of electromagnetic energy (either intended or unintended) by a source, and to the countermeasures which should be taken in order to reduce such generation or avoid the escape of any remaining energies into the external environment, and;
- Susceptibility or immunity issues, in contrast, refer to the correct operation of electrical equipment; referred to as the victim, in the presence of electromagnetic disturbances.

Simply put, EMC is achieved by addressing both emission and immunity issues; by suppressing the sources of interference and hardening the potential victims where necessary.

The importance of the EMC measurements survey is to identify the baseline electromagnetic environment in which the new tramway is to be built and operated in. It is important to identify any high emitting sources in the environment in order to ensure the new tramway is built with adequate immunity to such sources. It also provides a baseline to compare with measurements that will be taken once the tramway is built. In this way compliance of the tramway can be demonstrated by comparing the levels caused by the operating tramway with those associated with the environment.

Further to this, the importance of ground resistivity measurements at substation locations provides data for the substation designers to specify adequate earthing measures at these specific sites.

SECTION 2: Abbreviations

EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMF	Electromagnetic Fields
HV	High Voltage
OHL	Overhead Line

SECTION 3: Methodology

A site walk was carried out on the 5th September 2022 with the purpose of identifying suitable measurement locations, identifying access issues and identifying any hazards associated with the measurements. The site walk covered the route from Broombridge to Charlestown as shown in Figure 1 below.

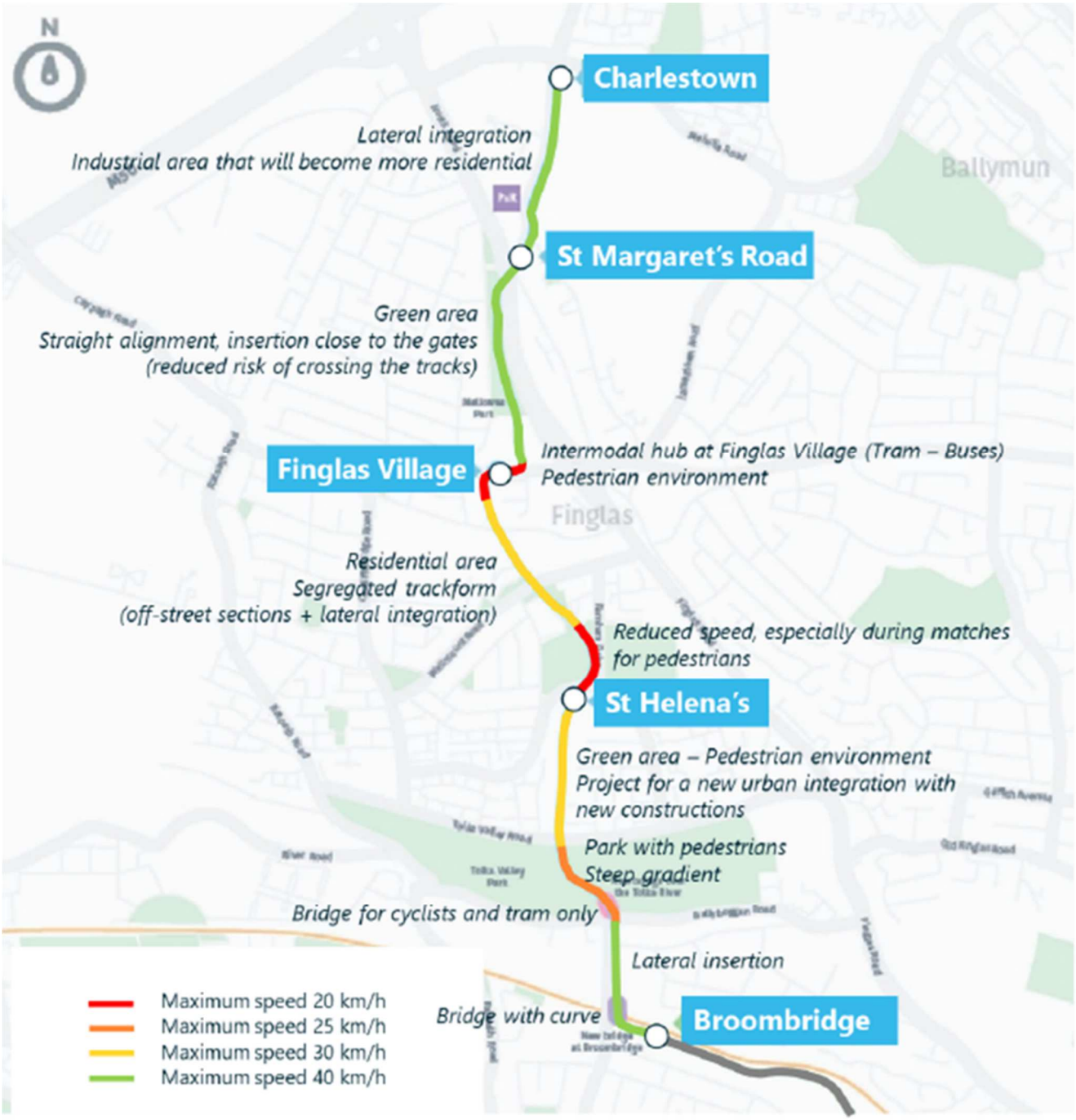


Figure 1 – Overview of the Luas Finglas route extension from Broombridge to Charlestown

SECTION 4: EMC Measurements

4.1 Radiated Emission Measurements

The test method for carrying out radiated emission measurements can be found in EN 50121-2:2017. In essence the test method requires an aerial to be set up on a tripod at a distance of 10m from the tramway. For these environmental measurements prior to the tramway being built, locations have been chosen at potential hotspots identified by the Desktop Survey, close to the tramway route. The ideal locations will have an area big enough for the tripod and aerial (approx. 2m^2), but also vehicle access which houses the measurement equipment (storage scope etc). If the area is in a location accessible to the public then bollards and safety tape will be used to segregate the area. Figure 2 below shows a typical set up of aerials and vehicle with recording equipment.

Figure 2 – Typical Set-Up with Aerials and Tripod and Measurement Equipment in Vehicle

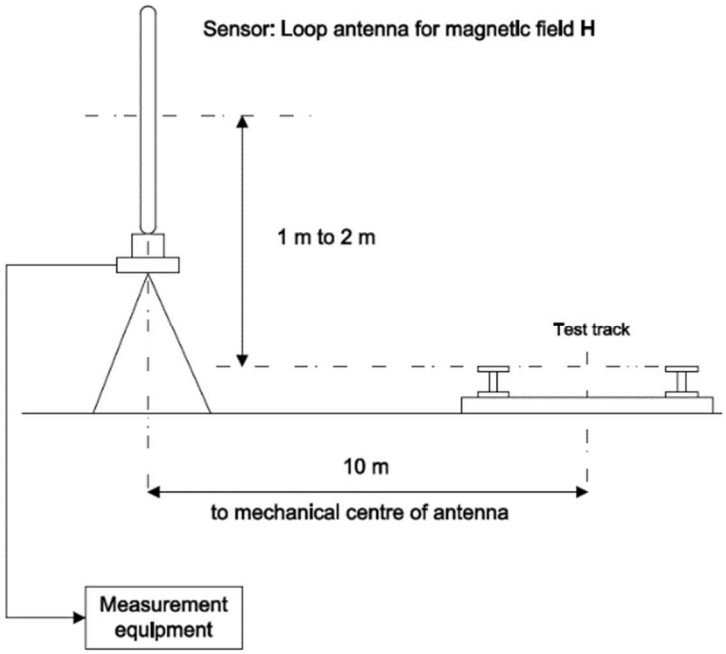


Figure 3 - Position of antenna for measurement of horizontal component of magnetic field in the 150 kHz to 30 MHz frequency band.

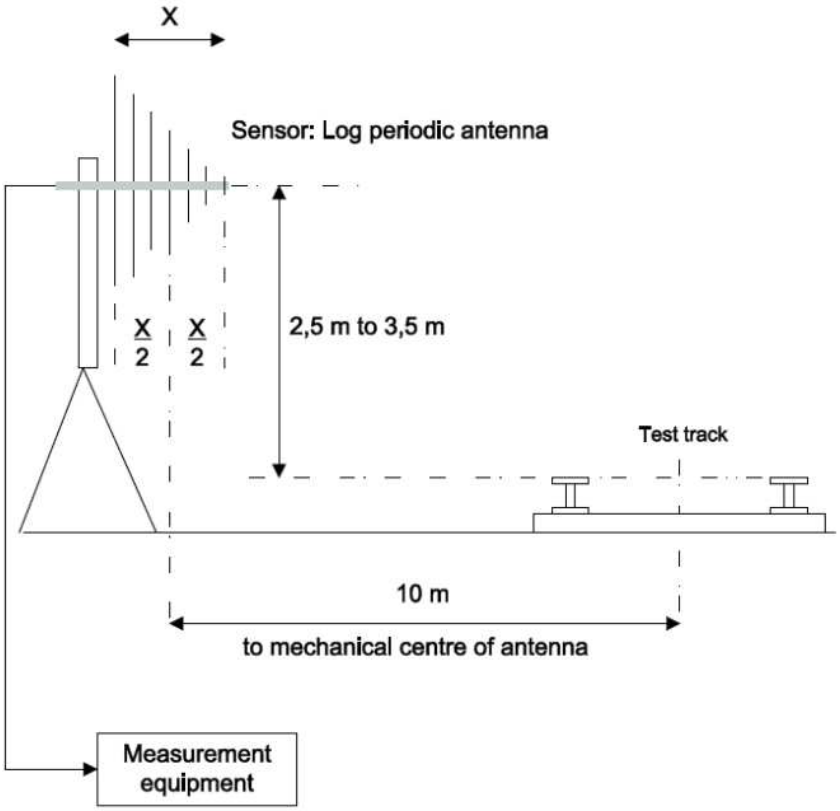


Figure 4 - Position (vertical polarization) of antenna for measurement of electric field in the 30 MHz to 1 GHz frequency band

4.1.1 Radiated Emissions Measurement Locations

Site 1 – Adjacent to Broombridge Station

The new tramway proceeds from the current terminus at Broombridge and runs adjacent to the Maynooth Railway line before rising and bending sharply over the line at the end of the station and over the canal. This is shown in Figure 5 below.

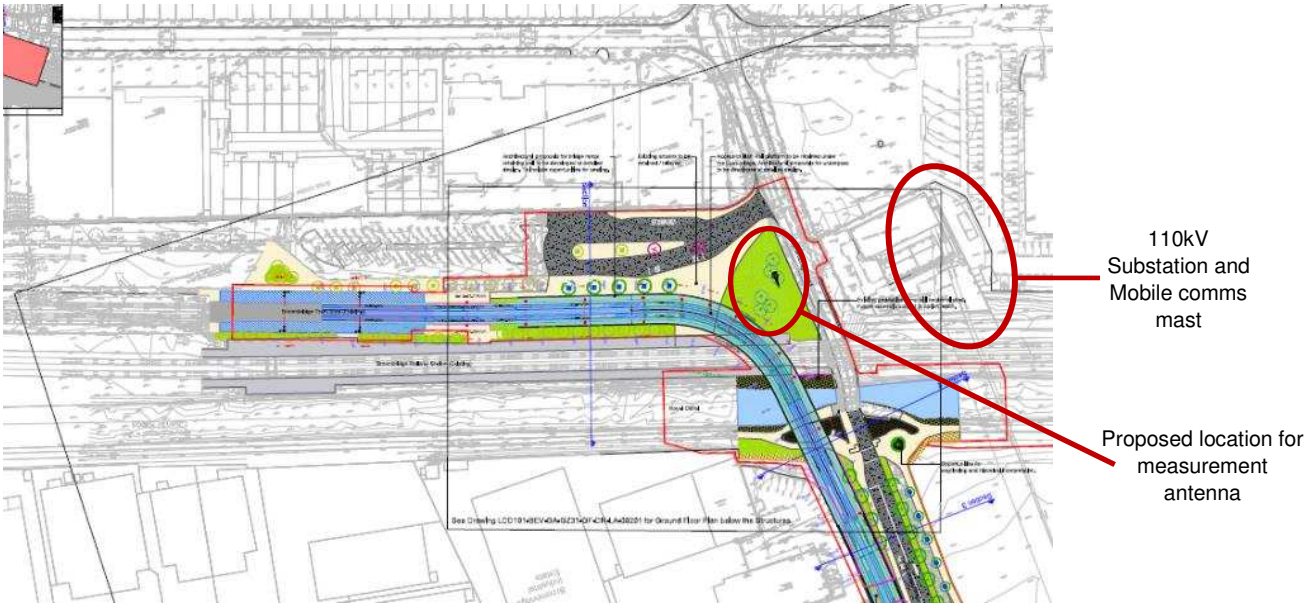


Figure 5 – Broombridge Station - Site 1, Location for Radiated Emission Measurements

Figure 6 – Google Earth View of Measurement Location for Aerials

Figure 7 – Photograph of the Grassy Area Proposed for Site 1.

Site 2 - Finglas Garda Station

The tramway cuts through the middle of the Finglas Garda Station site, through their car park. There is a transmitter aerial on their site with aerials for police transmissions as well as third party aerials for mobile communications. A good location to set up the measurement aerials is in the car park of the police station.

Figure 8 – Finglas Garda Station – Site 2, Location for Radiated Emission Measurements

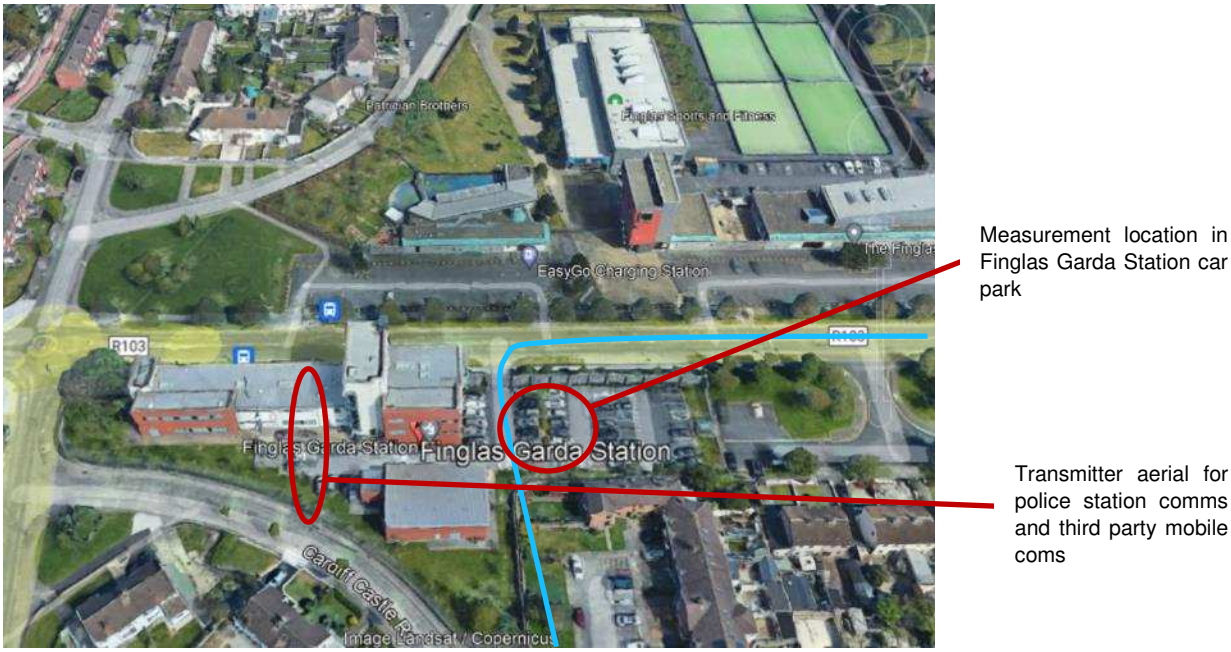


Figure 9 – Google Earth View of Proposed Measurement Location – in Car Park

Figure 10 – Photograph of Site 2, Looking into Garda Station Car Park

Note, the above photograph is looking into the Finglas Garda station car park from the Mellowes Road side. The tramway route will pass directly through this gate, through the middle of this car park area. The proposed measurement location for Site 2 is inside this car park.

Site 3 - Finglas Fire Station – New Substation Location

The tramway passes adjacent to the Finglas Fire station which is also the site of one of the new substations. There is road access to the location of the proposed new substation and therefore suitable for measurement aerials and the vehicle carrying test equipment.

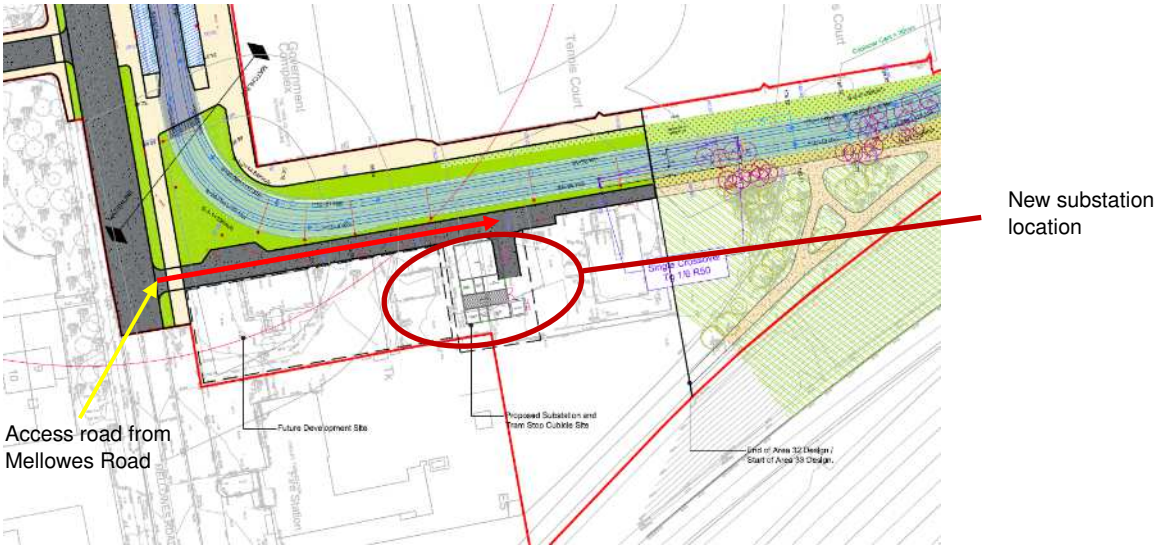


Figure 11 – Adjacent to Garda Fire Station - Site 3, Location for Radiated Emission Measurements

Figure 12 – Google Earth View of Proposed Measurement Location (Adjacent to Fire Station)

Figure 13 - Photograph of Site 3 – Location of New Substation Adjacent to Fire Station

Figure 13 shows the open area where the new substation is proposed to be sited. The shed to the left housed a welfare facility which was staffed and it was indicated there would be no objection to setting up the test equipment in this area. To the right of the bush on the right of the picture is a road access to the site.

Site 4 - Between Finglas Bypass and North Road – Adjacent to New Substation Location

Figure 14 – Between Finglas Bypass and North Road – Site 4, Location for Radiated Emission Measurements

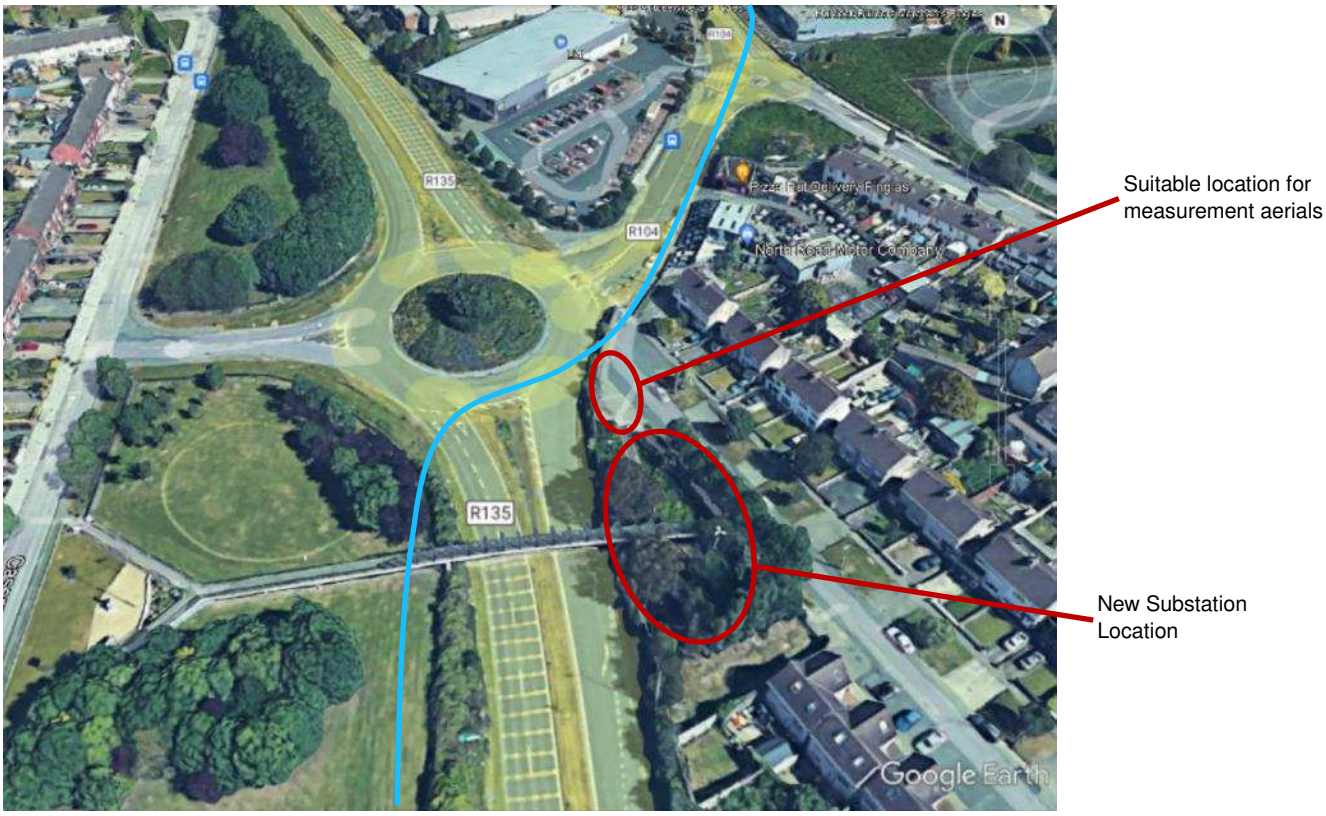


Figure 15 - Google Earth View of Proposed Measurement Location (Adjacent to New Substation Location)

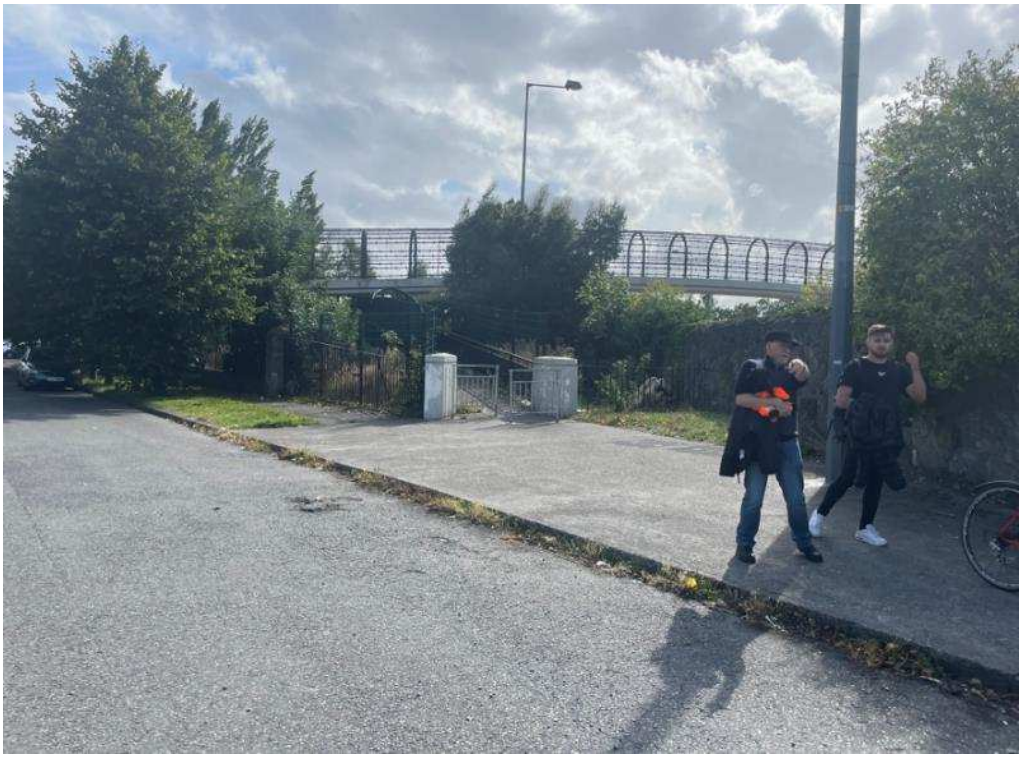


Figure 16 - Photograph of Site 4 – Measurement Location Adjacent to New Substation Location

The measurement location is on the paved area. The public access to the overbridge can be left accessible and the area taped to avoid any interference with the public.

Site 5 - Charlestown Terminus

The new tramway terminates at Charlestown close to the Charlestown shopping centre. This is the proposed location suitable for radiated emission measurements (Site 5).

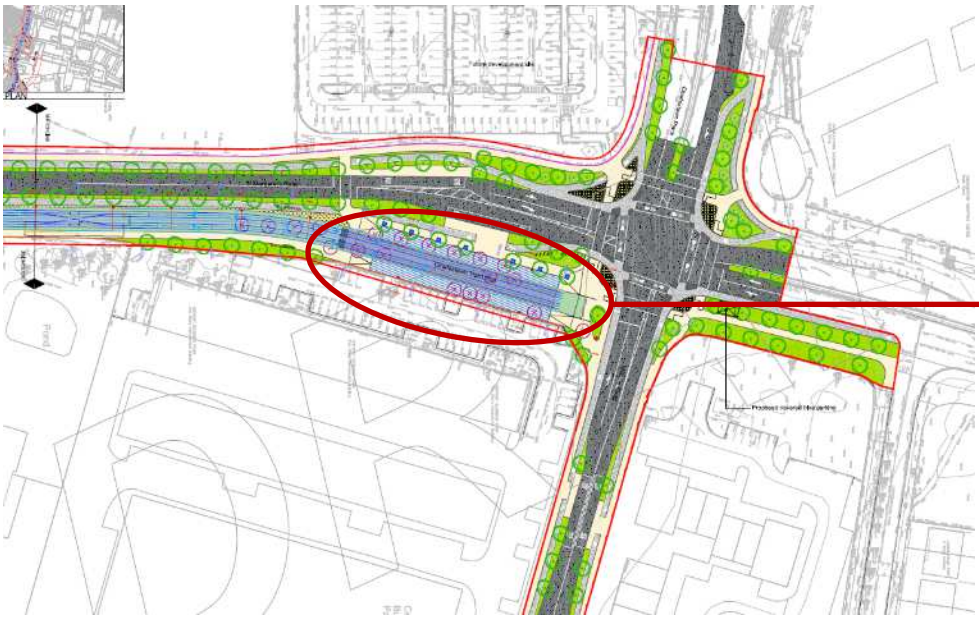


Figure 14 - Terminus Location of Tramway Close to Charlestown Shopping Centre – Site 5

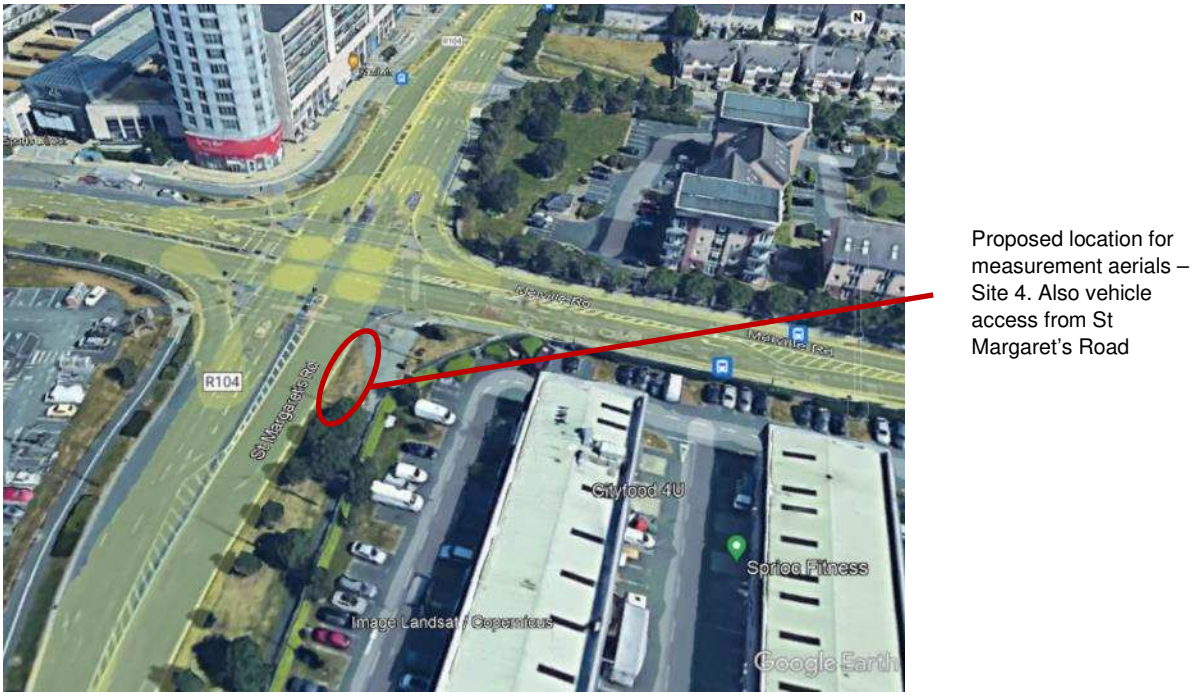


Figure 15 – Google Earth View of Proposed Measurement Location (right of St Margaret's Road)

Figure 16 – Photograph of Site 5 – Grass Area Adjacent to St Margaret's Road

4.2 Electromagnetic Field Measurements

An area of concern was identified from the Desktop Survey, where the tramway runs parallel and then crosses twice under a 110kV HV power line. The primary hazard that was identified are the 50Hz fields that could induce hazardous 50Hz voltages onto tramway rails or other lineside services. This requires a simulation study to determine worst case induction under normal, imbalanced and fault conditions however this is outside of the scope of this measurements survey. An indication of the normal levels however, can be determined from measurement of electric and magnetic fields under the lines. This will be carried out using simple hand-held measurement meters. Figure 17 below shows the NARDA ELT-400 meter in action. It provides and instantaneous reading of the field level at that particular location.

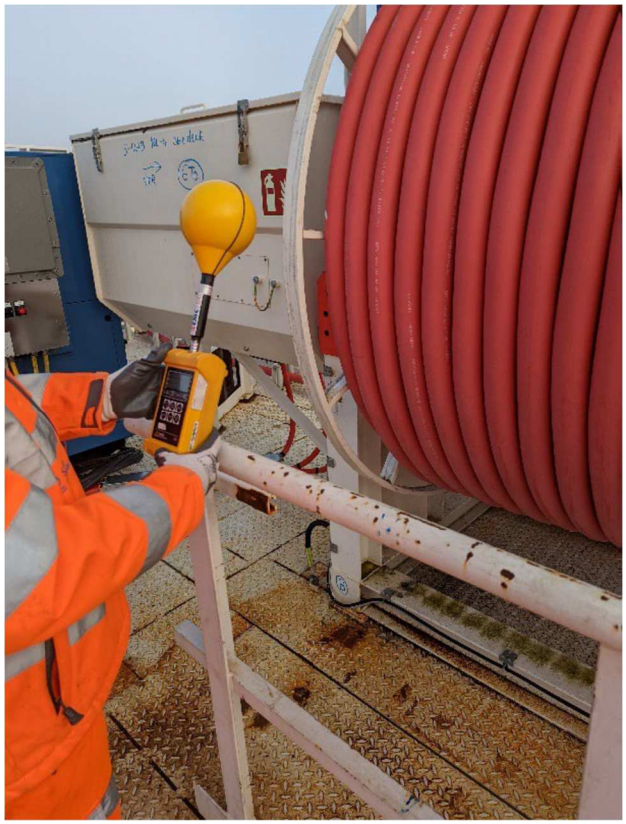


Figure 17 – Example Magnetic Field Measurement Using Hand Held Narda ELT-400 Meter

4.2.1 Measurement Locations for EMF Measurements

Site 6 – Parallel to Broombridge Road

The 110kV HV lines run parallel at approximately 50m horizontal separation from the new tramway route and parallel with Broombride Road as indicated in Figure 18 below. Spot measurements will be taken at 100m intervals along the parallel route on Broombridge Road.

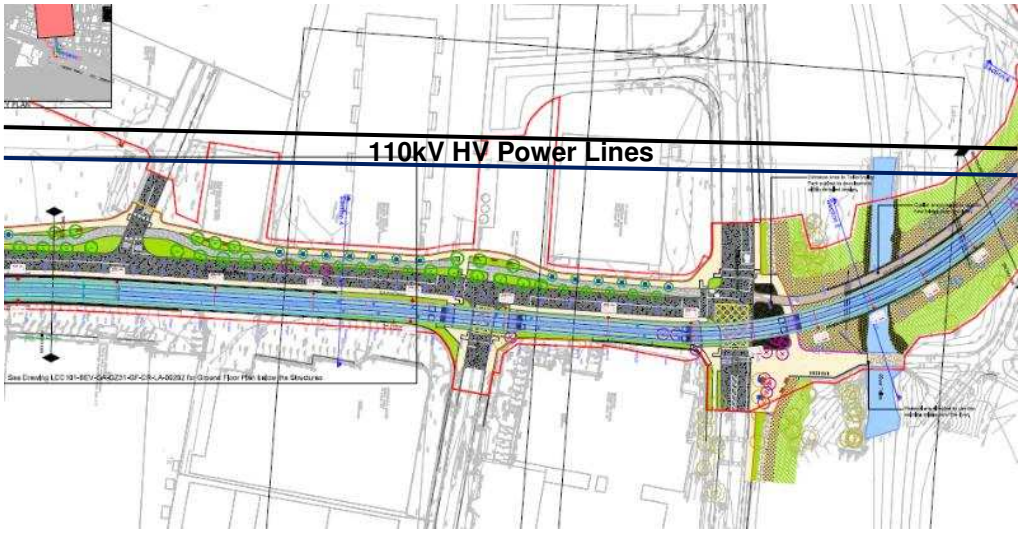


Figure 18 – Tramway Runs Parallel to HV Lines Along Broombridge Rd for 500m and 50m separated

Site 7 – Under the HV Lines in Tolka Park

The 110kV line turns at almost 90° within Tolka Valley Park and crosses the tramway at two locations quite close to each other as indicated in Figure 19 below. Measurements will taken directly under the HV lines at the crossing points of the tramway.

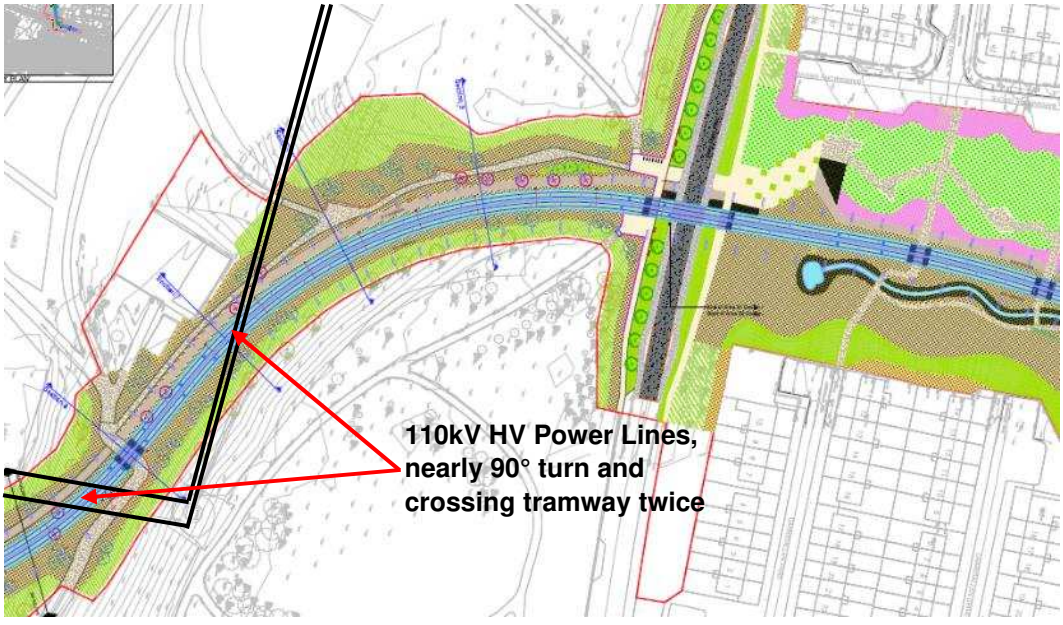


Figure 19 – 110kV HV Power Lines Cross Tramway Twice in Tolka Valley Park

4.3 Ground Resistivity Measurements

Ground resistivity surveys are required at the new sub-station locations to ensure the correct location of earthing rods and systems for the substation design, so that the earth rod resistance to earth value is sufficiently low to provide a proper safety earth. The measurement procedure described below is the Wenner (four rod) procedure that is given in BS 7430:2011.

The main objectives of the measurements are to:

- Determine an optimum position for the earth rods to be installed;
- Provide assurance that suitable low voltage supply disconnection times can be achieved under fault conditions;
- Assess the viability of sub-station candidate locations and assist with their earthing system design;
- Provide adequate protection of equipment from external fault sources, such as lightning strike and overhead line equipment faults.

The following equipment is required for these tests:

- Fluke 1625-2 GEO Earth Ground Tester;
- Four earth electrodes and cables;
- C.A.T Scanner (Cable Avoidance Tool).

For each location the following procedure is carried out:

1. Competent trained person to use cable avoidance tool before starting the test at each site location,
2. Insert the four electrodes (or half cells if required) at equal spacings of 2 metres from the test meter, in an approximate straight line;
3. Set the meter to ‘four pole’ method;
4. Press ‘Start Test’ and record the resistance reading, along with the rod spacing;
5. Repeat the above at 3, 4, 5 metre etc spacings as site conditions dictate;
6. Carry out the above procedure at various locations around the site.
7. Take a photo of the test setup and another of the site location.

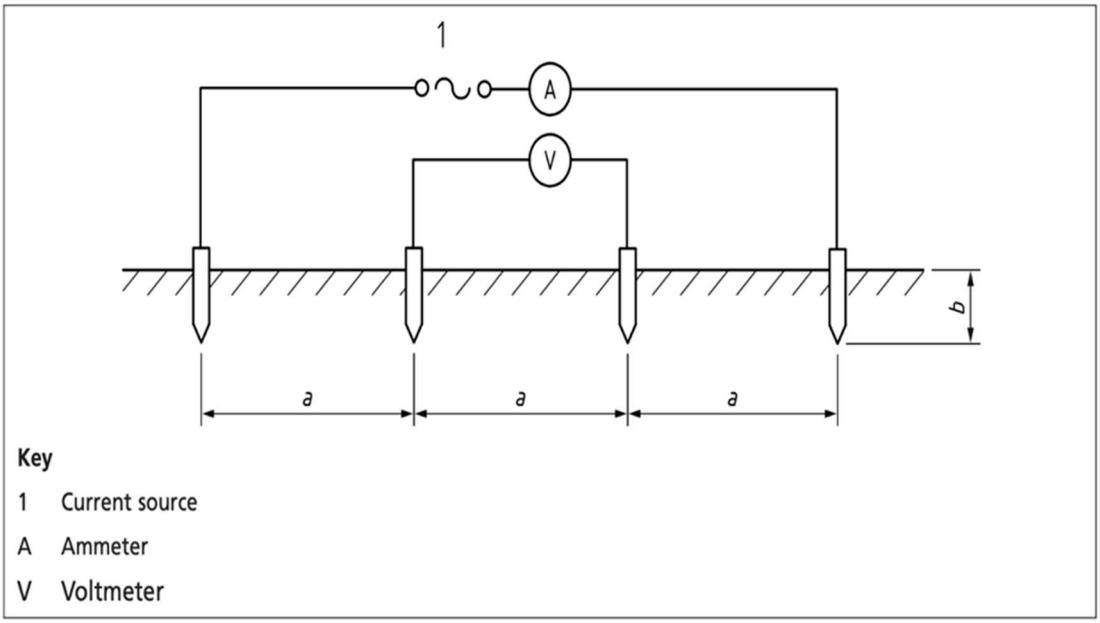
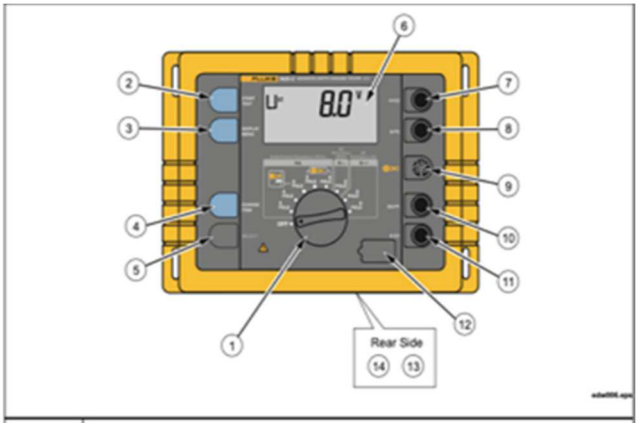


Figure 20 – Diagram of the Measurement Set-Up



No.	Description
①	Rotary switch to select measurement function and ON/OFF
②	"START TEST" button to start the selected measurement function
③	"DISPLAY MENU" button to select the setting or show test data
④	"CHANGE ITEM" button to change the selected setting value
⑤	"SELECT" button to confirm the setting value
⑥	Liquid crystal display (LCD)
⑦	Connection "H/C2" for auxiliary earth (4 mm ø)
⑧	Connection "S/P2" for probe (4 mm ø)
⑨	Connection to sense current test clamp
⑩	Connection "ES/P1" for earth electrode probe (4 mm ø)
⑪	Connection "E/C1" for the earth/ground electrode to be measured (4 mm ø)
⑫	USB Type B Port
⑬	Battery compartment for 6 alkaline batteries (type AA, LR6)
⑭	Screws to fasten the battery compartment

Figure 21 - Features and Functions of the Fluke Tester

4.3.1 Measurement Locations for Ground Resistivity Testing

Site 8 – New Substation Site Adjacent to Finglas Fire Station

Figures 11 and 12 have already detailed the Finglas Fire station site for radiated emission measurements (Site 3), close to the new substation location. Ground resistivity measurements are required on the actual ground that the substation will be located

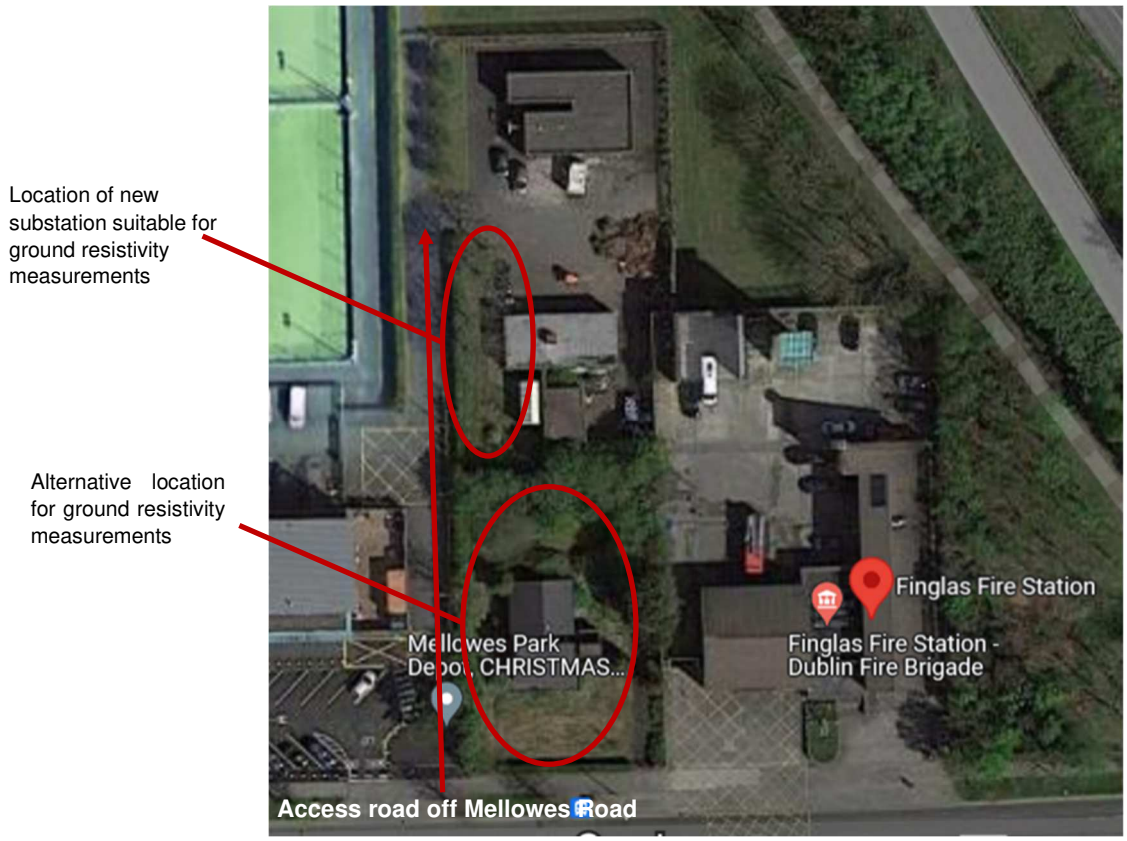


Figure 22 – Ground Resistivity Measurement Locations Adjacent to Finglas Fire Station

The upper of the two circles in Figure 22 is the best location for ground resistivity measurements as this is on the location of the new substation location. It is also easily accessible from the access road off Mellowes Road. If there were challenges with the preferred site due to utilities (e.g. a metallic pipe) which adversely affects readings, then the second location could also be tested as an alternative as it is close to the site of the new substation so likely to have similar earth resistivity properties.

Figure 23 – Test 1 – Approximately 30m long

Figure 24 – Test 2 & 3 – Approximately 20m long

Figure 25 – Test 4 – Approximately 15km long

Site 9 – Between Finglas Bypass and North Road – at the New Substation Location

Figure 14 and 15 have already identified the new substation location between Finglas Bypass and North Road and the adjacent location for radiated emission measurement (Site 4). However, the ground resistivity measurement needs to be carried out on the actual ground of the new substation. This is in an area where the pedestrian overbridge down slope is located. Figure 15 is replicated below as Figure 26, focussing specifically on the ground where the new substation is to be located. The footbridge is to be dismantled to make way for the new substation.

Figure 26 – Finglass Bypass/North Road New Substation Location

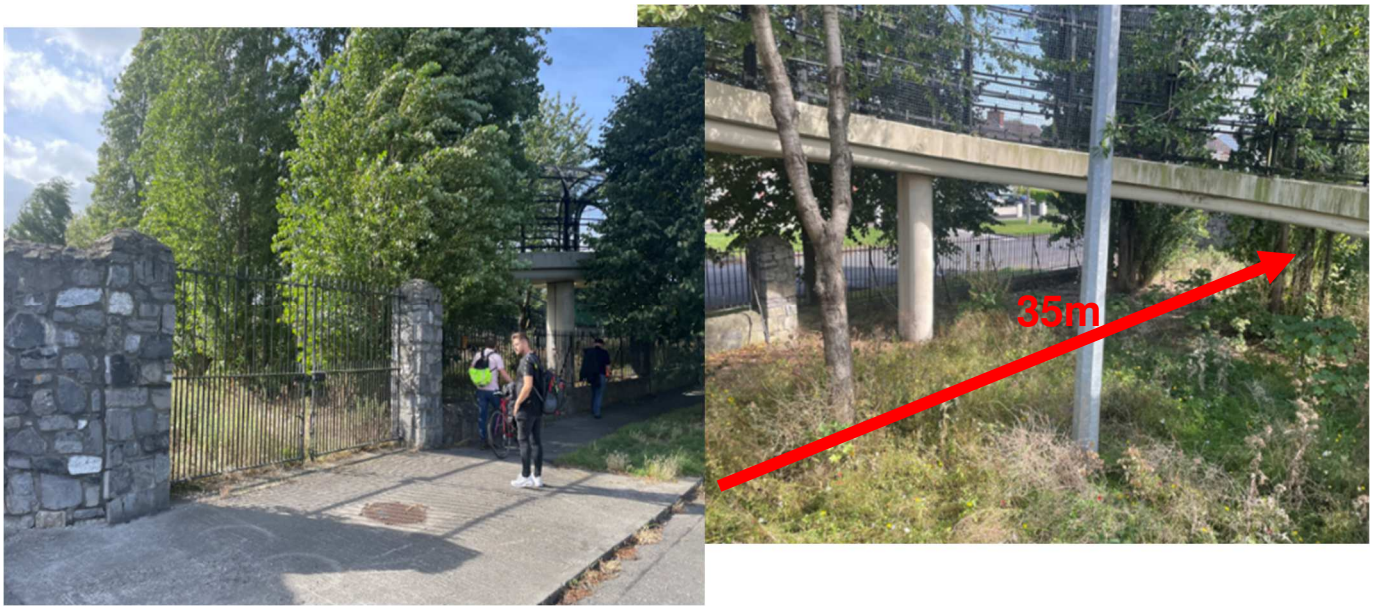


Figure 27 – Photographs of New Substation Site, the Access Gate from North Road which is Padlocked and Ground Resistivity Measurement Location

Ground resistivity measurement location for the four ground electrodes – approximately 35m long and therefore a suitable area for the test.

Figure 28 - 2nd Location for Ground Resistivity Measurement Looking in from Gate on North Road

Two test areas in Site 9 have been identified – one is 35m long along the length of the site parallel to North Road. The other is 25m long which is the width of the site at it widest point (looking in from the gates on North Road).

SECTION 5: Site Access Issues

5.1 Review of Site Locations

5.1.1 Site 1 - Adjacent to Broombridge Station

This measurement location is accessible to the public, however the patch of grass identified for the measurement aerial is not a walk-through area and can easily be taped off to avoid interference with public without causing any disturbance. Ideally, we would like the support vehicle containing the recording equipment to be allowed to mount the curb and park on or adjacent to the grass area.

Grass area adjacent to Broombridge Station for radiated emission measurements

Figure 29 – Site 1 Proposed Measurement Location Adjacent to Broombridge Station

5.1.2 Site 2 - Finglas Garda Station

This proposed measurement location is within the Finglas Garda station site – within their car park, so permission from the police authorities would need to be gained to allow this measurement to be carried out. If permission was not granted and alternative measurement location could be on the site of 'Bit Accrual'.

Measurement location inside Finglas Garda station car park

Alternative location on 'Bit Accrual' site if police do not grant access

Figure 30 – Site 2 Proposed Measurement Location in Finglas Garda Station Car Park

5.1.3 Site 3 - Finglas Fire Station – New Substation Location

The proposed measurement location for radiated emission measurements is accessed by a road off Mellowes Road (see Figure 22), so it is proposed to take the vehicle into the identified area. The white shed in the location is a welfare facility and security staff were present on the site visit who had no concerns with us accessing the area for measurements, for both radiated emission testing and the ground resistivity measurements. This permission needs to be confirmed.

5.1.4 Site 4 - Between Finglas Bypass and North Road – Adjacent to New Substation Location

The site is in a publicly accessible adjacent to the end of North Road and at the exit/entrance to the over-bridge. There is adequate space however to tape off the area whilst still allowing access to the footbridge. There will be little traffic on North Road as it is the end of the road so no passing traffic. No special permissions are expected to be required.

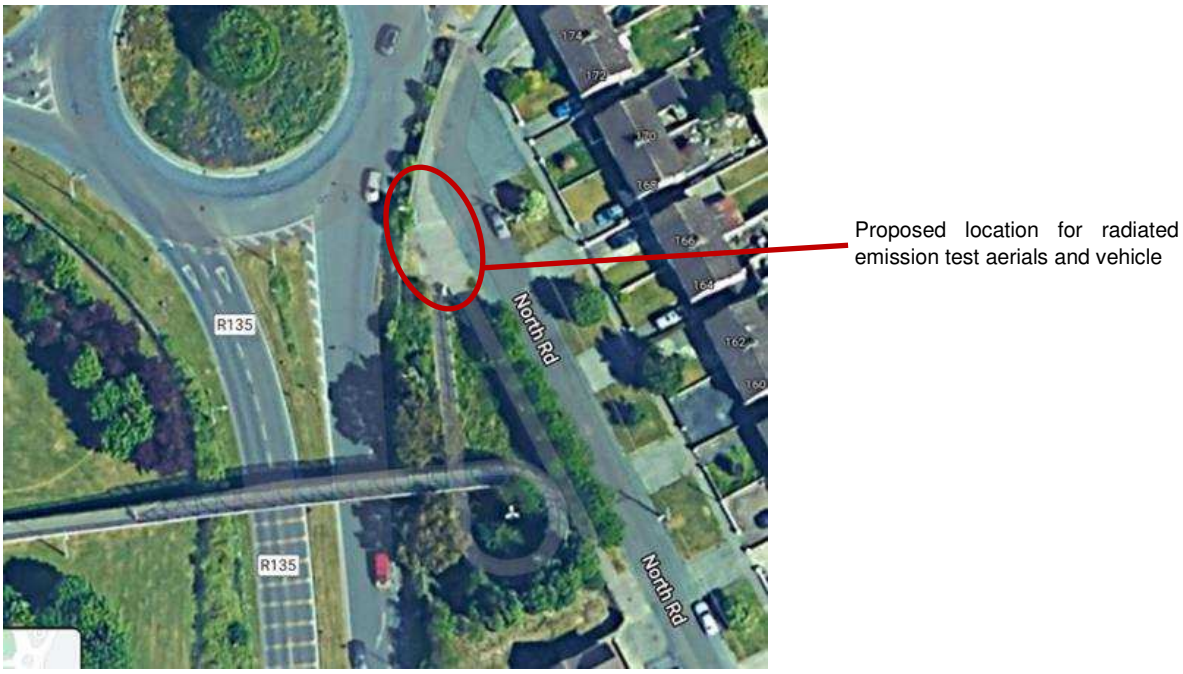


Figure 31 – Proposed Location for Radiated Emission Testing (Site 4)

5.1.5 Site 5 - Charlestown Terminus

The terminus at Charlestown is on the side of St Margaret's Road as indicated in Figure 32 below. It is accessible to the public but there is space for the measurement antenna and test vehicle which can be taped off to avoid interference with the public. No special permissions are expected to be required.

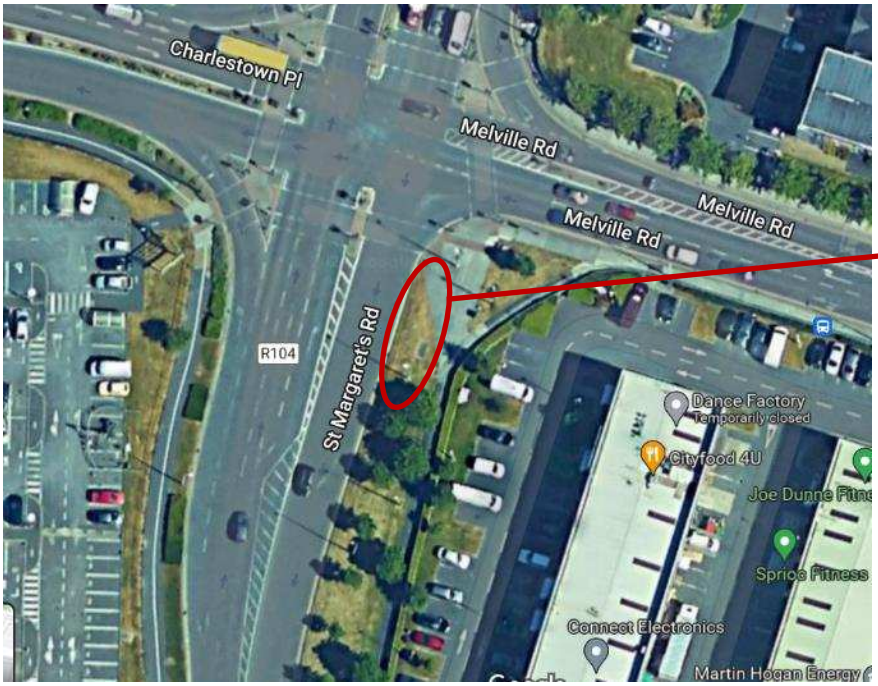


Figure 32 - Proposed Location for Radiated Emission Testing (Site 5)

5.1.6 Site 6 - Parallel to HV Lines along Broombridge

The electric and magnetic field measurements parallel to the 110kV HV overhead lines along Broombridge Road will be carried out using hand held meters every 100m along the parallel interface . These are quick measurements and very unobtrusive to public – little more than walking the route. No special permission is required for these measurements.

5.1.7 Site 7 - Under the 110kV HV Lines in Tolka Park

These measurements are the same as those described above for Site 6 and are very quick measurements and very unobtrusive to any public walking in the park. No special permission is required for these measurements. Figure 33 shows the route of the new tramway which follows the line of the path and the two crossing points under the HV wires.

Figure 33 – Site 7 – Tramway Follows the Path and Crosses Under HV Wire Twice

5.1.8 Site 8 – New Substation Site Adjacent to Finglas Fire Station

Figure 34 clearly identifies the two locations that may be required for ground resistivity measurements. Both are freely accessible – the preferred one via a track off Mellowes Road, and the alternative one on foot through a small gate. The preferred location does have a welfare facility with security staff manning it who showed no objection to our measurement requirements, however this should be confirmed.

In the event that we need to measure the ground at the alternative location, this area is accessed from a gate off Mellowes Road that was open and access could be gained (on foot only). However, there was a small homeless settlement on the area behind the building so this may cause access issues.

We require utilities data for this site so we can identify any services that could affect the ground resistivity readings. As a precaution we will use a Cat Scan to identify any electrical services however the rods we need to drive into the ground only go to a depth of 30cm so should not in any case disturb any such services.

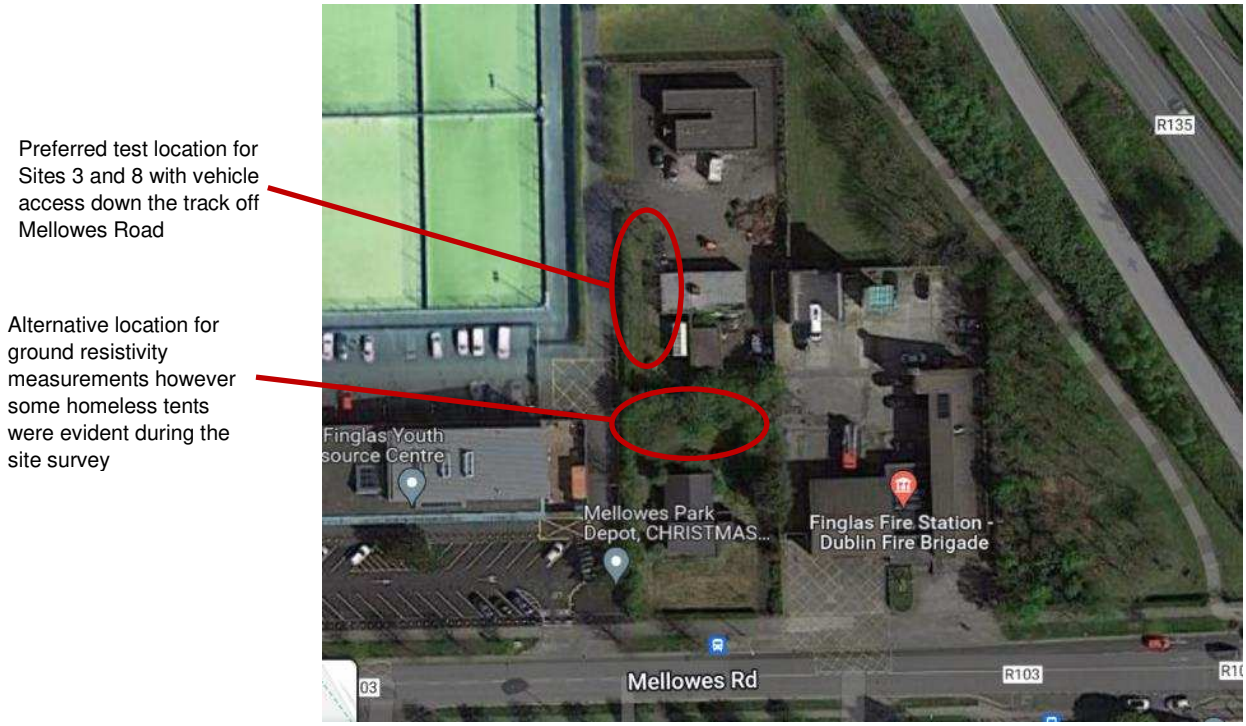


Figure 34 – Site 8, Preferred and Alternative Locations for Ground Resistivity Testing

5.1.9 Site 9 – Between Finglas Bypass and North Road

Site 9 is detailed in Figure 27 earlier in the report and the ground conditions seem very suitable for ground resistivity measurements. However, it is a fully enclosed fenced area with metal fencing. The only structures within the compound are the footbridge supports and a lamp in the centre. The only access point is through the padlocked gates so permission will be required to access the area and keys provided for the padlock. Figure 35 shows this gate access from North Road.

Figure 35 – Gate Access to Proposed Location for Ground Resistivity Testing (Site 9)

5.2 Site Safety

5.2.1 General Comments

A risk assessment has been carried out and detailed in Section 5.3. It is important that any pre-test information is provided by the project (e.g. utilities data for Sites 8 and 9). It is important that test engineers are familiar with the risk assessment and observe carry out all the control measures.

5.2.2 Timings and Test Schedule

Most test site will require and estimated of 4 hours of time for the measurements to be captured. No equipment needs to be left unmanned which would create additional hazards. The equipment and measurements are monitored at all times. Test sites 6 and 7 are quick measurements and will take only approximately one hour for both sites. A total of 4 consecutive days is expected to be required to carry out all the tests.

5.2.3 Site Safety

Adrian Hines will act as the Engineer in charge throughout the measurement surveyand will be responsible for maintaining safe working practices at the test sites.

- First Aid – a first aid kit will be taken on site
- Communication – mobile phone numbers will be exchanged between all engineers and project managers as agreed before tests so relevant people can be contacted as required or in the event of an emergency
- PPE – all persons on site to use where applicable:
    - Head protection (hard hats) EN397
    - Safety footware EN345 (mandatory)
    - Hi Vis tops EN471 (mandatory)
    - Gloves EN374 (mandatory)
- Electrical Safety
    - Using mains supplied power – an RCD to be used at all times
    - All equipment will be operated on 240V supplies
    - In reality supply will be via battery and inverters as there is no on site 240V mains supplies available

.

5.3 Risk Assessment

No.	Activity	Persons at risk	Severity	Likilihood	Risk	Control measures in place/required	Residual Risk	Comments
1	Manual Handling of test equipment from vehicle to test position	Test Engineers	2	2	4	2 trained staff. Safety boots to be worn. Handles on carriage boxes carried by two people	2	
2	Staff struck by road vehicles	Test Engineers	3	2	6	Test positions to be sited away from high traffic areas. Engineers to wear hi-vis.	3	Site 6 is a mobile 'walking test' along Broombridge Road. Stay on pavement – not in the road.
3	Slips, trips and falls	Test Engineers	2	2	4	Trailing cables to be kept to a minimum. Test area with rough ground and vegetation to be access with care and safety boots worn	3	Site 9 has only been viewed not walked and contains some high vegetation. Care to be taken on first access
4	Electric shock from test equipment	Test Engineers	3	1	3	Equipment to have current PAT sticker. Equipment to be protected from water with RCD protection	3	
5	Electric shock from driving resistivity electrodes into ground	Test Engineers	4	1	4	Data about utilities have been requested from the project so hazards are known before testing. Cat Scan used to survey test area before driving any electrodes into ground.	3	Electrodes are only required to be driven 30cm into the ground, so should not be anywhere near electrical cables that should be buried deeper in the ground than

6	Protection of other people and public at the test sites	All	2	2	4	Cables to be arranged so they do not pose trip hazard. Areas to be segregated where applicable. Appropriate warning signage to be used	2	
7	Weil's disease (leptospirosis)	Test Engineers	4	2	8	Observe proper personal hygiene. Avoid standing in water	4	
8	Covid	All present personnel	2	4	8	Staff with any Covid symptoms to report in sick and not attend the test. Social distancing to be practiced where practical.	4	
9	Needles, syringes etc (Aids and other diseases)	Test Engineers	4	2	8	Avoid picking up any needles/syringes that might be in the test areas particularly areas with vegetation and ground not easy to see. Wear gloves for protection and be very observant when driving rods into ground.	4	Site 8 is behind steel fence no access and overgrown vegetation, so hazards may not be visible. Site 9 has homeless tents so high risk of needles etc

SECTION 6: Conclusions

6.1 Pre-Test Requirements

6.1.1 Sites which are Easily Accessible But Are Also Public Areas

Access to all these areas which are also accessible to the public do not pose any significant issues or hazards and where necessary the test areas will be taped off avoid any issues with public. If any specific permissions are required for these sites we would request the project arranges these.

- Site 1 – Adjacent to Broombridge Station
- Site 4 – Adjacent to new substation Site (Finglas Bypass/North Road)
- Site 5 – Charlestown terminus
- Site 6 – Along Broombridge Road
- Site 7 – Tolka Park

6.1.2 Sites on Private Land

- Site 2 – Finglas Garda station premises belonging to the police authorities. Access needs to be arranged with the police authorities for the measurements in their car park (radiated emission measurement aerials and vehicle.
- Site 3 and 8 – Adjacent to Finglas Fire station. Permission from the fire authorities to be sought to allow these measurements on the land adjacent to the fire station
- Site 9 – On the new substation site (Finglas Bypass/North Road), behind metal fence and padlocked gates

6.2 Survey Tests

The actual survey measurements will be carried out at mutually agreed dates over a period of four consecutive days. Proposed dates suitable for the test team are:

- October 11th – 14th 2022.

6.3 Test Report

The test measurements will be fully documented in a Test Report and delivered within 3 weeks of the measurements survey.

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Údarás Náisiúnta Iompair
National Transport Authority

BARRY TRANSPORTATION
egis GROUP

egis

Project Ireland 2040
Building Ireland's Future