

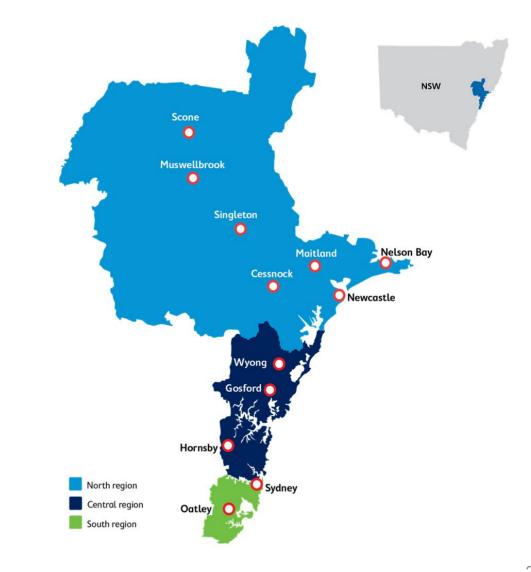
Submarine Cables

An overview of Ausgrid submarine cable installations and safe location methods to avoid danger or damage BYDA – 7th December 2023



Ausgrid Network

- 1.8 million customers
- Network covers 22,275 square km







Ausgrid Under Ground Cables

• 17,600kms of ug cables, only 31kms are submarine

Underground - 2023	km
132 kV UG ccts - oil	203
132 kV UG ccts - XLPE	361
66 kV UG ccts	10
33 kV UG ccts - gas	38
33 kV UG ccts - XLPE/PILC	537
5/11 kV UG ccts	8,744
5 kV UG ccts	16
11 kV UG ccts	8,728
LV UG ccts	7,053
- CONSAC	551
- HDPE	101
Grand Total UG Cables (km)	17,598

Submarine Cables - 2023	in service	out of service
11kV	18.7	2.1
132kV	12	4.9
33kV	0.7	2.1
6.6kV		
LV	0.4	
unknown		0.4
Grand Total Submarine (km)	31.8	9.4





Ausgrid Submarine Network

- Some 6,600 Volt installations
 Mostly in Pyrmont /Darling Harbour and decommissioned /redundant
- Mostly 11,000 Volt installations
- Some 33,000 Volt installations
 Most decommissioned / redundant
- Some 132,000 Volt installations
 Most decommissioned, many scheduled to be retired although some key feeders will remain in service for decades





Ausgrid Submarine Network

Sydney Locations

Sydney Harbour, Iron Cove, Lane Cove River, Parramatta River, Rhodes, Botany Bay, Port Hacking, Pittwater

Central Coast Locations

Empire Bay, St Huberts Island, Woy Woy, Avoca Lake, Narrara River, Tuggeragh Lake, Wallarah Creek

Hunter Locations

Lake Macquarie, Hunter River





Sydney Harbour 1935, Bennelong Point 33kV PILC (paper)





Darling Harbour 1942, Pyrmont Bridge 6.6kV (paper)





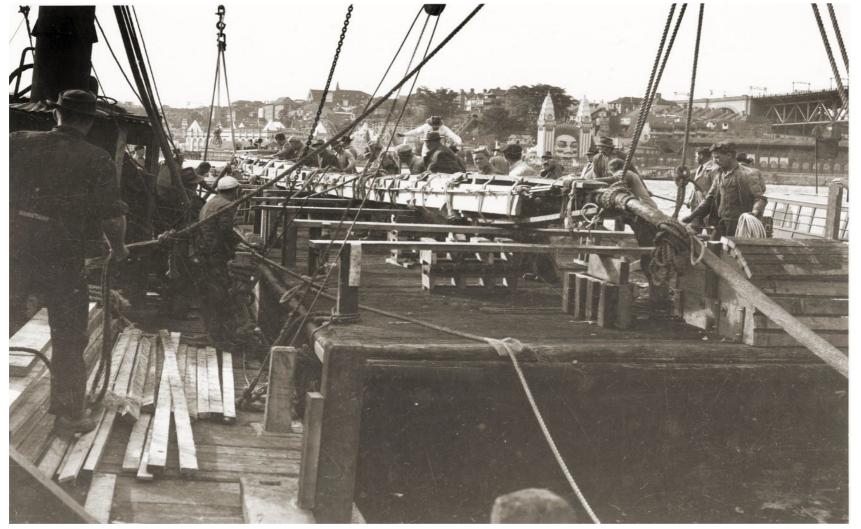


Sydney Harbour 1953, Lifting for Repairs at Dawes Point, 33kV PILC (paper)





Sydney Harbour 1953, repairs on a barge at Dawes Point, 33kV PILC (paper)







Sydney Harbour 1966, Dawes Point 132kV (oil)



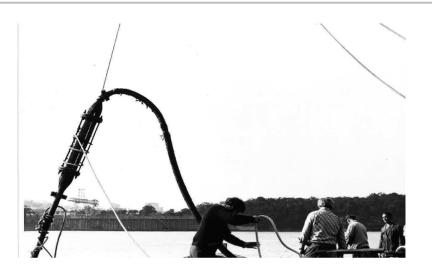


Sydney Harbour 1966, Dawes Point 132kV (oil)

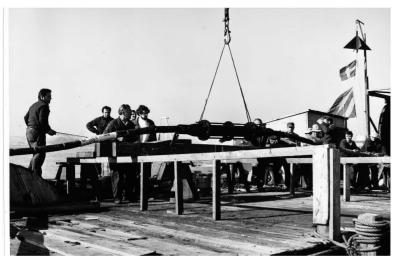




Sydney Harbour 1973, repairs, 33kV PILC (paper)



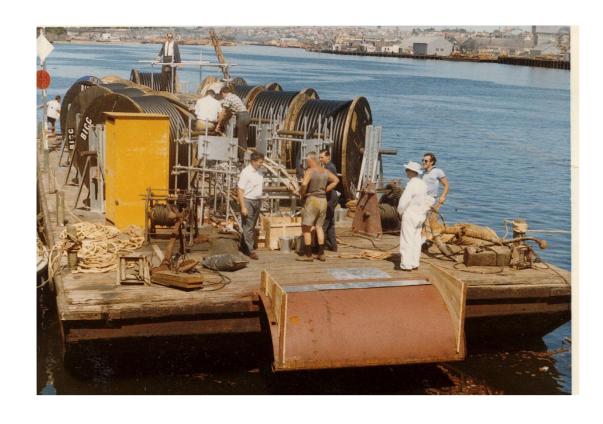








Sydney Harbour 1970s, Iron Cove 132kV (oil)







Botany Bay 2010, Kurnell to Bunnerong, 132kV XLPE (plastic)





Pittwater 2020, Scotland Island 11kV XLPE (plastic)







For Official use only

Submarine Cable Construction (PILC - Paper)

 Cables have steel wire armour to provide protection and strength (also brass tapes and lead sheath)



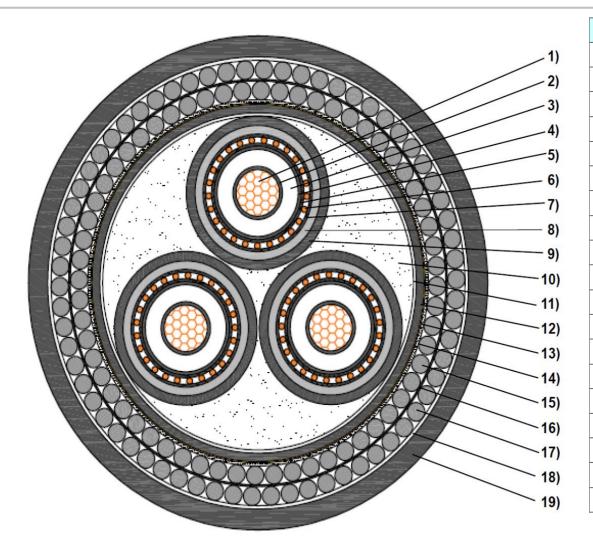
33kV HSL Cable 1928 Siemens



11kV 3C Cable 1967 Power Cables Australia



Submarine Cable Construction (XLPE – plastic)



No	DESCRIPTION MATERIAL			
1)	CONDUCTOR	PLAIN ANNEALED COPPER WITH WATER BLOCKING MATERIAL		
2)	CONDUCTOR SCREEN SEMI-CON. PE COMPOUND			
3)	INSULATION TR-XLPE COMPOUND			
4)	INSULATION SCREEN	EEN SEMI-CON. PE COMPOUND (BONDED TYPE)		
5)	WATER BLOCKING LAYER SEMI-CONDUCTIVE WATER BLOCKING TAPE			
6)	METALLIC SCREEN ANNEALED COPPER WIRES			
7)	WATER BLOCKING LAYER	SEMI-CONDUCTIVE WATER BLOCKING TAPE		
8)	METALLIC SHEATH	LEAD ALLOY (ALLOY E)		
9)	CORE OVERSHEATH	BLACK PE COMPOUND		
10)	FILLER	POLYPROPYLENE YARN		
11)	BINDER TAPE	NON-WOVEN FABRIC TAPE		
12)	BEDDING	BLACK PE COMPOUND		
13)	TEREDO PROTECTION LAYER	BRASS TAPE(S)		
14)	BINDER TAPE	SUITABLE BINDER TAPE		
15)	METALLIC ARMOUR (1 ST)	GALVANIZED STEEL WIRES		
16)	BINDER TAPE	SUITABLE BINDER TAPE		
17)	METALLIC ARMOUR (2 ND)	GALVANIZED STEEL WIRES		
18)	BINDER TAPE	SUITABLE BINDER TAPE		
19)	OVERSHEATH BLACK HDPE COMPOUND			





Submarine Cable Construction (XLPE - Plastic)





11kV 3C Cable 2010 (3C overall lead sheath)

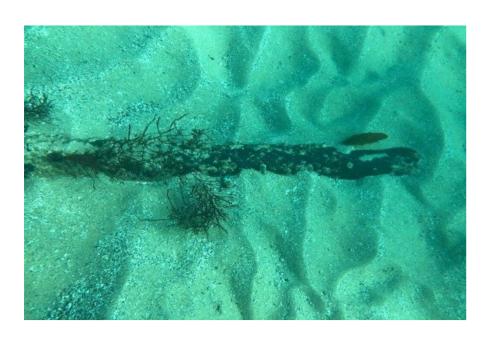


11kV Cable 2020 (individual lead sheath-HSL)



Submarine Power Cable – Burial (up to 1.5m deep)

Power Cables are buried up to 1.5m deep where ground conditions allow.



Cables are buried, in sand, silt and mud, usually by water jetting



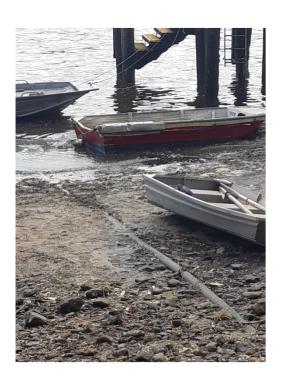
Cables are laid across the top of rock outcrops in the water, or cut into rock channels on the shore, this cable has marine growth on the PE sheath

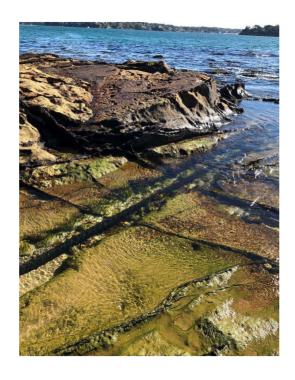




Submarine Power Cable – Burial (up to 1.5m deep)

Power Cables can become exposed following erosion by storms or boat wash









Submarine Cable – Protection

Cast Iron 'Protector Shells' used on telecoms cables 'dropped' on the seabed







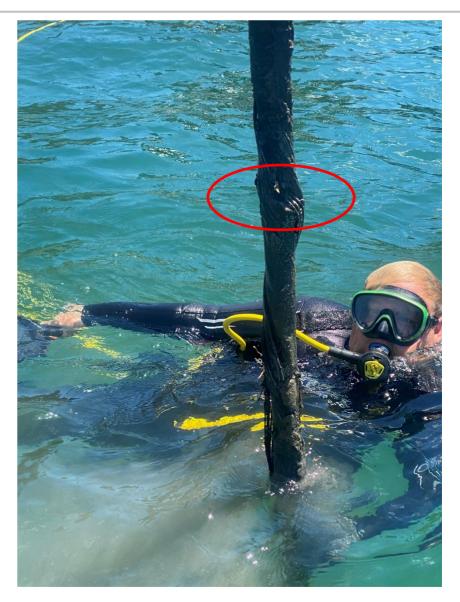


Failures

External Damage by;

- Anchors
 Commercial shipping
 Recreational vessels
- Marine Construction
 - Piles
 - **Temporary Anchors**
 - Temporary mooring blocks / chains
- Abrasion on rocks at shore landings or in deep water / or by mooring chains
- Zero age related failures to date (some 11kV cables up to 80 years, zero damage or failure)







Repairs by AG Transmission Team at Port Hacking / Pittwater / Iron Cove



2012 - abrasion on rocks



2020 – damage by contractor **Ausgrid**



2014 – abrasion / damage



2021 – damage by anchor



2015 – abrasion / damage



2023 – damage by contractor



Submarine Signs (at shore landings)















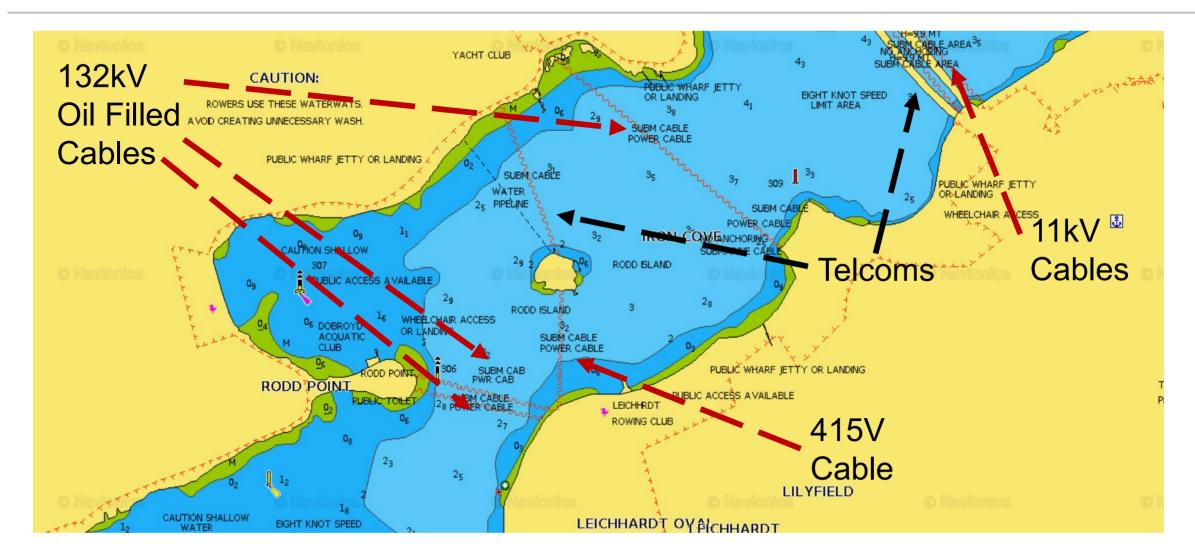
Footer

Records (AG GIS, AG route plans, AG surveys, BYDA etc)





Records (Hydrographic / Nautical / Boating Charts)

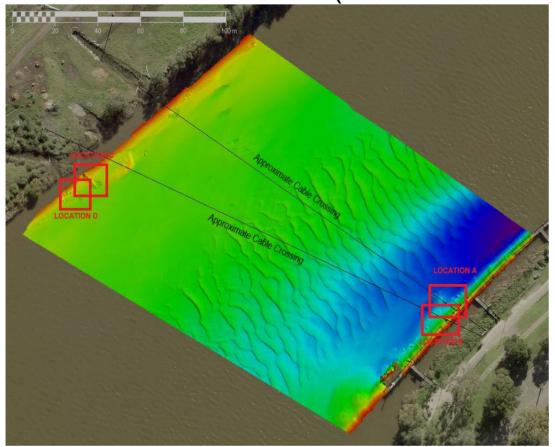






Underwater Cable Location Methods

Side Scan Sonar (towed behind boat) and/or magnetometer



Hunter River - 2 x 33kV cable crossings

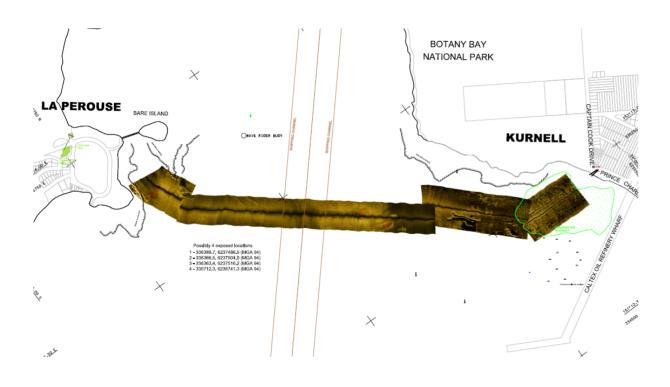
Close up of cables on shore line

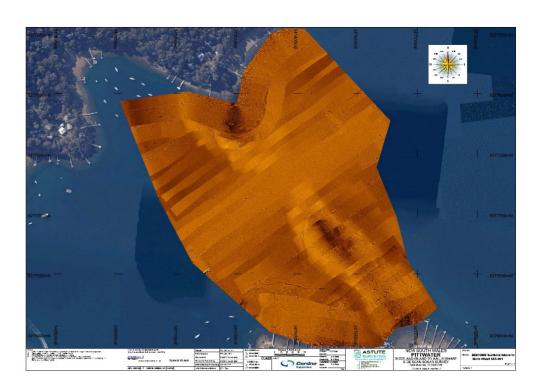




Underwater Cable Location Methods

Side Scan Sonar (towed behind boat) and/or magnetometer





Botany Bay 132kV crossing

Scotland Island 11kV crossing





Underwater Cable Location (Cable Scanner)

Submersible Double Depth Antenna



- Connects to RD8000 cable scanner
- 30m coil (longer coils available)
- 512Hz, 640Hz, or 8KHz
- Used by Ausgrid Test Team





Underwater Cable Location (RD8000 Scanner)











Underwater Cable Location (RD8000 Scanner)

- Connect signal generator to cable sheath
- Locate cable on shore landing using scanner
- Prove location by excavating cable on shore
- Follow cable from the shore into water
- Positively prove scanned cable location in the seabed with dive teams by water jetting on scanned locations at set intervals, eg 50m, 100m etc (note cables may be up to 1.5m deep or more in some locations, but will be shallower in others)
- Mark locations with buoys
- Take GPS locations of marker buoys
- Other search patterns can be used



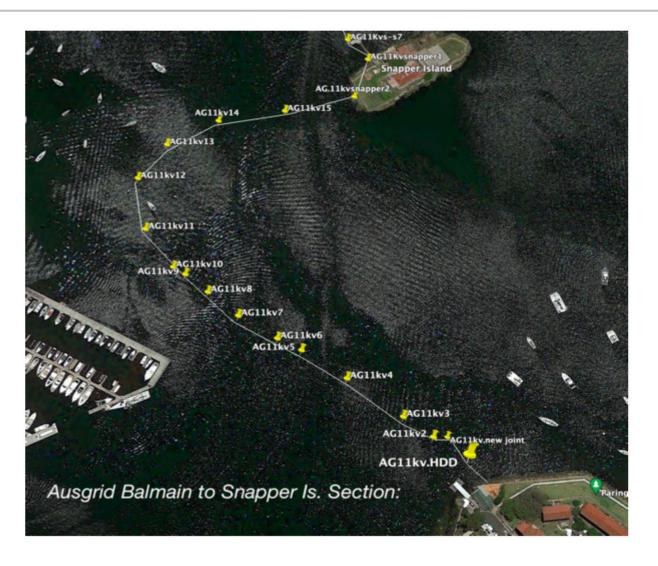




Underwater Location (11kV cable location report)

1.5.1:11Kv Cable Track & Burial Profile:

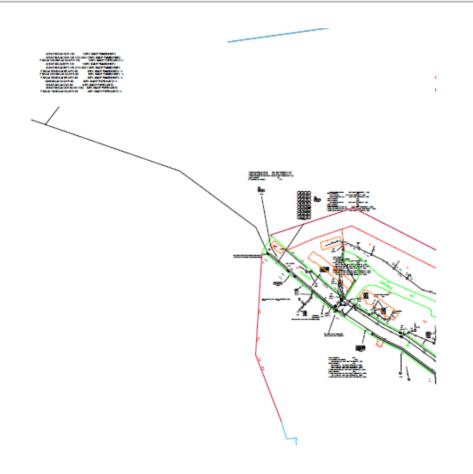
Way Point	Coordinates: Lat/Long	Coordinates: UTM	Burial Depth mm	Substrate Type	Water Depth m	Comment
AG11kv.HDD	33 51.291S 151 10.116E	330576.3E 6252429.02N	500	Silt on rubble/rock	5	HDD exit point
AG11kv1	33 51.289S 151 10.110E	330567.3E 6252431.3N	1000	Sand/silt	6	Cable buried to 1.0m
New Joint	33 51.285S 151 10.104E	330557.33E 6252439.7N	1000	Silt/shell	6	New joint 1.0m below seabed
AG11kv2	33 51.287S 151 10.098E	330548.14E 6252435.91N	200	Sand/silt on clay/shell	6	Old cable into original burial
AG11kv3	33 51.284S 151 10.082E	330523.37E 6252441.02N	200	Shell/mud	7	
AG11Kv4	33 51.277S 151 10.051E	330475.33E 6252453.11N	300	Silt	7	
AG11Kv5	33 51.272S 151 10.026E	330436.62E 6252461.66N	300	Silt/shell	7	
AG11Kv6	33 51.271S 151 10.013E	330416.54E 6252463.15N	1000	silt	7	
AG11Kv7	33 51.267S 151 9.991E	330382.48E 6252469.94N	400	silt	7	
AG11Kv8	33 51.262S 151 9.972E	330353.02E 6252478.66N	600	clay	7	
AG11Kv9	33 51.258S 151 9.958E	330331.3E 6252485.67N	600	Silt/clay	7	
AG11Kv10	33 51.257S 151 9.951E	330320.47E 6252487.32N	1500	silt	7	
AG11Kv11	33 51.245S 151 9.929E	330286.15E 625208.90N	400	Silt/clay	7	
AG11Kv12	33 51.225S 151 9.913E	330260.82E 6252542.42N	О	n/a	7	No burial
AG11Kv13	33 51.206S 151 9.918E	330267.9E 6252580.68N	400	clay	7	
AG11Kv14	33 51.188S 151 9.936E	330295.06E 6252614.44N	600	Silt/clay	6	
AG11Kv15	33 51.174S 151 9.966E	330340.86E 6252641.14N	200	Shell/rubble	5	
AG11kv snapper2	33 51.157S 151 9.996E	330386.57E 6252673.39N	0	sand	1	Snapper landing from Elliott st.
AG11Kv Snapper 1	33 51.137S 151 9.994E	330382.2E 62522710.1N	0	sand	0	Snapper to Spectacle
AG11Kvs-s7	33 51.130S 151 9.979E	330359.1E 6252722.2N	200	silt	5	
AG11Kvs-s6	33 51.111S 151 9.959E	330327.2E 6252757.06N	200	silt	5	
AG11Kvs-s5	33 51.088S 151 9.929E	330281.08E 6252799.3N	700	silt	5	
AG11Kvs-s4	33 51.073S 151 9.916E	330260.2E 6252826.1N	500	silt	4	
AG11Kvs-s3	33 51.049S 151 9.904E	330421.2E 6252868.09N	200	silt	4	
AG11Kvs-s2	33 51.025S 151 9.879E	330201.4E 6252914.1N	200	Gravel	3	
AG11Kvs-s1	33 51.005S 151 9.867E	330182.3E 6252950.03N	0	Rock	2	
AG Spectacle	33 50.989S 151 9.849E	330154.0E 6252979.1N	0		0	Spectacle Landing

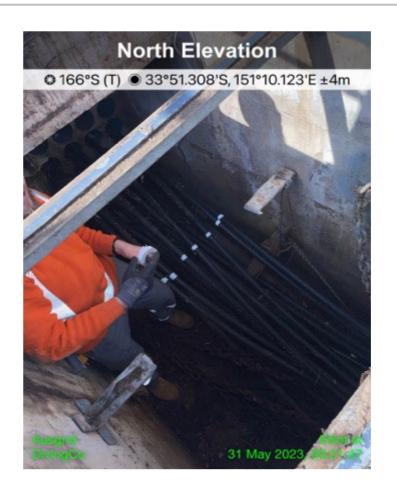






Underwater Location (telecom cable location)

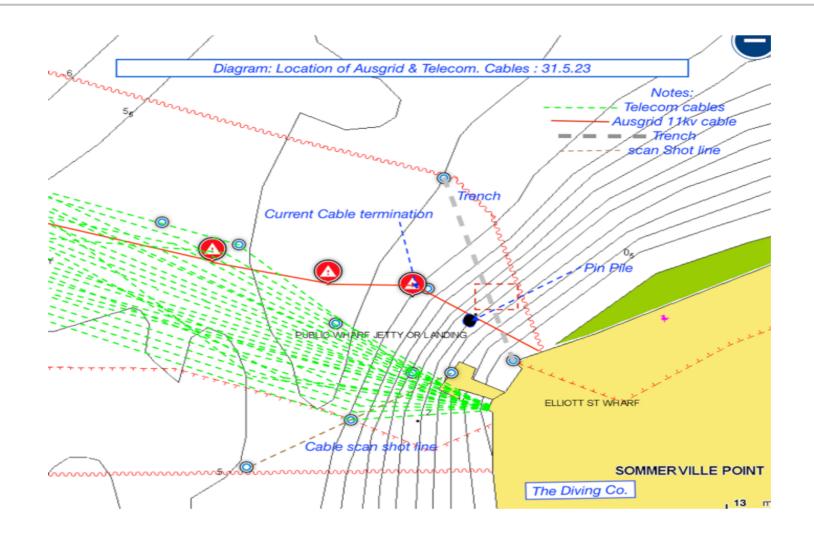




Location of 24 telecoms cables under water to positively confirm locations



Underwater Location (extract of telecom cable location report)







Underwater Location



Fully Submersible Cable Locator used by McLennan's Diving to locate 11kV cables



Submersible detector coil used by Coastal Cable Locators to find 132kV cables, DCL certified, NULCA member





Underwater Location, Avoid Danger and Damage

Summary: - Apply the same techniques that apply on land:

- 1) Identify and manage hazards (do BYDA checks)
- 2) Review BYDA plans, obtain any other plans, consult the asset owners
- 3) Never assume plans are accurate, never measure from plans (they are often indicative only)
- 4) Locate the cable using cable locators (a) on land and (b) in the water
- 5) Carefully expose the cables in the seabed and confirm their identity (use water jetting and cable locators)
- 6) Mark the location of the cables with (marker buoys and take GPS co-ords)
- 7) Ensure all services are located and a safe distance from the proposed works





Submarine Cables - Avoid Danger and Damage





Contact Ausgrid

1) Emergencies: 131388

2) Planning works: development@ausgrid.com.au

