

Hornsea Project Three  
Offshore Wind Farm



## Hornsea Project Three Offshore Wind Farm

Appendix 32 to Deadline 7 submission – Dudgeon Offshore  
Wind Farm Cable Route Geophysical Survey

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**WARWICK ENERGY LIMITED**

**DUDGEON OFFSHORE WIND FARM**

**EXPORT CABLE ROUTE**

**GEOPHYSICAL SURVEY**

**OCTOBER 2008**

**SURVEY REPORT**

Gardline Project Ref.	7818.1
Fieldwork Dates	06-Oct-2008 to 10-Oct-2008
Report Status	Final
Issue Date	18-Dec-2008

## REPORT AUTHORISATION AND DISTRIBUTION

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	Approved	..... K P Games

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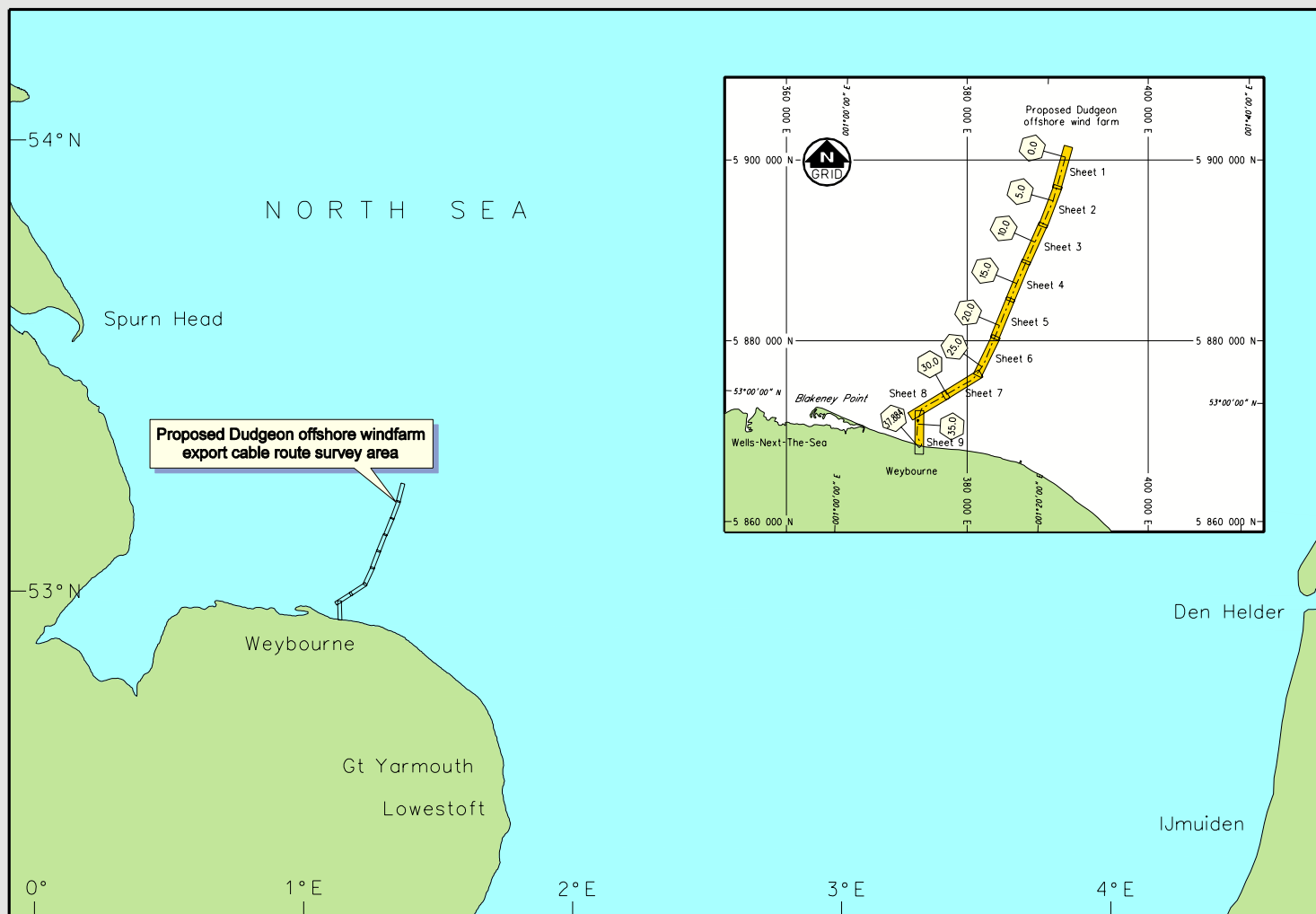
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For attention of  
Richard Evans

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LOCATION MAP

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## LIST OF DRAWINGS

Survey results are presented as A0 size alignment sheets at a horizontal scale of 1:5,000 and a vertical scale of 1:100. The charts comprise four panels showing:

- Bathymetry and Shaded Relief
- Seabed Features, Sonar Mosaic and Sidescan Sonar Track
- Shallow Soils
- Longitudinal Profile

Chart No	Title	Drawing No.
1	Alignment Sheet 1 of 9 KP0.000 to KP3.505	<a href="#">7818.101</a>
2	Alignment Sheet 2 of 9 KP3.332to KP8.007	<a href="#">7818.102</a>
3	Alignment Sheet 3 of 9 KP7.830 to KP12.505	<a href="#">7818.103</a>
4	Alignment Sheet 4 of 9 KP12.330 to KP17.005	<a href="#">7818.104</a>
5	Alignment Sheet 5 of 9 KP16.830 to KP21.505	<a href="#">7818.105</a>
6	Alignment Sheet 6 of 9 KP21.327to KP26.002	<a href="#">7818.106</a>
7	Alignment Sheet 7 of 9 KP25.680 to KP30.355	<a href="#">7818.107</a>
8	Alignment Sheet 8 of 9 KP29.994 to KP34.669	<a href="#">7818.108</a>
9	Alignment Sheet 9 of 9 KP33.559 to KP37.884	<a href="#">7818.109</a>

## **1. PROJECT SUMMARY**

### **1.1 *Scope of Work***

Gardline Geosurvey undertook a cable route survey for Warwick Energy Ltd off the north coast of Norfolk, with the object being to investigate the proposed export cable route from the proposed Dudgeon Offshore Wind Farm (Dudgeon) site using single and multi-beam echo sounder, sidescan sonar, surface-tow boomer and magnetometer equipment. Positioning control for the survey was the Fugro Starfix DGPS service.

The scope of work, as stated in the letter of instruction dated 25-Sep-2008, requested seabed and geological information with which to identify hazards and constraints for siting and burying cables.

To achieve these objectives, the following investigations were carried out:

- Multi-beam swathe survey to establish the bathymetry and identify any seabed features along the route corridor;
- Sidescan sonar survey to locate any objects greater than 2m and seabed features;
- Sub-bottom profiler survey to define shallow geology along the proposed cable route;
- Magnetometer survey to locate metallic obstructions including wrecks; and
- Preliminary mapping of any possible *Sabellaria* outcrops.

The survey was conducted over the proposed export cable route, which originates at the proposed Dudgeon site and extends to the north Norfolk coast near Weybourne. This survey is for early planning and route selection purposes.

## 1.2 ***Fieldwork Summary***

Survey Vessel	MV Confidante
Fieldwork dates	06-Oct-2008 to 10-Oct-2008
Analogue Survey Programme (line km)	274.97

All times are given in zone 0000.

The vessel, MV Confidante, set sail for site from Great Yarmouth, after a period of weather stand-by at 04:45h, 06-Oct-2008 and commenced operations on the route at approximately 08:55h. The cable route was completed at 11:09h, 10-Oct-2008, then after a period of weather standby the vessel returned to Great Yarmouth for re-supply before returning to the area to complete some outstanding work on the proposed Dudgeon site. For a full break down of activities see the operational logs in [Appendix C](#) (PDF only).

### 1.3 *Field Personnel*

<b>Gardline Geosurvey</b>		<b>Period</b>	
Party Chief	C Hudson	06-Oct-2008	10-Oct-2008
Senior Surveyor	A Villena-Lincoln	06-Oct-2008	10-Oct-2008
Surveyor	A. Horton	06-Oct-2008	10-Oct-2008
Surveyor	G Jamieson	06-Oct-2008	10-Oct-2008
Geophysicist	C Buckmaster	06-Oct-2008	10-Oct-2008
Senior Engineer	D Parillo	06-Oct-2008	10-Oct-2008
Engineer	S Fadli Bin Amzah	06-Oct-2008	10-Oct-2008
Engineer	M Azmil Zakaria	06-Oct-2008	10-Oct-2008

<b>Client</b>			
Fisheries Liaison Officer	C Jonas	06-Oct-2008	10-Oct-2008
Company Representative	N Evans	06-Oct-2008	10-Oct-2008

## 2. SUMMARY OF RESULTS

### 2.1 *Bathymetry*

Depths along the cable route recorded by the swathe bathymetry were within the range 8.1 metres LAT at KP34.2 to 33.7 metres LAT at KP10.7.

### 2.2 *Seabed Features and Clearance*

The majority of the seabed is characterised by a medium reflectivity, slightly mottled appearance. Seabed sediments are likely to consist of gravelly sand with occasional cobbles. There are also a number of areas where Holocene sands, characterised by rippled effect on the seabed, are noted. One is within a bathymetric low between KP10.29 and KP10.90, with another being recorded on a sandbank between KP23.70 and KP25.20.

A number of contacts have been found on the seabed, ranging from magnetometer deflections to a large broken wreck, while a number of linear contacts were also found on the centre line of the route. A further possible small wreck, expected to be that of a fishing boat, was also noted.

Between KP19.03 and KP19.19, two large magnetic anomalies are noted of 95nT and 750nT respectively. However, there are no associated contacts noted on the sonar records.

Around KP18 and to the west of the route are areas of gravelly sands that show characteristics often associated with *Sabellaria* accretions.

Point contacts within 50m of the route centreline are listed below

<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>W</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and Bearing</b>
390496.3	5898843	3	0.9	0.3	Point Contact	1.49	50m ESE
390220	5897851	3.4	0.4	0.2	Point Contact	2.52	45m ESE
388957.6	5894078	2.7	0.5	0.2	Point Contact	6.50	45m ESE
385936.6	5887252	25	25.6	1.4	Broken wreck	13.97	45m ESE
384951.3	5884890	5.2	0.6	0.3	Point Contact	16.53	35m ESE
384920	5884861	5.5	1	0.2	Point Contact	16.57	20m ESE
383880.9	5882327	8.1	0	0.5	Point Contact	19.30	20m ESE

Linear contacts within 50m of the route centreline are listed below

	<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and Bearing</b>
Start	385931.4	5887278	5.6		Associated with broken wreck	13.94	30m ESE
End	385933.6	5887273					
End	384869.9	5884966		0.2			
Start	383896.8	5882335	9.6	0.3	Linear Contact	19.29	30m ESE
End	383906.4	5882336		0.1			

Magnetic anomalies within 50m of the route centreline are listed below

<b>Easting</b>	<b>Northing</b>	<b>Anomaly</b>	<b>Comments</b>	<b>KP</b>	<b>Range and bearing</b>
389543.9	5895665	45nT		4.81	0m
388920.9	5894100	20nT	Sonar contact close by	6.5	0m
388548.9	5893254	35nT	Part of line of contacts	7.42	0m
388243	5892575	25nT		8.16	0m
387092.4	5889979	30nT	Same line of contacts	11.0	0m
386993.2	5889208	50nt	Linear magnetic contact	11.88-12.04	0m
385891.7	5887281	110nT	Associated with broken Wreck	13.96	

## 2.3 *Shallow Soils*

There is expected to be a veneer of gravelly sands with occasional cobbles overlying the Bolders Bank Formation which is expected to consist of firm to stiff, slightly gravelly sandy clay with pockets of sand and gravel (gravel is fine-course and consists of chalk and flint).

The route is crossed by channels of the Botney Cut Formation, which consists of interbedded clays, silts and sands and which was found in the following locations:

- Between KP7.10 and KP7.85; and
- Between KP9.96 and KP11.11.

The Bolders Bank Formation is expected to pinch out at seabed around KP18.08, marking the limit of the Quaternary sediments. Inshore of this point, Quaternary cover is expected to be thin or absent, and weathered chalk is expected at or close to seabed.

Between KP23.70 and KP25.20 a sandbank is noted. This sandbank shows an internal structure comprising of continuous sub-parallel reflectors indicating a well layered Holocene sand unit.

## **2.4 Conclusions and Recommendations**

- Data quality was of a good standard;
- The Kingfisher and UKDEAL data-bases have been checked. No in use cables or infrastructure related to oil and gas activity were noted as crossing the route;
- Full sonar coverage was achieved along the whole route and contacts have been mapped and described;
- Ground truthing of the data is required to confirm the sediment interpretation. Further studies using coring and CPT's should be conducted to confirm the nature of the shallow soils with particular emphasis on the inshore section where the Bolders Bank Formation is absent;
- A provisional sonar mosaic was provided to the vessel conducting the sampling programme with a view to aiding the selection of possible targets including those of possible *Sabellaria* accumulations. This information should be integrated into the interpretation once it becomes available;
- Two wrecks have been identified along the route, one of which has been charted but is slightly out of its given position and lies close to the centreline of the route. Further enquires should be made to the UK Hydrographic Office (UKHO) as to the nature of this wreck; and
- There were a number of magnetic anomalies that had no associated sonar contacts, so caution is urged in these areas.

### 3. DATA INTERPRETATION

#### 3.1 *Background Information*

Geophysical data have been interpreted with reference to BGS charting for the area as follows:

Spurn, Sheet 53°N - 00°E,  
British Geological Survey, 1:250,000 Series,  
published by Ordnance Survey.

The following versions were used:

Sea Bed Sediments  
Quaternary Geology  
Solid Geology

Information was also obtained from the following sources:

Birchall R. 2007. *Determining the Extent of Sabellaria Reefs During Seabed Surveys*. Proceedings of the 6<sup>th</sup> International Offshore Site Investigation and Geotechnics Conference: Confronting New Challenges and Sharing Knowledge, 11-13 September, London, UK.

Cameron, T.D.J., Crosby, A., Balson, P. S., Jeffrey, D. H., Lott, G. K., Bulat, J. and Harrison, D. J. 1992. *The Geology of the Southern North Sea*. British Geological Survey Offshore Regional Report.

Chroston, P. N., Jones, R. and Makin, B. (1999). *Geometry of Quaternary sediments along the north Norfolk coast, UK: a shallow seismic study*. Geological Magazine, **136**, 465-474.

Gardline Survey Report 7412.1. July 2008. Dudgeon Offshore Wind Farm Geophysical and Hydrographic Survey. Report for Dudgeon Offshore Wind Ltd.



### 3.2 Bathymetry

Water depths along the route range from 8.1m LAT at KP34.2 to a maximum of 33.7m LAT at KP10.7, with the most significant features being as follows:

- Between KP9.9 and KP11.3, a large 6m depression crosses the route, with gradients reaching 1:40 (1.4°);
- A 2m sand wave crosses the route at KP18.54 with a maximum gradient of 1:10 (5.7°);
- The route crosses the tip of the Sheringham Shoal sandbank between KP23.7 and KP24.9, gradients here reaching 1:44 (1.3°); and
- A minor sandbank crosses the route between KP33.9 and KP34.35.

### 3.3 ***Seabed Features***

Sonar data were of moderate to good quality with the lines run at the start of the survey being subject to some weather effects, with the swell being noticeable on the records closer inshore. The sonar was set to 500kHz and run at the 75m range in order to provide better imaging of individual objects, with all contacts with dimensions of over 2m being mapped. In addition, all magnetometer anomalies over 10nT were plotted. A sonar mosaic was also produced, which was sent to the vessel conducting the sampling along the route in order to aid the selection of suitable targets.

At the start of the route the seabed is characterised by a moderately reflective, mottled appearance expected to comprise of gravelly sands with occasional cobbles (see [figure 3.1](#)). This is expected to continue up to approximately KP7.1 where the route crosses a band of rippled sands up to KP7.54 (see [figure 3.2](#)).

After KP7.54, gravelly sands with occasional cobbles once again dominate up to KP10.08 where the finer, rippled sands predominate.

A magnetic anomaly of 35nT occurs on the centreline at KP11.3; this lines up with magnetic anomalies seen on the outer lines. No linear object was seen on the sonar records, though this line of anomalies does correlate with the underlying geology, where a channel is noted. Similar occurrences of magnetic anomalies lining up but with no associated sonar contacts occur at KP11.0 (30nT) and a linear anomaly from KP11.88 to KP12.0 (50nT).

A large depression crosses the proposed route between KP9.9 and KP11.3. The base of this is characterised by megarippled sand, superimposed on sand waves (see [figure 3.3](#)) and represents a more recent deposit of Holocene sands. The nature of the currents and tides in this area suggests that these are mobile bedforms.

After KP10.90 the gravelly sands with occasional cobbles again predominate. At KP14.0 there is a patch of rippled sands which marks the western point of a debris field associated with a wreck. This wreck is broken up, with the debris covering an area of approximately 150m x 40m and a maximum observed height of 2.6m. This wreck registered a maximum magnetic anomaly of 10,000nT. The closest debris lies 45m to the ESE of the centreline of the proposed route (see [figure 3.4](#)). The wreck is in two sections, and because of the extensive debris field it is thought to represent a vessel that has been subject to an explosion. 145m ENE of KP14.13 is a single large contact that may represent the sinker for a mine that may be linked to the wreck.

Gravelly sand with occasional cobbles continues up to KP18.5 with a thin band of rippled sands between KP17.70 and KP17.78. From KP18.5 megarippled sands and sand waves once again dominate.

90m ENE of KP17.34 is a large contact measuring 19.6x2.7x0.6. It has a magnetic anomaly of 55nT associated with it and is possibly a fishing boat (see [figure 3.5](#)).

150 - 250m to the WNW of the centre line between KP18.32 and KP18.55 are a number of contacts that may represent possible *Sabellaria* accumulations (see figures 3.6 and 3.7). The seabed around KP18 exhibits slightly larger rippled sands, which can be an indication of patchy *Sabellaria* accretions.

130m to ESE of the centre line, between KP19.03 and KP19.19 two large magnetic anomalies are noted, of 95nT and 750nT respectively (see figure 3.8). However, there are no associated contacts noted on the sonar records (see figure 3.9) and for such large anomalies this is unusual. A possible explanation is that this is a buried feature.

Gravelly sands with occasional cobbles again dominate up to KP23.8, while between KP23.8 and KP25.3 is a veneer of megarippled sands. These megaripples occur on the flanks of the Sheringham Shoal sandbank, which is present between KP23.7 and KP24.9. Gravelly sands then continue to KP26.0, before megarippled sands are observed again up to KP26.42. Gravelly sands with occasional cobbles return to dominate the remainder of the route up to KP33.6 when rippled sands are again seen at the end of the route.

The point contact list for all object with dimensions over 2m is presented below. Any objects recorded within 50m of the centre line have had the range and bearing from the nearest KP included.

<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>W</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and Bearing</b>
390364.9	5899485	2.2	1.1	0.5	Point Contact		
390821.7	5899384	5.2	1.2	0.2	Point Contact		
390813.6	5899372	2.6	1.8	0.3	Point Contact		
390813.9	5899367	2.6	0.5	0.2	Point Contact		
390844.6	5899180	3.8	0.8	0.1	Point Contact		
390287	5899091	4.6	0.7	0.1	Point Contact		
390826.3	5899079	2.6	1.7	0.1	Point Contact		
390803.8	5899066	5.1	1.3	0.4	Point Contact		
390295.1	5898993	2.8	0.7	0.3	Point Contact		
390760.8	5898936	4.7	1	0.4	Point Contact		
390496.3	5898843	3	0.9	0.3	Point Contact	1.49	50m ESE
390299.4	5898121	1.9	0.6	0.2	Point Contact		
390396.2	5897971	2.4	2.2	0.3	Point Contact		
390220	5897851	3.4	0.4	0.2	Point Contact	2.52	45m ESE
389762.4	5895565	2.5	0.2	0.1	Point Contact		
389654.7	5895529	3.9	0	0.1	Point Contact		
389665.5	5895263	2.9	2.9	0.4	Point Contact		
389003.8	5894750	1.8	0.2	0.1	Point Contact		
388957.6	5894078	2.7	0.5	0.2	Point Contact	6.50	45m ESE
388708.1	5894030	2.5	0.8	0.1	Point Contact		
389095.3	5893969	5.4	1.1	0.1	Point Contact		
389011.7	5893756	5.1	0.6	0.2	Point Contact		
388551	5893475	2	0.3	0.2	Point Contact		
<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>W</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and</b>

							Bearing
388377.1	5893259	6.4	1.4	0.3	Point Contact		
388434.3	5892658	2.5	1	1	Point Contact		
388440.1	5892652	7.1	1.4	0.1	Point Contact		
388434.2	5892650	5.3	3.2	0.5	Point Contact		
388111.7	5892639	1.6	0.1	0.3	Point Contact		
388212.4	5892269	2.7	1.8	0.6	Point Contact		
388328.4	5892088	2.3	0.5	0.5	Point Contact		
388052	5891765	2.3	0.2	0.2	Point Contact		
387897.6	5891652	2.6	0.2	0.5	Point Contact		
388001	5891618	2.1	0.6	0.5	Point Contact		
387154.4	5889670	2.3	0.8	0.3	Point Contact		
385964.1	5887675	4.8	0.1	0.4	Point Contact		
385983.7	5887256	2.9	1.8	0.6	Point Contact		
385936.6	5887252	25	25.6	1.4	Broken wreck	13.97	45m ESE
386012.8	5887246	27.8	4.8	2.6	Broken wreck		
385980.3	5887236	5.4	0.8	1.6	Broken wreck		
386026.9	5887233	38.9	34.2	0.9	Broken wreck		
386008.4	5887229	5.6	3.6	2.5	Broken wreck		
386054.6	5887227	31.2	14.2	1.8	Broken wreck		
386078.3	5887226	2.7	0.2	0.5	Point Contact		
386073.2	5887212	4.9	0.6	0.3	Point Contact		
386057.8	5887203	3	2.4	0.4	Point Contact		
386069.9	5887185	7.1	1.7	0.3	Point Contact		
385959.2	5887071	5	1.7	2.2	Point Contact		
385477.8	5887024	5.4	0.5	0.2	Point Contact		
385339.1	5886332	4.9	0.6	0.1	Point Contact		
385146.7	5886202	12.4	3.6	0.5	Large Mound		
385306.6	5886197	3.5	0.8	0.2	Point Contact		
385568.2	5885940	5.7	0.3	0.3	Point Contact		
385009	5885870	2.2	0.6	0.1	Point Contact		
385034.1	5885846	9.8	0.8	0.5	Point Contact		
384951.3	5884890	5.2	0.6	0.3	Point Contact	16.53	35m ESE
384920	5884861	5.5	1	0.2	Point Contact	16.57	20m ESE
385006.5	5884829	2.9	0.2	0.1	Point Contact		
384638.8	5884467	3.1	2.1	0.3	Point Contact		
384687.9	5884108	19.6	2.7	0.6	Possible Wreck with magnetic anomaly		
384440.4	5883407	7.5	0.7	0.3	Point Contact		
384451.7	5883400	2.5	0.4	0.2	Point Contact		
384024.1	5883327	2	0.6	0.2	Possible <i>Sabellaria</i>		
384049.3	5883319	8.2	1.7	0.2	Possible <i>Sabellaria</i>		
384016.3	5883314	2.1	0.5	0.1	Possible <i>Sabellaria</i>		
384017.1	5883307	6.6	0.6	0.2	Possible <i>Sabellaria</i>		
384032.8	5883301	2.6	0.8	0.2	Possible <i>Sabellaria</i>		
384012	5883297	5.8	2	0.2	Possible <i>Sabellaria</i>		
384018.4	5883293	1.9	0.2	0.2	Possible <i>Sabellaria</i>		

<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>W</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and Bearing</b>
383969.6	5883158	32.6	4.5	0.2	Possible <i>Sabellaria</i>		
383975.8	5883131	30.6	4.5	0.3	Large mound		
383974.7	5883097	8.1	3.1	0.7	Large mound		
383880.9	5882327	8.1	0	0.5	Point Contact	19.30	20m ESE
383649.9	5881143	2.5	0.4	0.3	Point Contact		
382276.8	5879197	7.5	1.2	0.2	Point Contact		
382350.6	5879129	4.1	0.8	0.1	Point Contact		
382687	5879091	2.9	0.8	0.2	Point Contact		
382676.6	5879057	4.7	0.4	0.1	Point Contact		
381989.2	5878252	5	1	0.2	Point Contact		
382369.2	5878123	6.8	1.5	0.2	Point Contact		
381139	5876989	3.7	0.6	0.3	Point Contact		
381065.7	5876472	3.7	1.1	0.2	Point Contact		
380085.4	5875315	3.2	0.6	0.1	Point Contact		
377499.1	5873709	2.2	0.9	0.5	Point Contact		
388 377	5893264	4	8	0.4	Point Contact		
389 010	5893755	0.5	3	0.1	Point Contact		

Linear contacts are presented in the table below:

	<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and Bearing</b>
Start	387783.1	5892231	10.3		Linear Contact		
End	387787.1	5892222					
Start	387789.5	5892219	5		Linear Contact		
End	387789.3	5892214					
Start	387790.7	5892213	7.5		Linear Contact		
End	387790.3	5892206					
Start	387794.3	5892207	9.6		Linear Contact		
End	387797.6	5892193					
Start	387799.4	5892190	27.2		Linear Contact		
End	387808.6	5892165					
Start	387810.6	5892148	18.5		Possible wire/chain		
End	387808.8	5892166					
Start	387284.5	5890290	2.7	0.3	Linear Contact		
End	387283.6	5890287		0.2			
Start	385931.4	5887278	5.6		Associated with broken wreck	13.94	30m ESE
End	385933.6	5887273					
Start	385657	5887175	17.3		Linear Contact		
End	385649.9	5887160					
Start	384868.1	5884963	3.1	0.2	Linear Contact		
End	384869.9	5884966		0.2			
Start	383896.8	5882335	9.6	0.3	Linear Contact	19.29	30m ESE
End	383906.4	5882336		0.1			
Start	382788.8	5879197	8.8		Linear Contact		
End	382760.1	5879181					

	<b>Easting</b>	<b>Northing</b>	<b>L</b>	<b>H</b>	<b>Description</b>	<b>KP</b>	<b>Range and Bearing</b>
Start	382697.5	5879162	11.2	0.1	Linear Contact		
End	382707.6	5879167		0.2			
Start	382727.3	5879168	12.3		Linear Contact		
End	382716.1	5879163					
Start	382642.2	5879133	50.5		Linear Contact		
End	382687.6	5879155					
Start	382077.6	5878784	5.6		Linear Contact		
End	382078.9	5878779					
Start	382081.8	5878761	23.9		Linear Contact		
End	382086.6	5878737					
Start	382095.4	5878687	10		Linear Contact		
End	382093.8	5878697					
Start	381396	5876264	112.6		Linear Contact		
End	381359.7	5876186					
Start	379188.9	5874696	11.9	0.3	Linear Contact		
End	379182.9	5874686		0.3			
Start	377894.8	5874045	66.4		Linear Contact		
End	377950	5874081					

Magnetic anomalies are presented in the table below:

<b>Easting</b>	<b>Northing</b>	<b>Anomaly</b>	<b>Comments</b>	<b>KP</b>	<b>Range and bearing</b>
390955.8	5899797	20nT			
390491.2	5899573	18nT			
390047.6	5898002	15nT			
389628.9	5895593	10nT			
389736.6	5895710	18nT			
389543.9	5895665	45nT		4.81	0m
388920.9	5894100	20nT	Sonar contact close by	6.5	0m
388633.3	5894026	30nT			
389073.9	5894074	35nT			
388360.5	5893411	20nT	Same line of contacts		
388447.7	5893368	30nT	Same line of contacts		
388548.9	5893254	35nT	Same line of contacts	7.42	0m
388493.9	5893312	25nT	Same line of contacts		
388588.3	5893160	35nT	Same line of contacts		
388336.2	5892965	25nT			
388459.3	5892870	35nT			
388243	5892575	25nT		8.16	0m
387871.9	5892322	25nT			
387949.8	5892476	60nT			
388004.2	5892416	30nT			
388294.1	5892137	18nT			
387852.9	5891297	15nT			

<b>Easting</b>	<b>Northing</b>	<b>Anomaly</b>	<b>Comments</b>	<b>KP</b>	<b>Range and bearing</b>
387555.2	5890815	18nT			
387885.1	5891213	15nT			
387685.5	5891109	20nT			
387371.4	5890989	15nT			
386971.2	5890282	20nT			
387092.4	5889979	30nT	Same line of contacts	11.0	0m
387157	5889918	25nT	Same line of contacts		
387294	5889885	25nT	Same line of contacts		
387220.4	5889854	25nT	Same line of contacts		
386875	5889090	25nT			
386993.2	5889208	50nt	Linear magnetic contact	11.88-12.04	0m
386774.2	5889058	20nT			
385891.7	5887281	110nT	Associated with broken Wreck	13.96	0m
385970.5	5887239	10000nT	Associated with broken Wreck		
386040.7	5887224	8000nT	Associated with broken Wreck		
386103.2	5887209	280nT	Associated with broken Wreck		
385997.5	5887108	100nT	Associated with broken Wreck		
385884.7	5886843	20nT			
385228.8	5886270	10nT			
385047.2	5885834	25nT			
384871.2	5885028	15nT			
385059.8	5884843	15nT			
384474.8	5884238	15nT			
384564.2	5883641	20nT			
384675.3	5884098	55nT			
384049.2	5883204	25nT			
383943	5883155	18nT			
384106.8	5882518	95nT			
384050.6	5882384	750nT			
383624.7	5881338	20nT			
383282.7	5881141	25nT			
383566.4	5881377	15nT			
383234.2	5881030	20nT			
382706.7	5879918	15nT			
382651.8	5879782	12nT			
382524.5	5878488	15nT			
382459.3	5878359	35nT			
382414.4	5878393	15nT			
382414.4	5878393	15nT			
380267.1	5875468	55nT			

377796	5873957	18nT			
<b>Easting</b>	<b>Northing</b>	<b>Anomaly</b>	<b>Comments</b>	<b>KP</b>	<b>Range and bearing</b>
377483	5873682	35nT			
386954.1	5889111	50nT	Start linear magnetic contact		
386993.2	5889208		End linear magnetic contact		
379765.5	5875437	25nT	Start linear magnetic contact		
379687.2	5875391		End linear magnetic contact		
379334.6	5874934	12nT			

Some fishing activity was noted when the survey was conducted which should also be considered.

No other major contacts were found along the survey route.



### 3.4 *Shallow Geology*

The performance of the boomer data was good, with reflectors clearly discernible to the multiple and in some cases through the multiple. Some of the early lines were affected by weather but this did not detract from the overall interpretation. An assumed seismic velocity of  $1700\text{ms}^{-1}$  was used to convert two-way-travel time into metres below seabed.

The start of the route (KP0) lies within the previously surveyed site of the proposed Dudgeon OWF. Sediments are expected to comprise a veneer of gravelly sands with occasional cobbles overlying the Bolders Bank Formation which is expected to consist of firm to stiff slightly gravelly sandy clay with pockets of sand and gravel (gravel is fine-course and consists of chalk and flint). The Bolders Bank is expected to extend to a depth of between 10 to 12 metres at the start of the route.

As the route heads towards the coast, the Bolders Bank Formation thins gradually but is generally expected between 5 and 8m, where it is encountered beneath the veneer of gravelly sand. There are also a number of occasions when the channel infill of the Botney Cut Formation comprising of interbedded clays, silts and sands are seen to incise into the Bolders Bank Formation (see [figure 3.10](#)). These Botney Cut channels intersect the route at the following locations:

- Between KP7.10 and KP7.85; and
- Between KP9.96 and KP11.11.

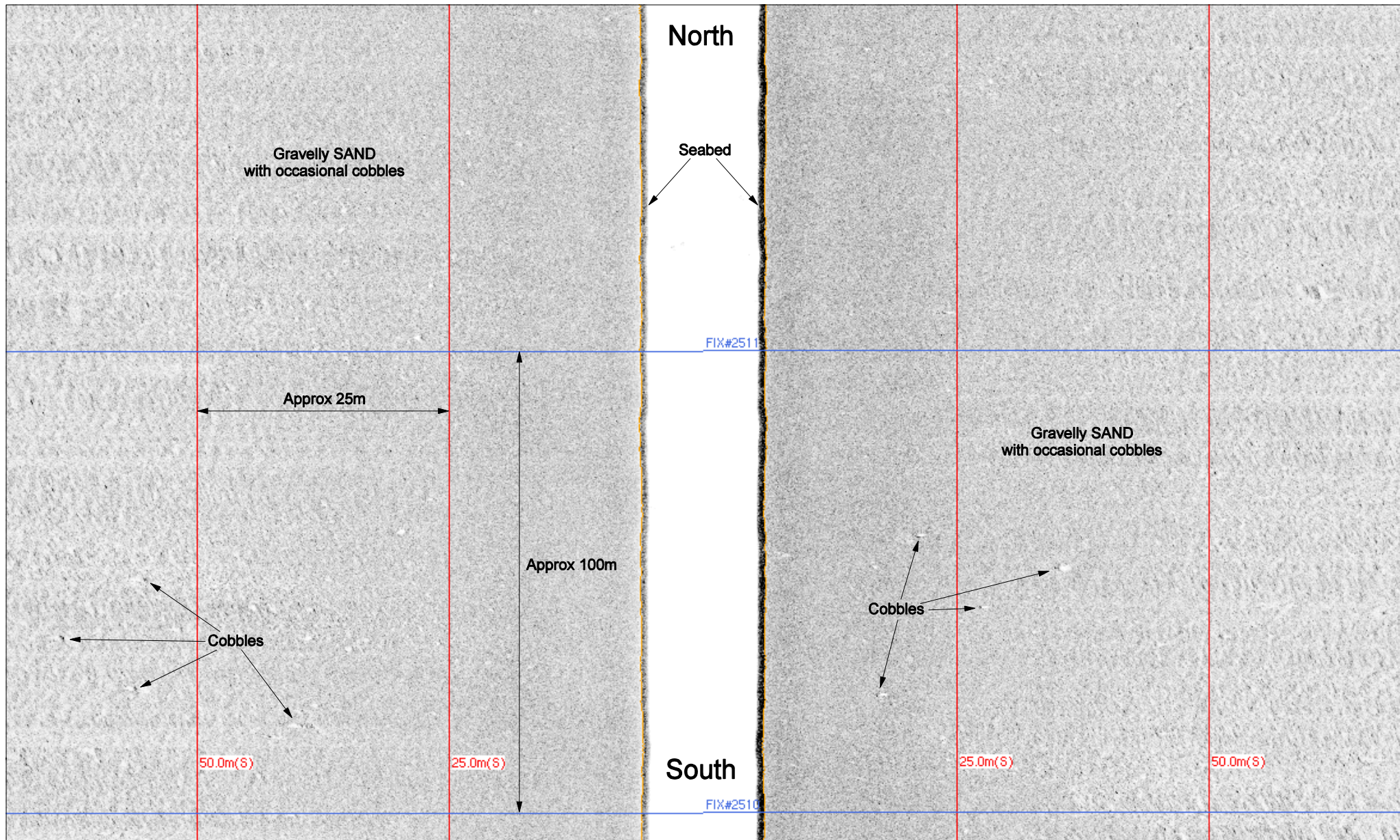
A significant change in the shallow soils properties is expected when the base of the Bolders Bank Formation becomes indistinct around KP17.5 - KP18.0 and is expected to pinch out at seabed around KP18.08 (see [figure 3.11](#)). This marks the limit of the Quaternary sediments; inshore of this point Quaternary cover is expected to be thin or absent.

Beyond KP18.8 and beneath the veneer of gravelly medium to course sands, weathered chalk is expected and this is reflected in the change in nature of the data; there is very little internal structure observed once the Bolders Bank is absent. A notable exception to this occurs between KP23.70 and KP25.20, where a sandbank is present. This sandbank shows an internal structure comprising of continuous sub-parallel reflectors indicating a well layered Holocene sand unit. This sandbank overlies the Botney Cut Channel unit which in turn lies in an expected Swarte Bank channel unit that has incised the weathered Chalk in this area (see [figure 3.12](#)).

Weathered Chalk is expected to be present along the rest of the route towards the shore, with a small shallow channel being noted between KP32.57 and KP32.69. A further, smaller Holocene sand accumulation is noted between KP33.50 and KP34.34.

A summary of geological conditions expected at seabed along the route is presented overleaf:

Unit	Formation	Description	Distribution
1a	Holocene sands	Loose fine to medium SAND with shell fragments	Within the sand banks and bands of rippled sands.
1b	Holocene sands and gravels	Gravelly SAND with occasional cobbles	Veneer on the seabed over remainder of survey route
2	Botney Cut	Laminated clays with silts, peats and fine sands infilling channels that cut into the underlying unit	Within the channels noted along the route Between KP7.10 and KP7.85. Between KP9.96 and KP11.11
3	Bolders Bank	Firm to stiff slightly gravely sandy CLAY with pockets of sand and gravel (Gravel is fine-course and consists of chalk and flint). Occasional boulders may be expected.	Blanket deposit seen along the route until KP 18.08
4	Weathered Chalk	Weak structureless CHALK composed of sandy silty fine to coarse GRAVEL with a clayey sandy silty matrix	Along the remaining section of the route at or close to seabed.

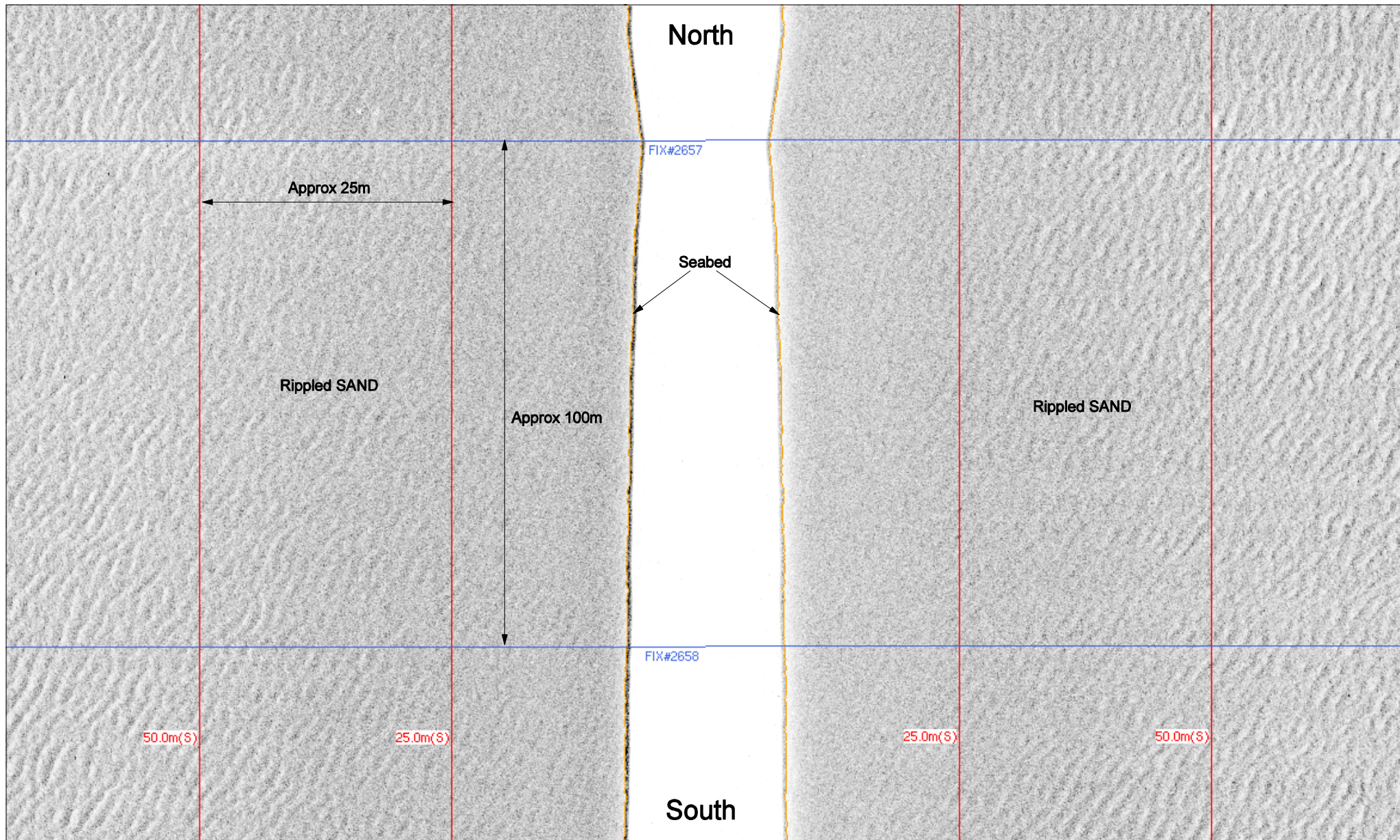


Line L150A

SIDECAN SONAR  
Illustrating gravelly sand with occasional cobbles

Fig. 3.1



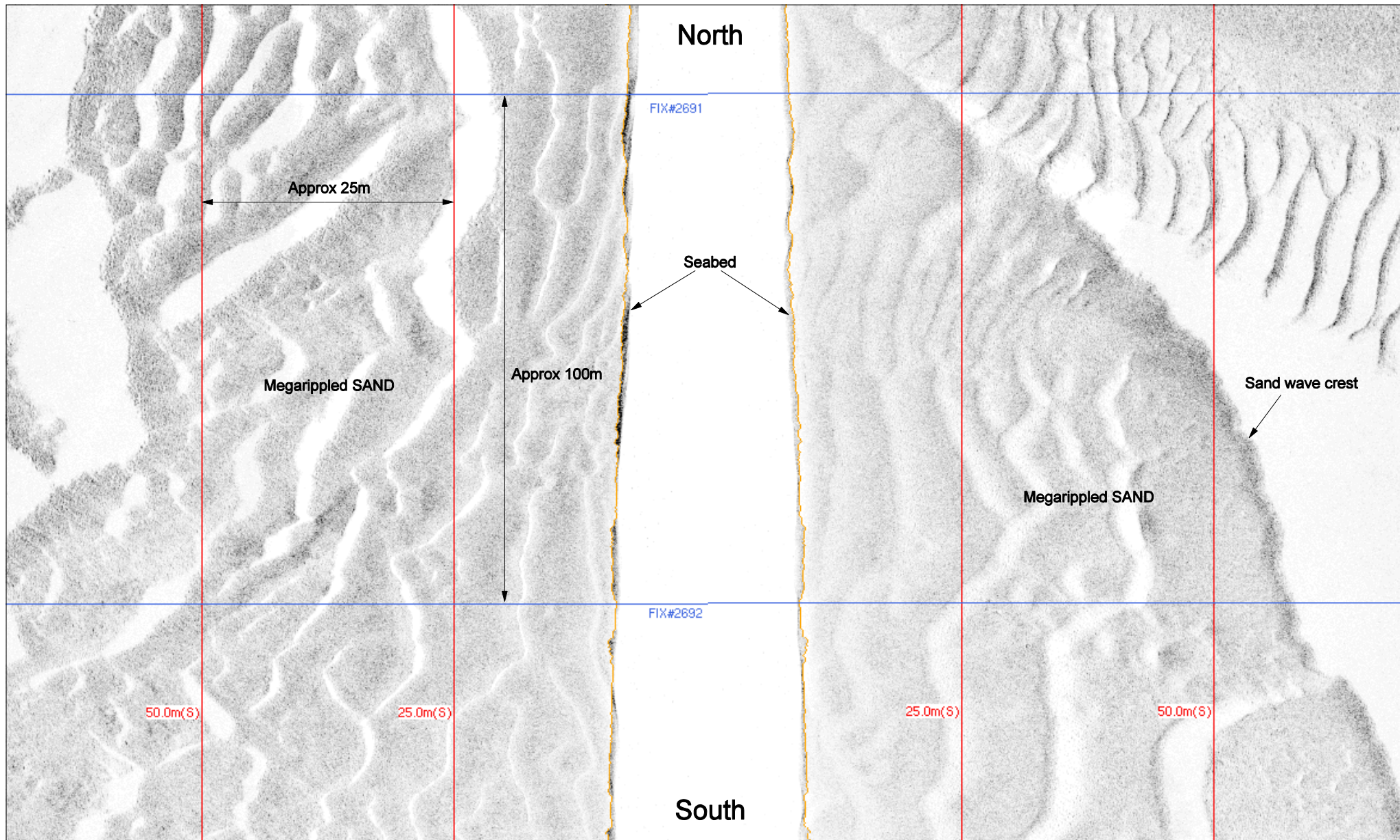


Line L225A

SIDECAN SONAR  
Illustrating rippled sand

Fig. 3.2



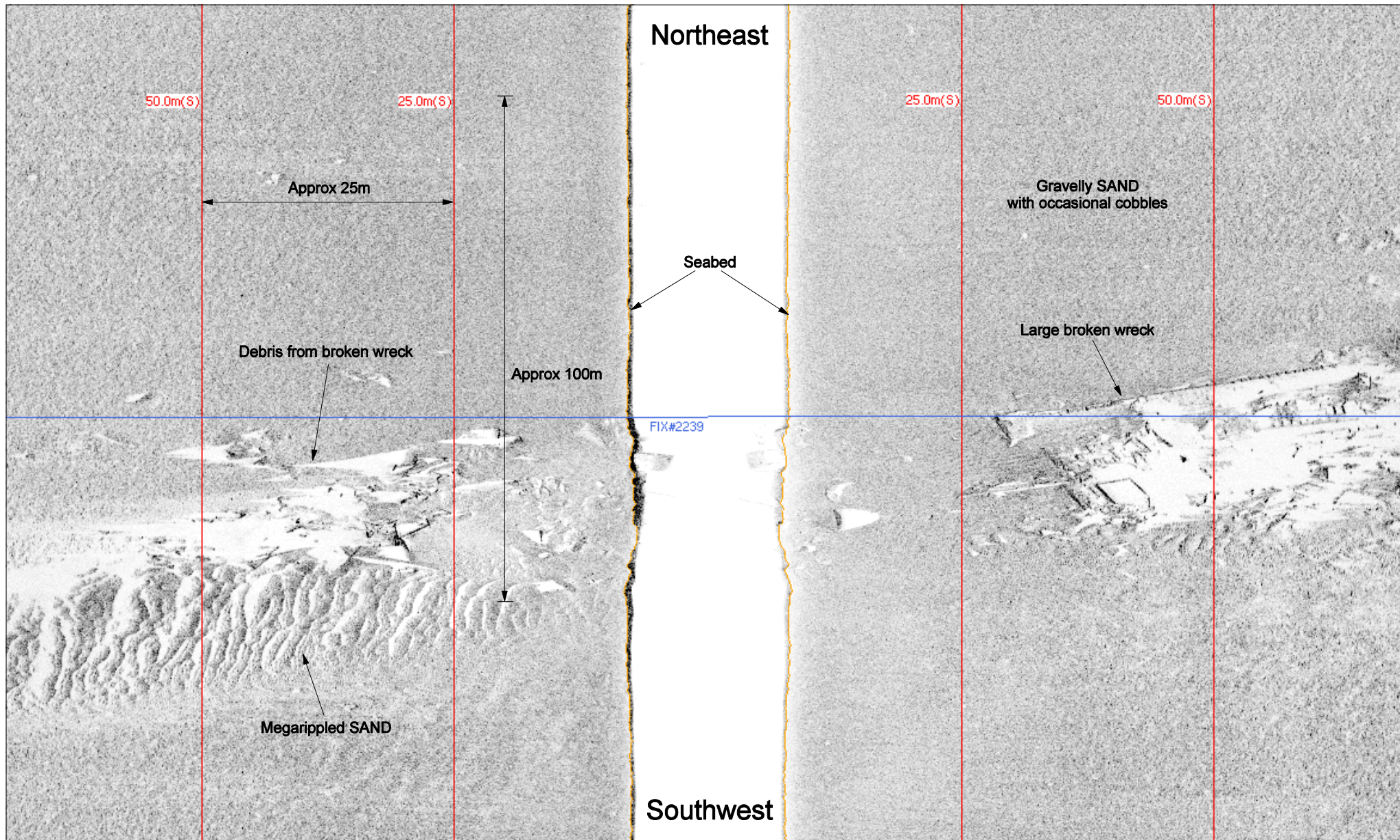


Line L225A

SIDECAN SONAR  
Illustrating megarippled sand waves

Fig. 3.3



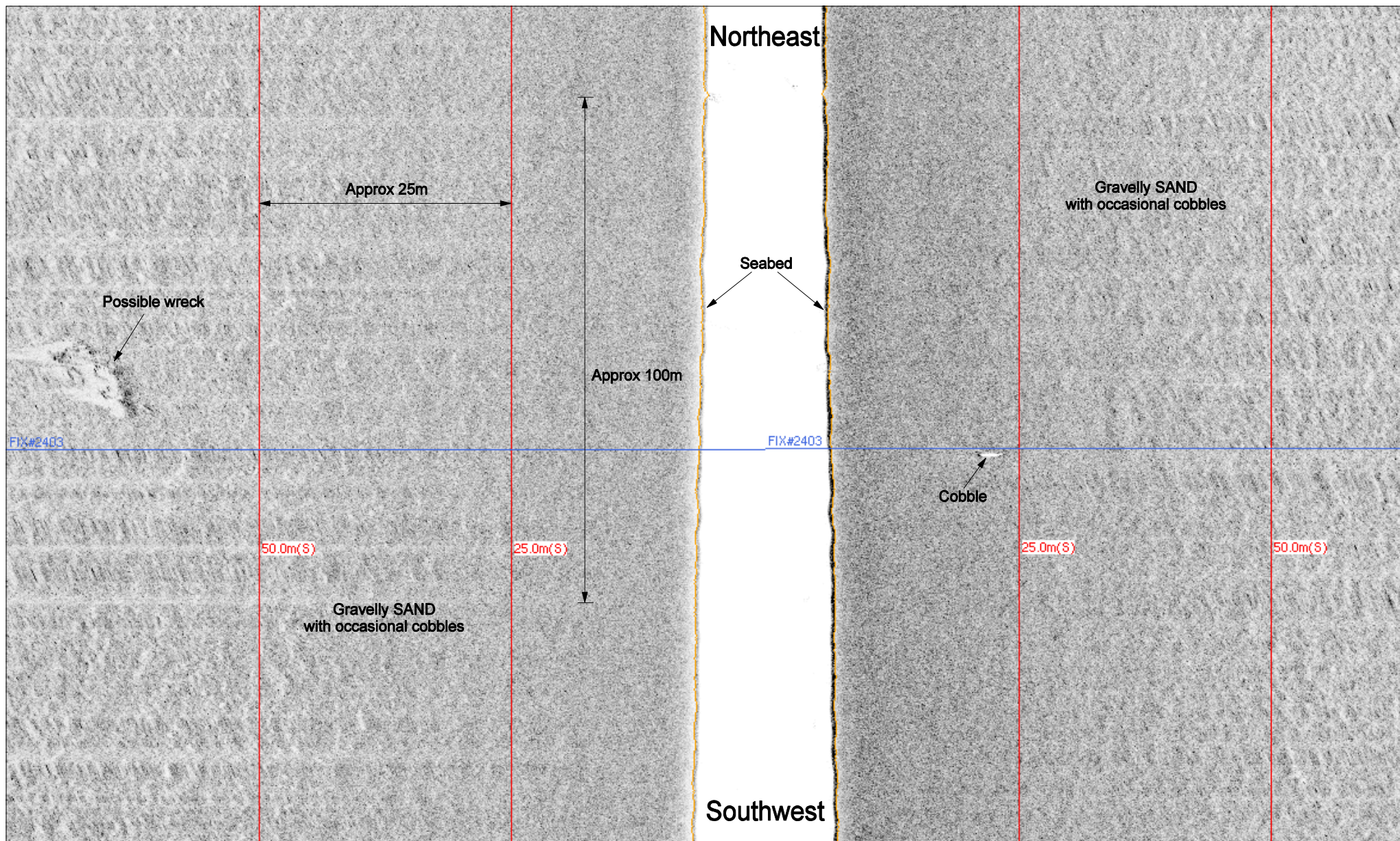


Line L75A

SIDECAN SONAR  
Illustrating large broken wreck and debris field

Fig. 3.4



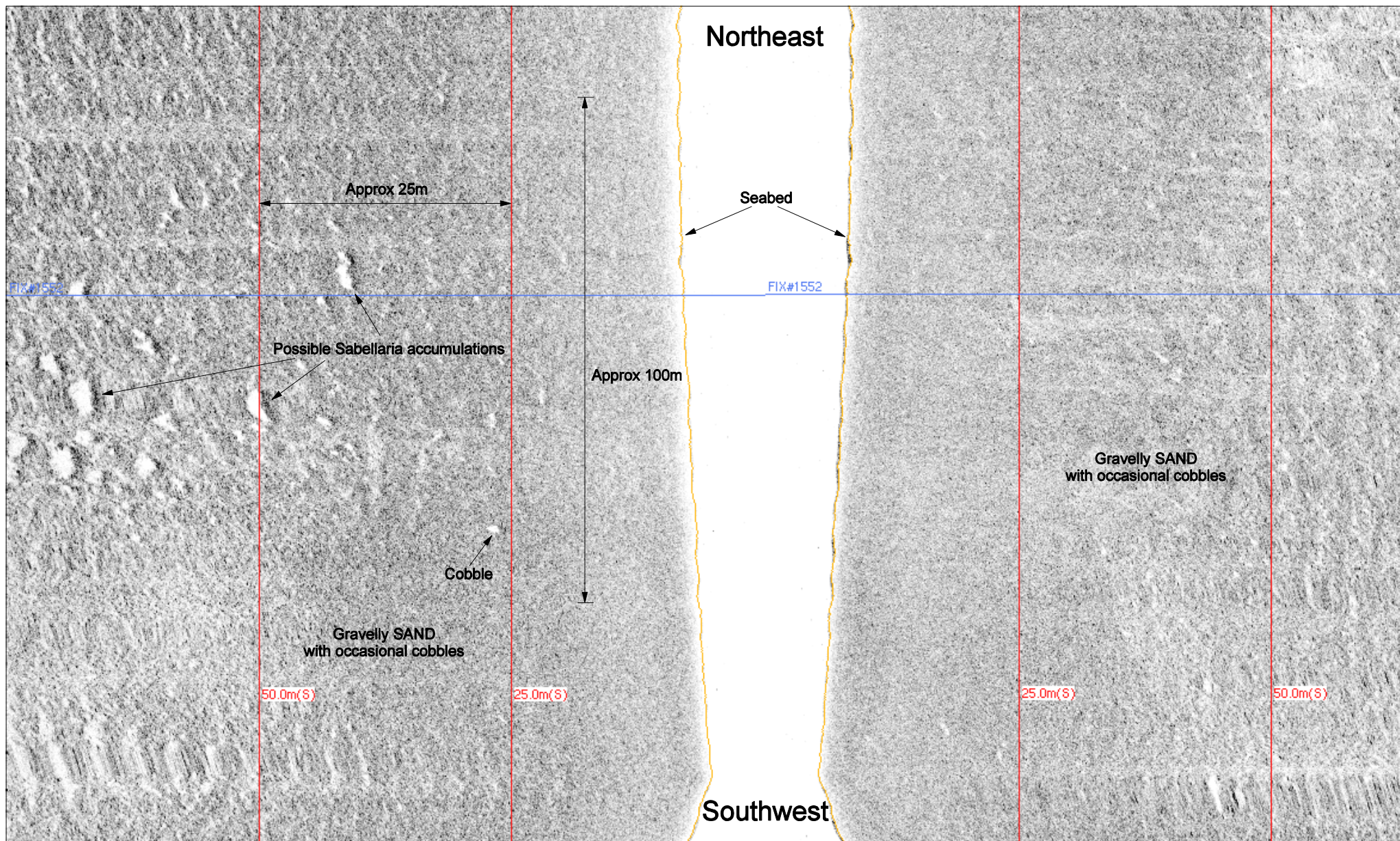


Line L150A

SIDESCAN SONAR  
Illustrating possible wreck

Fig. 3.5



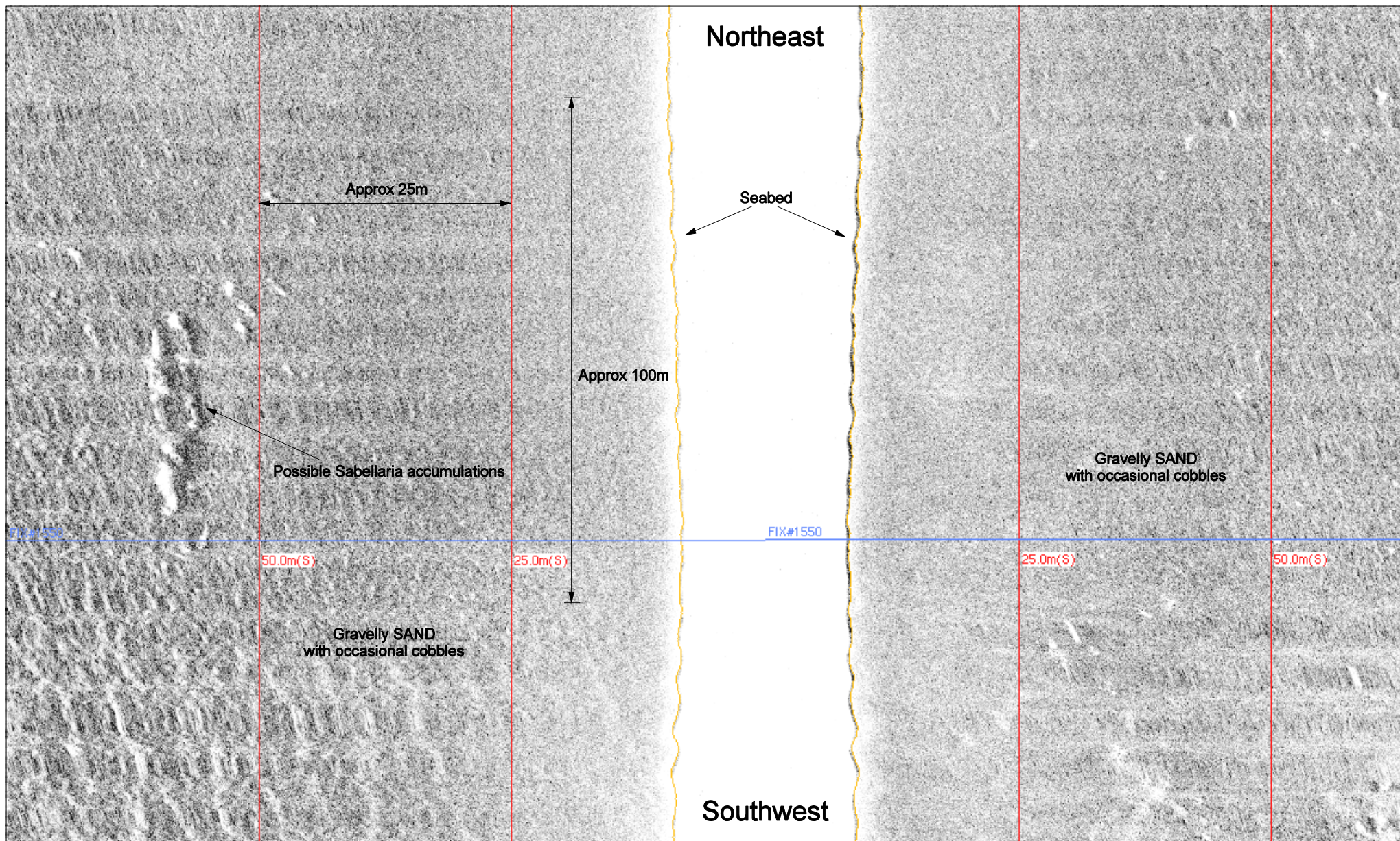


Line R150A

SIDECAN SONAR  
Illustrating possible Sabellaria accumulations

Fig. 3.6





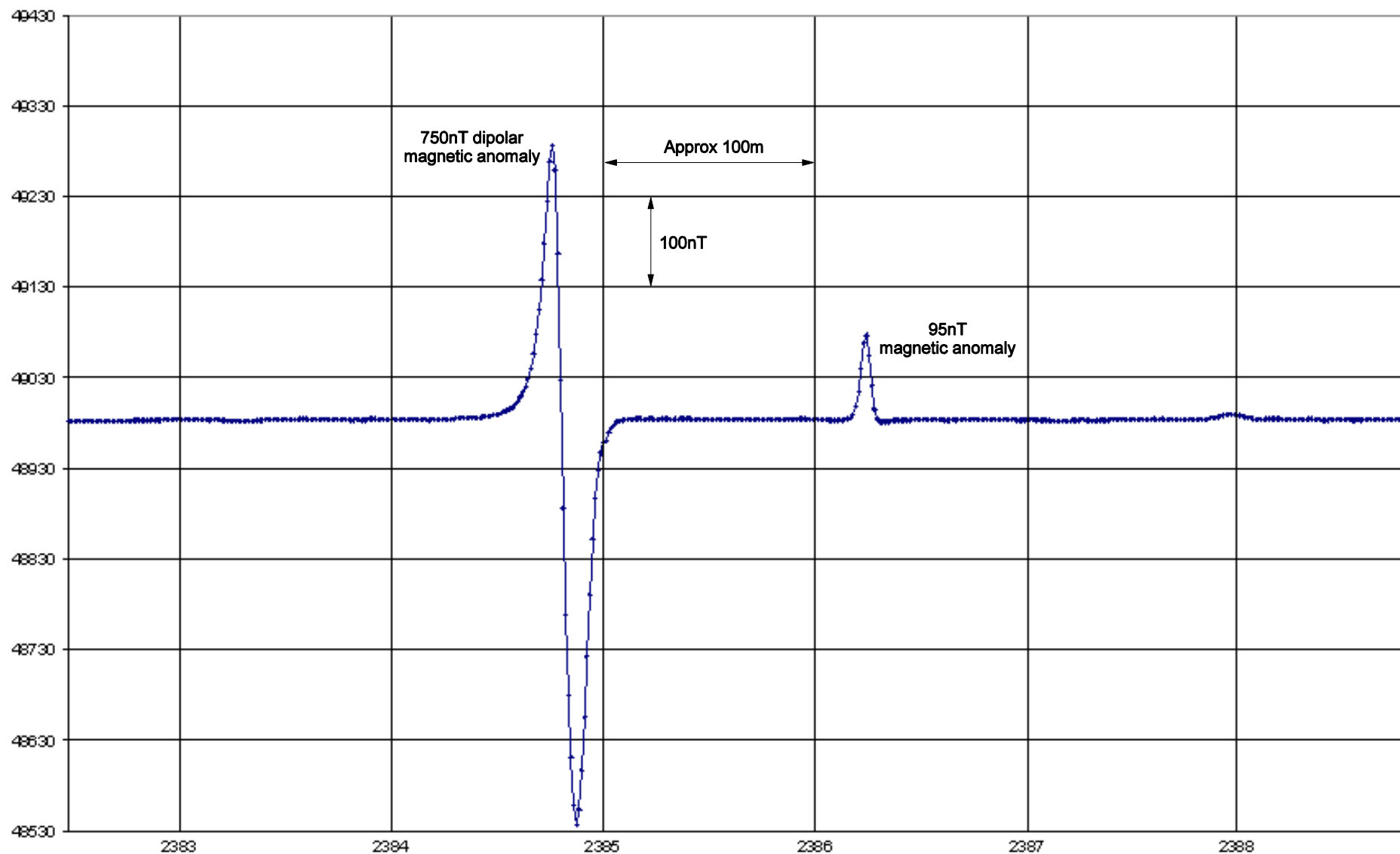
Line R150A

SIDESCAN SONAR  
Illustrating possible Sabellaria accumulations

Fig. 3.7

Southwest

Northeast

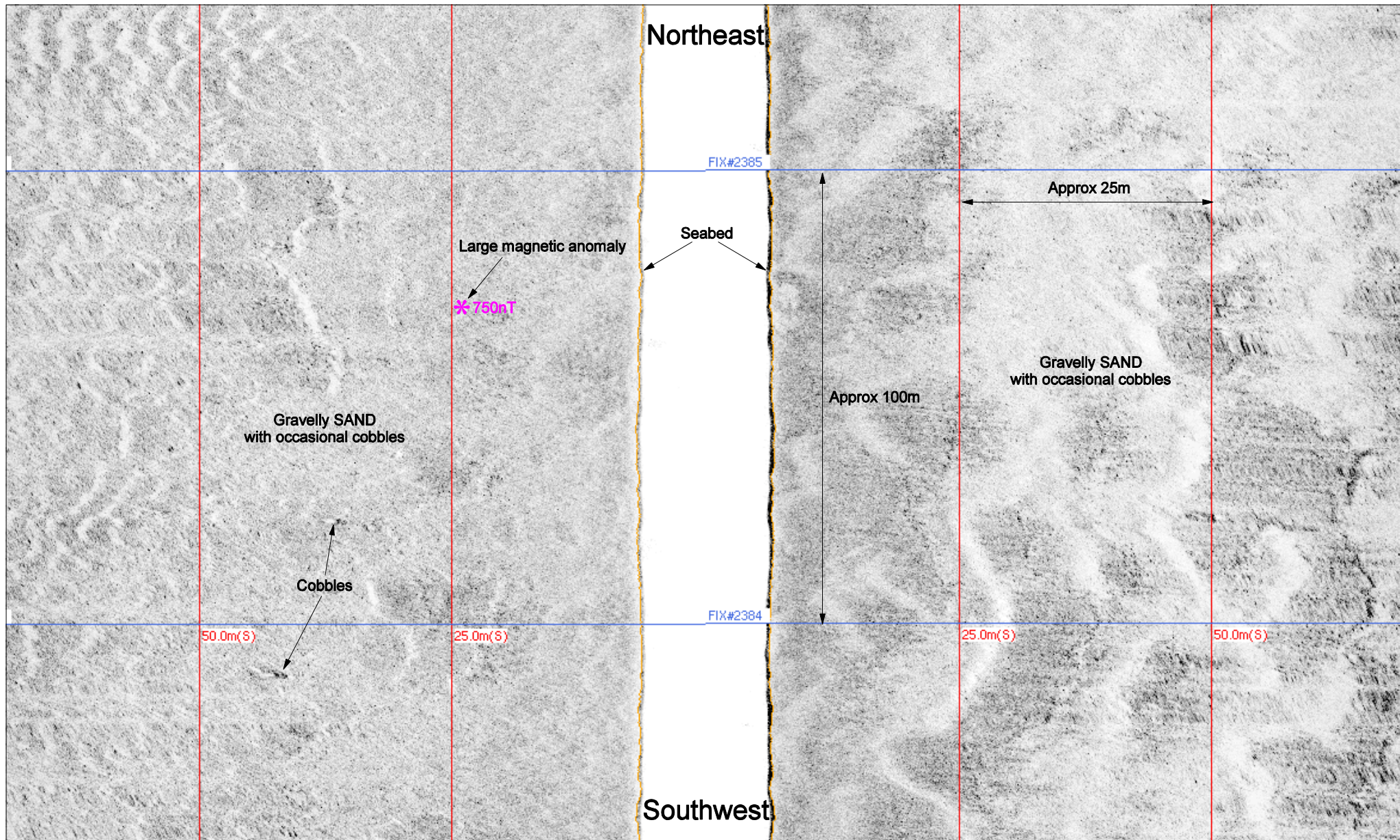


Line L150A

MAGNETOMETER  
Illustrating two magnetic anomalies

Fig. 3.8



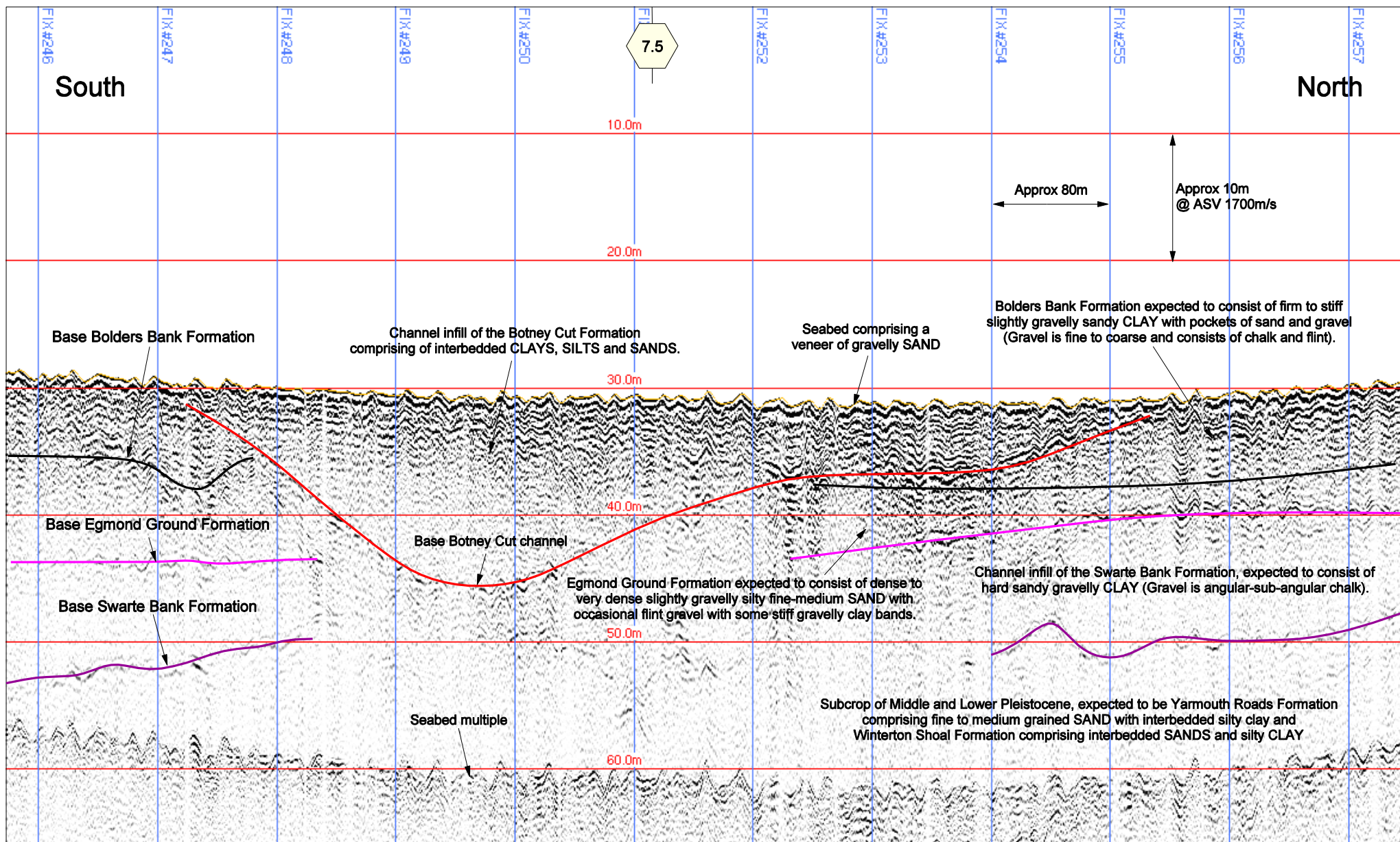


Line L150A

SIDECAN SONAR  
Illustrating seabed at large magnetic anomaly

Fig. 3.9





Line CL

**BOOMER**  
Illustrating Botney Cut channel

Fig. 3.10

