Annex A

Certificate of Registry of *Harvest Hope*, issued 27 July 2004

CERTIFICATE OF BRITISH REGISTRY

The Merchant Shipping Act 1995
The Merchant Shipping (Registration of Ships) Regulations 1993, as amended

PARTICULARS OF SHIP

Name Of Ship:	***HARVEST HOPE***				
Official Number:	***B14296***		*Radio Call Sign*		
IMO Number / HIN:			*Port*	***PETERHEAD***	
Type of Ship	***FISHING VESSEL***		*Port Letters and numbers:*	***PD 120***	
Engine Make / model:	***ANGLO BELGIAN MOTOR COMPANY 6DZC-750 (S/N 12484)***		*Engine ID No.*	***4608***	
Total Engine Power:	***742.00***	*kW*			
Overall Length:	***28.23***	*metres*	*Registered Length:*	***25.68***	*metres*
Breadth:	***8.70***	*metres*	*Depth:*	***7.40***	*metres*
Gross Tonnage:	***356.00***		*Net Tonnage*	***106.00***	
Year of Build	***1995***		*Country of Build*	***POLAND***	
Date of entry into service:	***24/01/1996***				
Type of Registration:	***FULL***				

This Certificate was issued on ***27 July 2004*** *at* ***11:25***

This Certificate expires on: ***13 October 2009***

ed ... .

and on behalf of the Registrar. General of Shipping and Seamen

Maritime and Coastguard Agency, an Executive Agency of the Government of the United Kingdom

Annex B

MRCC information relating to Beryl seabed pipeline

Message 02055-09052006
Priority: Normal
09/05/2006 09:06:14
From: Coastguard

To: Name Method
Fax

FOR THE ATTENTION OF

YOUR INFO AS REQUESTED.

BERYL/BRAE TO ST FERGUS PIPELINES
==========

Operator Mobil North Sea Ltd

Single Point of Contact (SPOC) for any incidents involving this pipeline -

1. Sage Pipeline Control Room, St Fergus	01779 876351	(24 Hrs)
2. Beryl Alpha Control Room	850000 ext 3222	(24 Hrs)
3. Mobil Grampian House Switchboard	850000 or 855222	(24 Hrs)

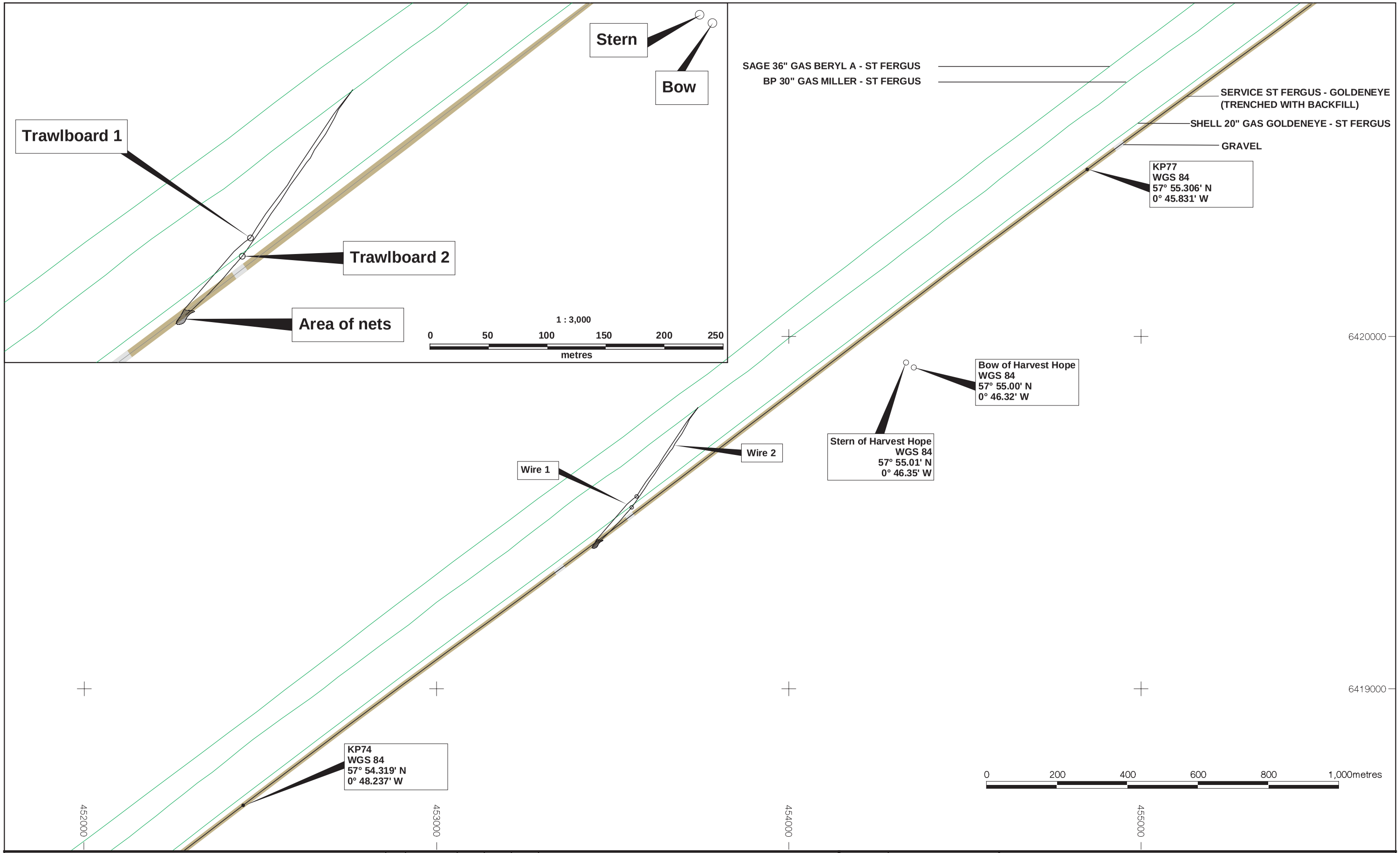
The SAGE (Scottish Area Gas Evacuation) pipeline runs from the Beryl Alpha riser platform to the St Fergus gas terminal. It transports gas from the Beryl Field and is later joined by spur lines linking gas export from Marathons Brae Fields and Amerada Hess Scott field.

The main pipeline is 338 km long and 30 inches in diameter.

Note - on several charts it appears that this pipeline is linked to the Miller to St Fergus line. This is not the case. The two pipelines run parallel to each other for the last 80 miles before reaching St Fergus but are completely independent of each other.

As with any SPOC it is their responsibility to advise other users of the pipeline regarding incidents involving it. However, any call to a SPOC reporting an incident or potential incident to a pipeline should include a request that the SPOC alerts other users of the pipeline.

Shell underwater survey plot in area of *Harvest Hope* wreck



NOTE:

Recommended exclusion zone between KP74 and KP77 until fishing debris recovered

REV	DATE	BY	CHKD	APPVD	DESCRIPTION
A	28/11/2005	CJF	PS		INITIAL ISSUE FOR COMMENT

REVISIONS

Projection system: TM0
Ellipsoide: Hayford
Datum: ED50

DRAWN	Colin J Fraser
DATE	28-11-2005
SCALE	1 : 10,000
CHECKED	Pete Sloman
APPROVED	

THIS IS A C.A.D. PRODUCED DRAWING AND MUST NOT BE CHANGED MANUALLY. WHEN PRINTED FROM PDF THIS DRAWING MAY NOT BE TO SCALE.

GOLDENEYE PIPELINE
HARVEST HOPE WRECK

Shell Exploration & Production

DRAWING NO	SHEETS	REV
0554014	1 of 1	A

Annex D

Notice to Mariners 2087(P)/03

II

2087(P)/03 NORTH SEA - United Kingdom Sector - Buchan Oil Field Northwestwards - Platform. Obstructions. Submarine pipeline.

Source: Shell U.K. Exploration and Production

1. The Goldeneye Gas Field is a new field being developed northwestwards of Buchan Oil Field. In connection with the development the following activities will take place:
2. In preparation for the installation of a production platform in June 2003, 4 obstructions approximately 5·5 metres high have been installed on the seabed centred on position 58° 00′·11N., 0° 22′·89W.
3. During May 2003 a submarine pipeline will be laid between:
   The position at 2. above.
   57° 56′·92N., 0° 41′·93W.
   57° 38′·74N., 1° 25′·53W.
   57° 34′·68N., 1° 32′·73W.
   57° 35′·26N., 1° 46′·25W.
   57° 34′·85N., 1° 49′·40W. (Saint Fergus Gas Terminal)
4. Construction activities will continue throughout the summer. Mariners are advised to keep clear.
5. Former Notice 3672(P)/02 is cancelled.

Charts affected - 2 (INT 160) - 115 (INT 1503) - 213 - 278 - 291 - 1409 (INT 1504) - 2182B (INT 1042) - 2182C (INT 1041) - 4140 (INT 140)

Annex E

Annual Notice to Mariners No.24/06

24. SUBMARINE CABLES AND PIPELINES — AVOIDANCE OF AND ASSOCIATED DANGERS

Source: Maritime and Coastguard Agency.

Former Notice 24/05 is cancelled. This is a repetition of the former notice.

1. Mariners should be aware of the need to avoid anchoring, trawling, fishing, dredging, drilling or carrying out any activity close to submarine cables and pipelines. Damage to telecommunication cables can lead to extensive disruption of international communications, whilst damage to power cables will interrupt electricity supply and could endanger life. Seabed mobility may leave a submarine cable spanning undulations and cause fishing gear to become irrecoverably snagged, putting a vessel in severe danger. Pipelines may contain flammable oil or gas under pressure; a vessel causing damage to a pipeline could face an immediate hazard either by loss of buoyancy due to gas aerated water or by fire or explosion, and result in an environmental hazard. Where it can be shown to be done wilfully or through negligence, such damage to a submarine cable or pipeline can lead to prosecution.

2. If a submarine cable is fouled whilst anchoring, fishing or trawling, every effort should be made to disengage from the cable by normal methods, without causing damage. If these efforts fail, the anchor, gear or trawl should be slipped and abandoned. Particular care should be exercised should a vessel's trawl or fishing gear foul a cable and raise it from the seabed. This may lead to a capsize situation due to the excessive load. Before any attempt to slip or cut gear from the cable is made, the cable should first be lowered to the seabed.

3. **SUBMARINE CABLES SHOULD NEVER BE CUT**, as this is likely to endanger life or cause serious injury. All power cables and most telecommunication cables carry high voltages.

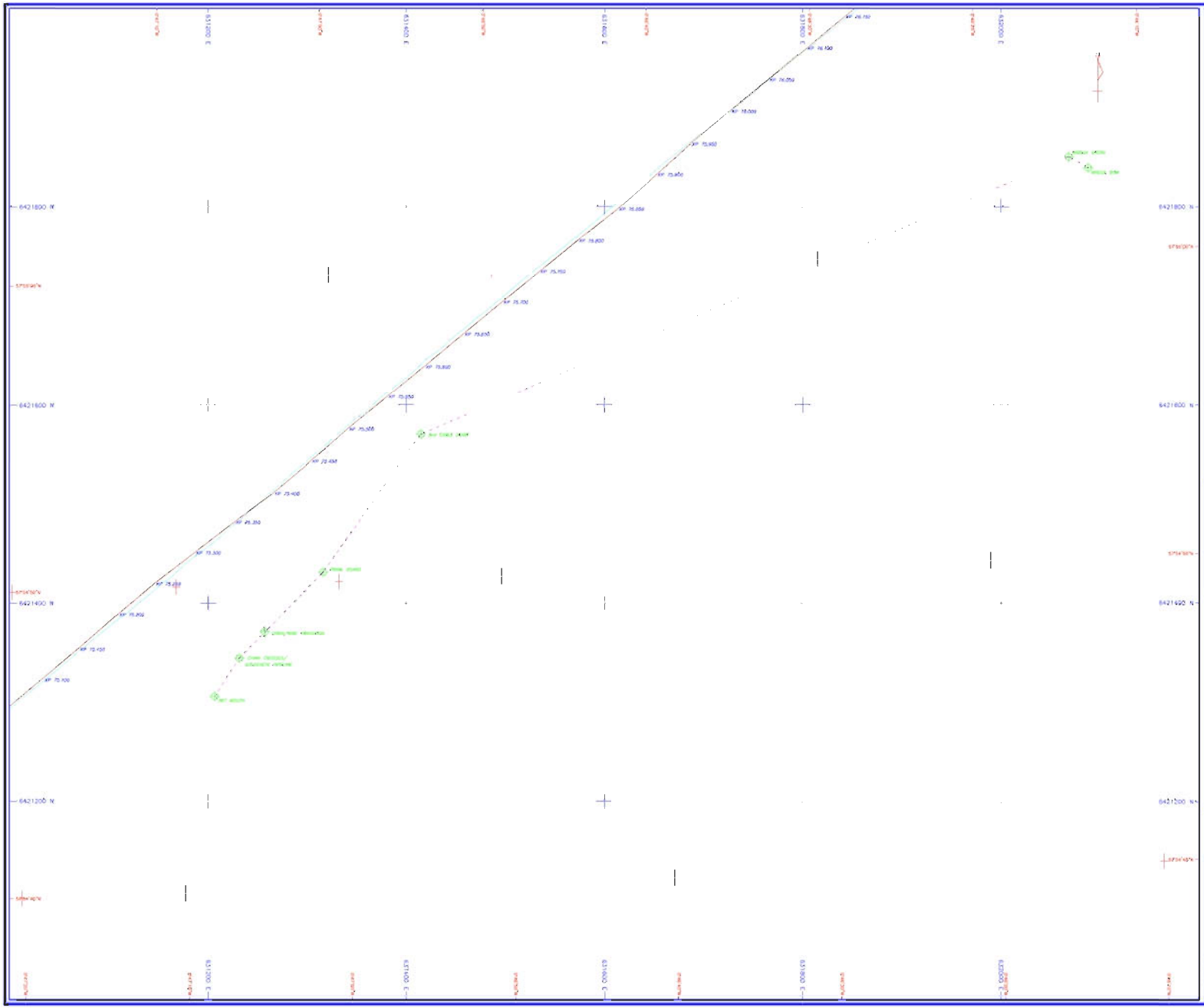
4. Submarine pipelines are not always buried and their presence may effectively reduce the charted depth by as much as 2 metres. Where pipelines are close together, only one may be charted. Pipelines may span across seabed undulations; the size and positions of such spans are not constant and may vary due to tide and wave action. It is possible for fishing gear to become snagged under a pipeline so that it is irrecoverable, which could present a serious hazard to the fishing vessel. In the event that masters or skippers suspect they have fouled a pipeline with gear or anchors, they should not place excessive weight on their gear, which could damage the pipeline and endanger their vessel and crew.

5. Incidents involving the fouling of submarine cables or pipelines should be reported immediately to the appropriate authorities. In most cases this will be the nearest coastguard, who should be contacted and advised as to the nature of the problem and the position of the vessel.

6. In UK waters, owners of vessels who can prove that they have sacrificed an anchor, net or other fishing gear, to avoid damaging a submarine cable or pipeline, will receive compensation from the owner of the cable or pipeline.

7. For more information on submarine cables and pipelines, including related regulations and charting policy, refer to The Mariner's Handbook (NP 100).

Miller 30” Main Gas Pipeline
Wreck Investigation survey plot



SCALE 1 : 2,000

0 20 40 60 80 100 120 140 160 180 200 m

PROJECTION AND SPHEROID

Universal Transverse Mercator Projection
International Spheroid 1924 – European Datum 1950
BP Projection Mnemonic ED50UTM31
UTM Zone 31 North

Grid unit	International metre	
Longitude of origin	03° 00' 00.00" West	Degrees
Scale factor at origin	0.9996000000	
Grid co-ordinate at origin	500000.00 E	metres
Grid co-ordinate at origin	0.00 N	metres
Semi major axis	6378388.0000	metres
Inverse Flattening	1/297.0	

NOTES

30" Gas Export Pipeline from Miller - 1990 KP Gatehouse

LEGEND

- KP Data Base
- As-Founded 30inch Miller Pipeline
- ROV track of Investigation Route
- Investigation Point

Stolt Offshore Limited

THE MILLER 30" MAIN GAS PIPELINE
WRECK INVESTIGATION

Chart Revisions

DATE	UPDATED BY	AGREEMENT	DESCRIPTION OF REVISION AND REMARKS
	D	-	Pocket Knife Investigation Point

Annex G

Extract from Subsea 7 Shell EPE Pipeline Inspection report

Introduction

On Monday 30th October 2005 the ROVSV Kommandor Subsea commenced a debris and damage survey between KP 74.000 and KP 76.000 of the N0209 pipeline and the N2805 umbilical in order to locate and investigate the debris of the Harvest Hope wreck and trawl gear. The primary purpose of the survey was to check for damage to the N0209 pipeline and N2805 umbilical.

The survey was conducted using ROV Pioneer 11 mounted with dual DHSS profilers and TSS 440 pipetracker and equipped with centre and boom colour cameras. Visibility was good throughout the survey, which was recorded on video tapes R05/084-88.

Survey Equipment

ROVSV Kommandor Subsea	ROV Pioneer 11
Seapath 200	Octans Fibre Optic Gyro
Veripos NR203 Inmarsat / HF DGPS (x2)	Winson Tritech SK704 Environmental Bathymetric System
Simrad HiPAP 500	RDI Workhorse Doppler Speed Log
TSS DMS Attitude Sensor	Tritech Dual Head Scanning Sonar (x2)
	TSS 440 Pipetracker System
	Obstacle Avoidance Sonar
	2 x HiPAP Transponders

Survey Configuration

Source	Surface Navigation	Subsurface Positioning
Primary	Veripos NR203 Inmarsat / HF DGPS	Simrad HiPAP 500
Secondary	Veripos NR203 Spot beam / HF DGPS	N/A

Survey Control

Horizontal Datum Parameters

All positioning was carried out on the ED 50 datum, with grid co-ordinates based on the Transverse Mercator projection, Central Meridian 0° East. The following geodetic parameters were entered into the QINSy online software in accordance with the Project Survey and Positioning procedures.

Spheroidal Parameters	
Spheroid	International (Hayford 1924)
Datum	ED50
Semi-Major Axis	6 378 388.000 m
Flattening	1/297.00000000
Central Meridian	0° East
Projection	Transverse Mercator (TM)
False Easting	500 000m
False Northing	0m
Central Meridian Scale Factor	0.9996

Time Datum

The time datum used for the project was local time GMT.

Summary of Operations

The survey operations were conducted between 09:00 30th October and 13:55 31st October 2005. A summary of the operations is tabulated below. All KP's are referenced to N0209 Shell Gas Goldeneye to St. Fergus Gas Pipeline.

Date	Time	Kp	Comments
30/10/05	09:00	74:000	V/L on location
	09:06		ROV Off Deck SOD P11/46
	09:36	73:982	Start survey of N0209 KP 74 to 76 VT# 05/084
	11:27	75.280	Fishing Debris located, ROV following chain in to burial
	12:02		Small GVI of netting, ROV following netting to North East
	12:09		Fix on net touchdown Position
	12:11		Fix on end of net
	12:22	75.238	Continue survey following chain to North East
	12:50	75.404	Fix on Port Trawl Board
	13:00	75:426	Fix on Roller attached to wire 1
	13:20	75.657	Wire 1 becoming loose and looping
	13:25	75.681	End of wire 1 not located, end of survey section. Recovering ROV
	13:30		ROV on Deck EOD P11/046 - WOW
	14:25		Vessel on position for next dive, WOW, Wind 34Kts
	15:35		V/L off DP continue WOW
	21:50	75.262	Assessing weather conditions at site
	21:55		ROV Off deck SOD P11/047
	22:12	75.258	Resume survey VT# 05/085
	22:29	75.386	Pause survey at wire xing of N0209, ROV following wire 2 to South West
	22:32	75.374	Position fix on Starboard trawl board
	22:45	75.235	Position fix on net and chain, then head back North East

Date	Time	Kp	Comments
30/10/05	22:50	75.281	Fix on wire crossing N02805 trench
	22:57	75.386	ROV continue to track wire 2 from Xing to pipe
	23:50	75.600	End of VT# 05/085
31/10/05	00:06	75.600	Start of tape VT# 05/086
	00:11	75.600	Fix at broken end of wire 2, same vicinity as wire 1
	00:35	75.036	Start survey of N0209 heading North east
	01:30	76.010	End survey of N0209, Conducting TRA for wreck investigation
	01:52	76.010	ROV moving in to locate wreck
	02:22		Harvest Hope stern found
	02:37		Harvest Hope bow found
	02:50		Wreck survey complete, ROV investigating scar marks located on sonar End VT# 05/086
	02:57		ROV moving back to N2805
	03:05		ROV recovering to deck, Heave 3m+
	03:13		ROV on deck EOD P11/047 V/L WOW
	08:24		V/L on location assessing weather
	08:25		ROV off deck SOD P11/048
	08:41		TSS 340 Background compensation check
	08:53	76.025	Start survey of P2805 start VT# 05/087
	09:49	75.261	Pause survey to fix fishing net over N2805
31/10/05	10:05	75.221	Resume survey south west side of net
	11:31	73.978	End survey section of N2805
	12:59		ROV relocates back to netting debris location End VT# 05/087
	12:59	75.228	ROV at south side of netting section
	13:01	75.229	Start survey of netting VT# 05/088

Date	Time	Kp	Comments
	13:48	75.251	Netting survey complete, ROV recovering to deck, End of tape VT# 05/088
	13:55		ROV on deck EOD P11/048

Results

The survey identified the debris of the trawl gear and the location of the wreck in the vicinity of the N0209 and N2805 pipelines (See drawing no. ET0261/KSS/05/1254). The trawl gear section was found to be located on and between the N0209 and N2805 pipelines. The trawl gear was not connected to the wreck of the Harvest Hope. The debris includes the net, and associated gear, two tow chains and the port and starboard trawl boards. A summary of the all debris is contained within the events listing below.

No evidence of the net having been caught on any pipeline or seabed feature in the vicinity of the trawl gear debris was observed during the survey. No damage to the pipelines was observed during the survey.

Easting (m)	Northing (m)	Comments
453470	6419422	Fix on chain and wire
453461	6419423	Fix on next section
453445	6419405	Fix on next section
453451	6419412	Fix on next section
453455	6419416	Fix on next section
453455	6419419	Fix on next section
453454	6419423	Fix on next section
453448	6419409	Fix on next section
454333	6419926	Stern of Harvest Hope Wreck
454355	6419912	Bow of Harvest Hope Wreck

2. Photos of debris items

Fig 1. Chain Crossing N0209

KP: 75.388 DCC: 0m

Fig 2. Wire crossing N0209

KP: 75.706 DCC: 0m

Fig 3. Netting section + Ground Line

KP:75.533 DCC: 27m

Fig 4. Netting section + Ground Line

KP: 75.545 DCC: 23m

Fig 5. Netting section

KP: 75.573 DCC: 7m

Fig 6. Netting section

KP: 75.563 DCC: 22m

Fig 7. Port Trawl Door

KP: 75.406 DCC: -14m

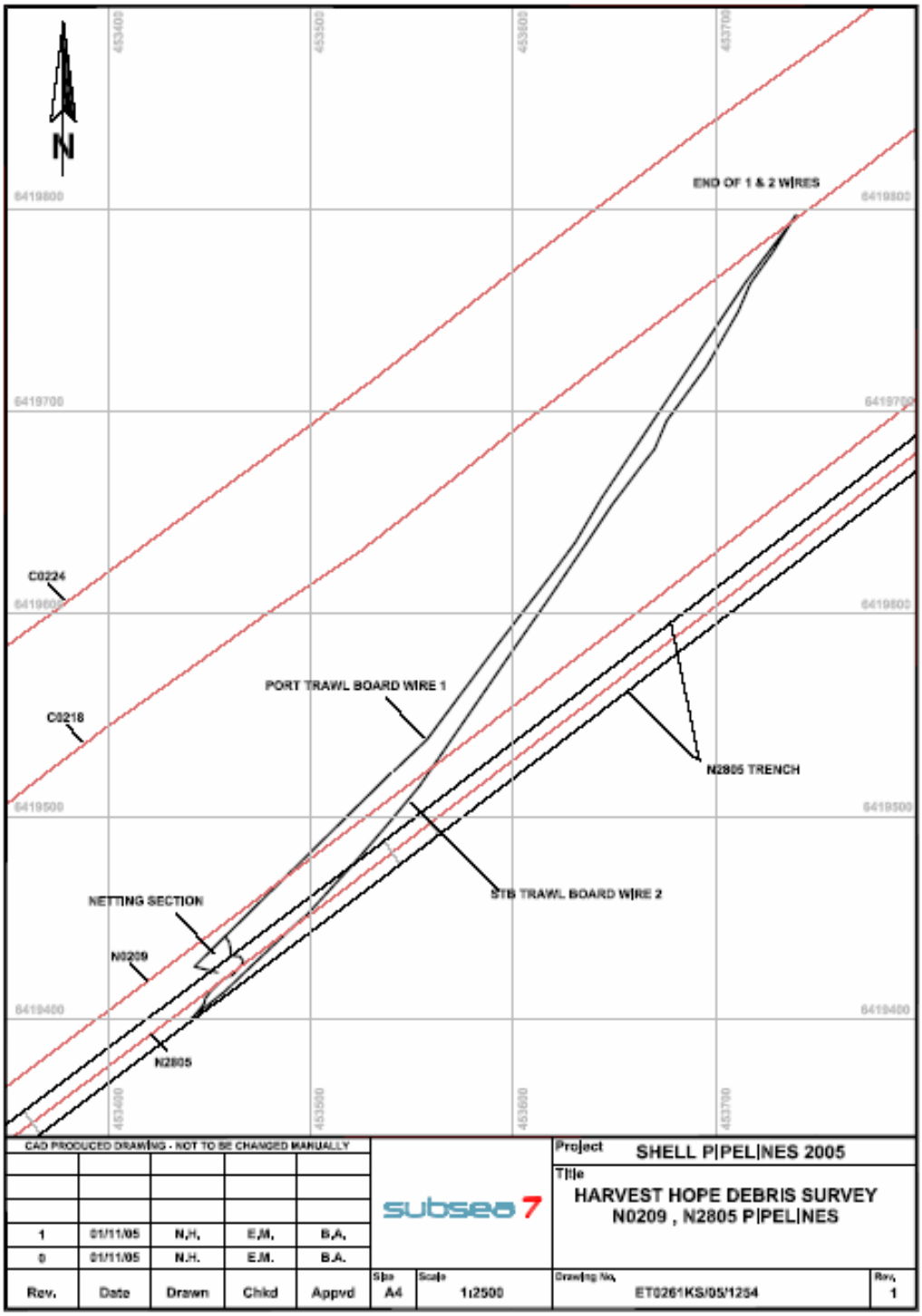
Fig 8. Stb Trawl Door

KP: 75.371 DCC: 6m

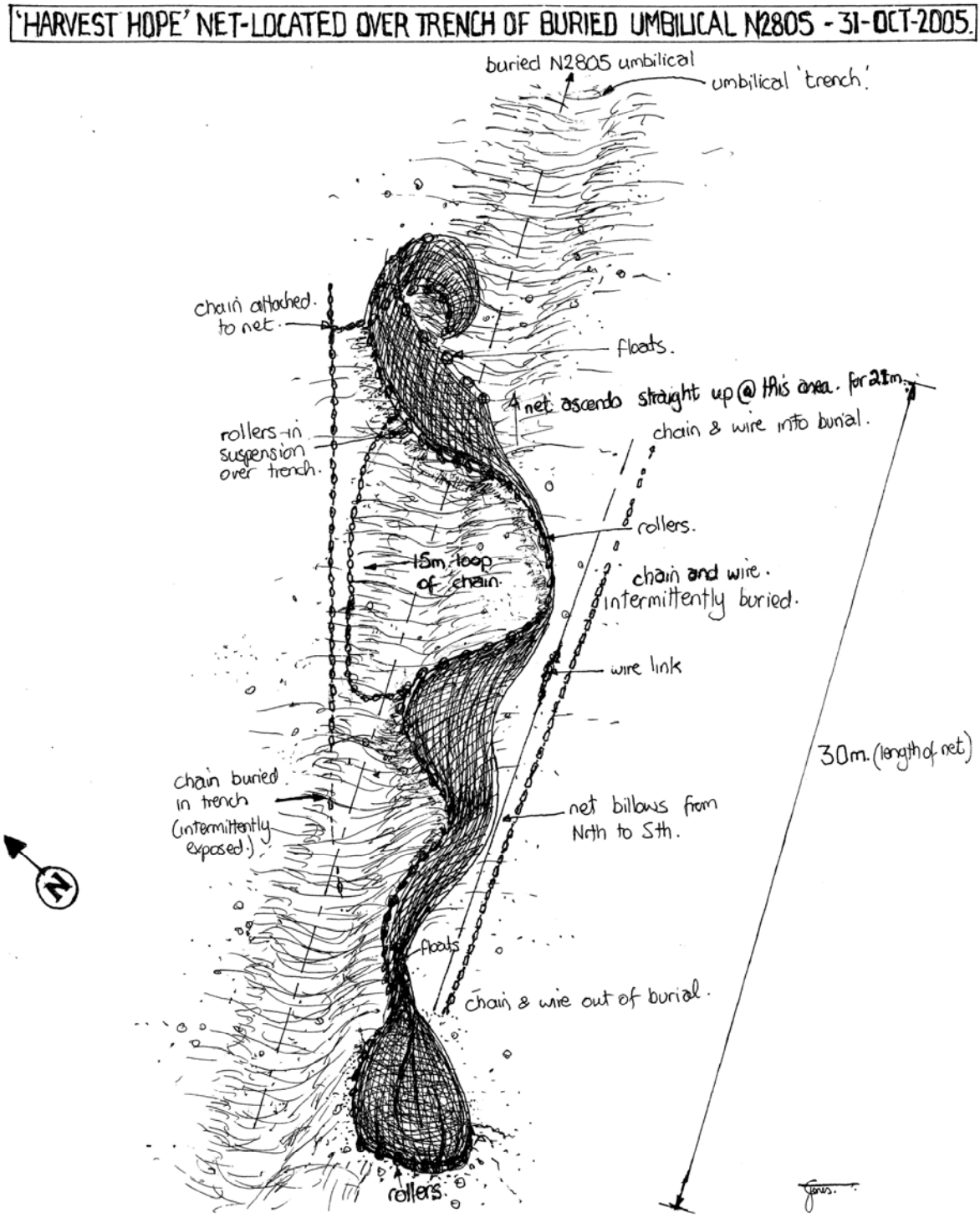
Fig 9. Harvest Hope Wreck

KP: 76.242 DCC: 157m

Chart of Debris Location



Sketches of debris area



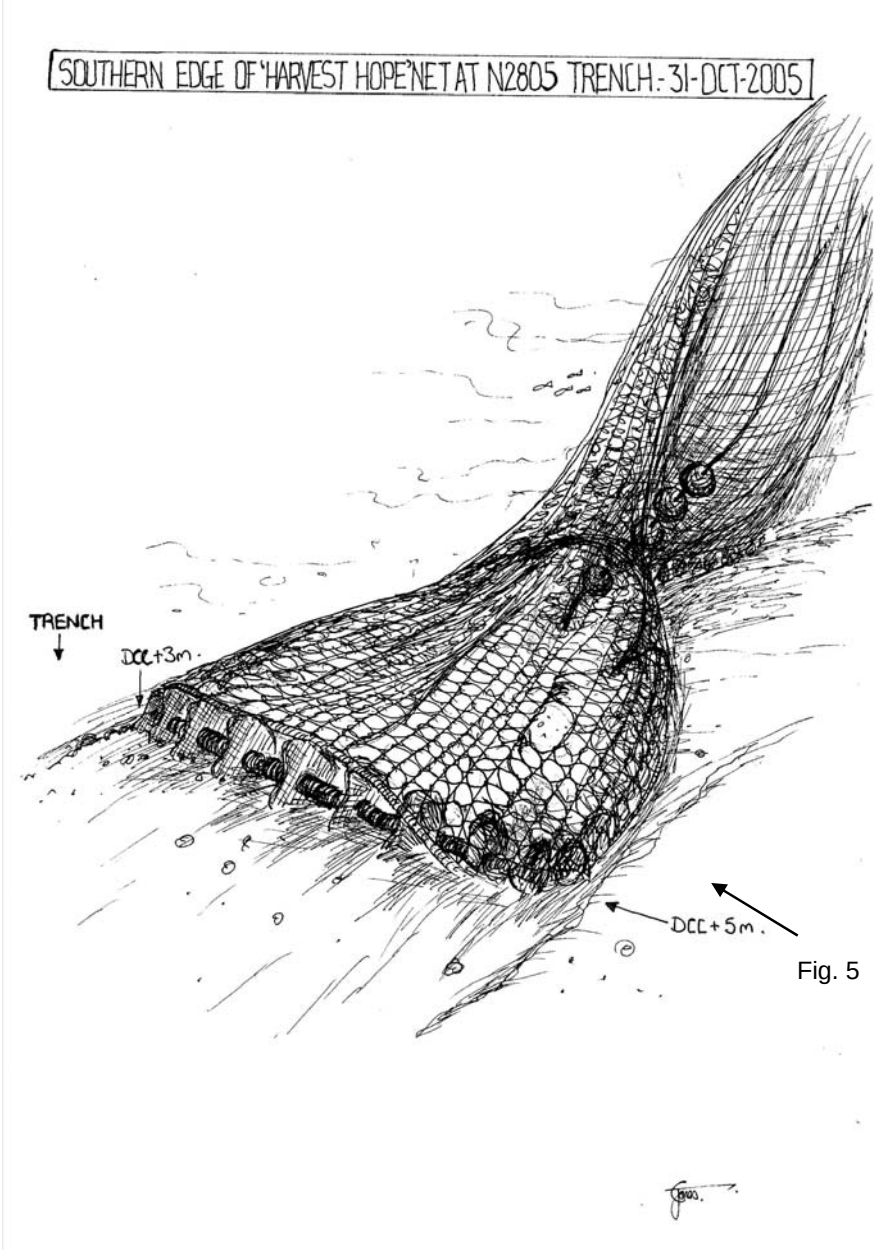


Fig. 5

DCC's relate to N2805. This page only.

Boreas Consultants Ltd report entitled:
Goldeneye Pipelines Assessment of Trawl Gear Incident at KP75.230

boreas

Goldeneye Pipelines

Assessment of Trawl Gear Incident at KP75.230

FOR

Shell UK Ltd

Boreas Report Number BR06022/SUK-56-A/Rev A Issued 15th February 2006

Made By :  Date : 15/02/06

Jerry Baker

Checked By :  Date : 15/02/06

Stuart McIntyre

INVESTOR IN PEOPLE

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CONTENTS

1. INTRODUCTION

The Goldeneye pipelines consist of a 20" gas line, laid on the seabed, and a 4" Glycol line which runs parallel to the gas line, trenched and buried, at an offset of approximately 20m to the south. Over most of the length, the Miller and SAGE trunklines run approximately 100m and 150m respectively to the north of the 20" gas line, creating a pipeline corridor of some 200m width.

In July 2005, the demersal trawler, *Harvest Hope*, sank in the vicinity of the Goldeneye pipelines. Subsequent inspection located trawl gear, partly straddling the trench of the Goldeneye Glycol line, in the vicinity of KP75 ~ KP76. Some of the gear appears to be buried, so that whether it is in contact with the Glycol line cannot be confirmed visually.

Shell requested the assistance of Boreas Consultants in determining the threats to the pipeline associated with either removing the gear, or leaving it in situ. The approach adopted was to scrutinise the available information (primarily ROV video records) to determine how the gear was rigged and how it came fast, so as to determine whether it should be removed and, if so, the optimum method for removal. Boreas' interpretation of the rig of the gear, and the sequence that led to the vessel coming fast and sinking, was presented to the skipper of the *Harvest Hope* for his confirmation so that the subsequent work was based on a sound foundation.

This report presents the information gathered and the analysis performed, and recommends two methods for removal of the gear, stating the preferred method.

2. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

2.1. Summary

The demersal trawler, *Harvest Hope*, sank close to the Goldeneye pipeline corridor in July 2005. It was reported that the capsize occurred after the trawl gear came fast. A subsequent ROV inspection of the pipeline route in the area located the gear of the *Harvest Hope* lying on top of the trench of the 4" Glycol line near KP75.230. It was determined that the net extends some 30m along the trench, and rises 21m off the seabed at the highest point. It is therefore a significant snagging hazard to other fishing vessels, submersibles, or even military submarines.

The likely sequence of events leading up to the trawl gear of the *FV Harvest Hope* coming fast in the area of the trench of the 4" Glycol line was determined by Boreas, primarily from a thorough review of ROV video records. This sequence was then proposed to the skipper of the vessel at the time of the incident (during which the vessel capsized and sank), who confirmed it and provided some additional details. (This was during a review meeting that involved the joint skippers of the *Harvest Hope*, and representatives of the Marine Accident Investigation Branch (MAIB), the Scottish Fishermen's Federation (SFF), Shell, and Boreas Consultants.)

Subsequent to the review meeting, additional information was obtained from side-scan traces of the area, recorded prior to the incident, which further corroborate the proposed sequence of events.

The objective of this assessment was to determine (a) whether the gear should be removed or made safe in situ, and (b) the optimum method for recovery of the gear (if recovery were recommended).

2.2. Conclusions

The following conclusions are drawn from this assessment:

- The gear creates a significant snagging hazard to other fishing vessels, submersibles, or even military submarines.
- A number of fishing skippers, including those of the *Harvest Hope*, are interested in recovering the lost gear. This would involve blind grappling in the very close vicinity of the 4" Glycol line, which would put the Glycol line at serious threat of snagging and major damage, so must be prevented. (At present, the guard boat is warning off would-be salvors.)
- It is most probable that the gear is stuck fast in stiff boulder clay, and that the Glycol line is not snagged.
- The very small possibility that the gear is in contact with the Glycol line should be taken into account when the recovery is planned and executed.
- The gear probably came fast because the chain bridle and tickler chain cut through a mound of compacted boulder clay left behind when the backfill plough either stalled or jumped at this location.
- The optimum approach to gear removal is to reverse the process by which it came fast.
- Another, similar backfill feature has been located near KP48.500, although this may not be so severe.

2.3. Recommendations

In light of the assessment, and the conclusions above, Boreas recommend that:

- The gear should be removed using one of the two options below, the first being the preferred method:

    1. Use of a grapnel positioned by an ROV to hook the net near the point of fixity, which is then pulled in the reverse direction to the original tow (an outline scope of work is presented in §6.3).

    2. Capturing and raising the cut ends of the warps, the warps then being hauled in while the vessel falls back until vertically above the point of fixity to free the gear (an outline scope of work is presented in §6.4).

- The trench at this location should be levelled with rock dump to prevent another trawler coming fast in the same way.

- The location near KP48.500 should be investigated and, if found to be similar in threat, should also be levelled with rock dump.

- Shell should promulgate the lesson learnt – that trawl gear can come fast in mounds of stiff boulder clay – around the offshore pipeline fraternity. The suggested recommendation is that, where a backfill plough stalls, it should be carried back to restart so that soil heaps are not left along the trench.

3. DESCRIPTION OF THE GLYCOL PIPELINE

The Goldeneye 20" gas pipeline, and the 4" Mono-ethylene-glycol (MEG) service line (the Glycol line), run for approximately 101km, in an 055° ~ 235° direction, between the Goldeneye wellhead platform (a Normally Unattended Installation – NUI) and the landfall at St Fergus. The 20" gas line is laid on the seabed over its full length. The Glycol line, which runs parallel to the gas line at an offset of approximately 20m to the south, was trenched and buried. Following the as-laid, and subsequent, inspections, some areas of the trench were augmented by rock dump.

Over most of the route between the Goldeneye platform and St Fergus, the Miller and SAGE trunklines run approximately 100m and 150m respectively to the north of the 20" gas line, creating a pipeline corridor of some 200m width.

Details of the Glycol line, taken from the pipeline data book[1], are given Table 3.1 below.

Parameter	Data
Linepipe Material Grade	ISO 3183-3 Gr L360QC, Seamless (X52)
SMYS at 50°C	359MPa
Suitable for Sour Service	No
Outside Diameter	114.3mm
Wall Thickness	11.1mm
Internal Corrosion Allowance	Nil
Negative Wall Thickness Tolerance	10%
External Pipeline Coating	FBE, 0.5mm thick
Weight Coating	None
Internal Flow Coating	None
Flanges	ASTMA694 F52, full face Alloy 625 overlay, rating 2500#
Design Pressure	250barg
Normal Operating Pressure	232barg
Elevation of Pressure Definition	16metres (relative to LAT)
Maximum Design Temperature	50°C
Minimum Design Temperature	-10°C
Contents Density	1100kg.m^{-3}
Design Flow Rate	600bbl/d
Pigging Requirements	Not designed to be pigged
Design Life of Pipeline System	20years

Table 3.1 Design parameters of the Goldeneye MEG service line

The target depth of burial of the Glycol line was 500mm to top of pipe[1].

Further information on the Glycol line trench, derived through this assessment, is presented in §5.

4. DESCRIPTION OF THE EVENT

4.1. Introduction

The trawl gear was discovered to be arrayed over a section of the trench of the Glycol line, in the vicinity of KP75.230. It was not clear whether the Glycol line itself was snagged (it had not been found exposed at that location by previous inspections). Therefore, in order to determine whether the Glycol line might be under threat, and the preferred solution with regard to removing or making safe the trawl gear, it was decided to attempt to reconstruct the sequence of events that led to the gear coming fast.

Subsequently, at a meeting that included the joint skippers of the *Harvest Hope*, representatives of the Marine Accident Investigation Branch, the Scottish Fishermen's Federation, Shell and Boreas Consultants[2], the sequence was confirmed. The descriptions below, and the subsequent recommendations, follow from this confirmation.

4.2. Rig of the Gear

Based upon observation of the ROV inspection footage, the gear was single rig, with simple rectangular V-doors. Wire and chain combination bridles link the foot rope of the net to the doors, while wire bridles connected to the chain bridles connect to the upper wings of the net. A plan view sketch of the gear is given in Figure 4.1.

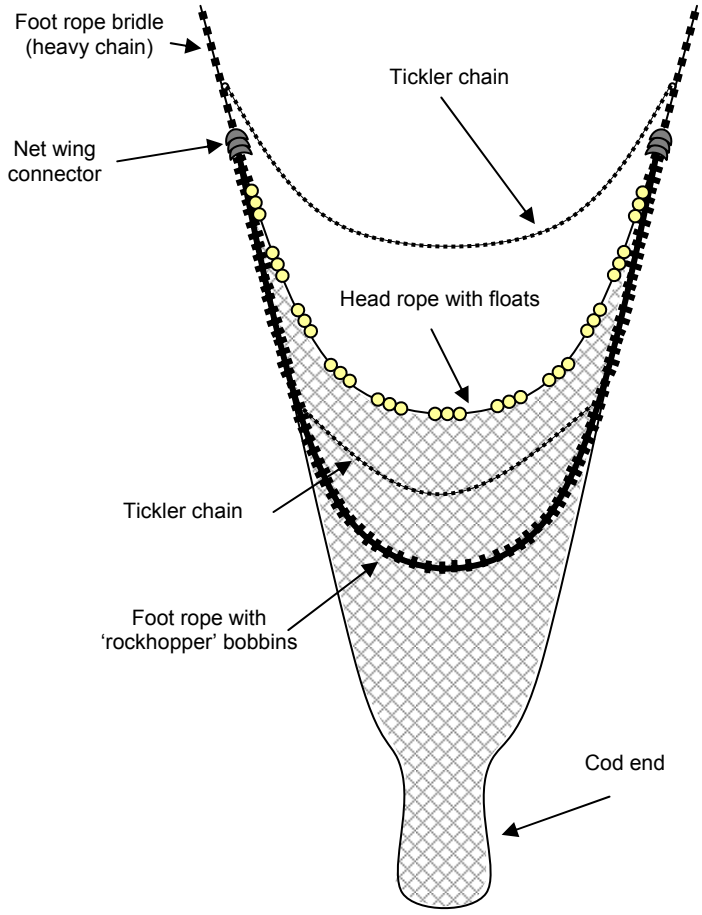

Figure 4.1 Plan view sketch of the trawl gear

The head rope is made buoyant by a series of clusters of floats. The foot rope has frequent large bobbins along its length, to which the net is attached. Tickler chains are spread across the mouth of the net, one connected a few links ahead of the foot rope end shackles, and one connected across the foot rope. (These are designed to entice fish off the seabed so that they are more easily caught.)

An approximate sketch of the gear, in elevation, is given in Figure 4.2. Although this may not be very accurate with regard to the wing arrangement and, especially, the cod end, it does illustrate the salient points. The skipper of the *Harvest Hope* stated that the net actually has twin cod ends; this arrangement is unlikely to have influenced the way the gear came fast, or the recommendations for its removal.

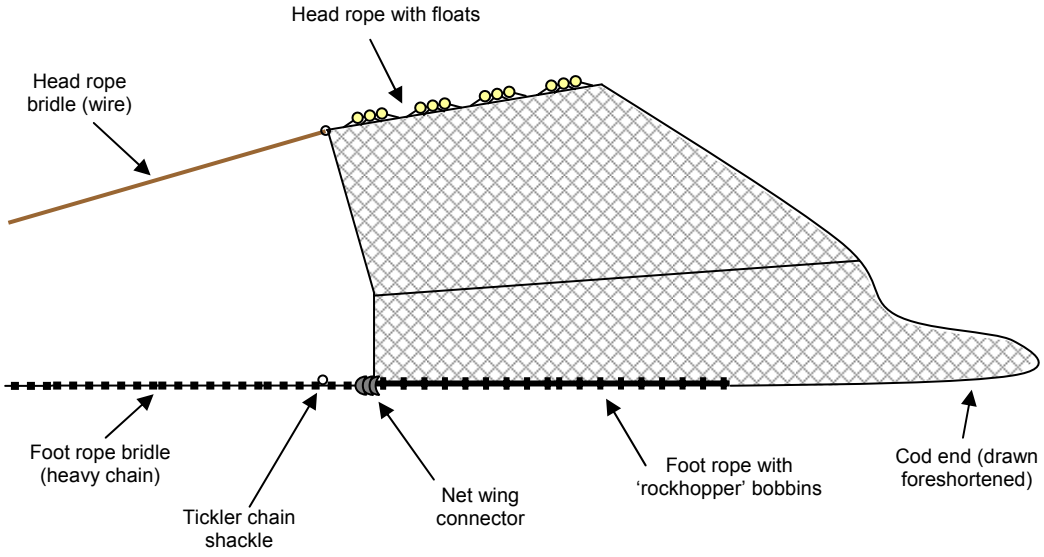

Figure 4.2 Sketch of the trawl gear in elevation

4.3. Sequence of Events

This sequence was reconstructed, based upon observation of the ROV inspection footage, and a general knowledge of fishing practice, and was then presented to the skipper of the Harvest Hope, who confirmed it to be correct[2].

The *Harvest Hope* was towing in a NE x E'ly direction, following the route of the 20" gas line, with the port trawl door close to, or possibly across, the gas line. As a result, the tow covered the trench of the 4" MEG line (see Figure 4.3).

In the vicinity of KP75.230, some part of the rigging in the vicinity of the lead tickler chain, where it connects to the port bridle, came fast. Attendees at the review meeting included four current or past trawler skippers and they agreed that the chains are likely to have come fast in the stiff boulder clay, with no discrete feature (pipeline, rock, etc) being required.

The port warp thus being fast, the *Harvest Hope* started to slew to port, carrying the starboard wing of the net past the port wing, skewing the gear. Ultimately, as the boat came fast, the gear was stretched along a line bearing 035° approximately. The starboard hand load was transferred via the bridle and the tickler chain to the point of fixity. The port head rope bridle was brought down to the seabed by the tension; the ends of the net, and the bridle/net connecting shackle all became buried.

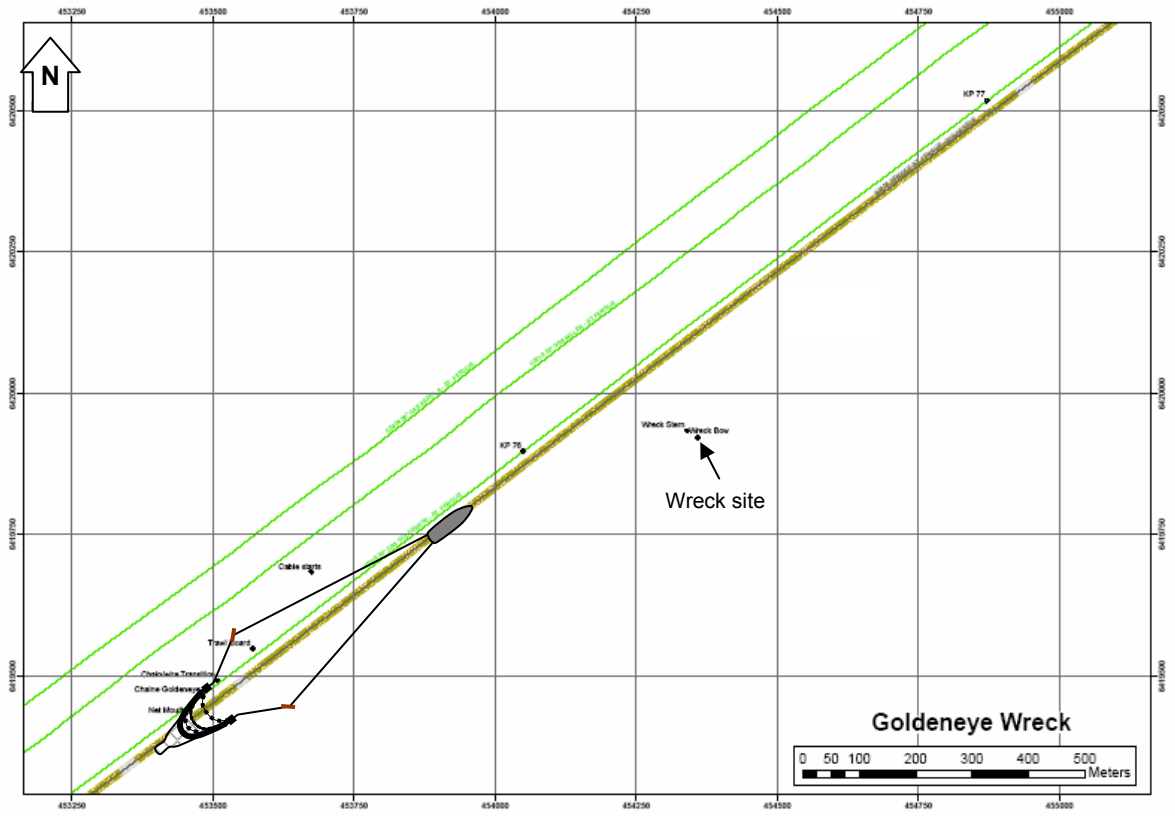

Figure 4.3 Schematic of *FV Harvest Hope* trawling along the Goldeneye pipelines

In the process of coming fast, the foot rope was flipped across the starboard warp/tickler chain. Because the tickler chain is shorter than the foot rope, a number of twists and turns appeared in the foot rope. Meanwhile, the back of the net, to the cod end, became entangled with the port wing (close to, and covering, the fastener).

This sequence is illustrated in the sketches – Figure 4.4 and Figure 4.5.

The skipper clarified that, on coming fast, seawater came inboard over the stern causing a list which, in turn, led to a failure of the hydraulics to the towing winches. As a result, it was not possible to fall back and recover the gear, so the warps were cut and the gear abandoned. Indeed, the vessel capsized and sank shortly afterwards, coming to rest where indicated in Figure 4.3. As a result, the bridles and warps are laid out across the seabed in a straight line from the net in a north-easterly direction. The cut ends of the warps are coiled loosely on the seabed, to the south of the Miller trunkline.

Since the starboard end of the net is not held to the seabed by being fast or buried, the floats have lifted that end of the net to a height of 21m above the seabed (measured by ROV). The wire head rope bridle has also been lifted clear of the seabed (possibly to a similar height off seabed – not investigated by the ROV). This creates a major snagging hazard, especially for other fishing boats, but possibly for submersibles or even military submarines (water depth approximately 90m).

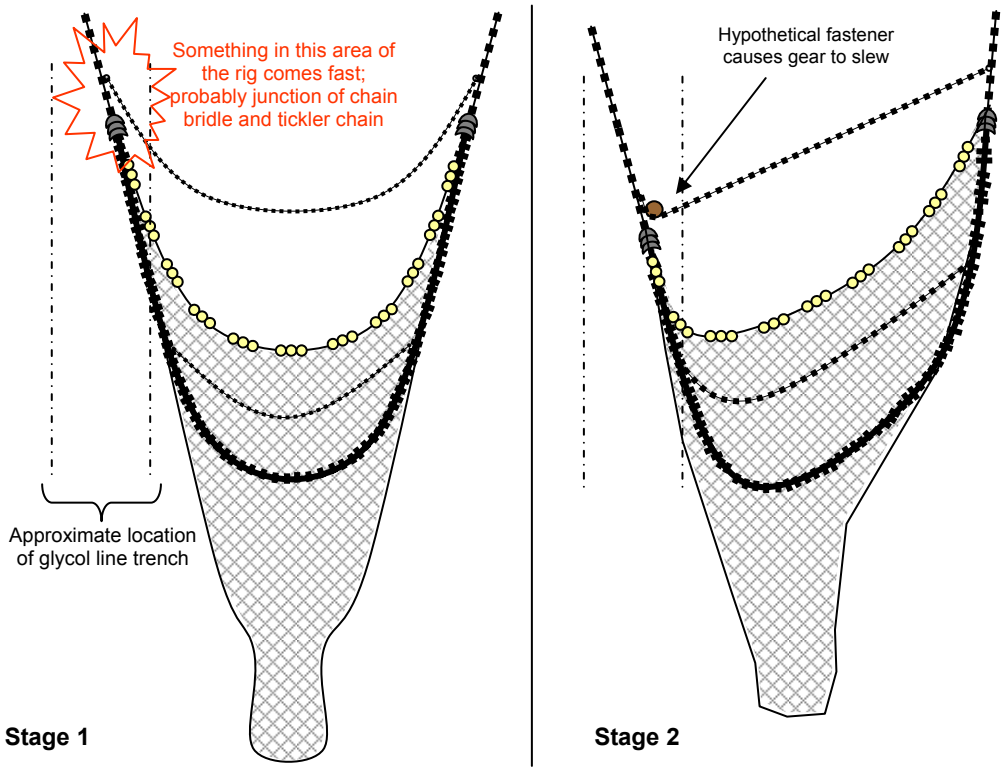

Figure 4.4 Schematic of trawl gear coming fast - stages 1 and 2

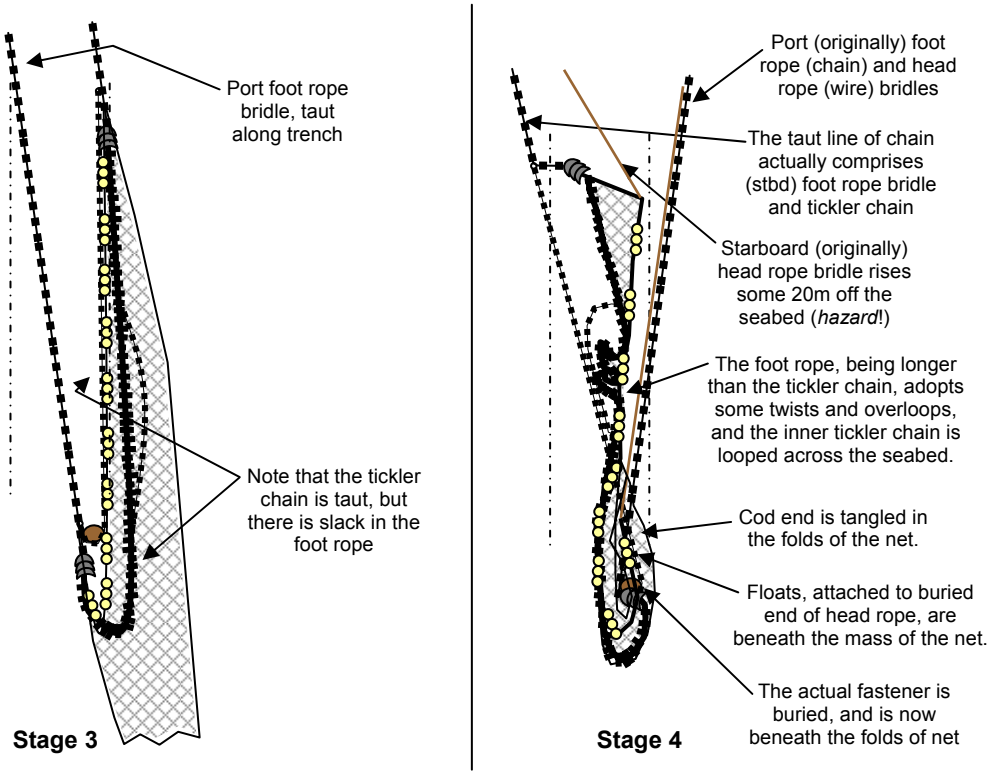

Figure 4.5 Schematic of trawl gear coming fast - stages 3 and 4

4.4. Current Status

It is assumed that the gear has not been disturbed since the ROV survey as a SFF guard boat has been stationed in the vicinity during all but the worst weather. This being the case, the gear lies along the trench line for a distance of some 30m, anchored at the south-westerly end by the fastener and to the northward by the chain bridles, trawl doors and warps. The point of fixity lies beneath the cluster of net formed by the port net wing, the main belly of the net and the cod ends.

There is a high probability that the gear is not fast on the Glycol line because:

- all the skippers (past and current) agreed that there is considerable anecdotal evidence of gear coming fast in 'mud' (taken to mean stiff boulder clays);
- earlier inspections had confirmed the glycol line to be buried in this area;
- it is difficult to conceive how the gear could have come fast while traversing along a small diameter, featureless pipeline.

However, any removal method should take account of the small residual possibility that the line is snagged.

Additional acoustic imagery has been obtain since the review meeting, which augments the understanding of how the gear came fast, and this is presented and discussed in §5.

5. SIDE-SCAN SURVEY DATA

Side-scan sonar traces, taken prior to the gear coming fast, have been inspected (following the review meeting). A segment for the location where the gear is fast is presented in Figure 5.1 [3].

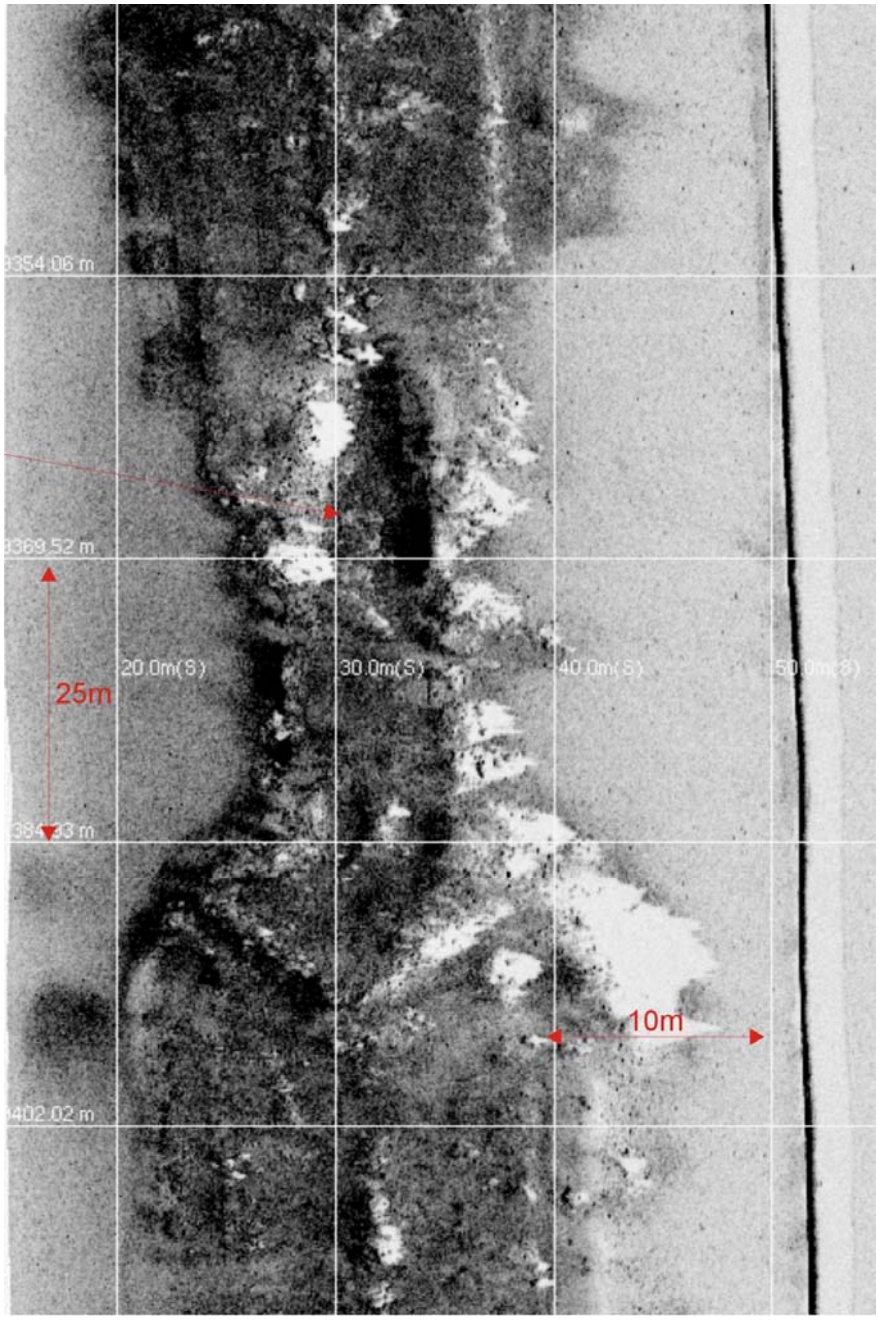

Figure 5.1 Segment of side-scan trace for KP75.152 ~ KP75.275

The sonar was towed along the left of the picture (i.e. Figure 5.1), heading from the bottom upwards. To the right of the picture the hard black return with the white band of shadow behind it represents the 20" gas line. The trench of the glycol line is nearer to the track of the sonar. To the bottom of the picture (beneath the lowest white fix marker), the trench is 'typical': in the middle is a small heap (dark return to the left, white shadow to the right) which should lie approximately above the Glycol line. There is little in the way of residual spoil to either side. Then, about a quarter of the way up the picture, there is a V-shaped heap across the trench. Above that, until almost the top of the picture, the trench is narrower and significant spoil heaps, including large lumps, are visible. At the top of the picture, above the top fix marker, the trench starts to look more like the 'typical' trench, although the result is rougher, and some residual spoil remains, especially on the right.

The interpretation of this[1] is as follows: the backfill plough was pulled from Goldeneye, towards St Fergus, which is from bottom to top of the picture. The V-shaped heap was created by the plough either stalling (and subsequently being lifted), or jumping, such that the spoil immediately in front of the blades was left in a compacted heap across the trench. The next 50m approximately was hardly affected by the backfill plough (if at all – although the Glycol line was apparently covered). The spoil heaps remain to either side, and the trench is quite deep. The lumps are evident on the ROV video records as large lumps of boulder clay. Towards the top of the picture, the backfill plough resumed its coverage, but it was still settling down so that the trench is rough.

At the time of the incident, the *Harvest Hope* was trawling in the opposite direction to the backfill plough (i.e. from top to bottom of Figure 5.1). The point at which the gear came fast, based upon a best estimate from the ROV video (the ROV was not driven right up to the net for fear of snagging), is in the bank of soil to the left of the Glycol line (looking at the picture) in front of the V-shaped heap (in terms of the backfill direction). The net appears to extend from this point towards the bottom of the picture.

In light of all the evidence, it appears likely that the port warp was running along the trench, with the tickler chain extending over to starboard (to the left in Figure 5.1). As the port wing reached the unbackfilled length of trench, it will have dropped into it such that the tickler chain started to cut through the bank and the spoil heap. On encountering the V-shaped heap, the resistance was enough to hold the gear fast.

This proposed sequence of events is outlined in Figure 5.2 (overleaf).

This corroborates the earlier analysis. In light of all the evidence, and the analysis, it is recommended that the optimum approach to removal would be to pull the net in the reverse direction to that in which it came fast. Consideration may be given to high pressure water jetting of the soil mound, although this will have to be performed with the net in place – i.e. jetting through the net.

It is further recommended that Shell should advise the general offshore pipeline fraternity that demersal trawl gear can come fast in heaps of stiff boulder clay and that, therefore, a requirement for backfill ploughing should be that, if a plough stalls, it must be lifted back along the route for re-starting. Options for promulgation might be via UKOOA, the Pipeline Users Group (PLUG), or even via the HSE (e.g. a safety notice).

[1] This interpretation was agreed by P Sloman (Shell), Fugro, and J Baker (Boreas).

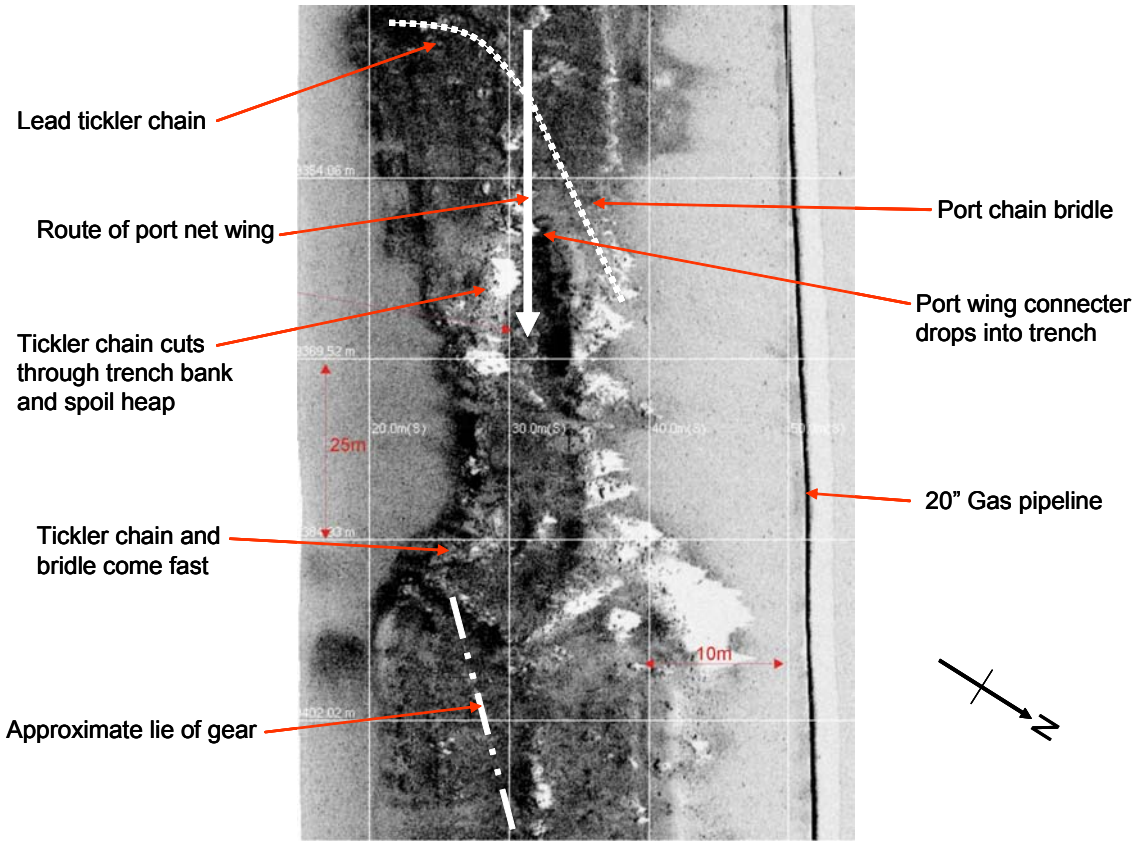

Figure 5.2 Proposed sequence of events superimposed on the side-scan trace.

It may be noted that an inspection of the ploughing logs, and of the side-scan data, has revealed one other location where there is a similar, if less marked, V-shaped heap. This is in the vicinity of KP48.500. This should be investigated to see whether it poses a similar threat to demersal trawl gear.

6. PROPOSED METHOD OF REMOVAL

6.1. Remove or Make Safe

It would not be easy to make the gear safe in situ, mainly because it is floating 21m off the seabed. It would be possible to lower concrete mattresses across it but there is a significant probability that the deployment frame would come fast in the net. Furthermore, this would require the deployment of a minimum of 15 large mattresses. An alternative method would be to build a 30m long steel frame and to lower this over the net to crush it down to the seabed. The frame and the net could then be covered with rock dump, but this would require significant volumes of rock and would leave an obstruction (albeit overtrawlable) on the seabed, such that a consent might not be granted. In either case, the bridles, trawl doors and warps should still be recovered.

It must also be recognised that the skippers of the *Harvest Hope* wish to recover their gear and, if it is not snagged on the Glycol line (as is believed), then they presumably have a right to attempt this[2]. This would involve them deploying a grapnel in the vicinity of the gear and dragging it (blindly) across the seabed until they caught their gear. There would be a significant threat that they would capture and pull the 4" Glycol line, and major damage could then be caused. The guard boat currently stationed above the location has apparently reported[4] a number of fishing boats approaching the area, presumably with the aim of salvaging the gear. They would adopt the same method if they could get close. Therefore it would be better to recover the gear in the safest possible way, rather than risking others attempting to recover it. Shell have committed verbally to recovering and returning the gear if this can be achieved safely[2].

Therefore, Boreas recommend full removal.

6.2. Options for Removal

The two main options for removal are:

1. Use of a grapnel positioned by ROV to hook the net near the point of fixity, which is then pulled in the reverse direction to the original tow (for reasons explained below, this is the preferred method).

2. Capturing and raising the cut ends of the warps, the warps then being hauled in while the vessel falls back until vertically above the point of fixity to free the gear.

The final selection will have to be made in consultation with the contractor who will perform the work. Outline scopes for the two methods are presented below.

6.3. Grapnel Method

6.3.1. Outline of Method

A grapnel must be positioned so as to snag the end of the foot rope as close to the point of fixity as possible. The line should be paid out to achieve a relatively shallow angle to the horizontal (to avoid lifting the glycol line in the unlikely event that it is snagged). An ROV should observe the point of fixity to confirm that the grapnel has purchase, and that the gear is moving (note: the seabed is hard boulder clay, so visibility is expected to be reasonable).

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[2] This assessment has not reviewed the legal position vis à vis the rights of the owners of the *Harvest Hope* to recover their gear, or of their rights to compensation if they are prevented from so doing (e.g. by burial of the nets). These issues would have to be addressed by Shell's legal department if there is a preference for making the gear safe in situ.

This approach could be used to recover all the gear in a single operation. Alternatively, the bridles could be cut and the warps and doors retrieved separately (by the method suggested in §6.4).

The grapnel method is preferred because the pull is almost axial to the glycol line, and nearly horizontal, so that damage should be minimal in the unlikely event that it is snagged.

6.3.2. Vessel requirements

One vessel is required to pull the gear: it is recommended that this be a fishing vessel (FV), ideally with one of the *Harvest Hope* skippers on board.

One ROVSV is required, deploying a work class ROV.

6.3.3. ROV requirements

A work class ROV with a manipulator capable of deploying the grapnel is required. It may be advisable to fit guards to the thrusters, and to fair off protruding equipment, to minimise the risk of the ROV getting snagged in the net.

Consideration should be given to cutting the bridles, and retrieving the warps and doors separately. The ROV should be equipped with a guillotine cutting tool for this purpose. Such a tool is recommended anyway, in case of unforeseen problems.

Consideration may also be given to providing high pressure jetting equipment to break up the bank of boulder clay prior to commencing gear recovery.

6.3.4. Preparation required

Prior to commencement, a grapnel should be prepared such that it can be manoeuvred by the work class ROV to engage the foot rope without the ROV itself becoming snagged. The team should be briefed with the aid of the video records.

6.3.5. Recovery exercise

- The ROVSV should be positioned down tide of the point of fixity (so that the ROV is not carried towards the net), and should deploy the ROV to the seabed. (Note: since the net is fast to the south of the Glycol line, the ROV should ideally be positioned to the north. Therefore, the task would best be started when the tide is on the turn before flowing to the northward.)
- The FV should lower the grapnel, on a warp, to the seabed, close to the ROV (a tag line may be used).
- The ROV should hook the grapnel into the foot rope, and should then monitor the behaviour of the net as it is pulled by the FV.
- The FV should deploy a minimum length of warp of 3.5d (where d is water depth) before commencing hauling, to ensure a pull that is close to the horizontal. Every effort should be made to confirm that the Glycol line is not snagged.
- The ROVSV should take control of the recovery, requiring the FV to cease heaving if there is any doubt about the safety of the recovery.

6.4. Vertical Pull Method

6.4.1. Outline of Method

A line, fitted with a suitable clamp, will be deployed to the seabed by the recovery vessel. The ROV will clamp this line close to the ends of the warps. The recovery vessel will then recover the warps to surface. Once the cut ends of the warps have been retrieved, and taken to the winches, this is the method normally used by fishermen to free gear that has come fast (but has not been abandoned).

The vessel will fall back along the track of the gear as it is pulled in. As it approaches the point of fixity, additional guidance should be provided to ensure that the gear is suspended vertically (information not usually available to a fisherman). The gear should then be pulled as gently as possible, while an ROV observes to ensure that the gear is coming free and that the glycol line is not following.

This method is not preferred because, given vessel motions in response to wind and swell waves, it may be difficult to effect a 'gentle' removal, and a fast response will be required in the unlikely event that the glycol line is snagged. However, it does have the advantage that no grapnel is deployed close to the Glycol line.

6.4.2. Vessel requirements

One vessel is required to reel in the gear: it is recommended that this be a fishing vessel (FV) ideally with one of the *Harvest Hope* skippers on board.

Note that, because the clamp is unlikely to be attached right at the ends of the warps, as the warps are recovered lengths of wire will be hanging freely close to the vessel's propeller(s). Therefore, this stage of the recovery may have to effected without stern propulsion, in which case a bow thruster could be advantageous.

One ROVSV is required, deploying a work class ROV.

6.4.3. ROV requirements

A work class ROV with two manipulators is required. One manipulator will be used to hold and open/close the clamp; the other will be used to capture a warp and draw it to the clamp. Note that, because they may be tangled on the seabed, it is recommended that both warps be recovered together. Therefore, the ROV will have to capture one warp, and then move to the other warp and repeat the exercise.

It may be advisable to fit guards to the thrusters, and to fair off protruding equipment, to minimise the risk of the ROV getting snagged by the warps. The ROV should be equipped with a guillotine tool for cutting the warps in case of unforeseen problems.

Consideration may also be given to providing high pressure jetting equipment to break up the bank of boulder clay prior to commencing gear recovery.

6.4.4. Preparation required

Prior to commencement, a tool is required that can be deployed by the work class ROV to clamp on to a warp wire. In practice, both warps will have to be hauled together so two separate clamps on a short bridle will probably be required. (Note: the second leg must be manoeuvrable by the ROV after the first is clamped on.) The clamps will be attached towards the cut ends of the warps but, due to the way they are coiled on the seabed, the actual ends may be hard to identify.

6.4.5. Recovery exercise

- The ROVSV should be positioned above the ends of the warps, and deploy the ROV to the seabed.
- The FV should lower a warp to the seabed, close to the ROV (a tag line may be used). The warp will have at its end the clamping tool(s).
- The ROV should clamp the tool(s) to the warps, and monitor as the FV starts to haul, to ensure that the clamps are holding.
- The ROVSV should then follow the warps to the area of the net, and be positioned down tide of the point of fixity (so that the ROV is not carried towards the net). (Note: since the net is fast to the south of the Glycol line, the ROV should ideally be positioned to the north. Therefore, the task would best be started when the tide is on the turn before flowing to the northward.)
- As the FV approaches the zenith of the point of fixity, the ROV should be used to guide the FV to a vertical position. The ROV should then monitor the pull out of the net, every effort being made to confirm that the Glycol line is not snagged.
- The ROVSV should take control of the recovery, requiring the FV to cease heaving if there is any doubt about the safety of the recovery.

6.5. Post Recovery

It is recommended that the trench depression in this area, especially close to the V-shaped bank, be levelled with rock dump once the gear has been recovered, to ensure that this cannot occur again. The volumes of rock required will not be large as it is only required to smooth the profile to ambient seabed level.

If the trench configuration at the location near KP48.5 is found to be similar, this should also be levelled with rock dump.

Note that the wreck will remain on the seabed some 150m from the Glycol line trench.

7. REFERENCES

1. Goldeneye 4 Inch MEG Service Pipeline Summary Data Manual, Chapter 100, Rev 0, June 2004.
2. Meeting held at the offices of Boreas Consultants Ltd, 14 December 2005. Participants: Colin Stephen (skipper of *Harvest Hope* during the incident), James Stephen (joint skipper), Bill West (MAIB), John Watt (SFF), Mike Sutherland (SFF), Andy Studman (Shell), Duncan Cursiter (Shell), Jerry Baker (Boreas).
3. Side-scan image provided by Fugro Survey Ltd.
4. Statement by Mike Sutherland, SFF, during the review meeting[2].