ACQUISITION REPORT

PGS Geophysical

Santos Australia Limited

M/V PACIFIC EXPLORER

2008 Brandt 3D MSS
Block T/35P Offshore Tasmania
Australia

2007112

25th February to 28th March 2008

version 1

PGS Geophysical – Marine Acquisition, Singapore

AUTHORISATION

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22nd April 2008

DISTRIBUTION

DESTINATION	**MEDIA**	
Client company office	Paper copy	Nil
Client company office	Electronic version	3
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REVISED VERSIONS

NUMBER	CHANGES	AUTHOR	DATE

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1 Introduction

1.1 Summary

PGS was contracted by Santos Australia Limited to acquire the Brandt 3D survey using the M/V PACIFIC EXPLORER.

The seismic survey area was situated approximately 150 nm south west of Melbourne and 40 nm west of King Island.

The vessel mobilised in Melbourne, Victoria after taking on supplies and bunkers. A start-up meeting was conducted on the morning of 24th February 2008 for both projects: 2007112 (Brandt) and 2007113 (Strahan).

On the morning of 25th February 2008, the vessel sailed heading for the prospect area. Streamer deployment started shortly after clearing the heads at Melbourne in open water.

On arrival at the prospect the 'PACIFIC CREST' was sent into the survey area to scout and check for fishing activity. Communications was established with John Hammond on the 'EDWARD J FARNIE'. John had started to clear the area of fishing gear and communicated our intentions to the local fishermen.

During deployment there was a short delay in replacing the lead-in on streamer 3, due to damage and corrosion, which had been anticipated before deployment. The remaining deployment went well. Before production could commence the 'PACIFIC CREST' again scouted the area and conducted a MMO watch, given that the first production line would be acquired after dark. The mobilisation was completed on 27th February 2008.

Fishing activity that was evident at start-up was concentrated on the 200m contour that passed through the south west corner of the prospect. On the evening of 27th February there was still fishing activity in this area, so operations commenced on the western edge of the first swath until the fishermen had cleared the area. Once the fishing community had cleared their equipment on 2nd March 2008 operations shifted to the eastern edge to quickly clear the area to minimise the impact on the local fishermen. This first swath was completed on 10th March 2008.

On the evening of 15th March the main recording system failed during a line change. The fault proved difficult to locate and a spare system was then utilised. This disruption resulted in a long period of downtime to enable the spare system to be configured and installed.

All the seismic equipment was recovered on 19th March for crew change; bunkers and supplies alongside at Melbourne on 20th March 2008.

The vessel departed Melbourne on 21st March. All equipment was deployed and production resumed on Sunday, 23rd March. On Tuesday, 25th March, the deteriorating weather conditions caused operations to be suspended with just one infill pass necessary to complete the survey. Sequence 111 was scratched for weather at this time. On Thursday, 27th March, weather conditions improved and the survey was completed with the acquisition of Sequence 112 being the last.

1.2 Key parameters

Source	:	2 x 3090 in^3
Source depth	:	6 m
Streamers	:	6 x 6000 m
Streamer spacing	:	100 m
Streamer depth	:	7 m
Near trace offset	:	104 m

1.3 Systems

Source type	:	Bolt LLXT guns
Streamer type	:	PGS RDH-S
Recording system	:	NTRS
Navigation	:	SkyFix.XP DGPS
	:	StarFix.HP DGPS
Float positioning	:	Fugro RGPS
Acoustic ranging	:	ION Digicourse

1.4 Production

Traverse km		**CMP km**		**Square km**	
prime	1503.52	prime	18042.84	prime	451.06
prime run out	266.96	prime run out	3203.55	prime run out	80.09
infill	253.41	infill	3040.88	infill	76.02
infill run out	44.94	infill run out	539.32	infill run out	13.48
TOTAL	**2068.84**		**24826.05**		**620.65**

Infill percentage : 16.85%

1.5 Survey timing

	Hours	% of total		Hours	% of total
Production	488.33	59.3%	Prime Production	175.57	21.3%
			Line Change	246.47	30.0%
			Infill	29.98	3.6%
			Run Out (Prime)	30.97	3.8%
			Run Out (Infill)	5.35	0.7%
Standby	240.22	29.2%	Weather	69.92	8.5%
			Local Transit / Prospect Change	58.25	7.1%
			Supply	51.35	6.2%
			In port	31.17	3.8%
			Fishing	0.05	N/A
			Line Change Standby	2.38	0.3%
			Port Call Bunkering	27.1	3.3%
Mob / demob	48.43	5.9%	Extended Mob, Instrument	0.27	N/A
			Streamer Deployment	46.17	5.6%
			Source Deployment	1.98	0.2%
			General Demob	0.02	N/A
Downtime	45.73	5.6%	Physical Problems	5.42	0.7%
			Recording QC Software	21.57	2.6%
			Bolt airgun airleak	3.72	0.5%
			Active Passive Modules	6.55	0.8%
			Bolt Airgun Autofire	3.95	0.5%
			Source separation	0.10	N/A
			Operator error – Instruments	4.43	0.5%
TOTAL	**822.72**				

2 Sequence of events

2.1 Daily log

Date	Total Km	Prime FF	Prime RO	Infill FF	Infill RO	wind f'ce	sea state	comments
23/02/2008	0.000000	0.000000	0.000000	0.000000	0.000000	6	Very Rough	Alongside Melbourne for crew change, bunkers and supplies.
24/02/2008	0.000000	0.000000	0.000000	0.000000	0.000000	8	High	Alongside Melbourne for crew change, bunkers and supplies. Start-up meeting for Santos Brandt 3D. Delayed sailing for new project due to poor weather forecast.
25/02/2008	0.000000	0.000000	0.000000	0.000000	0.000000	5	Rough	Departed Melbourne @ 06:00 for prospect, PACIFIC CREST delay in sailing due to late arrival of bunkers, departed at 14:30. Started deployment for Santos Brandt @ 13:25.
26/02/2008	0.000000	0.000000	0.000000	0.000000	0.000000	3	Rough	Continued streamer deployment, at midnight streamers 1, 2, 5 & 6 fully deployed. Streamer 3 is deployed to the front end, lead-in looks in poor shape, suspect it has been damaged by corrosion and decided to err on the side of caution and replace it, started @ 23:30.
27/02/2008	9.262500	9.262500	0.000000	0.000000	0.000000	3	Rough	Completed mobilisation for Santos Brandt. Started production first sequence @ 22:49. PACIFIC CREST scouted the area of the first few lines during the day to make sure no fishing activity in the area, also conducted whale watch at request of MMO to ensure no whales were in the area to allow us to start on the prospect after dark.
28/02/2008	90.206250	75.225000	14.981250	0.000000	0.000000	6	Very Rough	In production: Sequence.001,002 ,003, 004 & 005.
29/02/2008	83.175000	71.175000	12.000000	0.000000	0.000000	5	Rough	In production,: Sequence.006, 007, 008, 009,010,011. Sequence. 008 scratched due to multiple problems during the line with the recording system, gAS, NTRS and GCS90. Seq. 005 scratched from yesterday due to swell noise.

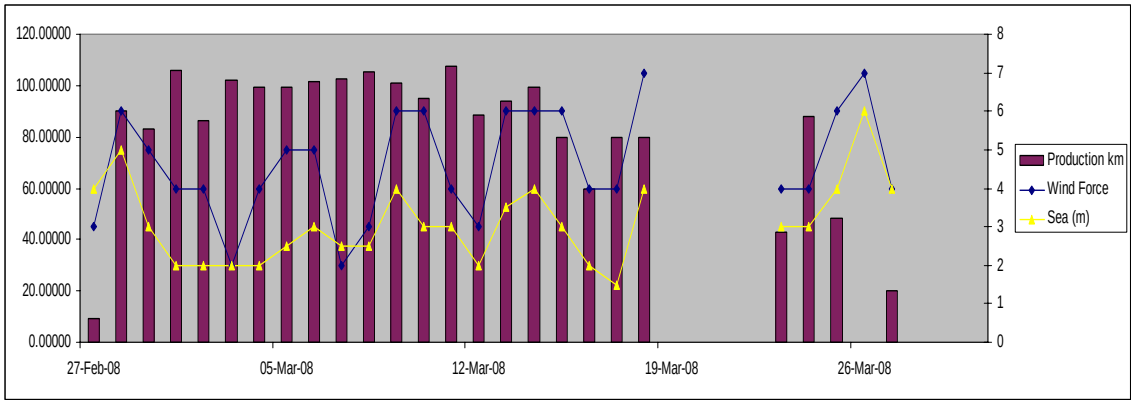
01/03/2008	105.918750	74.025000	12.000000	16.893750	3.000000	4	Moderate	In production: Sequence.011, 012, 013, 014, 015, 016.
02/03/2008	86.606250	74.418750	12.187500	0.000000	0.000000	4	Slight	In production: Sequence.016, 017, 018, 019, 020, 021. A few fishing vessels in the area are waiting to fish on the 200m contour SE corner of the prospect, in order to clear the area quicker have now moved to the eastern edge of the swath and work west.
03/03/2008	102.262500	84.468750	17.793750	0.000000	0.000000	2	Slight	In production: Sequence 021, 022, 023, 024, 025, 026.
04/03/2008	99.468750	67.575000	12.000000	16.893750	3.000000	4	Moderate	In production: Sequence.027, 028, 029, 030, 031.
05/03/2008	99.468750	84.468750	15.000000	0.000000	0.000000	5	Rough	In production: Sequence 032, 033, 034, 035, 036. PACIFIC CREST departed for Melbourne to pick up supplies.
06/03/2008	101.793750	69.900000	12.000000	16.893750	3.000000	5	Rough	In production: Sequence.037, 038, 039, 040, 041, 042. PACIFIC CREST off prospect at Melbourne dock for supplies.
07/03/2008	102.412500	65.250000	12.000000	22.162500	3.000000	2	Rough	In production: Sequence 042, 043, 044, 045, 046, 047. PACIFIC CREST back on location, WB out to transfer provisions with the crest.
08/03/2008	105.581250	67.575000	12.000000	23.006250	3.000000	2	Rough	In production: Sequence.047, 048, 049, 050, 051, 052. WB out for pinger change and front end inspection.
09/03/2008	101.043750	46.743750	6.000000	39.300000	9.000000	5	Rough	In production: Sequence.052, 053, 054, 055, 056, 057. First Swath now complete bar a couple of small infills.
10/03/2008	94.987500	46.200000	9.000000	33.787500	6.000000	4	Rough	In production: Sequence.057, 058, 059, 060, 061, 062. Completed last small infill pieces, first swath now complete.
11/03/2008	107.343750	92.343750	15.000000	0.000000	0.000000	4	Rough	In production,: Sequence.062, 063, 064, 065, 066, 067. WB out for bird and pinger change.
12/03/2008	88.500000	56.606250	12.000000	16.893750	3.000000	3	Moderate	In production: Sequence.067, 068, 069, 070, 071, 072. WB out for bird and pinger change. End of day circling on Sequence 72 aborted d/t Autofiring gun.

13/03/2008	94.087500	79.087500	15.000000	0.000000	0.000000	6	Rough	In production: Sequence.073, 074, 075, 076, 077. Start of day circling on seq. 72 d/t Autofiring gun.
14/03/2008	99.450000	84.450000	15.000000	0.000000	0.000000	6	Rough	In production: Sequence 078, 079, 080, 081, 082.
15/03/2008	79.575000	67.575000	12.000000	0.000000	0.000000	6	Rough	In production: Sequence 083, 084, 085, 086(EDITS NTRS/SYNC problems str5). NTRS streamer interface failed during the line change early evening, failed to see first two streamers (suspected software problem). Switched to the spare NTRS PC but difficulties configuring the system. Still configuring into next day.
16/03/2008	59.625000	33.787500	6.000000	16.893750	2.943750	4	Moderate	In production, Sequence.08 7(NTBP-NTRS), 088, 089,090. Start of day continued with spare NTRS installation and configuration. Sequence 87 acquired but still communication problems with the other systems, no header data received or written to tape, line NTBP. Eventually spare NTRS PC was correctly configured and installed in the following line change. Original NTRS system failure was down to corrupted NTRS system files, the same files were originally used to configure the spare system and hence the subsequent problems trying to configure the spare NTRS software, the software had to then be configured from scratch.
17/03/2008	79.556250	67.556250	12.000000	0.000000	0.000000	4	Moderate	In production: Sequence 091, 092, 093, 094, 095 (Reshoot Edits on Sequencec93),096 (Reshoot Edits on Sequence.86). Two reshoots d/t streamer 5 telemetry errors. WB launched to replace module 34/35 streamer 5 to fix telemetry errors.
18/03/2008	79.575000	67.575000	12.000000	0.000000	0.000000	7	Very Rough	In production: Sequence.097 (Reshoot-Edits on Sequence 86), 098, 099, 100. Start of day continuing reshoot d/t sync errors str5. In the evening commenced recovering streamers for port call Melbourne, (bunkers, supplies and crew change). Started recovery earlier than anticipated d/t weather conditions, having to retrieve gear heading SW away from Melbourne.

19/03/2008	0.000000	0.000000	0.000000	0.000000	0.000000	4	Rough	Start of day recovering streamers for port call Melbourne, all gear onboard @ 09:25. Transit to Melbourne, PACIFIC CREST following, arrive pilot station 21:30, pilot onboard shortly after, continued transit to Melbourne dock.
20/03/2008	0.000000	0.000000	0.000000	0.000000	0.000000	6	Very Rough	In port for crew change and refuelling. Received 700 cubic meters of MGO, 2 barges and 7 trucks. SEALINK engineer onboard to work on Norsat problems.
21/03/2008	0.000000	0.000000	0.000000	0.000000	0.000000	4	Moderate	09:15 departed Melbourne. 14:00 Pilot disembarked. 16:26 carried out Nortek ADP calibration. 18:26 started deployment. 4.4Km and 4.1 Km of streamers 1 and 6 deployed at midnight.
22/03/2008	0.000000	0.000000	0.000000	0.000000	0.000000	4	Slight	Deploying streamers throughout the day. Streamers 1, 2, 3, 5, & 6 fully out at end of the day. 1km of streamer 4 out.
23/03/2008	42.731250	19.837500	3.000000	16.893750	3.000000	4	Slight	Started production: Sequence 101, 102, 103. PACIFIC CREST arrived on prospect at 08:45, the Edward J. Farnie later in the afternoon.
24/03/2008	88.068750	59.175000	9.000000	16.893750	3.000000	4	Slight	In production: Sequence. 104, 105, 106, 107. Mechanical downtime due to airleak on approach to SOL.
25/03/2008	48.243750	39.243750	9.000000	0.000000	0.000000	6	Moderate	Started the day in production but shut down for weather in the evening. Production: Sequence 108, 109, 110. Sequence scratched for weather, 111. Weather at end of day NW F7/8 Seas 7.
26/03/2008	0.000000	0.000000	0.000000	0.000000	0.000000	7	Very Rough	Down for weather. Headed SW into seas until evening when conditions improved and we made a port turn back towards the work area. Streamer 6 came to the surface several times on the way back in strong following seas. 00:00 - 07:01 To be charged to Santos. 07:01 - 24:00 To be charged to shared account.

27/03/2008	19.893750	0.000000	0.000000	16.893750	3.000000	4	Moderate	Last sequence, 112. **SURVEY COMPLETE.** Workboat operation aborted due to streamer lift arm breaking. Start transit to 2007113, Strahan 3D in block T/36P.
28/03/2008	0.000000	0.000000	0.000000	0.000000	0.000000	4	Moderate	Inter survey transit, to be charged to shared partners. Workboat operation again aborted due to streamer lift arm breaking. Workboat launched again in afternoon but operation aborted before work complete as it was decided to recover all equipment due to poor forecast. Recovering streamers at midnight.

2.2 Daily production and sea state



2.3 Post plotted vessel positions

3 Key personnel

	25th February 2008 to 20th March 2008	20th March 2008 to 28th March 2008
Party Chief	Neil Jackson	Mike Moran
Chief observer	Errol Wright	Mike Coble
Chief navigator	Pete Jenkins	Nikolai Gritsenko
Chief mechanic	Kenny Brock	Larry Granzin
Chief geophysicist	Colin Hughes	Rune Strømme
Client representative onboard	Russell Stanley	Alex White
	Diane Osborne	Ray Doughty
Client contacts onshore	Andrew White	Andrew White

4 HSE

4.1 Statistics

Total Man Hours (uncorrected)	42624
Correction Ratio	0.98
Survey Hours	822.72
Hours in Calculation (# daily Conds. * 24)	840.00
Total Man Hours (corrected)	41,746.99
Small Boat Launches	11
Small Boat Exposure (man hours)	35.75
Incident Reports	1
Toolbox Meetings	12
Drills	6
Helicopter Ops	0
Helicopter Exposure (man hours)	0.00
MMO Sightings	0
MMO where action reqd.	0

4.2 Incidents

Focus Report Number	Marine Report	Seismic Report	Action by	Event Date	Event	Result
2456/08/MA	X		TMS	16-Mar-08	Personnel: Superficial burn from boiling water	FAC
2854/08/MA	X		PGS	27-Mar-08	Equipment: Workboat streamer lift arm broke	Loss minor

5 Survey operations review

5.1 Survey area information

Oilfield installations

There were no oilfield installations or activity in the area.

Oilfield activity

See above.

Shipping Activity

There was no shipping activity, other than transiting fishing vessels, in or near the survey area.

Sea Conditions, Tides and Currents

The sea conditions were good for most of the time, with winds mainly from SE to NE, for the majority of the time around force 4 to 5. For some periods the predominant swell from the south west would increase and necessitate lowering the streamer depth either to 8m or 9m. Tides and currents were weak in the area and not much infill was generated due to feather miss-matches.

In Sea Dangers

No specific in-sea dangers were identified other than the ambient temperature (~17°C) which required small boat crew to don survival suits before taking part in any in-sea operations.

Time sharing

One 2D seismic survey was conducted approximately 100km to the south of the prospect, there was no interference experienced.

Fishing Activity

Fishing activity was concentrated around the 200m contour crossing the south western edge of the prospect. At no time did the activity delay production but the operation had to be altered at times to accommodate their activities.

Weather

69.92 hours of time was lost to weather which equates to 8.5% of the time on the survey. The weather had been predicted to be worse than experienced.

The predominant swell was from the south west varying from 2 to 4 metres. This did limit the use of the workboat for some periods during the survey.

Cetaceans

A dedicated marine mammal observer (MMO) was present throughout the survey, there were no sightings recorded.

Naval Activity Including Civil Unrest

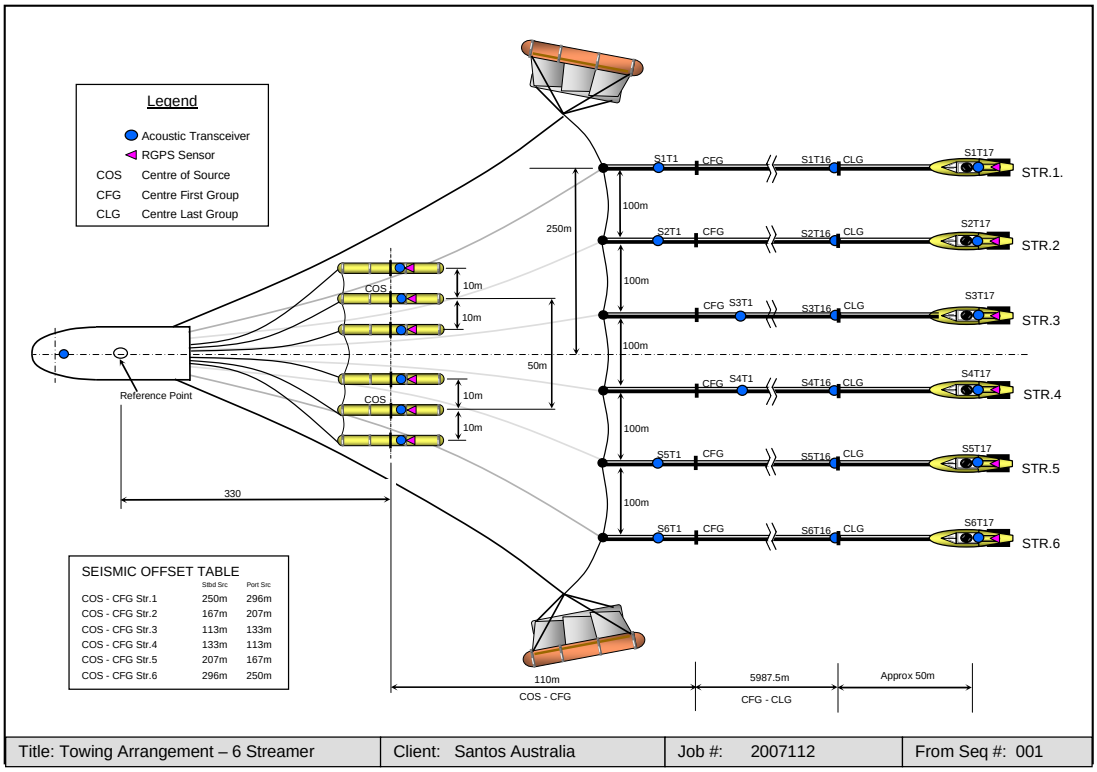
There were no naval activities during the survey.

6 Seismic energy source

6.1 Source details

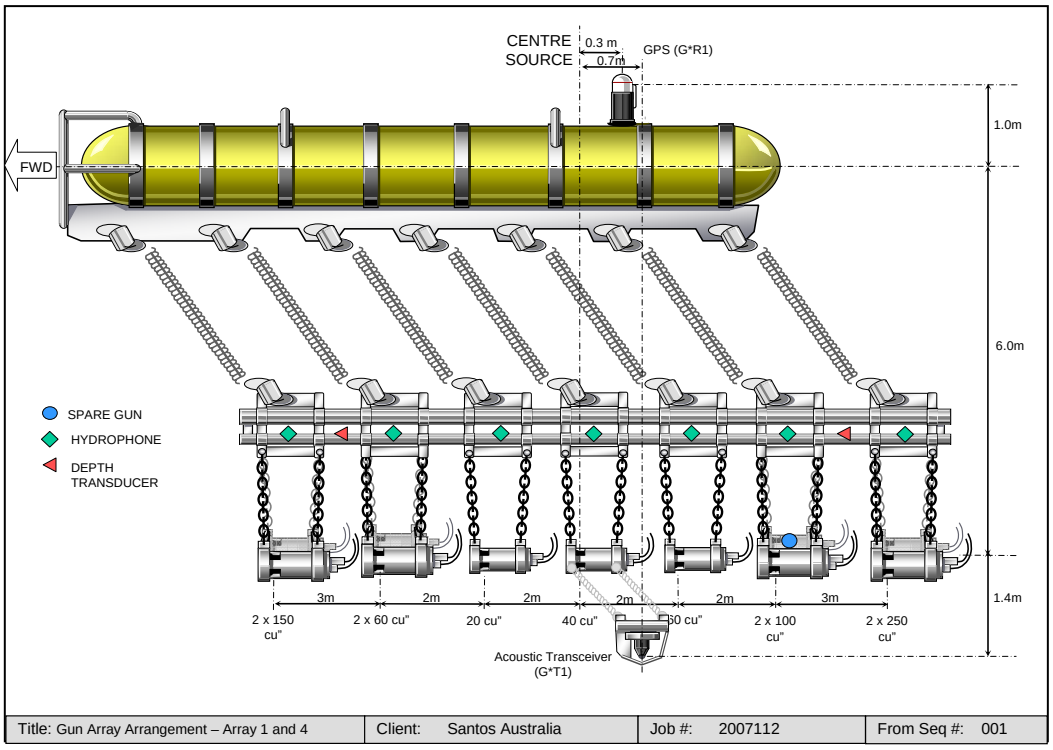
Source type	:	Bolt 1900 LLXT air guns
Air pressure	:	2000 psi
Volume	:	3090 in^3
Number of sources	:	2
Number of sub-arrays	:	6 (2x3)
Source separation	:	50 m
Sub-array separation	:	10 m
Source length	:	14 m
Gun synchronisation	:	± 1.0 ms
Drop-out specification	:	5 %
Shot interval	:	18.75 m
Depth	:	6 +/-1 m
Depth control	:	Fixed depth ropes
Depth monitoring	:	AGG depth transducers, GCS-90
Spacing control	:	Spread-ropes on sliding collars
Near field signatures	:	7 phones per subarray
Compressors	:	4 x Chirco
Source controller	:	GCS-90
Modelled source signature	:	See Appendix section 12.2

6.2 Offset diagram

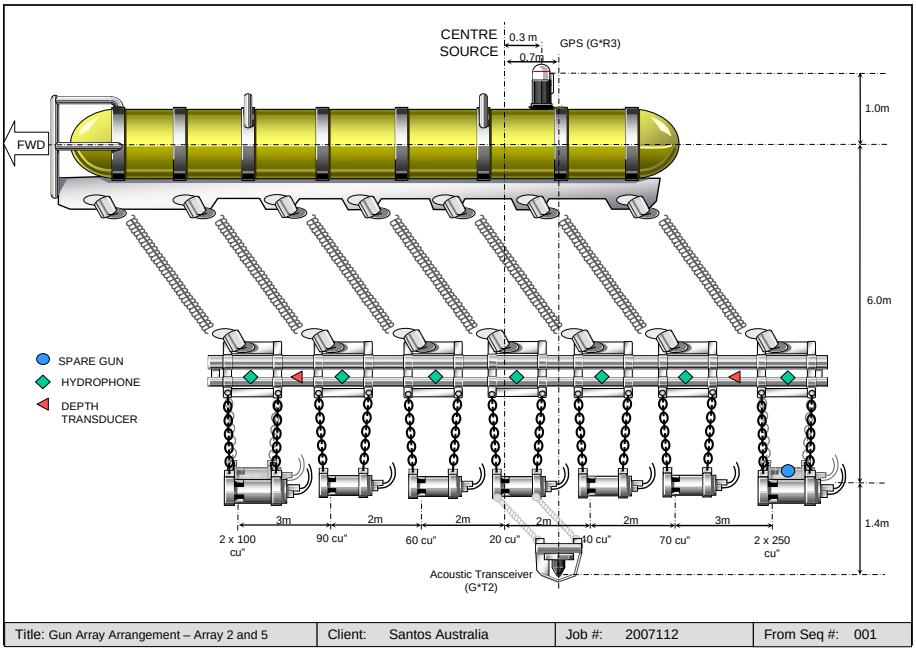


6.3 Gun array layout

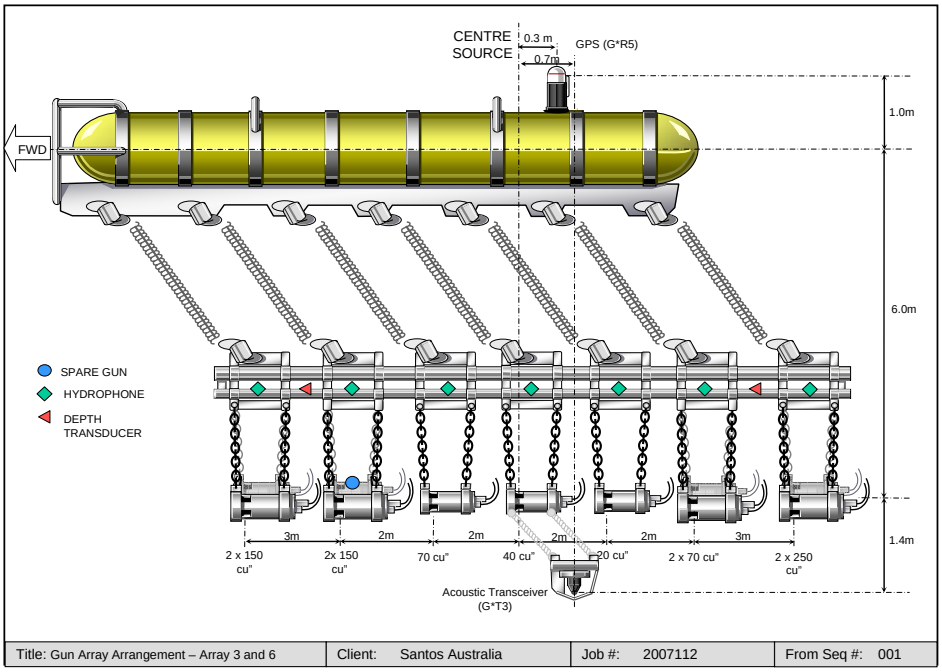
Array #1 & 4



Array #2 & 5



Array #3 & 6

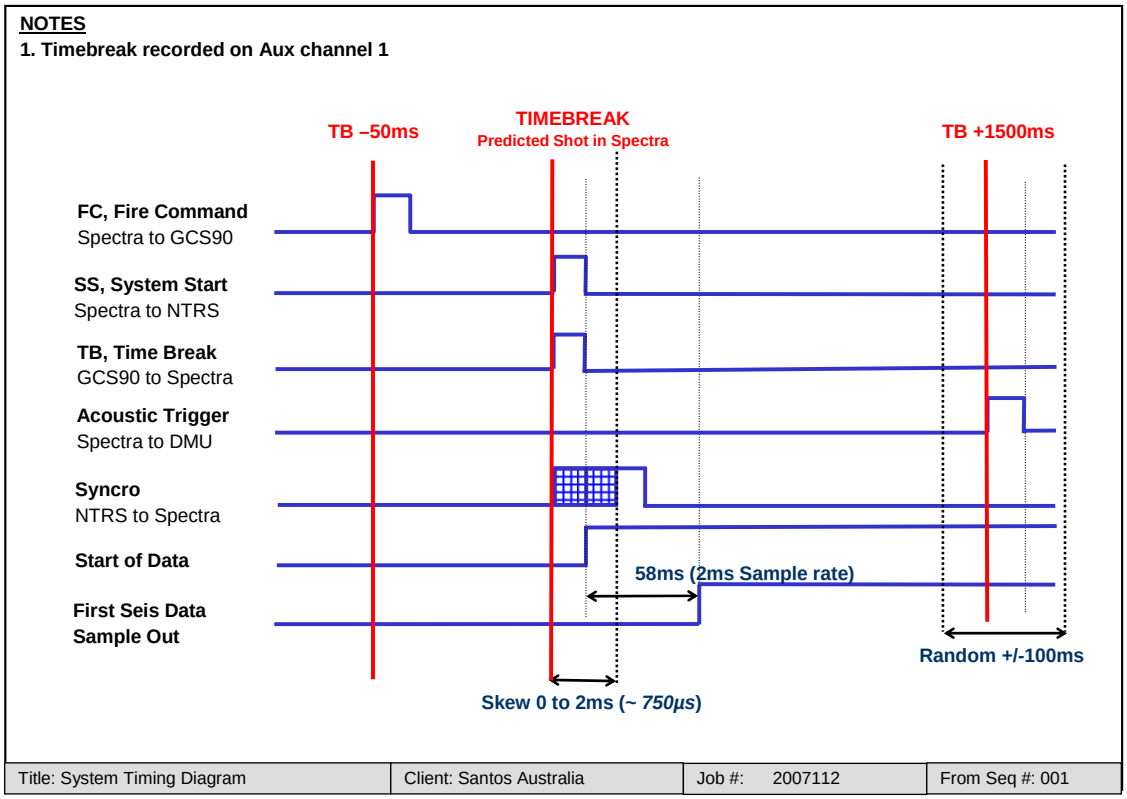


7 Seismic acquisition system

7.1 System details

Recording System	:	NTRS / gAS
Software Version	:	Version A.70a build 10581
Amplitude resolution	:	24 bit
Data Channels	:	6 x 480 = 2880
Auxiliary Channels	:	48 channels recorded to tape
Tape Transports	:	4 x IBM 3592 cartridge drives
Tape Format	:	8036 SEG D,
Recording Media	:	IBM 3592
Record Length	:	6144 ms
Deep water delay	:	0 ms
Sample Rate	:	2 ms
High Cut Filter	:	206 Hz /215. 20dB/octave
Low Cut Filter	:	4.60 Hz /6.00dB/octave
Gain Setting	:	12 dB
Polarity Convention	:	SEG, positive pressure gives negative number
SEG-D header description	:	see Appendix section 12.3

7.2 System timing



7.3 Streamers

7.3.1 Streamer details

Type of streamer	:	Teledyne RDH-S
Number of streamers	:	6
Streamer sensitivity	:	20 V/bar
Streamer length	:	6000m
Number of groups	:	6 per section
Group interval	:	12.5 m
Group length	:	12.5 m
Hydrophone type	:	T-2
Streamer depth control	:	Digibird 5011
Streamer depth	:	7m
Number of compass-birds	:	23/streamer (extra bird for outer streamers to compensate for door wash)

7.3.2 Trace Numbering

STREAMER	TRACE
Streamer 1	1 to 480
Streamer 2	481 to 960
Streamer 3	961 to 1440
Streamer 4	1441 to 1920
Streamer 5	1921 to 2400
Streamer 6	2101 to 2880
Auxiliaries	1 to 48

7.3.3 Component dimensions

	NUMBER per STREAMER	NOMINAL LENGTH (m)
Lead-in	1	700
Mini Lead-in Boot	1	3.5
Head Conventional Boot	1	2.7
Head AP Stretch Section	1	5
Head Dead section	1	15
Hydroscience Module	41	0.350
Live Sections	80	75
Tail Stretch Sections	1	50
Power Adapter Tail Swivel	1	0.340

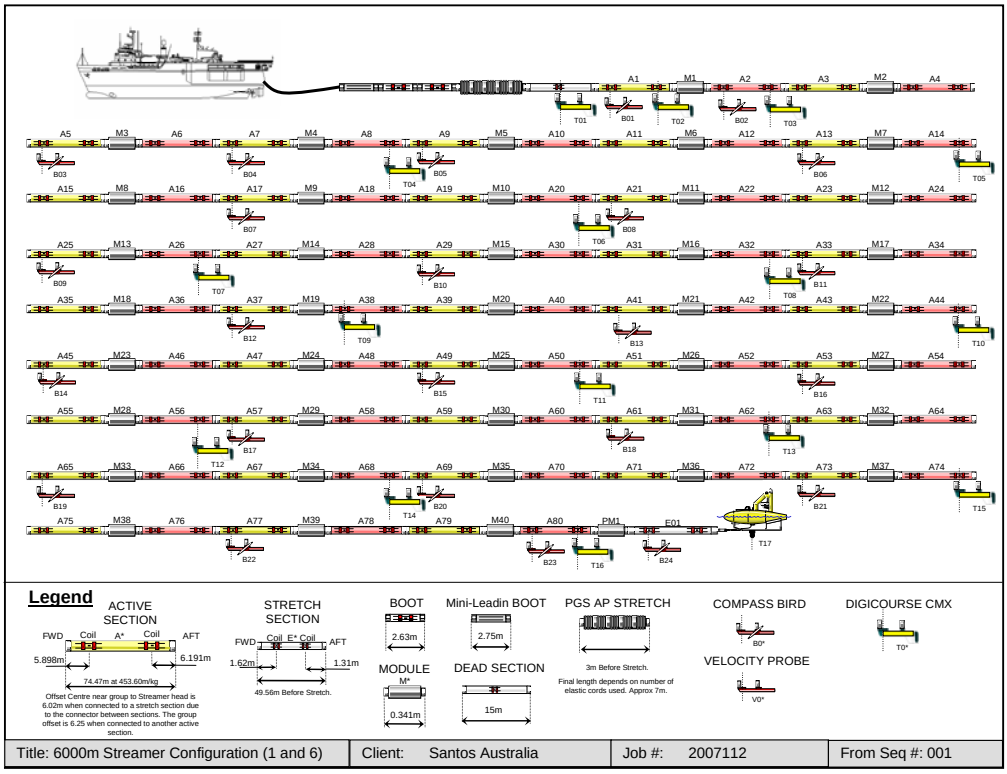
7.4 Recording System

7.4.1 Recording System performance

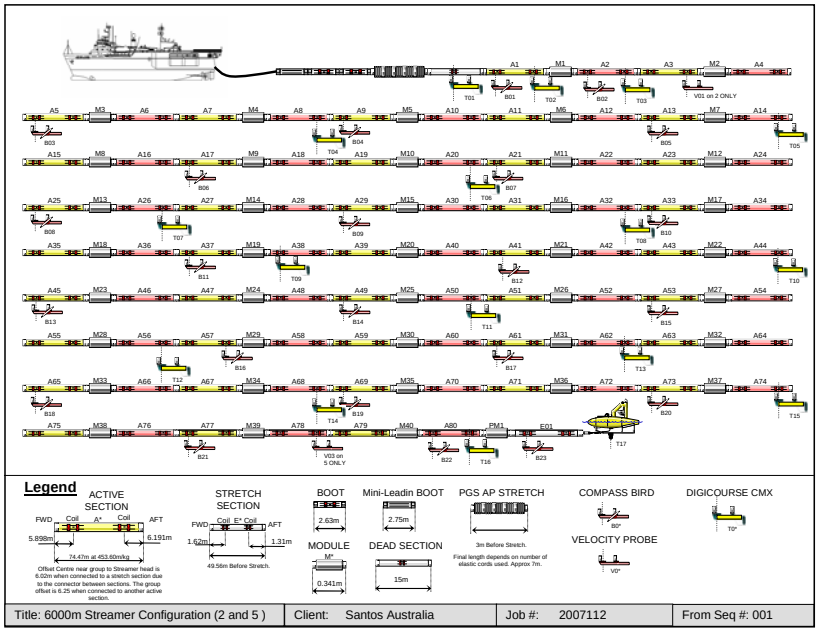
The NTRS and gAS systems performed well throughout the job.

7.5 Streamer layout

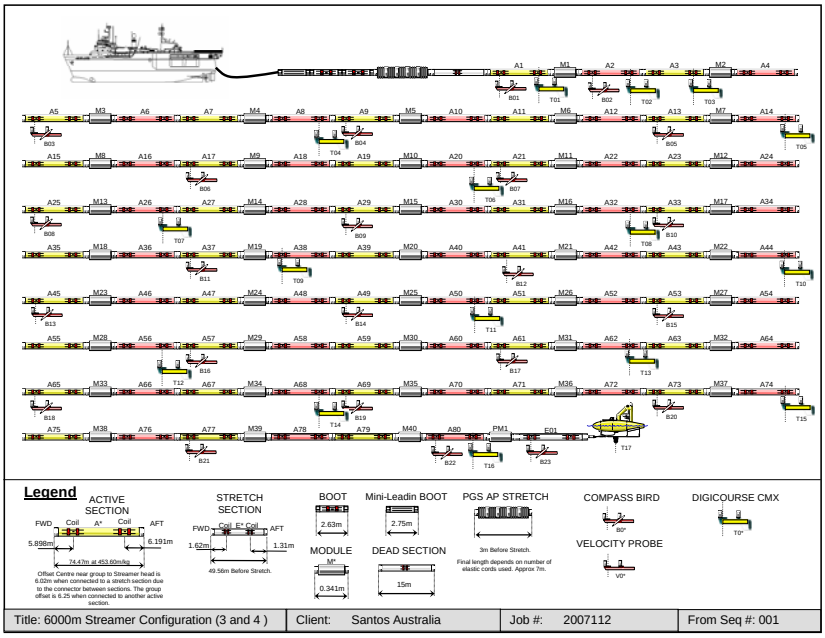
Streamer #1 & 6



Streamer #2 & 5



Streamer #3 & 4



8 Navigation and Positioning

8.1 Geodetic reference

8.1.1 Survey Datum

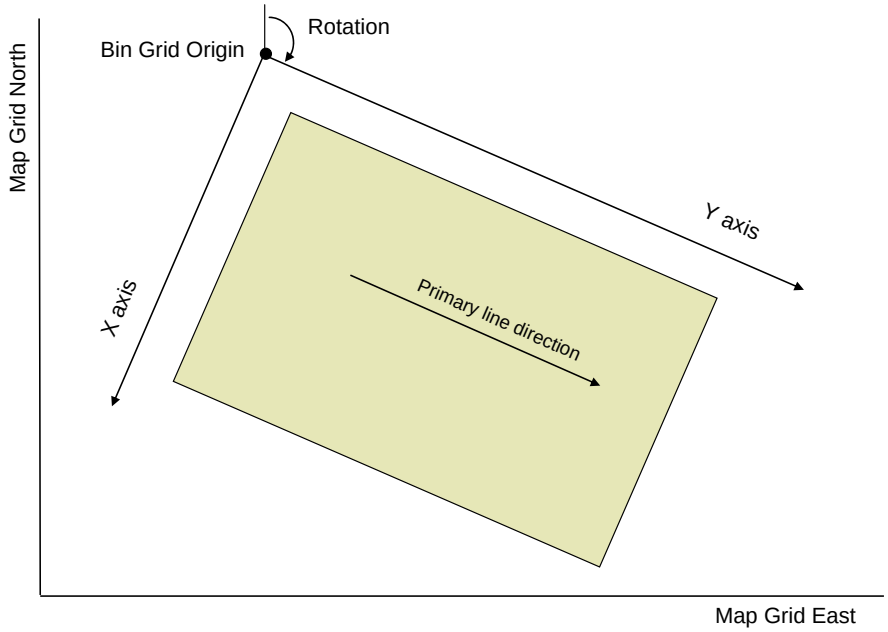
Survey Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis	:	6378137 m
1/Flattening	:	298.257223563
GPS Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis	:	6378137 m
1/Flattening	:	298.257223563

Geoid height EGM90 model : -6.7m
(calculated for centre of survey position 39º58'38.3''S 143º05'19.0''E)

8.1.2 Map projection

Projection	:	Universal Transverse Mercator
Projection System	:	UTM
Zone	:	54 (South)
Central Meridian	:	141° East
Scale Factor on Central Meridian	:	0.9996
Latitude of Origin	:	0º
False Northing	:	10,000,000 m
False Easting	:	500,000 m

8.1.3 Binning grid



Origin Easting (m)	:	682,357.41
Origin Northing (m)	:	5,590,692.37
Rotation (deg)	:	143.87°

	X	Y
Origin bin number	981	801
Bin number increment	1	0.33
Area size (m)	27675	24375
Bin interval (m)	25	6.25
Bin size minimum (m) at 100 m offset	50	6.25
Bin size maximum (m) at 6100 m offset	75	6.25

To assist the real time acquisition, guidelines were set for the required fold and the permissible number of adjacent columns that failed to meet this level, which should provide the requisite coverage essential for this survey.

For steering the spread during acquisition:

	% Nominal Fold	Nominal Fold	Required Fold	Max nominal missing cols
For near offset segment (100 m to 1600 m)	70	20	14	2
For near-mid offset segment (1600 m to 3100 m)	80	20	16	1
For far-mid offset segment (3100 m to 4600 m)	70	20	14	2
For Far offset segment (4600 m to 6100 m)	65	20	13	3

For analysis of the coverage from the final navigation data, linearly tapered flex displays were produced to determine where additional infill may be necessary.

For INFILL ALLOCATION:

	% Nominal Fold	Nominal Fold	Required Fold	Flex applied Beg / End
For near offset segment (100 m to 1600 m)	75	20	15	100% /125%
For near-mid offset segment (1600 m to 3100 m)	85	20	17	125% /150%
For far-mid offset segment (3100 m to 4600 m)	75	20	15	150% /175%
For Far offset segment (4600 m to 6100 m)	65	20	13	175% /200%

P6/98 Full fold coverage perimeter listing : see Appendix section 12.5

8.2 Surface positioning

8.2.1 System I

Type	:	SkyFix.XP, SDGPS Orbit and Clock Corrected
System Corrections via	:	Inmarsat (POR) and AP-SAT High Power Spot
Software	:	Multifix 4, version 2.01
Sub-Contractor	:	Fugro A/S
GPS Receiver	:	SPM 2000 TopCon

The SkyFix.XP service uses a technique called Satellite Differential GPS (SDGPS); a worldwide network of reference stations is used to calculate, in real time, the orbital information (ephemeris) of each GPS satellite with more precision than that transmitted by the satellite. Corrections to the broadcast ephemeris are then uploaded to the user via the existing SkyFix/StarFix satellite communication infrastructure.

8.2.2 System II

Type	:	StarFix.HP, DGPS	
Differential Corrections via	:	Inmarsat (POR) and AP-SAT High Power Spot	
Reference Stations in use	:	Melbourne	290 km distant
		Bathurst	930 km distant
		Cobar	975 km distant
		Ceduna	1215 km distant
Software	:	SPM 2000, version 4.26	
Sub-Contractor	:	Fugro A/S	
GPS Receiver	:	SPM 2000 TopCon	

The StarFix.HP service provides centimetre-level accuracy by measuring the carrier-phase differences on both GPS signal frequencies (L1 and L2) to more accurately model the state of the ionosphere, minimising errors associated with the transmission path between the satellite and the receiver. As with standard Differential GPS networks, corrections are derived by a network of reference stations located within the geographical area of operations and transmitted to the user via geostationary satellite links to provide coverage over wide areas

8.2.3 Float positioning

Relative GPS	:	Seatex models 320 & 220
GPS receiver	:	Ashtech G 12-L
UHF communication	:	Wood & Douglas, frequency 450-470 MHz
Software version	:	StarFix Suite RGPS v3.02.04

The relative GPS system works through using the pseudo-range phase differencing technique to provide the true range and bearing from the master antenna on the vessel to the GPS receivers on the in-sea equipment.

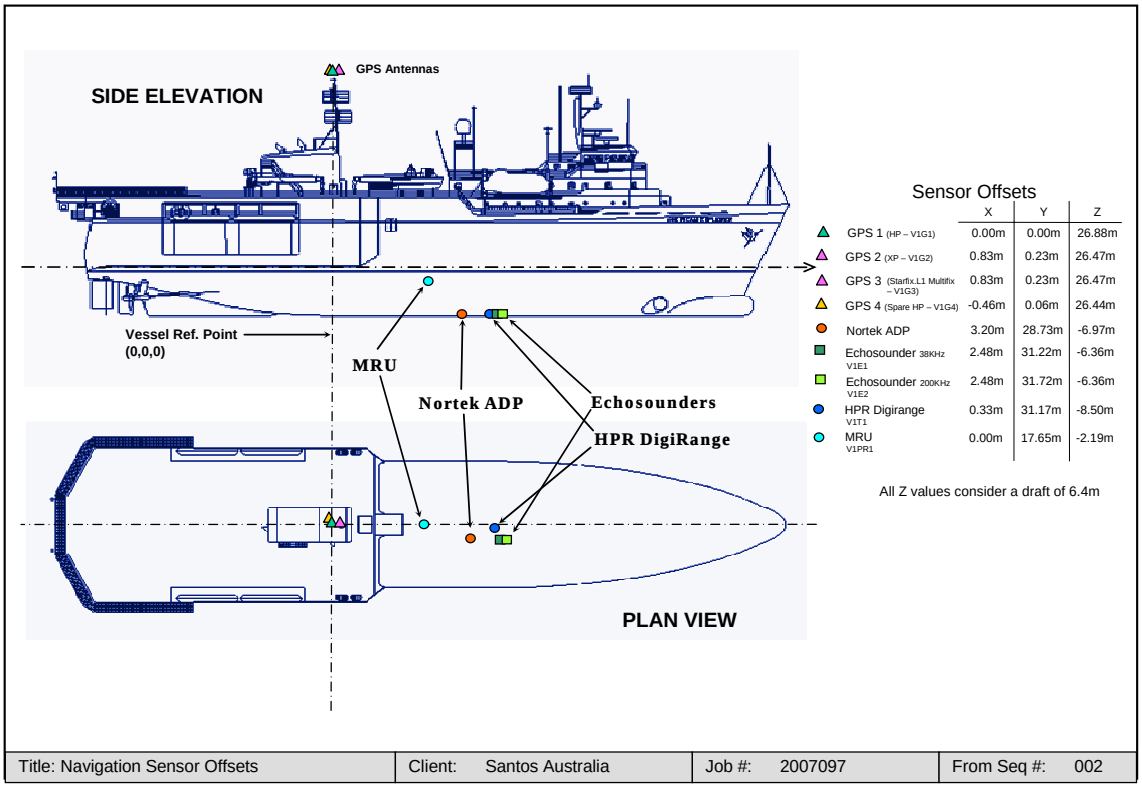
8.2.4 Heading reference

GPS Heading / Attitude system	:	Seapath 200
Gyro	:	SG Brown 1000S Gyro Compass

The Seapath 200 is an integrated GPS/Inertial attitude and positioning system. It is comprised of dual GPS antennae determining heading and position using carrier phase measurement. Inertial data from the Motion Reference Unit provides acceleration and angular information about three axes. Static speed and latitude corrections were applied to the gyrocompass via the internal controls and not automatically from the navigation system.

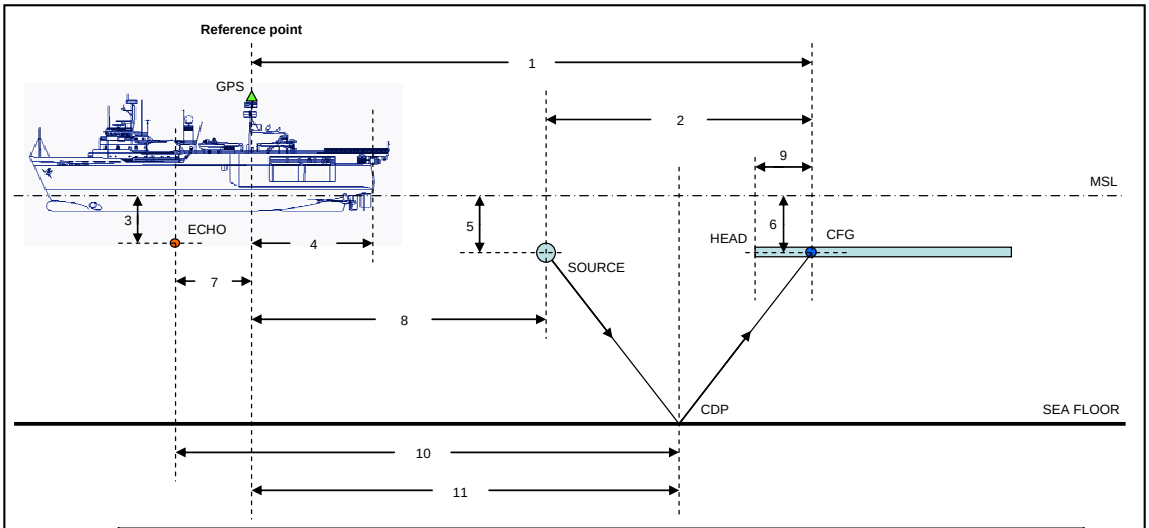
The Seapath 200 was used as main heading reference throughout the survey.

8.2.5 Navigation Sensor Offsets



Title: Navigation Sensor Offsets	Client: Santos Australia	Job #: 2007097	From Seq #: 002

8.2.6 Navigation Offsets



Key	Range	Distance (m)	Key	Range	Distance (m)
1	Streamer inline offset	435	7	Echo-sounder inline offset	31.47
2	Seismic offset	105	8	Source inline offset	330
	Nominal seismic offset input SCN / Census	*100*	9	Streamer head to Centre first group	6.25
3	Echo-sounder depth	6.36	10	Echo-sounder to CDP	413.97
4	Reference to Stern	32	11	Layback	382.5
5	Source depth	6		*Nominal layback input SCN*	*380*
6	Streamer depth	7			

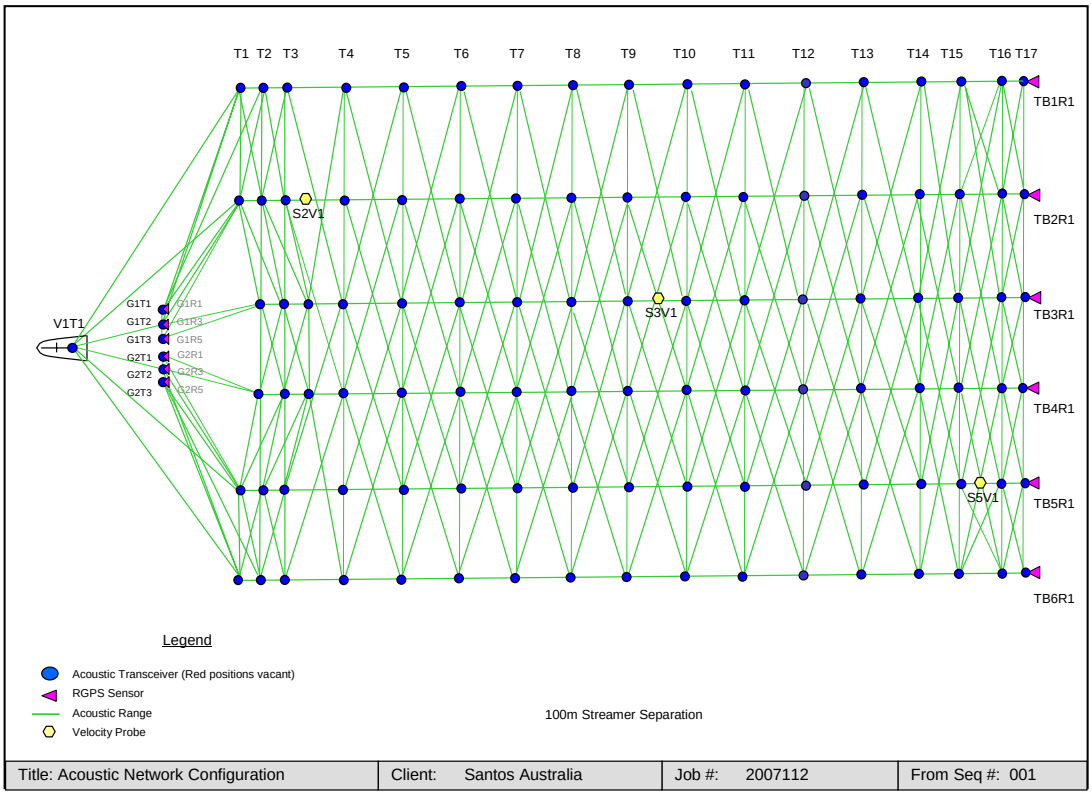
Title: Side View Offsets	Client: Santos Australia	Job #: 2007097	From Seq #: 002

8.3 Underwater positioning

8.3.1 Acoustic ranging system

System name	:	DigiRANGE
Software version	:	System 3, version 6.01
Operating frequency	:	50 – 100 kHz in 5 discrete frequencies

8.3.2 Acoustic network



8.3.3 Magnetic compasses

Bird Compasses	:	DigiCOURSE 5011 Compass/Bird
Software version	:	System 3, version 6.01
Compass Filtering	:	2s Sample rate, 14s filtering time
Magnetic variation	:	11.5°

This value was derived using the IGRF 2005 model for 1st March 2008 at the survey centre position.

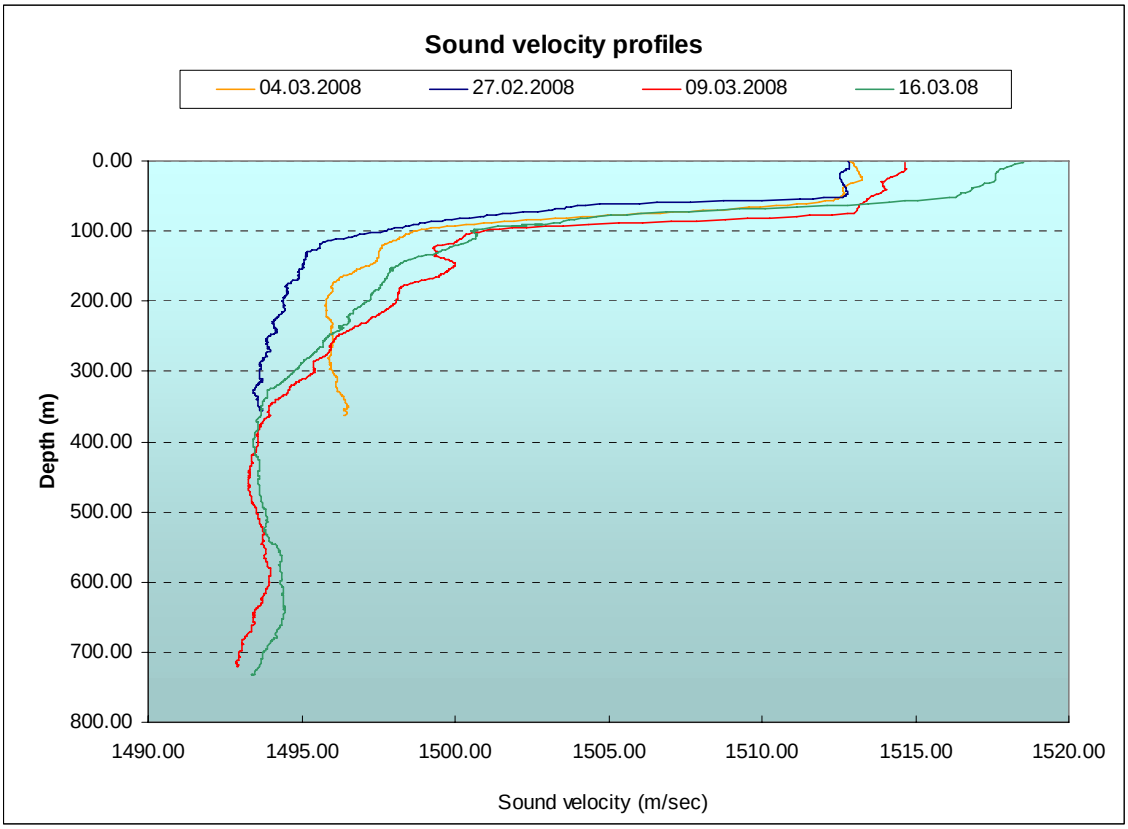
8.3.4 Echosounder

Type and model	:	Simrad EA500
Transceiver frequencies	:	38 kHz, 200 kHz
Heave compensated	:	Yes
Pitch & Roll corrected	:	No

8.3.5 Sound velocity

CTD probe	:	Model 600 CTD (1000μbar)
Serial	:	13829
Calibration Date	:	15th March 2007
Supplier	:	Valeport
Real time sensors	:	DigiCOURSE model 7000 (Velocimeter)
Software version	:	System 3, version 6.01

The following chart shows the results produced with data from the Valeport probe. A total of four profiles were collected during the course of the survey.



8.4 Navigation and binning systems

8.4.1 Integrated navigation system

Type	:	SPECTRA
Operating System	:	Linux Redhat 9
Supplier	:	Concept Systems Ltd.
Software version	:	10.09.01
Real Time Interface	:	PowerRTNU version 4.4.2
Machine type	:	2 x IBM X325 Servers 2 x IBM Intellistation
Tape storage	:	IBM 3590 / DAT
Disk Storage per Server	:	240GB
Disk Storage per Workstation	:	35GB
Disk storage device	:	RAID

8.4.2 Binning system

Type	:	Census
Supplier	:	Input / Output Systems
Software Version	:	4.4.1
Machine type	:	IBM RS6000 model 44P
Operating System	:	IBM AIX 4.3.3
Tape storage	:	IBM 3590
Hard Disk storage	:	75GB online, 75GB offline

8.5 Navigation System Performance

8.5.1 Vessel position

Two DGPS systems were operational for vessel positioning, SkyFix.XP and StarFix.HP. During the project, comparisons between the systems for the computed vessel position (Easting and Northing axis) indicated both systems performed well, with the mean difference less than 1.0 metre and the maximum difference less than 1.0 metres.

8.5.1.1 SkyFix.XP

The SkyFix.XP solution performed well for the entire survey with very few failures. When the system did fail to provide a converged solution the cause was determined to be firmware resets of the SPM2000 GPS receiver. The cause of the resets is part of an ongoing investigation by Fugro. Once the GPS position data string to the MultiFix software producing the XP solution fails it will cause the systems filtering algorithm to be reset. There is then a period when the solution will be rejected until the position re-converges.

8.5.1.2 StarFix.HP

The StarFix.HP solution also performed well for the survey period, with no problems. Even though the system has a similar SPM2000 to the SkyFix.XP there is still an ongoing investigation by Fugro into why some systems exhibit reset problems at times while others do not.

8.5.2 Acoustic ranges

Acoustic positioning for this survey was generally of good quality. A total of seventeen acoustic units were deployed per streamer creating a full acoustic network. Dynamic sound velocity was recorded using three individual velocity meters at the head, middle and at the tail of the network. The velocities recorded were used to calculate the acoustic ranges on a shot by shot basis and were used in the network adjustments of all the sequences.

The poorest performance was seen in the ranges between streamers 3 & 4 in the front net and ranges between vessel and guns, the areas directly affected by the prop wash and gun bubble, caused by its associated aerated water. This is traditionally a problem area and very difficult to improve upon.

Due to the full acoustic network the vessel was able to shoot through fairly poor weather conditions at times.

8.5.3 Compass Data

Twenty-four compasses were deployed on each of the outer streamers and twenty-three on each of the remaining inner streamers. The compass data was good throughout the survey. Compass data for all sequences were analysed for biases, stuck values and excessive noise with unacceptable compasses being rejected from the post-processing solution and physically replaced on the streamers when appropriate.

During the marginal weather conditions when the compass data did become unacceptably noisy with the streamers set at the contractual depth of 7m, number of lines was shot with the streamers at a depth of 8m or 9m. An assessment was made on the approach to each of these lines, based on Spectra's real-time unit variance and the expected weather conditions, as to the most suitable depth to use for the entirety of the line.

8.5.4 Remote Positioning

Positioning of the remote targets, 6 source arrays and 6 tail buoys, was very reliable. The units had all been recently used on the previous survey and continued to operate within the expected standards of accuracy.

8.5.5 Echo Sounder

The echo sounder data output in the final P1/90 depth records was derived from the 38 KHz transducer, which performed well throughout the survey. The raw data were not draft corrected but compensation for vessel heave, using data interfaced from the MRU, was applied. A fixed water velocity of 1500m/s was used internally by the echo sounder.

Final bathymetry data were produced after survey completion in the PGS Oslo office.

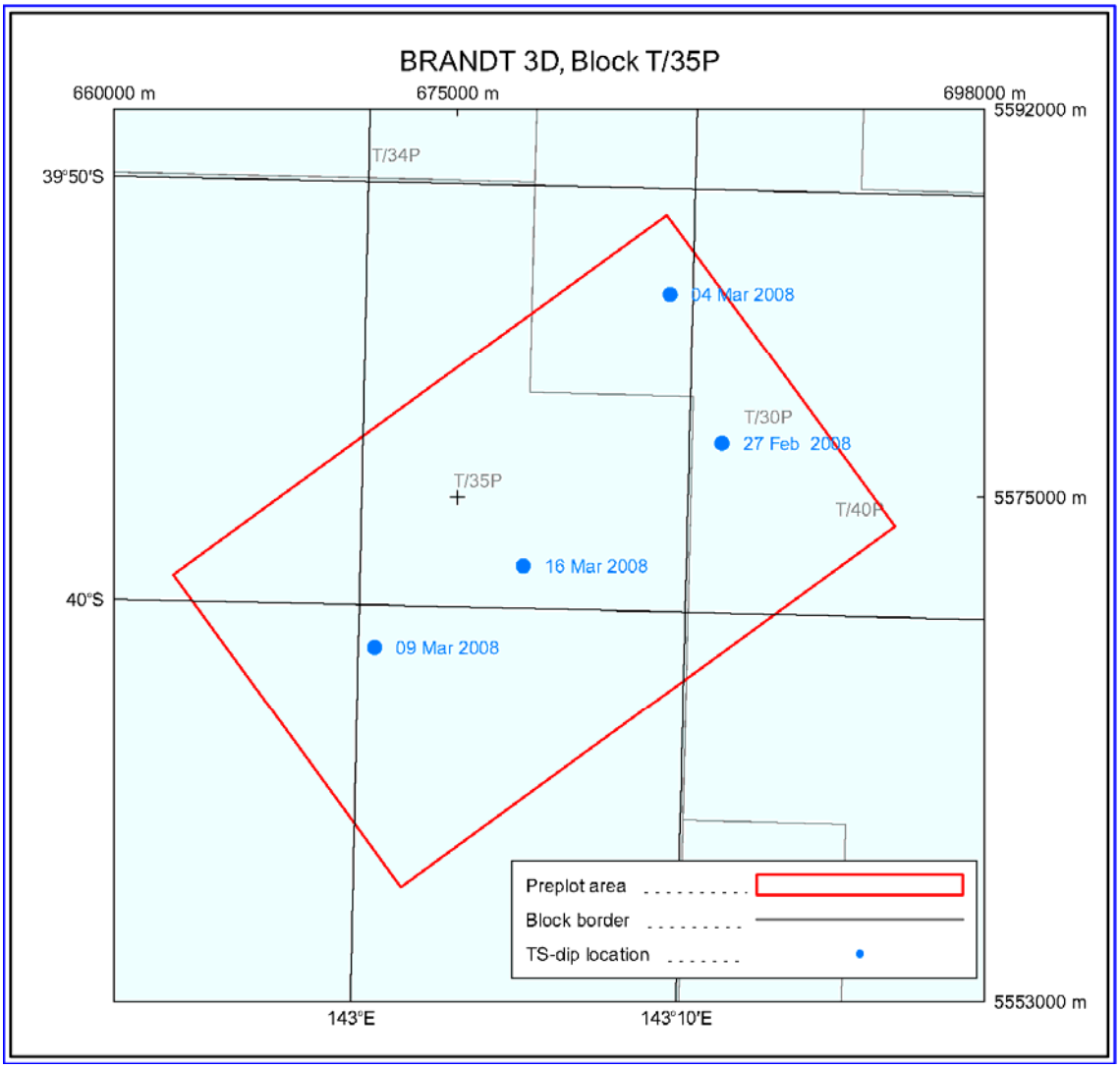
A special echo sounder tape was created, with depths corrected for draft, sound velocity and tide (MSL).

Draft corrections applied: 6.4m

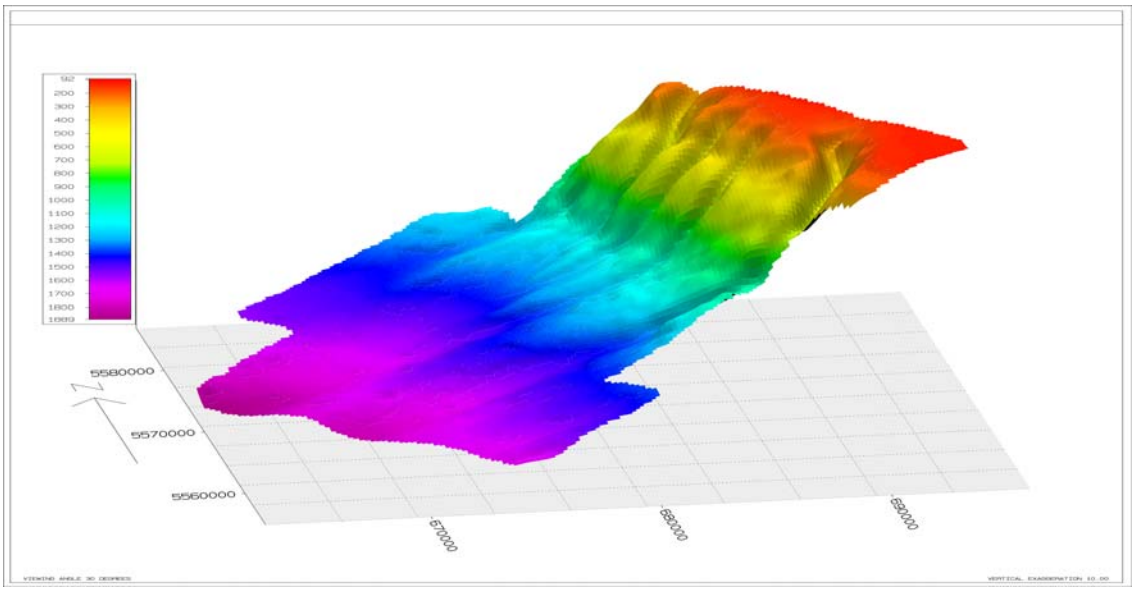
5 sound velocity profiles were collected in the area during the survey period. These were used to scale waterdepth values for sound velocity variations.

PROFILE #:	DATE	POSITION	
1	27.02.08	39°56S	143°11'E
2	04.03.08	39°52.5 S	143°09.3' E
3	09.03.08	40°01S	143°0.5' E
4	16.03.08	39°59S	143°5'E
5	24.03.08	NOT USED, NOT DEEP ENOUGH	

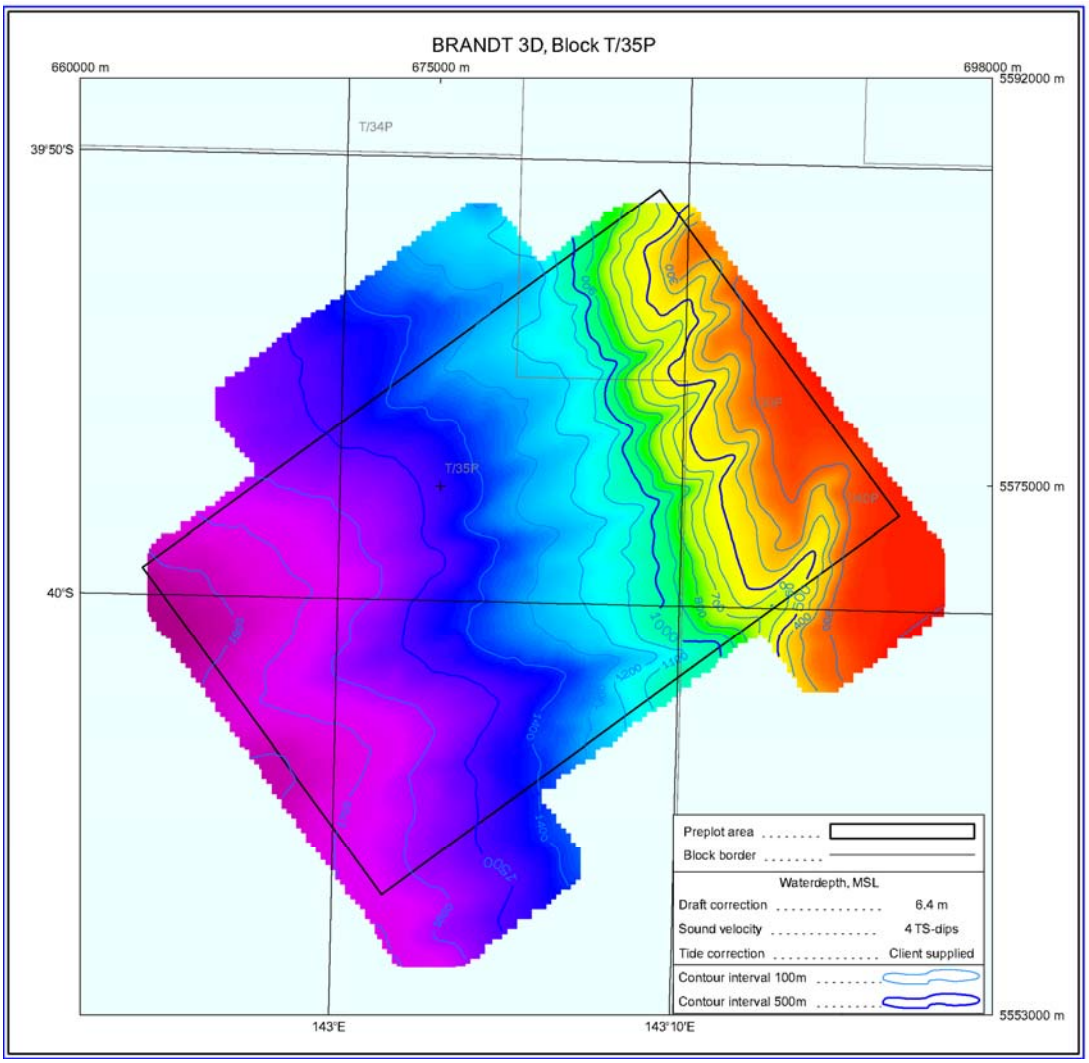
Tide corrections in MSL were supplied by the client, file name :BRANDT.txt
Location : 39°58'30"S 143 5°45E


BRANDT 3D, Block T/35P
660000 m
675000 m
698000 m
5592000 m
5575000 m
5553000 m
39°50'S
40°S
143°E
143°10'E
T/34P
T/30P
T/35P
T/40P
04 Mar 2008
27 Feb 2008
16 Mar 2008
09 Mar 2008
Preplot area
Block border
TS-dip location

TS-dips location



3D view of waterdepth



8.5.6 Heading Sensors

The Seapath system was used as the primary vessel-heading indicator for all sequences while the conventional SG Brown gyrocompass served as back-up and a redundancy check. Seapath performed without interruption and was used as the heading indicator for all sequences. The heading data was de-spiked to remove gross outliers, but not filtered.

8.6 Delivered P1/90 and P2/94

Raw navigation data were recorded in UKOOA P2/94 format during acquisition and verified for accuracy before a deliverable P2/94 dataset was produced. These datasets were recorded to 3590 tape cartridge. One set of P2/94 tapes client tapes was included with the seismic data delivered to the processing centre at CGG Veritas in Perth, one set included with the copy of the seismic data sent to the Santos Adelaide office, and a final set shipped to the PGS office in Lysaker for archiving. The format for these tapes is:

Data Format:	ASCII
Record Length:	80 bytes (no LF)
Tape Format:	dd, block size = 8000

Processed navigation data were delivered in UKOOA P1/90 format, recorded on 3590 tape cartridge. Each dataset included position records for vessel, sources, tail buoys, echo sounder, and all receiver groups.

One set of P1/90 tapes was included with the seismic data delivered to the processing centre at CGG Veritas in Perth, one set included with the copy of the seismic data sent to the Santos Adelaide office, and a final set shipped to the PGS office in Lysaker for archiving. The format for these tapes is:

Data Format:	ASCII
Record Length:	80 bytes (no LF)
Tape Format:	dd, block size = 8000

9 Navigation processing

9.1 Introduction

The final P190 was generated using either the NRT or SPRINT post processing systems. NRT is the SPECTRA near real time navigation processing module. The NRT system delivers a delayed position solution (P190) and associated quality assessment a few minutes after completion of the survey line. The delayed solution minimises the impact of latencies in certain observation streams and provides access to a portion of future data. This ensures that the NRT will provide a valid positioning solution significantly more often than is possible in the real-time solution. If manual processing were required, either due to NRT reported problems, abnormal QC statistical results, or observed situations on-line, the data was reprocessed using SPRINT.

9.2 NRT

The NRT is a separate licensed Spectra module. It gets the required information, data and from the Spectra Data-server and a NRT specific parameter file. The NRT data flow:

1. **NCN Calculated Positions**
   NRT uses the real time positions calculated by Spectra as the basis for gating outlying observations.
2. **Raw Sensor Data**
   Raw DGPS, RGPS, Acoustic, Compass, Velocimeter, Gyro, Echo sounder, Depth sensor data acquired by Spectra.
3. **Outlier Rejection**
   Based on the Spectra NCN calculated positions and observations, outliers in the raw sensor data (spikes and biases) are rejected. Note that this does not apply to compass observations, as these generally have low redundancy.
4. **30 Shot Filter Buffer**
   Raw observations (after outliers have been removed) are filtered to remove noise. Future data (60 shots) is used to improve the quality of filtering. Secondary spike rejection – based on time series – is applied to remove remaining spikes. This is particularly useful for compass observations.
5. **Compass Drift Detection**
   Temporary biases (drifts) in compasses are removed based on deviations from the smoothness of the streamers.
6. **Least Squares Adjustment**
   All filtered observations are used to update the positions in the network in a least squares adjustment. The weights of these observations are proportional to the quality of the data.
7. **Qualifier**
   An extensive set of checks is applied to the data and the solution. Which quality flag is assigned to the data is determined on the basis of the results of these checks.
8. **P1/90**
   The final positions are exported to a P1/90 file.
9. **QC End of Line Report**
   A QC report is created, containing the outcome from the main qualifier checks. A statistical report similar to the standard Sprint end of line report is also produced.

9.3 SPRINT

The SPRINT processing was comprised of the following steps:

- Data import
- Data pre-processing
- Network adjustments
- Data export
- Final quality control

Each of these steps is covered in more detail below.

9.3.1 Data import

Raw data were recorded to tape and disk in P2/94 format. After the end of the line these data were checked, and if necessary, corrections were made to the header to produce a final archived version. These data were then imported into Sprint, and a QC report generated. Included in this report were:

- P2/94 format errors or inconsistencies
- differences in configuration between successive files
- changes in gun sequence
- time between shots not within specified limit
- jump in shot numbers
- number of headers

9.3.2 Pre-processing

All data were pre-processed to ensure consistent results in the adjustment phase.

During pre-processing, observations were grouped by sensor type. Predefined spike rejection gates and noise suppression filters were applied to the raw data. Configuration files were used to save all gating and filter values. After analysis, the final values were applied in a batch mode.

Where circumstances dictated, the values were changed interactively before the data were batched.

After pre-processing of all the observations, a quality report was generated containing the following information:

Nobs	:	Number of raw observations.
Nrej	:	Number of data observations missing after processing.
Bad block	:	Maximum block of missing raw data (in seconds).
Nominal	:	Nominal values computed from the logged offsets, or user assigned.
Mean	:	Mean value of the observation.
Max. Delta	:	The maximum shot to shot increment.
Units	:	In which unit data is recorded.

9.3.3 Network adjustments

The network adjustment stage consisted of a least squares adjustment of the processed observations for each shot point. The software allows the observations to be treated as either a complete net, or a series of sub nets (e.g.: vessel antenna, front net, tail net, etc.). Sub nets were used for analysis of problem lines. A complete net was used for final adjustment after the individual sub nets were solved.

The streamer-shaping algorithm in use was an arc of curve fit through the pre-processed compasses. The streamer shape is adjusted through network computed node positions.

At the end of the net adjustment, a quality report was generated. Items included were:

- Network configuration
- Statistics on node co-variances
- All observations scale/correction/SD in use
- Statistics on node shot point intervals
- Statistics on observation residuals
- Statistics on network variance factor and degrees of freedom
- The error ellipse (semi-major axis/skew) of all defined nodes
- Streamer rotation

9.3.4 Data analysis

Data analysis were performed for all lines and allowed all data from the Ingres database to be displayed. There were two main uses for this facility. The first was to produce a standard set of QC plots for each line, and the second was to act as an investigation tool for problems seen at any stage of processing.

9.4 Data import

Raw data were recorded to tape and disk in P2/94 format. After the end of the line these data were checked, and if necessary, corrections were made to the header to produce a final archived version. These data were then imported into Sprint, and a QC report generated. Included in this report were:

- P2/94 format errors or inconsistencies
- differences in configuration between successive files
- changes in gun sequence
- time between shots not within specified limit
- jump in shot numbers
- number of headers

9.5 Pre-processing

All data were pre-processed to ensure consistent results in the adjustment phase.

During pre-processing, observations were grouped by sensor type. Predefined spike rejection gates and noise suppression filters were applied to the raw data. Configuration files were used to save all gating and filter values. After analysis, the final values were applied in a batch mode.

Where circumstances dictated, the values were changed interactively before the data were batched.

After pre-processing of all the observations, a quality report was generated containing the following information:

Nobs : Number of raw observations.
Nrej : Number of data observations missing after processing.
Bad block : Maximum block of missing raw data (in seconds).
Nominal : Nominal values computed from the logged offsets, or user assigned.
Mean : Mean value of the observation.
Max. Delta : The maximum shot to shot increment.
Units : In which unit data is recorded.

9.6 Network adjustments

The network adjustment stage consisted of a least squares adjustment of the processed observations for each shot point. The software allows the observations to be treated as either a complete net, or a series of sub nets (e.g.: vessel antenna, front net, tail net, etc.). Sub nets were used for analysis of problem lines. A complete net was used for final adjustment after the individual sub nets were solved.

The streamer-shaping algorithm in use was an arc of curve fit through the pre-processed compasses. The streamer shape is adjusted through network computed node positions.

At the end of the net adjustment, a quality report was generated. Items included were:

- Network configuration
- Statistics on node covariances
- All observations scale/correction/SD in use
- Statistics on node shot point intervals
- Statistics on observation residuals
- Statistics on network variance factor and degrees of freedom
- The error ellipse (semi-major axis/skew) of all defined nodes
- Streamer rotation

9.7 Data analysis

Data analysis were performed for all lines and allowed all data from the Ingres database to be displayed. There were two main uses for this facility. The first was to produce a standard set of QC plots for each line, and the second was to act as an investigation tool for problems seen at any stage of processing.

Configuration files were defined to create a standard set of QC plots for every line.

The following plots were included:

Inline miss-closure
Streamer rotations
Streamer separation
Distance vessel-sources, vessel-streamer heads
Shot point interval (distance and time) of vessel ref. position
Gyro and course made good of vessel ref.
Position comparisons (Field position vs. Post-processed position)
Network variance factor and degrees of freedom

Problem lines were more thoroughly investigated and required different plots for analysis.

9.7.1 Data export, P1/90 output

During the export process the receiver positions were computed and a P1/90-file was generated. The in-line miss-closure error was accounted for by applying a linear distribution of the error to computed receiver positions. A header was added to the data during export.
The data were written to 3590 tape cartridges.

9.8 Data quality control procedures

The first line was sent to the office for quality purposes; both the P1 and P2 headers were checked. The line was processed and the solution was compared with the P190 file from the vessel. This procedure was repeated after each crew change to make sure there were no errors introduced. In addition, lines were sent to the office when the QC parameters exceeded the thresholds given in the PGS standard procedures, or the Client's specifications.

The final P2/94 tapes were checked using PGS internal software **p2list**. This program checked and returned the following information:

- Which files were on a tape and if each file had a complete header.
- Number of end-of-file markers and if the last record had an EOF mark.
- The filename, the sequence, the media label identifier (H0003), the number of shots, the number of shot inconsistencies (missing or double shots) and the number of records.
- A checksum, which were used to verify that data on tape were identical to data on disk.
- For every file the first and last E1000 record was printed.
- If there were shot inconsistencies, the E1000 records surrounding the inconsistency were printed.

Final quality control performed on the data included a number of streamer comparisons, both inline and streamer-to-streamer.

- Vessel, source and receiver positions were checked for internal consistency.
- The applied streamer rotations and the inline miss-closures were checked.
- Latitude/longitude and grid coordinates were checked against the datum/projection defined in the header.

The final P1/90 files were also checked using a variety of software tools; Sprint QC tool, p1Plot and p1List, the two latter tools being PGS internal software. These software tools provided checks on the following:

Sprint QC:

- Contents of the first and last vessel record.
- Source id of the first and last source record.
- Number of even and odd shot points with different source id.
- Number of header records found.
- Number of vessel, source, tail buoy and receiver records expected and how many were found.
- Number of new line characters found.

p1check:

- Tape name and date of issue.
- Datum/projection information from the header.
- For every line in the file: start/end shot and start/end co-ordinates.
- Standard comment record (H2600) concerning lines and shots in the file.
- Linefeeds in the file.
- All records 80 bytes long.
- Number of end-of-file markers and if the last record had an EOF mark.
- Grid co-ordinates correspond to the latitude and longitude with the given datum and projection.
- A checksum, which were used to verify that data on tape were identical to data on disk.

p1list:

- Which files were on a tape and if each file had a complete header.
- Number of end-of-file markers and if the last record had an EOF mark.
- The filename, the tape version identifier (H0202) and the number of records.
- A checksum, which were used to verify that data on tape were identical to data on disk.
- For every line in the file the line name, FSP, LSP and the position of SOL and EOL was given.

Results of the P2list, P1list and p1plot were saved and copies are archived in the Oslo office.

All tape labels were created using PGS internal software **mklab**. All information on the labels was extracted from the files on the tapes.

9.9 NRT vs Sprint P190 Position Comparisons.

Periodically during the survey NRT P190 positions were checked by comparison with P190 data produced by post processing with Sprint. This was nominally every 10th line.

Lines which were reprocessed for problems are not included in the comparison since they naturally contain differences related to the reason for reprocessing.

Maximum position difference (m)										
Seq	Line name	Vessel		Sources		Tailbuoys		Receivers		Comment
		min	max	min	max	min	max	min	max	
001	1258P1001	-0.4	0.4	-1.8	2.4	-3.2	2.7	-11.7	9.3	First line QC
010	1498P2010	-0.5	0.5	-1.9	5.6	-2.9	2.1	-7.3	6.9	
020	1438P1020	-1.3	1.0	-2.4	2.3	-3.3	2.3	-8.9	9.0	
040	1366P1040	-0.3	0.2	-2.3	2.1	-2.6	2.1	-7.9	5.4	
050	1414P1050	-0.3	0.3	-1.8	1.6	-2.9	1.9	-7.1	5.5	
056	1426F1056	-1.0	0.8	-2.5	1.7	-2.5	2.5	-8.0	6.2	V1 instablities
058	1510F1058	-1.1	1.0	-2.8	2.1	-3.1	2.9	-10.3	6.0	V1 instablities
070	1594P1070	-0.4	-0.3	-2.6	2.1	-2.3	1.9	-7.6	8.1	
098	2038P1098	-0.3	0.5	-1.7	3.1	-3.0	2.5	-6.3	8.5	
101	1654F1101	-0.3	0.2	-1.5	2.2	-3.4	2.5	-7.4	10.6	First line CC, QC
105	1750P1105	-0.7	1.4	-2.2	2.8	-3.6	2.4	-9.9	10.8	S6 rotation inconsistency
112	1774F2112	-0.7	0.5	-1.9	2.3	-3.3	3.5	-9.3	7.3	25% Comp Rejected

10 Seismic data quality

10.1 Ship & rig noise

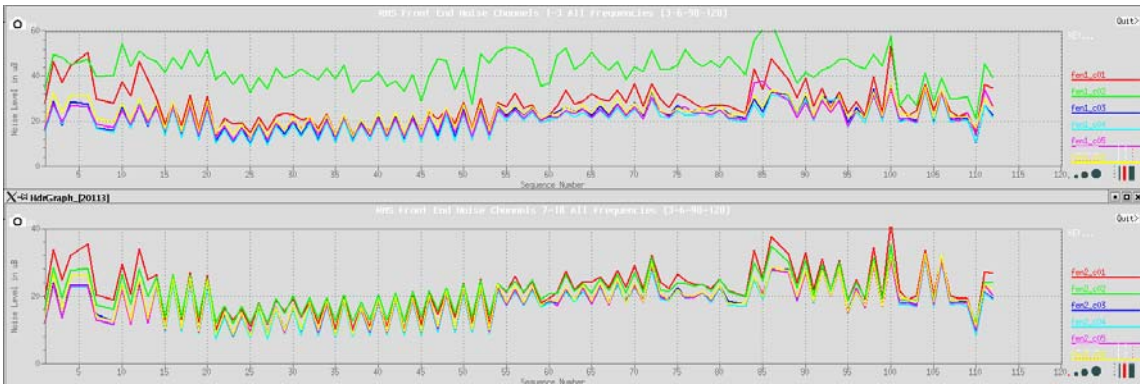
Not an issue for concern on this survey. Very few lines experienced ship noise and never to a level of any great concern.

10.2 Swell noise

Relatively few lines were affected by swell on this survey. The worst ones accepted were sequences 3, 4, 6, 7 and 112, with 6 being the worst with approximately 20% of traces being affected. Sequence 5 and 111 ended up being scratched due to swell and weather. Sequences 1, 2, and 9 – 13 were also affected. Swell noise was not seen again until sequences 77 and 78, where it affected just 1% of the traces.

Strum / Tug noise

Front end strum/tug noise (FEN) was seen on all cables but was particularly strong on streamer 1. The FEN was sensitive to vessel speed so adjustments were made to control the levels. The FEN was worse when the streamer depths were increased during times of marginal weather due to front dilt depth ropes at 8m and cables at 9m. Minor current noise affected sequences 10, 35, 58 and 59, the main result of which was to increase FEN due to crabbing of the vessel. Channel 1 on streamer 2 was quite noisy at times and caused the FEN average go up, explaining the streamer two graph below.



10.3 Source Separation Errors

Source separations were monitored online and actions taken to correct when needed. During sequence 51 arrays 5 and 6 showed an average separation of between 8 – 10 meters, a spectral shot comparison was performed and no noticeable difference was seen.

Telemetry and Parity Errors

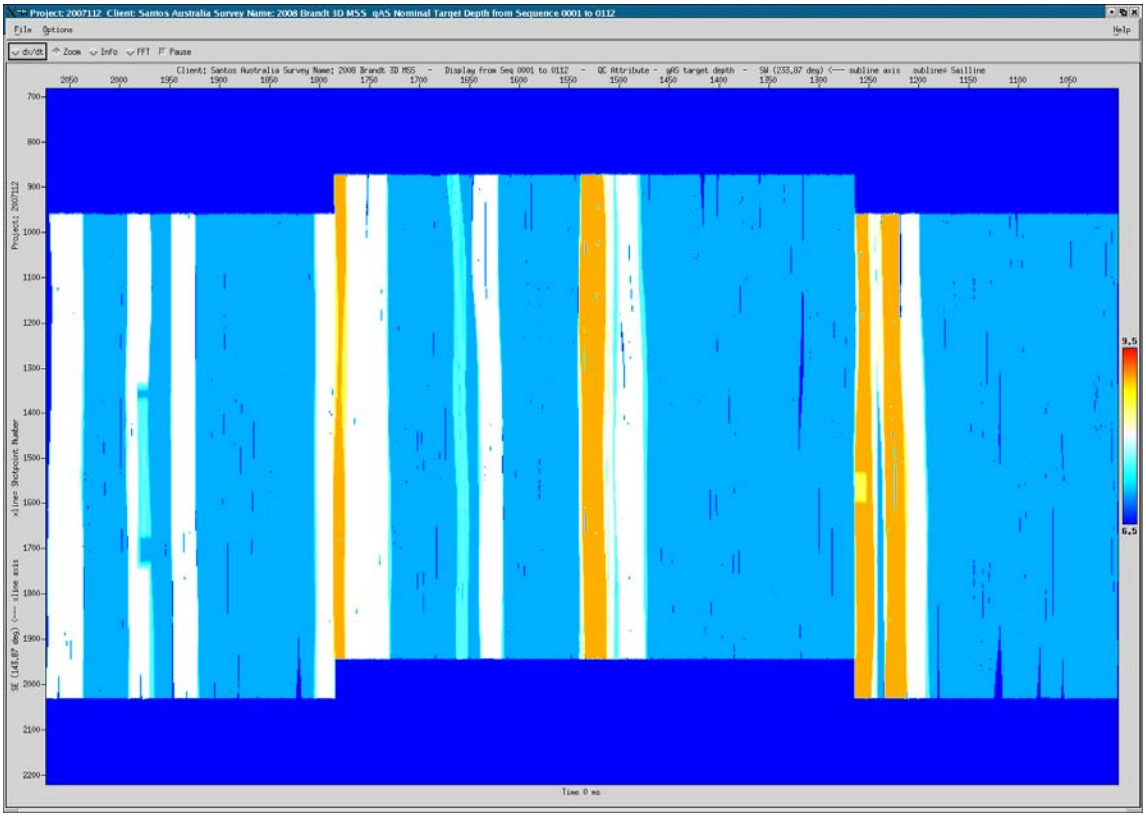
There was hardly any problem on this survey. Edits were made when required for the affected streamers.

10.4 Streamer Depth Errors

These were generally logged in the Observer logs as QC warnings.

On client request, the target streamer depth would be adjusted. Most lines ended up being shot at 7m, but some were shot on 8 and 9m because of poor weather conditions, see below.

7m	8m	9m
015 - 076	010 - 014	001 - 009
081 - 085	077 - 080	111 - 112
089 - 099	086 - 088	
	100-110	



10.5 Bad channels and Recording System Problems

After each sequence, all the recorded traces were checked for excessive RMS noise levels, weak or dead traces and for electrical spikes. This was done both automatically and interactively on-screen. The number of bad channels edited was always in spec.

Spikes
Automated spike detection was running on all the traces, across the entire record length, on the gAS recording system as well as online on the Viper system. The number of spikes was usually small, and the number of bad traces was always well within spec. The spikes can be identified by analysing the observers' logs. They should be removed during processing either automatically using a de-spike algorithm or manually by referencing the observers' logs. The big spikes were flagged as edits.

Cross-feed
No significant cross-feed was detected during the survey.

Header corruption
Header data transferred from the navigation system to the seismic recording system was sometimes corrupted affecting values stored in the extended header. These events were flagged in the observers' log as "nav header short" which can cause zero values in some of the navigation header fields such as shot point number or source identifier. These errors can be fixed in processing by manipulating the headers to restore the correct values so that these shots can still be used. Using the time stamp in the general header is an option. This time is GPS corrected and relatively accurate (Approx +/- 1s window).

10.6 Skew Correction for NTRS Recording

The NTRS acquisition system used on this survey is a continuous recording system, enabling recording with nearly zero dead time between records. However, as a result of this, time zero does not necessarily fall on a sample time. This automated system sub-sample correction is known as the skew and is defined as the interval between time zero and the next following sample.

Any skew correction factor errors were identified by time-break analysis and the relevant shots were flagged as edits. Most commonly the skew errors were flagged automatically by the recording system.

10.7 Air leaks and Auto-fires

Any auto-fires flagged by gas were checked by QC and removed from the log if proven to be false. The majority of air leaks were spotted immediately online and appropriate action taken.

Summary of causes of scratched and incomplete line sequences

Cause	Scratched	Incomplete or Edit
Air leak		
Source separation errors		
Compressor failure		
Auto-fire, misfire		072
SI / timesharing		
Ship noise		
Weather	005, 111	
Depth control errors		
Observing software / hardware	008, 087	089
Navigation software / hardware		
Strum noise		
Telemetry/parities/module failure		
Coverage		
Navigation Compass Problems		
Fishing activity & fishing gear		
Other		001

10.8 RMS and noise analysis

RMS Windows		
RMS Window 1 (Water Column):	60 - 560 ms	relative to start of record
RMS Window 2 (RMS minimum):	500ms	sliding window
RMS Window 3 (Signal 1):	2000 – 2500 ms	relative to start of record
RMS Window 4 (Signal 2):	3500 - 3000 ms	relative to start of record
RMS Window 5 (End of Record):	5500-6000 ms	relative to start of record

The gAS system produced online RMS values taken from 5 windows calculated on 1ms sample interval data. No instrument delay static was applied prior to analysis but a 5-8-90-120 Hz common band-pass filter was applied to all windows to remove noise occurring outside the bandwidth of the data. These RMS values were passed to the Viper system in real-time when needed to facilitate both online and offline RMS analysis. These values were also used to create areal rms and attribute displays using the PGS 'holoSeis' visualisation software package and Viper BinXYZ areal attribute handling.

1: Water Column noise window
The water column noise window (window 1) displayed the ambient background noise levels, and was also useful for assessing external sources of noise, such as ship noise. Noisy channels are generally much more obvious in this window too. The front traces, and in particular those on the centre streamers nearest the guns, recorded high amplitudes due to first break energy entering the window, and were of little use for QC purposes. To analyse these channels, normally the end of record RMS window was used. On this survey the end of record RMS window had too much residual energy to be useful for this on every line. The start and end of line noise records without the guns firing were analysed to assist in picking bad channels.

2: Minimum RMS
RMS was computed for 250ms about each sample of each trace, i.e. in a sliding 500ms window down each trace. The minimum RMS value for each trace is then stored in a header which can subsequently be plotted. This method ensures that the signal contribution to the RMS value is minimised.

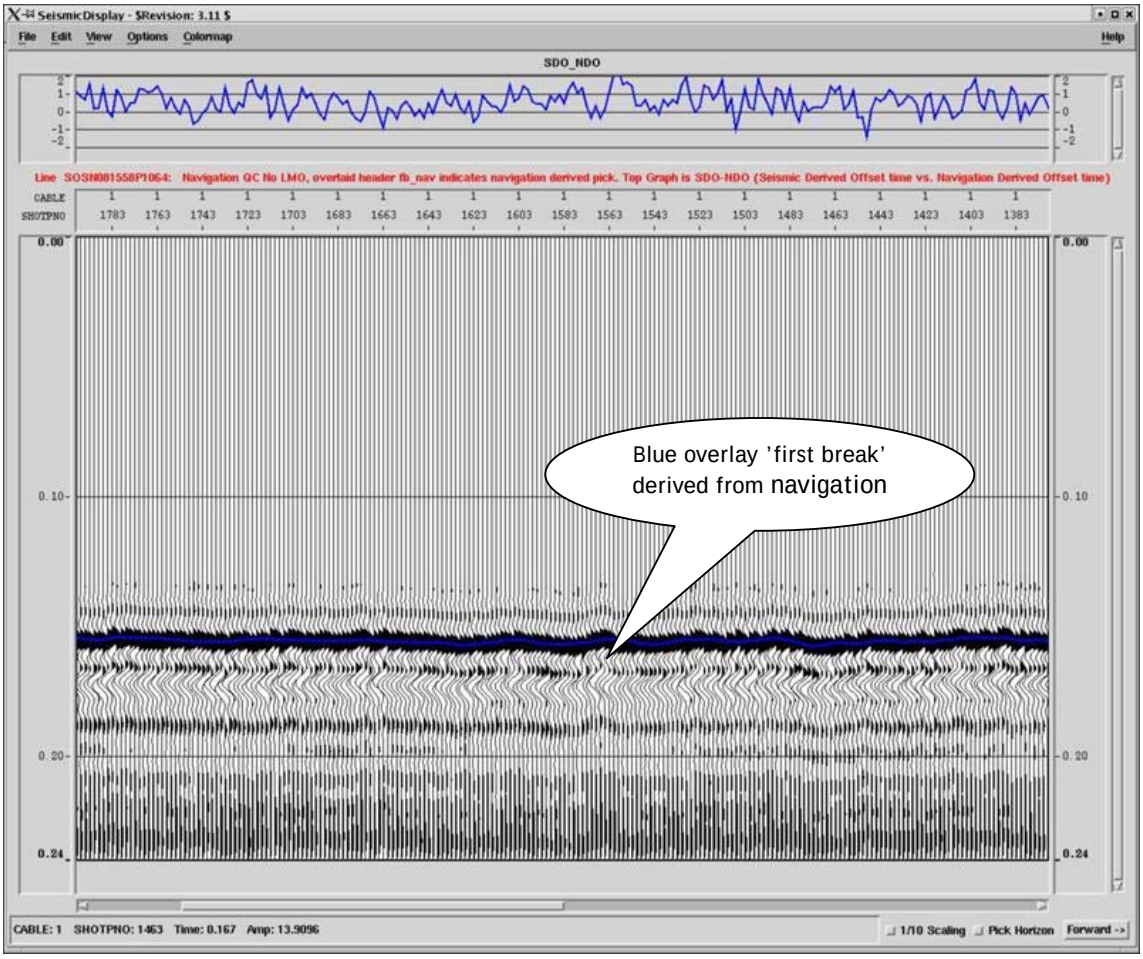
3, 4: Signal Windows
The RMS signal was calculated by the gAS QC system in both windows 3 and 4, as detailed in the table above. Reviewing the amplitudes of individual channels in these RMS windows could highlight weak or dead hydrophones, as the resulting contrast in the recorded amplitudes are greatest here.

5: End-of-record windows
This RMS end of record window (window 5) was used for monitoring ambient noise levels in addition to the water column window. This window was useful at times for examining the ambient RMS levels on the near traces that were affected by first break energy in RMS window 1. On this survey the amount of shot-generated energy recorded in this window was often very much higher here than in window 1, and so external noise sources, for example ship noise, would not necessarily be as easily seen in the end-of-record window. The reverberation/ residual energy made it more difficult to spot bad channels.

10.9 First break / P190 offset check

The nearest traces were merged with the P1/90 navigation data, and the navigation-derived first break was overlaid on the seismic data and checked on screen. In general, there was a good match between the P1/90 and the seismic data. The common offset cube was additionally used to verify navigation quality.

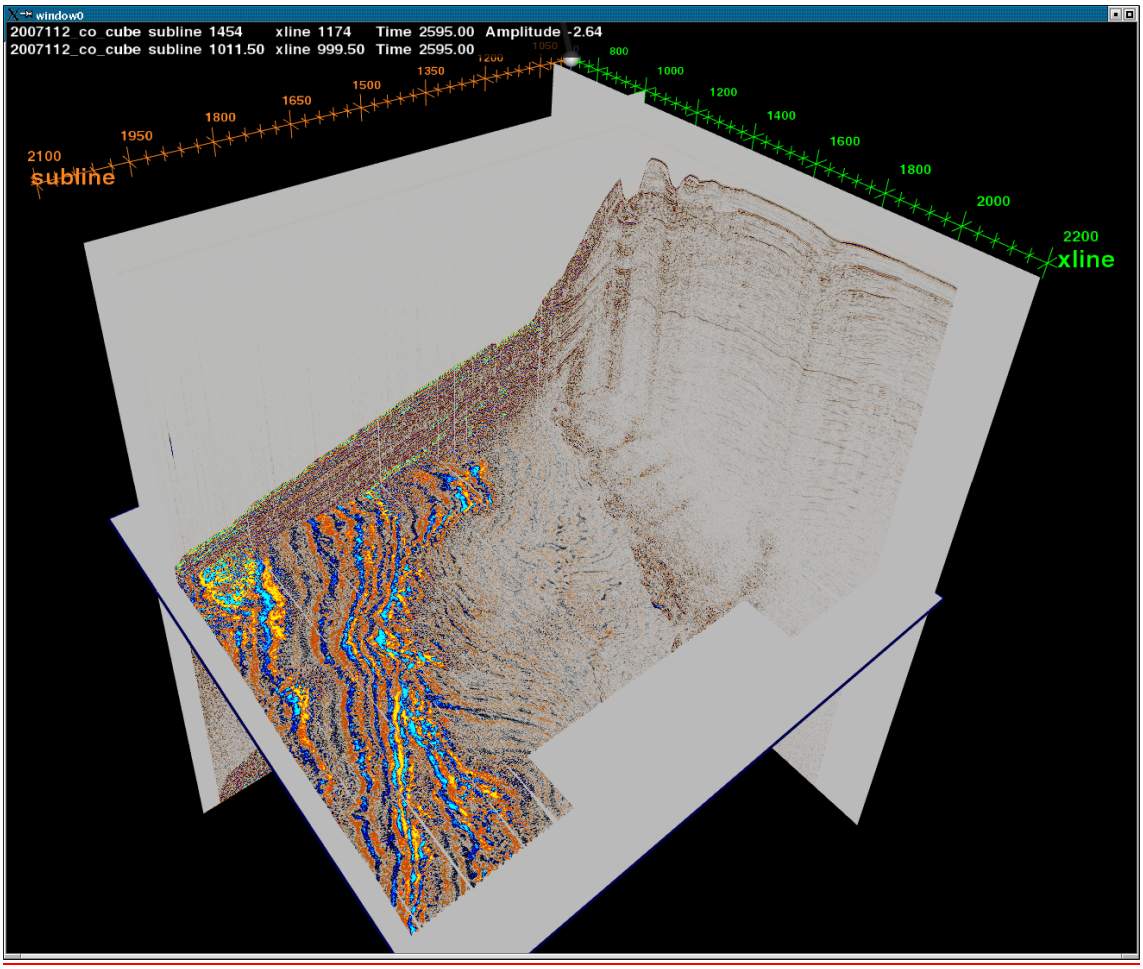
Sailine SOSN081558P1064 Streamer 1 Starboard Source



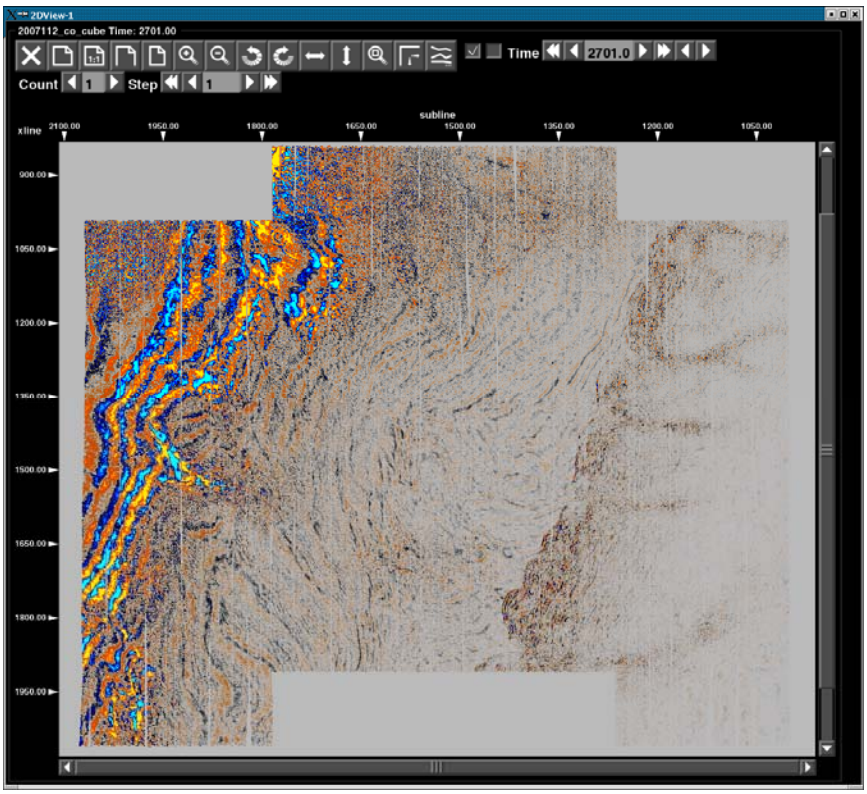
Common offset cube

The common offset cube was created using PGS' proprietary 'HoloSeis' 3D visualisation program. The main purpose of the cube analysis was to assist with QC of the navigation data after having been merged with seismic. The appearance of miss-ties or busts between lines in the cube could indicate problems with the navigation data.

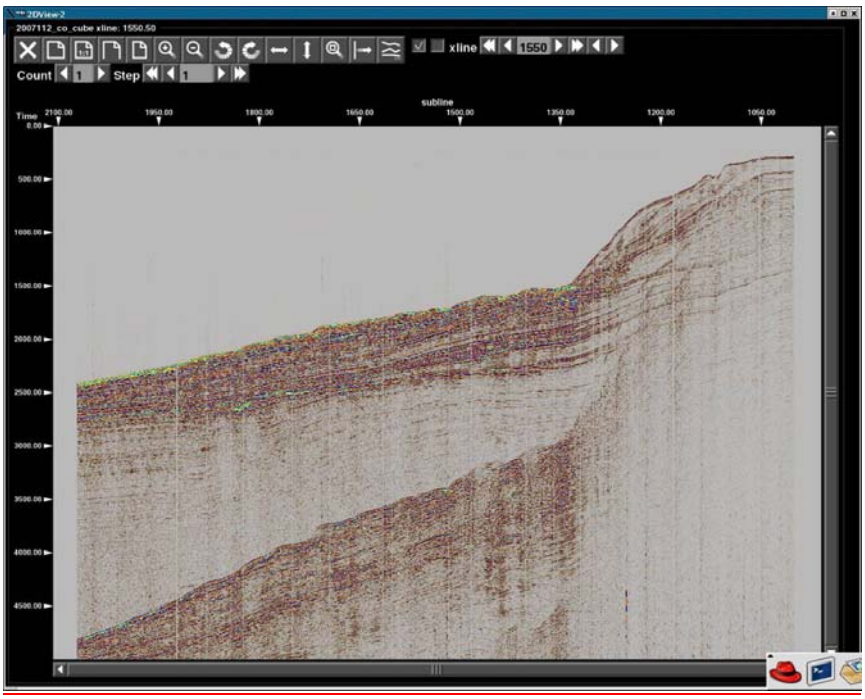
Holoseis plane view



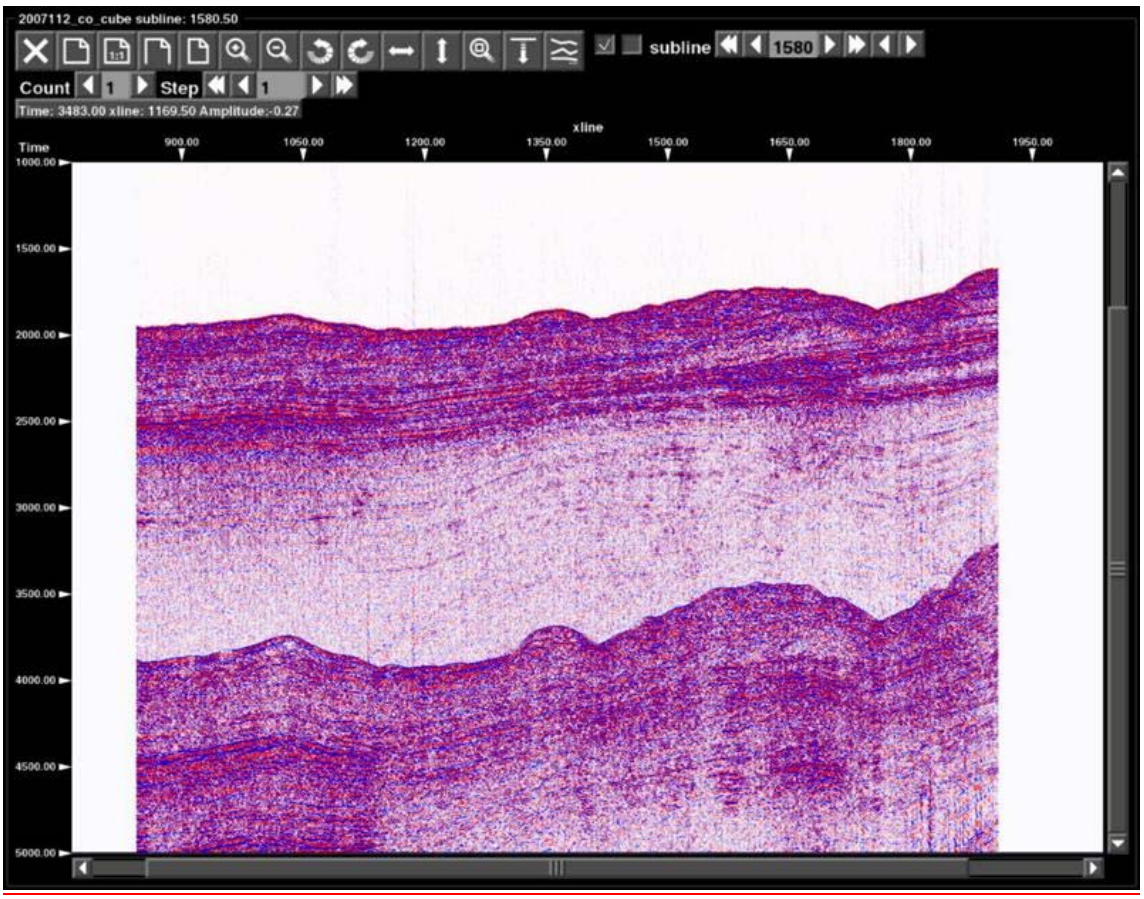
Time-slice at 2701ms



Cross-line at SP 1550



Inline 1580

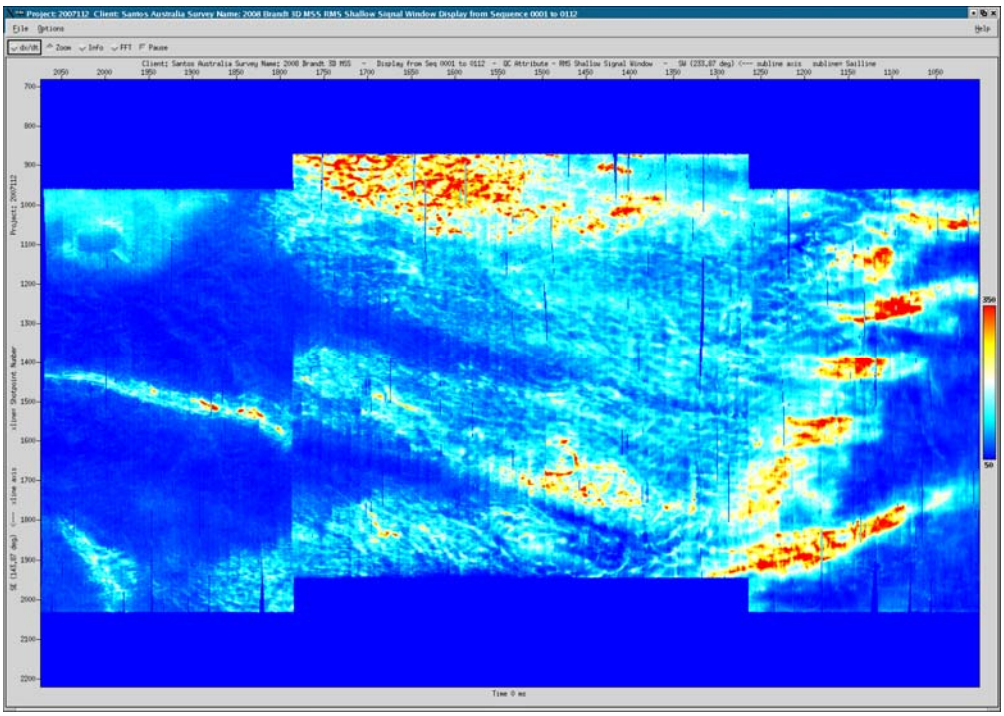


10.10 Seismic data attributes

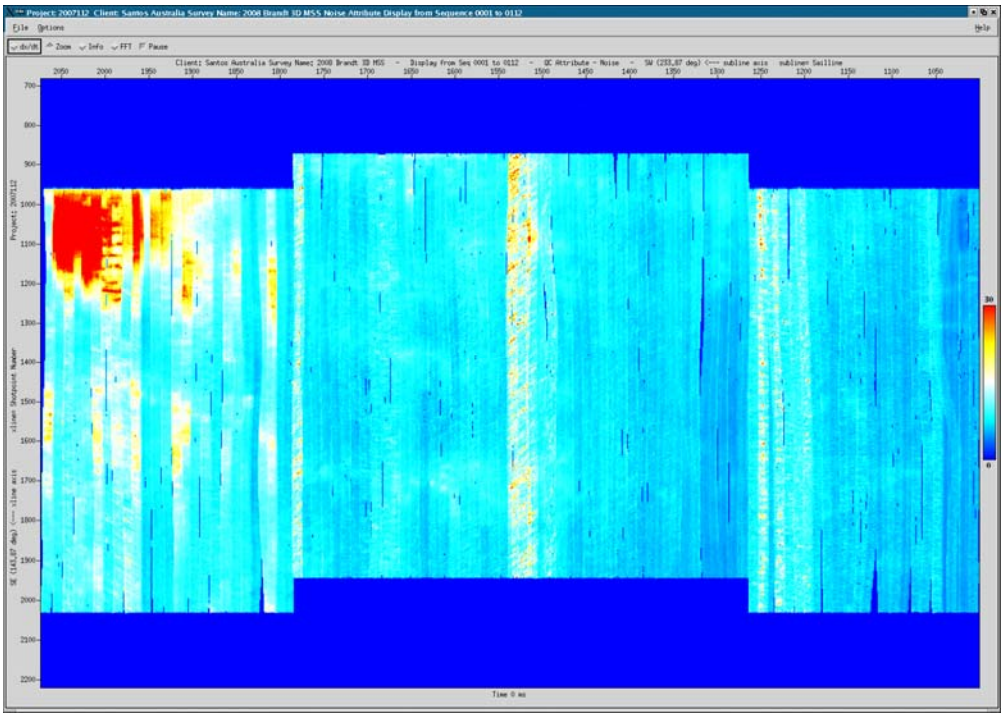
A number of attributes were calculated and binned both using holoseis and viper BinXYZ attribute handling to allow for investigation of streamer to streamer comparison and line to line comparison and matching over the whole survey.

RMS attributes were frequently investigated to quantify marginal lines with other lines previously accepted.

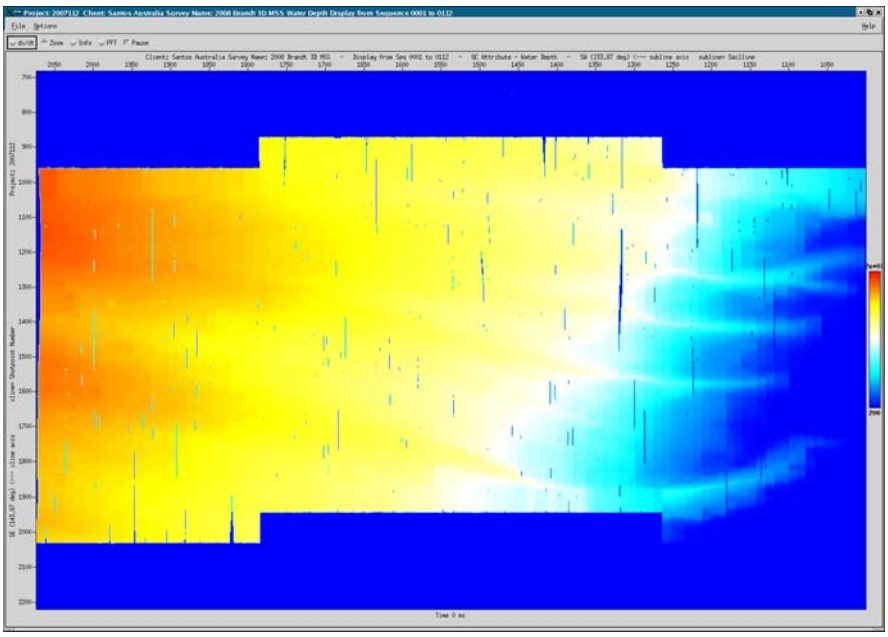
RMS signal window



Raw RMS noise



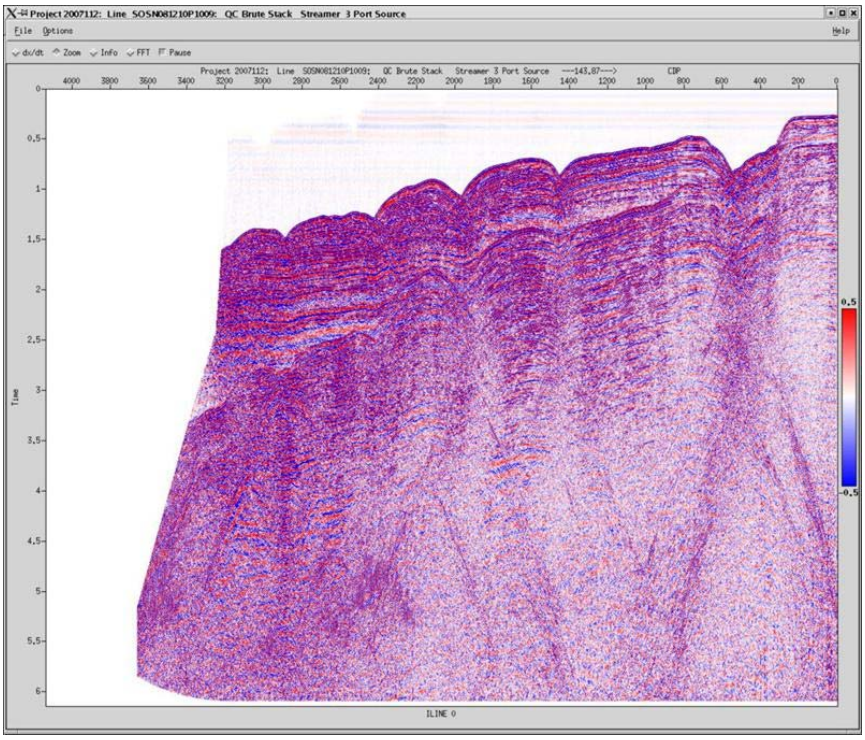
Water depth [m]



10.11 Brute Stack Data

An example brute stack display is shown below.

Screen Display Stack SOSN081210P1009 Streamer 3, Port source.



11 QC

The gAS acquisition system was used to monitor and record data in real time. The VIPER processing system was then utilised for the subsequent offline QC processing. Problems that occurred during production were investigated using all means available.

11.1 Online QC

Real-time RMS calculations were performed by the online gAS QC system for all channels of each shot, in five different time windows, as defined and explained in the section "RMS and noise analysis".

The PGS gAS acquisition system was used to provide real-time online QC displays that included:

- 2 x shot gathers, rotating through all streamers for every shot plus a further shot display fixed on one streamer.
- 'End of Record' and 'Water Column' RMS displays indicating the RMS levels of each channel for each shot point, for all 6 streamers. This enabled ambient noise estimates to be made, and external noise, such as ship noise, to be quantified.
- Cable depth variations display.
- Shot-to-shot difference display, for random noise analysis.
- Single near trace display, at full record length.
- Line graph display of gun volume, gun pressure and gun depth.
- Full-length auxiliary trace display from every gun hydrophone for the current shot.
- Stacked auxiliary trace display at full record length for each active shot, used for auto-fire detection.
- 2 x layered hydrophone display (one port array, and one starboard array) of the first 150ms of each auxiliary trace, for monitoring any variation in the gun signature along the line.
- Time break single trace display.

11.2 Offline QC

At the end of each line, as a minimum, the following displays were produced:

- Screen displays of one shot/km rotating through streamers
- RMS noise screen displays for bad channels and other noise analysis
- RMS signal screen displays for traces that might be weak
- Graphical RMS noise display of average channel RMS
- Stacked auxiliary near field phone data on screen for auto-fire analysis
- Layered hydrophone display of top 300ms of auxiliary hydrophone data to monitor variations in gun signature which might indicate an air leak or sub-array separation problem as well as a comparison with recent other line sequences to check for a possible signature change between lines
- Recorded time break screen display
- 'Smash Stack' shot-domain stacked data screen display to highlight any electrical cross-feed in particular.
- 2D Brute Stack paper plot.
- First break display with overlaid navigation offset on screen for comparison.

Further investigations were carried out as needed.

11.2.1 2D QC brute stack

A brute stack was produced for each line sequence in order to assess how noise interference (e.g. ship noise, swell noise, strum noise etc.) was likely to affect the final processed data. Each brute stack had deconvolution applied.

Brute Stack Processing Sequence

Transcription	From SEGD to Viper internal format
Static Correction	Skew correction (< 1ms) for continuous recording system
Geometry Assignment	Nominal 2D geometry (from preplot)
Select	One Source/Streamer combination for stack
Edit (zero)	Bad channels, Bad shots
Static Correction	–58 ms filter delay
High-pass filter	3-6 Hz
SINK	Swell or SI noise attenuation processing (if required)
Amplitude Recovery	T^2 gain (using average velocity)
Mute	First break mute
NMO Correction	Using client-supplied regional velocity function
Mute	Post-NMO mute
Stack	Stack CDP gathers
Static Correction	gun and cable static to mean sea level
Display	Paper plot/screen display (with adjacent trace averaging before plotting)

11.2.2 Navigation / seismic merge QC

A near trace dataset was merged with the final P1/90 files for all streamers. The navigation-derived first break was overlaid on the seismic near trace for each streamer and checked on screen. The measured sound velocity was used to determine the calculated arrival time from the P1/90 offset.

11.2.3 Common offset cube

A second P1/90 QC step was to build a 3-fold common offset (CO) cube to check for anomalies and miss-ties between sail lines on cross-line sections and time-slices.

For each source/streamer combination, one trace was selected by offset (~ 350m) and merged with P1/90 positional data then loaded to the common offset cube. The data was pre-processed and truncated to 5000 ms prior to loading. Once loaded to the cube, inline, cross-line and time-slice displays were viewed to check for potential navigation merge errors.

The cube was viewed using PGS' HoloSeis software package in full 3D. This software makes it possible to view all inline, cross-line and time slices, and permits interactive rotation, translation and stretch of the 3D common offset cube to enable a more detailed analysis of the data.

11.3 Computer systems

The Viper system hardware on the Pacific Explorer is set up as follows…

The mamba system had a serious hardware failure after sequence 028. It had to be rebuilt from scratch and we were not back up until sequence 040 was being recorded. The cgm plot sdi software was not back up towards the end of the survey, so stack QC was performed on screen from sequence 029 to 110.

2 x IBM x3650 nodes (2 x dual core processors/node, each node having 4 gb of RAM and 3 x 75gb disk drives) [mamba, python]. There is also 6.5 tb of external RAID disk attached to the mamba node.

3 x IBM x335 nodes (dual 2.8 GHz Intel Xeon processors/node, each node having 1.5 Gb of RAM and 2 x 146 GB SCSI disk drives) [Cpu01, Cpu02, Cpu03]

2 x Dell Precision 470 node (dual 3.0 Ghz Intel Xeon, with 3.84Gb of RAM and 2 x 360 Gb disks) [Hol01, Hol02]

Viper Node Configuration	
MAMBA:	Data-capture node, with real-time link to gAS recording system Control workstation Data-Processing node
PYTHON:	Data-Processing node and spare mamba replacement
CPU01:	Data-Processing node 3 IBM 3592 tape drive attached 2 IBM 3590 tape drive attached
CPU02:	Data-Processing node 1 IBM 3592 tape drive attached 2 IBM 3590 tape drive attached
CPU03:	Data-Processing node
HOL01:	Data-Processing node HoloSeis 3D viewing node
HOL02:	Data-Processing node HoloSeis 3D viewing node

This system runs Viper V4.0.2-3, a data QC and pre-processing suite of software tools on the CentOS v4 Red Hat operating

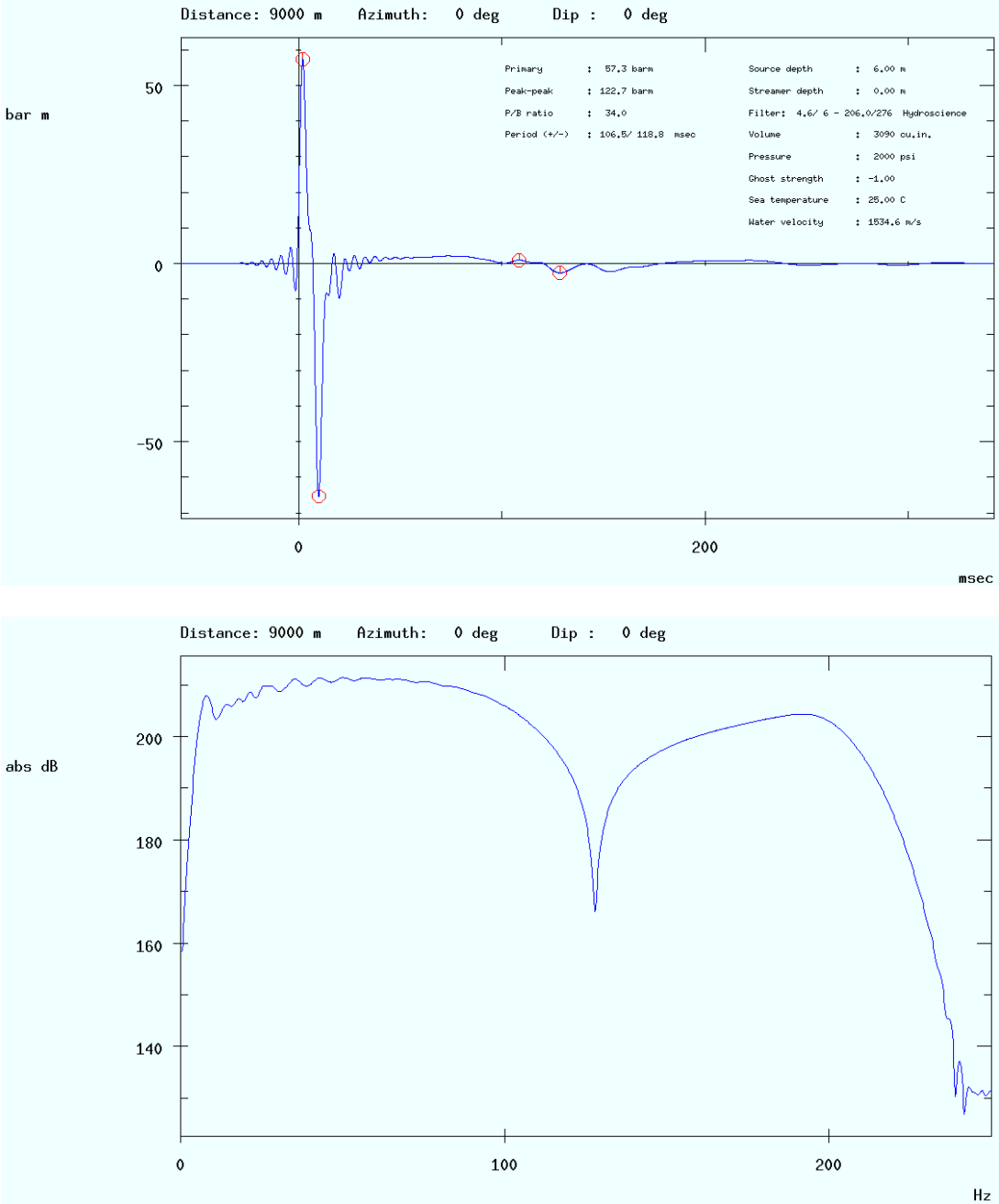
12 Appendix

12.1 Data shipments

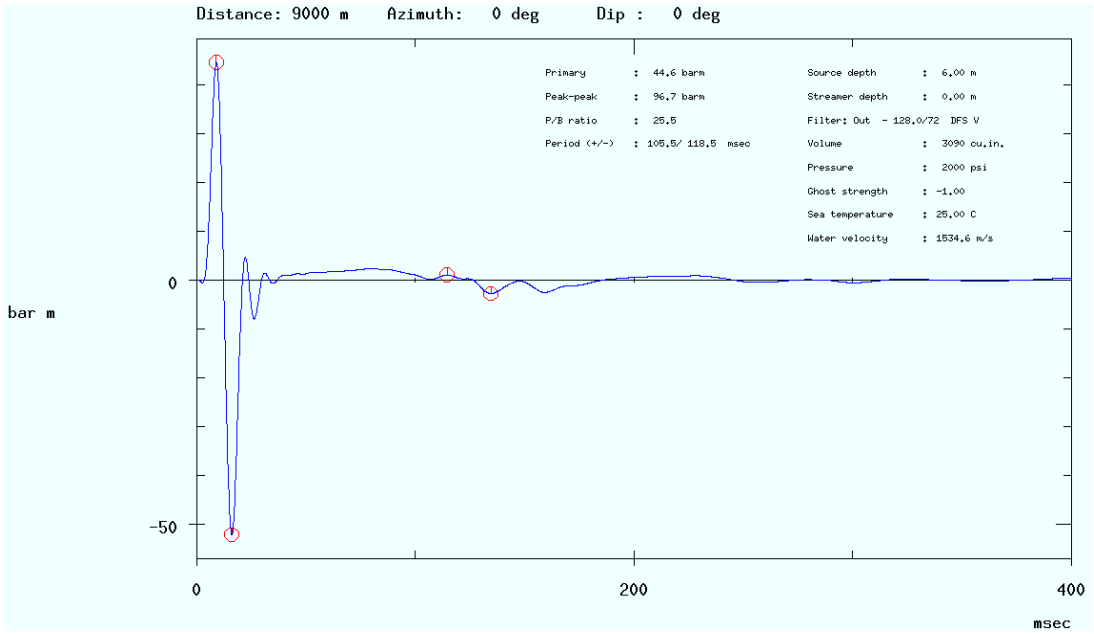
Date	Proforma	Content	Boxes	Wt	Shipping address	Comment
20th Mar 08	PAC13003679A	106x 3592 data tapes (data set 1) 3 x P294 tapes 3 x P190 tapes 1 x DVD containing observer logs Project 2007112	6	45 Kg	CGG Veritas 1st Floor, 38 Ord Street, West Perth, WA, 6872 Attn: Tony Weatherall Tel: +62 21 7698038 Fax: +62 21 7698015	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
31st Mar 08	PAC13003701A	12 x 3592 data tapes (data set 1) 1 x P294 tapes 1 x P190 tapes 1 x DVD containing observer logs Project 2007112	1	22 Kg	CGG Veritas 1st Floor, 38 Ord Street, West Perth, WA, 6872 Attn: Tony Weatherall Tel: +62 21 7698038 Fax: +62 21 7698015	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
31st Mar 08	PAC13003700A	2 x 3592 data tapes (data set 1) 1 x DVD containing observer logs Replacement tapes for sequences 1 and 3. Project 2007112	1	6	CGG Veritas 1st Floor, 38 Ord Street, West Perth, WA, 6872 Attn: Tony Weatherall Tel: +62 21 7698038 Fax: +62 21 7698015	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640

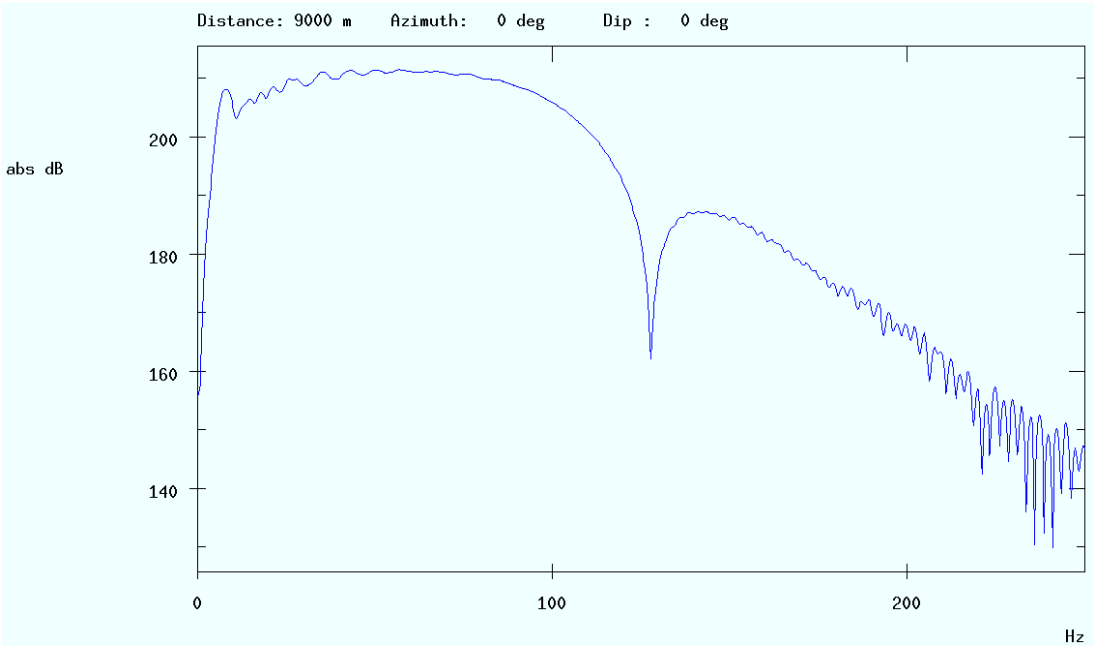
31st Mar 08	PAC13003708A	2x 3592 tapes with SEGY brute stacks and SEGY Nac\vqc Cube Project 2007112	1	1 Kg	CGG Veritas 1st Floor, 38 Ord Street, West Perth, WA, 6872 Attn: Tony Weatherall Tel: +62 21 7698038 Fax: +62 21 7698015	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
19 Mar. 2008	PAC13003680A	2 x 3592 data tapes (data set 2) DVD containing line logs Project 2007112	6	45 kg	Santos Australia Ltd. c/o Toll Priority Basement,191Pultney Street Adelaide S.A. 5000 Australia Attn.: Nick Papanicolaou	Via NT Shipping Agencies PTY Ltd PO BOX 443 0828 Berrimah NT Australia Attn: Robbie Robertson Tel +61 8894 72570 Fax +61 8894 72640
27 Mar 2008	PAC13003702A	2 x 3592 data tapes (data set 2) 1 x DVD containing line logs and tapelisting Project 2007112	1			
04.Apr.08	NP26/2008	P190 vespos P190 echo pos, depth corrected draft/sound and tide (MSL) Vespos plot Waterdepth plot Coverage plots Alls zones, Noflex CD with p190 and plotfiles			Santos Australia Ltd. c/o Toll Priority Basement,191Pultney Street Adelaide S.A. 5000 Australia Attn.: Nick Papanicolaou	DHL no9650092933

12.2 Source modelling



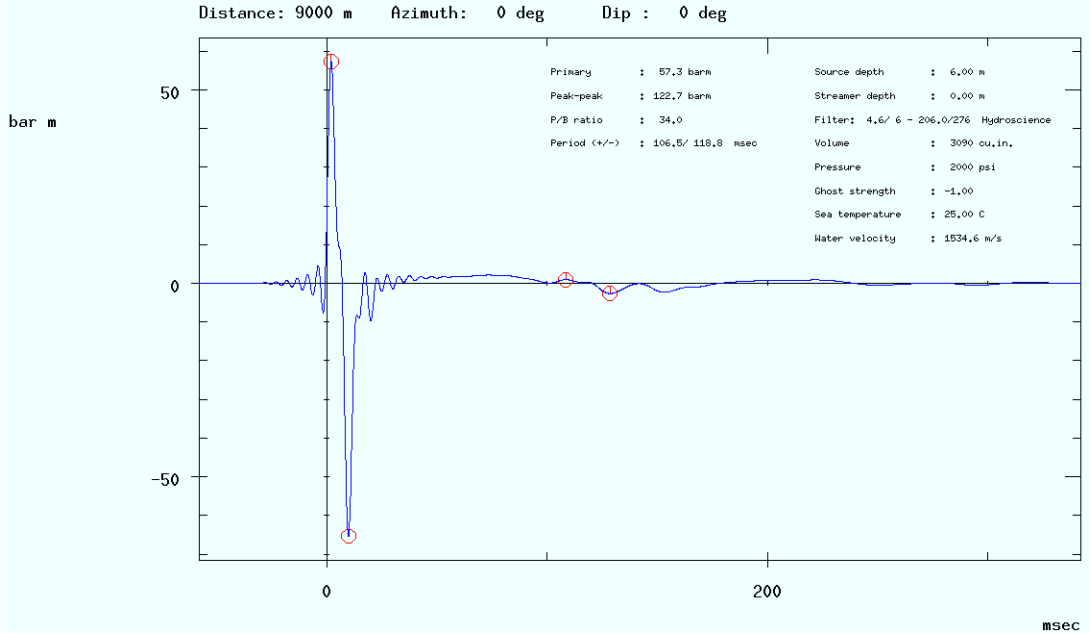
Modeled far-field signature and amplitude spectrum with Hydroscience recording filter (without receiver ghost).

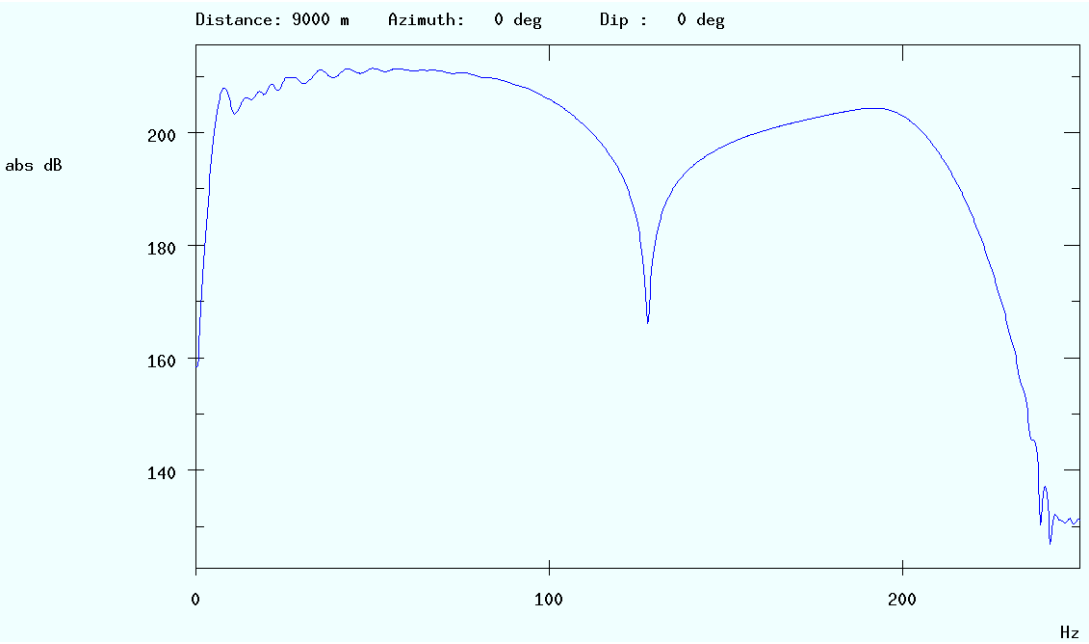




Modeled far-field signature and amplitude spectrum with DFS-V recording filter (without receiver ghost).

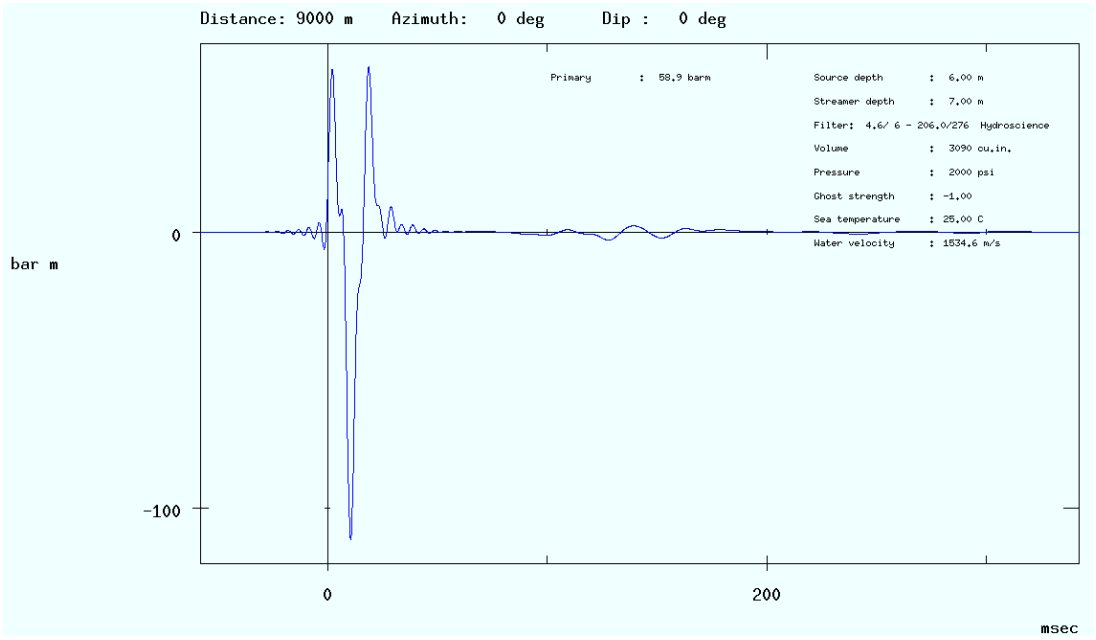
Full system response with source ghost only

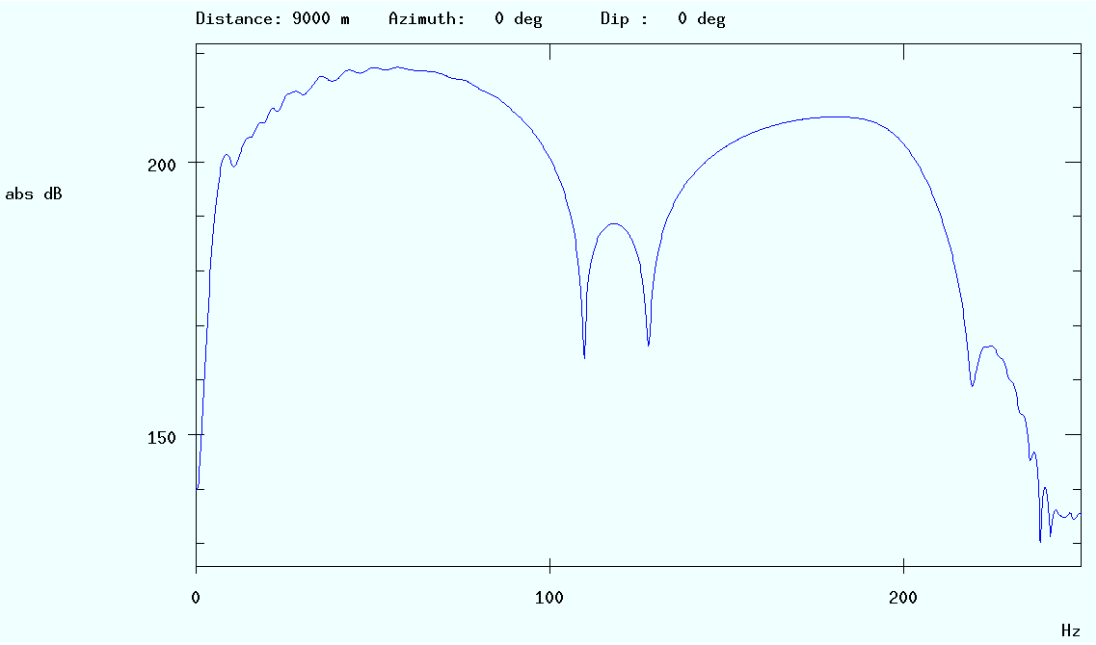




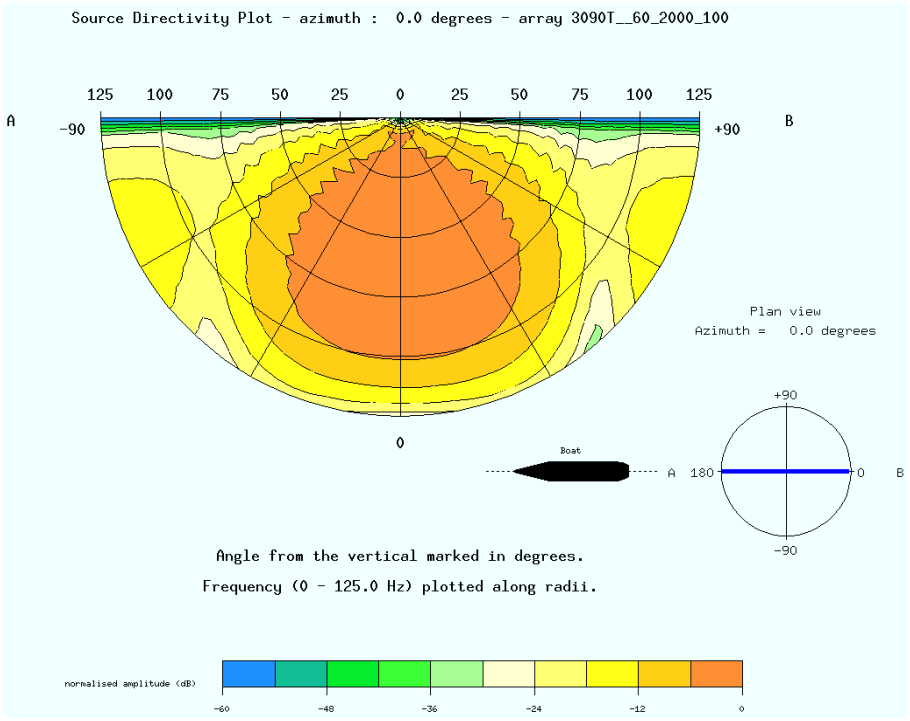
Modeled far-field signature and amplitude spectrum with full system response filter effect applied (without receiver ghost).

Full system response with source and receiver ghost





Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).



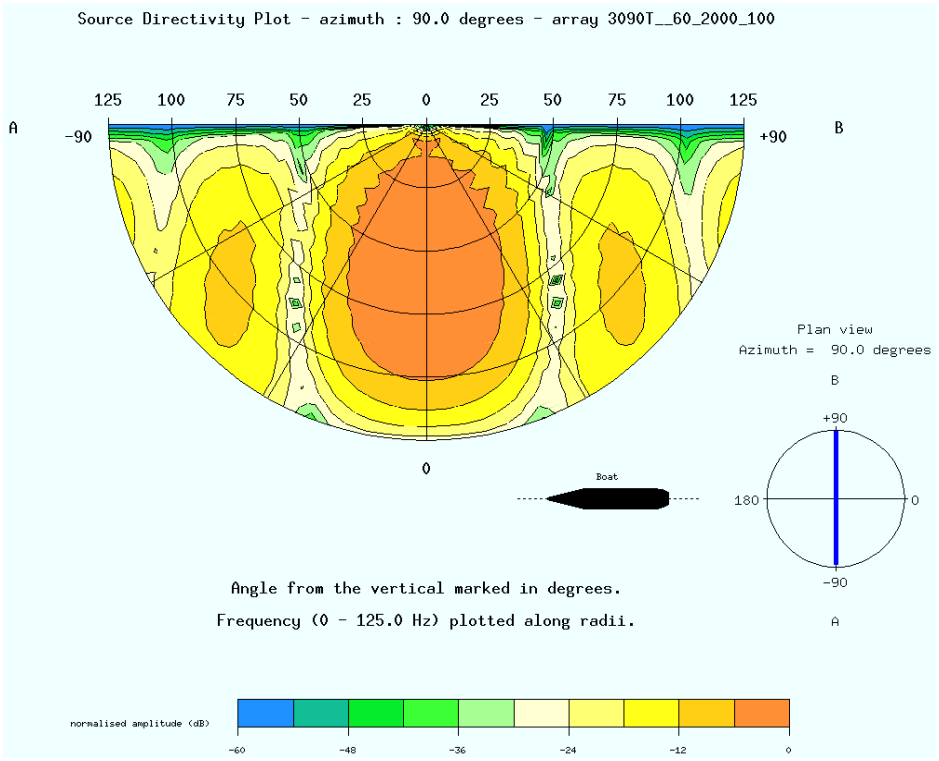


Figure 1: Directivity plot for constant azimuth of 0° and 90°.

12.3 SEG-D header

GENERAL HEADER #1		Starting byte 0
Bytes	Description	Value
01-02	File Number	399
03-04	SEGD Format	8036
	Bits Per Sample	24
05-10	General Constants	
11	Year	2008
12	Additional Header Blocks	2
12-13	Day	83
14	Hour	8
15	Minute	6
16	Second	42
17	Manufacturer's Code	41
18-19	Manufacturer's Serial Number	14
20-22	Not Used	
23	Base Scan Interval (ms)	2.0
24	Polarity	
25	Scan/Block Exponent	
26	Record Type	Normal Record
27	Record Length (ms)	170496
28	Scan-types / Record	1
29	Channel Sets/Scan Type	7
30	Skew Blocks	0
31	Extended-Header Blocks	0xFF
32	External-Header Blocks	0xFF

GENERAL HEADER #2		Starting byte 32
Bytes	Description	Value
01-03	Expanded File Number	0
04-05	Extended Channel Sets	0
06-07	Extended Header Blocks	890
08-09	External Header Blocks	119
10	Reserved	
11-12	SEG-D Revision Number	Rev. 0.0
13-14	General Trailer	
15-17	Extended Record Length	200
18-19	General Header Block Number	2
20-31	Reserved	
32	Extended Record Length	6

12.4 P1/90 header

```
H0100 AREA                      BLOCK T/35P - TASMANIA AUSTRALIA
H0101 GENERAL SURVEY DETAILS    3D, SINGLE VESSEL, DUAL SOURCE, SIX STREAMERS
H0102 VESSEL DETAILS            PACIFIC EXPLORER          1
H0103 SOURCE DETAILS            STBD SOURCE               1   1
H0103 SOURCE DETAILS            PORT SOURCE               1   2
H0104 STREAMER DETAILS          STREAMER 1 480CH          1       1   1
H0104 STREAMER DETAILS          STREAMER 2 480CH          1       2   2
H0104 STREAMER DETAILS          STREAMER 3 480CH          1       3   3
H0104 STREAMER DETAILS          STREAMER 4 480CH          1       4   4
H0104 STREAMER DETAILS          STREAMER 5 480CH          1       5   5
H0104 STREAMER DETAILS          STREAMER 6 480CH          1       6   6
H0105 OTHER DETAILS             N/A
H0200 DATE OF SURVEY            27 FEB 2008 - CONTINUING
H0201 DATE OF ISSUE OF TAPE     -- ---- ----
H0202 TAPE VERSION IDENTIFIER   ------------
H0203 LINE PREFIX               BRSN08
H0300 CLIENT                    SANTOS AUSTRALIA
H0400 GEOPHYSICAL CONTRACTOR    PGS GEOPHYSICAL - MARINE ACQUISITION
H0500 POSITIONING CONTRACTOR    FUGRO SURVEY AS
H0600 POSITIONING PROCESSING    PGS GEOPHYSICAL - MARINE ACQUISITION
H0700 POSITIONING SYSTEM        NAV SYSTEM 1: STARFIX.HP  SPM_4.26
H0700 POSITIONING SYSTEM        NAV SYSTEM 2: SKYFIX.XP   MULTIFIX 4 V2.01 XP
H0700 POSITIONING SYSTEM        INTEGRATED NAV SYSTEM: SPECTRA VERSION 10.9.01
H0800 COORDINATE LOCATION       CENTER OF SOURCE
H0900 OFFSET SYS TO NAV REF PT     1   2    0.00    0.00
H0901 OFFSET SYSTEM TO SOURCE 1    1   2   25.00 -330.00
H0902 OFFSET SYSTEM TO SOURCE 2    1   2  -25.00 -330.00
H0903 OFFSET SYSTEM TO E/S    1    1   2    2.48   31.22
H1000 CLOCK TIME                GMT
H1100 RECEIVER GROUPS PER SHOT  2880
H1400 GEODETIC DATUM AS SURVEY  WGS84       WGS84        6378137.000 298.2572236
H1401 DATUM SHIFT WGS84 TO WGS84   0.0   0.0   0.0 0.000 0.000 0.000 0.0000000
H1500 GEODETIC DATUM POST PROC  WGS84       WGS84        6378137.000 298.2572236
H1501 DATUM SHIFT WGS84 TO WGS84   0.0   0.0   0.0 0.000 0.000 0.000 0.0000000
H1600 DATUM SHIFTS                 0.0   0.0   0.0 0.000 0.000 0.000 0.0000000
H1700 VERTICAL DATUM            ES                      ECHO SOUNDER POSITION
H1800 PROJECTION                002 U.T.M SOUTH
H1900 ZONE                      54
H2000 GRID UNITS                1 INTERNATIONAL METERS    1.000000000000
H2001 HEIGHT UNITS              1 INTERNATIONAL METERS    1.000000000000
H2200 CENTRAL MERIDIAN          141 0 0.000E
H2600*****************************************************************************
H2600 THE Z OFFSET OF THE ECHO SOUNDER TRANSDUCER IS -6.36 METERS FROM THE
H2600 VESSEL REFERENCE POINT AT SEA LEVEL. TRANSDUCER DEPTH CORRECTIONS WERE
H2600 NOT APPLIED TO WATER DEPTHS.
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 METERS/SECOND.
H2600 THE WATER DEPTH DATA HAS BEEN DESPIKED.
H2600 THE ECHO SOUNDER DEPTH DATA HAS BEEN CORRECTED FOR HEAVE PRIOR TO BEING
H2600 PASSED TO THE INTEGRATED NAVIGATION SYSTEM.
H2600*****************************************************************************
H2600             FORMAT OF SHOT RECORDS
H2600      COLUMN           DESCRIPTION
H2600           1           'V', 'E', 'Z', 'S', 'T'
H2600                       V= VESSEL REFERENCE POINT
H2600                       E= ECHO SOUNDER
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H2600                       Z= INDIVIDUAL SOURCE POSITION
H2600                       S= CENTER OF SOURCE
H2600                       T= TAILBUOY POSITION
H2600        2-13           LINE NAME
H2600          17           VESSEL IDENTIFIER
H2600          18           SOURCE IDENTIFIER
H2600          19           TAILBUOY/OTHER IDENTIFIER
H2600       20-25           SHOT POINT NUMBER
H2600       26-35           LATITUDE (DDMMSS.SS)
H2600       36-46           LONGITUDE (DDDMMSS.SS)
H2600       47-55           MAP GRID EASTING IN METERS
H2600       56-64           MAP GRID NORTHING IN METERS
H2600       65-70           WATER DEPTH
H2600       71-73           JULIAN DAY OF YEAR
H2600       74-79           TIME (HHMMSS)
H2600
H2600*************************************************************************
H2600             FORMAT OF RECEIVER RECORD
H2600      COLUMN
H2600           1           'R'
H2600         2-5           RECEIVER NUMBER
H2600        6-14           MAP GRID EASTING IN METERS
H2600       15-23           MAP GRID NORTHING IN METERS
H2600       24-27           RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600       28-31           RECEIVER NUMBER
H2600       32-40           MAP GRID EASTING IN METERS
H2600       41-49           MAP GRID NORTHING IN METERS
H2600       50-53           RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600       54-57           RECEIVER NUMBER
H2600       58-66           MAP GRID EASTING IN METERS
H2600       67-75           MAP GRID NORTHING IN METERS
H2600       76-79           RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600          80           STREAMER CODE
H2600
H2600*************************************************************************
H2600 STREAMER AND TAILBUOY NUMBERING INCREMENTS FROM STARBOARD TO PORT
H2600
H2600 STREAMER  1: RECEIVERS NUMBERED  480 (FAR) TO    1 (NEAR)
H2600 STREAMER  2: RECEIVERS NUMBERED  960 (FAR) TO  481 (NEAR)
H2600 STREAMER  3: RECEIVERS NUMBERED 1440 (FAR) TO  961 (NEAR)
H2600 STREAMER  4: RECEIVERS NUMBERED 1920 (FAR) TO 1441 (NEAR)
H2600 STREAMER  5: RECEIVERS NUMBERED 2400 (FAR) TO 1921 (NEAR)
H2600 STREAMER  6: RECEIVERS NUMBERED 2880 (FAR) TO 2401 (NEAR)
H2600
H2600 STREAMER ROTATIONS HAVE BEEN APPLIED ON A SHOT BY SHOT BASIS.
H2600
H2600 INLINE MISCLOSURES ARE DERIVED ON A SHOT BY SHOT BASIS.
H2600 THESE INLINE MISCLOSURE VALUES ARE DISTRIBUTED LINEARLY OVER THE ACTIVE
H2600 STREAMER LENGTH. THE CORRECTED STREAMER LENGTH IS USED TO COMPUTE THE
H2600 FINAL RECEIVER POSITIONS.
H2600
H2600*************************************************************************
H2600 NAVQC
H2600*************************************************************************
H2600 PGS JOB NUMBER 2007112
H2600
H2600 ALL SHOTS FOR ALL STREAMERS ARE INCLUDED IN THIS FILE, DATA NOT TO BE
H2600 PROCESSED (NTBP) IS INDICATED BELOW AS NECESSARY.
H2600
H2600 LINES CONTAINED IN THIS FILE:
H2600
H2600 LINE: --------              SEQUENCE:  ---   FSP:   ----   LSP:   ----
H2600
H2600 FOR SEISMIC DATA EDIT, PLEASE SEE THE OBSERVERS LOG
```

12.5 P6/98 Full fold coverage perimeter

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H0100 3D SURVEY NAME            BRANDT, BLOCK T/35P, AUSTRALIA
H0200 BIN GRID DESCRIPTOR       ACQUISITION
H0300 GEODETIC DATUM NAME       WGS84
H0400 ELLIPSOID-AXIS-INV FLAT   WGS84        6378137.000 298.2572236
H0500 PROJECTION METHOD          002  U.T.M. SOUTH
H0510 PROJECTION ZONE NAME      ZONE 54
H0530 LON OF CM (DMS E/W)        1410000.000E
H0600 DESCR OF LINEAR UNITS     1 INTERNATIONAL METERS     1.000000000000
H0700 DESCR OF ANGULAR UNITS    1  DEGREES
H0800 BIN GRID ORIGIN (Io,Jo)     1001.0000   1001.0000
H0900 BIN GRID ORIGIN (E,N)        684156.39E   5587358.86N
H1000 SCALE FACTOR AT (I,J)     1.0000000000      0.0000      0.0000
H1100 NOM BIN WIDTH ON I AXIS    25.0000
H1150 NOM BIN WIDTH ON J AXIS    18.7500
H1200 GRID BEAR J AXIS (DMS)     1435212.000
H1300 BIN NODE INCREMENT I AXIS     1.000
H1350 BIN NODE INCREMENT J AXIS     1.000
H1400 COORDS (I,J,E,N) FST NODE   1001.0000   1113.0000    685394.59  5585662.73
H1401 COORDS (LAT,LON) FST NODE   395131.802S  1431002.538E
H1410 COORDS (I,J,E,N) SEC NODE   1001.0000   1451.0000    689131.30  5580544.05
H1420 COORDS (I,J,E,N) GEN PNT    1535.0000   1451.0000    678348.76  5572672.63
H2300 DATA EXTENT BIN GRID        1901.0000   1001.0000   2069.0000   1001.0000
H2400 DATA EXTENT MAP GRID        5587358.86  5557986.40   694106.22   662591.30
H2501 DATA EXTENT GEOG (N/S)      395037.795S   400638.690S
H2502 DATA EXTENT GEOG (E/W)     1431621.690E  1425415.979E
H2700 NUMBER OF PERIMETERS       1
H3101 FULL FOLD COV # OF NODES     3
H3201 FULL FOLD COV (I,J,E,N)     2069.0000   1001.0000    662591.30  5571616.02
H3201 FULL FOLD COV (I,J,E,N)     1001.0000   1001.0000    684156.39  5587358.86
H3201 FULL FOLD COV (I,J,E,N)     1001.0000   1901.0000    694106.22  5573729.24
H3201 FULL FOLD COV (I,J,E,N)     2069.0000   1901.0000    672541.13  5557986.40
H8002 EPSG PROJECTED CS NAME    WGS84  /UTM 54S
H8003 EPSG PROJECTED CS CODE    32754
H8006 EPSG DATABASE VERSION      6.13
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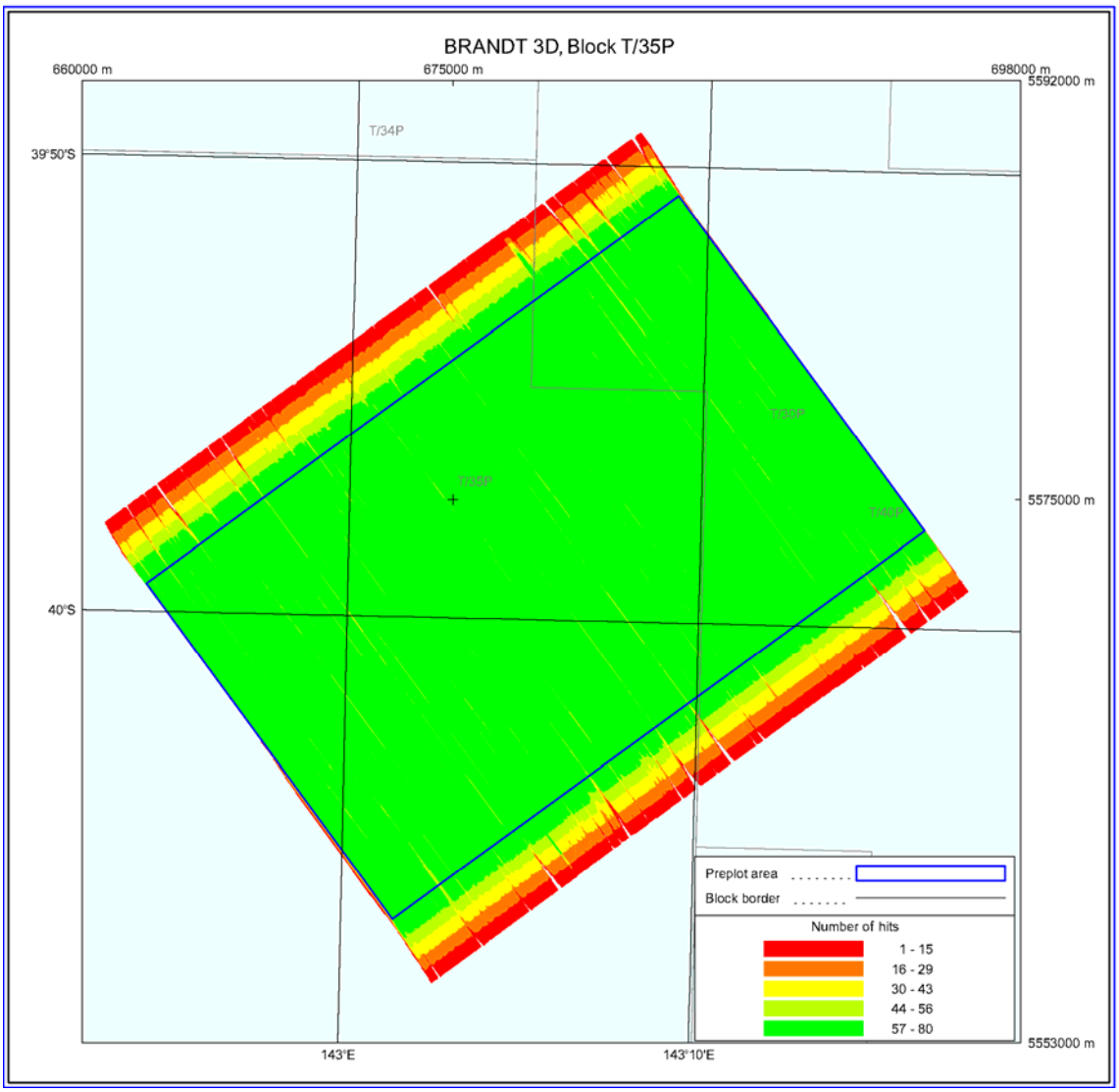
12.6 Coverage plot, Alls noflex



11.6 Cetacean sightings

Marine mammal sightings (cetaceans only) during the Santos, T/35P MSS between 27th February – 28th March 2008

Sight No.^	Time (AEST)	Vessel Position (lat/long)	Distance from vessel (m)*	Distance from Source (m)	Species	Group Size	Activity	Seismic Status	Mitigation Action	Line No. & Standby time (hrs)
1 06 Mar 08	11:55	39 59.34 143 15.75	100	300	CD	5	not defined	FP	NA	SOSN08-1102P1-039 Nil
2 07 Mar 08	10:57	39 54.81 143 05.11	2000-1500	1500	CD	20	feeding	FP	NA	SOSN08-1378F1-044 Nil
3 21 Mar 08	16:20	38 37 - 144 15 -	2000	NA	SRW	1	milling	NG/transit	NA	-
4 21 Mar 08	16:30	38 37.75 144 15.74	5000	NA	ULC	1	not defined	NG/transit	NA	-
5 22 Mar 08	09:35	39 30.07 143 22.42	3000-1000	NA	BW	2	slow travel	NG/deployment	MON	-
6 22 Mar 08	11:06	39 35.26 143 18.40	5000	NA	ULC	1	not defined	NG/deployment	NA	-
7 23 Mar 08	10:13	40 14.04 143 18.93	5	450	CD	15	bowriding	cyc/testing	NA	SOSN08-1654F1-101 Nil
8 27 Mar 08	09:09	40 14.32 142 59.86	4000-700	750	ULC	1	slow travel	NG/weather	MON	SOSN08-1774F2-112 Nil
9 27 Mar 08	10:23	40 11.25 143 07.21	5000-1800	1800	BW	2	resting/milling	cyc/testing	MON	SOSN08-1774F2-112 Nil

Key:

BW=blue whale
SRW=southern right whale
HB=humpback whale
BD=bottlenose dolphin
CD=common dolphin
ULC=unidentified large cetacean
USC=unidentified small cetacean

FP=full power
SS=soft start
NG/LT=no source active during line turn
cyc/LT=cycling of a single source during line turn
PD=power down to single source
* First sighting distance - closest approach
SD=shut down

no source active
NA=no action
NG/weather=no source active due to poor weather conditions
NG/technical=no source active due to technical problems
MON=monitor sighting
^ Cumulative sighting number