Geokinetics (Australasia) Pty Ltd

FINAL REPORT

2012 Bellevue-Pinelands-Jen&Argyle 2D Seismic Survey

CLIENT	:	QGC Pty Ltd
AREA	:	Surat Basin, Queensland
Contract	:	Reference No. 114767CNT – Amendment #1
COUNTRY	:	Australia
DATE OF SURVEY FROM	:	24 September 2012
DATE OF SURVEY TO	:	13 December 2012
DATE OF REPORT	:	8 January 2013
METHOD OF SURVEY	:	2D Land – Reflection Seismic Survey

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Table of Significant Dates

Project's Landmarks	
Signing of contract	26 July 2012
Contract Amendment#1	11 September 2012
Surveyors commence operations	24 September 2012
Advance party arrives	26 September 2012
Line preparation commences	29 September 2012
Independent Vibe Tests completed	1 October 2012
Recording Crew move in to base camp / Site inductions completed	6 October 2012
Crew procedure reviews and training	7 October 2012
Commence data acquisition	8 October 2012
Data acquisition Argyle 2D completed	13 November 2012
Data acquisition Jen 2D completed	19 November 2012
Line preparation completed	28 November 2012
Line Survey Operation completed	2 December 2012
Data acquisition Bellevue 2D completed	8 December 2012
Data acquisition Pinelands 2D completed	12 December 2012
All line equipment packed up	13 December 2012
Recording crew depart for Spofforth project	13 December 2012
Final Report	8 January 2013

601 Curtin Ave East,
Pinkenba QLD 4008, Australia

Statement of Quality

The survey reported herein has been conducted according to the standards specified in the contract covering the Work.

In the absence of such contractual standards, the survey has been conducted in accordance with the instructions of the Client or by the Technical Operating Standards of Geokinetics (Australasia) Pty Ltd.

To the best of our knowledge and belief the survey included no deviations from the set standards, either of letter or spirit, which are not specifically reported and justified in the following pages.

Dave Stegemann
Regional Operations Manager Australasia
Geokinetics (Australasia) Pty Ltd

1 ABSTRACT

A 2D Reflection high resolution land Seismic Survey totalling 335.77 line kilometres was carried out in Surat Basin, Queensland, Australia, from 24 September 2012 to 13 December 2012 (from the start to finish of all operations). The survey was known as the 2012 Bellevue-Pinelands-Jen&Argyle 2D Seismic Survey.

The work was carried out under a geophysical agreement between Queensland Gas Company Pty Ltd (hereinafter QGC) and Geokinetics (Australasia) Pty Ltd (Hereinafter Geokinetics). Under the signed contract; dated 26 July 2012 and its supplementary amendment #1 that was active on 11 September 2012, Geokinetics acquired data on a day rate basis, directly controlling survey, recording, HSE, and all related subcontractor services.

A Sercel 428XL recording system was mobilised for the project, connected to Input / Output (I/O) SM-24 geophones (6 geophones per group) planted on the surface at 10m or 15m receiver station intervals. The main seismic energy source employed was Input / Output Inc. AVH IV (60,000 lb) Vibroseis. Source array was a single Vibroseis unit, centred on the source point at 10m or 15m interval. The seismic source produced a single linear 14 second record length (10 second sweep length and 4 second listening time), with 6-80 Hz sweeping frequency. Dual onSEIS IHI IC-70 units were also used to produce seismic signals where the Vibrators were unable to access, or ground conditions were too wet or boggy for the Vibrators to safely operate. The onSEIS source array was two Geokinetics proprietary Dual onSEIS units with two pops per shot point. Field data acquisition method was Ping-Pong between two fleets of Vibroseis or onSEIS units. At the completion of the seismic program a total of 27,836 Vibroseis Points were acquired, with 1,672 VPs were skipped due to safety reasons, field obstacles, and similar operational / logistical reasons. Where possible, some of the Vibroseis limited access points were acquired with onSEIS units. A total of 1,318 VPs were acquired with onSEIS units out of the mentioned project's VPs total.

Complete Survey and Geophysics departments were fielded, equipped with the required field systems, computer hardware and processing software. Data quality monitoring was performed on a daily basis and seismic data processing was performed to a field 2D brute stack stage. Geokinetics' information management system Matrix was used to manage large volumes of recording and positioning metadata and to collate the required information for SPS file production.

2 OPERATIONAL OVERVIEW

2.1 Introduction to Operations

Queensland Gas Company Pty Ltd (hereinafter ‘QGC’) contracted Geokinetics (Australasia) Pty Ltd (hereinafter ‘Geokinetics’) to conduct a 2D Land Vibroseis Reflection Seismic Survey which was carried out in the Surat Basin, Queensland – Australia from 24 September 2012 to 13 December 2012. The 2012 Bellevue-Pinelands-Jen & Argyle 2D Seismic Survey is located approximately 12 kilometres south east of Miles and approximately 330 kilometres northwest of Brisbane.

Seismic Survey field operations was carried out from Geokinetics ‘Crew 488’ base camp that was located on QGC land close to the Warrego highway, 12 kilometres outside of Miles. The 2D seismic lines were widely distributed with the longest distance to the 2D lines was at approximately two hours’ commute from Base Camp.

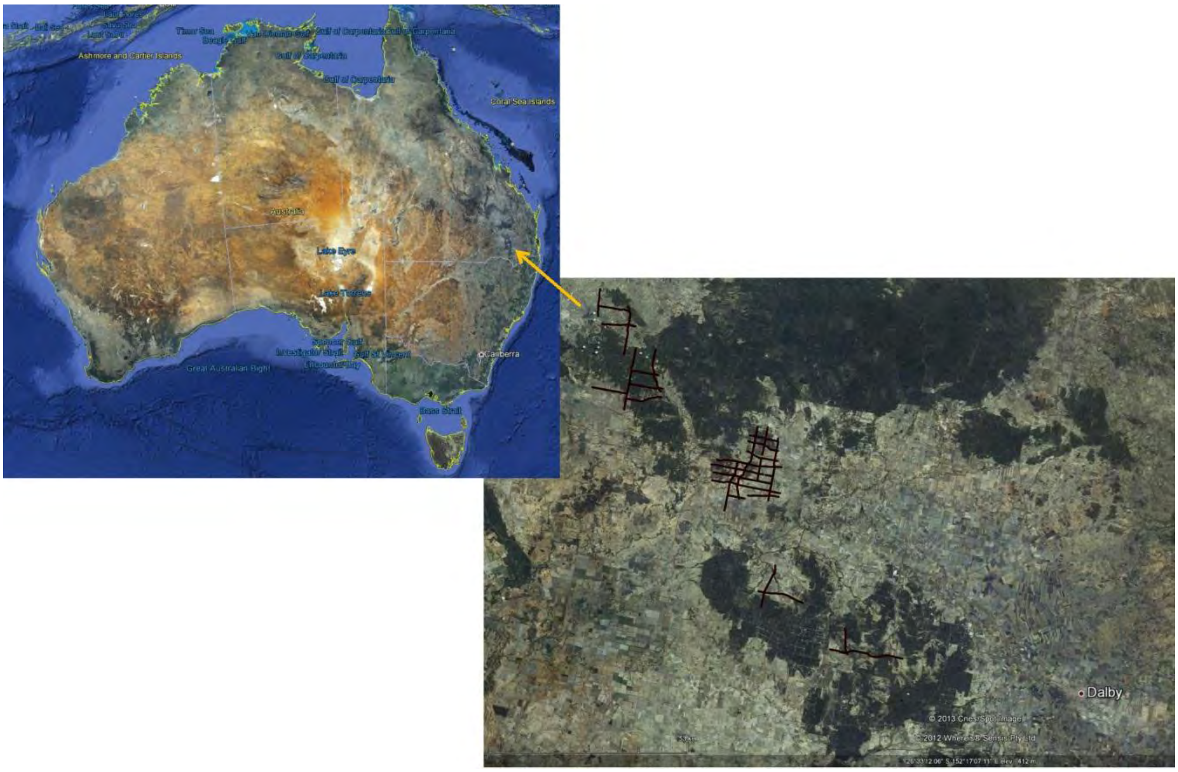


Figure 1. Seismic 2D lines location Map

Figure 2. 2012 Bellevue 2D seismic lines

Figure 3. 2012 Pinelands 2D seismic lines

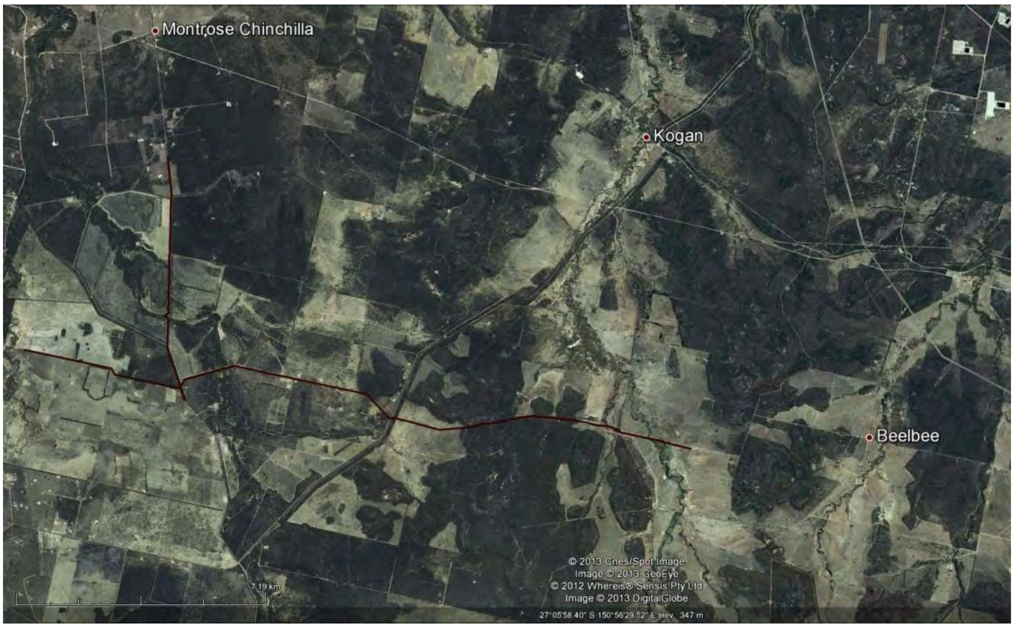


Figure 4. 2012 Jen 2D seismic lines

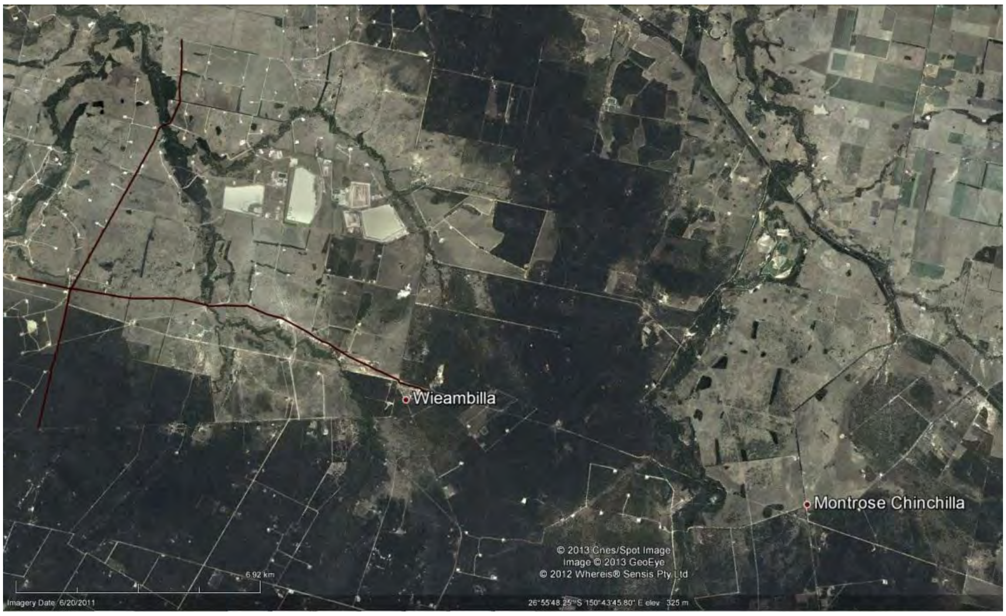


Figure 5. 2012 Argyle 2D seismic lines

2012 Bellevue-Pinelands-Jen & Argyle 2D Seismic Lines covered many exploration blocks. Table 1 lists the exploration blocks for the different areas.

Area	Exploration Block
Bellevue	ATP676, PL211, PLA 459
Pinelands	ATP574, ATP632, DAA11, PL171, PLA392, PLA393
Jen	PL278, PL442, PL273
Argyle	PL180, PL228, PL278

Table 1. Project's exploration blocks summary

The Geokinetics' advance party consisting of the Project Manager, HSE Advisor, Journey Manager and Survey Crew mobilised to the survey area on 26 September 2012. Site specific inductions and training was performed with the recording crew on 6 and 7 of October 2012. Once the crew 488 field start-up approvals had been signed off; the crew started laying out of the field line equipment on the afternoon of 7 October 2012 with seismic acquisition commencing on 8 October 2012. Data acquisition was completed on 12 December 2012. Crew demobilisation was completed on 13 December 2012.

2.2 Summary of Operations

The project consisted of 29,508 Vibroseis Points (VPs); 27,836 VPs acquired plus 1,672 VPs categorically skipped due to reasons beyond the field operation, along twenty eight 2D seismic lines (Table 2).

	Area	Seismic Line	Group Interval m	# Rec Points	Rec Line Km	#VP	VP Line Km
1	Bellevue	BEL12-010	10	1707	17.07	1708	17.08
2	Bellevue	BEL12-007	10	1778	17.78	1779	17.79
3	Pinelands	PIN12-013	10	999	9.99	1000	10.00
4	Pinelands	PIN12-119	10	971	9.71	972	9.72
5	Pinelands	PIN12-018	10	1216	12.16	1217	12.17
6	Pinelands	PIN12-010	10	1722	17.22	1723	17.23
7	Pinelands	PIN12-007	10	754	7.54	755	7.55
8	Pinelands	PIN12-005	10	431	4.31	432	4.32
9	Pinelands	PIN12-006	10	1363	13.63	1364	13.64
10	Bellevue	BEL12-004	10	1383	13.83	1384	13.84
11	Bellevue	BEL12-115	10	473	4.73	474	4.74
12	Bellevue	BEL12-011	10	1609	16.09	1610	16.10
13	Argyle	ARG12-008	10	1210	12.10	1117	11.17
14	Argyle	ARG12-005	10	1261	12.61	1112	11.12
15	Jen	JEN12-015	10	729	7.29	580	5.80
16	Jen	JEN12-003	10	2033	20.33	2034	20.34
17	Bellevue	BEL12-013	15	1263	18.95	1264	18.96
18	Bellevue	BEL12-006	10	2099	20.99	2100	21.00
19	Bellevue	BEL12-003	15	586	8.79	587	8.81
20	Bellevue	BEL12-005	15	584	8.76	585	8.78
21	Bellevue	BEL12-001	15	538	8.07	539	8.09
22	Bellevue	BEL12-008	15	981	14.72	982	14.73
23	Bellevue	BEL12-215	15	564	8.46	565	8.48
24	Bellevue	BEL12-009	15	1136	17.04	1137	17.06
25	Pinelands	PIN12-009	15	648	9.72	649	9.74
26	Pinelands	PIN12-005	10	730	7.30	731	7.31
27	Pinelands	PIN12-021	15	508	7.62	509	7.64
28	Pinelands	PIN12-002	15	598	8.97	599	8.99
			Project Total	**29,874**	**335.77**	**29,508**	**332.16**

Table 2. Project's total source / receiver efforts summary

2.3 Terrain, Access and Weather

The terrain throughout the survey area was undulating with undulating elevation changes along sections of the survey lines. The surface elevation ranged between 291.7 metres (along 2D line ARG12-008 ST#2792) to 449.8 metres (along 2D line PIN12-006 ST#1001) above mean sea level.

The project traversed over many private properties; all vehicles and source units were certified as being weed and seed free by Weed Hygiene Inspection Services (WHIS) before commencing work on the prospect area. Throughout the prospect a gate management system was in place informing the crew if a third Party washdown or non-certified washdown was required to enter the property. Where third party wash-downs' were not required, trained Geokinetics personnel conducted the wash-downs' and inspections on purpose built washdown pads coupled with Crew 488 fire fighting/washdown trailers. All non-certified activities were recorded in log books for future reference. This documented evidence and on site observation confirmed the barriers set in place were adhered to and all personnel, vehicles and equipment remained free of organic matter prior to departing one property and entering another. On three separate occasions the crew was approached by landowners requesting to see the third party certificates.

Two Geokinetics owned mobile washdown units and one WHIS contracted unit conducted all wash-down activities in the field and some vehicle wash-downs' were carried out in the base camp. Washdown waste was filtered, collected, stored and disposed of in accordance to prescribed requirements.

The main access routes were the Leichardt Highway and the Warrego Highway, many other public roads, private roads, land owner tracks and fence lines were also used as required. A Bob Cat mounted slasher/mulcher unit was utilised for gaining access to the 2D lines supplied by Mascot Drilling and Earthmoving. A total of 246.3 kilometres were slashed and a total of 10.77 kilometres were mulched for the project. To minimize the threat of starting a fire during the line preparation operations, the services of the Corporate Protection Australia Group (CPAG) were employed to be with the line preparation team at all times. Geokinetics crew 488 also introduced our own fire fighting vehicle manned by a qualified fire fighter. Along with these two units Mascot supplied a 1,500 litre trailered water tank that was also with the operation at all times. All dedicated fire fighting vehicles were equipped with qualified staff, a suitable sized water tank, fire fighting pump and a range of ancillary equipment including knapsacks, rake hoe's, lights and siren and a UHF two-way radio.

Mascot also supplied a fencing team to help with crew access throughout the prospect, a total of 38 permanent gates were erected and a total of 33 temporary fences were erected. Thirty two gate/fence repairs were also carried out on the prospect.

QGC Land Liaison Officers (LLO) maintained steady dialogue with landowners to facilitate the required access under predetermined conditions. Continued communications between field crew members, QGC LLO's and the observers assisted in timely responses to landowner related activities and any eventualities. The gate signage system supplied by QGC greatly improved the passing of weed hygiene information required to enter each individual property. The signs clearly stated the line number, gate number, if gate should be closed or open, washdown type required; either Certified, weed free or no washdown required. These signs also made it extremely simple that if a vehicle approached a gate that did not have a sign in place that it was not part of the permitted survey area and should not be entered. On one occasion the crew's prime mover used an unauthorized entrance to a property to enable him to safely turn the truck around, this was reported to the crew management and he was reprimanded for trespassing.

Vehicle traffic within the survey area was managed as per the traffic management plan by Workforce International. During the survey any heavy traffic identified on the live spread was reported and noted for reference.

Throughout the survey the crew's mobile recording vehicle and antenna trailer was located on the 2D lines. This allowed for the best communications to the Vibroseis, line crew and survey crew at all times.

Data acquisition progressed under close consultation with QGC to ensure that all environmental, health and safety requirements were adhered to. Good planning, detailed and precise implementation of procedures and policies from all parties involved managed to achieve the best outcomes within the prevailing conditions.

By far these four combined projects have proved to be the most testing and challenging projects ever encountered by Crew 488. The biggest challenge encountered was permitting and access, especially in the Bellevue area. The shooting sequence was altered many times, not enabling the whole crew (including Survey and line preparation) to work to their optimal performance levels. Due to permits / access limitations, additional time was required for the Crew in postponing the operation along a 2D line, and move to another line/prospect, then to go back the same line after gaining the required permits. The crew experienced many delays and standby due to permitting, access and working between the four prospects with changing recording sequence that wouldn't allow for a smooth transition between the 2D lines.

To enable the crew to work on the "Brown Fields" it was necessary for 12 key personnel to be trained in Gas detection, Risk Assessment and Permit to Work. These certified permit holders have also been required from time to time to perform their duties on other QGC owned properties.

Through the project the crew encountered properties which involved simultaneous operations with other companies and contractors whose prerequisites for entry demanded specific training accreditation. Examples of which were MacMahon's Cameby mine operations and Origin Energy parcels on the prospect. Current documentation of proof of completion of fit for work medicals and illicit drug testing for each employee and subcontractor had to be provided before entry into the mine. All vehicles entering the mine site had to be compliant with mine specifications and be audited prior to entry to the mine site.

From the weather point of view, the project duration was at the time of the year where the temperatures were starting to warm up to summer in the Western Downs. Humidity increased and during the hotter days took its toll on the line crew, restricting their working ability as it was necessary for the crew to take frequent breaks to get out of the heat. The official reported temperatures ranged from 3 degrees to 41 degrees throughout the project.

2.4 Administration Facilities

The majority of crew administration tasks were handled through Geokinetics Office in Brisbane; all other administrative needs on crew were managed by the Project Manager. All personnel arriving on crew completed a Geokinetics Crew 488 HSE induction, KJM Camp Induction along with a QGC HSSE induction.

2.5 Crew Accommodation

Crew 488 base camp was located in privately owned QGC land in a contracted KJM camp located off the Warrego Highway, approximately 12 kilometres south-east of the township of Miles. Offices for the Project Manager, Assistant Project Manager, HSE, Geophysics and Survey departments; along with crew, client and sub-contractor accommodation are within the Base Camp. All meals are provided by the camp catering staff.

During the advance and initial survey / scouting phase of operations the advance crew used rented houses in Miles as a base and accommodations before moving into the base camp on the 6 October 2012.

2.6 Communication

Communication with Geokinetics and QGC Brisbane Offices was conducted via;

- VSAT internet connection
- Voice over internet provider phones
- Mobile phones
- Satellite Phones

Land based operational communications were conducted via vehicle two-way and hand-held VHF and UHF radios. Operational discussions were the only radio communications allowed outside emergency procedure, while lengthy communications were held on a separate channel to ensure that production proceeded without disturbance. The recorder had cell phone coverage utilizing a booster antenna.

2.7 Permits and Public Relations

Permitting and Public Relations activities were handled by the QGC. These items are outside the scope of this report.

Geokinetics ensures all vehicles and trailers were weed and seed inspected prior to arriving on site, certificates were issued by WHIS and strict guidelines were followed by the crew to ensure all vehicles were kept as clean as possible at all times, vehicle interiors are also detailed on a weekly basis.

3 SURVEY AND POSITIONING

3.1 Overview

Topographic survey operation began on 24 September 2012 and was completed on 2 December 2012. Prior to crew mobilization to the survey area, land survey preparation was conducted on all equipment. GPS systems verification was performed at Miles base camp. Survey techniques used during the 2012 Bellevue-Pinelands-Jen & Argyle seismic survey were Real Time Kinematic (RTK) for receiver positions and dGPS for source positioning.

3.2 Survey Parameters

The geodetic parameters for the project was Universal Transverse Mercator Map Grid of Australia (MGA) zone 56S and GDA94 datum. The details of the grid and spheroid coordinate system are as follows:

Spheroid	GRS80
Datum	GDA94
Semi-Major Axis	6,378,137.000 metres
Reciprocal of Flattening	298.257222101
Projection	Transverse Mercator
Grid Zone	MGA zone 56 S
Latitude of Origin	000° 00’ 00”
Central Meridian	153° 00’ 00”
False Easting	500,000 metres
False Northing	10,000,000 metres
Scale Factor along C.M.	0.9996
Vertical Datum	AHDa

Table 3. Geodetic Parameters GDA94 MGA Zone 56 S

3.3 ITRF 2000 Frame

Australia sits at the leading edge of the giant Indo-Australian Plate, the plate moves in a north-easterly direction.

GDA94 is coordinate datum based on ITRF92 at the fixed epoch of 1994.0. ITRF coordinates will in general differ from GDA94 coordinates for two main reasons, namely tectonic motion of the Australian landmass and reference frame differences. Tectonic motion of the Australian landmass is approximately 7cm/year in the NNE direction. Differences between the ITRF92 coordinate reference frame and the ITRF2000 are at the several cm in magnitude. A standard 7-parameter transformation can adequately model these differences at the cm level, provided the 7-parameter transformation parameters are regularly updated to reflect the tectonic motion. (Adopted from paper of International Terrestrial Reference Frame – ITRF to GDA94 Coordinate Transformation; Geoscience Australia; Australian Government).

During the project “GDA – ITRF2000” datum was applied to transform DGPS Omnistar coordinates on Vibroseis units using GPSeismic software. Since Omnistar network are referencing to ITRF2000 frame. The detail GDA – ITRF2000-2012.5 geodetic parameters and datum shift is:

Spheroid	GRS80
Datum	GDA – ITRF2000-2012.5
Semi-Major Axis	6,378,137.000 metres
Reciprocal of Flattening	298.257222101
Shift Method	Bursa-Wolf (7 parameters)
Datum Shift from GDA94 to WGS’84	(geodetic; on GPSeismic sign)
DX to WGS’84 (m)	-0.0614
DY to WGS’84 (m)	0.0664
DZ to WGS’84 (m)	0.1731
Rotation X	-0.021690
Rotation Y	-0.017749
Rotation Z	-0.022313
Scale (ppm)	-0.001210
Projection	Transverse Mercator
Grid Zone	MGA zone 56 S
Latitude of Origin	000° 00’ 00”
Central Meridian	153° 00’ 00”
False Easting	500,000 metres
False Northing	10,000,000 metres
Scale Factor along C.M.	0.9996
Vertical Datum	AHda

Table 4. GDA IGS – ITRF2000 Datum; MGA zone 56S

GDA94 was adopted for horizontal datum and vertical datum was using Australian Height Datum using AUSGEOID98 geoids model. The AusGeoid98 Geoids model was adopted as the geoids-ellipsoid separation (N) model and was used over the survey lines. The Geoids model was used to convert from ellipsoidal heights (h) to the adopted MSL height.

3.4 Vertical Datum

The vertical datum for this project was AHD derived from a survey Permanent Marker close to the project area. The Permanent Marker used for the vertical datum was 29403 and 32805 (4th order vertical). The project's benchmarks were derived by GPS static observation using AUSGEOID98 geoids model.

3.5 Survey – Equipment Employed

Survey department equipment that was fielded during the course of the Bellevue-Pinelands-Jen & Argyle 2D Seismic Survey is listed below:

Land Survey Equipment	Quantity
Trimble R7 system	6
Novatel PROPAK-V3-XP-G2	6
Garmin GPSMAP78 Handheld GPS	13
NAVMAN 65T	23

Table 5. Land Survey Equipment List

The Trimble R7 GPS receiver system was utilized to observe static control network and to measure receiver station coordinates by RTK technique that running two RTK rovers which setup on two survey vehicles and one RTK base.

Novatel PROPAK-V3-G2 GPS receivers are setup integrated with Garmin GPSMAP3206 display for Vibes navigation system, this integrated system allowed the vibes operator to navigate to the source point.

Receiver positions were marked by water base spray paint (canning) or degradable paint marker with spraying paint machine that paint sprayed to the ground. This spray paint system is peg less marker and environment friendly. Geophone receiver layout crews using GPSMAP78 handheld GPS to find receiver position and relationship number of the paint marker.

Figure 6. Degradable paint spraying machine mounted below GPS antenna

The Garmin GPS displays digital map background under IMG typical Garmin format that is usually generated by Mapedit and CGPSmapper. The digital map shows unique number and position for receiver or source points, and displays topographic features such as access routes, creeks, gates, fences, boundaries and hazard locations (boggy patch, deep whole, no access track etc.).

Office Equipment and Program	Quantity
Laptop Computer – Alienware Work Station	1
A3 printer HP Officejet 7000	1
GPSeismic version 2011.4 (RTK processing program)	1
Trimble Business Centre (For Static observation)	1
ArcGIS 9.3 (mapping program)	1
Global Mapper version 13 (mapping program)	1
Map Source 6.15.11 (Garmin program)	1
Mapedit 1.0.64.1 (IMG format mapping program)	1
cGPSmapper (IMG format mapping program)	1

Table 6. Survey Office Equipment List

3.6 Survey - Methods Employed

3.6.1 Equipment Calibration

The GPS system were checked in Tasmania camp site after completion of 2012 Barra 2D seismic survey project on 16 August 2012 and well before the advance party departing towards the prospect area.

Instrument verification was carried out on the survey equipment prior to the commencement of survey operations in the field. Five sets of instruments were verified into two seasons, and involved receiver serial number: 5014K23752, 5023K30746, 5023K30734, 5023K30735, 5014K23763.

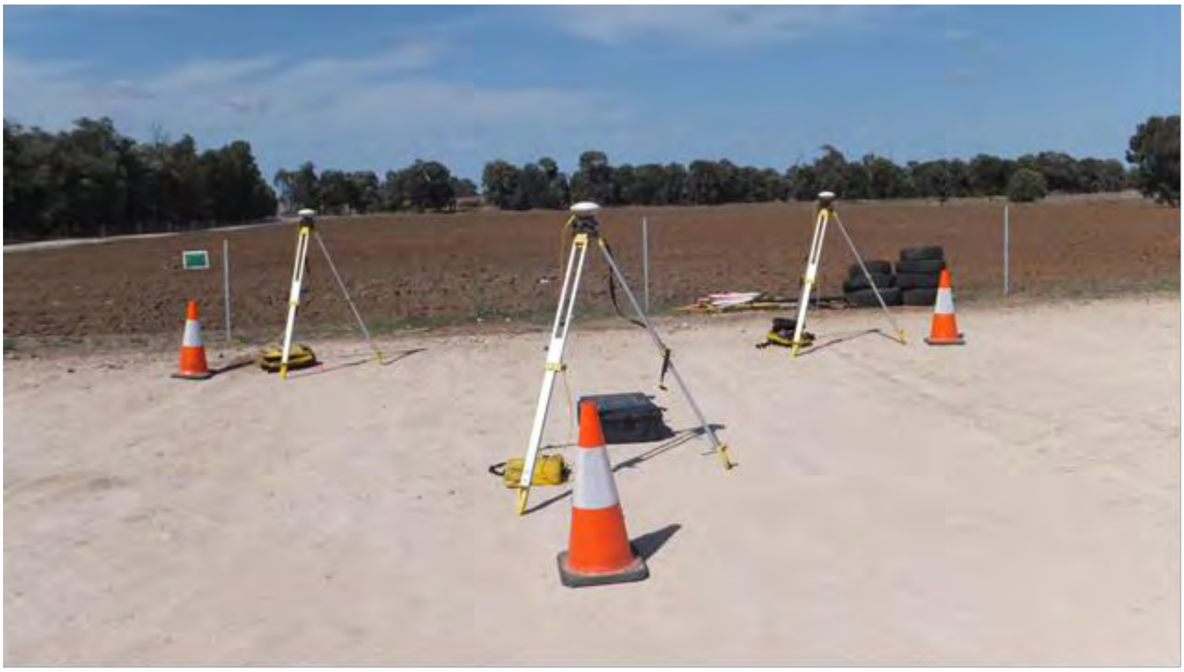


Figure 7. Trimble R7 Receiver Verification at Tasmania Base Camp

A measured 5m by 5m square was set up and one point in the middle and the distances between the points measured accurately with a measuring tape. The GPS units were then set up on the same time at five points logging data.

At the completion of the observation period the data was processed using Trimble Business Centre software and the resulting GPS baselines were compared with the taped baselines.

3.6.2 GPS Control Point Survey

The survey operation consisted of four different areas with the Crew Base Camp was located within Bellevue prospect. Pinelands prospect was about 100 km northwest of Bellevue, while Jen and Argyle were at almost the same distance toward the southwest from Bellevue. In order to cover the entire operation with good radio signal from the project's Base Station, six new control points were established within the area in addition to the existing control points.

Initially, five first order control points were established with reference to two government control points. Then, the rest of the control points were installed in reference to the first order control points.

The project's control station was tied to Australian national survey markers. The survey markers coordinate and information could be found on the website:

http://dds.information.qld.gov.au/DDS/Search.aspx

The project Coordinate system: GDA94 datum and MGA zone 56 S projection, AHDa vertical datum, and AUSGEOID98 geoid model.

Figure 8. Static observation on 185028 national control network

STATION	LATITUDE	LONGITUDE	EASTING	NORTHING	ELLIPSOID H	LOCAL H
33842	-27 03 08.378900406	150 48 53.027557077	283257.43	7005888.55	432.949	391.594
83412	-26 43 06.296097109	150 17 30.399809760	230577.013	7041887.95	352.988	312.256
89357	-27 02 33.413018978	150 45 56.095329995	278362.24	7006879.24	370.932	329.758
149842	-27 08 08.785624770	150 49 01.988486317	283664.9	6996646.31	400.245	359.166
149843	-27 07 05.083314736	150 45 36.752200384	277978	6998507.58	393.224	352.314
153013	-26 56 56.447387174	150 35 39.546432923	261170.66	7016938.85	353.006	312.17
153033	-26 55 25.471278837	150 46 18.473620366	278746.48	7020062.28	359.851	318.19
158495	-27 07 07.807418042	150 41 33.828695470	271288.53	6998302.64	391.05	350.48
158518	-27 02 50.083885558	150 26 38.917724077	246476.65	7005759.46	365.292	325.47
158521	-27 02 28.551677762	150 24 20.208599503	242639.52	7006344.14	360.142	320.446
159908	-26 56 25.633356004	150 22 37.771002935	239583.38	7017458.27	342.717	302.706
159913	-26 56 49.677502199	150 26 05.183276831	245321.13	7016835.55	341.907	301.712
159914	-26 57 31.242526645	150 27 31.794210838	247736.37	7015604.29	349.892	309.654
168624	-26 41 16.078443365	150 16 07.997885857	228226.129	7045232.47	375.751	334.955
176261	-26 52 45.805385434	150 50 43.080466576	285963.41	7025103.13	361.984	319.886
176657	-26 57 26.919414045	150 24 40.534778805	243009.24	7015641.43	346.433	306.372
176658	-26 58 47.642685042	150 34 37.438162480	259522.97	7013483.23	353.053	312.42
176671	-26 57 27.751440170	150 30 03.041852727	251906.51	7015795.01	350.18	309.768
176672	-27 03 53.419828890	150 37 25.599808148	264338.16	7004158.91	367.157	326.694
176675	-27 01 41.924324172	150 35 47.934183740	261569.43	7008155.58	359.117	318.61
176676	-27 05 46.169812555	150 39 46.732698455	268291.94	7000761.08	373.281	332.772
176678	-27 05 55.528982877	150 42 13.007907843	272327.02	7000547.25	392.851	352.16
176679	-27 06 56.905822855	150 49 55.883501061	285110.89	6998884.48	391.029	349.836
176680	-27 06 41.751540458	150 47 56.217264881	281806.72	6999293.63	408.25	367.152
177500	-26 59 53.892793196	150 22 34.920906122	239637.98	7011045.28	366.072	326.31
177501	-27 00 02.500568850	150 22 35.818666973	239668.25	7010780.8	362.223	322.47
177502	-26 56 24.971388352	150 27 36.422780976	247823.04	7017646.96	347.218	306.896
177503	-26 39 53.001008096	150 16 19.606609890	228492.45	7047796.966	401.85	360.923
177505	-26 59 33.117806964	150 27 56.060224155	248481.1	7011865.91	350.018	309.892
177507	-26 59 14.049906697	150 25 01.882436196	243665.63	7012355.49	354.727	314.77
177508	-26 56 50.488510637	150 24 40.285885801	242979.39	7016762.81	343.053	302.948
178876	-26 57 31.220004094	150 27 31.608027154	247731.22	7015604.88	349.92	309.682
178882	-27 01 50.736739224	150 34 34.738537030	259556.84	7007845.66	357.547	317.13
178883	-27 04 05.327691869	150 34 40.510119460	259795.64	7003705.62	360.289	320.024
178884	-27 03 52.980016244	150 37 25.910267265	264346.46	7004172.61	367.3	326.836
178885	-27 06 43.352647196	150 37 54.278955338	265227.01	6998942.88	369.686	329.378
178886	-27 06 45.037117097	150 40 55.114994782	270209.27	6998983.92	383.175	342.636
183507	-27 09 59.338991979	150 43 00.402952347	273769.15	6993066.22	397.544	357
183511	-27 09 47.347878668	150 46 25.755099791	279416.27	6993536.95	401.184	360.36
183523	-26 20 04.954387632	149 59 44.361009292	200105.474	7083758.269	418.291	376.915
183986	-27 00 49.487377891	150 38 06.852004553	265368.69	7009842.15	359.319	318.596
183988	-26 56 54.213160125	150 38 07.500534554	265250.89	7017084.67	355.793	314.78
183989	-26 56 56.292251054	150 41 42.777033077	271190.66	7017130.4	363.984	322.732
183990	-26 59 20.630314342	150 46 19.805703597	278910.88	7012824.72	411.795	370.396
183991	-26 59 22.216469976	150 49 28.755984393	284121.93	7012866.8	402.379	360.776
183992	-27 09 13.690435617	150 36 11.788775546	262492.11	6994261.52	370.016	329.982
183993	-27 09 31.564459045	150 39 06.341130626	267308.89	6993802.2	375.36	335.128
185028	-26 25 04.937399536	150 03 06.815502067	205933.477	7074651.767	412.8	371.585
185029	-26 29 19.334596523	150 04 46.415307955	208872.617	7066882.266	402.049	361.041
185032	-26 40 36.114388412	150 24 31.211691884	242116.695	7046753.223	361.323	319.9
185033	-26 44 11.994195777	150 24 09.328597752	241647.006	7040095.236	366.861	325.76
189024	-26 40 21.595215493	150 20 21.017004046	235188.084	7047057.714	363.194	322.046
189025	-26 42 32.288001727	150 19 50.669102952	234433.004	7043016.778	352.88	311.947
189030	-26 46 55.082105449	150 16 57.045315270	229805.349	7034824.878	354.86	314.471
BEL01	-26 38 07.418013232	150 22 41.855265835	238998.37	7051268.93	372.906	331.401
PINE01	-26 31 52.958355975	150 01 58.415155765	204327.523	7062045.538	398.896	358.212
PINE02	-26 30 29.615002618	149 56 50.226149716	195730.747	7064411.264	423.117	382.586
PINE03	-26 30 57.393048312	150 00 01.377150717	201046.026	7063680.927	425.086	384.428
PINE04	-26 27 33.335705787	150 01 03.963945976	202633.672	7070004.19	483.197	442.246
PINE-05	-26 17 15.921576284	149 56 06.204719161	193929.454	7088820.51	353.889	312.521

Table 7. Control Network Station and Survey Marker Coordinates List

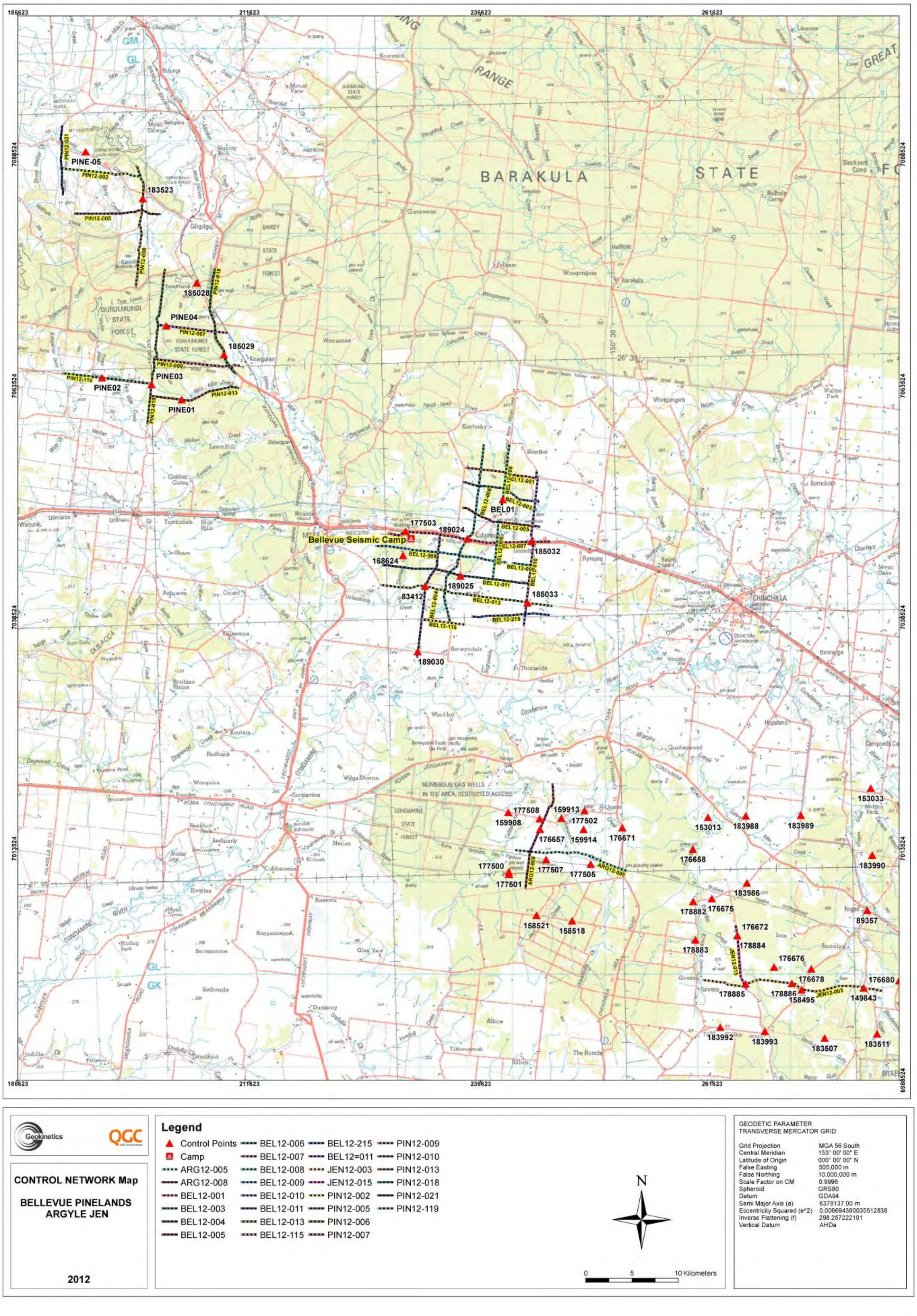


Figure 9. Survey Control Stations Network Map

3.6.3 RTK Surveying

RTK (Real Time Kinematic) was used to stake out receiver locations. Similar to all other differential GPS techniques, RTK depend on receiving of simultaneous information from two GPS sensors, a reference and a rover. The main difference with RTK is that no post processing for the data is required to achieve centimetre level accuracies. The reference station is set up on a point with known coordinates. The reference station then transmits its fixed coordinates and raw received data via radio modem to the roving station, where the necessary computations are performed. All kinematic surveys require initialisation before centimetre level accuracies are obtainable. Initialisation is the process by which the integer ambiguities are resolved. If a substantial loss of lock on a number of satellites occurs (for example under foliage), then the system needs to be re-initialized. Dual frequency receivers such as the Trimble R7 system can take advantage of algorithms which enable initialisation while the unit is moving. This is commonly termed on-the-fly (OTF) initialization. The Trimble R7 system equipment comprised a controller terminal, GPS sensor, GPS antenna and a radio modem.

Permanent survey markers that were established during the control survey were used as RTK base stations. Check readings were observed on previously surveyed points at the start and end of each working day and after each initialization, to verify correct system operation. Check readings confirmed that the radio link was working; that the proper coordinates had been used at the base; that the proper instrument heights had been entered at the base and rover and that the resolution of ambiguities was correct. All check and repeat observations were compared with known and previously surveyed results and monitored.

Figure 10. RTK base station at PIN05

Preplot coordinates were uploaded into the RTK units at survey office and were copied into the controller. The controller also stored all field-surveyed coordinates and survey quality control information; for later processing. 2 RTK rover survey units and one base station were used during the survey operations. One RTK crew consisted of one surveyor and one vehicle.

Some of the survey lines were along roads and tracks, however, some others were in paddy fields area. Possible detours were marked to cross the creeks, some of which required a 4WD to be engaged.

Some of the seismic 2D lines crossed environmentally sensitive zones. Vibroseis points offsets and path detours were carefully selected through these zones. For such zones, the Crew also deployed the environmentally friendly seismic source; Geokinetics proprietary onSEIS, to manoeuvre through narrow sectors of the seismic lines as an alternative/infill to the Vibroseis where possible. Backpack RTK surveys were deployed within the sensitive areas.

Five Vibroseis and five Dual onSEIS units were used as seismic energy sources during data acquisition. The final source position was calculated to the centre of gravity (COG) that was located at the centre of the vibroseis base pad or in the centre of the onSEIS two units. All source units (Vibroseis and onSEIS) were equipped with navigation systems. The system consisted of a differential GPS receiver that receives corrections from satellites and an integrated navigation system (INS) display. GPS NovAtel Propak-V3- XP G2system received differential GPS from the wide-area differential GPS satellite network, OmniSTAR. The Vibes and onSEIS units were also fitted with Garmin GPSMap 3206, a display unit which shows topographical features, source unit position and pre-plot shot point locations.

Figure 11. RTK survey by backpack

3.7 Survey set up and Quality Controls Deployed

3.7.1 Survey Data Processing

Survey data processing was conducted at base camp. Survey data was received and processed on a daily basis. Dynamic Survey Solution's GPSeismic version 2011.4 software package was used as the primary data management and processing software. The software was also used to generate pre-plot files, populate database files to survey applications, perform datum transformations, process RTK data, QC the survey data and generate the output data in the required formats.

GPS static control network processing was conducted using Trimble Business Centre 2.50 software.

3.7.2 Survey Data Quality Control

Crew 488 survey department procedures were checked to ascertain that the correct geodetic parameters were being adhered to, under both industry standard and Geokinetics survey specifications. Preplot locations for each receiver and source line were checked independently against the original supplied coordinates. Base stations for RTK were checked by measuring check points closest to the bench mark on a daily basis before survey production commenced. No significant errors were found.

Preplot coordinates were generated from the recording parameters and also based on scouted clear seismic line by line clearing crew. Those coordinates that were slightly modified due to field conditions followed detours that were cleared to avoid boggy patches and also followed the mulched track in the thick bush areas.

From the topographic/navigation survey point of view, the specifications (contractual standards) for the seismic survey can be evaluated by two components:

- The deviation of the staked out position to the pre-plot designed location.
- The absolute accuracy of the post-plot/final coordinates.

The combined effects of these two components provide the final accuracy. As a good practice; these parameters need to be checked on a regular basis.

3.7.3 Prepare map and upload coordinates into navigation unit

Preparation and updating the project's map onto the Crews' vehicles Garmin and Navman navigations system was a daily routine. Postplot source and receiver positions, fences, gates, protected zones, hazards and detour routes were uploaded on the navigation systems to assist the drivers. Strip maps for the recording crew were also prepared with similar types of information.

Figure 12. Crew 488 standard vehicle navigation system

Figure 13. Garmin Navigation system for all crew

3.7.4 COG comparison

At the end of data acquisition along each of the 2D lines, the QC department provided the COG data for all shots to verify and compare preplot locations against the final COG positions. In case of anomalies and unexplained offsets, a reshoot decision could be reached after a discussion with the QC department and the Observer.

COG Conversion				Preplot Source points				Vlookup value							Distance
2118325	212281.1	6937120	271.2	2109945	195855.6	6939752	272	2118325	212280.4	6937120.5	271.2	-0.7	0.4	0.0	0.9
2118305	212242	6937125	271.4	2109955	195875.4	6939750	272	2118305	212240.8	6937125.1	271.4	-1.3	0.1	0.0	1.3
2114775	205229.3	6937938	265.4	2113545	202961.3	6938766	265	2114775	205228.2	6937937.5	265.4	-1.1	-0.5	0.0	1.2
2114765	205208.8	6937940	265.4	2113555	202981.4	6938768	264	2114765	205208.4	6937939.6	265.4	-0.4	-0.2	0.0	0.5
2114755	205188.9	6937942	265.4	2113565	203001.3	6938769	264	2114755	205188.2	6937941.6	265.4	-0.7	-0.3	0.0	0.8
2114745	205169.6	6937944	265.4	2113575	203021.1	6938771	264	2114745	205168.5	6937943.5	265.4	-1.1	-0.1	0.0	1.1
2114735	205149.2	6937946	265.3	2113585	203040.9	6938771	264	2114735	205148.7	6937945.5	265.3	-0.5	0.0	0.0	0.5
2114725	205129.4	6937948	265.3	2113595	203060.7	6938769	264	2114725	205128.9	6937947.2	265.3	-0.5	-0.3	0.0	0.6
2114715	205118.7	6937948	265.1	2113605	203080.5	6938766	264	2114715	205109.6	6937951	265.1	[illegible]	2.7	0.0	9.5
2114705	205091.3	6937958	265.1	2113615	203100.3	6938763	264	2114705	205091.3	6937958.4	265.1	0.0	0.0	0.0	0.0
2114695	205075.2	6937968	265.1	2113625	203120.2	6938761	264	2114695	205074.3	6937968.2	265.1	-0.9	0.1	0.0	0.9
2114685	205058.7	6937979	265.1	2113635	203140.1	6938758	263	2114685	205057.5	6937979.3	265.1	-1.2	0.8	0.0	1.4
2113065	202009.4	6938876	266	2115255	206181.9	6937829	272	2113065	202008.7	6938875.7	266	-0.7	-0.3	0.0	0.7
2113055	201989.2	6938879	266.2	2115265	206202.7	6937826	272	2113055	201989	6938878.9	266.2	-0.3	-0.3	0.0	0.4
2113045	201969.7	6938882	266.3	2115275	206222.9	6937824	272	2113045	201969.3	6938882	266.3	-0.4	-0.4	0.0	0.6
2113035	201949.3	6938885	266.4	2115285	206242.2	6937822	273	2113035	201949.5	6938884.8	266.4	0.2	-0.7	0.0	0.7
2113025	201929.8	6938888	266.6	2115295	206261.1	6937820	273	2113025	201929.6	6938887.3	266.6	-0.2	-0.6	0.0	0.6
2113015	201909.8	6938891	266.8	2115305	206280.9	6937817	273	2113015	201909.7	6938889.8	266.8	-0.1	-0.9	0.0	0.9
2113005	201890.1	6938893	266.9	2115315	206301.5	6937815	273	2113005	201889.4	6938892	266.9	-0.7	-1.0	0.0	1.2
2112995	201868.9	6938895	267.1	2115325	206321.3	6937812	273	2112995	201869.6	6938894.7	267.1	0.6	-0.3	0.0	0.7
2112985	201851.2	6938898	267.3	2115335	206340.7	6937810	274	2112985	201850.2	6938897.8	267.3	-1.0	-0.4	-0.1	1.1
2112975	201829.3	6938901	267.4	2115345	206361	6937808	274	2112975	201830.4	6938900.3	267.4	1.1	-0.2	0.0	1.1
2112965	201811	6938902	267.6	2115355	206380.8	6937806	274	2112965	201810.7	6938902.9	267.6	-0.4	0.8	0.0	0.8
2112955	201791.6	6938906	267.7	2115365	206400.1	6937803	274	2112955	201790.9	6938905.8	267.7	-0.7	-0.4	-0.1	0.8
2112945	201774	6938909	267.7	2115375	206419.8	6937801	274	2112945	201771.1	6938908.5	267.7	-2.9	-0.3	0.0	2.9
2112935	201751.5	6938911	267.8	2115385	206440.1	6937799	275	2112935	201751.3	6938910.6	267.8	-0.2	-0.8	0.0	0.8
2112925	201731.7	6938914	267.8	2115395	206460.3	6937797	275	2112925	201731.3	6938912.9	267.8	-0.4	-0.8	0.0	0.9
2112915	201713.2	6938916	267.8	2115405	206479.9	6937794	275	2112915	201711.4	6938915.3	267.8	-1.8	-0.5	0.0	1.9
2112905	201693.4	6938919	267.8	2115415	206499.9	6937792	276	2112905	201693.1	6938917.8	267.8	-0.3	-0.8	0.0	0.8
2112895	201688.8	6938918	267.8	2115425	206519.7	6937789	276	2112895	201675.9	6938920.7	267.8	[illegible]	2.6	0.0	6.2
2112885	201651.5	6938922	267.7	2115435	206539.5	6937786	276	2112885	201659.4	6938922.9	267.7	[illegible]	0.8	0.0	7.9
2112875	201644.6	6938920	267.7	2115445	206559.5	6937784	277	2112875	201642.3	6938923.7	267.7	-2.3	3.6	0.0	4.2
2112865	201618.9	6938924	267.6	2115455	206579.4	6937781	277	2112865	201623.4	6938924.2	267.6	4.5	-0.2	0.0	4.5
2112855	201604.8	6938927	267.6	2115465	206598.6	6937779	278	2112855	201603.6	6938926.4	267.6	-1.2	-0.3	0.0	1.2
2112845	201585.4	6938929	267.5	2115475	206618.4	6937776	279	2112845	201584	6938929.3	267.5	-1.4	-0.1	0.0	1.4
2112835	201566.6	6938932	267.4	2115485	206638.7	6937773	280	2112835	201564.2	6938932	267.4	-2.4	-0.1	0.0	2.4
2112825	201546.2	6938935	267.2	2115495	206659.2	6937771	281	2112825	201544.2	6938934.4	267.2	-2.0	-0.2	0.0	2.0
2112815	201527.7	6938937	267	2115505	206679.2	6937769	282	2112815	201524.3	6938936.9	267	-3.4	0.0	0.0	3.4

Table 8. Example of a COG Comparison

3.8 Survey Field Operations

3.8.1 Survey Field Operations

RTK GPS positioning techniques were employed during the course of the survey for line layout. In some places, such as at creek crossings or areas with thick canopy, where GPS signals are obstructed, the chaining method was also utilised. Within environmental sensitive zones survey was conducted by backpacking.

3.8.2 Hazard Mapping

Good planning and preparation is the key to a successful survey outcome. For this project, good preparation meant building a features database and present safe access to the surveyed lines and display hazard location along the access. Scouting was conducted at the start of project before production to identify the hazard in survey area.

The main challenges of this seismic operation were to follow the seismic lines access rules and vehicles/equipment wash-down. There was limited access to the paddy areas, in addition to the project's requirement for a certified wash or weed and seed to enter most of the properties within the survey area. Access to properties was strictly limited to certain gates with a special QGC sign posted at the gate. The survey advanced party erected these signed based on the Client's instruction.

Figure 14. Well-marked access gate

Most of the seismic lines required slashing or mulching as a preparation before the seismic operation. Environmentally sensitive zones where line preparation was not allowed; detours and line offsets were implemented. Detour signs and other hazards marks such as pot holes, boggy patches; were established on the ground to assist the other crew members.

Figure 15. Hazards marks and a hand carry section

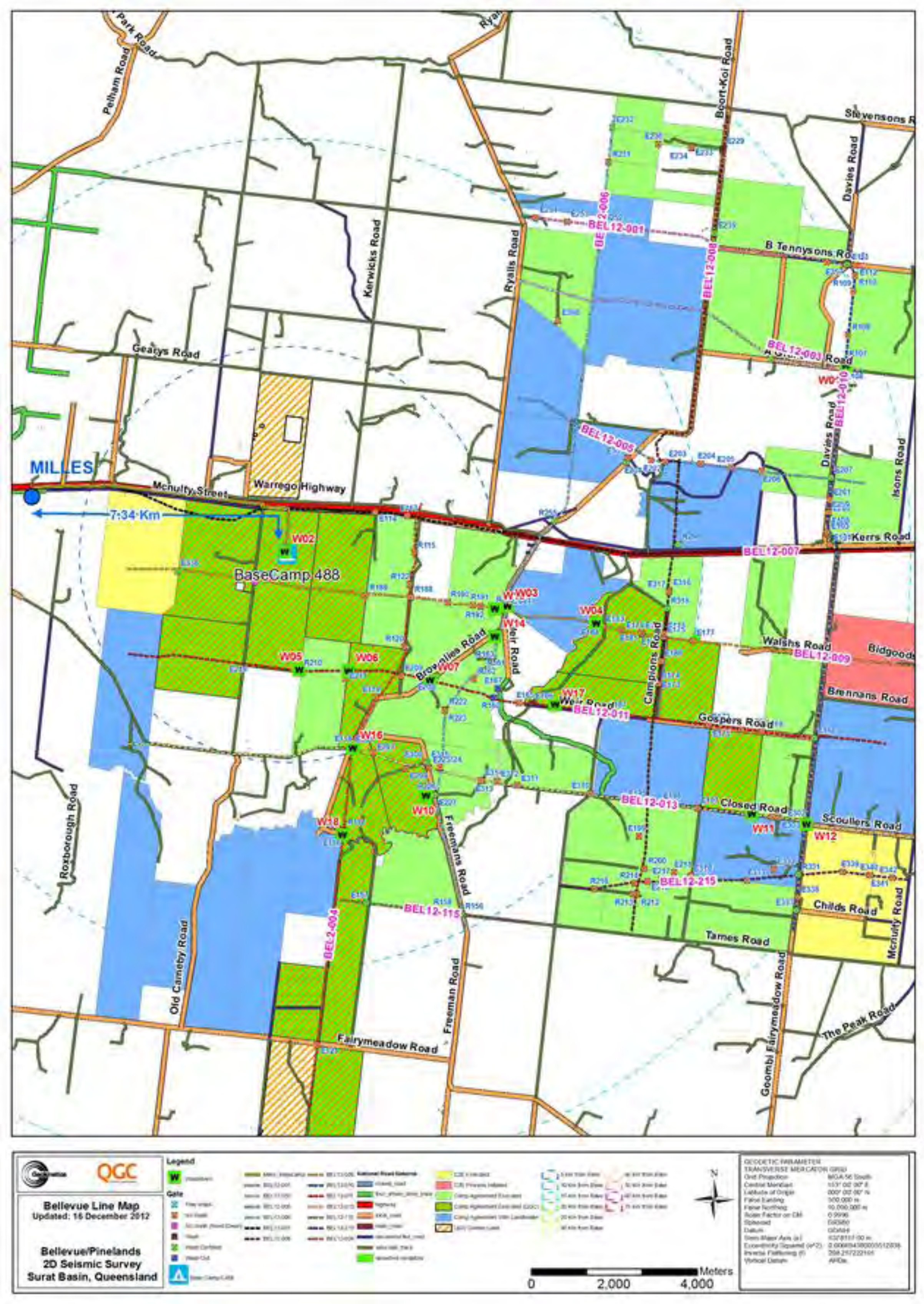


Figure 16. Bellevue 2012 logistic / mud map

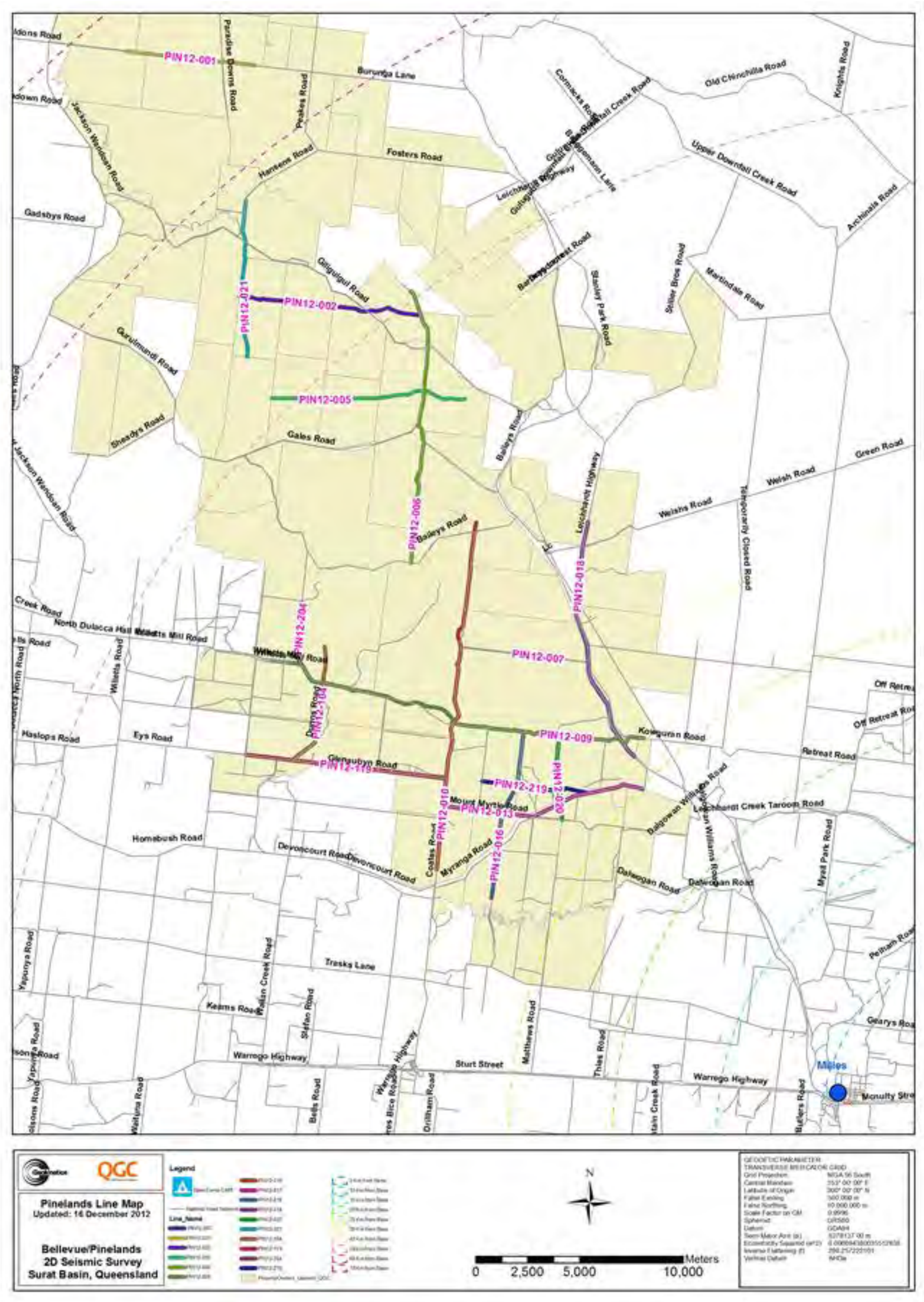


Figure 17. Pinelands 2012 logistic / mud map

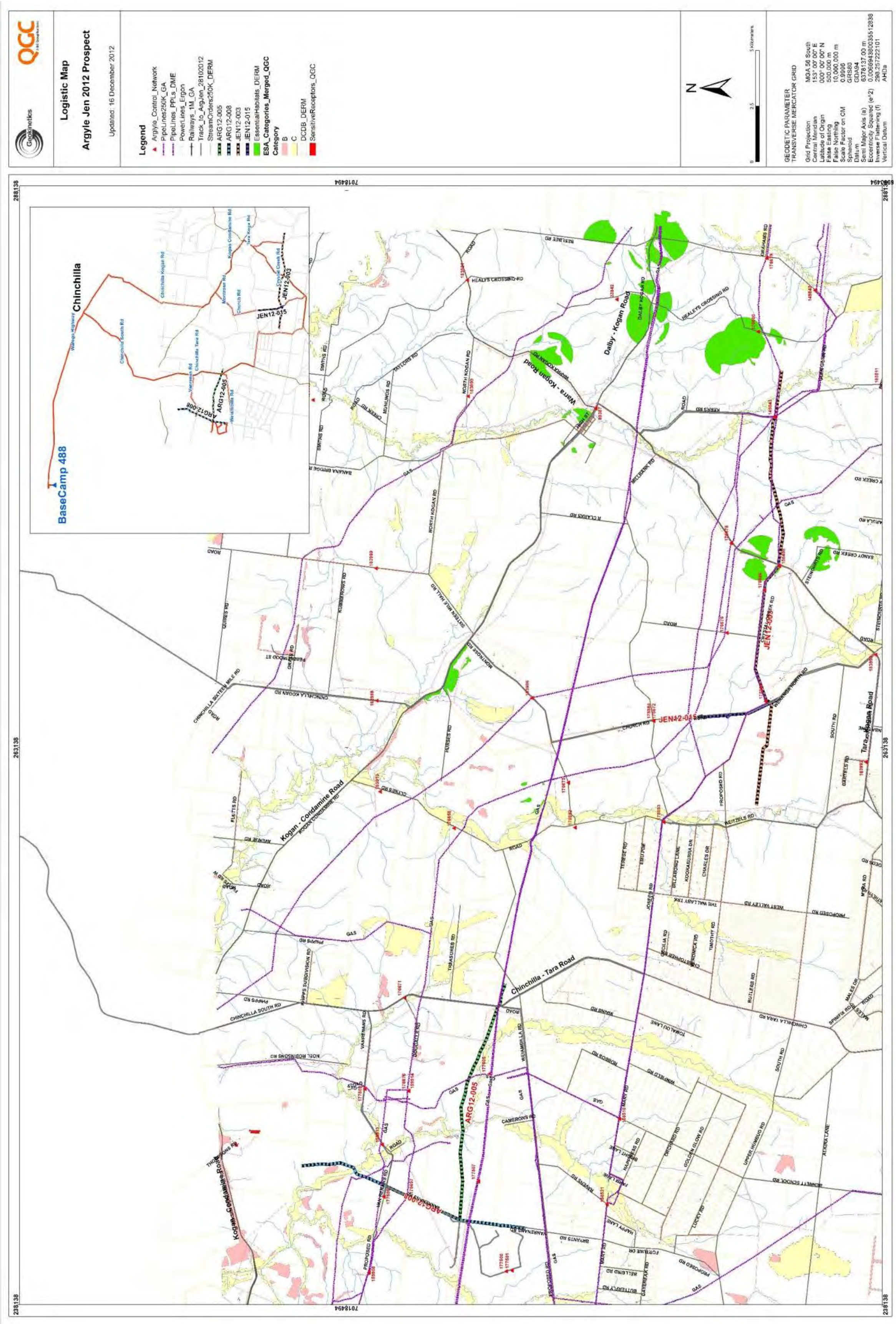


Figure 18. Jen and Argyle 2012 logistic / mud map

3.9 Source Point offsets guidelines

According to the signed contract, Crew 488 deployed two calibrated and tested Instantel MiniMate Plus units. Additional two real time PPV monitors were requested by the Client Representative and two Textel GTM / ETM monitors were deployed for the operation. Trained PPV operators joined the field crew throughout the project's duration equipped with the required software and hardware to implement peak particle velocity (PPV) tests.

Figure 19. Crew 488 MiniMate Plus unit

Figure 20. Real Time Texcel ETM and GTM PPV monitors

Peak Particle Velocity generated by the project's seismic source were monitored on selected sites, initially to estimate the operating safe distance to the seismic source and then to monitor the PPV values along sectors of the 2D lines close to manmade, natural structures, infrastructures and buildings for future references if required. All PPV testing activities were strictly supervised by QGC onsite Client Representatives. Using the project's logistic / mud map, the Client Representatives decided on PPV sites selections; test duration, test configuration and layout. Crew 488 PPV test operator conducted the tests then provided the acquired PPV data and analysis to the Client Representative.

Based on the PPV test within the surveyed area in addition to QGC accumulated previous PPV experience, the Client Representative provided the safe distance to the project's seismic source for different types of structures and a range of source efforts/arrays. The field crew adhered to the safe distance specification throughout the operation. Copies of the PPV tests data, analysis and reports were parts of the project's data shipment.

		AHV IV 60,000lbs				**onSEIS**
Structure	PPV (mm/s)	Offsets (m) 2Vibs, full drive	Offsets (m) 2Vibs, half drive	Offsets (m) 1Vib, full drive	Offsets (m) 1Vib, half drive	Offsets (m) 2 onSEIS Dual Units
Cemetery, Ancient Monuments	2	100	100	100	100	100
Residence or Barn, Bridge	2	100	100	100	100	100
Gas Compressor	3	50	50	50	50	50
Water Well	3	50	50	50	50	50
Gas Flare	5	25	18	18	16	25
Drill & Work-over rig	5	25	18	18	16	25
High pressure pipeline > 15 Bar	5	25	18	18	16	25
Petrol Station	5	25	18	18	16	25
Oil Well / Valve / Manifold	5	25	18	18	16	25
Irrigation Head & Work	5	25	18	18	16	25
Structures and Facilities with Concrete base (not private)	5	25	18	18	16	25
Overhead Power Lines (post/pylon)	10	10	9	9	8	10
Reservoir / Dam	10	10	9	9	8	10
Buried Gas bearing Poly Pipeline	10	10	9	9	8	10
Low Pressure surface Pipeline	10	10	9	9	8	10
Buried Electrical / Communications Cable	10	10	9	9	8	10
Buried Water bearing Poly Pipeline	10	5	5	5	4	5

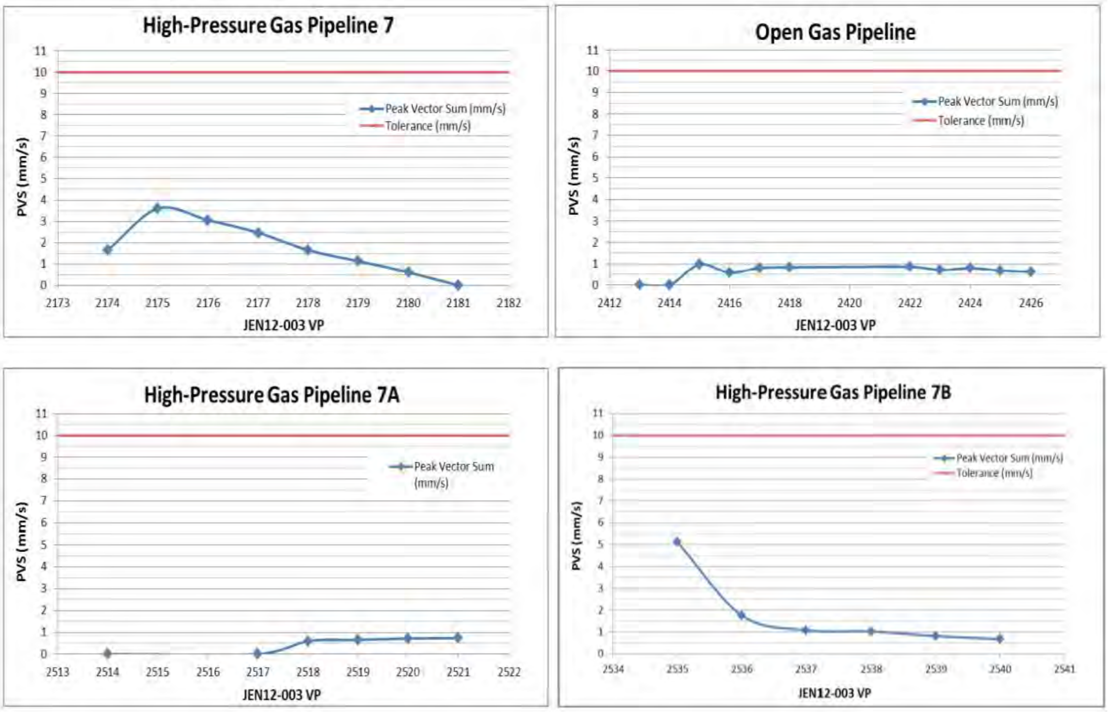
Table 9. QGC provided safe distance guidelines

Notes: 1- These distances should be used as a guide only, and PPV measurements should be taken live when the vibrators work close to Sensitive Receptors.

2- If the levels observed by the PPV operators approach or exceed the limits above, then the drive level should be reduced or the VP skipped.

PPV – Completed 16 November 2012

Jen12-003



PPV – Completed 26 November 2012

Bel12-006

Skip	Reason	VP
1216 - 1224	Pipeline	1207 – 1229
1401 - 1410	Pipeline	1397 – 1419
No Skip	Water Dam	1707 – 1729
2001 - 2022	Houses	1997 – 2025
2049 – 2081	School	2045 - 2085

Figure 21. Example of PPV test report

4 RECORDING OPERATIONS

The energy sources used for 2012 Bellevue-Pinelands-Jen & Argyle 2D seismic survey were five I/O AHV-IV (60,000 pound) vibrators units in addition to five Geokinetics proprietary Dual onSEIS units. The vibrators were out fitted with Sercel VE 432 vibrator electronics (DSD) and the onSEIS were fitted with SGD-SP synchroniser with seismic source TDMA decoder.

Figure 22. Crew 488 Vibroseis Units at star-up test

Figure 23. Crew 488 onSEIS Units next to a Vib

The recording system used for the survey was a 428xl (Line Controller Interface Unit 924439) manufactured by Sercel. The recording system was interfaced to a Sercel VE432 encoder (DPG) which initiated recording, provided QC for vibrator performance, and loaded parameters into the vibrator control electronics. Field hardware was comprised of 1500 Sercel 408 FDU (Field Digitizing Units). 1500 I/O SM-24 “6 x 1” geophone strings were utilised by the field crew.

Figure 24. Crew 488 Recorder and Radio Tower

2012 Bellevue-Pinelands-Jen & Argyle 2D seismic survey was an extension and a direct follow-up to 2012 Barra 2D seismic survey. Therefore Barra line equipment acceptance tests and the project's start-up tests were adopted for this operation. Further tests on the onSEIS units and the standard daily instrument tests were continued throughout the operation. Failed equipment was flagged, logged as faulty, and pulled out of operation then sent back to Brisbane Office for follow-up. Bad FDU's and geophones were repaired and retested to verify the integrity of the equipment prior to deployment. Geophones were tested using a Seismic Source Bird dog. FDU's were tested with a spare Sercel 408 recording system. A geophone rotation was completed in the Crew base camp over the course of the project utilising I/O SMT 300. All instrument tests were made available to the onsite client representative.

4.1 Recording Parameters

2012 Bellevue-Pinelands-Jen & Argyle 2D seismic survey recording parameters were provided by QGC and approved by the onsite QGC Client Representatives. The first version of the recording parameters was endorsed on 7 October 2012 and deployed along 2D line BEL12-010. Consequently other versions of the recording parameters were requested by QGC due to operational and geophysical reasons. The Crew adapted to these variations and employed requested recording parameters on the 2D seismic lines.

4.1.1 Recording Parameters Version 01

RECORDING

Recorder	Sercel SN428 XL, 24-Bit Telemetric
Source Control (Vib)	Sercel VE-432
Auxiliary Channels (Vib)	Aux 1 – Pilot Aux 2 – Return Ref Aux 3 – Sim GND Force Aux 4 – Time Break Aux 5 – Correlation pulse + Aux 6 – Correlation pulse - Aux 7 – 100 Hz Clock
Sweep Length (Vib)	10 Seconds
Listening Time (Vib)	4 Seconds
Record Length (Vib)	14 Seconds
Correlation Type (Vib)	Real time, unsummed uncorrelated and correlated data on tape. Both **Raw** and **Correlated** data will be saved.
Source Control (onSEIS)	SGD-SP synchroniser with Seismic Source TDMA Decoder (source driven capability)
Auxiliary Channels (onSEIS)	Aux 1 – Time Break Aux 2 – 100 Hz Clock
Record Length (onSEIS)	6 Seconds, then reduced to 4 Seconds
Sample Rate	2 ms
Data Format	SEG-D V2
Low Cut filter	Out
High Cut filter	0.8 Nyquist, 200Hz, Linear
Notch filter	Out
Preamp Gain	12 dB
Recording Media	NAS RAID Drive
Data Format	SEG-D, 8058
Polarity	SEG Normal

PHASE / POLARITY NOTES

Geophone Polarity	SEG standard; downward motion of seismonitor (tap on top of phone) results in a positive number on tape (Break Up on camera monitor)

Vibrator / System Polarity	True encoder reference signal (compensated for system filter response) is in phase with the weighted-summed accelerometer signal (sim out)

ACQUISITION GEOMETRY

Spread	Asymmetric Split with ± 3,000m minimum offset for each feet. Two fleets Ping-Pong production with fleet separation up to 1 km and acquiring odd and even VPs
In Line Offsets	0-----3km-----V1--1km--V2-----3Km-----0

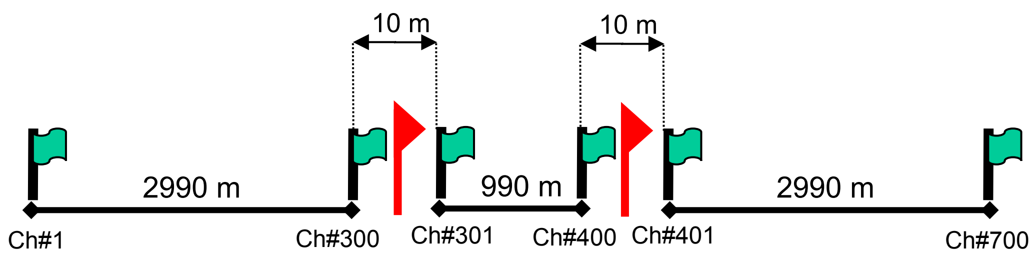


Figure 25. Recoding Spread Version 01

Full Spread	700 Channels
Sensor Interval	1.67 m
Sensor Type	IO SM-24
Source Point Interval	10 m
Source Line Offset from Receiver Line	2 m
Nominal Fold	350

SOURCE

Source Type 1	Vibroseis
Vibroseis Model	Input / Output Inc. AHV-IV
Control Electronics	Sercel VE 432
Communications	Motorola VHF Radio
Phase Locking Type	Ground Force
Amplitude Control	Peak to Peak
Hold Down Weight	60,000 lb.
Drive Level	80% (50% low force option)
Number of Vibrators per array	1
Sweeps per VP	1
Sweep Interval	10 m
Sweep Length	10 Seconds
Listening Time	4 Seconds
Record Length	14 Seconds
Sweep Frequency	6-80 Hz
Sweep Type	Linear

Sweep Tapers	300 ms Front end / 200 ms Back end
Sweep Array	Single point
Move Up	0 m
Inline Spacing	0 m
Cross Line Spacing	0 m
Array Length	0 m
Array Width	0 m
Source Type 2	Geokinetics onSEIS
onSEIS Model	Dual onSEIS
Carrier	IHI IC-70
Control Electronics	SGD-SP synchroniser with Seismic Source TDMA Decoder (source driven capability)
Electrical	Charge 850V DC, 3000A per magnet
Cycle time	6 Seconds
Vehicle Weight	28,250 lb.
Number of Baseplates per onSEIS	2
Baseplate separation	1.1 m
Number of onSEIS per array	2
Shot Point Interval	10 m
Number of pops per SP	2 pops individually recorded
Source Array Type	Linear Inline
Inter Array Move Up	0 m
Inline Spacing	6.8 m (between source COGs)
Cross Line Spacing	0 m
Array Length	7.9 m
Array Width	0 m

Table 10. 2D Recording Parameters Version 01

4.1.2 Recording Parameters Version 02

Version 02 recording parameters for 2012 Bellevue-Pinelands-Jen & Argyle 2D survey was generally similar to Version 01; apart from the following parameters:

Spread configuration	Symmetric Split Spread with ± 1,500m maximum offset. One Vibroseis per fleet; two fleets Ping-Pong production. Fleet spacing as close as possible within safe distances (approx. 100m), and acquiring odd and even VPs
In Line Offsets	0-----1.5km-----X-----1.5km-----0
Live channels	300 Channels
Nominal Fold	150

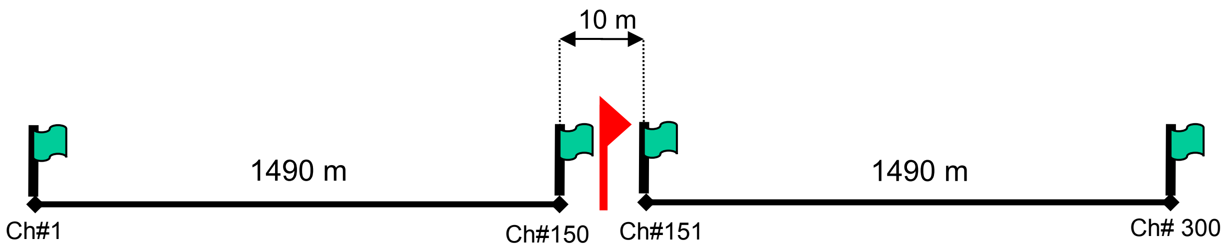


Figure 26. Recoding Spread Version 02

4.1.3 Recording Parameters Version 03

Version 03 recording parameters for 2012 Bellevue-Pinelands-Jen & Argyle 2D survey was generally similar to Version 01; apart from the following parameters:

Receiver Group Interval	15 metres
Source Group Interval	15 metres
Number of Live channels	468 Channels
Nominal Fold	234
Spread configuration	Asymmetric Split Spread with ± 3,000m minimum offset for each feet. Two fleets Ping-Pong production with fleet separation up to 1 km and acquiring odd and even VPs/VPs
In Line Offsets	0-----3km-----X1--1km--X2-----3Km-----0

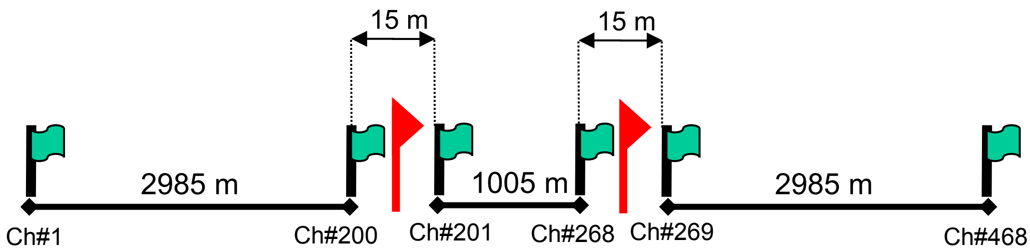


Figure 27. Recoding Spread Version 03

4.1.4 Recording Parameters Version 04

Version 04 recording parameters for 2012 Bellevue-Pinelands-Jen & Argyle 2D survey was generally similar to Version 01; apart from the following parameters:

Receiver Group Interval	15 metres
Source Group Interval	15 metres
Number of Live channels	402 Channels
Nominal Fold	201

Spread configuration	Asymmetric Split Spread with ± 2,500m minimum offset for each feet. Two fleets Ping-Pong production with fleet separation up to 1 km and acquiring odd and even VPs/VPs
In Line Offsets	0-----2.5km-----X1--1km--X2-----2.5Km-----0

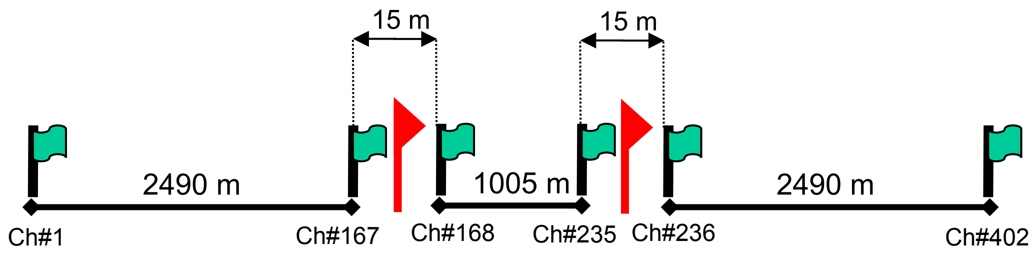


Figure 28. Recoding Spread Version 04

4.2 Source and Receiver Layout

4.2.1 Source Point Interval

The nominal source point interval was 10 metres (Version 01 and 02). For filed operation, the Vibroseis/onSEIS operators navigated to the source points as directed by GPS units that contained the preplot source point coordinates provided by the Survey Department.

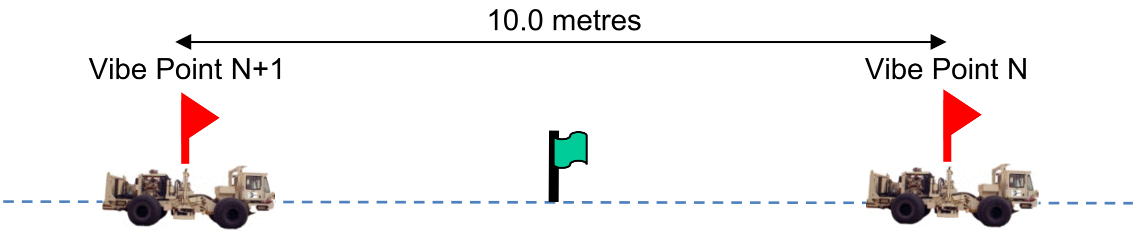


Figure 29. Vibroseis Source Array

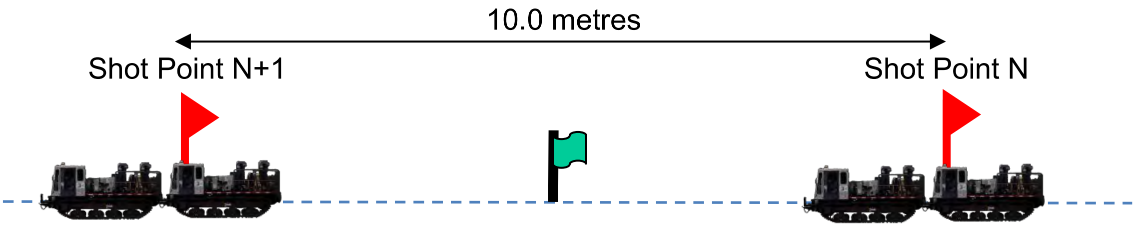


Figure 30. onSEIS Source Array

Note: For Recording parameters 03 and 04 source point interval was 15 metres.

4.2.2 Geophone Array

Geophone Array:

1- Normal array, 6 elements per string, one string per station, inline array.

2- Compressed array to maintain elevation difference of less than 2.5 m across the array due to obstructions.

3- Grouped / Bunched circular array where the elevation difference between geophone 1 and 6 more than 2.5 m

Note: All sensors; for all arrays above, shall be buried beneath the surface of the ground

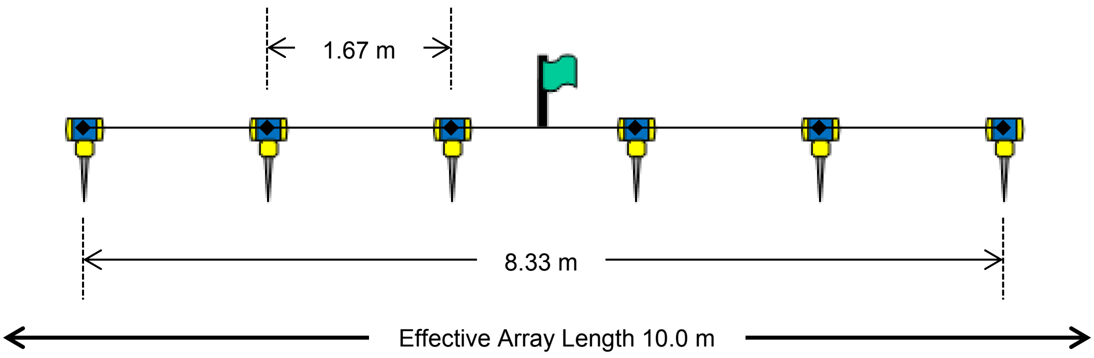


Figure 31. Normal Geophone Array V01 and V02

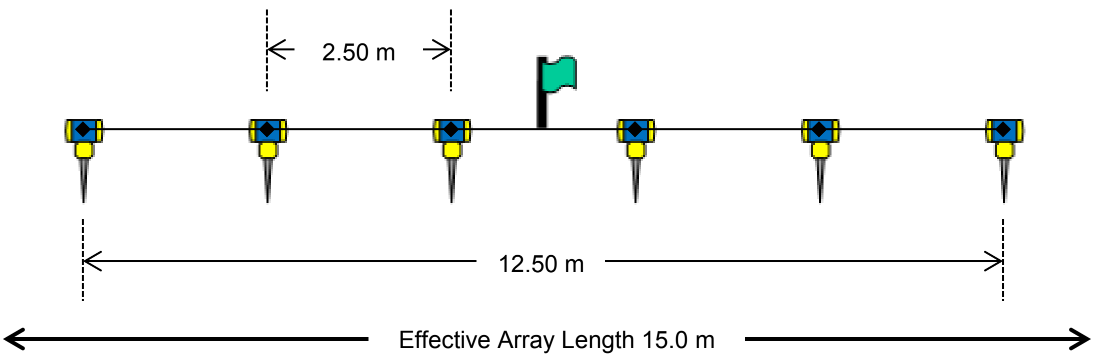


Figure 32. Normal Geophone Array V03 and V04

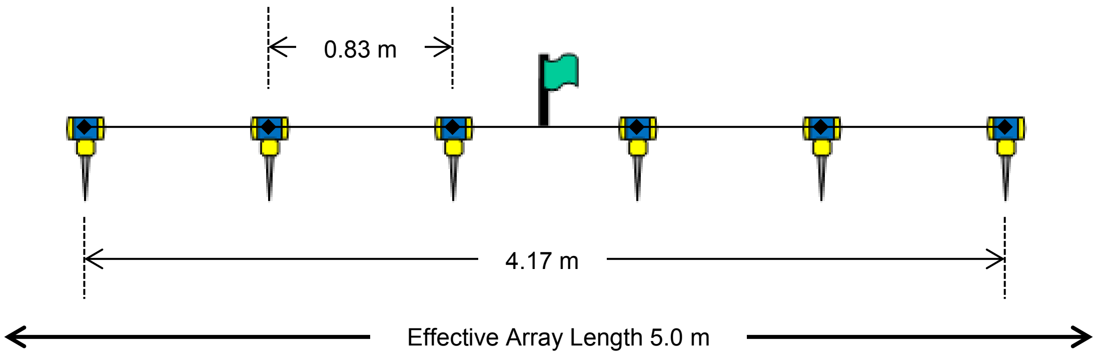


Figure 33. Compressed Geophone Array

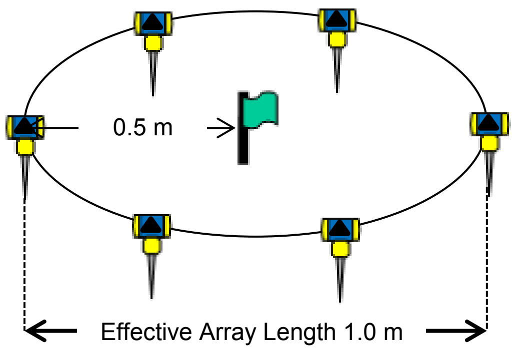


Figure 34. Grouped / Bunched circular Geophone Array

	2D Line	Acquisition Parameter	Group Interval (m)	Spread	Comments
1	BEL12-010	Version 01	10m	700 ch Asymmetric	
2	BEL12-007	Version 01	10m	700 ch Asymmetric	
3	PIN12-013	Version 01	10m	700 ch Asymmetric	
4	PIN12-119	Version 01	10m	700 ch Asymmetric	
5	PIN12-018	Version 01	10m	700 ch Asymmetric	
6	PIN12-010	Version 01	10m	700 ch Asymmetric	
7	PIN12-007	Version 01	10m	700 ch Asymmetric	
8	PIN12-005	Version 01	10m	431 ch static spread	Short line
9	PIN12-006	Version 01	10m	700 ch Asymmetric	
10	BEL12-004	Version 01	10m	700 ch Asymmetric	
11	BEL12-115	Version 01	10m	700 ch Asymmetric	
12	BEL12-011	Version 01	10m	700 ch Asymmetric	
13	ARG12-008	Version 02	10m	300 ch Symmetric	
14	ARG12-005	Version 02	10m	300 ch Symmetric	
15	JEN12-015	Version 02	10m	300 ch Symmetric	
16	JEN12-003	Version 02	10m	300 ch Symmetric	
17	BEL12-013	Version 03	15m	468 ch Asymmetric	
18	BEL12-006	Version 01	10m	700 ch Asymmetric	Note*
19	BEL12-003	Version 04	15m	402 ch Asymmetric	
20	BEL12-005	Version 04	15m	402 ch Asymmetric	
21	BEL12-001	Version 04	15m	402 ch Asymmetric	
22	BEL12-008	Version 04	15m	402 ch Asymmetric	
23	BEL12-215	Version 04	15m	402 ch Asymmetric	
24	BEL12-009	Version 04	15m	402 ch Asymmetric	
25	PIN12-009	Version 04	15m	402 ch Asymmetric	
26	PIN12-002	Version 04	15m	402 ch Asymmetric	
27	PIN12-005W	Version 01	10m	600 ch Asymmetric	Short line
28	PIN12-021	Version 04	15m	402 ch Asymmetric	

Note*: Due to logistic reasons some sectors of the line were recorded with Version 02 and 03. Double sweeps per VP were recorded along noisy parts of the line

Table 11. Summary of recording parameters deployed on the 2D lines

4.3 Recording Operation Statistics

2012 Bellevue-Pinelands-Jen & Argyle 2D seismic data acquisition commenced on line BEL12-010 on 8 October 2012 and continued through to 12 December 2012 when the final shot of the survey was acquired on line PIN12-005W.

Date	Line	#VP	Rec Km
8-Oct-12	BEL12-010	220	2.2
9-Oct-12	BEL12-010	741	7.7
10-Oct-12	BEL12-010	392	3.92
11-Oct-12	BEL12-010	15	0.15
12-Oct-12	BEL12-010	111	1.11
13-Oct-12	BEL12-010	246	2.58
14-Oct-12	BEL12-007	332	3.48
15-Oct-12	BEL12-007	630	6.94
16-Oct-12	BEL12-007	623	6.79
17-Oct-12	NO Production	0	0
18-Oct-12	NO Production	0	0
19-Oct-12	PIN12-013	988	10
20-Oct-12	PIN12-119	584	5.89
21-Oct-12	PIN12-119	400	4.45
22-Oct-12	PIN12-018	752	8.4
23-Oct-12	PIN12-018	479	4.95
24-Oct-12	PIN12-010	823	8.23
25-Oct-12	PIN12-010	687	7.2
26-Oct-12	PIN12-007	561	5.62
27-Oct-12	PIN12-007	522	5.52
28-Oct-12	PIN12-005	73	0.73
29-Oct-12	PIN12-006	278	3.19
30-Oct-12	NO Production	0	0
31-Oct-12	PIN12-006	886	8.91
1-Nov-12	PIN12-006	341	3.47
2-Nov-12	BEL12-004	559	5.81
3-Nov-12	BEL12-004	581	6.1
4-Nov-12	NO Production	0	0
5-Nov-12	BEL12-115	805	8.62
6-Nov-12	BEL12-011	379	4.00
7-Nov-12	BEL12-011	459	4.96
8-Nov-12	BEL12-011	388	4.49

9-Nov-12	ARG12-008	802	8.53
10-Nov-12	NO Production	0	0.00
11-Nov-12	ARG12-008	140	1.41
12-Nov-12	ARG12-005	629	6.46
13-Nov-12	ARG12-005	388	4.66
14-Nov-12	JEN12-015	545	5.80
15-Nov-12	JEN12-015(reshoot)	486	4.86
16-Nov-12	JEN12-003	668	7.11
17-Nov-12	JEN12-003	511	5.38
18-Nov-12	No production	0	0.00
19-Nov-12	JEN12-003	283	2.99
20-Nov-12	BEL12-013	587	8.88
21-Nov-12	BEL12-013	115	2.10
22-Nov-12	BEL12-013	208	3.44
23-Nov-12	BEL12-013	626	8.08
24-Nov-12	BEL12-006	313	3.36
25-Nov-12	BEL12-006	89	0.90
26-Nov-12	BEL12-006	390	4.92
27-Nov-12	BEL12-006	339	3.68
28-Nov-12	BEL12-006	460	4.61
29-Nov-12	BEL12-003	555	8.81
30-Nov-12	BEL12-005	565	8.78
1-Dec-12	BEL12-001	495	8.09
2-Dec-12	BEL12-008	188	2.82
3-Dec-12	BEL12-008	694	11.91
4-Dec-12	BEL12-215	153	2.30
5-Dec-12	BEL12-215	452	7.05
6-Dec-12	BEL12-009	374	6.42
7-Dec-12	BEL12-009	316	4.94
8-Dec-12	BEL12-009	429	7.28
9-Dec-12	PIN12-009	485	7.29
10-Dec-12	PIN12-002	533	8.99
11-Dec-12	PIN12-005W	566	6.15
12-Dec-12	PIN12-005W	597	8.80

Table 12. Seismic Survey daily production statistics

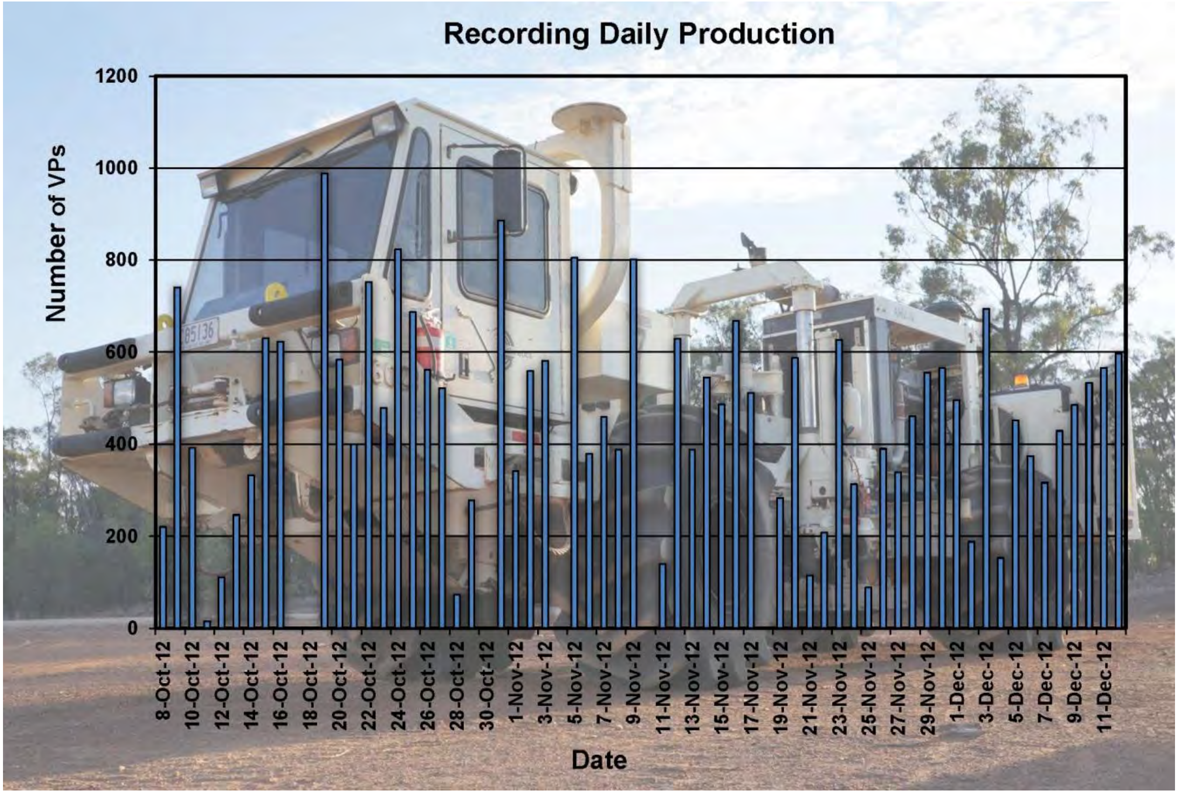


Figure 35. Recording daily production histogram

Project's total acquired Vibroseis Pints was 27,836 with an average daily production of 422 VPs per day.

4.4 Operational Comments

4.4.1 Logistics

2012 Bellevue-Pinelands-Jen & Argyle 2D seismic 2D lines were spaced many kilometres apart and located at very far distances from base camp that required long travel times at the start/end of each recording day. In effect to these line moves, the transfer of equipment from one line to the next, resulted in extremely inefficient moves from back to front lines. Due to an enormous amount of permit issues the Crew were unable to record within the most efficient shooting order. To reduce the "waiting for permit" downtime, the Crew frequently changed the program sequence and travelled from one prospect to another. Bellevue to Pinelands, back to Bellevue, Argyle, Jen, and then back to Bellevue before finishing the production at Pinelands prospect.

Individual land owners had property specific conditions that were required to be followed such as certified or weed and seed wash downs or specific points of ingress or egress. To insure recording was carried out as productively as possible operations meeting were held nightly and attended by all heads of departments to determine the most efficient way to precede on the following days recording and preparation activities. Washdown locations were strategically placed to the most effective positions. Where access was limited, and land holders were agreeable, gates were placed to limit detour times. Cables were rolled to minimise travel time and maximize vehicle equipment carrying capacity. This enabled the two designated equipment transporting vehicles to decrease swing times in order to increase efficiency. It also enabled transportation of equipment by other vehicles that were on crew if the need arose. To further increase of deployment and retrieval totals, redesign of transport vehicles was done prior to start up.

4.4.2 Noise on the active recording patch

Many seismic 2D lines were located along district roads and main highways (Warrago and Leicharht). This was beneficial in regards to decreasing access time and reducing access costs but complicated other aspects of the operation. To minimise the impact of this, direction of vehicular traffic had to be considered when determining the order in which data would be acquired. Traffic control was utilized to safely conduct operations. Alternate access routes were also used by company vehicles to decrease the effect of ambient noise on the recording spread to improve the quality of the data being recorded. Source point density was increased, through acquiring double sweeps per VP along noisy sectors, to stack out the negative effects of random noise.

5 GEOPHYSICAL QC AND DATA PROCESSING

The main role of Crew 488 Geophysics Department was to provide the geophysical support to QGC 2012 Bellevue-Pinelands-Jen & Argyle 2D Seismic Survey and to liaise with the Client and the onsite Client's Representative on all issues related to the geophysics parts of the operation. Well before the start-up of seismic data acquisition; the Client was directly involved in the project's recording parameters, design and the different possibilities of projects' implementation. These efforts continued throughout the operation.

The Geophysics Department also maintained a Quality Assurance and Quality Control role, to provide seismic data that is exempt of any anomaly; and can be directly utilised into the final data processing flows with a high level of confidence. The field QC work flow presented hereafter details all of the steps taken to guarantee an accurate geometry and that the sources and receivers are within Geokinetics recording specifications standards.

The QC geophysicists would cross check the shots geometry, and if required, determine the causality and located geometry issues. Once those geometry corrections were applied, final SPS files were produced. There was a further SPS check with Mesa software to ensure the geometry integrity of the acquired seismic data.

To ensure reliability of the recording sequence and to maintain consistency between actual recording and pre-planned acquisition, all recording was governed by script files generated according to Geokinetics guidelines. Recording scripts for individual lines were provided to the recording department from Survey during the acquisition phase of this operation. Green Mountain Geophysics' 3D/2D survey planning software Mesa Professional 12.0 was used to generate the recording scripts and check the CDP fold coverage.

5.1 Survey Design

QGC senior geophysics staff prepared an initial survey design before the job commenced. Offset, relocation guidelines and design changes were produced by the Geophysics Department, based on QGC's technical standards and supervision. The details of each case were discussed and approved by the onsite client representative before any changes were implemented.

2012 Bellevue-Pinelands-Jen & Argyle 2D seismic survey program was located in Surat Basin Queensland and consists of 4 different prospects as Bellevue, Pinelands, Jen and Argyle which cover many exploration blocks.

The Seismic program was modified during implementation of the survey. Locations and length of the 2D seismic lines were updated as the topographic survey of the seismic lines progressed. Station numbers of some 2D line were revised to match previously surveyed peg numbers; therefore, the survey started with a temporary numbering system, then revised and finalised at the line completion.

2012 Bellevue-Pinelands-Jen & Argyle 2D preplot program consisted of twenty eight 2D seismic lines with 29,874 receiver station at 10 or 15 meters receiver interval and 29,508 Vibroseis Points at 10 or 15 meters source point interval. Each of the 2D Lines starts and ends with a source point; therefore, 28 source points were added to the total receiver points.

To achieve a good tie between the new acquired seismic data and previous 2D seismic lines; Lines ARG12-008, ARG12-005 and JEN12-015 had additional receiver stations to source stations at the head/tail of the seismic lines. For these lines full fold was maintained at the normal start/end of the lines.

At the completion of acquisition, QCing and field data processing; the 2D program totalled 335.77 receiver line kilometres and 332.16 source line kilometres. The project's total acquired VP was 27,836 with 1,672 VPs were skipped due to field obstacles, and other operational / logistical reasons (total VPs 29,508). The final total receiver point for the project was 29,874.

Geokinetics Dual onSEIS units were used as infill seismic sources along 2D line sectors with limited access to Vibroseis, and/or to reduce the operational safety distance to manmade and natural obstacles in the field. The onSEIS shot points were integrated with the Vibroseis datasets. A total of 1,318 onSEIS SPs was part of the above mentioned Vibroseis project total effort.

Source Line	From Stn.	To Stn.	# of SPs
BEL12-007	1160	1292	133
BEL12-007	1297	1319	23
BEL12-007	2771	2890	120
BEL12-007	2894	2925	32
BEL12-007	2928	2938	11
BEL12-009	1000	1136	137
BEL12-009	1140	1191	52
BEL12-009	1194	1199	6
BEL12-009	1209	1226	18
BEL12-009	1229	1246	18
BEL12-009	1259	1276	18
BEL12-009	1279	1365	87
BEL12-009	1370	1382	13
BEL12-009	1384	1387	4
BEL12-011	1070	1131	62
BEL12-011	1138	1153	16
BEL12-011	1159	1171	13
BEL12-011	1182	1475	294
BEL12-011	1482	1538	57
BEL12-013	1361	1369	9

BEL12-013	1375	1377	3
BEL12-013	1379	1391	13
BEL12-013	1393	1399	7
BEL12-013	1406	1473	68
BEL12-013	1475	1487	13
BEL12-013	1491	1508	18
BEL12-013	1510	1524	15
BEL12-013	1529	1586	58
		Total	**1318**

Table 13. Summary for the onSEIS Shot Points

The Geophysics department provided the theoretical preplot coordinates, source or receiver offsets and final coordinates to the Survey department. Similarly the recording parameters and recording scripts for the seismic lines were provided to the recording crew for field implementation.

The Survey department provided appropriate maps for:

- The field layout crew
- The source crew
- The observers

Upon receiving the postplot coordinates for source points and receivers from the survey department, fold plots were produced to ensure that the fold coverage obtained conformed to the project's requirements. The Geophysics department closely interacted with the Survey and Recording departments in these matters.

5.2 Data Delivery to Geophysics Department

The acquired seismic data was saved on external Hard Disk Drives “HDD” in SEG-D Rev 2.1 format. The daily HDD was delivered to the QC department and normal seismic data quality control was then performed on the data.

Final source and receivers coordinates would be appended to the SPS files that would then be quality controlled. The final geometry was assigned to the seismic data and then loaded on to ProMax. Source and receivers indices were introduced to the final SPS files. Details of source and receiver SPS indices for each of the acquired 2D lines were well documented in the Line reports that were sent as part of the final data shipment.

The following procedures were set up prior to the commencement of production and were adhered to throughout:

5.2.1 Recorder:

- All supplementary data was copied to USB and sent directly to the Geophysics Department following completion of the days’ recording.
- Seismic data were saved on an external hard disk drive and were sent directly to the Geophysics Department.

The following charts show the daily production statistics for 2012 Bellevue-Pinelands-Jen & Argyle 2D Seismic survey for line clearing, Surveying and recording as received during the project's live cycle (28 September 2012 to 12 December 2012).

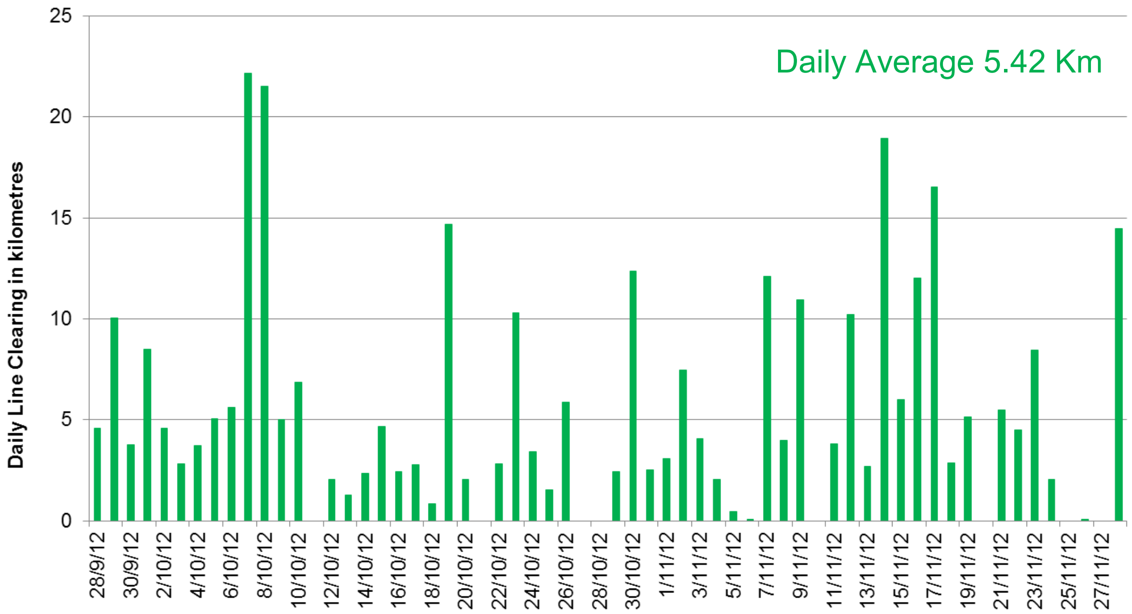


Figure 36. Daily Line Clearing Statistics

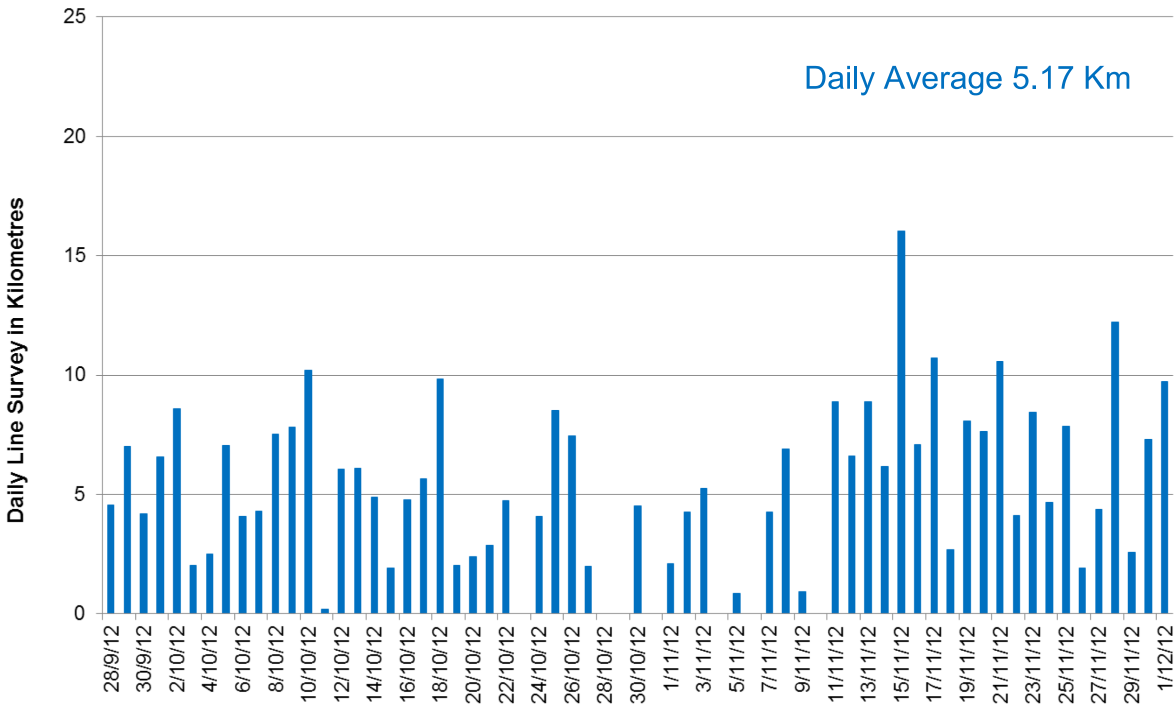


Figure 37. Daily Line Survey Statistics

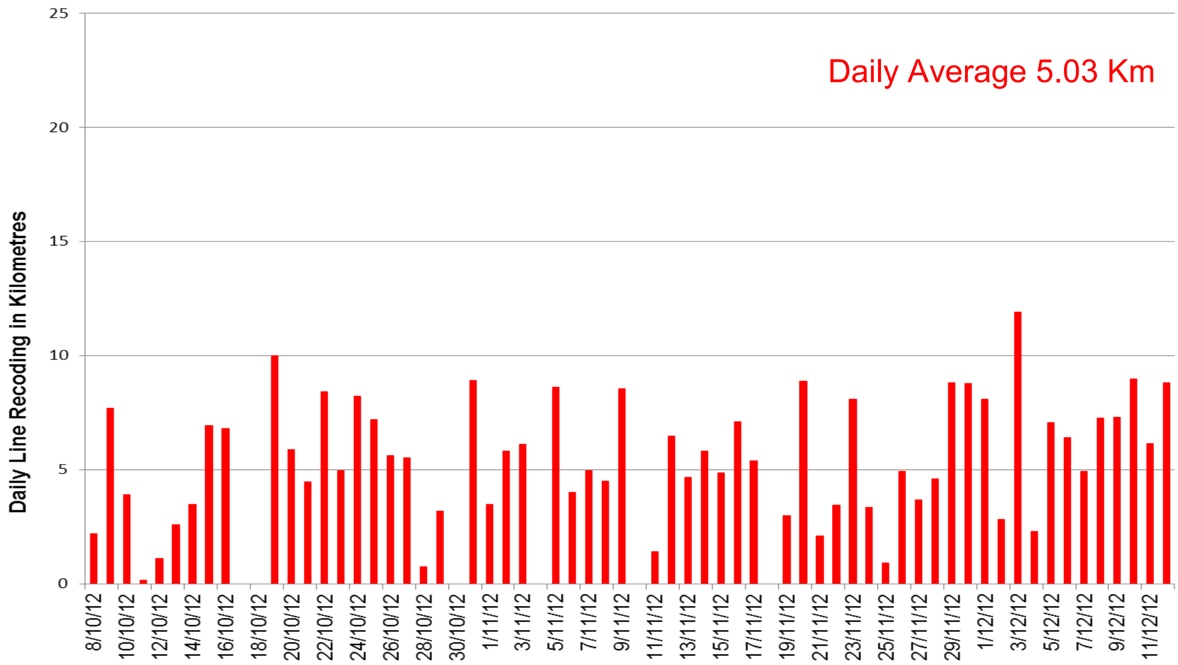


Figure 38. Daily Line Recording Statistics

5.3 Assigning Geometry with ProMAX

The survey geometry information was based on preplot and survey postplot SPS files. Final source coordinates were derived from the Centre of Gravity (COG) of the Vibrator unit for each source point. Receiver coordinates were based on the RTK coordinates as provided by the Survey department.

The shooting geometry information was loaded onto the in-house built Excel spreadsheet designed specifically for this project. This consisted of source, receiver and relational SPS files, along with observer's logs and the source and receiver coordinates from the Survey department. A first set of SPS files was then transferred from the spreadsheet and assigned to the seismic data loaded in ProMax.

5.4 QC Checks for Discrepancies & Anomalies

The geophysicists then checked for discrepancies between seismic data and its related survey geometry. If required, receiver coordinates were investigated. Shot geometry was also checked in two different ways to ensure the correct geometry. First geometry checked done by near offset shot display. Secondly, Linear Move-Out (LMO) displays were used to perform this step. Usually the LMO is less effective in picking source/receivers coordinates anomalies on 2D lines.

Once those geometric corrections had been applied, SPS files were produced and checked for formatting errors using Geokinetics' software "SPSFileIO' software. With these files, geometric datasets were produced to facilitate further checking and correction if required. After this check, final ancillary data was produced to be delivered to the client.

5.5 Scripts Provided to Recording Department

To ensure the integrity of the recording sequence, and to maintain consistency between preplan acquisition and actual recording, all recording was governed by script files generated from the agreed pre-plot model(s).

Scripts for entire project were provided to the Recording Department by the Geophysics Department; exclusions; and a list of shot points. GXT Technology's 3D/2D survey planning software, Mesa Professional, was used to ensure that offset source and receiver points were allocated with minimal effect on the final CDP coverage.

5.6 Equipment & Software

5.6.1 Processing Workstation: (QC & Infield Data Processing)

Workstation Elements	Parameters Employed and Recorded
Server	HP ProLiant Server DL380G5
RAID Array	12 x 2 TB RAID, HOT SPARE as configured
HP Storage works	HP Ultrium LTO2 Tape Drive
	HP Ultrium LTO3 Tape Drive
Network	24 Port Gigabit Ethernet Switch
	Cisco router and UPS

Table 14. Field Data Processing Workstation

5.6.2 Other Hardware

Hardware Elements	Parameters Employed and Recorded
CPUs	1 x Intel ®Core™ i7 CPU 2.8 GHz, 4 GB RAM, 500GB HDD
CPUs	1 x Intel ®Core™ i7 CPU 2.8 GHz, 8 GB RAM, 2TB HDD
Printer	Colour inkjet printer
External HDD	1.5 TB and 500 GB external Hard Disk Drives

Table 15. QC hardware

5.6.3 QC Software

Software Elements	Parameters Employed and Recorded
QC Software	ProMax 2D version 2003.19.1 MESA Professional version 12.0 Exceed version 12.0 Hatrix daily report database Testif-i Test Processing Suite v2.04 Microsoft Office Suite 2003 - 2007

Table 16. QC software

5.7 Geophysics Department data flowchart

The Geophysics department interacts heavily with both Survey and Recording departments. Data QCing operations began, in conjunction with the survey department, refining theoretical preplot coordinates and defining source and receiver offset guidelines.

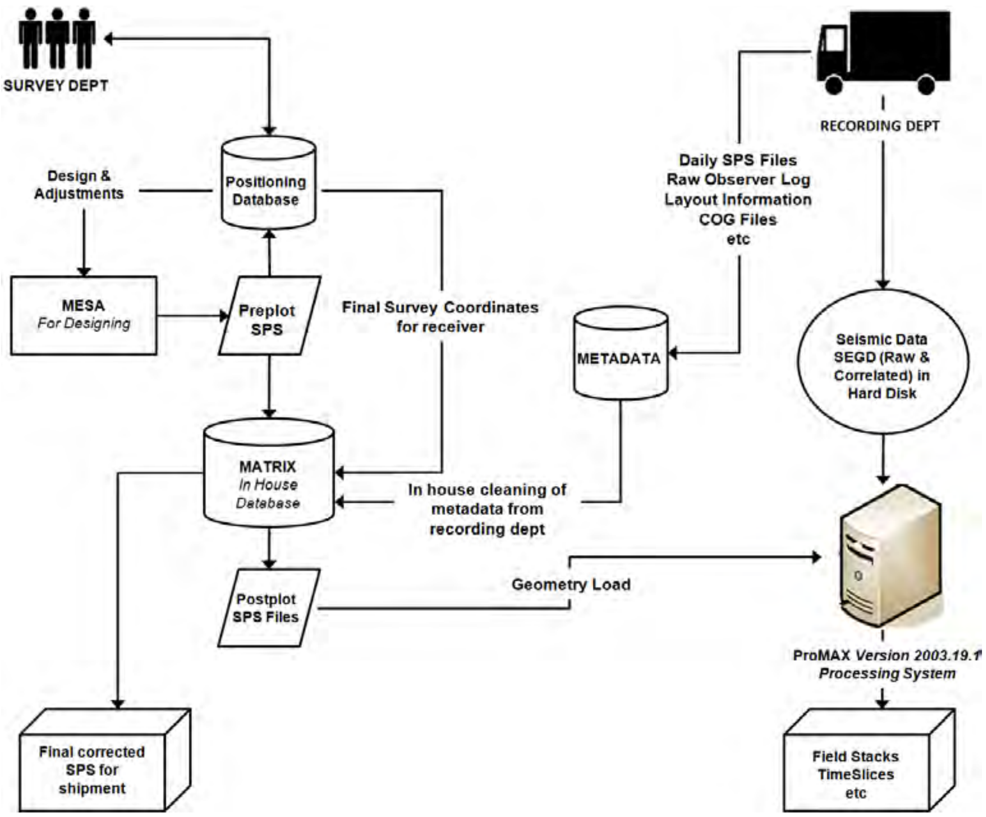


Figure 39. Geophysics Department Data Flowchart

5.7.1 Initial Workflow

- The received data was promptly logged with full details of the data noted.
- The SEG-D data were then immediately loaded into ProMax processing system. The acquired records were viewed by ProMax trace display module to confirm that the data were recorded correctly.

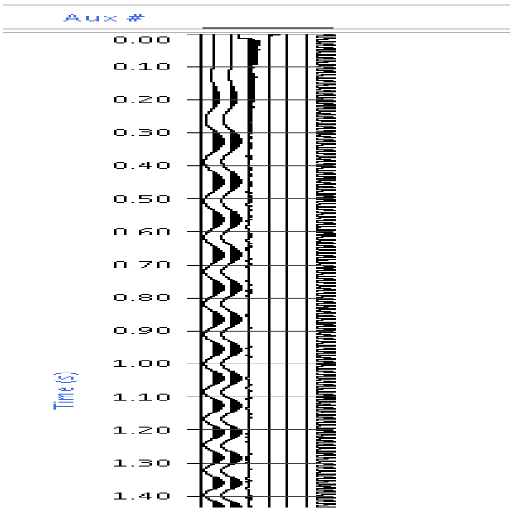
5.7.2 Further Workflow

- Produce recording scripts for the recording crew
- Receive and collect operations data from other departments for daily report.
- Prepare daily report and email a copy of the report to the Project Manager and the relevant parties.
- Load, edit and reformat the 2D Lines Observer Logs.
- Quality control the auxiliary traces for timing consistency.
- Check the acquired records as raw and filtered monitor displays. Quality controls the acquired records on shot domain.
- Prepare the final SPS.
- Apply the geometry on the day's production.
- On line completion, save the final SPS for data shipment.
- Check the final SPS files with MESA then process the final CDP fold.
- Perform field data processing for the daily acquired data. Extract 2D brute stacks along the 2D Lines.
- Prepare the project's deliverables and data shipment.

5.8 Field Data Processing

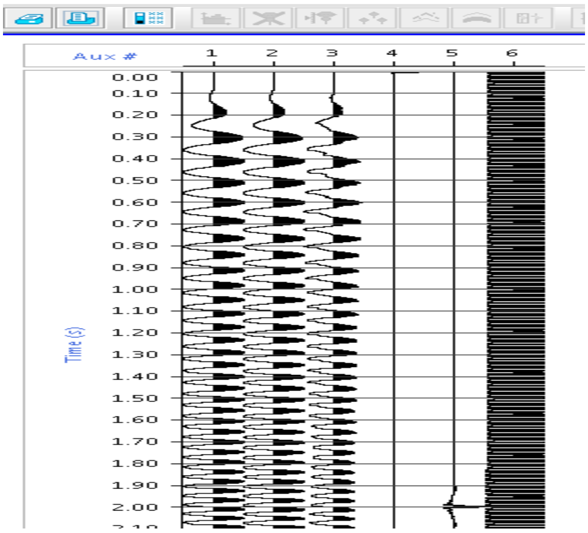
5.8.1 Raw Data Monitoring

All records received from the field were checked as an initial QC in the shot domain. Time breaks and general trends in reflection continuity, noise and surface geology could be observed in addition to reflection continuity, coherency, and bad or dead receiver stations. Anomalous records were promptly reported to the Observer to reinvestigate where a bad geophone suspected. As a general rule, substandard records were investigated, reported and proper action taken.



Channel Number	Header	Remarks
-1	Pilot	Pilot
-2	Return Ref	Vibe Return Reference
-3	Sim GND Force	No SIM, will look like noise.
-4	TimeBreak	TimeBreak
-5	Used for CORR pulse **+**	Correlation pulse @ 2sec.
-6	Used for CORR pulse **-**	Correlation pulse @ 4sec
-7	100HZCLOCK	100 Hz reference frequency

Table 17. Vib Records Auxiliary Channels AUX Setup (Without SIM)



Channel Number	Header	Remarks
-1	Pilot	Pilot
-2	Return Ref	Vibe Return Reference
-3	Sim GND Force	Sim GND Force Return
-4	TimeBreak	TimeBreak
-5	Used for CORR pulse **+**	Correlation pulse @ 2sec.
-6	Used for CORR pulse **-**	Correlation pulse @ 4sec
-7	100HZCLOCK	100 Hz reference frequency

Table 18. Vib Records Auxiliary Channels AUX Setup (With SIM)

The onSEIS records auxiliary channels were only two; -1 Time Break and -2 for 100 Hz clock.

The Auxiliary channels of all acquired field records were QCed and checked on ProMax display tool.

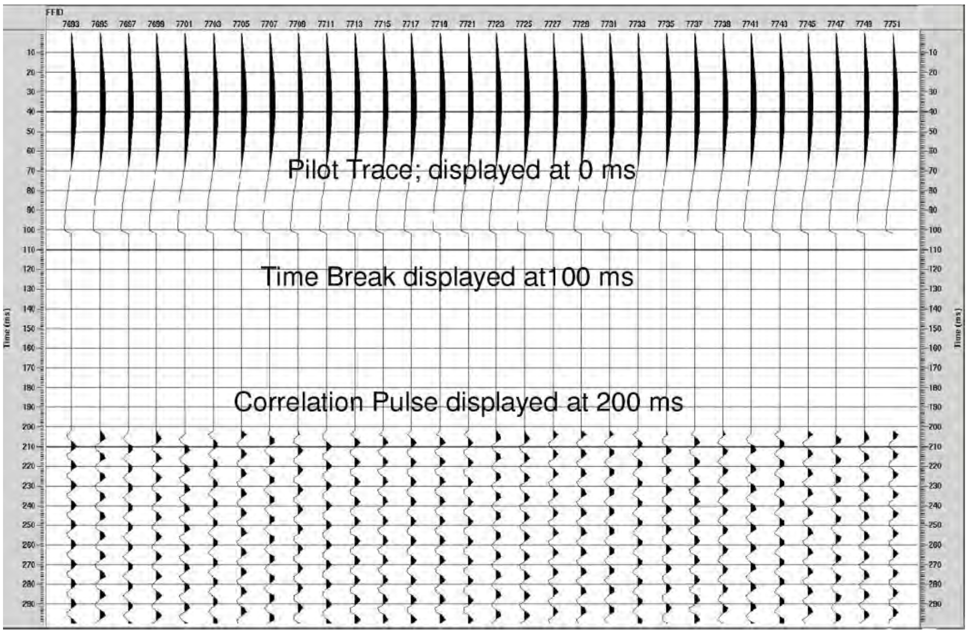


Figure 40. Example of time break auxiliary channel display – Vibroseis

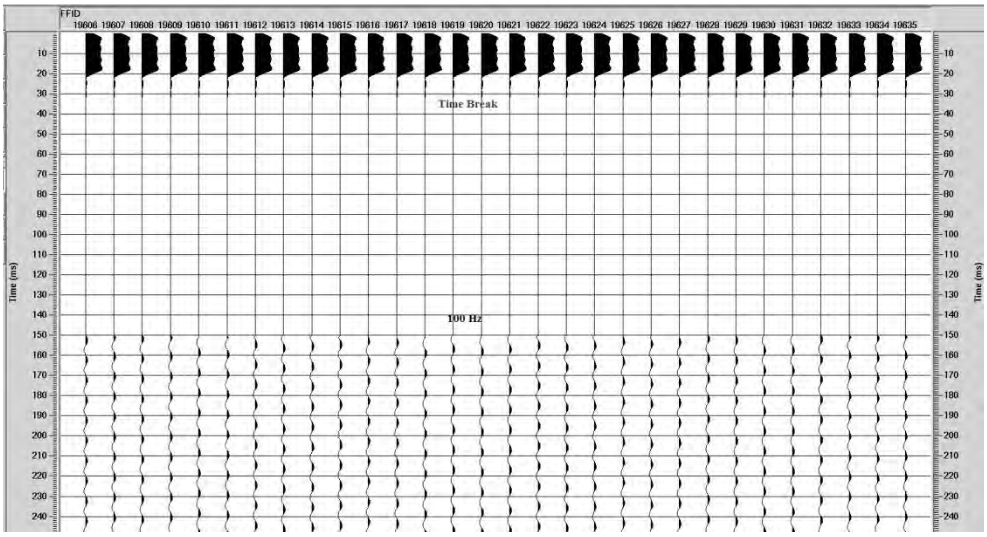


Figure 41. Example of time break auxiliary channel display – onSEIS

The field acquired seismic records were QCed as ProMax shot gathers. Seismic data quality was generally good; however various types of seismic noise were expected as the 2D lines were along active roads and tracks. To avoid the seismic noise generated by wind and weather, all receivers were buries. In addition the Observer limited the crew’s vehicles activities while recording and monitored the traffic for third party road users. Detailed remarks and comments were added to the observer logs reflecting the possible noise sources during the data acquisition.

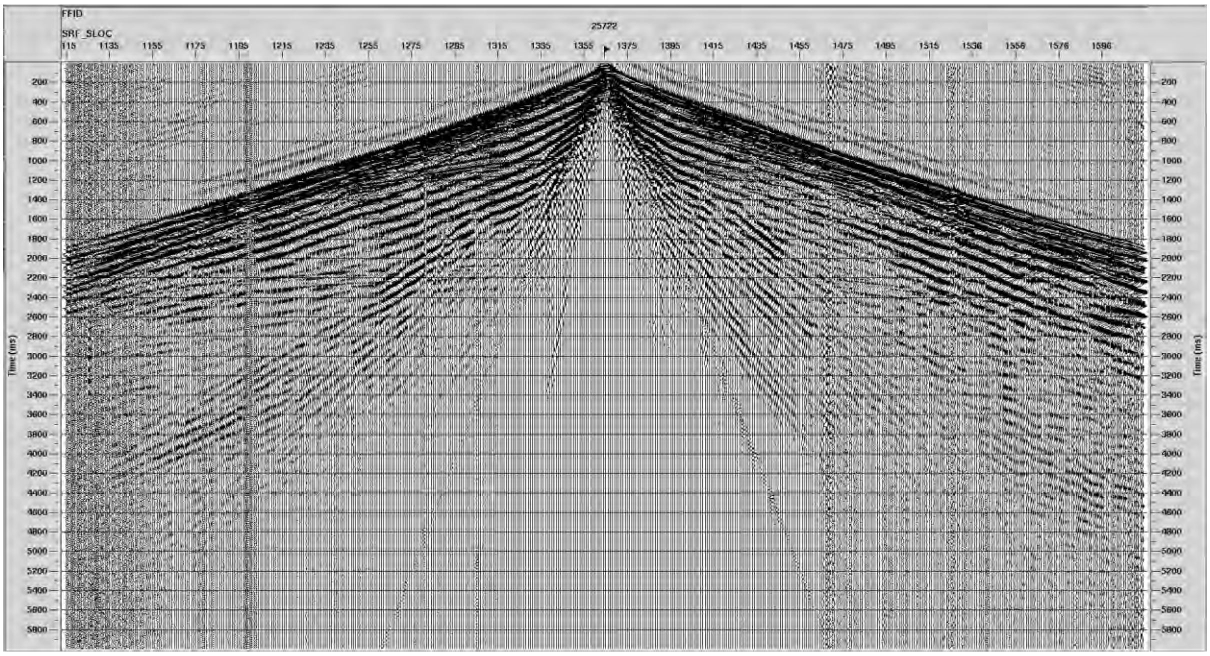


Figure 42. Raw shot display with all live channels active

5.8.2 Building & Checking Geometry in ProMAX

The geometry information from the SPS files was loaded to ProMax database and to the field data to create a seismic dataset with geometry loaded in the headers (often referred to as “geometry dataset”). The log file “ProMax output file” produced by the “Apply Geometry” flow was inspected to ensure all the valid records and all their channels were properly matched to the database information. The total number of traces in the dataset was also checked. A geometry applied gate was used to check the final coordinates of sources and receivers as received from the Survey Department.

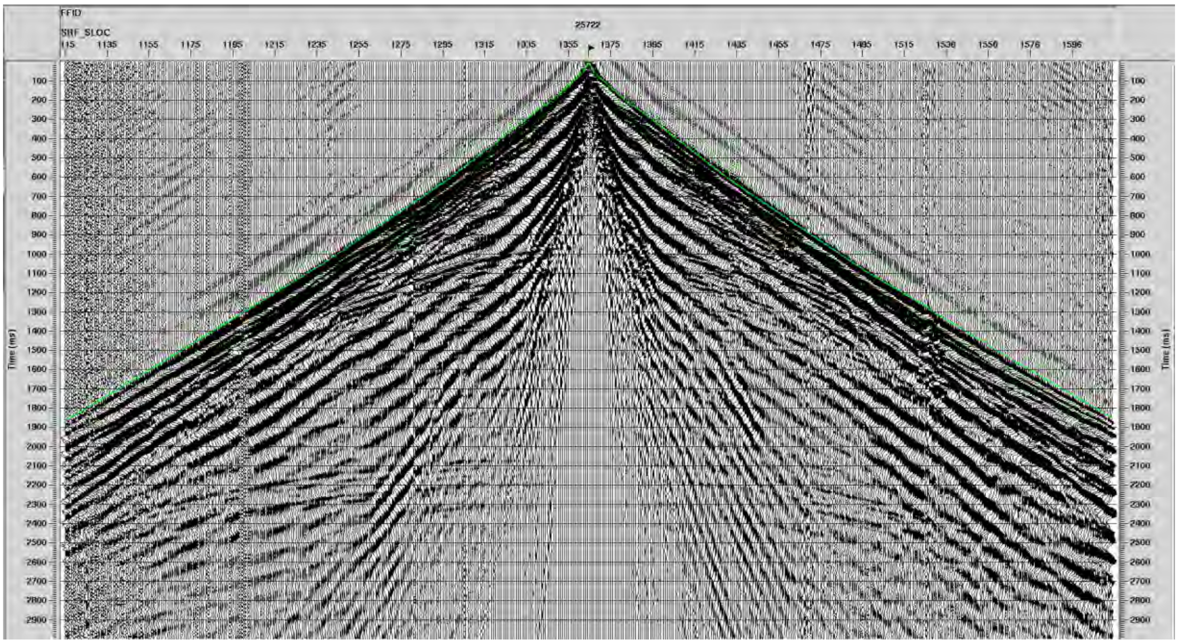


Figure 43. Geometry Applied shot gather with a geometry check gate

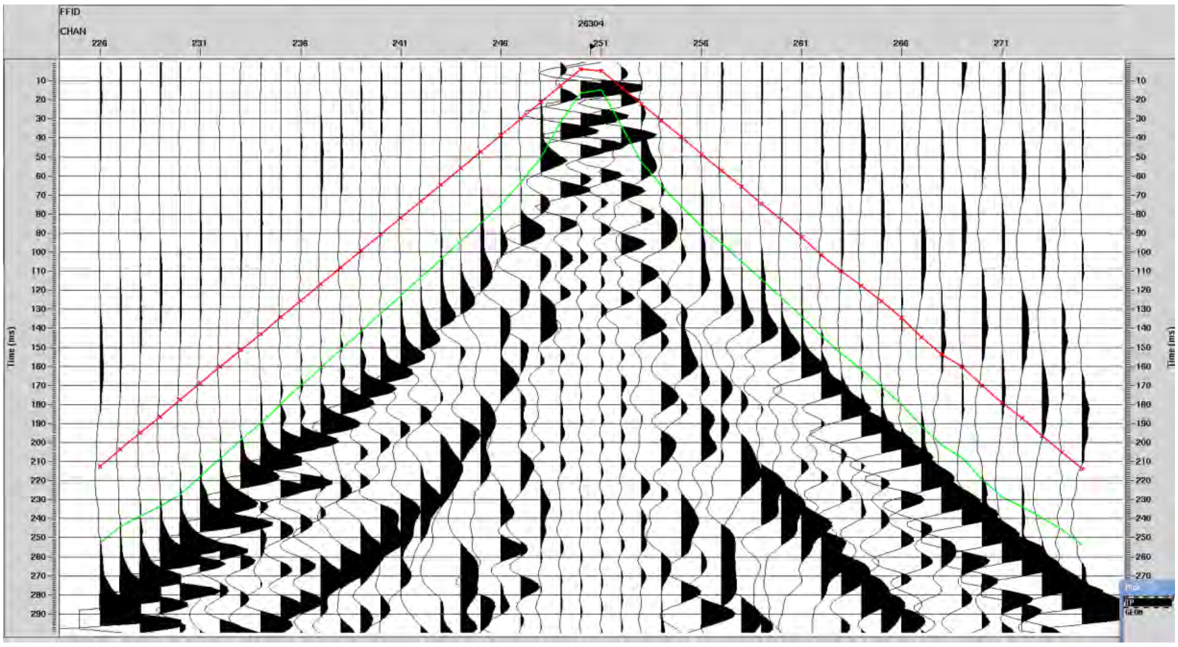


Figure 44. Source Position Check with near offset geometry gate

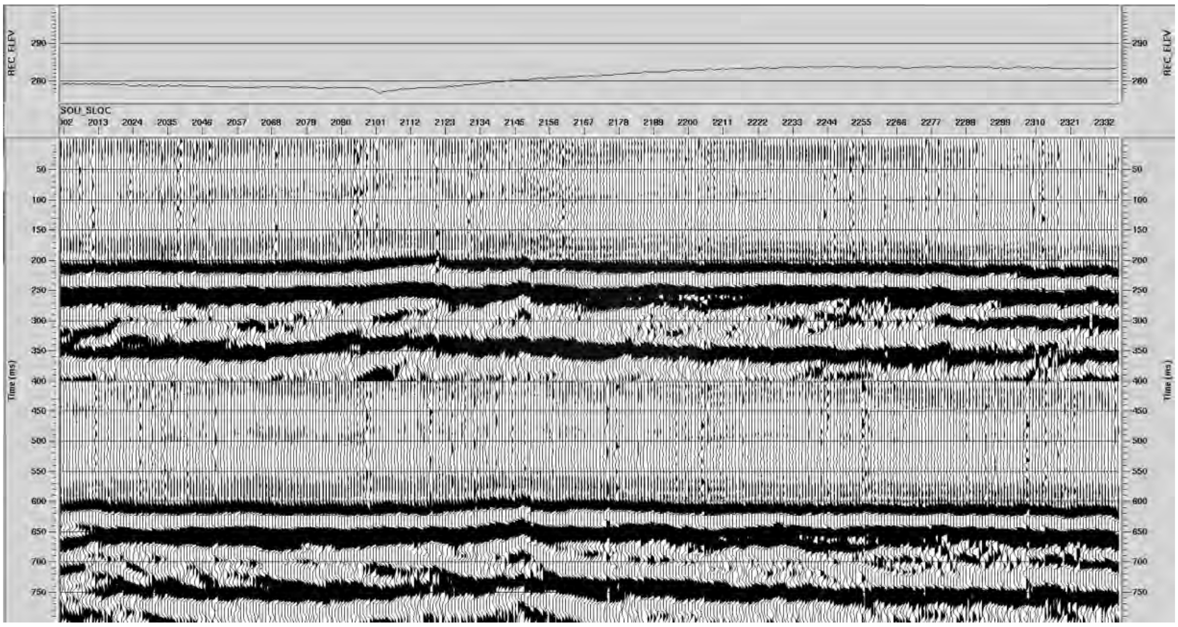


Figure 45. Source Position LMO Check with limited offset

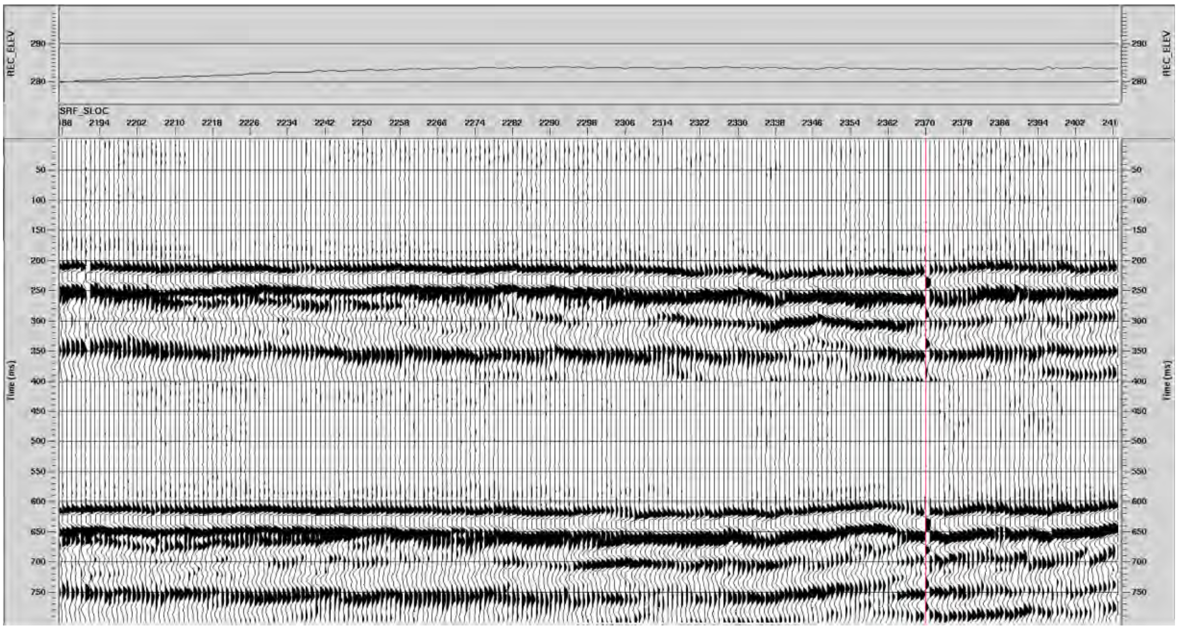


Figure 46. LMO receiver verification display, Reverse channel highlighted in red

5.9 Data Processing Flow

After the geometry had been checked, a simple data processing sequence was followed to obtain a field brute stack. The purpose of the field stack was not to create an interpretation tool but simply as field check of the integrity of the acquired seismic dataset and the accompanying SPS files. The following processing flow was used on ProMax, Version 2003.19.1:

	STEP	NOTES
1	Read SEG-D Data from Ex. HD to ProMax)	Sort traces in the raw dataset by component block. Separate the auxiliaries from RAW dataset.
2	Check RAW Dataset	When the data is received; after loading in ProMAX, check visually for all the shots traces. At this stage check for any line breaks, timing errors, quick QC of the data. True Amplitude Recovery. Trace Display (Scalar Mode – Individual; Gain – 1).
3	Geometry Assign to Database	Source & receiver coordinates and correlation file were prepared using a specially designed Excel spreadsheet.
4	Apply Datum Statics	Final Datum elevation 300 Replacement Velocity 2750
5	Analyse LMO	Position checking both for source and receiver positions.
6	Process Shot Domain / CSP	Resample 4ms Datum Statics Apply Bandpass Filter

		Time Variant Scaling Spiking/Predictive Deconvolution True Amplitude Recovery Type of Deconvolution Deconvolution operator length Operator Predictive distance Operator White noise level(s) Bandpass Filter Ormsby bandpass	 1.8 dB/sec Minimum phase predictive 200, 200 8,8 0.1,0.1 5-10-75-80
7	2D Velocity Analysis	2D Supergather Select CDP increment CDPs to combine Bandpass filter Automatic Gain Control Type of AGC Scalar AGC Operator Length ms Basis of scalar application Exclude hard zeroes? Velocity Analysis	 40 9 Mean 500 Centred Yes
8	Brute Stack	Normal Moveout Correction Stretch mute percentage	 30
9	Stack Display	BP Filter Time and Space variant filter Automatic Gain Control Type of AGC Scalar AGC Operator Length ms Basis of scalar application Trace Display	 Mean 1500 Centred

Table 19. Field Data Processing Flows

5.10 Velocity Analysis

Interactive velocity analysis was carried out within the 2D seismic data of the acquired line. Detailed velocity samples were analysed at 500m intervals. An initial fixed guiding velocity function (1500 - 5000m /sec) was used for velocity picking. Velocity functions were then used to generate a brute stack at the end of each line. Picked velocity functions were exported in text format and included to the data shipment supporting documents.

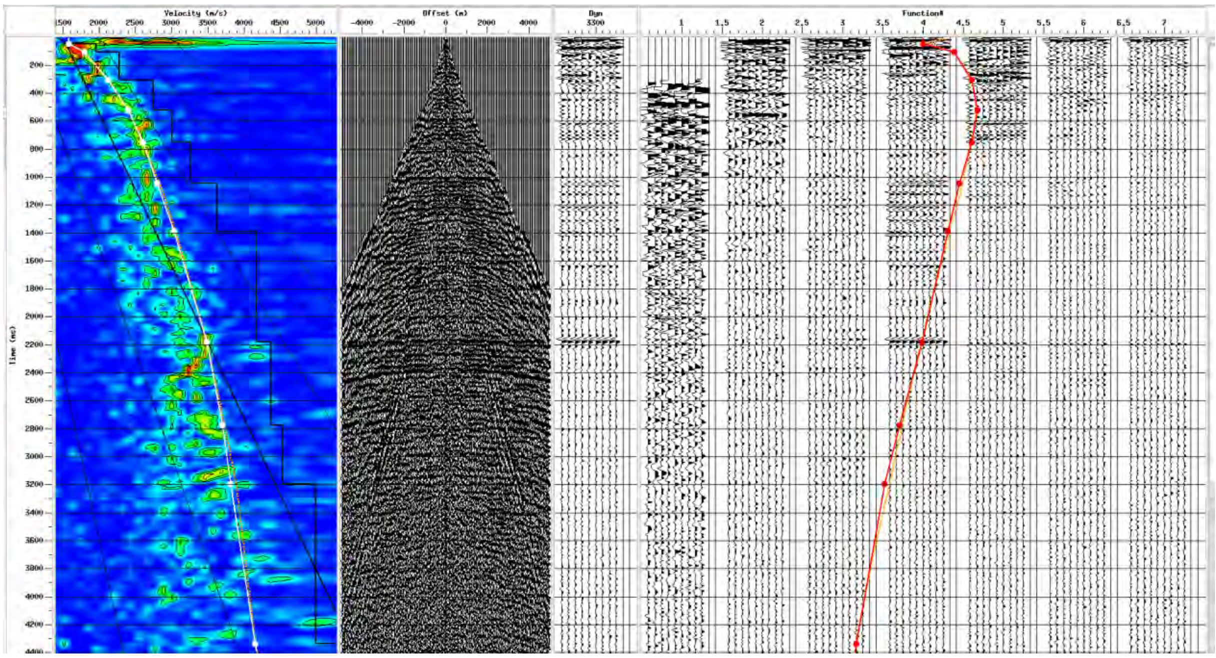


Figure 47. Typical velocity analysis panel along Line 12_01C

5.11 Field Brute Stack

The 2D field brute stacks of the acquired seismic data show continuous, coherent reflectors at the project's target two-way-travel (TWT) time approximately 1400 msec; and can also be traced down to 1800 msec in some sections of the lines. Many shallow reflectors can be also traced within the field stack images, particularly at 0 - 600 msec.

Seismic data quality of the acquired 2D lines is excellent with a good signal-to-noise ratio and very high fold coverage. Traffic and ambient seismic noise were highly suppressed by the stacking algorithms. The noise that appears in the raw shot display gathers was generally collapsed in the field stacks.

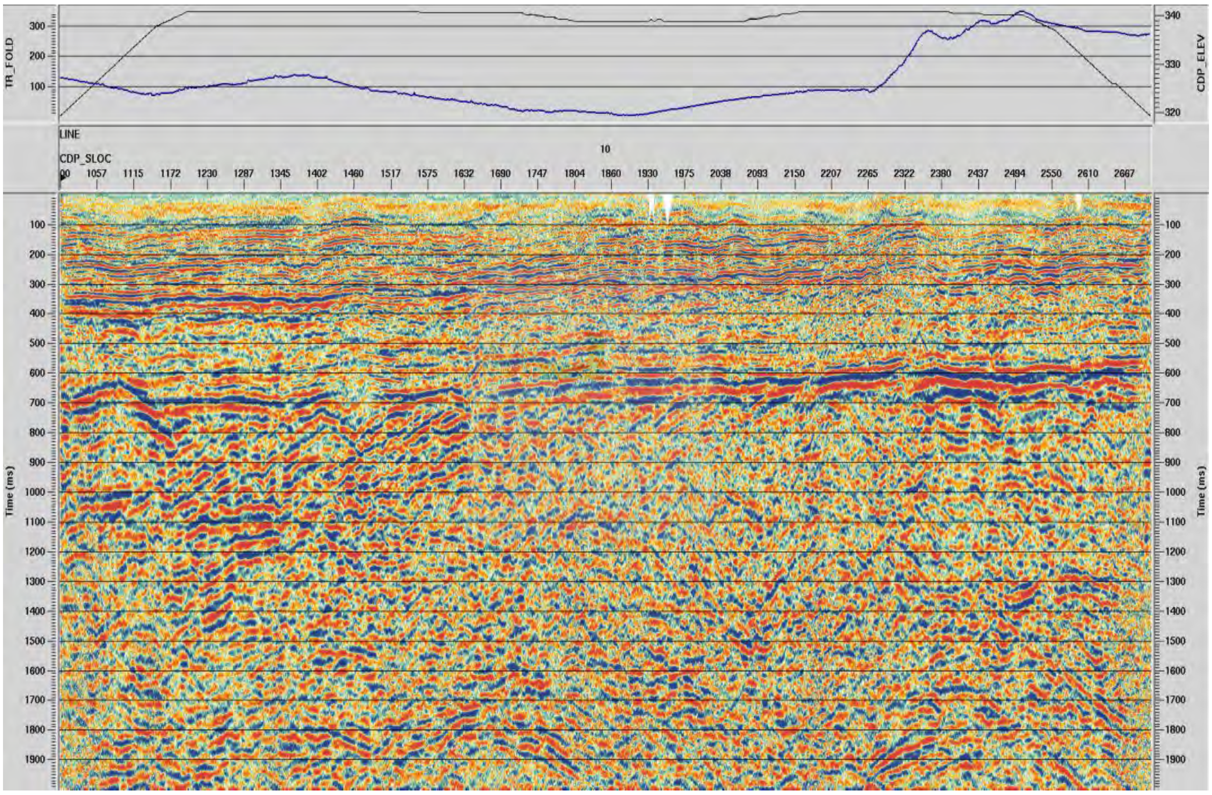


Figure 48. Field Brute Stack Line BEL12-010

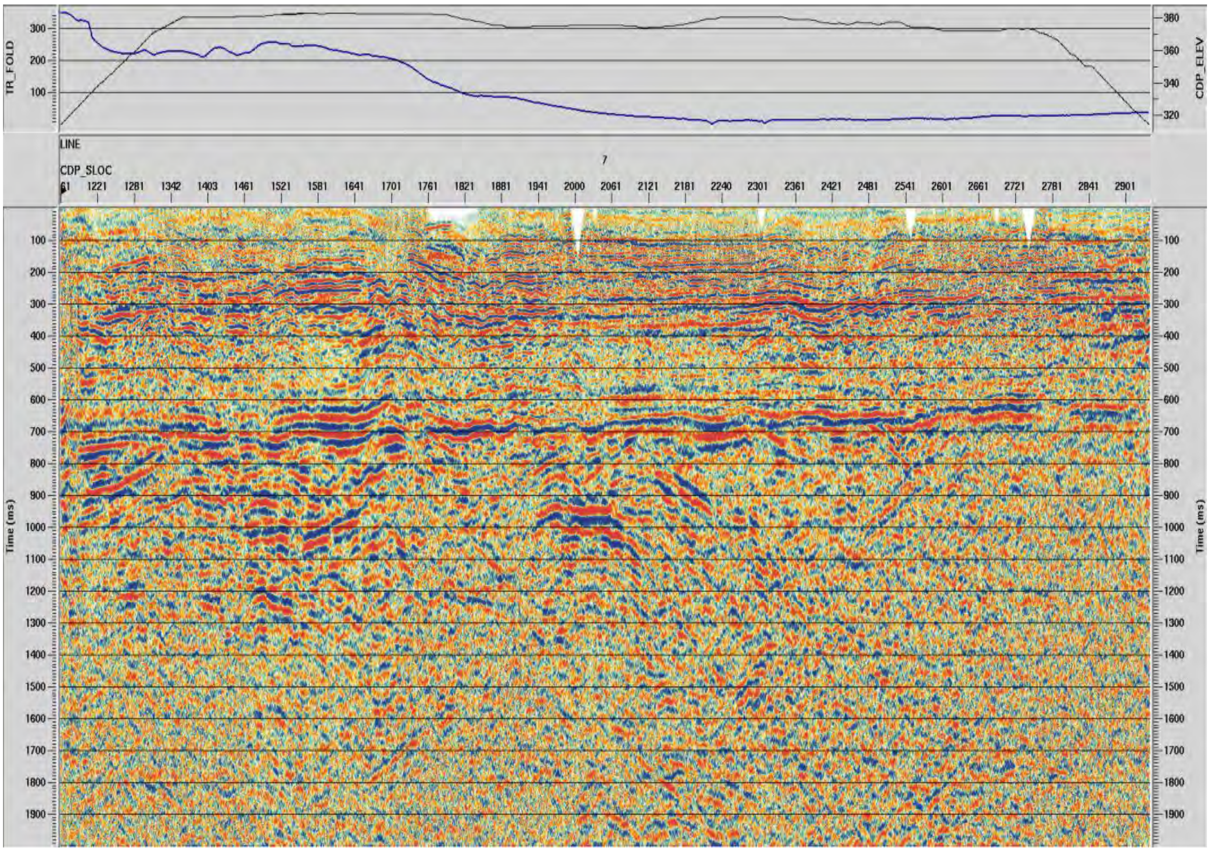


Figure 49. Field Brute Stack Line BEL12-007

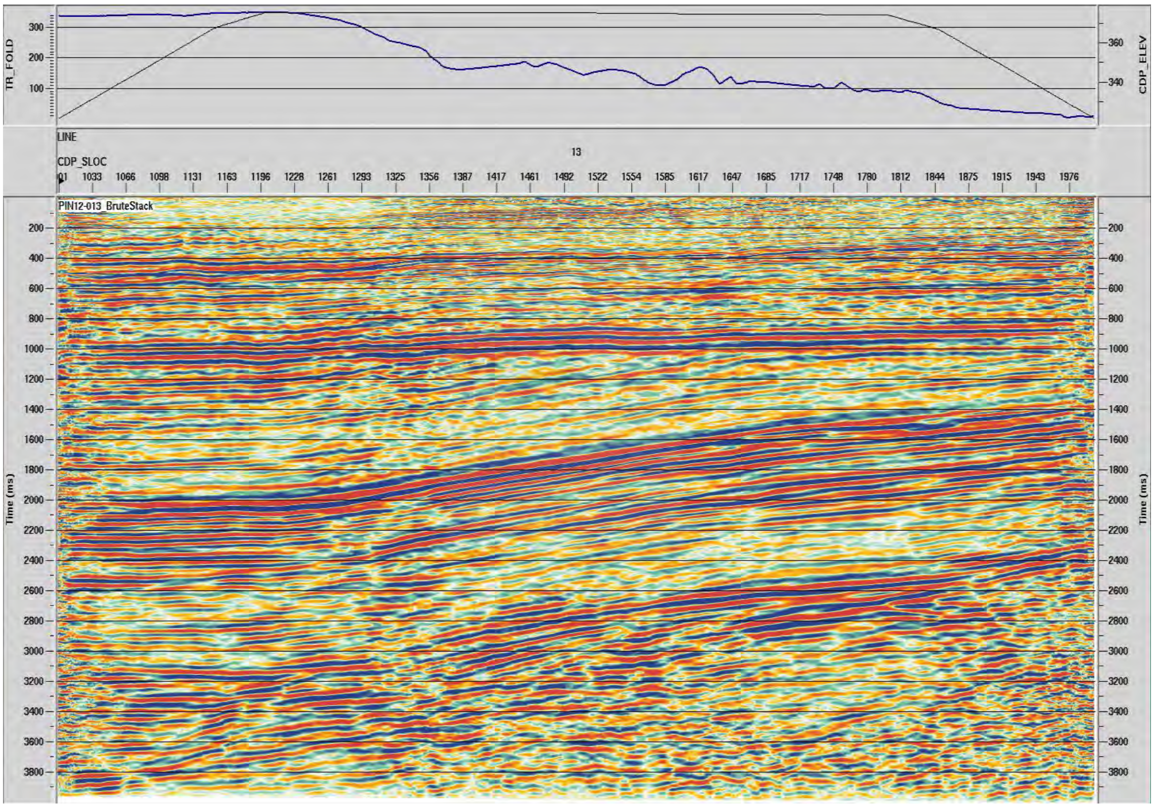


Figure 50. Field Brute Stack Line PIN12-013

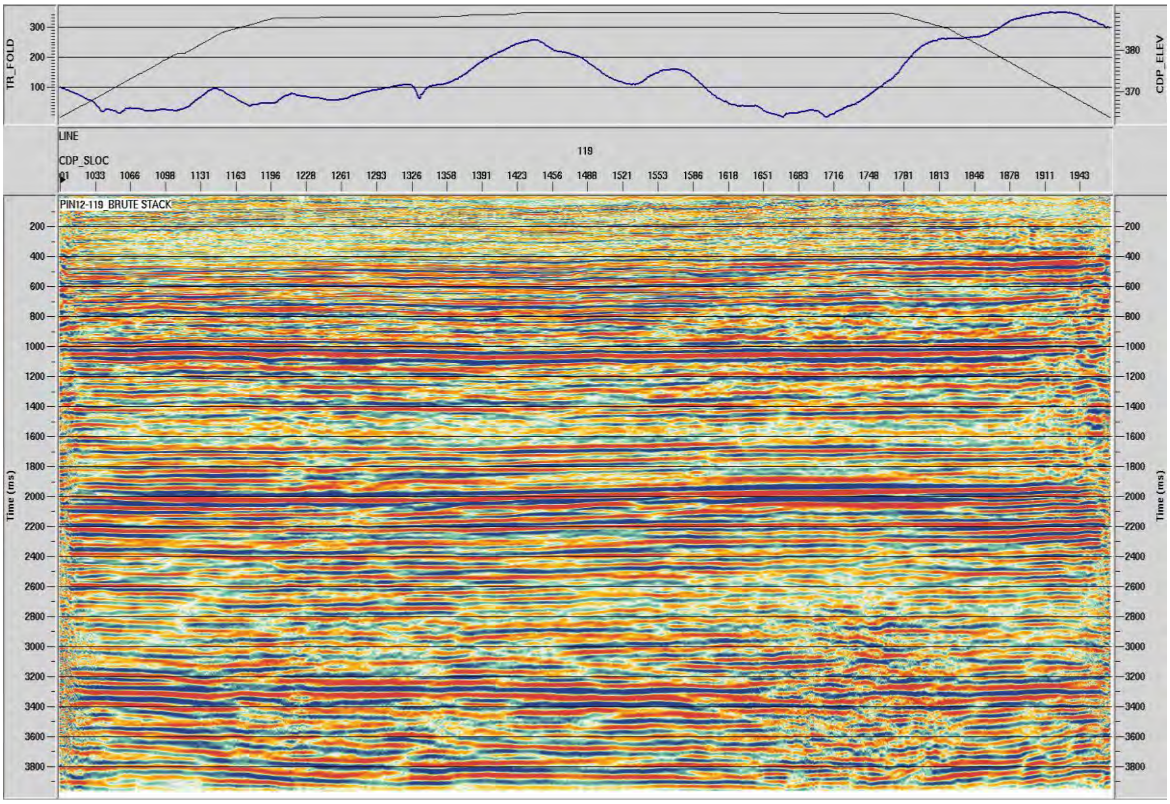


Figure 51. Field Brute Stack Line PIN12-119

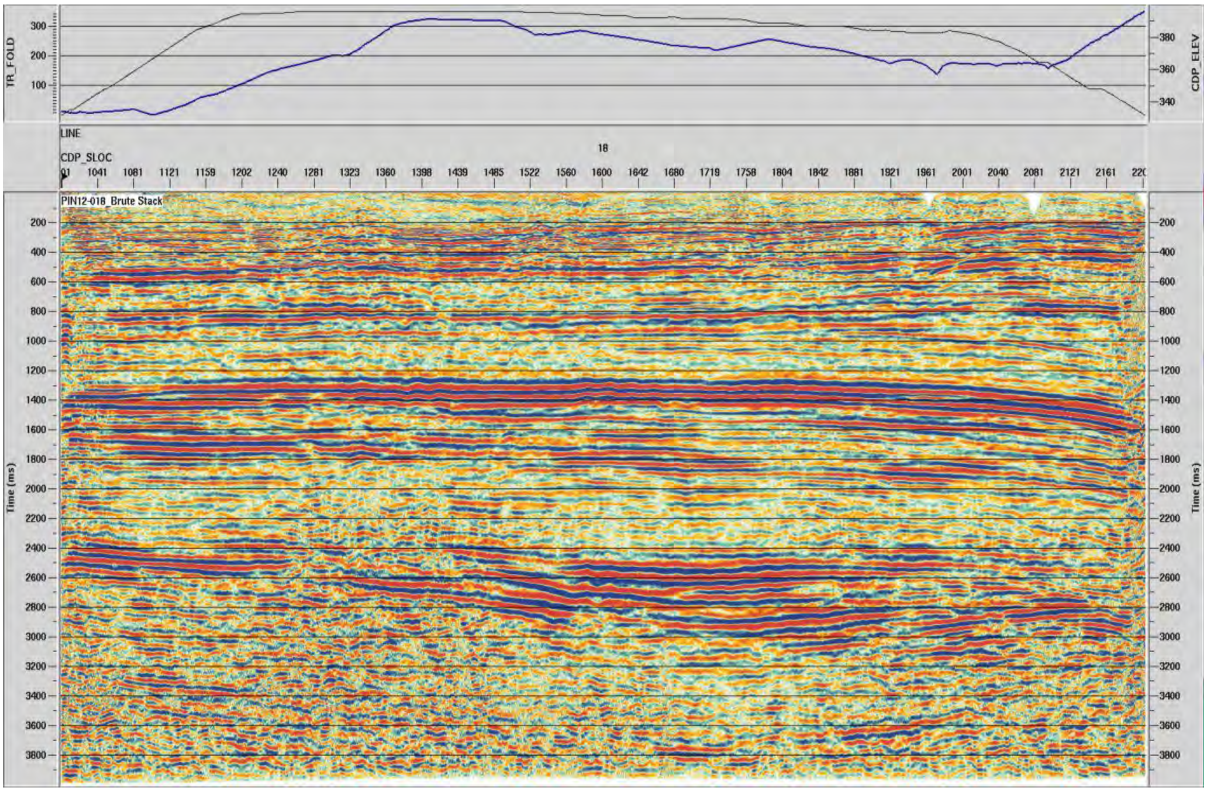


Figure 52. Field Brute Stack Line PIN12-018

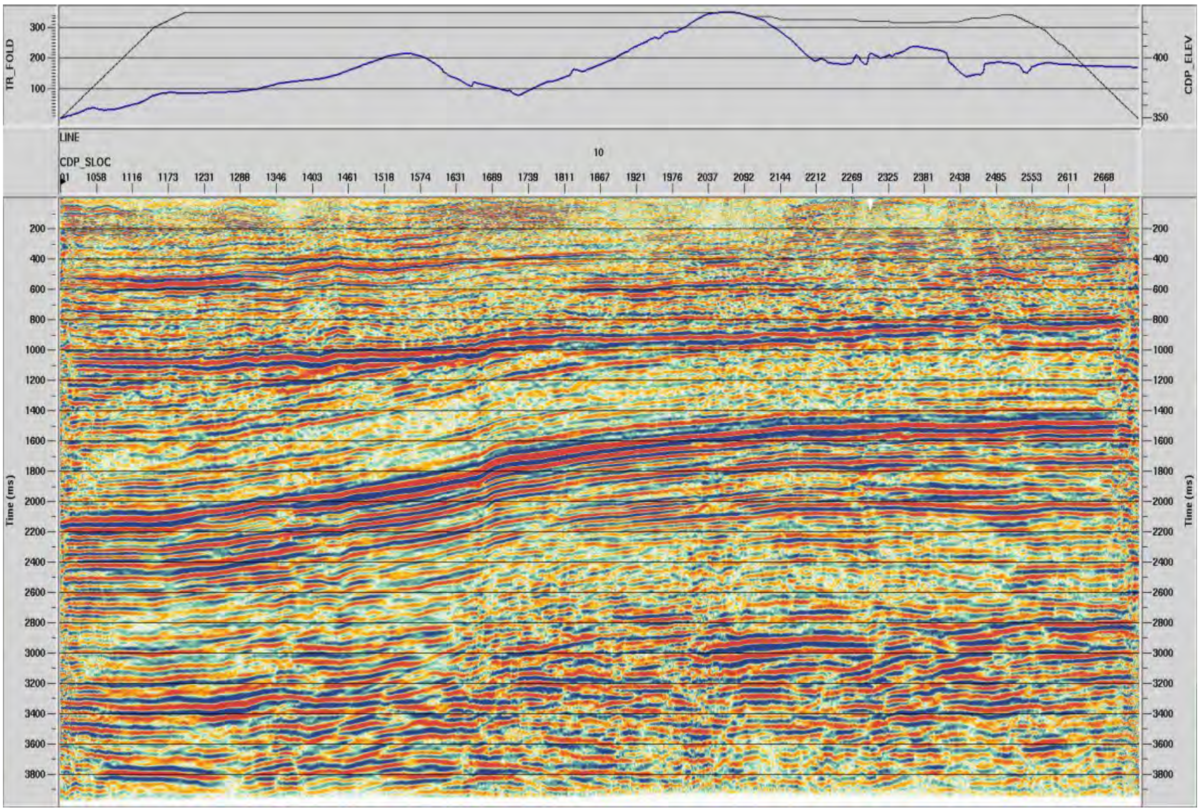


Figure 53. Field Brute Stack Line PIN12-010

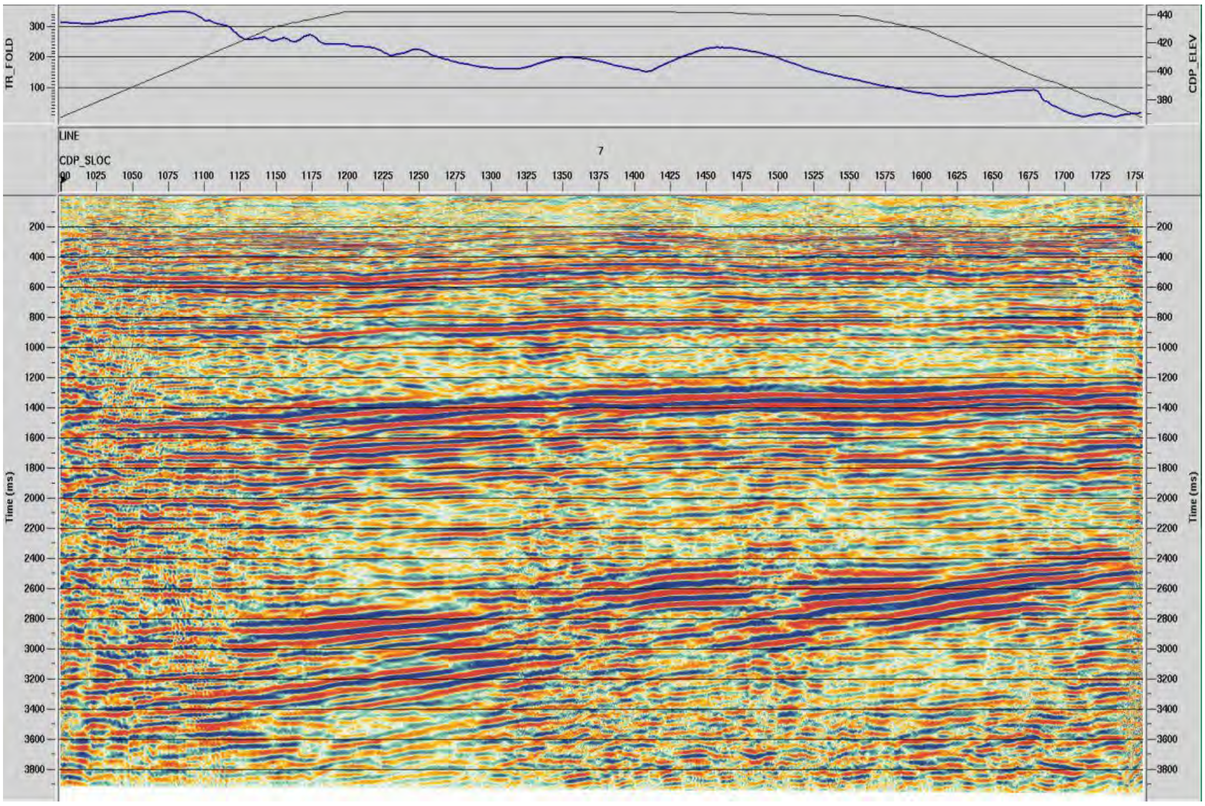


Figure 54. Field Brute Stack Line PIN12-007

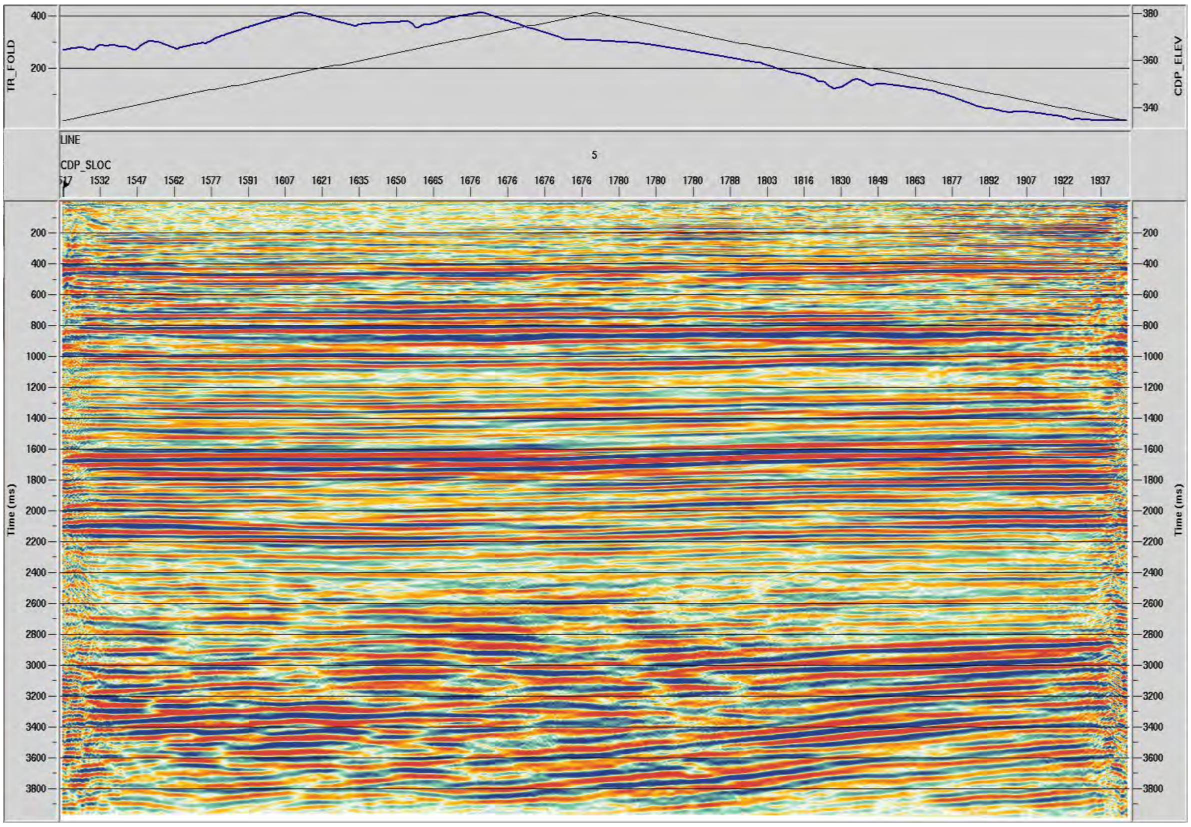


Figure 55. Field Brute Stack Line PIN12-005

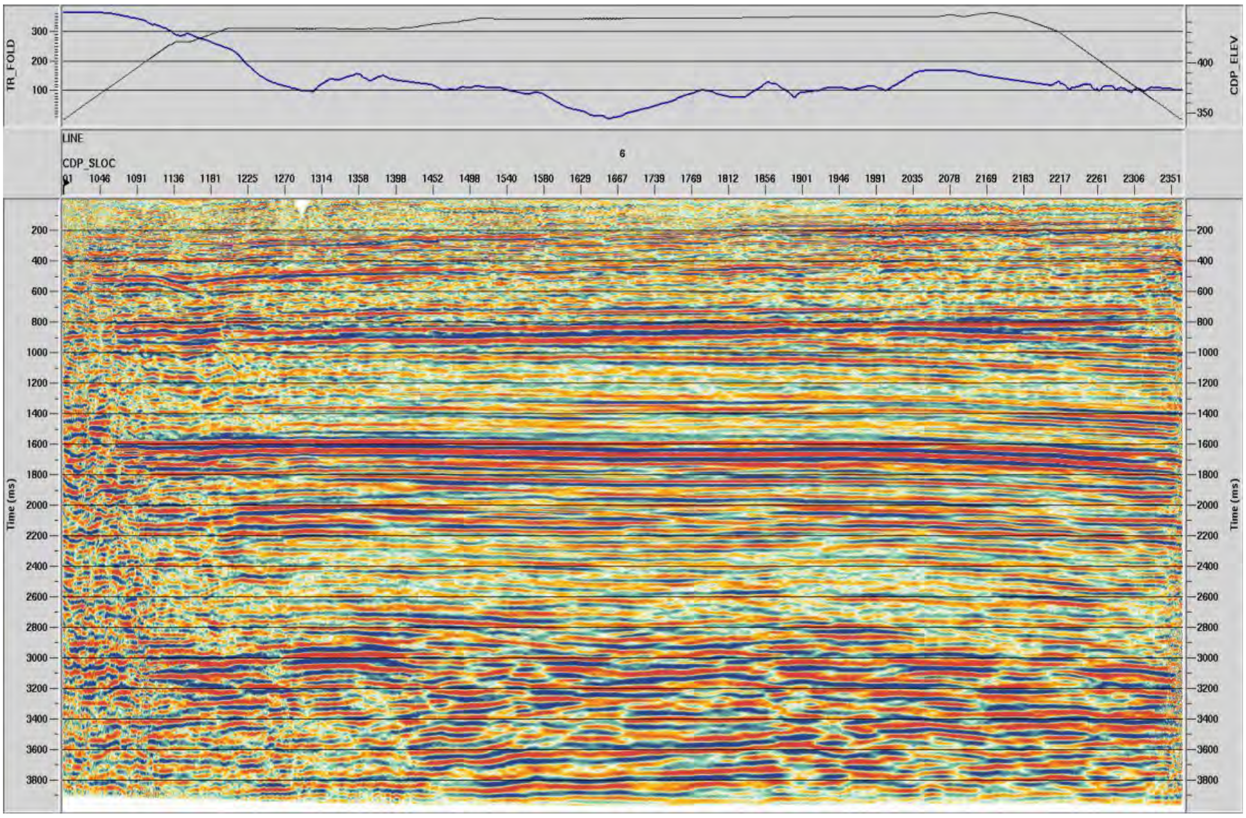


Figure 56. Field Brute Stack Line PIN12-006

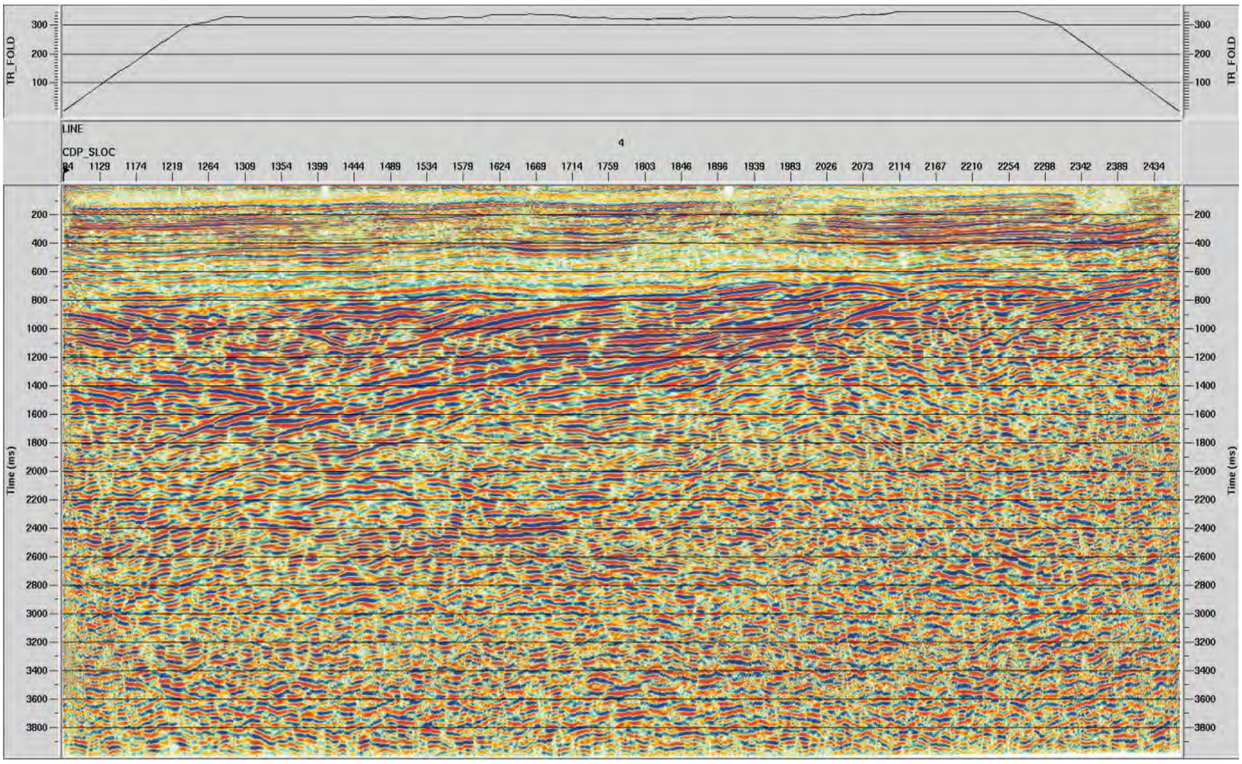


Figure 57. Field Brute Stack Line BEL12-004

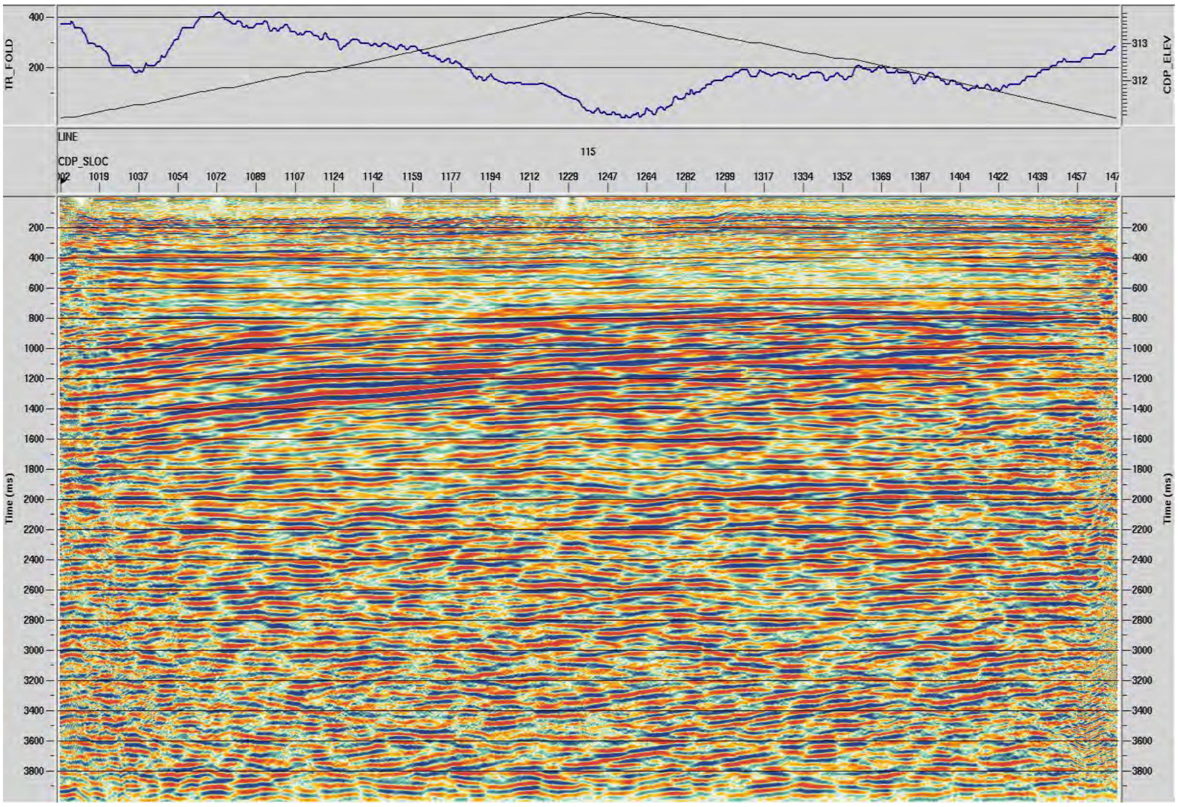


Figure 58. Field Brute Stack Line BEL12-115

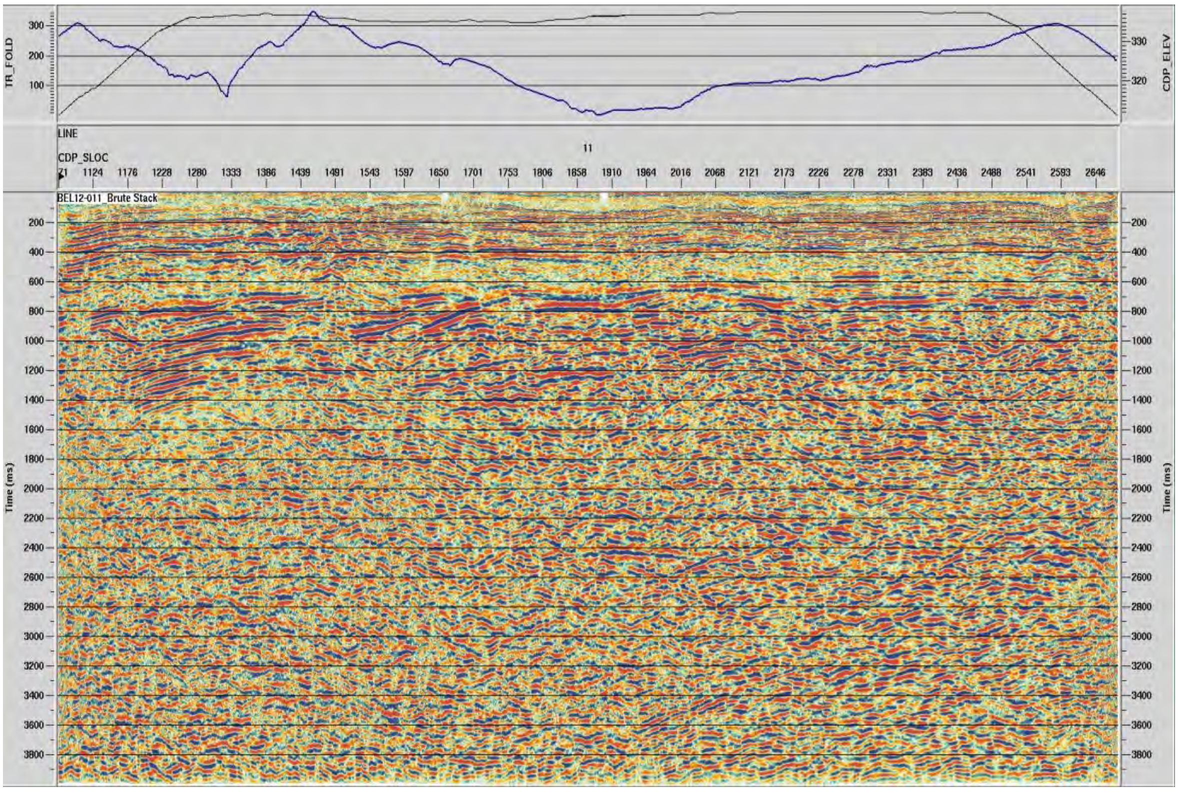


Figure 59. Field Brute Stack Line BEL12-011

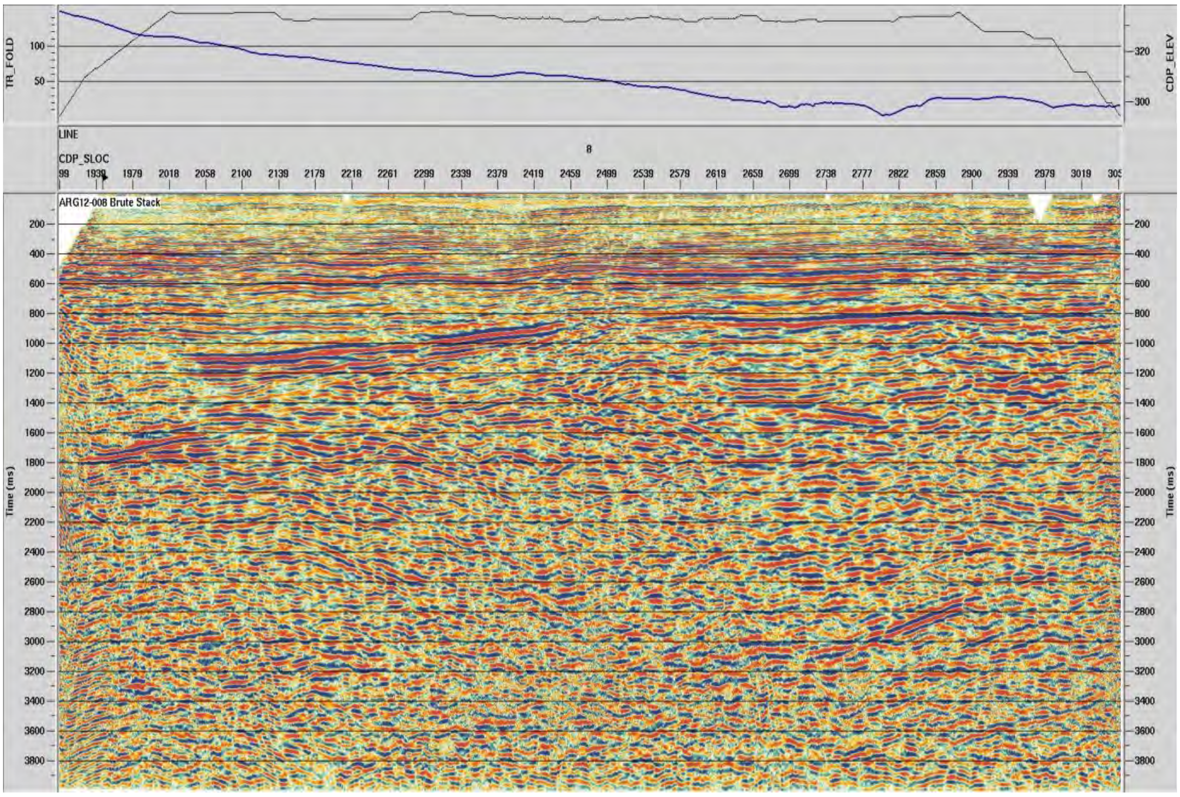


Figure 60. Field Brute Stack Line ARG12-008

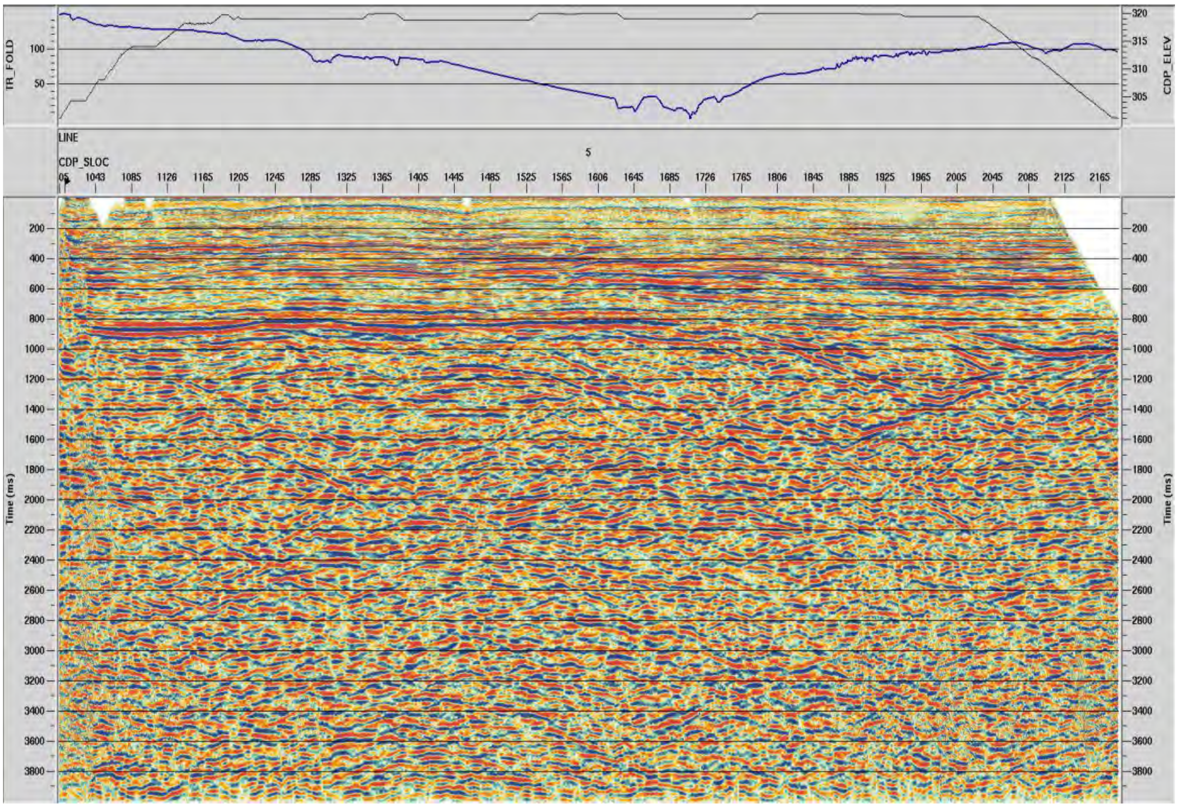


Figure 61. Field Brute Stack Line ARG12-005

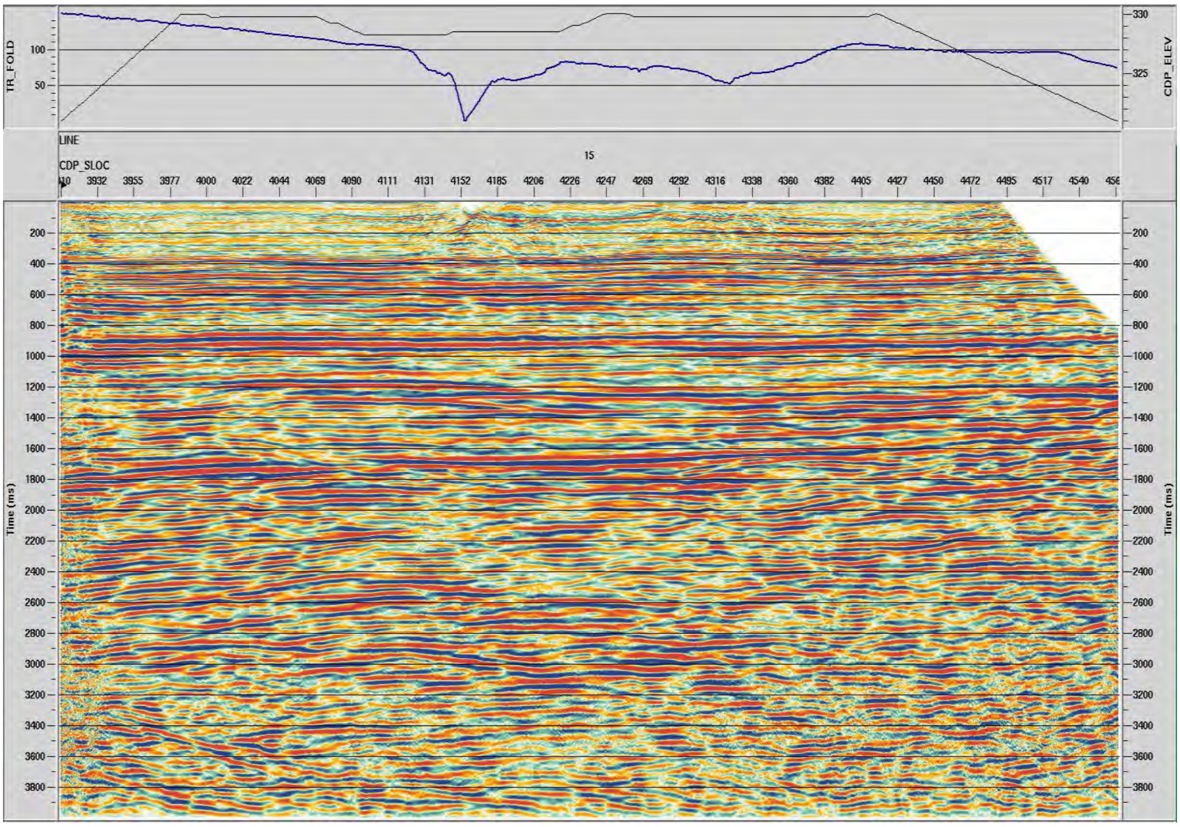


Figure 62. Field Brute Stack Line JEN12-015

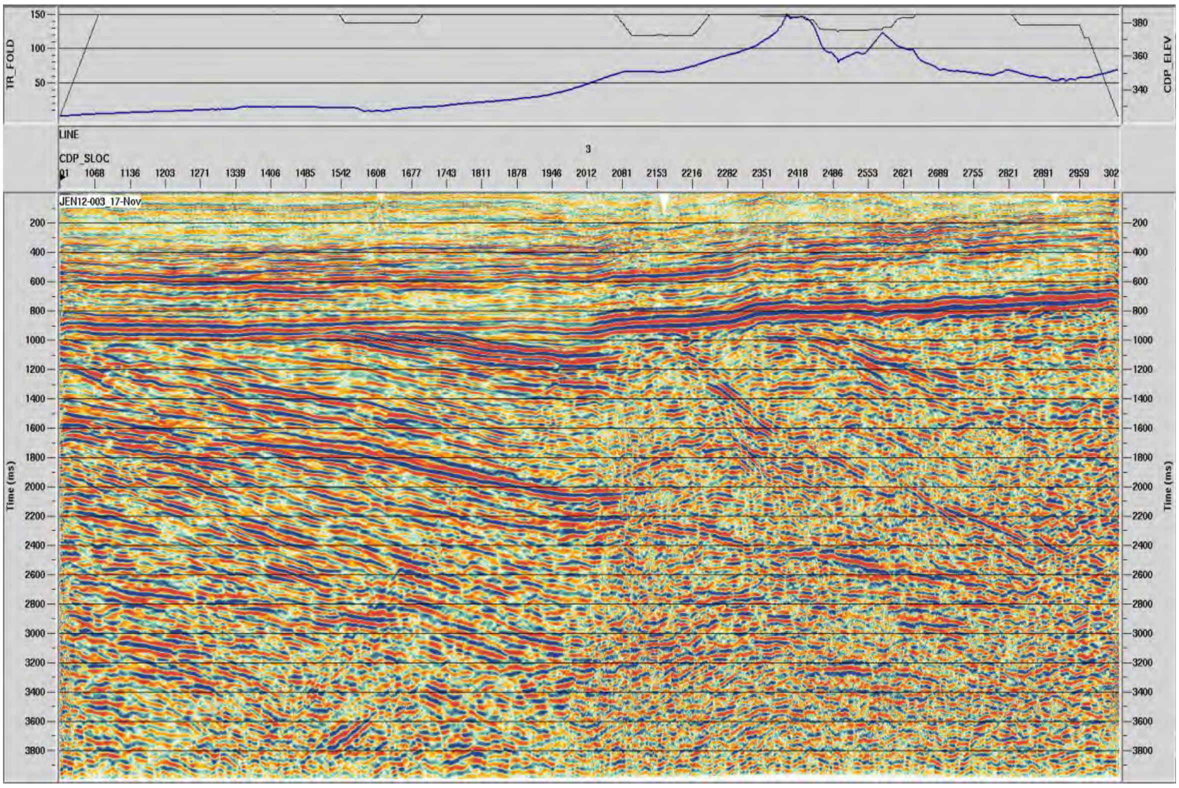


Figure 63. Field Brute Stack Line JEN12-003

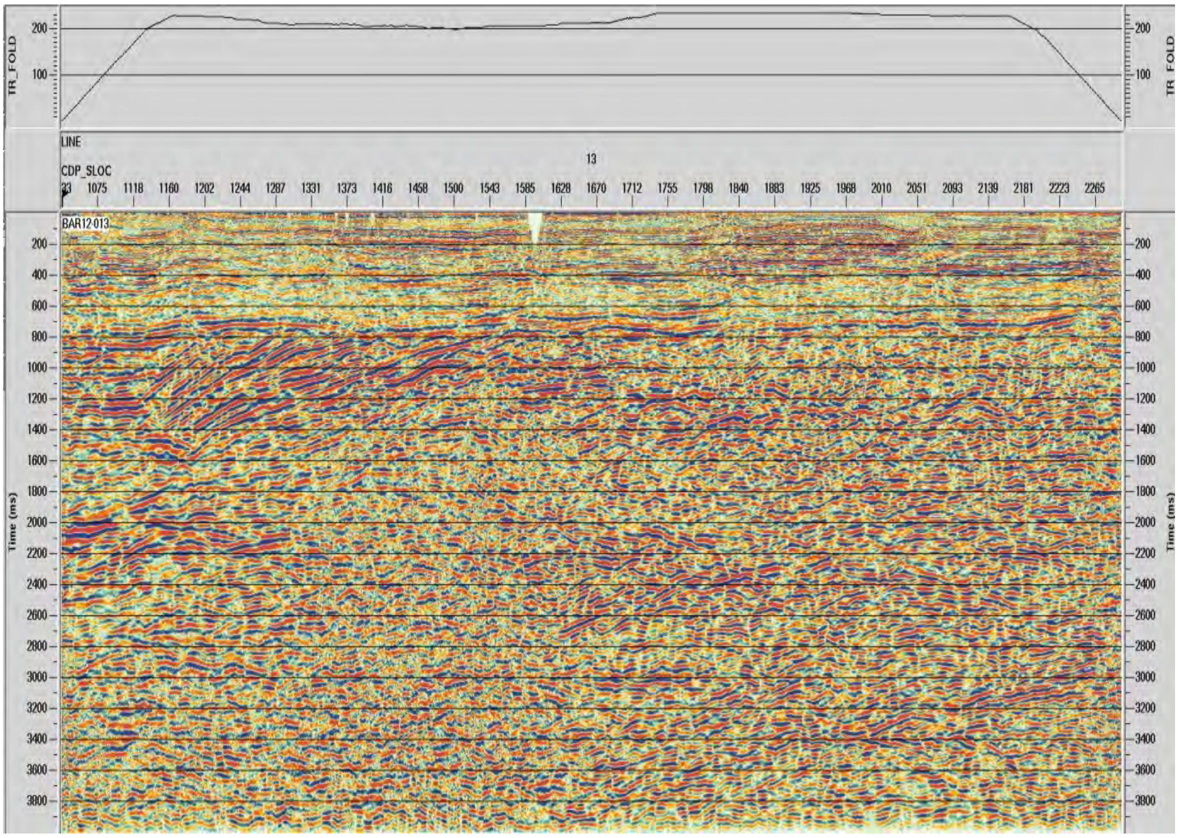


Figure 64. Field Brute Stack Line BEL12-013

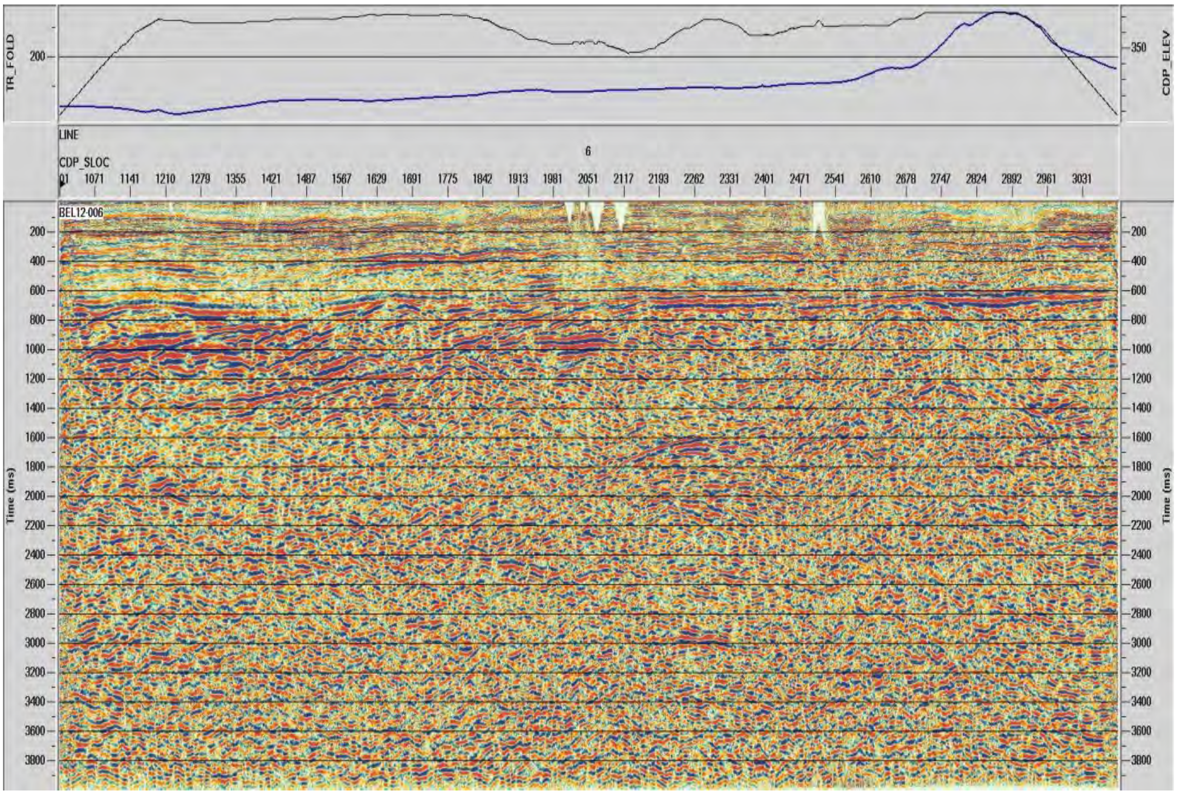


Figure 65. Field Brute Stack Line BEL12-006

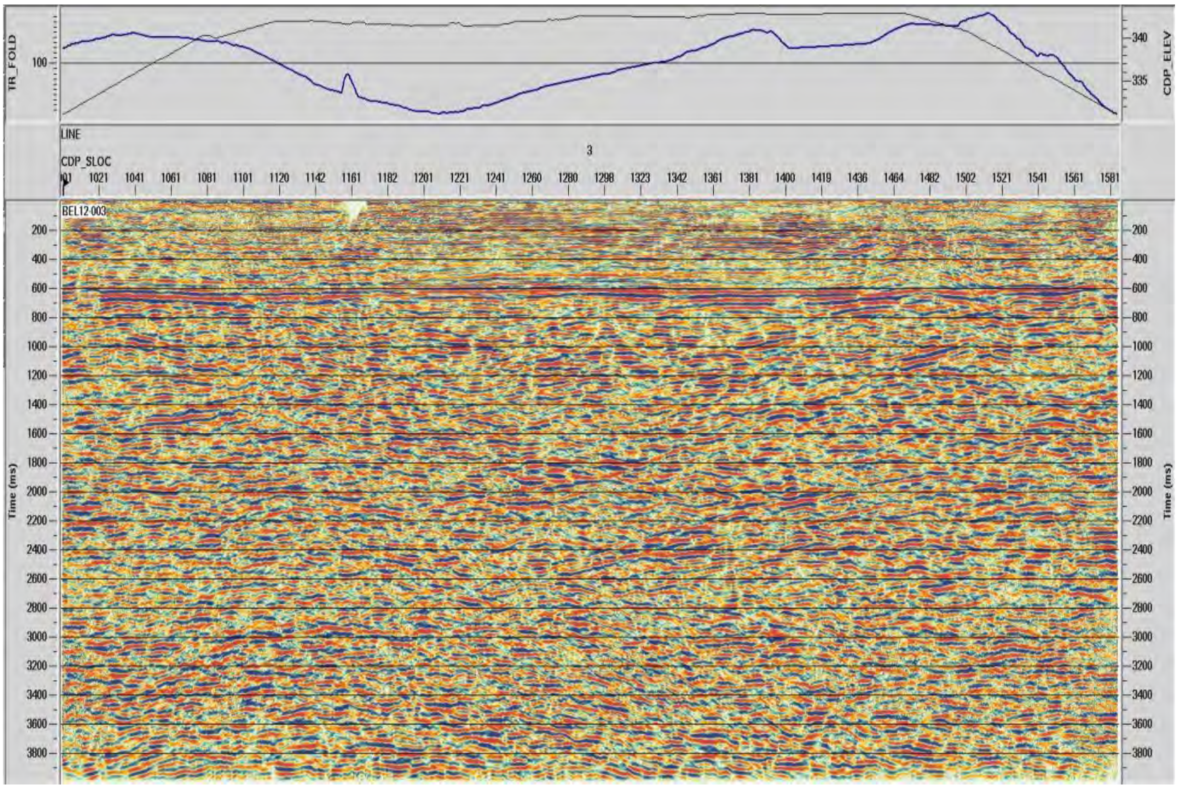


Figure 66. Field Brute Stack Line BEL12-003

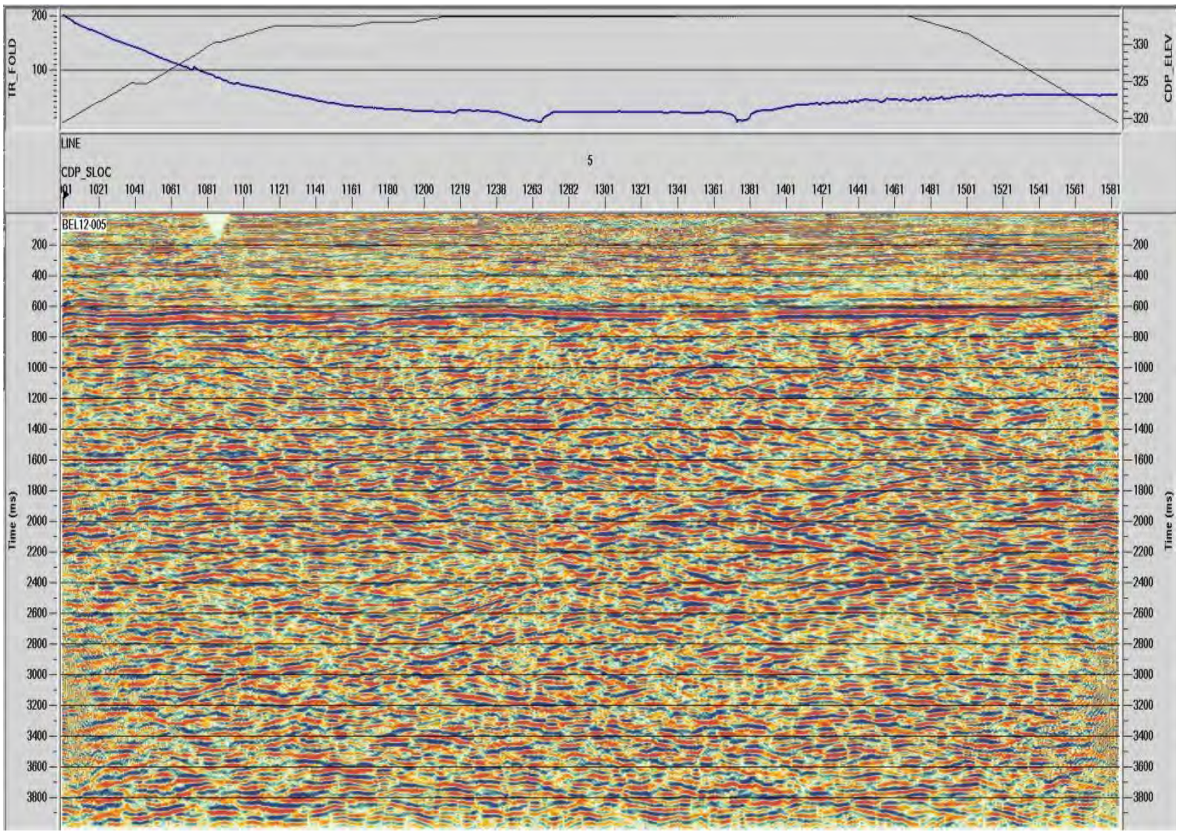


Figure 67. Field Brute Stack Line BEL12-005

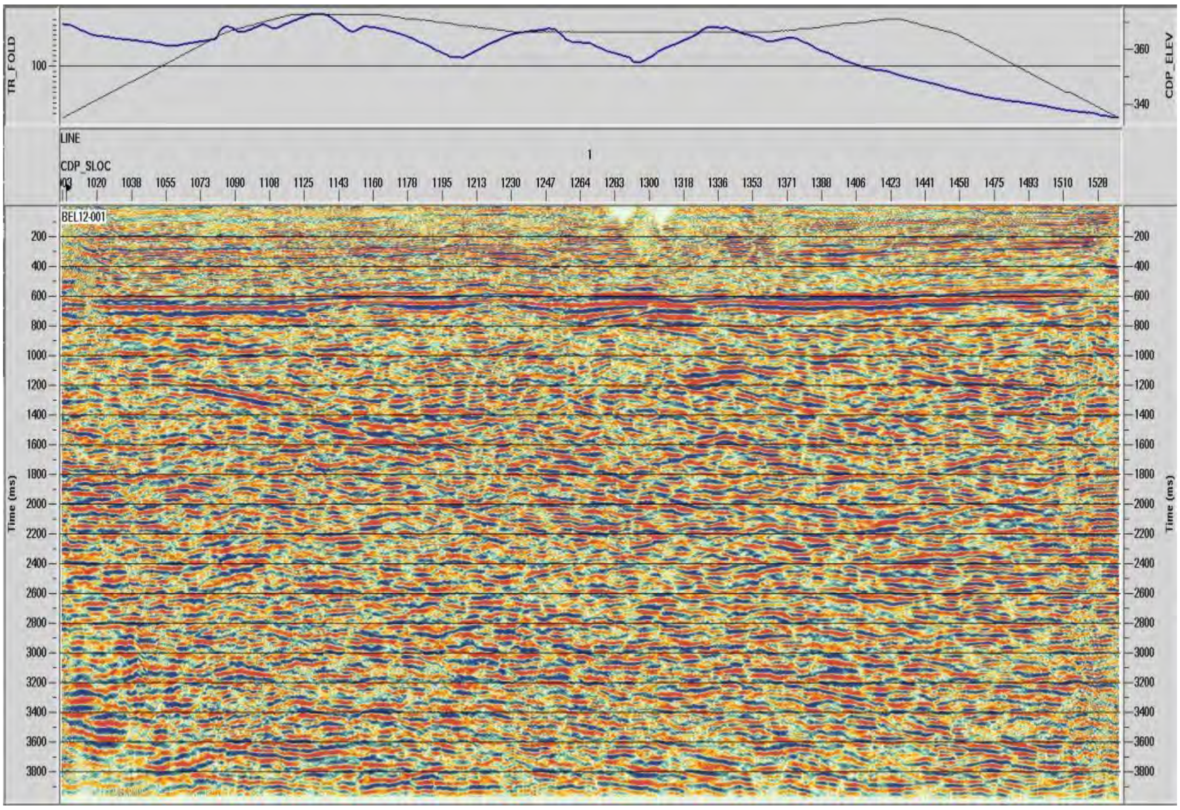


Figure 68. Field Brute Stack Line BEL12-001

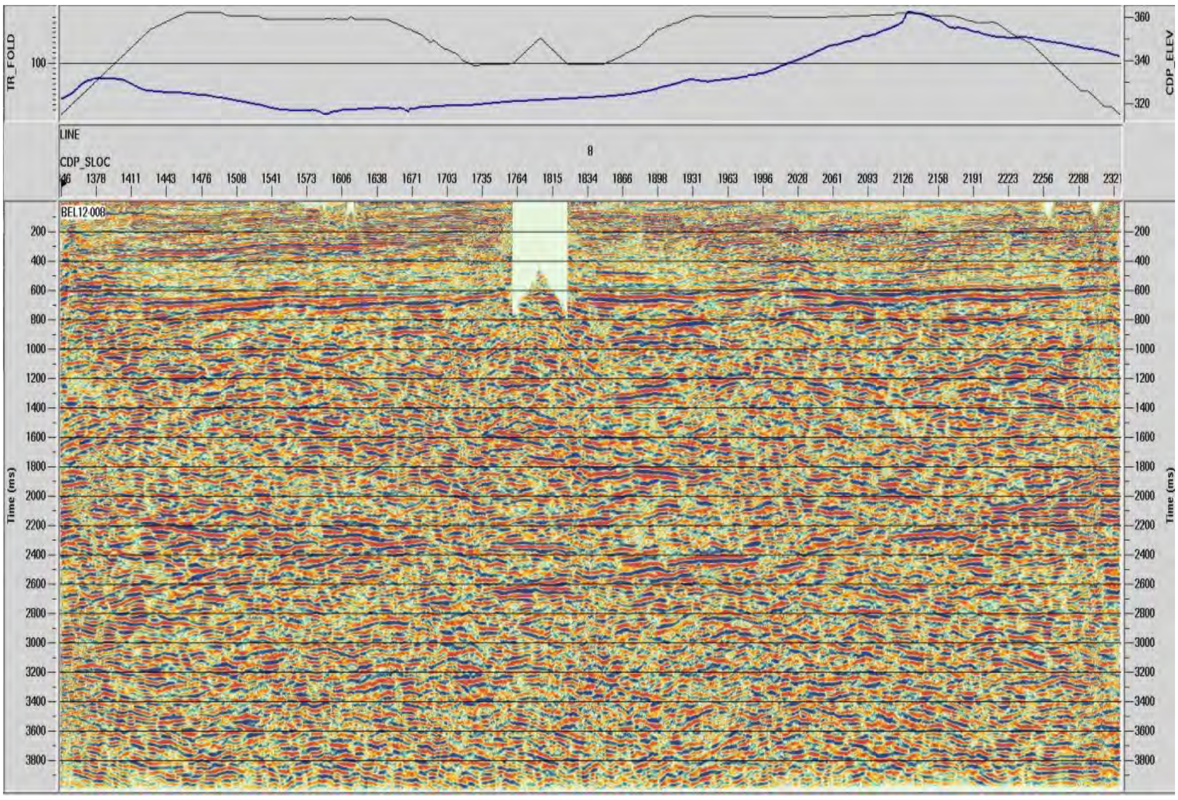


Figure 69. Field Brute Stack Line BEL12-008

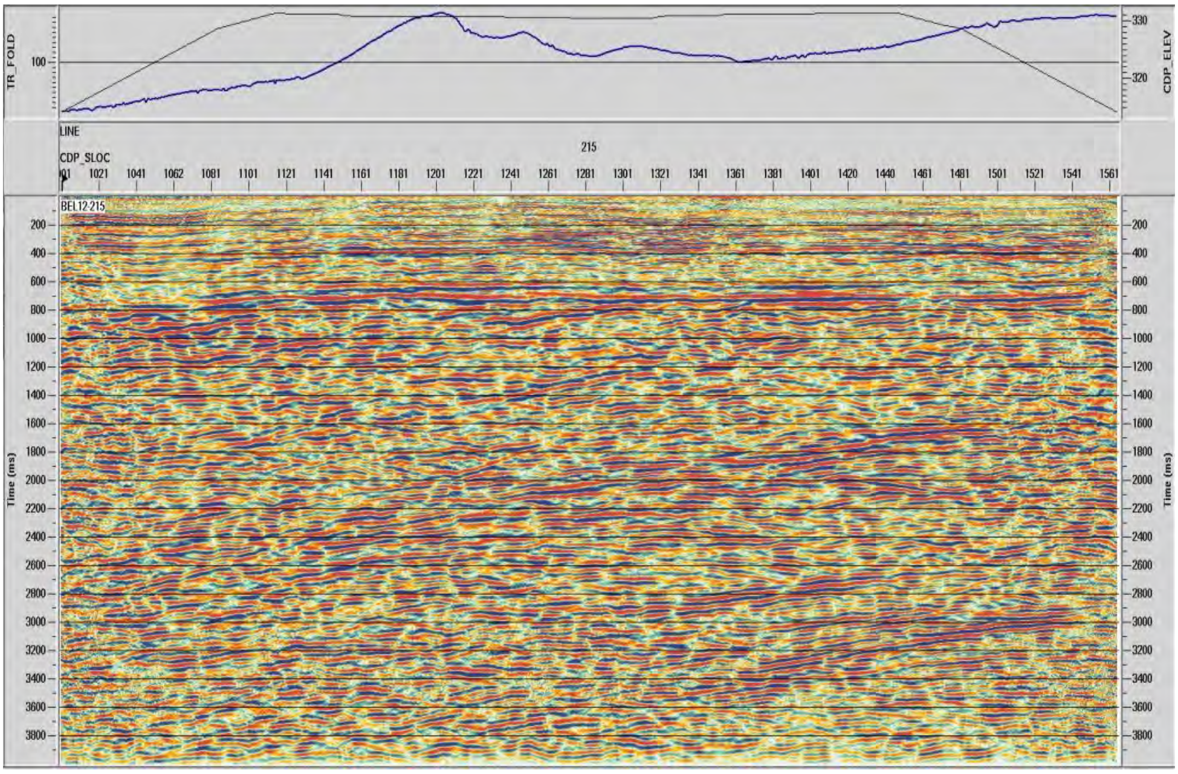


Figure 70. Field Brute Stack Line BEL12-215

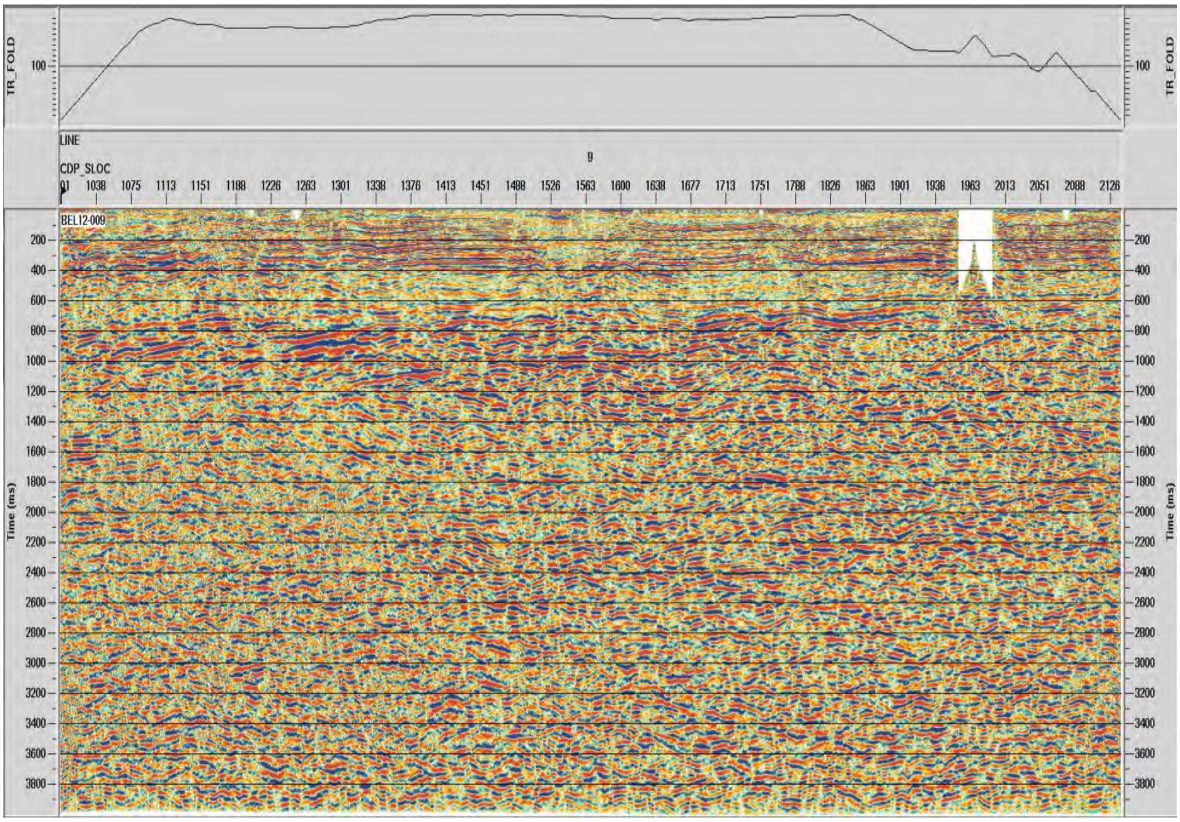


Figure 71. Field Brute Stack Line BEL12-009

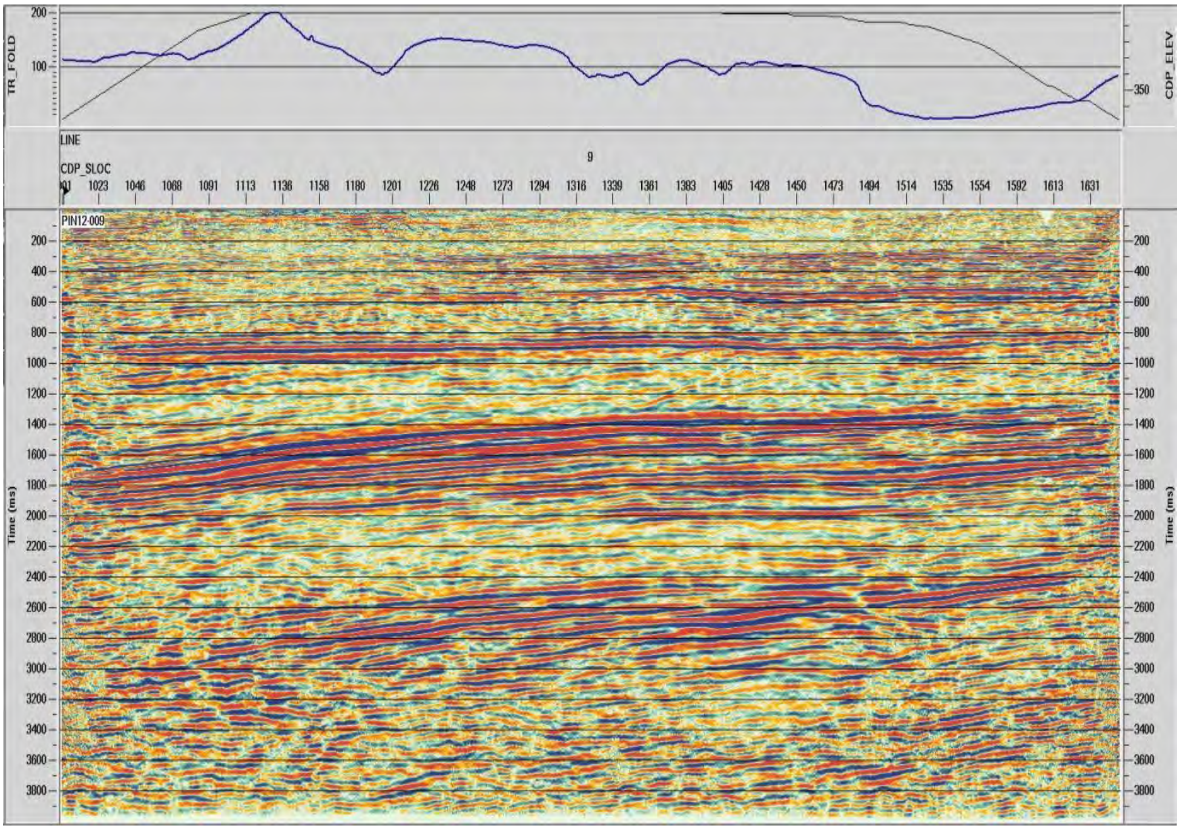


Figure 72. Field Brute Stack Line PIN12-009

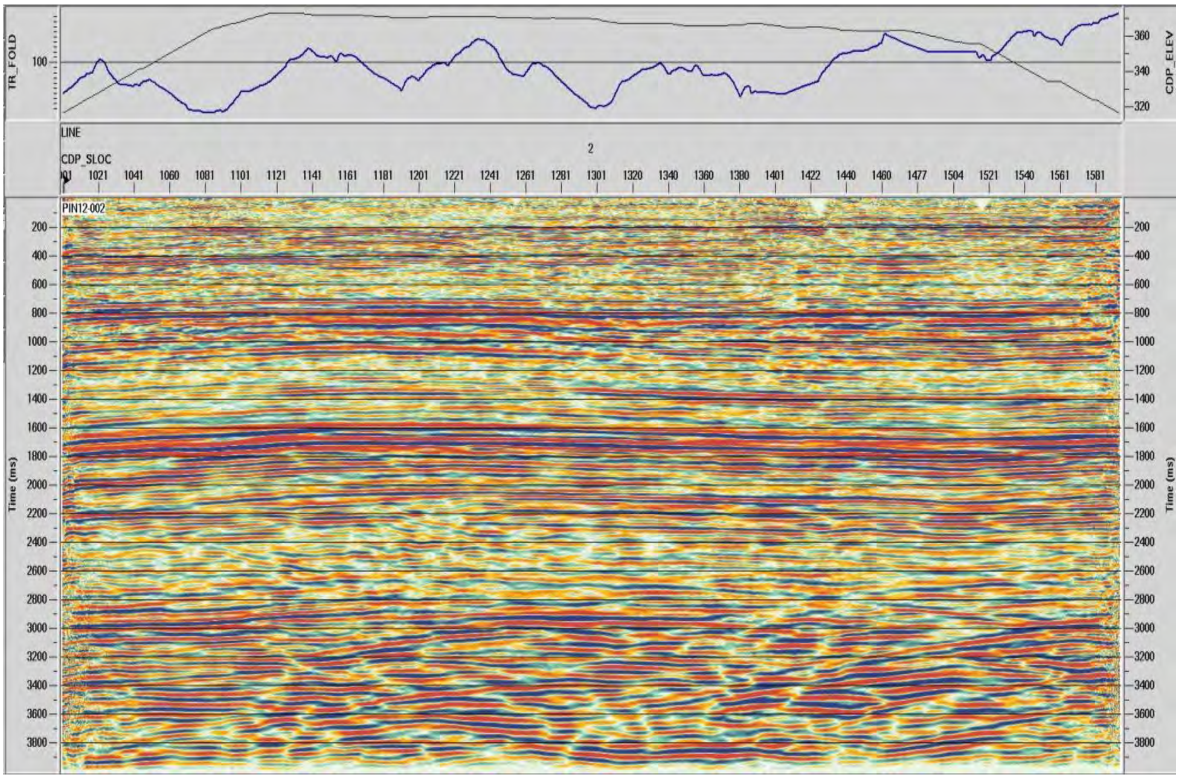


Figure 73. Field Brute Stack Line PIN12-002

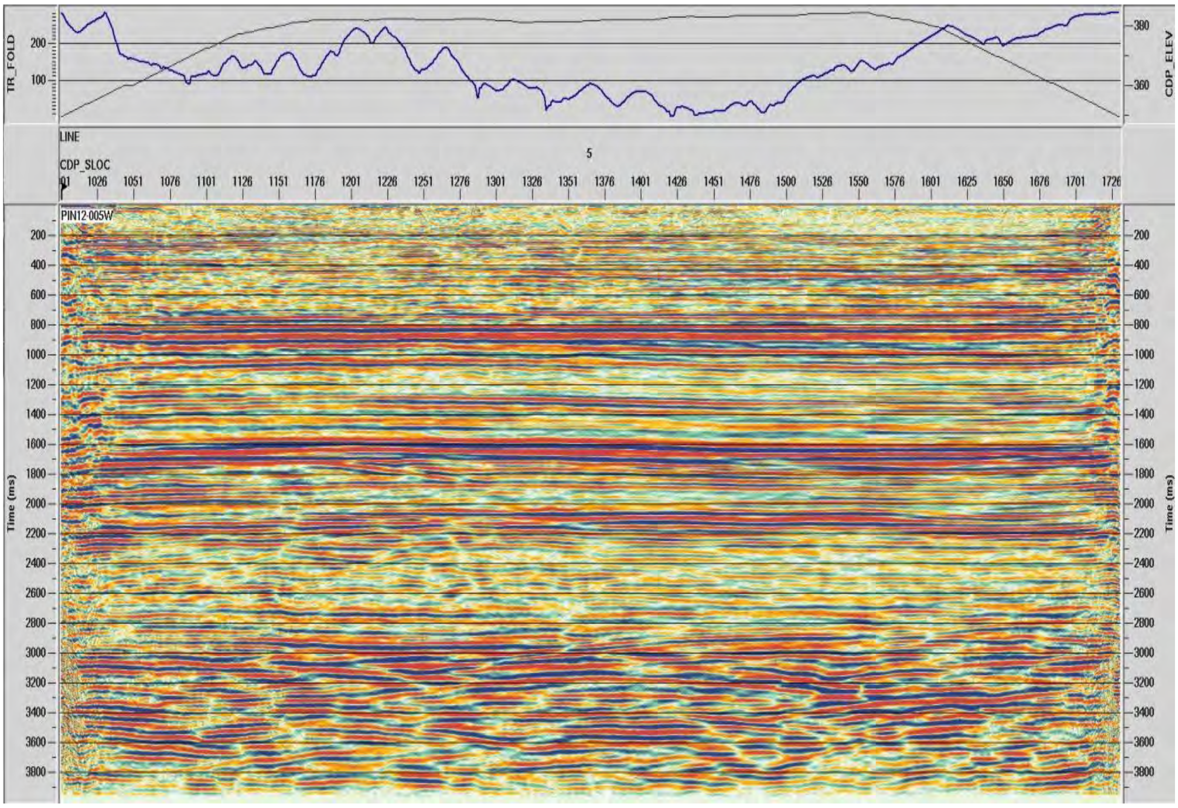


Figure 74. Field Brute Stack Line PIN12-005W

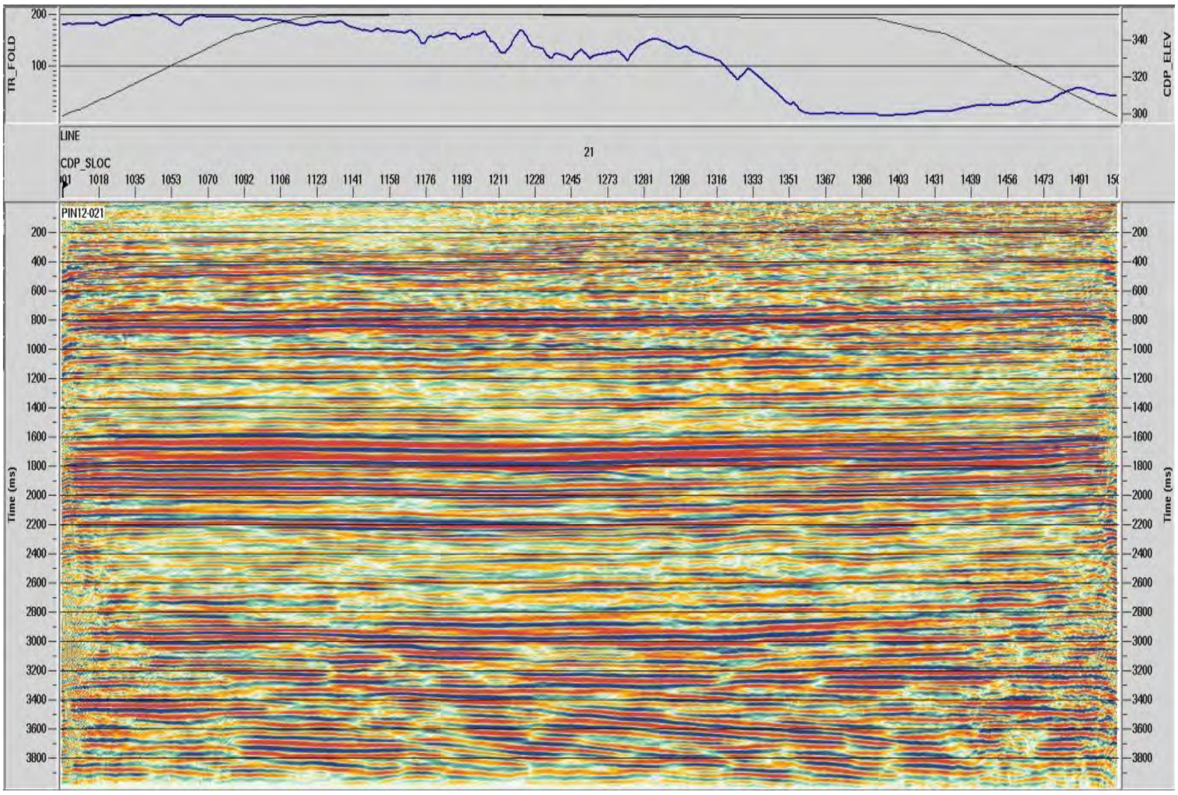


Figure 75. Field Brute Stack Line PIN12-021

5.12 Project's Deliverables

Data shipments were stored and sent under protected cover and under environmentally controlled conditions to maintain the integrity of the data medium. The main medium for data shipment was hard disk drive that was considered as the most reliable media for seismic data shipment. A full record of the data shipments to all destinations were kept and maintained by Crew 488 Geophysics Department.

Deliverables provided upon completion of each Seismic Line:

End of Line Deliverable Contact:
Hard disk drive and supporting documents
CGG VERITAS Centre,
38 Ord Street,
West Perth
WA 6005
Attn: Nigel Mudge

End of project deliverables:

Final Data shipment contacts
Hard disk drive and supporting documents
QGC Exploration
Level 25,
275 George ST.
Brisbane, QLD 4000
Attn: Richard England

Each Data Shipment consisted of the following items:

- Field RAW Seismic data (in SEG-D)
- Field Correlated Seismic data (in SEG-D)
- Seismic dataset with geometry (in SEG-Y)
- Raw and final observer's report and acquisition parameters
- Final SPS files
- QC Report
- Screenshots of field brute stacks along the 2D lines
- Data Shipment inventory
- Navigational (receiver and source positioning information)

6 HEALTH, SAFETY AND ENVIRONMENT (HSE)

Survey activities began on 24 September 2012 with the setting up of a new control point with static observations carried out on government control points. Shortly afterwards all recording equipment arrived on-site along with the first of the KJM Camp1 containers and several key contractor personnel. Project inductions commenced the following morning when the bulk of the advance crew arrived and before field activity commenced. Mascott management, KJM management and the Geokinetics HSE Advisor spent time dedicated to bridging the respective HSE Management Systems to ensure the observations from the previous (2012 Barra) project were addressed.

Other activities conducted during this period included commencing the field hazard identification and marking while surveying source and receiver points.
Slashing and survey activity was in full production by this stage and the arrival of the recording crew enabled the bulk of the inductions and job specific training activity to be carried out to close the approval process to initiate project start-up.

Figure 76. Geokinetics Crew 488 for the seismic 2D survey

6.1 Leadership and Commitment

Corporate HSE policies signed by the Geokinetics President and Chief Executive Officer Richard Miles were posted at the crew office entrance and the HSE Notice Boards. These policies were reviewed during the induction program and at interval throughout project duration. Senior crew management commenced the proceedings at each morning toolbox, each evening operations meeting and the weekly departmental safety meetings. Site visits by senior management were conducted regularly as where camp walkabouts and forward scouts of new areas.

Personal statements on safety were a regular feature of senior management’s commitment to the transfer of safety related information. Regular reviews where conducted of the action point list, STOP card submissions and weekly safety meeting minutes to ensure items requiring attention were monitored for remedial action and close-out. Senior management were involved in all incident reviews and monitored the close-out of each proposed remedy to guard against re-occurrences.

All morning toolboxes were conducted with safety at the forefront. Operational content was always backed up with a reminder that safety came first in every activity the crew undertook. When items or actions were required to maintain high standards of safety, management were committed to the supply of any available resource to ensure close-out was achieved. Senior management maintained communications with other Geokinetics crews, Brisbane head office and corporate headquarters to ensure intra and intercompany safety performances were evaluated to benchmark and determine best practice. Participation in standard and target setting and the implementation of procedure and measurement systems by senior management ensured realistic and reliable goal setting analysis.

Senior management do believe that safety is part of their job and their actions and behaviour displayed during 2012 Bellevue-Pinelands-Jen & Argyle 2D survey is testament to this.

6.2 Organisational and Operational Requirements

Line management accountability and responsibility is clearly defined an every plan, procedure and job description. Crew supervisors and group foremen conducted their duties in line with line management definition. Regular review both formally and informally was maintained to ensure performance objectives were assessed.

A robust safety management plan and emergency response plan was in place at project commencement and throughout. Events during the project tested these plan's content and it was determined that they were adequate in consideration of project requirements. Amendments and alterations were addressed to ensure these documents remained live. Oil and Gas Producers incident recording and reporting structure was maintained and consideration given to compliant environmental, Queensland Petroleum and Gas (Production and Safety) and Queensland Work Health and Safety reporting requirements.

Senior management and safety advisors are holders of the Certificate IV in Occupational Safety and Health. Crew management and safety advisors maintained a direct and functional link to all senior management within the organisation. All safety advisors have substantial experience in land seismic operations and demonstrate sound knowledge of and compliance to current safety management practices.

Safety is not tacked on to the operational requirement; safety department members have provided sound support to line management throughout the project.

Contractor management and alignment of safety requirements was addressed during the project start-up phase. Bridging requirements focussed on procedure alignment and compliance. Bridging documentation in its true form was replaced with Safety Management Plan and procedural review sign off by contractor management and / or contractor supervisors. This alleviated the ‘paper’ workload on HSE staff members and better illustrated the true nature of the working relationship, that being, all contractors work under the Geokinetics Crew 488 Safety Management System.

6.3 Personnel Selection and Training

All new employees were interviewed and assessed for suitability in Brisbane. The bulk of the new employees were field crew members who had supplied resumes prior to interview. All training requirements stipulated by QGC were met. Training and procedural reviews were conducted during the project start-up phase and as required throughout the project with the goal of 100% coverage for job specific training. A structured system was maintained to ensure the training needs were finalised before personnel began assigned work. On occasion, training was spread out over a manageable timeframe to ensure job requirements and training could be carried out in unison. This was limited to camp based personnel who were not required to partake in field activities.

The Green Hand program was well structured and maintained throughout the project. All new hires were physically identifiable with the provision of ‘GH’ vest and were assigned mentors to provide instruction and supervision at the completion of their training requirements. QGC training requirements and established Geokinetics training programs have been implemented to ensure employees hold the required job specific knowledge to perform their assigned tasks safely and effectively. Implementation of the training program was checked for functionality and compliance by updating and reviewing the training matrix on a regular basis. No field based activity was undertaken without first checking training requirements against an individual’s training matrix entries.

Improvement in training related activity was identified in the early stages of the project. Time to conduct the required training once on-site was limited. It is agreed that more time before project commencement is required to effectively complete training requirements. Procedural review and sign-off and task specific training was conducted prior to start-up of this project.

All job specific training has been supervised and run by experienced personnel who are competent in the training subjects. On the job training has been developed in consideration of the Green Hand program. Other job specific training has been completed and informal assessments have been undertaken to ensure the trainee has grasped the technical skills required to complete the tasks. Company employees and contractors have been provided training without distinction. No change in level of scrutiny or training content has been considered when conducting sessions with either group or individual classifications.

Training is not tailored only to operational concerns; training considers the safety of those conducting the job, the environment in which the work is carried at and importantly the safety of those working in the immediate area of operation. Reference to project and historical incidents are addressed in training content to ensure a 'lessons learned' approach is maintained.

6.4 Operating and Safety Procedures

The project specific risk assessment conducted prior to crew mobilisation is the process employed to ascertain what job specific activity will require procedural development and implementation. The crew procedures have been reviewed periodically during the survey. Additions and alterations have been made in response to particular incidents and those directly affected by the changes have signed off as acknowledgement of their understanding and duty of compliance. Particular attention to onSEIS related activity and work conducted in the vicinity of power poles has been undertaken.

Procedure folders have been distributed to four specific locations to ensure access is available to the relevant personnel. Contractor folders are in development to ensure bridging initiatives are transferred to the personnel conducting the job.

Non routine operations are not undertaken without due diligence to the job safety analysis process from which procedure is developed. It is a requirement that all tasks, new or old are risk assessed before activity commences. The HSE department and crew management are committed to compiling procedures that are defined, documented, followed and updated for all activities undertaken on crew. Work conducted in the Cameby Mine was undertaken under the direct supervision of the HSE department head. All those exposed to the mine were inducted by Cameby Mines and all activity fell under the management and supervision of a mine supervisor.

Geokinetics Permit to Work requirements were limited to working at height and works conducted on 240V camp electrical systems. All vehicles, mobile plant and operating equipment was inspected prior to field commissioning and periodically during the project. All inspection records were available in HSE and the mechanical department.

6.5 Emergency and Incident Response

The project specific Emergency Response Plan was developed during the planning stages and implemented prior to mobilisation to site. Rigorous review ensured all elements were accurate and tested prior to deploying personnel to the field. Key parts of the emergency response plan were placed in all field vehicles and mobile plant. Complete copies were strategically placed at key locations to ensure immediate response to emergency could be undertaken. The plan was tested several times while conducting drills both in camp and the field. Updates during the project were not required. Emergency responsibilities are clearly defined in section 3.3 of the Emergency Response Plan. Card holders are trained in the position allocated and tested during drills. Non-company agencies form part of the emergency response. These groups were either involved or contacted during drill exercises. The drill scenario and log sheet is used to conduct drills. These are finalised and distributed to allow lessons learned to reach full potential. Actual and drill events form an integral part of emergency response development and implementation.

Incident investigation is governed by incident severity. The Geokinetics incident report form and incident investigation and guidelines is utilised in conduct the required activity.

6.6 Project Operational Summary

6.6.1 Crew Statistics and Exposure Hours

Crew numbers averaged 74 once the full crew contingent arrived. The maximum number of personnel onsite in one day was 85 which including Geokinetics, QGC, sub-contractors and visitors. A total of 67,128 Man Hours were recorded. The hours accumulated without LTI and the end of the project was 187,074.

Group / Month	October	November	December
Geokinetics	18648	37440	44256
QGC	1992	288	4008
Contractors	8712	1331	1466
Visitors	792	99	1272
Total	30144	39158	51002

Table 20. Project Man Hours

6.6.2 Induction

The bulk Geokinetics induction was conducted on 4 November 2012 and as required thereafter. A comprehensive consultation process was maintained throughout to ensure all personnel were adequately informed of QGC's expectations and best practice process. This induction was the initial point of contact between Management and the where the importance of correct QHSE principles and methodologies could be emphasised. Information conveyed during the course of the induction process was both comprehensive and extremely informative. Crew 488 QHSE used this forum to educate, instruct and coach both new and established staff in the manner in which both QGC and Geokinetics expected them to safely operate throughout the project.

Crew personnel were required to complete the four components of the QGC induction, the Geokinetics Crew 488 site specific induction before work commenced in the field.

Geokinetics and in particular Crew 488 wishes to commend QGC's induction efforts in preparing the crew for the task at hand. The goal of zero harm and the expectation that the crew would conduct field activities with minimal adverse environmental impact was achieved with both Geokinetics and QGC's information, instruction and training.

A total of 260 inductions were recorded for the project. This includes the QGC and Geokinetics project specific inductions, the Geokinetics short visitor induction, Cameby Mines and the KJM Camp1 site induction.

Group / Month	October	November	December	Total
Geokinetics	141	26	7	174
QGC	6	18	7	31
KJM	141	18	7	174
Cameby Mine	0	62	0	62
Total	288	124	21	441

Table 21. Project Inductions

6.6.3 Training and Verification of Competencies

All completed crew training activities are summarised on the Crew 488 Training Matrix. It is from here that management can ensure that all personnel appointed to the operation have the necessary competencies, skills and experience to effectively and safely perform their required duties.

Prior to project commencement all Vibrator and onSEIS operators were assessed to verify competencies by scrutinising operator performance against the manufacturers' operating instructions. Task specific line crew training was conducted prior to commencing field activities. These included but were not limited to hazard identification and reporting, emergency response and preparedness, manual handling, noise and noise effect, vehicle checks and recording equipment deployment and retrieval.

Total training hours for the project was 1656 hrs.

Training Source/Hours	October	November	December	Total
Internal	635	466	30	1131
External	276	232	17	525
Total	911	698	47	1656

Table 22. Training Hours

Figure 77. Reversing and Trailer Reversing Training

6.6.4 Drills

Drills were conducted to demonstrate the crew's ability to respond to a wide range of emergencies, develop crew confidence and identify deficiencies in training. Another objective was to train the crew to ensure both individual proficiency and a strong sense of the team work was maintained to handle any conceivable operational emergency. A third objective is to test the operational status of the equipment while assessing it for suitability.

Drills conducted during the project included a Camp1 Fire Evacuation Drill, Field Operations Fire and Medevac Drill, Lost Person / Securatrak Duress Drill and a Spill Drill.

A total of 9 drills were conducted over the mobilisation and project duration.

6.6.5 Transport

Vehicle activity was reduced to essential driving only throughout the survey. The best way to avoid a vehicle incident is not to drive. The crew was encouraged to ask an initial question prior to deciding on vehicle movement, that is: "Is the journey really necessary?" As a result of a HIPO vehicle incident involving a rollover, this question was added to the top of all vehicle inspection sheets.

10 Toyota, Ford and Nissan utilities, 2 Toyota wagons, 2 Isuzu field trucks, 1 MAN service truck, 1 prime mover, 1 Volkswagen commuter van and 2 John Deere UTV's made up the crew vehicle fleet. Not all vehicles were on crew at all times and some even though on crew, were not driven daily. Pre-start vehicle inspections were conducted prior to any departure to ensure the vehicle was in a compliant state. Deficiencies were noted and actioned by the head mechanic and occasionally by technicians allowing the planned journey to proceed. A number of windscreens were replaced during the survey and at time of writing another vehicle windscreen has been reported as cracked due to stone damage. Several vehicle incidents were reported as real hazards associated with travelling around the project area were realised. These included a collision with a kangaroo and on a

separate occasion, a pig, a low speed collision with a tree branch, a reversing incident which resulted in a vehicle coming to rest in a culvert drain and a HIPO rollover incident. The morning toolbox was the ideal forum to focus attention to the hazards associated with all forms of vehicle travel.

Total vehicle kilometres recorded for the project was 255,242 kilometres.

Group / Kms	October	November	December	Total
Geokinetics	52,710	73,059	24,748	150,517
QGC	7,998	9,448	3,494	20,940
Contractors	35,446	41,780	6,559	83,785
Total	96,154	124,287	34,801	255,242

Table 23. Kilometres Driven during the survey

6.7 Crew Facilities

6.7.1 Accommodation and Meals

The KJM Camp1 facility accommodated the entire crew. Several safety, health and hygiene issues were addressed during the project with positive HSE result while efforts to align the standards with QGC and Geokinetics requirements continue at time of writing.

6.7.2 Offices and Workshops

The two extra containers delivered mid 2012 Barra project allowed for better work spaces; Geokinetics project management utilised the additional spaces to their fullest potential during Bellevue-Pinelands-Jen & Argyle operation. The mechanical workshop and technicians remained in their original locations where vehicle servicing and technical repairs and maintenance could be continued.

6.7.3 Fuel and Water Supply

A 23,000 litre diesel fuel container was utilised to supply fuel for the Crew vehicles and was conveniently located from the main camp. Refuelling was conducted by trained personnel only; several additional operators were trained during the project. All efforts to conduct refuelling at the end of the day were maintained to ensure a quick departure to the field could be achieved each morning.

Total fuel consumption for the project was 150,934 litres. This figure represents fuel consumed by vehicles, vibrators, onSEIS and stationary generators in addition to all client and contractor fuel usage.

Potable water deliveries were carried out as required. Total potable water delivered to Camp1 was 1,172,000 litres

Spill containment pallets located at the mechanical workshop were utilised to guard against oil spill release to the environment. Chemical storage lockers were available and utilised to segregate and contain. All areas where the transfer of fuel or oils was conducted were stocked with quantities of absorbent pads and sausage booms and shovels. Disposable plastic bags were supplied to allow an effective clean-up process should the need have ever arisen. Required items of personal protective equipment were stocked inside spill kits mounted on the MAN service truck, field service vehicle and at the camp refuelling facility.

Group/Fuel Consumed	October	November	December	Total
Geokinetics	27,558	23,404	8,958	59,920
QGC	795	830	425	2,050
Contractors	8,297	6,935	1,219	16,451
Total	36,650	31,169	10,602	78,421

Table 24. Fuel consumption for the project

6.8 Hazard Management, Risk Assessment and Job Safety Analysis

Hazard identification and subsequent analysis allowed for the implementation of specific control measures to guard against unfavourable outcomes in most instances. Surveyor hazard scouting and hazard notification was instrumental in allowing the safe execution of field activities. The new position created for hazard identification, marking and notification boosted the crews' efforts to capture hazards and control outcomes. The Geokinetics Risk Matrix was regularly utilised to determine safety and prevention measures for pre-mobilisation and ongoing field hazard analysis.

Safety critical field activities were conducted after a comprehensive Job Safety Analysis exercise was completed for the task and procedures distributed to strategic field locations enabled direct access as per regulatory requirements.

A Health Risk Assessment (HRA) was conducted during the early phase of the project which covered both camp and field activities. Supplies of electrolytes, adequate drinking water supply, hats and the insistence of working in direct sunlight with sleeves rolled down were examples of how the crew managed UV and dehydration hazards noted in the HRA. As temperatures increased the top ten hazards were reviewed and 'Extreme Heat' was included. Efforts to reduce the effects of ambient heat exposure were a main focus of the daily duties of the field medics.

Road transportation was unquestionably the number one hazard noted prior to survey commencement. Heavy vehicle activity on the roads from Brisbane to the camp and around the survey area was addressed consistently during toolbox discussions and weekly safety meetings. Pre-start vehicle checks, driver licence and mandatory training scrutiny and journey management procedure were measures implemented to ensure risk associate with driving activity was reduced to that which could be considered as low as reasonably practicable.

STOP Card submission was the cornerstone of the hazard management system. Crew participation was considered one of the highlights of the project. Both QGC and Geokinetics management commented on the excellent participation rate and linked crew HSE culture to this observation.

A total of 455 STOP Cards and 112 GO Cards were submitted during the project.

Figure 78. Ramp locking pin fitted to eliminate hazard

6.9 Safe Work Procedures

In order for the crew to operate in a continuously safe manner, safe work procedures were produced that eliminated or mitigated the risk involved with performing certain safety critical tasks. These procedures were tailored specifically for crew operations on 2012 Bellevue-Pinelands-Jen & Argyle 2D project and were the backbone to the crew conducting tasks in the safest possible manner.

Vibroseis procedures were signed as an acknowledgement that they had been read and understood and that the vibrator operators would conduct their activities in line with procedural content. With the introduction of an alternate source unit, onSEIS procedures were signed as an acknowledgement that they had been read and understood and that the onSEIS operators would conduct their activities in line with procedural content. Group inductions conducted prior to field deployment provided a brief opportunity to review and sign off on field related activities and other relevant procedure. As planned, extra time was allocated to conduct extensive procedural review and sign off prior to the commencement of this project.

New procedures written throughout the project were reviewed by the Project Manager before being signed off on as final approval.

6.10 Permit to Work (PTW) System

Safety critical tasks requiring added scrutiny and management control and attention were subjected to the PTW system. Working at Height, Night Driving and working on 240V electrical systems were the only activities attracting PTW issuance.

A total of39 PTW were written during the project.

6.11 Subcontractor Management

6.11.1 Mascott Drilling and Earthmoving

Line clearing, fencing and permanent / temporary gate installations were carried out by Mascott. Procedural reviews conducted prior to project commencement allowed bridging requirements. The contractors spent a period of time with the crew HSE Advisor amending existing procedures to satisfy operational requirements and meet HSE expectations.

6.11.2 KJM Contractors

Bridging KJM camp operations to meet Geokinetics and QGC expectations took place with particular attention paid to camp fire response and evacuation. Continuing without a dedicated camp boss but with a slightly more permanent staffing system, KJM improved noticeably in applying a systematic approach to camp management and client requirements. Repeated requests from crew project management and Brisbane based operations management for KJM to provide documented evidence of the required food license was an example. Plans are in place to rectify deficiencies noted on the project.

6.11.3 Workforce Road Services

Traffic management worked well on the project. Professionalism and structure were key elements displayed by the contractor; this was greatly appreciated and acknowledged by both Geokinetics and QGC. Reducing the number of personnel working on-site as the project neared completion gave rise to extra management efforts to ensure safe work systems were maintained.

6.11.4 Weed Hygiene Inspection Services

Washdown, inspection and certification was carried out efficiently and effectively with due regard to safe work systems and a safe workplace. Staff input and assessment of current operations allowed Geokinetics the opportunity to further develop strategies for such services.

6.11.5 HSEplus

The ability of the medic on crew to train and provide first response medical support if required was a dual function supplied by a single man contractor that was utilised to the fullest. Health and hygiene inspections supported by the medic, toolbox briefs, field observations and a mobile support vehicle were some of the functions HSEplus provided. The elevated November and December temperatures created a work situation that required constant management attention. HSEplus field support was crucial in this regard and both medics should be commended for their efforts to alleviate the effects of higher than average temperature exposure by the field crew members.

6.11.6 Corporate Protection Australia (CPA)

The two CPA Light Attack Vehicles manned by two personnel each at all times provided an extremely important function while slashing and mulching operations were conducted and in particular, on one occasion establishing a safe exclusion zone during a fallen power pole incident. Unfortunately the service was unable to maintain compliant vehicles in the field and a decision was made to reduce the two working vehicles to one after Geokinetics implemented their own first response fire vehicle manned by a qualified Geokinetics operator. Information, instruction and training were key elements utilised by the crew that CPA could also supply. Knowledge gained from this is valuable should a fire start on any future Geokinetics jobs. Several fires in the area were monitored and on one occasion the decision was made to move personnel away from heightened emergency service activity. By this stage CPA had moved south to Moonie.

6.12 QHSE Communication

QHSE information was communicated using both formal and informal methods. These methods consisted of daily toolbox meetings, department head safety meetings, individual departmental meetings, safety alerts and notice boards. Informal QHSE communication also took place between individuals discussing current and topical QHSE deficiencies and corrective measures that could be implemented; this was a good indication of the proactive QHSE culture evident on the crew.

6.12.1 Toolbox Meetings

These were held on a daily basis at the beginning of each day and at a specific place of work that involved personnel who worked in the immediate area or could be affected by the work. Toolbox meetings were essential in communicating safety at crew level. Topics discussed in these meetings ranged from Fire Danger Ratings to discussing trends identified through STOP card hazard reporting. Toolbox meetings are a fundamental forum used for effectively communicating health, safety and environmental concerns and initiatives.

A total of 108 toolbox meetings were conducted during the project.

6.12.2 Head of Departments (HOD) Safety Meeting

HOD safety meetings were held on a weekly basis on Saturday afternoons and involved all Heads of Department. This forum was where HOD's discussed their department specific concerns or provided information on the project in general. Department heads were instructed to take information gained from these meetings and transfer it to their immediate subordinates. The reverse was encouraged so that the subordinate could bring safety concerns to the table through their immediate supervisor.

The QHSE department provided statistical information on department performance with regards to KPI compliance and challenges. HOD's were fully briefed on their own QHSE responsibilities and performance in terms of items requiring their attention derived from the Action Point List and inspections and audits. This was an extremely important way of addressing significant QHSE matters on the crew.

6.12.3 Departmental Safety Meetings

Informal Departmental Safety Meetings were conducted as required; these were instigated by the heads of department or the most senior person available. Meetings primarily focused on specific departmental concerns however this forum was also used to disseminate issues discussed at the HOD Safety Meeting.

The goal of the department safety meeting was to keep all department personnel abreast of pertinent global and job specific QHSE information, and to gather information to take forward to the HOD Meeting.

It became apparent in the initial phase of the project that long days in the field would negate an opportunity for these meetings to take full effect. The meetings were re-structured to enable more than one department to conduct joint meetings with crew personnel.

A total of 23 safety meetings were conducted during the project.

6.12.4 HSE Notice Board

Positioned centrally to enable all crew, client, contractor and visitor personnel to revisit at daily intervals, the QHSE Notice board was a focal point for information transfer. Safety Alerts posted were reviewed in the morning toolbox and as required to ensure an informed workforce was achieved. Duty of Care notification provided management and workforce the required legal information to conduct daily tasks in accordance to law. Crew Organisation Chart showed clear lines of supervision, information flow and crew structure. The Manual of Permitted Operations for Vehicle Use was a key document reviewed periodically by drivers to ensure all road transport activity was carried out with the 22 items listed clearly understood before departure. Additional information was well received and crew personnel could often be seen reviewing and discussion board content after work.

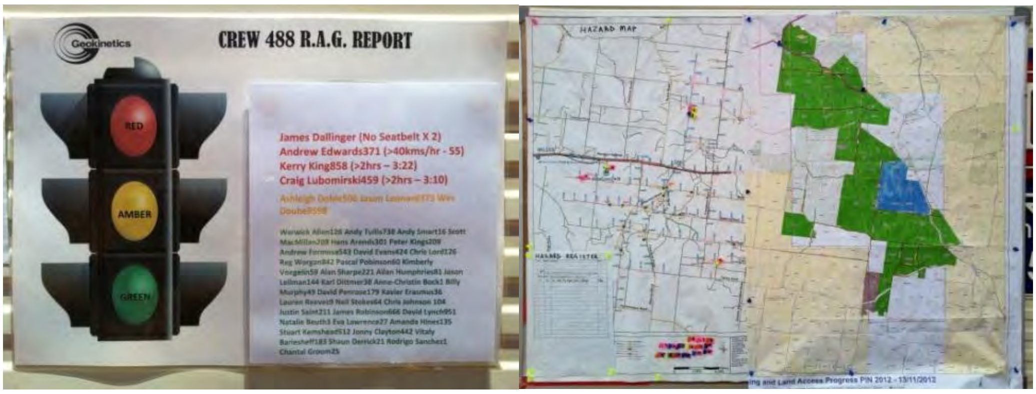


Figure 79. R.A.G Report and Hazard Chart

6.13 Communications and Emergency Response Action Plans

6.13.1 Communication

Land based operational communications were conveyed via vehicle two-way VHF and UHF and hand held VHF radio. Operational discussions were the only radio communications allowed outside emergency procedure while lengthy communications were held on a separate channel. A secondary form of communication was via satellite phone which became a key communications method in the more remote areas.

6.13.2 Emergency Equipment

All emergency response equipment was assessed for suitability prior to mobilisation. Three Automatic External Defibrillators on crew provided coverage in all corners of the project. The Royal Flying Doctors Service medical kit was permanently positioned in the Project Manager’s vehicle while workplace first aid kits were stationed in the recorder and various other locations. The head immobilisation spinal board and a recently purchased neck brace were in the Project Manager’s vehicle.

All other vehicles and workplaces were equipped with either workplace first aid kits or standard vehicle kits in addition to snake bite kits.

The HSEplus medical transfer vehicle had the capacity to rendezvous with emergency medical services should an incident in the field dictate medical evacuation.

The Surat Basin Rotary Wing Aero Medical Emergency (SBRWAME) helicopter could be accessed if a medical emergency warranted critical evacuation of a more seriously injured / ill person.

Fire emergency considerations included the placement of dry powder fire extinguishers in all vehicles and vibrators and the permanent placement of the same around accommodation areas and offices while a Class D Metal fire extinguisher was positioned to ensure metal fires could be extinguished should one eventuate. QGC supplied fire beaters, rakes and 16ltr first response water packs were also available if required.

The contracted first response fire unit provided coverage where slashing activities were conducted and centrally at the recorder where a response could be quickly initiate if required.

Spill response equipment was positioned at all points were fuels and oils were stored or transferred.

Figure 80. Spill Containment and Segregation

Figure 81. Crew Medical Emergency Equipment

6.14 Biosecurity

Vehicles, vibrators and onSEIS were all washed down before inspections were carried out by the third party Weed Hygiene Inspection Services. Where not required, Geokinetics personnel conducted the washdowns and logged activities for future reference. This documented evidence and on site observation confirmed the barriers set in place were adhered to and all personnel, vehicles and equipment remained free of organic matter prior to departing one property and entering another.

Two Geokinetics owned mobile washdown units and one contracted unit conducted all washdown activities in the field while some vehicle washdowns were carried out in Meandarra. Washdown waste was filtered, collected, stored and disposed of in accordance to prescribed requirements.

Figure 82. Crew Washdown Facility

6.15 Inspections, Audits and Corrective Action

A tight schedule undertaken by a busy crew made KPI compliance to Cross Audits a challenge. None the less, several inspections were undertaken by departmental members on another section. The items identified on checklists were reviewed and added to the Action Point List (APL) where required. No management audits were conducted during the project but it is anticipated that these will be conducted by both Geokinetics and QGC management in the near future. Daily vehicle, regular safety equipment and workplace inspections were undertaken to ensure safe workplaces and safe systems of work were maintained. Regular updating and review of the APL ensured the desire for timely and effective closure was maintained. The APL review at project completion was critical to ensuring outstanding items were identified and corrective actions could be implemented prior to the start of 2012 Spofforth project.

A total of 557 action points were generated during the project with 529 closed at time of writing this report.

6.16 Waste Management

All field rubbish generated was returned to Camp1 for correct disposal. The frequency of KLM contracted rubbish removalist that didn't meet previous project requirements was addressed prior to start-up and a marked improvement in volumes and storage was noticed during this operation.

Oil, chemical, weed and seed waste and contaminated soil was collected by Transpacific Waste and processed in their Toowoomba facility. In order to provide QGC of regulatory compliance to waste disposal and tracking requirements, Waste Transport Certificates were made available upon request.

Domestic waste statistics for the project were estimates based on field crew numbers and the daily activities undertaken. Waste oil and hazardous waste figures were carefully scrutinised before being submitted.

6.17 Land Owner Access

QGC Land Liaison Officers maintained steady dialogue with landowners to facilitate the required access under predetermined conditions. Continued communications between field crew members, QGC LLO's and the observers assisted in timely responses to landowner related activities and any eventualities.

During the later stages of the project several incursions into unauthorised areas were realised which resulted in several investigations aimed at avoiding any reoccurrence.

Plans are afoot to rectify noted deficiencies and the results will be implemented without delay.

6.18 The Ten Most Significant Hazards

1. Land transportation: Three road transport incidents were reported involving firstly a contractor vehicle rollover on QGC land, secondly the cable truck struck a tree branch in Chinchilla during an unscheduled stop and finally an incident where a Geokinetics field vehicle reversed into a culvert drain on Old Cameby Rd. One kangaroo strike and one pig strike were reported while a third incident involving wildlife resulted from a kangaroo striking a vehicle driven at low speed. Two vehicle damage incidents were reported both of which occurred off-road in moderate vegetation.

2. Fire: Two fire events and 1 fire incident were reported. A non-permitted private landholder burn resulted in the camp members mustering while later in the project large fires burned in the Miles district due to lightning strikes. One of these fires resulted in an initial field crew muster that was soon downgraded to a relocation of the work group and the continuation of work in a near area.

   The one fire incident reported was the direct result of a downed power line contacting dry grass after an onSEIS knocked down the power pole. The quick response of the onSEIS operators who extinguished the two separate small grass fires must be commended. Without their effective recovery of the situation a large grass fire would have most definitely got hold in a highly sensitive QGC land area. A footnote worth mentioning from the incident recovery is that the potential for loss of life due to electrocution must not be discounted when analysing the operators' movement around and over the potentially live line.

3. Working adjacent to roads: No incident. Excellent traffic management program undertaken by Workforce Road Services.

4. Snakes and spiders: Several snake sightings, no near miss or incidents. Maintain required PPE to all field crew members whose hands contact the ground and pay particular attention to areas likely to be inhabited by venomous snakes considering the recent fatality in an adjacent area.

5. Slips, trips and falls: No incident.

6. Line clearing operations: No incident.

7. Remote location / lack of vehicle access: No incident.

8. Extreme Heat: No recordable incident, several precautionary assessments and recovery initiatives.

9. Vibroseis, onSEIS and high pressure / electrical systems: One incursion by a Vibrator into an unauthorised area. Two onSEIS incidents involving collision with fixed objects.

10. Fuels, oils and chemicals: No incident.

The following table and matrix illustrate the month in which an incident occurred, the number of each individual incident type, the total number of incidents recorded during the project and the incident classification mapped on the Geokinetics Risk Matrix.

Incident Type / Date	October	November	December	Total
Trailer Hitch Brakes	A			1
RWC Hand / Mattock	B			1
Driveway Disturbance	C			1
3rd Party Fire	D			1
Vehicle Damage	E	M, N		3
RTA KJM Rollover	F			1
Kangaroo / Pig Strike	G, J	P		3
FAC Surveyor Eye	H			1
FAC KJM Hand Cut	I			1
Abdominal Complaint	K			1
NWR Medivac	L			1
FAC KJM Burn		O		1
Culvert Drain Reverse		Q		1
FAC KJM Forearm		R		1
onSEIS Power Pole		S (unclassified)		1
onSEIS Tree Stump		T		1
Back Complaint		U		1
Incursion Mack Truck			V (unclassified)	1
Incursion Vibroseis			W (unclassified)	1
FAC Hand Cut			X	1
Total	12	9	3	24

Table 25. Project's incident statistics

CONCEQUENCE					INCREASING PROBABILITY				
					A	B	C	D	E
SEVERITY	People	Assets	Environ mental	Reputation	Never heard of in industry operations	Has occurred in industry operations	Has occurred in geophysical operations	Happens more than yearly in geophysical operations	Happens more often than monthly in geophysical operations
0	No Injury / Illness	No Damage	No Effect	No Impact			J,K,L,U	P	G
1	Slight Injury / Illness FAC	Slight Damage <$500	Slight Effect	Slight Impact	I	R	T	A,C,E, O, X	
2	Minor Injury / Illness RWC or MTC	Minor Damage <$5000	Minor Effect	Limited Impact				B,D,H, Q	N
3	Major Injury / Illness LTI	Local Damage <$25000	Local Effect	Considerable Impact			M		
4	Single FAT / Total Disability	Major Damage <$100000	Major Effect	National Impact				F	
5	Multiple Fatalities	Extensive Damage >$100000	Massive Effect	International Impact					

	INSIGNIFICANT; no action required	
	LOW RISK - control at workplace level	
	MEDIUM RISK - requires constant management attention	MAJOR HAZARDS
	HIGH RISK - intolerable; reduce at least to medium risk before any exposure	

Table 26. Geokinetics Risk Matrix