

Geophysical Operations Report

Jonothon 3D Seismic

PEL 638

Document Number

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Revision 0

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REVISION HISTORY

Revision	Revision Date	Document Status	Revision Comments	Author	Approved by
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1 ABSTRACT

The Jonothon 3D Seismic survey covered approximately 154km² of PEL 638 in the South Australian section of the Cooper Basin. It was acquired early 2015, with processing completed mid-2015.

The primary objective of the survey was to produce drilling targets to meet tenure and farm-in program commitments. The data was intended to evaluate the potential for Permian gas trapped in the Patchawarra Trough.

The survey met the project objectives and was deemed a success.

2 INTRODUCTION

The Jonothon 3D Seismic Survey overlaid parts of PEL 638, PRL 75, 76, 77 and PEL 90. The non-operated area of PPL 156, accessed under AAL 219 was included to ensure full coverage of prospect targets.

The project was operated by Senex Energy Limited, pursuant to a Farm-in Agreement under which Origin Energy Resources Limited acquired an interest in PEL 638 and the PEL 638 Deeps JV.

Bruce Beer & Associates provided the Bird Dog for the project. The Field Supervision Report provides a detailed history and database with photographs for all aspects of the field operations and is included in Appendix 1.

Bruce Beer & Associates undertook the GAS Audit at the completion of groundworks, and this was subsequently verified by a Senex audit. The GAS Audit report is included in Appendix 2.

The Work Area Clearance was conducted in conjunction with line preparation activities by representatives of the Yandruwandha-Yawarrawarrka Native Title Claimant. The groups were accompanied by their appointed technical experts who prepared reports on the clearance results.

Line preparation was undertaken by Terrex Contracting. Line preparation took place between February 7th 2015 and March 6th 2015.

Surveying and chaining operations were undertaken by Terrex Spatial. Line survey took place between February 8th 2015 and March 6th 2015.

Seismic acquisition was conducted by Terrex Seismic. Recording operations commenced on March 3rd and were completed on March 14th 2015. The Terrex Group Field Operations Report is included in Appendix 3.

Data processing was undertaken by CGG (Australia). Processing took place between April 2015 and June 5th 2015. The Processing Report is included in Appendix 4.

Table 1 Survey Statistics

Recording Project Statistics			
Acquisition Start Date	3 rd March 2015	Total Recording Hours	100.4
Acquisition Finish Date	14 th March 2015	Total Work Hours	190.9
Acquisition Days	12	Weather Delays	0 hours
		Animal Damage	0.9 hours
Total Linear km Recorded	447.3	Km/Recording Hour	4.55
Total Square km Recorded	153.644	Km/Work Hour	2.34
Total VPs Recorded	8931	VP's/Recording Hour	88.98
Total VPs Skipped	3	Km/Recording Day	37.275
Percentage VP's Skipped	1%	Efficiency %	53%
Total VPs Overall	8934	VPs per Recording Day	745
Source Line Spacing	350m		
Receiver Line Spacing	350m		
Source Interval	50m		
Receiver Interval	50m		
Sweep Length	8 Seconds		
Listen time	4 Seconds		
Sweeps/VP	1		
Live channels	2688		
Live Patch	168 ch x 16		
Fold	lines 12 fold inline, 8 fold cross line, 96 fold nominal.		

The contracting groups involved in the survey are summarised in Table 2

Table 2 Contractors

Operation	Contractor	Contact Detail	Report
Bird Dog	Bruce Beer & Associates	brucebeer@internode.on.net	Appendix 1
GAS Audit	Bruce Beer & Associates		Appendix 2
Line Preparation	Terrex Contracting	julie@terrexseismic.com	Appendix 3
Line Survey	Terrex Spatial		
Data Acquisition	Terrex Seismic		
Data	CGG (Australia)	peter.scruton@cgg.com	Appendix 4

processing			
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3 SURVEY OBJECTIVES AND TARGETS

The Cooper Basin is an intra cratonic sag basin deposited during the Permian and Triassic. This is overlain by intra cratonic Jurassic and Cretaceous sediments of the Eromanga Basin. The Patchawarra Trough is deemed to be the source for hydrocarbons which have migrated from there toward the basin margins and up into the Eromanga sequence.

The Jonothon 3D seismic data was used to evaluate the potential for Permian gas trapped in the Patchawarra Trough. The primary targets were stratigraphic traps in the Patchawarra Formation. Secondary potential was expected in the Toolachee, Epsilon and Tirrawarra formations. Depth to targets range from 3000 m to 3800m.

4 GEOPHYSICAL EXPLORATION HISTORY

The Jonothon 3D is located in the northern area of the Patchawarra Trough, just to the south of the Deramookoo Shelf.

Previous 2D seismic was recorded in the area initially in 1978, as a series of long widely spaced regional lines.

Drilling commenced in 1980 at Beanbush-1 to the south of the Jonothon area. Beanbush was cased and suspended as a future gas producer from relatively tight sands in the Patchawarra Formation.

Wimma -1 was drilled as a follow-up well in 1981, to the southwest of the Jonothon Survey. Very small gas flows were recorded from the Toolachee, Epsilon and Patchawarra formations and although no conventional gas pay was interpreted, extensive unconventional sandstone reservoirs were identified.

Both Beanbush and Wimma were drilled on anticlines.

During 1995, 1996 further infill 2D seismic was recorded and the Moondie -1 exploration well was drilled in 1996. Small gas flows were recorded from the Toolachee and Patchawarra formations and no conventional gas pay was recorded in the well. Moondie-1 was drilled on a large four-way closure within the area of the later Jonothon 3D.

In June 2014, Senex farmed out areas of the Patchawarra Trough previously covered by PEL 514 to Origin Energy as PEL 638.

5 PLANNING METHODOLOGY

5.1 Overview

Consultation with experienced Cooper Basin field consultants, desktop review of High-Resolution Orthoimagery and a field scout were used to prepare for the project.

Prior to conducting this survey Senex and Terrex conducted a comprehensive risk assessment to ensure appropriate strategies were in place to manage the identified risks. In addition:

- Senex conducted a review of the Terrex HSE Management System and defined its interface with the Senex HSE standards, regulatory requirements and project risks in the Project HSE MS Bridging Document
- A project specific safety plan was prepared by Terrex to address the identified major risks
- A project specific emergency response plan was developed and validated via an ER Drill

5.2 Environmentally sensitive areas and SEO

The Jonothon 3D Seismic Survey was conducted under the *Statement of Environmental Objectives for Geophysical Operations in South Australia (DSD, 2014)* which provides objectives and measurements for the preparation and use of seismic lines in order to minimise impact and maximise rehabilitation. The dozer operators and surveyors were all inducted and competent in the techniques required to meet these objectives.

The Jonothon seismic survey area was mostly contained within the Marqualpie land system, with a portion of the south-west corner located within the Cooper land system.

The Marqualpie is a dunefield land system which is generally comprised of low crescent and semi-circle shaped irregular sand ridges, showing an overall north-northwest to south-southeast trend. The Marqualpie dunefields within the survey area are associated with the Candradecka and Patchawara Creek systems. The dunes become less distinct in the east and are replaced by undulating sand plains. The land system, particularly the area covered by the seismic survey, is dominated by crescent dunes of deep red siliceous sands with minimal clay content. Soils within the swales are variable, with grey cracking clays being common.

The Cooper land system is characterised by multiple floodplain and lake land units, which can be differentiated on the basis of frequency and intensity of flooding.

Comprehensive environmental guidelines on the preparation of lines were provided in written form and during inductions. These guidelines were followed by the various crews. The key issues managed for the Jonothon 3D seismic survey related to:

1. Maintaining channel profiles on creek crossings and drainage profiles on floodplains;
2. Presence of trees and dense vegetation;
3. Likely occurrence of large numbers of cultural heritage sites near watercourses;
4. Restricting the depth of dune cuts to meet the SEO (must be less than 1 m deep);
5. Undertaking standard measures to minimise visual impacts (gentle weaving of lines, offsetting of dune cuts, dog-legging at track crossings);
6. Risk of introduction or spread of weeds, particularly if equipment is mobilised from other areas of the Cooper Basin;
7. Fire;
8. Livestock and wildlife; and
9. Pipelines and infrastructure.

A GAS environmental report for this area was compiled (see Appendix 2), the report also contains the EMP report and GAS audits for the project.

5.3 Survey Equipment

Terrex utilised the Sercel 428XL recording system for seismic acquisition, with AHV-IV 62,000 lb peak force vibrators for source.

Terrex used their trailer camp to house the crew.

5.4 Parameter Selection

Acquisition parameters were derived from similar programs in the Cooper Basin. No experimental program was held.

5.5 Key Approvals

Associated Activities Licence (AAL) 219, appended to PEL 638, was applied for on August 25th 2014 and granted to Senex on November 26th 2014. AAL 221 was 1.6 square kilometres in area and overlapped Santos operated PPL 156.

An Activity Notification was provided to DSD on December 15th 2014.

6 CONSULTATION

6.1 Landowner

The survey overlaid part of Innamincka Station, managed by the Morton Family. They were served a notice of entry on October 15th 2014 and were provided weekly progress updates by Senex by report format over email.

6.2 Cultural Heritage Clearance

An agreement exists with the Yandruwandha-Yawarrawarrka group (YY) who are the Native Title claimants over the survey area and under that agreement consultation and field inspection of proposed line locations are required prior to conducting any fieldwork.

The YY were advised of the survey with a Notice of Entry on October 15th 2014 and were subsequently consulted for the Cultural Heritage Clearance.

Work Area Clearance of the seismic lines was carried out in conjunction with the Line Preparation Operations using 4WD vehicles equipped with on-board navigational equipment consisting of a GPS unit coupled with a laptop computer. This equipment traced and recorded the team's position in relation to the terrain and the proposed seismic lines. The specialists documented the clearance process with field notes, photographs and handheld GPS units.

The field inspection was followed by a report from the technical specialists detailing the clearances and specific exclusions.

7 FIELD OPERATIONS

7.1 Health and Safety

During the project more than 37,000 man hours were worked with no recordable incidents.

Table 3 Project Key Safety Statistics

Terrex Seismic Man hours	20,874
Subcontractor Man Hours	16,224
Fatalities	0
Lost Time Injuries	0
Medical Treatment Injuries	0
Audits / Inspections conducted	8
Emergency Drills	2
Spills to the Environment	0
LTIFR	0
TRIFR	0

7.2 Line Preparation & Survey

Line preparation was subcontracted through Terrex Seismic to Terrex Contracting (TC) of Brisbane, Queensland. Terrex Contracting provided three Komatsu D65 dozers, two John Deere graders and a camp to house the WAC, Line Prep and Survey group. Each dozer was equipped by Terrex Spatial with a GPS receiver containing the coordinates of each line including heritage no-go zones and conditions. Line preparation took place between February 7th and March 6th 2015.

Surveying was sub-contracted through Terrex Seismic to Terrex Spatial (TSp) of Brisbane, Queensland. Information on the survey methods and geodetic and geophysical datum employed is in the Terrex Group Report (Appendix 3). Line surveying took place between February 8th 2015 and March 6th 2015.

A total of 884.45 linear kilometres of seismic lines were surveyed. This consisted of 437.15 kilometres of receiver lines, pegged at 50-metre station intervals and 350-metre line intervals, and 447.30 kilometres of source lines, and pegged at 50-metre station intervals and 350-metre line intervals.

Table 4 Control Station locations established.

Station.	Easting	Northing	AHD	Comments
Survey Datum				
WAL1	467419.370	6998539.860	43.867	AUSPOS Generated Mark
JON1	466308.090	6989386.424	51.116	AUSPOS Generated Mark
JON2	461072.064	6986641.763	47.210	AUSPOS Generated Mark
JON3	456906.291	6987733.637	52.899	AUSPOS Generated Mark
Control Checks				
JON1	466308.090	6989386.424	51.116	GIVEN (AusPos)
	466308.114	6989386.411	51.115	OURS Grafnet Static Observation
	0.024	-0.013	-0.001	Misclose
WAL1	467419.370	6998539.860	43.867	GIVEN (AusPos)
	467419.335	6998539.88	43.889	OURS Grafnet Static Observation
	-0.035	0.020	0.022	Misclose

7.3 Recording Operations

Terrex Seismic was selected as the Vibroseis seismic data acquisition contractor for this project. Full details of the operation are in Appendix 1 and Appendix 3. The acquisition parameters are listed in Table 5.

Table 5 Acquisition Parameters

Instrumentation	
Instruments	Sercel 428XL
No. Channels	2688 (16 lines x 168 ch)
Tape Drives	IBM Ultrium LT02 (dual drive – 200 Gbyte per tape)
Tape Format	SEGD Revision 1 8058IEEE Demultiplexed, Noise edited correlated summed 4 sec record
Filters	Hi cut 200 Hz, (0.8 Nyquist - Linear) Lo cut: Out
Sample Rate	2 ms
Record Length	4 sec
RTC	Yes
Correlation Type	Zero Phase, After Sum
Stack	Diversity stack plus burst edit
Source Parameters	
Vibrators	Two groups of 2 x Input-Output AHV-IV Buggy Mounted vibrators
Electronics	Pelton Vibpro
Sweep Frequency	Mono-sweep, 4-80Hz
Sweep Length	8 seconds
No. Sweeps	1 standing

VP Interval	50.0m on lines approx. 350m apart
Vibrator Array	2 vibs in line, 12.5m pad to pad standing. Centred on source stations, No move-up.
Sweep Amplitude Taper	100% (none)
Drive Level	80% varied by amplitude control function
End Tapers (cosine)	0.25s
Phase Locking Type	Ground Force
Amplitude Control	Peak to Peak
Receiver Parameters	
Receiver Group Interval	50.0m on lines approx. 350m apart
Number of live traces	2688
Spread	16 lines x 168 channels live 25m near trace 3662m far trace
Geophones	Sensor SM4 10 Hz
Array	12 in-line, centred on stations, 4.167m spacing
Connection	Series/Parallel (6x2)
Multiplicity	12 fold inline 8 fold cross line 96 nominal

The data quality was generally good throughout the grid with several individual reflectors visible right across the field records, strong first breaks and minor amount of noise.

The average recording rate for the survey was 745 VP's (37.725 km/per day). 4.55-km/recording hour was achieved which is a good performance for the crew. The average cycle time for the given parameters was about 41 seconds per VP.

7.4 Rehabilitation and de-permitting

At the end of field acquisition activities, the lines were checked for any rubbish and pegs left behind. Terrex Contracting undertook a restoration program to remove any temporary gates, rip any rutting or compaction and repair any damage that was noted during the survey

Three Environmental Monitoring Points (EMP) were established which will enable a record to be kept over time as the lines recover.

8 DATA PROCESSING

8.1 Processing tests

CGG of Perth WA was awarded the contract to process the data.
The Contractor report in Appendix 4 discusses the detail and results of the processing.

8.2 Processing sequence

1. SEG-D input TL/Sl=4000/2ms
2. Nav merge
 - a. Output - Shot Gathers with Geometry**
3. Amplitude Divergence Compensation
4. Trace Edit/Despiking
5. Minimum Phasing
6. First Break Picking/Tomostatics
7. Apply Provisional Residual Statics
8. LNA/RNA 1st pass
9. VA01 1050x1050m
10. Inv Q Amp & Phase
11. SC Spiking Deconvolution
12. Residual Static #1
13. LNA/RNA 2nd pass
14. Surface Consistent Amplitude Correction
15. VA02 1050x1050m
16. Residual Static #2
 - a. Output - Intermediate Post-Stack Migrated Cube (via FTP)**
 - b. Output - Pre-Interpolation Gathers**
17. 5D Interpolation (Fold 12x8=96 - 23x15=345)
18. Remove Amplitude Divergence Compensation
19. 3D PSTM to Velocity Lines
20. VA03 525x525m
21. 3D PSTM with smoothed VA03
22. VA04 525x525m
 - a. Output - Post-Migration Raw Gathers**
23. Radon3D
24. VA05 Dense VTI V/Eta
25. PSTM Gather Flattening (Trim)
 - a. Output - Final PSTM gathers (Shifted to MSL 0m Datum)**
26. Stack
 - a. Output - Raw Full Fold PSTM Stack**
27. Footprint Removal (FKF3D)
28. Spectral Shaping
29. CADZO De-Noise
30. Shift from Processing to MSL=0m Datum
 - a. Output - Final Full, Angle and Azimuthal stacks**

8.3 Static corrections

A replacement velocity of 1850m/sec to a final datum of 0m ASL was used.

8.4 Archived data

SEISMIC GATHERS:	01_JONOTHON_RAW_SHOT_GATHERS_GEOM_APPLIED_SHOT_LINE*.sgy 02_JONOTHON_PRE_INTERPOLATION_SHOT_GATHERS_IL*.sgy 03_JONOTHON_RAW_PSTM_GATHERS_IL*.sgy 04_JONOTHON_FINAL_PSTM_GATHERS_IL*.sgy
SEISMIC CUBES:	06_FINAL_FULL_FOLD_PSTM_STACK_CUBE_MSL_DATUM_JONOTHON3D.sgy 07_RAW_FULL_FOLD_PSTM_STACK_CUBE_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_ULTRA_NEAR_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_NEAR_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_MID_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_FAR_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_ULTRA_FAR_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_63_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_108_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_153_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_198_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 11a_RUGER_AVAz_CUBE_Aiso_INTERCEPT_MSL_DATUM_JONOTHON3D.sgy 11b_RUGER_AVAz_CUBE_Biso_GRADIENT_MSL_DATUM_JONOTHON3D.sgy 11c_RUGER_AVAz_CUBE_Bani_AZIMUTHAL_GRADIENT_MSL_DATUM_JONOTHON3D.sgy 11d_RUGER_AVAz_CUBE_Bani_FRACTURE_AZIMUTH_MSL_DATUM_JONOTHON3D.sgy
KINEMATIC CUBES:	12_DENSE_AZIMUTHAL_VNMO_SLOW_CUBE_MSL_DATUM_JONOTHON3D.sgy 13_DENSE_AZIMUTHAL_VNMO_FAST_CUBE_MSL_DATUM_JONOTHON3D.sgy 14_DENSE_AZIMUTHAL_VNMO_AZIMUTH_CUBE_MSL_DATUM_JONOTHON3D.sgy 15_FRACTURE_DENSITY_KINT_CUBE_MSL_DATUM_JONOTHON3D.sgy 16_FRACTURE_AZIMUTH_OF_KINT_CUBE_MSL_DATUM_JONOTHON3D.sgy 17_DENSE_STACKING_VELOCITY_RMS_CUBE_MSL_DATUM_JONOTHON3D.sgy 18_DENSE_EFFECTIVE_ETA_CUBE_MSL_DATUM_JONOTHON3D.sgy 19_DENSE_AVERAGE_VELOCITY_CUBE_MSL_DATUM_JONOTHON3D.sgy 20_DENSE_VINT_CUBE_MSL_DATUM_JONOTHON3D.sgy 21_PORE_PRESSURE_PREDICTION_CUBE_MSL_DATUM_JONOTHON3D.sgy
ASCII ATTRIBUTES:	22a_JONOTHON3D_FLOATINGDATUM_ILXLXYSTAT.ascii 23a_JONOTHON3D_TOMO_LW_AND_RESID_SPRCVXYSTAT.ascii 24a_STACKING_VEL_PREMIG_JONOTHON3D.ascii 25a_MIG_VELOCITY_SMOOTH_JONOTHON3D.ascii 26a_POSTMIG_STACKING_VELOCITY_JONOTHON3D.ascii 27a_JONOTHON3D_FOLDCOVER_ILXLXYFOLD.ascii
FINAL REPORT:	28a_SENEX_JONOTHON3D_FINAL_PROCESSING_REPORT.pdf

9 CONCLUSIONS AND RECOMMENDATIONS

The Jonothon 3D project achieved the project plan's definition of success. It was completed within the forecast time frames, with a high level of safety and care for the environment, the data quality was good and the scope of work was achieved.

The acquired data was generally of a very high standard which when stacked in the field yielded well resolved images.

The Bird-Dog GAS audit and a subsequent follow-up audit by Senex indicated that the project's groundworks achieved compliance with the Statement of Environmental Objectives.

All contractors utilised during the survey met their contractual obligations. A detailed list of conclusions and recommendations is contained in the Field Supervision Report (Appendix 1). Key points of these were:

- Daily toolbox meetings proved to be a productive forum to discuss operational issues and contributed to the building of team work among the crew members. The practice of separate toolbox meetings for vibrator operators could be reviewed as it set these people aside from the main body of the crew.
- The data acquired was of consistently good quality. The observers maintained a good standard of quality control regarding faulty traces and all reasonable efforts were made to minimise noise on the spread.
- Working relationships between Senex, Terrex Seismic, Terrex Spatial, Terrex Contracting and the WAC crews were positive and respectful.
- The ground conditions on the survey area were relatively easy on the equipment and access tracks readily negotiable.
- Although Terrex was not contractually obliged to provide a QC person, one was provided which was of considerable benefit.
- In summary, Jonothon was a successful 3D seismic survey. It was recorded in an efficient and safe manner without any LTIs and without any loss of time due to weather.

10 REFERENCES

Department of State Development (2014). Statement of Environmental Objectives for Geophysical Operations in South Australia (DSD, 2014)

11 FIGURES

Figure 1 Jonothon 3D Permit Map

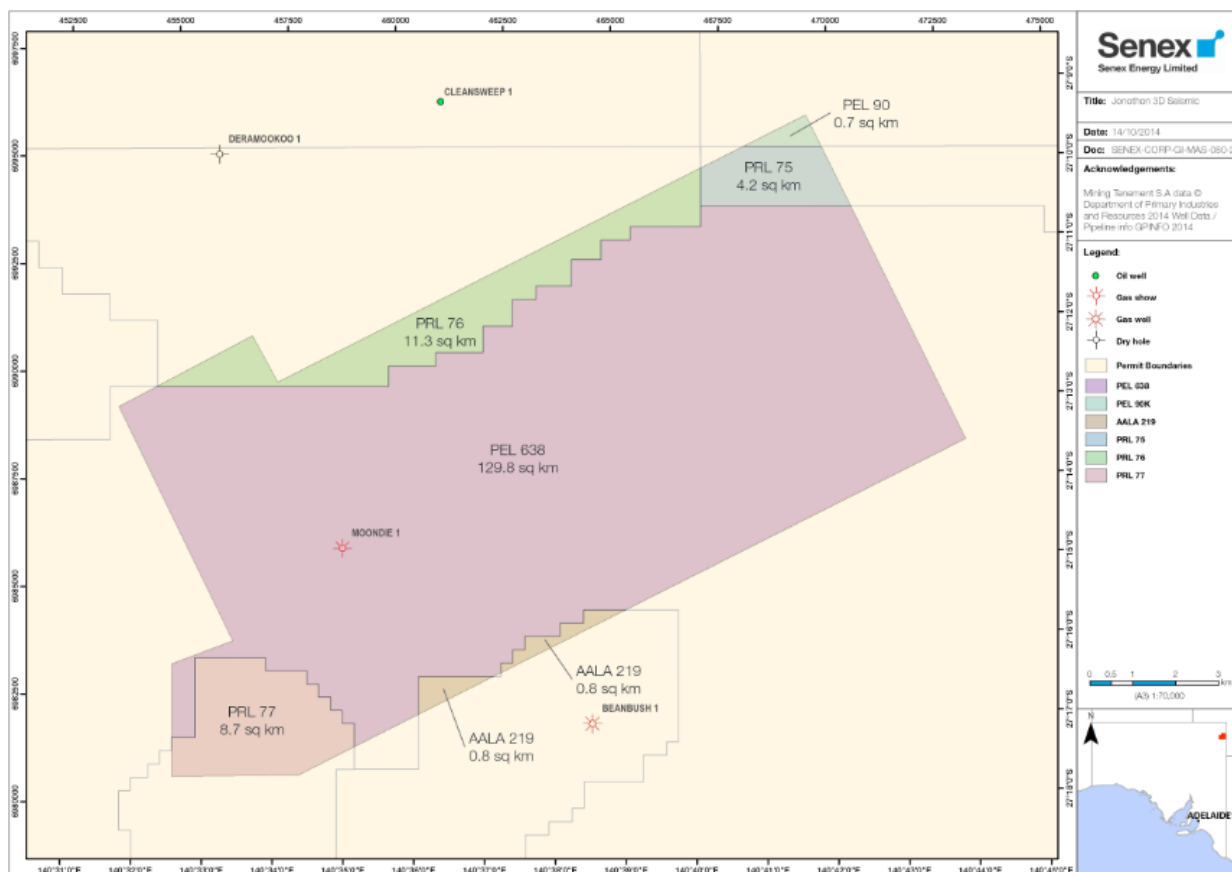
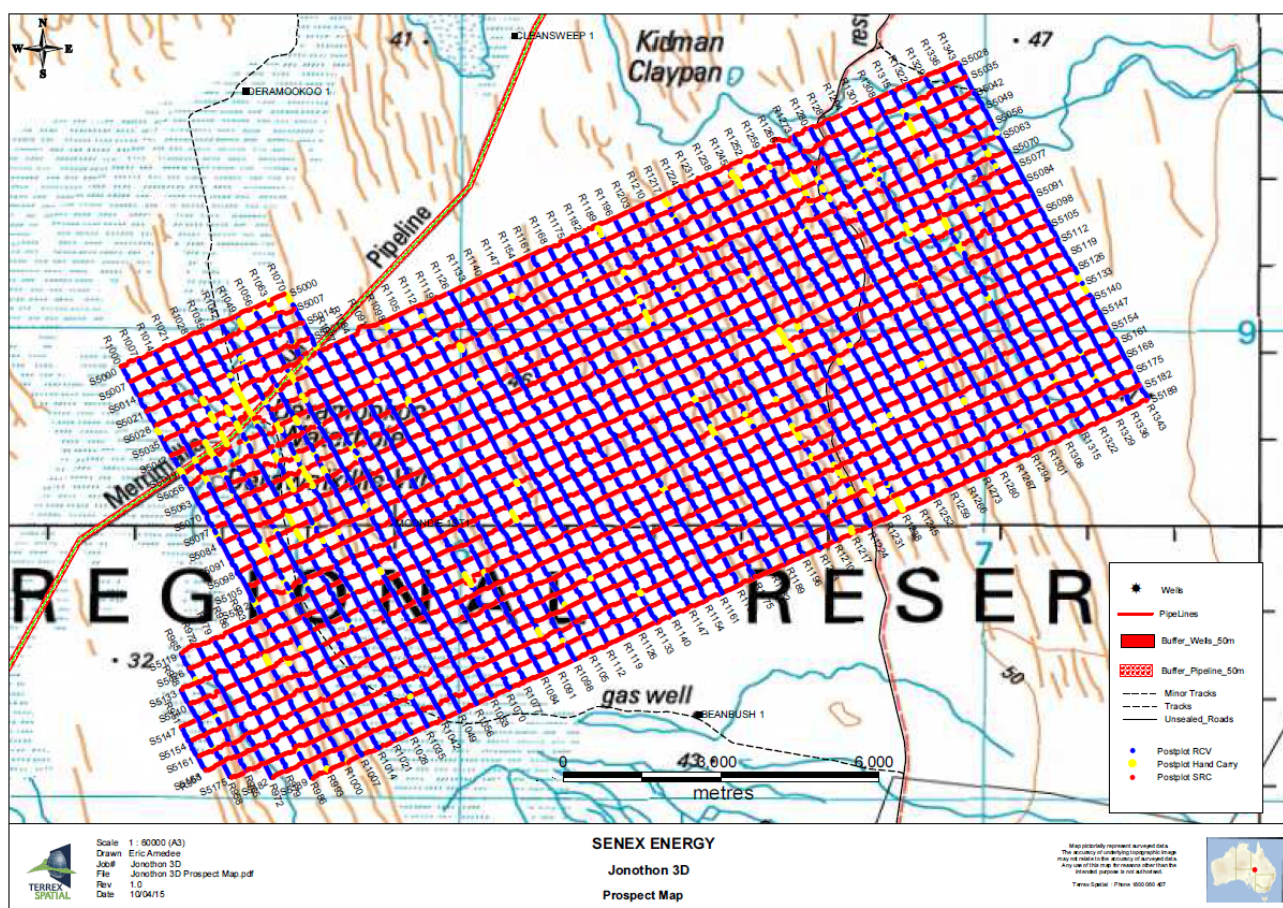


Figure 2 Jonothon 3D Line Location Map



APPENDIX 1

Bruce Beer & Associates Senex Energy 2014 Jonothon 3D Field Supervision Report

Field Operations Report

Jonothon 3D seismic survey

PEL 90, PEL 638, PRL 75, 76 & 77, AAL 219
Cooper Basin – South Australia



Written by Steve Munro in conjunction
with Bruce Beer & Associates.

April 2015

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1.0 INTRODUCTION

The Jonothon 3D seismic survey was recorded in the Cooper Basin in permits PEL 90, PEL 638, PRL 75, 76, 77 and AAL 219 for Senex Energy Limited during February and March 2015.

The survey, located on Innamincka Station in the north-east of South Australia, covered an area of approximately 152.4km. Innamincka Station is operated as a pastoral lease by S. Kidman & Coy and also as a joint use Regional Reserve overseen by the Department of Environment and Land Management. As the crow flies, the survey area lies about 70km to north of Innamincka and is accessed by the Cordillo Downs Road and the Keleary access road (see following location map).

The survey was planned to have commenced in early January 2015 however the program was delayed due to heavy rains that fell over several days at that time.

The aim of the survey was to acquire good quality 3D data across a cumulative area of approximately 153 km². The program was undertaken as part of the Area D Agreement dated 21 February 2014 under which Origin Energy Resources Ltd. acquired an interest in PEL 638 and the PEL 638 Deeps JV.

The data from this survey will be processed to produce drilling targets to meet tenure and farm-in program commitments.

The Terrex group was contracted for the survey. Terrex Contracting prepared the lines, Terrex Spatial surveyed the grid, and Terrex Seismic recorded the data. Line preparation and survey were contracted on an hourly basis, while recording was contracted on a 'lump sum' basis.

Terrex Contracting, Terrex Spatial and the Work Area Clearance (WAC) teams operated from a camp located at the Walkillie-1 well site to the north of the seismic grid at the following coordinates:

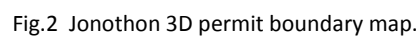
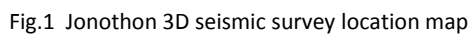
S 27°08'05" E 140°40'16"
MGA Zone 54 467421mE 6998596mN

Terrex Seismic operated from a camp site located approximately 3km to the south of the grid and immediately to the west of the Keleary access track. Coordinates of this camp were:

S 27°16'31" E 140°40'37"
MGA Zone 54 468123mE 6982928mN

All field personnel working on the project (Terrex Spatial, Terrex Contracting, Terrex Seismic, Bill Hedditch & Associates, Independent archaeologists & traditional owners from the Yandruwandha & Yawarrawarrka tribes) completed a site-specific environmental induction and a cultural heritage induction before commencing work on the survey. Inductions were presented by Senex client representatives, Steve Munro and Leigh Franks, on various dates during the project.

The project was managed by Mark Kneipp of Senex Energy Limited, Brisbane and represented in the field by Steve Munro & Leigh Franks of Bruce Beer and Associates.



The survey was situated mostly within the Marqualpie land system, with a portion of the south-west corner located within the Cooper land system. The Marqualpie is a dunefield land system which is generally comprised of low crescent and semi-circle shaped irregular sand ridges, showing an overall NNW to SSE trend. The dunes are associated with the Candradecka and Patchawara Creek systems. In the east the dunes become less distinct and are replaced by undulating sand plains.

Overall, the survey area had little variation in relief, as is shown in the following figure.

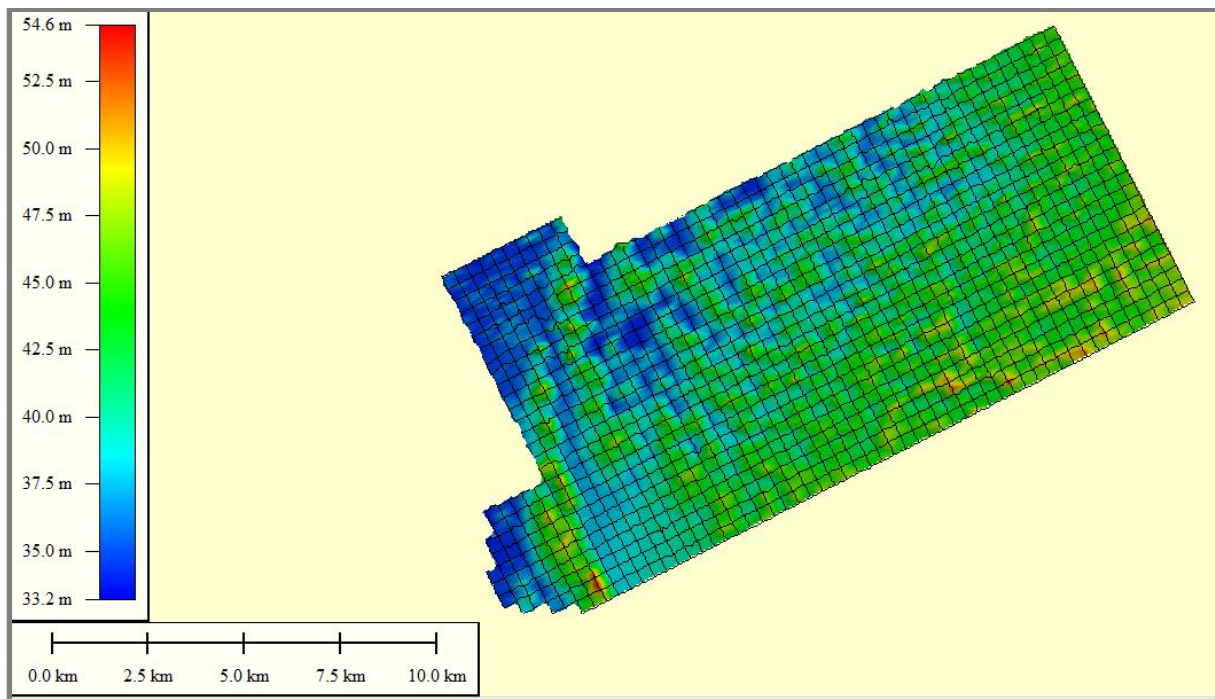


Fig.3 Elevation profile of the Jonothon 3D grid

In the south west of the survey the dunes supported whitewood, narrow-leaf hopbush, sandhill wattle, emu bush, prickly acacia and a sparse covering of grasses. Creek lines supported dense vegetation including zones of coolibah and whitewood. Low lying swamps contained lignum, swamp canegrass, old man saltbush, acacia species and sparse grasses & groundcover.

1.1 Location and access

The program area was accessed from Innamincka on unsealed roads and tracks. As there was no rain in the general program area during the survey, all roads and tracks remained available for access. However, due to the heavy rainfalls in the general catchment area during January, the Cooper Creek causeway north of Innamincka had water to a depth of approximately 50mm flowing over it in early February. Terrex Contracting and Terrex Spatial both crossed the creek without incident at this time.

The water level in the creek fell during the survey but the causeway was still submerged when Terrex Seismic demobilized from the project area on March the 16th.



Fig.4 Members of WAC team on the north side of Cooper Creek on 6th February 2015.

2.0 LOGISTICS

Terrex Contracting, Terrex Spatial and the WAC crews occupied a camp at the Walkillie-1 well site to the north of the grid immediately west of the Keleary access track. Personnel were accommodated in Terrex Contracting caravans and KJM units. Fuel, food supplies and potable water were trucked in from Cooper Parks or Moomba and KJM contracting removed liquid waste as required.

Terrex Seismic mobilized to the Jonothon survey from south west Queensland after a washdown of all plant and equipment at Eromanga (a full list of equipment is included in the appendices) and established camp immediately west of the Keleary access road approximately 3km south of the grid. Personnel were accommodated in a relatively new Terrex owned camp. Fuel, food supplies and potable water were again trucked in as required from Moomba and Cooper Park. Similarly, KLM carted liquid waste from the site as required.

Crew change movements were either via Moomba or Innamincka airport.



Fig.5 A fuel supply truck at the Terrex Seismic camp.

2.1 Communications

Broadband internet was the primary means of communication to points beyond the survey area. The internet supported emailing and VOIP telephone services. WIFI access to the internet was available for crew members and pre-paid VOIP coupons were also available.

Satellite phones were deployed and ready in the manager's office, with HSE when in the field, and at the recorder.

VHF radio was utilized for operational purposes: CHN 1 for the recorder and CHN 2 for the vibrator crew. UHF radios were used by the line crew on various channels with CHN40 used to communicate with third party traffic.

In Vehicle Monitoring Systems, IVMS, were mandatory for the crew and monitoring statistics were sent to the HSE department listing any exceptions.

3.0 TIMETABLE OF EVENTS

Thursday, 5 February 2015	Leigh Franks and Terrex Spatial arrived at Walkillie-1 well camp site.
Friday, 6 February 2015	Met incoming WAC teams at Moomba, returning with two hire vehicles and one specialist vehicle.
Saturday, 7 February 2015	Inductions in the morning with production commencing in the afternoon.
Sunday, 8 February 2015	Survey start marking with 7.2km in WAC cleared areas. Additional grader arrives from Innamincka.
Monday, 9 February 2015	SIMOPS concerns with Santos vehicles. 3 dozers and 2 graders working.
Tuesday, 10 February 2015	Evening 'pit stop' meeting to remind specialists and operators of procedures.
Wednesday, 11 February 2015	Senior Surveyor Eric Amedee arrives, line pointer out.
Thursday, 12 February 2015	Some mechanical issues with grader. Guidance issues with dozers being resolved.
Friday, 13 February 2015	Client Rep Steve Munro arrives. Clearing starts on western side of Keleary Rd.
Saturday, 14 February 2015	One grader continues to operate.
Sunday, 15 February 2015	Safety Sunday. Scouted Seismic camp south of the grid.
Monday, 16 February 2015	Dan Thomas away at Mudrangie with YY scouting camps sites.
Tuesday, 17 February 2015	Leigh Franks departed Jonothon for the Bauhaus 3D survey.
Wednesday, 18 February 2015	Very few artefacts. Problems with 2 dozers.
Thursday, 19 February 2015	The second grader is operational again & will be on the grid tomorrow.
Friday, 20 February 2015	Some juggling of the WAC crews was required in the field due to two members unavailable to work.
Saturday, 21 February 2015	The proposed campsites for the Mudrangie survey were inspected (photos in the PDF images file) by Steve & Murray - neither site was considered particularly suitable.
Sunday, 22 February 2015	Another partial power failure today caused by overloading the supply (similar to yesterday's failure). As a permanent solution another generator was commissioned and the camp load has now been distributed between the 2 units.
Monday, 23 February 2015	Slower production today from both survey & line prep. Survey infilling hand-carries on receiver lines while line clearing slowing in the west around the Deramookoo water hole complex and the Merrimellia pipeline.

Tuesday, 24 February 2015	CH crew for dozer 4 down for most of the day with vehicle problems.
Wednesday, 25 February 2015	Steve & Warren pegged the TSA2 camp on the Jonothon survey & alternative campsites for TC2 on Mudrangie.
Thursday, 26 February 2015	Low line prep production rates due to the WAC change over.
Friday, 27 February 2015	Two vibrators from TSA2 arrived at TC2 camp today. They were redirected to the seismic camp, which is situated approximately 17km. south of the TC camp.
Saturday, 28 February 2015	Slow line prep in the western area around the pipeline.
Sunday, 1 March 2015	The Terrex recording crew arrived at about 6pm.
Monday, 2 March 2015	TS completed camp set up approximately 2.5km south of the grid on Keleary Rd.
Tuesday, 3 March 2015	Confirmation of the recording parameters received at about 1pm. Production began in the afternoon.
Wednesday, 4 March 2015	Some survey issues with hand-carry positions. Sometimes unclear where the points are. Have talked to the surveyors.
Thursday, 5 March 2015	Two additional crew changes. Dave Keats in for Darren Rea & Pete O'Donnell (Mad Dog) for Joel Carry.
Friday, 6 March 2015	TC2 moved to Mudrangie.
Saturday, 7 March 2015	Inspected the TC2 campsite at Walkillie-1. It has been left tidy with little evidence of occupation.
Sunday, 8 March 2015	Welcome Dean Hausmann to the camp. Dean is working with the vibrators and the recording truck to implement a more accurate navigation system.
Monday, 9 March 2015	Recording production down again today as one vibrator fleet (1 vib down) was down for about 4 hours. It was the same vib (unit 4) as yesterday.
Tuesday, 10 March 2015	The cable truck now parked on the southern access track ready for loading the spread at the end of recording.
Wednesday, 11 March 2015	All the spread now in place to complete recording. Line crew have been driving source lines clearing any pegs or rubbish.
Thursday, 12 March 2015	The vibrators working in the vicinity of the pipeline & the wet areas in the western portion of the grid. There are several unavoidable skips in the area.
Friday, 13 March 2015	Heavy transport arrived at the camp to float vibrators to Jasmine at the end of recording.
Saturday, 14 March 2015	Recording completed at 8:30am. Line crew lifting all the remaining spread.
Sunday, 15 March 2015	All the spread out of the field and in camp.
Monday, 16 March 2015	Recording crew demobilizing from Jonothon & proceeding to the Jasmine survey.
Tuesday, 17 March 2015	Steve Munro demobilizing to Brisbane by road.

4.0 SURVEY DESIGN

4.1 Fold

The survey was designed to have a nominal fold of 96. This was achieved using the following configuration:

Cross-line fold: $(\text{number of receiver lines in the live patch}) \div (2 \times \text{moveup}) = 16 \div 2 = 8$

In-line fold: $(\text{number of live traces on a line}) \div (2 \times \text{moveup}) = 168 \div 14 = 12$

Total fold = (in-line fold) x (cross-line fold) = 96

4.2 Maximum offset

As a rule of thumb the maximum offset should be approximately the same as the primary target depth.

With the live patch configuration used for the Jonothon survey, a maximum offset of 4932 metres was achieved. Offsets of this magnitude should adequately image the deeper Permian features of the survey area.

4.3 Azimuths

The patch dimensions for the survey were as follows:

In-line dimension: 8350 metres

Cross-line dimension: 5250 metres

The patch dimensions generated an aspect ratio of 0.63

As the aspect ratio is greater than 0.5, the Jonothon survey would be considered a 'wide azimuth' survey. Wide-azimuth surveys are well suited for velocity analyses and static solutions, which are two characteristic issues for processing Cooper Basin geophysical data.

A 'double triple stagger' design component was incorporated into the design, which effectively increased the azimuth and offset distributions in the bins. The lay-out for the double triple stagger is shown in the following figure.

4.4 Near surface control

No uphole surveys were recorded during the seismic data acquisition survey.

In the absence of this data, near surface corrections will be computed from refraction models derived from the first breaks. With the wide azimuth nature of the survey and the clearly defined first breaks, robust static solutions should be available

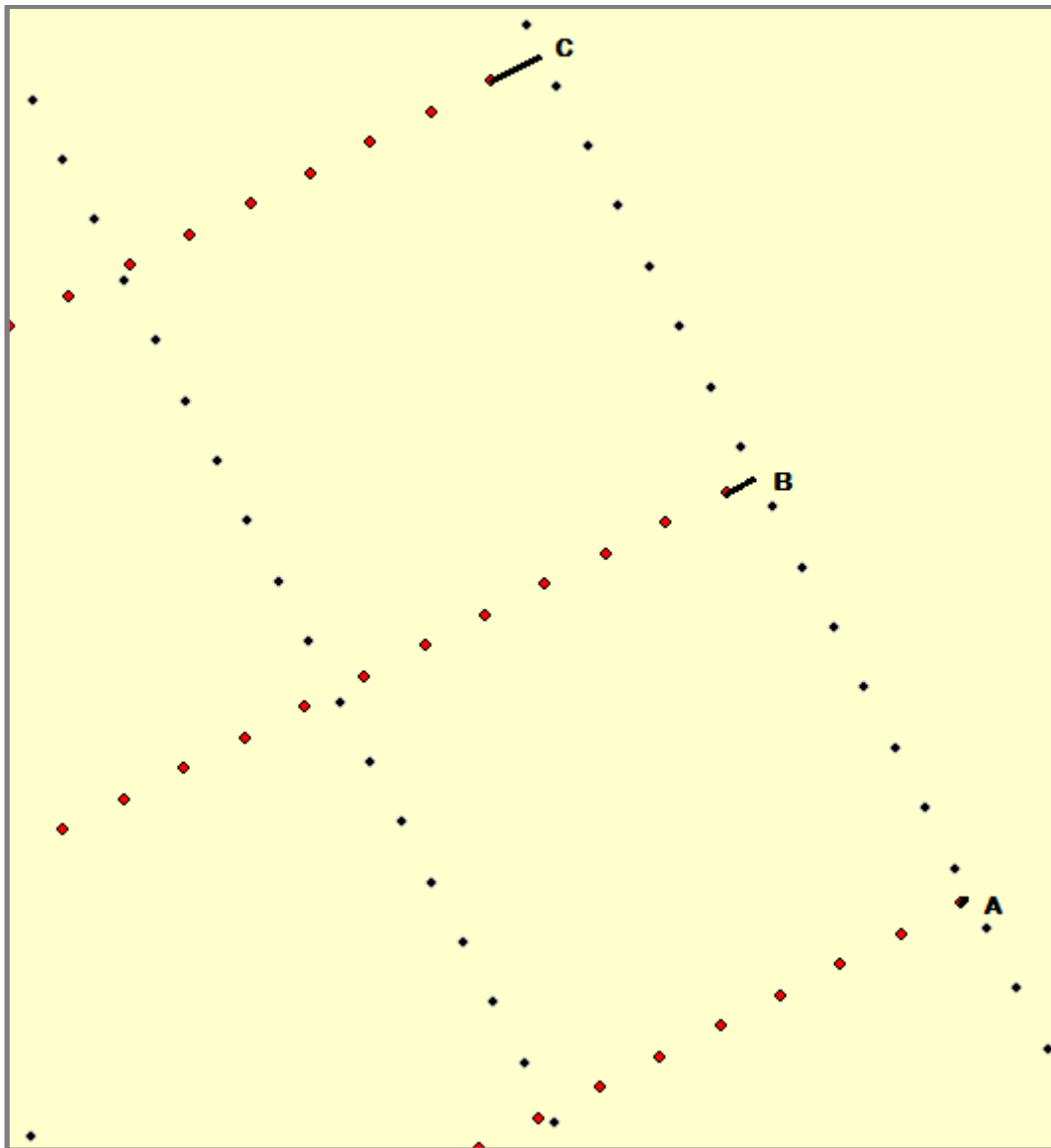


Fig.6 Double triple stagger. The stagger design can be seen diagrammatically from source lines A to line C (red dots). The first points on the lines were offset from the receiver line (blue dots) by an increasing amount from line A to line C. The pattern, or stagger, was then repeated for all source lines throughout the grid.

A similar stagger was applied for the receiver lines with respect to the source lines. Hence the description of Double Triple Stagger.

4.5 Bin dimensions

Recording with 50 metre VP intervals and 50 metre receiver intervals produced 25 metre x 25 metre square bins.

4.6 Receiver arrays

Number of geophones: 12
Geophone spacing: 4.16m
Array length: 45.83m
Location: centred on the peg

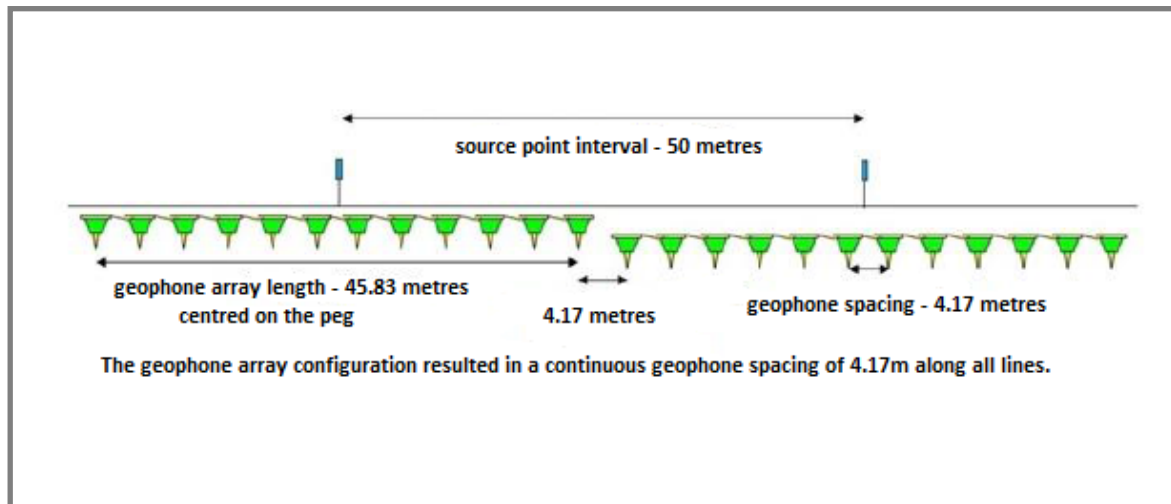


Fig.7 Receiver array diagram.

4.7 Source arrays

The source array consisted of 2 vibrators in-line with a 12metre pad-to-pad spacing centred on the VP.

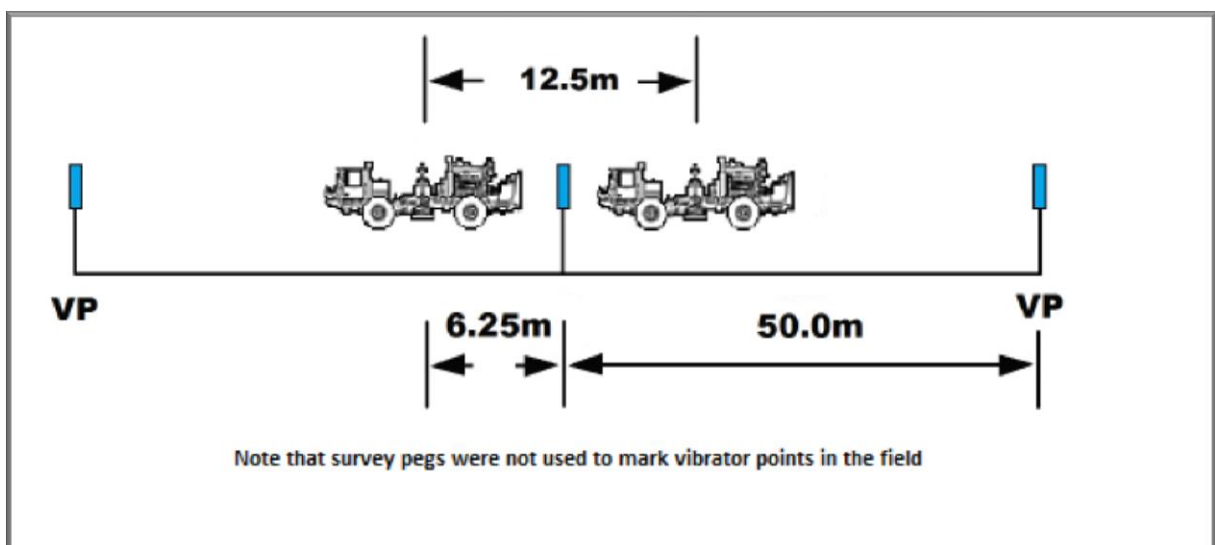


Fig.8 Source array diagram.

5.0 RECORDING

A general description of the recording parameters can be found in the Service Agreement in the appendices to this document.

5.1 Acquisition system

Acquisition type:	Sercel 428XL
Energy source:	4x4 AHV-IV buggy vibrators
Sweep control:	Sercel VE464, source driven
Peak force:	62,000 lbs
Hold down weight	62,000 lbs



Fig.9 Observer Joel Carry in the recording truck.

5.2 Recording parameters

The recording parameters were established before the recording crew had mobilized to the survey area. No experimental or parameter testing was done for the Jonothon survey before recording commenced.

The recording parameters are listed below.

Geometry	
Source line / receiver line geometric relationship	orthogonal
Receiver line interval (metres)	350
Source line interval (metres)	350
Receiver interval (metres)	50
Source (VP) interval (metres)	50
Sub-surface bin dimension (m)	25 x 25
Maximum number of receiver lines in live patch	16
Max number of live receivers per receiver line	168
Maximum offset (metres)	4932
Maximum minimum offset (metres)	495
Nominal inline fold	12
Nominal cross line fold	8
Nominal total fold	96
Source parameters	
Number of in-line vibrators per fleet	2
Number of vibrator fleets	2
Pad-to-pad (metres)	12.5
Sweep length (secs)	8
Start sweep frequency - Hz	4
End sweep frequency - Hz	80
Sweep structure	linear
Sweep taper (msecs)	250
Drive level	80%
Sweeps per VP	1
Centre of vibrator array	on the peg

An in-line array of 12 equally spaced geophones centred on the peg, as displayed in Fig.7, was employed for recording the Jonothon survey.

A source array consisting of 2 vibrators centred on the peg was used to record the survey. A single sweep, with pad-to-pad spacing of 12.5m, was recorded at each VP (a diagram of the source array is shown in Fig.8).

The survey was recorded in a 'leap frog' manner with two fleets of two vibrators.

To confirm that the vibrator array was actually centred on the unmarked surveyed positioned, a vibrator scout would randomly select an actual COG position and record that position with an OmniSTAR differential GPS unit. The coordinates of the COG position were then compared with the survey post-plot position. The checks confirmed that the COG positions were within tolerance..

Independent checks on the coordinates of COG positions were done with a hand-held Garmin. Given the limited accuracy of the Garmin, this exercise was instigated to check for gross errors only. The following 2 diagrams demonstrated that the COG positions were centred on the peg as required by the survey design.

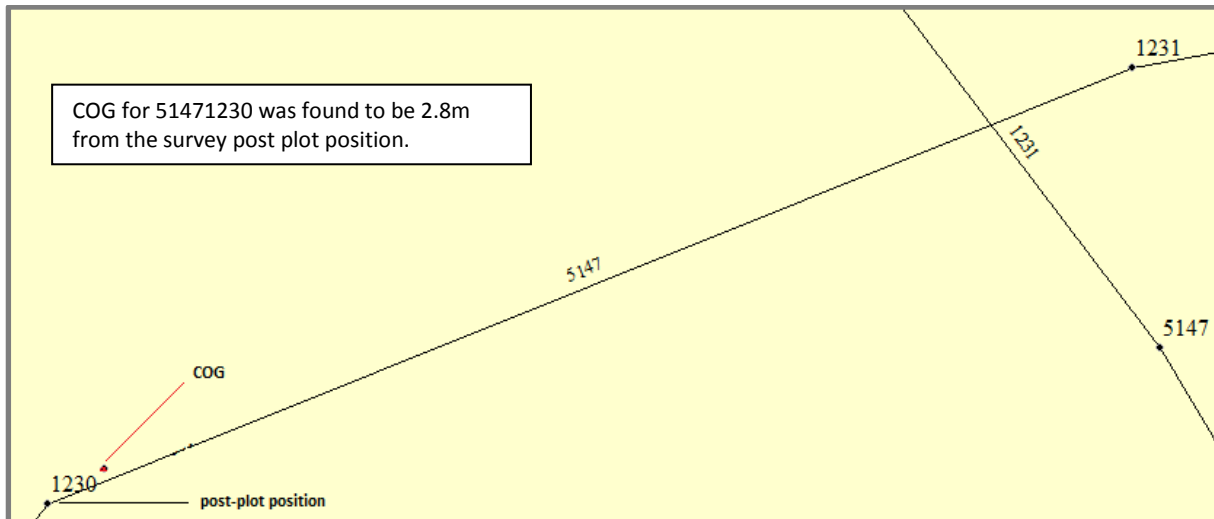


Fig.10 COG check I

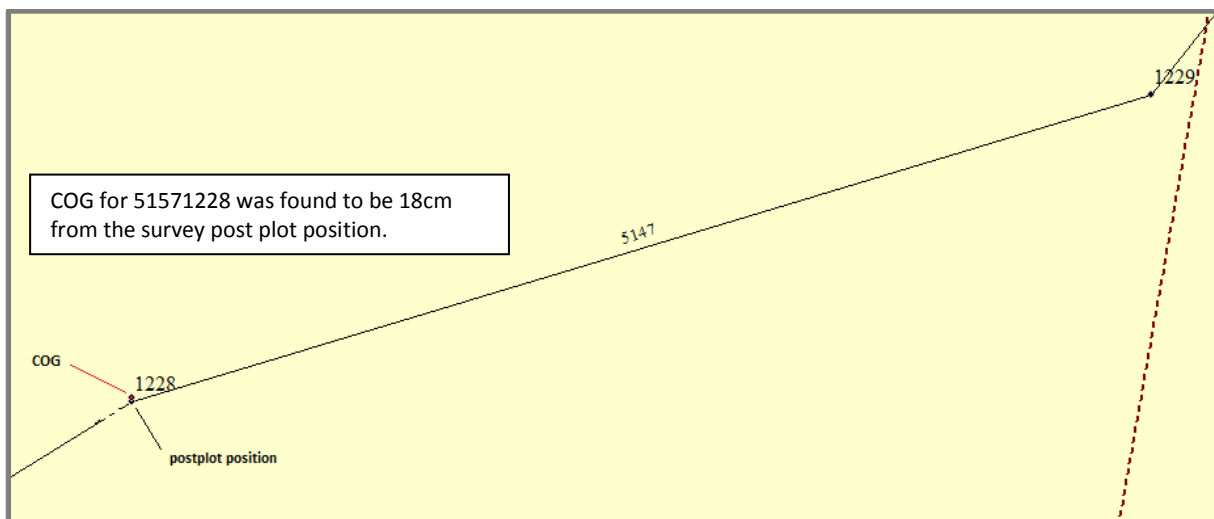


Fig.11 COG check II

During the recording of the survey one vibrator experienced intermittent electrical problems that resulted in the use of one fleet at these times. As Terrex had entered a fixed-price contract for the recording of the survey, this problem was not of great concern to Senex.

The survey was recorded using single and double salvos in a single panel. There were no fences in the survey area however the Merrimellia pipeline in the south west of the grid required small detours. A crossing point was conveniently positioned which meant only a small amount of lost time was experienced recording around the pipe.

There was no waiting on spread during the job.

The weather during the survey was consistently hot with some temperatures in the high 40s recorded. The line crew was stood down on one occasion when a temperature of 48° was recorded. Other than this incident, there were no other delays experienced due to weather.

The high temperatures were also a constraint for the vibrators. Stu Rauckman, the vibrator technician, managed the machines' response to the temperatures carefully throughout the survey. As the land surface in the survey area predominantly consisted of sand or clay plains without any rocky outcrops; the vibrators were fitted with sand tyres. This ground surface made it relatively easy for the front line crew to plant the geophones.



Fig.12 The Merrimellia pipeline in the south west of the grid.

5.3 Offsets

A significant number of VPs and receiver points were offset from their preplot position mainly for cultural heritage and environmental reasons and to a lesser extent to avoid the pipeline infrastructure. Some gaps in the very shallow section of the 3D data volume and acquisition footprints may be evident as a result of the offsets however this should not have any detrimental effect on the deeper target zones.

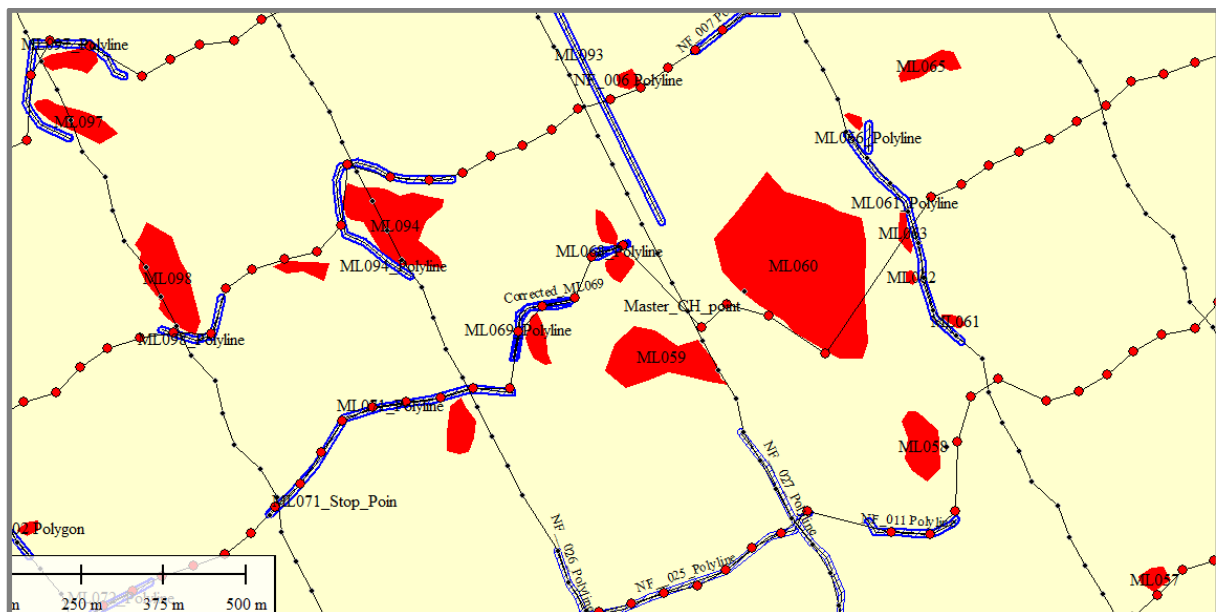


Fig.13 Example of offset VPs around cultural heritage sites.

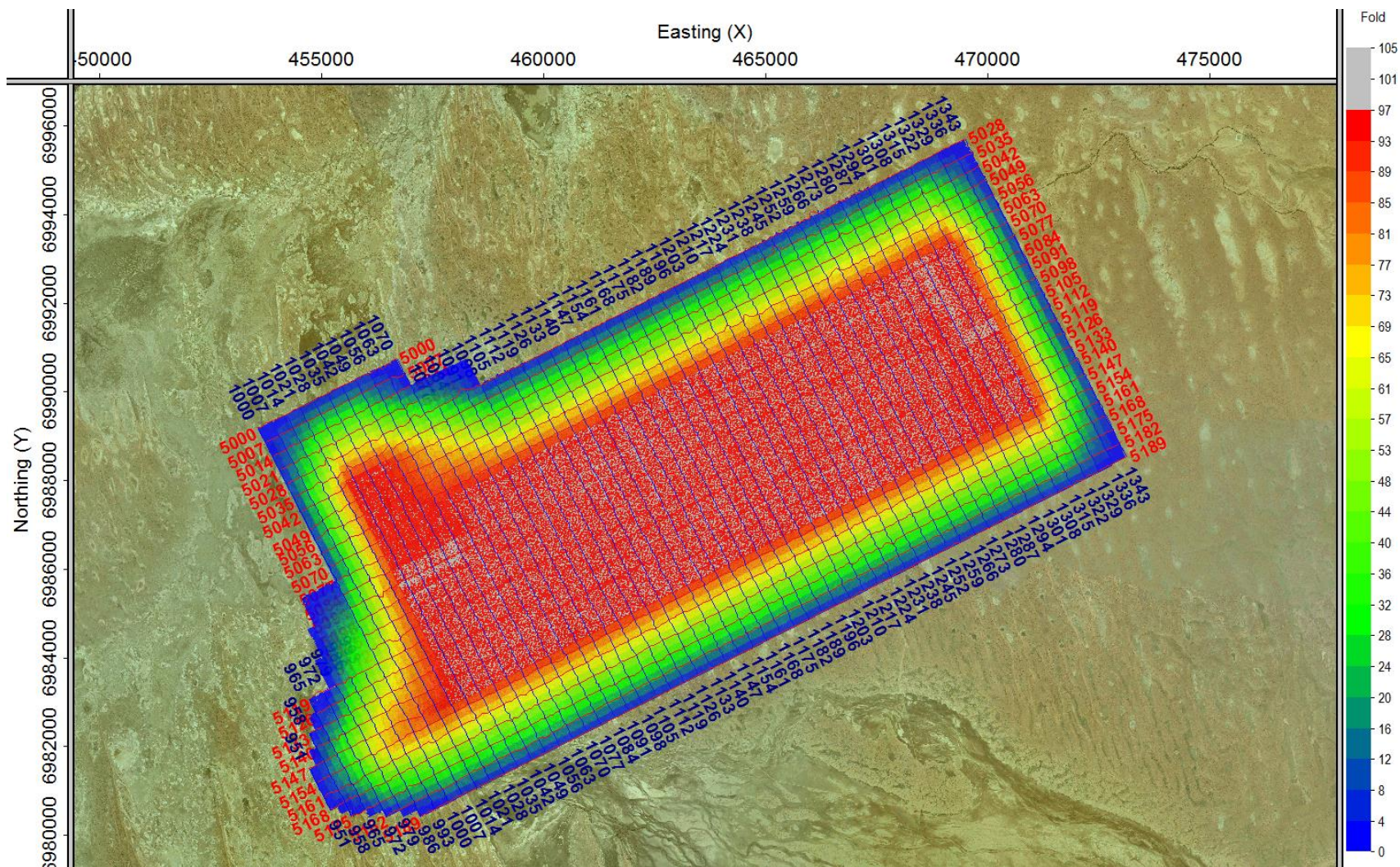


Fig.14 Recorded fold.

5.4 Recorded fold

As discussed in the section on survey design, a nominal fold of 96 was anticipated from the preplot position of the source and receiver locations. Given the large number of offsets from the preplot positions, the actual or recorded fold differed slightly from the design. This is illustrated in the previous figure where a number of bins can be seen to have a fold in excess of 96 (the light grey areas) and similarly (but not well illustrated), some bins in the 'full-fold' area have less than 96 contributing traces.

5.5 Recording statistics

The following is a summary of the VPs designed , surveyed and recorded.

Number of VPs designed	8946
Number VPs skipped by survey	12
Number of VPs surveyed	8934
Number of VPs skipped by recording	3
Number of VPs recorded	8931

The following pie graph is a display of the allocation of hours worked during the recording of the survey. As is displayed the majority of productive time was spent on recording data followed by time spent on laying out and picking up spread.

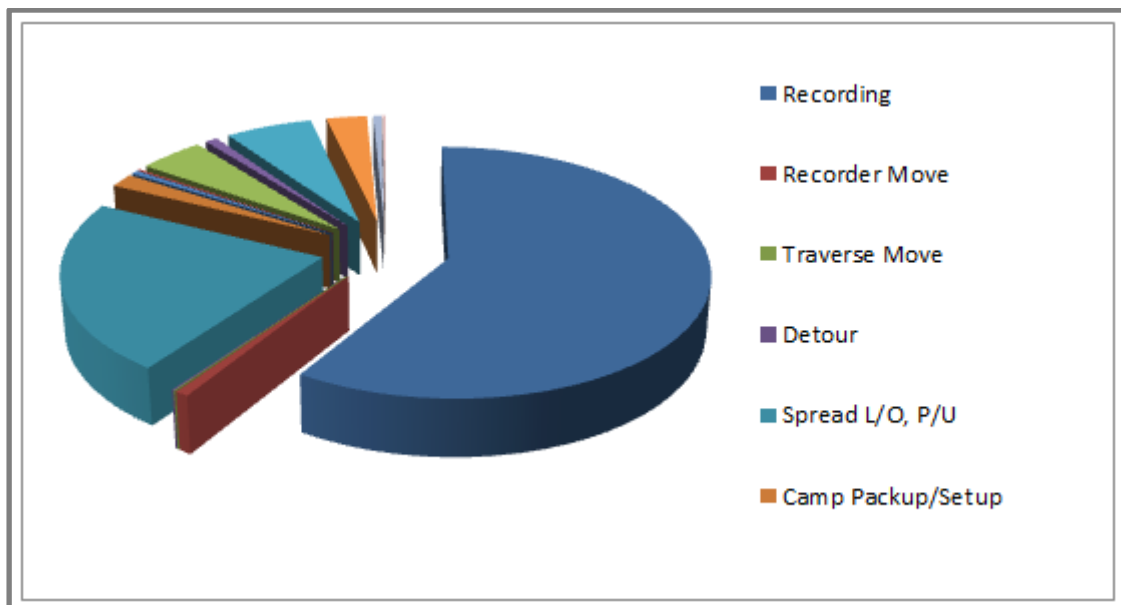


Fig.15 Allocation of hours worked.

5.6 Crew strength

The Service Agreement between Senex and Terrex Seismic (see appendix) stipulated a crew size of 54 people. During the recording there were several crew changes which resulted in 74 Terrex people on the Jonothon survey at various times. The table below shows where these people were deployed on the job.

Crew manager	2
HSE	2
Cooks	2
Mechanics	2
Supply drivers	4
Kitchen hand	1
Observers	3
QC	1
Cable repair	3
Vib ops	7
Vib technician	1
Trouble shooters	2
Line boss	1
Line crew	39
Total	74

The crew members were all competent at their respective roles and good team work was evident. Morale was generally good in spite of the uncertainty that lay ahead in the industry with the recent collapse in the world oil price. The full crew list appears in the appendices.

Senex contracted paramedical services directly from HSE Medical Services. Malcolm Ball filled this role for the Jonothon survey.



Fig.16 Paramedic, Malcolm Ball in the field.

Observers

Three observers were on the survey at various times. The job started with Mardon Day and Joel Carry sharing the duties until Joel left to attend to maintenance of equipment in Western Australia. Joel was replaced by Peter O'Donnell. All three men are experienced and competent operators and, along with the line boss, they directed the recording operations efficiently.

It is relatively unusual to have two senior observers on a crew at one time, however, as seismic activity was retracting at the time of the Jonothon survey, Terrex was overstaffing the crew to keep as many key personnel employed as possible.

Line boss

Andrew (Pommie) Williams was the line boss who worked in conjunction with the trouble shooters and the observers to coordinate all the field effort. Ryan Newbould assumed the line boss position when Andrew went on leave.



Fig.17 Line crew load geophones into a transporter at the end of the job.

Cable repair

Cable repair was led by Cherrine Collier, an experienced and popular technician.

Spread damage caused by animal activity was not a major issue however there were isolated incidents of damage caused by animals chewing cables.

Cables were monitored continuously by the observer and any damaged cables were swapped out of the live patch as soon as possible. Very few cables were actually repaired during the survey.

The geophone 6 packs were cycled through the cable repair workshop for leak-testing and repair, if required, before they were redeployed.

5.7 Cattle activity

The survey was recorded on Innamincka station, a pastoral property that grazed cattle. Several herds of cattle were in the vicinity of the grid during recording, however, minimal damage to cables and geophones attributable to the cattle was experienced. The cattle tended to frequent areas close to water adjacent to the Keleary access road.

5.8 Final line inspections

The footprint of the Jonothon seismic survey was relatively gentle on the landscape.

21 locations were visited for GAS auditing after recording activity and a series of inspection traverses across the grid was done.

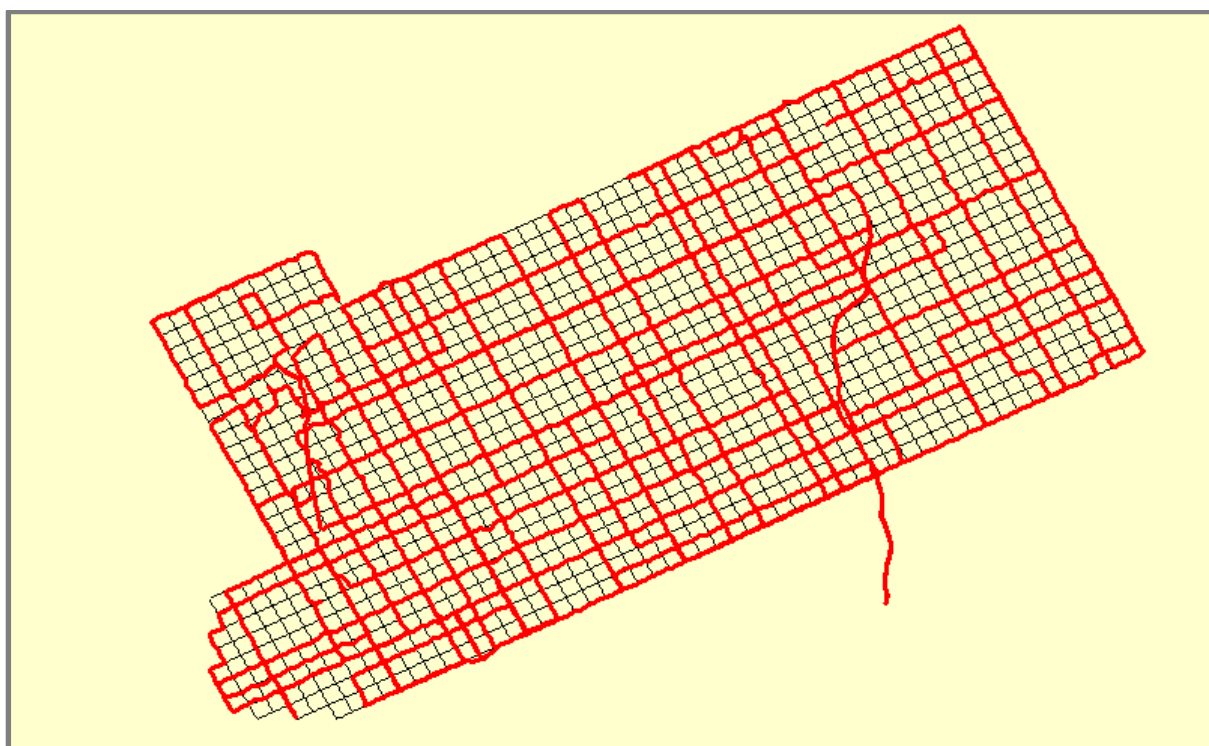


Fig.18 Final inspection lines (red) on the 3D grid.

For more information see the Jonothon Environmental report, written by Steve Munro.

6.0 QUALITY CONTROL

Terrex Seismic was not contracted to provide a quality control (QC) function for the recording of the Jonothon survey. In spite of this Terrex chose to supply Kyle Sterry, an experienced geophysicist, for the QC role at no extra cost to Senex.

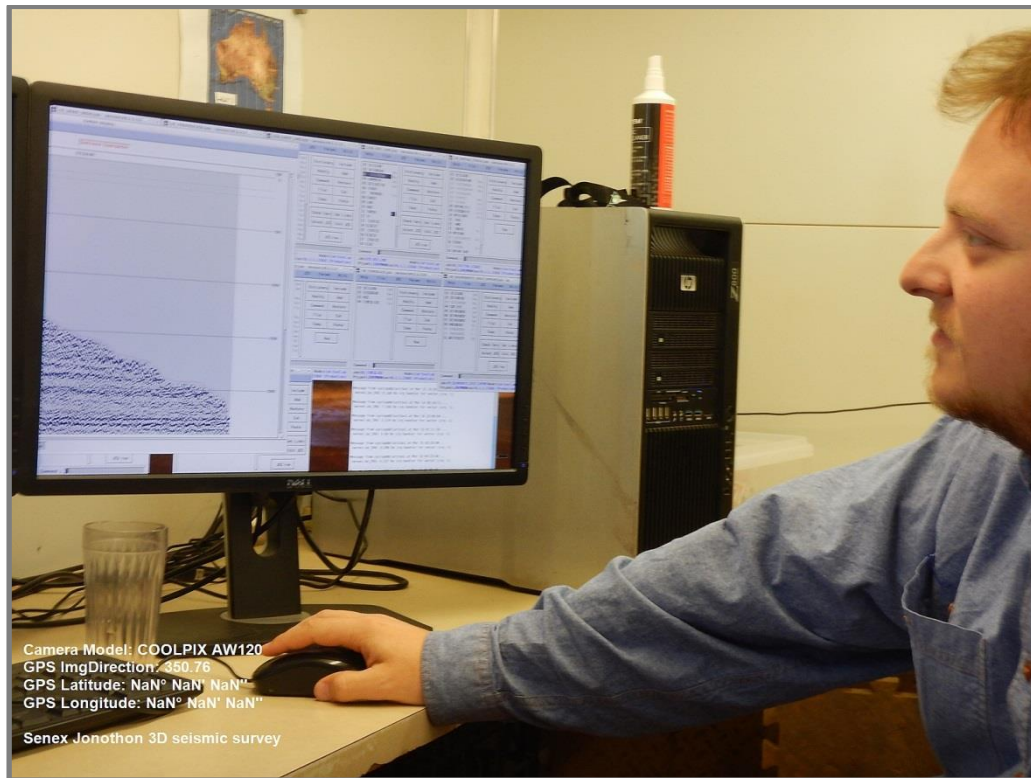


Fig.19 QC geophysicist, Kyle Sterry processing the 3D data cube.

The data quality was generally good throughout the grid with several individual reflectors visible right across the field records, strong first breaks and minor amount of noise. The following field records support these observations.

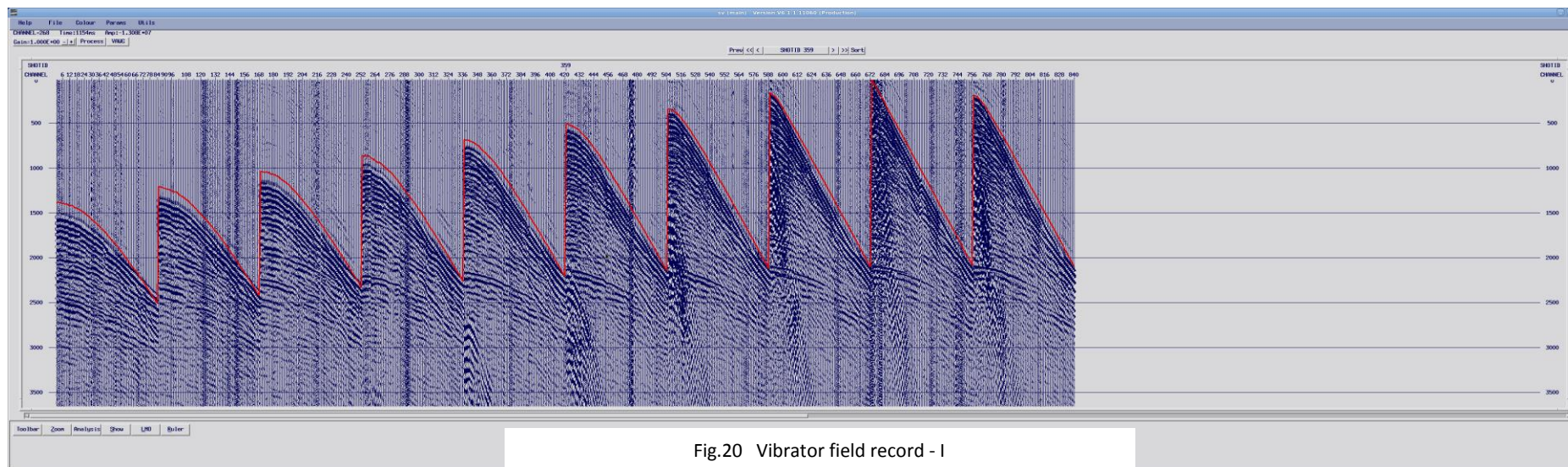


Fig.20 Vibrator field record - I

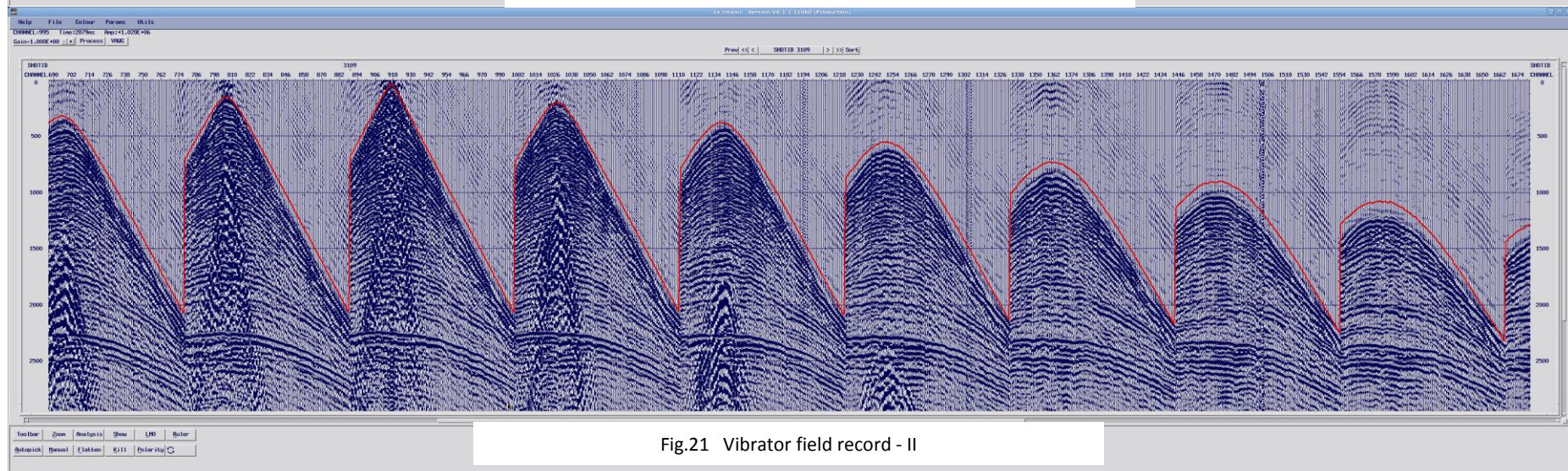
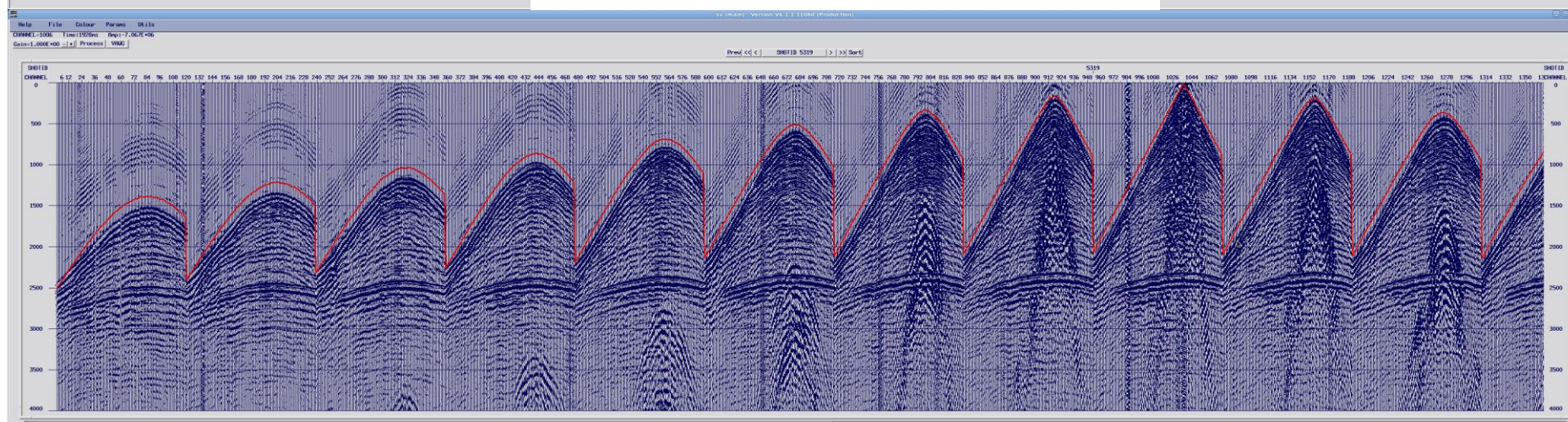
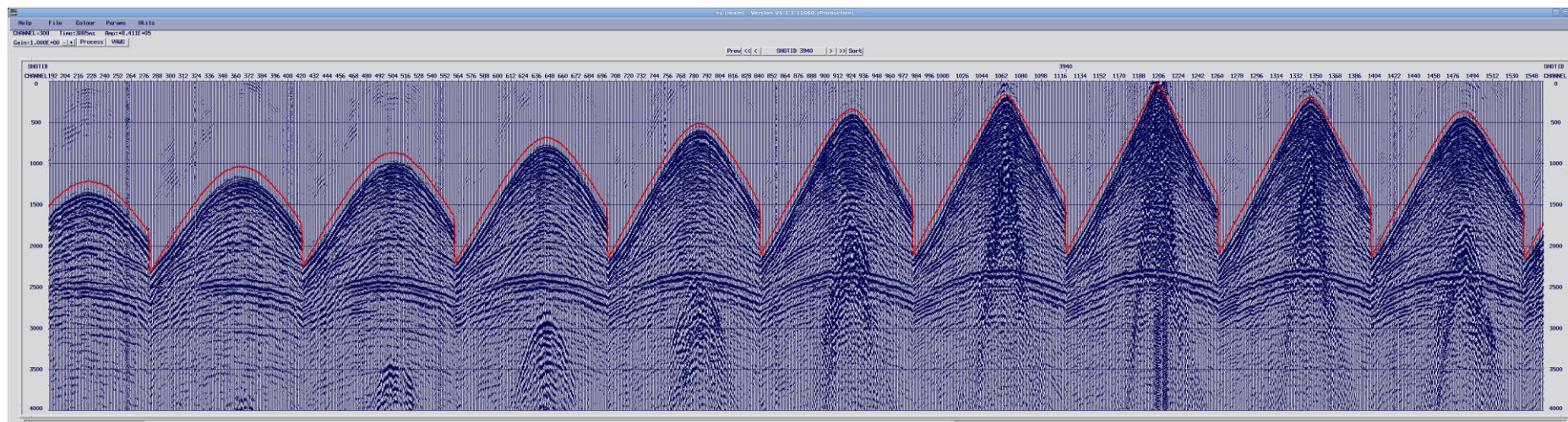


Fig.21 Vibrator field record - II



As well as preparing scripts for the vibrators and QC'ing the field data, basic 3D processing of the data through to a brute stack stage (a number of brute stacks is included in the appendix) was completed. The stacks were generated using the Globe Claritas software and were of a good standard given the basic processing flow that had been applied.

The parameters applied were as follows:

Process	Parameters	Comments
PRE-PROCESSING		
Reformat field SEG-D to Claritas internal format (HDF5) Discard Auxiliary traces Make and apply geometry		Remove void files Remove "non-live" traces Using final SPS files Add CDPs to headers
Write to SEG-Y		For shipping to the processing centre
SIGNAL PROCESSING AND DATA CONDITIONING		
FK filter	+ve dip cut off of 25 ms / trace Taper 0.35	Inside 1000 ms AGC wrapper
Spherical Divergence	Velocity Power: 1.0 TWT Power: 1.0 Scale Factor: 1.5 X Power: 0.5	Velocities from NMO file
Trace by trace predictive Deconvolution	Gap: 16 ms Operator Length: 50 ms White noise: 0.1% Manually picked offset dependant design gates	
Sort to CDP order		
VELOCITY AND STATICS MODELLING		
Correction to floating datum	Elevation statics applied to a smoothed datum. Replacement velocity 2000 m/s	
Velocity Analysis	Every 100 CDP Every 50 th Inline	Interactive picks NMO supplied in shipment as Claritas text format
Normal move-out correction	70% stretch mute	
AGC gain	500 ms window	

Residual Statics, surface consistent	Statics derivation: Apply NMO TWIN: 1250 2500 ms Max shift: 8 ms Iterations: 30 Oversample: 4 AGC: 250 ms (model traces)	
GENERATION OF FIELD STACKS		
Stack	Stack with unity normalisation	
Correction from floating to final fixed datum.	Datum elevation 70 m Replacement velocity 2000 m/s	

7.0 HEALTH, SAFETY & THE ENVIRONMENT

The following document formed the basis of HSE practices on the Jonothon survey:

The seismic campaign HSE MS bridging document, 2014 Cooper Basin with Terrex Seismic (Document: SENEX-CORP-HS-BRG-017), was developed to:

‘...define the Health, Safety and Environmental Management System (HSE MS) interfaces between Senex Energy and Terrex Seismic and covers the seismic operations in support of the Senex 2014 Cooper Basin Campaign.’

This document existed as an agreement between Senex and Terrex.

A ‘safety first’ approach was emphasized throughout the project by all the participating contractors. Toolbox meetings were used as a forum to emphasize safety issues and also for a time to discuss issues raised on HIR cards.

7.1 Inductions

Site inductions were held at the beginning of the project and at the time of the arrival of new personnel at crew changes times.



Fig.24 The WAC, survey and line preparation crews assemble for induction.

The main points covered during the inductions were:

- Risks involved in remote environments
- Driving risks
- Snake bite risks
- The need for adequate hydration
- Safe work practices
- Culture heritage awareness

7.2 Toolbox meeting

About 15 minutes was assigned for toolbox meetings every morning before the crew departed the camp. Prior to the meeting all personnel on the crew were breath tested for alcohol.

Toolbox meetings on Sundays were 'Safety Sundays', which comprised of detailed discussions or presentations on specific safety issues.

Hydration issues, emergency snake bite response, camp move protocols were topics covered.

7.3 Incidents

There were no work related incidents during the Jonothon survey.

7.4 Procedures and documentation

The Jonothon 3D Seismic Field Operations Manual provided the framework for the survey. This document listed the following:

- The technical scope of the program
- recording parameters
- stakeholder contact information
- emergency reporting procedures
- environmental management
- HSSE and CH management
- Land access management
- WAC and management

Other HSE documents for the survey included:

- Statement of environmental objectives (SEO) – a document that defined incidents and described ways of assessing environmental impacts using GAS scoring.
- Seismic campaign HSE MS bridging document – a document incorporating the HSE and management systems of Senex and Terrex.
- Emergency response plan - a plan to provide all parties involved in the survey with guidance to respond to an emergency or serious incident associated with the seismic survey.
- Health, safety, security and environmental plan (HSSE)

7.5 Journey management

Journey management procedures were used as a safety measure for all people travelling to and from the project area. A daily procedure of personnel returning to camp identifying themselves was also utilized. In addition to this, any camp-based personnel (crew manager, mechanics, supply drivers etc.) leaving the camp signed themselves out on a journey management white board.

Email messages were used to confirm the location of personnel on major journeys.

8.0 CULTURAL HERITAGE / WORK AREA CLEARANCE

The Jonothon survey area lies within the Yandruwandha and Yawarrawarrka (YY) Native Title Land.

Continuous work area clearance (WAC) was undertaken immediately in front of the line preparation machines, which allowed for any issues to be resolved as they presented. Three WAC crews were used for the Jonothon survey with each team consisting of 2 tradition owners, 1 archaeologist and a driver. The YY people and the archaeologists were accommodated at the Terrex Contracting camp and quickly became part of the camp community.

All points of cultural heritage – aboriginal and non-aboriginal – were recorded and documented by the archaeologists as points, lines, corridors or polygons. This information was given to the surveyors who incorporated it into field maps and GPS guidance systems.

A number of early European cultural heritage sites were recorded in the south west of the grid in the vicinity of the Deramookoo water hole.

There were numerous sites identified during the preclearance surveys by the WAC crews and a number of significant artefacts were found.

The clearance work was managed by Bill Hedditch Nominees in the field and Dan Thomas of Senex. Dan's role was daily management and coordination of the activities of the 3 WAC crews. WAC activities commenced on 7th of February 2015 and concluded on the 5th of March 2015.



Fig.25 WAC crew member inspect artefacts on a clay pan.

9.0 LINE PREPARATION

Following inductions and general discussions, Terrex Contracting commenced line preparation on the 7th of February 2015 and continued until the 5th of March 2015.

The Terrex Spatial surveyors installed the preplot data into GPS guidance systems in the dozers and graders prior to the dozers walking to the grid. Work commenced in the north east portion of the grid and all the area of the grid to the east of Keleary access road was prepared as a block before any work commenced on the west side of the road.

A senior survey was on hand during line preparation to monitor progress and resolve any issues as they presented.



Fig.26 Line preparation adjacent to the Merrimellia pipeline.

Terrex Contracting crew manager was Robert Pugno (affectionately known by everyone as, Grinner) and the Terrex Seismic advance manager was Warren Campbell.

10.0 TOPOGRAPHICAL SURVEY

Terrex Spatial was contracted to peg the receiver lines, survey the source lines and place and maintain guidance systems in the dozers.

The surveyors processed and analysed the spatial data at the end of each day. At the beginning and end of every day checks were made on known points. The check done at the beginning of the day involved re-observing pegs that had been observed on the previous day. Similarly, checks on heights and horizontal positions were done when crossing other lines in the 3D grid. Before line preparation commence, checks were made for GPS errors (for instance setting the wrong datum).

Terrex Spatial utilized the OmniSTAR High Precision regionally corrected GPS system, which allowed real time solutions and gave an accuracy of less than 0.1m in heights and 0.05m in X-Y position. The advantage of the OmniSTAR system was that it made deployment of base stations redundant, and a rover with the appropriate OmniSTAR hardware modification was required. Base stations were erected however and OmniSTAR positions were calibrated against the base station position.

The disadvantage of the OmniSTAR system was the need to ensure that the system was always 'locked'. In the event that lock was lost, there was an approximately 45 minute production delay while the system was 'relocked'. The Real Time Kinematic (RTK) system was also utilized during the Jonothon survey.



Fig.27 Surveyors monitoring spatial data at a base station.

Terrex Spatial was also responsible for line pointing duties and ensuring that the Work Area Clearance (WAC) was understood and adhered to during the line preparation phase of the survey. The surveyors collated the WAC information and included no-go areas and forced corridors onto all field maps.

Receiver positions were marked with pins and wooden stakes, however, source positions were not physically marked on the ground. Vibrator operators used their GPS tablets in the machines to guide them to the individual source point locations.

Surveying operations commenced on 8 February 2015 and were completed on 6 March 2015. Terrex Spatial was managed by senior surveyors Eric Amedee and Stew Folley. Dean Hausmann spent time on the crew assisting with the GPS navigational instruments in the dozers and the vibrators.

The reader is directed to the Terrex Spatial final report for further details.

11.0 SUMMARY AND RECOMMENDATIONS

- The Jonothon survey was completed successfully without any lost time incidents.
- Daily toolbox meetings proved to be a productive forum to discuss operational issues and contributed to the building of team work among the crew members.
- The practice of separate toolbox meetings for vibrator operators could be reviewed as it set these people aside from the main body of the crew.
- Terrex Contracting and Terrex Seismic managers were Rob Pugno, Warren Campbell, Dave Keat and Darren Rea. All these people were capable, safety conscious and competent.
- Terrex Spatial was managed by Stew Folley, Eric Amedee and Dean Hausmann, all competent at their jobs.
- The data acquired was of consistently good quality.
- The observers maintained a good standard of quality control regarding faulty traces and all reasonable efforts were made to minimise noise on the spread.
- Working relationships between Terrex Seismic, Terrex Spatial, Terrex Contracting and the WAC crews were positive and respectful.
- A strong sense of team work was evident among crew members.
- All crew members displayed a considerate attitude to the Cooper Basin physical environment.
- Health and Safety was at the forefront of everyone's mind.
- The ground conditions on the survey area were relatively easy on the equipment and access tracks readily negotiable.
- Day time temperatures were always hot during the survey and at times were extreme.
- Although Terrex was not contractually obliged to provide a QC person, one was provided which was of considerable benefit.
- In summary, Jonothon was a successful 3D seismic survey. It was recorded in an efficient and safe manner without any LTIs and without any loss of time due to weather.
- The Terrex group of companies performed to a high standard and would be recommended for further work.

APPENDICES

- Service agreement
- Crew list
- Equipment supplies
- Brute stacks

SERVICE AGREEMENT

SERVICES AGREEMENT – SEISMIC

Senex Energy Limited and Terrex Pty Ltd

Contract number F29, dated 1 January 2014

Scope of Work: Jonothon 3D Seismic

In accordance with the Agreement between Senex Energy Limited and Terrex Pty Ltd for the provision of seismic data acquisition services by Terrex Pty Ltd, the parties agree that the Jonothon 3D Seismic survey will be carried out in accordance with the terms of the Agreement and the Scope of Work set out below.

Survey Name	Jonothon 3D Seismic
Area of Operations	PEL638, AAL221
Commencement Date:	
Line Clearing Start Date	February 2015
Acquisition Start Date	March 2015
2D / 3D	3D
State	South Australia
Sedimentary Basin	Cooper
Rate Structure	Acquisition Crew - Lump Sum Rate Line Prep & Survey Crew – Hourly Rate
Rate Structure Document No. / File Name	Senex Repricing Summary February 27 th 2015.msg Senex Interim Rates Schedule (2015) GD Feb 27.pdf (Ref Greg Dunlop Email 27 th February 2015)
SEISMIC AQUISITION	153 sq km
Total # source line km's	447 km
Total # receiver line km's	437 km
Crew Size	54
# Extra Channels	0
# Extra Line Crew	0
# Extra Landcruisers	0
Advance Party	Yes, at Terrex cost
Paramedic	0 (Senex to Supply)
Infield QC	1, included in Lump Sum price
Acquisition Type:	Sercel 428XL
Energy Source:	Four 4x4 AHV-IV-62,000lb Peak Force Vibrators (two groups of two)
Vibrator Point Interval:	50m
Source Line Interval	350m
Total # source points	8,946
Vibrator Array:	2 Vibes – 12.5m P to P, 2 Groups of 2 vibes operating
Vibrator Array Location:	Centred on Station

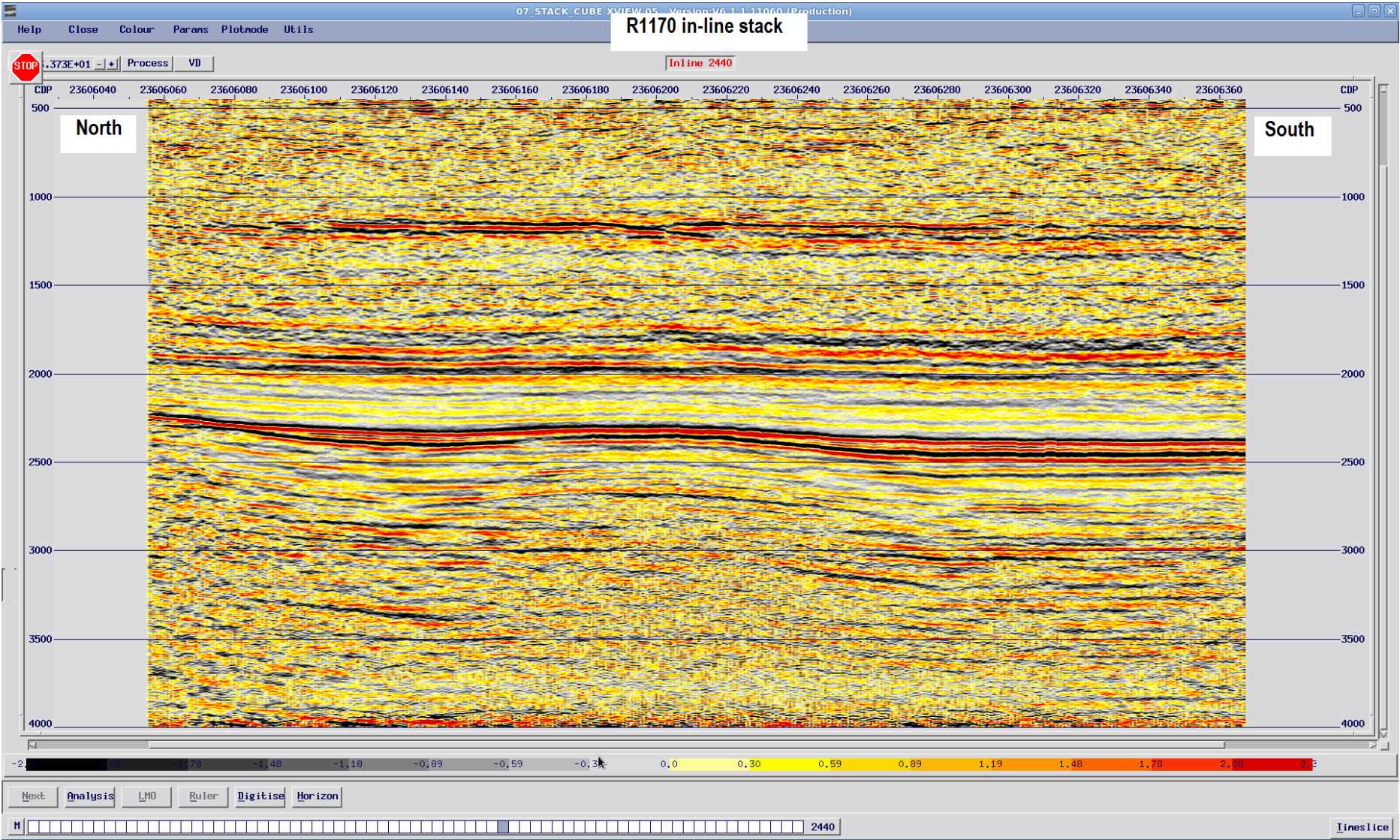
Receivers:	Groups of 12 SM24 10Hz Geophones
Receiver Interval:	50m
Receiver Line Interval	350m
Total # receiver points	8,743
Receiver Array Location:	Centred on Station Peg
Receiver Array:	12 phones over 45.83m (4.16m spacing) centred on station
Live Patch	16 lines x 168 Channels
Sweep Length:	8 Sec
Number of Sweeps:	1
Sweep Type:	Monosweep
Sweep Frequencies:	4-80Hz
Sweep Control:	Sercel VE464, source driven
Accelerometers:	Sercel
Similarity System:	Sercel
Peak Force:	62,000 lb
Hold Down Weight:	62,000 lb
Vibrator Drive Level:	Force Control on – 80% Peak Force
Phase Lock:	Ground Force Phase lock
No. of Channels Live:	2688
Taper Length (ms)	250 ms
Taper Type	Cosine
No. of Channels on Crew:	7500
Source Effort:	160 secs per km
Fold:	96
Near Offset	50m
Bin size	25mx25m
Record Length:	4 sec
Correlation Sample Rate:	2 ms
Written to Tape S.R.:	2 ms
Output Data Format:	SEGD
Terrex Representative	Jon Turner
Client Representative	Mark Kneipp
Other costs	Accommodation & messing of WAC Crew.
Line Maps	To be appended to this document
Line end co-ordinates	To be appended to this document
Camp Type- Terrex/Hire	Terrex
LINE CLEARING	
# Graders	2
# Dozers	3
# Mulchers	0
# Fire Tenders	0
Camp Type- Terrex/Hire	Terrex Camp

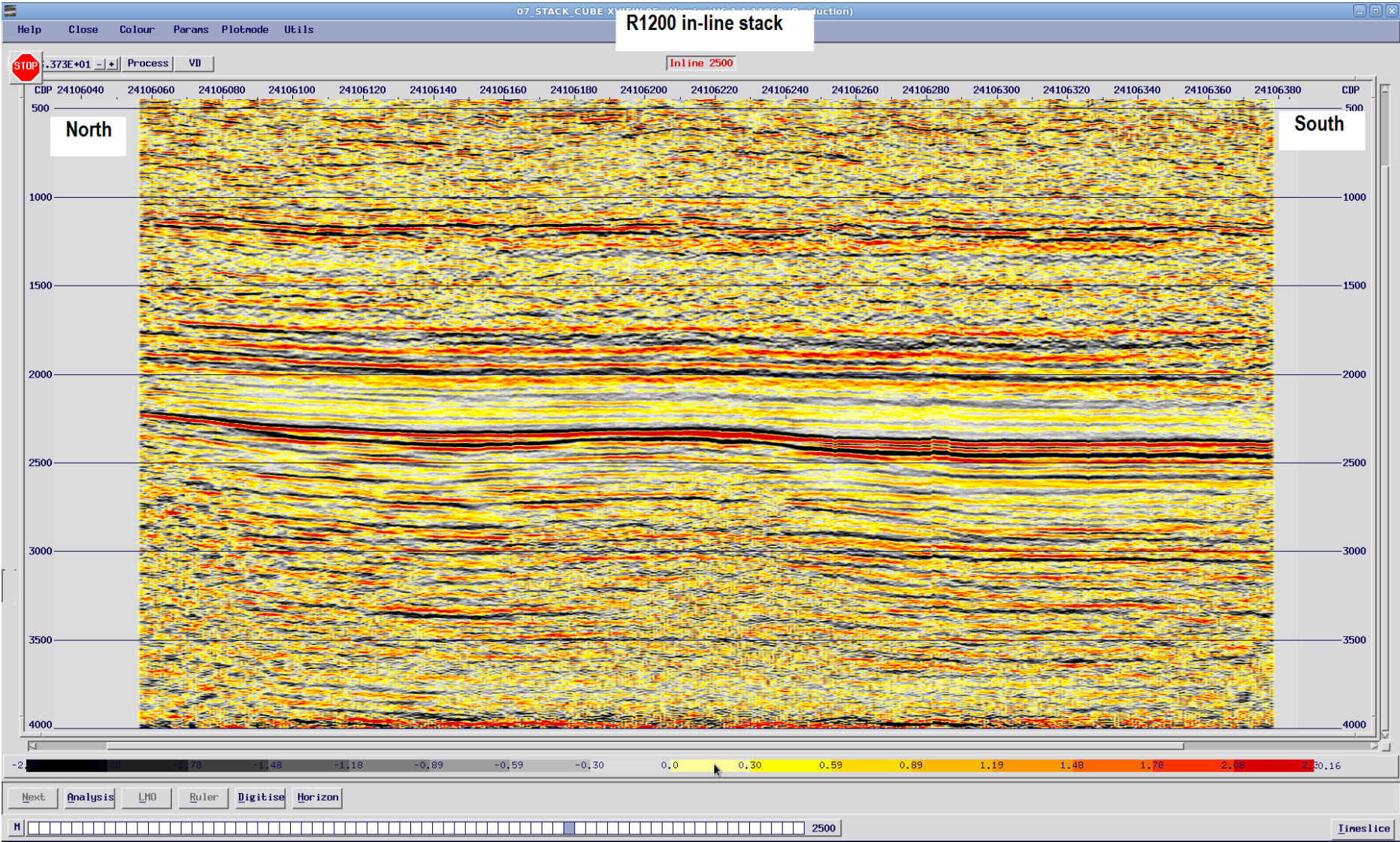
Infield Paramedic	0 (Senex to Supply)
Frontier Basin Surcharge- Y/N	N
Cultural Heritage Monitors	
TC Camp- Y/N	Y
Accom- Y/N	Y – 13 Pax
Messing- Y/N	Y – 14 Pax (inc Bird Dog)
Hire Camp- Y/N	N
Accom- Y/N	N
Messing- Y/N	N
LINE RESTORATION	
# Graders	1
# Offsider & LV	1
# Terrex Toyota 4x4	0
# Hired Toyota 4x4	0
Camp Type- Terrex/Hire	Terrex
	Note: Line Restoration requirements to be confirmed by Bird Dog at end of Line Prep.
LINE POINTING	
# NavMini Systems	7
# Senior Surveyor	0
# Line Pointing Crew	1
LINE SURVEY	
# Senior Surveyor	1
# Line Survey Crew	2

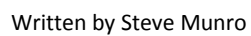
Crew Manager	Dave Keat	Line Crew	Justin Selter
Crew Manager	Darren Rea	Line Crew	Kenneth Grace
HSE	Courtney O'Connor	Line Crew	Kristian Prott
HSE	Graham Kohler	Line Crew	Kyle Janneker
HSE	Jason Sherras	Line Crew	Lachlan Fazldeen
Cook	Layne Geddes	Line Crew	Lachlan Jones
Cook	Maria Hanna	Line Crew	Liam Byrne
Cook	Mark Gill	Line Crew	Liam Gillen
Mechanic	Robert Harrington	Line Crew	Luke Anderson
Mechanic	Rhys Klincke	Line Crew	Luke Scadding
Mechanic	Steven Mejak	Line Crew	Martin Vale
Supply Driver	Rob Vernon	Line Crew	Matthew Woolley
Supply Driver	Murray Whyte	Line Crew	Paul Parsons
Supply Driver	Michael Jones	Line Crew	Peter Poznik
Supply Driver	Alan Fuller	Line Crew	Peter Webber
Kitchen Hand	Meree O'Carroll	Line Crew	Poemark Toese
Observer	Peter O'Donnell	Line Crew	Ryan Ward
Observer	Joel Carry	Line Crew	Shane Ollerenshaw
Observer	Mardon Day	Line Crew	Tegan Wilson
QC	Kyle Sterry	Line Crew	Thomas Midgley
Cable Repair	Sue Lewis	Line Crew	Ty Turner-Bryan
Cable Repair	Cherrine Collier	Line Crew	Alex Kerr
Cable Repair	Wayne Hubbard	Line Crew	Jacob Arnell
Vib Op	Kirsten Heindel	Line Crew	Jacob Pihama
Vib Op	Ronald Dover	Line Crew	Jamie Goodwill
Vib Op	Jack Hancock	Line Crew	Joshua Stinson
Vib Op	Andrew Ribar		
Vib Op	Luke Samios		
Vib Op	Daniel Blackburn		
Vib Op	Dwaine Bloom		
Vib Tech	Stuart Rauckman		
T/Shooter	Alisha Glover		
T/Shooter	Ryan Newbould		
Line Boss	Andrew Williams		
Line Crew	Andrew Cheyne		
Line Crew	Ben Dillon		
Line Crew	Ben Tabone		
Line Crew	Cameron Brooker		
Line Crew	Carlie Warne		
Line Crew	Chris O'Donnell		
Line Crew	Christopher Grams		
Line Crew	Clinton Avenell		
Line Crew	Daniel Richardson		
Line Crew	Daniel Tabone		
Line Crew	Danielle Walker		
Line Crew	David Wex		
Line Crew	Dylan Ashenden		
Line Crew	Emma Stolz		

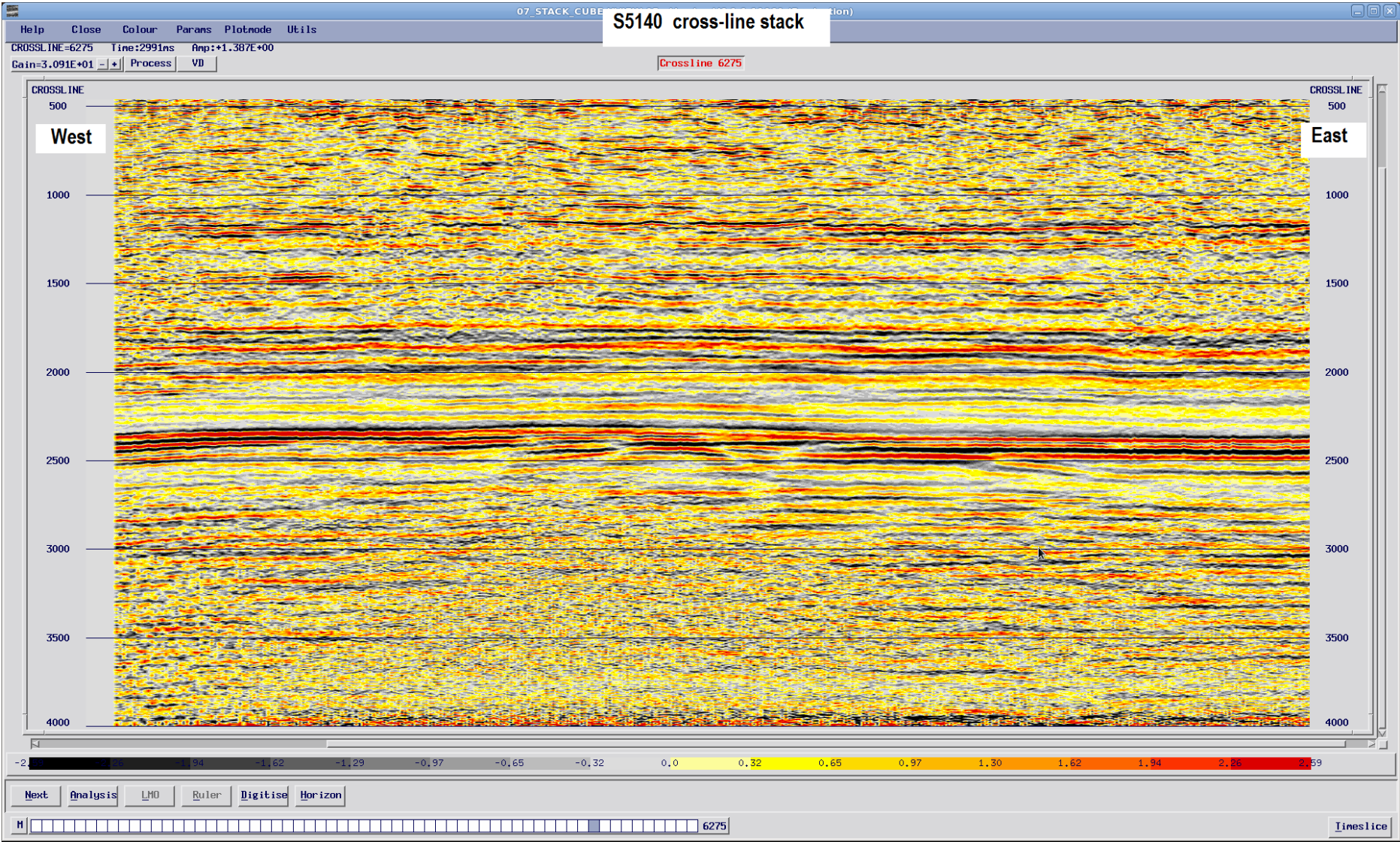
Equipment supplied by Terrex Seismic

4x4 AHV-IV 62,000lb vibrators	4
Recording truck	1
Vibrator service truck	1
Cable repair truck	1
Water truck	1
Storage truck	1
Supply truck	1
Water truck	2
Prime mover	4
30,000L self bunded semi trailer	1
Spread truck	1
Generator trailer	1
Workshop trailer	1
Firefighting trailer	1
Storage trailer	1
Toyota Landcruisers	20









APPENDIX 3

Terrex Seismic Senex 2014 Jonothon 3D Field Operations Report

Jonothon 3D Seismic Survey

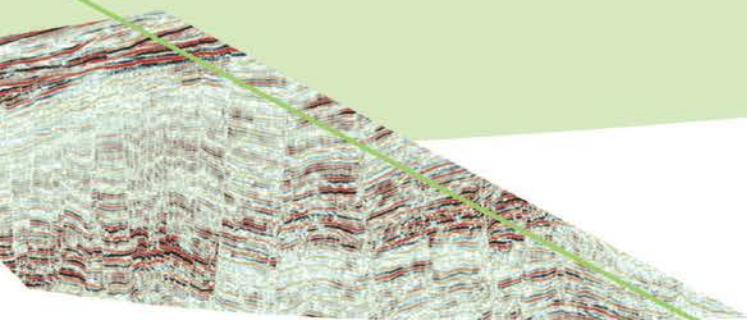
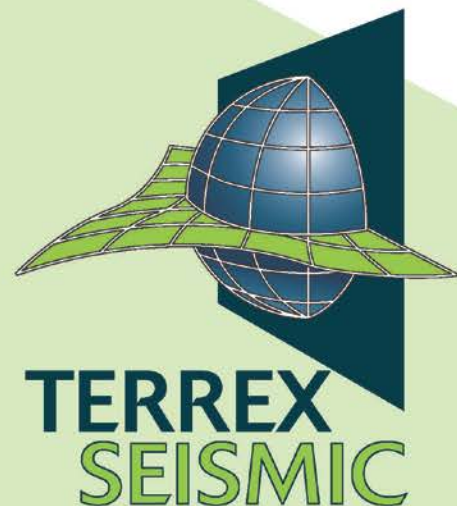
Field Operations Report

Prepared for Senex Energy Limited

1st March 2015 to 17th March 2015

Job No. J00269

Crew A2



Field Operations Report

For

Jonothon 3D

PEL 638, AAL221

Written by

Dave Keat - Crew Manager

Crew A2

This report is confidential and was prepared exclusively for Senex Energy Limited

Terrex Seismic is certified to OHSAS 18001, ISO 14001 and AS 4801.

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TERREX GLOSSARY OF TERMS

Term	Description
Acquisition	All days onsite doing seismic related activities i.e. from the first station laid to the last station picked up, any experimental or spread testing time
Recording	Covers all the days data was recorded i.e. from the first VP to the last VP
Survey	All activities the client paid for including mobilisation/demobilisation

1. INTRODUCTION

Terrex Seismic (Terrex) was contracted by Senex Energy Limited (Senex) to conduct the Jonothon 3D Seismic Survey. The total survey was completed in 18 days with mobilisation beginning on the 1st March and demobilisation on the 17th March.

Acquisition commenced on the 2nd March after camp setup / inductions were completed and was completed on the 15th March when the last spread truck was loaded. Recording was completed in 12 days with 153 Sq. Kms acquired for the project, this was completed between the dates of the 3rd March and the 14th March.

1.1 Geographic Location

The Jonothon 3D was located in the north eastern corner of South Australia, only one campsite was utilised for the entire survey. The camp was located on the Keleary Road which ran through the prospect in a north/south direction, Camp Coordinates were: Latitude 27° 16' 30" Longitude 140° 40' 37".

The survey was conducted in the Marqualpie dune field land system, which is generally comprised of low crescent and semi-circle shaped irregular sand ridges, showing an overall north-northwest to south-southeast trend.

The Marqualpie Dune Fields which lay within the survey area are associated with the Candradecka and Patchawara Creek systems. The dunes become less distinct in the east and are replaced by undulating sand plains. The land system, particularly the area covered by the seismic survey is dominated by crescent dunes of deep red siliceous sands with minimal clay content. Soils within the swales are variable, with grey cracking clays being common.

The land system has similarities to the Cooper land system, but does not have any connection to the Cooper Creek system. Small clay pans and lakes occur within swales and several watercourses draining the gibber country to the north and east cut through the dune field, including the Montkeleary Creek and Candradecka Creek. Generally drainage tends to be internal to the crescent dunes with some interconnection of dunes where washouts have occurred.

The primary vegetation cover on the dunes is a sparse hummock grassland of lobed spinifex, Sandhill cane grass, rattle-pod and Sandhill wattle. This land system is characterised by multiple floodplain and lake land units, which can be differentiated on the basis of frequency and intensity of flooding. Dunes vary from red siliceous sands to whitish siliceous sands - red dunes are older and may have a clayey core. Pale dunes are recent deposition from the floodplains. Major waterholes are typically present on the main and northwest channels of the Cooper due to post- flooding freshwater pockets with salinity varying both in relation to time since flooding and salt input from saline alluvium or local springs. Soils are pale grey sandy to silty clays.



Photograph 1 Small creek arterial

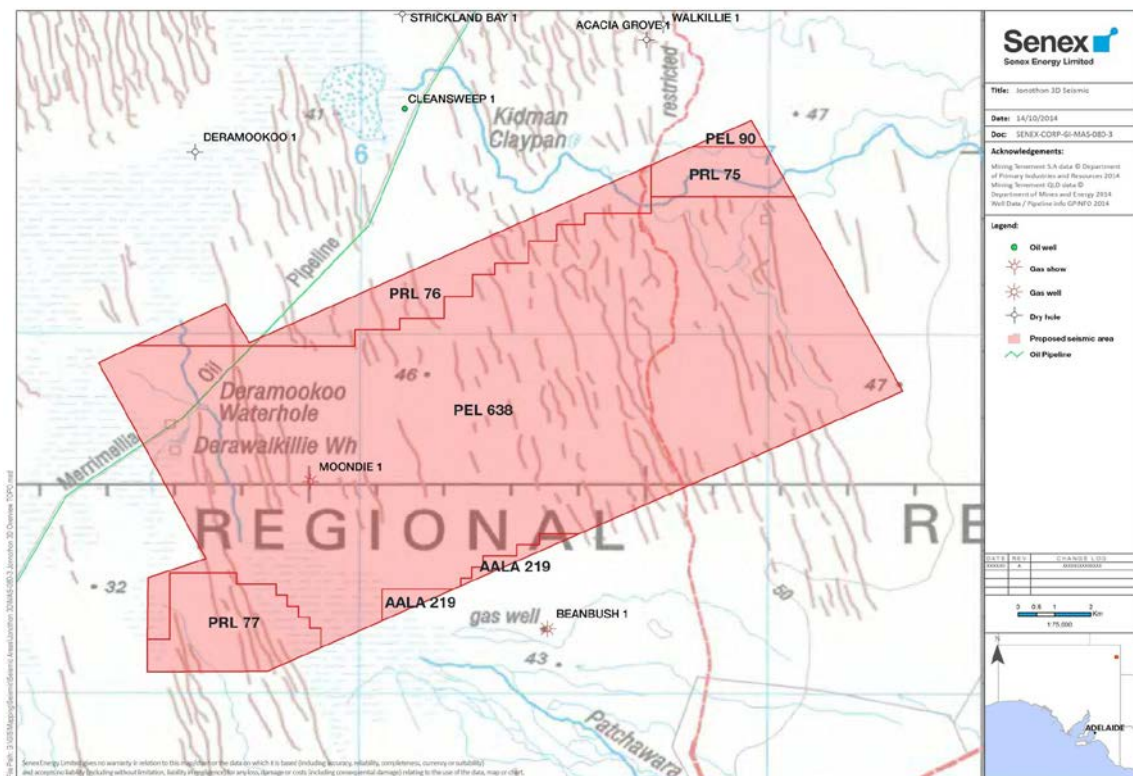


Figure 1 Area Map

1.2 Health, Security, Safety and Environmental

The Senex Energy Jonothon 3D Seismic Survey was conducted between the 1st March and the 17th March, 2015. Crew A2 worked onsite to complete this survey totalling 20,784 man hours, with an additional 17,808 subcontractor man hours.

One incident was recorded for the project and was identified as a non-work related incident.

No LTI, MTI or near misses were reported. 107 hazard identification reports were lodged and 104 closed out. During acquisition there were a total of 183 hours of training, 405.9 hours of toolbox meetings and 8 audits/inspections. 1356 alcohol tests were conducted with 1 positive result. 5,834 km's were driven by the crew with 2 breaches recorded.

Refer to Appendix E - HSE – Jonothon 3D End of Contract Report for additional information.

1.3 Climatic Conditions

Average Minimum Temperature:	26 degrees
Average Maximum Temperature:	37 degrees
Days lost due to wet weather:	Zero
Rainfall:	Zero mm

1.4 Logistics

The survey crew mobilised from Eromanga, Queensland on the 1st March 2015 and arrived at the Jonothon 3D prospect the same day.

Crew A2's mobile camp consisted of a fully equipped kitchen with two Chefs & kitchen hand, a diner seating 20 persons comfortably and a fully equipped laundry & shower block. A toilet block with five single units & storage tank inside the trailer, fully equipped workshop with two mechanics & supply driver, and a dual skin 24,000ltr bunted fuel pod to service all vehicles.

Twin generators and 26,000 ltrs of combined storage tanks for potable & raw water, plus 2 x 10,000 ltr water trucks for supply.

The camp is equipped with 13 x Vans, 9 of which sleep 6 x personnel and 1 x lunch van, 3 x office vans with bunks for Crew manager, HSE & Client. Full camp accommodating 60 x personnel, refer Photograph 2.

Fuel was obtained from Puma Energy located in Brisbane and was transported to site by Direct Fuel Services, approximately 25,000ltrs every ten days.

Potable water was obtained from the Santos Moomba facility and was collected by our water trucks onsite, approximately 15,000ltrs every second day. Food was from PFD Adelaide and delivered by KJM transport to site. KJM also removed our septic and grey water waste, requiring tankers every 6 days removing approximately 30-35,000ltrs.

Upon completion of the Senex Jonothon 3D the crew mobilised to the Senex Mudrangie 3D.



Photograph 2 Seismic Camp

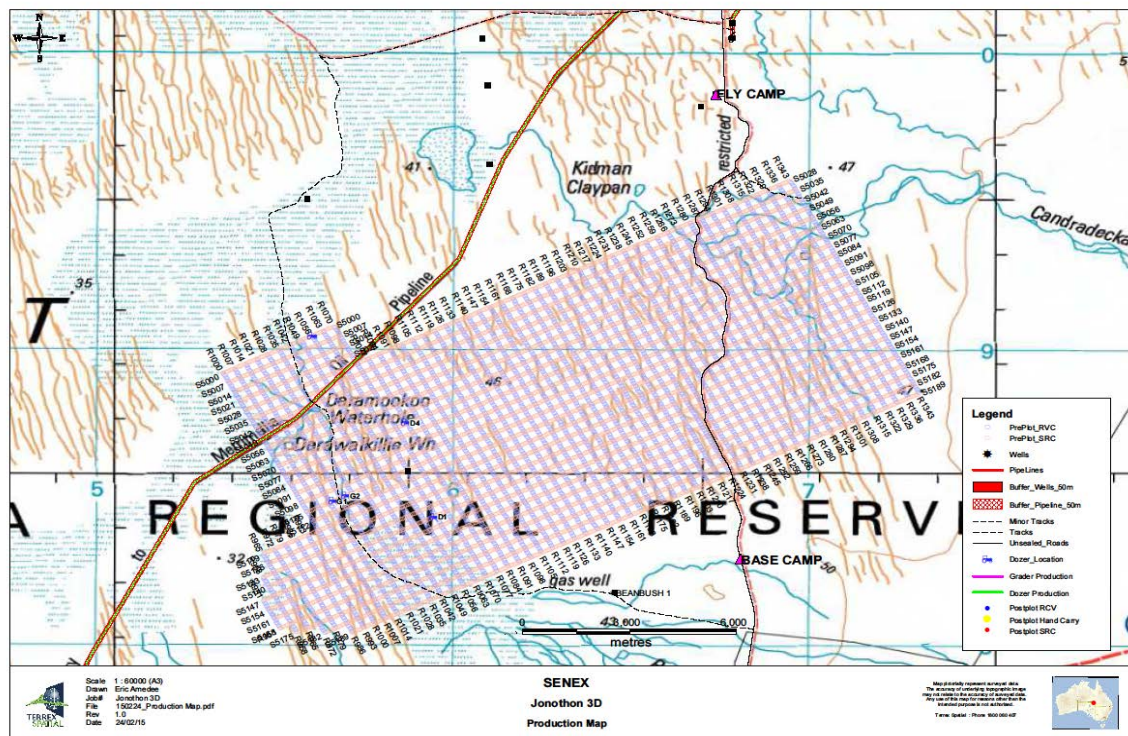


Figure 2 Survey Map

2. SURVEYING

2.1 Line Pointing/Chaining/Surveying

Line pointing & survey services were provided by Terrex Spatial.

Terrex Spatial mobilised to site on the 5th of February where for the next two days they helped setup camp and completed inductions. On the 8th of February pegging commenced after Terrex Contracting cleared approx. 7.1 km the previous day. Pegging was completed on the 7th of March and personnel demobilised the same day to the next Senex prospect of Mudrangie 3D. No problems were encountered with the surveying of this program.

Refer to Appendix D - Terrex Spatial – Jonothon 3D Final Report for additional information.

Table 1 Terrex Spatial Personnel

Crew Member	Position
Jim Cagney	Project Manager
Dean Hausmann	Project Manager
Steve Foley	Senior Surveyor
Andrew James	Surveyor
Darren Kam	Surveyor
Fraser Pichon	Surveyor
Eric Amedee	Contract Surveyor
Navneet Jain	Surveyor
Andria Gibson	Surveyor
Justin Matthews	Surveyor

2.2 Line Clearing

Line clearing services were provided by Terrex Contracting Crew No. 2.

Daily reporting was completed by TS Advance Party Crew Manager Warren Campbell.

Terrex Contracting mobilised to site on the 4th February and after completing camp setup / inductions started line preparations on the 7th Feb 2015 and completed line preparations on the 5th March 2015.

Table 2 Terrex Contracting Personnel

Crew Member	Position
Robert Pugno	Crew Manager/Operator
Michael Birrer	Operator
Brad Makejev	Operator/Offsider
Guy Cato	Operator/Offsider
Paul Malmstrom	Operator
Robert Talbot	Operator
Jimmy Hawthorn	Operator

2.3 Production figures

	Terrex Spatial	Terrex Contracting
Range of Kms/day:	1.6 > 66.9	2.4 > 33.928
Average Kms/day:	31.5875	32.7574km
Minimum Production:	1.600	2.400km
Maximum Production:	66.900	33.928km
No. of lines:	85	85
Total Days Onsite:	28	30
Total Production Kms:	884.450km	884.450km

3. SERVICES

3.1 Permitting

Permitting services were provided by Client.

No problems were encountered with land access or permitting throughout the project.

3.2 Fencing

Fencing services were carried out by Client Rep: Steve Munro

Rewiring drop fences & existing gates that needed repairs.

3.3 Paramedic

The Client provided Paramedic services for the survey, Senex engaged Health-Security-Education Paramedics services.

A risk assessment determined a paramedic was needed onsite when the nearest medical establishment was over 1 hour travel away. The paramedic provides a higher level of medical aptitude than previously on remote crews and could provide essential first response treatment to any medical emergency.

3.4 Traffic Control

Traffic Control Services were not needed on the Jonothon 3D project,

Terrex provided and displayed the appropriate signage, where cables crossed the Keleary Road.

3.5 Client Representative

The Client Representative for this survey was Steve Munro from Senex.



Photograph 3 Fully Equipped Paramedic Vehicle in Field



Photograph 4 Vibrators in production crossing Keleary Road



Photograph 5 Cable truck laying out spread

4. RECORDING/PROCESSING

The Recording crew worked with 7500 channels infield, this was sufficient to record the prospect as a single panel and enable free spread movement and not hinder recording time. Two fleets of Vibrators x 2 were utilised using sand tyres over the entire prospect, the survey was recorded efficiently because of the easy access throughout the prospect, Line crew and Vibrators were only hindered by large soft sand dunes in certain areas of the prospect.

The survey was recorded with peg less source lines, the Vibrators encountered a few issues with the guidance systems at first, then progressed well throughout the rest of the survey with Dean Hausmann (Terrex Spatial) helping improve & setup the system to eliminate any further problems, Dean fitted the Omni Star guidance system to the scout vehicles & trained the Vibrator Operators in gaining accurate source points & QC of recorded positions.

There was minimal hand carry areas across the prospect and only one pipeline that went through the North Western part of the grid, with only one access over the pipeline on an already existing track.

4.1 General Survey Details

Survey:	Jonothon 3D
Survey Location:	PEL638, AAL221
Total Kms/Sq. Kms:	153 Sq. Kms
AFE Code:	PEL638 – AAL221

4.2 Cable Field Recording

Instruments:	Sercel 428
No. Channels:	2688
Tape Drives:	LTO
Tape Format:	SEGD
Filters:	0.8 Nyquist Linear Phase
Sample Interval:	2 ms
Record Length:	4 secs
RTC:	Yes
Correlation Type:	After Stack
Stack:	Diversity Stack

Source Specifications

Vibrators:	Two x 2 Groups x AHV-IV Buggy mounted
Electronics:	Sercel VE464
Sweep Frequency:	4-80Hz
Sweep Length:	8
No. Sweeps:	1
VP Interval:	50m
Vibrator Array:	2 inline – 12.5m Pad to Pad
Sweep Amplitude Taper:	100% (none)

Drive Level:	Force Control on – 80% Peak Force
End Tapers (cosine) (s):	250 ms
Phase Locking Type:	Ground Force Phase lock

Receivers

Receiver Group Interval:	50m
Spread:	16 lines of 168 Channels, patch 8400m inline x 5600m cross line
Array:	12 phones over 45.83m (4.16m spacing) centered on station
Connection:	2 x 6 Packs, wired 3 x 2 series/parallel
Multiplicity:	96

3D Grid Design

Receiver Line Interval:	350m
Number of Receiver Lines	16
Source Line Interval	350m
In Line Fold	12
Cross Line Fold	8

4.3 3D Recording

4.3.1 Panel 1

The Jonothon 3D was recorded in one single panel starting in the north east and heading south west with 2 x 2 fleets of vibrators.

Swath 1

Recording started on the 3rd March 2015, at station S5028/R1343 for a total of 169 VPs/2.251 Sq km. Line crew continued initial layout and had to negotiate large soft dunes.

Swath 2-6

Recording continued on the 4th March for a total of 838 VPs/14.33 Sq km.

Production was steady with a few instrument problems & field crew continued layout across the Keleary Rd safely.

Swath 7-13

Recording continued on the 5th March, for a total of 980 VPs/16.76 Sq km. The Vibrators negotiated the Keleary Road crossings utilising the scouts with road signage in place.

Swath 11-19

Recording continued on the 6th March, for a total of 926 VPs/15.83 Sq km. Good production staying consistent.

Swath 17-23

Recording continued on the 7th March, for a total of 824 VPs/14.09 Sq km. A few instrument problems in the vibes caused the production to decrease slightly with only one fleet operating.

Swath 21-27

Recording continued on the 8th March, for a total of 700 VPs/11.97 Sq km. Only one fleet was in production for most of the day, new instrument arrived and was fitted in vibe 4.

Swath 26-31

Recording continued on the 9th March, for a total of 670 VPs/11.45 Sq km. Electrical issues on the vibrators hindered production for most of the day, repairs complete.

Swath 29-37

Recording continued on the 10th march, for a total of 911 VPs/15.58 Sq km. Production was good and crew performed a field drill which was very well executed by all.

Swath 35-41

Recording continued on the 11th March, for a total of 860 VPs/14.70 Sq km. Production stayed consistent, line crew completed spread layout on prospect and started loading gear at staging area.

Swath 40-47

Recording continued on the 12th March, for a total of 881 VPs/15.07 Sq km. Good production again today and line crew continued loading gear.

Swath 46-56

Recording continued on the 13th March, for a total of 1077 VPs/18.42 Sq km. Great production from all field crew, continued loading gear.

Swath 52-56

Recording continued and was completed on the 14th March for a total of 98 VPs/1.6 Sq km.

4.4 Crew Performance

Terrex Seismic Crew A2 performed extremely well, they negotiated all hazards with safety first in mind & concentrated on their tasks. The crew continually presented HIR and Take Five cards to better improve awareness of hazards and communicate the importance of driving to the conditions and wearing the right PPE for the tasks at hand.

Their work performance and communication skills overall was very impressive, with continued supportive comments at toolbox meetings from the Client Representative and Management.

5. QUALITY CONTROL

5.1 Observer Comments

Line crew were laying out gear and hardwires recorded and processed before production commenced on the afternoon of the 3rd of March with 169 VPs recorded.

The recording rate was fairly consistent with a daily average of 745 VPs/day being acquired.

There were a couple of reboots required in the recorder usually because of lost comms with the 464. Also vibrator #4 had a lot of problems ranging from TDMA, Wi-Fi, and bad sweeps.

Apart from this, the job went smoothly with a very easy panel design, no headaches at all.

Line crew, once again, worked well together considering we had amalgamated two crews into one. Morale was generally high.

On the morning of the 14th March recording was completed and retrieval of line gear commenced.

5.2 Infield QC

The In-Field QC unit worked as an integral part of the crew and coordinated data flows between the different units on the crew during the seismic operation. The dataset was acquired between 3rd and 14th March, 2015.

The In-Field QC unit performed the quality control of data and seismic processing on a daily basis. The unit was responsible for checking the seismic data and associated coordinates files for data verification, geometry, noise and overall seismic quality. Field stacks were generated on a daily basis for the various surveys to show the preliminary results were meeting the client's objectives.

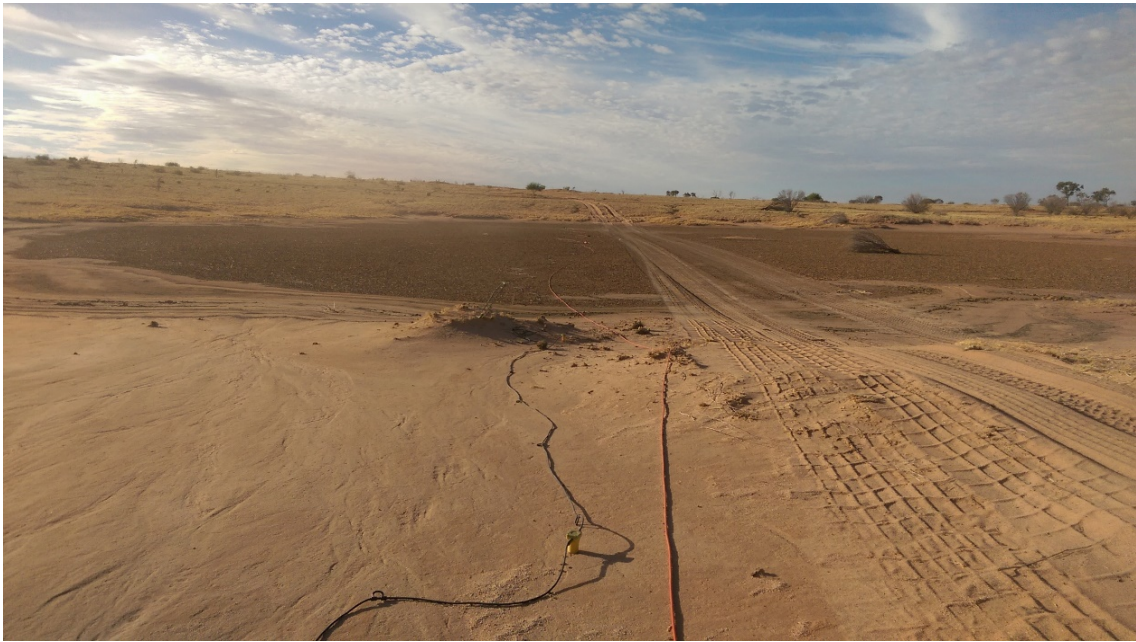
In addition to data checking, the unit was responsible for the shipments of data to client's nominated addresses.

5.2.1 Survey Location

The Jonothon 3D Seismic Survey is located in tenement PEL638, AAL221 within the productive Cooper Basin in north-western South Australia, some 55 km north of Innamincka and approximately 100 km north of Moomba, South Australia. The area is adjacent near the Cordillo unsealed road to the Innamincka settlement.

The land in the seismic survey area consists of sand dunes with flat areas of halite clay pans from old lake beds.

The survey is detailed in the map in **Error! Reference source not found.** and comprised a subsurface area totalling 153 Sq. Kms with 8,743 receiver stations and 8,931 source stations in the final dataset.



Photograph 6 Receiver line over dried lake area



Photograph 7 Prospect area showing a source line, dried lake, sand dunes and vegetation



Photograph 8 Prospect area along source line with bushes and sand dune ridge on the horizon



Photograph 9 Vibrators on the traverse, typical sandy ground and foreground vegetation



Figure 3 Map of survey areas overlain a satellite imagery. (Inset: general location in Australia).

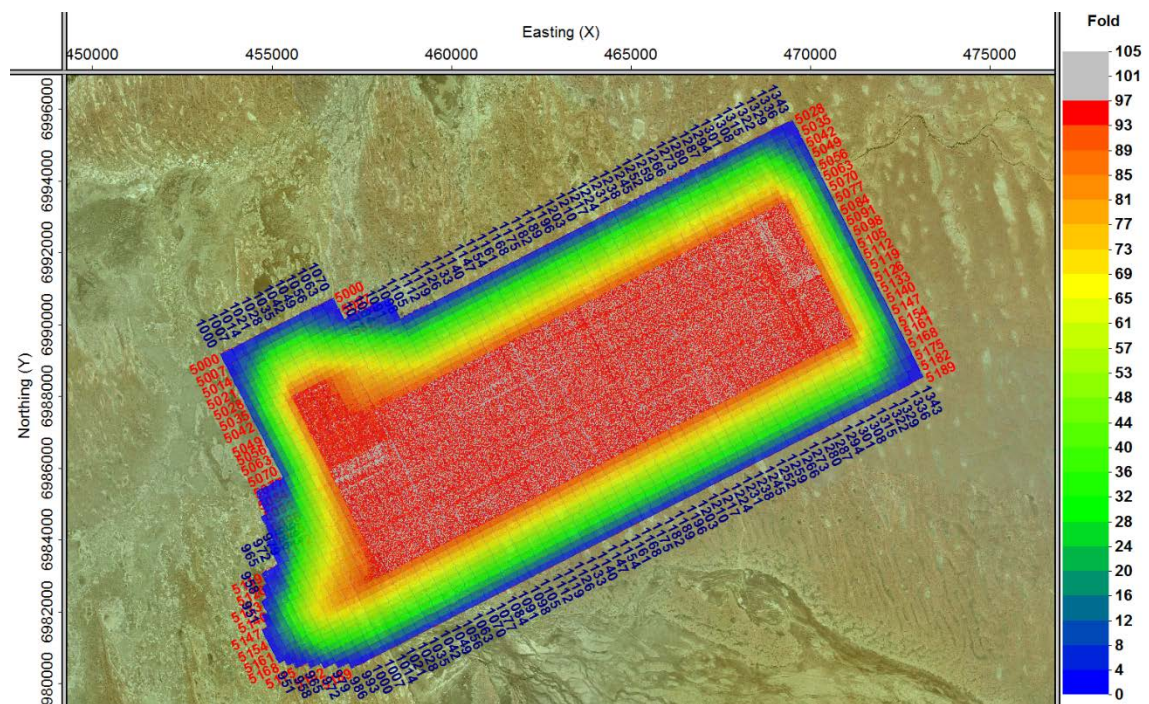


Figure 4 Fold coverage map showing maximum fold generated in OMNI using final SPS coordinates, all offsets (grey - above target fold)

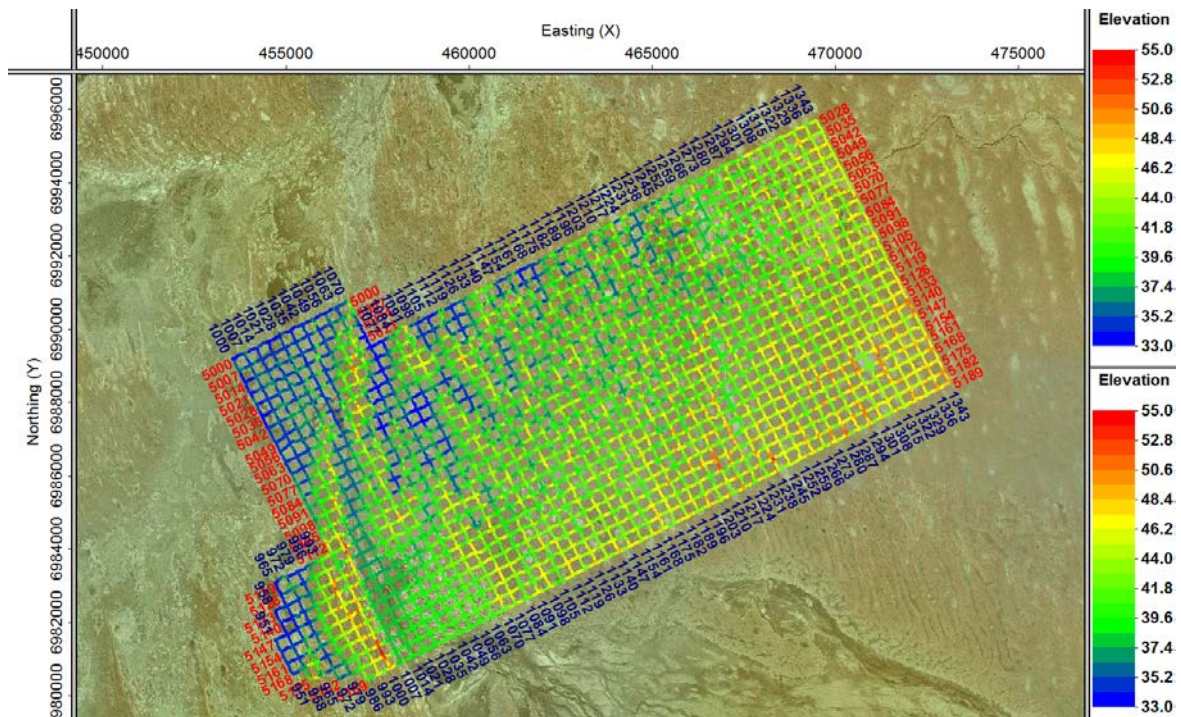


Figure 5 Source and receiver stations, coloured by elevation, from final SPS data

5.3 Personnel

The In-Field QC unit was staffed by a Senior In-Field Geophysicist and was supported by Senior Geophysicists based in Terrex Seismic offices in Brisbane and Perth. The staff involved in the quality control and processing of data in this project are listed in Table 3.

Table 3 QC Personnel involved in the Project

Name	Duration Dates
Kyle Sterry	1 st to 16 th March, 2015
Richard Barnwell	Support from Brisbane
Geoffrey Dunn	Support from Perth

5.4 Equipment

The QC unit operated out of a dedicated data processing trailer located on crew. The hardware is secured with shock mounts and straps to facilitate easy mobilisation, the main components are detailed in Table 4.

Table 4 QC Unit hardware listing

Number	Item Description
1	High specification processing system: 1x Hewlett Packard z800 dual-CPU (16 cores) workstation, Red Hat Enterprise Linux v6.5, 64 GB RAM 1x Hewlett Packard Core i7 4700MQ (8 cores) laptop, Windows 7 Professional, 16 GB RAM
3	24" widescreen monitors
1	Brother J6910DW A3 colour inkjet multifunction printer
1	Gigabit (1GbE) network switch
1	3.0 kVA UPS



Photograph 10 Portable In-Field QC unit equipment and office

5.5 Software

The main geophysical, technical and spatial software components are listed in Table 5.

Table 5 Software

Software	Version	Purpose
Claritas	v6.1.1.11060	Data processing and seismic QC
OMNI	v14.001	Survey design and planning
Global Mapper	v12.02	Manipulating spatial data
Copy+	v3.1.0 RHEL	Recording and verifying data to tapes
Testif-I	v2.05	Instruments and Vibrator performance analysis tool

Claritas is the processing software used to import, analyse raw seismic data, and geometry using imported SPS files. It is also used to generate field stacks and export geometry applied data in SEG Y format.

OMNI is used to analyse pre-plot (pre-surveyed positioning) spatial data, import surveyed data, edit or move stations, add infill stations, generate recording scripts (set of computer instructions for the recording system on spread geometry for each shot point).

Global Mapper is a mapping package that is used to import a variety of spatial data set types, to generate maps and to process and reformat spatial data to be used in other packages such as OMNI.

Copy+ is used to read, write and verify data to and from tapes.

Testif-I is used to independently verify that instruments (geophones, field cables) and vibrators are performing to specifications and high standards.

5.6 In-Field QC Processes

The schematic in Figure 6 outlines the interaction and data flows between the QC department and the other crew operations.

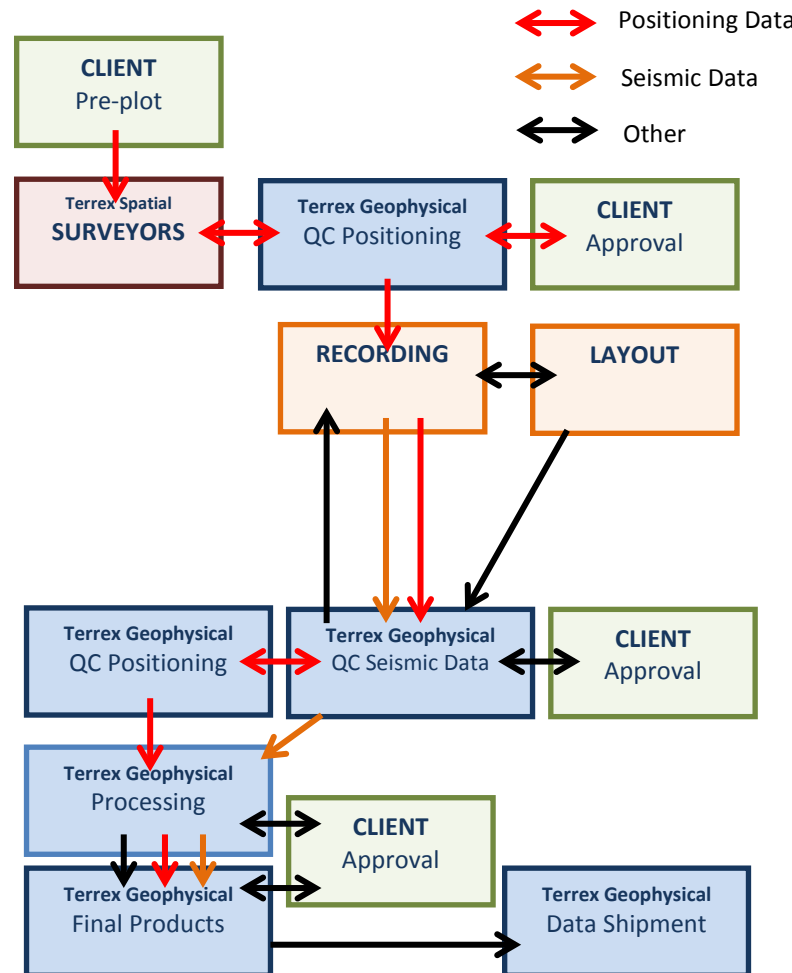


Figure 6 In-Field QC process diagram

The main responsibilities of the in-field QC unit are as follows:

- Maintaining the contracted geophysical specifications from the client**
 This included regular field visits to the line crews, vibrator fleet and the recorder, liaison with the client representatives on matters concerning the project's design, fold coverage, daily progress, data quality and compliance of the acquired seismic data with the contractual specifications.
- Generating acquisition progress data**
 Generation of daily progress map, daily production statistics such as swaths, production count and ranges
- Generation of recording scripts**
 A set of instructions with coordinates and spread geometry for the recording system and vibrator control and positioning.
- Quality control of the seismic, coordinates and support data**
 Including the analysis and processing of the co-ordinate data to generate a final corrected data set, and the analysis of the seismic data to identify and correct any issues.

- Processing data to Field Stacks**
 Using the final co-ordinates the data was processed to generate a field stack. Along with a first look at the processed data, these stacks provide additional quality control along with additional information such as first pass velocities for the processing centre.
- Generation and shipment of final data products**
 To the processing centre for the final processing, the client for data archival along with the provision of test data and field stacks for further client assessment
- HSE Compliance**
 The In-Field QC unit are heavily involved in the HSE programme of the crew with personnel attending the daily HSE toolbox meetings, operational meetings, weekly Safety Sunday sessions, reporting hazards, near-misses and Take 5s using Terrex Seismic's reporting system.

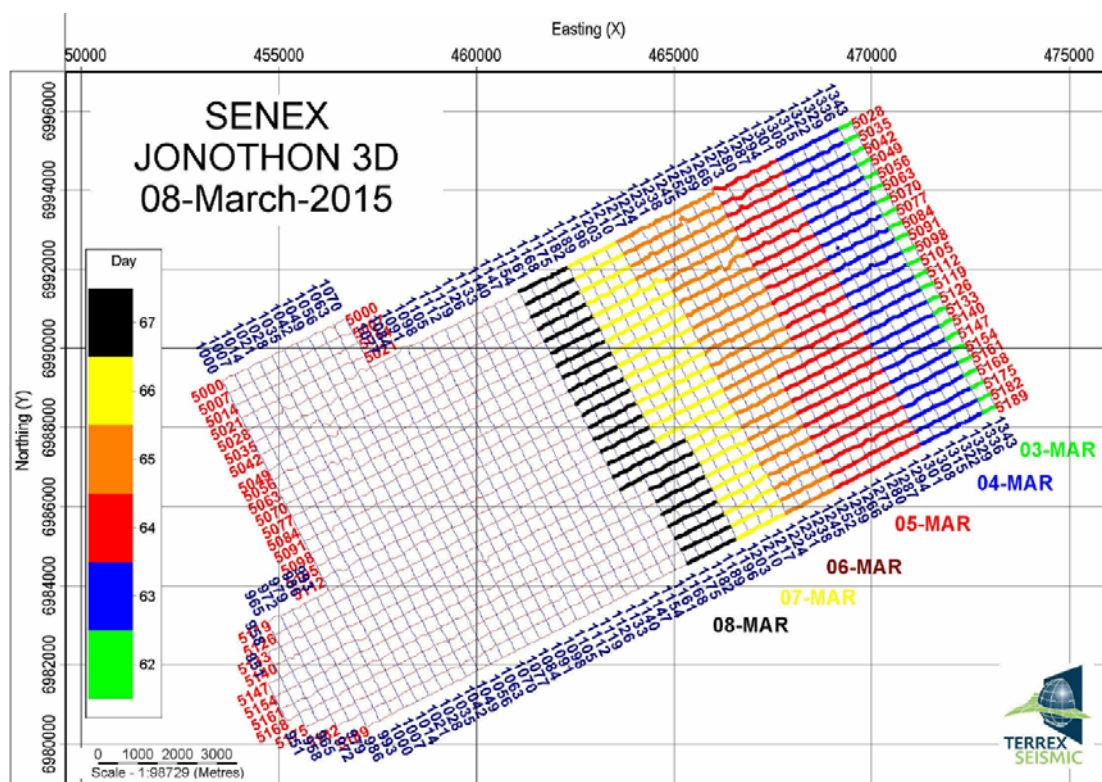


Figure 7 An example of the daily progress map produced by the In-Field unit

5.7 Project Start-Up

5.7.1 Acquisition Parameters Tests

On a previous seismic survey completed for the client a week before this project (Bauhaus 3D), a number of hardware (vibrator similarity) tests were conducted to determine the optimum starting taper lengths for the client's proposed eight seconds 3-80 Hz linear sweep with a 200 ms start taper and an eight-second 4-80 Hz linear sweep with a 250 ms start taper.

Tests were conducted from 200 to 500 ms in 50 ms increments and processed in Testif-I software, an industry standard tool for analysing hardware results. The results were included in that project report. The In-Field Unit recommended 500ms for the 3-80 Hz sweep and 400 ms for the 4-80 Hz sweep. Refer to the Bauhaus 3D report for more details.

A 250ms start and end taper was selected for production.

5.7.2 Recording Parameters

The recording parameters described in the tables below.

Table 6 Source parameter used in production

Parameter	Description
Energy Source	Two I/O AHV-IV Commander vibrator 4x4 buggy, SEG normal polarity
Vibrator Specs	Peak force 60,000 lbs
Acquisition System	Sercel 428 XL
Source Point interval	50 m – Centred on source station: Along 350m source lines orthogonal to the receiver lines.
Vibrator Array	2 vibrators inline
Sweep details	4 –80 Hz linear upswing (V1) 8.0 seconds sweep time
Number of sweeps/VP	1 sweep
Sweep tapers	250 ms start, 250 ms end tapers, cosine
Sweep control	Sercel VE464 (Source Driven) Vibrator Electronics
Accelerometers	Sercel
Vibrator Drive level	Force Control On, 80% Peak Force
Phase Lock	Ground Force Phase Lock

Table 7 Receiver parameters used in production

Parameter	Description
Receiver sensors (G1)	12x 10 Hz SM24 Equivalent Geophones / Group
Receiver Point interval (G1)	50 m
Receiver Array (G1)	In line, 4.16 m spacing
Receiver patch (G1)	Nominal spread: Symmetrical split-spread, 16 lines, 168 channels with roll on/off 350 m receiver line interval
Nominal Fold	96 in 25 m X 25m CDP bins

Table 8 Recording parameters used in production

Parameter	Description						
Acquisition system	Sercel 428 XL – 24 bit telemetry system						
Listening Time	4.0 seconds						
Sample interval	2.0 ms						
Recording filters	<table> <tr> <td>Hi-cut filter</td><td>Out</td></tr> <tr> <td>Low cut filter</td><td>3 Hz</td></tr> <tr> <td>Anti-Alias filter</td><td>200 Hz (80% of Nyquist).</td></tr> </table>	Hi-cut filter	Out	Low cut filter	3 Hz	Anti-Alias filter	200 Hz (80% of Nyquist).
Hi-cut filter	Out						
Low cut filter	3 Hz						
Anti-Alias filter	200 Hz (80% of Nyquist).						
Recording format	SEGD to tape, LTO2						
Recorder processing	None						
Data recorded to tape	<table> <tr> <td>Uncorrelated</td><td>Odd numbered files } On 3rd March, 2015 only</td></tr> <tr> <td>Correlated</td><td>Even numbered files } On 3rd March, 2015 only</td></tr> <tr> <td>Correlated</td><td>From 4th March, 2015 (after FFID 359)</td></tr> </table>	Uncorrelated	Odd numbered files } On 3 rd March, 2015 only	Correlated	Even numbered files } On 3 rd March, 2015 only	Correlated	From 4 th March, 2015 (after FFID 359)
Uncorrelated	Odd numbered files } On 3 rd March, 2015 only						
Correlated	Even numbered files } On 3 rd March, 2015 only						
Correlated	From 4 th March, 2015 (after FFID 359)						

Parameter	Description	
Auxiliary channels	Channel 1	True Reference via aux channel (uncorrelated)
	Channel 2	100 Hz timing reference from VE464
	Channel 3	VE464 timebreak
	Channel 4	Correlation of true reference at 0.5 s
	Channel 5	Correlation of true reference at 3.5 s
	Channel 6	True Reference (digital pilot)

JONOTHON 3D – ACQUISITION GRID

RECEIVERS 350m X 50m
SOURCES 350m X 50m
TRIPLE STAGGER

GRID ORIGIN (GREEN CIRCLE)
DEFINED AT INTERSECTION OF:
FIRST SOURCE LINE : 5000
FIRST RECEIVER LINE : 951

451,387.9 m E
6,988,057.1 m N

MGA : GDA : Zone 54

LAST SOURCE LINE : 5189
LAST RECEIVER LINE : 1343

REC LINE DIR 153 degs
LENGTH 9,500 m

SOURCE LINE DIR 63 degs
LENGTH 19,650 m

ACQUIRED WITH SHOTS AND RECS AT MIDPOINT
LOCATIONS, BUT WITH A STAGGER APPLIED:

PATTERN OF 3 IN THE INLINE DIRECTION:
0m, +16.67m and -16.67m
BOTH SHOT POINTS AND RCVR POINTS

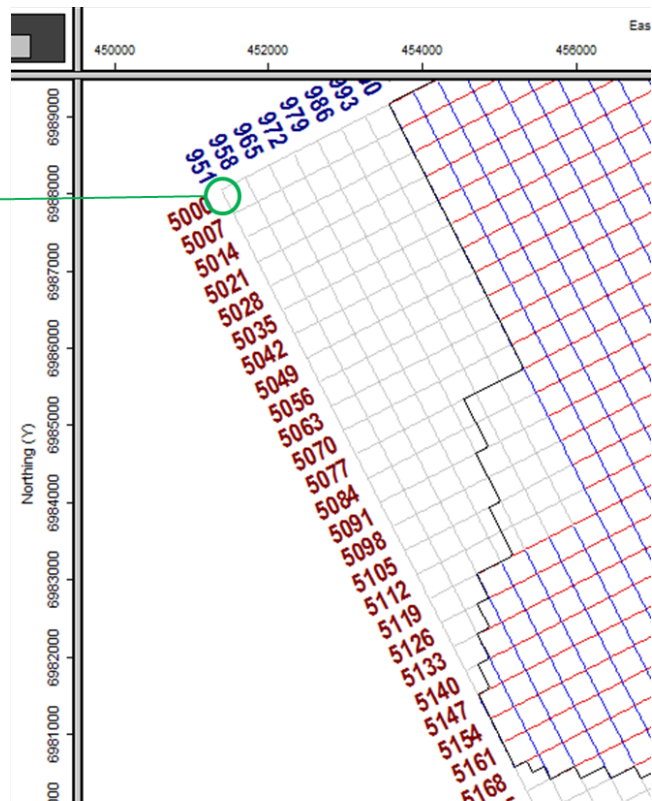


Figure 8 Acquisition Grid definition.

5.8 Data Quality Control

5.8.1 Instruments Testing

As part of the internal QC conducted by observers in the field, a set of standard instrument tests are run prior to each day's production that all the instruments are in working order, as listed in Table 9. All values are well within manufacturer tolerances.

Table 9 Daily instrument tests

	TEST	COMMENTS
1	Gain tests	Maximum error 1.0% gain, 20 μ s phase
2	RMS noise tests	Maximum 0.25 μ V at 12 dB gain, 1600 mV scale
3	Common mode rejection tests	Minimum 100 dB
4	Cross-feed tests	Minimum rejection 110 dB
5	Total Harmonic Distortion tests	Maximum -103 dB
6	Impulse tests	
7	Impedance tests	

5.9 Vibrator Hardwire Similarities

At the start of the job hardwire similarities were conducted on all vibrators that would be in production and processed in Testif-i. Regular testing was conducted thereafter to ensure performance remained within specifications.

It must be said that hardwire tests are very dependent on sweep parameters and ground conditions. Harsh sweep parameters that fall outside the manufacturer specifications for the vibroseis and hard, uneven ground surface will adversely affect the results. An example hardwire test from project startup can be found in Figure 9.

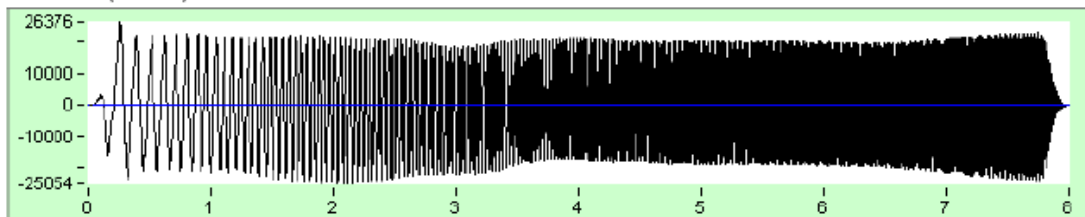
Vibrator Analysis

Terrex Seismic Crew A2
Senex Jonothon 3D

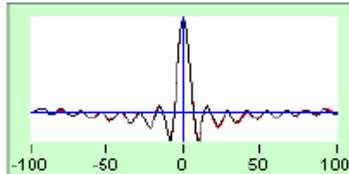
Recorded on 3rd March '15 at 3:27:33 pm
Processed on 3rd March 2015 at 3:25:27 pm

Record to Process <input type="text" value="3"/>	Reference Chan. <input type="text" value="9"/>	Minimum Frequency <input type="text" value="5"/> Hz @ -20 dB	Force Channel <input type="text" value="10"/>
Record Found <input type="text" value="3"/>	Start Time Ref. <input type="text" value="3"/>	Maximum Frequency <input type="text" value="79"/> Hz @ -20 dB	Baseplate Channel <input type="text" value="0"/>
No. Harmonics <input type="text" value="0"/>	Sweep Start (s) <input type="text" value="0.000"/>	Sweep Length (s) <input type="text" value="8.000"/>	Mass Channel <input type="text" value="0"/>
			Vibrator Id. <input type="text" value="Vib 3"/>

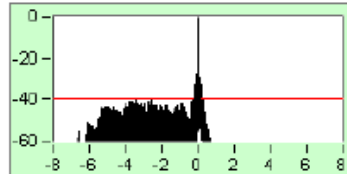
Data Trace (Pounds)



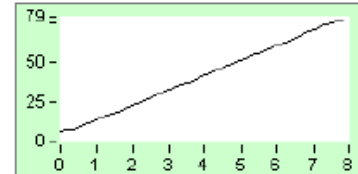
Wavelet (Normalised) v Time (ms)



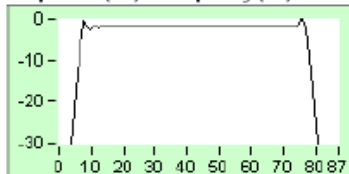
Wavelet (dB) v Time (s)



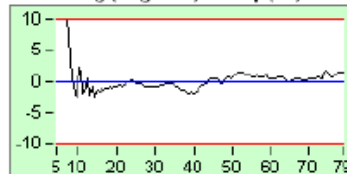
Frequency (Hz) v Time (s)



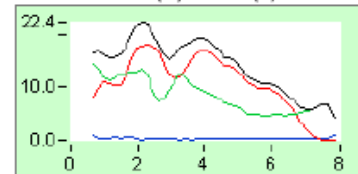
Amplitude (dB) v Frequency (Hz)



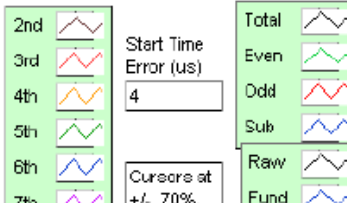
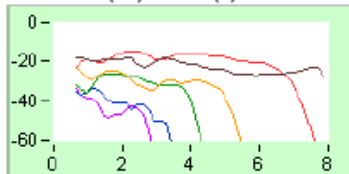
Phase Lag (Degrees) v Freq. (Hz)



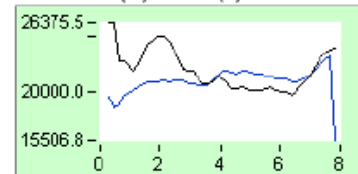
Total Distortion (%) v Time (s)



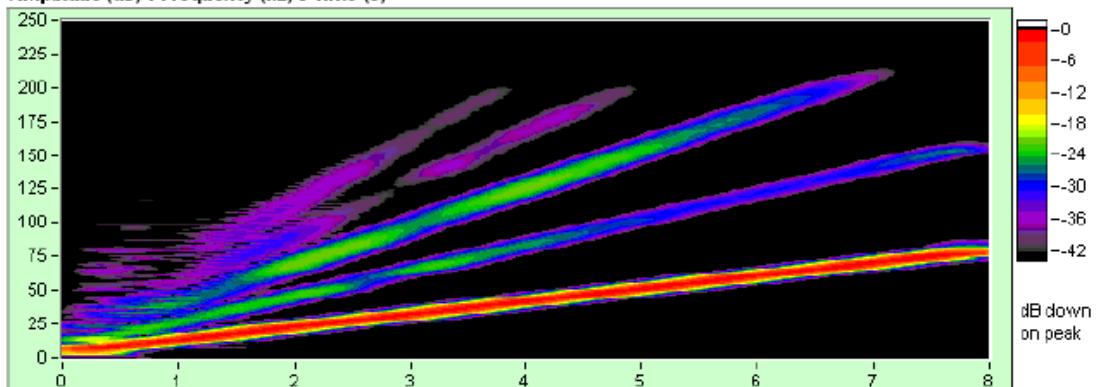
Harmonics (dB) v Time (s)



Peak Force (lb) v Time (s)



Amplitude (dB) v Frequency (Hz) v Time (s)



Test-i Version 2.05, licence 4050009218 next update 3. © Verif-i Ltd.

Figure 9 A hardwire similarity test example

The hardwire test shown in the above example shows a typical example with a typical primary harmonics with low distortions. The distortion levels are kept low and under control after a peak at 2 seconds. This is

seen in across all vibrators and the sweeps were automatically adjusted slightly to respond to the ground conditions. The correlation is very close to the idealised wavelet with a limited amount of positive time noise. The amplitude wavelet shows some undulations after the initial peak caused by the Gibbs effect and is likely due to the short starting taper. The results presented are acceptable.

5.9.1 Geometry Validation

For seismic data processing purposes, the final surveyed elevation data was merged with the source point XY coordinates recorded from the vibrators GPS systems (after validation and correction of any erroneous GPS readings). The receiver's positioning (XY and Z) used surveyed original positioning.

Particular attention was given to this part of the operation as coordinating shots and receivers are critical to the integrity of the acquired seismic data. A well-developed Terrex Geophysical system utilised dedicated seismic positioning software called OMNI, and automated scripts and templates to generate an accurate final SPS dataset containing only valid records. A schematic of the process flow from receipt of data from the recorder, through verification to generation of final corrected SPS files is shown in Figure 10.

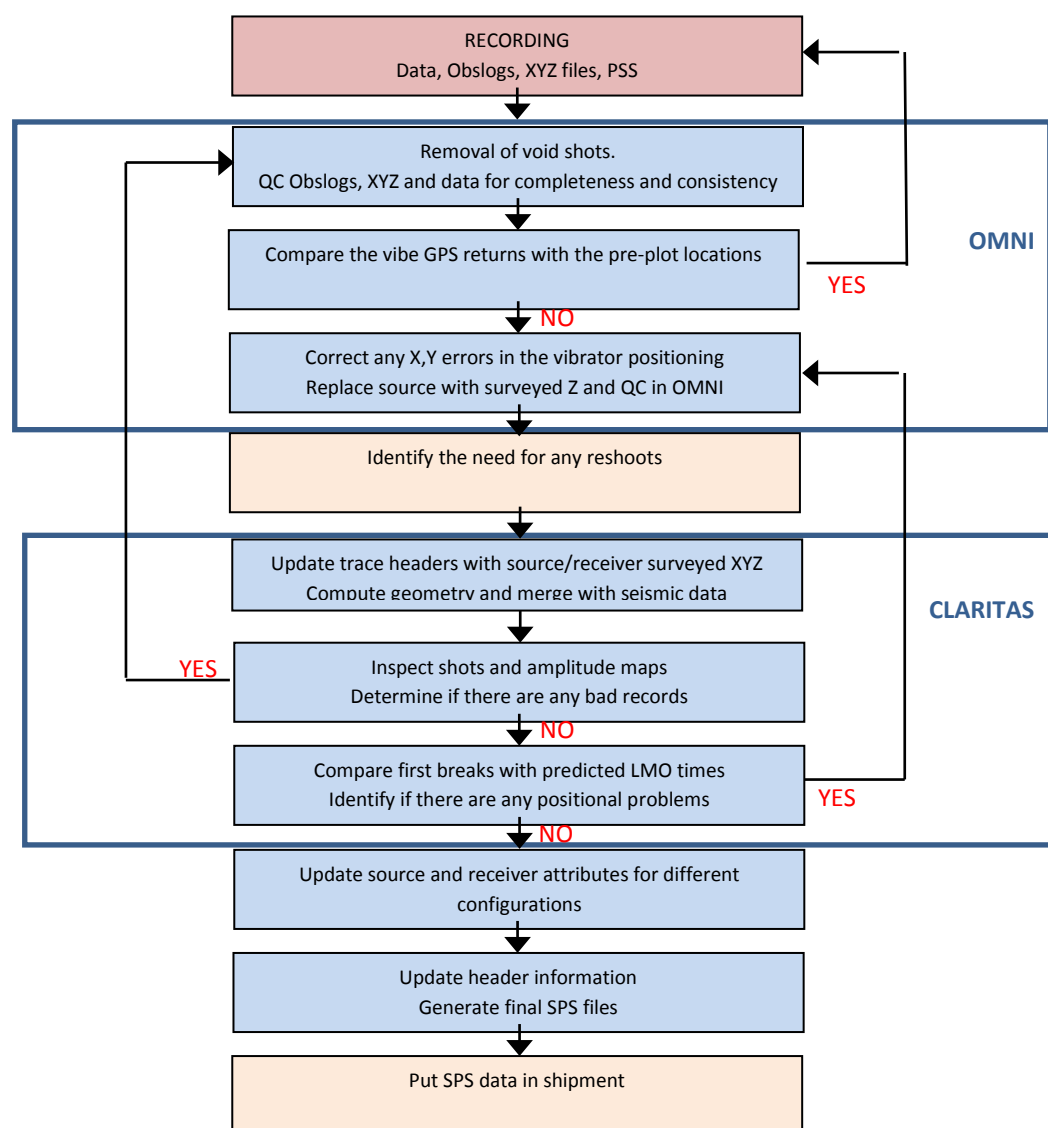


Figure 10 Flowchart of the navigational QC process

Large offsets (>5m) were analysed and checked with comments in the observer logs or with the observers themselves and the source point may be included with a new set of coordinates, a re-surveyed elevation,

reshot or voided with a skip. The comparison of COG co-ordinates with the surveyed source points was conducted both statistically and graphically, as shown in Figure 11.

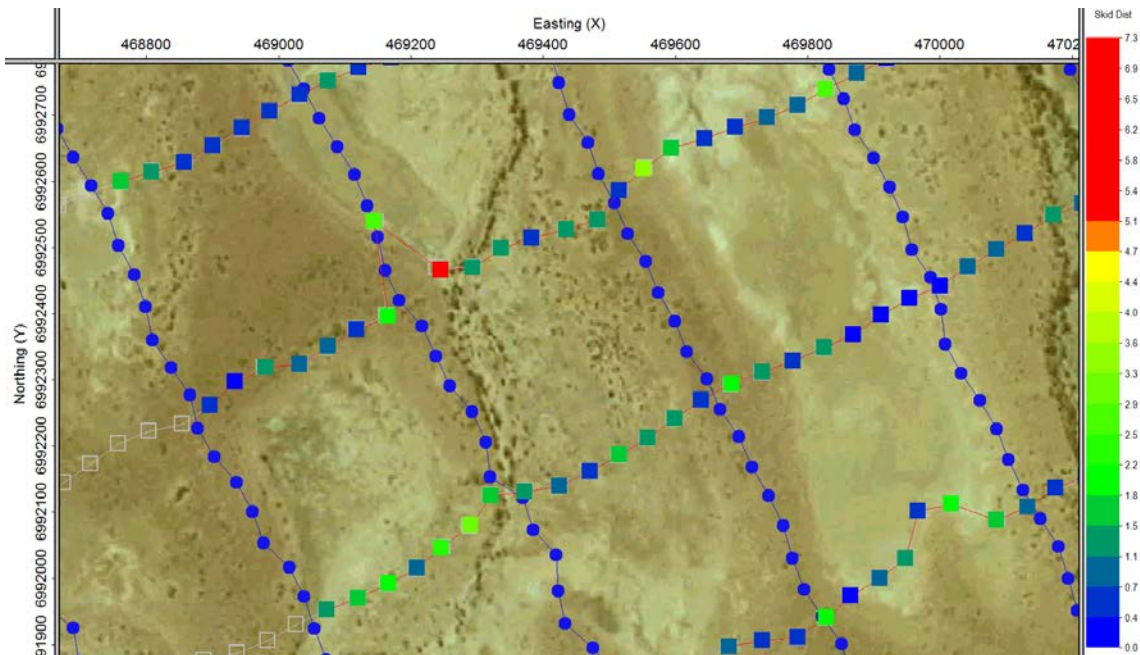


Figure 11 Checking vibrator COG (squares coloured by skid distance (m)) against surveyed positions (grey boxes)

Field seismic data were copied to the Claritas workstation and verified. Raw shots were analysed and seismic data integrity checks were performed promptly after receiving the data. In case of anomalies such as geometry errors, missing shots or below-specification shots, the In-Field QC unit reported the issues to the observers, vibrator technicians and any other relevant personnel before the spread was picked up in order to rectify errors.

The first stage of the data processing includes a quality check of the navigational data. The valid seismic data was merged with the navigation data. Each raw shot is reviewed to identify any noise or data issues, first arrival times are predicted using a constant velocity linear move-out based on the observed moveout of the first breaks and overlaid on the gathers (as shown in Figure 12) to identify any mis-positioning issues. Common source and common receiver stacks of the LMO corrected data are also generated as shown in the examples in Figure 12.

Any mis-positioned sources or receivers or spread errors are identified as timing errors in the LMO displays and the cause is investigated and corrections made to the SPS files and updated in the data prior to the SEG-Y generation and further processing. This ensures the SPS files are correct and matches the seismic data.

All supplied positioning data were delivered in SPS v2.1 format with a full set of descriptive headers which include projection and datum used for the coordinates and elevation data.

It should be noted that the original SEG-D seismic trace headers contain elevation data from the vibrators' GPS system and these should be updated using the supplied SPS files in the data shipment. The SEG-Y files already contain the updated correct elevation from survey and any XY corrections as the supplied SPS files was used to update the trace headers prior to exporting the SEG-Y files.

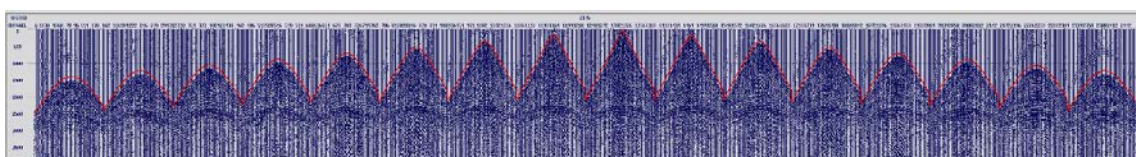


Figure 12 Geometry check

The geometry check image in Figure 12 indicates the first arrivals are coming back at a moderate velocity, speeding up at the mid to far offsets where the recorded event is a strong refraction from a shallow interface, giving a flatter profile. The red line is a velocity profile for a given offset using a velocity setting of 2000 ms^{-1} .

A linear move out scan (LMO) was run to select an optimum velocity and offset range for first breaks analysis, as shown in Figure 13.

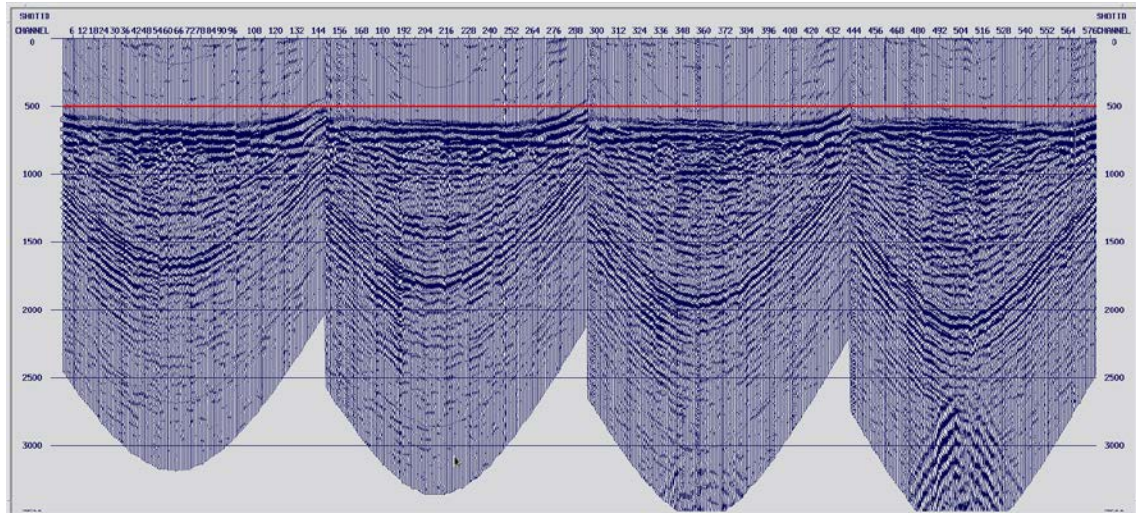


Figure 13 *LMO Flattening Check*

Further geometry checks include LMO receiver stacks and LMO shot stacks to find any misallocated stations, or where stations have been misnumbered for their positions. Occasionally noise and elevation changes can confuse the results. The regular jumps are due to moving from one receiver line to the next with the corresponding change in elevations.

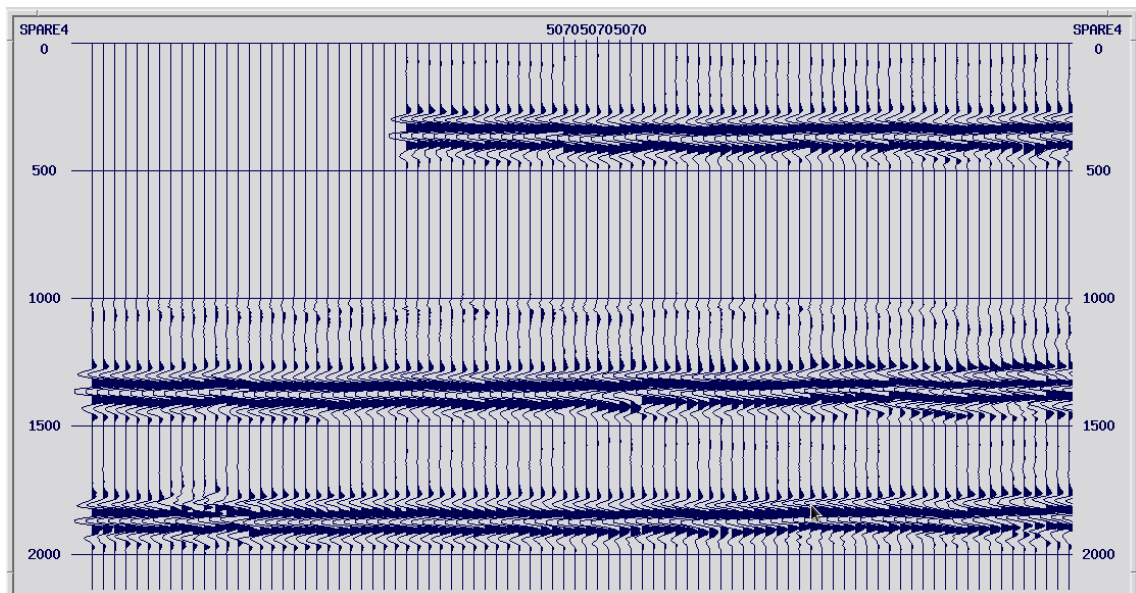


Figure 14 *Example common shot LMO stack*

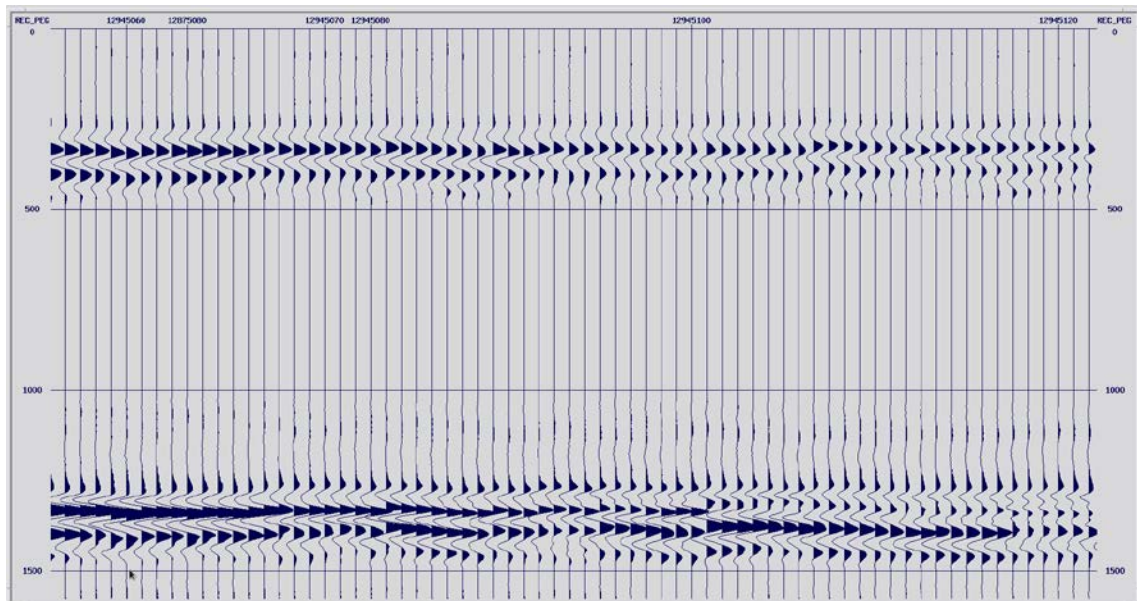


Figure 15 Example common receiver LMO stack

Once the geometry is applied to the traces, the CDP fold is calculated and plotted as shown in Figure 4 on page 15. This is used to confirm that the data is complete and meets the client's specifications. Claritas' geometry application is used to confirm the positions, elevations and CDP numbering.

The 3D perspective view is utilised to display any ambiguities or spikes as shown in Figure 16 and Figure 17 while the CDP fold plot (see Figure 18) ensure there are no unexpected gaps in the data.

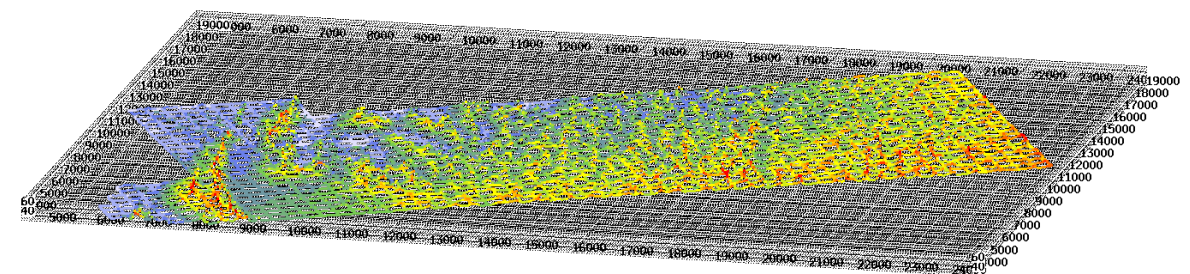


Figure 16 3D perspective view with elevations from the geometry database

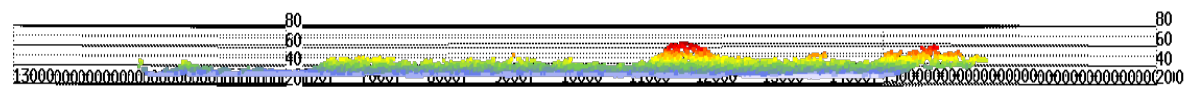


Figure 17 Elevation profile from the geometry database

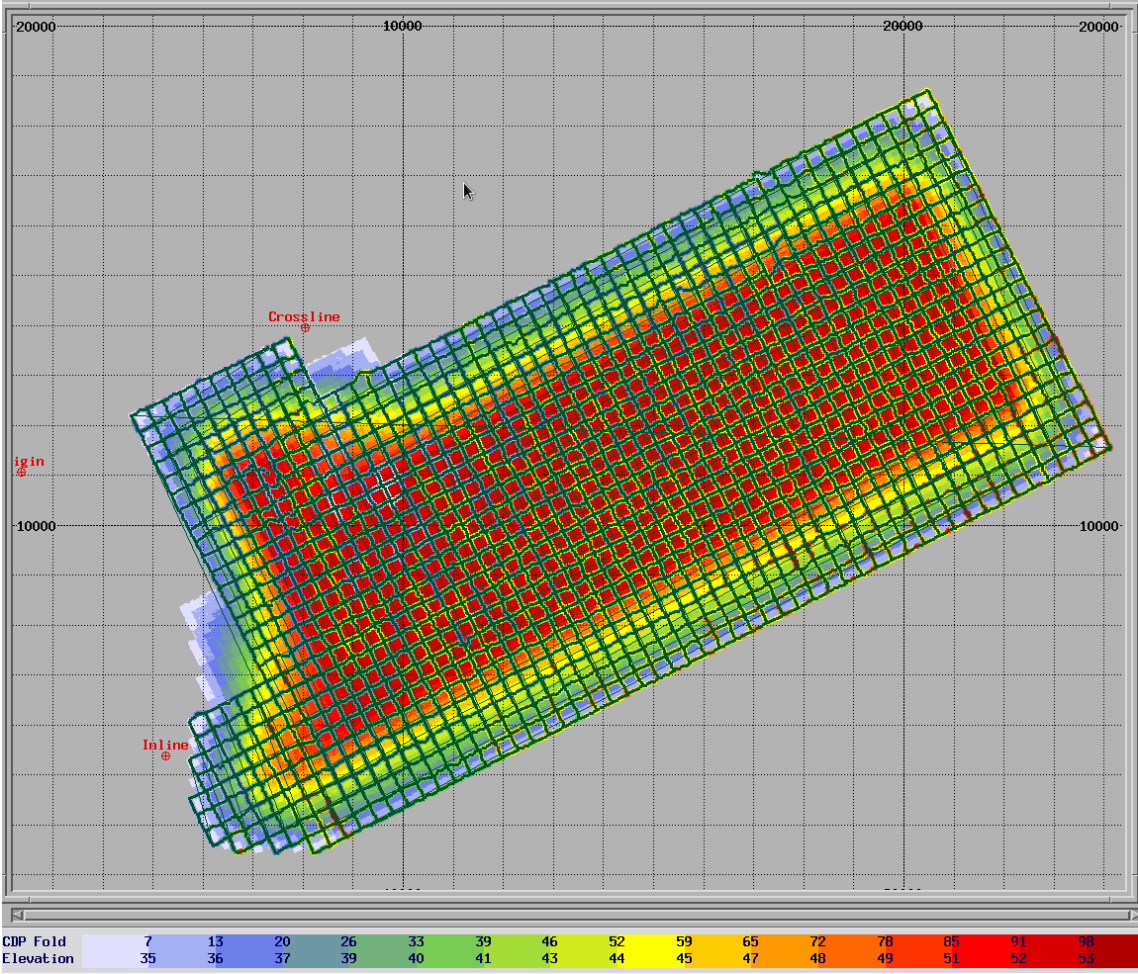


Figure 18 CDP fold plot with elevations from the geometry database

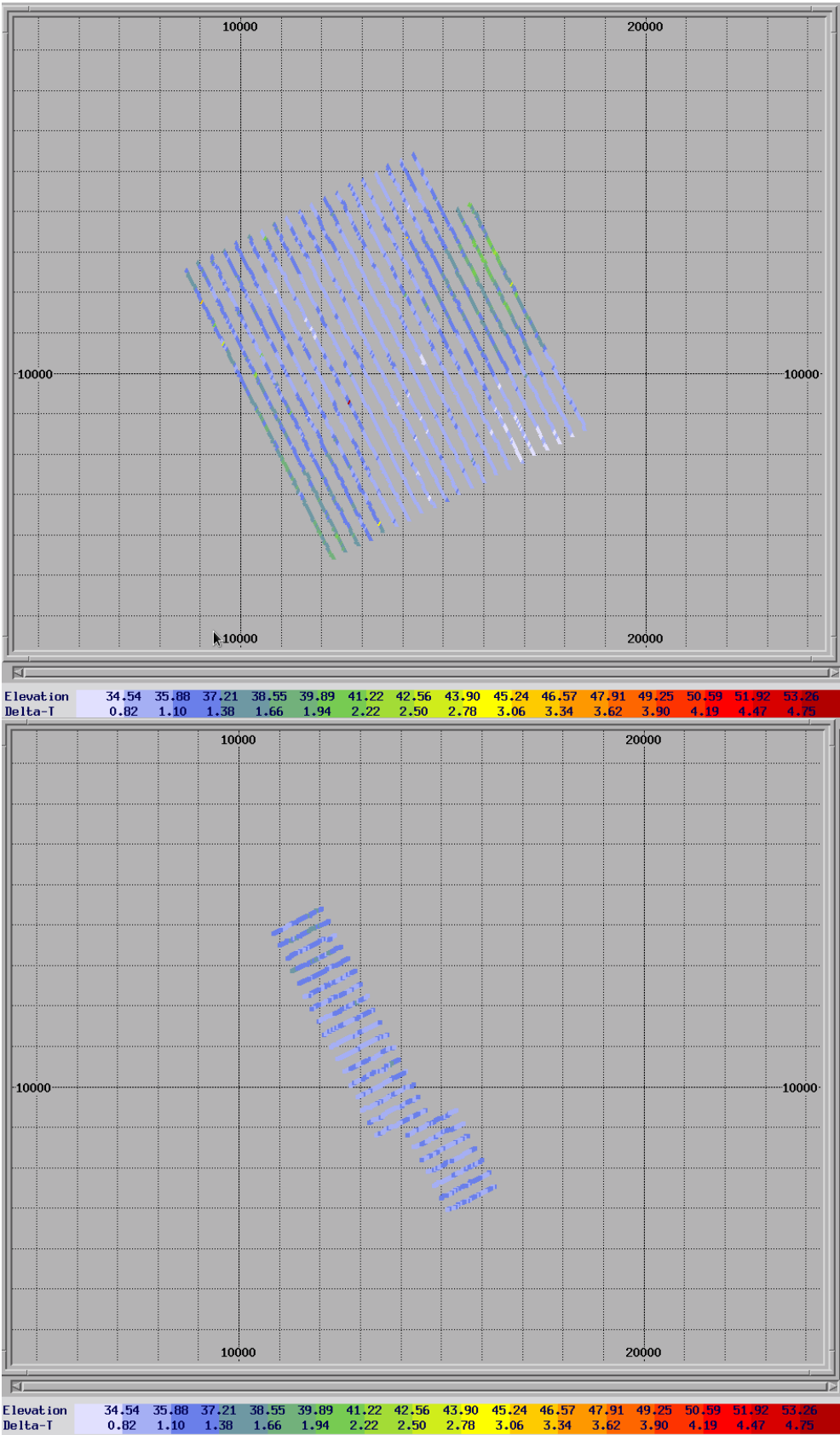


Figure 19 Map of RMS amplitudes of receivers and shots

A RMS map is generated to analyse the source(s) of any noise. A dedicated flow was used to filter out the first breaks and a spherical divergence filter applied to balance the amplitudes, and windowed from 500ms to 3000ms below the first breaks. The average RMS amplitudes were then plotted in separate maps for

source and receivers, see Figure 19. The above example show very limited noise, with exposed ridges receiving more wind noise.

5.9.2 Processing Sequence

The processing sequence applied is detailed in Table 10 and was taken from the test flows produced during the sweep tests prior to the first production shot. The processing commences with the seismic data once the daily SPS files have been validated, corrected (if required) and applied to the data. A schematic flowchart of the data processing is included in Figure 20.

This project was acquired using the Sercel 428 acquisition system, the SEG-D data supplied on tapes do not have any post-recording editing (correlation is automatically applied) and the use of the supplied Obslogs and QCLogs along with the final SPS files are required to utilise the SEG-D raw data. The supporting data was used to create the SEG-Y files; the positions in the RPS, SPS and XPS files correspond to the locations of the data in the SEG-Y files.

Table 10 Processing Sequence and Parameters

Process	Parameters	Comments
PRE-PROCESSING		
Reformat field SEG-D to Claritas internal format (HDF5) Discard Auxiliary traces Make and apply geometry		Remove void files Remove "non-live" traces Using final SPS files Add CDPs to headers
Write to SEG-Y		For shipping to the processing centre
SIGNAL PROCESSING AND DATA CONDITIONING		
FK filter	+ve dip cut off of 25 ms / trace Taper 0.35 of the k-value.	Inside 1000 ms AGC wrapper
Spherical Divergence	Velocity Power: 1.0 TWT Power: 1.0 Scale Factor: 1.5 Offset Power: 0.5	Velocities from NMO file
Trace by trace predictive Deconvolution	Gap: 16 ms Operator Length: 50 ms White noise: 0.1% Manually picked offset dependant design gates	
Sort to CDP order		
VELOCITY AND STATICS MODELLING		
Correction to floating datum	Elevation statics applied to a smoothed datum. Replacement velocity 2000 m/s	
Velocity Analysis	Every 100 CDP Every 50 th Inline	Interactive picks RMS velocities supplied in shipment as Claritas text format

Process	Parameters	Comments
Normal move-out correction	70% stretch	
AGC gain	500 ms window	
Residual Statics, surface consistent	Statics derivation: Apply NMOXcorr Window: 1250 2500 ms Max shift: 8 ms Iterations: 30 Oversample: 4 AGC: 250 ms (model traces)	
GENERATION OF FIELD STACKS		
Stack	Stack with unity normalisation	
Correction from floating to final fixed datum.	Datum elevation 70 m Replacement velocity 2000 m/s	

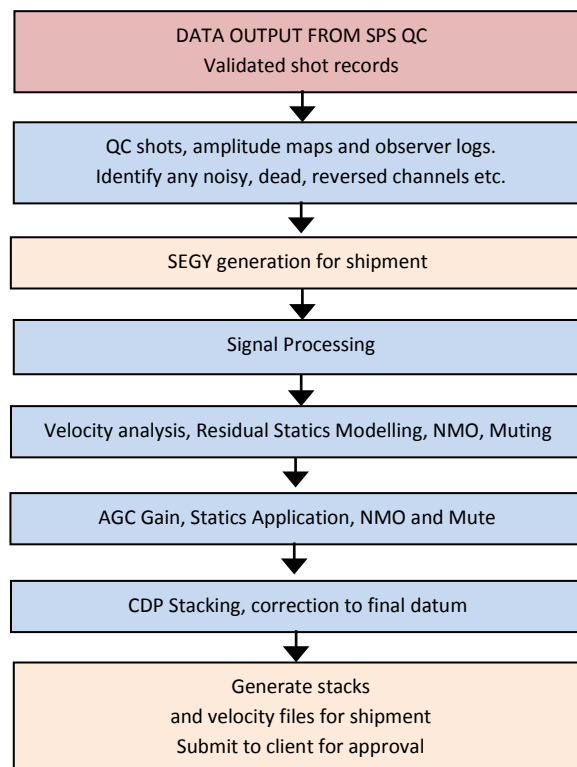


Figure 20 Data Processing Flowchart

5.9.3 Signal Processing

Once the data has been quality checked and any issues addressed, the signal processing steps detailed in Table 10 on page 30 were applied, to balance the data and attenuate unwanted noise and events other than reflections prior to the imaging.

5.9.4 Interactive Velocity Analysis

A velocity analysis was carried out at regular intervals (see Table 10 for interval count) on the data after the application of the signal processing. The velocities of the reflection events along the line were picked, in order to apply a normal move-out correction to account for the differing travel-times to the various offsets recording reflections from the same sub-surface point.

Velocities are picked interactively, by examining a range of analyses as shown in the examples in Figure 21 and Figure 22.

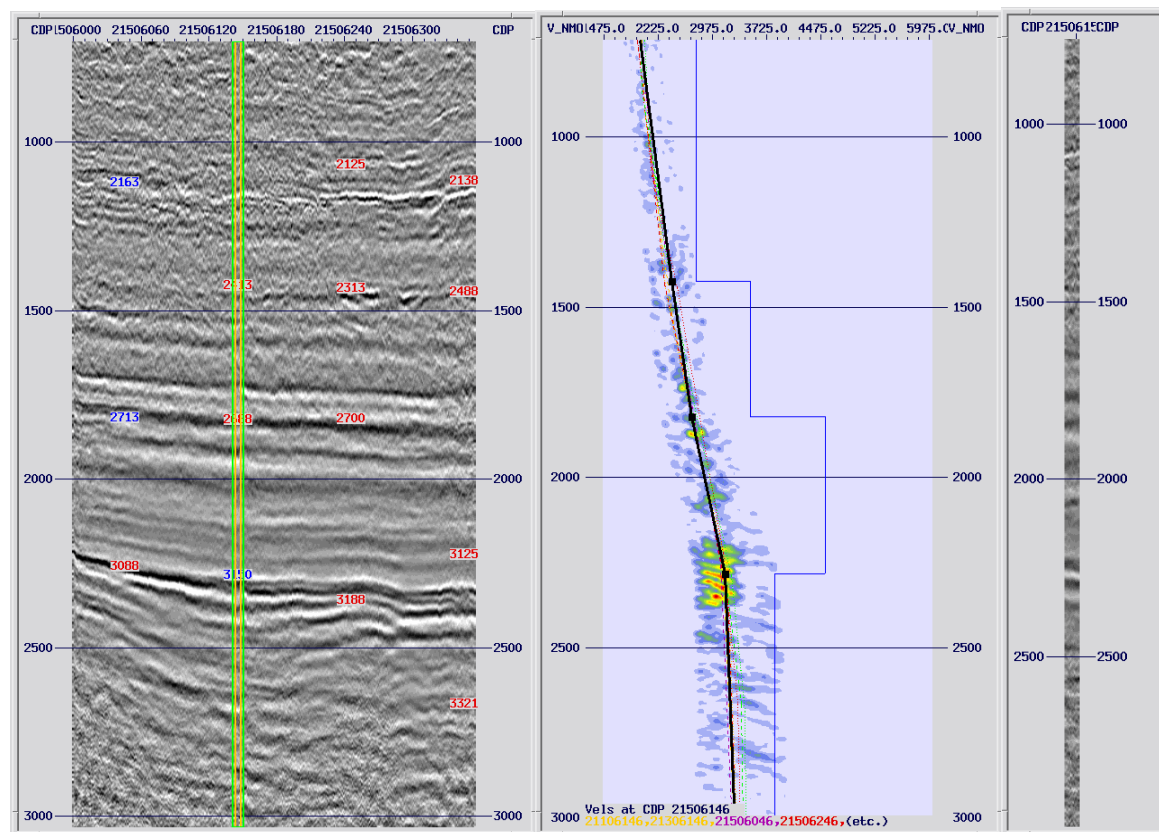


Figure 21 CDP stack, semblance, interactive stacking (left to right)

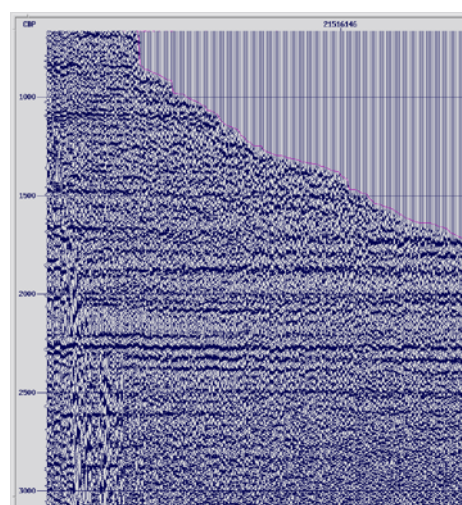


Figure 22 Window showing traces with NMO applied

The velocity analyses, show strong clean reflectors across the offsets within the mute. Well flattened by the first order NMO correction applied. Observable static shifts are consistent within traces and likely due to stations crossing dunes and should respond well to residual statics application.

5.9.5 Field Stack Generation

After the application of the picked velocity field and surface consistent residual statics solution, data with common midpoints are summed to generate the field stacks and screenshots captured daily.

5.10 Project Information

5.10.1 Shipment Specific Information

See combined obslogs and QC logs for comments. All dates and times are in local time (South Australia, Australia).

5.10.2 Daily Production Notes

The In-Field QC unit tracked the production as part of the daily QC processes to ensure all valid data are kept in the final products and match the final combined observer log, final SPS files and SEG Y data. Only the valid shots were counted, and skips are defined as those skipped on the surveyed position, not on the pre-plot design. Ancillary comments are provided and more details were supplied in the data shipment as part of the QC Log. The shooting direction was from high to low numbers.

Table 11 Daily Production Statistics

Date	Julian Day	FFID From	FFID To	Voids	First VP	Last VP	Valid Shots	Skips	Comments
03-Mar-15	62	1	358	11	51891342	50281336	169		First day of production. Odd = uncorrelated, Even = Correlated. 1 swath only today. Sunny/hot, windy pm
04-Mar-15	63	359	1197	1	50281335	51891301	838		All records correlated only. Sunny/hot, less windy pm
05-Mar-15	64	1198	2175	1	51821300	51261252	977	2	Sunny/hot, windy all day
06-Mar-15	65	2176	3108	7	51191251	50351223	926		Sunny/warm, windy all day
07-Mar-15	66	3109	3939	7	50561222	51261195	824		Sunny/warm, light breeze
08-Mar-15	67	3940	4640	1	51331195	51401154	700		Sunny, warmer, light breeze
09-Mar-15	68	4641	5318	8	51471154	51401139	670		FFIDs 4788-4790 low freq/hi amplitude noise – possibly seismic events? Sunny/hot, windy pm
10-Mar-15	69	5319	6229	0	51541139	51331097	911		Sunny/hot, windy all day
11-Mar-15	70	6230	7091	2	51191097	50351056	860		Partly sunny/hot, windy
12-Mar-15	71	7092	7976	4	50351055	50001028	881		Partly sunny/hot, windy
13-Mar-15	72	7977	9057	4	50701027	51750958	1,077	1	Sunny/warm very windy all day (windiest day on project)
14-Mar-15	73	9058	9155	0	51470951	51190977	98		Cool, calm Last day of production.
Total:	12 days			46			8,931	3	Note: receiver station 1028,5045 was not originally surveyed due to creek water, but is recorded as a live trace and a valid station and with an interpolated elevation

5.10.3 Navigation Data

The survey was acquired using a survey projection of **MGA Zone 54** and GDA94 datum and all coordinates uses this system.

The SPS files generated were in standard 2.1 format, as described in Table 13 and Table 14 and contain all available data for each shot point, variable lines count and channels depending on layout/pickup progress.

In addition to the nominal geometry described in the recording parameters, several other source array configurations and types were used around obstacles or in areas of steep terrain, these were noted in the SPS files and their point codes listed in Table 12 as well as in the headers of the SPS files themselves.

Table 12 Point codes for the source and receiver types

Point Code	Description	Usage
Receiver Arrays		
G1	12 geophones linear array, 50 m interval	Production
Source Arrays and types		
V1	1 sweep, 2 vibrators (80 Hz linear, 250 ms tapers 8 seconds sweep at 80% drive level)	Production

5.10.4 Specification of Final Products

The SPS co-ordinate files were written with a survey projection and datum detailed in section “5.10.3 Navigation Data” on page 35, using the standard 2.1 format, as described in Table 13 and Table 14 below.

The different source and receiver arrays utilised are recorded as point codes listed in Table 12 on page 35.

Table 13 SPS source and receiver format description

Definition	Columns	Format
Record Identification	1	‘R’ or ‘S’
Line name	2 – 11	F10.2
Point Number	12 – 21	F10.2
Point Index	24	I1
Point Code	25 – 26	A2
Point Depth (m)	31 – 34	F4.1
Uphole Time (ms)	39 – 40	I2
Easting (m)	47 – 55	F9.1
Northing (m)	56 – 65	F10.1
Elevation (m)	66 – 71	F6.1
Julian Day	72 – 74	I3
Time (hhmmss) (UTC)	75 – 80	3A2

Table 14 SPS relational file format description

Definition	Columns	Format
Record Identification	1	'X'
Tape number	2 – 7	3A2
Record number	8 – 15	I8
Record increment	16	I1
Instrument code	17	A1
Source line number	18 – 27	F10.2
Source point number	28 – 37	F10.2
Source Index	38	I1
First channel in group	39 – 43	I5
Last Channel in group	44 – 48	I5
Channel increment	49	I1
Receiver line number	50 – 59	F10.2
First receiver point in group	60 – 69	F10.2
Last receiver point in group	70 – 79	F10.2
Receiver point index	80	I1

The validated raw seismic data was updated with the geometry and were recorded in standard SEG-Y format, the header locations used are shown in Table 15. An example SEG-Y EBCDIC header is included in Figure 23.

Once generated the SEG-Y data is independently verified on another system with a standalone SEG-Y viewer and the coordinates extracted and viewed in OMNI against the final SPS for a final coordinates quality check, is then ready for shipment to the client. The SEG-Y datasets have no processing applied. The headers were updated with the validated geometry information.

Table 15 SEG-Y header locations

hINFORMATION	CLARITAS NAME	BYTE LOCATIONS	FORMAT	COMMENTS
File Number	RECORDNUM	9 - 12	4b-int	
CMP Number	CDP	21 - 24	4b-int	
Offset	OFFSET	37 - 40	4b-int	Decimetres
Rvcr elev	REC_HT	41 - 44	4b-int	Decimetres
Source elev	SOURCE_HT	45 - 48	4b-int	Decimetres
Source X	SOURCE_X	73 - 76	4b-int	Decimetres
Source Y	SOURCE_Y	77 - 80	4b-int	Decimetres
Rcvr X	REC_X	81 - 84	4b-int	Decimetres
Rcvr Y	REC_Y	85 - 88	4b-int	Decimetres
Year	YEAR	157 - 158	2b-int	
Julian Day	DAY	159 - 160	2b-int	
Hour (UTC)	HOUR	161 - 162	2b-int	
Minute (UTC)	MINUTE	163 - 164	2b-int	
Second (UTC)	SECOND	165 - 166	2b-int	
Channel Num	CHANNEL	185 - 188	4b-int	
SP number	SHOT_PEG	189 - 192	4b-int	
Rcvr number	REC_PEG	193 - 196	4b-int	

hINFORMATION	CLARITAS NAME	BYTE LOCATIONS	FORMAT	COMMENTS
CMP X	CDP_X	197 - 200	4b-int	Decimetres
CMP Y	CDP_Y	201 - 204	4b-int	Decimetres
Azimuth	AZIMUTH	219 - 220	2b-int	In tenths of degrees
Line Number	SPARE1	225 - 228	4b-int	

```

C02 PROJECT: PEL638 AAL 221 JONOTHON 3D, COOPER BASIN NORTH EAST SA, AU
C03 LAND 3D, RECORDED LENGTH 4000MS, SAMPLE INT 2MS
C04 DATA: RAW SHOT GATHERS WITH GEOMETRY, 4000MS, SAMPLE INT 2MS
C05 FFID RANGE 9058 - 9155 SHOT RANGE 51190965 - 51470979
C06 FORMAT SEGY, SAMPLE FORMAT IBM 32BIT FP
C07 ACQUIRED BY TERREX SEISMIC CREW A2, DATE 14-MAR-2015 JD073
C08
C09 RECORDING PARAMETERS
C10 SERCEL 428
C11 VIBROSEIS, 1 x SWEEP: 4-80HZ, 08SEC, TAPERS 250/250MS
C12 CORRELATION BEFORE STACK, ALIAS FILTER 0.8 NYQUIST, NOTCH OUT
C13 INLINE RECEIVER ARRAY 12 OVER 50.0M, GEOPHONES SM24, FREQ 10HZ
C14 RP INTERVAL: 50.0M, LINE SPACING: 350.0M
C15 INLINE SOURCE ARRAY 2 VIBS, SWEEP NUMBER/VP 1, DRIVE LEVEL 80%
C16 VP INTERVAL: 50.0M, LINE SPACING: 350.0M
C17 GEODETIC PARAMETERS
C18 VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM
C19 PROJECTION: GDA94 ZONE: MGA54
C20
C21
C22 PROCESSING SEQUENCE
C23 RAW DATA, 4 SEC, 2 MSEC,
C24 GEOMETRY UPDATE WITH FINAL SPS
C25 SEG Y OUTPUT
C26
C27
C28 BYTE LOCATIONS FOR TRACE HEADER
C29 FFID :9-12(INT), REC ELEV (dm) :41-44(INT), SOURCE ELEV (dm) :45-48(INT)
C30 SOURCE X (dm):73-76(INT), SOURCE Y (dm):77-80(INT), LINE NUMBER :17-20(INT)
C31 RECEIVER X (dm):81-84 (INT), RECEIVER Y (dm) :85-88 (INT),
C32 SHOT YEAR:157-158(INT), SHOT DAY:159-160(INT),
C33 SHOT TIME HOUR:161-162(INT), SHOT TIME MINUTE:163-164(INT)
C34 SHOT TIME SECOND:165-166(INT), CDP NUMBER :21-24(INT)
C35 OFFSET (dm):37-40(SINT)
C36 SOURCE STATION: 189-192 (INT),
C37 RECEIVER STATION: 193-196 (INT)
C38 CDP X (dm):197-200(INT), CDP Y (dm):201-204(INT), CDP ELEV (dm):225-228(INT)
C39
C40 WRITE SEG Y, PROCESSED BY QC DEPARTMENT, END EBCDIC

```

Figure 23 Example SEG Y EBCDIC header

5.11 Results and data examples

5.11.1 Raw shots

Raw record displays are shown below and are typical of the records observed during the acquisition.

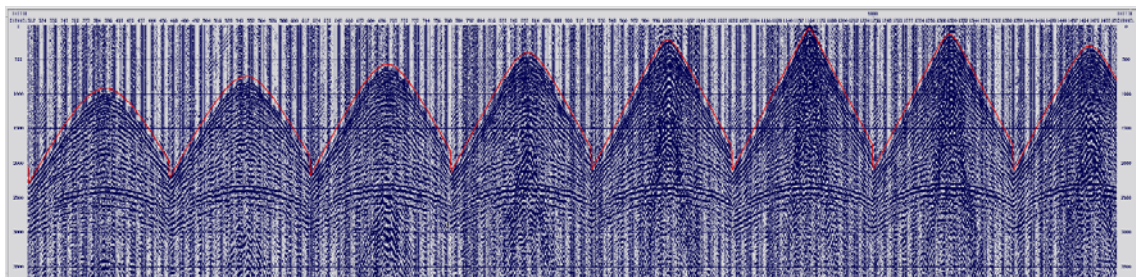


Figure 24 A typical raw shot record, zoomed in

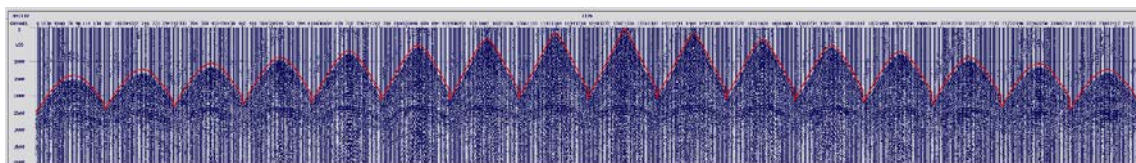


Figure 25 A typical raw shot record showing all receiver lines

Strong reflectors can be seen in the processed display in Figure 27, clearly showing reflectors in the near, mid and far offsets, especially the strong high amplitude response in the region around ~2000 ms and some faint reflectors can be observed at the 4000 ms region. There are some source generated noise evident in the pre-first breaks, possibly harmonic distortions arising from the short taper lengths.

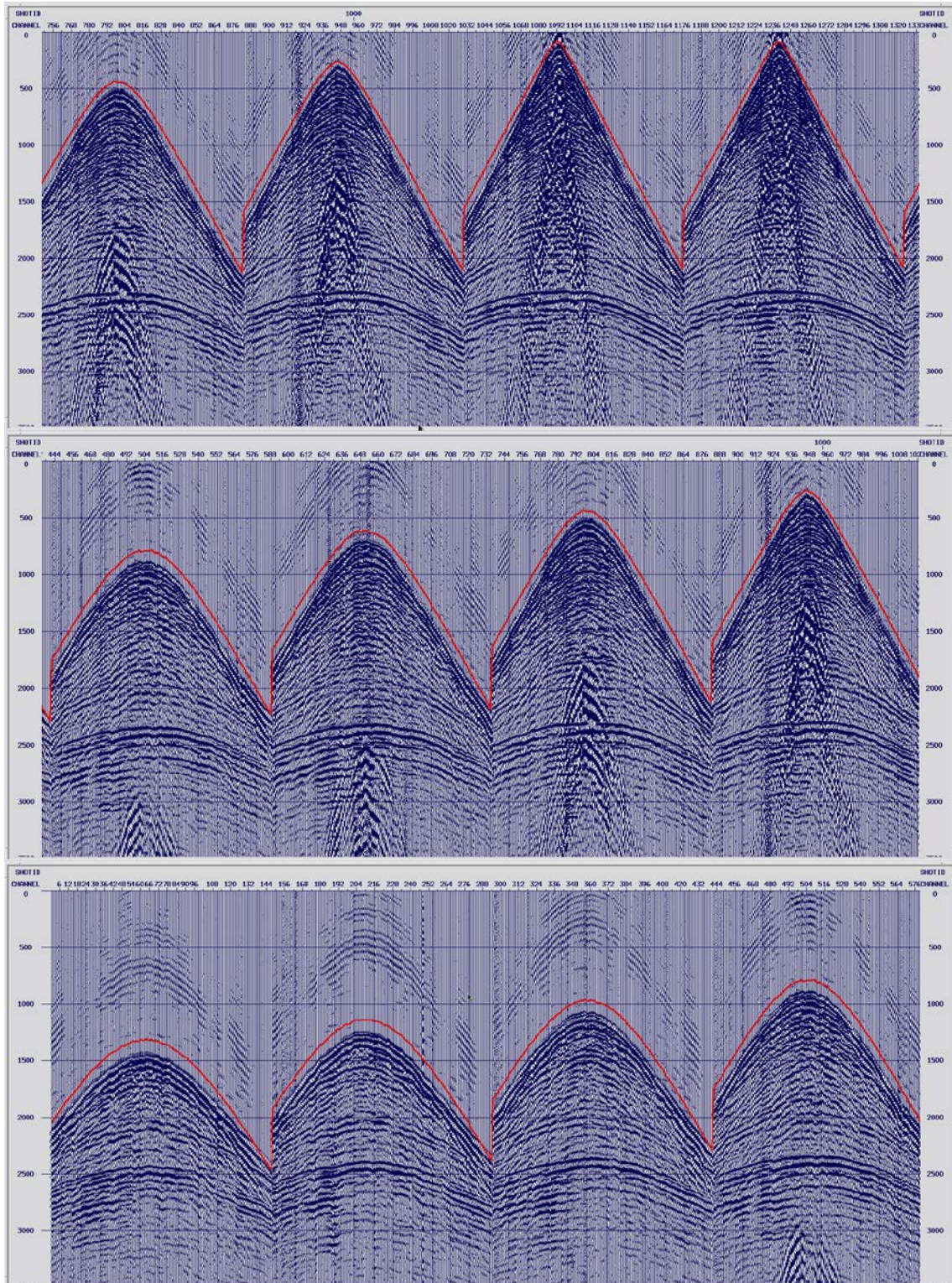


Figure 26 Typical raw shot displays – from top to bottom; near, mid and far offsets

5.11.2 Processed shots

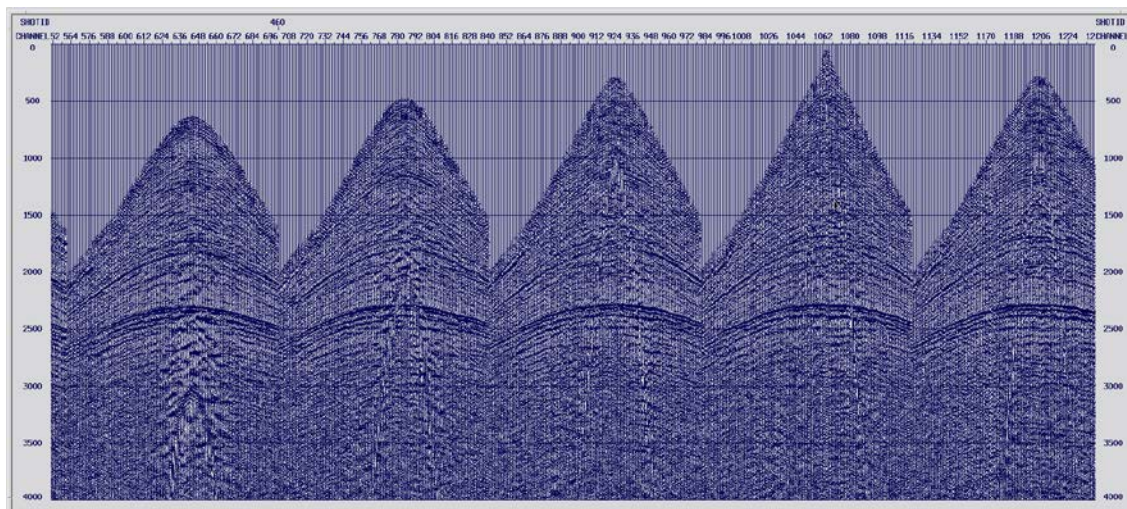


Figure 27 Typical pre-processed raw shot display, AGC applied

The processed raw shot display demonstrates some of the major noise components have been effectively attenuated using the filters applied during processing while preserving the strong signal response, especially at about 2,300 ms.

5.12 Stacks

The field stacks generated for this project show strong reflectors at various depths, clearly delineating features and other geological structures such as a large anticline in the centre of the prospect at 2300-2500 ms. The velocity files for these stacks are provided in the shipment.

Example stack displays can be found in Figure 28 to Figure 34 below. It should be noted that the processing applied in these field stacks is designed for efficiency with regards to the resources and time available on crew, to provide a quality control product in the stack domain and an early indication of the data and structures. Significant improvements would be expected after the data has been fully processed.

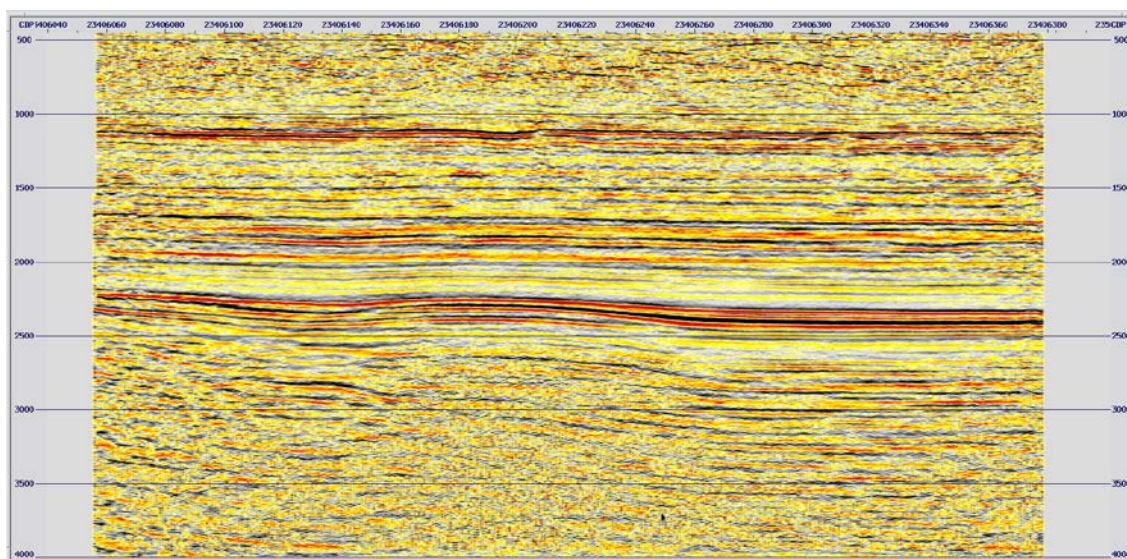


Figure 28 Typical stack

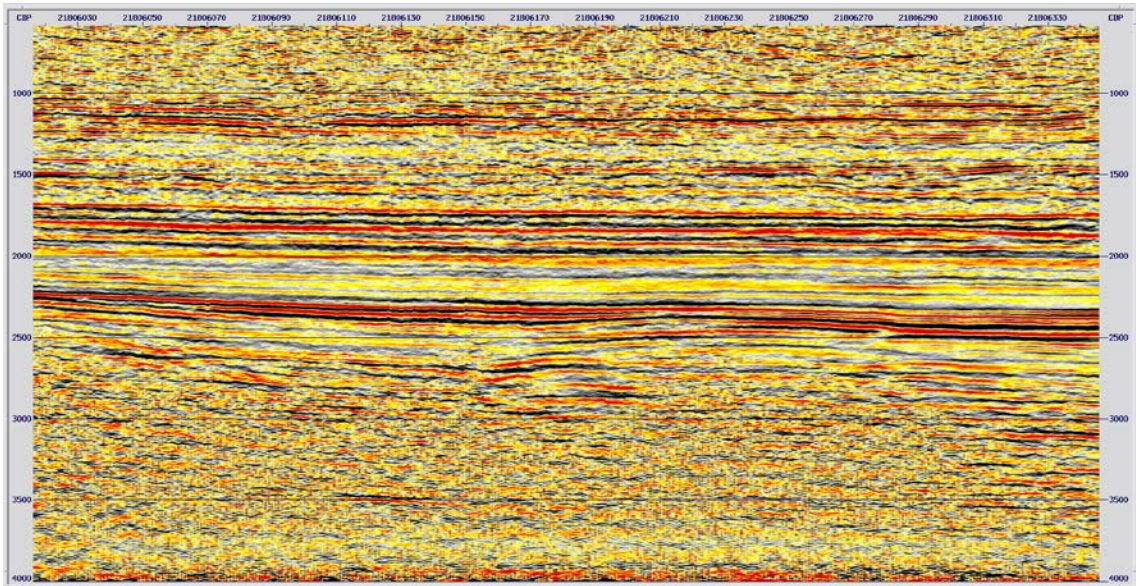


Figure 29 *Stack after residual statics applied*

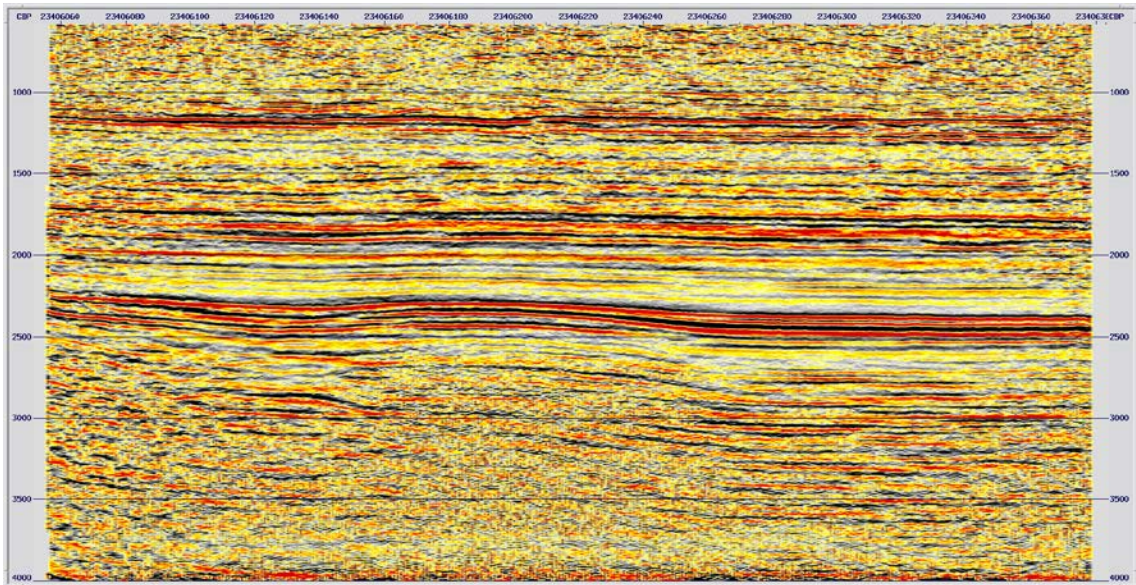


Figure 30 *Stack with residual statics applied*

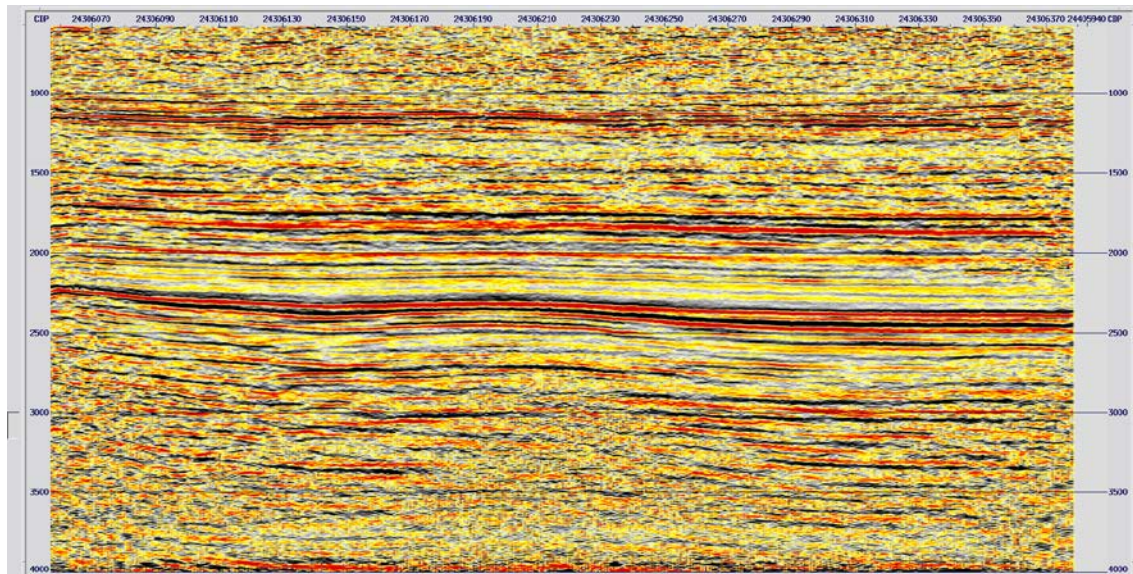


Figure 31 *Stack with residual statics applied*

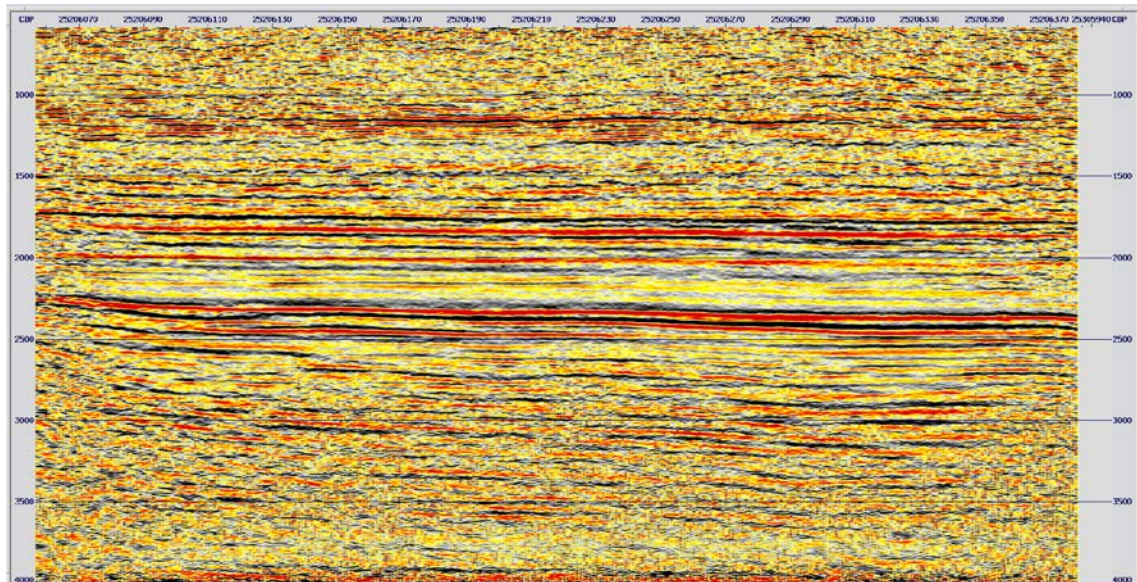


Figure 32 *Stack with residual statics applied*

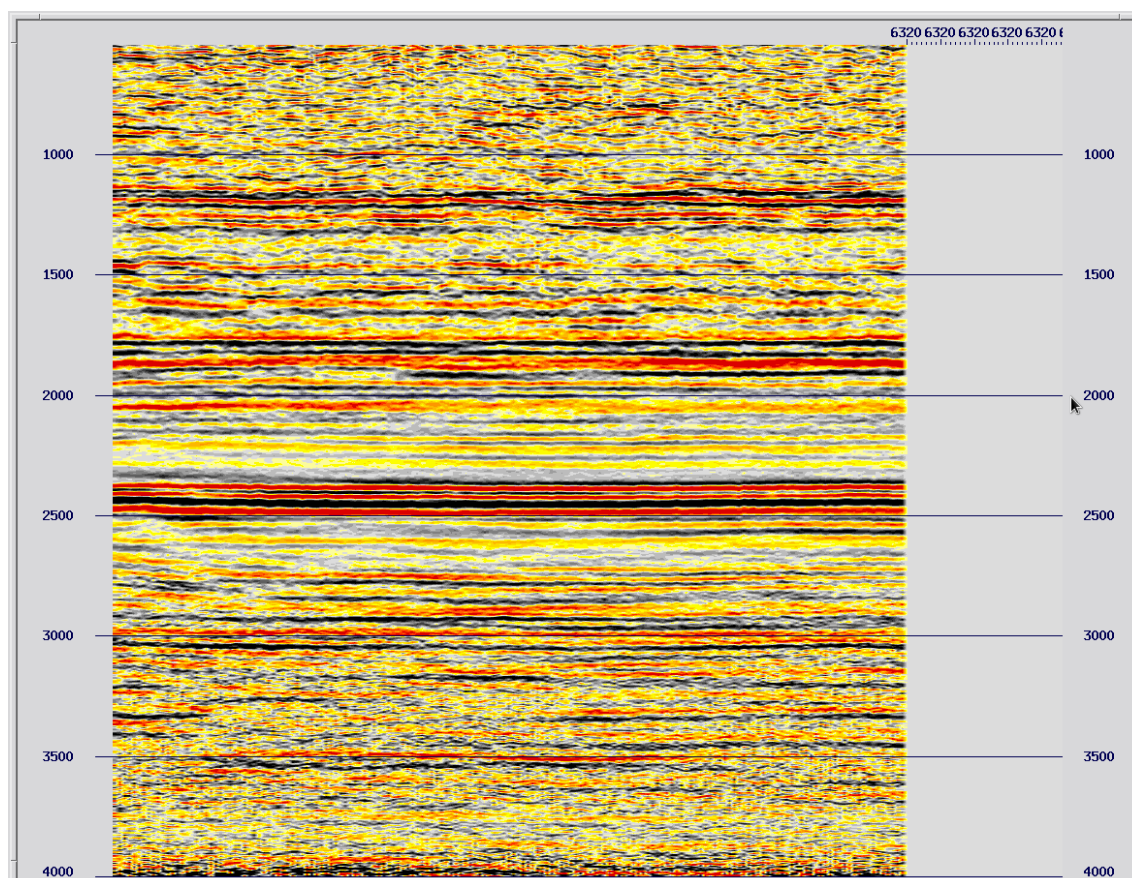


Figure 33 *Stack (crossline) with residual statics applied*

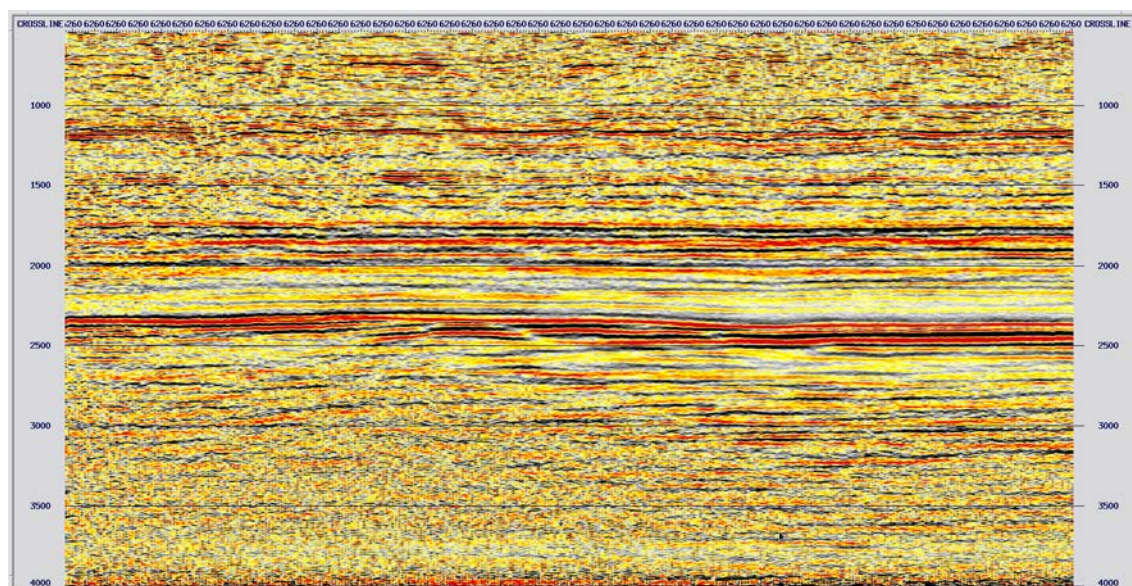


Figure 34 *Stack (crossline) with residual statics applied*

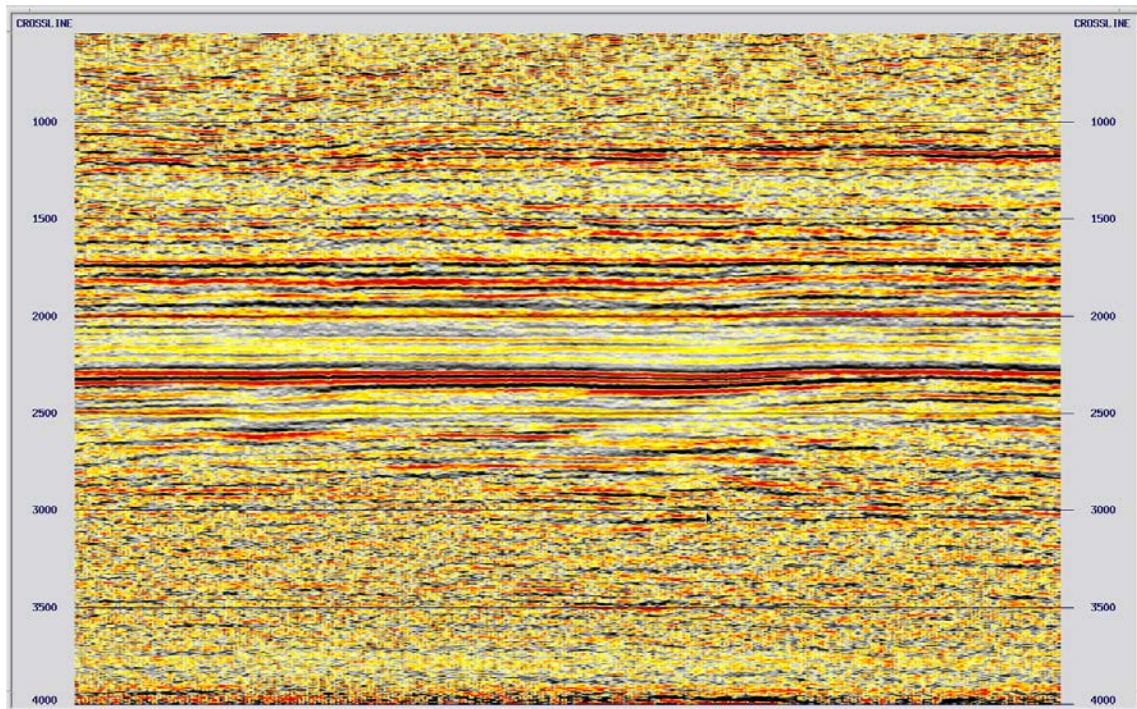


Figure 35 *Stack (crossline) with residual statics applied*

The stacks depicted very obvious, continuous reflectors throughout the entire prospect 1100 and 2500 ms two-way time (TWT) and partial reflectors down to the bottom of the recording window at 4000 ms TWT.

5.12.1 Timeslices

A cube was generated and a series of timeslices were displayed. Screenshots are shown below (Figure 36 to Figure 39) showing the structural changes, possibly anticlines and synclines through the layers:

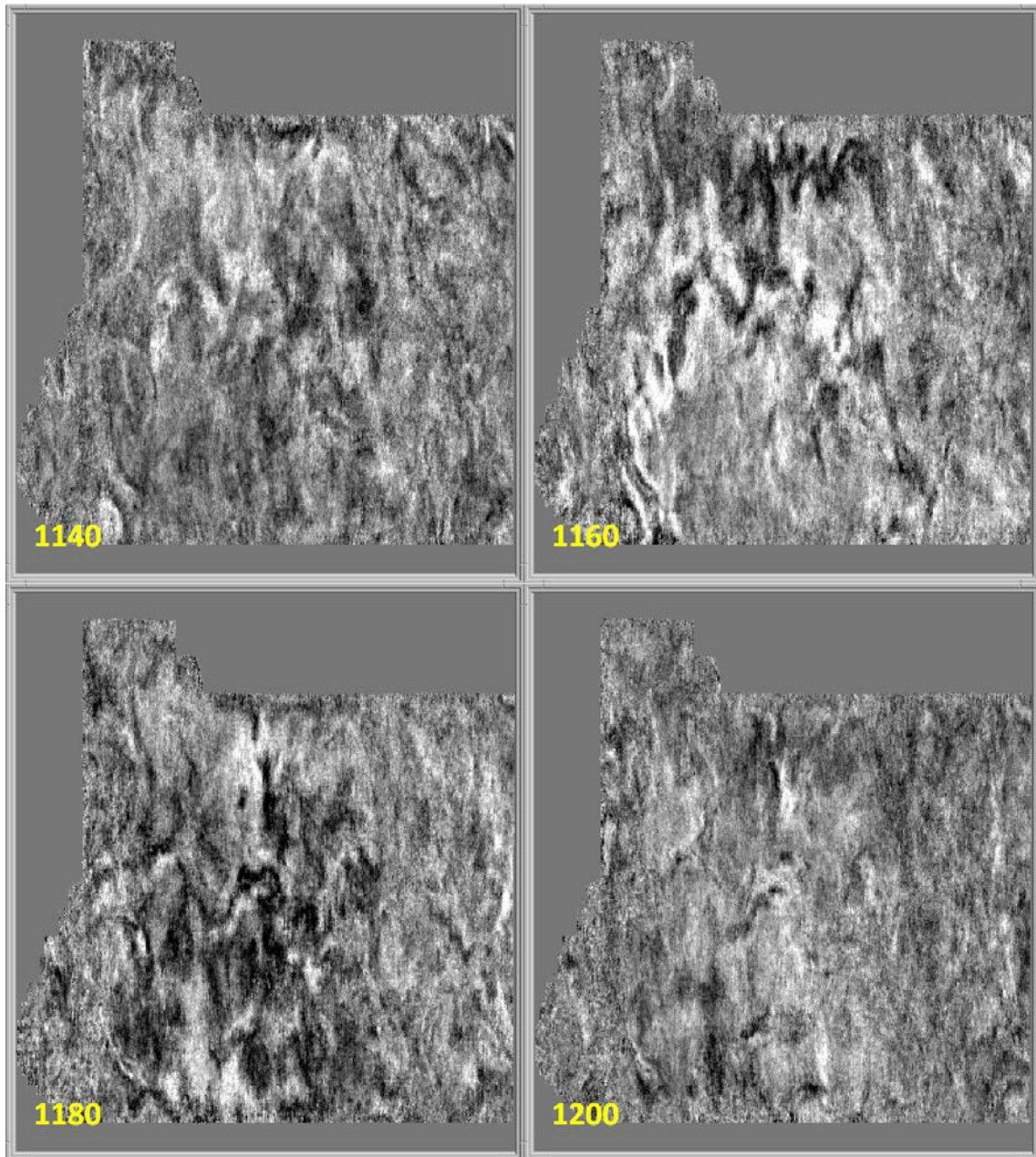


Figure 36 Timeslices (yellow text denotes timeslice in ms)

The above timeslices show complex channel patterns in the region of 1000 to 1200 ms.

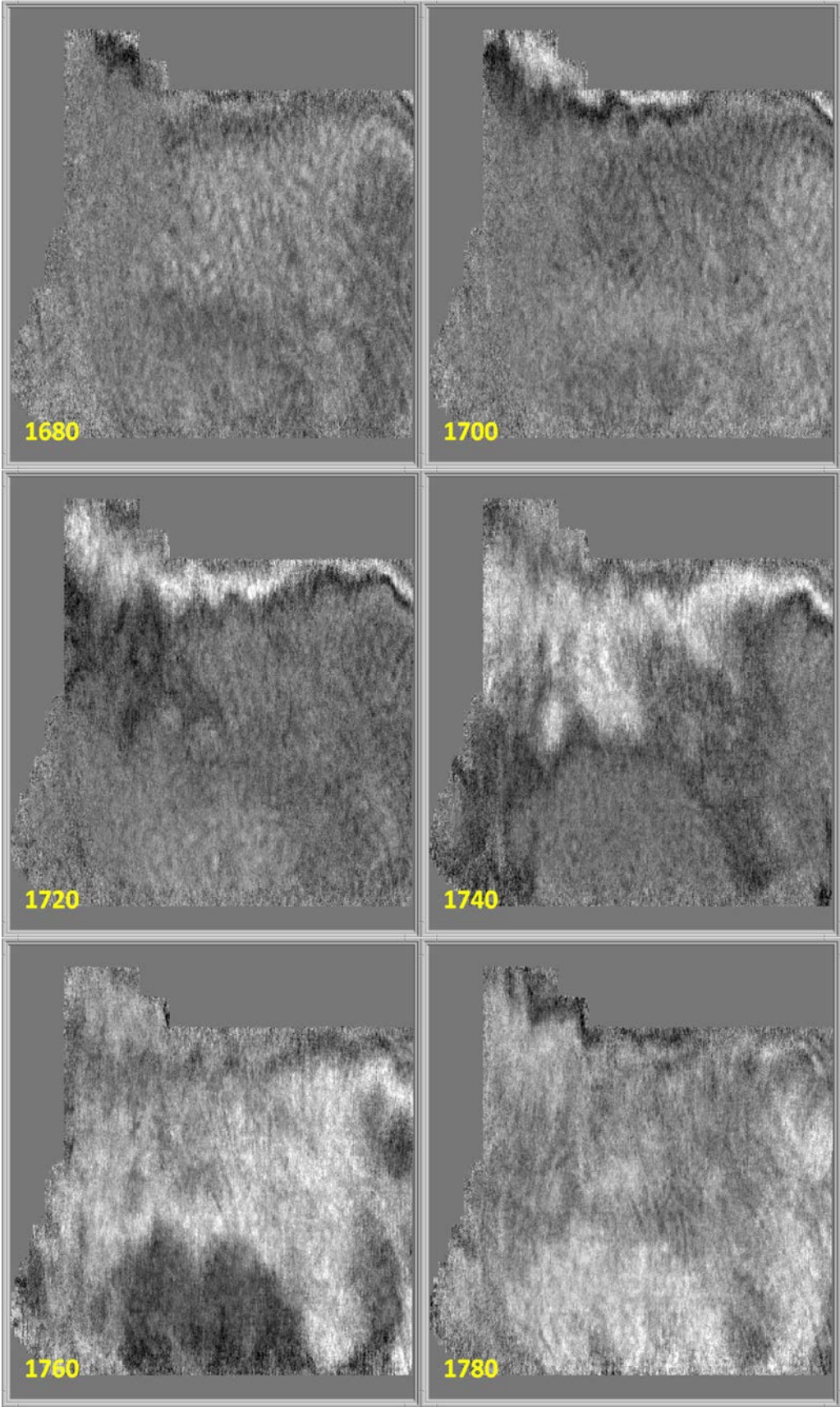


Figure 37 Timeslices, (yellow text denotes timeslice in ms)

The above slices show a large structure appearing at 1680 ms in the northern extremities and is widespread over the whole survey area at 1760 ms. A similar theme is repeated from 2260 ms as shown in Figure 38 on the next page but with much increased structural complexity.

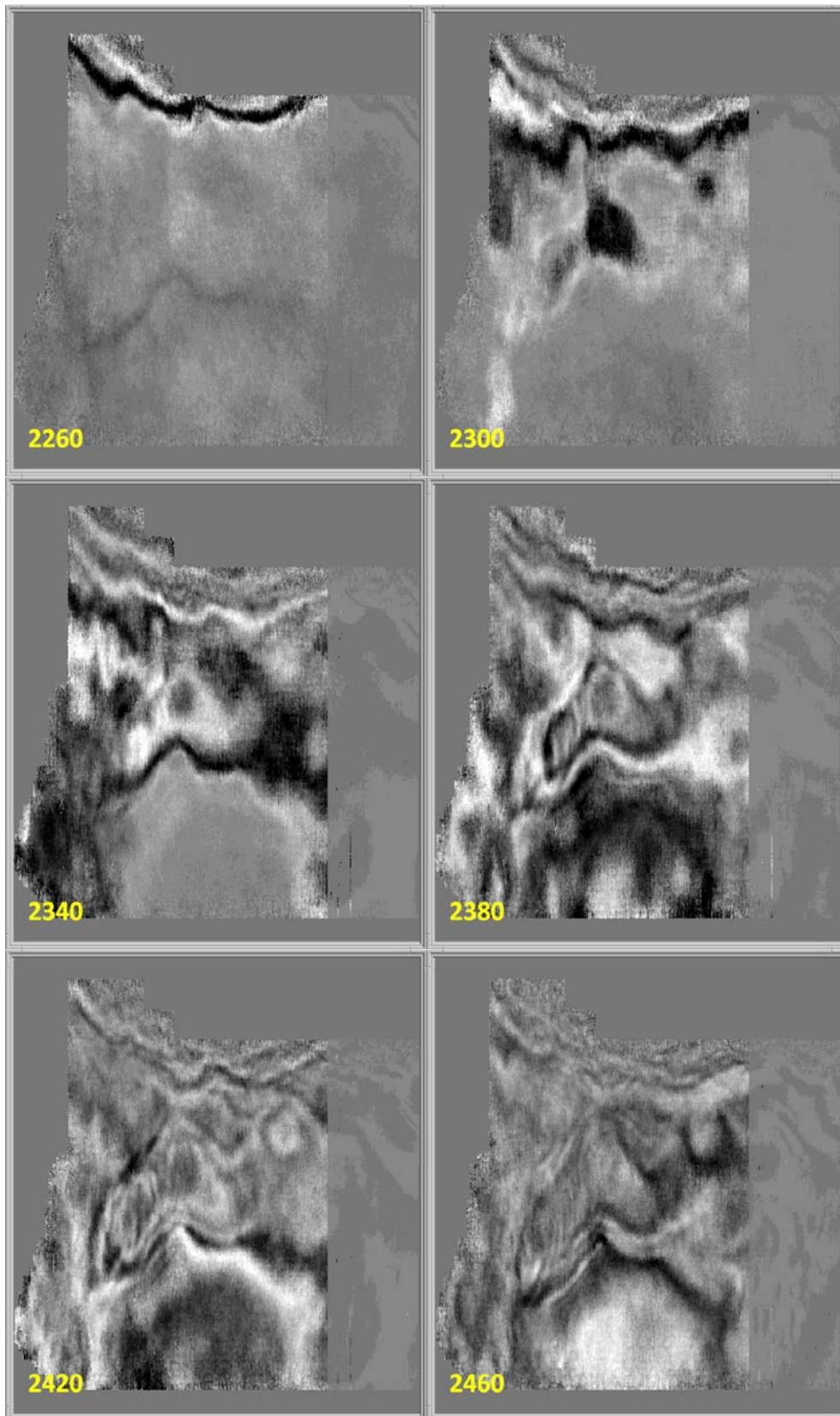


Figure 38 Timeslices, (yellow text denotes timeslice in ms)

(The right side of each slice has a different gain scaling due graphics rendering in software).

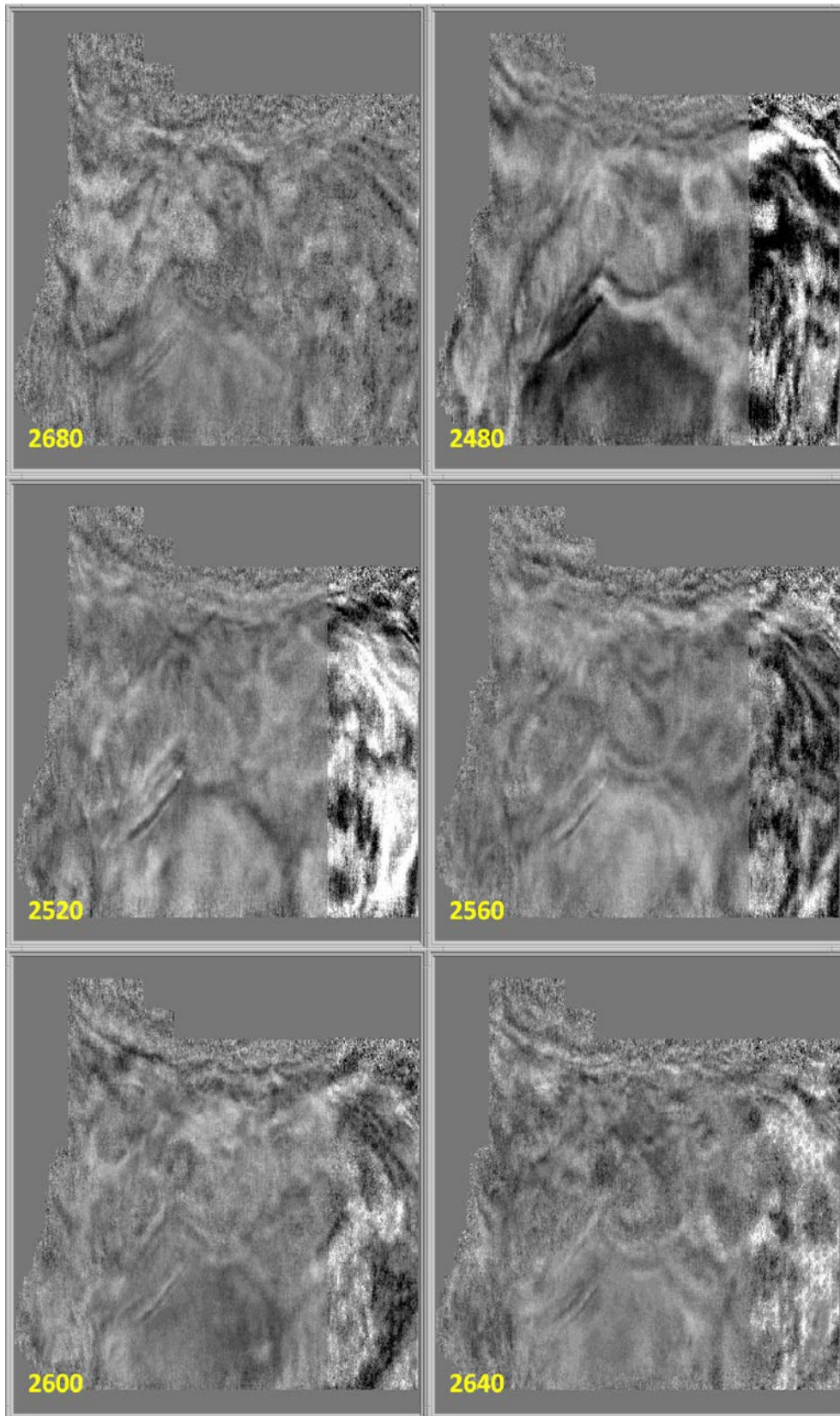


Figure 39 Timeslices, (yellow text denotes timeslice in ms)

(The right side of each slice has a different scaling due to graphics rendering in software)

The structures show contain what appears to be anticlines and synclines of various sizes and orientation.

5.13 Data Shipments

The In-Field unit was responsible for the seismic data shipment to the client, processing centre and infield representatives, details on the data and destinations can be found in Table 17.

The supporting data was supplied on either the hard drive or DVD media and included the following data:

- SPS files, version 2.1 (Source, Receiver and Relations (S, R and X files)
 - See Table 13 (page 35)
 - Table 14 (page 36) for formats
- Final, edited and combined observer logs relevant to the shipment
- Quality Control Logs (Notes about the data in the shipment)
- Raw daily files (unedited observer logs and ancillary files)
- SEG-Y geometry applied data (updated with final SPS files)
 - See Table 15 (page 36) for header locations
- Field stacks, NMO velocity (Claritas format) files

The field data tapes were recorded as SEG-D revision 2.1 on tape cartridges. Tapes were read back to verify the data integrity before shipment.

The raw, correlated and validated seismic data updated with the geometry was supplied in standard SEG-Y format, the header descriptions can be found in Table 15 (page 36) and an example of the EBCDIC headers in Figure 23 (page 37).

Table 16 Shipping Details

Client Office ("A" copy)		Client Office ("B" copy)	
Shipping Agent	Australian Air Express	Shipping Agent	Australian Air Express
Company	Senex Energy Ltd	Company	Senex Energy Ltd
Contact	Mark Kniepp	Contact	Mark Kniepp
Address	Level 14, 144 Edward St. Brisbane QLD 4001	Address	Level 14, 144 Edward St. Brisbane QLD 4001

Table 17 Summary of shipment details

DAILY			
What Data	Comments	To Where	Medium
Raw Data	Screenshots of raw shot gathers	Client Rep	USB
Brute Stack	Screenshots of field stacks	Client Rep	USB
ON COMPLETION			
Field stack	Screenshots of field stacks	Client Rep	USB

AT PROJECT END			
<i>What Data</i>	<i>Comments</i>	<i>To Where</i>	<i>Medium</i>
Original Seismic Data	SEG-D Correlated	Client office, “A” Copy	LTO2 tape cartridge
Geometry Applied Data	SEG-Y Geometry Applied		Hard Drive
Support Data	SPS, obslogs and other usable data		
AT PROJECT END			
<i>What Data</i>	<i>Comments</i>	<i>To Where</i>	<i>Medium</i>
Original Seismic Data	SEG-D Correlated	Client office, “B” Copy	LTO2 tape cartridge
Support Data	SPS, obslogs and other usable data		DVD
AT PROJECT END			
<i>What Data</i>	<i>Comments</i>	<i>To Where</i>	<i>Medium</i>
QC Final Report			FTP/Email

5.14 Conclusions and Recommendations

The recorded data is of an excellent standard. The field stacks show that objectives were imaged effectively, highlighting features around the areas of interest. It is expected that final processing will yield excellent and usable datasets.

In-Field Quality Control has been useful in this project, from flagging out corrupted files that were reshot in following day to identifying and repairing files with bad geometry, incorrect coordinates or removing poor records with questionable or missing attributes. This process help to improve data quality of the final product, and reduce time spent at the processing centre in trying to remedy the problems. Some issues flagged by the In-Field Unit were rectified immediately in the field when the equipment and staff is present. Otherwise, potentially useful data will have to be removed.

The data quality is of a high standard with stacks showing strong continuous reflectors from 1000 ms to 2500 ms with partial reflectors below 2500 ms.

Appendix A Cable Field Equipment Specifications

Recording Equipment

Data Acquisition System:	SERCEL 428 - 24 Bit 3D Seismic
Similarity System:	Pelton VIBRPO Real Time
Computing:	Sun Blade Computer with 4 x 19inch Flat Screens
Plotter:	Veritas V12 Plotter, UPS, LIM, APM
Tape Drives:	2 x LTO High Density
Comms:	1 x 10 metre 6 DB Boost High Gain Antenna

Source Equipment

Vibrators:	4 x AHV-IV 364 Buggy Online.
Peak force:	62000 lbs. per Vibrator
Hold-Down Weight:	62000 lbs. per Vibrator
Vibrator Control Electronics:	Sercel VE464
Sweep Generator :	Sercel VE464

Electronics are capable of Trade Marked Varisweep.

Line Equipment

Seismic Cables:	1875 (4 x FDU's per cable) 7500 channels
Takeout's:	55m separation between takeout's
LAUL Units:	202
LAUX Units:	25
Transverse Cables:	82
Battery's:	228
Battery Chargers:	4 Sercel
Geophones:	Sensor SM24 10Hz geophones or equivalent
Geophone Strings:	7500 (12 Ph/group)
Geophone Tester:	1 x Sensor SMT200
Vehicle Radios:	All vehicles fitted with VHF & UHF

Note: Terrex Seismic warrants that 90% of equipment will be used in field and up to 10% may be undergoing repair and maintenance.

Appendix B Vehicle Equipment Listing

	Vehicle	Rego.	Trailers	Rego
1	CM Wagon	027 RNR		
2	Eagle	167-TCC	(A) Spread Cage, (B) White curtain sider,	KW-7842, 1TPA-725
3	Eagle	1TEPL-545	(A) Red curtain sider, (B) Red Curtain sider	1TNY-914, 1TNY-915
4	KW Green & white (Crane)	675-RDS	(A) Trailer fuel pod, Showers	SY-17-ED, TBJ-265
5	KW Green & White W/model	KW-9880	Kitchen, Dolly #2, Diner	SY-59-DZ, SY-64-DU, SY-60-DZ
6	Green & White T600 KW	1EKO-576	Gens/Tanks, Dolly #1, Freezer/Vibe	TBJ-267, SY-84-DT, YFC-837
7	KW Blue W/model (Crane)	KW-9943	Workshop	571-QWD
8	Paystar flatbed- A1	1DDE-229	Waste Tank Trailer	314-QWX
9	Paystar Flatbed - Water tank	1DDE-235	Shitters (Stool Bus)	SY-33-EG
10	Freightliner	1DDE-225		
11	Iveco Supply Truck	044-TLE		
12	Cable Repair	402-RPF		
13	A2 Recorder	492-MZJ		
14	A1 Recorder	RPF-438		
15	White Curtain sider (spread)	212-RTJ		
16	White Curtain sider (spread)	772-RNW		
17	Paystar Storage truck	1DDE-227		
18	HSE Troop Carrier	478-LGW		
19	Line Boss Ute	740-RQA	CM Office Van #1	S023-TDB
20	T/Shooter Ute	741-RQA	HSE Office Van #2	S024-TDB
21	T/Shooter Ute	646-RSQ	Client Van #3	S826-TDC
22	T/Shooter Ute	023-RNR	6 Man Van #4	S279-TDA
23	Jug Ute	849-LIX	6 Man Van #5	S278-TDA
24	Jug Ute	852-LIX	6 Man Van #6	S277-TDA
25	Jug Ute	017-RNR	6 Man Van #7	S276-TDA
26	Cable Ute	848-LIX	6 Man Van #8	S275-TDA
27	Cable Ute	850-LIX	6 Man Van #9	S274-TDA
28	Cable Ute	853-LIX	6 Man Van #10	S273-TDA
29	Cable Ute/De-peggers	855-LIX	6 Man Van #11	S272-TDA
30	Cable Ute	851-LIX	6 Man Van #12	S280-TDA
31	Spare Ute	018-RNR	Lunch Van #13	S825-TDC
32	Back Crew Wagon	845-LIX	Elross/office van	1TLB-133

	Vehicle	Rego.	Trailers	Rego
33	Back Crew Wagon	846-LIX	Elross - 6 x Man	1TLB-734
34	Front Crew Wagon	073-RAH	QC Office	1TMH-835
35	Spare Vibe Crew Wagon	747-RCZ	Dual Box Trailer	605-QUM
36	Front Crew Wagon	844-LIX	Wash/Sign trailer	YIE-696
37	Spare/Client Wagon	026-RNR		
38	Vibe Crew Wagon	829-SMR		
39	Paystar - Service Truck	1DDE-234		
40	Mecho Ute	067-RAH		
41	Vibrator		AHV-IV Vibe	C32657
42	Vibrator		AHV-IV Vibe	C32658
43	Vibrator		AHV-IV Vibe	C32659
44	Vibrator		AHV-IV Vibe	C32660

Appendix C HSE Policy & OH&S Standards



Health Safety Environment and Quality Policy

Terrex is a Seismic Acquisition and Surveying Contractor providing services to the Oil, Gas, Mineral and Infrastructure Industries.

Our vision is to be one of the world's most operationally efficient, technologically advanced, innovative and safest onshore Seismic Acquisition and Survey service providers.

Our aim is to provide a healthy and safe workplace while minimising the environmental impacts of our activities and satisfying our customers' expectations.

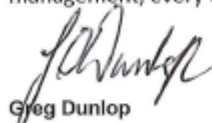
We at Terrex are committed to:

- Providing a healthy and safe workplace for our employees, contractors and the general public.
- Conducting all operations in such a manner as to minimise their impact on the environment.
- Promoting the protection of all Natural and Cultural environments that can be affected by our activities.
- Respecting all forms of indigenous and non-indigenous heritage and maintaining cultural heritage values.
- Seeking to continuously improve in the efficient use of natural resources and energy through recycling and waste management.
- Regularly review and improve our process to minimise health and safety hazards, negative significant impacts to the environment and prevent pollution.
- Establishing measurable objectives and targets for improving our safety and environmental performance.
- Working with our customers, suppliers and employees to seek continual improvement of our activities through consultation and communication.
- Complying with legislation and industry codes of practice wherever we conduct business.

To ensure this commitment we have implemented an Integrated Management System, which meets the requirements of:

- AS/NZS 4801 Occupational Health and Safety Management Systems
- OHSAS 18001 Occupational Health and Safety Management System
- AS/NZS ISO 14001 Environmental Management Systems.
- AS/NZS ISO 9001 Quality Systems

This policy is basic to all Terrex operations and adherence is the prime responsibility of management, every employee and all contractors / sub-contractors.



Greg Dunlop
Chief Executive Officer

Dated: 31st July 2015



Drug and Alcohol Policy

Terrex is committed to:

- Ensuring the Safety and Health of its employees and its subcontractors is maintained;
- Maintaining a SAFE and Healthy workforce and workplace through a proactive approach.

Scope

This policy outlines the responsibilities and applies to all employees of TERREX and all of its subcontractors.

All personnel are considered "on the job" whenever he/she is on:

- Any Company or client property, including parking areas; or
- Company time even if off Company premises – including paid lunch, rest periods, and periods of being on call.

Responsibilities

- Terrex is responsible for maintaining a Drug-Free Workplace and Workforce.
- As a Duty of Care to all employees and contractors, the company will initiate:
 - Random;
 - Upon suspicion;
 - With cause; and
 - Post-accident / incident Drug and Alcohol Testing.

It is expected all employees and contractors will co-operate with the nominated Company Representative in this matter.

- The Company prohibits the use, unauthorized possession, manufacture, distribution or sale of illegal drugs, illegal inhalants, drug paraphernalia or controlled substances (i.e. all chemical substances or drugs listed in any controlled substances act or regulation applicable under any federal and/or state local laws) by any employee or contractor while on duty, while on Company premises or work sites or conducting Company business, or while operating or occupying any Company vehicle/equipment at any time.
- It is the responsibility of an individual to disclose to the nominated company representative any use of prescription drugs and over-the-counter drugs or designer / "look alike" drugs, prior to entering the work place. As the use of prescription drugs and/or over-the-counter drugs may also affect an employee's job performance and seriously impair his/her ability to work safely and effectively. Misusing prescribed or over-the-counter medication on company property or company assignment is strictly prohibited. Designer or "look alike" drugs are prohibited on all Terrex work sites. Non-disclosure will be treated as a breach of this Policy.
- Subject to Client approval and compliance with the Company's Drug and Alcohol and Fitness for Work Policies, outside of working hours Terrex permits the consumption of mid-strength and light beer only within Terrex camps.
- It is the responsibility of all employees and contractors to have a 0% blood alcohol reading before commencing and during work hours.
- Pertaining to employees and contractors in rehabilitation or self-rehabilitation, confidentiality of personal information will be maintained, although personal information will be released by the Medical Services on a need-to-know basis or as required by law.
- All personnel working on Company premises or performing Company work must have read this Policy and will be asked to cooperate with the administration of this Policy. A breach of this policy and the associated procedure may result in disciplinary action.



Greg Dunlop
Chief Executive Officer
Dated: 31st July 2015



Fitness for Work Policy

Terrex is committed to providing a safe, healthy and productive workplace for all its employees. The company recognises that alcohol, drugs, substance abuse, some illness and fatigue will impair employees' ability to perform their jobs properly and that any of these factors will have adverse effects on safety, efficiency, and productivity.

Scope

This policy outlines the responsibilities and applies to all employees of TERREX.

All personnel are considered "on the job" whenever on:

- Any Company or client property, including parking areas; or
- Company time even if off Company premises including paid lunch, rest periods, and periods of being on call.

Policy

- All personnel are responsible for attending work in a fit condition free of illnesses that may impair their ability to conduct their duties in a safe, efficient and productive manner and must consider the risk of others contracting the illness.
- All personnel are responsible for attending work well rested and free of impairment from fatigue.
- The company prohibits the misuse of legitimate drugs, or the use, possession, distribution or sale of illicit or non-prescribed controlled drugs, or other substances, on Company business or premises.
- Any employee who takes prescription medication should check with their doctor to establish if the use of the medication will impair their work performance, or pose a safety risk to the worker or any other person in the workplace. If so, the worker should seek advice in writing from their doctor and provide a copy of this letter to their manager.
- Drug and Alcohol testing will be conducted by the company on a daily / random or for cause basis.
- The company recognises alcohol, drug or substance dependency as a treatable condition. Employees who suspect they have a dependency problem are encouraged to seek professional advice and to follow appropriate treatment promptly before it results in work performance problems.
- Employees working outdoors are required to undergo periodical medical examinations at the Company's expense.
- All employees are required to comply with the requirements of the Company's Workplace Rehabilitation program and actively support employees who are participating in rehabilitation.
- All employees are required to comply with this Fitness for Work Policy and the relevant company procedures that support this policy that are listed below. Failure to meet the requirement of this policy and its associated procedures will result in disciplinary action, up to, and including, dismissal.
 - TS-PRO-18 Workplace Rehabilitation
 - TS-PRO-19 Drug and Alcohol
 - TS-PRO-20 Code of Conduct
 - TS-PRO-22 Journey Management
 - TS-SOP-GEN009 Fatigue Management



Greg Dunlop
Chief Executive Officer

Dated: 31st July 2015

Appendix D Terrex Spatial – Jonothon 3D Final Report



J000269

2015 Jonothon 3D Survey Final Operations Report

Prepared for

***Senex Energy Limited
and
Terrex Group***

February – March 2015



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***Dynamic Satellite Surveys Pty Ltd trading as Terrex Spatial has a
Quality Management System, externally certified to
AS/NZS ISO 9001:2008 standards by SAI Global Pty Ltd (Lic #QEC10046)***

This project was undertaken for Senex Energy Limited and Terrex Group.

The purpose of the job was to install and 3D seismic lines. The use of the data for any other purpose is not authorised.

All data contained in this report and on the attached CD is deemed to be final and overrides any previous data received from TSp, unless otherwise stated.

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1

INTRODUCTION

The following report covers the **2015 Jonothon 3D Seismic Survey**, performed by Terrex Spatial (TSp) Crew 2, whilst contracted to Terrex Seismic (TS) for Senex Energy Limited (Senex).



Figure 1 **Project Location**

The survey area was located 800kms NNW from Adelaide, approximately 60km north of Innamincka, South Australia, see **Appendix A - Project Map**.

The prospect straddled the rarely used Beanbush – Deramookoo Road in the west and the Keleary Access Road in the east. The camp site was located at the Walkillie #1 well site (P&A) approximately 4Km from the north side of the prospect on the west side of the Keleary Road. Access to the prospect could be made south via the Keleary Road or via the Cuttapirrie Road which ran west off the Keleary Road north of camp and joined up with the Beanbush – Deramookoo Road approximately 10km north of the western end of the prospect.

The Keleary to Merrimelia and Cook to Merrimelia oil pipelines ran through the western corner of the prospect as well. The Keleary pipeline was an above ground flowline. The two pipelines were located roughly 20m apart. There was only one crossing point which was the Beanbush – Deramookoo Road.

Terrain was mainly small to medium sized sand dunes running predominantly north to south separated by sandy undulating swales with some larger flats in the south towards Patchwara Creek. There was a large waterhole (Deramookoo) in the western corner of the prospect with numerous Cultural Heritage site in the vicinity.

A total of 884.45 linear kilometres of seismic lines were surveyed (447.30km Source & 437.15km Receiver). Both Source and Receiver lines were surveyed at 50.0m station intervals. The survey was recorded in stakeless mode – no source pegs other than check stations were placed in the ground. The vibrators had navigation units installed which guided operators to the surveyed source locations. Dean Hausmann (Survey Operations Manager) was on site to fit equipment and oversee vibrator GPS operations at the start of the recording acquisition. Receiver lines were pegged as per normal methods.

Terrex Contracting (TC) supplied a camp for the line preparation crew while TSp supplied two office / sleeper vans for its personnel. KJM supplied demountable accommodation for the Cultural Heritage personnel and any overflow from the TC camp. TC supplied all messing, showering and toilet facilities. Potable water was sourced from either Moomba or Ballera. TC supplied refuelling and mechanical facilities.

Throughout the survey the weather was warm to hot with periods of gusty winds.

The survey operations (actual) were completed between the 8th February 2015 and the 7th March 2015.

1.1 Survey Parameters

The following table gives a summary of the basic survey design parameters for the Jonothon 3D seismic survey. The survey was an orthogonal 3D grid, however both receiver and source points were designed with a 3 step stagger pattern based on the conventional point location with the offsets being at the receiver and source bearings.

Table 1 Survey Design Parameters

Parameter	Receiver	Source
Start line	951	5000
End line	1343	5189
Line increment	7	7
Line spacing	350m	350m
Station interval	50.0m	50.0m
Station Increment	1	1
VP interval	N/A	50.0m
Line bearing (grid)	153°00'00"	63°00'00"

Parameter	Receiver	Source
Number of lines	57	28
Inline Stagger 1	-16.66m	-16.66m
Inline Stagger 2	0	0
Inline Stagger 3	16.66m	16.66m
Stagger 1 Sequence	R1000/1021 ...	S5000/5021 ...
Stagger 2 Sequence	R1007/1028 ...	S5007/5028 ...
Stagger 3 Sequence	R1014/1035 ...	S5014/5035 ...

Table 2 Point Locations

Nominal origin points	Easting	Northing
Rec Origin station (10075000)	453894.06	6989305.97
Src Origin station (50071000)	453752.03	6988868.85



2

INSTRUMENTATION AND PERSONNEL

2.1 Personnel and Logistics

Terrex Spatial personnel involved in the survey were as follows:

Table 3 Personnel

Personnel	Qualifications / Position
Jim Cagney	Bachelor of Surveying Project Manager
Dean Hausmann	Bachelor of Surveying Operations Manager
Eric Amedee	30 years Seismic Surveying Experience Senior Surveyor
Stewart Folley	Cert IV in Surveying – 25 years Survey Industry Experience Senior Surveyor/Line Pointer
Justin Matthews	Bachelor of Science – GIS (Masters) Line Pointer/ Survey Technician
Andrew James	Cert IV in Surveying Line Pointer / Survey Technician
Fraser Pichon	Cert IV in Surveying Survey Technician
Darren Kam	Cert IV in Surveying Survey Technician
Navjeet Jain	Cert IV in Surveying Survey Technician
Andria Gordon	Cert IV in Surveying Survey Technician

Personnel and equipment logistics were supported by the Terrex Spatial Banyo office.

2.2 Equipment

Equipment provided by Terrex Spatial and used on this project:

Equipment	Description	Quantity
Mobile Plant	Toyota Landcruisers (Dual Airbag)	3
	Toyota Landcruiser Dual cab (Dual airbag)	1
	Toyota Landcruiser 200 Wagon (Eric Amedee)	1
	Office / sleeper caravans (office / 2 bedrooms)	2
	Tandem axle trailer	1
Communications	Iridium satellite phones	4
	UHF vehicle based radios	3
	UHF Office radios	2
	UHF handheld radios	2
Survey Instruments	NovAtel 702G GPS Antennas	6
	NovAtel OEMV GPS Receivers	6
	30Watt Radio transmitter (RTK)	1
	30Watt Radio transmitter (Repeater)	1
	Trimble Fiberglass Bi-pods	2
	Tripods	2
	Tribachs	2
	G-Mouse External GPS Antennas	6
	NovAtel DLV GNSS GPS receivers	2
	NovAtel DLV GNSS GPS antennas	2
Computing Hardware	Toshiba Laptops	2
	2TB Network Attached Storage (NAS) Drive	1
	Uninterrupted Power Supply (UPS)	1
	Motion Tablet computers (GPS Controller)	3
	Motion Tablet computers (Machine GPS)	3
	Algiz 10X (Machine GPS) tablets & antennas	5
	Uniden GPS receivers (Crew navigation)	4
	HP Officejet 7500 E910 printer	1
	Acer tablet	1
Software	Nav12 setout software	Ver 2.23
	GPSeismic Processing Software	Ver 14.3
	MapInfo Professional	Ver 8.5
	NavMini machine guidance software	Ver 2.63
	GlobalMapper	Ver 16.1
	Waypoint GrafNet static processing software	Ver 8.2



3

SURVEY REFERENCE SYSTEMS

3.1 Geodetic Datum

This project was based on the Geocentric Datum of Australia 1994 (GDA94), which is based on the Geodetic Reference System 1980 (GRS80) model defined by the following parameters:

Datum:	GDA94 (Geocentric Datum of Australia 1994)
Spheroid:	GRS80
Reference Frame:	ITRF92 (International Terrestrial Reference Frame)
Semi-Major Axis Length:	6 378 137.0
Inverse Flattening:	298.257222101
The Unit of Measure:	International Metre

3.2 Map Projection

Final rectangular coordinates were based on the Map Grid of Australia 1994 (MGS94). Parameters for this projection are as follows:

Projection:	Universal Transverse Mercator (MGA Zone 54)
Latitude of Origin:	0°
Central Meridian (CM):	141° E
Scale Factor at CM:	0.9996
False Easting:	500 000
False Northing:	10 000 000
The Unit of Measure:	International Metre

3.3 Height Datum

All elevations obtained relative to GDA94 have been reduced to the Australian Height Datum (AHD) using the AUSGeoid09 Geoid – Ellipsoid separation model to determine the separation (N) for the particular area.

GPS observations are made on the GDA94 datum. The height associated with this datum is an ellipsoidal height (h). The Australian Height Datum (AHD), the height datum associated with MGA94, is an orthometric height, which is measured as the height above mean sea level, or the geoid (H).

The function that defines the relationship between the ellipsoid and orthometric heights is:

$$H = h - N$$

Or

$$\text{AHD} = \text{GDA94} - (\text{Geoid-Ellipsoid Separation})$$

AUSGeoid09 is the fourth in a series of national geoid models produced for Australia by the Geoscience Australia. The geoid-ellipsoid data is prepared for the Australian region from:

- EGM2008 Earth Geopotential Model;
- Satellite gravity observations;
- Geoscience Australia's land gravity database;
- Geometric component from GPS and AHD data that accounts for varying offset between a gravimetric quasigeoid and the AHD

AUSGeoid09 N values were interpolated using the in-house NAV12 software and GrafNet Version 8.20 software, distributed by Waypoint Consulting Inc.



4

SURVEY CONTROL

Survey Control points WAL1, JON1, JON2 and JON3 were established on the Jonothon 3D prospect using the Geoscience Australia (GA) AUSPOS online processing service (1.). The AUSPOS results were verified with a post-processed static baseline between WAL1 and JON1 and RTK checks between the other control points. WAL1 was actually BM Walkillie1 at the Walkillie #1 well site, which was also the camp site for the prospect. This BM was surveyed in 1985 and did not have any usable survey information to compare against.

The GPS datum stations adopted for the survey in MGA Zone 54 Co-ordinates are listed below.

Table 4 Datum Stations

Station	Easting	Northing	AHD	Comments
WAL1	467419.370	6998539.860	43.867	AUSPOS Derived
JON1	466308.090	6989386.424	51.116	AUSPOS Derived
JON2	461072.064	6986641.763	47.210	AUSPOS Derived
JON3	456906.291	6987733.637	52.899	AUSPOS Derived

The AUSPOS¹ method requires a minimum of 2 hours of static GPS data to be logged which is then post processed using the AUSPOS online service in a network adjustment with GA Continuously Operating Reference Stations (CORS). This process typically produces accuracies better than 0.05m.

Static observations were processed in a single network in GrafNet software, which allowed the analysis of data, least squares network adjustment, and output of station coordinates. The relative

¹ AUSPOS is Geoscience Australia's on-line post processing engine located at: <http://www.ga.gov.au/earth-monitoring/geodesy/auspos-online-gps-processing-service/faq1.html>

accuracy between control points will be better than 10mm +/- 10ppm at the one sigma level for baselines between 1km and 200km in length.

Primary GPS stations were monumented with a star picket driven in at ground level. A star picket witness post (1.8m) placed within 0.5m of the ground mark. A metal tag detailing prospect name and survey station name was then attached to the witness post.

All raw data and processing files are archived by date and backed-up daily. Field booking sheets are later scanned to digital files. A comprehensive set of data is made available at the project completion including field sketches, processing files, statistical analysis of the network and Permanent Marker station summary diagrams.

The misclose values of control checks can be seen in Appendix B - Survey Control and Miscloses.



MONUMENTATION

5.1 Environmental Monitoring Points (EMP)

At the request of Senex Energy, three (3) Environmental Monitoring Points (EMPs) were installed prior to the commencement of line clearing operations. Points installed were each marked by a star picket with an aluminum identification tag. A listing of EMPs is included in **Appendix D - Environmental Monitoring Points**.

5.2 Permanent Survey Marks (PSM)

Permanent Survey Marks (PSM's) consist of a 1.8m steel fence post (star picket) witness post with a stamped aluminum tag attached, and 0.6m star picket driven flush with the ground at the base. The level and position of the 0.6m picket is the actual reference mark. A PSM was placed at each of the established survey control stations. A listing can be seen in **Chapter 4 – Survey Control**.

5.3 Line Stations

Receiver lines were surveyed at 50.0m station intervals. Wooden stakes, painted blue and numbered front and back, were used to mark every fifth receiver station with intermediate stations being marked by blue pinflags. Source lines were not pegged as the vibrators were to be operated in stakeless mode using GPS navigation. Source lines were driven by the surveyors with the source points being automatically recorded by the GPS software, however white stakes were placed at every 50th station as a reference / check for the vibrators. The surveyor also had the option of recording source points manually.

Receiver line ID's started at 951 and Source lines at 5000. Station numbering increased consecutively progressing along the lines from North West to South East on receivers and South West to North East on source. All lines were surveyed in 3D stakeout mode.

A detailed line listing can be seen in **Appendix C - Line Listing**.



6

METHOD OF SURVEY

6.1 Line Preparation

TC were contracted to carry out the line preparation on the Jonothon 3D. Dozing commenced on 7th February and was completed on 5th March. Grading was completed on 7th March. Production was very steady averaging 32.75Km / day.

TC supplied three dozers and two graders for the job. There were periods where there was only one grader working due to personnel numbers and machinery breakdowns. The dozers also had mechanical issues mainly with overheating.

TC line clearing equipment was fitted out with TSp GPS Seismic line clearing units. These units comprise either Algiz 10x or Motion tablets running TSp NavMini machine guidance software in combination with an external Garmin USB or serial GPS receiver. The line preparation GPS units had some problems during the survey especially the Garmin external GPS receivers and the new Algiz tablets – two of which overheated. It was found that some of the Garmin GPS units were defective and were possibly part of a bad batch. They were replaced and this appeared to resolve the issue.

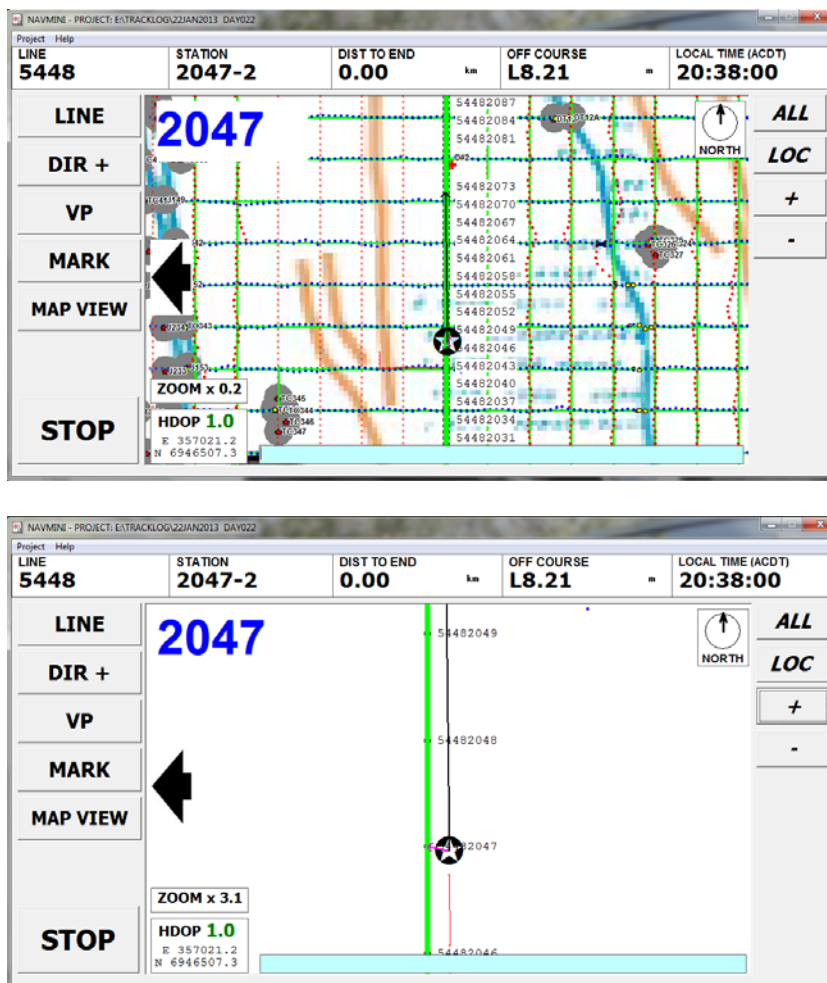


Figure 2 Example NavMini navigation screens

In the case of GPS accuracy loss, operator's back-track down the line to the last good position fixes to confirm the GPS antenna is still in working order. For small distances, such as passing under trees, operators will use back-sighting down the line to pass the obstacle and reacquire position fix. When operating with poor positional accuracy, preference is to walk forward with the blade up until accuracy is restored. This way when the line is cleared the operator will be able to forward sight. If, for an extended period of time, GPS fix isn't possible the operator will pull-up and make contact with the line pointer. The line pointer will assess the situation and the best approach to proceed such as walking ahead with a hand-held GPS and flagging the route for the operator.

The TSp Line Pointer worked closely with the operator scouting ahead where possible and on-call for assistance in the field. When in radio range, TC operators also have the available assistance of the senior surveyor at camp, as well as Survey Technicians in the field. Machine operators GIS data and accompanying hardcopy maps were updated daily and toolbox briefings held discussing obstacles likely to be encountered during the day.

The prospect fell within the Yandruwandha / Yawarrawarrka (YY) native title area. Three Cultural Heritage work area clearance (WAC) crews consisting of two persons in each crew were employed and managed by Senex. Senex supplied a CH supervisor to manage operations and archaeologists to accompany each crew, process CH data and supply CH data files to TSp. TSp processed this data and updated line preparation and survey GPS units with current CH information. A WAC crew

accompanied each dozer and assisted the dozer by locating CH sites and suitable access to detour around them.

6.2 GPS Surveying

Two modes of GPS surveying were used on the prospect – Real Time Kinematic (RTK) with Omnistar satellite corrections and standard RTK using radio broadcast corrections. Of the two, the radio based RTK mode enables higher accuracy in position and elevation co-ordinates and is also much quicker in gaining RTK initialisation. Omnistar based RTK is more flexible in that a terrestrial base station is not required, however initialisation takes much longer each time and position accuracy is less than with radio based RTK. For 3D work it is usually preferable to use radio based RTK as the baseline distances are normally shorter and the positional accuracy is much better. The Omnistar RTK survey method was used for the majority of the line surveying.

The Omnistar RTK survey method utilised dual frequency (L1/ L2) phase data received from US Navy NAVSTAR satellites and Russian GLONASS satellites to provide three-dimensional positioning. Corrections for the GPS satellite positions are received from a privately operated source, which transmits them from another satellite. These corrections are applied in real-time to improve position accuracy.

Using these methods of positioning calculation, the NovAtel dual frequency real-time kinematic method can achieve accuracies of better than $\pm 0.15\text{m}$ in position and elevation for radio RTK and $\pm 0.30\text{m}$ for Omnistar RTK, depending on satellite constellation geometry.

Using the TSp in-house developed Nav12 software, checks and ties were examined in real-time operation to assess coordinate integrity.

6.3 Processing and Quality Control

All survey data were immediately recorded internally on the Motion Tablets and subsequently downloaded to the office computer each evening.

Quality of the satellite data was monitored by careful examination of the various on-screen quality control statistics produced by the NAV12 software. These checks on data integrity are in the form of standard deviation (or sigma) values for Easting, Northing and Height and are generally better than 0.15 metres.

Any recording of positions where the standard deviation values exceeded 0.15 metres was highlighted to the surveyor at the time of recording. Following this, it was possible to re-initialise the GPS in order to obtain a more accurate solution. Any recorded position falling outside the required tolerances was flagged for further investigation and re-recording if necessary.

Numerous checks on pre-recorded marks were observed during each day's survey in order to confirm the integrity of the RTK corrections and the placed markers.

All in-field data was recorded to Nav12 files for traceability and archived accordingly. Field booking sheets were used by each surveyor, each day, and scanned at a later date. Additional quality checking information included a database of production, Finals checklist, daily reports and daily productions maps.

On return to camp the field data was downloaded into GPSeismic QuickView processing software where further QC checking was done and any points requiring review were flagged. Several QC checks were done and the data was then loaded into a survey database where further checking could be done. The QC checks included the following:

- Base coordinates and elevation were checked on download against the control data.
- Antenna heights were checked.
- Cross line and inline offsets from design were checked for any anomalies.
- GPS quality checks. (Horizontal precision, Vertical precision, Number of satellites and RMS.
- Initialization checks.
- Checkshot comparisons
- Old Permanent Marker comparisons
- Missing station checks.

Once checking was complete in QuickView and loaded into the survey database, data could then be queried using GPSQL and the results exported to mapping software (MapInfo / GlobalMapper) or to reports. The mapping software allowed for quick visual checking of point locations. Final survey data was also generated through GPSQL. GPSQL also had numerous QC / reporting capabilities including vertical and horizontal profiling, point interpolation, check shot comparisons, offset data recalculation, DEM operations, intersection calculations, station interval calculations, flexible reporting options and extensive data management capabilities.

Daily reports were emailed each day, along with daily production maps, and weekly reports as required.



7

DATA PRESENTATION

All line files were checked and finalised before the survey crew demobilised from the project.

All final data were in UTM grid coordinate format on the MGA94 Zone 54 projection on the GRS80 reference spheroid. All elevations were on the Australian Height Datum (AHD71).

Data including maps, dozer track files and postplot survey data were submitted to the Senex Client Representative on a daily basis.

Final data produced were:

- **Daily Reports Folder** - XLSX containing tabs for daily report and production map
- **Final Operations Report** - PDF of the final operations report
- **Final Survey Data Folder**
 - **SPS/RPS** - Receiver data in r01 and Source in s01 format
 - **SEG** - Line data in SEG P1 format
 - **UKA** - Line data in UKOOA format
- **MapInfo Folder** - Associated TAB files
- **Maps Folder** - PDF of General and Panel Maps
- **Photographs Folder** - JPG files of all job photographs
- **EMP Folder** - JPG files and PDFs of EMPs

All files are backed up on digital disks in the Brisbane office for future reference.



HEALTH, SAFETY AND ENVIRONMENT

All personnel were aware of safety conditions concerning all exploration seismic surveys. The Terrex Spatial **“Quality Policy Statement”** and **“Health, Safety and Environment Policy”** documents were adhered to at all times.

Terrex Spatial adhered to the Terrex Seismic ERP and SSSP documents, which governed this project.

Besides site inductions, all TSp personnel have completed 4WD and First Aid training. All personnel had also completed the Senex heat stress online induction.

Senex supplied a paramedic to the crew. The paramedic spent each day with the CH clearance crews as a driver.

All TSp vehicles were fitted with UHF radios, satellite phone, shovel, first-aid kit, dry powder and water fire extinguishers, vehicle recovery equipment and rotating beacon. Vehicle prestart checks were carried out each morning and the prestart check books filled out and passed onto the crew HSE officer.

Daily toolbox meetings and weekly safety meetings were chaired by the TC crew manager and documented by the crew HSE officer. All personnel including Client Representative and CH crews were breathalysed each morning prior to the toolbox meeting. There was good participation at the toolbox meetings by all parties.

9

OPERATIONAL ASPECTS

TSp Crew 2 mobilised to site on 5th February 2015. The initial crew consisted of Jim Cagney (Project Manager), Stewart Folley (Senior Surveyor), Andrew James (Line Pointer), Fraser Pichon (line surveyor) and Darren Kam (line surveyor). The Terrex Contracting (TC) Crew 2 camp was located at Walkillie #1 well site (P&A). KJM supplied demountable vans and a generator for the Cultural Heritage clearance crews

TSp Crew 2 and TC Crew 2 personnel were inducted by Senex client representative Leigh Franks on 6th February. The Cultural Heritage (CH) clearance crew personnel arrived later that evening. TSp Crew 2 personnel set up the navigation GPS units on the dozers, set up the survey GPS units and created project data and maps as well during the day.

On the morning of 7th February Leigh Franks conducted a CH induction and Robin (TC HSE) conducted a “working around heavy equipment” induction. CH clearance and line preparation operations then commenced. The survey crew began mapping the prospect and Jim Cagney and Stewart Folley worked in the office setting up the project.

AUSPOS static data was also logged at Walkillie 1 BM (WAL1) on 7th February to establish a check station at the camp site for the Omnistar RTK survey. This was successfully processed the next day.

Survey fieldwork commenced on 8th February with one field crew while mapping of the prospect continued. The survey crews used Omnistar receivers to commence fieldwork. The second survey crew commenced on 9th February while Eric Amedee (Senior Surveyor) commenced mobilization from Yeppoon the same day.

Eric Amedee arrived on crew on the afternoon of 10th February. He took over from Stewart Folley as Senior Surveyor on 11th February. Andrew James (line pointer) went on break on 12th February and Stewart Folley took over as line pointer. Jim Cagney remained on crew until 15th February then moved over to Crew 1. There were further survey crew changes during the survey with Navjeet Jain (line surveyor) in on 17th February, Andria Gordon (line surveyor) in on 18th February, Fraser Pichon out on 18th February, Darren Kam out on 19th February, Justin Matthews (Line Pointer) in on 25th

February and Stewart Folley out on 26th February. Dean Hausmann (Operations Manager) visited the crew on 26th February, remaining on crew until 6th March at which time he moved to the recording crew camp. Dean spent most of his time on crew setting up the vibrator GPS for stakeless source operations.

Survey and line preparation operations continued smoothly with moderate production in small to medium sized sand dune terrain. The WAC crews were only doing 10hr days so production often finished early if there was no line cleared ahead of the dozer.

There were numerous hand carry sections on receiver lines due to dozer operators moving lines off the slopes of dunes many of which could easily have been kept on line. There were also numerous hand carry sections in the western corner of the prospect due to many CH sites, creek channels and Santos pipeline corridor. The survey crew used radio based RTK for the hand carry sections of line – JON1, JON2 and JON3 were used as RTK base stations during the survey. There was one skipped (dead) receiver station which fell in a waterhole.

There were also many source offsets and detours for the Santos oil pipelines, CH sites and waterholes in the western corner. There were twelve (12) vibrator skips due to these obstacles.

Dozing operations were completed on 5th March while grading and survey operations were completed on 7th March. The camp, including the KJM vans, were moved to Mudrangie 3D (west of Bookabourdie Satellite) on 6th March without incident. It was a short camp move of approximately 75Km.



10

CONCLUSIONS AND RECOMMENDATIONS

Throughout the Jonothon 3D TSp Crew 2 achieved adequate production enabling it to stay within a day or two of line preparation. At the end of the survey the crew had to travel back from Mudrangie 3D prospect for one day to complete the fieldwork – this was due to the number of backpack receivers in the western end. Overall survey operations ran smoothly and no major operational issues were encountered.

TSp Crew 2 were using GPSeismic processing software for the first time on this prospect. The introduction of this software, which is specifically designed for managing 2D and 3D seismic surveys, required some changes to survey field and office procedures. It was a learning curve during the survey but most issues had been resolved by the end and a processing regime had been established to utilise on future surveys.

There were many late nights processing CH data so that it would be ready to load into the line preparation and survey GPS units in the mornings. On future surveys this processing could be delayed until the morning and then update the units in the field.

Survey Statistics:

- The project consisted of 844.45 kilometres pegged over a period of 28 days
- Averaging 31.59kms per day (including hand-carry and field checks)
- 220 Hand-carry points, due to infrastructure or CH sites and deviations.
- 1 Dead station due to creek
- 12 Vibes Skips due to creek, pipeline or CH sites.

TSp hopes to utilise the experience gained from this project to further develop and grow in our ability to face evermore challenging projects. We welcome any feedback to aid in continual improvement.

Signed,

Terrex Spatial

Eric Amedee

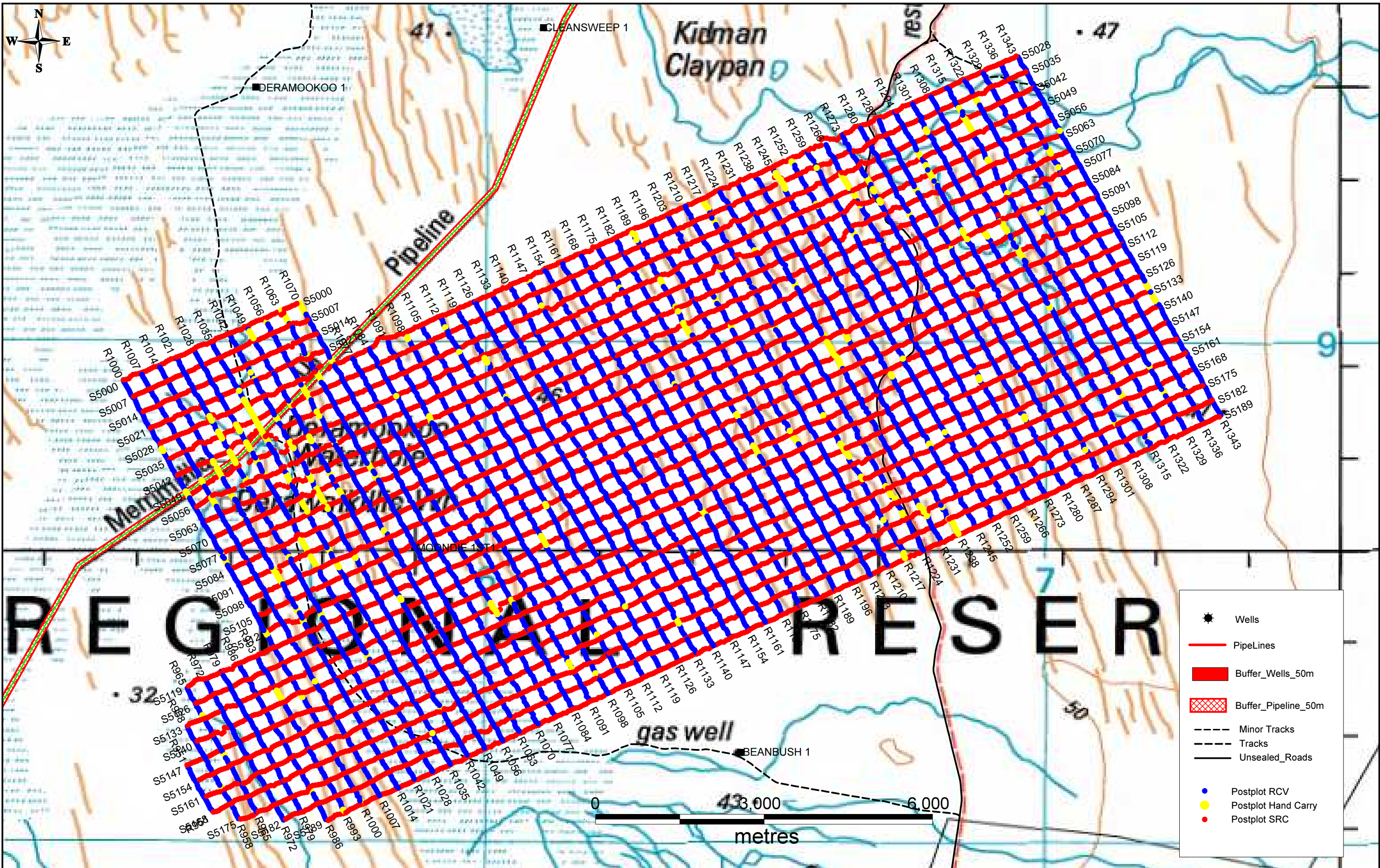
Senior Surveyor



11

APPENDICES

Appendix A - Project Map



Scale 1 : 60000 (A3)
Drawn Eric Amedee
Job# Jonathon 3D
File Jonathon 3D Prospect Map.pdf
Rev 1.0
Date 10/04/15

SENEX ENERGY

Jonathon 3D

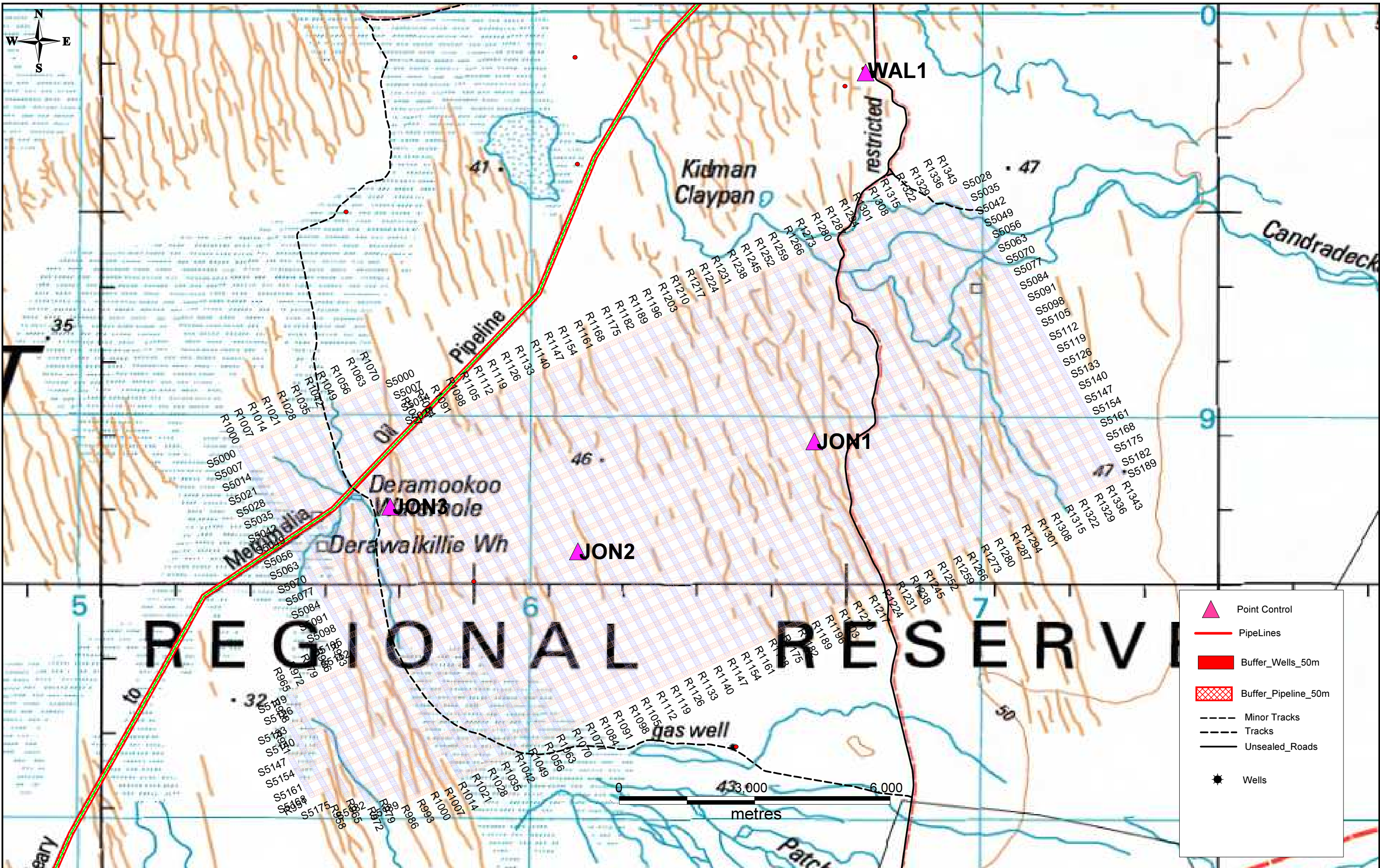
Prospect Map

Map pictorially represent surveyed data.
The accuracy of underlying topographic image
may not relate to the accuracy of surveyed data.
Any use of this map for reasons other than the
intended purpose is not authorised.

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Appendix B - Survey Control and Miscloses



Scale 1 : 60000 (A3)
Drawn Eric Amedee
Job# Jonothon 3D
File Jonothon 3D Control Map.pdf
Rev 1.0
Date 10/04/15

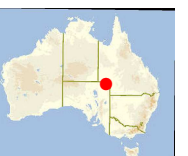
SENEX ENERGY

Jonothon 3D

Control Map

Map pictorially represent surveyed data.
The accuracy of underlying topographic image
may not relate to the accuracy of surveyed data.
Any use of this map for reasons other than the
intended purpose is not authorised.

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Survey Control and Miscloses

All values are MGA94 (Zone 54), AHD71 (Ausgeoid09)

Survey Control Stations:

Survey Reference System:			MGA Zone 54 / AHD71 (AUSGeoid09)		
Initial Control Datum Used:					
DAY	STATION	EASTING	NORTHING	RL	COMMENTS (Origins and Accuracy)
37	WAL1	467419.370	6998539.860	43.867	AUSPOS derived
46	JON1	466308.090	6989386.424	51.116	AUSPOS derived
51	JON2	461072.064	6986641.763	47.210	AUSPOS derived
59	JON3	456906.291	6987733.637	52.899	AUSPOS derived

Control Miscloses:

DAY	STATION	EASTING	NORTHING	RL	COMMENTS
37	JON1	466308.090	6989386.424	51.116	GIVEN - AUSPOS
46		466308.114	6989386.411	51.115	OURS - static
		0.024	-0.013	-0.001	MISCLOSE (OURS - GIVEN)
37	WAL1	467419.370	6998539.860	43.867	GIVEN - AUSPOS Day 037
59		467419.335	6998539.88	43.889	OURS - AUSPOS Day 059
		-0.035	0.020	0.022	MISCLOSE (OURS - GIVEN)

Appendix C - Line Listing

Jonothon 3D Seismic Survey

Receiver Line Lengths Summary

Line	From	To	PTS	km
R951	5147	5167	21	1.05
R958	5133	5174	42	2.10
R965	5119	5174	56	2.80
R972	5119	5181	63	3.15
R979	5119	5181	63	3.15
R986	5119	5188	70	3.50
R993	5119	5188	70	3.50
R1000	5000	5188	189	9.45
R1007	5000	5188	189	9.45
R1014	5000	5188	189	9.45
R1021	5000	5188	189	9.45
R1028	5000	5188	189	9.45
R1035	5000	5188	189	9.45
R1042	5000	5188	189	9.45
R1049	5000	5188	189	9.45
R1056	5000	5188	189	9.45
R1063	5000	5188	189	9.45
R1070	5000	5188	189	9.45
R1077	5028	5188	161	8.05
R1084	5028	5188	161	8.05
R1091	5028	5188	161	8.05
R1098	5028	5188	161	8.05
R1105	5028	5188	161	8.05
R1112	5028	5188	161	8.05
R1119	5028	5188	161	8.05
R1126	5028	5188	161	8.05
R1133	5028	5188	161	8.05
R1140	5028	5188	161	8.05
R1147	5028	5188	161	8.05
R1154	5028	5188	161	8.05
R1161	5028	5188	161	8.05
R1168	5028	5188	161	8.05
R1175	5028	5188	161	8.05
R1182	5028	5188	161	8.05
R1189	5028	5188	161	8.05
R1196	5028	5188	161	8.05
Line	From	To	PTS	km
R1203	5028	5188	161	8.05
R1210	5028	5188	161	8.05

Line	From	To	PTS	km
R1217	5028	5188	161	8.05
R1224	5028	5188	161	8.05
R1231	5028	5188	161	8.05
R1238	5028	5188	161	8.05
R1245	5028	5188	161	8.05
R1252	5028	5188	161	8.05
R1259	5028	5188	161	8.05
R1266	5028	5188	161	8.05
R1273	5028	5188	161	8.05
R1280	5028	5188	161	8.05
R1287	5028	5188	161	8.05
R1294	5028	5188	161	8.05
R1301	5028	5188	161	8.05
R1308	5028	5188	161	8.05
R1315	5028	5188	161	8.05
R1322	5028	5188	161	8.05
R1329	5028	5188	161	8.05
R1336	5028	5188	161	8.05
R1343	5028	5188	161	8.05
		Total:	8743	437.15
		# Lines:	57	

Jonothon 3D Seismic Survey

Source Line Lengths Summary

Line	From	To	PTS	km
S5000	1000	1069	70	3.50
S5007	1000	1069	70	3.50
S5014	1000	1069	70	3.50
S5021	1000	1069	70	3.50
S5028	1000	1342	343	17.15
S5035	1000	1342	343	17.15
S5042	1000	1342	343	17.15
S5049	1000	1342	343	17.15
S5056	1000	1342	343	17.15
S5063	1000	1342	343	17.15
S5070	1000	1342	343	17.15
S5077	1000	1342	343	17.15
S5084	1000	1342	343	17.15
S5091	1000	1342	343	17.15
S5098	1000	1342	343	17.15
S5105	1000	1342	343	17.15
S5112	1000	1342	343	17.15
S5119	965	1342	378	18.90
S5126	965	1342	378	18.90
S5133	958	1342	385	19.25
S5140	958	1342	385	19.25
S5147	951	1342	392	19.60
S5154	951	1342	392	19.60
S5161	951	1342	392	19.60
S5168	951	1342	392	19.60
S5175	958	1342	385	19.25
S5182	972	1342	371	18.55
S5189	986	1342	357	17.85
		Total:	8946	447.30
		# Lines:	27	

Appendix D - Environmental Monitoring Points



EMP/ERF LOCATION DIAGRAM

TSp-FF-36
REV 2.0
December 2011

PROJECT / JOB # Jonothon 3D CLIENT Terrex / Senex DAY / DATE Feb 2015

NAME: EMP01 (Tagged EMP01 Jonothon 3D)

AREA: KELEARY (Oil field) ACCESS RD - SA MAP REFERENCE : _____

<u>Grid Coordinates</u>		<u>Geographical Coordinates</u>	
Easting:	467039.2 E	Latitude:	27°13' 43.8" S
Northing:	6988175.4 N	Longitude:	140°40' 01.6" E
Datum:	MGA94 Zone: 54	Datum:	GDA94

Mark Description: **Station is located at the intersection of line S5140 and R1231 on flat ground, eastern base of a low rolling dune, adjacent Keleary access track (western side), 12km south of Walkillie Bore.**

Photograph looking North at station.



Photograph looking South at station.



Photograph looking East at station.



Photograph looking West at station.





EMP/ERF LOCATION DIAGRAM

TSp-FF-36
REV 2.0
December 2011

PROJECT / JOB # Jonothon 3D CLIENT Terrex / Senex DAY / DATE Feb 2015

NAME: EMP02 (Tagged EMP02 Jonothon 3D)

AREA: KELEARY (OIL FIELD) ACCESS RD - S.A MAP REFERENCE : _____

<u>Grid Coordinates</u>		<u>Geographical Coordinates</u>	
Easting:	467338.9 E	Latitude:	27°12' 22.1" S
Northing:	6990677.1 N	Longitude:	140°40' 12.7" E
Datum:	MGA94	Zone:	54
		Datum:	GDA94

Mark Description: **Station is located at the intersection of line S5098 and R1259 on top of a low rolling dune, western side of Keleary access track, 9Km south of Walkillie Bore.**

Photograph looking North at station.



Photograph looking South at station.



Photograph looking East at station.



Photograph looking West at station.





EMP/ERF LOCATION DIAGRAM

TSp-FF-36
REV 2.0
December 2011

PROJECT / JOB # Jonothon 3D CLIENT Terrex / Senex DAY / DATE Feb 2015

NAME: EMP03 (Tagged EMP03 Jonothon 3D)

AREA: Bushbean (Well) access track - SA MAP REFERENCE : _____

<u>Grid Coordinates</u>		<u>Geographical Coordinates</u>	
Easting:	456566.8 E	Latitude:	27°14' 41.4" S
Northing:	6986378.6 N	Longitude:	140°33' 40.6" E
Datum:	MGA94	Zone:	54
		Datum:	GDA94

Mark Description: **Station is located at the intersection of line S5077 and R1028 on the western side of Bushbean access track, in the southern area of Deramookoo Waterhole (2km south of Cook to Merrimelia oil pipeline).**

Photograph looking North at station.



Photograph looking South at station.



Photograph looking East at station.



Photograph looking West at station.

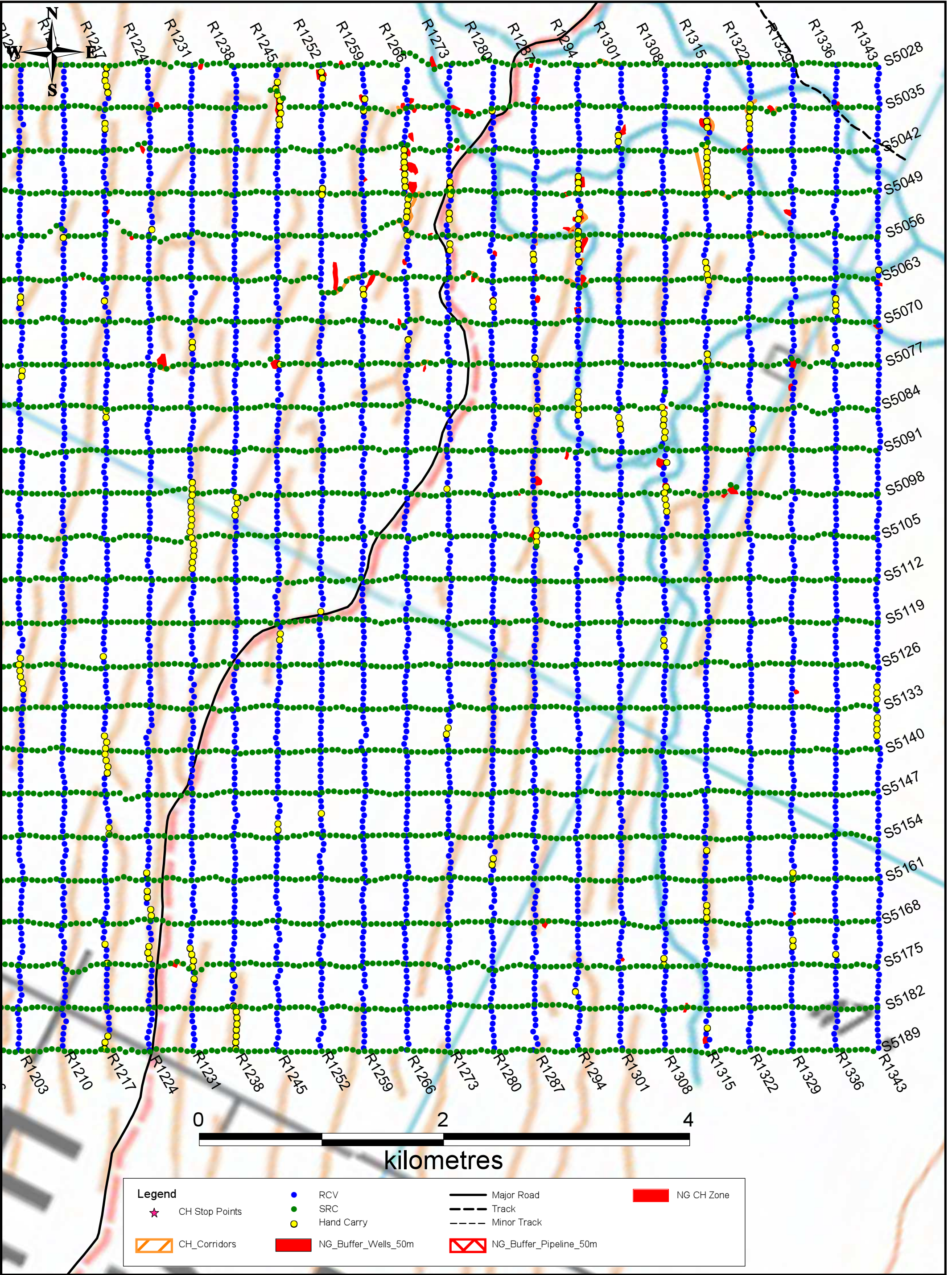


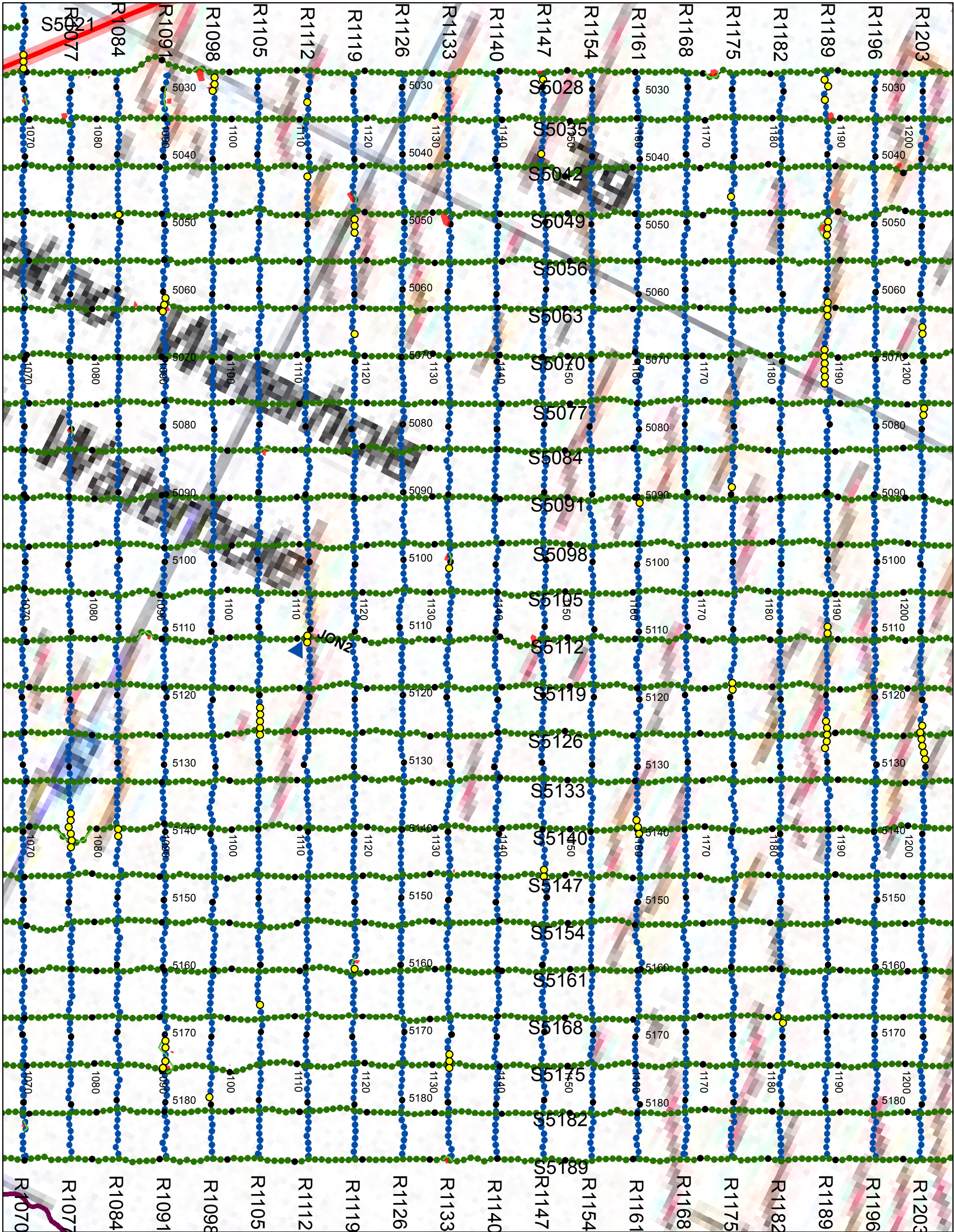
Jonothon 3D Seismic Survey

Environmental Monitoring Points

EMP	Easting	Northing	Elev.	Comment
EMP1	467035.14	6988182.50	39.32	INT R1231/S5140
EMP2	467336.55	6990677.72	44.10	INT R1259/S5098
EMP3	456566.80	6986378.60	N/A	INT R1028/S5077

Appendix E - Panel Maps





Legend

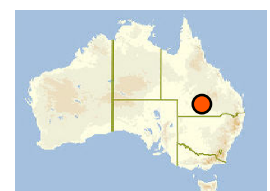
- Hand Carry Receiver (Yellow dot)
- Source (Green dot)
- CH Site areas (Red line)
- CH Sites (Pink line)
- STOP Points (Red circle with 'X')
- Roads (Purple line)
- Pipelines_50 (Light pink line)



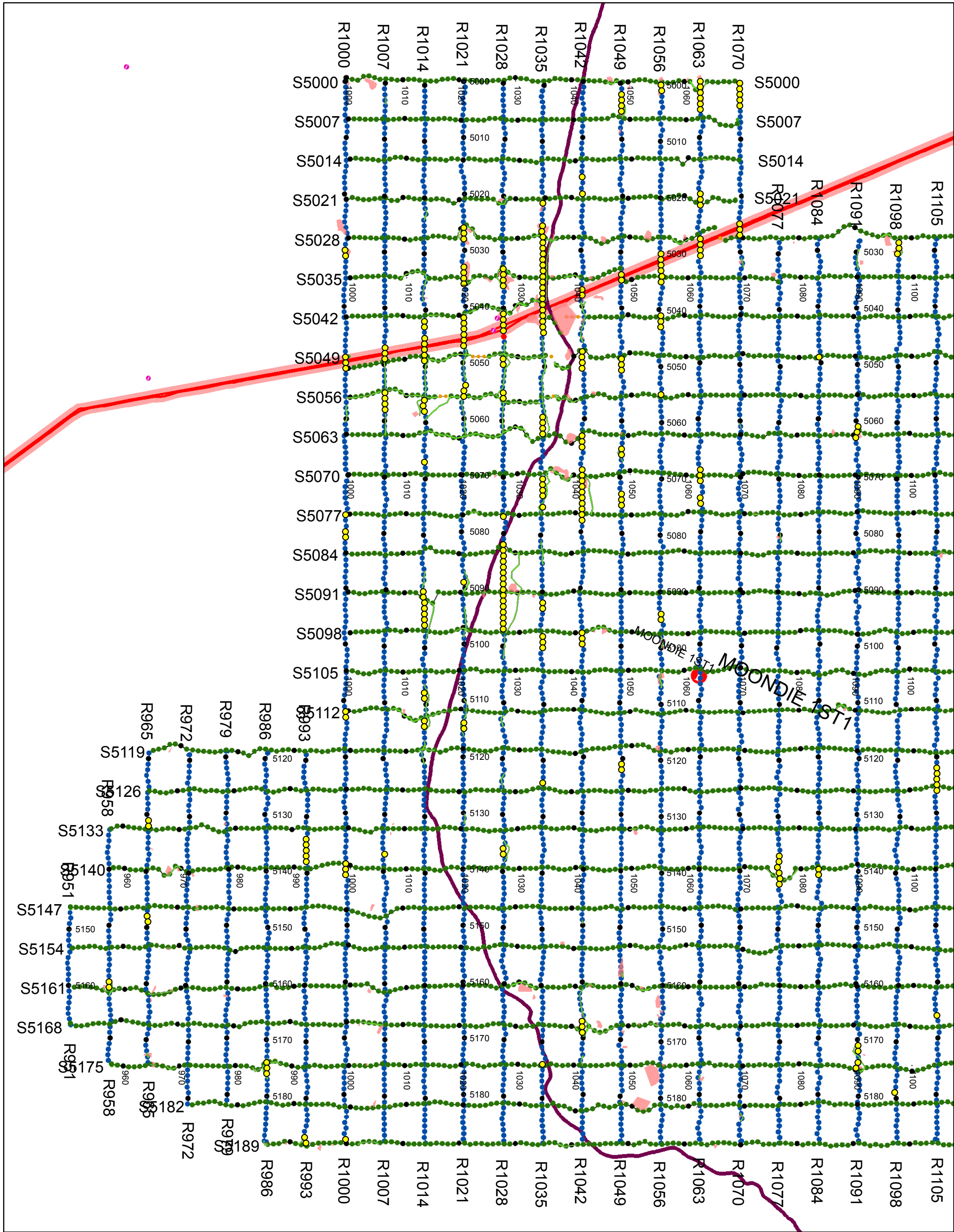
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Job#: J000269
Jonothon_3D_Panel_Centre_150304
Rev: 1
Date: 04/03/2015

Senex Energy Jonothon 3D Panel Map (Centre section)

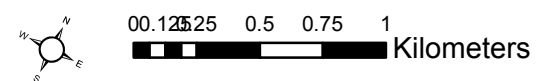
Map pictorially represent surveyed data.
The accuracy of underlying topographic
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Terrex Spatial : Phone 1800 060 407



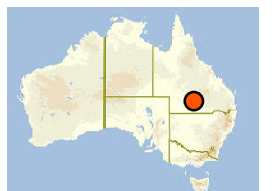
- Legend
- Hand Carry
 - Receiver
 - Source
 - CH Site areas
 - CH Sites
 - Roads
 - Pipelines_50



Scale: 1:25000
 Drawn: ERA
 Job#: J000269
 Jonothon_3D_Panel_West_150307
 Rev: 1
 Date: 07/03/2015

Senex Energy Jonothon 3D Panel Map (Western section)

Map pictorially represent surveyed data.
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 of surveyed data. Any use of this map
 for reasons other than the intended
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Terrex Spatial : Phone 1800 060 407

Appendix F - Photographs



Photograph 1 **Access Track**



Photograph 2 **Cultural Heritage Team – Mark/Aaron – S5000**



Photograph 3 **Claypan**



Photograph 4 **Claypan R1063**



Photograph 5 **Jon1**



Photograph 6 **Jon2 Outlook**



Photograph 7 **Jon2**

Appendix E HSE – Jonothon 3D End of Contract Report



Jonothon 3D Seismic Survey

01/03/2015 – 16/03/2015

HSE End of Contract

Client: Senex Energy Limited
Location: Cooper Basin
Permit: PEL 638
Project No: J00269

Crew A2 & TC 2

Richard Barnes - Operations Manager

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Tables


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1 Summary

01/03/2015	Mobilise to Senex Jonothon 3D on the Keleary access track and start to set up camp. Set up muster point and update muster point register.
02/03/2015	Finish setting up camp. Client Site and Cultural Heritage induction to line crew. Some line crew go out and start production. The rest finish off setting up of camp.
03/03/2015	Client Site and Cultural Heritage Inductions for the rest of the crew. All line crew out online on production. Getting ready for crew change.
04/03/2015	Crew change. Client Site and Cultural Heritage Inductions. Terrex Site re-Inductions. IVMS re-issue of keys.
05/03/2015	Peter O'Donnell arrived to site today. Client Site and Cultural Heritage Inductions. Terrex Re-Induction and Re-issue of IVMS keys. Fit for Purpose Campsite Audit and Inspection Checklist. HSE Observation- Kitchen-TS-SOP-KIT001/TS-SOP-KIT002/TS-SOP-KIT003/TS-SOP-KIT004
06/03/2015	Luke Samios arrived to site today. Go through all smoke detectors.
07/03/2015	Client Site and Cultural Induction. Terrex re-Induction. Re-issue of IVMS key. SOP Training.
08/03/2015	Safety Sunday-Hyperthermia and Heat Stress-facilitator-Malcolm Ball Paramedic. Fire Drill to Muster Point. HSE Observation – Laying out of Seismic Cable TS-SOP-RC006 and HSE Observation- Laying out Geophones-TS-SOP-RC011.
09/03/2015	Delivery of stock for RFDS box N2472. Paramedic to restock.
10/03/2015	Courtney O'Connor arrived today. Terrex Re-Induction. Issue of IVMS key. Field Emergency Drill-roll over.
15/03/2015	HSE Handover.
16/03/2015	Demob Journey Management, preparation for camp move.

2 Statistical Summary

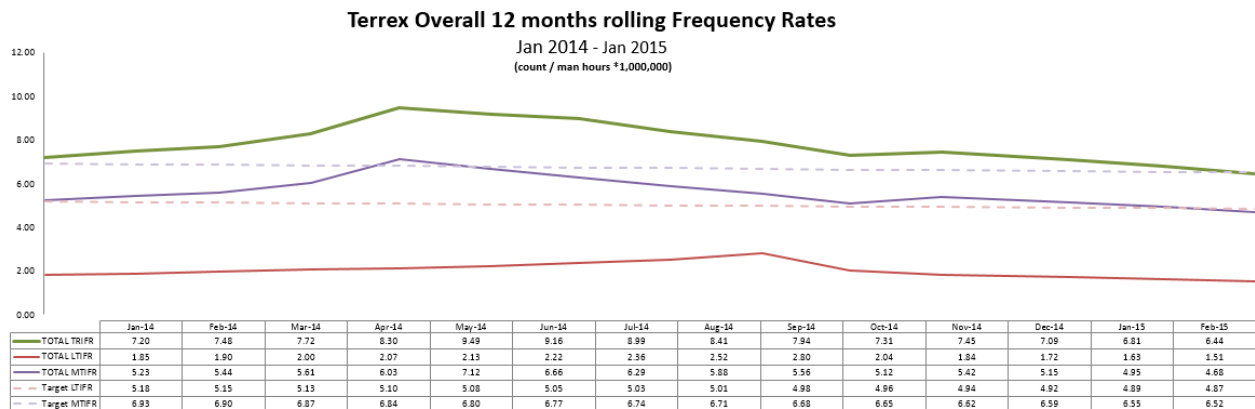
Table 1 Contract Statistics – Monthly Breakdown

<div> <div>Combined Crew A2 and TC2 Monthly Safety Stats</div>  </div>			
	Feb	Mar	YTD
Terrex Seismic Man-hours	1224.00	19560.00	20784.00
Sub-Contractor Man-hours	15792.00	432.00	16224.00
Fatalities	0	0	0.00
LTI's	0	0	0.00
MTI's	0	0	0.00
Days since last MTI/LTI	0	0	0.00
Serious Potential Incidents (SPI)	0	0	0.00
First Aid Incidents	0	0	0.00
Environmental Incidents Land Spills (< 5 litres)	0	0	0.00
Cultural Heritage Incidents	0	0	0.00
Incident / Accident Reports	1	0	1.00
Near Miss Reports	0	0	0.00
Work Days Lost	0	0	0.00
Hazard Identification Reports	80	27	107.00
Training Hours	74.00	109.00	183.00
Tool Box / Safety Meeting Man-hours	155.50	250.40	405.90
Audits / Inspections	3	5	8.00
Drills	1	2	3.00
			37008.00

TOTAL TRIFR	0.0	0.0	0.0
TOTAL LTIFR	0.0	0.0	0.0
TOTAL MTIFR	0.0	0.0	0.0
Hazard Identification Report	4701.5	1350.5	2891.3

Lead Indicators	Feb	Mar	YTD
Hazard Identification Reports Received	80	27	107.00
Hazard Reports Closed - No. Closed out in ATR	78	26	104.00
Audits/Site Inspections inc HSE obs/ins.	3	5	8.00
Equipment Inspections	106	210	316.00
Training & Induction Hours	74	109	183.00
Tool Box / Safety Meeting Man-hours	156	250	405.90
Tool Box Meetings Conducted	15	13	28.00
HSE Meeting Conducted	3	2	5.00
Risk Assessments Conducted	0	0	0.00
JSA's &/or PTW Conducted	2	0	2.00
SOP's Reviewed	0	1	1.00
IVMS Kms Driven	2,493	3,341	5834.00
IVMS Breaches	0	2	2.00
Drills	1	2	3.00
BAC Conducted	523	833	1356.00
BAC Passed	523	832	1355.00
Drug Test Conducted	0	9	9.00
Drug Test Passed	0	9	9.00
New Hires Commenced this week	0	0	0.00
Employees terminated /left this week	0	1	1.00

Table 2 Overall Terrex Safety Performance vs Terrex Targets



2.1 Key Performance Indicators

Key Performance Indicator	Measure	Achieved (yes/no)	Performance Score
All personnel to complete Santos Level 1, 2 & Heat Stress Inductions as well as Santos Approved 4WD training	100% Compliance	YES	100%
Land Transportation Incidents per month	<2	YES	100% No Land Transportation Incidents
Emergency Drills Conducted per project (specifically fire or medical)	1+	YES	100%
ATR/Hazard Reports Closed out within 90 days	90%	YES	100%
IVMS Exceptions per project	<10	YES	5
Documented Crew Manager Inspections per month	4	YES	100%
Documented Department Head Inspections per month (Line Boss, Mechanic, Cable Repair)	each department head once per month	YES	100%
Site Audit of Subcontractor Activity	each contractor 3 monthly	YES	100%
Consistency in Hazard Reporting volume & Quality throughout all departments based the ratio of number of people in each department	At least 1 per person per month (all departments)	YES	100% 107 HIR Cards Received.

3 Land Transportation

3.1 IVMS Risk Management Report

A2 IVMS Report

Risk Management Report																	
Company Name		Terrex															
From		Mar 01, 2015															
To		Mar 16, 2015															
Distance Unit		km															
Speed Unit		km/h															
Item	Group	Group	Total Distance	Speeding > 5 kph		No Seatbelt		Harsh Braking 17 k/h/s		Device was unplugged		Possible Tamper		Open Circuit on Antenna		Short Circuit on Antenna	
				Duration	Count	Duration	Count	Duration	Count	Duration	Count	Duration	Count	Duration	Count		
David McKone	CREW A2		891.67	0:00:27	1	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
#529876862 Chris Grams	CREW A2		453.17	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
5323330102 Jacob Arnall	CREW A2		2.97	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582954477 Kristian Prott	CREW A2		472.91	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
640150925 Carlo Paul	CREW A2		525.93	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
640150943 Paul Parsons	CREW A2		731.81	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
640808343 Jamie Goodwill	CREW A2, Terrex Seismic Aux		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
363597228 Thomas Midgley	CREW A2		449.92	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582947051 Peter Webber	CREW A2		273.17	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
454742268 Poemark Toese	CREW A2, Terrex Seismic Aux		58.91	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Dave Keel	CREW A2		39.85	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578466535 Benjamin Tabone	CREW A2		820.61	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582943903 Ron Dover	CREW A2		447.57	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578436231 Andrew Williams	CREW A2		1554.78	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578437451 Daniel Richardson	CREW A2		31.22	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
577386376 Murray Whyte	CREW A2		1226.68	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
640285027 Alex Kerr	CREW A2		619.09	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
529887664 A. Dorrington	CREW A2, Terrex Seismic Aux		796.24	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
532134388 Cameron Brooker	CREW A2, Terrex Seismic Aux		726.02	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Lachlan Falzdeen	CREW A2		257.40	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Jacob Pihama	CREW A2		1275.83	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578432615 Dianne Williams	CREW A2		52.30	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578465139 Ryan Ward	CREW A2		180.32	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582946819 Cherrie Collier	CREW A2		0.06	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
627870149 Stephane Mallard	CREW A2, Terrex Seismic Aux		0.20	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Sophie Carter	CREW A2		1296.91	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
640809775 Matthew Woolley	CREW A2, Terrex Seismic Aux		116.67	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582944503 Clinton Avenell	CREW A2		453.17	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
211962442 Lachlan Jones	CREW A2, Terrex Seismic Aux		422.38	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
464269356 D. Wex	CREW A2, Terrex Seismic Aux		625.26	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
529880482 C. Brooker	CREW A2, Terrex Seismic Aux		0.57	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
532132134 K. Grace	CREW A2, Securatrak Reporting, Terrex Se		180.70	0:00:57	2	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
580898080 Christopher O'Donnell	CREW A2		452.91	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582251813 Daniel Blackburn	CREW A2		498.75	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582944159 Jacob Arnall	CREW A2		30.01	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582965567 Kirsten Heindel	CREW A2		696.57	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
676083019 S. Ollerenshaw	CREW A2		735.48	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
532484216 Benjamin Greaney	CREW A2		0.88	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
580867644 L. Gillen	CREW A2		97.03	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
687588250 Adam Cameron	CREW A2		172.92	0:14:53	2	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
454571527 A. Cheyne	CREW A2, Terrex Seismic Aux		0.29	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
463724032 Courtney O'Connor	CREW A2, Terrex Seismic Aux		652.82	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
532130988 P. O'Donnell	CREW A2, Terrex Seismic Aux		484.72	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
#530045696 Luke Anderson	CREW A2, Securatrak Reporting		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
HSE	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Emma Stolz	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Cameron Brooker	CREW A2, Securatrak Reporting, Terrex		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Hayden Fairfield	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Stephen Smith	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Joshua Fleming	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582249388 Luke Samios	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Mark Bright	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
529888236 Geoff Oswell	CREW A2, Terrex Seismic Aux		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
C. Brooker	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
529889280 Bill Perkins	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Daniel Blackburn	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
532334730 Neville Draper	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Bob Gardener	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
M. Finch	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Jack Burke	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
577395306 Peter Poznik	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Ben Dillon	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578452887 Anna Dorrington	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
578452929 Alisha Glover	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Warren McConville	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Jacob Arnall	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
J. Selter	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
Steven Weare	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	
582959527 Benjamin Dillon	CREW A2		0.00	0:00:00	0	0:00:00	0	0:00:00									

TC2 IVMS Report

Risk Management Report													
Company Name		Terrex											
From		Feb 05, 2015											
To		Feb 28, 2015											
Distance Unit		km											
Speed Unit		km/h											
Item	Group	Total Distance	Speeding > 5 kph		No Seatbelt		Harsh Braking 17 k/h/s		Device was unplugged		Possible Tamper		Short Circuit on Antenna
			Duration	Count	Duration	Count	Duration	Count	Duration	Count	Open Circuit on Antenna	Count	
5321341158 G Cato	TC2 NEW, Terrex Seismic Aux	2.76	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
Michael Grassick	TC2 NEW, TC3 NEW	1097.79	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
Jason Lawer	TC2 NEW	509.25	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
383180842 R.Wilson	TC2 NEW	883.61	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
#532328150 Brodie Atkinson	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
Jake Cammeron	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
Ty Nisbet	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
B Makejev	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
529876542 I.Williams	TC2 NEW, Terrex Seismic Aux	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
Robin Knight	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
#627875245 Chris Merrett	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
#464205696 Bob Garden	TC2 NEW	0.00	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00	0	0:00:00
		2493.42	0:00:00	0.00	0:00:00	0.00	0:00:00	0.00	0:00:00	1.00	0:00:00	0.00	0:00:00

4 Risk Assessments



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Document

Risk Register V.1

5 Emergency Response Procedures

5.1 Drills



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Document

ERP Drill 150310



Adobe Acrobat
Document

Muster 150308

6 Meetings

6.1 Induction



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Senex Jonothon 3D

6.2 Daily Toolbox



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01/03/15 TBM



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02/03/15 TBM



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03/03/15 TBM



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04/03/15 TBM



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05/03/15 TBM



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06/03/15 TBM



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07/03/2015 TBM



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09/03/2015 TBM



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11/03/2015 TBM



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12/03/2015 TBM



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13/03/2015 TBM



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14/03/2014 TBM

6.3 Weekly Meeting – Safety Sunday



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08/03/2015 TBM



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Document

15/03/2015 TBM

7 Audits and Inspections

7.1 Inspections



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Document

HSE Obs 050315



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Document

HSE Obs 080315



Adobe Acrobat
Document

FFP 050315

8 Training

Training Summary

	Personnel Participating	Training Time (Hrs)	Total Time (Hrs)
Terrex Site Inductions:	113	1	113
Terrex Site Re-inductions:	16	0.5	8
SOP Revisions:	53	0.5	27
Safety Sunday:	203	0.3	61
JSA Training:	34	1	34
Total Training Hours:			243 hrs

9 Events Reporting

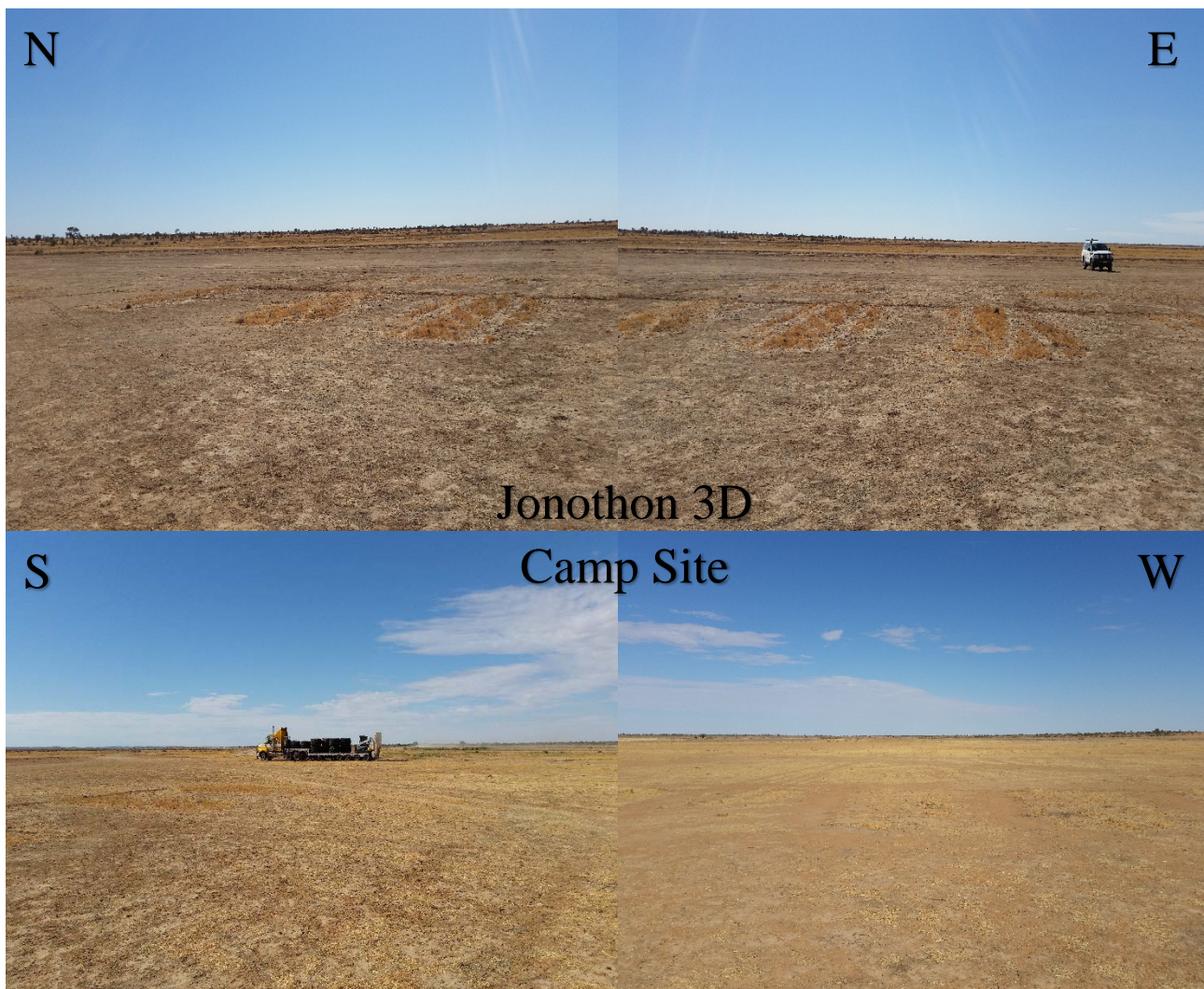
9.1 Incident Reporting



Incident
Report.PDF

Incident Report #1

9.2 Environmental



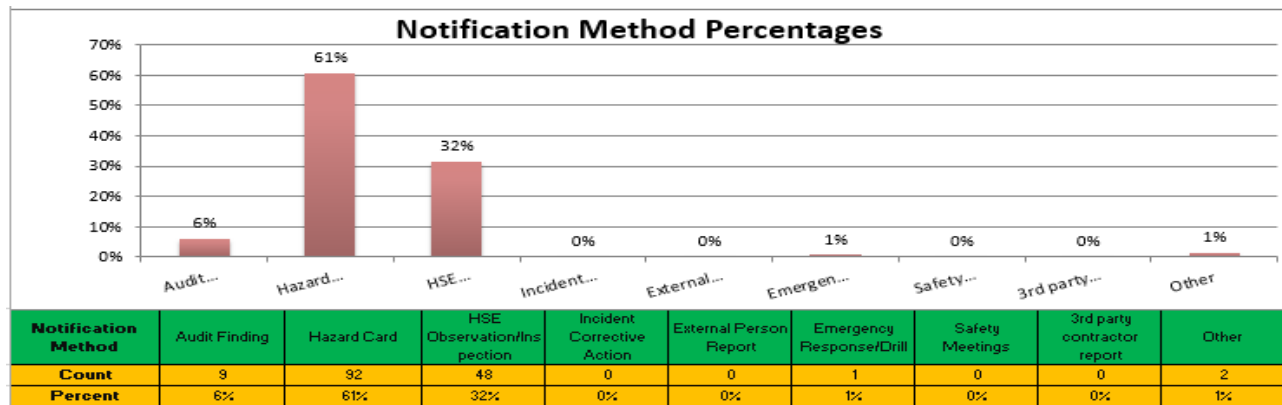
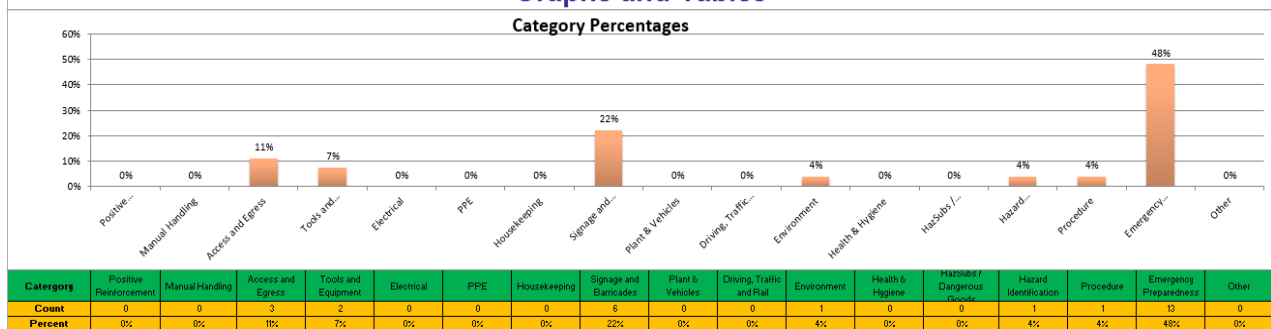
9.3 Hazard Reporting

HIR cards submitted over the project

Total	
HIR Cards	107
% Closed	97%

A2 ATR

Graphs and Tables



9.4 Action Tracking Register

113	J00269	3/03/2015	S. Ollernshaw	Hazard Card	Hazard Identification	No dune poles	Minor	Get dune poles so we can see each other	HSE	3/03/2015	3/03/2015	Closed
114	J00269	5/03/2015	G.Kohler	HSE Observation/Inspection	Health & Hygiene	Fridge and freezer in a mess after camp move	Minor	Fridge and freezer need to be restacked onto shelves	Kitchen Staff	5/03/2015	5/03/2015	Closed
115	J00269	5/03/2015	G.Kohler	HSE Observation/Inspection	Health & Hygiene	Floors in fridge and freezer are dirty.	Minor	Fridge and freezer need to be swept and mopped.	Kitchen Staff	5/03/2015	5/03/2015	Closed
116	J00269	7/03/2015	Cherrine Collier	Hazard Card	Electrical	Plug B on outside of cable repair truck still live even when turned off.	Minor	Plug tagged out until electrician comes and fixes the outlet.	HSE	10/03/2015	19/03/2015	Closed
117	J00269	8/03/2015	Shane Ollernshaw	Hazard Card	Driving, Traffic and Rail	Cars from other camps doing over speed limit in opposite direction on main track	Minor	Keep left on main track and warn others road users via radio.	HSE	8/03/2015	8/03/2015	Closed
118	J00269	8/03/2015	Shane Ollernshaw	Hazard Card	Environment	Vibes pad prints in the sand dunes are deep and can be harmful to other vehicles.	Minor	Drive slowly along source lines safely and efficiently	HSE	8/03/2015	8/03/2015	Closed

119	J00269	8/03/2015	Shane Ollernshaw	Hazard Card	Environment	Sun Strike	Minor	Put Visor down and wear sunglasses and drive to conditions	HSE	8/03/2015	8/03/2015	Closed
120	J00269	8/03/2015	Rob Vernon	Hazard Card	Driving, Traffic and Rail	Don't drive with thumbs inside the steering wheel as you could break you thumbs	Minor	Keep your thumbs out of steering wheel	HSE	8/03/2015	8/03/2015	Closed
121	J00269	8/03/2015	Rob Vernon	Hazard Card	Hazard Identification	Strong winds and car doors don't mix	Minor	Hold on to your doors and be careful when exiting the vehicle	HSE	8/03/2015	8/03/2015	Closed
122	J00269	8/03/2015	Kenneth Grace	Hazard Card	Environment	Large crab holes just off the track, slips, trips and falls	Minor	Stay focused, eyes on the path, situational awareness, boot laces done up.	HSE	8/03/2015	8/03/2015	Closed
123	J00269	8/03/2015	Kenneth Grace	Hazard Card	Environment	Sharp sticks and branches ie-bending over to pick things up stick in eye.	Minor	Wear glasses and all protective PPE	HSE	8/03/2015	8/03/2015	Closed
124	J00269	8/03/2015	Ben Dillon	Hazard Card	Hazard Identification	Low lying branches and trees	Minor	Keep aware look up and keep an eye on surrounding areas	HSE	8/03/2015	8/03/2015	Closed
125	J00269	8/03/2015	Kenneth Grace	Hazard Card	Hazard Identification	Sticks and branches on receiver lines may cause vehicle damage	Minor	Anything dodgy that could cause punctures throw off to the side of the line	HSE	8/03/2015	8/03/2015	Closed
126	J00269	8/03/2015	Kristian Prott	Hazard Card	Housekeeping	Loose pegs and pinnies in utes	Minor	Tape up before travel to ensure they don't fall out	HSE	8/03/2015	8/03/2015	Closed
127	J00269	8/03/2015	Ben Dillon	Hazard Card	Health & Hygiene	Not enough sufficient food for lunches	Minor	Need more fresh food	HSE	8/03/2015	8/03/2015	Closed
128	J00269	8/03/2015	Kristian Prott	Hazard Card	Access and Egress	Dunes on line being cut up too much	Minor	Ensure tyre pressures, speed and gears are accessed when going up them. Take care of them as they are our only access in and out.	HSE	8/03/2015	8/03/2015	Closed
129	J00269	9/03/2015	T.Wilson	Hazard Card	Hazard Identification	Unable to see oncoming vehicles when tracking over dunes on line	Minor	Call up number on line before going over large dunes	HSE	9/03/2015	9/03/2015	Closed
130	J00269	9/03/2015	R.Newbould	Hazard Card	PPE	Wearing face mask when blowing out vehicle	Minor	Put mask on and stop being a hero	HSE	9/03/2015	9/03/2015	Closed
131	J00269	9/03/2015	Kenneth Grace	Hazard Card	Hazard Identification	After park up or when driving up lines and getting water out of the back	Minor	Before driving off check back doors are closed and don't forget to check mirrors before driving off.	HSE	9/03/2015	9/03/2015	Closed
132	J00269	10/03/2015	Sue Lewis	Hazard Card	Hazard Identification	Does Emergency button work if your vehicle loses all power	Minor	If not think about putting battery back up in it.	HSE	12/03/2015		In Progress
133	J00269	3/03/2015	S. Ollernshaw	Hazard Card	Hazard Identification	No dune poles	Minor	Get dune poles so we can see each other	HSE	3/03/2015	3/03/2015	Closed
134	J00269	5/03/2015	G.Kohler	HSE Observation/Inspection	Health & Hygiene	Fridge and freezer in a mess after camp move	Minor	Fridge and freezer need to be restocked onto shelves	Kitchen Staff	5/03/2015	5/03/2015	Closed
135	J00269	5/03/2015	G.Kohler	HSE Observation/Inspection	Health & Hygiene	Floors in fridge and freezer are dirty.	Minor	Fridge and freezer need to be swept and mopped.	Kitchen Staff	5/03/2015	5/03/2015	Closed
136	J00269	7/03/2015	Cherrine Collier	Hazard Card	Electrical	Plug B on outside of cable repair truck still live even when turned off.	Minor	Plug tagged out until electrician comes and fixes the outlet.	HSE	10/03/2015	19/03/2015	Closed
137	J00269	8/03/2015	Shane Ollernshaw	Hazard Card	Driving, Traffic and Rail	Cars from other camps doing over speed limit in opposite direction on main track.	Minor	Keep left on main track and warn others road users via radio.	HSE	8/03/2015	8/03/2015	Closed
138	J00269	8/03/2015	Shane Ollernshaw	Hazard Card	Environment	Vibes pad prints in the sand dunes are deep and can be harmful to other vehicles.	Minor	Drive slowly along source lines safely and efficiently	HSE	8/03/2015	8/03/2015	Closed
139	J00269	8/03/2015	Shane Ollernshaw	Hazard Card	Environment	Sun Strike	Minor	Put Visor down and wear sunglasses and drive to conditions	HSE	8/03/2015	8/03/2015	Closed

TC2 ATR

6	J000269	7/02/2015	Leigh Franks	Hazard Card	Access and Egress	Trip hazard when filling up vehicles	Minor	Watch footing , keep eyes on task	HSE	8/02/2015	8/02/2015	Closed
7	J000269	8/02/2015	Leigh Franks	Hazard Card	Procedure	Radio channels must be broadcast	Moderate	Process put in place for field workers	All	8/02/2015	8/02/2015	Closed
8	J000269	8/02/2015	Leigh Franks	Hazard Card	Environment	Rabbit warrens opening up into big holes	Minor	Put rippers through them first then cut lines	Grader operator	9/02/2015	9/02/2015	Closed
10	J000269	8/02/2015	Jimmy	Hazard Card	PPE	Hard hats out of date for hiab	Minor	Replace with new hard hats	HSE	15/02/2015		Closed
11	J000269	9/02/2015	Steve	Hazard Card	Manual Handling	Carrying items up stairs with hands full	Minor	Ask for help with items/ doors	Kitchen	9/02/2015	9/02/2015	Closed
12	J000269	9/02/2015	Steve	Hazard Card	Access and Egress	Trips when using stairs	Minor	use of handrails, eyes on task	All	9/02/2015	9/02/2015	Closed
13	J000269	9/02/2015	Steve	Hazard Card	Health & Hygiene	Taking perishables in the field	Minor	Use of ice packs to keep items cool	All field staff	9/02/2015	9/02/2015	Closed
14	J000269	9/02/2015	Steve	Hazard Card	Health & Hygiene	Stress/ work pressure	Moderate	Talk with supervisors HSE, use of company wellness program	All personnel	9/02/2015		Closed
15	J000269	9/02/2015	Gary Barnet	Hazard Card	Tools and Equipment	Hire vehicles have no jacking plate	Moderate	Source plates for hire vehicles for jacking	CH Drivers	9/02/2015	9/02/2015	Closed
16	J000269	9/02/2015	Leigh Franks	Hazard Card	Driving, Traffic and Rail	Distracted drivers could drive over buried pipes	Moderate	make sure GPS is on and awareness of pipeline through job	All personnel	9/02/2015	9/02/2015	Closed
17	J000269	9/02/2015	Leigh Franks	Hazard Card	Plant & Vehicles	Starting vehicle while reaching through window, may cause unwanted movement	Moderate	Always be seated in drivers seat when starting machinery/ vehicles	All personnel	9/02/2015	9/02/2015	Closed
18	J000269	9/02/2015	Leigh Franks	Hazard Card	Environment	Rabbit holes littering prospect	Moderate	keep eye on task while walking or driving on prospect	All field staff	9/02/2015	9/02/2015	Closed
19	J000269	9/02/2015	Leigh Franks	Hazard Card	Plant & Vehicles	Santos vehicle speeding along Keleary Rd ID 6262	Minor	Remain alert and drive to conditions, good communication	All field staff	9/02/2015	9/02/2015	Closed
20	J000269	9/02/2015	Leigh Franks	Hazard Card	Plant & Vehicles	Machine ideling in long vegetation causing foire risk	Moderate	Be aware of combustible material, turn car off if practicle	All personnel	9/02/2015	9/02/2015	Closed
21	J000269	9/02/2015	Andrew	Hazard Card	Health & Hygiene	Using sharp knives causing cuts	Moderate	Using cut resistant mesh gloves when cutting	Kitchen staff	9/02/2015	9/02/2015	Closed
22	J000269	9/02/2015	Jimmy	Hazard Card	Positive Reinforcement	Stopped machine noticed grind stone called up CH	Minor	Good communication and good work practices	Operators	9/02/2015	9/02/2015	Closed
27	J000269	8/02/2015	Trudy	Hazard Card	Other	Office for other contractors	Insignificant	have office to keep people out of kitchen and sun	Senex client	9/02/2015	9/02/2015	Closed
28	J000269	8/02/2015	Trudy	Hazard Card	Hazard Identification	Safety rails absent on shower step	Minor	attach safety rails fo access and egress	Camp Manager	25/02/2015		Closed
29	J000269	8/02/2015	Trudy	Hazard Card	Hazard Identification	safety rails to toilet get hot from afternoon sun	Minor	Lag or paint hand rails	Camp Manager	10/02/2015	10/02/2015	Closed
30	J000269	9/02/2015	Paul	Hazard Card	Tools and Equipment	Noisy air con hard to sleep	Minor	change out unit when practicle	Maint	20/02/2015		In Progress
31	J000269	9/02/2015	Paul	Hazard Card	Health & Hygiene	Ice scoop left in machine	Minor	remove to top of machine	All personnel	9/02/2015	9/02/2015	Closed
32	J000269	9/02/2015	Joel	Hazard Card	Tools and Equipment	No puncture repair kit in vehicle	Minor	Put in vehicle	CH Drivers	10/02/2015	10/02/2015	Closed
33	J000269	9/02/2015	Trudy	Hazard Card	Driving, Traffic and Rail	Washouts and loose edges	Moderate	Flag bad areas	CH Drivers	10/02/2015	10/02/2015	Closed
34	J000269	9/02/2015	Joel	Hazard Card	Plant & Vehicles	No reversing alarm on vehicle	Minor	fix unit	Senex client	10/02/2015		Closed
35	J000269	9/02/2015	Joel	Hazard Card	Health & Hygiene	not hydrating enough	Minor	carry water at all times when out in the field	All personnel	10/02/2015	10/02/2015	Closed
36	J000269	10/02/2015	Steve	Hazard Card	Hazard Identification	Spills when cooking in kitchen	Minor	clean up min imise hazard	Lkitchen staff	10/02/2015	10/02/2015	Closed
37	J000269	10/02/2015	Steve	Hazard Card	Tools and Equipment	Hot water burn from tap	Minor	Make sure to turn cold on before putting hands under	Kitchen staff	10/02/2015	10/02/2015	Closed
38	J000269	11/02/2015	Gary Barnet	Hazard Card	Health & Hygiene	People smoking while toolbox is on	Minor	Refrain from smoking in smoking area while meeting is on, relocate meeting point	All personnel	11/02/2015	11/02/2015	Closed
39	J000269	11/02/2015	Leigh Franks	Hazard Card	Procedure	Loud music/ headphones impairing hearing	Moderate	Ensure you can hear oncoming traffic/ radio comms	All personnel	11/02/2015	11/02/2015	Closed
40	J000269	11/02/2015	Paul	Hazard Card	Tools and Equipment	Aircon fail	Minor	stop work until aircon is fixed	Operators	11/02/2015	11/02/2015	Closed
41	J000269	11/02/2015	Jimmy	Hazard Card	Plant & Vehicles	Good work practices from guy	Insignificant	Nil	Operators	11/02/2015	11/02/2015	Closed
42	J000269	11/02/2015	Steve	Hazard Card	Health & Hygiene	Consuming too many electrolight can make you sick	Minor	Use as per instruction	All personnel	11/02/2015	11/02/2015	Closed
43	J000269	11/02/2015	Steve	Hazard Card	Health & Hygiene	Dishes left in rooms	Minor	Don't take to rooms	All personnel	11/02/2015	11/02/2015	Closed
44	J000269	11/02/2015	Steve	Hazard Card	Access and Egress	Using wrong dorr in kitchen causing collision	Moderate	make use of entry exit signs to kitchen	All personnel	11/02/2015	11/02/2015	Closed
45	J000269	12/02/2015	Leigh Franks	Hazard Card	Procedure	Incorrect radio channel, wrong channel, radio off	Insignificant	do regular radio checks	All personnel	12/02/2015	12/02/2015	Closed
46	J000269	12/02/2015	joel	Hazard Card	Environment	Bites from fauna	Moderate	Carry appropriate medications/ treatment	All personnel	12/02/2015	12/02/2015	Closed
47	J000269	12/02/2015	Jimmy	Hazard Card	Procedure	No CH polygon on maps	Moderate	Enter correct data on motion	Survey	12/02/2015	12/02/2015	Closed
48	J000269	12/02/2015	jimmy	Hazard Card	Procedure	Detour around CH site wait for CH guidance	Moderate	Wait for direction after consolidation	All field staff	12/02/2015	12/02/2015	Closed
49	J000269	12/02/2015	Joel	Hazard Card	Other	Mobile phones computers left on in room possible fire hazard	Moderate	Make sure while room unattended turn off equipment	All personnel	12/02/2015	12/02/2015	Closed

50	J000269	12/02/2015	Trudy	Hazard Card	Other	soreness when sitting in same location all the time	Moderate	Change positions in vehicle and posture	All personnel	12/02/2015	12/02/2015	Closed
51	J000269	12/02/2015	Joel	Hazard Card	Driving, Traffic and Rail	Check wheel nut for them coming loose	Minor	follow pre start guidelines	All personnel	12/02/2015	12/02/2015	Closed
52	J000269	11/02/2015	Dan	Hazard Card	Environment	Spills on ground/ refuelling ect	Moderate	Make sure spills are cleaned up and reported	All personnel	12/02/2015	12/02/2015	Closed
53	J000269	11/02/2015	Jimmy	Hazard Card	Plant & Vehicles	Seat belt locking and hard to pull out	Minor	Replace or pull slowly on belt	Drivers	12/02/2015	12/02/2015	Closed
54	J000269	11/02/2015	Paul	Hazard Card	Hazard Identification	Incorrect signage on Kleary rd	Moderate	Move signs to warn 3rd party traffic oncoming machinery	Crew manager	12/02/2015	12/02/2015	Closed
55	J000269	12/02/2015	Paul	Hazard Card	Procedure	No communication when leaving camp to Kleary Rd	Moderate	Use channel 17 and move signage to suit	Crew manager	12/02/2015	12/02/2015	Closed
56	J000269	12/02/2015	Dan	Hazard Card	Other	Urinating near camp	Moderate	Urinate as per discussed areas	All personnel	13/02/2015	13/02/2015	Closed
57	J000269	13/02/2015	Joel	Hazard Card	Health & Hygiene	Fluids leaking from toilet	Minor	Fix if effluent	Camp Manager	13/02/2015	13/02/2015	Closed
58	J000269	13/02/2015	Steve	Hazard Card	Environment	Bites from snakes/ dingo ect while running	Moderate	Watch for fauna give wide berth report sightings	All personnel	13/02/2015	13/02/2015	Closed
59	J000269	13/02/2015	Steve	Hazard Card	Health & Hygiene	Spills at coffee station, scraps	Moderate	Clean up after yourself	All personnel	13/02/2015	13/02/2015	Closed
60	J000269	13/02/2015	Leigh Franks	Hazard Card	Environment	washouts on lines yet to be graded	Minor	Drive to conditions eyes on task communication	All field staff	13/02/2015	13/02/2015	Closed
61	J000269	13/02/2015	Joel	Hazard Card	Health & Hygiene	Not washing hands after smoking or before eating or drinking	Minor	Wash hands to minimise spread of germs	All personnel	13/02/2015	13/02/2015	Closed
62	J000269	13/02/2015	Leigh Franks	Hazard Card	Driving, Traffic and Rail	Dust plumes approaching traffic	Minor	slow down to minimise dust cloud behind vehicle	All personnel	15/02/2015	15/02/2015	Closed
63	J000269	13/02/2015	Leigh Franks	Hazard Card	Procedure	Not enough info on CH board	Moderate	Include more relevant info on board to help with rescue/ search	All personnel	15/02/2015	15/02/2015	Closed
64	J000269	14/02/2015	Gary Barnett	Hazard Card	HazSubs / Dangerous Goods	bundling fallen over on fuel pad	Minor	stand back up and place timber to help stabilise wall	All personnel	15/02/2015	15/02/2015	Closed
65	J000269	14/02/2015	Jimmy	Hazard Card	Tools and Equipment	worn air hose fittings, unwanted movement from detachment	Moderate	replace worn leaking fittings	Mechanical	25/02/2015		Approval Pending
66	J000269	14/02/2015	Steve	Hazard Card	Emergency Preparedness	First Aid kit needs restocking	Minor	Restock missing items	HSE	15/02/2015	15/02/2015	Closed
67	J000269	15/02/2015	Jimmy	Hazard Card	Health & Hygiene	Food stocks rotated when new orders come in	Minor	Rotate food stocks	Kitchen	15/02/2015	15/02/2015	Closed
68	J000269	15/02/2015	Joel	Hazard Card	Driving, Traffic and Rail	Distracted when using motion GPS while driving	Minor	Drive slower/stop ask navigator to operate	Field Staff	15/02/2015	15/02/2015	Closed
69	J000269	15/02/2015	Joel	Hazard Card	Procedure	Injury or getting disoriented when in field	Minor	Keep in contact with vehicle/ line of sight with vehicle	Field Staff	15/02/2015	15/02/2015	Closed
70	J000269	15/02/2015	Joel	Hazard Card	Health & Hygiene	Personnel seem different quiet withdrawn	Minor	Communicate with supervisor or others	All personnel	15/02/2015	15/02/2015	Closed
71	J000269	15/02/2015	Joel	Hazard Card	Other	Not being able to hear persons at pre start	Minor	Move closer get them to speak up	All personnel	15/02/2015	15/02/2015	Closed
72	J000269	15/02/2015	Ron Dennis	Hazard Card	Tools and Equipment	Injury when changing tyres	Minor	Correct lifting techniques	all personnel	15/02/2015	15/02/2015	Closed
73	J000269	15/02/2015	Ron Dennis	Hazard Card	Plant & Vehicles	Injury from unwanted movement	Minor	Make sure car has stopped in neutral and handbrake applied, drivers ok	All personnel	15/02/2015	15/02/2015	Closed
74	J000269	15/02/2015	Ron Dennis	Hazard Card	Plant & Vehicles	Being hit by other vehicles exiting car	Minor	Check before exiting/ use mirrors and others	All personnel	15/02/2015	15/02/2015	Closed
75	J000269	15/02/2015	Ron Dennis	Hazard Card	Health & Hygiene	Wrappers/ waste left in toilet cubicles	Minor	remove and put items in bin	All personnel	15/02/2015	15/02/2015	Closed
76	J000269	15/02/2015	Ron Dennis	Hazard Card	Plant & Vehicles	Front suspension U/S in fuel truck	Minor	Fix/ repair U/S items	Mechanical	28/02/2015		Closed
77	J000269	17/02/2015	Bob	Hazard Card	Driving, Traffic and Rail	Sopping on brow of dune may cause accident	Minor	Pull well clear of top of dune	All field staff	15/02/2015	15/02/2015	Closed
79	J000269	16/02/2015	Warren Campbell	Hazard Card	Emergency Preparedness	Putting rubbish in butt bins causing fire hazard	Moderate	Use appropriate receptacles for rubbish	All personnel	16/02/2015	16/02/2015	Closed
80	J000269	16/02/2015	Bob	Hazard Card	Tools and Equipment	Hand tools worn not fit for use causing injury	Moderate	Replace/ dispose of worn stuffed equipment/tools	All personnel	16/02/2015	16/02/2015	Closed
81	J000269	16/02/2015	Bob	Hazard Card	Environment	Vehicle congestion around workshop	Minor	Communication and spotters make yourself known	All personnel	16/02/2015	16/02/2015	Closed
82	J000269	16/02/2015	Kayleen	Hazard Card	Health & Hygiene	Water hot out form tanks for showers	Moderate	Shower in mornings, cover tanks	All personnel	16/02/2015	16/02/2015	Closed
83	J000269	16/02/2015	Joel	Hazard Card	Positive Reinforcement	Everybody sharing the work load	Minor	Positive obs	CH Crews	16/02/2015	16/02/2015	Closed
84	J000269	17/02/2015	Joel	Hazard Card	Driving, Traffic and Rail	Loose items in vehicles becoming a projectile	Moderate	Put items in parcel area of vehicles	All personnel	17/02/2015	17/02/2015	Closed
85	J000269	17/02/2015	Joel	Hazard Card	Other	miscommunication unclear instruction	Minor	ask for instructions/ directions until full comprehension	All personnel	17/02/2015	17/02/2015	Closed
86	J000269	17/02/2015	joel	Hazard Card	Health & Hygiene	insufficient sleep for work	Minor	Talk with supervisors HSE, use of company FFV sheet	All personnel	17/02/2015	17/02/2015	Closed
87	J000269	17/02/2015	joel	Hazard Card	Health & Hygiene	Correct use of medications, declaration	Minor	let medic know of your conditions	All personnel	17/02/2015	17/02/2015	Closed
89	J000269	17/02/2015	Joel	Hazard Card	Environment	Snakes animals under bags/ bins	Moderate	Be mindful and keep from firing line	All personnel	18/02/2015	18/02/2015	Closed
90	J000269	17/02/2015	Joel	Hazard Card	Driving, Traffic and Rail	Vehicle moving when personnel not seated or buckled up	Minor	Drivers to ensure personnel are seated and buckled up	Drivers	18/02/2015	18/02/2015	Closed
91	J000269	17/02/2015	Joel	Hazard Card	Driving, Traffic and Rail	No airco working in vehicle	Minor	Get fixed before moving off	Drivers	18/02/2015	18/02/2015	Closed

92	J000269	17/02/2015	Jimmy	Hazard Card	Tools and Equipment	No external Fire extinguisher on grader 5	Minor	Install extinguisher	CM	18/02/2015	18/02/2015	Closed
93	J000269	17/02/2015	Jimmy	Hazard Card	Environment	Line R1245 comes out on road below crest of dune	Moderate	Take extreme caution when crossing road	All personnel	18/02/2015	18/02/2015	Closed
94	J000269	17/02/2015	Bob	Hazard Card	Plant & Vehicles	Wiring mess and bare wires in dash KW truck	Moderate	To be fixed by competent person	CM	1/03/2015		Closed
96	J000269	19.02.2015	joel	Hazard Card	Access and Egress	Slip or trip on wet steps	Minor	Use handrails watch step	All personnel	19.02.2015	19.02.2015	Closed
97	J000269	19.02.2015	joel	Hazard Card	Plant & Vehicles	Vehicles not chocked when changing wheel	Moderate	use chocks when jacking vehicles	All personnel	19.02.2015	19.02.2015	Closed
98	J000269	19.02.2015	joel	Hazard Card	Plant & Vehicles	Vehicle faults / problems	Minor	report through pre starts book	All personnel	19.02.2015	19.02.2015	Closed
99	J000269	19.02.2015	joel	Hazard Card	Access and Egress	blocking doorways steps causing hazard	Moderate	keep means of clear egress access and doorways steps	All personnel	19.02.2015	19.02.2015	Closed
100	J000269	19.02.2015	joel	Hazard Card	Emergency Preparedness	littering smoke buttsw in field or fire hazard	Moderate	extinguish all cigareetes , place in pocket or recepticle	All personnel	19.02.2015	19.02.2015	Closed
101	J000269	19.02.2015	R Tibet	Hazard Card	Hazard Identification	High Dunes on prospect	Moderate	Communication before taking on dune	All personnel	19.02.2015	19.02.2015	Closed
102	J000269	19.02.2015	Gary Barnett	Hazard Card	Emergency Preparedness	Radio not monitored on CH17 from office	Moderate	Have it monitored	CM	19.02.2015	19.02.2015	Closed
103	J000269	19.02.2015	Joel	Hazard Card	Environment	Dust storms	Moderate	Stop work sit in car wait to pass	All personnel	19.02.2015	19.02.2015	Closed
104	J000269	19.02.2015	Joel	Hazard Card	Health & Hygiene	Personnal water bottles collecting grime may cause upset stomach	Minor	Clean own bottles regularly	All personnel	19.02.2015	19.02.2015	Closed
105	J000269	20.02.2015	Joel	Hazard Card	Hazard Identification	Personnel not acknowledging radio calls when out in the field	Moderate	Correct calling procedures while on prospect	All personnel	21.02.2015	21.02.2015	Closed
106	J000269	20.02.2015	Joel	Hazard Card	Access and Egress	wind catching diner doors/ fall from steps	Moderate	Use of handrails do not put your self in line of fire	All personnel	21.02.2015	21.02.2015	Closed
107	J000269	20.02.2015	Joel	Hazard Card	Hazard Identification	Airconditioners leaking water onto electrical equipment	Major	Move electrical items contain leak report to be fixed	CM	21.02.2015	21.02.2015	Closed
108	J000269	20.02.2015	Joel	Hazard Card	Plant & Vehicles	Seat suspension collapsed	Minor	Fix or replace	Mechanical	21.02.2015	21.02.2015	Closed
109	J000269	21.02.2015	Joel	Hazard Card	Driving, Traffic and Rail	Vehicle moving nearly running over feet	Moderate	Drivers to ensure that all persons have exited the car and doors are closed before moving	all personnel	22.02.2015	22.02.2015	Closed
110	J000269	22.02.2015	Robin Knight	Hazard Card	Manual Handling	Sharps in bi can cause injury	Minor	watch for hidden hazards	All personnel	22.02.2015	22.02.2015	Closed

10 Health Performance

10.1 Alcohol Testing

BAC Tests Conducted over the project

	Feb	March	Total
No. Tested	465	891	1356
% Passed	465	890	99.92%

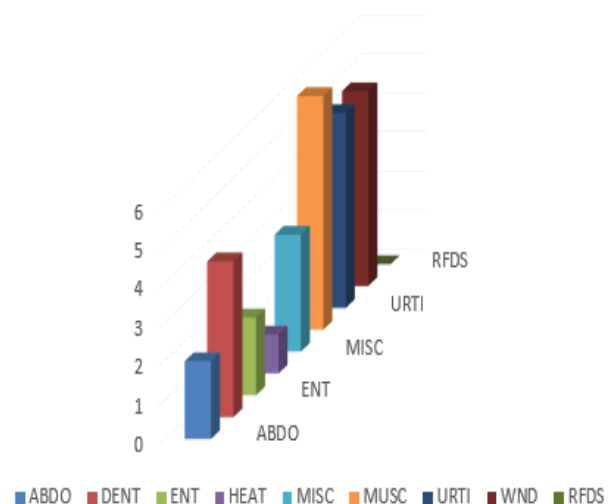
10.2 Drug Testing

Preliminary Drug Tests over the project

	March	Total
No. Tested	9	9
% Passed	100%	100%

10.3 Illnesses

Code	Visits	Condition
ABDO	2	Abdominal pains
DENT	4	Dental: All dental conditions
ENT	2	Ear, Nose, Throat Infections
HEAT	1	Heat Illness
MISC	3	Non specific
MUSC	6	Muscular Skeletal: Soft tissue injury, Sprain/Strain
URTI	5	Colds, Influenza type symptoms
WND	5	Wound Care: Lacerations, Dressings, Suture removal
RFDS	0	Royal Flying Doctors Referral
FAC	0	First Aid Condition
MTI	0	Medically treated condition.
LTI	0	Loss Time Incident



Appendix F Safer Workplace – Hazard Observation Incentive

The Hazard Observation process and Hazard Report Booklet provides a formal mechanism for the identification and reporting of unsafe acts and conditions. Hazard Reports empower individuals to observe their environment and fellow employees to minimize risks to a level that is as low as reasonably possible.

Terrex Seismic is committed to ensuring the health and safety of all of its employees, contractors and visitors. In line with this aim, we are providing an incentive scheme in which individuals will be rewarded for their dedication to a safer workplace.

At the Head of Department Meeting, at the end of each month, the Crew Manager, in consultation with the field HSEA will conduct a review of the HIR cards submitted and the card which is deemed to have the most merit for improving safety on the crew will be chosen as the winner of a \$100 Prepaid Visa Card.

During the Jonothon 3D Seismic Survey, there have been 2 winners chosen being:

1. Alisha Glover
2. Matthew Wooley

Appendix G Personnel Crew List and Numbers

CREW LIST

Admin Staff	
Crew Manager	Dave Keat
Crew Manager	Darren Rae
HSE Advisor	Jason Sherras
Camp Staff	
Mechanic	Robert Harrington
Mechanic	Rhys Klincke
Mechanic	Steve Mejak
Cook	Mark Gill
Cook	Maria Hanna
Cook	Layne Geddes
Supply	Murray Whyte
Supply	Robert Vernon
Supply	Allan Tuite
Supply	Michael Jones
Campy	Carlie Warne
Campy	Sjaan Scadding
Technical	
Observer	Peter O'Donnell
Observer	Mike Coughlin
Vibrator Crew	
Vibe Op	Ron Dover
Vibe Op	Andrew Ribar
Vibe Op	Peter Poznik
Vibe Op	Luke Samios
Vibe Op	Neville Draper
Vibe Op	Daniel Blackburn
Vibe Op	Dianne Williams
Vibe Op	Kirsten Heindel
Vibrator Technical	
Vibe Tech	Stuart Rauckman
Vibe Tech	Stephane Mallard
Senior Line	
Line Boss	Andrew Williams
Troubleshooter	
Troubleshooter	Alisha Glover

Troubleshooter	Susan Lewis
Troubleshooter	Lachlan Fazldeen
Troubleshooter	Ryan Newbould
Line Crew	
Line Crew	Clinton Avenal
Line Crew	Jacob Arnall
Line Crew	Dylan Ashenden
Line Crew	Cameron Brooker
Line Crew	Andrew Cheyne
Line Crew	Benjamin Dillon
Line Crew	Liam Gillam
Line Crew	Kenneth Grace
Line Crew	Christopher Grams
Line Crew	Alex Kerr
Line Crew	Thomas Midgley
Line Crew	Chris O'Donnell
Line Crew	Shane Ollerenshaw
Line Crew	Jacob Pihama
Line Crew	Kristian Prott
Line Crew	Daniel Richardson
Line Crew	Emma Stolz
Line Crew	Joshua Stinson
Line Crew	Ben Tabone
Line Crew	Daniel Tabone
Line Crew	Ty-Turner Bryan
Line Crew	Martin Vale
Line Crew	Ryan Ward
Line Crew	Daniel Walker
Line Crew	Peter Webber
Line Crew	David Wex
Line Crew	Paul Parsons
Line Crew	Luke Scadding
Line Crew	Teagan Wilson
Line Crew	Matthew Woolley

CREW NUMBERS

POSITION	NUMBERS
Crew Manager	1
HSE Advisor	2
Mechanic	2
Cook	2
Supply	1
Campy	1
Observer	2
Cable Repair	2
Vib Crew	6
Vib Tech	1
Line Boss	1
Trouble Shooter	2
Line Crew	32

Appendix H Recording Statistics



Jonothon 3D Seismic Survey - Recording Statistics

		T KEY / L SUM																				STANDBY			TOTALS													
Acq Pstr Optn	Date	Mobilisation	Camp Setup/ Packup	ToolBox	Safety Meeting	Travel	Recorder Setup	Initial Layout/ Pickup	H/Wires, SIMS, Sweep Tests	QC Spread	QC / Testing	Recording	Trouble shooting	Recorder Moveup	Spread Chowage	Detours	Traverse Move	Recorder Down	Vibes Down	Other	TL Total	Cumulative TL Total	Inductions	ST Total	Cumulative ST Total	Total Hours	Total Hours TD	VPs	VPs TD	Charge VPs	Charge VPs TD	Ships	Ships TD	L/km	L/km TD	SqKm	SqKm TD	
A	01-03-15	10.00																				10.00	10.00				10.0	10.0										
A	02-03-15		3.00	0.30		0.70	0.10	8.40														12.50	22.50	0.50	0.50	0.50	13.0	23.0									2.251	2.251
A	03-03-15			0.30		0.60	0.40	7.90			0.10	2.90										12.70	35.20			0.50	12.7	35.7	169.0	169.0	169.0	169.0			41.900	41.900	14.332	16.583
A	04-03-15			0.30		0.60	0.40		0.50		0.10	9.30	0.30					0.30	0.30			12.30	47.50			0.50	12.3	48.0	838.0	1,007.0	838.0	1,007.0						
A	05-03-15			0.30		0.30	0.20				0.10	9.60	0.70				0.60					11.80	59.30			0.50	11.8	59.8	980.0	1,987.0	980.0	1,987.0	2.0	2.0	49.000	90.900	16.761	33.344
A	06-03-15			0.30		0.60	0.30				0.10	9.60			0.70		0.10	0.30				12.00	71.30			0.50	12.0	71.8	926.0	2,913.0	926.0	2,913.0			46.300	137.200	15.837	49.181
A	07-03-15			0.30		0.30	0.40				0.10	9.70	0.30	0.30				0.40				11.80	83.10			0.50	11.8	83.6	824.0	3,737.0	824.0	3,737.0	2.0	2.0	41.200	178.400	14.093	63.273
A	08-03-15			0.30	0.20	0.70	0.20				0.10	8.80	1.00	0.50						0.30		12.10	95.20			0.50	12.1	95.7	700.0	4,437.0	700.0	4,437.0	2.0	2.0	35.000	213.400	11.972	75.245
A	09-03-15			0.30		0.80	0.30		0.30			9.40	0.80			0.10						12.00	107.20			0.50	12.0	107.7	670.0	5,107.0	670.0	5,107.0	2.0	2.0	33.500	246.900	11.459	86.704
A	10-03-15			0.30		0.80	0.40				0.10	10.00	0.40								0.50	12.50	119.70			0.50	12.5	120.2	911.0	6,018.0	911.0	6,018.0	2.0	2.0	45.550	292.450	15.580	102.284
A	11-03-15			0.30		0.80	0.30					9.70	0.30	0.50		0.10						12.00	131.70			0.50	12.0	132.2	860.0	6,878.0	860.0	6,878.0	2.0	2.0	43.000	336.400	14.708	116.992
A	12-03-15			0.30		1.00	0.30				0.10	10.20	0.20									12.10	143.80			0.50	12.1	144.3	881.0	7,759.0	881.0	7,759.0	2.0	2.0	44.050	379.500	15.067	132.060
A	13-03-15			0.30		0.70	0.20					10.20	0.70									12.10	155.90			0.50	12.1	156.4	1,077.0	8,836.0	1,077.0	8,836.0	1.0	3.0	53.850	433.350	18.420	160.479
A	14-03-15			0.30		0.60	0.20	9.60			0.10	1.00			0.20							12.00	167.90			0.50	12.0	168.4	98.0	8,934.0	98.0	8,934.0	3.0	3.0	4.900	438.250	1.676	152.155
A	15-03-15			0.30		0.40		11.30														12.00	179.90			0.50	12.0	180.4		8,934.0		8,934.0	3.0	3.0		438.250		152.155
A	16-03-15			0.30																	10.70	11.00			0.50	11.0	191.4		8,934.0		8,934.0	3.0	3.0		438.250		152.155	
Grand Total		10.00	3.00	4.50	0.20	8.90	3.70	37.20	0.80	0.70	0.90	100.40	4.70	1.30	0.90	0.80	0.40	1.00	0.30	11.20	190.90	1621.10	0.50	0.50	7.50	191.4	1,628.6	8,934.0	75,650.0	8,934.0	75,650.0	3.0	28.0	438.25	3664.20	152.16	1284.86	

Appendix I Survey Daily Reports

Refer separate document **"J00269 – Senex - Jonothon 3D Daily Reports"**

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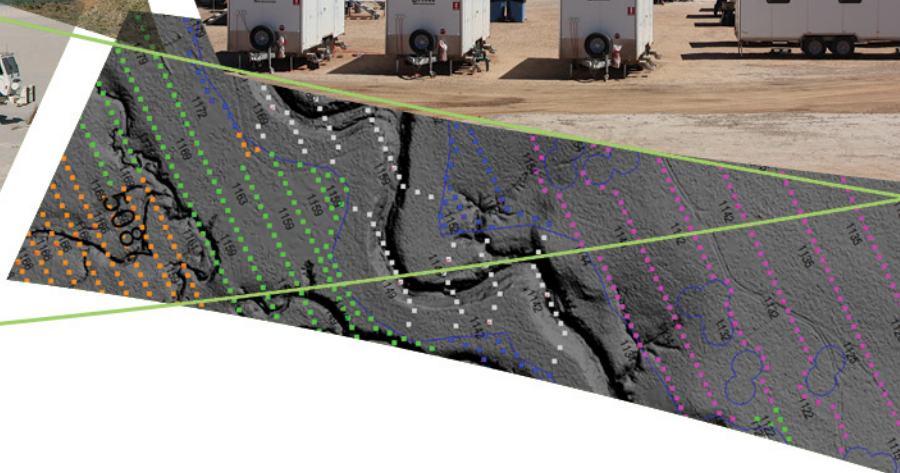
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APPENDIX 4

CGG (Australia) Senex 2014 Jonothon 3D Processing Report



SEISMIC DATA PROCESSING REPORT FOR SENEX ENERGY Ltd

Location:	Cooper Basin
Permit:	PEL 638
Survey:	Jonothon 3D
Date:	27 th May 2015

Katy Sutherland
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1 Introduction

1.1 Scope of Report

This report describes the seismic data processing of the 158 km² of Jonothon 3D 2015 onshore survey for Senex Energy Ltd by CGG between April 2015 and June 2015. Jonothon is situated in PEL 638 in the Cooper Basin.

Project management and parameter testing were conducted in Perth and production was run at CGG processing hub in Singapore.

The project was registered under CGG project number ph194se.

1.2 Purpose and objectives of the processing

The processing goals were: high SNR, good temporal resolution and pre-stack time migrated datasets suitable for AVO and AVAZ analyses.

1.3 Personnel

For Senex :

Brendon Mitchell

Sr. Geophysicist

For CGG:

Katy Sutherland

Sr. Geophysicist

Marwoto

Team Leader

Anatoly Osadchuk

Sr. Land Advisor

Peter Scruton

Geophysical Supervisor Land

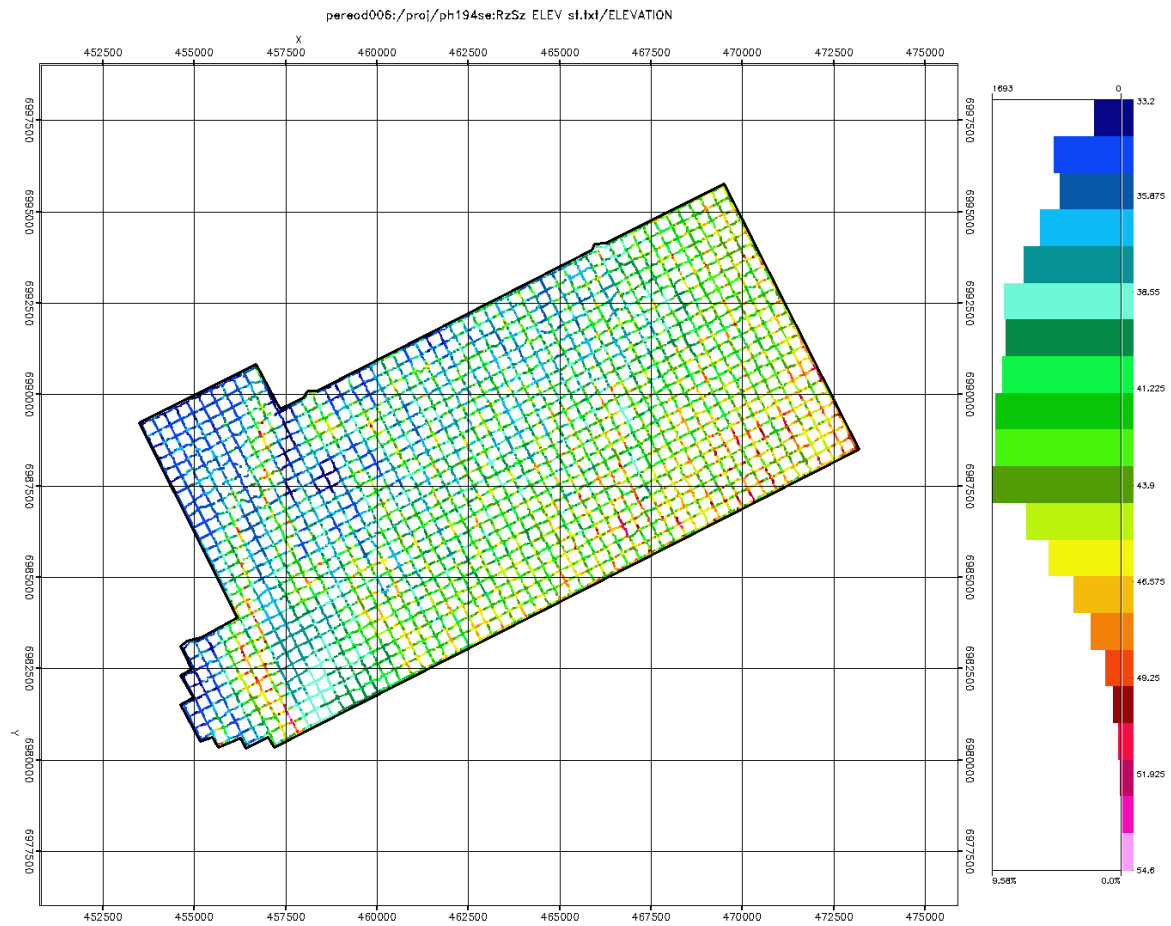


Figure 1: Jonothon 3D Basemap. Source lines (NE) and Receiver lines (SE). Elevations.

1.4 Acquisition Parameters

General Parameters Jonathon3D	
Survey Name	Jonathon 3D
Acquisition contractor	Terrex Seismic Crew A2
Year acquired	2015
Volume	150 km ²
Energy Source:	I/O AVH-IV
Electronics:	Sercel 464 Electronics
Source Point Interval:	50 metres
Source Line Interval:	350m
Source Array:	2 Vibrators, 12.5 m pad to pad
Source Array Location:	Centred on the source point
Receivers:	10Hz geophone
Receiver Interval:	50 metres
Receiver Line Interval:	350m
Receiver Array Location:	Centred on receiver point
Receiver Array:	12 over 45.83m (4.16m spacing)
Sweep Length:	8 seconds
Number of Sweeps:	1
Sweep Type:	Linear Upsweep (Mono Sweep)
Sweep Frequencies:	4-80 Hz
Sweep Tapers:	250 milliseconds start/end
Sweep Control:	Sercel 464
Peak Force:	67,000 lbs
Vibrator Drive Level:	80% force
Phase Lock:	Peak to Peak
No. of Channels on Crew:	2688
No. of Channels Live :	16 lines x 168 channels nominal
Maximum Fold:	96
Bin Size:	25m x 25m
Record Length:	4.0 seconds
Correlation Sample Interval:	2 milliseconds
Output Data Format:	SEGD Correlated
Hi- cut filter:	200 Hz
Pre-Amp Gain:	12 dB

2 Processing

2.1 Processing Sequence Summary

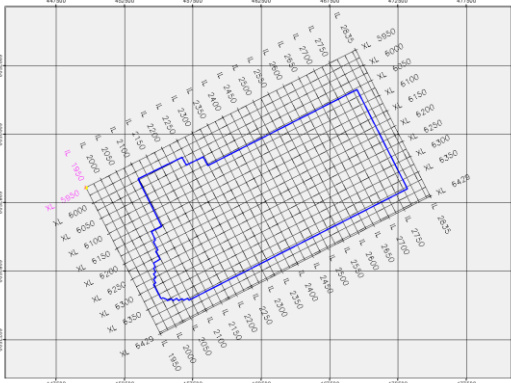
1. SEG-D input TL/SI=4000/2ms
2. Nav merge
 - a. **Output → Shot Gathers with Geometry**
3. Amplitude Divergence Compensation
4. Trace Edit/Despiking
5. Minimum Phasing
6. First Break Picking/Tomostatics
7. Apply Provisional Residual Statics
8. LNA/RNA 1st pass
9. VA01 1050x1050m
10. Inv Q Amp & Phase
11. SC Spiking Deconvolution
12. Residual Static #1
13. LNA/RNA 2nd pass
14. Surface Consistent Amplitude Correction
15. VA02 1050x1050m
16. Residual Static #2
 - a. **Output → Intermediate Post-Stack Migrated Cube (via FTP)**
 - b. **Output → Pre-Interpolation Gathers**
17. 5D Interpolation (Fold 12x8=96 → 23x15=345)
18. Remove Amplitude Divergence Compensation
19. 3D PSTM to Velocity Lines
20. VA03 525x525m
21. 3D PSTM with smoothed VA03
22. VA04 525x525m
 - a. **Output → Post-Migration Raw Gathers**
23. Radon3D
24. VA05 Dense VTI V/Eta
25. PSTM Gather Flattening (Trim)
 - a. **Output → Final PSTM gathers (Shifted to MSL 0m Datum)**
26. Stack
 - a. **Output → Raw Full Fold PSTM Stack**
27. Footprint Removal (FKF3D)
28. Spectral Shaping
29. CADZO De-Noise
30. Shift from Processing to MSL=0m Datum
 - a. **Output → Final Full, Angle and Azimuthal stacks**

2.2 SEGD Input

At this step SEGD field records 4s/2ms were converted to CGG internal format. Data was found to be in good technical condition: no digital distortions and no corrupted headers encountered.

2.3 Geometry and Grid

The geometry database was created from SPS files, loaded to trace headers and gridded to 3D CMP as follows:

Geometry Information	
Geodetic Datum	GDA 94
Projection Zone	54 S
Grid Corners (INL/CRL) (X,Y)	
	(1950, 5950) (449688.96989, 6988607.41039)
	(2835, 5950) (469402.48924, 6998651.95020)
	(2835, 6429) (474839.02547, 6987982.14707)
	(1950, 6429) (455125.50612, 6977937.60726)
INL/CRL Increment	1/1
CMP Cell Size	25x25m
	Subsurface Coverage Polygon
	X
	Y
	455230.083
	6985778.369
	453479.951
	6989235.152
	456697.586
	6990833.099
	457012.827
	6990246.098
	458262.922
	6990854.840
	458589.033
	6990235.228
	469502.902
	6995779.125
	473187.963
	6988517.707
	457197.624
	6980375.786
	457121.531
	6980517.101
	456828.030
	6980386.657
	456708.456
	6980484.490
	456447.567
	6980364.916
	456338.863
	6980506.231
	456045.363
	6980354.046
	455947.529
	6980495.361
	455643.158
	6980348.610
	455567.065
	6980451.879
	455306.176
	6980549.713
	455164.861
	6980527.972
	454621.342
	6981528.047
	454773.527
	6981636.751
	454632.212
	6981908.511
	454784.398
	6982038.956
	454610.471
	6982327.021
	454784.398
	6982441.160
	454632.212
	6982712.920
	454751.786
	6982821.624
	454610.471
	6983109.689
	455088.768
	6983386.884
	454773.527
	6983941.273
	454936.583
	6984060.848
	454621.342
	6984636.978
	454751.786
	6984789.164
	454469.156
	6985387.035

2.4 Amplitude Divergence Compensation

The effects of geometrical spreading were compensated using P. Newman's formulae and single velocity function:

$$G = TV^2$$

The compensation was provisional - to support signal processing, and ultimately was replaced by amplitude compensation computed and applied by 3D PSTM.

2.5 Trace Edit

Firstly shots denoted in observer's logs marked "VOID" were deselected, then an automatic trace edit routine was run. The passing criteria for traces was RMS amplitude below +24dB and above -24dB.

Trace Edit Statistics	
Total traces before edit	16,243,176
Traces in output from trace edit	16,228,464
Dropped Traces	14,712 (0.09%)

2.6 Minimum Phasing

The phase of the data was treated with the aim to achieve a consistent wavelet before deconvolution. The survey employed a Vibroseis source and as such was converted to minimum phase.

Figure 2: Min Phase Operator shows that the spectral content within the sweep frequency range remains unchanged after minimum-phasing.

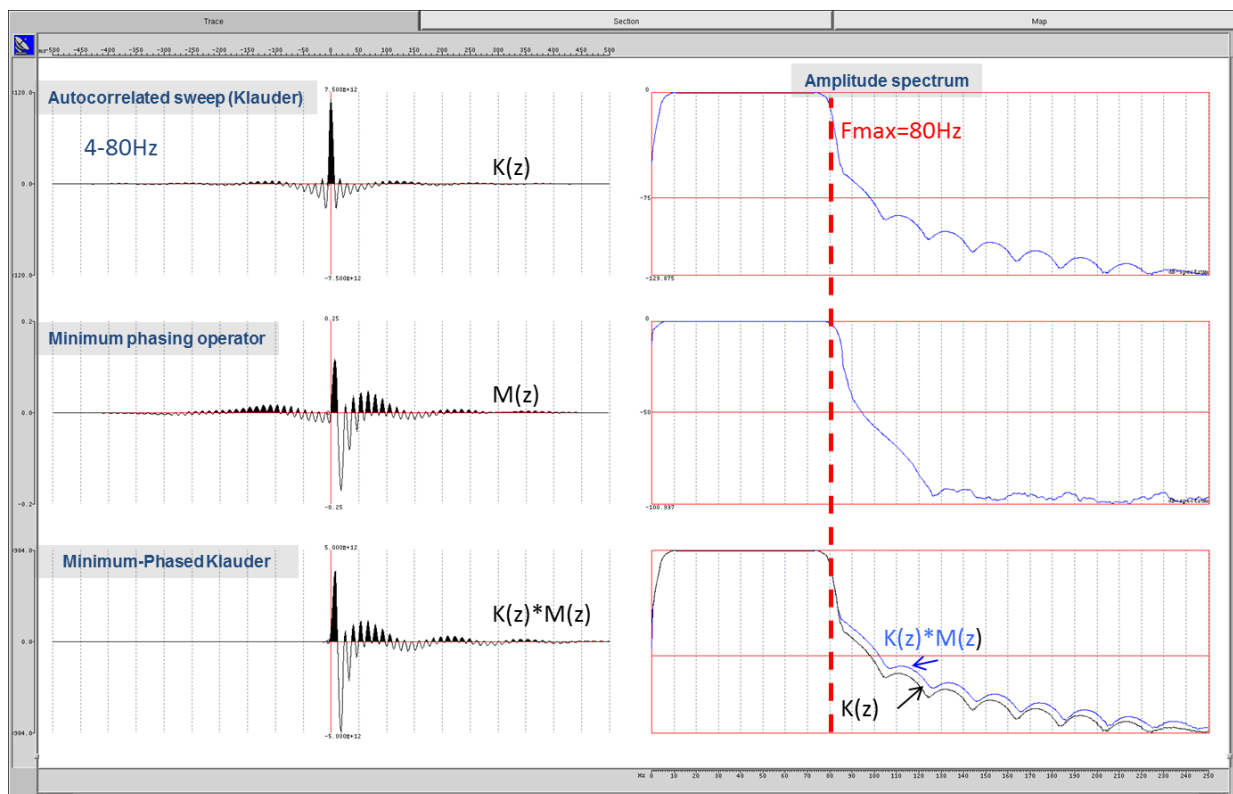


Figure 2: Min Phase Operator

2.7 First Breaks and Tomostatics

First breaks were auto-picked on raw shots and qc'd visually and using difference between predicted and actual first breaks.

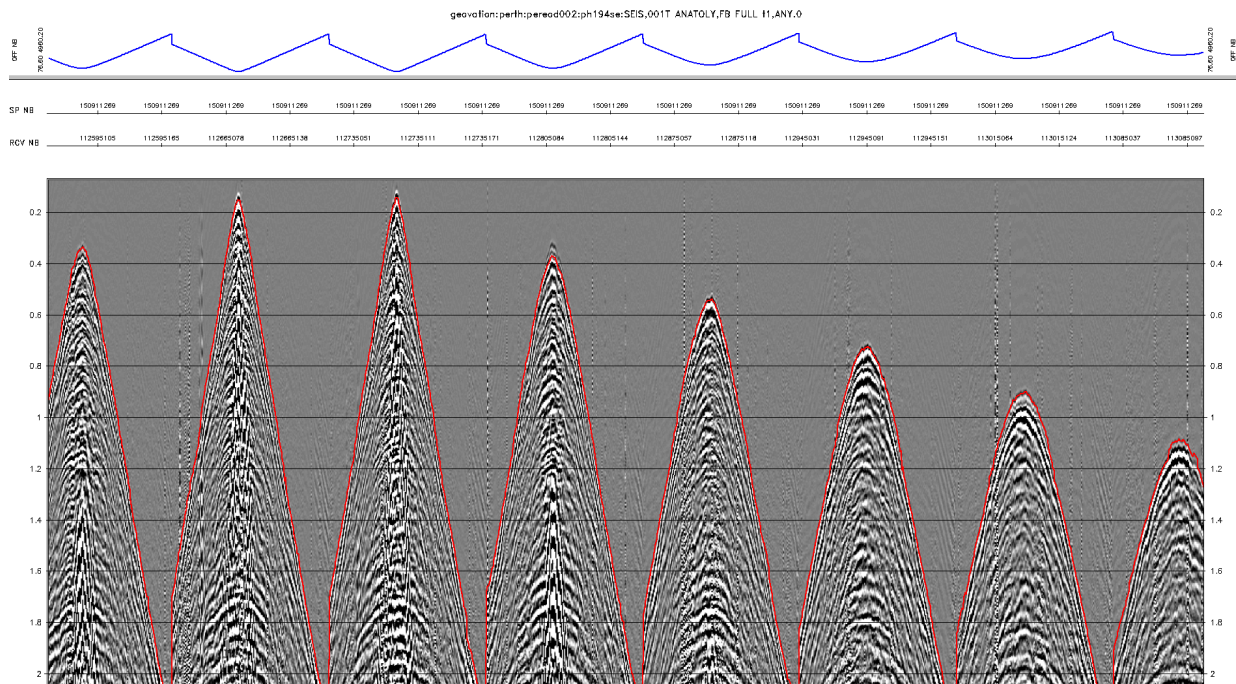
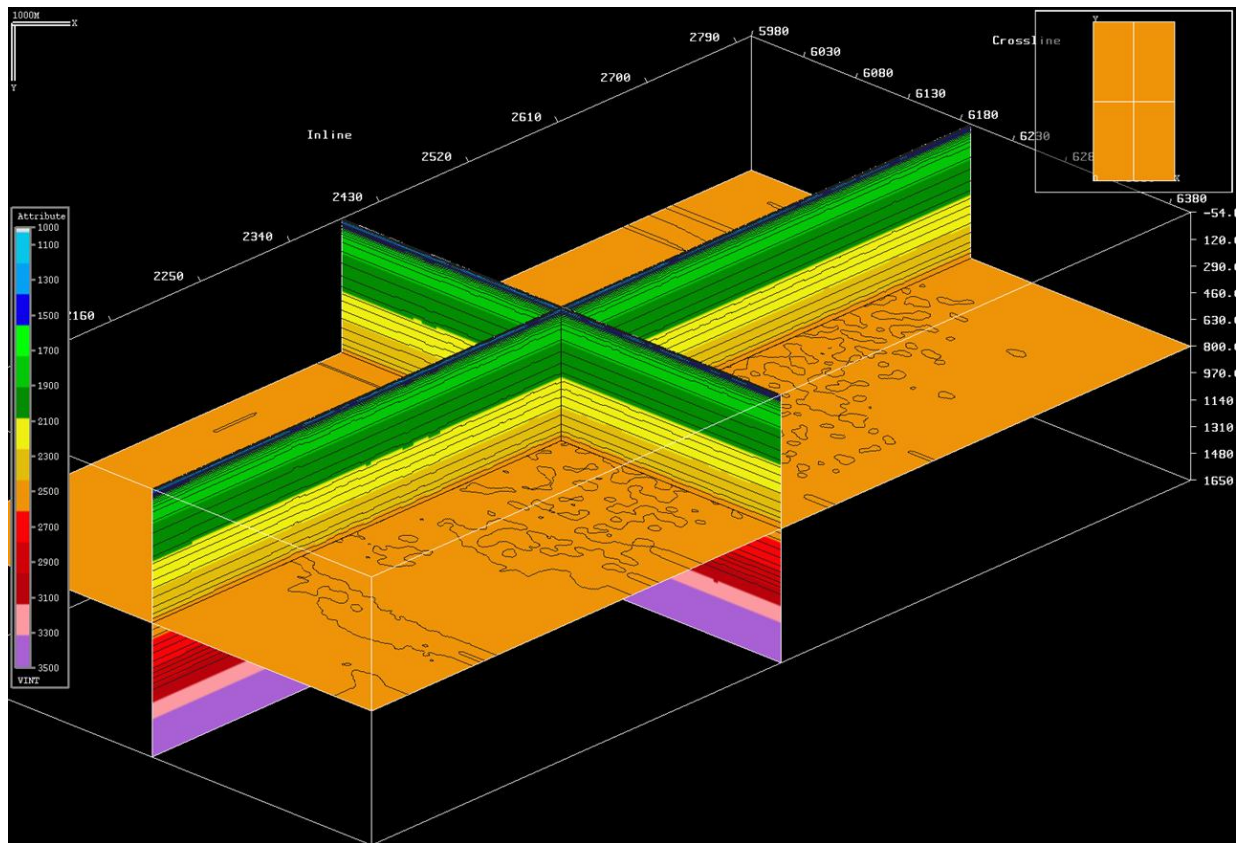
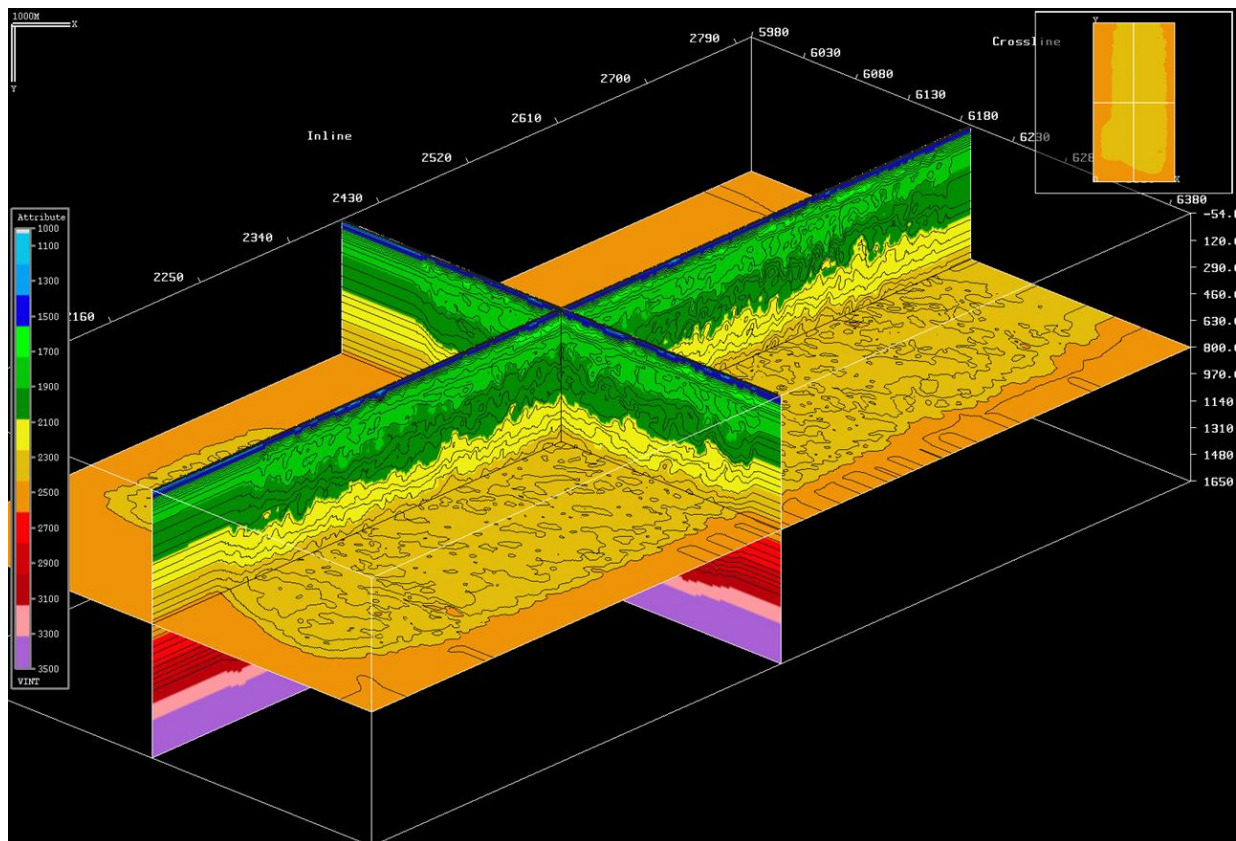


Figure 3: First Breaks QC on selected shots.

The initial model for tomography consisted of seven uniform layers:

Initial Tomography Model	
Layer	Thickness/ V_z
1	20m/1200m/s
2	100m/1750m/s
3	300m/1950m/s
4	220m/2180m/s
5	240m/2370m/s
6	430m/2765m/s
7	365m/3400m/s
	3940m/s half-space

Error! Reference source not found. shows the initial velocity model as described. The final tomographic solution is depicted in **Error! Reference source not found.**

**Figure 4: Initial Velocity Model****Figure 5: Final Tomogram**

Tomography non-linear solution treats first-breaks as diving rays events and inverts the travel times to $V(z,x,y)$ tomogram by computing V in each XYZ cell. Long Wave tomostatics is based on vertical travel time through the tomogram.

Tomography Key Parameters	
Cell X/Y/Z	25x25x15m
Offset Range	25 - 4000m
Datum	MSL = 0m
Pseudo-datum	150m below topography
$V_{\text{replacement}}$	1850m/s

Apart from tomostatics, elevation statics were also computed. After comparative evaluation, including QC stack sections, the tomostatic solution was accepted for production.

2.8 Random and Linear Noise Attenuation

For random noise attenuation, the module FDNAT was used. FDNAT attenuates high-amplitude noise in decomposed frequency bands. It uses frequency-dependent and time-variant amplitude threshold values in defined trace neighborhoods to detect and suppress noise specific to different frequency ranges and different times.

Two passes of FDNAT were run: in shot domain on each cable separately, then in receiver domain – separately on each shot line. Each sweep index was processed through the two passes of FDNAT on its own. Application was in 3 – 120 Hz range in 9 Hz bands.

For linear noise attenuation, the LINAT module was used. LINAT attenuates ground roll on cross spread data with orthogonal geometry. Data is first put into an orthogonal cube that is defined by two spatial attributes and time to form a T-X-Y cube and then is transformed to F-Kx-Ky domain. It is analysed and filtered in that domain. Results are then transformed back to T-X-Y domain.

LINAT Parameters	
Domain	XSpread
$V_{\text{min}} - V_{\text{max}}$ Range	100-3000m/s
Frequency Range	1 – 125Hz

Both processes were applied on NMO corrected data.

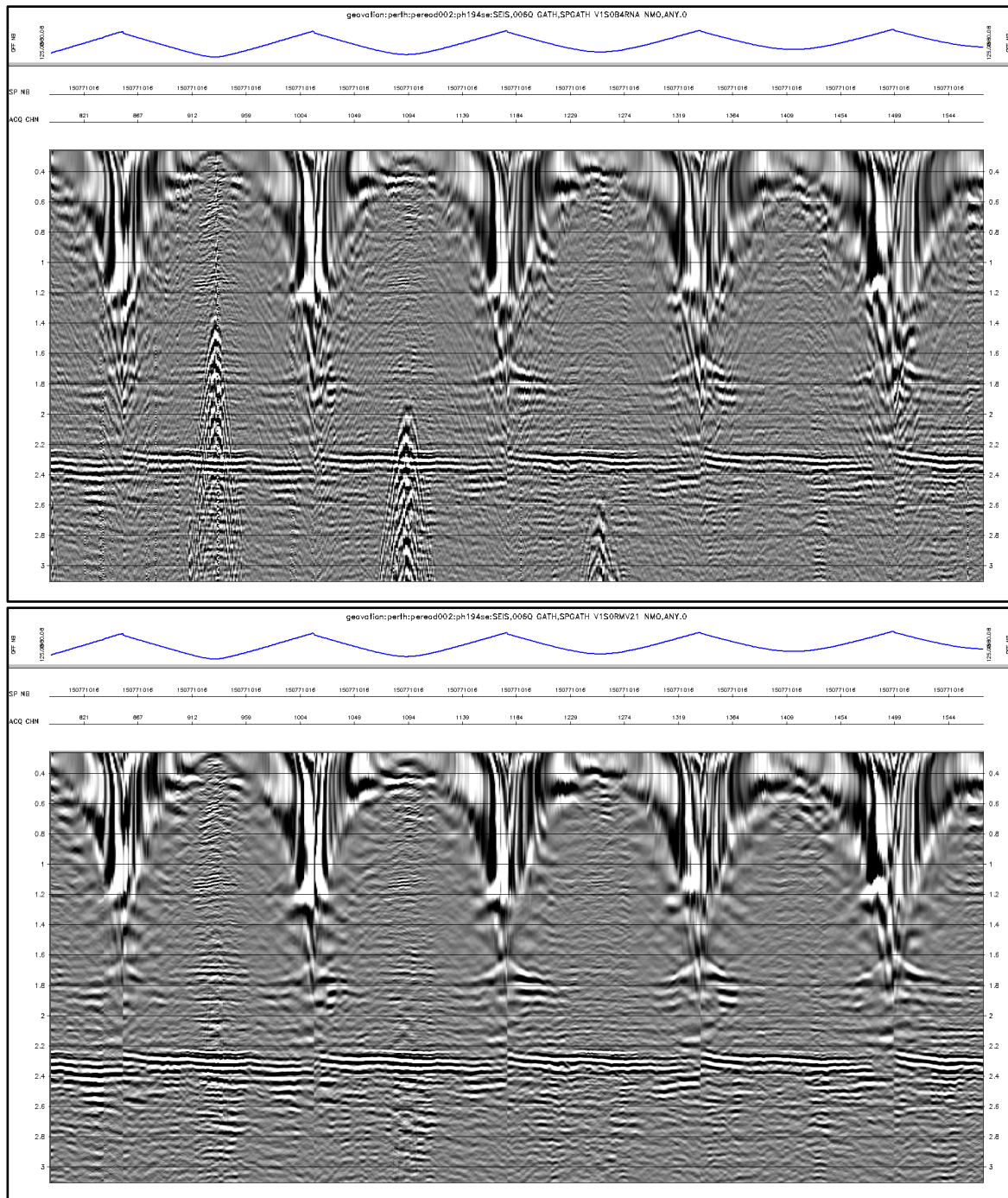


Figure 6: Example of shot gathers before and after FDNAT/LINAT noise attenuation

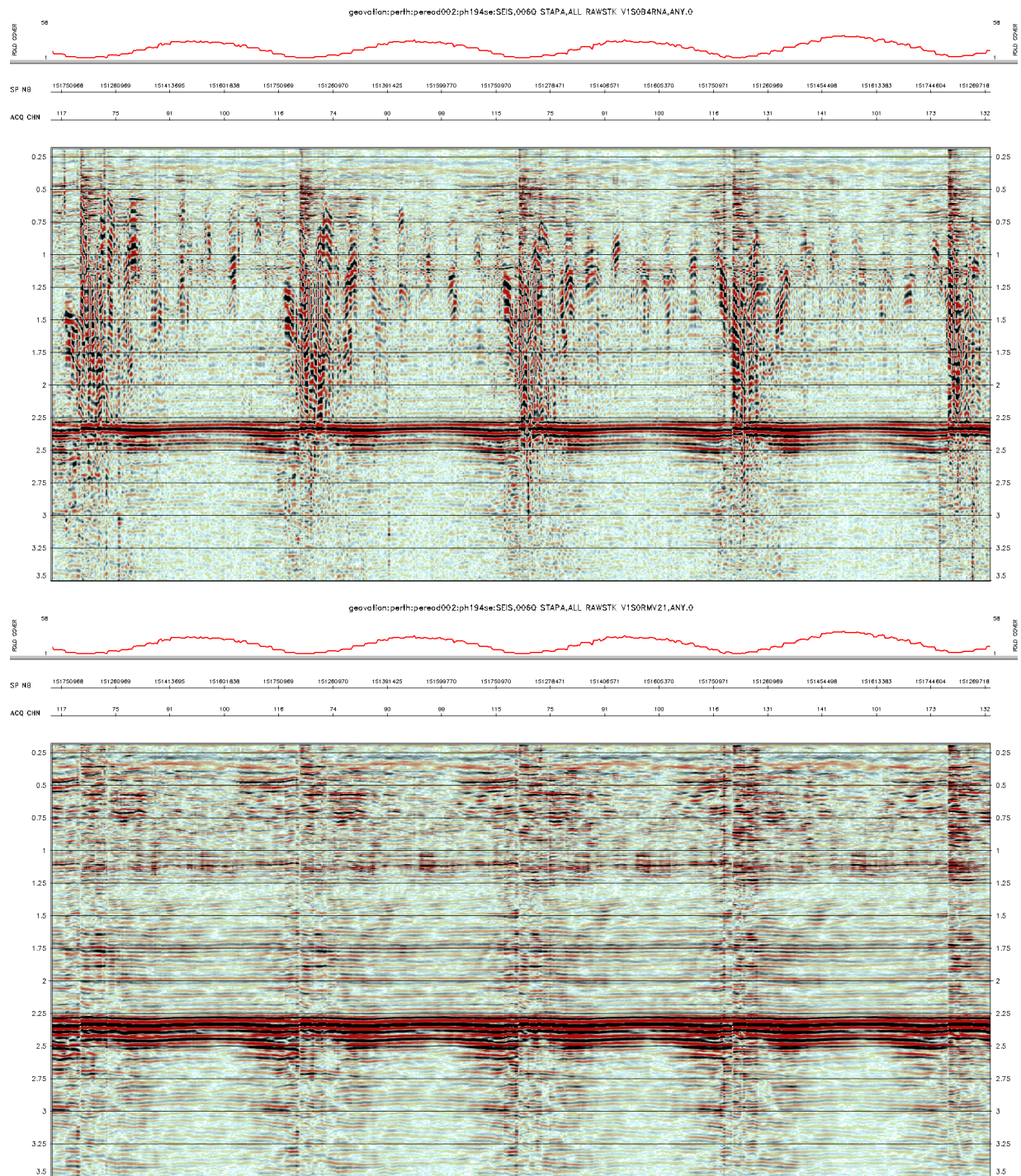


Figure 7: Example of stacks before and after FDNAT/LINAT noise attenuation

2.9 Inv-Q

The module DEABS performs an accurate time and space varying inverse Q filtering to seismic data. The process restores the spectral balance in the wavelet and removes the non-stationary phase components from the seismic data, therefore preconditioning the data for further deterministic or statistical processing methods.

Attenuation analysis was conducted on the data and an Inverse Q function derived from the analysis

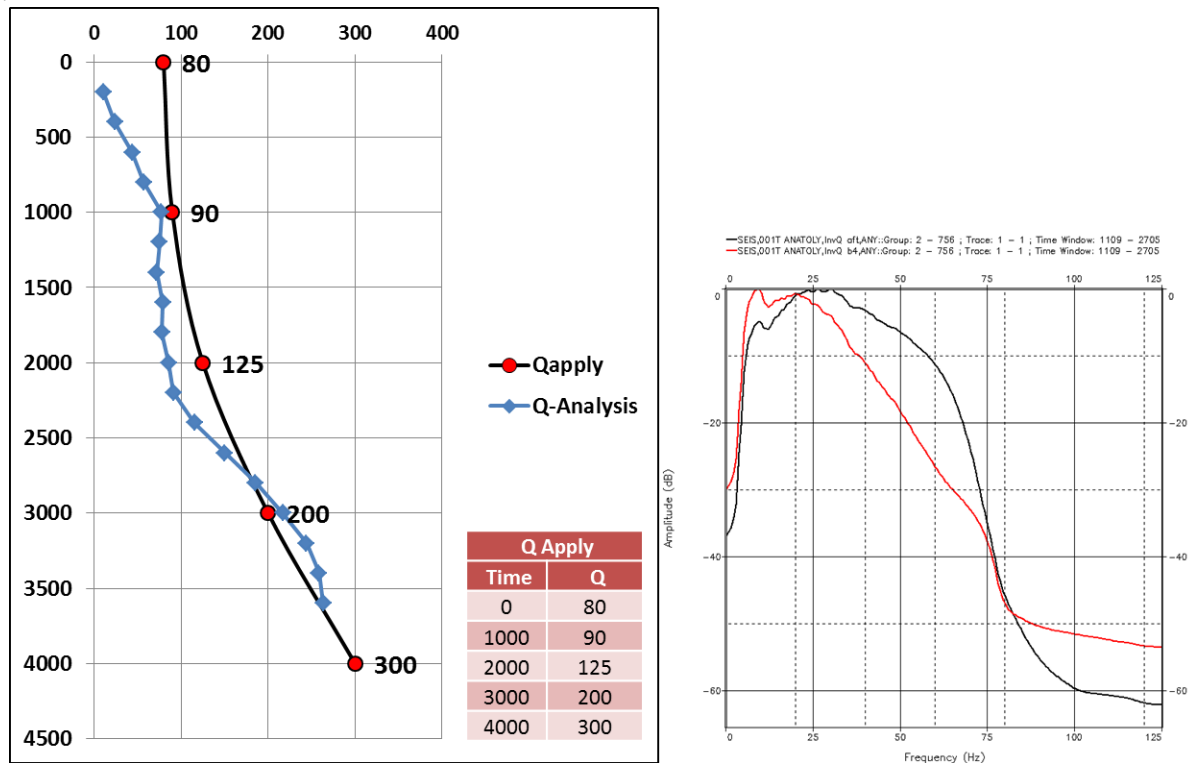


Figure 8: Inverse Q Function and Spectral Analysis – before (red) and after (black) Inv-Q Amp&Phase

2.10 Surface Consistent Deconvolution DECSC

DECSC performs a pre-stack deconvolution. Each trace is expressed as the combination of a filter common to all traces with four filters characterized respectively by:

- Shotpoint position
- Receiver position
- CDP
- Shooting distance

The deconvolution is performed in two phases:

- 1st phase: filter estimation
- 2nd phase: deconvolution of input traces

DECSC Parameters	
Start Window	$1000 * \sqrt{(1.2^2 + (OFF_NB/2250)^2)}$
End Window	$1000 * \sqrt{(2.5^2 + (OFF_NB/2500)^2)}$
Operator Length	200ms
White Noise	0.1%

Only shotpoint and receiver operators were applied.

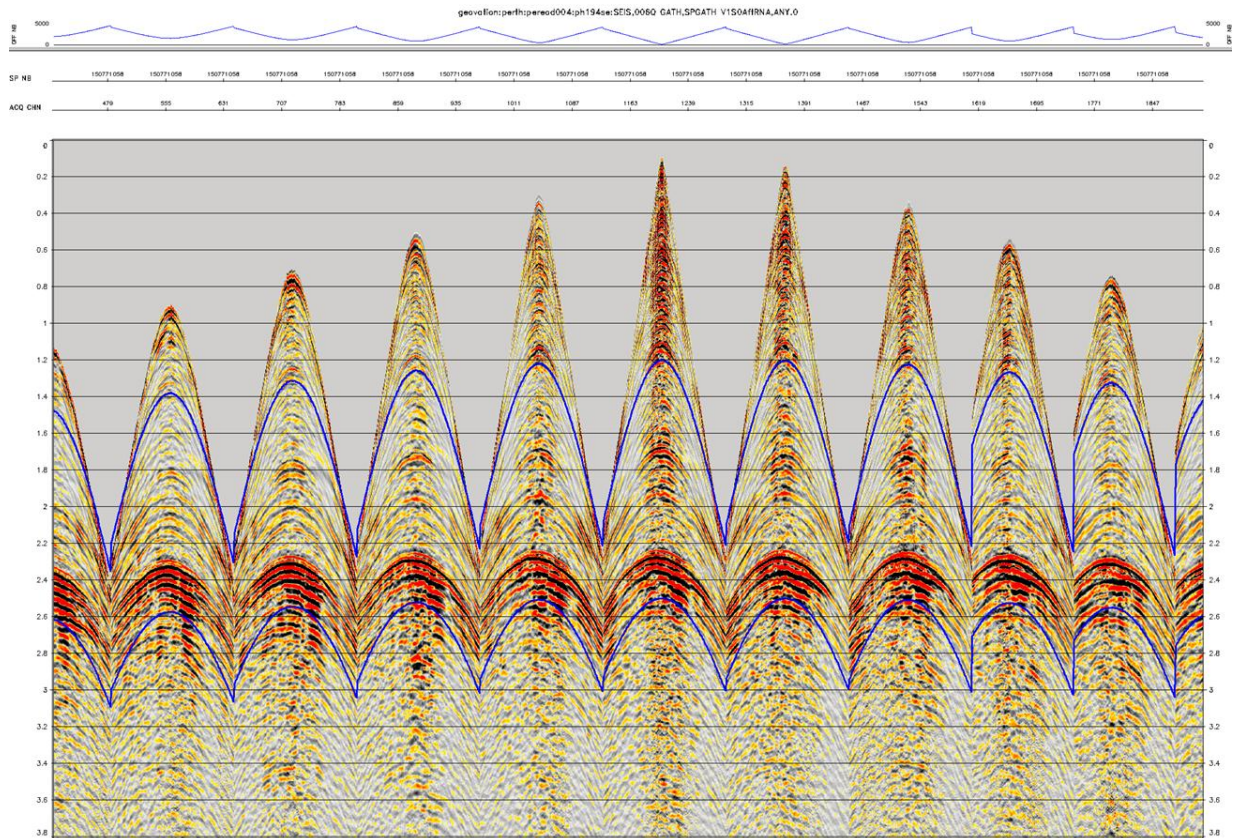


Figure 9: Deconvolution operator design window displayed on shot gather

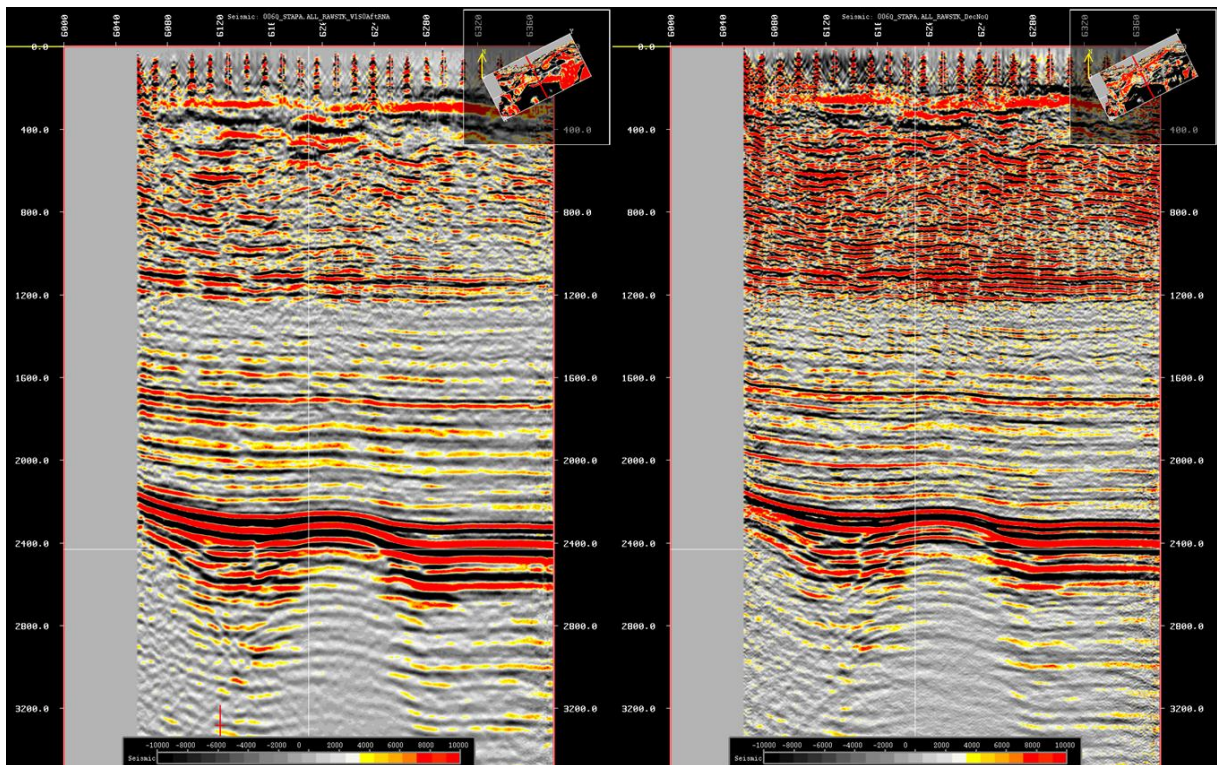


Figure 10: Stack before and after SC Spiking deconvolution

2.11 Surface Consistent Residual Statics (MOCAS)

MOCAS (Monte-Carlo/Annealing Simulation) computes Surface-Consistent residual statics using a non-linear scheme based on a Monte-Carlo method coupled to a simulated annealing approach. The module uses NMO corrected data and takes into account azimuthal velocity variation in case of WAZ.

A non-linear approach that uses the Simulated Annealing concept (*Kirkpatrick et al., 1983*) coupled with a Monte-Carlo technique (*Metropolis et al. 1953*) allows computing surface consistent residual statics at the global minimum. In this technique, the cost function usually suddenly increases (called the crystallization step) when a certain set of statics and an ad-hoc temperature is achieved (cooling schedule). Different kinds of cost functions can be used; they are based on either the stack power (*Rothman, 1986*) or the coherence of the neighboring CMP gathers to optimize the reflections on the final CMP stack (*Vasudevan et al., 1991*).

The Monte-Carlo approach implemented in MOCAS uses a cost function that is based on the coherence of the stack with some robust criteria to stabilize the results (*LeMeur and Merrer, 2006*). The cooling schedule is computed as a function of the number of iterations and the initial temperature T^0 . This temperature is determined during a pre-processing step of tens of iterations that precede the non-linear inversion. The whole process contains hundreds of simulations, each of which is randomly explored for all the shot points and receiver stations to avoid bias and cycle-skipping (*Dahl-Jensen, 1989*). For each selected shot point or receiver station, a random static value is chosen and applied to the pre-stack data. The cost function variation reflects the influence of this random static shift through the neighboring CMP gathers: for a positive variation the static shift is accepted, for a negative one the static acceptance depends on the metropolis criterion thus avoiding a local minimum (*Vasudevan et al., 1991*).

MOCAS requires a large amount of memory to store seismic traces.

Two passes of residual statics were calculated – the first was using a single velocity to provide some coherency and allow better results in subsequent noise attenuation processes – these were rerun and replaced once first pass velocities were calculated. The second was calculated after further velocity control and noise attenuation and was added on top of the first pass.

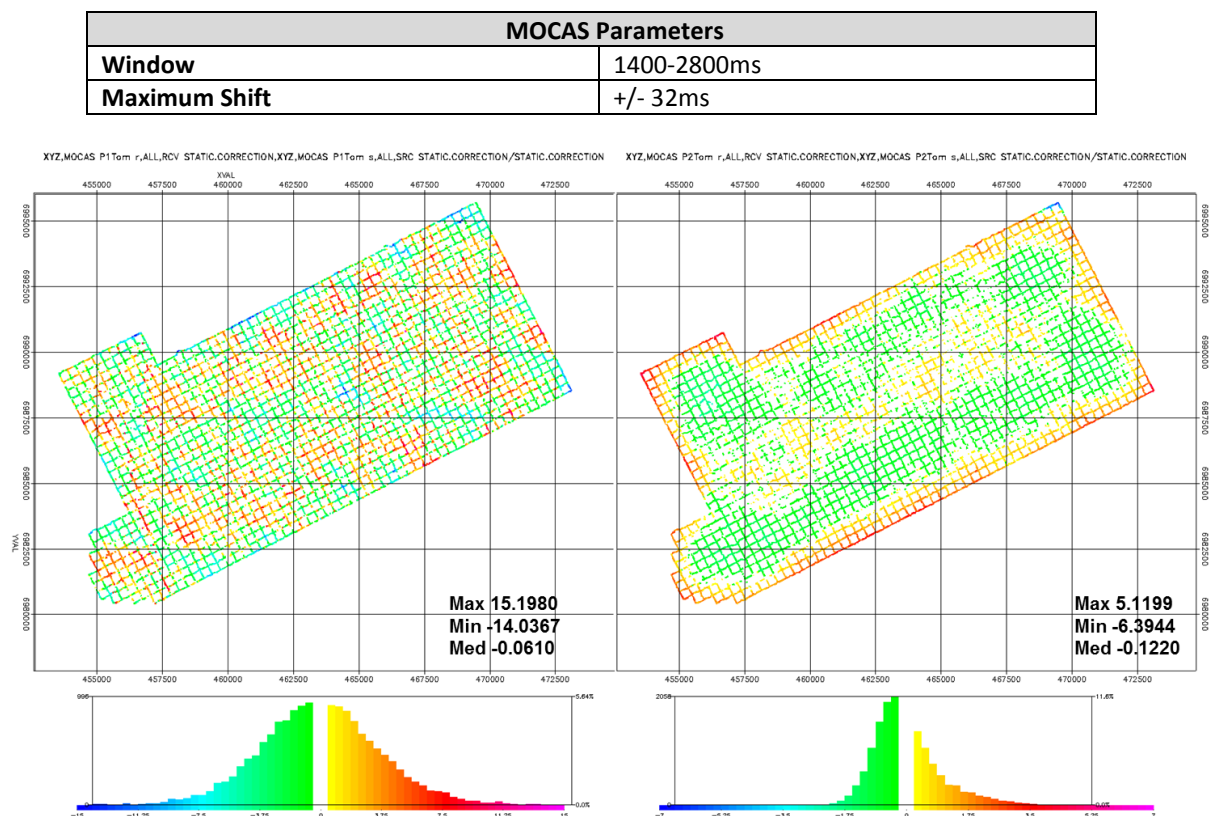


Figure 11: Shot and Receiver Residual Statics First Pass and Second Pass

2.12 Surface Consistent Amplitude Correction (SCAC)

SCAC attempts to compensate for source amplitude variation, receiver coupling, as well as for effect of near surface condition in a surface consistent manner. It computes shot, receiver, and offset amplitude terms, but unless requested only shot and receiver terms are applied.

SCAC Parameters	
Amplitude Computation Window	1400-3200ms
Corrections Computed	Shot, Receiver, Offset
Corrections Applied	Shot, Receiver

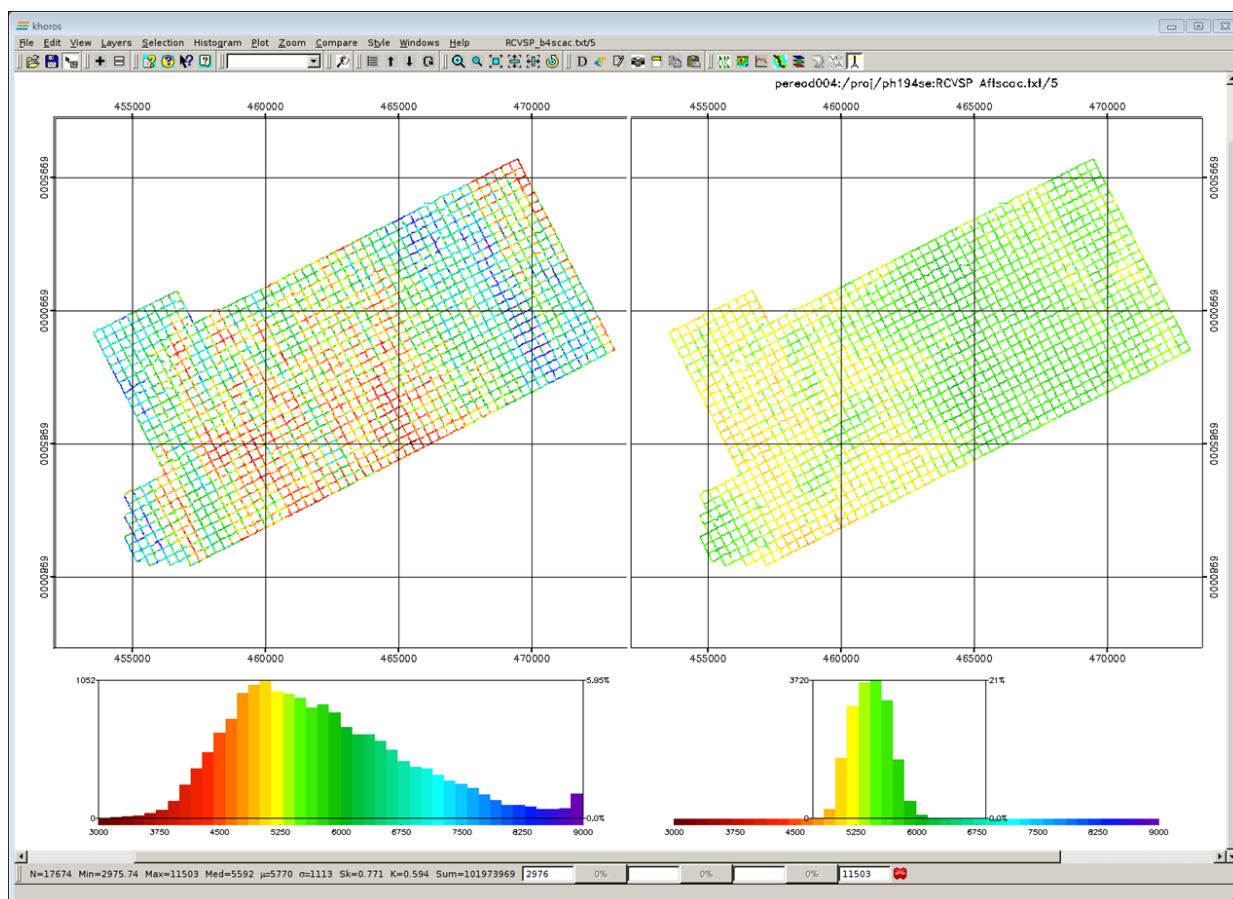


Figure 12: RMS Amplitude before (left) and after (right) correction

2.13 5D Interpolation FREND

The module FREND performs multi-dimensional Fourier data mapping/regularisation. Data is processed in overlapping spatio-temporal blocks. After temporal FFT, each frequency slice is transformed into the spatial frequency domain with an irregular Fourier transform (similar to the anti-leakage Fourier transform). The reverse transform reconstructs traces at specified IL/XL/OFFX/OFFY coordinates (mapping).

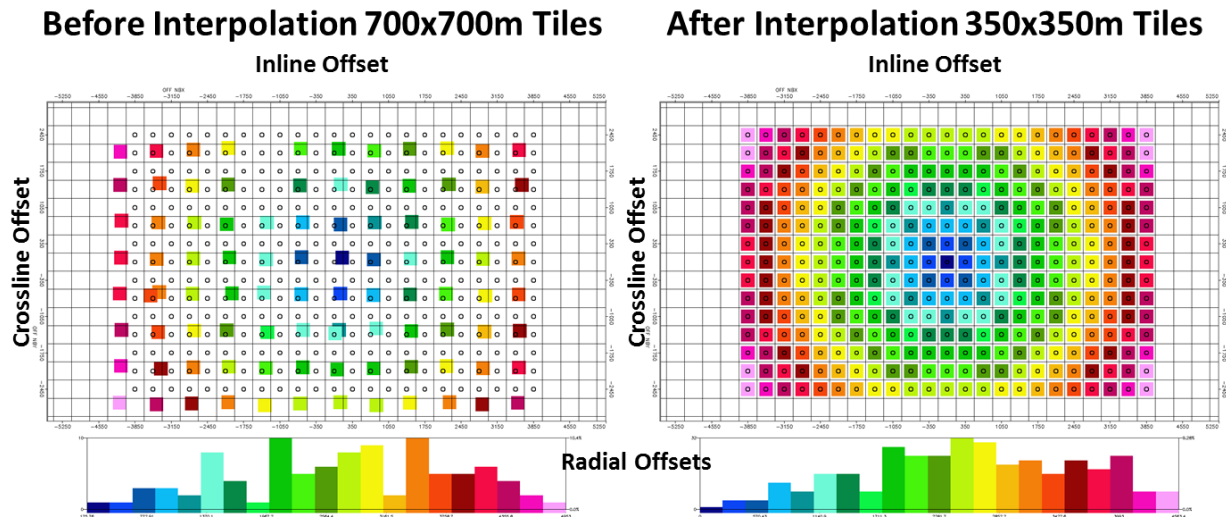


Figure 13: CMP gather geometry before/after interpolation. Stack fold rise: $12 \times 8 = 96 \rightarrow 23 \times 15 = 345$

An example of the data before and after interpolation is shown below in Figure 14.

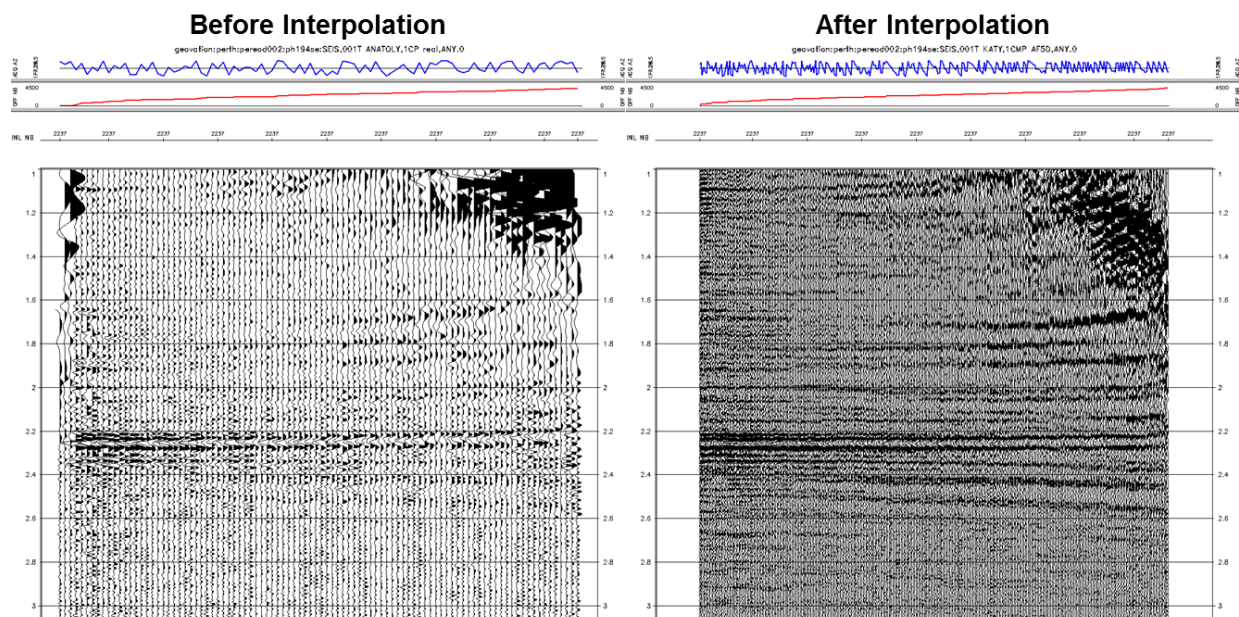


Figure 14: Typical CMP Gather Before/After Interpolation

2.14 Manual Velocity Picking

There were four passes of manual velocity picking:

- VA01 1050x1050m – to support Residual Statics #1
- VA02 1050x1050m – to support Residual Statics #2
- VA03 525x525m – on targeted 3D PST-migrated lines, to create migration V-field
- VA04 525x525m – post PSTM, to create a guide V/Eta

To make sure that near traces included in an analysis CMP gather, velocity locations were positioned at shot/receiver line intersections.

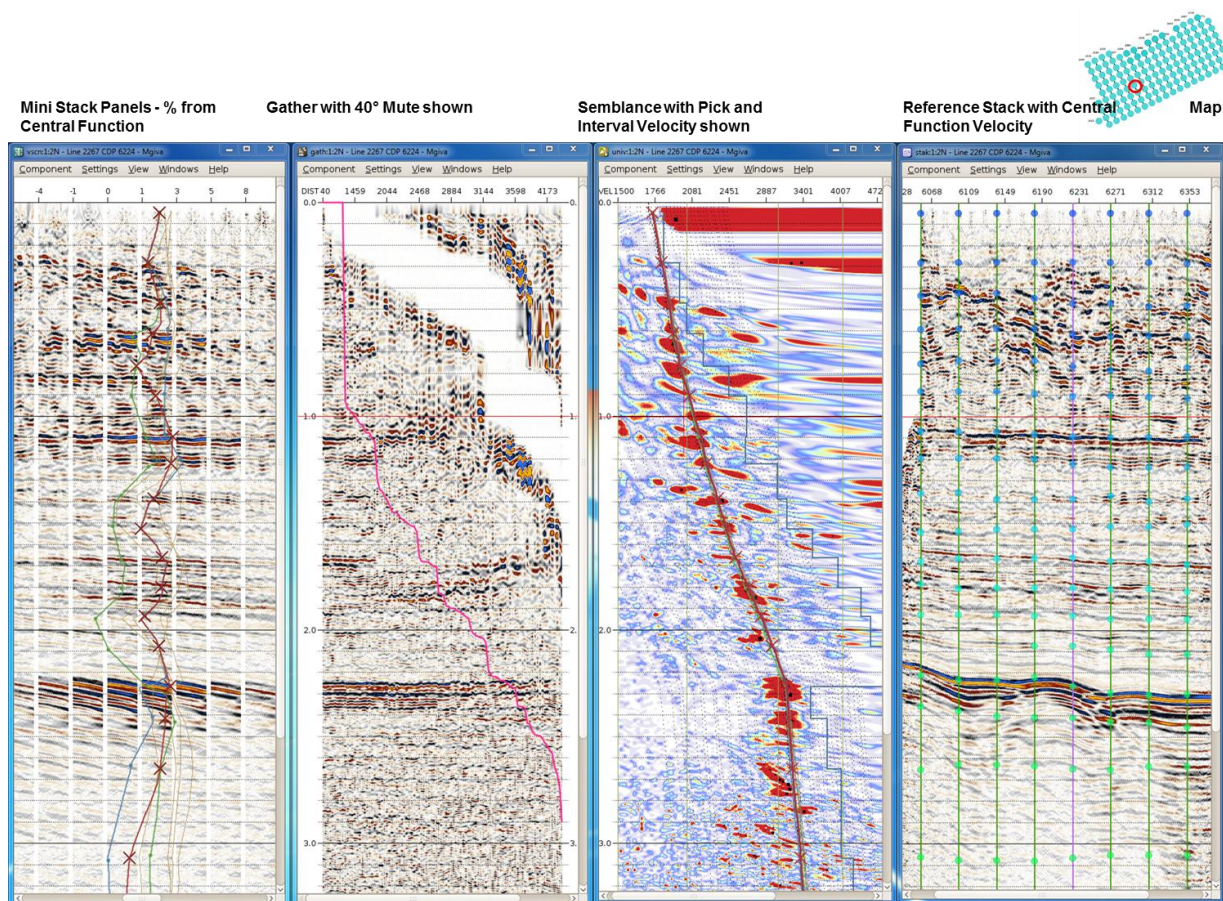


Figure 15: Interactive Picking VA02 1050x1050m example.

2.15 3D Kirchhoff Pre-Stack Time Migration

Kirchhoff migration module is a trace-by-trace migration, which treats each output sample as the apex of a diffraction curve. Input samples are summed along the diffraction curve, which is characterized by a locally defined 1-D RMS velocity function and raybending. The reflector image is built by constructive interference. Geometrical spreading compensation is included into migration as amplitude terms of the Green function.

Kirchhoff Pre-Stack Time Migration Parameters	
Mode	Single Fold COV cube migration (each COV separate)
Migration Velocity	VA03 smoothed radius equals half-aperture
Dip Limit	60°

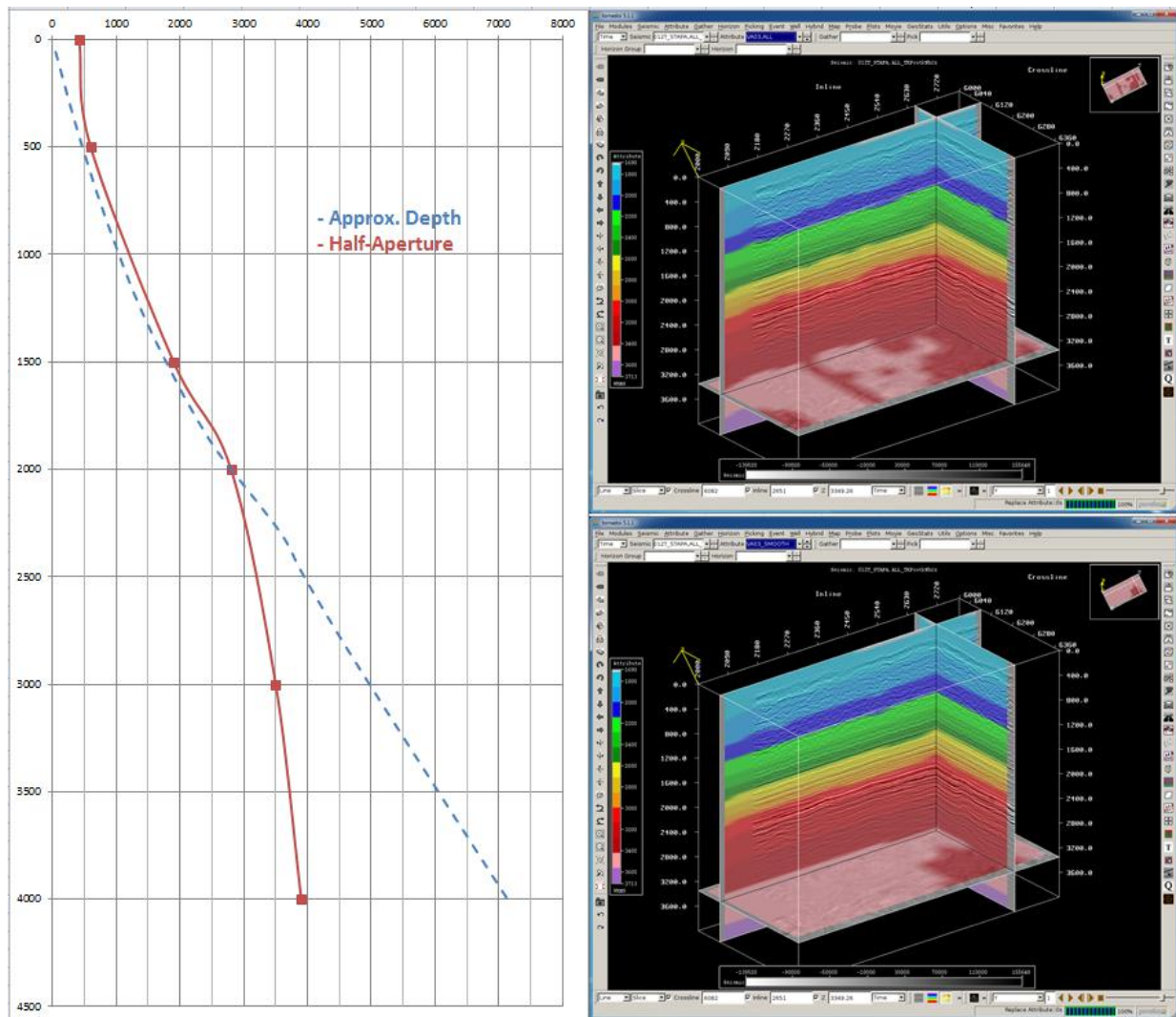


Figure 16: Migration velocity and half-aperture with approximate depth for reference.

2.16 3D Radon

The module TQXQY performs 3D Radon 3D parabolic Radon filtering of 3D NMO-corrected CMP gathers, taking into account the X and Y components of the offset vector, and handling azimuthal variations of the curvature of the paraboloids. The module computes a model of primary and multiple events. This computation is based on data decomposition into user-defined paraboloids and performed using a high resolution, de-aliased, 3D parabolic Radon decomposition in the Fourier domain. The high resolution feature results in sparse, highly focused around a few components Radon spectra. Events corresponding to paraboloids with the largest curvatures are considered to be multiples. Events corresponding to paraboloids with the smallest curvatures are considered to be primary events. Limits between primaries and multiples are defined by the user. The difference between the data and the sum of the primary and multiple events is considered noise. The model of multiples and, optionally, a part of the noise are subtracted from the input data.

3D Radon (TQXQY) Parameters	
Transform DTMIN-DTMAX	-340ms - 1600ms
Cutoff DTCUTS	180ms
Azimuthal Anomaly DTAMAX	100ms
Reference Offset	6000m

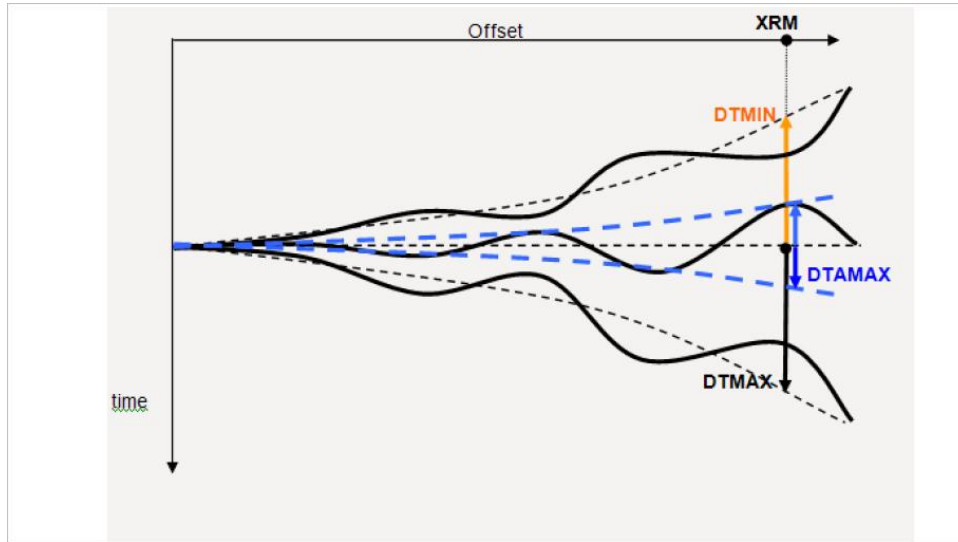


Figure 17: 3D Radon key parameters

2.17 HDPIC VTI Velocity Analysis

After applying azimuthal NMO corrections, a dense V_{nmo}/η analysis HDPIC was run on each CDP.

In VTI model reflections, travel time is expressed through V_{nmo} and effective η (Alkalifah & Tsvankin)

$$t_{\rho}^2 = t_0^2 + \frac{\rho^2}{v_{nmo}^2} - \frac{2\eta \rho^4}{v_{nmo}^2 [t_0^2 v_{nmo}^2 + (1 + 2\eta) \rho^2]}$$

$$\eta = \frac{1}{2} \left\{ \left(\frac{V_a}{V_{nmo}} \right)^2 - 1 \right\}$$

Where ρ – radial offset and V_a – anelliptical (horizontal) velocity.

The HDPIC module is used to generate dense volumes of velocity and anellipticity moveout parameters. It is based on an original approach of the anelliptic shifted hyperbola moveout equation which corresponds to a sixth order approximation of anisotropic travel times. Both velocity and anellipticity parameters are simultaneously estimated using the full coverage of the data. The scanning of two internal uncorrelated parameters generates bispectral panels at time slices. The sampling of these parameters is directly related to the sensitivity of the normal moveout. For practical reasons, HDPIC outputs the uncorrelated parameters dt_n and τ_0 to help further interpolation, filtering and conversion to V_{nmo} and η (anellipticity) parameters.

A corridor, limited by the minimum and maximum values of Velocity and η reduces the analysis domain. Semblance maximum is used as the automatic picking criteria.

Computed effective parameters can be converted to interval:

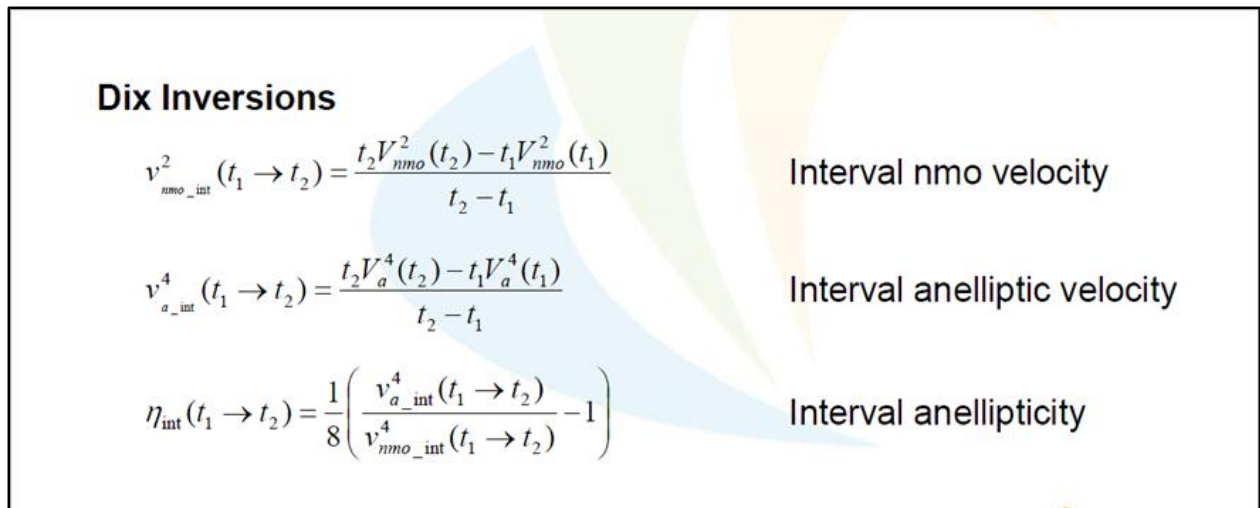


Figure 18: Dix Inversion Equations

HDPIC Parameters	
TWT Sampling	32ms
Semblance Window	24ms

The HDPIC result was QC'd volumetrically in Tornado, on NMO corrected gathers, semblances and stacks.

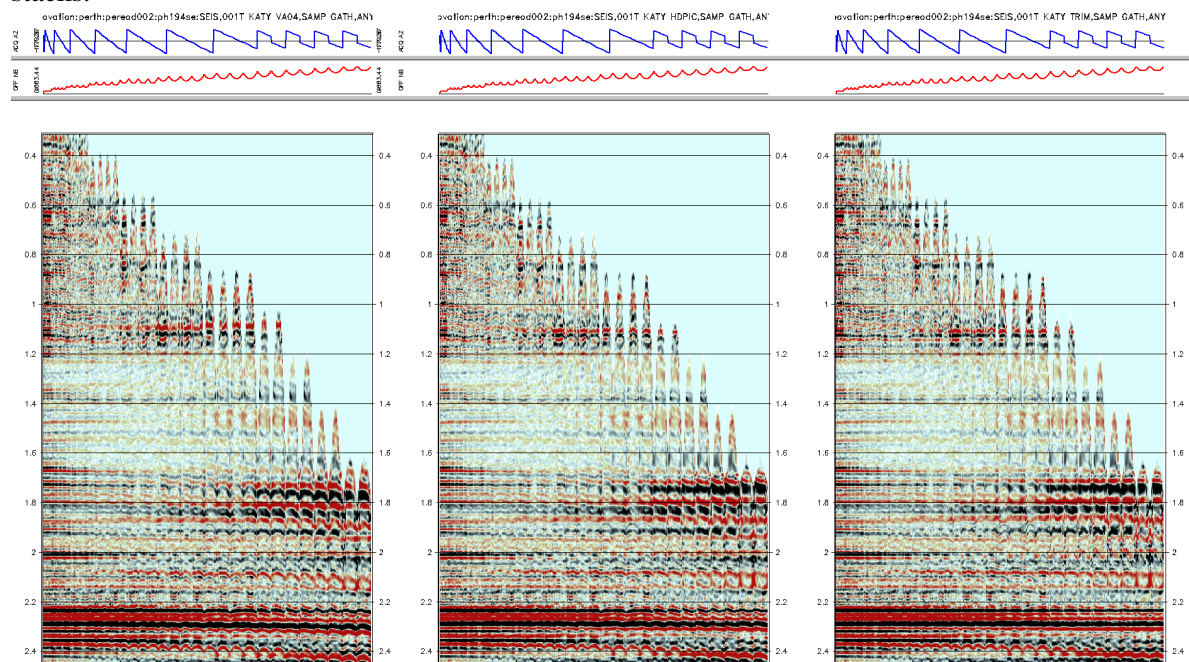


Figure 19: PSTM gathers. NMO from the left: VA04, VA04 + HDPIC, VA04 + HDPIC + Trim Statics

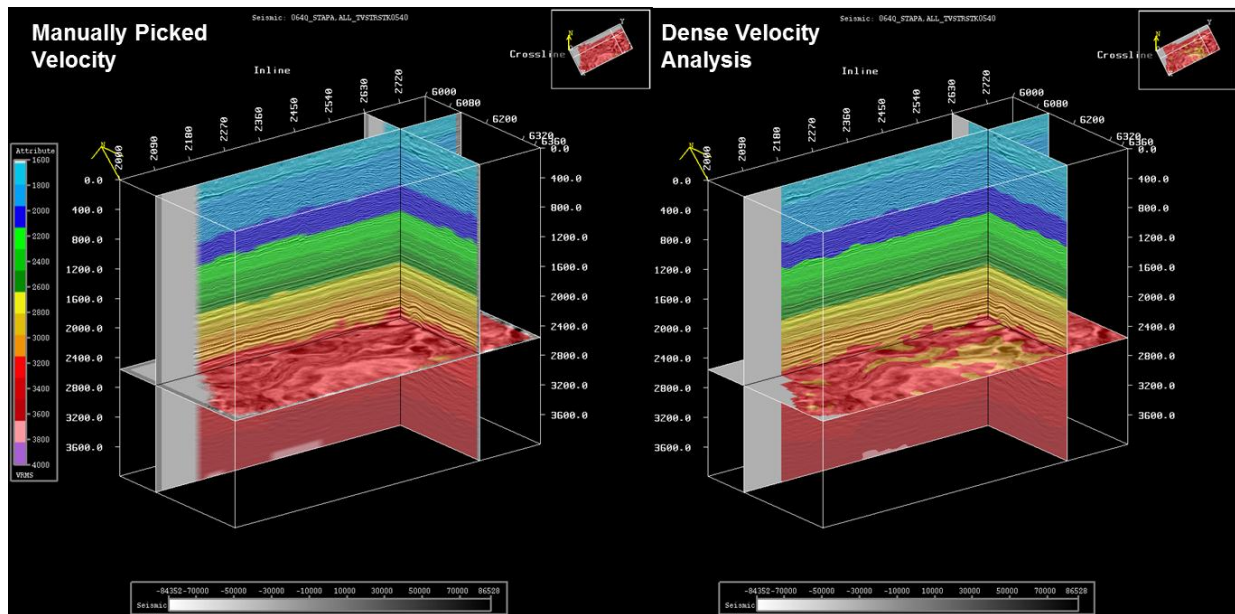


Figure 20: Manually Picked vs Dense Velocity Analysis

2.18 Trim Statics

Time-Variant trim-statics was computed in 360ms gates from 100 to 4000ms and a maximum time shift of 16ms.

2.19 Stacking

Incidence Angle Stacks were designed as follows:

Angle Stack Parameters	
Full Stack	5 – 40°
Ultra – Near	0 – 15°
Near	15 – 25°
Mid	25 – 35°
Far	35 – 45°
Ultra – Far	45 – 55°

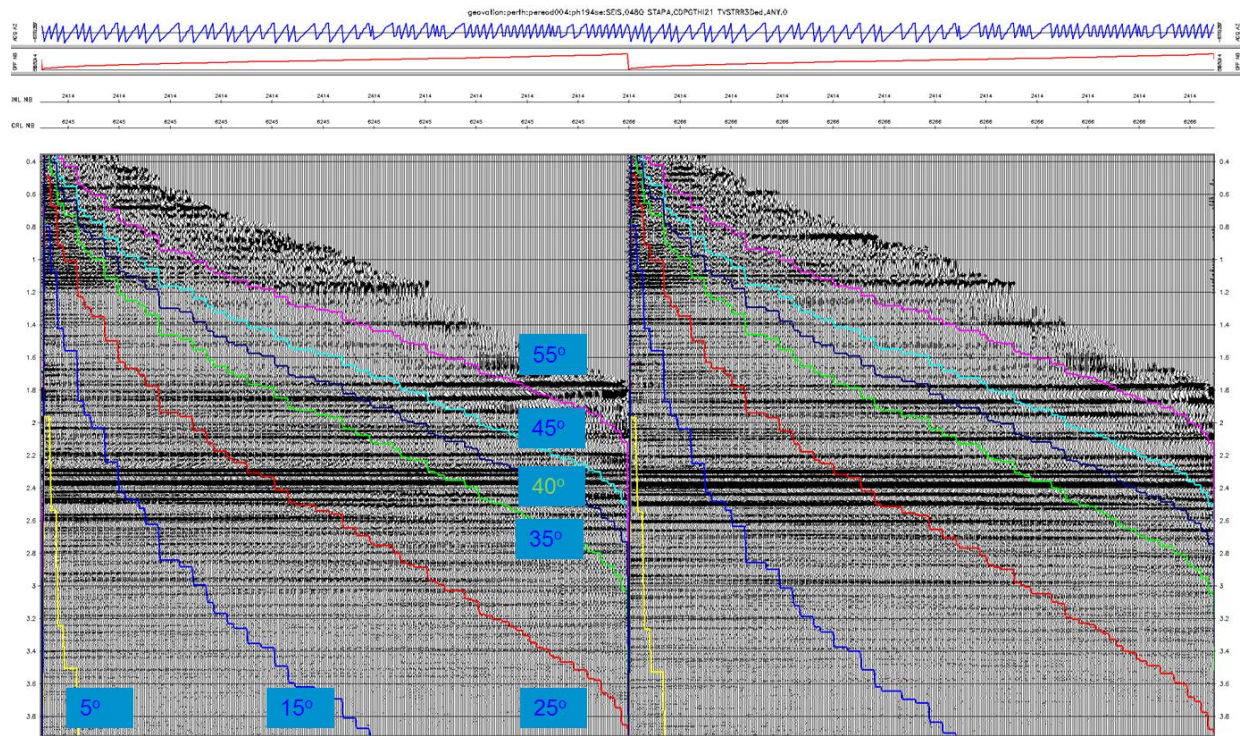


Figure 21: Stacking Mutes

Azimuthal stacks at increment 45° were generated, all with $15 - 45^\circ$ mute. Traces for the stacks were collected at 45° increment from survey direction (63° from North for Jonothon 3D) as shown in Figure 22.

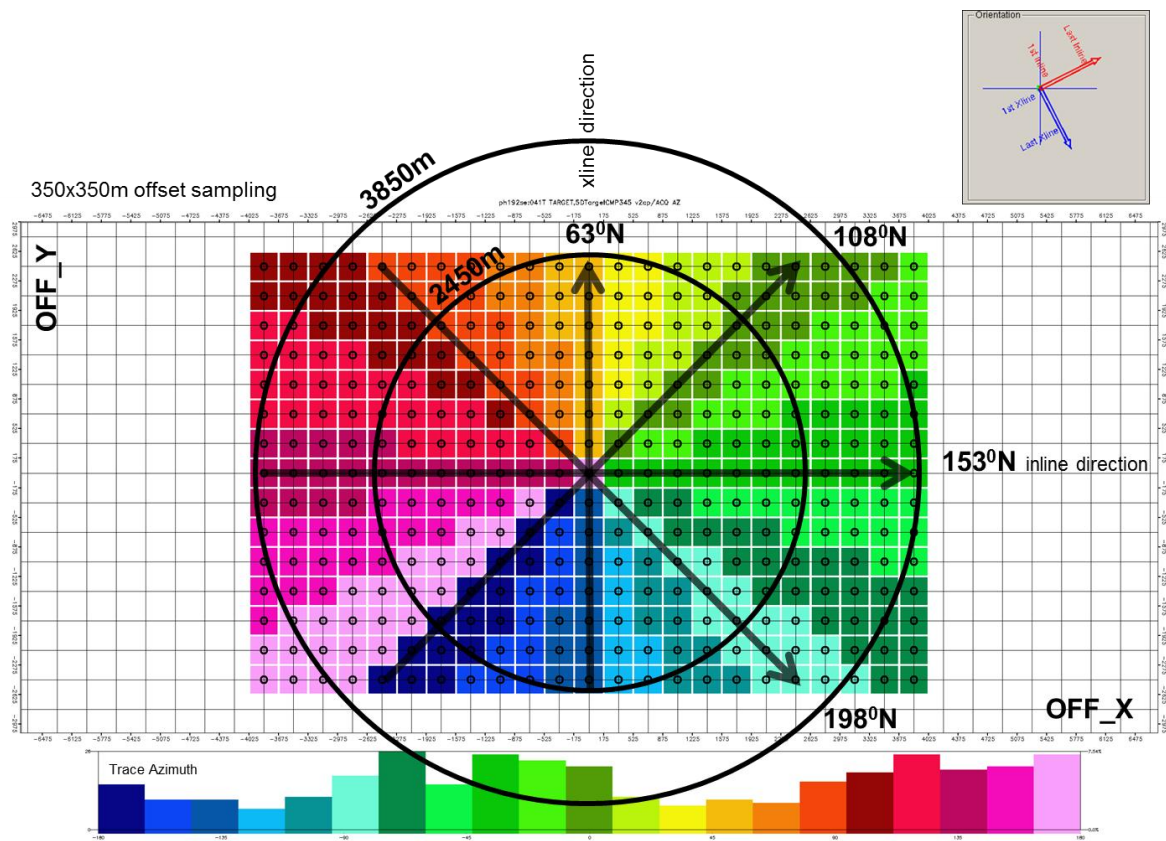


Figure 22: Azimuthal Stacks Design

2.20 Footprint Removal (FKF3D)

The CGG module FKF3D is designed to attenuate acquisition footprint originating from the presence of large spacing between source lines and receiver lines in 3D land data. The attenuation is done in the f-Kx-Ky domain. FKF3D can detect and subtract acquisition footprint from input volumes. The method assumes that acquisition footprint is spatially periodic and that geology does not have such periodicity. Footprints are automatically detected and attenuated from the input data when the Auto-Detect (AD) option is selected.

FKF3D Parameters	
Domain	Post – Stack 3D cube
Mode	Auto-Detect
IL/XL Block Taper	100x100 Subvolume, 50% taper
Temporal Window	400ms

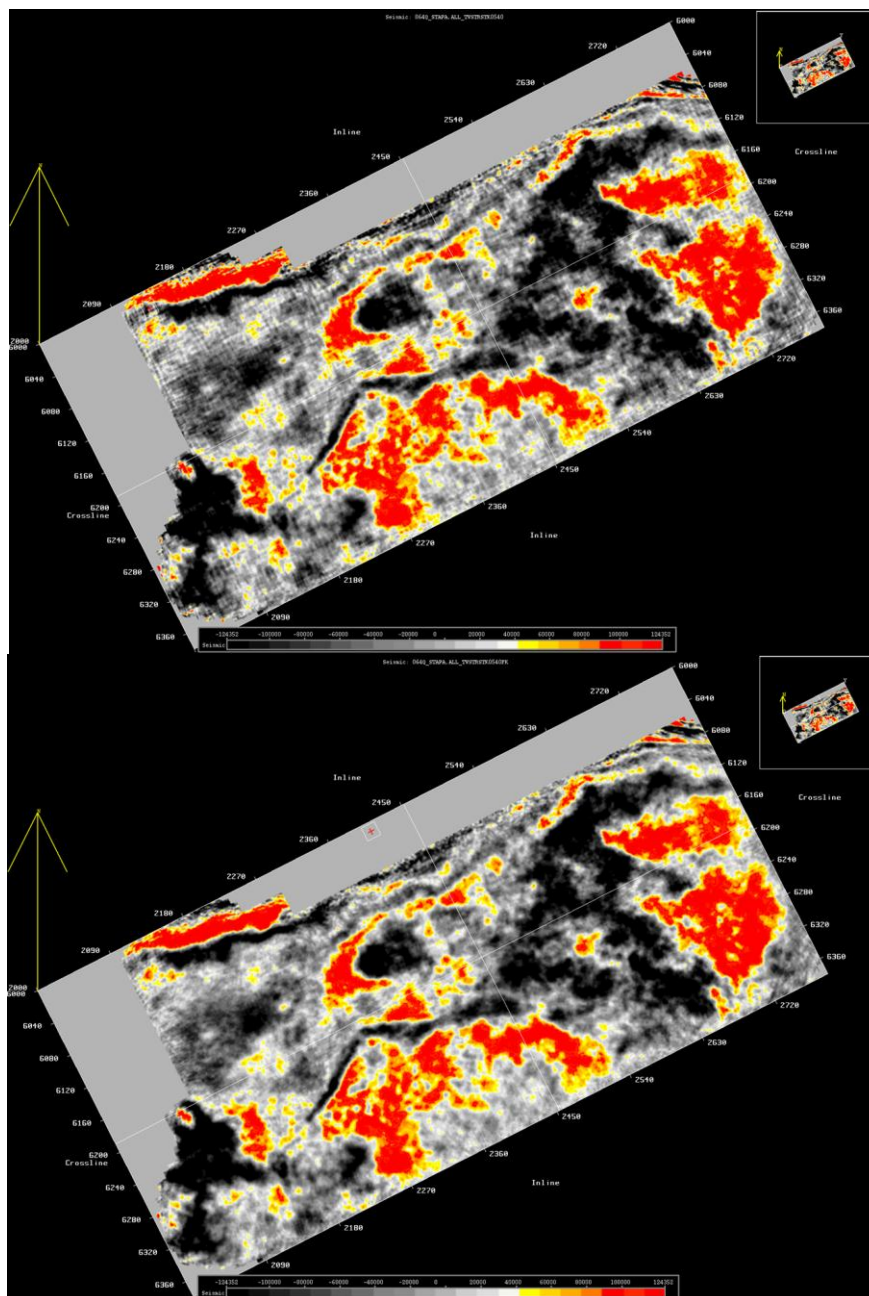


Figure 23: Footprint removal at timeslice 2100ms before (top) and after (bottom)

2.21 Spectral Correction and CADZO

Spectral correction was implemented in the wavelet domain by applying statistical whitening in the range of 7-74Hz (central frequencies with tapering).

Post-stack CADZO was applied on all products labelled “FINAL” in the deliverables table (see List of Deliverables by Filename).

In CADZO, input traces are Fourier transformed to frequency domain where they form a complex Hankel matrix. Singular Value Decomposition (SVD) reduces the rank of this matrix. Then it is returned to Hankel form and FFT'd to time domain. Signal tends to span over lower ranks, random noise occupies higher. Noise is filtered out by limiting rank of the output matrix.

Post – Stack CADZO Parameters	
Domain	Post – Stack 3D cube
Mode/Rank	Hankel/3
IL/XL Block Taper	11x11
Temporal Window	400/200ms

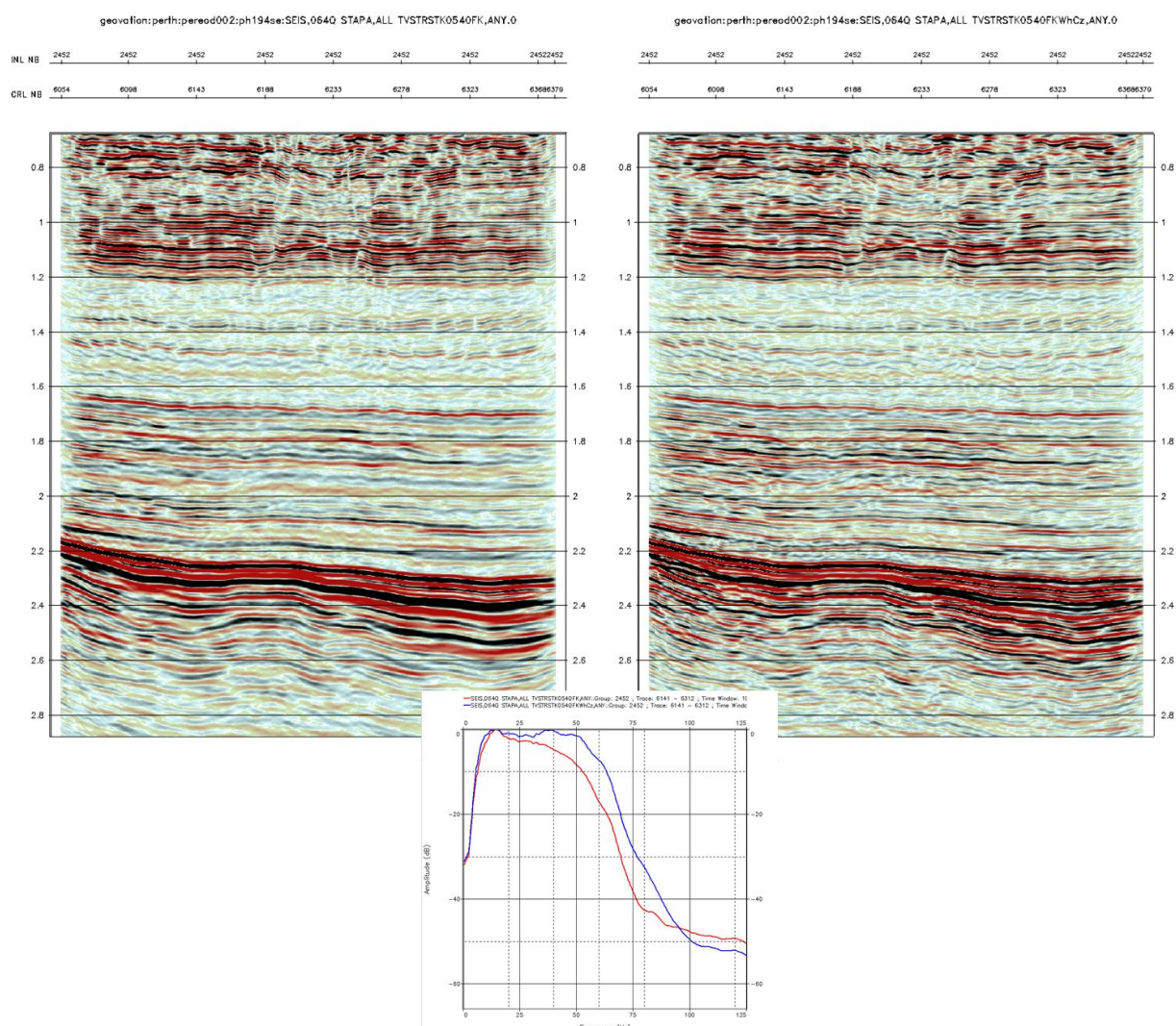


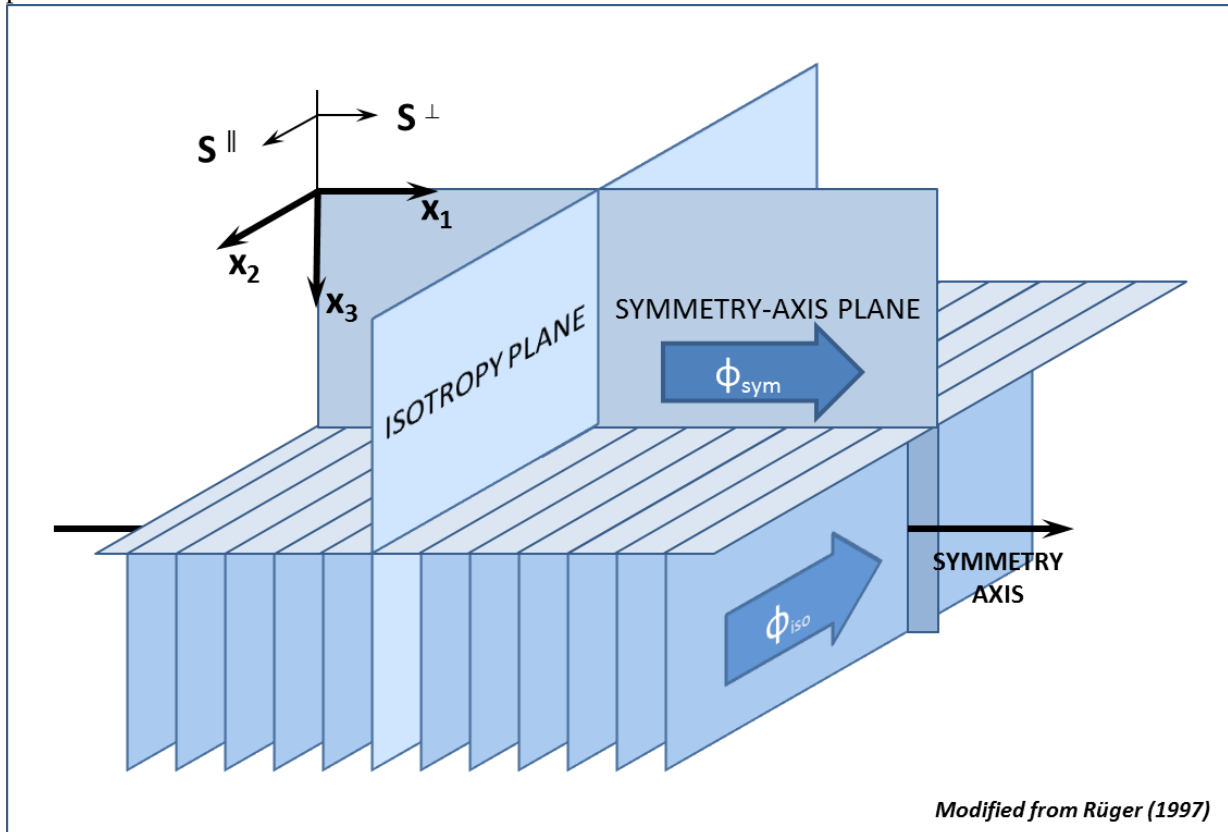
Figure 24: IL2452 Post-Stack Spectral Correction + CADZO: before/after.

2.22 AVAz, VVAz and Pore Pressure Attributes

Extra outputs were generated to further supplement the seismic stack cubes.

RUGER CUBES

Rüger (1998) linearized the Zoeppritz equation for the case of an isotropic half-space over an HTI half-space. As shown below, the symmetry-axis is at right angles to the fractures and the isotropy plane is parallel to the fractures:



The Rüger equation for Anisotropic AVO for HTI media is:

$$R(\theta_i, \phi_j) = A_{iso} + [B_{iso} + B_{ani} \sin^2(\phi_j - \phi_{iso})] \sin^2 \theta_i$$

Where:

- $R(\theta_i, \phi_j)$ = the reflection coefficient at incident angle θ_i ($i = 1..N$) and azimuth angle ϕ_j ($j = 1..N$)
- ϕ_{iso} = azimuth angle in isotropy plane
- A_{iso} = isotropic intercept
- B_{iso} = isotropic gradient, and
- B_{ani} = anisotropic gradient.

Four cubes were produced as part of the deliverables:

- A_{iso} Intercept Cube
- B_{iso} Gradient Cube
- B_{ani} Azimuthal Gradient Cube
- B_{ani} Fracture Azimuth Cube

Error! Reference source not found. shows an example of extraction of attributes along a particular horizon.

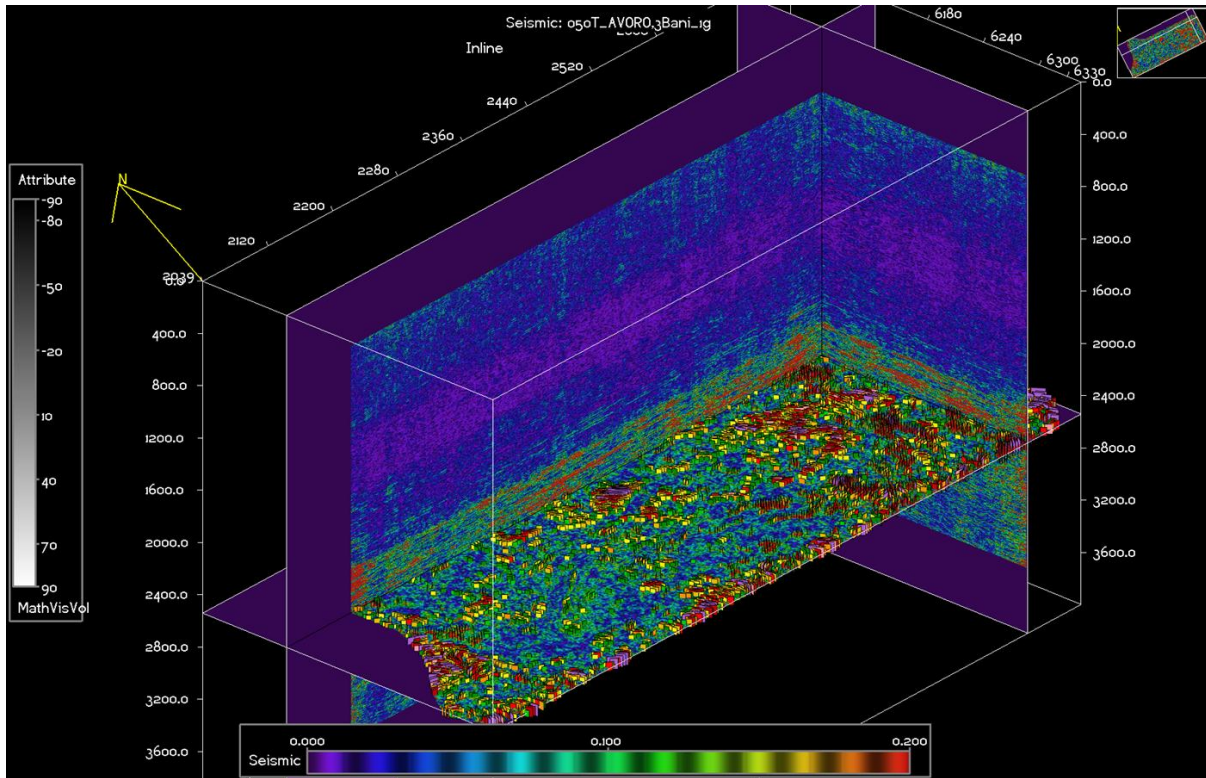


Figure 25: B_{ani} and its azimuthal direction

AZIMUTHAL VELOCITY ANALYSIS

Azimuthal velocity analysis purpose is two-fold:

- improve gather flattening by accounting for azimuthal NMO anomalies
- evaluate azimuthal velocity anisotropy parameters and attempt to interpret them in terms of fracture density and orientation

It is expected that the fast velocity direction coincides with fracture direction and $\frac{V_{fast} - V_{slow}}{V_{fast}}$ is proportional to fracture density.

The theory behind is based on assumption that what in an isotropic medium used to be a 3D hyperboloid is now an elliptically squeezed/stretched in horizontal plane 3D hyperboloid.

Azimuthal Travel Time

$$T = \sqrt{T_0^2 + \frac{R^2}{V_\varphi^2}}$$

Where:

$$\frac{1}{V_\varphi^2} = \frac{\cos^2(\varphi - \omega)}{V_{fast}^2} + \frac{\sin^2(\varphi - \omega)}{V_{slow}^2}$$

And:

$$\begin{aligned} \omega &- \text{fast velocity azimuth} \\ \varphi &- \text{trace azimuth} \\ k &= \frac{V_{fast} - V_{slow}}{V_{fast}} \end{aligned}$$

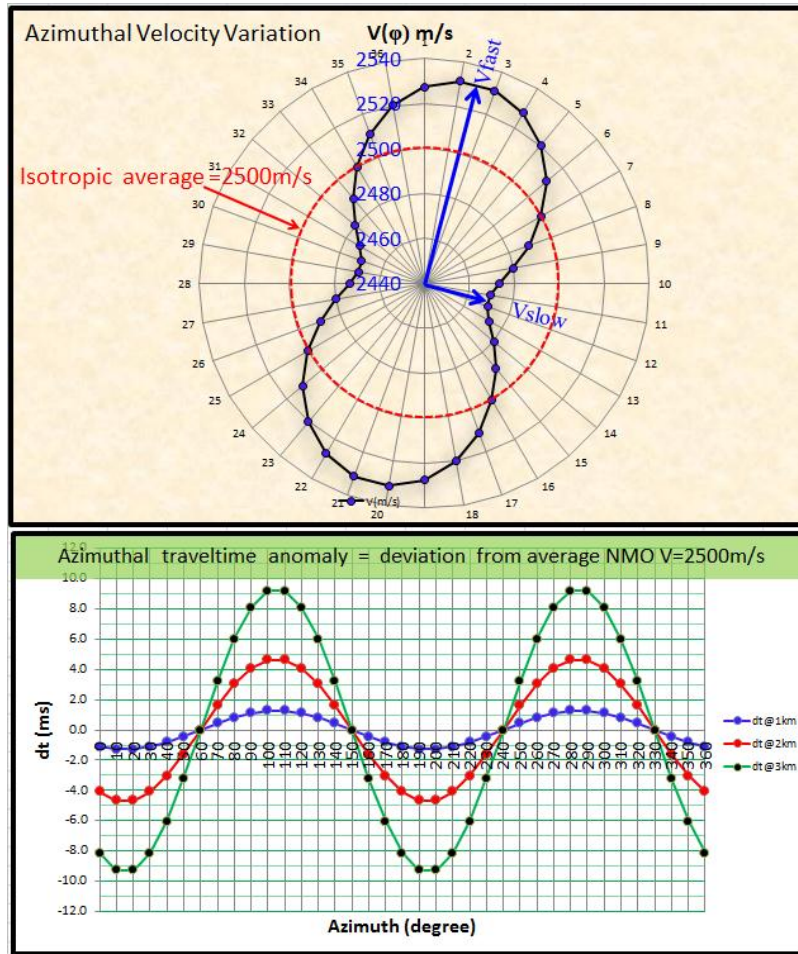


Figure 26: Azimuthal V_{nmo} anisotropy $\omega=15\text{deg}$ $k=2.5\%$ and corresponding moveout anomalies at offsets 1km, 2km and 3km

Associated with azimuthal anisotropy, 5 kinematic cubes were generated:

- V_{nmo} Fast
- V_{nmo} Slow
- Azimuth V_{fast}
- $k = \frac{V_{fast} - V_{slow}}{V_{fast}}$
- Fracture azimuth of k

PORE PRESSURE PREDICTION

Pore pressure gradient was generated using dense velocity analysis (HDPIC). Normal compaction trend was computed at each grid location using Pennnebaker's formula and linear regression on the transit times, i.e. slowness, in the top $z < 800\text{m}$ of the subsurface:

$$s_{nct} = s_0 e^{\frac{-z}{k}}$$

Pore pressure gradient was assumed as:

$$G = H + c_1 \Delta s + c_2 \Delta s^2$$

Where:

- H = hydrostatic gradient
- $\Delta s = s_{va06} - s_{nct}$
- $c_1 = 36.5 \text{ Pa}/\mu\text{s}$
- $c_2 = 36.5 \text{ Pa} \cdot \text{m}/\mu\text{s}^2$

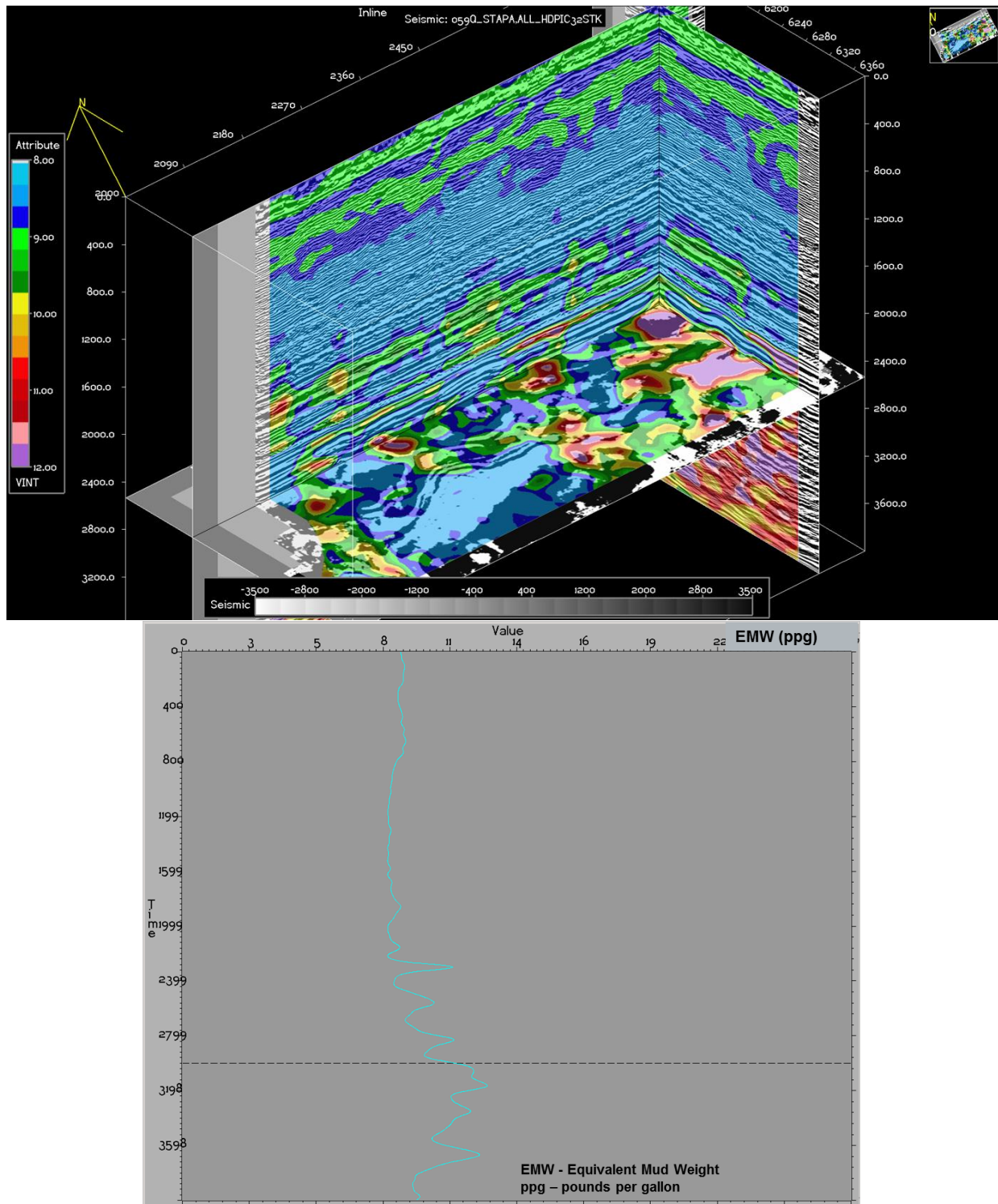


Figure 27: Detail of Pore Pressure Prediction: Uncalibrated Pore Pressure Cube overlaid on Seismic and Pore Pressure in EMW (Equivalent Mud Weight), i.e. ppg units

More detail can be found in “Geopressure prediction from automatically-derived seismic velocities” (*T. K. Kan and Herbert W. Swan GEOPHYSICS, VOL. 66, NO. 6 (NOVEMBER–DECEMBER 2001)*).

One PPP cube was generated.

2.23 Conclusion

Generally, the processing of the area went smoothly. Good communication between client and processing team was essential to ensure there were no halts in the processing flow. Major milestones were met. Extra deliverables requested did not impact the timeline. Processing delivered good imaging, satisfactory resolution and AVO compliant PSTM gathers.

Test data and PowerPoint files were made available to Senex for comment at key stages through the “Engage” online client reporting system. Processing parameters and sequences were tested and recommended by the CGG Land Team and approved by Senex for production.

The appendices show examples of the EBCDIC headers, as well as a full list of final deliverables (by filename and by media supplied to client.

Katy Sutherland	Senior Geophysicist
Anatoly Osadchuk	Senior Land Advisor
Marwoto	Team Leader

3 Appendices

3.1 EBCDIC and Trace Header Examples

3.1.1 PRE-INTERPOLATION CMP GATHERS

```

CLIENT          : SENEX ENERGY
DATA            : 02 PRE INTERPOLATION CMP GATHERS (ON FLOATING DATUM)
DATA RANGE      : IL 2450 - 2499
RECORD LENGTH   : 4000MS, SI=2MS
SURVEY          : JONOTHON 2015 - TERREX CREW A2
AREA            : COOPER BASIN (PEL 638)
GEODETTIC PARAMETERS : LOCAL GDA94, MGA54
IL/XL RANGE     : IL 2450 - 2499, XL 6000 - 6379 ; CELL SIZE : 25X25M
PROCESSING GRID CORNERS (INL/CRL) (X/Y)
(1950, 5950) (449688.96989, 6988607.41039)
(2835, 5950) (469402.48924, 6998651.95020)
(2835, 6429) (474839.02547, 6987982.14707)
(1950, 6429) (455125.50612, 6977937.60726)
INLINE FROM SW TO NE INC=1, XLINE FROM NW TO SE INC=1
SEG Y HEADER BYTE POSITIONS:
BYTES 09-12      : FIELD FFID          BYTES 37-40      : OFFSET
BYTES 73-76      : SP_X                BYTES 77-80      : SP_Y
BYTES 81-84      : RCV_X                BYTES 85-88      : RCV_Y
BYTES 141-144    : BIN_X (IBM FP)      BYTES 145-148    : BIN_Y (IBM FP)
BYTES 197-200    : INLINE              BYTES 201-204    : XLINE
BYTES 209-212    : SP NUMBER           BYTES 213-216    : RCV NUMBER
BYTES 127-128    : SP LINE             BYTES 129-130    : SP POINT
BYTES 131-132    : RCV LINE            BYTES 133-134    : RCV POINT
BYTES 135-136    : SURVEY NUMBER (JONOTHON=1)
BYTES 233-236    : PROCESSING DATUM (IBM FP)
BYTES 237-240    : AZIMUTH FROM NORTH (IBM FP)
PROCESSING SEQUENCE:
01. REFORMAT SEG Y TO INTERNAL FORMAT RL/SI=4000/2MS.
02. TRACE EDITING, NAV-SEISMIC MERGING
03. MINIMUM PHASE CONVERSION 04. TV^2 SPHERICAL DIVERGENCE COMPENSATION
05. APPLY TOMO STATIC          06. LNA/RNA IN XSPREAD
07. INVERSE Q (AMP & PHASE)
08. SURFACE CONSISTENT SPIKING DECON, LENGTH 200MS, WH 1.0%
09. 1ST VELOCITY ANALYSIS    10. 1ST RESIDUAL STATIC
11. 2ND RNA                  12. SURFACE CONSISTENT AMPLITUDE CORRECTION
13. 2ND VELOCITY             14. 2ND RESIDUAL STATICS
15. INVERSE TV^2 AMPLITUDE DIVERGENCE COMPENSATION
16. NMO BACKED OFF
17. PROCESSED BY CGG, PERTH DATA PROCESSING CENTRE, MAY 2015

```

BYTES WORD MEANING 2-D 3-D:

Bytes	Format	Meaning	Comments
9 – 12	I4	Field Record Number	
13 – 16	I4	Trace Number	
17 – 20	I4	SP Number	
21 – 24	I4	CMP Number	
33 – 34	I4	17 Stack word	
37 – 40	I4	Source Detector Distance	
41 – 44	I4	Elevation Receiver/Detector	x10
45 – 48	I4	Elevation Source	x10
49 – 52	I4	13 Depth of Source	x10
61 – 64	I4	6 Station Number Source (processing)	9 digits Same as acq 209-212
65 – 68	I4	7 Station Number Detector (processing)	9 digits Same as acq 213-216
69 – 70	I2	Elevation and Depth Scalar	1
71 – 72	I2	Coordinate Scalar	1
73 – 76	I4	X-Coordinate Source	
77 – 80	I4	Y-Coordinate Source	

81 – 84	I4	X-Coordinate Detector	
85 – 88	I4	Y-Coordinate Detector	
89 – 90	I2	Coordinate Units	1 (meters)
91 – 94	I2	IBM-FP Trim Static	0
95 – 96	I2	Shothole time at source	0
99 – 100	I2	Field Static Correction at Source Location	0
101 – 102	I2	Field Static Correction at Detector Location	0
109 – 110	I2	Time of First Sample (TMFS)	0
111 – 112	I2	Time of First Sample (TMFS)	0
113 – 114	I2	First Live Sample	
115 – 116	I2	Number of Samples in This Trace	
117 – 118	I2	Sample Interval in Microseconds for This Trace	
127 – 128	I2	(acquisition)	SP Line from SPS
129 – 130	I2	(acquisition)	SP PEG from SPS
131 – 132	I2	(acquisition)	RCV Line from SPS
133 – 134	I2	(acquisition)	RCV PEG from SPS
135 – 136	I2	Survey Number	Hurron2D = 2
141 – 144	IBM-FP	X-Coordinate at Cell Centre	BIN_X
145 – 148	IBM-FP	Y-Coordinate at Cell Centre	BIN_Y
149 – 152	IBM-FP	X-Coordinate Midpoint	CMP_X
153 – 156	IBM-FP	Y-Coordinate Midpoint	CMP_Y
185 – 188	IBM-FP	Residual Static Correction at Source Location:	Res. 1+2
189 – 192	IBM-FP	Residual Static Correction at Detector Location:	Res. 1+2
193 – 194	I2	CMP datum correction applied	0
197 – 200	I4	Inline Number within 3D Survey IL	
201 – 204	I4	Crossline Number within 3D Survey XL	
205 – 208	I4	CMP Number	IL*10000+XL
209 – 212	I4	Field Station Number Source *note b (acquisition)	9 digits. Same as 61-64
213 – 216	I4	Field Station Number Detector *note b (acquisition)	9 digits. Same as 65-68
217 – 218	I2	Field Record Number	Same as 9-12
221 – 222	I2	Source Type 1=Vibroseis 2=Dynamite	
225 – 228	IBM-FP	Relative & Residual Source Static	Total Statics: DS+Res1+Res2
229 – 232	IBM-FP	Relative & Residual Detector Static	Total Statics: DS+Res1+Res2
233 – 236	IBM-FP	CDP datum correction	NOT applied
237 – 240	IBM-FP	3D Azimuth	Source-to-Receiver Azimuth from North, 0-360deg range, Deg.

NOTES:

Field Station Number Source = Survey Number *10⁸ +Source Line*10⁴+Source Peg (Source Line and Source Peg as in SPS)

Field Station Number Detector = Survey Number *10⁸ +RCV Line*10⁴+RCV Peg (RCV Line and RCV Peg as in SPS)

3.1.2 PROCESSED PSTM GATHERS

CLIENT : SENEX ENERGY
 DATA : 04 FINAL MIGRATED CMP GATHERS (MSL DATUM)
 DATA RANGE : IL 2400 - 2449
 RECORD LENGTH : 4100MS, SI=2MS, 100MS ADDED TO START OF DATA (T0=-100MS)
 SURVEY : JONOTHON 2015 - TERREX CREW A2
 AREA : COOPER BASIN (PEL 638)
 GEODETIC PARAMETERS : LOCAL GDA94, MGA54
 IL/XL RANGE : IL 2400 - 2449, XL 6000 - 6379 ; CELL SIZE : 25X25M
 PROCESSING GRID CORNERS (INL/CRL) (X/Y)
 (1950, 5950) (449688.96989, 6988607.41039)
 (2835, 5950) (469402.48924, 6998651.95020)
 (2835, 6429) (474839.02547, 6987982.14707)
 (1950, 6429) (455125.50612, 6977937.60726)
 INLINE FROM SW TO NE INC=1, XLINE FROM NW TO SE INC=1
 SEG Y HEADER BYTE POSITIONS:
 BYTES 37-40 : OFFSET
 BYTES 141-144 : BIN_X (IBM FP) BYTES 145-148 : BIN_Y (IBM FP)
 BYTES 197-200 : INLINE BYTES 201-204 : XLINE
 BYTES 135-136 : SURVEY NUMBER JONOTHON=1)
 BYTES 205-208 : BIN NUMBER (ILX10000 + XL)
 BYTES 233-236 : PROCESSING DATUM (IBM FP)
 BYTES 237-240 : AZIMUTH FROM NORTH (IBM FP)
 PROCESSING SEQUENCE:
 01. REFORMAT SEG Y TO INTERNAL FORMAT RL/SI=4000/2MS.
 02. TRACE EDITING, NAV-SEISMIC MERGING
 03. MINIMUM PHASE CONVERSION 04. TV^2 SPHERICAL DIVERGENCE COMPENSATION
 05. APPLY TOMO STATIC 06. LNA/RNA IN XSPREAD
 07. INVERSE Q (AMP & PHASE)
 08. SURFACE CONSISTENT SPIKING DECON, LENGTH 200MS, WH 1.0%
 09. 1ST VELOCITY ANALYSIS 10. 1ST RESIDUAL STATIC
 11. 2ND RNA 12. SURFACE CONSISTENT AMPLITUDE CORRECTION
 13. 2ND VELOCITY 14. 2ND RESIDUAL STATICS
 15. 5D ORTHOGONAL BINNING/REGULARISATION AND INTERPOLATION
 16. INVERSE TV^2 AMPLITUDE DIVERGENCE COMPENSATION
 17. PSTM TO VA03 LINES 18. PSTM WITH SMOOTHED VA03
 19. 4TH VELOCITY ANALYSIS 20. RADON3D
 21. DENSE VA05 25x25m VEL/ETA
 22. TRIM STATICS
 23. STATICS CORRECTION TO FIXED DATUM 0M MSL, 100MS ADDED TO START OF DATA
 24. PROCESSED BY CGG, PERTH DATA PROCESSING CENTRE, JUNE 2015

BYTES WORD MEANING 2-D 3-D:

Bytes	Format	Meaning	Comments
17 – 20	I4	Grid Inline Number	
21 – 24	I4	Grid Xline Number	
37 – 40	I4	Source Detector Distance	
71 - 72	I2	Coordinate Scalar	
81 – 84	I4	X-Coordinate 3D Cell Centre	
85 – 88	I4	Y-Coordinate 3D Cell Centre	
89 – 90	I2	Coordinate Units	1 (meters)
109 – 110	I2	Time Of First Sample (TMFS)	0
111 – 112	I2	Time Of First Sample (TMFS)	0
113 – 114	I2	First Live Sample	
115 – 116	I2	Number of Samples in This Trace	
117 – 118	I2	Sample Interval in Microseconds for This Trace	
141 – 144	IBM-FP	X-Coordinate at Cell Centre	3D Grid Cell Centre
145 – 148	IBM-FP	Y-Coordinate at Cell Centre	3D Grid Cell Centre
197 – 200	I4	Inline Number within 3D Survey IL	
201 – 204	I4	Crossline Number within 3D Survey XL	
205 – 208	I4	CMP Number	IL*10000+XL
233 – 236	IBM-FP	CDP datum correction	

237 – 240	IBM-FP	3D Azimuth	Source-to-Receiver Azimuth from North, 0-360deg range, Deg.
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3.1.3 FINAL PSTM STACK

CLIENT : SENEX ENERGY
 DATA : 06 FINAL FULL FOLD PSTM STACK CUBE (MSL DATUM)
 RECORD LENGTH : 4100MS, SI=2MS, 100MS ADDED TO START OF DATA (T0=-100MS)
 SURVEY : JONOTHON 2015 - TERREX CREW A2
 AREA : COOPER BASIN (PEL 638)
 GEODETIC PARAMETERS : LOCAL GDA94, MGA54
 IL/XL RANGE : IL 2000 - 2785, XL 6000 - 6379 ; CELL SIZE : 25X25M
 PROCESSING GRID CORNERS (INL/CRL) (X/Y)
 (1950, 5950) (449688.96989, 6988607.41039)
 (2835, 5950) (469402.48924, 6998651.95020)
 (2835, 6429) (474839.02547, 6987982.14707)
 (1950, 6429) (455125.50612, 6977937.60726)
 INLINE FROM SW TO NE INC=1, XLINE FROM NW TO SE INC=1
 SEG Y HEADER BYTE POSITIONS:
 BYTES 21-24 : CDP NUMBER BYTES 25-28 : FOLD COVER
 BYTES 73-76 : CDP_X BYTES 77-80 : CDP_Y
 BYTES 141-144 : CDP_X (IBM FP) BYTES 145-148 : CDP_Y (IBM FP)
 BYTES 197-200 : INLINE BYTES 201-204 : XLINE
 BYTES 205-208 : BIN NUMBER (ILX10000 + XL)
 BYTES 233-236 : PROCESSING DATUM (IBM FP)
 PROCESSING SEQUENCE:
 01. REFORMAT SEG Y TO INTERNAL FORMAT RL/SI=4000/2MS.
 02. TRACE EDITING, NAV-SEISMIC MERGING
 03. MINIMUM PHASE CONVERSION 04. TV^2 SPHERICAL DIVERGENCE COMPENSATION
 05. APPLY TOMO STATIC 06. LNA/RNA IN XSPREAD
 07. INVERSE Q (AMP & PHASE)
 08. SURFACE CONSISTENT SPIKING DECON, LENGTH 200MS, WH 1.0%
 09. 1ST VELOCITY ANALYSIS 10. 1ST RESIDUAL STATIC
 11. 2ND RNA 12. SURFACE CONSISTENT AMPLITUDE CORRECTION
 13. 2ND VELOCITY 14. 2ND RESIDUAL STATICS
 15. 5D ORTHOGONAL BINNING/REGULARISATION AND INTERPOLATION
 16. INVERSE TV^2 AMPLITUDE DIVERGENCE COMPENSATION
 17. PSTM TO VA03 LINES 18. PSTM WITH SMOOTHED VA03
 19. 4TH VELOCITY ANALYSIS 20. RADON3D
 21. DENSE VA05 25x25m VEL/ETA 22. TRIM STATICS
 23. ANGLE MUTING 05-40 DEG 24. STACK 25. FOOTPRINT ATTENUATION 3D FK
 26. SPECTRAL WHITENING 27. POST-STACK RNA
 28. STATICS CORRECTION TO FIXED DATUM 0M MSL, 100MS ADDED TO START OF DATA
 29. PROCESSED BY CGG, PERTH DATA PROCESSING CENTRE, JUNE 2015

BYTES WORD MEANING 2-D 3-D:

Bytes	Format	Meaning	Comments
17 – 20	I4	Grid Inline Number	
21 – 24	I4	Grid Xline Number	
37 – 40	I4	Source Detector Distance	
71 – 72	I2	Coordinate Scalar	
81 – 84	I4	X-Coordinate 3D Cell Centre	
85 – 88	I4	Y-Coordinate 3D Cell Centre	
89 – 90	I2	Coordinate Units	1 (meters)
109 – 110	I2	Time Of First Sample (TMFS)	0
111 – 112	I2	Time Of First Sample (TMFS)	0
113 – 114	I2	First Live Sample	
115 – 116	I2	Number of Samples in This Trace	
117 – 118	I2	Sample Interval in Microseconds for This Trace	
141 – 144	IBM-FP	X-Coordinate at Cell Centre	3D Grid Cell Centre
145 – 148	IBM-FP	Y-Coordinate at Cell Centre	3D Grid Cell Centre
197 – 200	I4	Inline Number within 3D Survey IL	

201 – 204	I4	Crossline Number within 3D Survey XL	
205 – 208	I4	CMP Number	IL*10000+XL
233 – 236	IBM-FP	CDP datum correction	
237 – 240	IBM-FP	3D Azimuth	N/A

3.1.4 FRACTURE DENSITY KINT CUBE

CLIENT : SENEX ENERGY
 DATA : 15 FRACTURE DENSITY KINT CUBE (MSL DATUM)
 RECORD LENGTH : 4100MS, SI=2MS, 100MS ADDED TO START OF DATA (T0=-100MS)
 SURVEY : JONOTHON 2015 - TERREX CREW A2
 AREA : COOPER BASIN (PEL 638)
 GEODETIC PARAMETERS : LOCAL GDA94, MGA54
 IL/XL RANGE : IL 2000 - 2785, XL 6000 - 6379 ; CELL SIZE : 25X25M
 PROCESSING GRID CORNERS (INL/CRL) (X/Y)
 (1950, 5950) (449688.96989, 6988607.41039)
 (2835, 5950) (469402.48924, 6998651.95020)
 (2835, 6429) (474839.02547, 6987982.14707)
 (1950, 6429) (455125.50612, 6977937.60726)
 INLINE FROM SW TO NE INC=1, XLINE FROM NW TO SE INC=1
 SEG Y HEADER BYTE POSITIONS:
 BYTES 21-24 : CDP NUMBER BYTES 25-28 : FOLD COVER
 BYTES 73-76 : CDP_X BYTES 77-80 : CDP_Y
 BYTES 141-144 : CDP_X (IBM FP) BYTES 145-148 : CDP_Y (IBM FP)
 BYTES 197-200 : INL_X BYTES 201-204 : XLINE
 BYTES 205-208 : BIN NUMBER (ILX10000 + XL)
 BYTES 233-236 : PROCESSING DATUM (IBM FP)
 PROCESSING SEQUENCE:
 01. SPATIAL SAMPLING 25x25m
 02. TEMPORAL SAMPLING 2ms
 03. AZIMUTHAL VALUES (IF PRESENT) ARE FROM EAST, CCW DIRECTION
 04. STATICS CORRECTION TO FIXED DATUM 0M MSL, 100MS ADDED TO START OF DATA

BYTES WORD MEANING 2-D 3-D:

Bytes	Format	Meaning	Comments
17 – 20	I4	Grid Inline Number	
21 – 24	I4	Grid Xline Number	
37 – 40	I4	Source Detector Distance	
71 – 72	I2	Coordinate Scalar	
81 – 84	I4	X-Coordinate 3D Cell Centre	
85 – 88	I4	Y-Coordinate 3D Cell Centre	
89 – 90	I2	Coordinate Units	1 (meters)
109 – 110	I2	Time Of First Sample (TMFS)	0
111 – 112	I2	Time Of First Sample (TMFS)	0
113 – 114	I2	First Live Sample	
115 – 116	I2	Number of Samples in This Trace	
117 – 118	I2	Sample Interval in Microseconds for This Trace	
141 – 144	IBM-FP	X-Coordinate at Cell Centre	3D Grid Cell Centre
145 – 148	IBM-FP	Y-Coordinate at Cell Centre	3D Grid Cell Centre
197 – 200	I4	Inline Number within 3D Survey IL	
201 – 204	I4	Crossline Number within 3D Survey XL	
205 – 208	I4	CMP Number	IL*10000+XL
233 – 236	IBM-FP	CDP datum correction	
237 – 240	IBM-FP	3D Azimuth	N/A

4 List of Deliverables by Filename

FILENAME	DESCRIPTION	MEDIA	DATUM	COMMENT
SEG Y GATHERS				
01_JONOTHON3D_RAW_SHOT_GATHERS_GEOM_APPLIED_SHOT_LINE*.sgy	Raw Shot Gathers with Geometry Applied	LTO	N/A	Sample Rate 2ms, Trace length 4000ms. No NMO applied.
02_JONOTHON3D_PRE_INTERPOLATION_SHOT_GATHERS_IL*-.sgy	Pre Interpolation Shot Gathers	LTO	Float	All statics applied and loaded to headers. NMO and Spherical Divergence corrections backed off .
03_JONOTHON3D_RAW_PSTM_GATHERS_IL*-.sgy	Raw OFFXY PSTM Gathers	LTO	Float	Sort 2D CMP/OFF. NMO backed off
04_JONOTHON3D_FINAL_PSTM_GATHERS_IL*-.sgy	Final OFFXY PSTM Gathers	LTO	MSL 100	Sort 2D CMP/OFF. Trim Statics applied.

MSL 100 = STATICS CORRECTION TO FIXED DATUM, 100ms ADDED TO START OF DATA

FILENAME	DESCRIPTION	MEDIA	DATUM	COMMENT
SEG Y STACK CUBES				
06_FINAL_FULL_FOLD_PSTM_STACK_CUBE_MSL_DATUM_JONOTHON3D.sgy	Final Full Fold Stack	USB	MSL 100	Full Post-Stack Processing
07_RAW_FULL_FOLD_PSTM_STACK_CUBE_MSL_DATUM_JONOTHON3D.sgy	Raw Full Fold Stack and Raw Angle Stacks	USB	MSL 100	No Post-Stack Processing. Sample Rate 4ms Trace Length 4000ms
08_RAW_ANGLE_PSTM_STACK_CUBE_ULTRA_NEAR_MSL_DATUM_JONOTHON3D.sgy				
08_RAW_ANGLE_PSTM_STACK_CUBE_NEAR_MSL_DATUM_JONOTHON3D.sgy				
08_RAW_ANGLE_PSTM_STACK_CUBE_MID_MSL_DATUM_JONOTHON3D.sgy				
08_RAW_ANGLE_PSTM_STACK_CUBE_FAR_MSL_DATUM_JONOTHON3D.sgy				
08_RAW_ANGLE_PSTM_STACK_CUBE_ULTRA_FAR_MSL_DATUM_JONOTHON3D.sgy	Raw Sectorized Stack	USB	MSL 100	No Post-Stack Processing. Sample Rate 4ms Trace Length 4000ms. Mute 15-45°
09_RAW_PSTM_RADIAL_STACK_AZIMUTH_63_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy				
09_RAW_PSTM_RADIAL_STACK_AZIMUTH_108_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy				
09_RAW_PSTM_RADIAL_STACK_AZIMUTH_153_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy				
09_RAW_PSTM_RADIAL_STACK_AZIMUTH_198_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy	Ruger Cubes	USB	MSL 100	
11a_RUGER_AVAz_CUBE_Aiso_INTERCEPT_MSL_DATUM_JONOTHON3D.sgy				
11b_RUGER_AVAz_CUBE_Biso_GRADIENT_MSL_DATUM_JONOTHON3D.sgy				
11c_RUGER_AVAz_CUBE_Bani_AZIMUTHAL_GRADIENT_MSL_DATUM_JONOTHON3D.sgy				
11d_RUGER_AVAz_CUBE_Bani_FRACTURE_AZIMUTH_MSL_DATUM_JONOTHON3D.sgy				

MSL 100 = STATICS CORRECTION TO FIXED DATUM, 100ms ADDED TO START OF DATA

FILENAME	DESCRIPTION	MEDIA	DATUM	COMMENT
KINEMATIC CUBES				
12_DENSE_AZIMUTHAL_VNMO_SLOW_CUBE_MSL DATUM_JONOTHON3D.sgy	Azimuthal Dense 25x25m Vnmo Slow	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
13_DENSE_AZIMUTHAL_VNMO_FAST_CUBE_MSL DATUM_JONOTHON3D.sgy	Azimuthal Dense 25x25m Vnmo Fast	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
14_DENSE_AZIMUTHAL_VNMO_AZIMUTH_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m Azimuth of Fast Vnmo	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
15_FRACTURE_DENSITY_KINT_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m Azimuthal Anisotropy Kint=(Fast Vint-Slow Vint)/ Fast Vint	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
16_FRACTURE_AZIMUTH_OF_KINT_CUBE_MSL DATUM_JONOTHON3D.sgy	Kint Azimuth	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
17_DENSE_STACKING_VELOCITY_RMS_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m VTI Vnmo	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
18_DENSE_EFFECTIVE_ETA_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m Effective ETA	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
19_DENSE_AVERAGE_VELOCITY_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m Average Vavg	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
20_DENSE_VINT_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m Vint	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
21_PORE_PRESSURE_PREDICTION_CUBE_MSL DATUM_JONOTHON3D.sgy	Dense 25x25m Uncalibrated Pore Pressure in ppg units.	USB	MSL 100	Floating Datum in Headers. Sample Rate 4ms Trace Length 4100ms
ASCII ATTRIBUTES				
22a_JONOTHON3D_FLOATINGDATUM_ILXLXYSTAT.ascii	Floating Datum	DVD	N/A	IL/XL/X/Y/Statics
23a_JONOTHON3D_TOMO_LW_AND_RESID_SPRCVXYSTAT.ascii	Tomo LW Statics and Residual Statics	DVD	N/A	Tomostatics and Residual Statics
24a_STACKING_VEL_PREMIG_JONOTHON3D.ascii	Stacking Velocity VA02	DVD	Float	1x1km . 9 column format with FD.
25a_MIG_VELOCITY_SMOOTH_JONOTHON3D.ascii	Migration Velocity Smooth VA03	DVD	Float	0.5x0.5km. Smoothed. 9 column format with FD, 0<TWT <4100ms
26a_POSTMIG_STACKING_VELOCITY_JONOTHON3D.ascii	Post PSTM Velocity VA03a	DVD	Float	0.5x0.5km. 9 column format with FD.
27a_JONOTHON3D_FOLDCOVER_ILXLXYFOLD.ascii	Bin Coordinates with PSTM CDP Fold	DVD	N/A	IL/XL/X/Y/Final Stack Fold
28a_SENEX_JONOTHON3D_FINAL_PROCESSING_REPORT.pdf	This document	DVD	N/A	

MSL 100 = STATICS CORRECTION TO FIXED DATUM, 100ms ADDED TO START OF DATA

5 List of Deliverables by Media

TAPE NUMBER	DESCRIPTION	MEDIA	CONTENTS
FOR SENEX (COPY 1 TO SENEX, COPY 2 FOR ORIGIN)			
LTO L00XXX (COPY 1) LTO L00XXX (COPY 2)	SEISMIC GATHERS	LTO4	SEISMIC GATHERS: 01_JONOTHON_RAW_SHOT_GATHERS_GEOM_APPLIED_SHOT_LINE*.sgy 02_JONOTHON_PRE_INTERPOLATION_SHOT_GATHERS_IL*.sgy 03_JONOTHON_RAW_PSTM_GATHERS_IL*.sgy 04_JONOTHON_FINAL_PSTM_GATHERS_IL*.sgy
FOR SENEX (COPY 1 TO SENEX, COPY 2 FOR ORIGIN)			
USB U003 (COPY 1) USB U004 (COPY 2)	SEISMIC CUBES/ KINEMATIC CUBES/ ASCII ATTRIBUTES	USB	SEISMIC CUBES: 06_FINAL_FULL_FOLD_PSTM_STACK_CUBE_MSL_DATUM_JONOTHON3D.sgy 07_RAW_FULL_FOLD_PSTM_STACK_CUBE_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_ULTRA_NEAR_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_NEAR_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_MID_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_FAR_MSL_DATUM_JONOTHON3D.sgy 08_RAW_ANGLE_PSTM_STACK_CUBE_ULTRA_FAR_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_63_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_108_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_153_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 09_RAW_PSTM_RADIAL_STACK_AZIMUTH_198_DEG_FROM_NORTH_MSL_DATUM_JONOTHON3D.sgy 11a_RUGER_AVAz_CUBE_Aiso_INTERCEPT_MSL_DATUM_JONOTHON3D.sgy 11b_RUGER_AVAz_CUBE_Biso_GRADIENT_MSL_DATUM_JONOTHON3D.sgy 11c_RUGER_AVAz_CUBE_Bani_AZIMUTHAL_GRADIENT_MSL_DATUM_JONOTHON3D.sgy 11d_RUGER_AVAz_CUBE_Bani_FRACTURE_AZIMUTH_MSL_DATUM_JONOTHON3D.sgy KINEMATIC CUBES: 12_DENSE_AZIMUTHAL_VNMO_SLOW_CUBE_MSL DATUM_JONOTHON3D.sgy 13_DENSE_AZIMUTHAL_VNMO_FAST_CUBE_MSL DATUM_JONOTHON3D.sgy 14_DENSE_AZIMUTHAL_VNMO_AZIMUTH_CUBE_MSL DATUM_JONOTHON3D.sgy 15_FRACTURE_DENSITY_KINT_CUBE_MSL_DATUM_JONOTHON3D.sgy 16_FRACTURE_AZIMUTH_OF_KINT_CUBE_MSL_DATUM_JONOTHON3D.sgy 17_DENSE_STACKING_VELOCITY_RMS_CUBE_MSL_DATUM_JONOTHON3D.sgy 18_DENSE_EFFECTIVE_ETA_CUBE_MSL_DATUM_JONOTHON3D.sgy 19_DENSE_AVERAGE_VELOCITY_CUBE_MSL_DATUM_JONOTHON3D.sgy 20_DENSE_VINT_CUBE_MSL_DATUM_JONOTHON3D.sgy 21_PORE_PRESSURE_PREDICTION_CUBE_MSL_DATUM_JONOTHON3D.sgy ASCII ATTRIBUTES: 22a_JONOTHON3D_FLOATINGDATUM_ILXLXSTAT.ascii 23a_JONOTHON3D_TOMO_LW_AND_RESID_SPRCVXYSTAT.ascii 24a_STACKING_VEL_PREMIG_JONOTHON3D.ascii 25a_MIG_VELOCITY_SMOOTH_JONOTHON3D.ascii 26a_POSTMIG_STACKING_VELOCITY_JONOTHON3D.ascii 27a_JONOTHON3D_FOLDCOVER_ILXLXYFOLD.ascii

FOR SENEX (COPY 1 TO SENEX, COPY 2 FOR ORIGIN)			
DVD DVD003 (COPY 1) DVD DVD004 (COPY 2)	FINAL REPORT	DVD	28a_SENEX_JONOTHON3D_FINAL_PROCESSING_REPORT.pdf