

SEISMIC DATA PROCESSING REPORT

BLUE ENERGY

Location : Queensland
Permits : EPP's 813 814 854
Surveys : Moranbah / Glenden
 : Aramac Injune
 : Maryborough

Date : February 2009

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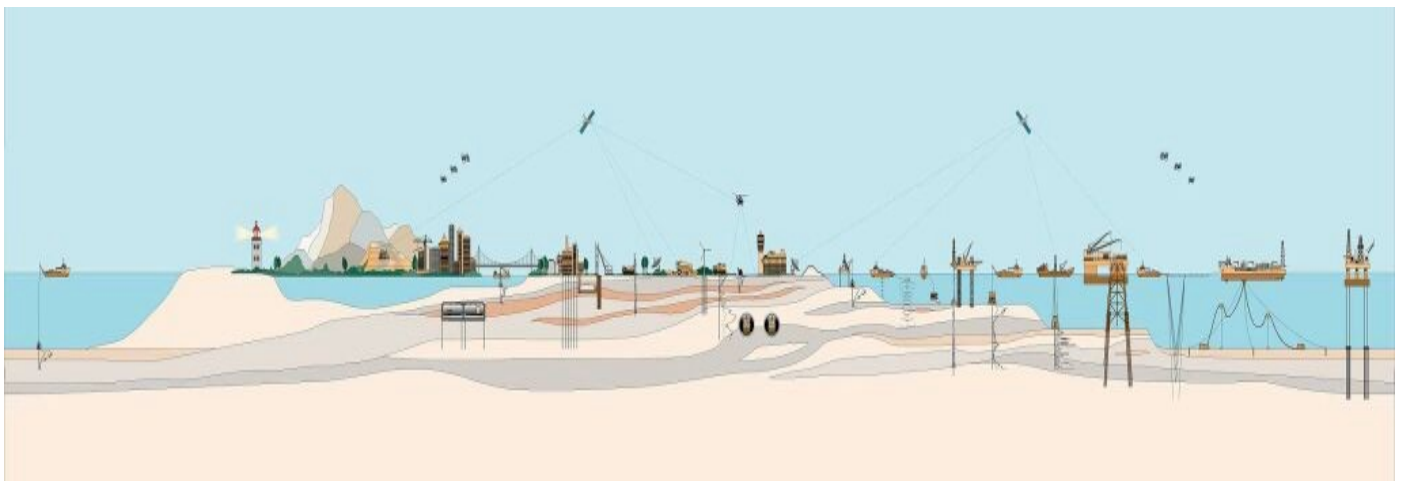


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1 INTRODUCTION

The 2008 Blue Energy 2D Seismic Survey's were processed by Fugro Seismic Imaging at its Perth office from September 2008 to February 2009.

The survey was made up in the following way.

Moranbah / Glenden	10 lines of 45.15 km
Aramac	4 lines of 64.86 km
Injune	3 lines of 58.36 km
Maryborough	3 lines of 23.01 km
Total	191.38 km

A line summary is given in section 3.0.

Field data was acquired by Terrex seismic crew 404 during September to November 2008.

Maryborough was acquired by Velseis in November.

2 ACQUISITION PARAMETERS ARAMAC

2008 Aramac 2D Seismic Survey	
<i>Data recorded by:</i>	Terrex seismic crew 404
<i>Date recorded:</i>	October 2008
<i>Seismic source:</i>	Vibroseis
<i>Source array:</i>	1 in line centred on half station
<i>Pre amp gain:</i>	12 db
<i>Sweep length:</i>	10 seconds
<i>Sweeps per vp:</i>	1
<i>Sweep frequency:</i>	4-64 Hz
<i>Sweep type:</i>	mono 200 ms taper
<i>Vp interval:</i>	20 m
<i>Recording system:</i>	Sercel 428
<i>Record length:</i>	3 sec
<i>Sample rate:</i>	2 milliseconds
<i>Tape format:</i>	SEG-D revision zero phase
<i>Field filters:</i>	0.8 to NQ
<i>Data channels:</i>	120
<i>Coverage:</i>	60 fold
<i>Geophone type:</i>	SM24 10 Hz
<i>Geophone array:</i>	6 in line centred on station
<i>Element spacing:</i>	0.7 m
<i>Group interval:</i>	20 m
<i>Split spread:</i>	1190-10-vp-10-1190m

3 ACQUISITION PARAMETERS MORANBAH

2008 Moranbah 2D Seismic Survey	
<i>Data recorded by:</i>	Terrex seismic crew 404
<i>Date recorded:</i>	September 2008
<i>Seismic source:</i>	Vibroseis
<i>Source array:</i>	3 in line centred on half station
<i>Pre amp gain:</i>	12 db
<i>Sweep length:</i>	6 seconds
<i>Sweeps per vp:</i>	1
<i>Sweep frequency:</i>	4-72 Hz
<i>Sweep type:</i>	mono 200 ms taper
<i>Vp interval:</i>	15 m
<i>Recording system:</i>	Sercel 428
<i>Record length:</i>	2 sec
<i>Sample rate:</i>	2 milliseconds
<i>Tape format:</i>	SEG-D revision zero phase
<i>Field filters:</i>	0.8 to NQ
<i>Data channels:</i>	240
<i>Coverage:</i>	60 fold
<i>Geophone type:</i>	SM24 10 Hz
<i>Geophone array:</i>	6 in line centred on station
<i>Element spacing:</i>	1.25 m
<i>Group interval:</i>	7.5 m
<i>Split spread:</i>	896.25-3.75-vp-3.75-896.25m

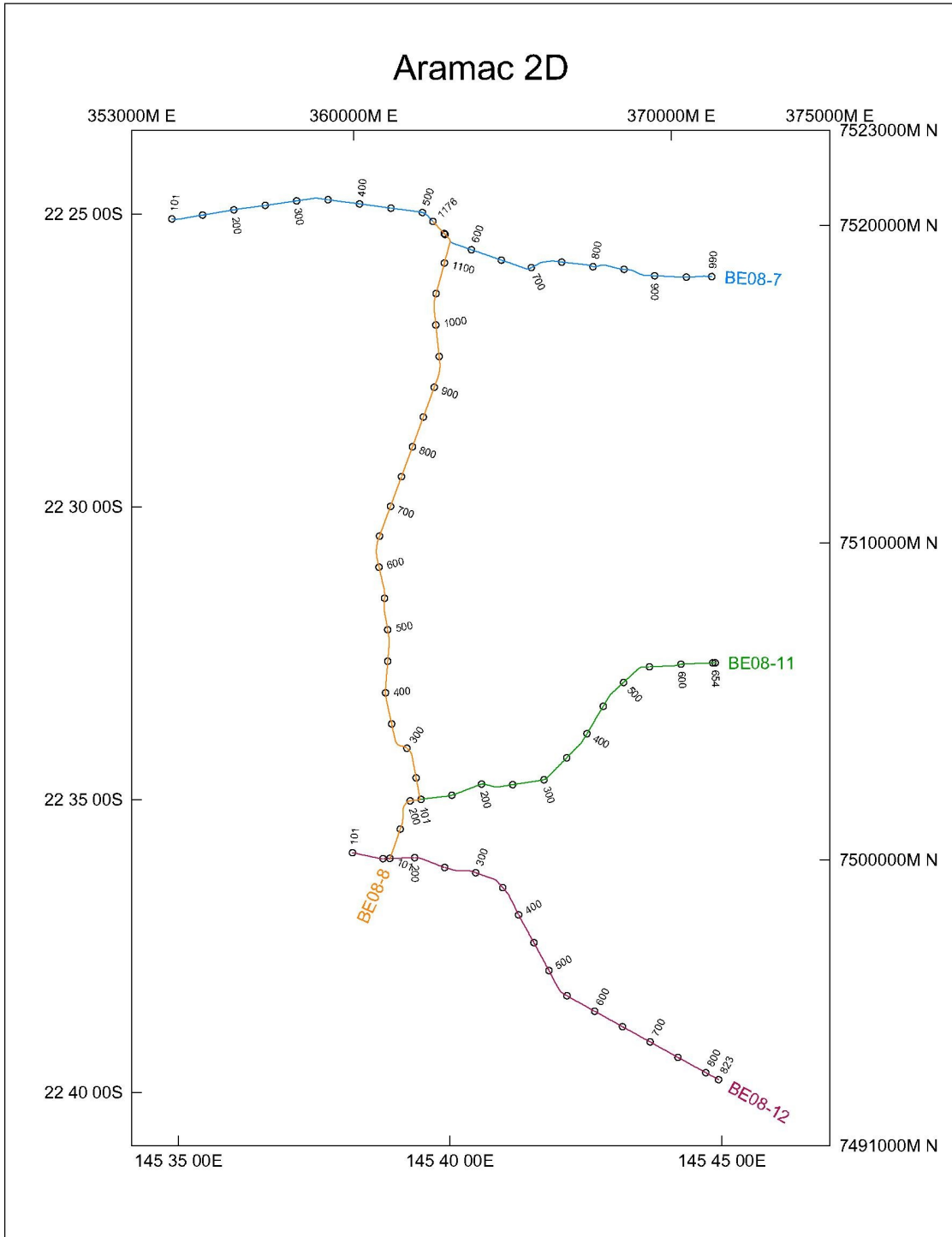
4 ACQUISITION PARAMETERS INJUNE

2008 Injune 2D Seismic Survey	
<i>Data recorded by:</i>	Terrex seismic crew 404
<i>Date recorded:</i>	September 2008
<i>Seismic source:</i>	Vibroseis
<i>Source array:</i>	1 in line centred on half station
<i>Pre amp gain:</i>	12 db
<i>Sweep length:</i>	12 seconds
<i>Sweeps per vp:</i>	1
<i>Sweep frequency:</i>	4-80 Hz
<i>Sweep type:</i>	mono 200 ms taper
<i>Vp interval:</i>	40 m
<i>Recording system:</i>	Sercel 428
<i>Record length:</i>	3 sec
<i>Sample rate:</i>	2 milliseconds
<i>Tape format:</i>	SEG-D revision zero phase
<i>Field filters:</i>	0.8 to NQ
<i>Data channels:</i>	120
<i>Coverage:</i>	60 fold
<i>Geophone type:</i>	SM24 10 Hz
<i>Geophone array:</i>	6 in line centred on station
<i>Element spacing:</i>	Group plant on hasp
<i>Group interval:</i>	20 m
<i>Split spread:</i>	1190-10-vp-10-1190m

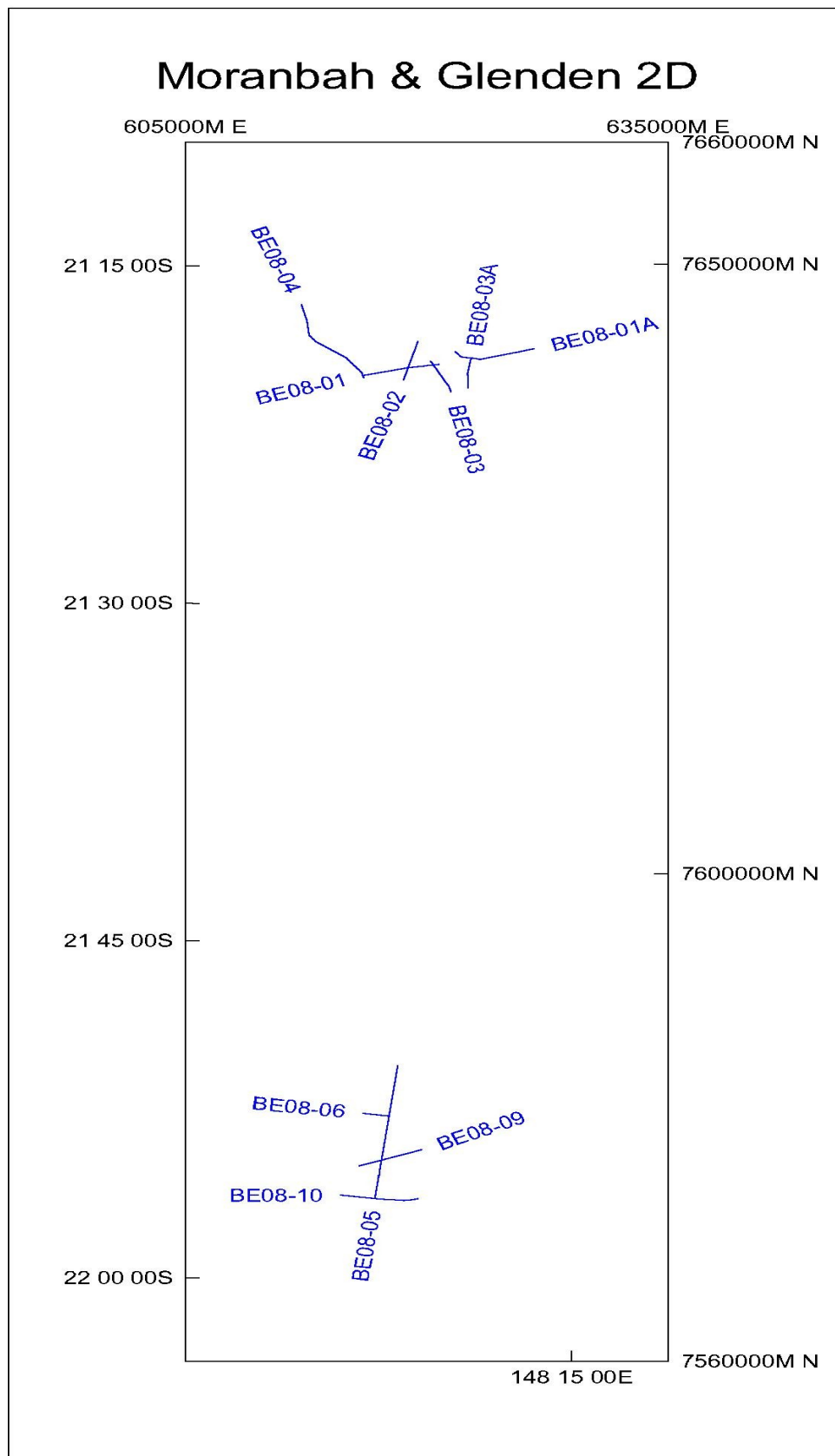
5 ACQUISITION PARAMETERS MARYBOROUGH

2008 Maryborough 2D Seismic Survey	
<i>Data recorded by:</i>	Velseis
<i>Date recorded:</i>	November 2008
<i>Seismic source:</i>	Sosie
<i>Pre amp gain:</i>	2~7
<i>Vp interval:</i>	10 m
<i>Recording system:</i>	348
<i>Record length:</i>	1 sec
<i>Sample rate:</i>	1 milliseconds
<i>Tape format:</i>	SEG-Y
<i>Field filters:</i>	40 Hz – 375 Hz notch out
<i>Data channels:</i>	120
<i>Coverage:</i>	60 fold nominal
<i>Geophone type:</i>	SM4 30Hz 220 Ohms
<i>Geophone array:</i>	6 in series over 5m
<i>Group interval:</i>	10 m
<i>Split spread:</i>	600-10-vp-10-600m

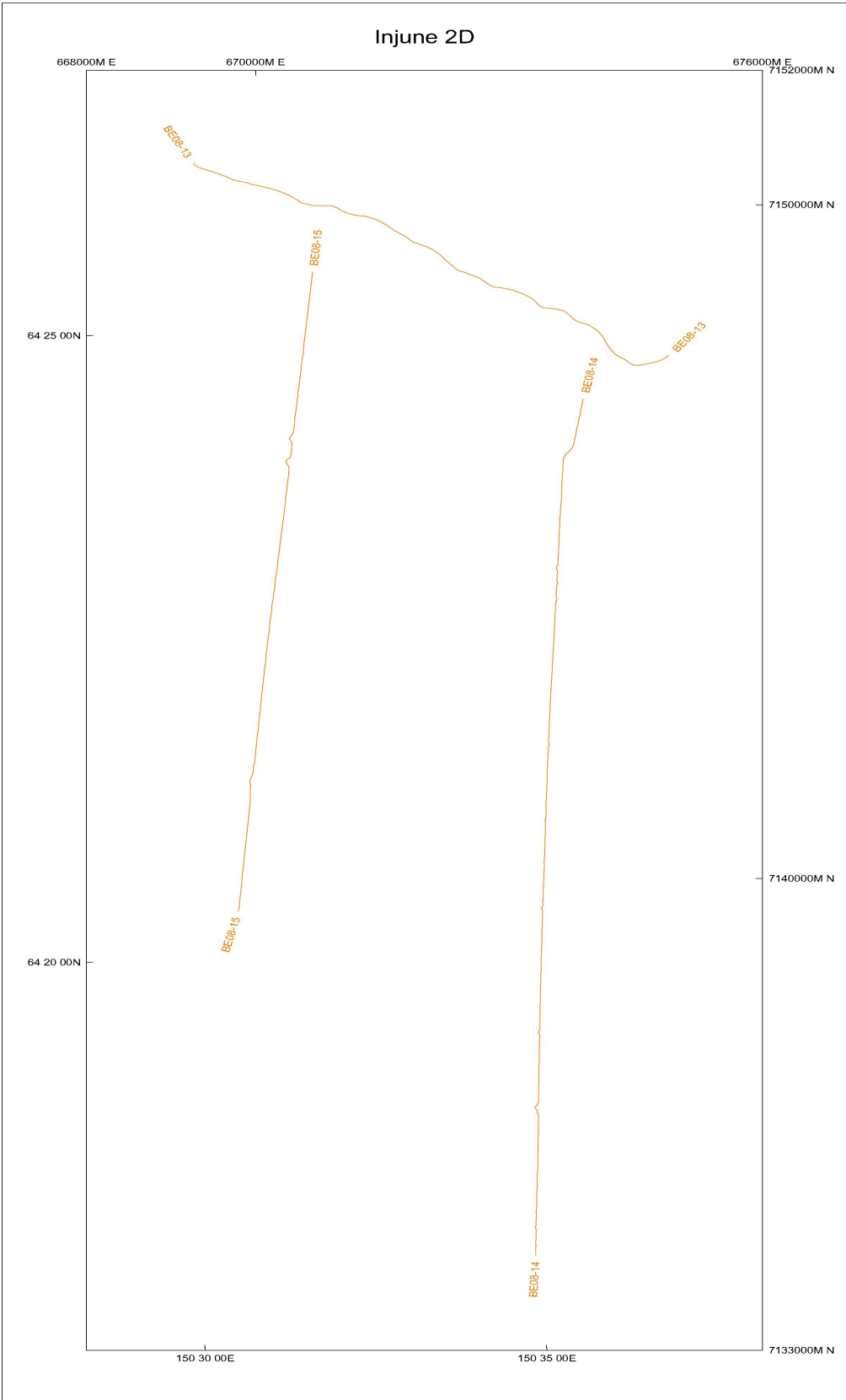
6 SURVEY MAP (Aramac)



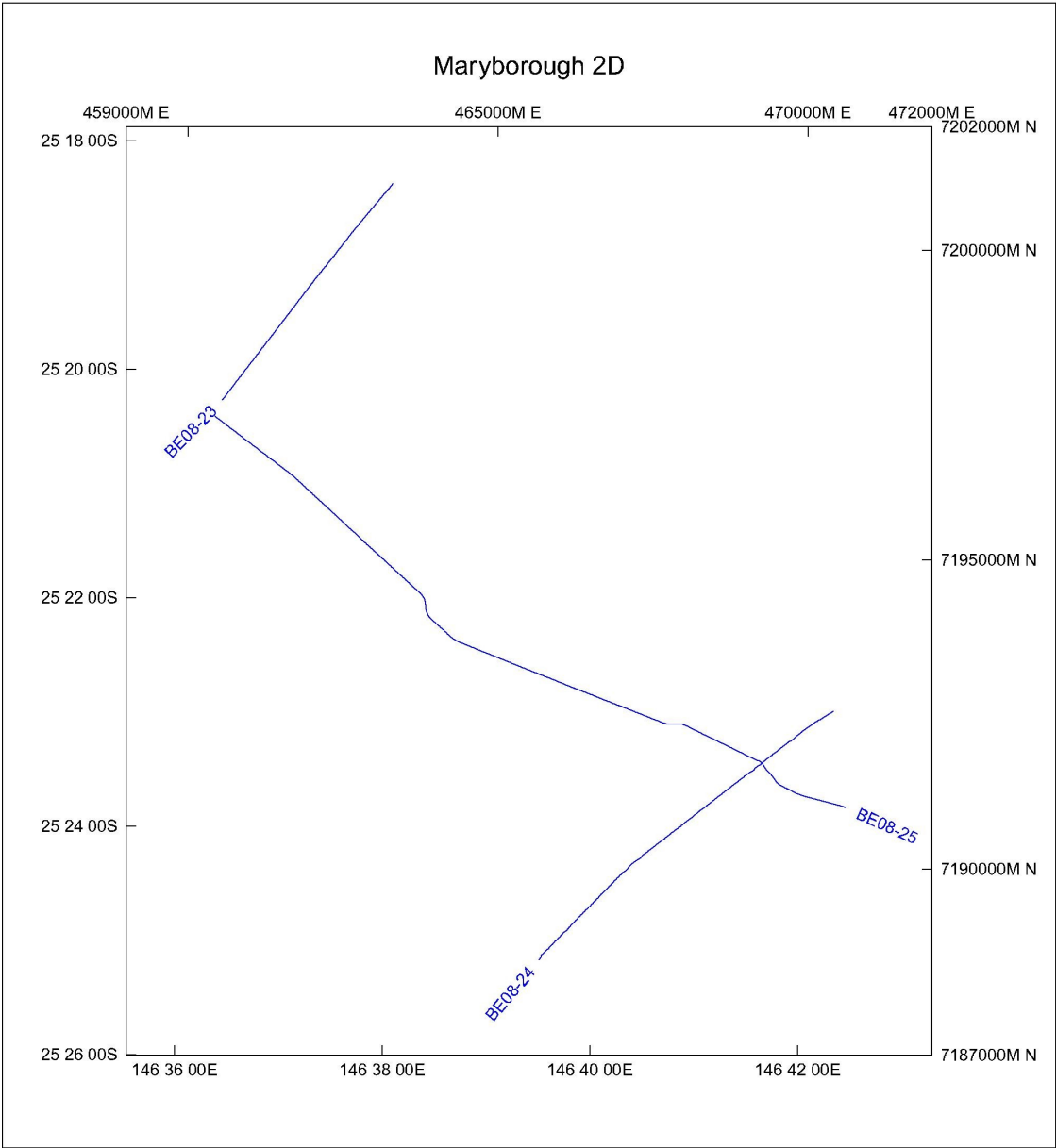
7 SURVEY MAP (Moranbah / Glenden)



8 SURVEY MAP (Injune)



9 SURVEY MAP (Maryborough)



10 LINE SUMMARY

ARAMAC

line	sp	cdp	length
BE08-07	101-990	4-1780	17.8
BE08-08	101-1136	4-2078	21.52
BE08-11	101-654	4-1105	11.08
BE08-12	101-823	4-1448	14.46

MORANBAH-GLENDEN

line	sp	cdp	length
BE08-01	100-740	1-1280	4.808
BE08-02	540-100	1-880	3.308
BE08-03	478-260	2-437	1.643
BE08-04	1010-100	2-1819	6.832
BE08-05	100-1570	1-2926	11.033
BE08-06	318-100	1-439	1.643
BE08-09	644-100	1-1088	4.088
BE08-10	100-750	1-1300	4.883
BE08-1A	800-100	2-1389	5.258
BE08-3A	420-190	1-459	1.732

INJUNE

line	sp	cdp	length
BE08-13	200-533	3-639	13.360
BE08-14	207-851	3-1283	25.800
BE08-15	201-680	3-956	19.200

Maryborough

line	sp	cdp	length
BE08-23	230-675	1-892	4.470
BE08-24	100-723	2-1247	6.250
BE08-25	100-1328	1-2457	12.290

11 PARAMETER TESTING

The standard processing test sequence included review of the following processing phases and parameter choices:

1. Initial gain correction to compensate for spherical divergence and absorption losses.
2. FK cuts of 1200, 1500 and 1800 m/sec were compared.
3. Mute Testing.
Mutes were selected by inspecting a series of stacked panels with increasing offsets. Selected mute was checked by displaying a range of NMO corrected cdp gathers with the mute annotated but not applied.
4. Post Stack Deconvolution tests were looked at but were found to not be required.
5. Taup was looked at but not used.
6. Filter panels were run to confirm the range and times of the final filters.

Extensive extra testing was done on line BE08-13 in the Injune survey. This line was shot on a fault resulting in poor signal to noise ratio and a fair dispersal of energy.

The same applied to the Maryborough survey which was acquired by Velseis in a completely different way to the other surveys.

12 PROCESSING SEQUENCE

12.1 TRANSCRIPTION

Field data were converted from SEG-D format to Fugro's internal format. (SEGY) for the Maryborough survey.

12.2 GEOMETRY

Geometry was assigned and survey data used to update trace positions and offsets stored in data trace header.

12.3 GAIN RECOVERY

Spherical divergence gain function was used.

Gain (db) = $1.0t + 20\text{Log}(t)$

12.4 FK FILTER

Multichannel FK velocity filter : 2000 m/s

Applied to lines BE08-13, 23, 24 and 25

12.5 CDP GATHER

Shot records were sorted into common depth point gathers.

Nominal fold = 60 CDP interval = 3.75m Moranbah

Nominal fold = 60 CDP interval = 10m Aramac

Nominal fold = 60 CDP interval = 10m Injune

Nominal fold = 60 CDP interval = 5m Maryborough

12.6 DECONVOLUTION

Surface consistent spiking deconvolution using one window

Operator	120	ms
Gaps	2	ms
White noise	0.1	%

for Moranbah / Glenden

Design	near	50-1000	ms
	far	350-1300	ms

for Aramac and Injune

Design	near	100-1500	ms
	far	1000-1800	ms

for Maryborough

Design	near	100-800	ms
	far	400-900	ms

12.7 REFRACTION STATICS

Refraction first breaks were picked using Green Mountain Refraction Statics Delay Time Method which estimates the refractor velocities to model the weathering thickness. A constant weathering velocity of 1000 m/s was used for statics computation. No upholes were available for this survey. Raw refraction statics were tied at intersections by averaging the two intersecting raw values and used as calibration points.

A datum of 200m was used throughout the survey.

12.8 FIRST PASS VELOCITY ANALYSIS

First pass velocities were interpreted using Fugro's interactive velocity analyses program "MGIVA". Each analysis comprised a 20 CDP stacked panel, repeated 15 times with a different NMO velocity functions. The velocity function displayed at +/-3 %, +/-6%, +/-9%, +/-12%, +/-16%, +/-20% and +25% increments from a central velocity function which was based on a regional velocity function. The MGIVA velocity analysis is a 'map driven' package, where the user can instantly see modifications to the velocity field in map or section view. Neighbouring velocity functions are superimposed on the current location for easy recognition of velocity trends. Velocity interpretation is performed on the pre-computed stack suite, or on a colour contoured semblance display. Semblance interpretation is assisted with markers illustrating the position of potential multiples, and with an interval velocity curve. Analyses were performed at 1.5 km intervals.

12.9 FIRST PASS RESIDUAL STATICS

Fugro "NEBULA" Surface-consistent Residual Statics Package computes statics based on summed cross-correlations at source and receiver locations. A pilot trace is constructed at each CDP using a weighted mix of stacked traces. Cross-correlations of the pilot trace with traces in the respective CDP gather are summed into buffers for each source and receiver station number before being resampled and picked to derive a static value.

12.10 SECOND PASS VELOCITY ANALYSIS

Second pass velocity analysis was performed on gathers with first pass residuals statics applied. The first pass velocity field was used as centre function for Fugro's interactive velocity analysis package, MGIVA. Analyses were performed at 1.0km intervals.

12.11 SECOND PASS RESIDUAL STATICS

Second pass residual statics was run using the picked second pass velocity field as input to NMO corrections.

12.12 DIP MOVE OUT

Log stretch DMO using Hale algorithm. Run on Moranbah / Glenden and Aramac only.

12.13 FINAL VELOCITY ANALYSIS

Third pass velocity analysis was performed on DMO gathers with both first and second pass residuals statics applied. The second pass velocity field was used as centre function for Fugro's interactive velocity analysis package, MGIVA. Analyses were performed at 0.5km intervals.

12.14 NMO CORRECTION

NMO correction was performed using the final velocity functions.

12.15 MUTE

A stretch mute of 40% was run on all lines.

12.16 PRE-STACK SCALING

The CDP gather traces were modulated to compensate for amplitude irregularities by scaling each trace using 200 ms AGC .

12.17 STATICS

Floating datum to final seismic reference component of the statics is applied prior to stack. This corrects the data from floating datum to a final datum. (see refraction statics 10.7). To avoid losing data above datum, data was time shifted by 200ms prior to static correction to datum and a new time origin of -200ms was established.

12.18 CDP TRIM STATICS

Fugro's "PASTA" package was used to compute cdp consistent residual statics. "PASTA" is an automatic residual statics program which applies static shifts on a CDP consistent basis, using cross-correlations of NMO-corrected CDP gather traces with a CDP pilot trace for each depth point.

12.19 COMMON DEPTH POINT STACK

The traces within each common depth point gather were summed using $1/\text{root}(N)$ stack compensation

Nominal fold = 60	CDP interval = 3.75m	Moranbah
Nominal fold = 60	CDP interval = 10m	Aramac
Nominal fold = 60	CDP interval = 10m	Injune
Nominal fold = 60	CDP interval = 5m	Maryborough

12.20 MIGRATION

Finite Difference Migration uses the technique of downward continuation in order to map reflectors to their true time position. It is performed in the frequency – space domain. Steep dip second order solution (65 degrees) and depth step of 12m were used.

12.21 BAND PASS FILTER

Unwanted noise that lay outside the frequency range of the desired reflection and diffraction data were removed by the application of a series of time variant filters.

Moranbah / Glenden

Time (ms)	Frequency (Hz)
1000	4 / 8 - 60 / 75
2000	4 / 8 - 40 / 55

Aramac and Injune

Time (ms)	Frequency (Hz)
1000	4 / 8 - 50 / 65

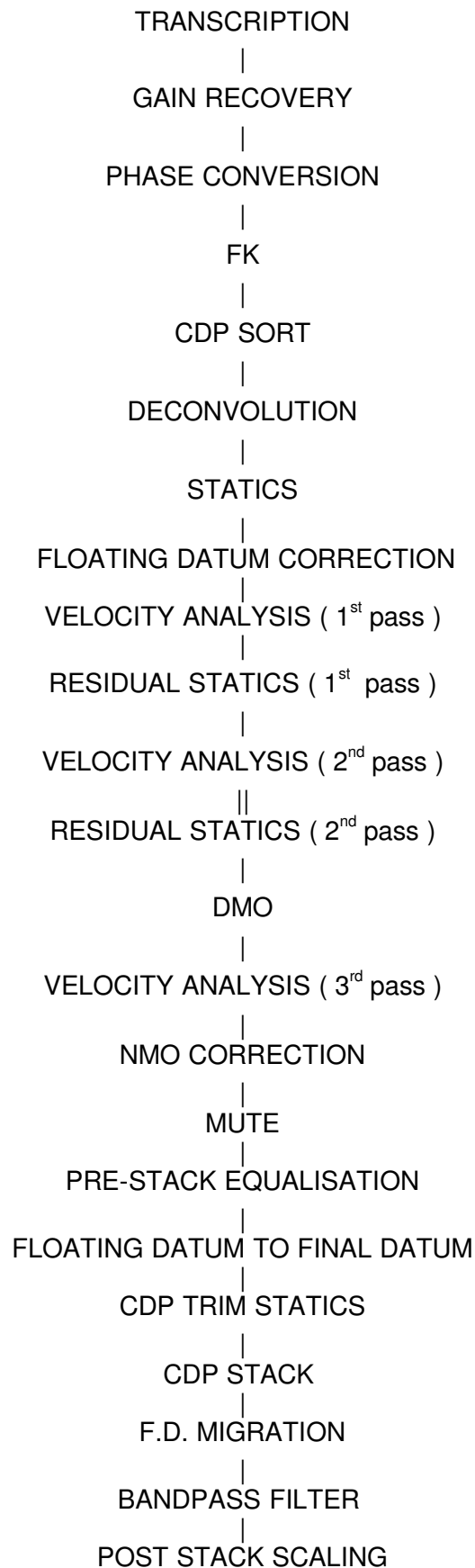
Maryborough

Time (ms)	Frequency (Hz)
0	10 / 15 - 105 / 120

12.22 POST STACK SCALING

Dual window AGC with window lengths of 1000 ms and 400 ms.
Equalisation applied : 50%

13 PROCESSING SEQUENCE DIAGRAM



14 FINAL DISPLAYS

Final displays of final stack & final migration stack were produced in CGM+ format

Horizontal scale: 1 : 20,000 (50 traces per inch)

Vertical scale: 10 cm/sec

15 ARCHIVES

Final migrated stacks, final stacks, raw final stacks, raw migrated stacks true amplitude final stacks, and deconvolved gathers for each line were written onto DVD in SEG Y format for workstation interpretation and archival.

Trace headers summary

<u>BYTE</u>	<u>DESCRIPTION</u>
17-20 (32-bit)	SPNO
21-24 (32-bit)	CDP number
41-44 (32-bit)	Elevation
81-84 (32-bit)	CDP easting
85-88 (32-bit)	CDP northing
97-98 (16-bit)	Source residual static
99-100 (16-bit)	Receiver residual static
101-102 (16-bit)	Receiver static
103-104 (16-bit)	Datum static applied
189-192 (32-bit)	SP number
109-110 (16-bit)	Time of first sample
115-116 (16-bit)	Number of samples
117-118 (16-bit)	Sample interval
189-192 (32-bit)	SP number

16 DATA DISPOSITION

To Blue Energy

- 1 DVD for each area containing
 - digital prints in CGM+ format
 - velocities in Western format
 - static listings for all lines
 - CDP coordinates for all lines
 - Raw final stacks
 - Raw migration stacks
 - Final migration stacks
 - Final stacks
 - True Amplitude stacks
 - Deconvolved gathers
 - Processing report emailed in pdf format
 - Returning field tapes, observers reports and support data

17 CONCLUSION

The 2008 Blue Energy processing project preceeded in a smooth and timely manner. The new data started arriving in September 2008 and the final archives and processing report sent at the end of January 2009.

Having a range of surveys with different acquisition parameters and characteristics made the data varied and this in turn made processing the job both interesting and enjoyable. The results surprised and pleased everyone concerned and we would like to thank Mike Swift and Cameron Belcher for their prompt replies to any queries that arose and for providing additional information when it was needed.

Mick Curran
Processing Geophysicist