



# norwesterly

FOURTH EDITION MARCH 2013

## SPECIAL ARROWSMITH-2 EDITION

Dear Fellow Shareholder,

Norwest has started 2013 with the Arrowsmith-2 well delivering encouraging results:

- Carynginia Formation flowing with an initial rate of 350,000 scf/d (standard cubic feet per day), and;
- The Kockatea Shale flowed at an average rate of over 200,000scf/d over a two day period following the shut in monitoring period and during clean up, with a maximum gas rate of over 400,000 scf/d and 22 bbls of oil recovered from the wellbore.

These results have built on those of 2012, which proved a significant year for Norwest with the completion of the first phase of operations on the unconventional Arrowsmith-2 well achieving outstanding results. This successful program reinforced the view that Norwest has now emerged as a valid participant in the shale gas industry currently evolving in Australia.

The original Arrowsmith-2 hydraulic fracture stimulation program in mid-2012 only allowed for brief periods of flowback on each of the stimulated intervals due to time and cost constraints, hence it was always intended that the well would be re-entered once the frac spread and associated equipment had been demobilised, in order to carry out a comprehensive evaluation program on the well. This is, after all, the first dedicated shale gas well to be drilled in Western Australia, there is still much to be learned about how these shale sequences perform, and it needs to be conducted thoroughly in order to properly plan a future program, involving the potential drilling of our first horizontal well.

When the well was initially drilled in 2011, and the comprehensive coring and logging program was carried out, it was expected at the time that it would be possible to high-grade target intervals, and also that some intervals may prove to be non-prospective once results were reviewed. However what actually happened was that from the coring and logging program, it became evident that each of the four formations had strong merit, and all required further evaluation. In most programs, a company would be targeting one or possibly two intervals – in this well we had over 1000 metres of prospective shale / sandstone to evaluate, over four different formations – quite a unique scenario.

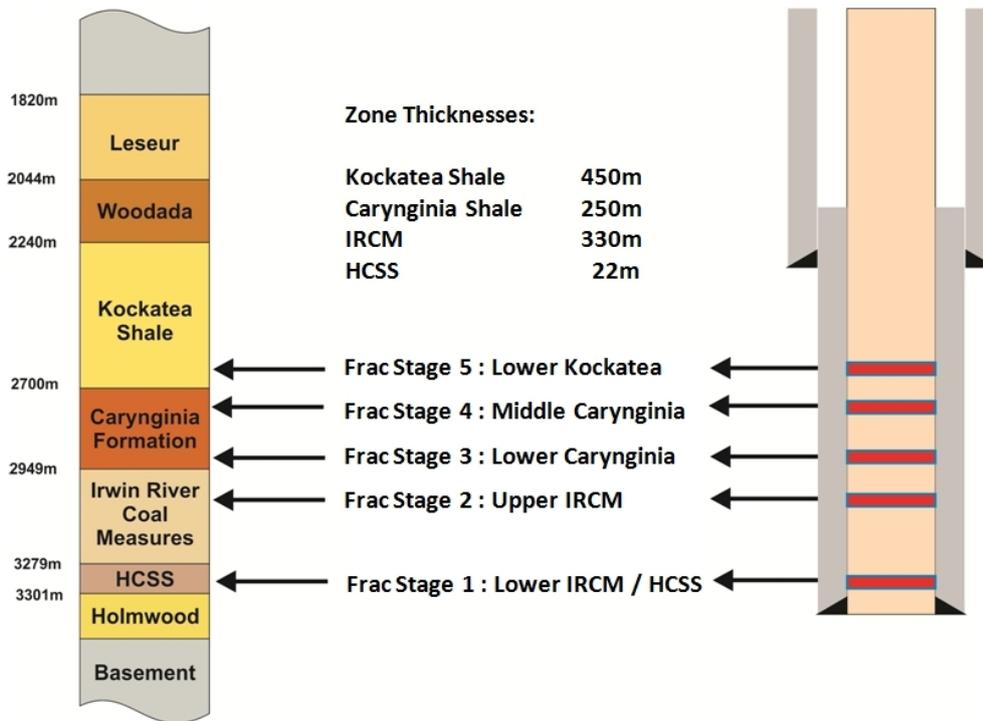


Figure 1. Arrowsmith-2 Frac Stages 1-5

As a result of this preliminary work, the hydraulic fracture stimulation program was designed to place one fracture stage in each of the Kockatea Shale, the Irwin River Coal Measures and the High Cliff Sandstone, and two fracture stages in the primary target for the well, the Carynginia Formation. The two frac stages in the Carynginia Formation were only separated by 15 metres, but the limit of the frac spread horsepower meant that each frac stage needed to span a maximum height of around 50 metres. Hence two 50 metre frac stages in the Carynginia were used. It was always intended to mill out the plug between the two Carynginia frac stages post frac in order to flow the sequences back together. Tracers used in these two sequences will assist Norwest in evaluating the proportion of gas attributed to each of the two stages.

Late 2012 saw the shut-in of the Kockatea Shale interval in order to conduct a pressure build-up analysis on the formation. The oil flow from this interval, although welcomed, certainly provided issues for Norwest, both operationally and in the analysis phase. Although the Kockatea Shale interval is now sealed off, analysis continues on the identification of the oil source, how laterally extensive it may be, and whether it has the potential to produce at commercial rates.

### Where are we in the program?

**Carynginia Formation (Lower 2890 – 2940m, Middle 2824 – 2875m):** The current status of the well is that clean-up and flowback on the Carynginia Formation is underway. As this edition of *Norwesterly* goes to print, a positive result has been obtained in that with only ~50% of the injected frac fluids returned to surface, an early peak rate of 350,000 standard cubic feet per day (scf/d) was recorded, and it is anticipated that this gas rate will improve significantly once sufficient frac fluids have been produced back to surface.

The Carynginia Formation is considered to be a highly prospective shale gas target, with gas production to surface, excellent pressure support, good TOC values and other important shale gas indicators all present.

It is important to note that the Carynginia Formation flowed at 4MMscf/d from the Arrowsmith-1 well when it was drilled in the mid-sixties, and this well was not fracture stimulated. The Arrowsmith-1 well is located just 400 metres away from Arrowsmith-2. Also, in a market release on 9<sup>th</sup> November 2010, Norwest's Joint Venture partner AWE Limited reported that the middle interval of the Carynginia Formation had the potential to contain 13 to 20 trillion cubic feet of gas (TCF) throughout the northern Perth Basin, with a recoverable reserve potential of higher than 4 TCF of gas. AWE is a Joint Venture partner in the EP413/Arrowsmith project, with a 44.252% interest.



Figure 2. Carynginia Flare, Saturday 16<sup>th</sup> February 2013

**Kockatea Shale (2639 – 2681m):** Following the shut-in / monitoring period that concluded at the end of January 2013, the Kockatea Shale interval was flowed back for several days prior to its isolation and drilling out of the plug separating the Carynginia. In the final clean-up process 22 barrels of oil was recovered from the frac fluids that remained in the well, and a peak rate of 413,533 scf/d was also recorded, with an average rate recorded over a two day period – 30<sup>th</sup> & 31<sup>st</sup> of January of over 200,000 scf/d. As noted in the project updates on this interval, both oil and gas rates fluctuated significantly throughout the evaluation period, thought to be caused in part by the three phases of oil, gas and water flowing intermittently in the well, and the possibility of sand (proppant) at the perforations also blocking flow at different times. Regardless of these fluctuations, further investigation and understanding of this interval is certainly warranted.

#### ***Which interval is the source of the oil?***

The initial oil samples taken from the well were quite waxy, with an estimated API of 37°, and a pour point of ~50°C, however later samples were a much lighter oil, with a pour point of closer to 24°. It is believed that the presence of the initial waxy oil flowing through such a fine fracture network contributed to issues with consistent flow for the oil, water and the gas phases. In analysis

carried out post-frac, including a comprehensive re-working of the petrophysics, the potential source interval of this oil was narrowed down to either shale oil production from the shale interval, or a potential source at the base of the Kockatea in the Hovea-Wagina Formation. Across the Hovea-Wagina Formation, a total of ~10.6m of limestone reservoir was intersected via the fracture network, and it is thought that the oil could also be derived from this carbonate interval. The Norwest project team has commenced reviewing and analysing this dataset, however at this time no definitive conclusion has been reached. Nevertheless whatever the source, any oil discovery always warrants further investigation, particularly as the Arrowsmith field lies in a corridor of oil producing fields, and the Hovea Member (at the base of the Kockatea Shale) is a well-known producing source of oil in the Basin. Norwest sees considerable shareholder value in further evaluating this oil discovery.

**Note: The hydraulic fracture stimulation fluids used for intervals 2-4 were recycled on subsequent zones in order to significantly reduce the amount of water used throughout the program. This technique of recycling water was successful, and will be implemented in any future hydraulic fracture stimulation programs that Norwest undertakes.**



Figure 3. Kockatea Shale oil sample



Figure 4. Kockatea Shale flare 02/09/2012

**Irwin River Coal Measures (3000 – 3050m):** This interval is a ~350 metres thick hybrid shale/sandstone interval, and has only had a very brief period of flowback during the original program due to the previously mentioned operational constraints. It is believed that having left this interval for some time now, the pressure will have recharged the formation and opened up the fracture network, so that a good flow of gas is expected. The hybrid nature of this interval is quite appealing, as the sandstone layers represent much higher porosity than the shale layers, and so potentially the ability to contain a larger quantity of gas in the pore space. This interval will be flowed back later in the program, once the work on the Carynginia Formation is complete.

As a matter of note, during 2009 AWE fracture stimulated the Perth basin Corybas-1 vertical well to test the Irwin Coal Measures Formation as an “unconventional” play. Subsequently in April 2010 the well was connected to the Dongara processing facility and began producing at initial rates over 4 million standard cubic feet of gas per day. At the end of October 2010, the well was producing at a commercial rate of 1.2 million standard cubic feet per day. AWE commented that the results of this flow test were very encouraging and support the view that an optimally designed fracture stimulation program will liberate commercial gas flows. It also commented that the implementation of best completion practises, and drilling horizontal wells which are multi staged fracture stimulated, could achieve significantly higher production rates and recoveries.

**High Cliff Sandstone (3279 – 3301m):** This interval is the deepest in the Arrowsmith-2 well, and is a tight sandstone interval. The frac interval intersected both the High Cliff Sandstone, and the lowermost section of the Irwin River Coal Measures. Due to the longest initial flowback period for all of the intervals fraced of 14 days, it returned 85% of the injected fluids in the initial period of flowback, and presented a peak rate of 777,000 scf/d before being shut-in to continue the program. It is expected that when this zone is re-entered, a significantly higher rate will be achieved. As this is a tight sandstone play, it is dependent upon reservoir size, so a 30 day well test is planned, along with the 3D seismic program to better map the surfaces, in order to define reservoir size and the commerciality of the zone.

**Resource Estimation:** Norwest has engaged DeGolyer and MacNaughton, a US based resource evaluation consultancy to commence work on defining a resource estimate for each of the zones in the well. Until flowback is complete on the remaining zones, the results will be preliminary. It is expected that by the end of March a report will be complete on data available at the present time. This will greatly assist Norwest in defining the program going forward in developing the Arrowsmith field.

### **Program going forward**

The permit is due to be renewed for a further five years from 1st May 2013. The work program for this renewal is likely to include 3D seismic to more accurately map HCSS closure, more accurately map the base of the Kockatea, and help with the planning of future horizontal well(s). At this time it is not known which intervals will be high-graded, and therefore targeted for a future drilling program.

Each of the formations targeted by Norwest in the Arrowsmith-2 campaign are considered prolific and extensive plays within the Basin.

### **Other Activities:**

**2013 Excellence in Oil & Gas Conference:** Norwest is currently preparing for the 2013 Excellence in Oil & Gas Conference in Sydney from 4 to 6 March 2013. Norwest has a booth at the conference and will be making the opening corporate presentation on day one, placing Norwest in the spotlight! It is anticipated that there will be considerable interest in the Arrowsmith shale gas activities, and that our booth will attract considerable attention. In attendance will be myself, and Norwest's senior management team - Shelley Robertson (Asset Manager/Shale Gas Operations Manager) and Andrew Sutherland (Technical Advisor). Accordingly this fourth edition of *Norwesterly* has been published to precede the conference, deals specifically with the Arrowsmith shale and tight gas plays, and provides our valued shareholders with an update on progress of the project.

The corporate presentation will be published on the day of the conference and will be available on the Norwest web page: [www.norwestenergy.com.au](http://www.norwestenergy.com.au) I hope that this publication has assisted you in understanding operations to date, and what lies ahead. Regarding the program going forward – the primary objective is to gain a better understanding on each of the intervals under investigation. We have over 1000 metres of shale / sandstone thickness to high-grade and further develop. As the program continues over the next few months, Norwest is continuing to strive to attain the best

possible results, with the lowest cost base possible, and will continue to work in achieving increased shareholder value.

One final point - although the gas rates generated from the various zones in the Arrowsmith-2 well are considered small in 'conventional' terms, when scaled up to a 10-20 stage horizontal shale gas well that has been hydraulically fracture stimulated, the volumes produced are significant. This is an important point to remember!

I greatly look forward to the year ahead – it is exciting times for Norwest and all its shareholders! Remember, we are still the pioneers in the northern Perth Basin shale gas industry, and there is much to be done in moving this through to commercial production, however I firmly believe Norwest is up to the task, and with the support of our shareholders, we can make this a reality.

Yours sincerely

**Peter Munachen**  
Chief Executive Officer / Director  
Norwest Energy NL

