

Bowen Gas Project

Community information sessions 29-31 October 2012

Introduction

Arrow is seeking to develop opportunities for the supply of gas to new export and domestic markets, including a proposed Liquefied Natural Gas (LNG) plant at Curtis Island near Gladstone. As part of this work, Arrow is undertaking an environmental impact statement (EIS) covering the area of its proposed Bowen Gas Project (BGP) which extends from Glenden in the north, to Blackwater in the south.

In October 2012, Arrow Energy held a series of community information sessions in the Bowen Basin. This was the second series of sessions aimed at discussing the proposed Bowen Gas Project with the local community. The information sessions were held from 29 to 31 October 2012 at:

- Middlemount, 29 October 2012
- Moranbah, 30 October 2012
- Blackwater, 31 October 2012.

Questions and answers were captured by JTA Australia and are presented in this document. To ensure that this valuable information could be shared throughout the broader community, the following notes were compiled to reflect the discussion across all three sessions.

How to read these notes

Questions and comments from the audience are in bold type. The responses given by Arrow staff are provided in regular type.

In some cases responses have been summarised or additional information has been included to provide further context or explanation; this information is italicised following the answer.

If you have any further questions or comments about the project, the meeting notes, or if you would like detailed maps of the exploration areas, please contact the project team:

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Glossary

ATP	authority to prospect
BTEX	benzene, toluene, ethylbenzene, and xylene
CSG	coal seam gas
DEHP	Department of Environment and Heritage Protection
DERM	Department of Environment and Resource Management (former name for DEHP)
EA	environmental authority
EIS	environmental impact statement
FID	final investment decision
IVMS	in-vehicle management system
LNG	liquefied natural gas
MPa	Megapascals
psi	pounds per square inch
PL	petroleum lease
QGC	Queensland Gas Company
QWC	Queensland Water Commission
RO	reverse osmosis
RPM	revolutions per minute
SCADA	supervisory control and data acquisition service
SIS	surface to in-seam (drilling)
THPS	tetrakis (hydroxymethyl) phosphonium sulfate

Conversions

- 1 kilolitre (KL) = 1,000 litres
- 1 megalitre (ML) = 1,000,000 litres
- 1 gigalitre (GL) = 1,000,000,000 litres
- 1 terajoule (TJ) = 1 000,000,000,000 joules

Queensland Government Acts mentioned

- Acquisition of Land Act 1967 (QLD)*
- Environmental Protection Act 1994*
- Mineral Resources Act 1989*
- Petroleum and Gas (Production and Safety) Act 2004*
- Water Act 2000*
- Water Supply (Safety & Reliability) Act 2008*

Middlemount

Date:	29 October 2012	
Venue:	Middlemount Community School Hall	
Presenters:	Carey Bradford, Exploration Manager (South)	Arrow Energy
	Fergal Convery, Project Manager Bowen Gas Project EIS	Arrow Energy
	Kavita Prasad, Groundwater Modeller	Arrow Energy
Facilitator:	Jan Taylor, Principal	JTA Australia

1. When will the Social Impact Management Plan (SIMP) be released?

The SIMP comes out as part of the EIS so you'll probably see that in January or February 2013.

2. As local government people we tend to worry about our roads and traffic. One of the main things that you mentioned is whether our highways and arterial roads are capable of handling the impacts. I think everyone in this area realises at the moment that our highways and arterial roads aren't coping and our local roads are at a lower standard than that. So I think there just needs to be an awareness that there are some major impacts as part of the process and you will need to work with the Department of Transport and Main Roads (DTMR) and local council. That's fine for the future, however, I'm just wondering about the current impacts of exploratory work regarding traffic on roads. Is that being monitored? Is there any infrastructure funding being provided at the moment to counteract current traffic effects on road?

Arrow has placed in-vehicle monitoring systems (IVMS) in all of our company vehicles, but we've also asked all of our contractors to have IVMS installed in their vehicles. We'll be able to backtrack and know what sort of traffic was going where. It's all linked to a global positioning system (GPS) so the number of kilometres driven, whether the guys are having their two hour breaks; all of those sorts of things are tracked. Under the Act [*Petroleum and Gas (Production and Safety) Act 2004*] there is a notifiable road use policy so when we exceed a number of tonnage hours over the roads, we need to enter into an agreement to negotiate with local councils as to how we can make good and be fair and equitable in our contributions. That said, we probably haven't always been the best at it in the Bowen but we're improving the procedures and we have a lot of technology to map all of that out.

3. Is that information available and reportable?

Yes. In the Surat - where I do a lot of my work these days - we've been working out how we can best make use of that information. Largely, the councils haven't been so upset about exploration activities *per se*, although they [*vehicles*] can do damage in the wrong conditions. Where there have been concerns raised with the resource companies is when they build a 100 man or a 1,000 man camp and haven't done anything to upgrade the road. That's where they've really been quite touchy and, understandably, it's up to the resource companies to live up to the commitments they make.

- 4. From an emergency services point of view, how many people are currently onsite, where are the sites, and where are you getting the workforce from? From an emergency services viewpoint we obviously want to know if there are people in isolated areas where things can go wrong, how do we access them, what is the size of those groups? That's the sort of information we need to know.**

With a pipeline project, that's something which is a bit larger and we'll have to look at whether we supply our own paramedics in some of those remote areas. Usually with exploration drilling we're pretty mobile and on the move quite regularly. We've found it easier to set up emergency evacuation locations in advance and these should be no more than five or 10 minutes from the majority of our drill sites. If our people rang in an emergency, ambulance officers would be able to meet them and be escorted to the location. In addition, all the rigs would have rig markers. So from the turn-off from a major location, there should be a 'drill rig number X in this direction' signposted at every corner. The ambulance should be provided with these emergency locations in advance.

- 5. I know you guys are mobile and I know that you're setting up a test facility here and a test facility there, but what sort of timeframe are you spending at each one of these? Are these emergency signs being moved to accommodate that? I can imagine guys might set up the first two or three and then say 'oh look, we're just five minutes up the road. It's all okay'.**

As much as I'd like to say we are highly mobile, these days as a drilling company, the average exploration drill rig now has about 10 to 15 semi-trailers worth of equipment. So it is a reasonably large project to meet the safety commitments and the requirements under the Act [*Petroleum and Gas (Production & Safety) Act 2004*], which have been going up and up as we venture into our project. The guys do generally put the signs out unless there is some sort of issue. Where we would run into more of a drama is with the guys doing maintenance work - installing new pumps, finalising that work. Some of the guys may be spraying weeds or that type of work. We have a Journey Management Centre (JMC) that looks at that process. It's a telephone number we call to log every journey of more than an hour. If we don't ring in at the time we said our journey would finish, the JMC rings our supervisor. If then we can't be located, the JMC will ring you guys [*Emergency Services*]. The vehicles should have IVMS and the JMC should be able to give you their exact location.

IVMS also tracks if you have a very harsh deceleration event, which could indicate there may have been an accident. JMC would be able to give that person a call in the field to see if they are all right.

- 6. What groups of people are out there at the moment and on what sort of cycle? How many people are we looking at – you said 10 or 15 semi-trailers, so I presume there is probably at least a workforce of 10, 15 people?**

Yes. The general shift on a small rig might be five people for the first shift. Sometimes they are housed in proximity or on an adjacent field to the drill site. The very largest rigs would have about 12 staff per shift. That's about the maximum you would see on them.

- 7. In regards to the aquifers, if there's so much good technology in place, why are we seeing failures in the system, I mean in other areas? To what extent do you notice it affect the groundwater around here and bores to 100 metres or so?**

So you're talking about failures with drills or wells, that sort of thing?

8. There have been instances where gas has got into bores and this sort of thing. Why are we having failures?

Basically gas in water bores isn't uncommon, in fact there's a long history of it particularly in the Surat, of well over 100 years. In America it probably goes back 300 years, but you can look back with drilled water bores and there's already gas in it. If the well is designed and constructed properly there should be no problems with it. We use steel casing; in the top section we would use two to three different sized strings telescoping down. We then pump cement through the centre of the casing and up the outside, and we do that with each string. Where problems might arise is if the cementing wasn't done properly in the first place. There are a number of things that could go wrong with a cement job. For example something could clog-up the hole; the weight of the cement could be too heavy which could make the cement flash early; gas bubbles that form at the bottom of the well could actually come through the cement and form a micro-annulus. We think the numbers of those wells potentially affected would be one or two in 100. We would put in place monitoring on all wells, and have monthly to bi-monthly inspections to look for those issues. When the issue does come up, we mill the casing out and squeeze cement into it or remove the whole lot from top to bottom and start again. It comes down to a very good well design and executing that well design properly.

In the last 12 months the Queensland Government and industry have implemented a mandatory Code of Conduct for constructing and abandoning coal seam gas wells. That basically puts the same onus on us drilling the coal seam gas well as it would if you were doing a high pressure, high temperature well. It sets a very high standard compared to where we were at in regards to minimum requirements. It wasn't like we were running around doing things however we wanted to, but now the actual nature of the casing sizes, everything, is dictated to us as a minimum mandatory standard. We believe those things put in place a lot of protection around groundwater. We haven't seen any issues as far as we can ascertain relating to groundwater in Australia, based on our legislative and experienced advice. In America there have been some isolated issues that are currently being studied and potentially fracking has been blamed. In the cases that I've seen it was poor construction of the wells in the first place that potentially led to that problem, and then an inadequate regulatory framework to monitor those things. They're the things we have in place here to stop that happening.

[Gas leaking from water bores is not necessarily related to the construction or operation of Arrow gas wells.]

Gas emanating from a water bore is not a new phenomenon in Australia. There are a variety of reasons, including that in some instances water bores are drilled by landholders into coal seams. In effect, as water is extracted by the landholder from the coal seam over time, coal seam gas is released.

Arrow designs and constructs its wells to ensure they meet or surpass all regulations. World class design and construction techniques ensure that wells are isolated from their surrounds, both above and below ground, with gas and water completely contained within the well. The integrity of the well is also ensured through vigilant maintenance; it is a business imperative that Arrow wells don't leak gas.

Arrow works in a heavily regulated industry. If a landholder reported that a water bore was leaking gas in the vicinity of an Arrow well, the 'make good' provisions that now apply through regulation require the company to fully investigate it. If Arrow was deemed responsible from a water bore, it would be required by regulation to take formal action to 'make good' for gas leaking.]

9. Just following on from that last question, you said there was one or two in 100; so was that since regulation was brought in?

No, that just tends to be a general failure rate; you can't predict what would be occurring down the hole. If for example some rock caved in beside the casing when we were trying to cement, causing it to collar-off, and we couldn't get the cement up to the surface, that could throw in some problems. Historically that is the failure rate we see in the oil and gas industry due to problems with this style of work. We do have a number of measures in place to counteract that risk. One thing we have is what we call a float shoe, or a non-return valve placed at the bottom of the casing and what we call a plug. We pump the cement in, then we put a plug in. That plug should push all the way down to the float shoe to make sure all of the cement is pushed up the side of the casing, so that the cement returns to surface and it holds the pressure and can't go back inside the well. There are a number of measures we have in place, but obviously not everything always goes to plan. It's about having that monitoring behind it to make sure that when things don't go to plan, you can find it and fix it. There are a number of points in the code of practice around design of the cement slurry and monitoring. We can do cement bond log tests - when we're initially testing cement design and the weights and constituents that go into the cement. When we first do that in a new area we would run cement bond logs and prove that the formation of the cement and the practices that we put in place are consistent with getting a good bond and good integrity.

[It is a business imperative to ensure that Arrow wells don't leak gas.]

Wells are drilled and maintained to the highest standards. Internal and external inspections are conducted, wellhead valves are regularly tested and corrosion surveys are undertaken to ensure integrity.

Arrow has always abided by the regulations in its well construction and operations.

Where a well is not required for operational purposes, Arrow plugs the well and rehabilitates the site, which is in accordance with regulations.]

10. So if something does go wrong, how long do you have to fix it so that it doesn't ruin the groundwater?

Most of the time we would pick it up beforehand in the pumping process, watching the pressures as we pump, those sorts of things. If there were annulus problems with bubbles coming up, we should see issues fairly early on in the piece, within the first day or two. Some of the other things would have to be monitored. I guess every case would be individual and we'd have to look at it. We're not as worried about contamination, i.e. a fresh water surface aquifer becoming contaminated by coal seam gas activities. Generally what we would see

would be a flow the other way around because you're creating a low pressure environment in the coal seams. We expect the water to flow both ways from below the coal seams and above back into the coal seams. If methane and other things are present, we would be able to measure it, there would be extensive monitoring networks around wells to pick these things up

Just to clarify, the one or two frequency was around a failure in the well construction. It wasn't around failure of the well construction that led to impacts to the groundwater.

11. So you monitor the wells when you put them down there, but do you monitor them afterwards? How long do you monitor them after that point?

The wells have monitoring around the wellhead. They are all hooked up to a supervisory control and data acquisition service (SCADA). We're monitoring water flow in the well because there's a number of factors around defective stress and keeping a little bit of pressure head on the well that are very important for us and enable the well to flow as best as it possibly can. It's also in our interest to monitor it from a production point of view. There are also regulatory inspections that the guys have to do around the wellhead to identify any potential leaks. That goes on for the life of the well. On top of that we have water monitoring wells. The Queensland Water Commission (QWC) dictates to us the number [*of monitoring wells*] that we have to put in the Surat and we'll actually put in a larger number than that stipulated to monitor groundwater. If the model shows us that we expect 'X' amount of drawdown and drawdown is different to that, then we know there's something going on and we would investigate either through interference pumping testing or shutting wells in and monitoring the reaction. The groundwater models are the base protection for us to anticipate what we think should be happening, and when monitoring shows things that don't match it [*expectations*], we would investigate further.

12. Now, I might get this wrong but I've got two bores on my property. They're good bores and we rely on them.

You've just put down a hole on my property, to 800m I think, but what we're interested in is the first 33m. If we don't get water before we go through the basalt, well we're not going to get it so we need to look after that. I'm just wondering as it's very close to the surface what guarantees have we got that you won't get something damaging into it, whether it's a stream or a pool.

There's always some level of uncertainty and risk. The Queensland Government has recognised this and has put in place what it calls 'make good provisions'. This means that if there is an impact on the quantity of your water, and we exceed the trigger levels it has set, I believe it's two metres for a surface aquifer like that, we're required to make good. What 'make good' means is that we have to find a way to either maintain your supply or compensate you for the impact. That could involve deepening the bore, finding an alternate location for your bore, hooking you up to a water supply that we pay for. We would be required to mitigate you for that impact for as long as that impact exists. Generally what we think the issue will be is that we may reduce the amount of available water. We think it's a moderate amount based on the fact that the water-holding capacity of the coal is very minimal compared to the aquifers. While we draw down quite a large amount of head, we think and the modelling suggests, that there'll be very little drop in most of the aquifers that

we're working around. If we do have some unforeseen effect that affects your quality or quantity of water, then we're required to make good for as long as it takes.

Just to clarify, that was a core hole that was drilled on your property and it's already been cemented back to surface, so that hole is now totally secure. As Carey mentioned earlier, if we were doing appraisal wells or exploration or production wells, then they would be open for a period of time. We would do water, quality and surface level tests on that bore to determine what it was before we start our activity and manage it into the future so we could see any variation of what it was, to what it is. That's when the make good process comes into play, if there is any impact we would be coming to an arrangement to ensure that you weren't affected in any way. So in your case where it's only an exploration core well, we drill down and take the core sample out, then fill it back up with cement so it's completely secure up to the surface.

13. Ok. What is the two metres? Does it have to drop two metres before you can get anything done?

No, that's what we guarantee. If the water table drops two metres, that's the trigger.

Two metres in unconfined and five in confined aquifers is the threshold that is currently set. To provide some perspective, in the Surat Basin there are some 20,000 registered water bores across the project areas. Of those, we think there will be around 500 on our tenement that will be impacted, maybe a few more. Our modelling is a little bit more conservative than what the QWC has put forward. You can see there is some impact; we're not saying there's none, but it is mitigated to a certain amount by the amount of water we take compared to what can be stored and how quickly surface aquifers are able to recharge after flood events. We need to model that and keep an eye on it. We do have that commitment to make good and we do have the commitment to do a baseline bore assessment before any production or appraisal work goes on.

We've actually got four different water monitoring processes. We've got the baseline bore assessment on existing bores; we will leave some of our exploration wells and turn them into test bores. We've got assessment bores on all our water storage ring tanks or water storage dams that are double lined, to determine whether there's any leakage out of those dams, and we also have a deep water aquifer monitoring process where we're obligated under the Act [*Petroleum and Gas (Production and Safety) Act 2004*] to run a series of deep water bores to test the different levels of aquifers and see if there's any variation in them. So under the process and the legislation, there are four different types of processes where we monitor and manage different water levels through the Basin.

That's just to give you an overview; we can answer more detailed, property specific questions one-on-one.

14. There are not a lot of bores in the area.

Yes, we're just commencing our baseline bore assessments now.

15. My question comes because you're just about to start fracing on my property. You're supposed to have done your tests on the existing bores I've got, but where are

your test bore holes before you frac so you can prove you're not going to interfere with the water levels where you're fracking?

We have to do an assessment on any existing bore that is within two kilometres of the fracking site, and I think that's been done on your place for those within that vicinity. If it hasn't been done yet, it will be done prior to or within 30 days of the commencement of that activity.

16. Is that information forwarded to us or is it just kept by Arrow?

No, you can have that information. We'll give it to you once we get the results back.

17. Shouldn't that all be upfront before you start fracking? Shouldn't we get that information?

It'll be done before it impacts. The government says we must provide the test results within 30 days of them becoming available. I can confirm that with you, but that's pretty much what it is. Within 30 business days of the results being available, you'll have them and I'll have them done within 30 days of activity starting.

18. I thought you weren't fracking; you're not fracking down in the Surat Basin.

That's right, yes.

19. So why is it okay for here?

We've committed to not fracking in the Surat Gas Project area because we don't have to. We sit on a very high permeability fairway so it would be pointless for us to frac. In the Bowen Basin our tenement is nowhere near as permeable as it is in the Surat and so in the past we have done what we call surface to in-seam (SIS) drilling i.e. horizontal drilling. To overcome that really difficult permeability problem that we have in the Bowen Basin, we drill a vertical well and then drill another well from a distance away. We then drill horizontally in the [coal] seam for six or seven hundred metres and intersect our production [vertical] well. It's quite an expensive method of extracting gas, and once we start to get down below about 500 metres or so, it actually becomes an uneconomic way to extract gas. At some stage we need to come up with a way to look at how we can get that gas out, if not for us but coal miners as they will have to work out how to do it if they wish to go beyond that depth. As a consequence we have been looking at fracking and we are trialling it at this stage. Currently it's not a major part of our development plans, but it would be remiss of us not to have a look at what the benefits of this process could be and what economies it would add to the program.

Fracking has quite a dubious reputation; one that it doesn't particularly deserve. In our Bowen fracking programs we'll be using what we call 'micro-seismic' in the pilots. We will hang sensors down each of the surrounding wells and we will use the way that the waves and the fractures propagate through the coal seam to be able to prove where fractures begin and stop. As I said, fracking does have a bad name across the globe, but I don't think it is deserved. They've been fracking in Australia for the best part of 40 years out west in Roma and it's only been with coal seam gas and shale oil in America that it's really picked up the stigma that's attached with it today. We think it's a safe process and we have to prove that it is.

I think most of the concerns from fracking are more about the chemicals used, although we've got pretty high standards here in Australia. Most people have obviously heard of the film 'Gaslands' and the hype that caused in relation to the American shale oil industry and how that relates to Australia.

The fracking fluids in Australia are highly regulated. It is absolutely untrue that we're allowed to go around pumping what we want to pump down the hole whenever we want. It is not in any company's best interests to create an ecological disaster despite what you see in 'Gaslands'. The fluids we typically pump are 99.5% water, a small amount of vinegar, sand and what is called a biocide. The reason we use the biocide, much the same as any water well in the country, is because you don't need bacteria that lives down in the coal seams or the underground water eating your casing or your tubing strings, so you need to sterilise the well. Biocide sounds a bit like 'megadeath' or something like that but basically it is just a disinfectant, a sterilising agent, which is designed to go down, kill the bugs and then break down. The one that we use is THPS or tetrakis (hydroxymethyl) phosphonium sulfate which won the Environmental Protection Agency (EPA) award, in the United States for being an environmentally friendly sterilising agent for use in wells.

Where Australia differs is that we must give the landholder details of what will actually be going down the well before we undertake fracking, and afterwards we have to show what we pumped, how we pumped it, in what stages and what the results were. That's really quite different to some of the early days in the US where they weren't required to disclose much and things may not have been done the same way. The other thing you might see in 'Gaslands' is about people becoming unwell and having nosebleeds etc. You need to be aware of the quite different nature of the products that we're working with in Australia. In coal seam gas we're extracting better than 98% methane; sometimes there are very small amounts of hydrogen sulfide and sometimes very small amounts of carbon dioxide and nitrogen, but generally it's very pure and very clean.

That's because the coal in a lot of cases hasn't even gone into the gas window. The gas that is being produced from the coal is actually being made by bugs in the coal, they take carbon dioxide and the coal and they turn that into methane. It's quite a neat little reaction. At quite deep depths you can get the coal actually cooking itself to the point that it produces methane although that's generally not the case in our zone of interest. If it is the case, there might be 0.001% ethane, so two carbon chains rather than just one piece of carbon. We don't see any of the things that you would associate with oil.

The shale game takes place at two to 3,000 feet below the earth; it occurs in rocks that typically have an organic content of 2 to 5%, so very small amounts of organic content are caught up in those rocks. Where they are different is they've been taken not just into the oil window and through the gas window, they've gone generally well beyond so they've produced a number of products. Methane is a major proportion of it, but generally a lot of higher hydrocarbons like you would expect in crude oil. A number of those things that get produced are what we call condensates, they are very volatile organic substances and while there's a good market for them, they can escape into the environment. The two products are vastly different; methane is not toxic. You would suffocate if you were in a room completely full of it because we breathe oxygen but it would not do anything other than that, whereas a number of the other organic compounds can be quite problematic.

20. Suffocation was enough, thanks.

It isn't toxic *per se*. I've worked in underground mines for a number of years and you don't see those issues. They get fungal problems from working in the water and those sorts of things, but we don't see some of the issues that are being thrown out there by the movie 'Gaslands' or other people. We don't say there's no possibility of things like hydrogen sulphide being produced, but this is why we use the biocides down the hole.

Does that give you some idea and some reassurance?

21. Well, I don't approve of fracking.

Is that because you're concerned about chemicals?

22. No, the actual fracking just opens it up for a lot of other things and you can't replace water. You might say you're going to make good and fix it, but do you know how much water there is and how much water we need per week?

Do you mean in this area?

23. This is not just for now. This is for 50 years' time when our grandchildren are running the places. We rely on having this water and you could shut up shop, change your name and we're stuck.

Your unconfined aquifers at the surface where the majority of these things do go on are quite shallow. We actually start our work at about 200 metres and generally quite a bit deeper. There are a number of rocks that intervene between those two layers. To have a look at a fracking operation in the States for shale gas you might see 50-odd trucks there, a large number of them compressors and salt holders with all sorts of things going on. When we're fracking we only need three or four trucks, maybe two compressors, our sand mixer and someone to throw the fluid down the hole. We're fairly confident that the fractures stay where we say they are, based on the fact that the coal has a strength of about eight Megapascals (MPa), whereas the majority of the rocks in the coal measures start at about 20 pascals and work their way up from there, so there's a large difference in the strength of the rocks. We will be using micro-seismic to image the way that these fractures propagate through the coal so that we can prove to people what happens.

24. My concern is that I've got a sub-artesian bore and the water is at 320 metres, right in the middle of where you are.

That bore comes to within 30 metres, that's how much pressure is in it. I water my whole property with that bore and you're playing around in the same aquifer I'm in for my main water supply. That is my main concern. You haven't done enough drilling to know what water's in that land before you start fracking.

I can take that on board. I'm not aware of the exact details in this case but we can ask the geologists to look into what data we've got and how we based that decision to go ahead. Before we do any fracking we need to do a risk assessment based on how we're going to do the job and what the surrounding geology is. I can look into finding that assessment for you, to show you what was considered in designing that program. At this stage that's the best I can say with the data I've got so I'll chase that up.

[Follow-up with the landowner occurred the next day to confirm the distance of frac wells from his nearest wells and a copy of a map of the area was provided. Baseline bore assessments including sampling of water were completed on the two bores nearest the site and on the water in the frac dam. These reports and MSDS sheets for fracking fluids were hand-delivered to the stakeholder. Works have commenced on access roads and upgrades as agreed with the landowner.]

25. Everyone tells us there's no water when they test it.

Well, there are two flowing bores within five kilometres of each other and then we've got a couple of sub-artesian bores there. How can that be allowed when you haven't told the landowner what's going on? I thought you said that you told them and you keep them informed and it doesn't seem like it's happening.

You're telling us you're going to do this and that, but it never happens.

Unless I'm wrong I think the problem is there's nobody here who actually has the specifics in terms of your particular property and where it's happening. Can we undertake to dig up some of that information and then somebody can come back with an informed response because I think that's what you want.

26. What I was about to say was that he said they're going to come fracking in a couple of days. Well, that team probably won't get the notification. They'll come and be doing it before he's heard anything.

Well, it's a bit better organised than that. They can actually find that out.

27. Arrow knows internally, but we don't know as graziers.

Yes, and that's a failing on our behalf that you've been concerned about the process and we haven't explained what we know of the area. But we'll chase up what we know and provide it to you.

28. With the fracking, how far away do you have to be to let other people know?

I don't think there's anything in the legislation *per se* that says we have to tell the next door neighbour that we're fracking. Typically with such a program the fractures would propagate out 100 metres around each well. It would be good process for us to let neighbours know what we're doing in the area which is why we come out and consult. We have had these requests in other places, not just for fracking, but also putting down exploratory wells. So yes, we recognise there's a need to get out and consult.

Anybody that's within two kilometres of the well will be notified because we have to contact them in relation to existing water bores. If you're on an adjoining property and have a bore, you'd be contacted for sure.

29. But two kilometres isn't far enough because water's connected for kilometres underground.

Yes, but the fracking's only going 100 metres.

30. Yes, but if you're within 100 metres of that seam, but on my property, what's going to happen to us? That's my concern.

That's why we do the baseline monitoring of the bores to see if there is any effect on those bores.

31. I think the point about that was that it's done afterwards. He'd really like to know at the start of it.

It has to be done within 30 days of fracking; any impact in that 30 days would be negligible because it's a long-term effect. There's a legislative requirement to do a baseline assessment so you know the level and quality of the water at that point in time.

We also do what we call interference testing where we would typically drill one well in the middle of three or four and then we would see what drawdown, if any, adjacent wells had on the nearby wells. We do those studies to look into how fluids will be moving within the seam and that sort of thing.

We know that doesn't completely get rid of your concerns. We understand that and Arrow understands how absolutely essential the whole water issue is for any part of Queensland. Arrow will find out more details, and provide those to the landholder. What's important is that in the future if any landowners have concerns it's important to make contact with Arrow as soon as possible to give its staff an opportunity to come out and attempt to answer any questions specific to Arrow's operations on or near your property. *[Comment by Jan Taylor]*

Just on that again, Arrow has recently made some structural changes which will be implemented over the next couple of weeks from an access point of view in regards to people's properties and information. Because of the growth of the Bowen Basin activity I've got a team of land liaison people, ecologists and cultural heritage people all as part of my Access team. We've regionalised them to specific areas now. As the landowner would tell you, he's probably the person we deal with the most because he's got a fair bit of activity on his properties. He's been dealing with probably half a dozen different people in the land team over the last 12 months so he's probably asked the question and somebody's passed it onto someone else and maybe he has or hasn't got his answers, but he knows where he can ring to get his answers. We've now put our land liaison people into three regions so we've got a region that'll be working from Moranbah north and a group of three that'll be working from Moranbah down towards Dysart and then from Dysart down towards Blackwater. So each landowner will have a specific team of three people to work with, and if you can't get any of those three, you've all got my number so you just ring me and I'll get you the answer. *[Comment by Ross Graham]*

32. Ross, could I suggest that all landowners get emailed or notified of those people?
(this question was directed to Ross Graham, Arrow Energy's Northern Land Access Manager)

Yes, November 12 [2012] is the actual start date for formalising this structure so it's just a recent change. The company's gone through quite a significant amount of growth over the last 12 months and it's now aligned a lot of its business activities to the different departments. We're going through this process of change and we will make sure that the respective landowners are contacted to tell them who their direct point of contact will be.

The guys will be out over the next month or two to make sure that they at least touch base.

Moranbah

Date:	30 October 2012	
Venue:	Moranbah Community Centre	
Presenters:	Carey Bradford, Exploration Manager (South)	Arrow Energy
	Fergal Convery, Project Manager Bowen Gas Project EIS	Arrow Energy
	Kavita Prasad, Groundwater Modeller	Arrow Energy
Facilitator:	Jan Taylor, Principal	JTA Australia

1. What is the lifespan of the project?

The project life is expected to be approximately 40 years depending on all the factors involved. Santos drilled one of their first wells 24 years ago and they are still producing economically.

2. What's the compensation package for a landholder when you drill a well?

Arrow has a compensation package based on the value of the land and the amount of impact that it would have on the land and how long that impact would last. That's negotiated between us and the landholder. We do have a package and a method of calculating it out. It does depend on the number of roads; in Surat in particular a lot of our drill pads are basically straight off the main road. It's quite easy to come up with a compensation agreement but when we tie it all in with general grazing country for the drill pad itself you're looking at around \$3,000, but then the roads are a huge impact on that.

3. What about freehold and leasehold land?

No, because the impact on the landholder is the same. The visual amenity, the lights, noise and the impact on production for the year is exactly the same.

4. You spoke about these seven and a half thousand wellheads and pipelines. When will this stuff be going out to tender for people to show their interest in working with you?

We encourage people to start registering their interest now. There are a number of works that are going on right now, but we will make our final investment decision at the end of 2013 when we get serious about the longer term contracts and moving forward. But you can register your interest now; tell us what your services are right now on the website: http://www.arrowenergy.com.au/page/Careers/Suppliers/Register_Your_Interest/

5. It's a great thing that the Suttor Road is the only road that you're going to cause slight damage to. But if you travel along the Peak Downs Highway, into the township of Moranbah, you'd notice that that road is in dire need of repair. BMA probably contribute 60% of the wear on it, Anglo produces 20% of the wear and everybody else produces the rest. The problem for council is that while you meet your EIS requirements of being under 4% usage and there's technically no damage to the road, so there's no contribution; but at the end of the day there is a contribution to wear and tear because all that impact on that road is causing damage to it. Everybody has

to play a part; otherwise if you guys and Anglo and BMA etc. are supposedly not causing an impact what we'll have to do is just get the ratepayers of the community to pay for it.

I will try not to be too longwinded in the answer but it does take a bit of an explanation. The EIS essentially is an in-principle approval and there are ongoing detailed approvals after that which will come with specific locations. Typically what we'll see in 2014 and earlier in the piece, after we've hit the 'go' button on this project, is an environmental authority application for the first three to five years of development. Typically that will be three to five facilities or gas fields as well.

Further to that when it actually occurs we can provide details of the road traffic movements around that piece of the project. That's done through a safety mechanism for driving which we are very strict on with Arrow personnel and all their sub-contractors. Every vehicle has an in-vehicle monitoring system (IVMS) which is essentially a GPS tracker. The data can be downloaded from all vehicles to see where we've been and where the impacts are. We'll sum that up and provide that to council or Department of Transport and Main Roads (DTMR) to help fill whatever commercial arrangements are put in place over coming years to contribute to the upkeep of those roads.

6. It may not be related to the project, but domestic gas? Are you thinking about any other domestic supply or power generation locally?

We are focusing heavily on our LNG Project. It's a mega project and we are looking to spend up to \$3 billion per year. We are committed to meeting our current gas contracts which include supplying Dyno Nobel and Townsville from here and there are a number of power generation projects in the Surat. We will assess them based on their merit. I know there's been a lot in the newspapers about domestic gas reservations and what companies should do about it but the simple fact of the matter is that the price of gas has risen. The cost of production in the coal mines has risen; our costs for drilling have risen substantially so the cost of supply has risen.

I wouldn't believe all you see from a number of manufacturers. We are committed to supplying domestic gas. We don't have any plans for additions but obviously as the state grows that may become an attractive option to us in the future.

I'm the Operations Manager [*Greg Kulawski*] in the north running our domestic business up here around Moranbah. I'll just add a little detail – in addition to the Dyno Nobel plant which is here in town as you know, in total we produce around 50 terajoules (TJ) a day. Close to half of that will be going to Dyno Nobel as it is ramping up now to full production. We also have an ongoing supply to the Moranbah Power Station (run by AGL) in town which produces for local supply and into the grid which is a long-term-contact. So there is quite a bit of a gas one way or the other that actually stays in Moranbah, the rest goes north to Townsville Power Station.

7. I don't actually see much of Arrow on the back of the sporting kids around Moranbah. Do you sponsor the local soccer, netball or football clubs? What is it that Arrow is doing in Moranbah, especially for the juniors, don't worry about the seniors?

Arrow is committed to investing in the community. We have a Brighter Futures community investment program, which is available for community groups to apply for funding three times each year. Some of the sporting groups or community groups that we've provided funding to this year include the Moranbah Neighbourhood Centre and Simply Sunshine. There was a self-sustaining garden that was funded just recently. We also funded a capacity building project at the Middlemount Sports Association where the community members could complete a lifeguard course or an AustSwim course.

In addition the 'Youth Making a Change' initiative was where young people from across the Bowen Basin came together and worked with a facilitator to talk about changes they'd like to make in their community and develop a plan for the future. The Dysart State School Parents and Citizens Association and a school science project at the school is another example. There are plenty of examples where Brighter Futures funding has been provided for initiatives for young people.

8. Arrow Energy is down in the Surat Basin, have there been any studies on bores in relation to whether you have affected the Artesian Basin in any way?

With the amount of irrigation that goes on in the Surat, the areas around Dalby through to Chinchilla and south through to Cecil Plains are very high value, highly productive agricultural land which largely relies on the Condamine Alluvium aquifer for water supply. Over the last 50 years it's been quite heavily over-allocated to the farmers in the area and we've noticed substantial drops in the quantity of that water. The Great Artesian Basin is an absolutely vast water resource estimated to be 25 million gigalitres which is a massive amount of water.

Recently the Queensland Water Commission (QWC) has looked at the cumulative impacts of all four major projects going ahead together at the same time i.e. the volumes of water that would be extracted out of the Surat Basin, at that time, and what the impacts would be on the surrounding aquifers. To give you some idea of the impacts we are talking about, out of 21,000 water bores across the Surat Basin, QWC believe 500 bores would be impacted beyond the make good trigger level (our slightly more conservative water modelling suggests 750 affected bores), which include a two metre drop in a surface aquifer and a five metre drop in head in a confined aquifer; we would be required to make good on those.

The modelling shows that the impacts are quite manageable. The extraction by agricultural producers is in an order similar to all four proponents together. One of the things that we would look at doing to mitigate those impacts is re-injection into a lower aquifer; if we reduce the pressure in coal seams there's a buffering effect so the nearest aquifers would lose the most amount of head leaking in or down into the coal measures and so on until you get to the surface aquifer which would have a much smaller effect.

By injecting into those lower aquifers you would mitigate that effect to some degree but our real preferred solution in the Surat is what we call a virtual re-injection or substitution of allocations. We would take the brackish water from the coal measures and put it through a reverse osmosis (RO) plant. We would go to the landholder, block their bore and provide them with our treated water. When water comes out of the RO plant it is not suitable for agriculture at that time, but we would amend it with calcium to bring all the sodium absorption ratios into specification and then we would hand that off.

At our farm outside Dalby at Theten we have an irrigation trial with centre pivots and we are using our treated RO water to grow chick peas and things like that.

9. But there's a small impact?

Yes there will be some impact and that's where we would look to manage that water balance.

The other thing that the Queensland Water Commission (QWC) has put upon us is to put in a number of water monitoring bores across the Surat Basin; some into the deeper aquifers which are quite important further west, some into the shallow aquifers, some into the coal measures. Arrow's water modelling team then models those impacts.

10. How far west?

We haven't put them far, far west as Santos is out that way. The government has recently gone through a number of capping exercises to cap all the water that's actually being lost out of the Artesian Basin. That will help to some extent as water evaporation in bore drains is similar to the extraction of the four proponents. We will put a number of monitoring bores throughout and monitor the reservoir pressures and effects.

We have a number of those bores now and have a work plan over the next couple of years to continue putting those bores in.

11. So the bores you have put in the west, how are they going with their tests?

You don't see a lot happen straight away with this sort of extraction. We only have a smallish field development compared to what the major field development will look like. The extractions that we do at the moment are very different to what agriculture is pulling out, they're much smaller. We are not seeing our activities having any impacts yet but when all four proponents are drilling up to 30,000 - 40,000 wells that is when we will see those interlinking fields start to have an effect.

We will model those effects and measure them in the water bores and then watch what happens. If things aren't going the way we've modelled them, then we need to go and investigate. The easiest way would be to shut in wells, watch how our water heads come back and move through it like that.

12. We are just a bit concerned about that sort of stuff, especially in the Artesian Basin.

And that is why we spend a lot of time, effort and money on bringing the science to the table.

13. With this agricultural thing, there is talk about bores being affected. I've done some work out Chinchilla way and one gas company, I'm not sure which one it was exactly, has actually gone to the extent (and cost) of treating that water and pouring it back into the creeks at Chinchilla which then goes to the weir. Now the town has water all year round that they never used to have. Farmers have gallons of water to use that they never used to have.

These are all an upside to the gas industry. Although they might be saying they're affecting a well here or there, by the same token they're putting that water back into a

creek for the farmers and the community to use. We have got to look at the positive side not always the negative one.

My family's from Chinchilla and I worked at Arrow and drilled a lot of the early gas wells out in the Dalby area. It was at the height of the drought and it was apparent to me at that time that water would be just as important to our industry as gas was. At the time Chinchilla was a dying town with probably half the shops in the main street closed. Now it's quite a vibrant town with lots of things happening.

But we do need to address these concerns; people have a right to know what the impact will be on their livelihood, how we can co-exist together and what the long term effects of the industry are.

I believe there are a lot of positives to it, not the least being that it's quite a clean source of energy. We're taking a water resource that is too salty to be used in most cases and turning it into a useable product. There will be some impact, and it's modelling that impact and working out what it's going to be and putting it forward so that people can understand how it works, that is the important thing.

14. You were talking about taking the water coming out of the bore, putting it into a filtering system to clean and then putting back in the system. Are you going to do that here in Moranbah?

Yes, the Queensland Government has said the old method of just letting it evaporate and concentrate in a dam is not acceptable, so we have just implemented our first RO plant out on the Moranbah Gas Project. The gas project will have a number of facilities both for compression and water treatment and some of them will be large centralised facilities doing both compression and water treatment. They will have reverse osmosis plants installed and we would then look at beneficial use off-take agreements with various people.

It's a lot easier for us in the Surat as there is a large number of irrigation allocations already in place. It isn't so much the case in the Bowen but there is definitely a large demand for industrial and town water and otherwise.

Just to add to what Carey said, we have a reverse osmosis plant up and running in Moranbah now. It's treating the water we produce and we are discussing beneficial use with a number of parties including some exploratory discussion with the council, which will continue. If we have a chance to supply water to the council we would be very happy to do so. *(Comment by Greg Kulawski)*

Blackwater

Date:	31 October 2012	
Venue:	Blackwater Civic Centre	
Presenters:	Carey Bradford, Exploration Manager (South)	Arrow Energy
	Fergal Convery, Project Manager Bowen Gas Project EIS	Arrow Energy
	Kavita Prasad, Groundwater Modeller	Arrow Energy
Facilitator:	Jan Taylor, Principal	JTA Australia

1. Whereabouts are the locations of the production facilities? Are there any around Blackwater?

Currently there aren't. We've commenced operations in the Moranbah area and also in the Surat Basin around Dalby. In terms of the current reference case and development sequence in the EIS for Blackwater, we'd be looking at 2033 for a major facility being built here. However, that is an indication only at the moment. Based on proving up reserves across the basin the development sequence can change and there will be progressive updates on that.

I am responsible for the Bowen Gas Project during its concept-select phase and that's where we are now. Fergal referred to the major production facility; we call it either the integrated processing facility (which assumes we process both the gas and the water) or the central gas processing facility. There are also other production facilities so we have low pressure gathering lines that take the gas from the well to a compression station where all we do is raise the pressure of the gas to then be able to export it further on.

If you look at the overview of the tenement areas, Blackwater is in a tenement so there is an expectation it will have some wells. There'll also be some gathering infrastructure and some type of production facilities but there's some variability about what those would be.

(Comment by Katie Whittle)

2. The presentation tonight was quite general; can someone give more detail on the anticipated impacts of your project on the Blackwater community?

There was one slide there which really just dealt with the cumulative impacts; it looked at all the projects and how they're all rolled up together and what it may mean. The detail will come through in the Environmental Impact Statement (EIS). I can't really talk to the specifics on it at this stage, but when the EIS comes out the Social Impact Management Plan, otherwise known as the SIMP, should illustrate to you what we expect in terms of impacts, what mitigations and commitments we will make to control those, both from implementation of our own project and cumulative impacts.

For example we identify the need to work with Emergency Services to assist with early planning and to help them resource up as required. Emergency Services will be advised wherever we're going to be, and when we're going to be there. That is just an example so

there are lots of management plans being built around what we've identified in the social impact assessment.

3. When is the SIMP due?

The SIMP is coming out as part of the EIS, so you should see that in late January.

4. It was pleasing to hear your guidelines about collaborating with landowners. What's the general response been from property owners so far? I mean, you seem to come across as though you are really trying hard to do the right thing. Have you had a positive response? Unfortunately we hear so much negativity. What's the general response been to date from landholders?

I think it's generally quite good but it does vary. There are some people who are fundamentally opposed to what we do. They just don't like the idea of it, they've been told that it's a terrible thing; it will pollute the water, that sort of thing. So the onus has been on us to prove the science. The industry has been somewhat on the back foot in trying to play catch-up and get the science out there. The industry has also grown very quickly in Queensland. As I said, Arrow started off with about 10 people, very limited cash flow and minimal ability to do what it needed to prove to the market that it had a viable proposition. All of those things have added up to where we were a couple of years ago.

As we became a bigger company, we had more of a focus on compliance and building relationships and doing things exactly the way they should be done and where we want to be, which is something different again. When we do surveys now throughout Queensland, we notice that the number of people supporting coal seam gas is increasing dramatically. As we get the science out our job will become easier and easier. The way we have typically worked in the past is that we will go into an area and generally find someone who's willing to work with us. By doing what we say we'll do and acting with integrity word generally gets out among the neighbours quite quickly and we build upon that. It's generally been quite positive but it's been a long journey for us too.

5. With the Bowen and Surat Basins, is the EIS at the same stage for the Bowen Basin as it is for the Surat Basin? If a business decision is made for the Bowen Basin here, how soon do you envisage starting work on the pipeline and other infrastructure?

The final investment decision (FID) is planned for the end of next year [2013] for the whole project. That's everything, the LNG facility, both pipelines and both upstream fields in the Surat and Bowen Basins. In terms of its EIS and project development, the planning and design stages for the Surat are a little bit more progressed. It's probably in the order of four months ahead of the Bowen, but the Bowen has been steadily catching up with it, so we plan that both will be at the same level of maturity, from an EIS point of view, at the end of next year before we make a final decision on the project.

6. Will they pit one against the other?

No, it's a balance as we need both fields.

7. Has Arrow got an efficient way of treating waste water ,instead of just putting it in a pond and letting it evaporate, that's actually working at the moment?

Evaporation ponds are not allowed by government at all anymore. I worked on a lot of Arrow's very early exploration wells and at that time, nearly 10 years ago, it was one of the worst droughts Queensland had seen. It became very apparent that the water would be just as important as the gas; that has come to the forefront particularly in the last few years when we talk about the four major projects all happening at once and the volumes of water that we will produce.

Arrow has a reverse osmosis (RO) plant outside Dalby. RO is a method of pushing water through a membrane and extracting the salts. Arrow also has an RO plant in Moranbah. When we go to full field production we will also have a number of facilities that are quite centralised to process the water. The water which actually comes out of the RO plant is a little bit too clean so things like sodium aren't in the right proportion to other elements that are in there. We amend the water by adding calcium and other elements into it to adjust that ratio.

We need to work out what we can do with that water. Our plan is to enter into a beneficial use agreement. One of our preferred methods is a substitution of allocations so where irrigators currently have an allocation, we will give them our produced water that's been treated and they can use that for irrigation. Currently we're trialling irrigation on our farm at Dalby [*Theten*], using the amended water. Other options would be town supply or re-injection into other aquifers to mitigate effects on ground water.

When we reduce the head in the coal seams we may see a reduction in head in other aquifers but by injecting either below or above the coal seams we can mitigate that to some extent, or there are industrial uses as well. There's quite hefty legislation around beneficial uses [*of water*] but our preference is to try to keep that net water balance in check.

- 8. My husband's one of the biggest sceptics, but tonight's been quite refreshing. Is there a website or place that I can go to when someone brings up an argument, so that I can refer that person to it in order to dispel myths or clarify or confirm their comment? You've got very good technical data here tonight but it's over my head. You said your compliance is very good and I believe you, but give me somewhere where I can get the facts with core, gutsy arguments.**

There is Arrow's website at: www.arrowenergy.com.au. We also have all the publications and banners you see here. There is also an industry body called APPEA, its website is www.appea.com.au/coal-seam-gas.html. APPEA presents the industry view of things but probably the better one to go to is the old DERM website. The department has been renamed Environment and Heritage Protection (www.ehp.qld.gov.au/management/coal-seam-gas/index.html). There are a number of videos there by Andrew Brier who was working for the regulator; he then worked for Santos but is now working for the GasFields Commission. His view comes from a different angle; it's a scientific view from an engineer's perspective on what coal seam gas is; what the potential risks are and what mitigations we have in place to address those risks. From your point-of-view I would suggest the government site would probably be the best.

- 9. What is the biggest hurdle facing you when you come to a township like this and you talk to the local people?**

In all honesty, we never know what we're going to get, some nights we get a lot of technical questions, some nights it's a lot about supply. The social impacts always come to the forefront. Communities want to know a number of different things depending on what their focus is. Some nights we get mainly graziers who are concerned about ground water, some nights we get a lot of people from council who want to know what the potential impacts are and how we're going to mitigate them.

One of the tough things is knowing who to bring. Funnily enough at a number of the consultations in the past we've had a lot of questions about pipelines, and no one bar Fergal, who has a rudimentary knowledge of pipelines, was here to answer the questions. This time we brought along one of our pipeline experts and he didn't get one question all week.

I think we're fairly open and honest in wanting to communicate. In the past, industry could be accused of not having done enough, nor done it very well, so we're trying to make up for lost ground. Trying to anticipate what the questions will be and who to bring can be tough sometimes. It's good if we've got a small group of people who know what the majority of the project is about; as well we always try to get back to people if we can't answer their question on the night.

10. This is for the pipeline man. My understanding is that there are three other players in the Surat Basin, there are four altogether, so that means there'll be at least three pipelines built from Roma to Gladstone. Are there any other players in the Bowen Basin or is it just Arrow that's in the Bowen Basin? I know it's been huge task to bring the pipelines through from Surat at this stage.

There are a number of players in the Bowen Basin although not many, other than the four major proponents, would have the critical mass to do very much. The other point is that the Bowen Basin as we know it is quite a long basin. For other players like Santos and Origin who classify some of their tenure as Bowen Basin; it's actually at the very southern end so they would connect with the Surat pipeline. There would be the possibility of another pipeline from the Moura area straight through as well. There's probably enough gas around there to fuel a small power station and there's been a little bit of movement on that front recently.

I find it very hard to see that anyone else would have enough gas to start talking about it, although I could be wrong. We tend to hold about 75% of the best part of the basin, so we've been quite lucky in the Bowen to pick up such a commanding tenure.