

Bowen and Hillsborough Basins

Community information sessions 10-13 October 2011

Introduction

In October 2011 Arrow Energy held a series of community information sessions to discuss its coal seam gas exploration program in the Bowen and Hillsborough Basins.

Questions and answers were captured by JTA Australia and are presented in this document. Questions varied across the five sessions; to ensure that valuable information is shared throughout the communities, these notes summarise the discussions across all sessions. The notes are based on written records and include paraphrasing.

The information sessions were held from 10 to 13 October 2011 at:

- Proserpine, 10 October 2011
- Glenden, 11 October 2011
- Dysart, 12 October 2011
- Middlemount, 12 October 2011
- Moranbah, 13 October 2011

Arrow is now seeking to develop opportunities for the supply of gas to new domestic and export markets, including a proposed LNG development at Curtis Island near Gladstone. As part of this work, Arrow will expand the scale and extent of exploration works throughout the northern Bowen Basin (between Glenden in the north, Blackwater in the south and east to Duaringa), as well as to the Hillsborough Basin in the Proserpine area, and the Styx and Capricorn Basins in the Marlborough-St Lawrence area.

How to read these notes

Questions and comments from the audience are in bold type. The unbolded responses are from Arrow staff.

In some cases responses have been summarised. Where one response to a commonly-asked question was more comprehensive at one session than another, the more detailed response has been used in the interests of better understanding. In some cases, additional information is included to provide further context or explanation; this information is in brackets within the text, or 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:

Freecall: 1800 038 856

Email: info@arrowenergy.com.au

Post: Reply Paid 81 Hamilton QLD 4007

Acronyms

ATP	Authority to prospect
BTEX	benzene, toluene, ethylbenzene, and xylene
CSG	coal seam gas
CNPC	China National Petroleum Corporation
DEEDI	Department of Employment, Economic Development and Innovation
DERM	Department of Environment and Resource Management
EA	environmental authority
EIS	environmental impact statement
EDO	Environmental Defenders Organisation
FID	final investment decision
LNG	liquefied natural gas
MPa	Mega Pascals
PL	petroleum lease
RPM	revolutions per minute
QGC	Queensland Gas Company
QWC	Queensland Water Commission
RO	reverse osmosis
SIS	surface to in-seam (drilling)

Conversions

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

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*

PROSERPINE

Date:	10 October 2011	
Venue:	Proserpine Entertainment Centre	
Facilitator:	Jan Taylor, Principal	JTA Australia
Presenters:	Tony Knight, Vice President Exploration	Arrow Energy
	Carolyn Collins, General Manager, Environment and Water	Arrow Energy

- 1. You claim the data proves this is a completely safe process, how long have you been collecting this data? Who have you been collecting it from? Who is the authority that signs off on it? Where is all this science and what will the impacts be? It seems that it will take twenty years before you actually know your impacts? You tell us that you've been doing this for seven years – come back in thirteen.**

When you say the data, we get all sorts of data from the things that we do. You are probably talking about environmental and groundwater issues. Exploration is one of the primary data sources – testing, logging and measuring what's below the ground. This enables us to see where the aquifers are and what their character is. There is also a lot of information available from other companies to give a broad picture.

We have a vast array of water bores that have been drilled across the whole state. There are also measurements we can take from the surface, remotely – i.e. photos etc.

- 2. How often do you collect it? Who signs off on this stuff?**

There are different sorts of data, so when you drill a well for example, then you can say that an aquifer is at this depth, then you have that data point pinned down.

- 3. When you interfere with an aquifer, then what happens? Where's your data on that?**

We don't claim to know everything. We take available information to build models that collate all the information that we have. We can then predict what will happen – that is our starting point. We monitor it over time; if our predictions are as we thought they should be, then we know what's happening. If they deviate from our predictions, then either we need to modify our program, our activities or update the model. It is an ongoing process.

- 4. In the meantime you are experimenting with us.**

We use science and fact to develop an understanding of what we're doing. We monitor that over time and change our behaviours based on the results of monitoring.

- 5. We are very concerned regarding coal and coal seam gas mining exploration in the area. This region has had very little modelling of aquifers on either a regional or local scale. I have a few questions, firstly the salt issue. There will be millions of tonnes of salt produced by your industry. No one has yet said how they'll deal with the salt – they say they'll find a way, but it's all ideas, no definite plans.**

I think what you're talking about is the very large scale CSG-LNG developments – such as in the Surat Basin. This area does not suit that sort of development. This basin is quite different;

it's just not the same sort of geology. That also applies to other areas where we're exploring as well. I take your point however about the broader development in the Surat.

In terms of the salt, we're not waiting for new technology – it's there already. We actually don't have a significant quantity of salt when you're talking about the salt processing industry. We're in the situation now that we have a quantity of salt that might be produced from our projects in the Surat basin but none of those projects have actually commenced in any serious way. We're working together with the other major CSG companies to ensure that the salt issue is something that we can solve together, because we will need the quantities from all four companies to be able to make it happen. What we don't have at this point in time is a known quantity of salt so that we can actually enter into contracts with any company who will take that salt. There is a huge amount of salt imported into Australia currently so there is a market here in Australia for it. In the interim, we will manage it responsibly.

- 6. I know that you are here today to speak on behalf of Arrow but as a community we feel the need to focus on the cumulative effects of what is happening in Queensland on an economic scale - jobs and investment, and also on the environmental and social side of things. There are threats to our food, water and energy security; it's not coal vs gas, but gas vs renewables displacing the uptake of those. With the cumulative effects of the unprecedented boom of this industry in mind how do you compensate for the loss of an aquifer? How much do you pay per well to landholders, and how much money does the company make from each well? And quickly, you said that benzene is trivial - why?**

I'll take the last question first i.e. benzene. Where benzene has been detected in samples it has been amounts of approximately two parts per billion – that's what I meant by trivial. I am not saying that benzene is a trivial substance – clearly it's not. What I do say is that our investigations, which were monitored and observed by government officials, pointed to the fact that the source of that benzene was some lubricants that we used. Now that we know where it came from we can eliminate the use of any substance containing it.

In terms of compensation clearly we are a commercial company and work in commercial terms all the time. In a recent Senate Inquiry a senator had some formula where she said that we return 0.00007% of the value of the well. I think that she assumed that every well earns \$10 million per year of its life. This is completely untrue. What we do with compensation is reflect how the land is used – there are different aspects to it, whether it's grazing country vs forest country vs crop country. We look at the size of our footprint both geographically and in time - so whether we're there for one month or one year. Then there's the issue of added value: does it make it more attractive to landholders to have a well in their field, that's what we're trying to understand, what that added value will look like. It will be different for different people and will depend upon a whole host of things which I can't exactly quantify here and now.

- 7. I've heard figures of \$250 to \$2,000 per well, and some wells do earn millions of dollars. If one of those figures is in the ballpark, do you think such a discrepancy is fair?**

People don't often relate the value of the product they use to the compensation they pay. For example, a software company produces a program; they will sell that program for the best value they can get around the world. It might cost that company \$10,000 to produce that

software, but they might make \$10 billion dollars out of that. It's the same for us; we try to pay what is right, what is due to the landholder for the use of the land, as opposed to looking at the value of the gas. It's not an equation that is very easy to measure. The Australian gas market pays very low prices. Worldwide, energy is a huge market.

8. And loss of productivity, contamination of water or exploding wells which you've had recently – is that not something we should be concerned about?

The well blow-out issue was a safety incident which we can address and learn from. We have explained that in some detail in the media. It is an issue that was resolved and was related to the type of well that was drilled. The new wells we drill are designed differently to control that risk.

Clearly it is not our intention to contaminate aquifers. We do not believe that we contaminate an aquifer simply by drilling through it. The practices we use do not introduce contaminants. We isolate the well from aquifers so that connection is not established. Coal seam gas extraction works by taking water from coal seams. Taking that water out allows the gas to flow. Clearly we will have an impact on those coal seams or any adjacent aquifers by taking the water out; however that is not to say that we reduce that water to zero, we simply change the pressure. We don't reduce someone's supply of water overnight. That is why monitoring is so important.

The rate of change to the water drop in pressure is very important. Whether it impairs the capacity of the landowner to access water from that bore depends on the construction details of that bore – the depth of the bore, the size of the pump and so on. There's a process that we have to go through to assess all bores in the vicinity of our operations immediately before we commence production in that area. Part of that process will assess whether or not we are likely to impact that bore. And where we are, we are obligated to provide the same or better water quality source to that landholder. What the guys spoke about earlier, about our strategy to manage water resources in the basin is about substitution of those allocations. So where someone is already using groundwater in an area that has an allocation our intention is to treat the water to a standard that is as good or better and replace that water supply, thereby preserving that resource and replacing it with water that may not previously have been usable for that same purpose.

9. The Great Barrier Reef Marine Park has identified in the last couple of years some areas east of the Don River where groundwater comes up and flows into the marine park – has there been any monitoring or studies to determine where that water comes from and how it might impact the marine park if any contaminants enter into the marine park?

If that's an issue of concern it would be captured by our EIS process if we were to develop in that area.

10. You say you're obligated to tell the landowner if you've affected the bore and that you'll then replace the water. How will this water be replaced? Are you just going to arrive with a tanker of treated water?

It will depend on the actual circumstances. It will depend on the location; for example it might be right beside where we are treating water, so we can pipe that water straight to it. It might

be that there is a town supply which we could add to as part of a tanker or water cartage process. In some situations it might actually be deepening a bore and providing the landowner with a temporary supply in that fashion. Or it may just be compensatory. We aim to work with landholders now. As Simon said we're doing baseline assessments before we start producing. The requirement we have under the legislation is to enter 'make good' agreements with those people who may potentially be affected by our activities within a three year period. That agreement will identify potential solutions or potential make good steps that we will take; it's agreed one-on-one with the landowner and that could include a range of potential solutions depending on what is actually found. That doesn't mean they will necessarily be impacted, but we will have agreed what will be done if they are.

11. I note on your exploration map part of the area goes into Repos Bay. Are we likely to see a gas exploration platform in Repos Bay?

No, the reason the map goes offshore is simply the way the government issues tenements, which is in what's called a graticular block which is minimum latitude by minimum longitude. It's just a grid across the state. We don't have rights to go offshore.

12. How long until the Arrow LNG facility in Gladstone reaches capacity, once you start production?

If we take the decision to go ahead with the project in 2013, it takes three and a half years to build the plant, so that's 2016. In the meantime we will have to be drilling wells to build up the gas supply to supply that plant. The plants can be run at different levels so we start at 20% capacity, 40%, 60% 80% and then to full capacity.

13. The reason I ask that question is that I note that the multi-cargo facility at the Abbot Point terminal has made an allowance there for an LNG facility. I was wondering whether Arrow has any interest there.

No, absolutely none. There are other companies in the Gallilee Basin, but we're not part of any developments up there.

14. Tony, in your presentation you said that you have three exploratory wells already drilled here, and that you might do another couple in the next twelve months. How likely is it that you will go ahead into production?

Exploration is a risky business in that before you do the exploration you don't know what result you're going to get – it may or may not be there.

15. Do the three wells look promising?

No, not great – there's coal there and gas, but not stellar amounts of either. What's interesting from our point of view is that there are other formations here below the ground (but not coal) that might be suitable as gas reservoirs too, that we might look at in the future. At this stage we just don't know in terms of this region – all we have are essentially a few pin pricks in the ground, which are not enough to tell us much yet. I should add we have no right to mine oil shale or any interest in mining oil shale.

16. I know that in America a lot of natural gas comes from oil shale.

A shale deposit is quite different to oil shale. In the US there is a large shale gas industry. The US has gone from being a net gas importer to being a gas exporter. But in Australia there hasn't been much success at all in getting gas from shale, it's a different geology here.

17. **I'm glad you haven't made a big pitch about CSG being a greener source of energy as I think that has been pretty well disproved. A Cornell University assessment in 2010 concluded *CSG may contribute significantly to greenhouse gas emissions and so should not be considered as a cleaner alternative to coal and oil.***

Clearly the exploratory well process is very different from production. I think that the concern of the general public is generally about production. Once the easily available CSG has been extracted, the need for fracking the seams will become more attractive and that involves other problems. Fracking in the UK was stopped because of earthquake issues, and this may become a more obvious problem here with time. Re contamination of aquifers below the seams being affected, the well pipe may protect water supplies above, but no one can know what will happen after fracking if pollutants migrate downward and find water.

While companies promote good practices with their containment ponds, and may find some market for the accumulated salt, without expensive and power hungry reverse osmosis the spoils ponds pose a real threat to the surface water supplies, especially in times of flooding.

Because of the lack of any statewide approach, with each exploration/extraction lease being dealt with on a project by project basis the overall impact and consequences of so many new wells could be missed until it is too late.

You are expressing a broader concern beyond this exploration project by looking at the cumulative impacts of all projects. Clearly the government is very aware of the cumulative impacts and these are taken into account in our EIS. I understand what you are saying in terms of a lack of a coordinated strategy; however we are not government, we just play by the rules it makes.

While we are trialling fracking in the Bowen Basin as an alternative process it's not our preferred production method in that basin. In fact we don't produce any gas from fraced wells. There are horizontal wells we drill that are not fraced; it remains to be seen whether fracking will be appropriate. Where we do have fracking trials going on we're only using chemicals which break down in sunlight when pumped back to surface. We're confident that we're not going to cause devastation like that shown in the *Gaslands* film. That may be the case in the US, but it's certainly not the case here.

18. **The National Industrial Chemical Notification and Assessment Scheme, which I'm sure you're aware of, claims to have only looked at two out of the twenty-three chemicals being used in fracking.**

We only use two chemicals – pool chlorine and acid which are very common products. I can't speak about what other companies are using.

- 19. We've seen media coverage in the past where companies similar to yours or maybe even yours have gone into areas where the development is opposed by the landowner and by the community. What gives you the right to trespass on these properties to establish a mining presence there without the consent of the owner with very little or no compensation?**

Quite simply, we can't. We do not have the right to trespass on land. The right to explore an area is via the state government's legal right to access minerals below ground. We have to obtain consent by way of an access and compensation agreement with the landowner. There are a number of steps that we have to go through. We don't have a right to just go ahead; we must comply with a framework of rules.

Also, if you think about it, it's not good for business. Why would you choose, with the twenty year life of a gas well, to force your way onto a property...what happens in the next twenty years if Arrow begins its relationship with the landowner that way.

- 20. So are you saying that if the landowner does not agree, you won't establish a mining presence on his land?**

No, the rights to minerals reside with the state and only it can determine who has access to those minerals. We have the rights to explore an area, and there are legal mechanisms whereby we could go through the Land Court process to gain access to a property. However, that is not Arrow's approach; we prefer to be on good terms with landowners. Not everyone we go to is opposed to CSG. So yes, we have a legal right to go to the Land Court to access land, but the question remains whether we choose to do that. As a matter of policy we prefer not to, but it is a reserve right that we have even though our policy is to negotiate.

- 21. As a kid I can remember before the dam was built here that the aquifer went to low levels during drought and then it was replenished. The levels we see now are probably some of the highest ever. What concerns us as growers is that there's only a certain amount of water. We have allocations of water to which we must adhere. Each bore is licensed, metered and monitored. I'm not anti-CSG in any way – I just want to see that it is done properly in an environmentally-conscious fashion. There is only so much water to be got from under the ground. Some farms only get water from underground; they do not have dam allocations. Some irrigation bores have been drilled in excess of 40 years; we do not want to see them destroyed.**

What we do is to try to ensure that the way we go about our processes safeguards those shallow aquifers. I say shallow in the sense that typically water bores take water from down to about 100m, not many go deeper than that. CSG usually doesn't occur any shallower than 150 metres below ground. Our wells in the Bowen basin are at 600m. Your shallow aquifers down to 100m are getting recharges during flood events and that sort of thing, that's why they are sustainable over time. The water we're taking is from coal seams which are far deeper. There is a lot of separation between them. The separation is critical as the layers of rock between these levels and the coal seams are impermeable; the water cannot migrate within a short timeframe from the shallow aquifers down to the coal seam. It can happen over long periods – and that's why we monitor.

- 22. The Lock the Gate movement is a coalition of over 10,000 landowners nationwide who are engaged in grassroots campaigns against resource companies coming onto their**

land. During the last sitting of the Australian Parliament the Green Senator for Queensland introduced a bill to allow landholders to say ‘no’ but we’ve seen the LNP and ALP vote that down. What we hear is that Arrow and other CSG companies have such good practices that negotiation is available but the major parties are not giving that ultimate veto right to the landholder.

Do you think it’s right for landholders to invite someone onto their land of their own free will and then for that person to be arrested merely for sitting on the ground when a pipeline’s coming through? How can that be a good relationship?

That’s a fair question. I think you are talking about QGC’s pipeline which has done that. It is not Arrow, we would not seek to get people arrested – that’s not the way we want to do business. We want to set up the right relationship from the start. We applaud the people of Proserpine who have attended today to ask us questions and hear us out.

- 23. If you’re going to go through an expensive court process the odds are stacked against landholders when going up against a company backed by international companies worth many billions of dollars.**

Look, no one wants to go to court. We don’t choose to go to court in any situation. Going to court is simply not good for business; we don’t want to go hard on a landowner, that’s simply not good for our reputation.

We have been in the Surat Basin for many years and there is one particular family which does not want to have anyone on its land. The process of talking to them, persuading them, convincing them has been a really long process and there has been no talk of court as part of that.

You talked about how expensive the legal process can be. The Environmental Defenders Organisation (EDO) has been fairly active in that regard so there are avenues to use.

Comment - there are two EDO groups in Queensland but they have very little funding from the Queensland Government.

- 24. I would like a clarification on the fracking issue – it is not used in the Surat basin but may be in the Bowen Basin?**

Arrow’s tenure in Surat occupies the shallower area, the edge so to speak. In that area the permeability of coals is very high so the ability of the gas and water to move through the coal is very high. The whole idea of fracking is to artificially enhance permeability. We have naturally high permeability, so we do not need to frac. As you go further into the basin that permeability decreases so other companies like QGC, Origin and Santos may have to frac.

I mentioned earlier that we drill horizontal wells in the Bowen Basin. We drill a horizontal well which intersects the vertical well. That combination works pretty well and that’s what we’ve been doing up to now to produce our gas. The Bowen Basin has different coal measure formations – some of those the horizontal drilling doesn’t really suit because the coal seams are so thick. That’s why we are trialling fracking.

- 25. And what technique are you looking at in the Hillsborough Basin?**

We don't know yet, that's why the exploration is important. The work we're doing now is working out if there is coal and does it contain gas? One of the key things we need to measure, which we haven't done yet, is permeability. That will tell us what the most appropriate well technique is. We would not be fracking during this exploration process.

- 26. So you say that you are obligated to farmers if something happens to their water. I gather you won't be going to the farmer and saying 'We've upset your water' it will be farmers coming to you, whether it is salinity in their water or a disturbance in their aquifer. How long will it take you to compensate that farmer? What is in place for you to determine whose fault it was? Will the farmer have to take you to court you to make you do anything? Who makes those decisions?**

Basically we have an ongoing monitoring program as an early detection system. It's not as though impacts are going to occur immediately. Over time we are going to be monitoring bores in and around the areas that we are operating in so that we understand the trends that are happening there, both in terms of water level and quality over all the aquifers – not just those that we are operating in. There is a continuing responsibility that goes on forever, in terms of liability for water impacts. The regulating entity is DERM. Petroleum companies are the ones responsible for any impaired capacity of your bore until we can demonstrate otherwise. The Queensland Water Commission also does a cumulative study and modelling. It will be designating those tenure holders who will be responsible in particular cumulative management areas. The bottom line is that DERM is the regulator; QWC has independent experts that it uses for advice, and we feed into that process as well as through our ongoing monitoring.

- 27. Do you have an interest in underground mining? If you struck a substantial deposit of coal, dug it out, and then coal leaks into an aquifer...that must affect it, surely?**

In Queensland, gas activities (including CSG) are administered by the *Petroleum and Gas (Production and Safety) Act 2004*. The *Mineral Resources Act* covers coal mining. What we have here is an exploration right under the *Petroleum and Gas Act*, it doesn't let us even think about coal mining, all we can do is produce gas. So coal mining is not on the agenda at all for Arrow.

- 28. But if you take water and gas out, will that area be replaced by water from the aquifer above?**

There seem to be two parts to your question – one is, by taking water out will that lead to subsidence? The answer is that that is something we are looking at in modelling, however we predict that the answer will be no. The amount of water in a coal seam is quite small; 2% of the volume of the coal seam is water and the gas is absorbed into the coal. When we drain water out the coal is still there holding in place the overlying aquifers.

In terms of will that water we take out be replaced? The important factor there is the rate of change at which that water is replaced by water from other aquifers. If there's a very shallow aquifer that may only be 100m or so deep it's separated from the coal seam potentially by several hundred metres of low permeability material – and that would act to prevent any migration of water from that shallow aquifer down into the coal seams where we would be removing water. Those are certainly the sorts of things we investigate when we're at the exploration stage. We work out how much water we'll produce to understand the impacts we'll

have, the rates of change and to work out what we'll do with the produced water if we need to use it to mitigate potential impacts.

29. What is fracking – I'm sure there's more than one person here wondering what that is? Does it require large quantities of water? If this occurs in the Bowen Basin, what volume of water will be required?

Fracking is the abbreviation for hydraulic fracturing. The process is that we drill a well and cement and case it as usual. We perforate the steel casing in the coal seam interval. We then pump water down the well at extremely high pressure and it goes down the well and out those perforations into the coal seam. The water is pumped down at such high pressure that it cracks apart the coal within a 100 metre radius around the well on a horizontal plane. We then follow through with sand which is intended to prop open the fractures.

In terms of the amounts of water, I can tell you we use about 220 tonnes of sand, and about 200,000 litres of water per well. However, it is a somewhat self-sustaining process in that the water we pump out can be used to frac other wells.

In the Bowen Basin there are three coal measure formations. Two of those are ideally suited to horizontal wells and that's what we have planned for our CSG to LNG development. Re the third formation we are trialling fracking there to see if we can source gas from it.

30. I'm in cane farming. We've had two slight earthquakes recently; what effect would an earthquake have on pipelines, wells, dams on properties etc?

The gear we put in the ground is very robust. It can certainly handle a pretty rugged environment. Obviously it depends on the magnitude of the earthquake. However, assuming a significant quake which actually ruptures our pipeline, we have safety control mechanisms that deal with a catastrophic event like that. The dams we use have different levels catering for different things.

The CSG industry has very specific standards which apply to it, more than any other industry. We have different requirements to farming and coal mines. We have specific conditions around floodplains and we have to submit detailed dam design reports which comply with the government's guidelines (and that are signed off by a third party engineer). They have to be constructed in such a way that they can't be inundated. None of our dams were inundated during last year's floods, nor were they close to being inundated.

31. What is a horizontal hole and how does it happen?

For a horizontal hole you have a thing called a down-hole motor, and behind that is a steering assembly. We start off at an angle on the surface then curve the hole down to the coal seam. Every 6m the steering assembly sends back a signal to the surface to advise where it is so you can figure out where it's going. That's why we can intersect an 8 inch hole from 1.5km away.

32. You mentioned the site required for drilling is 70 metres x 70 metres. You haven't mentioned access roads and pipelines. You can't know the footprint. What's your average footprint on the wells you have drilled so far?

The footprint changes obviously while we're drilling and during construction when we have quite a big footprint. Once we have the well in the ground it comes back down to that 70 x 70m enclosure. So during construction in an area of 100 hectares we will probably impact 4%, and once we've finished the construction phase, probably 2%. Wells are not randomly spaced. While they are flexible in location well spacing is a consideration. It depends on the geology, but they are typically 800 to 1,000m apart i.e. one well per square kilometre. That will really depend on the size of the gas supply we are trying to meet. So with a small domestic contract to supply a power station you might only need ten wells a year whereas a bigger project like an LNG plant might need hundreds of wells per year.

33. Does Arrow or the CSG industry receive any taxpayer funded subsidies?

No, we pay for everything and more. We don't have any government funding.

34. When you are developing a well, what is the lifespan for usage of that well? What happens afterwards – do you rehabilitate the land? What about the water supply?

An exploration well has a very short duration as we're really just after some information. Once we get the information we seal it up, cut off the casing below ground level and rehabilitate the site.

A production well may have a life of ten to twenty years depending on the geology. We can change that with the spacing of wells that go in the ground. You can reduce the life of wells if you have more wells, conversely if you have fewer wells they will each have a longer life. It's about getting the balance right.

At the end of the well life we take out any pumps etc. Below ground the well is filled with cement then cut off below ground level, typically at 1.5m and the area is rehabilitated. We leave the well as it is underground; however, it is cemented up and sealed off.

35. How much traffic, trucks, etc will be going through town? Speeding trucks cause houses to shake.

Arrow's activities are very light here so you won't see much truck traffic from us in Proserpine. Later that may be part of any environmental impact study i.e. looking at traffic and road impacts.

We do use contractors and we do have powers in that sense as we impose rules. If they exceed the speed limit then we can cancel the contract.

36. Do you think CO₂ sequestration would be economically viable? Will it work?

To be honest, I don't know enough about the science to know for sure.

GLENDEN

Date:	11 October 2011	
Venue:	Glenden Community Centre	
Facilitator:	Jan Taylor, Principal	JTA Australia
Presenters:	Carey Bradford, Exploration Manager South	Arrow Energy
	Carolyn Collins, General Manager, Environment and Water	Arrow Energy

1. Do you have workers' camps?

We have established temporary camps in a number of places. One is south of Moranbah with 30% fly in/fly out. Although we encourage our staff to live in Moranbah, accommodation is stretched.

2. Will there be any staff based in Glenden?

If accommodation is available we would consider it but usually we can't get any.

Comment - Bringing people in would make it even tighter.

DYSART

Date:	12 October 2011	
Venue:	Dysart Civic Centre	
Facilitator:	Jan Taylor, Principal	JTA Australia
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1. Where does the water you use come from? Do you depend on dam water? What water is used?

It is sourced from SunWater. We need a licence to take water; we do not take it from the landowner's dam.

2. Are the conditions of entry written down? Do you only carry out activities specified in the agreement?

Yes, we enter into a written contract with the landholder which sets out all conditions of entry and specifies the activities we are allowed to carry out on the property. Some landholders specify things they want, conditions they need.

3. So the well is in a fenced off area? Where do you keep trucks and tractors and other machinery? Are they parked nearby? Would the landowner be liable for any damage caused to equipment outside the fenced area?

Firstly we don't visit every day, only when we want to do maintenance.

When drill rigs are sitting on site we haven't had any serious issues. We have tables for core samples etc. All of this would be covered by the contract. Landholders would not be liable for any damage caused by stock etc.

MIDDLEMOUNT

Date:	12 October 2011	
Venue:	Isaac Regional Council Boardroom, Middlemount	
Facilitator:	Jan Taylor, Principal	JTA Australia
Presenters:	Carey Bradford, Exploration Manager South	Arrow Energy
	Carolyn Collins, General Manager, Environment and Water	Arrow Energy

1. In relation to the dams that you build when you're actually drilling a hole, how big are those dams?

During the first exploration phase the bore hole is drilled and data collected from it which gives us gas content, gas saturation and permeability. In the Bowen Basin permeability is generally very, very low, so we like to check that we can actually flow the gas. Given that we've got good gas and good gas saturation but perhaps low permeability it still can be very difficult to flow the gas in that situation. So we come in and do a pilot stage and we would then put in a dam. The dam for that stage would be about nine megalitres. It has about a 110 by 110m footprint fenced out with nine and a half megalitres in capacity.

The small pits for drilling are only 8 by 1.5m. They vary from different drill rigs and sometimes you have three, four or five pits but they're usually only one and a-half, two metres deep and probably four by two, five by three. It depends on the rigs that are used.

2. So the dam actually gets bigger when you go to a production well?

Yes, because water is extracted from the coal seam then.

3. How long do the dams stay there?

In the pilot series, they'll stay for 18 months. Then they can be remediated and the land rehabilitated or we can hand over the dam to you after we've remediated it i.e. taking the lining and all the water out of it. We can give them back to landowners if that's what they wish.

As for the dams that we do in the exploration phase, eventually most drilling will be pitless so then we won't need to put those dams in except perhaps small ponds while we're drilling. That gives us a lot of benefits; we can recycle the drilling fluid several times over before we need to have it processed again. So there are savings in water for us. We've currently got the Shell technical content expert for solid control over here in Australia; he is looking at different drilling fluids we can use that are more user friendly as well as the recycling methods we can use for the drill cuttings and generally how to make that a better process.

4. What provision do you make with a dam when there is excessive rainfall with water overflowing the dam and contaminating the property? There'd be salt in that water, too, wouldn't there?

There are dam design standards that are specific to the coal seam gas industry. Our dams have to be lined and have to be designed to take into account rainfall data so that they can capture that water. We're not allowed to discharge any water from those dams, even during

the wet season. We need to make sure that that happens. With the drilling pits that Carey was referring to, that's a different thing. That's not actually a dam as such but a containment structure for the drilling process itself. For the larger dams, whether it's for an appraisal or a pilot program, or for the production phase, very tight, stringent rules apply. And we build them in such a way they don't get inundated by water.

We need specific approval by government for each dam that we construct.

- 5. We know the government doesn't care. Going back to production dams, after you put the dam in what do you do with the water when you fill it? Do you leave it there and let it evaporate; do you cart it away or pipe it?**

What Arrow's been working towards over the last couple of years is a beneficial use program for the water. All our water now has to be treated, or at least beneficially used in an untreated form if it's not going to be treated. There are several uses for the water; what we're working towards now is having a treated stream of water which can go to a whole range of beneficial uses, whether that's agriculture, industrial or urban supply. We're more advanced down in the Surat Basin where we have a greater volume of water that we produce; we've got several beneficial uses in place down there already, and we've been doing that for quite a few years.

- 6. What sort of environmental rehabilitation work do you do with the areas after the exploration has moved on and what are the timeframes?**

Our licences require us to have commenced rehabilitation of the exploration sites soon after we've finished them. It depends on the licence for that particular area but usually within six to twelve months. We try to do it as soon as we possibly can after having done the exploration. Basically it's taking the drilling muds away, so we actually take that out. We backfill any of the pits and seed the area (we have a requirement to make the vegetation growth basically what was there prior to us commencing our activities). So remediating exploration sites is a fairly simple and straightforward process.

- 7. In projects that you've done before, in a ballpark figure, what sort of timeframe could you give, before you could drive past a site where a well was and not know that one had been there?**

It depends on where you're operating but in quite a lot of the areas up here, particularly once you get one wet season, revegetation takes off pretty quickly. However, we have a requirement to monitor the areas for at least three years.

- 8. What have you got in place to prevent the spread of weeds?**

We've got a procedure in place within Arrow that vehicles need to be washed down. There's a risk assessment done at the particular areas we go to, depending on where we're coming from and where we're going. When you know you're going into an area that has a weed infestation issue, wash downs are definitely compulsory. For other areas, there's an assessment done as to whether there is a risk of transporting any weeds. Arrow is taking that very seriously and more often than not we just do the wash down rather than taking the risk.

- 9. Okay. So say you wash it down and you miss a few weeds. Let's take rat's tail grass for example, we know it can come up in five or ten years' time. What procedures will you**

take there? Do you come through with a weeds' expert and check it out first so you are aware of any infestations afterwards?

We have to understand all the ecology, the good plants as well as the weeds.

10. How long for? Let's say you come in and do a test hole, there's nothing there, you leave and the weed comes up five years later.

We have an ongoing requirement to monitor while we own that tenure. If we've been in there and while we're still accessing that particular property we have an ongoing obligation to monitor. If there is an infestation as a result of our activities, we are responsible for that. In the Surat Basin at the moment there've been a lot of weed outbreaks which are more a result of the flooding from the last wet season. But yes, the monitoring is definitely done and it's documented and agreed with landholders.

11. Do all companies operate the same way?

I can't speak for any other company. I think we actually do quite a good job in this area and probably exceed the performance of some other companies.

We've bought some portable washdown units for the cars with big rubber mat bunding. We'll trial them and see how they go. In particular areas that may be something where a landholder can ask for compensation and, if that's what was wanted, that's what we'd do. We're pretty happy to work with you.

Just another point, we've got a training program now where we train quite a number of our people in weed and seed certification, identification and wash down processes. So when the guys do wash down their vehicles, they know what to look for, they know where to wash them down and how to make sure they're clean. We'd probably have 40 or 50 people qualified through that course and we've got a few more scheduled to ensure that our people do understand what they're looking for and do know where to look and how to wash down their vehicles. They are qualified to certify vehicles, but we've got a policy where self-certification's not acceptable. You have to do someone else's vehicle, not your own. So we have gone down through that training path to ensure that it's not a case of just our word, we have done the training to understand what we're doing.

The other thing we do is that any, gravel, soil, or whatever else we might need to bring onto the property also has to be certified as pest free. And we do have forms, you know, the standard forms from government, so we actually utilise those as well.

12. What are the beneficial uses of the water afterwards?

In the Surat Basin we've been supplying a couple of feedlots down there for a few years now with untreated water. The landowners blend that with their water and use it for that purpose. We use it for power station cooling processes, coal washing, there's some small-scale irrigation. So there are quite a few options readily available down there for us. We're working with DERM and others at the moment to try to get some better approvals in place, and processes to be able to use that with a wider range of landowners. Up here, particularly around Moranbah where we're actually producing at the moment, it's a bit more difficult to find an off-take for the water because the mines have alternative supplies through SunWater. But as we expand, the most likely solution will be to support an industrial process, whether it's a

mine or something else, and that's what we're pursuing. At the moment we don't produce enough water to be of interest to anybody.

- 13. I've got QGC knocking on my door at the moment for a walk-through, just exploratory, and I see your name comes up on the heading of the letter as well. Does that eliminate you from doing the same thing? Are they doing that for you as well?**

There are some tenures here we share with QGC. It came about via the takeover of a company called Pure Energy; we had a buy in to Pure Energy, and QGC bought it out. So we are now in partnership with QGC in a couple of tenures. With these types of things an operator is nominated; while we might provide QGC with money if it is the operator the work will be done by and on behalf of QGC.

- 14. With the lease on my place QGC comes in about two-thirds of the way and then you take it over from there. So I was wondering if QGC is going to do the whole exploratory thing even though your name is on the letter heading as well as QGC.**

Is that seismic work?

- 15. Yes.**

This may be down the north end of Baralaba and Dingo. QGC is doing some work as part of a joint venture or co-tenement arrangement. QGC will do its half and Arrow will do the other.

- 16. So you will come on after them, will you?**

No, they'll do that area and we'll do the adjoining area. So Arrow won't visit the same area as QGC, we won't do it twice. We'll share the information.

- 17. I have a problem there because the property I've recently purchased (where you have the lease) is infested with a small amount of rat's tail grass. We have a management plan for its eradication where we go in one way and out through another property we have. What's worrying me is that I don't want people going through the fence and then coming back through on the same line.**

Well, from a land perspective, our guys would visit you to find out about the area and understand any special circumstances; we would abide by any specific conditions that you place on us, and we'd put that into our agreements. So that if you say we come in this way and go out that way or we have a portable washdown or whatever we need to do, that's the arrangements we make with you to minimise any possibility of weed transfer or to reduce any other potential impact on your property.

- 18. Because another one goes from my existing property where I haven't got any rat's tail grass, through into another property that has the rat's tail grass, and I'm more concerned about them going down that line doing a seismic and then driving back out. I don't want that happening and I've been sort of arguing for about nine months about some way of getting around it.**

Well, if QGC is doing the work, then it would be their half of the arrangement and we won't go in where they are. So they do the work on what I think is a joint tenement there. QGC is probably obligated to put both companies on the letter because of the joint arrangement.

And Arrow is trying to work with QGC to say 'You take that tenure and we'll take that one and call it even'. That's how we'd prefer to be seen.

19. What would happen down the track in the case of something being found? Would you come in and work that tenure, if there was a well to be put there? What would happen then?

We are competitors with QGC so we don't normally choose to work together, although due to a relic of history we do in this area.

If it came to be that we move to a production phase, then one company would become the "operator", which means that they would be responsible for activities on the ground. At this stage it is too early to tell how the tenure ownership and management will end up, and therefore who might be the operator.

20. One of the major issues I have, and which I don't think you understand, is the loss of privacy for us. I drive around this country from here to Baralaba on a Saturday and a Sunday and there are cars just running in and out of places everywhere. I know every track that goes into my place, and on our properties there's stuff lying all over them that belongs to us. There are three or four seismic lines that go through my place and I feel we lose a lot of privacy out of this. A lot of people don't seem to respect that and they seem to be saying that if I don't agree they have the right to enter anyway. Well, you know, if it's going to come push to shove, there'll be another thousand people who think like I do. I mean, I don't like push and I know we can't stop progress but, at the same time, there's got to be a little bit more respect for us than what's there at the moment.

Well, from Arrow's perspective, we've got stringent rules in place. In the presentation there was a slide that talks about land access requirements, not only the legislative ones for the Land Access Code, but Arrow has twelve of its own land access rules which are policed tightly. If our people breach them, that could result in the termination of their employment or the termination of their contracts to work for the company. Members of our land team are the only people who deal with the landowners. We don't have drillers or geologists or any other part of the company dealing with the landowners. So if there is an issue there is one point of contact.

This means landowners will receive the same message or outcome. We try to do that to avoid what you're saying; a mix of all these different people ringing you about different things. We try to consolidate that into a one-on-one relationship so that we deal with specific properties and their owners and have discussions and make arrangements. So we do it by consensus, not confrontation. From our perspective that's the only way to work a relationship, to make sure everybody understands what we're doing and to have that ongoing relationship so if you've got a problem you can bring it to us and we'll give you an outcome or an answer and resolve the concerns.

Comment: well that's one problem I see...the different approach by various people and companies on the same issue. Even from twelve months ago, we're no longer dealing with the same person. I know takeovers have happened in between, but at the same time it's very hard to deal with three or four different people on the same issue over a twelve month period because it goes nowhere.

21. What's the lifetime of the actual pipeline?

The pipeline has a 40 year design life, and that can be extended.

22. I was just wondering how long it's going to last for. And how many times a year do you run up and down it? What sort of access do you need?

We tend not to drive it as it's just too long...it's a 600km long pipeline. Most of the time we'll fly and once a year we'll probably access the cathodic protection points which are normally close to roads or tracks. And every five years we run what we call an 'intelligent pig' through it which monitors what's happening inside the pipeline. We try not to access the land if it's not strictly necessary but of course we do it after floods. If there are any washouts or the like, then we'll go in and fix it but we don't plan on driving down the line once a month or once a year or anything like that.

23. What height would you fly?

We have to fly at least 500 feet.

24. It's a pity one of your mates didn't know about that the other day although it wasn't an Arrow fellow.

You should be talking to DEEDI about that.

25. I have. Still doesn't do much.

If we were to do something like that they'd come down on us like a tonne of bricks.

26. Your helicopters would have been just 500 feet when they were flying over my property when they first came.

But they would have been 500 feet. On each of those helicopters there is a GPS tracker that we put on-board to monitor the height the pilot is flying. He is aware of it and it means we have the record to show that it was a minimum of 500. It's normally a thousand feet because we feel that 500 feet is too low as far as safety is concerned.

27. Could I just cut in there? Your vehicles are all fitted with GPS tracking?

The ones up on the Bowen Basin are. We've had all vehicles fitted in the last six weeks. And we're requiring all of our contractors to do the same. So if they're not going to have it, they don't work for us.

The other thing that we have done is get involved with the Isaac Regional Council on notifiable road and vehicle use so we contribute to the region for road maintenance and the like. Our Vice-President of Exploration, Tony Knight, is discussing that with Isaac Regional Council now to make sure that we contribute our share.

Should pipeline construction activity result in a load on this network that is disproportionate with age or which reduces its ability to service the local community for which it was intended, then the Traffic Management Plan will dictate what measures such as road maintenance need to be enacted to enable the road use to continue.

28. When are you going to start getting serious as to where you intend to put the pipeline?

Within the next two or three months we'll be visiting landholders with option or easement deeds to secure an easement for the pipeline.

29. And are you going to stick by point number two up there? Add value to the compensation?

Yes, the compensation package is open for negotiation. 'Add value' includes items that would probably be property-specific, landowner-specific, and they may not be direct dollar amounts.

30. If you get a water pipeline through your place, you can usually hook in and get access to it. Obviously, with you fellows, you don't actually do anything really do you...except make a mess?

Well, the pipelines are usually rehabilitated after a very short period of time.

31. Is the pipeline underground?

Yes, all underground.

32. What depth is the pipeline?

It depends on the land use, but if you're blade ploughing in the area, it will be 1.2, 1.5 metres. If it's shallow, the minimum is 750mm, but on average we'd probably be about 900mm.

33. When you first come in, clear the area and dig it, how long does it take before you fill it in?

If you were to stand on the side of the pipeline and watch us, it'd take us approximately three months from the time we first open it up to the time we've rehabilitated it.

Unforeseen circumstances such as inclement weather could cause this period to be longer.

34. What if cattle fall into it?

The trench is only open for a matter of weeks. If there are a lot of cattle, we'll be asking you to basically either move the cattle to a different paddock, which we'll pay you for, or we'll run electrified fencing.

Alternatively if cattle do fall into the trench and die, then the landholder will be compensated for any such loss taking account of the sex, age and condition of the beast and other external factors such as the state of the market.

Historic evidence across a wide range of ground conditions and pipeline diameters demonstrates that cattle, or any other livestock, do not habitually fall into the trench.

35. And how do they get from one side to the other to access water?

There will be intervals along the pipeline, again discussed with you guys and having looked at where the cattle normally walk, or where landholders might habitually travel for farm management/animal husbandry reasons, there'll be special places where the cattle can move through. On average, there'll be a gap every 250 to 500 metres.

We're aware of what the cattle do, you know. Most of the Arrow guys e.g. our land agent, Bob, used to run cattle so we'll work with you re how often we need to put the gaps in. But yes, if cows do end up in the trench – we'll compensate you for that.

36. If a cow goes in the trench it could lose a calf. Do you compensate only for that cow or do you compensate for that beast and however many calves it might produce for the next ten years?

As stated above, if cattle do fall into the trench and die, then the landholder will be compensated for any such loss taking account of the sex, age and condition of the beast and other external factors such as the state of the market. Thus a young heifer with many years of breeding left in front of it will be compensated for at a different rate than an old cow or a steer.

37. Was it one of you fellows said a few weeks ago on the ABC on *Country Hour* that (and I'll probably stand corrected, it mightn't have been Arrow) you wouldn't go through a person's place if they really didn't want you there?

The pipeline has to get from one end of the country to the other and if everybody says they're not going to have it, then it just couldn't work. But we intend to negotiate our way through by following clearly established Arrow Energy and industry guidelines which will ensure all landowners are treated fairly and equitably. Once the pipeline is buried and rehabilitation completed, after a year you probably wouldn't notice that it was there, and after four or five years you'd be hard pushed to see exactly where it was.

38. What about cultivation if you go three metres deep?

We can go through laser-levelled ground, flat ground, irrigated ground, cultivated or grazing, you name it, we've done it before and we've put it back as it was successfully. In one or two seasons you'll never even know the pipeline is there.

39. So you rip up all the soil that's been sitting there for years – the Brigalow soil - and you put it back the same?

Yes we do.

We start by clearing the vegetation and stockpiling it, then strip and stockpile the topsoil and then excavate and stockpile the trench material. We then put it back in the same manner ensuring that the topsoil is not contaminated by trench spoil and that no soil inversion occurs.

40. How wide's your pipeline? A metre? Forty-two inches or was it 1.2 metres?

Forty-two inches, that's just on a metre, yes.

41. What size hole do you go in first off? Do you go in with three different rigs?

No, we use one multi-purpose style rig, normally a UDR 1200 or a UDR 1000 style of rig. The top hole's normally about eight and a-half inches, with a seven and seven-eighth casing rig.

We put that down to about 12 metres. Then we'd go for just slightly smaller than that diameter and we'd put about a six inch casing in down to about 70m. The next string of casing goes down to 100, 200, whatever we deem is necessary in the area. That's about four, four and a-

half inches. And then our HQ¹ coring is about four inches, 99mm, and that normally goes through to total depth at that size.

42. How long will it take you to go a thousand metres to core it all the way in an appraisal hole?

Coring all the way is an exploration function. A really good crew could knock it over in two weeks, other crews maybe three, four weeks. It depends where we set the casing and whether the ground's a bit broken. When we're coring, we use what we call a HQ3 system; it's actually in a split, so imagine a tube just split in half; that goes in the middle. That goes inside a tube and that goes inside a core barrel. Now the tube and the split are able to be retrieved via a grapple. The grapple's got the core and we core down.

We send the grapple down the hole. It picks up the tube and the split and brings it back to surface; then we can put another tube and split down the hole and start coring again. The core is quite high speed, probably between 400 and 700rpm. It cuts quite a good hole and it's generally six metre runs at a time, but if the ground's a little bit broken or if we're going through coal with a bit of clay in it, we 'wedge off'. This means the bit breaks and it's not being forced into the tube properly and then you start grinding the rock that's in the tube with the rock that's on the ground, and we need to pull that. So it depends how often they wedge off, but the deeper you go the longer your trip times are to pull.

If we're doing a full test run, a month is usually reasonable.

43. Twenty-four hours a day?

Yes, twenty-four hours a day although some of the well testing could take a week.

44. With that core hole, can it be turned into a production well?

No. We do not turn those core holes into production holes.

The exploration holes are there to collect data on gas content. Gas saturation and permeability are also key pieces of information. You get very complex relationships between those three parameters. In the Surat Basin we have reasonably low gas content, reasonably good saturations and very high permeability. Those wells produce heaps of gas. In the Bowen Basin we have very, very high gas content, but very low permeability, and that combines to make it very difficult to extract the gas although they produce for quite a long time. So the basins do have different profiles.

We do find the Bowen more challenging to get the gas out than the Surat. When we go in in the Bowen Basin we drill it. Before the rig moves offsite, we will cement that hole to surface and then within six months we'll come back. We'll cut the well off 1.5m below the ground; we weld on a steel cap to the top of the well; a small plaque will be installed on that steel cap and then we'll infill that. We fill that area, infill the pits, and we aim for that to be done six months after completion. With the wet season this year it has been difficult for us so we have had some troubles.

¹ HQ is a term to describe a certain type of drill rod and that allows for core to be recovered by using a wireline. The core is about 63mm diameter.

45. If you find what you want there, what happens then? Are you going to go down the same area again?

The next phase is the appraisal phase and, as I said, in the Bowen Basin we know we've got good coal. We know the coal's generally holding a lot of gas although its saturation can be a little bit low. But the biggest problem is that permeability is extremely low. So while we have most of those things, it's not a straight line equation; there's a very complex relationship between all those factors so we need to prove that we can commercially flow that gas. We know gas will come out of the ground, but for us to be able to have people go and service that at the required intervals and put in the infrastructure to send it to market, then those gas wells actually have to produce significant volumes of gas.

We then need to go and drill three surface to in-seam (SIS) wells in a line as a pilot. We drill more than one because in unsaturated coal we actually need to reduce the water head in the well a little bit to make the gas flow. There can be complex relationships with saturation so we need to work out where it is and we then know how much water we have to pull out of the well to start the gas flowing. It's not always going to flow the way that we thought but when it does flow we can then determine whether it's going to be a commercial grade. However, we generally need about eighteen months to two years to determine that.

46. Like the exploration wells?

No, while these appraisal wells are in the ground they take some time to de-water. When you're in a full production field where you do have quite a number of wells in the area and you have dewatered the coal seams, it's much easier to bring other wells online in addition to them. But when you just have three wells out in the middle of nowhere, it takes quite a long time to get the water to come down. So the pilot phase would exist with an associated dam and three wells for at least two years.

47. Can I just clarify then for me as well as for others, the exploration phase will probably take six months, the appraisal phase will probably take two years?

The exploration phase, yes; the appraisal phase sometimes runs hand in hand with exploration. Sometimes we do the appraisal work right behind exploration. It's not necessarily a discrete exercise at a time.

We like to have the data from the exploration wells, and then the appraisal wells confirm what the exploration wells tell us. They also remove the uncertainty involved with extracting gas in the low permeability coal. And they are often run fairly closely behind each other.

48. You spoke earlier about the holding dam and salt and brine. That's pretty deadly stuff. I lived next to a hide processing works for about 30 years which had state-of-the-art holding ponds that were never going to let anything out but it went over the top after some heavy rain. Even in diluted form salt is pretty deadly stuff.

When we treat the water, the brine stream is about 10 to 20% of the volume; we contain that in dams which have to have a double lining. So there's a secondary containment system which has to have seepage detection and also a return system if there is any seepage. There are very strict standards for the dams we build now and we do not think there is a significant risk of the type of leakage you are talking about.

49. Has any brine been lost yet?

No.

50. In relation to the dams you say you're treating the water, you're doing this, and you're doing that, but what about during abnormal rainfall?

We did have a significant wet season last year which was worse than we had predicted it might be. We didn't have any dam issues in that wet season, either in the Surat or Bowen Basins. Our dams are built with a buffer zone; they have to be designed for a one in 200 year flood. They've been talking about increasing that now to a one in a thousand year flood event. So the design capacity is actually to ensure that it has an adequate buffer in terms of storage area for any wet season.

In fact we had several major wet weather events at our Moranbah dams in the last wet season. They aren't catchment dams; they're like turkey's nests so they're higher. They're well above the ground so they only capture what falls directly over the dam.

51. What happens to the water? How long does it sit there? A lot of it must evaporate. If you get 60 inches of rain, that's 60 inches a year in evaporation, what happens to that salt silting up the side?

We run them at an operating level basically, so it's not as though the water levels would drop enough to have a salt crust up the side. That would present a risk of it blowing everywhere so we make sure the water levels are high enough.

We have brine dams whose purpose is to concentrate the salt. We're also looking at crystallisation processes to make that process faster, so we can remove the salt. Our licences actually require us to take the salt away.

52. A brine dam would be a worry. By gee, it's deadly stuff.

Yes, and we take that very, very seriously.

53. Nothing ever grows there again either, only some tough looking burr or something. You'll never see grass again if this salt and brine goes over your paddock.

Yes, we understand that.

54. I already know about evaporation because we had a mate that is from down south and he can take us and show us whatever we want to see. He said some other companies have them in the Surat and he said they evaporate, and the salt blows from the west and goes to the east, and you can't grow a bloody thing all the way around.

We haven't experienced that.

Comment - No, you haven't, but the other company has.

55. If you come onto my property and put in a well and set up these liners and tanks, or whatever you call them above ground, would you take my advice about flood levels?

Such advice is always important. As Ross was saying before, engagement with the landowner who knows the area is a key part for us in planning our activities. If we talk to you at the

exploration phase and get a better understanding about the land, how you use it, how water flows, all those sorts of issues, they feed into our decisions further down the track as well. If development does occur we always have those discussions. In the Surat we're working very closely with a lot of the landowners, particularly around Cecil Plains, about exactly those sorts of issues...flooding, overland flows, all the issues that are important with regard to their livelihoods. It's really important to get it right.

56. So we could negotiate on the basis that the well is on a flood plain and if there is a disaster, we'd be well compensated for it?

We are legally bound to compensate you for that if there's a disaster. We don't do that upfront because if we do it the right way, which is what we fully intend to do, and work with you to make sure that you're comfortable with the way we do it, we shouldn't be in that position. But should it occur, yes, we're fully liable.

57. We saw a heap of drilling rigs under water down in the Surat last year. I was told that the company was advised to shift the camp and rigs before they were flooded but they didn't do so, and yet it went well under water. I don't know what company it was.

A lot of that seemed to happen where companies were advised to shift and no one did. It all went under. That's the sort of thing that concerns me...companies ignoring the advice of landowners and not recognising they do have a fair bit of knowledge of their own land.

That's a critical part of our access requirements. We have wet weather access rules where we don't send our crews onto properties if storms have come through the night before. We have a standard operating procedure where our staff can self-assess if it's just a small amount of rain. But if there's excessive rain, we'll always contact the landowner prior to having the crews go in to ensure they don't damage the property...or we'll have arrangements in place to repair things before they are damaged. That'll be by agreement with the landowner. Some landowners say *'come in and do your job and get out. If you cause grief, just fix it at the end.* And some will say *I don't want you to damage the tracks and the like, so we stay out.* There are different formulas available but it's always by agreement with a set of rules agreed to both by landowners and our guys.

58. There are always a lot of different standards. We're all graziers, but there are a lot of different types...some are conscientious, others not. I know people who don't care and say *let the gas people come. I'm here to manage cattle and make a living out of them.* You'd hate to see me driving cattle over your ponds every day of the week but I have to put up with you coming onto my land so there has to be some respect.

Exactly right. It's all about relationships.

Comment - I know we can't stop progress, but at the same time we've got to be respected.

59. How are the dams fenced off? You say they're plastic lined, but how are they fenced off?

We have four strand barbed wire fences.

60. I'll tell you something; you'd never come on my place and put a dam on it if you're only going to fence it like that.

If you want a six foot cyclone fence, we'll put that around it if that's what you want.

61. If it's a plastic-lined pool no insurance company will cover you because that is classed as a pool. We've been down this track; we've checked it out. We've got a town right on our boundary. If you come in and stuck a thing like that right next door to the town, you'd have kids there left, right and centre.

It depends. What Ross is talking about is some locations where they are fenced like that out in the middle of a property. The fences are four foot with four or six strand barbed wire and the pool requirement is twelve hundred millimetres

62. Yes, but a barbed wire fence? Anyone can get through a barbed wire fence.

In a lot of circumstances we have panel fencing and, more often than not, that is what we use. When we go to the production phase and have substantial sized dams, nobody can get over or through the fences. It's for stock as well as for human health and safety. That is a condition of our Environmental Code.

63. Is that the government code, or just Arrow's?

It's a government code. It's up to the companies to make sure that we meet the requirement; each company can have a different specification for the fence so long as it meets the code.

I'm sorry, Lyn. I thought you were talking about our small nine megalitre dams, not the big three or four hundred megalitre storage ponds. They've got six foot security fences right around, or cyclone fencing.

64. That's why I'm so fanatical about dams as we are on the boundary of the town and we have kids coming through us all the time.

I think the important thing is that we would do it by consultation. If that's what you think is necessary and we believe that's the case, then we'd take appropriate actions to ensure we didn't have a risk factor. The risk is greater to us than it is to you. Because of regulatory requirements we would have to ensure that our risk assessment is done to the maximum.

Comment - With that QGC/Arrow land we talked about earlier what happens if you buy out QGC then find a few things have changed for the worse on properties. I tell you what; they're the biggest pack of mongrels you'd ever deal with. They'll come and leave rat's tail grass on your place and don't give a bloody stuff. And then you've got to get a solicitor to fight them.

65. Just as a matter of interest with regard to those ponds, will they kill a working dog?

With the water quality, you mean? No, the main issue with the water is its salinity. It's not toxic, as some people are making it out to be. It's salty but that's the extent of it.

Comment - I was just interested to know. You've got dogs out working, they get hot and they'd race anywhere to drink. I just wanted to know.

66. Okay then. I'll put one to you - If you were drilling a production well, how far away from a bore would you move?

It depends. In the Bowen Basin we don't see much interaction so there could be a few hundred metres between wells, but that doesn't necessarily mean that's what we would do. If you had a bore there, we'd probably look at a minimum of 500 metres. It would be interesting for us because we'd be able to use your bore as a measuring point and that would be valuable to us. And at 500 metres, I think the majority of the intakes in the Bowen Basin would be mitigated.

We identify all bores within two kilometres of appraisal wells at the moment. We monitor those bores for any movement in quality and quantity of water while we're doing the appraisal drilling.

67. Let's say a well was put down by Tony Knight originally and all his documentation's there. We've since pumped it because we know QGC's coming and they said, "No, we won't bugger the bore and we'll make good." But in that case if it's unequipped, do you put a test pump down like the coal mines and test it, or not?

Well, we could if we needed to. It depends on the construction of the bore. If the bore's in the right location for testing and the structural integrity and everything is good within the bore, we can build that into our program.

But, you often have bores some distance from coal seams. In many cases, you're just not going to see the impacts, particularly in the Bowen Basin where the strata is so impermeable that interconnectivity would take an extremely long time to occur, if at all. In the coal seams here, the water volume in the coals is quite small.

The Queensland Government has introduced a requirement for CSG companies to conduct "baseline" tests of water bores to check on their construction, water levels, quality and so on. If a well hadn't been equipped or pumped, then we would still be bound to check it to establish its baseline condition, and from there determine if any of our subsequent activities had affected it.

68. Well, where we are, it can't be drilled. BMA has pulled out of a few holes because it couldn't pump them. They can't blow enough out. They've got holes full of salty water for miles.

For us, like Carey said, we need to understand all that information before we decide to go to production phase. If we did find an area where there was much more water than gas we'd not develop it. It's not viable for us to develop it and keep producing water with all the attendant costs. It's not an area where we'd want to go to production. It's something we evaluate very carefully; water is a significant cost for us to deal with, and we want to produce as little of it as possible.

In the testing phase one of the things we do is called a drill stem test. We have packers that can go down the hole and straddle the coal seams or any areas of interest like aquifers. We inflate the packers and then we can measure flows in and out, the permeability, and then deflate them and pull them out. That's at the exploration phase, and the appraisal phase is just that...to check how much water we're producing, its quality and the gas flow. Before we

ever go to real full-paced production, we need to de-risk the areas for all the things you're talking about.

69. How deep are your holes on average in this area?

We're generally talking exploration work down to about 800m; targetting 400 to 600m is not too bad. The coal miners have quite a lot of data for us so we don't have to go in too shallow too often. Occasionally we 'overcook' one and go too far down the dip to check where the top of the coal seams begin. Sometimes that happens. There's a bit of faulting or something that we haven't predicted, or the seams roll away a bit harder than we thought and we might go to a thousand metres. But most of our rigs can't go much further than that.

70. In relation to risk management, do the wells themselves have the potential to cause or exacerbate any disaster events in the area? Will they increase the risk of bush fires, things like that? Is there a risk of explosion?

We've just done a massive study with the Queensland Emergency Services which showed the risk of our wells catching fire is pretty minimal. Their design is such that they won't just explode on us. Emergency Services concluded (and have said so publicly) that there is no concern around gas wells and there is no risk to public safety from explosions.

71. That's if they're operating safely?

No, there is no risk at all given the nature of coal seam gas.

72. Have there been any explosions in America?

I don't know. But the geology and processes are quite different here.

73. I would have thought you'd bring a fair bit of that technology over here. Didn't you say you had an American working here?

Of course it's possible for Americans to provide us with some expertise but when you see some of the recent television documentary footage from the US it's not necessarily coal seam gas and it's certainly not the same geology and processes we use here.

74. I was more interested in the pipelines, actually. How many go up in America?

Obviously, they've got more history than we do so they have hundreds of thousands of kilometres of pipeline. Some of it was built in the 1930s and 1940s when there was no steel technology.

It seems that every four or five years there is an explosion there or something of the kind. But remember it's a very different system in the States because the industry is self-regulating.

75. So US companies are not as strict?

Nowhere near. As well as having to obtain a pipeline licence and environmental approval we have an Australian Standard for design, construction testing and operation that is probably one of the toughest in the world. Requirements on us include the intelligent pig I told you about earlier; it is basically the equivalent of an X-ray that goes up the pipeline, measures the

diameter and the thickness of the wall; if there's any cracking, corrosion or geometric irregularities, anything, it shows up on it.

The regulations require us to do that every five years...and the same with our cathodic protection. We monitor it closely so if there's a hole or defect in the coating system, even a tiny little pin hole, we'll know. Then we'd do a direct current voltage gradient survey. We walk along the pipeline with a little detector and if there is an indication of a defect, we will dig the pipeline up, find the hole in the coating and we dig it up and repair it.

76. Obviously if you do it in the next ten years, as you probably will, you'll probably sort out any problems but what about in fifty years when my grandkids come along and...

No, we quality control; we survey every pipe.

As stated earlier, the design lifetime is 40 years and that is the term that the licence is issued for. Where it is intended to operate a pipeline beyond its design life, then, prior to the expiry of the design life, an investigation will be made of the design, operating conditions and history of the pipeline, to determine its condition and any limits for continued safe operation. The pipeline shall only continue to be operated under the conditions and limits established and approved by the government regulator.

77. In twenty years' time how well will the site be cleared and marked?

The pipeline markers are normally at every property boundary at every bend, at roads, tracks, railways, rivers or at 400/500m spacings. While it depends on the cultivation, we are required to mark the pipeline as described above. However there is some avenue for discretion in cultivated areas.

Markers are also required to be installed on an intervisibility basis.

78. So it'd be pretty hard for them to hook a dozer or an excavator through it?

It's possible, but I'll put it this way: our pipeline can take a 90 tonne excavator trying to make a dent in it and can handle it. A blade plough will bounce over the top of it. Both of these activities will make a dent in the pipeline, it'll damage the coating, but it won't let the gas out.

However, if you sit there for a few days with a posthole driller you will drill a hole in it. There's nothing we can do about that.

79. We're going to know where it is, but the grandkids mightn't. What if they just get a worker in or something like that and say go down there with the dozer and rip.

The pipeline markers are required to be installed at all times whilst the pipeline is operating, so they will be there at day one and in 60 years' time, if the design life is extended.

Throughout the lifetime of the pipeline, the operator will stay in touch with all existing and new landowners (read grandchildren) and ensure ongoing communications and education for the simple reason that this will enhance everyone's safety and the pipeline's security.

The whole pipeline will have its position determined by GPS from one end to the other, so I'm sure the technology's going to be far ahead of us when your grandkids grow up.

There's another system that we're considering, particularly close to urban areas, where we can actually detect if a vehicle approaches a pipeline. So we can tell if an excavator's driving towards the pipeline, and then we'll get on the phone to the landowner and say 'you've got a dozer heading towards our pipeline. Were you aware of it?'

80. Do you keep the pipeline area cleared so your guys can come in and drive through?

We'll leave a small track and we need to keep that open in case we have to come and do some repairs in the future. We wouldn't like the forest trees to grow back over the top of it. We have a 30m wide easement and we keep about 10m relatively clear. We're not going to slash it but if there's Brigalow regrowth etc. we'll come along and we'll cut it down because we don't want trees growing over the top of the pipeline.

81. So you guys will want an easement?

Yes, we'll want an easement for the pipeline.

82. Is it an ongoing payment for the pipeline?

The pipeline is an easement, so that's a one-off compensation payment. We pay you for the value of that piece of property based on a formula. We pay 100% for a narrow strip over the top of the pipeline and a percentage for the rest of the easement.

83. That's on the current market value, isn't it?

Yes that's right.

84. Is that about \$500 an acre or something like that?

It's a lot more than that. It depends on the property obviously as different properties have different values.

Easement Compensation is assessed using guidelines set down by the Acquisition of Land Act 1967 (QLD) and the relevant Land Court cases.

The compensation payable reflects the reduction in the value of the land caused by the easement. However an easement is only an interest in the land and therefore the loss in value is calculated as being a percentage of the freehold value of the easement area. The percentage applied by the valuer is based on previous Land Court cases and decisions.

For rural land the percentage loss in value is usually between 20% and 50% depending on a number of factors including the size of the easement relative to the size of the property and the location of the easement on the property.

85. Are you only using the easement to build the pipeline or are you outside the easement to actually build the pipeline?

Yes sometimes we do need to go outside the boundaries of the easement, e.g. for a creek crossing we'll have to go a bit wider. In those circumstances we will negotiate and pay for a wider width but we'll keep to the same 30m easement. There'll be an extra payment to go wider than 30m.

86. So usually you'll only need to be on the 30 metre easement?

In 99% of cases the 30 metres is wide enough. There'll be occasional turnaround areas where you have to allow big trucks to turn around and there may be a few lay-down areas, but most of those will be negotiated with the landowner prior to construction.

87. How many pipelines will be in the area eventually?

We had this question in Surat where there are actually four major pipelines, four by forty-two inch pipelines going up the full length of the Surat. If there's enough gas in the Bowen to warrant that amount of pipeline, then there will be more pipelines. If there's not enough gas then there'll probably be fewer.

88. Are you utilising yours: what happens when it's full?

We have an expansion plan for it but we wouldn't just put in the minimum sized pipeline. You can always put extra compressors on to put more gas through but it's normally cheaper in the long run to build another pipeline than to start putting lots of compressors on it.

89. How far apart are the compressor stations?

We'll only have compressors at the gas processing plants in the Bowen Basin and nothing in between.

90. So on the surface there'll be nothing?

There will be some valve stations roughly every 40 to 60 kilometres apart, and they'll be adjacent to a road. We need all-weather access, so they'll be carefully sited so hopefully we can find a road.

91. How many different companies are operating in the Bowen Basin?

For gas?

92. Yes, for gas.

I know of five. It depends where you define the cut-off for the Bowen Basin...for example if you consider Moura is in the Bowen Basin...

93. What about in Central Queensland?

In Galilee, Alpha, those areas, you're talking eight to ten companies through there.

94. Has Arrow bought Bow Energy?

We're in negotiations. We've made an offer; the offer's been accepted, so there's a fair chance that we'll get over the line.

95. So you'll pick up their stations, the wells that they've already got there?

Yes, we'll take over their tenement.

96. If you go ahead with the acquisition of Bow, will you require a second pipeline? It has a proposed pipeline in place.

Most of our gas will come from the Surat Basin as it's easily produced there. Bowen Basin is additional to that and is still at an early stage. We're very confident about the Surat and already know the sorts of volumes that we're talking about. In the Bowen it's much less certain as we need to do much more exploration work. There is talk that we will up the ante and make our refrigerators at Gladstone bigger to take more gas out but it's a little too early to tell yet.

However, we wouldn't be building a second pipeline. Bow Energy has a couple of different acreage areas and tenements so we may build laterals of 20 to 30 km long from that area into the main pipeline. If exploration goes as far south as Blackwater and there is viable gas then it'll be a hundred kilometre long lateral. However, there won't be a whole new pipeline that goes all the way to Gladstone.

97. So you'd kind of just do a spur line from wherever you had your gas and take it across to the other one.

Yes, to the power station at Blackwater. But it depends on where the gas is, we have to find it first.

98. There's a lot of gas around Dysart, isn't there?

Yes, there is.

99. How much gas do you have just north of Middlemount?

There's quite a lot of gas but it's whether we can get it out. In terms of the Bowen Basin tenements we think there is in the order of 36,000 petajoules. If I converted that energy-wise to barrels of oil, it's about 12.5 billion barrels of oil. That's what we think the Bowen Basin holds. The recoverable from that is probably a smaller order of magnitude at this stage but we're confident we can increase that.

MORANBAH

Date:	13 October 2011	
Venue:	Moranbah Workers Club	
Facilitator:	Jan Taylor, Principal	JTA Australia
Presenters:	Carey Bradford, Exploration Manager South	Arrow Energy
	Carolyn Collins, General Manager, Environment and Water	Arrow Energy

- 1. About a year or so ago, I can recall some issues about benzene being found in one of the holes out at Moranbah. I know you're not using benzene, but could you just enlighten us on what the outcome of that was?**

Yes, the benzene was at very low levels of about two parts per billion. This is right down at the limit detectable by the machines so it's very minute levels. We don't use benzene in our fluids but there are numerous ways that it could get into the ground. My suspicion is that it may have got into the wells in the days when some of the pipe grease (or dope as they call it) lubricating the joints may have got into that well. We have looked at all of those things, and it's possible some of the guys were not using the most friendly pipe grease then. Perhaps they were servicing a truck and got grease on the casing when they put it in. I guess what it shows is that the monitoring, the regulation and the scrutiny is working because things are being picked up that are absolutely minute.

- 2. Once wells are closed, how often are they monitored?**

Once we finish drilling a well it's plugged and abandoned, as it's referred to in the legislation, and we rehabilitate the site. We don't need to go back and check on the well but we do go back and check on the vegetation and the rehabilitation. The monitoring has to occur for between three and five years or until it's self-sustaining and the government actually signs off that we've finished our work in that area. If we're looking at a production area and we've got a network of groundwater monitoring wells, that monitoring will continue for the life of the project and quite likely beyond it. We won't be relieved of that responsibility until the government is satisfied there will be no more potential impacts for which we'd be liable.

- 3. Can you comment on the fifteen wells in Dalby that belong to Arrow that have just had BTEX found in them six weeks ago?**

The issue there is the same as Carey mentioned for the ones in the north. They were not required to be reported to government because monitoring showed the levels were still very low and well below World Health Organisation standards for safe drinking quality. They were being monitored for seepage detection by DERM; they're shallow bores to a depth of between 30 and 40m, and in that area there is no groundwater source which is actually providing any water for drinking supplies or similar. The quality there is very poor naturally so there is no issue. Again the potential source of the BTEX is the grease and lubricants used in the drilling process and they would have been drilled exactly the same as any other water bore in that area.

- 4. My question isn't on the wells and it might sound like it's a little bit focused on Moranbah but as Liaison Officer for the Moranbah Traders I am aware of your Brighter Futures program. Do you have any plans to have a local procurement program**

introduced soon, such as some of the other large companies are doing? I'm not putting pressure on you, just asking you because it's been talked about a lot.

It's an area that we're working on in Arrow in the longer term re the strategies we're going to be putting in place with all contracting and procurement. We do want to be using or sourcing products locally and we're doing a lot of work around exploring what those options are. We also need to understand our own needs for the long term and marry the two together. So it's something we're looking into, but we haven't got a firm policy in place as yet.

5. I'd like to know where the temporary camps are going to be and when you guys are planning to start construction of the camps?

Their location will only be determined once we've appointed a construction contractor who has to decide from which direction the pipeline will be built which determines where the camps are. They'd normally be 80 to 90 kilometres apart so we might start in the middle and go both ways; we might start at either end and go towards the middle. It's a year-long process before we start construction during which we start looking for camp sites and seek development approval from the government on the selected sites. The camps tend to be far outside town like the pipelines. Willing landowners will be sought to host the camp for us probably about 2014/2015.

6. How many people will be in each of your camps?

The main camp will probably house about 500 people, and the slide camp, which is the first camp that goes in, about 150 people. It just depends on the construction contractor and how he wants to run it; there might be two smaller camps as opposed to one larger camp.

7. The reason for my question is my colleague and I are from Moranbah Medical, one of the two general practices in town. It's been an historical problem for us that companies with camps mistakenly assume they don't impact on a town's infrastructure. With a camp of 500 people we will see significant numbers of extra patients. It will be important closer to the time to ensure your community relations people talk quite closely with Queensland Health and with the private GP services. At the moment one in four of our patients is a non-resident worker, so whether they come from Coppabella or one of the other camps near here, we see significant numbers and they are rising. One in three of the presentations to the emergency department is a non-resident worker so we hope that Arrow's not going to make the mistake that has been made in the past, i.e. assuming there won't be an impact.

No, we understand that and it is part of our emergency response plan. We will be in contact with all the GPs and hospitals. Our camps are normally quite a way from towns so we have Careflight helicopters and we have a full-time paramedic as part of the camp. We are aware that we do have to make arrangements with the local medical service suppliers in communities. And that's not just in Moranbah, it's everywhere.

8. When are you expecting to put the contract out to tender?

It will probably be the end of 2013 for the pipeline because we're looking at a combination of the Bowen and Surat. Our contracting strategy has not been finalised so we may split it into two separate contracts or maybe one big contract for both pipelines.

9. **Comment: in regards to the medical question, it's really important that everyone responds to the EIS document, so don't just assume that someone else is going to do it for you. If you have particular queries or concerns, make sure you write a response to the EIS. Council will respond, but obviously the more responses that come through, the more likely that the Coordinator-General introduces guidelines that Arrow has to implement. So just be mindful of that.**

The Environmental Impact Statement (EIS) process generally takes two years. Legislation requires that major projects go through that assessment before development can commence. In our industry we tend to do exploration and lower level of activities under normal environmental authorities and then when we get to a point, as Arrow has now, where industry is proposing large scale projects, we fall within the category of an Environmental Impact Statement. The process that Arrow is going through is a voluntary EIS process which is under the *Environment Protection Act*. It's managed by DERM, not by the Coordinator-General who manages projects with 'significant project' designation, which we didn't seek.

In coming months Arrow will do a lot of EIS technical studies for the Bowen Gas Project, like we have for the pipeline. By the end of 2012 we'd hope to have submitted the EIS to government for assessment against the agreed terms of reference. If DERM believes the EIS meets those terms it will go out for public comment. This gives anyone in the community an opportunity to comment on any aspect of that project; Arrow will be provided with the comments and must come up with responses to them.

If there are some significant issues we fail to address, we will be required to submit a supplementary EIS which goes back to government for approval, after which it issues a set of conditions. Those conditions are not an approval to go ahead and develop the project; they are merely an approval to say you have completed that level of assessment. Then we need to apply for all the development licences and permits (and environmental authorities) to be able to start work. So the EIS is just one stage towards being able to start the project.

10. **How do you explain to lay people that you will be any different from what has been happening down south? How do we go back to our community and say *Arrow assures us its project is not going to be as dangerous as everyone predicts it will be?***

I'll clarify to start with that Arrow also has a big presence down south, so it is one of the four proponents operating in the Surat Basin. I assume by the 'dangerous' comment that you're referring to groundwater impacts rather than anything else. The issue of groundwater is one which I think is just less understood by most people because of the amount of knowledge we have about it and indeed what the actual impacts from that type of activity are. A lot of media and other information that's out there in the public at the moment isn't necessarily factual; a lot of it is based on different types of projects, different circumstances, different regulations, different geology.

What we do here in Queensland is quite different to what we see coming in from other parts of the world. We do not believe the project will have the devastating effects that people are talking about. The water we take from the coal seams is not toxic water, it's not poisonous, although it does have a reasonably high salinity level. That said, it's only about a sixth of the concentration of sea water so in the scheme of things that's not as bad as people tend to make out. We do need to treat the water because of that salinity, but not for any other reason.

We also use the water we currently produce for a number of purposes e.g. cattle at feed lots, some irrigation, and a few industrial processes as well.

In relation to explosion and other potential dangers put out there, there's not a significant risk of that either. Arrow did have an incident recently with a well blowout; it has come up at a few of our sessions this week and was identified as part of the process of drilling the well. We've since rectified that issue and it should not be an issue in the future. We've also done an extensive risk assessment around bush fires and the potential for such disasters. The risk assessments have demonstrated the likelihood is low of anything happening, and that having wellheads throughout the region is not a fire risk. The Commissioner for Emergency Services has confirmed he supports the risk assessments that have been undertaken.

11. Does fracking come into that as well? Can you explain what fracking is, please?

Fracking is hydraulic fracturing which, as the name suggests, is a fluid injection process. We inject water (99.5% water and sand and very minor components of other additives which Carey referred to earlier in the presentation). The process injects some pressure into the coal seam to increase its permeability. The process is not harmful the way it's done in this industry; with the coal seams and the way they are structured, there is a type of preferential pathway for the fracturing to occur. We induce a radius frac of about 100 metres around the well itself.

We have committed not to frac in the Surat project area but we have done some fracking trials in the Bowen Basin. We're still determining what the best method of drilling is up here and there are several options. It may be a better option for us to drill horizontal wells along the coal seam in the Bowen but we're still evaluating what the technology might be if we need to do it.

12. In regard to fracking again, it's not your policy to do it at this point in time. Is that correct?

It's not our policy in the Surat because the permeability of the coal there is an order of magnitude higher, and the permeability of the coal determines how deliverable the gas will be. In the Bowen Basin we talk about permeability in millidarcies, often around one or two millidarcies. In the Surat Basin we'd talk about permeability in darcies, up to ten darcies. We would be wasting our time, money and effort fracking in over 95% of the Surat tenure.

13. With respect to the additives you were talking about for fracking; you said you still haven't decided what they will be...or is the information available on your website?

It's public information. We use sodium hypochlorite which is a type of bleaching agent, and acetic acid which is vinegar.

14. That's Arrow's policy, but there are other companies that are still using BTEX, isn't that correct?

No, BTEX has been banned in Queensland; a responsible company would not knowingly use it.

15. The Queensland Government says it has banned BTEX but it hasn't actually followed through in legislation yet, has it? Is that correct?

It is regulated under the *Petroleum and Gas (Production and Safety) Act*. Requirements around that have already been implemented. In the *Environmental Protection Act* and Regulations, it may not be directly referred to but our environmental authorities have conditions around them which require a whole range of activities, including monitoring, and specifying what can and can't be used. It's quite clear that we can't use anything with BTEX in it and certainly don't intend to do so. There is a fact sheet over there on fracking.

16. As has been reported in the media, the Queensland Government still hasn't released a full list of the chemicals to be used; can you comment on that?

That's the type of thing I referred to earlier. There are many non-factual items in the media. All the information about frac chemicals is available. There is no secret. There's not really a lot to reveal; we don't use those nasty products.

17. We've seen footage of gas coming through water lines. What causes this and how can it be stopped? How can water well be un-poisoned once it's poisoned?

For the people whose wells had gas burning in them, that's been happening long before the CSG industry came along; there are notable instances of it a hundred years ago. Farmers and graziers have been drilling down and extracting water from coal seams without even knowing they were doing it. The water from coal seams is normally not sweet enough for someone to want to drink, but this is what they've done. A gas well has pretty much the same design as a water well. They're very similar things, as I said; their water bore is essentially working as a gas well.

18. The one I'm thinking of is near Tara very close to a property I grew up on and we never ever had any trouble with gas in our water.

The gas is coming from a coal seam, because that person has drilled into the coal seam, and that well is extracting gas from the coal seam.

19. I'm just wondering what the workforce living in Moranbah is expected to be once this pipeline goes through, and is Arrow going to do anything towards providing housing for the region?

We do offer incentives and it's our preference that people who work here full-time live in the community although a certain number of our staff will be fly in/fly out...currently 30% is the nominal figure. We would ideally like to attract more people to live in Moranbah. We do offer healthy incentives for people to move who wouldn't otherwise be able to rent in the area.

I'm not sure if anything's moving forward but we're always reviewing that process. As you know, the rents in Moranbah are quite steep and fluctuate wildly during periods of boom. We try to address it though and try to encourage our people to live here with their families.

20. What are the expected numbers? Can you provide a percentage increase?

Although Iain talked about the pipeline project scope, it's still very early stages for Arrow in terms of any other development. As we develop the project description for the proposed Bowen Gas Project, we won't be in a position to start to understand what that will mean in terms of workforce numbers, timing and development. We would anticipate that we'll be able to come back to you with some of that information in twelve months.

- 21. I just want to go back to the question that was asked earlier. I'm sure a lot of you here would have seen that 60 Minutes program some months ago where they showed the guy who'd been on the property for a long time, with the gas coming up with the water. Can you explain a little more about the history and what goes on with those types of things?**

In the particular instance you referred to, a gas well has been created. The farmers have actually drilled their water bores into the Walloon Coal Measures, the same strata from which our gas comes. What they've done is de-pressurise the well over time and, as that happens, the pressure drops in that particular part of the aquifer and gas flows. That particular person has, I think, another six bores in and around that area; not all of them are doing that.

That's often due to the geology because it changes around there; there are some unique pockets where more gas will be present than usual. The other water bores you refer to, ones you used when you were growing up, may be connected into other aquifers. There are quite a few into the coal seams, but the majority of bores out there aren't connected to a coal seam, but into other aquifers above or below. It's unlikely they will ever have gas in them. It's not as though the gas migrates right up through the strata and into any water bore; that just doesn't happen.

The landowner will tell you that he did that when he was interviewed as an old party trick. That guy is actually on Arrow tenure and we've had a lot of positive dialogue with him about the issue.

- 22. In relation to the Bowen Basin pipeline that goes to Gladstone I believe it is quite large compared to the one that goes to Townsville. Because of its length, what monitoring systems are there to check for leakage and that sort of thing, particularly with the ground movement that started in the area a bit north in recent times? What measures are there to monitor the pipeline for leakage?**

To start off with, the pipelines are divided into segments in between the mainline valves. The temperature and pressure in each of those segments is monitored so we will know if there's a leak anywhere along that section. Are you talking about coal mine-induced ground movements or are you talking about natural ground movement?

- 23. Natural ground movements because I don't know where the pipeline is going to run compared to the coal mines. I know some of their overburden shots wouldn't help you at all, but at what sort of pressure is that pipe likely to be running?**

The pipeline will be designed somewhere between 10.2MPa and 13.3MPa but will probably run closer to 9 to 10MPa. Arrow will be able to pick up relatively small leaks from the differential pressure system. A large leak will be very obvious and will automatically shut down the pipeline. Even a very tiny leak is detectable because the ground around it freezes and you can clearly see dead vegetation in that area. Normally we fly along the pipeline and we pick it up by the change in vegetation. Around the more densely populated areas towards Gladstone and Rockhampton we'll be looking at a leak protection system which is effectively a microphone, a fibre optic microphone that runs parallel to the pipe and can pick up the tiniest of leaks. It will be able to hear the leak just as it can if a large vehicle or an excavator approaches the pipeline. As the machinery is loaded off the truck we'll know it's happening so will be able to send somebody there to find out why it's close to a pipeline.

- 24. Obviously you have heard about the Bowen earthquakes. What would happen if we had that scenario and you're all systems go? I know I'm playing devil's advocate here, but what would happen? What do you have in place?**

In Australia the only real record of a pipeline being affected by an earthquake was in the Northern Territory. It had a very large earthquake and the fault shifted in the order of six metres. One end of the pipeline contracted and the other end was stretched. The pipeline never lost its integrity as steel can stretch a lot. We also look at every single fault zone; there are certain methods that we can apply to the pipeline trench that will allow it to cater for those types of faults. We have potentially active faults near Gladstone and we monitor them. We've done a lot of study on them and there's a methodology that we will apply to make sure the pipeline remains intact, even if you have a major shift that could cause massive devastation to the surrounding areas.

- 25. Just to add to that, I think the biggest concern is that everyone thought a nuclear power plant in Japan was a good idea at the time too, and then a natural disaster hit. I think the biggest concern is that natural disasters do happen and when they do will these big gas pipes come out of the ground.**

Normally we tend to stay far away from towns. We do get close to a few houses in rural areas but that is taken very seriously. If there's a risk of a natural disaster like an earthquake, we make sure that the wall thickness of the pipeline is a lot thicker than a standard pipeline. A lot of the Shells guys have more experience from the Sakhalin project where they go through eight to ten fault zones in far northern Russia. It's fairly standard practice to put pipes down through faults and there are fault-proven methods that cater for it. To the best of my knowledge, there's never been a pipeline fail because it was involved in an earthquake.

- 26. Are you looking into housing issues, it's a very big issue for us here. Why can't new land be opened up? It's imperative that you do your homework.**

It's certainly an issue for us and we recognised that some time ago. The company does have quite a few people looking at various options and working towards solutions. If we don't take this issue seriously now and start to work towards solutions, we won't be able to maintain the business that we have, let alone expand in the future. So we are working on that and we do know we have responsibility to make it happen.

- 27. In regard to salt management, once you add up the hundreds and thousands of tonnes of salt that will be produced once the project's up and going, is it just going to be stored on the site? You said none of the companies like Arrow have contracts or any undertakings with any other business to take on that salt and get rid of it**

The long-term objective is to beneficially use the salt and Arrow's committed to doing that. The conditions in our approvals already say that we must take it away from the site. We are looking into various options which were alluded to in the presentation. There are a few issues including that we haven't yet taken the final investment decision on our large-scale project. Also, until we get that approval we won't understand the actual volumes of salt, so we won't be able to negotiate any contracts with particular companies.

The other thing we're doing is working collaboratively with other CSG companies in the Surat. The primary reason for that is we won't be producing enough salt on our own to be able to

support a chemicals industry which produces some beneficial use product, so we need the salt from all companies to make that happen. The technology is there. We're sampling and doing trials on crystallisation for the types of water that we have, and we're all quite serious about working collaboratively on that as a solution in the future. First we do need to have a good handle on the volumes and timing of the salt to be able to sign somebody up for a contract to invest in it. In the interim it is in our brine ponds, and the standards for those dams now requires that we have a double lining with a seepage detection and return system; there's also very strict monitoring around those particular dams as well. We do take the salt issue very seriously and we realise the impact of salt, particularly in the high fertile agricultural areas.

- 28. About 15 years ago there was going to be a pipeline from New Guinea carrying natural gas. It just seemed to die and no-one ever heard any more about it. I know some pipeline's been put in because I come from Maryborough and there's actually a pipeline that comes to Maryborough. But what happened with that project?**

What happened is that coal seam gas appeared on the scene and it wasn't needed any more. A lot of people who work for my team actually were involved in that pipeline route and our pipeline route is very similar to the one that was put forward by AGL and Petronas at the time. We're now exporting gas and don't need to import it, thanks to the CSG industry.

- 29. Comment: I'd like to say that we've been dealing with Arrow Energy for a while now and they are a really great bunch of guys to deal with.**

Thank you very much; most appreciated.

- 30. As an ex-Gladstonian, I'm now a Moranbahian of 40 years. However, I do have all my family down there and when it comes to cumulative impact, they have the most I've ever seen. Curtis Island used to be a pristine little mud-crabbing area. What do you say to the people of Gladstone who believe it's going to be detrimental to the harbour's health with all the cumulative issues happening there at the moment?**

Through the EIS process we're trying to engage with as many people in the community as we can, including fishing and recreational groups, and all of those other people who have concerns. What we have found is that people are a bit fatigued with consultation, talking about issues and working through some of the solutions to those. In the EIS itself we are working through those things that have been identified. As the last LNG company to go through the EIS process there are some advantages and disadvantages. One of those disadvantages is that we need to study the cumulative impacts more than the other proponents. It's something that is built into what we propose in our social impact management plan and the way that it's being managed. We're trying to take the pipeline across to the island quite differently to the other companies. We're staying away from The Narrows and considering putting the tunnel in closer to Gladstone itself. We're really trying to work through some of those issues in a meaningful way. Arrow's EIS will be submitted at the end of this year and then will be out for public comment early in 2012. That'll be another opportunity for engagement and trying to work through any residual issues that might arise.

- 31. Because of all these TV shows we've seen lately like *Insight*, *7.30 Report*, *Lateline*, the *GasLand* documentary I know it's different in the States because they frac and often with noxious chemicals. You're saying that with Arrow we've got absolutely nothing to**

worry about in regard to fracking chemicals, water tables being reduced or any other concerns like that at all?

In relation to the fracking issue and groundwater becoming poisonous, I'm saying no, we don't believe there is a significant risk. In relation to water table levels, we're still studying that. We believe there will be some drawdown in some aquifers and our groundwater modelling at this particular point in time is showing that it will occur. We're currently working to expand our groundwater monitoring program. That will mean we're actually monitoring various aquifers and the levels in them, so both quality and pressure. What that will allow us to do is calibrate the model over time, so take the real time data, and compare that to what we've actually predicted. That will allow us to understand whether we're on the right path with our predictions, or whether we need to refine the modelling to reflect what we're actually seeing. The model itself is based on 10,000 groundwater bores and core samples. Over 4,000 of those gave water quality data as well. We've proposed a lot more work to better understand the interconnectivity of various aquifers, particularly around the Walloon Coal Measures and the Condamine Alluvium which are very important areas and significant water resources. That's one we will be following very closely.

There are probably 7,000 or 8,000 gas wells in Queensland. There is a very strict regime of testing and reporting on gas leaks around wells; the figures were very small re the number of leaking wells. If a well is leaking, there's generally a reason, a maintenance issue or something that hasn't been picked up. If there's a severe downhole problem we're quite able to remediate it, bring it out or cement it up. The risk is very small. I think there's been a deliberate demonisation of the industry and yes, I think it's a very safe, efficient, clean and productive extraction of an energy resource. I don't think the industry is anywhere near as bad as it's been made out to be.

32. Can I ask how many people here have seen the *GasLands* documentary? SBS television ran it and it was also run in some movie theatres. Some of you have seen it...Carey will you comment on the difference with the Queensland scene?

In my mind the difference between shale gas and CSG is the maturity of the coal source. In coal we're dealing with something that's 60, 80, 90% carbon-based. It's at very shallow depths and has only been cooked up to a certain level. A fair proportion of our gas is actually sourced by bugs that eat the coal and produce methane from it, and that methane is absorbed on the surface of the coal. Coal's a very fragile reservoir, much like a sponge. The surface area of coal is massive in comparison to its volume. When we go to shale gas, we're talking about rocks that have between two and four per cent organic content in them. They've been cooked up to much higher temperatures or at much greater depths; this is as opposed to coal seam gas where we get 98 to 99.8% pure methane with a little bit of nitrogen and maybe a bit of carbon dioxide although we do see hydrocarbons, condensates and other things. And typically in the US the shale gas has been left to evaporate rather than be beneficially used. So there's a huge difference between what we produce as well as a huge difference in the technology. Here we do SIS (or horizontal) drilling whereas with shale gas they do horizontal drilling and fracking. It's a very different industry.

33. Could I go through this list of questions fielded on Monday at the Proserpine meeting. There's probably about ten or so here.

The first question is how the emissions are monitored but I think we've covered that. What percentage of production will be exported?

That's a difficult one. What we're proposing as part of the Surat Gas Project EIS is that the gas will go both to domestic and overseas markets. Currently there's not a high demand for it in the domestic market but that may change over time. We will continue to supply gas to meet existing, and future, domestic contracts. We will obviously commit to supply a quantity of gas in our LNG contracts and will meet that as well. It's difficult to nominate a percentage. The Bowen Gas Project, which is only proposed and yet to be described, and the yet-to-be defined field development plan are still under development.

34. How are you going to deal with the excess salt build-up? There was also mention contracts had not been sorted to deal with that salt.

I said earlier that we're committed to taking the salt away. We're already working on the salt quantities, predicting when it will be available and trying to work towards securing a contract. At this stage we can't physically do that, but we are working very hard towards trying to define the project and work towards that goal.

35. The integrity of your reverse osmosis process and the waste water: do you have proof that it is working, and working well?

Reverse osmosis is a proven technology and is quite widely used. Arrow has plants in the Surat Basin using reverse osmosis where we are working on a recovery rate of between 10 and 20% brine and we might be able to improve that over time. The water quality testing that we do (both on the water that goes into the plant and that comes out the other end) demonstrates that it's effective.

36. In what form will you be offering offsets for the clearing of natural eco systems?

You might be aware the Queensland Government has just released its Biodiversity Offsets Policy. There are a whole range of options that can be exercised under it and there are also requirements in our environmental authorities for existing activities to enter into offset arrangements with the government. There will be other cases, particularly with the proposed LNG expansion, where offsets will be imposed and there will be set ratios of clearance versus what we need to actually remediate or support over time. As an industry we'd like to work towards a more constructive offsets arrangement where we can collectively join together to make a real difference in terms of the offset, rather than doing it in small piecemeal arrangements. These are the discussions we're having with government at the moment, but there are lots of options.

37. Can I ask if everybody knows what offsets are? Can you explain the concept?

If we clear any vegetation, or indeed if other industries do, there's a requirement both at state and federal levels for us to then reinstate an equivalent quantity of vegetation or eco-system or habitat. So however an offset is defined or whatever the impact, it's basically a like for like. The quantities, however, aren't one for one, and in some cases it's one in 100 so if one tree is killed you might have to plant 100 trees or purchase an area supporting the same type of eco-system, remediate it, and convert it to a conservation area which will essentially be locked up forever.

In relation to the Surat Gas Pipeline we've purchased a property to offset some small abandoned cycads. It's a federally endangered species, so we've undertaken to replace at a rate of five to one. For every one of those cycads we dig up, we have to try and translocate them; even then we still have to have a five to one offset. We've purchased a property adjacent to a National Park and we'll be planting cycads inside that property which is an almost overgrown weed-infested piece of ground. We'll clear it up and plant the cycads in it and then give it back to the National Park.

38. How close are the production wells to each other?

CSG works around a lot of complex relationships between gas content and gas saturation and permeability, so it's not a straight line equation. You have to work out what your reservoir characteristics are to determine the well spacing that's going to efficiently extract that gas. Nominally we'd work at about 800m in the Surat where we have high permeability. We can even get them out to 1 to 1.5km if we were really pushed. The production curve and declines all change, but at the end of the day we get a similar amount of gas from them. Here in the Bowen Basin, where it's very tight, we might have around 250 to 500m between SIS wells, but they do get tighter in places where we drill in our chevron-style pattern.

39. What's SIS?

SIS is surface to in-seam horizontal-style drilling and a chevron is a V shape. The proximity of wells is not an easy one to answer and it varies based on all the reservoir characteristics. We are flexible; we have sat down with irrigators in the Surat, looked at their properties, the way their drainage works, and at where they have head drains. We've then sat down and told them where we'd like to put wells on their property. They come back and tell us which wells really wouldn't work for them. Then we consider the comparative figures without those wells and there is usually enough flexibility to make changes. What I really want to get across is that well spacing doesn't necessarily mean a grid pattern of 800 metres.

40. Are you telling the public that once production has extracted all the easy gas then Arrow has to frac to get the rest out?

As I said, it's only in the Surat that we have committed not to frac as it would be a waste of time and money when the coal seam is so permeable there. In the Bowen Basin it is different as we have very tight coals; we use horizontal style drilling to open up a lot of the coal to a well bore and that overcomes the permeability trouble. Because of the high quality thick seams that we have in the Bowen that is usually the preferred option.

However, as we start to go deeper, i.e. the 600 to 800 metre mark, it becomes more and more difficult to justify the cost of drilling a well like that. We're currently doing technology trials on techniques like radial drilling. This involves the use of coiled tubing, so it's a bit like a string that goes down and it can bend very easily and very tightly, and then you drill out into the seam. With a jetting style where we don't use a drill bit, we use high pressure water to drill out into the seam. We're looking at combinations of different SIS horizontal drilling technologies, drilling out and drilling large leaf-like patterns into the coal to figure out what will work best for us. Fracching is not necessarily the answer as the trials we've done so far have been unsuccessful.