Introduction

In October 2011 Arrow Energy (Arrow) held a series of community information sessions to provide an update on the Surat Gas Project, and to communicate the preliminary findings of, and the proposed strategies for, the associated Environmental Impact Statement (EIS). Questions and answers from those sessions were captured by JTA Australia and are presented in this document.

The purpose of these meeting notes is to reflect the questions asked and answers provided during the community meetings. While the notes include some paraphrasing and summarising; every effort has been made to preserve the integrity of the discussions.

Questions varied across the six sessions. To ensure that valuable information is shared amongst the communities of the Surat Basin, these notes contain questions and answers asked across all sessions.

The Surat Gas Project community information sessions were held from 24 to 28 October 2011 at:

- Goondiwindi 24 October
- Millmerran 24 October
- Dalby 25 October
- Cecil Plains 26 October
- Chinchilla 27 October
- Miles 28 October

The proposed project is Arrow’s largest gas exploration and development program in the Surat Basin and involves continued exploration in the basin to identify the most economic and environmentally acceptable areas for future gas production. The areas covered by the project extend from Wandoan to Dalby and south to Millmerran and Goondiwindi.

Copies of the presentations given at the October community information sessions are available on the Arrow Energy website at www.arrowenergy.com.au.

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. In others, additional information is included to provide further context or explanation; this information is italicised following the answer.

Arrow will hold another round of information sessions in April or May 2012 to coincide with the public exhibition of the EIS. The purpose of those sessions will be to present the EIS and to assist the community to understand its results. Arrow will advise of session dates nearer
to the time. If you have questions or comments about the project or these meeting notes, please contact the project team during working hours on:

freecall 1800 038 856
email: suratgas@arrowenergy.com.au
post: Surat Gas Project, Reply Paid 81 Hamilton QLD 4007

Acronyms
ATP  Authority to prospect
CSG  coal seam gas
dB  decibel
DEEDI  Department of Employment, Economic Development and Innovation
DERM  Department of Environment and Resource Management
DNR  Department of Natural Resources
EA  environmental authority
EIS  environmental impact statement
EMP  environmental management plan
FID  final investment decision
GAB  Great Artesian Basin
GJ  gigajoules
kPa  kilopascals
LNG  liquefied natural gas
PJ  petajoules
PL  Petroleum lease
psi  pounds per square inch
QWC  Queensland Water Commission
RO  reverse osmosis
SAR  sodium absorption ratio
TDS  total dissolved solids
TRC  Toowoomba Regional Council

Conversions
1 megalitre (ML) = 1,000,000 litres
1 gigalitre (GL) = 1,000,000,000 litres

Queensland Government Acts mentioned:
Environmental Protection Act 1994
Petroleum and Gas (Production and Safety) Act 2004
Mineral Resources Act 1989
Water Act 2000
Water Supply (Safety & Reliability) Act 2008
Figure 1 – Diagram showing predicted impacts in 2024 and 2061 with no mitigation.

COAL SEAM AQUIFERS
(WALLOON COAL MEASURES)

➢ Peak impact in 2024 with recovery occurring as abstraction winds down
➢ With no mitigation
Figure 2 – Diagram showing example of potential well-field layout
Figure 3 – Map showing Surat Gas Project area
**Figure 4 - Moranbah gas processing facility**

**Figure 5 – Slide showing substitution to maintain water balance**

**CONDAMINE ALLUVIUM**

**HIGH LEVEL STUDIES**

- Substitution to maintain water balance

Past

<table>
<thead>
<tr>
<th>Recharge</th>
<th>Landholder off-take</th>
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<tr>
<td>12.20 GL/yr$^1$</td>
<td>46.4 GL/yr$^1$</td>
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<tr>
<td>36 GL/yr$^2$</td>
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Future?

<table>
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<tr>
<th>Recharge</th>
<th>Net off-take after substitution</th>
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<tr>
<td>12.20 GL/yr$^1$</td>
<td>&lt; 46.4 GL/yr$^1$</td>
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<td>36 GL/yr$^2$</td>
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- CSG Leakage
  - Average of 1.8 GL/yr
  - A cumulative volume of 90 GL by 2065

1. DERMP 2010, central Condamine Alluvium data availability review
2. CSIRO 2008, upper Condamine groundwater model calibration report
Figure 6 – Slide showing predicted impacts on the Condamine Alluvium without mitigation

SHALLOW AQUIFERS  
(CONDAMINE ALLUVIUM)

- **Cumulative impact** of all CSG proponents **without mitigation**

- **Maximum incremental impact** in **2065** of **~2.5m** (potential uncertainty range of 1 to 4m)

- **Impact** in western portion of Condamine Alluvium

- **With no mitigation**
1. Could you elaborate on the subject of confidentiality agreements between Arrow and landowners?

That is actually quite a hot topic and a number of people have raised it. Arrow doesn't have any objections to the confidentiality clause being removed at the request of the landowner. This has been Arrow's position for a number of years.

Arrow does have this clause in some agreements at the request of the landowner. It is always optional in Arrow's view, or at least has been optional for a number of years now.
1. **How many pages long will the EIS document be?**

When Arrow is preparing the EIS it doesn’t really look at the length of the document so I can’t give a definite answer. It will be at least several hundred pages, including the EIS itself and the technical studies.

_Correction – the EIS is likely to be several thousand pages._

2. **Can I assume that the discovery process for the EIS will uncover everything of relevance (for example I have a licensed bore and a water entitlement)? Should I volunteer to Arrow that I have an irrigation bore I am concerned about?**

Part of the process of the EIS is to look at groundwater and Arrow’s potential impacts and usage. However, there are a number of other processes that apply to Arrow’s tenures in general. One of those is developing an understanding of all the bores that are in existence out here, and also starting to take steps towards doing baseline assessments on all bores in tenures where we are going to be producing water.

So yes we have that in our database, our model has been built from all the available information including registered bores and geological cores that have been taken. If the Department of Environment and Resource Management (DERM) already has details of your irrigation bore then Arrow will know about it.

3. **How long is the consultation period for the EIS?**

The EIS will be out for public consultation for a period of between six and twelve weeks. Depending on the feedback during that initial round, there may be a supplementary EIS. Arrow is currently assuming that a supplementary will be required by the Queensland Government as it has been imposed on the other three proponents.

4. **Will you be supporting the consultation with information sessions or other activities?**

There will be detailed presentations on specific things that Arrow is doing at the moment, particularly around groundwater and the impacts on agriculture, and how to mitigate the impacts on agriculture as well. You will be able to find these presentations on the Arrow website (www.arrowenergy.com.au).

Arrow will also be doing another round of displays and information sessions after the public release of the EIS documents (early next year) to run through the specifics of exactly what you can expect to find in the EIS document. We won’t be presenting the details of every single thing in the EIS, but the summaries are starting to come out now. Have a look at the Arrow website; there is a lot of information already on it.
5. **Bow Energy is an offshore company isn't it?**

No, Bow Energy is an Australian company. If you are a keen watcher of the Australian stock market, you might remember that Bow and Arrow were established by the same group of people, and were then split in half. Arrow was the company that held the CSG assets, and Bow was the company that held the conventional oil and natural gas assets.

After they split apart, Bow decided to move into CSG because that was where the industry was heading. Since then, Arrow has been bought out and subsequently became interested in Bow. So in a sense the two companies are just reverting to the original situation where they were operating as one.

6. **Re: salt, I understand you've got a long term resource, although if you are exporting it all over the world I guess it won't last as long as if we were using it here. It's said that you are going to sell some of that salt, but you'll never sell all the salt that is going to come out of this will you?**

I'll get Scott to talk about it in detail, but the problem is that we don't have enough salt. I say that only half-jokingly; it takes a lot of salt to convince someone to build a factory to convert it into products.

We are in discussions with a couple of the larger companies that supply chemicals all over the world. And I'm talking about chemicals that aren't particularly nasty but used for things like glass manufacture. There is a lot of glass used in the automotive industry for windscreens and other items like that, and we know a lot of that industry happens in south-east Asia.

One of the companies that we are talking to at the moment about producing salt products from our waste water is looking to export all that salt to South-East Asia for use in the automotive and glass manufacture industries. That is just one of the potential uses. Australia is a net importer of salt, which is hard to believe.

Cheetham Salt is an Australian company that has drying beds all over Australia e.g. in North-Western Western Australia. Cheetham produces a lot of the salt that is used in Australia, but we still import a lot so there is a market for the salt that we are able to produce from our water.

7. **Can you explain a bit more about the groundwater and substitution and how you are going to manage that?**

That is a pretty open ended question and I probably can't answer all of it, but I'll start with the substitution and how we came up with that as part of our strategy.

We recognised the extraction of water required for the CSG industry would have an impact, and that we couldn't do that in isolation. The agricultural sector in particular was obviously concerned, as most of you are trying to wind back your water production to reach sustainable levels. We realised we'd be run out of town if we just said “right that's our water and we are transporting it out of the region” so we decided on a strategy that is designed to minimise the net take of water from the basin.

Substitution of allocations is one of the methods of achieving that. So when we talk about substitution of allocations what we mean is that we will take the slightly brackish water that is in the coal seams, treat it, and then deliver it in a pipe to someone who already has an
allocation for water. There are still some regulatory issues around that e.g. production and use, and matching those up.

There are other methods that we expect we will have to use such as reinjection and use on our own farm. Currently we also supply water to power stations and for other industrial uses. In brief, substitution is when you guys stop taking water, and instead we supply that water to you.

8. I want to talk about cross aquifers. At the last meeting you indicated you would be extracting water from the Walloon Coal Measure and indicated that you might be giving some of that water to the Condamine Alluvium for example. Now in theory that is good but the reality is that the Condamine Alluvium is over-allocated already. Over the last three years we've been seeing reductions in our allocations on that aquifer. For those people who are already on the Walloon Coal Measures, how do you actually guarantee they are going to have a sustainable water supply going forward?

There is absolutely no doubt that the Walloon water users are going to be impacted by our activities. We don't try to hide behind that, we don't give you a BS line. But you will get priority to the water.

We have a legal obligation but it is also part of our plan to make sure that we replace the water in the area that we take it from. We would not leave you dry to send water 50-100kms up the road. ‘Make good’ is the language in there.

9. Do you know how much of the current agricultural water is taken out of the Walloon Coal Measures? And are you looking to balance that up? For example, if I've got a 500 ML licence, I'm entitled to get some of that water back if you're on that same aquifer, but what happens if the total licence is 5 GL and you are extracting 10 GL? How do we ensure the long term sustainability of the aquifer if you are outstripping the current allocations from that aquifer, but still giving (for example) 5 GL to another aquifer?

I guess what you are saying is that it is relatively straightforward while there is still water there and we are treating water that you would otherwise have pumped. In the longer term we are going to have to move water around to make good. We won't be pumping and extracting from every area in the basin at the same time; that will happen over phases. We don't need to do that, so that will be one of the options for obtaining water.

Over time, there will be some recharge. We are still in the modelling and data gathering phase, but it looks like the recharge rate is better than expected and we should be able to bridge the gap on a local basis without having to haul water from (for example) Wandoan down to here.

10. You say that (recharge) water doesn't move very fast in the Walloon Coal Measures. How are you going to get it back in there? The recharge might be better but it would take a long time wouldn't it?

In the time that it will take for the water to recharge the Walloons, it will be incumbent upon us to ensure that water supply is provided from somewhere else, whether that is from another
part of the project that is being developed, and water is being transferred to that area. That could be one option.

11. How would it get there?

It would go via a pipe network.

12. What is the quality of the water that goes back in? Is it very salty?

The water that we'll put back in will be better quality than the water that comes out. We can’t give you an exact composition because we'll need to match it to what’s in the aquifer or what suits your land. So if it is reinjection we can’t just put clean water down into the ground, it has to match what is in the ground...and the same with farming. That is one of the reasons that I talked before about the Daandine and Theten farming project. A big part of that trial is for us to get the remineralisation of the water right. If the water goes straight through a reverse osmosis treatment plant, it won’t have enough of the right minerals in it which means it can strip minerals out of the soil. We’ve got to get that right, and we are using calcium chloride at the moment to amend the sodium absorption ratio (SAR).

13. I've got a government list here with a lot of chemicals on it. If you pump any of these into the coal structure, how far will they travel? And secondly, when they are in the coal structure and it is a drought period and the ground cracks, is that going to go down and cause more gas to be released as well as pollution?

When the ground cracks it will neither affect the integrity of the well nor the integrity of the coal seam reservoir. The wells are designed in such a way that they are immune to those types of stresses. Generally speaking, the top of the coal is 150 to 200 metres underground and there are alluvial aquifers, sands, muds, all sorts of strata on top of it.

14. But in some places there aren't any strata on top of the coal.

Yes there are places where the coal is shallow, but there isn’t any gas in those seams.

15. I have heavy black soil under my ground. When we drilled there for water years back you could smell gas in the bore when it was opened up.

Sorry I shouldn’t have talked in absolutes. Yes, there is gas, there will be gas, but it won’t be of interest to us. There won’t be enough gas in a shallow coal seam for a CSG project. I don’t know about other companies but if they do it the way we do they won’t be interested either.

Note too that methane has no odour, so it is suggested as a possibility that gas able to be detected by smell may have been hydrogen sulphide (rotten egg gas) which can occur, for example, in stagnant pools of water.

16. When the coal releases the gas, does the land subside? Can there be subsidence after it has been extracted?

In theoretical terms, yes, as we are taking the water out of the pores in the coal. This "porosity" of the coal is a only a couple of per cent, so it is not like in a loose sandstone aquifer where the water is a large part of the volume that is there, and when you release that pressure then it collapses quite significantly. We expect that in reality there will be no subsidence, since the strength of the remaining coal will be more than adequate to maintain
the structure of the seam. Regardless, we will engage an expert in geomechanics to model these effects for us.

There may be some stresses, but there are other stresses, e.g. rock mechanic stresses that we expect will equal it out so there will be no massive changes on the surface from that process. And there is a lot of rock in between that top coal and the surface.

17. I have some concerns, and I’ve expressed those to you singly and collectively. A few months ago I believed there was going to be a significant amount of water removed from the Walloon Coal Measures, in fact the word ‘dewater’ was used, and I guess that is enough to put the fear of God into most people who access the Walloon Coal Measures around Millmerran. Now I explained to you before that when I was first elected Mayor of this community we tried to obtain the best knowledge available in Queensland. We got Professor Ray Volker to tell us about groundwater, and the impact that extraction of significant amounts of groundwater is likely to have on this community.

Quite frankly I would suggest we probably wasted the $10,000 that we spent there, because at the end of the day there was nothing definitive. The point I want to make is that obviously there has been a change either in terminology or in the science in the last few months since I picked this information up. I think you’ve got to recognise the fact that the extraction of significant amounts of water out of the Walloon Coal Measures will have a significant impact on the economy of this community. ‘Make good’ is fair enough but before I was prepared to back any projects like this I want to make sure there is some comfort if you are going to continue to extract water out of the Walloon Coal Measures. They are sensitive, they are not high-producing, and dewatering could be the effect.

The other matter is environmental impact studies. It’s all very well to do them but even organisations like the one I’m involved with, i.e. the regional council, have real problems with the complexity of environmental impact studies. And we’re not Robinson Crusoe here, Western Downs, Roma - all those councils have real trouble interpreting what the likely outcomes are as a result of environmental impact studies.

These are comments and I’d like your response to them please.

On the first issue (i.e. the use of the term ‘dewatering’), we have used insensitive language about things like that – we will not ‘dewater’ so that there is no water left in the coal. That is not what happens. I’m qualified to make that apology – if you google my name you’ll see a really stupid statement that I once made that we would drain the countryside.

We’ve learnt that using words like that is insensitive; what we think is acceptable terminology for the oil and gas industry clearly ignites emotions. Yes, we are pumping off water, but the primary purpose is not to remove all the water from the coal, it is to depressurise it so that gas can desorb out of the coal. There will still be quite a significant amount of water left inside the coal when we are gone. We definitely do not want to pump any more water than is necessary. I’ll take that one on the chin as we could communicate these things in a better way.

Re: the complexity of the EIS, it is complex and it is long. That is why we do sessions like today. Our website will contain good summaries of the impacts and what we plan to do to
mitigate those impacts. The presentation that we will be doing early next year will do the same thing, to try to get it to an easily digestible amount of information.

18. **How are you going to ‘make good’?**

We don’t have all the answers to that yet. When we were here six months ago we showed you the preliminary findings of our groundwater assessment. We’ve since done the next level of detail re our modelling which validated the answers that we got from the preliminary groundwater assessment. The next phase is to add in the mitigation methods. All the modelling that we’ve done so far assumes that Arrow (and, in the second model, all the CSG operators) takes the water out and it never gets into the system again. It evaporates off or gets sent to the coast or some other destination.

Clearly that is not what we propose to do. We want to bring the water back in to be beneficially reused, so after the next phase of modelling, and the next round of these meetings, we will be able to report back on that.

Last time we were here we showed the predicted drawdowns in the Condamine Alluvium. This slide (see Figure 1 on page 3) is for the Walloon Coal Measures which are of particular relevance not only to the people in this area but also to the rest of the Surat Basin. On the left the figure shows peak impacts in 2024 which is when we would cease production, and then recovery occurring as extraction winds down. The figure on the right shows the predicted drawdowns in 2061. In relation to our ‘make good’ obligations, they persist beyond the actual extraction and production of coal seam gas and we are obliged to continue to ensure that the same quantity and quality of water supplied is maintained in the basin.

19. **Can I just ask what science you base that on as I’m not aware of it? The University in Toowoomba is struggling as it tries to set up a groundwater study.**

The whole CSG industry is working together in terms of understanding cumulative impacts. The groundwater model that Arrow has built uses the 10,000 or so wells that have been drilled in the Surat Basin and uses water level and construction details from around 4,000 bores as well. That goes into constructing and calibrating the model which allows us to determine how certain or uncertain the model is. From there we build in a monitoring program that allows us to monitor the predictions of the model, and where they start to deviate from the observations we can make adjustments to the model. That is the process the science is based on.

20. **So in 40 years you are still going to be around to put water back in to the Walloon Coal Measures?**

That is our obligation. Not necessarily to put it back into the Walloon Coal Measures but to manage the impacts that we create. That is relatively normal in our industry; there are a lot of obligations that go on after production ends and they are enshrined in legislation or in our licences.

21. **What is the projected yearly take from the Walloon Coal Measures…and over what period of time?**

Over the 25 year estimated life of the project it is going to average 25 GL per year. A gigalitre is a thousand megalitres; for context a swimming pool holds about 1 megalitre of water.
22. What is the licensed take out of the Walloon Coal Measures?
   Out of the Condamine Alluvium it is between 45 and 65 GL/yr. Out of the Walloons at the moment it is between 9 and 13 GL/yr.

23. What is Arrow's current take?
   It is fewer than 2 GL. In the Surat at the moment we produce about 6 ML a day.

24. Where do you put all that?
   Right now in our Kogan-Daandine fields it gets treated and put onto a farm as a trial. Eventually we won’t be running farms but at the moment we need to as a trial.

   At Tipton it is going into dams right now but we are building a treatment project there. We are probably about half way through right now. It will eventually go onto farms there. We also supply to feedlots, mines and power stations.

25. In regards to land access and compensation, are you using the new rules, and do you want an agreement where the landowner can't tell anyone else what is in it?
   Arrow uses the new rules as a minimum. Our normal agreement is more favourable to the landowner than the rules require. And we’ve found by making some adjustments to our standard agreement that it is more acceptable, with fewer areas of disagreement.

   Re the confidentiality thing, it is up to the landowner. We don’t demand a confidentiality clause, but we are happy to have it in there if the landowner asks for it. And it is fair to say that most of the time the landowner requests it.

26. Do you have a formula for working out compensation?
   Yes we do. There are fixed amounts which are around compensating you for your management time, any costs, and any professional fees that you might have. Then there is a payment around loss of productivity for the land that we take up. That is basically how it works out.

27. Does that mean the landowner receives an annual payment while the well is in production?
   We make the payment whether or not the well is producing; in other words we pay you compensation while we are taking up space in your paddock and will continue to do so until the land is rehabilitated. There is also an upfront payment to cover initial costs, disturbances and that type of thing and then there is an annual payment every year until we are out of there.

28. Is there a typical well density?
   For production wells, it's 800m, so one well every 800m. But we’ve been doing quite a bit of work on that to determine how far we can spread those wells out, because obviously the further they are apart the less impact there is. We’ve found we can drop 20-30% of the wells from an area, and we can move them around quite a bit. Generally what happens is that it
takes longer to get the same amount of gas out—it can be a number of years longer. So there is a compromise...if there are fewer wells then we are there for longer.

29. For each well, what is the typical area around the well?

It is a 70 x 70m area which will be connected by a gathering line which is generally up to 30 metres wide, and those gathering lines connect all the wells up so you can imagine them to be the best part of 800 metres long.

30. Does it require mains power?

If it does, we will put it there. The way that we power a well at the moment is via a generator that runs off the gas being produced. Before the well has pumped down to the coal seam, the gas gets back-fed through the gathering network, and then it gets fed from the well once the well is producing.

31. Does the 70 x 70m area include storage for the water that gets produced?

No, that goes to the dams. As the slide shows (see Figure 2 on page 4), the water goes into an untreated or raw water dam; the water then goes through the reverse osmosis plant and is treated and amended (salts/minerals added). The water is used for agriculture, town water supplies, power stations, coal mines (the latter are supplied with untreated water). The brine from the treatment goes to a brine dam where the salt is concentrated.

32. Is it correct there is one dam per a certain number of wells?

Yes, at Tipton we have about 150 wells, and there are currently two dams. We are building a few more dams as part of the reverse osmosis plant. But generally for several hundred wells there will be a compressor station and three or four dams, and if it is in that area there might be a water treatment plant as well.

33. So there are separate water and gas pipelines?

Yes, there are two pipes, but in the same trench, installed at the same time.

34. And I can cultivate over it?

Yes, as part of the rules and the code of practice for the installation of those gathering networks, we have to consider all the possible and current uses for that land and design the pipeline appropriately for that. Generally what that means is that you put the pipe deeper.

35. Providing you haven't got any creeks to cross?

Well you have to design for creek crossings and those types of things. You need to design so that people can drive heavy machinery across it. There is a range of different things that have to be taken into consideration. We absolutely make sure that those pipes are safe.

36. Fraccing is a concern for some people but apparently you don't use toxic chemicals. Can you tell us briefly what is involved?

We don't frac in the Surat Basin. The sort of coal that we have in the depths of the coal seams goes from about 200 to 600 metres, and we don't need to frac that to get the gas out.
As you get deeper, the coal becomes more consolidated, the gaps or pores in it close up, and companies which have that sort of coal may need to frac it.

Up in the Bowen Basin, where the coal is a different type of coal, we’ve tried fracciing. However, in the Surat Gas Project area we’ve made a commitment that we won’t be fracciing, because we don’t need to, and it’s an expense that we just don’t need.

There is a fact sheet that talks about the chemicals that we use when we frac and they are normal, household grade chemicals. There is nothing in there that includes the alarming chemicals that you see on some of the literature.

37. Does each well require permanent staffing on a shift basis?

No, only when we are drilling. The drilling process goes for a week or two, site preparation before that perhaps for a month, and then laying the pipelines and putting in the service facilities, the gas and water pumping system (which is contained on a small skid) all that sort of stuff. We might be on your place for up to three months. Generally it will be much quicker than that. If we do it well, if everything goes well, it can be a few weeks. So there will be lots of people and lots of machines running around then, but during the production phase we only visit a well three times a week.

That will be a bloke in his ute, driving around and taking readings most of the time. However, every now and again, every two to three years, we need to do a workover where we bring a rig back and basically go through two thirds of the drilling process again. That takes up that full 70 x 70 metres, there are trucks and rigs etc. Then after the workover is finished, it is back to that normal production routine with minimal visits.

38. In regard to remote monitoring, telemetry...is there any chance of getting our telephone network upgraded to support your telemetry? 3G would be very good...

It is possible that some of the networks will need to be upgraded, but generally the infield stuff is by radio rather than 3G. We’ll have radio back to our base, and it will be connected by either microwave link or fibre. So industry does often bring along new main backbones; that’s certainly happened up in the Daandine-Kogan region where the power stations were built.

39. Some companies are doing work on directional drilling, have you advanced that at all? And secondly, as you know I used to be Mayor of the Cecil Plains area as well as Millmerran. You have imposed an 800 metre grid onto a highly productive farm, with your 70m hardstand around it, and basically you really have stuffed up an irrigation farm that is highly developed, laser levelled and that type of thing. How are you going to deal with these irrigation farms?

Directional drilling...directional drilling is our base drilling technology up north in the Bowen Basin where all the coal is mined in Queensland. The coal up there is suited to directional drilling because it is in very thick, tight seams with very high gas content. In the Surat, the type of coal makes it quite challenging to drill directionally. There are lots and lots of seams, there can be twelve or more seams. If you drill horizontally you can’t intersect all of those seams, and it is really tough to get hole stability horizontally in the Surat coals...and it is a lot more expensive.
That's why we drill a simple vertical hole. We are currently in the early stages of planning to do what is called deviated drilling; basically, from one pad we drill one well down, and then a number of other wells out at angles. That allows us to gather from a lot larger area around the one pad on the surface. It is definitely one of the technologies we are considering so that we would only need to be in one paddock rather than ten paddocks on that good country.

The other thing is, if you have a look on our website next week, there will be a slideshow on there that I'll be doing at Cecil Plains. It goes through a bit of a journey about imposing an 800 metre grid, and then moving the wells and infrastructure around so that it is sympathetic to farm activities and infrastructure.

That is the journey that we are on, and it's a journey that we are on with real live third party landowners who are helping us to understand the impacts and the best ways of doing it. So we know that we have to get it right, we know that we can’t put an 800 metre grid over the floodplain country.

We did a cultivation trial at Grassdale to see how we could work it into the farm, but that was absolutely done as a cooperative type of thing. All the rest of it is on pretty rough grazing country.

40. In terms of a 70 x 70m pad, with roads and pipeline access to it, is there an additional requirement for a bushfire / grassfire buffer zone that would have an impact on grazing or cropping outside that 70 x 70m area?

Yes, there is a requirement for bushfire management inside the 70 x 70m zone but not outside it.

So grassland up to two foot high can be within 15 or 30m, and it is about 35 metres for the Brigalow or timbered country. You might have seen some pictures in the Dalby Herald that showed effective vegetation control. There was scorched earth that stopped before the well.

41. There is no gas flaring, or burning off of gas at a wellhead is there?

No, there isn’t at a normal well but there might be gas flaring at a pilot well. We’ve got guys in what we call our central monitoring facility that watch what is going on with fires and will deal with those threats. If we had something like that then we’d deal with it appropriately.

42. If there is a problem with a pipeline or a leak somewhere, what contingency plans are there? Are there valves that can be shut off at certain places?

Yes, there are. Depending on where it is, we might be able to shut off one well and its connection or we might have to shut off a large section of the field. The focus is to immediately make the site safe, and if that means we have to turn half the field off, we have to do so. We then decide how to recover from that.

43. What are the pipelines made from?

The pipelines are made from two different types of material. When I talk about the gathering lines that run between the wells, that connect all the wells up to the facilities, they are made out of high-density polyethylene, i.e. plastic. They are thick and flexible, and pretty resilient to damage. You can hit them pretty hard and they won't be impacted.
44. What about movement in the soil, contractions and expansion of the soil?

They are actually more resilient to that because they are slippery and don’t have a coating on them. Steel pipes are used for the high pressure side e.g. out of the compressor stations and when the gas goes off to power stations or eventually the Gladstone LNG plant; those steel pipes are run at really, really high pressures like 1500-2000 pounds per square inch (psi), so they are quite large and thick steel pipelines.

Now I’ll tell the pig story...if you have a steel pipe in the ground, how do you stop that from leaking? Firstly you bury it deep so it is not in the way of deep ripping or normal farming machinery; in really sensitive spots you might even lay a concrete slab over the top underneath the surface.

How do you stop it from corroding? You put a really high integrity coating on it, and test that coating before the backfill goes in. That’s one of the main quality control procedures. We also do what is called cathodic protection, which is basically where we impress a small electrical current on it which reverses corrosion. So instead of metal being released off the pipe, it’s the other way around.

And how do we make sure that all of that is still okay? We run things called ‘pigs’ which sense whether there is any loss of the steel. They sense the magnetic flux so they can tell whether there is steel there or not, and how thick it is, and we run those pigs through every five to ten years.

45. Do you call them anything other than smart pigs?

They are called intelligent pigs.

46. That cathodic protection that you talked about, there is no sacrificial anode, and there is no submersion in water so does that really work?

There is a sacrificial anode, either a magnesium anode which is attached to the pipe and it corrodes in preference to the steel, or a silicon-iron anode, and a separate current that is driving that system.

47. Is that because most electronic rust protections systems available are a con?

Yes because you don’t have a flow path back. However, what you have with soil is a flow path back. So the only time that you don’t have a flow path back is if you have really clean dry sand. But with most or all other soil types you get a flow of ions through the soil. So rust protection only works on your ute if it is caked in wet mud.
1. In terms of emissions, what is the safe distance from a well site? The slide you showed says it is 175-225m, but you gave higher figures. Is that for the wellheads or production facilities? From a workplace health and safety perspective if you have staff working around a well site, will they be exposed to emission levels which could be harmful? Will this information be made available?

That is the figure around a production facility because that is the main source of emissions. For a wellhead it is a much smaller distance. Production wellhead infrastructure is essentially the same as the motor in a tractor or other vehicle; in the same way that tractor or vehicle emissions disperse in the atmosphere, the same happens with the wellhead. As you know, there are some 7,500 wellheads proposed so there would be a cumulative contribution of all those; not so much at ground level but in the upper atmosphere which could cause a health effect or what we call airshed loading. The emissions at a well site are sufficiently small that they will disperse readily and not affect the airshed, and consequently not affect human health.

_The issue with air emissions is when you get significant volumes of very high rates, as from gas turbine exhausts. That’s why you get a much more intense plume or emission profile from a production facility where you might have anything up to half a dozen gas turbines running in close proximity. You get a [atmospheric] loading in that immediate vicinity which is typically caused by an eddying effect that brings the plume back to ground. If it’s a windy day there will be eddies bringing the pollutants back to the ground; they are air particulates, and that’s what we’re concerned about. If it’s a nice clear day then they will just be emitted into the atmosphere and dispersed._

All this information will be covered in the EIS.

2. With these emissions from wells are you factoring into your assessment the fact that we may have an employee working on a machine which is emitting similar pollutants into the air so there will be cumulative impacts of not only the wells, but also other machinery being used in the vicinity.

The answer to that is no. The reason for this is that those emissions are what we call transient emissions. For that to be a real issue, you would have to park the tractor next to the well and run them both flat out for a long period of time to get any sort of profile of what the emission might be. With a tractor driving up and down a paddock plus an operating well the emissions will disperse very quickly so will not create a local issue. The real issue with the wells, is if they create regional issues.
Last year DEEDI required all the operators to do health impact testing of the emissions at well sites and round our facilities. I think that information is now on the public register. It showed that by working around a well, for the duration that anyone is likely to be there, there were no health impacts.

3. In regards to the environmental impact and farm management, are you classifying entry into properties under amenity? What about farm management issues? Farms are dangerous workplaces, there is a lot of risk.

There is no question we have made some mistakes but we have also done many things correctly although that obviously hasn’t made the newspapers. We’re absolutely committed to making sure that we get the administrative things correct such as notices of entry; those processes are followed as well as the real workability issues or amenities. We have to understand those things; for example we can’t be out there in the field when you guys want to spray. That isn’t something you necessarily know about three weeks before; it might come up in a matter of days. We haven’t worked out all the answers yet but clearly we have an obligation as an employer to get our employees off that rig if you want to spray. We are focussing first of all on infrastructure and hopefully you’ll see we have made some progress by listening to local people about the big infrastructure issues but the next level of detail is planning activities with people.

4. According to the map with the red lines, is that the limit of the licences sought by Arrow in the Surat Basin? (see Figure 3 on page 5)

It’s the limit of the environmental licences we are seeking for the Surat Gas Project. We already have other acreage over which we’re applying for exploration permits; however, in terms of the project area committed to the LNG project that’s the limit. We are exploring and applying for more acreage but it’s not for this project. If we do, we’d have to go through the same process we are doing now and a separate one at that.

That red polygon you can see on the map is the extent of the Surat Gas Project area environmental impact study. Any gas extracted from within that area will be dedicated to the export project. We do hold more acreage that we are applying for west of here, for example, but if we wanted to develop that area we’d have to develop a separate EIS for it.

There are three key approvals that we need to get. The first is the Petroleum Permit (Authority to Prospect) either to explore or develop. The next is the environmental authority, that’s the area the red line shows. The third is obviously the landowner’s agreement to access the land. There are a lot of other licences and permits we need to get, but those are the three big ones. So this process is about getting the environmental authority for the project and it will approve supply to that project. Unless you go through the entire process again no other area will be approved to supply it.

Just one more thing, the area could potentially shrink, as we are still exploring the southern boundary and some of the eastern boundaries as well. So it won’t get bigger than that but it could get smaller.

5. You explained the process of the environmental impact study and you said this is what you have been doing from 2007-2011. Just from a layman’s point of view, there are already 500 wells or something like that out there, where does that fit into the EIS?
There are two processes here. Gas development can be approved under level one or level two environmental authorities. You can actually apply to do a mini impact assessment to develop a small number of wells. For a long time, all the gas operators in this region were operating under that framework where they would bring on another ten wells, and then they might bring on a facility. They were effectively small assessment processes and approvals attached to them; they did not require an environmental impact statement to operate that number of wells.

What became apparent when the LNG industry took an interest in coal seam gas was that it wasn't going to be a small, manageable, incremental change. The government determined that the scale of the project was such that it could not be assessed under that old process and that it needed to be assessed under an EIS. That is how Arrow's existing operations are currently permitted and licensed. It is also how the Dalby expansion project, the several hundred well expansion of the Dalby facility, was assessed and approved. Notwithstanding that, the Surat Gas Project looks at the impact of the expansion project, not in terms of seeking approval for it but considering how those existing wells, along with those proposed for the LNG project, will cumulatively affect the local area.

Every time we go through one of these assessments we end up with the latest conditions from the government. The environmental conditions we had when we built Daandine in 2006 allowed us to build evaporation ponds and didn't require us to manage floodplain work any differently to bush country work. But now, with all the changes, every time we propose new work new conditions are added on and we are subject to new requirements.

6. Relating to your last slide, what does evapotranspiration mean?

Plants take water out of the ground to transpire, to produce CO₂. Evaporation is essentially taking water from open water or from the ground. So the two of them together (evapotranspiration) means taking water out of the ground.

7. Someone mentioned that when water is put through reverse osmosis treatment some minerals have to be added otherwise the water destroys the soil. What minerals have to be added?

For the water we use on the farm we've added calcium using two different chemicals at two different stages; one is calcium chloride and the other is calcium sulphate. Re the latter we added some powdered calcium sulphate at one stage, but the continuous process is the injection of calcium chloride to manage the sodium absorption ratio (SAR) of the water.

8. Who directs what is put in? Is this usually the reason for the hardness of the water, the calcium?

Yes, it's normal water chemistry used by the town council. At government treatment plants, they will sometimes mix in some untreated water; we can't do that as we have a deficit in some minerals and an excess in others so we have to target what we add in.

9. With the stuff that's going into the irrigation, are you re-inventing the wheel?

The industry is new and the government has quite rightly imposed conditions to make sure we do it properly. We could cause damage if we didn't manage the remineralisation just as we might if we didn't manage the application of water to the paddock. Hopefully over time we will
prove that we can manage it successfully and then conditions will be more consistent with how you use water on your land.

10. I have one more question. If you needed a cool drink today would you be prepared to have mineral-added RO Arrow water or Anna Bligh’s recycled sewage?

I have drunk water out of our treated water dam and it is sweet, pleasant water. I would much rather drink it than the town water here or in Brisbane.

11. When Lloyd was talking about his evaluation models he said that each of the companies is doing its own models and in the Arrow one the evaluation came out similar to the other companies. The sceptic in us would say that's no surprise. Then he said that the state government is also doing its own modelling as an overall position. Does each of the companies have to provide its own raw data to the government on a regular basis?

Yes, we've given DERM all the data that went into our model, all the observation and calibration data, estimates of hydraulic properties, pressure differences between aquifers. As a result it probably has a better data set than any individual company so we will see the model it comes up with, likely before the end of the year.

The latest information from QWC is that its model will be released early in 2012.

12. Where Arrow buys a property that has an allocation of Condamine alluvium water and you don’t want the water, will those allocations be available?

In general our approach is to substitute existing allocations. So if we ended up buying a property that had an allocation from the Condamine Alluvium that might be one of the ways we achieve that substitution. We could stop pumping from that bore and make available the clean water we produce. We want to try to get the amount of extra water taken from the basin as minimal as possible. From feedback we've received everywhere, the last thing people want is for us to behave as if we have rights to the water over and above everyone else, and for us to pipe the water away from the basin. We’re trying to do it so we’re producing water so you won’t have to; we want to get that water back into the system. The chance of us buying a lot of land where the Condamine Alluvium bores are is relatively low as we are mostly trying to buy land on the inside radius of our area of tenure and generally there isn't good alluvial groundwater there. In that country, near our Daandine project, it's 25,000ppm TDS in the upper aquifer – and that's no use for anything.

13. Are you planning on selling treated CSG water into the Nathan SunWater pipeline project that’s going to be running from Dalby through Chinchilla and up to the Nathan dam?

We are looking at all our options. We are not considering taking water from down here in that direction. We may have a surplus of water in the northern area around Wandoan so may be bringing water back into this area rather than taking it out. There is enough demand for water down here that we won’t need to ship water up there from the Dalby area.
14. What quantity of salt residue will remain after the reverse osmosis (RO) process?

When it’s initially treated it will be a 10-20% concentrated saline solution (and 80% clean water). We will use a range of technologies to crystallise that salt, some of which may involve circumstances where we now capture that remaining water e.g. thermal treatments where it comes off as steam. When we say that we want to minimise the net take for the volume of water, we will never be able to get 100% back as there will always be losses due to circumstances such as evaporation. It will be more in the range of 80-90% that we can recover.

15. You have quoted a lot of figures re your forecasted impact on water; will you be presenting the actual figures publicly?

Yes. We have the baseline bore assessment program at the moment collecting information from farmers' bores. We are also drilling our own groundwater monitoring bores in the upper aquifers as well as taking samples from the Walloon bores where we have our gas wells. All that information ends up on the public record.

16. Is there a threshold that the government sets i.e. if you have a large impact then something has to happen?

The trigger levels the government has set are 2m in an unconfined aquifer such as the Condamine and 5m in a confined aquifer.

17. There’s lots of concern around the brine and salt crystals left over, what research is being done into what to do with that?

The technology required to process those salts exists already although there aren’t any plants out there at the moment. We are having commercial discussions with people who can process that and turn it into a valuable product (for example glassmaking uses the types of things that are in salt). Australia is currently a net importer of salts so there is certainly a market. It’s not all sodium chloride (table salt), there’s also calcium, magnesium, all the carbonates.

18. My question is on the trigger thresholds and make-good; there is a trigger level of 2m in an unconfined aquifer but aquifers have been declining for the past 25 years. Now irrigators are taking up to a 50% cut in allocations so we hope we will see the levels increase in declining aquifers. How will we determine what 2m is in a very variable natural water level?

The trigger level sets off the second stage of assessment, known as the bore assessment. The Queensland Water Commission (QWC) will be making those predictions through its model that’s currently under development, the results of which will be released either at the end of this year or early next year. Any bores predicted to have a drawdown in excess of that trigger level will have that second type of assessment undertaken which is a far more detailed assessment than the baseline assessment. If the bore has an impaired capacity as a result of petroleum activities, then the quantity of water will be replaced (made good) by Arrow.

19. So it’s not really a straight 2m thing, it’s more of a model prediction from the QWC than a process you go through in the make-good or access and compensation agreement?
Yes, it’s a separate agreement, a make-good agreement. The QWC model will predict an area within which bores will be impacted by more than the trigger level; it’s then incumbent upon that tenure-holder to go to those bore owners and work out whether that predicted drop will result in an impaired capacity in that bore. In a bore that has maybe 100m of available drawdown a 5m drop may not necessarily impair the capacity of that bore. Conversely, a bore that has only 6 or 7m of available drawdown may be significantly impacted by a 5m drop in head.

20. Of the bores you just mentioned that are expected to be impacted, are they only in the Walloon Coal Measures or also in the Condamine Alluvium?

For the first iteration of the model, i.e. the first impacted area prediction, it could potentially be that it is only in the Walloon Coal Measures, but it could be in any aquifer. We are predicting impacts in all the layers, as is the QWC.

21. Are there any assets other than roads and pipelines that are needed for your projects?

Yes, there are wells out in the field. The wellhead site is 70 x 70m but during normal operation that comes back down to just 10 x 10m. All those wells are connected up to each other and to the central processing facilities by two pipes – gas and water. Those pipes are made of high density polyethylene, thick strong plastic. The pipes range from four inches to two feet in diameter, they get bigger as you get closer to the facility. From there, the gas goes through a compressor station which takes the gas from about 10psi or 70 kilopascals (kPa) and discharges at about 1500psi. At the moment it goes to power stations, and in the future to the LNG plant, in high pressure steel pipelines. The water pipes go to an aggregation dam where all the water from the field is collected. It then gets treated by the RO treatment plant and there is an amendment plant as part of that where remineralisation happens. The reject goes off into brine ponds, and the good water goes to treated water dams where it can then be used for irrigation, town use and industrial supply. We also supply untreated water to a range of industrial and agricultural enterprises such as feedlots, power stations and coal mines.

22. How will you power your well sites? Will it be coming from the reticulated supply, or generated from your gas at site?

It will likely be generated from gas on site. Currently at the wells there is a generator that gets fed by the gas we produce. It might go towards reticulating power and in that case we would likely build a small power station at our integrated production facility and then run power out from there to the field.

23. So you say that you will require 70 x 70m for drilling then reduce it down to 10 x 10m but I understand that you will need to be there a number of times during the life of the project to do workovers etc. Is it correct that during those times it will be back to 70 x 70m??

Yes, every two to four years we will need to do a workover. During a workover much the same equipment will need to come to site as during the drilling but the effect is about half that of drilling operations. We have a number of technology trials going on to try to reduce the number of workovers required. As you can imagine it is a significant cost for us, but also a significant imposition for you as the lease gets pushed back out to that big area. Compensation is always worked out on the larger size.
24. The Chinchilla well which had 30 seconds of fame on 60 Minutes with all the water and gas coming out of it, how was the compensation situation worked out with that?

I’m not sure which well exactly you are talking about there, but I think you might be mixing up two different stories that were in the news. One of which was on 60 Minutes where there was a landowner up Hopelands way who lit his bore up. His bore is into the Walloons, he’s been pumping that bore for ten years and for the last five years he’s been getting gas to surface. He’s basically drilled himself a gas well. For 100 years they’ve known in that country that you can get gas from those wells.

The second one was our incident earlier in the year – Daandine 80 – there were some fairly impressive pictures of the water geyser. It was never on fire, there was never any risk of that happening because there was a lot of water coming out of the hole as well. We had an incident while running the pumping that caused that to happen. We regained control of that situation very quickly, unfortunately we didn’t have the mud that we needed on site to make the water dense enough to do what we call ‘kill’ that well; when a well does that we inject heavier fluids into it which basically overcomes the gas pressure and settles it down. It took us a day or two to get the necessary muds to be able to do that.

We’re compensating the landowner for any possible damage to that paddock. We’re working through a range of options, one of which includes effectively swapping with him one of our paddocks on a farm we own next door for him to run his cattle on, while we make sure that his site is cleaned up properly.

25. Do you pay money for the compensation or swap land?

We definitely usually pay money, although it depends on the country. There are a couple of fixed amounts, so no matter what sort of country it is you get a fixed amount for your management time and the inconvenience of having to deal with us, and you get a fixed amount for you to spend to cover legal costs or other professional fees.

26. What do you pay as a yearly rental for mining on a property?

Yearly amounts for a production well range for $500 to $5000.

27. How much money are these wells making?

Our average well produces about 250gJ per day; we get about $500 per day. That’s our selling price; on top of that we have many costs. Most of our domestic gas projects are out of the money at the moment due to the changes in environmental conditions – we don’t make very much money if anything from them. Like any business we look at the rate of return – so we look at the costs of the infrastructure and how much we can sell the gas for. The returns we are getting are usually about 10-15%. Gas wells are quite different to say an oil well, which may produce huge quantities of oil. Each gas well produces about two petajoules (pJ) of gas, not a huge amount of money in value terms. That is why we need a large number of wells. There is a huge demand for energy around the world, and the export market pays a higher price, which is partly why the industry is developing how it is.
28. Why not pay a percentage of what your wells on a property earn? Why don’t landowners own what is under the ground?

In Australia governments own what is under the ground. In the US there is also a large amount of land where the same applies but there are places there where you effectively own everything to the centre of the earth. In Australia that isn’t the case, the Crown owns the resource, and we have to pay government a royalty to extract it. What we’re trying to do is to add value for you in having us on your farm. We understand there are costs and impacts around infrastructure, around planning and activity and around the amenity, i.e. the quiet enjoyment of your farming lifestyle.

We know we are going to have to compensate for some of that. It’s not about nickel and dimes; it’s about making sure our compensation is fair across all the different land and farming types. Our calculation isn’t about production; it is based on our impact on your land. It’s about your land value and what it can produce. If we based our compensation on how much the wells produce then it could be unfair for some landowners as wells range from 1% to 100% different flow rates and we don’t know what each well is going to flow until after we drill it. So if I came onto your place and drilled three wells and they were all bad wells and your neighbour had three good wells that would be inherently unfair because the impact on you is the same as the impact on your neighbour. That’s why we compensate you based on a proportion of what your land is worth and a proportion of the productivity of your land.

29. Where will Arrow move to next?

We cannot move onto any area where another proponent holds tenure. We also will not be looking at moving east, as there is not much gas there.
ARROW ENERGY - CECIL PLAINS

Date: 26 October 2011
Venue: Cecil Plains Hall

Presenters: Tony Knight, Vice-President Exploration Arrow Energy
Darren Stevenson, Asset General Manager, South Arrow Energy
Barton Napier, Senior Principal Coffey Environments
St John Herbert, Groundwater Modelling Coordinator Arrow Energy
Facilitator: Jan Taylor, Principal JTA Australia

1. **How many pages do you anticipate the EIS to be?**

   We anticipate about 3000 pages and there's about another 3000 odd pages of specialist studies. When I set out on this process the Queensland Government said it didn’t want any more than 13,000 page EISs, as it said it would be too much for people to digest. We’ve tried to ensure the EIS is addressing the really critical issues and of course those required by the Terms of Reference. We’re trying to make it as succinct as possible so you can digest it relatively easily.

2. **Is the community to be notified when you lodge it with the government in December, or do we have to wait until February before we actually know that it’s coming?**

   You won’t be notified when it goes to government for review as that is an internal procedure. When the government deems it suitable to go on public exhibition, there will be advertisements placed in all the regional papers and national papers such as The Australian alerting you to the fact that it’s going on exhibition. Arrow will do a lot of work to make it known that it’s going out. We have to make it available at all regional libraries to make sure it is on public display and that there is enough access to it. There’s a lot of work being done to work out how we do that. The intent is to give everyone as much access as possible, not to make it difficult. We want to do more than is required to make it as accessible as possible, including publishing it on a website.

3. **When the EIS document becomes public, do you anticipate there will be some sessions like this to walk people through the document and explain the conclusions you have arrived at?**

   Most definitely; there’s a lot of planning already in place and the intention is that within a week or two of it going out we will be here with as many experts as possible to take you through the EIS. We’ll explain the conclusions re the impacts, where to find the information, and explain the process of how to make a submission. One of the important things to note is that a letter of protest is not a submission as it’s not asking us a question, it’s making a statement. Instead, a submission should challenge the EIS and pose a question you want answered. We then have to respond to that.

4. **Even though we are lay people, and our responses won’t necessarily have a technical slant to them, will they be considered?**

   They will all be considered. Please don’t underestimate the importance of lay responses. In this business I deal with scientists and engineers all the time, and quite often very simple lay
questions can be overlooked. Just ensure your submission is about something in the EIS, don’t just say ‘I don’t like this project’ as we can’t respond to that. There’s no silly question as far as I’m concerned.

5. **On your slide explaining the environmental framework, you talked about environmental values and desktop and field studies. What proportion of determining the environmental values of our farms and our communities is dedicated to a desktop study and what is actually ground truthed?**

Can I address that in the agriculture presentation? Typically, environmental values do start being addressed in a desktop study. That’s basically to ensure we understand all the literature on that subject. For example if you are talking about terrestrial flora and fauna, the scientists will review all the published literature on what is known about this region, search all the wildlife databases which record sightings and compile a picture of the environment. They then review that and determine the most significant areas or the ones we have the least understanding of, and then they will do their fieldwork based on that knowledge. The fieldwork tries to do two things, it tries to identify and verify. Where they feel there are deficiencies the focus of the field work will be to identify what might be there. Where they might doubt the integrity of the information, i.e. where things may have changed over time, they then target it for verification. I don’t know how much you deal with regional ecosystems in your communities, but the mapping often doesn’t reflect the reality of what is on the ground. We have to get that right, which is what the studies will do.

6. **There was a picture of a central gas processing facility at the end of the slideshow – is that typical of what we will see in this area?**

That was a production facility which was a set of compressors (see Figure 4 on page 6). Yes, you will see them.

There are probably six or eight of these facilities proposed for the area between Wandoan and Millmerran. They cover approximately a hectare in total and there will be six to eight of them spread over the whole region.

7. **I had a quick look on the Surat Gas Project website and saw that there are going to be about 7,500 wells, 49% of which will be on potential strategic cropping land (SCL), so does that mean 3,700 wells on SCL? How does that work?**

If you look at the map, the better country is towards the inside rather than the outside of the curve. Geology and geography line up so that’s also the shallowest wells for us. We expect our well spacing to get bigger as we go further into the good country so the density of wells will be more as we go deeper into grazing country. In terms of the 7,500 that’s basically a few numbers multiplied as we don’t have the full field development plans yet. It’s fair to divide it in half but it won’t be like that. There will be fewer wells on good arable country and more wells where the deeper coal is.

8. **In terms of the rehabilitation of the 70 x 70m footprint, does the EIS look at that size or the 10 x 10m site?**

It’s 70 x 70m during the project. It can’t be 10 x 10m because we come back every few years to do a workover which involves the same gear you see during the drilling operation. In
practice it’s about half the activities you do when drilling a well; you pull the pump out and put it back in. That process needs the full 70 x 70m and we plan around that.

9. **What studies are there to show that in the long term the soil in the 70 x 70m grid can be rehabilitated?**

One of our studies recommended which trials to do before it goes out onto the country, to make sure it will work. A lot of that work has already started. It won’t be a trial and error process on your property as it will be trialled on Arrow properties.

10. **The SCL slide before, you were talking about type one or type two impacts but you didn’t specify what activities referred to. Will all the activities, right from the well activities to the central processing facilities, be considered type one?**

Type one is diminished productivity, and that will principally relate to wells and gathering lines. Gathering lines are rehabilitated very soon after production, but you have diminished productivity for the period during which the land is disturbed and the period it takes to recover and be rehabilitated. The well is a longer proposition; it’s there until depleted, and then filled in, capped and rehabilitated. It means diminished productivity as well as being there for a longer period.

Type two is about changed land use; development of the integrated production facility is so invasive that generally we can’t rehabilitate it back to what it was, but we can get it back to grazing land for example. That’s a long term enduring land use change. Development of those production facilities (field compression, central gas or integrated processing) are the types of activities contemplated under type two.

11. **I just wanted to make a comment about the 3% figure. You said that 3% was the upper impact. I guess in some instances I would agree with that, however on my farm the 3% has a direct effect on the other 97% of my farm. So you can’t say it would be just 3% that would be impacted on the black soil country.**

What we understand is that 3% is the direct impact and physical disturbance. We recognise there will be indirect impacts; if you put a well in the middle of a paddock you are going to change headlands etc. which will create indirect impacts. We talk about that in the study but it cannot be quantified. We could paint the worst case scenario i.e. if we were to put a well in the middle of each paddock. However, that would be misleading as Arrow wouldn’t be allowed to do it. You wouldn’t let Arrow do it, government wouldn’t allow it and Arrow doesn’t want to do it anyway. The difficulty with the agriculture study is trying to give you a realistic understanding of what is likely to happen based on a lot of work with you and attention to some issues that have been talked about. But I do recognise it could affect the other 97%.

12. **My other question is in regards to Section 805 of the Petroleum and Gas Act which deals with unreasonable interference. A whole host of things that you have listed in your presentation particularly affect the sort of farming here on the eastern side of the river. Do you keep that section of the Act in mind when you do the study? I would suggest a number of those things would fall into that category?**

We are mindful of the Act. The process that I have responsibility for is the environmental assessment; while we have regard to legislation, the main issue is that we satisfy the EIS
Terms of Reference and assess impacts. The legislation you are talking about regulates the industry. When the government issues the environmental authority it will state how it wants to police the impacts and specify appropriate conditions.

13. **What company did you employ to do the agriculture assessment? Was the information you have mostly from that company or was there some local input?**

The impact assessment was done by a company called Gilbert and Sutherland based on the Gold Coast and Toowoomba with an office in North Queensland as well. We are damned if we do and damned if we don’t when we do agricultural impact assessments. Ideally we’d like to use the people you use, because then we’ll get absolute understanding of what happens out here but we’ve been pilloried in the past for using the guys you do. What we try to do is to find someone who really understands what we’re dealing with out here and has knowledge of agricultural systems generally and also an understanding of the science around soils and things like that. We’re trying to balance the science of what you do and the science of the landscape you are dealing with in terms of the agriculture. We made a lot of enquiries about relevant consultants in the region from people who worked here and the best we came up with was Gilbert and Sutherland. Has there been local consultation? No, but that’s part of this process, why we’re here today. However, Arrow’s community committees form a part of this and this information was recently presented to the Intensively Farmed Land committee. The feeling I get from some of the feedback from that session is that we’re not very far off the truth and that we have probably captured the majority of your issues. Gilbert and Sutherland have produced an 80 page report which will be published as part of the EIS.

14. **So that report won’t be available until the EIS is complete?**

That is my understanding. It will definitely be released as part of the EIS.

15. **With the pipelines and the easements, how deep are those pipelines and is machinery able to drive over them?**

We have to design the depth of those pipelines to suit hazards in that location including the way you work your land, the sort of machinery you use, the size and weight of the machinery. The minimum depth is 750mm but our standard for cultivation is 1200mm and we’ll put it lower if it needs to be, including if you use really big machinery or soil horizons dictate that it needs to be deeper. There’s a code of practice under the *Petroleum and Gas (Production and Safety) Act 2004* which says we have to do that; we have to do a risk assessment, and then build it to withstand all reasonable expected activity over it.

16. **With regard to medium and high pressure pipelines, are you talking of putting them down the road reserves or on the landholder’s property adjacent to the road reserves? I’ve seen on your website that you require a 30m wide right-of-way to put your pipes in; wouldn’t that be wider than the road reserve?**

I wasn’t talking about the high pressure pipelines; we showed some of the route for the high pressure pipeline in the presentation this morning. It will be more or less in a straight line and will cut across paddock boundaries, but we’re trying to minimise that as much as we can; we’re looking to divert it so that it has less of an impact on strategic cropping land. For the gathering system and the medium pressure pipelines it’ll be in the location that has the least impact. So yes, we do need working space to put those pipelines in, and we understand that
there are planning laws which state what you can put inside the road reserve to manage
overland flow and all of those things, so I don’t have all the answers right now, but the pipeline
will go in the spot where it has least impact.

17. I’d hazard a guess that most roads have a power line along one side so you won’t be
able to use that side, and the other side will probably be too narrow. I’d suggest in
most cases it will end up on the landholder’s property and then you will need a right-of-
way over the farm.

There won’t be an easement for those.

18. Well, you’ll need a right-of-way which is a technical easement. There’s a statement I’d
like to make about the presentation. It’s good to see you’re undertaking this process to
tell us what sort of a horror story we’re potentially faced with, but we don’t have those
high and low point vents on our properties. How are they going to be powered? You
have stated your preference for overhead power lines so we have to assume it’s not
just going to be a little wellhead, there are going to be power lines all over the place as
well and perhaps these high and low point vents so I’d encourage everyone to have a
really good look at what is going on their property because it’s going to be a lot more
than half a dozen wells.

I don’t think it’s reasonable to say that overhead power is our preference; it’s one of the
options. There’s a significant advantage in getting the well down into that little box by
changing the downhole pumps to an electric submersible pump; that means you don’t need all
that gear on the top as the drive and everything is down the hole. To make it worthwhile
removing all that stuff you also want to remove the generator because that would be what has
the biggest bulk and the most noise once you remove the top drive. To do that, you have to
bring power to site. Now that might be overhead, it might be underground – we haven’t made
those decisions yet. We’re investigating all those things, and we’ll try to come up with what the
best compromise is for each of the different features of the impacts, whether it’s having the
power there and how hard it is to come up with the best compromise possible.

19. I was just looking at the timing: your wells will be operating for 18 to 19 years. I know
that the Petroleum and Gas Act gives you the right not just to extract the gas, but also
to store gas, brine and water. The pipeline has to be a dual run. Do you expect to be
out of there in 18 or 19 years or do you expect that you will be using these rights under
the Act to store gas or brine?

No, we don’t expect to use those rights; our environmental conditions won’t let us. The P&G
Act allows us to do a range of things, but we don’t have environmental conditions which
narrow that down to the specific activities we’re allowed to do and the way in which we must
do them. For example, you might think we’re going to bring water back and put it down the
hole. We can’t do that, we don’t have the environmental licence to do it. The P&G Act might
allow us to but we can’t unless we have an environmental authority which licenses and
conditions that specific activity.

20. In regards to the high point vents – driving around here quite a few of them seem to
dribble water, is it treated or raw water? I would suggest that this would be totally
unacceptable on our sort of farm land. I see in the existing areas of development that
there is a proliferation of warning signs. I’ve spent much of my farming career
removing things that past farmers and graziers have erected, I would hope that you don’t think that you’ll have those things up every 100m or so?

If you see high points dripping water, please let us know. On some of our older fields you might see the high point vent come up and it has a vent to atmosphere. We’re going through the fields at the moment and plumbing them back in to the water line. The gas comes out at the water line and gets pushed back into the gas line. Then there’s a low point drain on a gas line and water might condense there and collect at the bottom. We can’t just force it back in because the pressures are different; we have a collection tank and maybe a pump to automate it. Out in this country you will see fewer of those than you would see over at Kogan or Daandine in the undulating country. They are only needed where’s there a reasonable change in elevation of the pipe – it’s where it captures the gas or water because of that change in elevation.

In regards to warning signs, the minimum standard is that it must be inter-visible, meaning you can stand somewhere and see a sign in both directions. We know that those signs are a problem so we need to work out a way to achieve the same risk mitigation that those signs do. Those signs are really designed to go down a road so if you have council working along it, or Telstra or Ergon, they will know there is a pipeline there. With new mapping technology, there is a way to indicate presence electronically to assist workers and, perhaps, reduce need for signage.

21. In terms of the sustainability of the Walloon Coal Measures aquifer, in about 2005 I believe there was a resources operation plan done by DNR on the Great Artesian Basin and the associated aquifers. The Walloon Coal Measures was one of those, and at the time there were some existing licencees requesting more water. We were told we would have to wait for the Arrow project to establish whether there would be any more water available. I think the existing licencees take about 4000mL out of that aquifer and I believe that coal seam gas is going to take an additional 40-45mL a year. Can you explain how you will ensure the existing licences are protected and that the viability of our businesses will be protected? There are a lot of people who rely on that aquifer, and without that water supply their businesses will no longer exist.

That is a very significant issue. We can answer your question now, but later there will be presentations on how we will manage the water issues so are you happy to wait and then perhaps ask your question again if you feel that we have not adequately addressed this issue? (Questioner agreed).

22. You said that the Slumberger Model has one square km cells on the x and y axis, and there are 15 horizontal units in the z axis. Are they equally spaced? Re 15 units over a 2.5 km depth, does that mean 2.5kms divided by 15, and each one is the same?

No. Perhaps just to reiterate, in the presentation we generalised and said 120,000 cells, so I think 300 x 400, and it is not exactly that, it is more like 430 x 270, so that’s in plan, 430 rows by 270 columns looking down on the top of that 120,000 cells 1km square in plan.

*In the XY direction cells have a uniform size of 1000 by 1000m. However, in the z (vertical) direction layers vary in thickness according to the known thickness of the aquifers and aquitards. So they are not of uniform thickness.*
The 15 model layers are of different thicknesses, where each thickness relates to a particular hydrogeological unit.

A computer model works by establishing a regular grid of cells over an area, with each cell containing a series of values. Each cell in this case is about one square kilometre in area, or one km by one km. We model all major geological layers in the basin, with values like thickness, depth, permeability etc - so that we can understand the geology and hydrogeology of a large area with precision.

23. **Is the Condamine Alluvium captured in that?**

The Condamine Alluvium is part of layer one which has three parts including the Condamine Alluvium and its overlying weathered formation or sediment. Slumberger looked at the CSIRO groundwater model and used that as a blueprint for putting the Condamine into the model.

24. **What about calibration? You mentioned that those points you are able to calibrate successfully you are confident about and those that you can’t are a bit of a mystery. Are you able to say what percentage of these points in the model you are able to calibrate successfully and what percentage you cannot?**

I wouldn’t be discussing points because we don’t set parameters for all 1.8 million cells. There is never enough information to distinguish between here and there at the level of each individual cell so Schumberger might use the same properties for vertical and horizontal hydraulic conductivity over the whole area which is standard industry practice.

For example in representing the Gubberamunda formation it has the same properties so is it a mystery? No, we are still using the best available information that we can get as professionals, based on whatever we’ve been able to piece together from studies. The first source of information we would use is aquifer tests, you might hear them referred to as pumping tests or pump tests which is a bit of a misnomer because we are not really testing the pump, we are testing the aquifer.

In that kind of test, people drill a hole, install a pump in the hole, pump for a day, several days or even some tens of days and measure changes in piezometric head¹ in that hole and nearby observation ones, in order to infer the properties of that unit. Then you use those properties and extrapolate them over the region.

25. **You did say there are some numbers in the model that you can calibrate successfully and some that you can’t; I want to know, for every thousand numbers in the model, what percentage of those you calibrate successfully, and what percentage do you not know about or you can’t calibrate successfully?**

The first way to answer that is to say there are probably not thousands. There is a lot of detail in the geometry but the total number of parameters in the model are in the order of tens, so 30 or 40 or something like that. As a percentage, I can’t answer that. We have different levels of confidence in all the model parameters. I know Arrow is investigating that and staff are probably chomping at the bit to answer it. First let me go to that next step of the influence of the different levels of the parameters on predictions at different places.

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¹ Piezometric head is a measure of the pressure of groundwater.
I think the question you are asking is if the extent of uncertainty is acceptable for this level of model i.e. the level of model complexity we are talking about here in the EIS. Lloyd presented three levels of complexity that you can have and I think that is the question being answered through the review.

What I’ve said and will say is that I believe the Slumberger model is at least as good as the other models that are being prepared in this region and for other projects of this kind. I have no doubt that the model will get better.

We need to see predictions which quantify uncertainty at the time the EIS is finished. The company is on the right track, but I can’t answer the question either.

26. You talked about volumes of water in the model, and St John suggested that water quality is important? Does the model account for quality as well as quantity?

The first answer is that it doesn’t. It’s just looking at volumes of water. There are questions that people ask about quality; models can be used to answer those questions. Although we are not modelling water quality as yet some of the studies we are doing will consider the geochemistry of the groundwater aquifers and what can happen if different waters mix. When we get the Arrow simulator, we can actually make up the models using groundwater modelling software, and start bringing in some of the geochemistry side of things.

27. I was interested in the model you put up showing the water balance and the ‘ins’ and ‘outs’, in particular the impacts for the Walloon Coal Measures, the Springbok, Hutton, Precipice and Condamine Alluvium. What I see is a hell of a lot going out, and not a hell of a lot coming in. When you talk about the recovery rates you are expecting there will be recovery of 40-50 in the Springbok as well as an impact of 40-50 initially; Hutton and precipice seem to be the ones that are really going to be impacted yet your capacity to mitigate by reinjection into the Hutton appears to be limited due to the clay content. What happens if you cannot reinject, or it’s not feasible; or if you can’t find enough irrigators to take the virtual substitution water. What happens then? Are you constrained by the amount of water that you can take?

So the first question is about the water balance in the alluvium?

28. In all the aquifers...

The injection studies mean (while there is limit on the recharge rate in the Hutton) that for a particular bore, you can’t get as much water down there in the same timeframe as you could for the Precipice i.e. you sometimes need to put in more bores to achieve the injection rate you need. So here we have a calculated leakage rate of 1.8gL per year coming out of the alluvium; we feel we can either substitute or manage it by re-injection or maybe a combination of both substitution and re-injection.

That’s why there’s a range of mitigation strategies, from substitution to re-injection to see how we put that much water into it.

In terms of the Hutton and Precipice, it will be a case of how many bores will it take to either inject that water or how many bores do you have to substitute for, to pull that water out.
29. I’m just wondering what would happen if you didn’t have the capacity to do your virtual substitution? Can irrigators have confidence in the quality of that water?

We’re confident that with the sustainable substitution approach there is sufficient demand for water significantly in excess of what we expect to produce. But if you look at impacts on individual farmers we might need to address those by a range of measures. We might need re-injection to support the fluid levels in your bore, it might be a by-product of treated water to your place, it may be a range of different ways of solving the particular problem. We have committed to uphold that obligation to fix that particular problem. That’s why we are taking forward a number of options.

On the reinjection front we dug an exploration well and converted it to a reinjection trial well in the Precipice. The data we got from that in terms of its injectivity rates exceeded our initial expectations so it doesn’t seem the science will be a problem for us, or demand.

30. Ideally you wouldn’t want to put it down there would you? You wouldn't put it in the Precipice, that's not the plan is it?

We are considering reinjection into the Precipice because we might want to store water to manage the different production profiles across the life of the project.

31. So you might be putting it into the Precipice and then later pulling it out and giving it to the Condamine Alluvium?

That’s right, it might be a part of the solution.

32. So when you answered my question earlier that you weren't going to use your rights under the P&G Act to store water, you perhaps are?

We don’t have those rights at the moment; we do not have the right to reinject or store water under our environmental authorities. We do have those rights under the Petroleum and Gas Act, so you are quite correct about that, but for us to do the reinjection trial we need to make application to have our authority changed. Then we will need to present a mini-environmental impact study to get approval to do a trial. That trial will have certain monitoring conditions around it; after all that, if it is well managed and successful we might be granted the right to do it.

33. Are you expecting the water in the Precipice is going to be a similar quality to the water in the Condamine Alluvium?

No, we aren’t. We believe we will have to work out the chemistry to ensure that if we use solutions like that we can deliver water suitable for specific uses.

34. It concerns me that you are not modelling the water chemistry, particularly in the Condamine Alluvium, when that was a fundamental part of John Hillier's argument.

We are on a journey and the first part of the modelling exercise is to model the hydraulics; you have to model the hydraulics before you can model water quality in the model. Simultaneously we have more and more data about water quality as we draw from our connectivity study between the two units.
35. The historical water level data for the Condamine Alluvium shows it is very cyclic, and has variations in the bore water levels of the order of the variations in Arrow’s model. What are you validating it against? You really have to validate it using water chemistry.

There are data loggers from DERM in the Condamine. We’ve got some of that data, but you are right that geochemistry will give us the best answer to nail down focus points.

36. There is a shortage of monitoring bores, data from the bores, and its chemistry. The monitoring bores you are putting in to measure the transmissivity, are they in two dimensions as you have shown or will you have an array of them so that we will have a three-dimensional approach?

There will be a network of monitoring bores, including laterally and there will be a mixture of bores with vibrating wire piezometers which you can set at several different levels. We might have eight of those through many different aquifers and we will have the traditional open bore as well from where we take water quality samples.

37. I’ve noted down a few things that concern me. We are talking about Arrow’s activities but there are other players in this industry; surely we have to join up all the effects. Is that situation being addressed? Lloyd’s model seems to only pertain to Arrow’s situation which is only part of the problem.

The impact predictions we showed were a cumulative impact from the four major CSG producers based on our proposed field plan; plus we’ve added the currently available data on what they think they are going to extract. So that 450 megalitres a day we graphed, that was the combined total for the four producers. We also had another scenario which is just Arrow on its own.

38. I guess that partially answers the question. Obviously the object of the exercise here is to reduce the water table, therefore reducing the pressure, and it would appear from what you’ve said that after Arrow’s finished this will all stabilise out in terms of water levels etc. If they are going to stabilise out, where is the water coming from? Is it coming from other aquifers, is it coming from the recharge or what? We are concerned about the Condamine Alluvium, we cannot have it being depleted.

What you see in the model is that when you depressurise the Walloon and reduce the water pressure, you change the Condamine Alluvium and other units above. Water leaks from the above unit down into the Walloons because the pressure gradient has to balance out upwards. In the Walloon some of that flattening out of the water levels is due to the seepage

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2 A piezometer is a well screened at a specific interval in which the water level is measured directly by lowering a measuring tape down the hole, while a vibrating wire piezometer (VWP) uses the resonance of a coil to measure water pressure and is placed in a hole filled with grout.

The water pressure exerts a pressure on the VWP through the grout and this is measured as an electrical signal in a cable that runs to the surface. The advantage of VWPs is that several VWPs can be placed in a grouted well at different levels and you can get information on water pressures in several aquifers from a single hole. Both are methods that have been used for a considerable period of time and are well understood in the groundwater and geotechnical industries.
from above and below aquifers as well as just pressure recharge from the left and right and all around.

You are right about why you get that cascading effect. This aquifer replenishes the Walloons which has another pressure gradient that draws down the aquifer above it, all the way up to the Condamine Alluvium. And that is what we see when we run the cumulative impact model, but with no mitigation measures. When we show you pressure recovery we are not saying it’s all going to be fine, the pressure is all going to come back on its own. We know we need to work with the mitigation and substitution systems to hopefully prevent unpredicted impacts because it’s obviously a lot easier to prevent something than it is to repair it afterwards.

In terms of geochemical studies, if we look at impacts in the Hutton and the Precipice, the Precipice does look a better injection target but we are aware that if we inject into the Hutton we might be able to buffer it against the Precipice and never have those impacts in the Precipice and above. There are all sorts of things that we are looking at.

39. **When you talk about reinjection, I don’t know how you are going to get it all back in again? Obviously some is going to disappear, quite a large proportion I would imagine. When it's 50, 60, 80 years down the track, what's going to happen to the Condamine Alluvium? Seepage will continue, you'll be gone and there'll be no reinjection.**

We are moving from an impact predictor model to an aquifer simulator, where we are simulating all these scenarios. We have the initial data that says on average 1.8gL per year will be induced to leak out of the Condamine into the Walloons if we did nothing.

The question then becomes can we prevent the impact occurring during operations if we build in a series of mitigation measures where we substitute or inject into the Condamine. The next question is then how much of the response happens after the operational time; do we need to put more in there earlier to act as a buffer so that when the drawdown comes in later we get back to the starting point with no net loss. We are looking at all these questions.

40. **With your mitigation measures and allocation substitution with RO water, I know other proponents are having trouble with it being considered a hazardous waste, so what permits do you need to allocate it and what testing is being done.**

A number of permits are required. If we clean water up using the RO process, we then re-mineralise or 'amend' it. We need to add back the calcium or magnesium to get the SAR back into whack for agricultural purposes so half our treatment plants now have that. That ensures the water quality is suitable for agriculture. At the moment the RO plant at Theten is the only one where we are allowed to use the water for cultivation purposes.

There are a very great number of monitoring requirements and very tight specifications around water quality and what we do with it e.g. are we allowed to cultivate with it, how do we monitor groundwater, soil composition, all those sorts of things. If it is going into something that might end up for human consumption (e.g. one of the other companies puts it into the Condamine Weir) then we need to get an endorsement from the Office of Water Supply Regulator. It has something like 150 different tests to make sure Arrow meets both quality and composition standards.
41. **On the re-use trials, how long have they been going and are they successful? Is it a viable option?**

We haven’t yet made the first water application. Hopefully, we intend to do that before Christmas, perhaps early December.

Is it going to be successful? We know the quality of the water; we know it’s compatible with the groundwater and the overland flow water so we have no reason to believe it will be unsuccessful. What we need to prove is that we can manage the monitoring and the amendment process in a reliable fashion.

42. **It seems to me that the approval for gas extraction has far outstripped the understanding of its impacts and what you need to do about them. It’s happening over a huge area of Queensland, some of which has very valuable groundwater resources. Why wouldn’t you develop up the knowledge before gas extraction occurs in some of those areas e.g. on the Condamine Alluvium? Why wouldn’t you test some of your models and prove some of the theories around mitigation before you cause some of the impacts you seem to intend? And one other thing while I’m speaking, in some of the previous EIS approvals for companies to the west of us here, there was commentary around subsidence caused by the extraction of groundwater. Will subsidence be an issue in this region because of your extraction activities?**

We plan to drill two wells at Kogan next year. I’ve drilled zero wells in my production fields this year. I actually have enough wells in my existing fields that I don’t expect I’d have to do more than twenty wells over the entire Daandine Kogan area, maybe some in the western part of Tipton, before this project reaches approval in 2013 or 2014.

So there are another couple of years where we can collect more monitoring data. We’ve made the commitment we won’t be going out onto the alluvium for some time and we stand by it. We’ll be targeting country we know where the impacts are lower. So there is probably ten years of data to gather that we will be able to do before we embark on that drilling campaign.

I’ve been asked a number of times about subsidence. A photo-micrograph on the pore space was shown in the presentation. I think the porosity of the formation that you see is a single digit number, perhaps 1 to 2%. We’re taking up the water in those pores.

The coal stays intact so there is no change in the physical structure of what is below the ground. In that sense the strength of the coal and the rocks above it is maintained. We are researching this via companies that work in the coal mining industry (where subsidence occurs) so it is something we are looking into.

43. **Could we get some clarification about the water balance slide where you had the red and green arrows? I’m confused about the figures. On the left hand side with the recharge figures, there is a figure of 12-20 gigalitres per year, and then 36 gigalitres a year in year two? (See Figure 5 on page 6)**

The references for those figures are down at the bottom of the slide; depending on what literature you read (from 2008 or 2010) that is the current variable estimate for recharge.
44. So you are suggesting that landholders have an unsustainable take-out at this stage?

Well, no, I’m not making any comments about that at all, just saying there is a certain amount of take out. We are going to do high level studies to build mitigation measures into our project to see if we need to use mitigation measures such as substitution or injection to change that balance.

45. From the data supplied, water balance is going to be negative in all the aquifers in the area, and any landholder who has a licence in any of those aquifers is going to be adversely affected. But we will all be affected in different ways depending on your activity and its location within the aquifer. So what process is Arrow going to use to resolve the problem with each licence holder or landholder?

I think you are referring to the ‘make good’ process. The way it will work is that the Queensland Water Commission (QWC) has been appointed to prepare an Underground Water Impact Report for the Surat Cumulative Management Area. It is also developing a groundwater model in which it will predict drawdowns in the same way that Arrow has done. The QWC will produce two predictions; the first will be predictions for each aquifer within the next three years and then for each aquifer there are also trigger levels.

So if it predicts in an aquifer that a trigger level will be reached, then that particular bore, or every bore within that particular area, has a bore assessment done. If that detailed assessment determines there will be an impaired capacity to that bore then the owner or user of that bore will not be able to take the same quantity of water as previously.

If that is the case, the tenure holder must enter into a ‘make good’ agreement with the owner of that bore; the agreement will provide details re how that same quantity and quality of water is maintained for the owner of that bore if impaired capacity occurs.

46. What are the legal requirements to do that?

It is legally enshrined in legislation so we are obliged to do it.

47. What about after you’re gone? For how long are you required to do that?

As long as required.

48. You had a plan up which showed a drop in water levels in some areas on the western edge of half a metre to two and a half metres. Is that on the positive side? Could it be out by a factor of ten? (see Figure 6 on page 7)

These are the results of the predictions. A model is a simplification of reality so there is uncertainty in it and we try to conceptualise that uncertainty. What we have done so far is to undertake sensitivity analysis. The analysis shows that if we vary the parameters in the model and still maintain a reasonable calibration then we get about 60% difference in the answer. Therefore at the moment we think the lower end of the range is one metre and the higher end about four metres.

49. Just looking at the higher end of the range, and looking at the map, my feeling is that at a four metre fall there would be a lot of irrigators without water.
Yes, if this 2.5 metre contour area became four, and then this one (0.5) went up 60% to 0.8 you’d see an increased impact.

50. You are putting farms at risk with a 2.5 to 4 metre drop in water levels.

Yes, that is the prediction without any mitigation measures in place. Our aim is to avoid that.

51. I was wondering whether the Office of the Water Supply Regulator has any jurisdiction over the supply of water for stock and domestic purposes where it is used in the home and for human consumption? I’m talking about where there is treated CSG water that ends up in a home without having to go through a town water supply system, through some sort of substitution arrangement?

CSG water is classified as recycled water so it is automatically covered by the Office of the Water Supply Regulator, unless there is an exemption. Anything that would directly or indirectly augment a drinking water supply is captured by that.

52. Does that mean you’ll take that into account for supply to homes?

It has to be, there is no way around it.

53. A question on the model: on this slide it talks about the potential uncertainty range. Back in May, we were told the model had a 60% degree of uncertainty. How do we interpret the uncertainty that you have in the model now, compared to 60% in May?

The May figure of 60% is still the number we are working on for the uncertainty analysis; it is taking us longer than we thought.

54. Today's slides: I think most of us are interested in taking some time to go through them. I've just arrived. Is it possible to get a copy of the presentation?

The presentation will be going up on the website (www.arrowenergy.com.au). For those people who can’t download it easily we are happy to send out a hard copy. So whatever is easiest for the individual, just let us know.

As you know details of the question and answer session are taken down so you will all receive a copy of every meeting that is held as part of this round.

55. I have a comment on what you had to say about ‘make good’. While what was said was entirely true, the ‘make good’ legislation as I understand it obligates the company to enter into an agreement. It doesn’t obligate it to make good, to replicate what we already have in terms of the quality and quantity of our water supply. It obliges the company to enter into a make good agreement only. I’d suggest this is something totally different to what most people understand ‘make good’ to be.

Anyone who is in a position where they have to enter into that sort of negotiation seriously needs to take some legal advice.

You are right in terms of how the legislation is worded, but basically once agreement is reached it is then a document that has a legal meaning. So both sides are obligated to meet its conditions.
56. [Question directed to Cr Paul Antonio] Is the Council going to allow Arrow to lay pipelines down the side of the road, or is it going to lay them in our properties?

Paul Antonio: at this point in time I don’t have the definitive answer to that. As you know, you and I have been working on an issue around the Nangwe rubbish dump. I’d suggest there is a bit of a gap between what I’m being told by our people and what you are being told. I think that council generally has a very strong view on CSG mining on good agricultural land, and its intrusion across the Condamine.

This isn’t a unanimous view, but it is strongly held. We will do what we can to ensure we have appropriate measures in place before anything happens. In our planning meeting yesterday we took a number of steps around mining as a result of community pressure. I’d suggest to you that as far as our guys are concerned, they’re definite on this. We have a view we need to have a lot more questions answered before we are comfortable with it as a council.

57. In the slide show before, we were talking about the effects Arrow is going to have on the farming industry. Just for interest’s sake, ginning is going to go up $10 a bale. A percentage of that is wages as the ginners are paying to keep their people, to stop them going to work in the mines. We are already going to have to pay a premium this year to have Arrow and other miners in the area. It is already going to affect our bottom line to the tune of $5,000 to $10,000 this year.

I won’t say we have a different approach, but the approach we are taking differs to some of the other companies in that we are trying to hire locals for our ongoing workforce. Yes there will be some wage pressures because of that but there are a bunch of other community benefits that aren’t there if we had everyone live in camps, flying in and flying out, and taking all the money they earn out of the community.

At the construction stage though, we’ve heard that people don’t want that short term impact in their local community. They’d rather see us build camps and then cope with the effects of a rapid influx of people separately. We like to employ people who live locally; it helps us keep wages down because there is a big difference between what someone gets paid when they are working on a two-on, two-off roster in camp to what they get paid with us, living in one of the towns around here.

The difference isn’t the numbers that get quoted around; we are not paying operators $100,000 a year. I’ve heard that, from multiple people over the last few days. It is nothing like that, absolutely nothing like that.

58. It is costing us money already.

I appreciate that so we are going further than most of the other operators to try to address that issue.

59. If I can be very general re groundwater, we’ve got the Great Dividing Range as a source of recharge, and at the very opposite end of the spectrum we’ve got the Great Artesian Basin (GAB). In between the barriers are confined and unconfined aquifers some of which have interception activities, some of which are proposed to have extra interception in the form of CSG.
We discussed water balance earlier. I actually look at it as water imbalance because we are going to change the current water balance. I realise that it is already modified and, to include a point that was briefly touched on, the system as we know it is now licensed. With time and experience the licences are being modified to make them sustainable. Not so long ago the Queensland Government legislated a GAB plan which made specific reference to the groundwater and it is actually zero. So water balance is very pertinent.

60. The further point I wanted to make is that we are making gains on the groundwater model; a couple of years ago it was suggested that there would be no impact. We’re now heading towards defining an impact (whether or not we believe it) but it’s a start. The focus is on that now and not salt from RO. I haven’t heard of a plan to dispose of the salt which is a very significant part of the problem so I’d like to hear where you are up to with it.

In terms of issues like salt, the focus hasn’t been removed. In fact we are working on it just as hard as the other issues, and continuing to refine what our approach might be. We don’t have a project yet on a significantly large scale to engage a third party to be able to process that salt for a beneficial use which is our ultimate aim. There is a huge market for salt but it also requires us to work with other players to do that because none of us have enough salt on our own.

It is certainly a very high focus; it will be part of the EIS and will continue to be part of our management plans.

61. I commend Arrow Energy for the decision not to frac in the Dalby expansion area. In fact, given the growing community concern about fraccing, Arrow’s decision not to frac has been held up as a very positive move.

I now draw your attention to this document which is an environmental authority for the Jordan Project Area. The principal holder is QGC, the joint holders are APLNG, Australian CBM and Arrow. For those of you who do not know, Australian CBM is a wholly owned subsidiary of Arrow Energy. Where a petroleum authority is held by two or more parties, those parties are referred to as joint holders.

This authority, approved on 26 July 2011, amongst other things gives the joint holders authority to drill 2000 CSG wells, of which 1700 will be fracced. Separate to this, I note a paragraph on page 19 of the EMP for ATP 676 for Arrow which states Arrow does not, and will not, utilise hydraulic fracturing techniques on ATP 676. Yet I see that sub-blocks D, W, X, and Y on block Brisbane 2528 on ATP 676 are included in the Jordan Project area. I also note that QGC’s hydraulic fraccing risk assessment management plan of March 2011 says the following, and I quote: ‘There will be an unknown percentage of wells outside the frac blocks that will be damaged during the drilling process and will require hydraulic fraccing to bypass this damage. Finally there will be some percentage of wells over the life of the field in both the fracced and non-fracced blocks that will benefit from re-fraccing.’

My question is: can you please explain to me how Arrow, as a joint venture signatory to the Jordan Project area, has a contradictory stance to fraccing, and how the company reconciles the risks to both your shareholders and to the landholders in the areas which you operate as a joint holder. Further, can you please furnish me with a list of
references and data that show the logic in your decision-making to accept an 85% frac rate in these areas as opposed to a 0% frac rate in the Dalby expansion area and part of ATP 676.

You might recall during the last round of community information sessions we travelled through the Surat Basin from Wandoan to Goondiwindi. We mentioned then that we had undertaken a land swap with BG or QGC in the ATP 676 area. The swap originated from about 2000/2001 as a commercial agreement between QGC and Arrow in what is called a farm-in arrangement, which is quite a common thing in the resource industry.

There were some different blocks of ground under ATP 676 which Arrow (or a subsidiary, Australian CBM) held as title holder. Under the farming arrangement QGC did some of the work in order to earn an interest in those blocks. This is quite a normal thing that goes on.

What we have ended up with ten years hence is a situation where we are inadvertent partners with QGC, even though there we have no alignment with it. So what we have done is set in place a legal arrangement which in effect was a land swap agreement. Arrow can’t transfer the title to the ATP but it can have a commercial land swap arrangement which says QCG has 100% interest in that piece of land and Arrow will take 100% interest in the other piece, to get rid of the shared arrangement that was in place.

So we went from having a 50-50 arrangement here, and a 50-50 arrangement there. We said you take 100% of that, we’ll take 100% of this and that makes it easy. That was step one.

Step two then is that QGC applies for a petroleum lease (PL) in its 100% area. If QGC decides to frac, Arrow has no control over that. We stand by the commitment that where we are doing the EIS in the Surat Gas Project area we will not frac. We haven’t changed on that.

62. So you say in one document that you won’t frac in ATP 676, yet in the Jordan Project authority which incorporates part of 676, there could be fracking?

Only if it’s done by QGC.

63. So it will be done by QGC, but as a joint holder do you have a commercial interest in that?

No, absolutely not.

64. Then why is your name here?

Perhaps we should do this over a map. The ATP provides the exploration right and we have title to that. The petroleum lease is the production document.

65. So you are allowing QGC potentially to frac where you have title rights?

The ATP will be converted to a PL held 100% by QGC. That little portion where you mentioned the sub-block numbers will be transferred to QGC, so that is its area.

66. Are you happy to have your name on that document knowing that you are a joint holder, and to publicly say you will not frac, but in this arrangement QGC will potentially frac those parts.
If the inference is that we are using QGC as a proxy to frac for us, that is incorrect. It is simply an arrangement that we've had in place to do a land swap which is quite common.

When the work occurs it won’t happen under the ATP. You can’t go into a production drilling program under an ATP, and you certainly can’t drill 2000 wells. You have to have petroleum leases to do that, and those petroleum leases will have nothing to do with Arrow. It is a transitional paperwork thing. The actual work can’t happen yet as Arrow’s name is still on there. When it does happen, Arrow will have zero interest in that land.

67. Just before the break, there was a comment made regarding the community and Arrow's impact on it. That presupposes there is going to be a workforce in the area. What happens if the workforce isn't there? It is going to impact us, our rents, our mortgages, all that sort of stuff.

The comment was that the company wanted to source its workforce in the surrounding community, but that presupposes the workforce is actually there.

I probably should have said that what we would like is a locally-based workforce which will involve some recruitment from the local community. A great number of the people in my team have been sourced locally, but it will also involve bringing people in from other areas, and helping them become members of the local community.

So it wasn’t so much that I want to have only people who are born and bred on the Downs it’s more that I would like to have a workforce which spends its money here and brings up families here. They will probably end up coming from the coast, down south, or the west.

68. Yes, but that will still drastically impact on our communities because it means these people are going to need somewhere to live. Cecil Plains isn’t a big town. It will impact quite dramatically on the living arrangements for most of us. What is the solution for that? Is there going to be specific housing built for them, or are we going to see the rents go through the roof so people like us can’t afford to work here.

Higher rent is one of the impacts in the socio-economic part of the study. Before I returned to work in the Surat, I was working in the Bowen Basin; Moranbah rents are through the roof, so a four bedroom house up there can cost $1,500 to $3,000 a week.

Morally, Arrow can’t let that happen here so it is investing in housing projects. We already have done so in Gladstone (the earliest acute impact will be there) to relieve that stress.

I don’t expect we’ll have hundreds of people moving to Cecil Plains. The workers I’m talking about are operations people who will have on going full time jobs. That’s not going to be hundreds of people in Cecil. It might perhaps be 400 people in Dalby.

69. Prior to this meeting on Friday, I sent an email to Jan requesting an agenda so if there were some issues that weren’t of interest I wouldn’t attend those sessions because, like most others here I’m fairly busy.

She replied there wasn’t an agenda available on the Friday. I re-sent the email yesterday, there was no reply. Surely a meeting like this would have an agenda prior to it, and that agenda would be available to any of us. I'm very disappointed that Jan failed to answer our request on Arrow's behalf.
That's a fair point...I think I responded on the Friday and said I'd get back to you Saturday, didn't I? Yes. I didn't get back because we didn't have an agenda by Saturday and then I've been out here since Sunday.

The difficulty with these presentations is that because of constantly increasing information becoming available it's a moving feast in that until almost the first moment of the presentation we don’t always know the order of presentations. In fact, we made an amendment this morning, that's how difficult it is. We emphasised in both the newspaper advertisements and invitation letters that these sessions were going to include water and agriculture, which we saw right across the area as being vitally important.

But it's a fair comment, it's a fair criticism and I cop it. Please accept my apologies.

**70.** For some time now we've been interchanging, or exchanging, views with the Arrow people about potential effects on our farms, and I guess on one hand it's heartening to see that those things have been acknowledged but until today we haven't seen the answers to any of those things.

**Will the EIS provide the answers that we're seeking on those potential impacts? Is that the process when the answers will be given?**

Yes, the EIS is normally expected to answer those questions but I can’t give you an answer today re the impact on agricultural productivity in the region i.e. how much will be lost.

We can't assess that to be honest; it’s the same difficulty we’re having with native vegetation. Arrow’s intent is not to impact native vegetation, and to minimise the impact on your properties. I could paint you a hundred scenarios about what it might look like, but none of them would probably be close to the truth.

What we’ve tried to do in the EIS in relation to those matters, in particular agriculture, is say that we can give you an order of what the magnitude might look like. We felt it was then more important to ask what we wanted to achieve out of this. As I said earlier the environmental impact assessment is about two things: firstly identifying and assessing the impacts and secondly how to manage those impacts, which is probably the more important part for you, and government and regulatory authorities. There are two tests to do this.

The first is whether the project should proceed. I can’t answer that question as it's what we call a societal question i.e. how your feedback influences politicians. It’s ultimately what politicians think collectively on behalf of their constituencies that will determine whether this project proceeds or not.

The next matter is that we have to define mitigation objectives and measures which seek to protect environmental values. What you're looking for really embodies how they will be managed. We've given an indication of what the impact will be on an individual property but can’t actually quantify it. I know that's a roundabout answer, but it's the reason we’re struggling in that space. Does that help a bit?

**71.** Yes, it does. But I guess the vast majority of landholders are still grappling with the fact that Arrow has yet to provide concrete answers to our real issues. Sometimes those answers will have a dollar sign in front; sometimes there will be exclusion zones, and that sort of stuff.
It’s a complex issue, because our farms are complex operations. They’re different here to properties west of here. Somewhere along the line Arrow is going to have to actually answer those questions.

Can I perhaps take a little bit of latitude here and explain the lifecycle of a project? I’m not trying to be facetious here. The problem when we do an impact assessment is that it’s the very start of the project. The project is progressively defined as it goes on in time, to the point where it’s actually implemented.

Most times the impact assessment process is done early when we are looking for those really big impacts that can impact on whether the project should be built and, if it is, how?

So it’s early in the piece and we can only do so much in helping you to understand what it means on your property. Later you’ll have a better definition of what it means to your property because government will impose conditions on Arrow’s operations on your property.

You’ll get further definition when Arrow comes and talks to you. Then there’s a further and subsequent parallel phase where it talks to you about compensation to deal with the impacts that can’t be dealt with.

Unfortunately, it is a long process to get there; it’s not one I can answer today. That’s why we recognise this is a stressful process because it takes time for all those pieces of the jigsaw to come together to give you the ultimate answer. I know that’s a roundabout answer but I hope through the EIS I can give you as much information as I can pull together. But I also recognise there are other pieces of the puzzle that will subsequently come.

72. One of the fears of the community is that once the EIS process is finished, and approval is given with or without conditions, it then loses its ability to have direct input into the shape of the proposal. Is that a legitimate fear?

If you ask me that personally, then my answer is no. The reason I say that is because if the government approve it, it doesn’t mean it can proceed because Arrow then has to seek something like 400 permits and licences and conditions to actually be able to do anything.

As well as the high level documents that Darren spoke about i.e. the environmental authorities which set high level conditions, there are many other permits required. When government approves an EIS it’s really saying to Arrow it is authorised to go to DERM and other agencies to obtain the necessary permits.

Now not all of those permits are subject to public involvement, some are just procedural but very heavily regulated re what’s required and how they fit together. However, others do have input processes, and you’ll find that a lot of the conditions which are applied to this project (like the earlier ones) will require consultation. So the door’s not closed.

Typically, the process to get all those permits takes about a year or so to work through agencies and, in many instances, with the community. So the answer from my point of view is that the door’s not closed. Your ability to comment about the project in general is significantly reduced, but the door’s not closed on how or when it happens.
73. Tony, when you were speaking this morning you mentioned work was happening around River Road. I have heard it mentioned that Arrow’s been down there…can you explain to us what you are doing down there?

There were some old exploration wells that had been drilled, and we were going through the final step to rehabilitate them. You need to bring the drilling rig to the site, it runs a drawstring to the bottom of the hole that’s been drilled, and it’s cemented in stages. Then we cut the casing off below ground level, and rehabilitate the surface. That’s what they’re doing.

74. When was the well drilled? Was it a recent thing?

I don’t have the dates but I can include them in the meeting summaries we send out.

*There are 13 wells on River Road that were drilled between March 2007 and January 2012.*

75. What has tweaked my curiosity is that I know there’s a six month period or something along those lines under the environmental authority for rehabilitation. We obviously didn’t see Arrow there six months ago so there’s been considerable time lapse; is it a normal thing to leave a period of time before it’s done?

We are actually converting some wells for groundwater monitoring. There are a number of wells we’re doing the rehabilitation program across, and in some of those we installed a piezometer, which measures water pressure as part of the groundwater study. A number of the bores are kept open for that purpose. To some extent the weather also delayed us because we need to get access to land to do this activity. Those two things contributed to the delay.

76. So you are telling us it’s been a long period of time?

Yes, the wells are secure and the gas can’t escape because it is held by water pressure.

77. Is the water drawn down?

The water level is static, there’s no production in the area so the water level there is a natural water level. We’re not affecting it.

78. What about exchange between aquifers?

That’s where we use the casing, and cementing, that we talked about previously. All the upper aquifers are encased and cemented off. We only drill into the Walloon Coal Measures.

79. The well had been there for ten years; is that an acceptable period of time?

I don’t know about that well but certainly Arrow is a company that’s been drilling wells since 2000. There’s a legacy of wells that need rehabilitation works, and we’re doing that now as part of a widespread program to ensure any of those wells that haven’t been done in the past are now rehabilitated.

80. So there are a number of wells that could have been done in that period of time?

I don’t know the time period, but certainly there are wells that have been left because the thinking back in the earlier days was that it’s a good thing to have monitoring points around the field, even during production. That’s why a lot of the wells were left open in anticipation
they would be used for groundwater monitoring or for gas pressure. We don’t do that anymore as we now drill dedicated monitoring bores for that purpose.

81. **On the topic of drilling the wells, I have to confess my eyes were glazing over a year ago when you were telling us how you drill the wells and put the steel casing down.** As a quick refresher, when you drill the well and you put the steel down, does the steel go all the way to the bottom of the well?

   It’s put down in stages, so it’s a telescopic arrangement. When we drill the first section of the hole, it goes down to the bottom of that section, then we drill the next section and yes, casing goes down to the bottom of that section. In an exploration hole we case down to the Walloon Coals but in a production well there’s casing all the way down.

82. **With exploration holes, do they do the cement grouting thing around it or just for the production ones?**

   No, all the wells are cased and cemented.

83. **They put the cement down the middle of the well; it has to get all the way to the bottom when it's forced out the sides, is that right?**

   Yes, like a syringe.

84. **I’m concerned it's roughly about an inch thickness around the outside, is that right?**

   The annulus, yes.

85. **What happens if the well is crooked?** If the well is drilled a bit crookedly, and there’s only one or two inches of cement on the side, then if the well is drilled crookedly any more than two inches the steel casing will be butted up against the soil. You can’t force the cement there, so you’re going to have holes, or exposed parts of the casing, or cement grouting. Is that true?

   A lot of processes are put in place to make sure we drill vertical wells as there are problems with inclined wells, as you’re pointing out. We also use centralisers to make sure the casing is held in the centre of the hole, for the reason you mentioned that if you keep a space between the casing and the bore hole itself, cement can get to the surface. This is a routine thing we do so part of the test of a successful cement job is that you get the cement back to surface. And we do that.

86. **So it doesn’t matter if the well’s not drilled straight then?**

   Look, we drill straight wells. The rigs are designed to lock into place at 90 degrees, so you start it off straight. The way you configure what they call downhole assembly dictates how straight the well is. It’s a very established practice to put in place the right measures to drill a straight hole.

87. **Well, I’m a bit worried about that, Tony, because I’ve been on to the QDEX website and I’ve looked at a lot of well completion reports; so much so that I’m sick of it. Every single one of the wells that I looked at had one of those circular diagrams attached to it, and a data sheet attached to that. Every single well was crooked.**
I will concede that over 300 or 600 metres, some of those wells were only a metre or two metres off the vertical, but I found one well that was 59 or 56 metres off the vertical. There are examples of 9 metres, 7, 53, 3.7, 38.7, 36, 6, 22.5 metres, 17.5 metres and so on. So you don't drill vertical wells.

There's one in there whose deviation I can't remember but it went out, came back in, went out and came back in, and while it was doing this it was going around it like a corkscrew, like a wormhole.

Some of these wells are as recent as 2009 so you don't drill vertical wells because these are for exploration and they don't go public until two and a half years later. But there's no such thing as a completely vertical well.

Yes, you're right. We do start vertically but the ability to keep it so decreases the deeper you go. You mentioned 300 or 600 metres...at that depth it might be a metre off which is the normal aim for the tolerance range. On the way down you can also strike formations that can cause it to deviate; that's not uncommon.

It doesn't matter with an exploration well as it has a short term life, and is then plugged.

It does matter in a production well so between the drilling process and bringing it into production; we run tools in the well (called a verticality log) which tells us how straight it is. If it's not straight, it may not be suitable as a production well. You cement it back up to a point and try again or, in some cases, you re-drill the whole thing. That also happens.

88. I'm going to have to get back onto the QDEX website and go through every single one. I won't look at the exploration ones but I'll go through and look at all the production ones because, I don't know about the rest of my community but to me personally those figures are extremely alarming.

You've been telling us for the last 18 months or so that you guarantee the integrity of your wells, and the way that they're drilled. Yet they have a little bit of steel that is a corrosive substance, and it's surrounded by some cement that I've got no confidence actually encases that well. You're drilling through our alluvium, and these things are as crooked as anything. My son could draw a straighter line.

I think that's overstating it because what's important is that we achieve a complete annulus of cement between the casing and the hole. A deviation of two degrees, of one degree, does not prevent us from doing that. In the Bowen Basin where we directionally drill, the wells bend by seven degrees every 30 metres. There's no problem getting cement around that curvature. The wells start vertically and end up horizontally, by design. The fact that the well was slightly bent, or even highly bent, does not change its integrity at all.

89. I'll just make a comment on that, Tony, before I ask my question. You're dealing with a sensitive community, and I hope you've identified that. You stated that Arrow drills straight holes when in fact it doesn't. So when you're asked that question, you have the opportunity to say that Arrow doesn't because that builds trust. It's a bit like the fracking issue; you're buying community acceptance when there's a bit of smoke and mirrors there.
My question is on the subsidence issue. You seem pretty confident on it so will you guarantee in any conduct and compensation agreements that there will not be subsidence?

That’s subject to some work being done by subsidence experts. We will take their advice, their direction, and put in place appropriate measures based on that information. We’re not experts on that issue which is why we use external consultants who are experts. Subsidence modelling and monitoring is extremely advanced because of the coal mining industry. We can use the expertise they’ve developed from a vast number of mining projects around the world.

90. It’s just that it’s a pretty critical issue because I don’t think even Anna Bligh can make good if a farm drops by three or four metres.

With due respect, it’s impossible to drop three or four metres. Even in a coal mining situation, where a long wall miner extracts three or four metres of coal, by the time that translates to the surface, it’s not three or four metres, it’s much, much less because there are both bulking and subsidence factors.

It’s irrelevant here anyway because we’re only taking out two percent of the volume of material in that coal seam. The coal seam structure doesn’t change, it’s only that little bit of water in those walls; the layer cake of coal seams and other formations that make up the stratigraphy of the area is still intact.

I’m not a farmer, but I’ve spent a lot of time talking to people in this community and others and we understand that on that flood plain the top profile of soil is critical. If this study showed there was going to be a catastrophic impact to it then we realise that would be a really, really big problem. It’s not something that gets solved by us giving you ten grand or drilling your bore deeper. We take that issue very seriously which is why we’re doing the study; once we have the results we’ll deal with it appropriately.

91. So you’d consider something like that a knock-out for operations?

I don’t know what the results of that study are going to be but we understand that it’s a significant impact.

92. Given that your EIS is imminent and there’s lots of work happening on it, we’ve all spent a lot of time in the last couple of years looking at flood plain issues but they don’t seem to be getting any less. Has your company considered, through whatever means, relinquishing its tenure above the Condamine Alluvium?

In relation to your comment that they don’t seem to be getting any less I was hoping that particularly after what I showed you today it demonstrated a willingness for us to understand and try to work through the issues.

It frustrates me that we aren’t yet at the end of that process so I accept your frustration that we can’t give you absolute answers. However, we are working through those issues and will continue to do so. Believe it or not but one of the positive things that comes out of these sessions is that as we eliminate some concerns, others get raised so we’ll go away and work on those. I doubt we’ll ever turn up and there won’t be any questions, but you know we are working on many issues.
93. So the gas reserves are such that you’re not willing to make relinquishment a goodwill gesture?

There appears to be an economic gas field out there. Although we don’t know the development costs we’re working to understand what it’ll cost to manage the impacts.

94. With reference again to that River Road exploration hole we questioned earlier, somewhat unfortunately but fittingly you used the word legacy to describe some of those earlier bores and the need to tidy up that work or finish it off.

As I understand the history from direct conversation with the landholder, he was approached in 2001; he was told the preferred site to drill the exploration well was immediately adjacent to his residence. The farmer rejected that, accepted a site somewhere else on the farm and a compensation agreement was reached.

It’s been ten years since that compensation agreement was honoured by Arrow; it happened for the first two years and no further. There has been very poor communication about the results from that hole.

There’s been no notification of access when Arrow inspected that hole …at least until very recently. One time recently the landholder saw lights at the site at night, went over to investigate, and found a couple of your staff members with a laptop at the exploration hole.

To close the hole off, formal access was required as it would look a bit obvious that something was happening with all the equipment required. The landholder then pointed out that Arrow hasn’t been providing compensation under the agreement for the last eight years. It was then promptly fixed up in two days to achieve access.

I think the word legacy is somewhat fitting. We’re dealing with things that come out of the woodwork time and time again. You just referred to your willingness and intent to work with landholder issues; none of this may be your personal fault but from our point of view Arrow the company hasn’t worked for us.

The first time we were here we acknowledged very clearly and openly that there’d been a long history of Arrow in the region, and all sorts of things had been done that were not good. You’ve drawn on one example of that.

The commitment now is to fix up those things that need fixing and I hope you can see from these last four visits that we want to improve how we operate and engage with you.

I take on board the particulars about the recent events, and I’ll follow up with our land and exploration managers to find out what’s going on and then get back to you. What I’d like to convey is that we’ve got a job to do to fix up some of those legacy things left behind by the company, and that’s what we’re doing.

95. This well was drilled ten years ago, and it wasn’t six months ago that someone was there after dark, in an unmarked vehicle. It’s not on. Any wonder we still do not believe you.
A whole bunch of stuff is being fixed up. I'll put my hand up and admit there is stuff out there that I don’t remember doing. I’m prepared to stand up and say it was my mistake but we are actually out there fixing things. I’m sure with the best intentions we’ll still bugger stuff up in the future but we will fix it up.

96. **The inference seems to be the exploration hole is a different matter, it's inconsequential in the overall project.**

I appreciate that. We’re now absolute that we cement the hole before we finish. That causes us an inconvenience sometimes when the geos might regret a monitoring kit hasn’t been put down the well but we now know it has to be standard practice to cement the hole.

I’ve been advised by my guys that on the particular property I think you’re referring to that perhaps the landholder wasn’t reminded or forgot he had to submit an invoice for the compensation payment which is why it was late. But that said we’re in the process of rectifying it with the landholder. With regards to the guy not accessing the property appropriately, that’s absolutely correct. He did that, and that person no longer works for Arrow.

97. **Does Arrow Energy use cavitation drilling?**

No.

98. **You don’t? You do not intend to use cavitation drilling in this area?**

No.

99. **Why not?**

We don’t need to. Cavitation is a process where you drill a well out of a coal seam, and you basically inject air, at really high pressure, and let it go all of a sudden. You do that and you get fracturing. It's not fraccing as we know it, but that cavitation process creates a cavity in the ground. We don’t use it because we don’t need to now or in the future. It’s the same reason why we don’t use fraccing: the permeability of the coal is so high gas flows quite readily, it doesn’t need any enhancement.

100. **What is the average production of a single gas well in Queensland?**

That’s a hard one because there are so many variables… the depth of the coal, the gas content, the type of well, there is no simple average figure. Also a well produces a lot of gas early in its flow, and tails off over a long period. In my fields it ranges from about 100 gigajoules a day up to a bit less than 300 gigajoules a day.

101. **Can you explain what a gigajoule is?**

There are twenty gigajoules in a nine kilo gas bottle, or 100,000 standard cubic feet. So if you let the gas out at no pressure, it would fill up 100,000 standard cubic feet.

102. **And that's in one day?**

Yes. You might have heard much larger numbers from some of the other operators because with different technology you get different results. We know of CSG wells where they have fracked and cavitated that might be ten or twenty times that rate. I wish I had some.
103. After listening to Arrow’s presentation this morning on both land and water issues, and their answers, and listening to landowners this evening and some of their issues, I wonder if we could have a show of hands who would allow Arrow on their property in its present form. Anyone who wants to can raise their hand...

That gives Arrow a fairly good indication of where it is at the moment. Thank you.

104. What’s the gross value of production for one day?

Gross production value is $2 to $2.50 per gigajoule. Those wells which are at 100 gigajoules a day, we sell each gigajoule for between $2 and $2.50.

105. Do you use pressure grouting in your work constructing the wells so that you press your cement from the bottom up or from the top down to get greater well integrity?

The CSG wells we grout from the bottom to the top. With the process we mentioned before, we pump cement down inside the casing; it then goes up again between the casing and the wall of the hole.

The groundwater monitoring bores are constructed by the same rigs and drillers cement them in the same way.

106. Yes, is that a change? Have they recently changed the standard, or is there some new standard coming in?

No, it’s the standard that Arrow has applied to the construction of those wells. They are done by the same building and completions team; it’s the standard way of doing the project.

107. I’ve taken a fairly broad interest in this. I’m involved in the Surat Basin Corporation; I’m involved in the CSG Engagement Group. My wife and I come from an agricultural background and we drove down from Toowoomba today and crossed undoubtedly some of the most valuable agricultural land, not just in the Toowoomba Regional Council area, not just in Queensland, not just in Australia, but probably some of the most productive country in the world.

I think it’s incumbent upon you to tell us just what price you are prepared to pay to actually operate on that land? Community feeling is strong, the risks are high. In my lifetime, and I’m only a pretty young bloke, I’m only in my 20s (if you believe that you’ll believe anything). I’ve seen enormous land use change in this area. I’ve seen it go from grazing to farming to intensive farming, and I wouldn’t be dreaming to suggest that it has a big role to play in feeding the world.

Are there alternative places for you to go? How determined are you to drill here? I represent the Toowoomba Regional Council and have been authorised by the mayor to say what I’m saying. We are extremely concerned about the move to extract CSG this side of the Condamine River with the limited knowledge we have about CSG, about groundwater, and all those sort of things.

I understand there must be enormous economic pressure for you. I understand in talking to your CEO that you see this as your soft spot in terms of production. Quite frankly, I just wonder is it worth the effort? Is it really worth the effort? As I said
previously, you are dealing with some of the best agricultural land in the world. And there are other places that you can go, not all that far from here.

Is it worth the effort? That's what we're here finding out. That's what we're exploring, it's why we're doing the groundwater work, land use etc. to see if there's a way. We've made a commitment that we won't develop east of the Condamine until we have sustainable means to remove the gas we know is under the ground there.

We're not there yet but have made progress. We've still got a bit of work to do, that's clearly acknowledged, so we have not made a firm decision either one way or the other.

We are currently developing gas in the Bowen Basin and doing other things but there is so much gas here it is worth the effort to see if there is a way to get it out. That's really what we're about. It's also why we're taking our time, we're still two years away from a final investment decision so there is a lot of time left to do the studies that are required.

Clearly we won't do things that jeopardise the livelihoods of hundreds and thousands of people. We're trying to find a way to co-exist. We think it's possible, and we're doing the work, but time will tell. We'll come back here every six months to keep you updated as to where it's going. If we can't prove there's a way that gives people confidence then we haven't succeeded in our challenge. But that's what we're about, it's getting that information to give people confidence.

You've heard a lot of science today, and that's what we'll keep presenting because science is all that we can work on. The science will dictate the way we can do things here.

108. In May I asked whether you guys would be able to provide us with water quality analysis of water that's been through the Arrow RO plant. Can we have it please?

Yes, we can do that.

109. When? I asked in May five months ago...I'm still waiting.

Can someone write that down? I'll get you something by the end of the week.

110. Thank you.

Sorry about that.

111. And can I have the lab reports from that?

Yes, that's what I'll get for you. Do you want the amended or unamended report?

112. I'll have everything, and I'll work it out for myself. I'm happy to take as much as you want to give.

It's basically in the public domain anyway. There's so much information from monitoring on Theten that there's no issue with us sharing that. We want to demonstrate it's safe and reliable.

113. Can you tell me, off the top of your head, what SAR you're aiming for?

The number is four.
114. Can you get it to less than two, because that’s the groundwater SAR?

I’ll get those answers for you, and get back to you.

*As per DERM requirements, Arrow Energy is required to maintain a Sodium Absorption Ratio of 4.*

115. In May I also asked a question regarding when you are handing back the tenures. The answer I got later on was 2045. Is that still the date?

In the presentation I talked about exploration results in the south, and I said that in ATP 679 we’ll be giving back some ground there next year.

116. I wasn’t here when you spoke this morning, Tony. In May, I think, Andrew came up to me and said 2045 was the answer to my question, and that you guys would be gone in 2045.

A petroleum lease has a 30 year life. I assume that’s what he was referring to; if it was granted in 2015, then 2045 is correct.

117. That was just a leading question because at a recent Senate Inquiry in Canberra Heffernan asked all the CSG companies what happens about the monitoring when you guys are gone. So what happens in 2045, with groundwater monitoring? The companies responded that their responsibility for doing groundwater monitoring ends when they return their tenure to the state government. So what happens in 2045?

The way the *Water Act* works with the *Petroleum and Gas Act* our obligation continues for a period that will be determined…it doesn’t rely on the tenure itself. There are other access arrangements etc. that can be made to ensure the ongoing monitoring is done until the government’s satisfied that it’s all right to cease doing it. But the liability, in terms of any impact, continues in perpetuity.

118. Can you email me the sections of the Act where it says that? Because you can download the transcripts of the Senate Inquiry and there, without fail, company after company said groundwater monitoring ends when the tenure is handed back. I remember reading what the QGC woman, Catherine Tanna, said. That's what she said.

I’m not sure what you’re referring to about the Senate Inquiry but what I described is the legal situation.

119. The state government has also said it will pick up the slack for the monitoring after you guys have handed back your tenure. That scares me because you’re a wholly owned subsidiary, and you’ve got wholly owned subsidiaries. The reason for these companies to be set up as wholly owned subsidiaries is to limit liabilities to the parent companies. It would be really nice for us to see Royal Dutch Shell and PetroChina send us letters giving us an assurance they are going to guarantee any impacts that may or may not eventuate in perpetuity. Can you pass that on to Andrew, to pass on to his bosses?

It'll be recorded.

120. Does anyone else want to ask questions because I’ve still got some more.
In relation to the SAR, we will be constrained in terms of what we produce in water quality as that will be determined by DERM. In many cases its idea differs from what you or I might think SAR should be; we'll just have to work with that.

121. I would hope at Theten they would want it to be less than six because government reports say that SAR ratios six and upwards will cause harm to these soils?

It is four.

122. You guys have been busy in the community recently and there's been a landowner, a neighbour of mine, who's been approached by Arrow Energy in the last couple of weeks. The timing of the approach is pretty interesting because I'm a member of the Central Downs Irrigators Group so I get to hear what goes on at the committee meetings. I'm aware you've been in discussions with the committee of the Central Downs Irrigators about putting down monitoring sites as you want to put some monitoring wells around an alluvial well to see if you can get any information.

At the same time as you're having those discussions, completely independently and without mentioning it to the irrigator group, you approached another landowner in the community about doing a different sort of monitoring.

I assume this is for the 300 monitoring wells. That alarms us as a community because you didn't mention it at the Central Downs group; the landowner said that whoever it was had a piece of paper from the Toowoomba Regional Council saying Arrow has its permission to come on and have a look around the site. I'm wondering if you'd be able to show us a copy of that letter from the council to Arrow.

Yes there are a couple of monitoring bores proposed for that site; they are completely unrelated to the study we're discussing with the Central Downs irrigators.

123. It's related to your activities on the pipeline? We don't understand.

So the question was about whether or not the Central Downs Irrigators...

124. No, the question was if we can see the letter from the Toowoomba Regional Council that was shown to the landowner at that first meeting.

I'm not aware of this letter so I'll undertake to find out more about it. None of my people here are familiar with it.

125. The problem is that the Toowoomba Regional Council is not familiar with this letter either. We've approached them and asked for a copy of the letter, but they can't find it.

All we can do is try to follow it up as no Arrow staff here know anything about it.

*Internal investigations have revealed nothing regarding a possible letter from the Council. We note that such a ‘Consent letter’ from the Council does not align with the land access process. As part of this, the company would provide a notice of entry to the landholder, and the Council would not be involved in the process.*

126. You had three Arrow people present at a Central Downs Irrigators committee meeting talking about groundwater monitoring and selecting sites for one type of groundwater
monitoring analysis; wouldn’t it have been prudent in that conversation to say that you were within two to three days of sending a land access officer to a member of this local community to discuss putting a well down into the Walloons and into the Hutton. It might be a different study, but it’s still water monitoring. Wouldn’t you have thought that that was a good idea?

The answer’s been given. The reality is that no Arrow staff know what this is about but we will go back and check and, if necessary, talk to the recipient to find out what this is about.

Every time we do these sessions we give an update on what we’re up to. We’ve said before that we’re doing exploration works and where it’s being done. What you referred to might just be a part of that activity. We said we’d put down bores, and we’d monitor. Perhaps that’s all it is but I’ve said I’ll check and come back with the answer.

127. Rubbish.

We’ve said we’ll get back to you on the specifics of this one

128. I don’t think it comes as a surprise to you that you guys have got a credibility problem in this room. The reasons for that are many and varied, and some go back a long way and some don’t. If you expect the community to have confidence in what you’re doing, and what it is that you propose to do here, you need to be up front about everything. To have two different groups of people running around doing things in relation to water monitoring is fraught with danger.

This is the sort of issue that it creates. As Chair of the Irrigator Group, when I get a local landowner ringing me up to say he’s had an approach from Arrow to put down some monitoring holes and we don’t know anything about it when only two days before you’ve been talking to us, it doesn’t create a good look. I don’t know if there’s any ill intent meant by it, but if you’re serious about shoring up credibility, you can’t let things like that happen.

There was no ill intent. The land agent was out doing a job as part of a large program for water monitoring bores that we’d previously committed to. The timing is unfortunate but we’ve taken it as feedback that we need to brief community leaders like yourself on Arrow’s broader program at the very least. Then when you receive that phone call you’ll know what’s happening.

I would add that there aren’t two separate groups doing activities in relation to groundwater monitoring. It’s a centralised activity but there is more than one person working on it.

The amount of work we have to do to execute the program is quite significant which means a lot of people are working on it. When we came to see you, and I was one of those people, we were very specific about what it was we were there to discuss. We didn’t have all night and you didn’t want us there all night, so we talked very specifically about the proposed study that we’d be doing. I thought it went quite well…and of course we are very happy to engage at any point in time about any of our work.

We will be doing a broader groundwater monitoring program, and we’re out now trying to identify those sites for a 2012 works program.
129. On that topic, do you think it's wise to have your water monitoring site on a contaminated site?

That's the sort of information my guys are finding out as they go out and do these things. There are a lot of sites we have to understand e.g. potential sources of contamination pre-dating Arrow's activities; there is a whole range of things we need to understand.

Both desktop and field scoping will occur before we commit to a site. We discover unexpected information...it could be a grazing property and we find there was a dip there. The fact that it was a contaminated site goes into our assessment to determine if it's a suitable site or not.

It wasn't as if we went out looking for a contaminated site, we found it because of the thorough process we go through.

130. I understand that according to the Environmental Protection Act there's a timeframe within which you have to have your EIS submitted to government, is that right? Is it right that you've only got something like two years to submit it for the first time?

The timeframe is flexible but the process does take around that time. You can do it in a shorter timeframe but there are a lot of stages in that process. It could actually be extended well and truly outside our control as it will depend on the resources in government to analyse submissions as well as a whole range of other things.

131. I was talking about your initial one, this December. You seemed pretty keen to have it in to the state government by December, is there a deadline that you're trying to meet, in that initial submissions timeframe?

Yes, they're internal company deadlines. For us to take the steps needed to make a decision about whether we want to proceed with this project, we need to understand what the approval process might look like, what the costs of managing this project might look like, and we need to take all of that into consideration when the company makes a decision as to whether it wants to proceed with the project.

132. The question I'm asking is not about your internal timeframe but if there is something enshrined in law, like a section of the EP Act that says you've got one year, two years, to do this initial submission?

I don't believe so but remember Arrow is doing a voluntary EIS, not doing one where it's been asked to submit one.

133. I might be wrong, I thought it was two years. Maybe it's something a little bit further down the track, something which gives you more time.

I'm really troubled you're submitting it now as I understand the process takes several years to finalise which would give you time to further the studies you're doing. I would like to reinforce something that was said earlier on...there is so much that you do not know at this moment in time about what's happening on the flood plain. You mentioned that in regard to further research and going forward you need to look at faults and fissures.
We’ve got a massive fault out there and I understand we don’t have a lot of data on it at this point in time so you will need to look at the connections between the hydrostatic units. If you remember that analysis has not yet been done for the fault, (the Cecil Plains syncline) and there is a big gap in the data regarding the interaction between the Condamine Alluvium and the intervening layers, where they’re present, and the Walloon Coal Measures. Why on earth are you sending in the EIS now before you have the data and the answers?

You say you’ve got to find out where the no go zones are, and the maybe go zones, and the definitely go zones but without doing those analyses you will never know whether the Horrane Trough may be a no go zone.

Can I answer your question in a couple of ways? The EIS process tries to include as much detail as it can, but its purpose is not to define all the detail. A lot of that additional detail, as I said earlier, is contained in subsequent permits which go through their own approvals process.

What the EIS tries to do is assess, theoretically, the worst case. My job through the conduct of all the studies (including air and noise and, to some extent, water) is to try to present to you the worst case scenario. And how we determine that?

In the noise modelling the actual computer programs and algorithms or mathematical formulas used for the calculations have inbuilt conservatism. In other words they’ve already overestimated the impact. The meteorological model we built to inform that calculation is a very conservative worst case model, so there’s another layer of conservatism. Then we add into that the full output of all the machinery, which would never occur in reality, and you get another level of conservatism.

In the EIS we’re trying to present to you, the broader community and the government what is the worst case...in other words it will never be worse than this. How much less it will be depends on a lot of factors including mitigation measures, rehabilitation, etc. What the process is trying to do is ensure that what you’re trying to comprehend and assess represents the worst case, not something much less. That’s what the process is trying to do, and it’s on that basis that governments will make a decision as to whether they think the project should proceed.

There’s another factor...what we call uncertainty. Another part of the process is to try to define uncertainty, and how that’s dealt with. If we don’t adequately describe it governments will impose conditions as you’ve seen with some of the other proponents. It’s possible that Arrow will end up with similar conditions. However, where there is uncertainty and the proponent hasn’t been able to describe that, government will do one of two things.

First, it may say to go back and do more studies before it will give the right to proceed, or it will build in a condition which says that until the company defines the uncertainty to a sufficient level to satisfy all the stakeholders, the project can’t proceed without additional monitoring over a period of time.

I’ve been involved with numerous EIS processes, in equally concerned communities as yours, where that’s been the government’s response. Those projects haven’t proceeded until those questions have been answered.
Does that go some way to answering your question? The timeframe is a notional two years but if you read the Act the Minister has discretion to vary that, and in two ways. He can say he wants extra studies (from those stipulated in the Terms of Reference) and the company has to accept it. In addition if the proponent's having difficulty with the project description (including any uncertainty) it can apply to the Minister for an extension. There isn’t a statutory period, per se, of two years under the *EP Act*.

There are time limits on how long approvals can last. If Arrow was to get this project approved next year, there’s a sunset clause on how long that approval stands before it would have to go back and do it again.

134. I've just got a statement to make in regards to a comment that Darren made earlier about the farm up on the screen. Darren said Arrow worked with Stuart on that to see how gas field development might play out on a flood plain. From our perspective, we undertook that study to inform our community how significant the impact is going to be. We didn’t do it so much to work with you in order to help design a gas field, we did it to demonstrate to our community what we’re in for.

I took quite some pains to try to say we haven’t obtained out of this an agreed design for a gas field. There is no expectation that I’m going to turn up next week at Stuart’s place and sign him up for that. I appreciate what you guys hope to get out of it but what we’ve obtained is an understanding of how things would look. We haven’t worked out costs and nor do we have details about timing and workability.

My feeling is that what we’ve done so far is probably the easy bit; timing and workability around the farm is going to be a lot harder. There are still things that we need to sort out before we have any conversations about access. So I’ll say it again, in no way did I seek to imply that anyone who’s been involved has consented to anything with Arrow. It’s purely a desktop exercise to inform us about what we need to do to manage the really obvious impacts… it’s only just started.

135. I’ve got a question for you, Jan. After the last community consultation we received an email from Enhance wanting us to do a survey. Is it going to be conducting a survey after this one? I would suggest that perhaps it shouldn’t, considering it was described in the email as independent when it isn’t.

(Jan Taylor) I’m sorry, for starters it is not Enhance, it’s Enhance Research which is a totally separate company. Are you talking about the fact that the husband of an Arrow staff member is a director of that second company? Do you really think that anyone with any intelligence at JTA is silly enough to put themselves in a situation where their integrity, as well as the integrity of the survey, is called into question? JTA chose the survey company on the basis of the best possible professional market research company.

136. I’m not saying that, Jan. All I’m saying is that the sole director of that company is an ex-high level State Labor Government employee, and he’s married to someone you know. I’m not insinuating anything. I’m just making that statement, that for an email saying that this was an independent company, and when I googled the company, this comes up, it’s clearly not independent.
I’m not inferring anything about this man’s character at all, that’s not the issue. The issue is that based on his previous job, and based on whom he might be married to, I wouldn’t consider that company independent...regardless of whether he keeps his mouth shut at night, you know? Like, I could keep a secret from my husband, but that doesn’t mean I’m independent.

(Jan Taylor) Do you understand what Enhance Research is? Do you understand that the gentleman in question is not a director of that company? Do you understand that the people who work for Enhance Research have nothing to do with him or his particular company (which is not the research company)? In fact, the sole person within Enhance Research who did that survey is a gentleman called Gerd Haberkern who was not only totally independent but also the best professional market researcher available.

I have to say that I take exception to your comment because I don’t bring anybody in unless I can be guaranteed of their independence and their integrity. It’s my name here that’s—

137. I’ve got something to say in regards to that. This is the second meeting now that we’ve attended where you’ve publicly attacked my family. And my husband is not a professional but you are. He is a person whose family, business and community is at risk by this company that you’re here working for, and I think it’s appalling behaviour. Yes, he calls out, and perhaps he shouldn’t. But you’re employed here to do a job, and name calling and derogatory statements are unacceptable. I’m just wanting to close with, and you might all think this is hilarious, Arrow Energy, but what I’m saying is the truth, and it’s true to us.

This is a job for you guys, you get paid whatever you get paid, and you get your annual leave, and you get to go back to Brisbane and worry about what colour to paint the fence, but these are our lives that you’re messing with here. There is no doubt that Arrow Energy continues not to have social acceptance in this community. You’ve never had a social licence to operate, you haven’t got it now, and until you can work out how to operate on that flood plain without harming that water, and without compromising our ability to farm, you’re not welcome.

But Jan, you won’t be welcome in this community either if you continue to make personal remarks about my family. In November last year you commented that this is not a family reunion, because my husband and I were asking a lot of questions, and only today, when my husband called out, you said to him he doesn’t know what he’s talking about. Now that’s just not on. And we will not tolerate that as a community any further.

We won’t tolerate it from you, and I’m sorry, Arrow, you guys have a long way to go if you want us to come to the table and deal with you in a decent manner. You’ve confused our honesty, integrity and politeness with acceptance. You continue to lie to us, you continue to withhold information from us that courtesy would dictate you share, and this community says no to you for the foreseeable future.

(Jan Taylor) There is just one thing I will say. My response today should be put in context…I did say (you) don’t know what you’re talking about…but that was in direct response to his statement that I ‘don’t want to hear from the community’. At that stage, I had allowed unlimited questions; you and everyone else in this hall were encouraged to ask questions and
were given the courtesy of a response. His comment to me was made five minutes after he arrived in the hall (when the question and answer session was well under way) and was a gross misrepresentation of the truth.

Arrow wants to hear from the community and the fact that we are still here at this time of day is absolute proof of that. That’s all I’m going to say on it, because it’s getting a bit too personal for my stomach and I have to say I don’t appreciate it.

138. Leisa, I just want to say that my comment is not an attack on your family. I'm merely saying that a JTA email said Enhance Research is doing an email survey, the company is independent, it won't be going to the government or to Arrow. But when I googled Enhance Research, I find this person is the sole director.

(Leisa Elder) What Jan said is the absolute accurate answer, and I stand behind it. Anything you want to raise with me about my family, take it offline. But Jan has given you the answer, there is no connection. It's not worthwhile even raising the question. My husband was Deputy Premier of Queensland eleven years ago. Okay, I'm sorry this has ended on this note. I really am. You've been a fantastic audience, and I would like to thank you all very, very much.

(Jan Taylor) Thank you very much for having come here today. I'm sorry we've ended this way, it's unfortunate, but everyone's entitled to their opinion. I just hope that you will remain involved, that's the most important thing, because as we have made clear today this is an evolving story. You need to remain involved to be able to ask the questions, that really is vitally important.

So thank you all very much, I hope you get home before the storm, and I hope the rain is what you want. Thank you all very much.

139. Thank you. If I may just say something very quickly, probably related to everything not on the science side as that's not me. I always make a comment related to lifestyle and family when I come. It concerns me that a lady I know a year ago said to me, oh, yes, we've got a couple of wells at our place. No problem at all. I saw her two weeks ago, and she said we now have twelve wells and a compression station. She said it is a living nightmare, men, trucks...sorry, it's not Arrow Energy, by the way, it's another company. Sorry, I need to start with that.

She said her little paradise is gone. I think I've counted 37 Arrow badges here, by the way. That scares me too, why are there so many here. But it is going to impact on us more than just environmentally because she has found just twelve wells on her property a living nightmare. It's a cultivation farm and her husband spends most of his time negotiating.

Can I say it's not fair to bring the experience of another company to this forum. We are not the other companies, we are Arrow.

140. Well, as someone who's looking down the barrel of a shotgun, there are still many concerns whatever the company... and I publicly say it wasn't Arrow Energy, okay?
1. I’d like to make a comment on the population projections where you say that Arrow’s impact will be contained within the organic growth of the population in our area.

That might be so for Arrow but when we’ve got two other major companies here, plus the Solar Dawn and UCG projects and everything else going on at the moment the cumulative impact is going to be a lot, lot more than our organic growth.

We have KPMG doing an affordable housing survey (well, actually a housing survey) for the whole of the Western Downs. And some of the very preliminary figures (so don’t get too excited about them) show there is going to be a hell of a lot more growth than in the organic growth corridors as predicted by the Queensland Government.

I totally agree with today’s headline in the Chinchilla News that the impact on people out here who are forced to rent is absolutely horrendous. And there is a statement in there that the Council should be taking up the slack on this. Well, we are faced with a very hard philosophical question here as to whether it is Council’s core business providing housing for people who can’t afford to live anywhere else?

I contend it is a state and federal government responsibility not that of local government because our only source of income at the moment is rates. If we are expected to pick up the slack for affordable housing for those in need rates will need to increase at least 25%, it could even be more.

So we have a lot of problems. That’s why I’d like to challenge you on your population predictions because I think the cumulative impact is going to be a lot more than is indicated there.

I don’t have a problem with that, Bill; you’re right these are only Arrow’s figures and I acknowledge there is a cumulative impact. We are required as the last major CSG proponent to look at the cumulative impacts. One of the difficulties we have is getting real data about what that impact might be. As you would know, the council and government is starting to develop working groups to try to pool all the information, as you said, to try to get a handle on what it means to this region in terms of the overall impact.

As Darren will explain later, Arrow’s intention is that the construction workforce for the big facilities will be in a camp so we won’t be putting an accommodation demand on towns. So what we are looking at from Arrow’s perspective, and I don’t want to disagree with anything that you’ve said but these figures are about the operational workforce over 25 years, how it ramps up and where it gets housed.
There will be pressures in Chinchilla, Dalby and Millmerran because this is where the depots are going to be. Will all those people be housed here? It’s difficult to answer because people will decide where they want to live. One of the difficulties with the social impact assessment is trying to predict human behaviour; the extent to which we try to measure it is to look at the worst case scenario and know it will be something less than that by distributing people around.

Take me and my colleagues as an example. I live 100kms from where I work, some of my colleagues live right in town and some don’t. There will be natural distribution around. What we are trying to do is to get a feel for where the stresses will be. And you are right, the cumulative stress of Wandoan, CSG development etc. will put a lot of pressure on the region.

Arrow can only try to understand and assess that with government and the other proponents because there isn't the information in the public domain to inform that through the EIS.

2. Will it be harmful in the long term to have houses within 225 metres of a wellhead?
You've run scenarios on noise levels at 300 metres from each wellhead; if you're unfortunate enough to have a grid over your property of 700 square metres of wellheads you probably have a 50% potential of working within those gases no matter where you go. And you have nearly 100% potential of hearing one of those wells anywhere on your property. Is that correct or what you had on the overhead?

Not strictly, no. Noise and air quality criteria are about long term exposure not what we call incidental or transient exposure. And the other thing that I hadn't put up there, and it's in all of the studies, are the emissions modelled over a year, every hour of the year, and sometimes down to minutes of an hour.

They're trying to simulate what will happen under all the atmospheric conditions throughout a year, through the seasons, given wind directions, etc. And what you are seeing reported there is the worst case. What I haven't put up there is how often that might occur. Typically what we see is what might be found on one or two occasions a year. But the way the assessment process works is that we are required to report what the worst case is; perhaps the frequency of that occurring should also be there. There’s enormous conservatism built into these models.

What they're saying is that at 300m, if you had those atmospheric conditions, with that noise on that day, it would occur X times a year. In terms of concern about being around the equipment, your chances of exposure to it are very small. It's why DERM sets the guidelines that way i.e. to contain the exposure.

If we said it's going to occur 15, 20, or 40% of the year, that's a problem. Then we would have to go back and revisit the modelling, advise Arrow that it was unacceptable and it would have to reconsider what it was going to do because DERM has set a threshold of what is and isn't acceptable.

I gave an example a couple of days ago that a wellhead motor is a bit like your tractor and you're only going to get eddying etc occurring in very rare worst case conditions, typically for a very small part of the year, but that's what we're required to model. If you equate it to a pump down the back paddock with a diesel motor on it, or a tractor operating, that's what you're getting from the wellhead.
Facilities are different; they're operating 365 days a year, 24 hours a day, to pressurise the gas. The eddying that brings the gases down to ground level only occurs under worst case conditions for a small part of the year. Because they're such significant volumes, those instances are important in making sure that people are not exposed. Does that help you?

3. Yes, but in one part of it you talk about a pump or something like that. I suffer from hearing loss but I can still hear my motors more than 700m away. So if I'm unfortunate enough to have a grid of 700m, no matter where I go on that property I can hear a noise.

I'm not going to stand here and say you won't hear a noise. The noise guidelines are about protecting against sleep disturbance so they're generally set against night time background noise levels. It's not about what happens in the daytime because, as you said, you might be driving a tractor or harvesting so there'll be a lot more noise which is why the guidelines apply to the night when you're trying to sleep or enjoy the amenity of your area. It doesn't mean you can't hear them in the daytime as they will be background noise on very quiet days.

The idea is that you can go to sleep at night and not be disturbed by it, and you can work on your property during the day and not be disturbed to a point where the noise is a nuisance, that's the idea of DERM's noise guidelines. The Australian guidelines are based on World Health Organisation standards and a lot of research has been done by the WHO on what constitutes sleep disturbance.

We are doing a number of technical things as we know we can reduce both noise and emissions. If we can get electric submersible pumps to work, the noise from the top drive and the rods that drive the pump will be down the hole, removing one of the noise sources.

Another way to remove noise sources is to remove the generator so Arrow is considering that by doing trials using submersible pumps which we have done at one of our fields in the Bower Basin. There are some negative aspects to that as well because poles and wires can interfere with certain farming activities.

We need to go underground to able to achieve that as technically there are only certain distances that you can take some of that power to. Our major focus areas are to try to reduce noise and emissions so they are as low as they can be and improve the visual amenity of well sites. In mature fields around the world they look like that one in the box, there is no noise unless it's a really high producing oil field. Normally the noise will be similar to when you hear one of your bores flowing, i.e. practically no noise.

4. You've talked about noise being both high and low, but you haven't put any decibel readings on it. Can we have some decibel readings for daytime and night time, please?

Yes, we can share that information with you. I won't rattle them off my head because I'll inevitably get them wrong but if you come and talk to one of us afterwards we should be able to get you that. The key thing though is obviously noise levels change as you get closer or further away. Is 225 metres the number? Yes, that's where the noise level gets down to background plus three decibels (dB) whereas if you stand right next to the generator, it'll be much louder. But we can talk you through that.
5. With all the water you’re drawing out, and what you’re going to put back, what happens with all the salt that’s left on top?

The remaining salt is removed through the reverse osmosis treatment process. We recover about 80% to 90% of usable water through that process which means 10 to 20% is left as a concentrated brine solution stored in really high integrity dams.

The way they’re built now they have two layers of high density plastic. There’s a seepage channel between the layers so you can tell if it’s leaked; beneath that there’s another seepage channel that drains into a pit. You can sample all those things. If there’s an escape from the first seal you’ve still got that protective barrier. Beyond that, the dam is built with clay so is highly impermeable. Dam standards have increased significantly in the last few years.

Once we collect enough salt, we expect it to be reprocessed. It will be dried and existing technology applied for processing…the only thing missing is enough salt. At the moment the four large CSG proponents are talking to a couple of salt processors who could purify it once we have enough scale to make it valuable commercially. There’s a big market as Australia is a net importer of salt; it isn’t just sodium chloride or table salt, it also has magnesium and carbonates and other matters that make it attractive for industries like glassmaking.

6. I understand there’s going to be something like 2,000 tonnes of salt extracted per day, not just by Arrow but by the whole industry…that’s a lot of salt.

It is a lot of salt but the market requires even more. I’m not sure about the exact tonnage but it’s not more than the salt market is. There are commercial technologies and a market for it.

7. It seems a lot of years between now and 2065. There will be a lot of thirsty cattle and people if it’ll take until 2065 for even some of this water to be replaced naturally.

The modelling shown is without the return of the water that we extract back into the system. The commitment we’ve made before is that we’ll work towards a sustainable solution, or as much as we can achieve, and we’ll minimise the net take of water.

In most of our areas groundwater is used for other things. One of the options is for us to deliver water by pipe; the person now pumping groundwater stops doing so and takes our water instead. We call that substitution of allocations.

Reinjection is another alternative. We would take water of a quality that’s not useful for many things; we will use our power to clean it and then add that in so there’ll be a net increase in the amount of usable water during that period. That’s our aim.

There will be some losses as we can’t say 100% of the extracted water will end up back in the system because there’ll be some evaporation while it sits in dams before and after being processed, and there’ll be some evaporation and losses through that final process of crystallising the salt. The numbers you saw did not include us adding any of that water back into the system.

Over the next few months the modelling we do, to validate what we’ve done, will take it to the next level of detail. Then we will add in the extracted water for current water users.
It’s important to remember the impact predictions don’t include mitigation measures. You saw an illustration of how the system operates before you put in mitigation measures to depressurise the Walloons, causing leakage upwards and downwards. In terms of mitigation scenarios, there’s more impact on the Hutton and the Precipice. However, if you’re looking at substitution or injection as an option, it’s obviously good if you could get that water into the Hutton; you certainly don’t want that impact to transmit to the Precipice. And similarly if you can get it into an aquifer above the Walloons you can maybe stop and mitigate that impact further and allow the pressure to move. That’s all part of the scenarios we’re putting forward.

8. The removal of the salt from the coal seams in an aquifer…obviously it’s there for a reason. You’re not putting it back. Does anyone know what the impact will be? You’re re-injecting it in an aquifer above. What’s going to happen with the coal seam?

One of the most important things you have to do when you inject water is match it to the water quality of the aquifer. If it comes out of the Walloons it gets treated and will then have to be amended to make it as least reactive as possible with the aquifers. That kind of technology has been used a lot overseas in the last 20 years, in both aquifer storage and recovery schemes. In the wet season they pump it down into the ground as extra storage for the dry season. There is an example I think from Des Moines in Iowa which has a city water supply of some 5.7 gigalitres of water stored for emergency supply.

Again, it’s a case of technology that’s been used for a long time to manage those water quality issues. We know the studies we have to do…sorry, what was the second question?

9. Pulling all this salt out will cause an imbalance. I wonder what it will be down the track. Does anyone know what’s going to happen in the future? There might be other countries doing it; have they found anything that may impact us later on? I know it’s a long way away but there are generations ahead of us who might be affected.

Again, I think it comes back to the same point i.e. the geochemistry is critical. If you match the water going back in, you minimise the amount of reaction. If you get it right there are no impacts because you don’t allow any discrepancy to create a reaction. Again, looking overseas to some of the projects there, municipal water supply is used.

10. What I meant was that you’re not putting it back where you extracted it from. What’s the difference? What’s happening down there in the Walloons?

There will be an overall removal of salt from the Walloons but there will be a pressure recovery because pressure moves faster than the water. You will see pressure recovery in the Walloons because generally the recharge bed is from rainfall, so it tends to be a carbonate, bi-carbonate water and it picks up salt as it runs through the system over a long period of time. A lot of hydrochemistry and studies we’re doing are to look exactly at all these issues re how long they take, and what are the hydrochemical reactions that are going to occur, not only over longer units but also between units.

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3 Des Moines Water Works (DMWW) has developed a series of Aquifer Storage and Recovery (ASR) wells along with several suburban water utilities that by the year 2020 will have the capacity of 15 millions of gallons per day (56.7 ML/d) and water storage of 1.5 billion gallons (5.7 GL) to offset peaking water use during traditionally high consumption periods on hot summer days. (Accessed Feb 2012, [http://www.desmoinesmetro.com/regional-economic-development/site-selection/utilities/](http://www.desmoinesmetro.com/regional-economic-development/site-selection/utilities/))
11. Would re-injection be on the edge of the water table or in the centre of it? Earlier you showed the Walloons have the potential for a drawdown of 70 metres. It seems to me that anyone on that outer edge who once had a bore would be in a fair bit of trouble.

So, when you re-inject, is it going to be on the edge or in the middle? If it's in the middle, the water's got to go uphill. If it's on the edge, you have the potential for it to go downhill.

We don't know the exact location yet. We do know the pressure impact from the injection well can travel tens of kilometres, so we may not need to put an injection well exactly where you want the pressure to come back; we can put the injection well here and it will propagate in all directions.

We won't be re-injecting back into the Walloons at the same time to maintain the pressure in there. We need to reduce that pressure for gas production. One of our options in the longer term, once the gas has drained out of that area, might be to re-inject water from the Walloons in a slightly different part of the basin. But we would not be re-injecting simultaneously with extraction because it would prevent gas coming out of the ground.

If you own a bore there, we're going to have to find an alternative solution if your bore is affected. It's likely that if your bore is nearby, or within our gas field, it would be affected; that's why we said before we'd have an obligation to bring the water to you in a pipe or some other method like that to 'make good'. So to be clear, we cannot do what we're trying to do without some impact during the gas production phase on the Walloon bores.

12. As a continuation of what you just said then, my mind's ticking over a bit. If you reckon you can't re-inject straight away into the Walloons, where are you going to put the water in the meantime?

Imagine we're on your place and you've got Walloon bores for stock and domestic use. We'll have to bring water to you that you would have had otherwise if we hadn't been pumping. We might store it temporarily in other aquifers.

As we said before, we might put it in the Hutton or the Precipice during that time and then be able to have water available until the natural recharge occurs. Or we might move it to another part of the basin where there's a more severe impact at the time.

There are a range of solutions although we haven't yet worked out exactly what's going to be required in every case. It's part of the modelling that's going on. However, if you had water then we have to make sure you still have it.

13. Reinjection is a good and positive thing but will beneficial use with treated CSG water become less important? Is the security of town water for farmers going to be of less priority than water injection?

The easiest way for me to answer that is to say our priority is sustainability and we will use different methods in different areas to achieve that. So in some areas the geology and the land use might say reinjection is the best solution.

In others, if it's out in farming land where there are heaps of people pumping water out of the alluvium, the solution there may well be substitution of allocations and beneficial use and we
deliver it in a pipe or re-inject it into the aquifer. So it’s horses for courses but we have to make sure we get the right balance.
1. Arrow mentioned in its presentation the shallow coal you are relinquishing. At what sort of depths are you finding there’s no gas?

It depends. In different parts of the basin it can vary, but generally there is no gas in coal less than 100m in the Surat Basin, and it gradually increases with depth from that point down.

2. When you guys relinquish it, will there be open cut coal miners wanting it?

Yes - coal miners will push to dig deeper as coal prices and demand increases. While a few years ago people said 60m depth was the economic limit for open-cut mining of coal, it is now much deeper.

What we’re interested in often isn’t very good for open cut, and we’re also targeting different coal seams. Some of the existing coal mines are targeting seams that have far too much water and not enough gas to be interesting for us. We don’t want to produce any unnecessary water so one of my goals is to produce as much gas for as little water as possible, which is good for everyone.

3. Thanks. One of the things in John’s speech, which was very good (thanks, John, very informative) was when he talked about 800-metre spacings. I saw a presentation a couple of years ago which was adamant that it was 900 metres. I ask this because QGC said 750 metres, Santos is 400 metres. One of the concerns I have is that companies use wider spacing but as production drops, they come in and fill in the gaps so in the future we’ll see a lot more wells than anyone’s talking about.

I agree that’s a valid concern. A good analogy to the geology we have in the Surat Basin is the Powder River Basin in Montana and Wyoming in North America where they did a similar thing i.e. 800 metre spacing. That’s approximate because it’s never on a grid and we do have quite a bit of flexibility. That correlates to a 160-acre grid i.e. one well inside 160 acres. What they often started doing in those fields was putting wells in at 320 acres, or even bigger, then they might return and place what they call an in-fill well. We think it’s highly unlikely at that 800-metre space that we’d be doing in-fill drilling. If anything, we’ll be pushing our well spaces back rather than in.

4. I was just wondering what’s your average property size? If you’re talking one well at 160, is it acres or hectares?

160 acres.

5. What is the average size of the properties within your tenure?

It ranges. There are farming properties we’re looking at now that are less than 1,000 acres so they can be less than 1,000 acres to something like 10,000 hectares so it’s a really big
range. Farms gets smaller as you go further east or on the upside of the shape, then the farms get bigger. As you get on the inside of the curve, you go from cultivation to cotton farming where a family can farm 10,000 acres of cotton, a really big enterprise. Farms are bigger in grazing country where the land is less productive. There’s not really an average.

I want to clarify something I said previously. We may come in with wider spacing than 160 acres and in-fill back to that. Do you know what I mean? We might put in a well every second or every third slot and then come back later on and drill the other wells.

6. What concerns me is there are US examples where they’ve come down to 160 metre spacings. Everyone imagines that at 750, 800, 900m you can live amongst it. But if you come down to 160m, it would be horrific for those of us in residential areas.

There’s not enough gas in that sort of space for us to pay for that many wells so the ideal is to have wells as far apart as you possibly can to recover that gas because it costs more money to have more wells yet you can only recover the same amount of gas. The advantage in putting more wells in is to get the gas out more quickly or if you’ve got really tight coal, which we don’t have. As you go further west in the basin the capacity of the coal decreases so it’s harder for the water and gas to travel through it, and that’s one of the things that pushes us to close the space around it.

7. So you still say you won’t need to frac any of this at all?

We made a commitment we won’t frac in the Surat Gas Project area. We’re not finding any exploration results that make us regret that commitment.

8. I’m just wondering if you can give us an idea of the timeframe for things to happen in this area? I know there are exploration wells under conduct and compensation agreements at the moment. Can you give us an idea of the timeframe?

I’ll just bring up a map because it’s easier to talk to that. *(See Figure 3 on page 5)*

In our existing production area, the Tipton Field, Daandine and Kogan which are all partially developed, there’s still a lot of spacing in that where we can put future wells; there’s some exploration going on there, but most of it is about water management.

That area there and this area right here between Miles and Wandoan is where we expect to start in 2013-2014 if the project is approved; it’s where we expect the main construction and drilling programs would start.

To get ready for that, we’ve done a large amount of exploration here. We’re much earlier in the exploration and appraisal or pilot testing phase up in the Miles and Wandoan area and what’s happening at the moment are five or six well pilots and a dam and maybe a pipeline connecting a number of pilots up.

In these other areas, the Chinchilla-Hopeland area, or in the Millmerran or Goondiwindi blocks, it’s mostly front end exploration where we’re drilling chip and core holes to find out if there is coal and if so how much gas is in it. We’ve started putting pilots down in the Millmerrran area and we hope to do some pilots out in the better country to obtain a good understanding of what the resource looks like out there.
9. You spoke about Arrow’s community involvement and John talked about the workforce coming in during the construction phase. I wondered whether you could expand on your plans to work with the community to develop your workforce from the local community via traineeships, apprenticeships, and that sort of thing both during construction and operations.

When we talk about operations it includes construction of drilling wells and pipelines. However, when John was talking about construction he was referring to the major facilities, big dams etc. Large companies will come in to help us build the big items but we’ll also build up our own workforce and use locally based contractors to do wells, gathering lines and the operational stuff.

The best example I can give is what we’re doing in Dalby where we have a production area. We don’t plan to have a production area anywhere else in the next few years but we have a range of different programs there. We tend to hire semi-skilled workers with oil and gas experience so we’ll hire fitters, mechanics, even non-trades people and put them through a two and a half year program that we’ve developed internally to help people become competent to do those jobs.

We also have a program with the Dalby State High School where we’ve got 15 trainees at the moment. Those kids are in grades 10, 11 and 12; they’ve elected to take some of their subjects as trade-based subjects. The school has invested a lot of money in facilities and those kids come out with a nationally recognised certificate in gas operations.

We don’t need to hire all those people at the moment so we’re actually training more than we’ve got jobs for because the growth isn’t there for the next couple of years. That’s one of the things we’re doing, building up that skills pool. Once we’re ready and we’ve got some firm plans to move into other areas such as Miles and Chinchilla, we’ll attempt to do similar things there.

We don’t just hire local farm hands and mechanics. We also hire a lot of people whom we encourage to move to town. So when we say local hire, we’re not just trying to steal your workers so much as have people who become part of the community, spend their money in town, help justify expansion of hospitals and medical services and all those sorts of things.

10. I was talking to Arrow about what happened last year with the release of water. Can you explain to me why the water had to be released?

Actually I think it was January this year (2011). I won’t need to remind you that in December and January it rained a lot. One of the impacts of that was that our dams got full. We went into that summer with 200 days storage capacity available and in some areas that increased overnight by 20 days and the long-term forecast was for it to keep on raining, which it did.

We discharged water that had been treated through the reverse osmosis process into a local creek. We had the authority to do it so that we didn’t breach our dams. By discharging that clean water (from the RO plant) we could then lower the levels of all the dams so that if there was another major storm surge we wouldn’t have a loss of containment in any of those dams.

11. Are you reviewing the design of the dams now in light of that?
Not really. We think that emergency environmental discharges will be something that we need to rely on in extreme seasons like 2010/2011. It was probably the worst year in the last ten to fifteen years in terms of the intensity and duration of the wet season.

In such a case not only does the dam fill with rainwater but the opportunities for beneficial use of it cease. Normally the mines can’t get enough of our water but their pits filled up so they couldn’t use it. Farms were saturated so didn’t want it. The range of off-take options stops in such extreme weather and the only really valid way of releasing that water if you have concerns about your dam integrity is into the environment.

The plus side is that when it’s like that generally the receiving streams are so high and flowing so fast that the dilution of the water we add is very high and there are negligible environmental impacts. To be able to discharge like that we have to comply with the rules of the Office of Water Supply Regulator. It is the same agency and the same rules that govern the quality of drinking water so it’s a very stringent and controlled process.

12. I never had the chance to catch up on the well explosion back in May? The thing that I’m curious about is the exclusion zone dictated by the police and the fire brigade. They later said it was an over-reaction and I could see that but I’m wondering, in a worst case scenario, what is the real safety zone?

It’s within the 70 by 70m lease. I’m not trying to be defensive but it wasn’t an explosion and the chances of it ever exploding were extremely low because there was so much water coming out of the gas. The gas pressure was forcing the water out of the hole but because there was so much water in the gas the chances of an explosion were very low. The gas is lighter than air and you could see from the pictures that it was going quite a ways into the air.

We do need to manage site safety; in that particular instance the landowner requested control of property access, so that was one of the reasons why it was done like that.

13. Thanks for that. I saw a lot of over-reaction, and two days later someone at Dalby was telling me they could still smell it so I had a lot of fun trying to explain it to them.

It wasn’t a good thing, but it wasn’t anywhere near as bad as it was portrayed.

Jan suggested I talk about the process we go through if something like that happens.

It’s not unusual to get what’s called a kick when you’re doing a workover or completion. Something happens while you’re pulling tubing which might cause a bit of a vacuum, it brings up a gas pocket, and some water comes to surface. That’s not an entirely unusual thing and we’re kitted up for that.

In that particular instance, the kick was obviously quite significant, and we didn’t have the mud needed to kill it. The way we do it is to increase the density of the water that we pump back down the hole to increase the density so as to overcome the pressure of the gas in the reservoir, and then that forces the gas to stop flowing.

The mud is actually potassium chloride which is a relatively benign salt that we use to weight up the water. We didn’t have the right amount of potassium chloride to do the job the way we wanted to, which was one quick kill shot. We tried a slow one, that didn’t work. It took us about 24 hours, maybe 48, to get the gear and materials to do that and then it was solved.