



 Arrow Surat Community
Reference Group committee
meeting

19 November 2021

ATTENDING:	<p>Ian Hayllor (AgForce) John Hughes (DoR) Lee Coulthard (GFCQ) Virginia Wacker (TRC) Liz Edwards (Arrow)</p>
ALTERNATES:	<p>Michelle Zaunbrecher (Arrow) for Rachael Cronin Chris Jones (Arrow) for Stephen Denner Alice Davies (Arrow) for Rita Hassan</p>
APOLOGIES:	<p>Ann Leahy MP, Colin Boyce MP, Pat Weir MP, Paul McVeigh (WDRC), Matt Paul (APPEA), Brian Bender (BSA), Todd Williams (DCCI), Scott Braund (ALFA), Nic Clapham (CDIL), Jodie Taylor (WDRC), Marcus Doumany (AFLA), Rita Hassan (Arrow), Rachael Cronin (Arrow), Stephen Denner (Arrow)</p>

ATTENDING:	<p>Stuart Armitage Graham Burt Stewart Hayllor Stephen Williams Dan Skerman Bev Newton Chris Wicks (Arrow) Brydie Hedges (Arrow)</p>
ALTERNATES:	<p>Zeb Dawson (Arrow)</p>
APOLOGIES:	<p>Neville Wirth, Glenn Ogden, Warren Myring, Ian Valler, Max Murray (Arrow), Gary Lees (Arrow), Richard McLean (Arrow)</p>

GUEST PRESENTERS:

Alice Davies (Arrow)

Chris Jones (Arrow)

David Wigginton (Arrow)

Tim Thomas (Arrow)

Mahmoud Oraby (Arrow)

Matt Denyer (Arrow)

> Safety moment – 12 Weeks of Christmas
Alice Davies – Community Officer, Arrow Energy



Week 7
TRAVEL SAFETY

~ 12 weeks of Christmas safety



Week 1

DECORATING SAFETY

Use a ladder to hang decorations up high. Falls are likely to occur when standing on furniture.

When decorating outside, keep your ladder away from power lines.



HANDLING HOLIDAY STRESS

Choose your own happiness & mental health over the desire to please everyone - it's OK to say no.

Stick to a budget & plan ahead.

Unplug & live in the moment.



Have fun! It's your holiday too.



Week 2

Make sure lights aren't frayed or damaged.

Don't run cords under rugs or furniture.

Give your lights a chance to cool down.

Think about who is at home for your low hanging decorations.



Week 5

Don't mix water fun with alcohol.

Never swim alone.

Supervise young children.

At the beach, always swim between the flags.

When boating, ensure you have the correct safety equipment.



Week 3

RESPONSIBLE DRINKING

Weekly alcohol intake triples over the festive season.

Careful popping the bottle of bubbly!

Plan some alcohol free days.

Alternate alcoholic & non-alcoholic drinks.

Always arrange lifts or call an Uber.



Week 6

Holidays are the most fun when you're a kid, but their vulnerability is also high.

Remind them to be extra careful on the roads, distracted drivers are plentiful at this time.

At events, do a quick scan for potential breakables or hazards.



Week 7 TRAVEL SAFETY

Don't post on social media about how long you will be gone.

Do your safety checks on the car before you leave ~ & don't forget the first aid kit!

Read up on the 'Fatal Five' to keep them front of mind.

Plan ahead.

Be flexible.

Be patient.



Week 8 PET SAFETY



Make sure your guests know not to feed table food to your pets.

Leftovers can be dangerous for animals. Buy them a special pet 'treat' so they aren't left out. Keep them hydrated.

Pets can be spooked by commotion. Offer them a quiet place to escape.



Week 9 THINK SECURITY

Foil the opportunistic thief, close & lock your doors and windows.

Online shopping means packages. Make sure you have a safe place for them to be left. If you don't, consider using a collection point.

Don't post about your gifts or holidays on social media.

Secure your worksite.

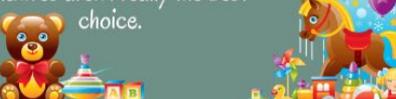


Week 10 TOY RELATED TRAUMA

A hospital trip while memorable, is not a fun way to celebrate the festive season.

All the cool presents with wheels - bikes, skateboards, scooters - really need a helmet too. A mouthguard is also not a bad idea.

Be careful how you open gifts - knives aren't really the best choice.



Week 11 FOOD PREP SAFETY



Food poisoning is the gift you want to avoid giving.

Wash your hands.

Find out if any of your guests have food allergies.

Don't eat food that has been on the table for more than 2 hours.



Week 12 HEAT SAFETY

Summer in Australia can get toasty & bring a range of heat related injuries.

Stay cool.

Stay hydrated.

Stay informed about conditions.

Look out for those 'at risk'.

Slip. Slop. Slap. Seek. Slide.





Arrow update

Michelle Zaunbrecher - VP HSE & Transformation, Arrow Energy

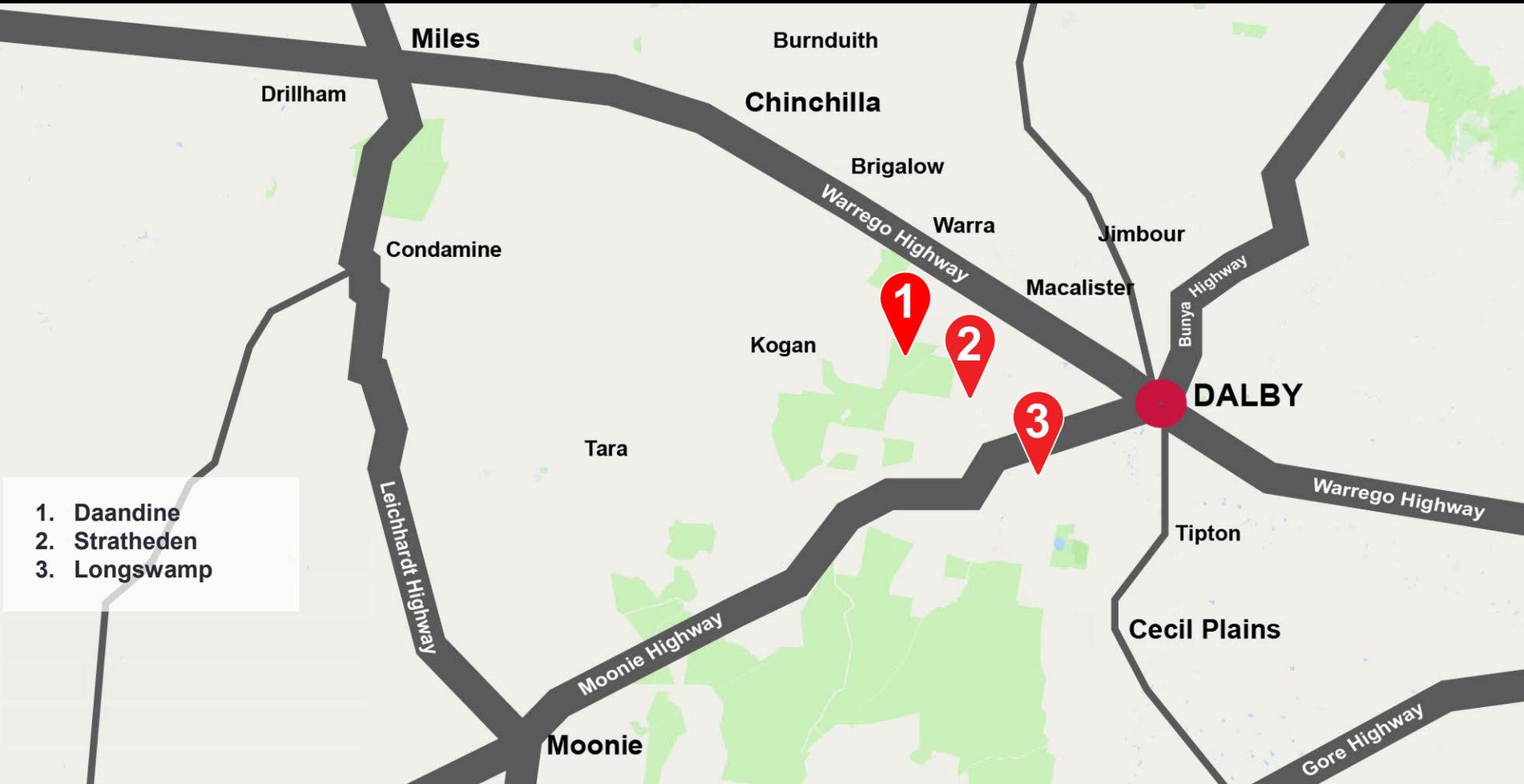


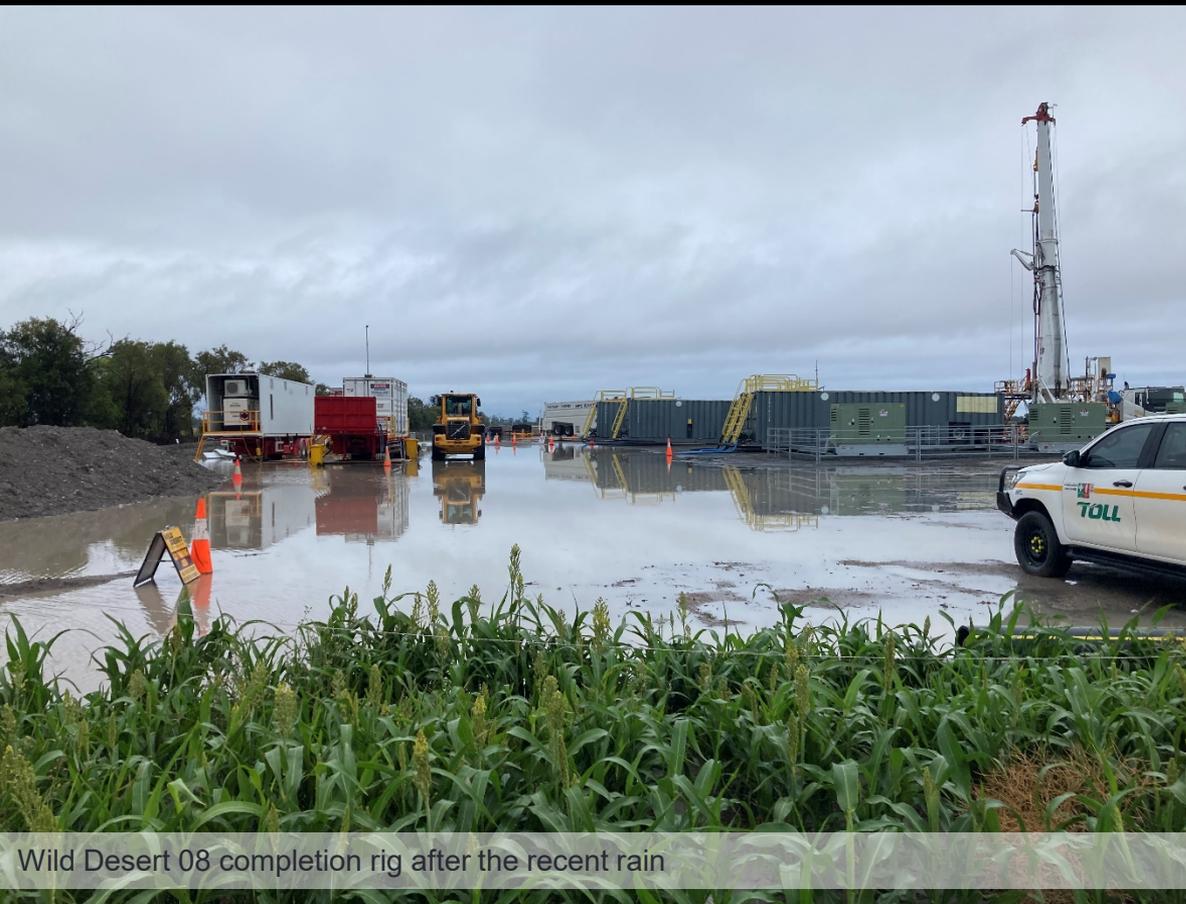


Current operational activities

Chris Wicks – Principal Development Planner, Arrow Energy

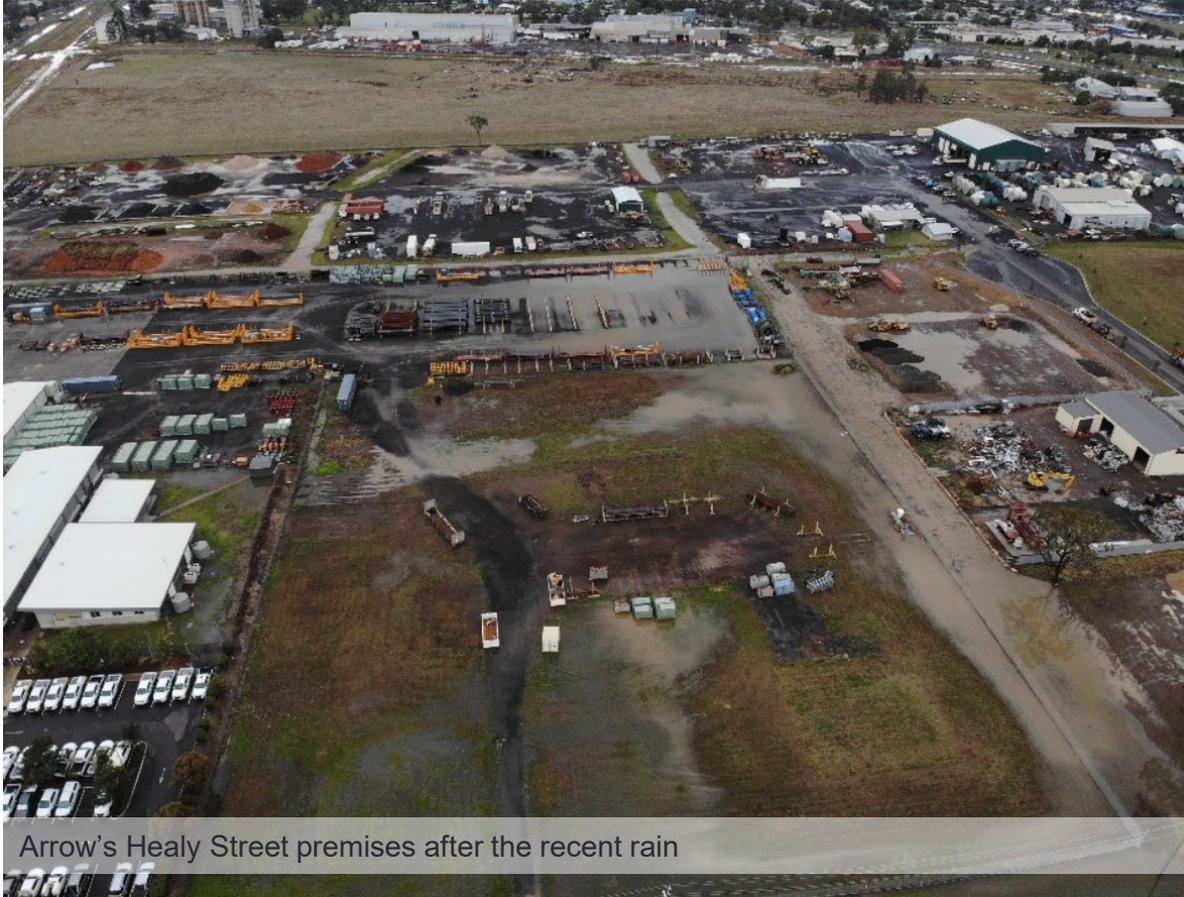






Wild Desert 08 completion rig after the recent rain

- Rigs recommenced work earlier this week following wet weather
- Current rig activity:
 - 2 drilling rigs off Broadwater Road
 - 1 drilling rig Kupunn Road
 - 2 well completion rigs in the Duleen Kupunn area
 - 3rd well completion rig to commence once weather improves
- Pipeline construction (Daandine and Stratheden areas)
- Also bore and well maintenance activities (Daandine, Hopeland and Kogan areas)
- New Telecoms room up and running at Daandine



- Dalby Warehouse Expansion project just commenced on Arrow's Healy street premises
 - Scheduled to finish April 2022
 - Increased traffic / activity around Healy Street
 - New warehouse building with awning, temperature-controlled room and carparking
 - Gravelled hardstand
 - Roof canopy extension
 - Contractor McNab

Arrow's Healy Street premises after the recent rain



- David Daandine connections project started in April, progressing well:
 - low pressure gas header connections from Duleen Kupunn west to David Inlet Processing Facility (IPF)
 - construction of pipelines including water transfer lines
 - a telecommunication tower will also be installed at the IPF site
 - will link to fibre backbone, Tipton to Miles

Progress at the David Inlet Processing Facility (IPF)

➤ Road upgrades underway

- Road upgrades include:
 - strengthening and widening
 - management of flow paths and maintenance of existing floodways
 - new culvert installation where required
 - spray sealing, road signs, guideposts, markers and line-marking

Completed	<ul style="list-style-type: none">• Leahys Road maintenance and upgrade• Section of Duleen Daandine Road• Moonie Hwy and Daandine Nandi Road Intersection• Moonie Hwy and Broadwater Road Intersection
Under construction	<ul style="list-style-type: none">• Dalby Kogan and Daandine Nandi Road intersection• Dalby Kogan Road and Leahys Road intersection• Sections of Daandine Nandi Road• Section of Ducklo School Road
Planning phase*	<ul style="list-style-type: none">• Section of Broadwater Road• Braemar-Warra and Dalby Kogan Road intersection• Kerwicks Road and Warrego Hwy intersection• Boundary Road

*Planning phase - subject to approvals





Surat Gas Project update

Chris Wicks - Principal Development Planner, Arrow Energy



Area wide planning – shed meetings 2021

Locality	Shed meeting date
<ul style="list-style-type: none">Duleen Kupunn update	14 May 2021
<ul style="list-style-type: none">Kogan Road	25 June 2021
<ul style="list-style-type: none">SpringvaleGrassdale	26 August 2021
<ul style="list-style-type: none">Boundary Road	21 September 2021
<ul style="list-style-type: none">Miles	3 November 2021
<ul style="list-style-type: none">St RuthWest Prairie	Date TBC
<ul style="list-style-type: none">GreenbankNandi	Date TBC



Area Wide Planning :

- ~382 wells in AWP

Finalising Design :

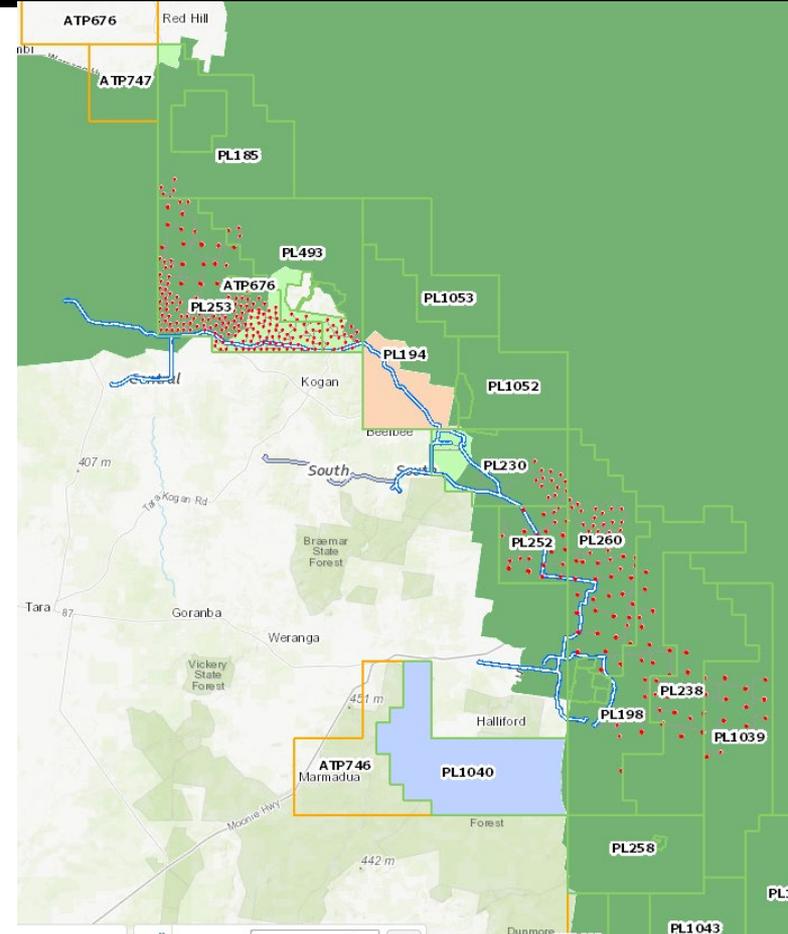
- ~235 wells

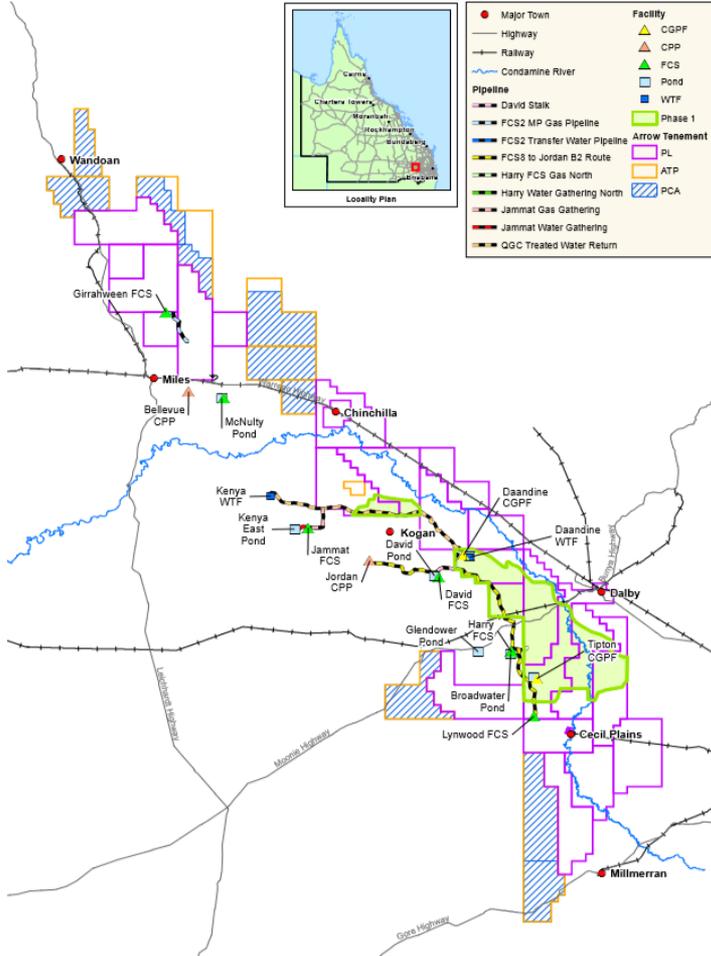
Negotiating and securing agreements :

- ~221 wells – Under negotiation

Executed Agreements :

- ~238 wells





- Area Wide Planning and landholder negotiations continuing for planned development to 2023/4
- Progressing development proposals for the broader Surat project:
 - Miles area with proposed supply to QGC facilities and a future Arrow FCS
 - Cecil Plains area – expansion of the existing Tipton development area south from Tipton
- Lynwood to Jordan Pipeline landholder re-engagement and route assessment
- Kogan North area finalizing development plans with landholders and JV partner

> Table discussion





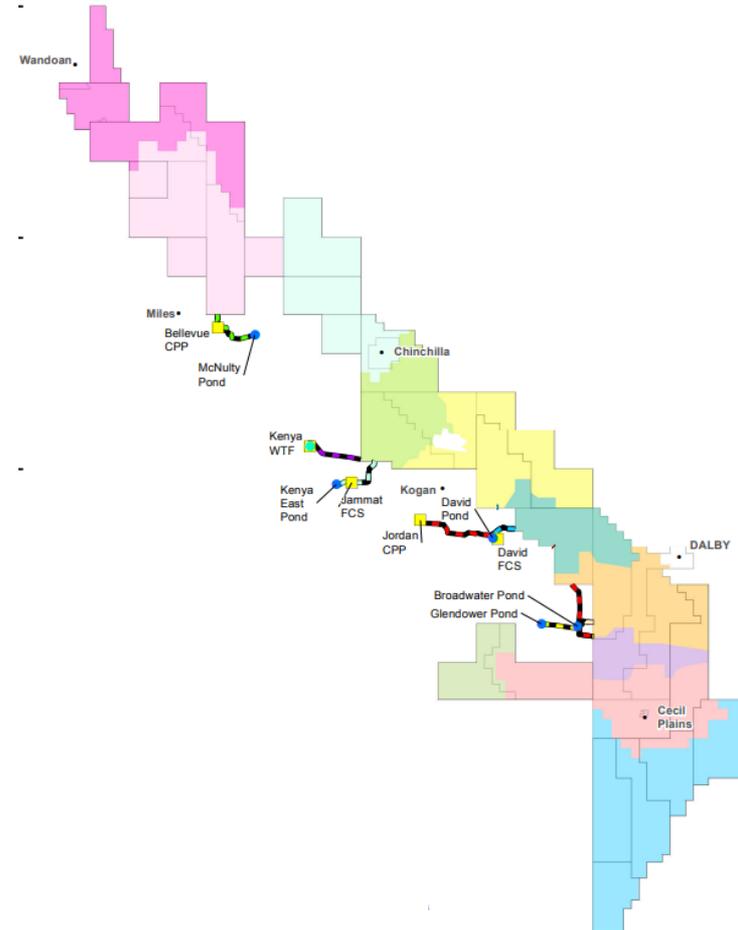
Regulatory approvals

Chris Wicks - Principal Development Planner, Arrow Energy



Regulatory Approvals – Update on Current Applications

- Australian Government (*Environment Protection and Biodiversity Conservation Act*)
 - Offset Area Management Plan – Stage 1 activities 2020-2023 (lodged 19 Oct)
 - Water Monitoring and Management Plan – update (lodged 9 Aug)
- Queensland Government (*Environmental Protection Act*)
 - Hopeland (PL253) Stage 1 EA Amendment – lodged 6 Oct
 - Petroleum Survey Licence (PSL2044) – annual extension lodged 7 Oct
 - Biodiversity offsets x 2 (Report + Notice of Election) – lodged 19 Jul and 27 Sep
- Queensland Government (*Regional Interests Planning Act*)
 - RIDA application Low Pressure Header – lodged 28 Apr; 3 x Requirement Notices; Response by 30 Nov 21
 - RIDA application Wells and Gathering – lodged 20 Sep; 2 x Requirement Notices; Response by 27 Jan 22

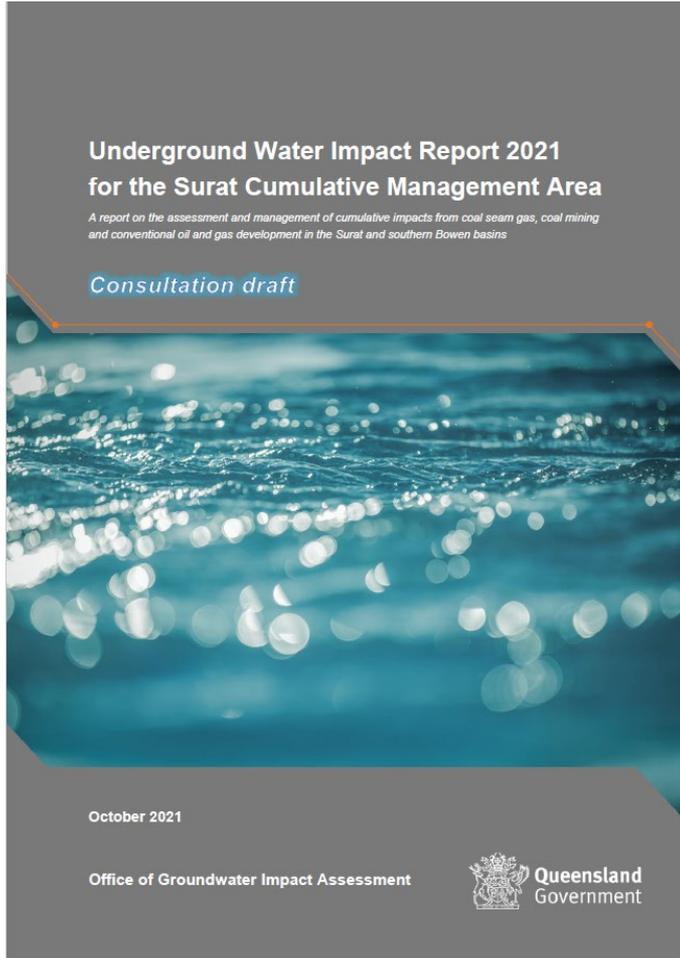




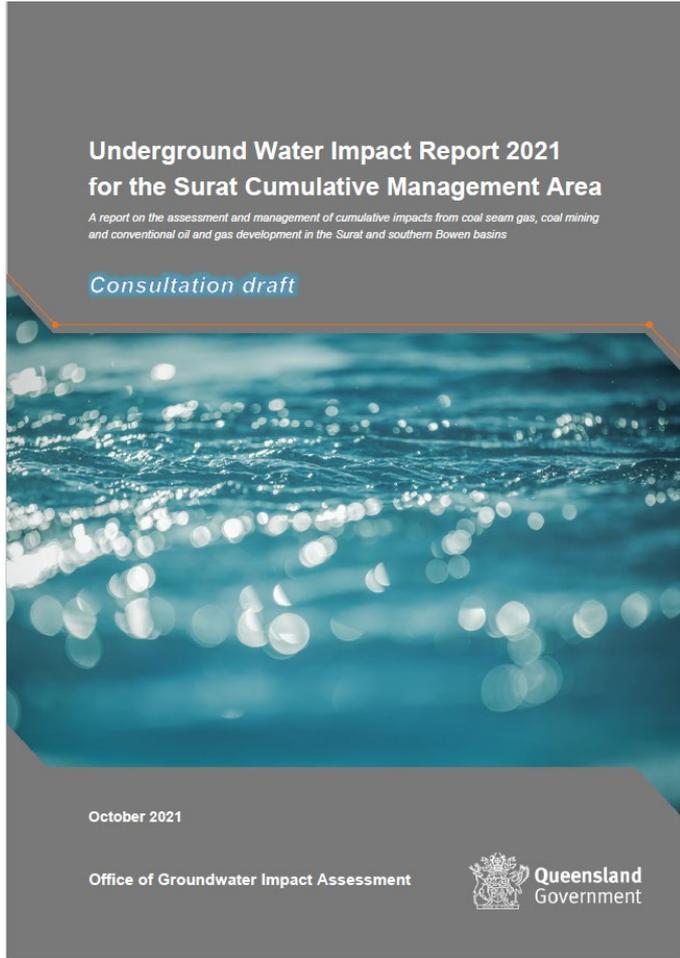
Monitoring and management obligations

Chris Jones – Senior Hydrogeologist, Arrow Energy





- Every 3 years Office of Groundwater Impact Assessment (OGIA) prepare the Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (CMA).
- This is the 4th UWIR following 2012, 2016 and 2019 versions.
- UWIR is based on a groundwater model which has been redeveloped using data collected since 2019.
- The draft 2021 UWIR is open for submissions until 26 November.
- Following consultation on the draft 2021 UWIR, the UWIR is required to be approved by the Department of Environment and Science (DES) prior to taking effect.



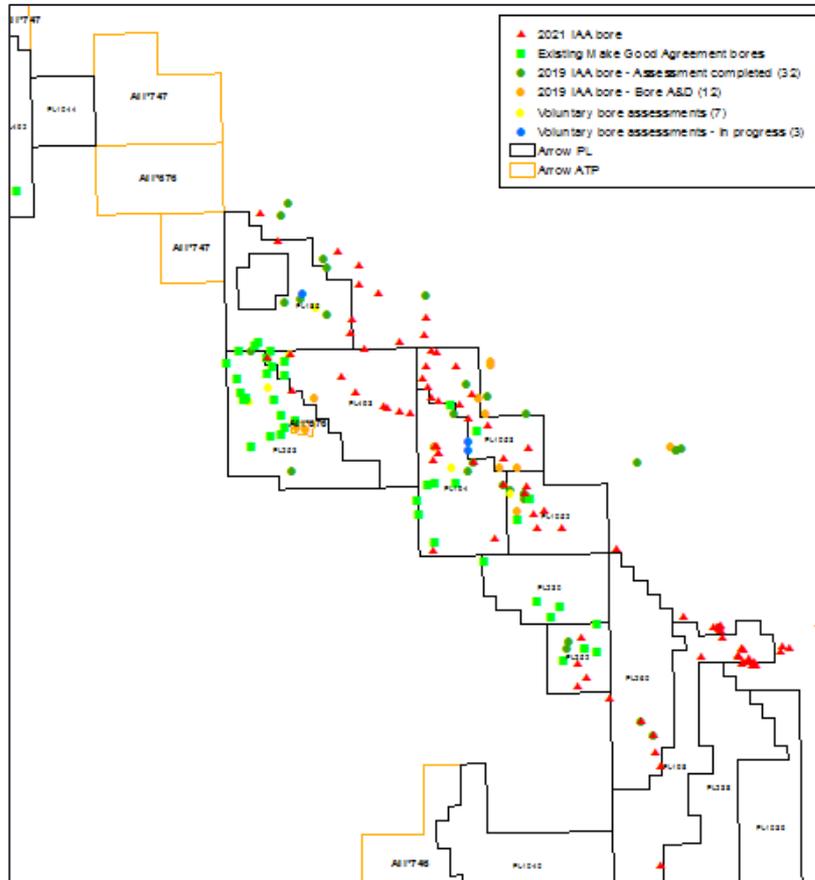
Existing Impacts

- Consistent with the predictions in the previous UWIR – up to about 400m observed in the Surat Basin CSG target formations and to a lesser extent in the Springbok Sandstone.
- No impacts are identified in the Hutton Sandstone, Precipice Sandstone or Condamine Alluvium at this stage.

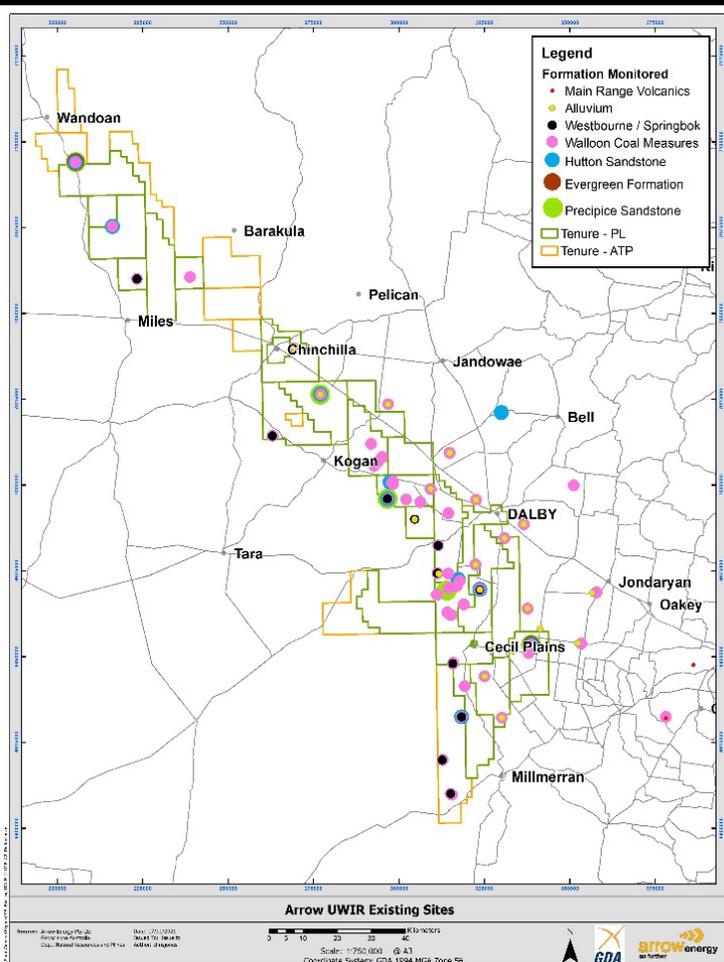


Predicted Impacts

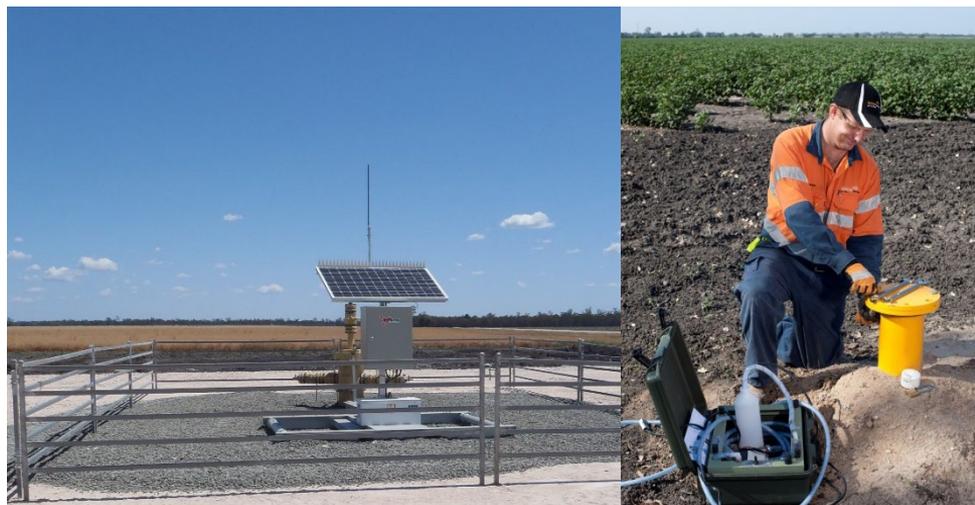
- Broadly similar to the previous UWIR in 2019.
- For most areas, impacts of 450m or less are predicted in the CSG target formations, and 80m in the Springbok Sandstone.
- Only minor impacts of less than 12m are predicted in the Hutton Sandstone and Precipice Sandstone.
- Impacts on groundwater levels in the Condamine Alluvium remain less than 1m.
- Modelling of subsidence predicts that most of the cropping area around the Condamine Alluvium is likely to experience less than 100 mm of subsidence, with a maximum change in slope for most areas of less than 0.001% (10 mm per km) and up to 0.004% (40 mm per km) for some areas.

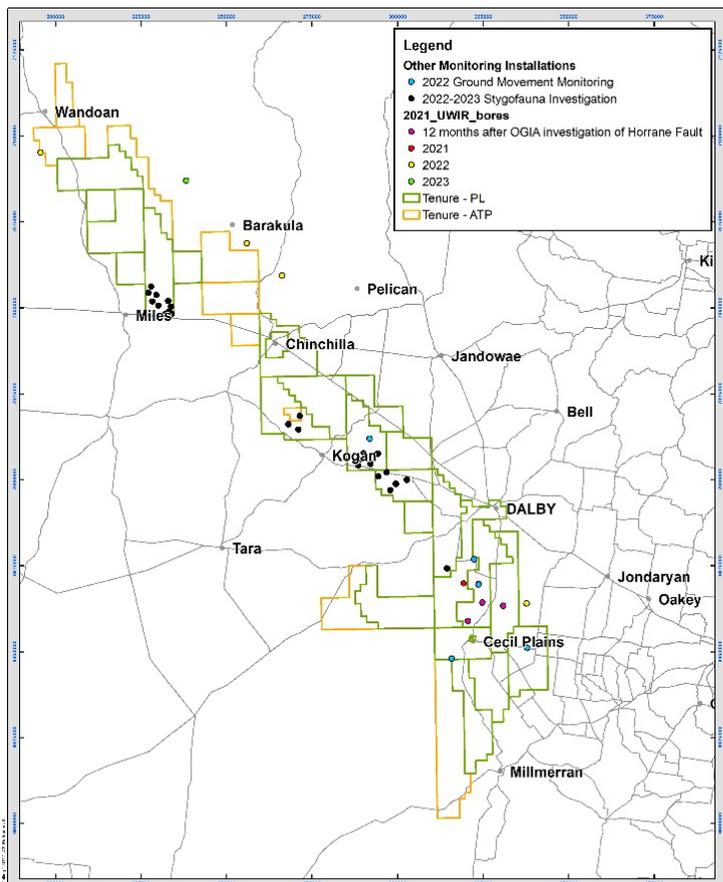


- The UWIR identifies predicted impact (greater than 5m drawdown) to landholder bores:
 - within 3 years i.e. the immediately affected area bores (IAA bores)
 - any time in future i.e. the long term affected area bores (LAA bores).
- A total of 108 IAA bores and 702 LAA bores have been identified.
- 89 IAA bores and 277 LAA bores for which Arrow is the responsible tenure holder.



- Across the entire CSG industry, as of late 2020, the UWIR monitoring network comprised about 690 monitoring points in the Surat Basin.
- Arrow currently monitors a network of 259 groundwater bores in the Surat Basin alone. To comply with the UWIR, Arrow monitors:
 - 131 points for water level and pressure
 - 28 points for water quality.

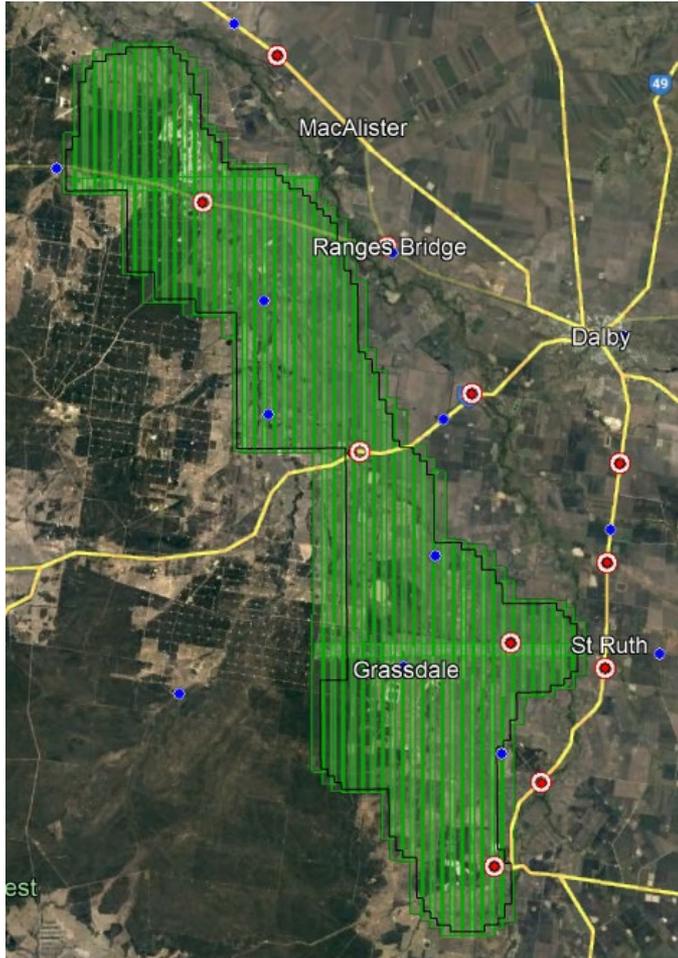




- Due to the 2021 UWIR, and other obligations, Arrow will install:
 - 25 points for water level and pressure for the UWIR
 - 1 point for water quality for the UWIR
 - 5 points for ground movement monitoring
 - 24 points for stygofauna investigation



Arrow Future Monitoring Installation Sites



- Arrow has commissioned AAM to conduct aerial LiDAR survey
 - Within 3km of existing production and new drilled wells
 - Resolution at 4 points per metre and accuracy better than 5cm
- Currently being surveyed.





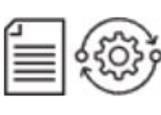
Produced water update

David Wigginton - Concept Engineering Manager, Arrow Energy



> Condamine alluvium substitution scheme

- Expression of Interest closed 10 September
- There was sufficient interest to achieve the substitution target of 3600 ML/yr so we are proceeding to the next stage.
- Next steps:
 - Opportunity for BUN Committee and EOI respondents to provide feedback on draft substitution agreement
 - Arrow to consider feedback and finalise agreement
 - Selection Process

						
Call for EOI	EOI closed	Distribute draft agreement	Agreement review session	Agreement feedback period closes	Selection process	Landholders advised
Complete	Complete	December 2021	Dec/Jan 2021	Jan 2021	March – April 2022	May 2022

- Brine stored in 3 ponds:
 - Daandine
 - Tipton
 - Kenya (under construction)
- Ponds are double HDPE lined, with leak detection and collection
- Brine will eventually be crystallised into solid salt
 - Not required until at least 2030
- Reference case salt solution is to landfill solid salt in a fit for purpose facility



- CSG Brine Management Stakeholder Engagement Process (DES led) currently underway
- CSG Industry has investigated salt solutions
 - Beneficial Use
 - Ocean Outfall
 - Landfill
- Beneficial use limitations:
 - No guarantee of technical performance
 - Significantly higher GHG emissions
 - Significantly greater transport movements (input chemicals and final product)
 - Insufficient market demand; market is already fully supplied by low cost producers
 - Waste stream still requires landfill
- Timeframe to salt solution allows time for further technological advances or beneficial opportunities to emerge



Arrow's Subsurface Logging

Tim Thomas - Integrity & Compliance Specialist, Arrow Energy
Mahmoud Oraby - Principal Petrophysicist, Arrow Energy



- Purpose
- Well Integrity Assurance Activities
- Subsurface Logging Definition
- Subsurface Logging Scheduling
- Subsurface Logging Outcomes
- Well Integrity Logging
 - Casing and Cement Evaluation
 - Cement and Radial Bond Logging Tools
 - Tool Theory
 - Logging Interpretation

- Purpose of this presentation is to share information around what subsurface logging is and how it is employed in Arrow's well stock



- Assurance of well integrity is a key priority in how Arrow drills, operates and abandons wells
- Assurance activities are completed throughout a well's lifecycle and are designed to assess and confirm that risks around well integrity are effectively managed
- Major assurance activities include:
 - **Subsurface inspection, i.e. logging**
 - Subsurface testing, i.e. casing and packer pressure test, leak tests, etc
 - Surface inspection of wellhead, i.e. visual and wall thickness testing
 - Surface testing, i.e. wellhead pressure testing, valve function testing, leak testing, etc
 - Operating envelope surveillance, i.e. monitoring of operating pressures and rates
 - Analysis of subsurface environment, i.e. produced water analysis, scale and corrosion detection, etc
 - Assurance of documents and records, i.e. completion and review of records
- Subsurface logging is just 'tool in the toolbox' and is completed in conjunction with other activities

- Downhole logging involves the running of specialised tools into wells to gather subsurface data, pertaining to either formation or installed architecture (open hole vs cased hole)
- Purpose is to gather data that is otherwise inaccessible from the surface. Examples of data include:
 - Open hole: porosity, resistivity, fractures, etc
 - Cased hole: cement bond, cement tops, casing corrosion, etc
- Logging tools can be conveyed via, wireline, tubing (coiled/jointed) and drill pipe. Can be deployed stand-alone or when a rig is over a well
- Logging has been conducted since the 1920s and is used not only in oil and gas, but also in mineral, water and geothermal drilling



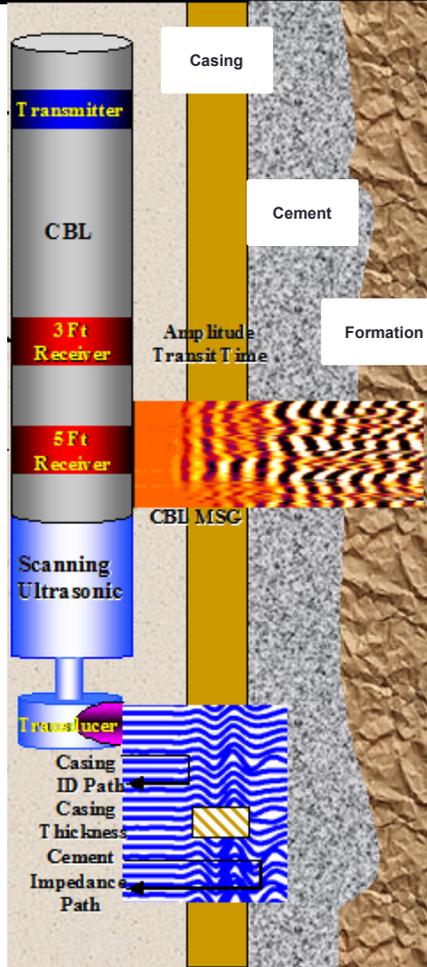
- The decision on when and how to log wells is based on a detailed logging strategy, which itself is based on risk assessments of subsurface hazards. This strategy stipulates minimum logging requirements for different well types
- Open hole logging is conducted on all Arrow wells to ensure that the well is drilled as per the planned well path and to assist in the confirmation of subsurface lithology
- For wells in less explored areas, more advanced logging tools are used to gain additional data on the subsurface
- Cased hole logging is conducted on a representative basis for drilling campaigns, with logging frequency increasing if there is change in well construction practices
- Additionally, increased cased hole logging will be conducted for wells when well integrity issues have or are suspected to have occurred
- Prior to the conduct of new logging, a historical review of the well and surrounding ones will be conducted to review available logging results

- After the logging tool has been pulled out of the well, data quality checks will be completed to confirm the validity of the tool outputs
- Once checked, the data will be analysed to confirm the assumptions made around the lithology and/or the condition of casing and cement
- If the log results indicate a difference in the formation or issue with the casing and cement, several remediation options are available, including:
 - Change the depth that casing will be set
 - Plug back/cement off
 - Mill, perforate or retrieve casing
 - Remedial cementing
 - Plug and abandon the well
 - Change well operating envelope
 - Increase well surveillance
 - Re-log the well



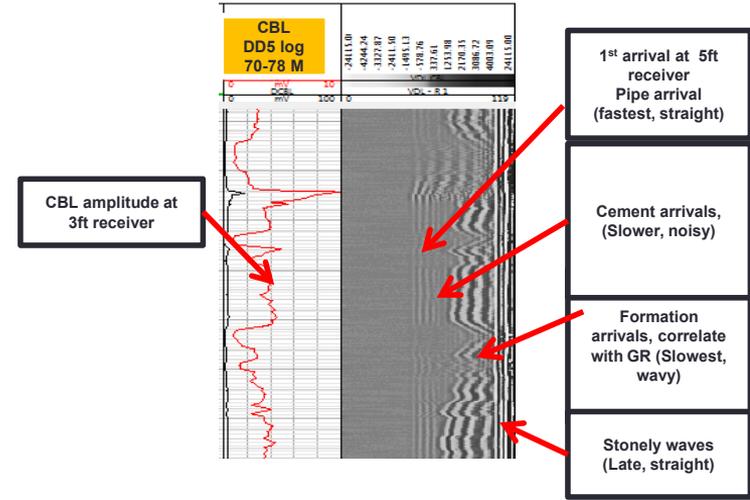
- Introduction - Casing and Cement Evaluation
- Tool physics 101
- Cement Evaluation – HOW
- Cement Evaluation – Example
- Cement evaluation – WHY

Sonic and UltraSonic for Cement and Casing quality

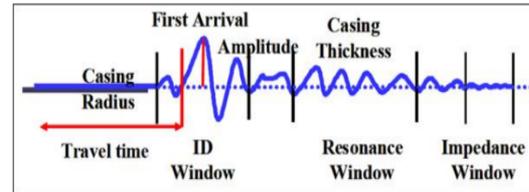


CBL responds to the casing-cement interface **averaging all around**

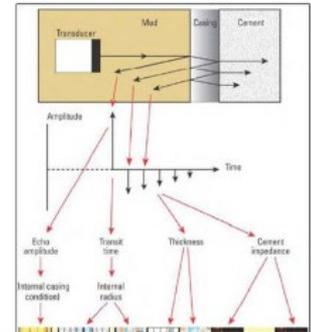
UltraSonic tools respond to the casing-cement interface with **azimuthal resolution** to spot channels



ULTRASONIC SIGNALS CONVERTED TO CASING INTEGRITY



ULTRASONIC SIGNAL RESONATING THROUGH THE CASING



> How does a CBL work?



Free Pipe - Bad Cement Flag < 40% CBI



Partially Bonded Pipe - Patchy Cement 40-60% CBI



Partially Bonded Pipe - Supported Pipe 60-80% CBI

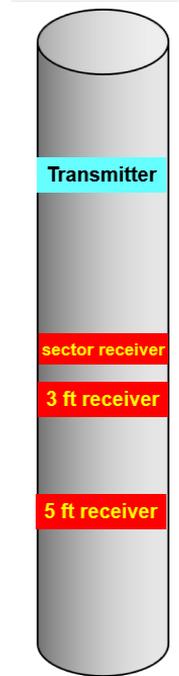


Bonded Pipe - > 80% CBI

Using Sound Energy, it listens for the difference in the sound. The better the bond, the quieter the sound returned.

So, could you hear the difference?

- CBL with an additional sectored receivers
- Provides information on radial continuity of bonding or channels
- Depending upon the above
 - Sectors roughly 2 feet from source
- Six radial amplitude measurements for 1 11/16" tool
- Eight radial amplitude measurements for larger tool 3 1/8" tool
- Some tools have relative bearing sensor
 - High side and low side of hole determination



- CBL, Sonic Tools **{Quantitative}**

- Amplitude

- High indicates free pipe
 - Low indicates cement
 - The Bond Index is the percentage of measured signal in relation to the difference between the theoretical values for perfectly cemented pipe and the theoretical value for free pipe. It does not represent the circumferential percentage of the annulus that is filled with cement. The bond index is interpreted in context with all other data.

$$BI = \frac{\log(A_{fp}) - \log(A_{Is})}{\log(A_{fp}) - \log(A_{100\%})}$$

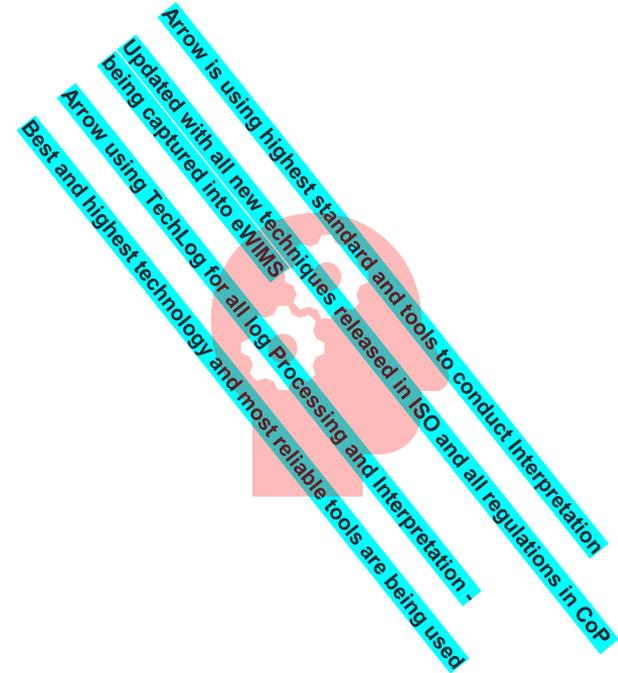
BI = bond index
A_{fp} = free pipe amplitude
A_{Is} = the measured amplitude
A_{100%} = what is considered to be 100% bonding

- Waveform **{Qualitative}**

- High activity indicates cement “wiggle on VDL” – good correlation with GR and DTC
 - Low activity (railroad) indicates free pipe “straight lines on VDL” - strong casing arrivals – visible chevrons
 - Provides the basic data for evaluating the quality of the cement sheath
 - Delineate cemented from non-cemented sections by interpreting waveforms of acoustic signals
 - Horizontal measurement is in time

- Derivative **{Qualitative}**

- Collar response on Derivative track - Wide and solid chevrons = free pipe
 - Collar response on Derivative track - Missing or flat chevrons= bonded pipe
 - Collar response on Derivative track - Chevrons with just dark edges = microannulus



Cement Evaluation Theory - Example

High amplitude

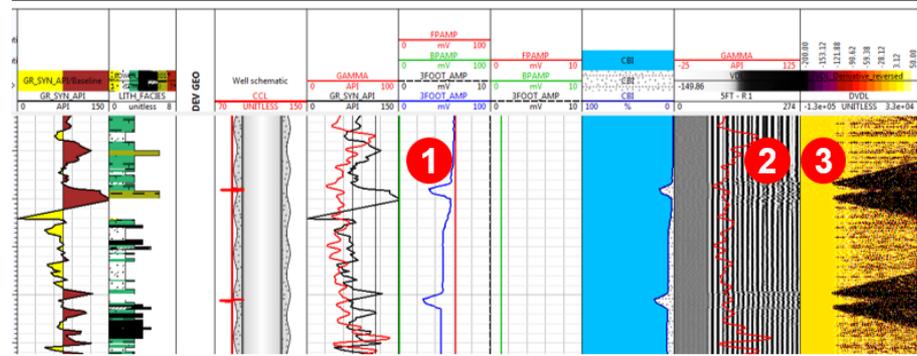
1

Straight lines VDL- strong casing arrivals – visible chevrons

2

Collar response on Derivative track - Wide and solid chevrons = free pipe

3



Low amplitude

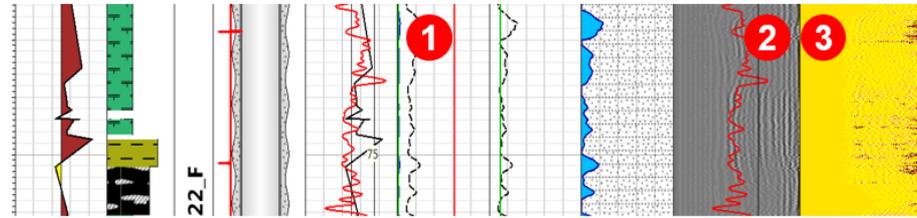
1

Wiggly lines VDL, no casing arrival - correlates with GR or DTC

2

Collar response on Derivative track - Missing or flat chevrons = bonded pipe

3



Low-high amplitude

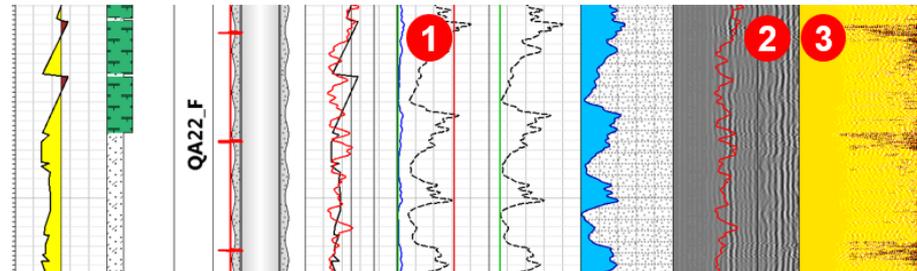
1

Wiggly lines VDL- weaker casing arrivals - no clear correlation with GR or DTC

2

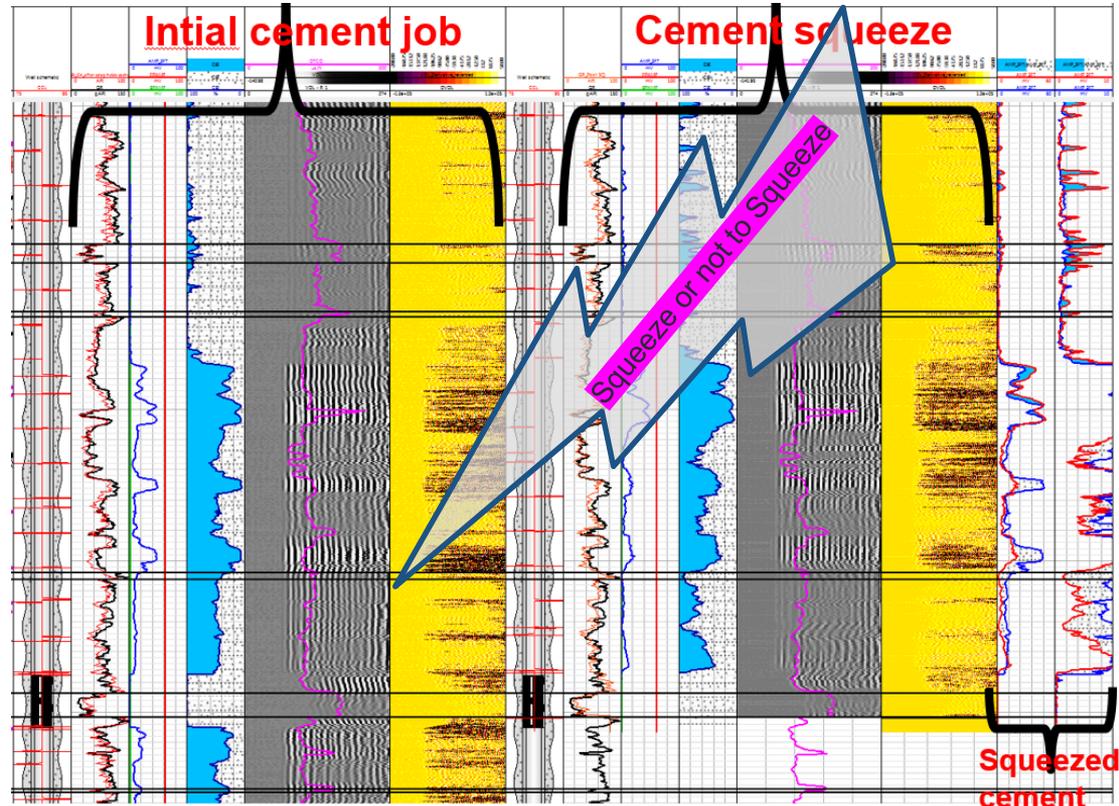
Collar response on Derivative track - Chevrons with just dark edges = microannulus

3



- Why we evaluate cement
 - To assure that pipe is **supported**
 - To assure that pipe is **protected** across potentially damaging zones
 - To assure **isolation between zones**
- To Squeeze or not to Squeeze
 - The ultimate goal of cement evaluation is to determine either the squeeze is required or not?
 - If squeeze is required – can we squeeze or not?

Because cement that is placed in the annulus and allowed to set cannot be removed and replaced, regardless of its quality, the overriding objective of a cement bond evaluation is **not to determine the quality of cement** in the annulus, but rather **to differentiate between solids and liquids in the annulus**



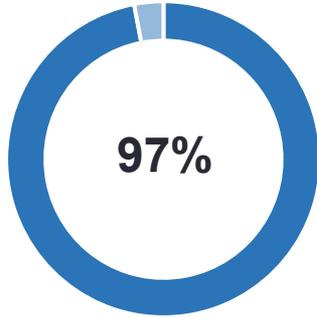


Local jobs and contracting

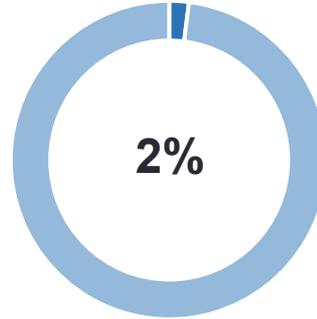
Matt Denyer - Principal Local Content, Arrow Energy



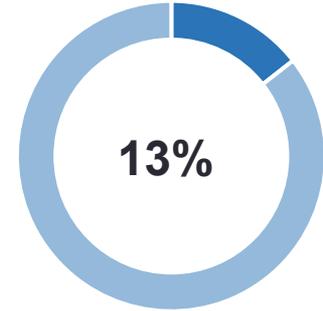
Australia



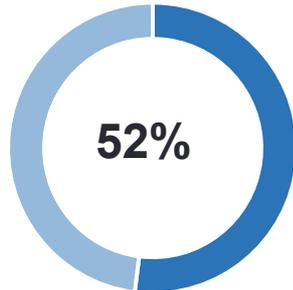
WDRC



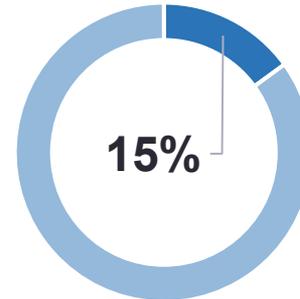
TRC



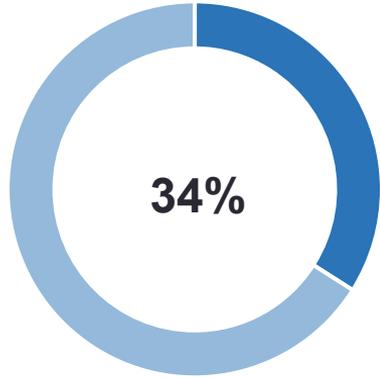
Queensland



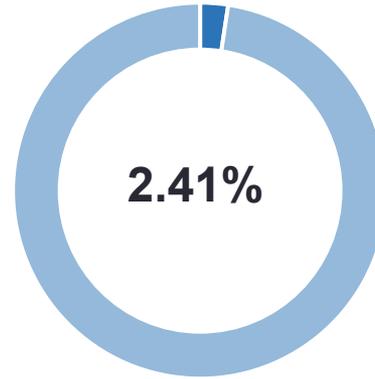
Surat Basin



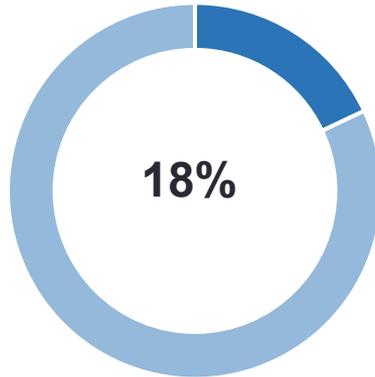
Surat



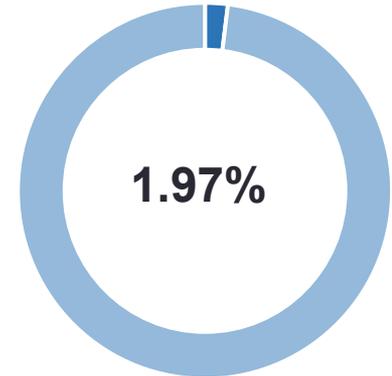
Indigenous



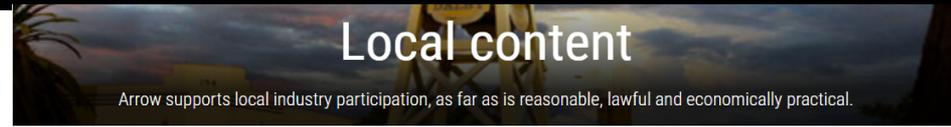
Female



Upskilling

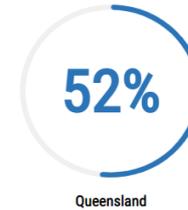


- Arrow's website has been updated to highlight our commitment to engaging the local community in SGP
- Current spend and workforce data is live
- Stage 2 of the project will promote
 - Arrow's Contractors
 - Contractor Scope with Arrow
 - Contractor website for job seekers and supply chain opportunities
- Targeting go live week commencing 22 November
- <https://www.arrowenergy.com.au/suppliers-contractors/local-content>



Local Content - expenditure

Local Content Q3 2021 financial performance



Local content - workforce

Q3 2021 Local Workforce and Diversity



 Minutes of previous meetings and actions



> Any other business



© Arrow Energy Pty Ltd November 2021

While Arrow Energy Pty Ltd has endeavoured to ensure that all information provided in this publication is accurate and up to date at the time of publication, it takes no responsibility for any error or omission relating to this information. Furthermore, the information provided shall not constitute financial product advice pursuant to the Australian Financial Services Licence held by Arrow Energy Pty Ltd's related body corporate. To the maximum extent permitted by law, Arrow Energy Pty Ltd will not be liable for any cost, loss or damage (whether caused by negligence or otherwise) suffered by you through your use of this publication.

