

Safety Advisory

Drilling water bores in gas prone areas



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This information is provided to assist water bore drillers in understanding the risks associated with drilling water bores, test holes and monitoring bores in gas prone areas.

Early records indicate that drillers have encountered gas when drilling water bores in the Surat Basin since 1899 (Geological Survey Queensland, Publication 299). The gas present in the water bores is natural gas. Natural gas consists mostly of methane which is colourless and odourless and occurs in the coal seams (coal seam gas).

In the coal seam the gas is held in place by water pressure. As part of the extraction process for Coal Seam Gas (CSG), water is removed from the coal seams to facilitate the release of gas. When water is extracted from the well the groundwater level may decline in the surrounding area allowing gas to be more freely released from the coal. This may increase the chance of encountering gas when drilling in coal seam gas areas.

Risks of drilling in gas areas

Water bore drillers must take precautions before drilling in areas where natural gas could be encountered. If natural gas is present in the formations when drilling gas may start to flow into the bore hole, into the annulus and/or inside the drill pipe.

This may result in what is commonly called a 'kick'. In this situation, if the down hole fluids pressure is not controlled (by increasing the hydrostatic pressure of the drilling mud and/or using a blow-out preventer) a kick can quickly escalate into a 'blowout' where the gas reaches the surface. A 'blowout' can create a plume of gas that can be easily ignited. Depending on the force of the escaping gas, the drill string can be ejected from the well casing increasing the risk of injury and damage to plant and equipment.

How to identify risk areas

The CSG industry is targeting the:

- Walloon Coal Measures in the Surat Basin
- Bandanna Formation and equivalent or slightly older formations e.g. Baralaba Coal Measures, Rangal Coal Measures, Moranbah Coal Measures in the Bowen Basin
- Betts Creek Beds and Aramac Coal Measures in the Galilee Basin.

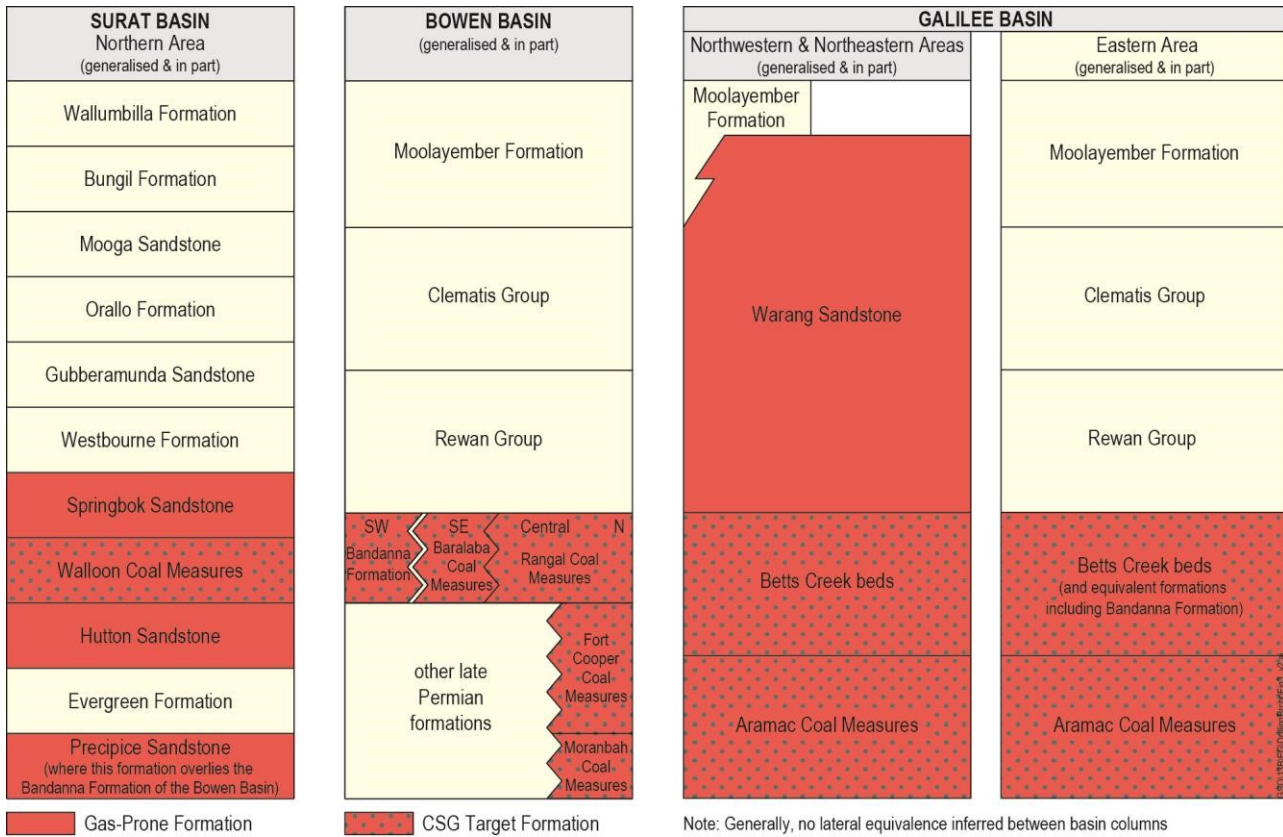
Conventional gas can similarly lead to mobilisation of free gas and cause issues for water bore drillers. The conventional gas industry has predominantly targeted the Precipice Sandstone in areas surrounding Roma, Surat, Condamine and Wallumbilla.

Regardless of the specific resource industry, many formations (that are also aquifers) contain natural gas. Formations potentially posing gas-safety issues for water-bore drillers, are:

- Surat Basin
 - Springbok Sandstone
 - Walloon Coal Measures
 - Hutton Sandstone
 - Precipice Sandstone
- Bowen Basin
 - Bandanna Formation (Denison Trough/south-western area), Baralaba Coal Measures (Taroom Trough/south-eastern area), Rangal Coal Measures, Fort Cooper Coal Measures and the Moranbah Coal Measures (central to northern area)
- Galilee Basin
 - Warang Sandstone
 - Betts Creek beds
 - Aramac Coal Measures

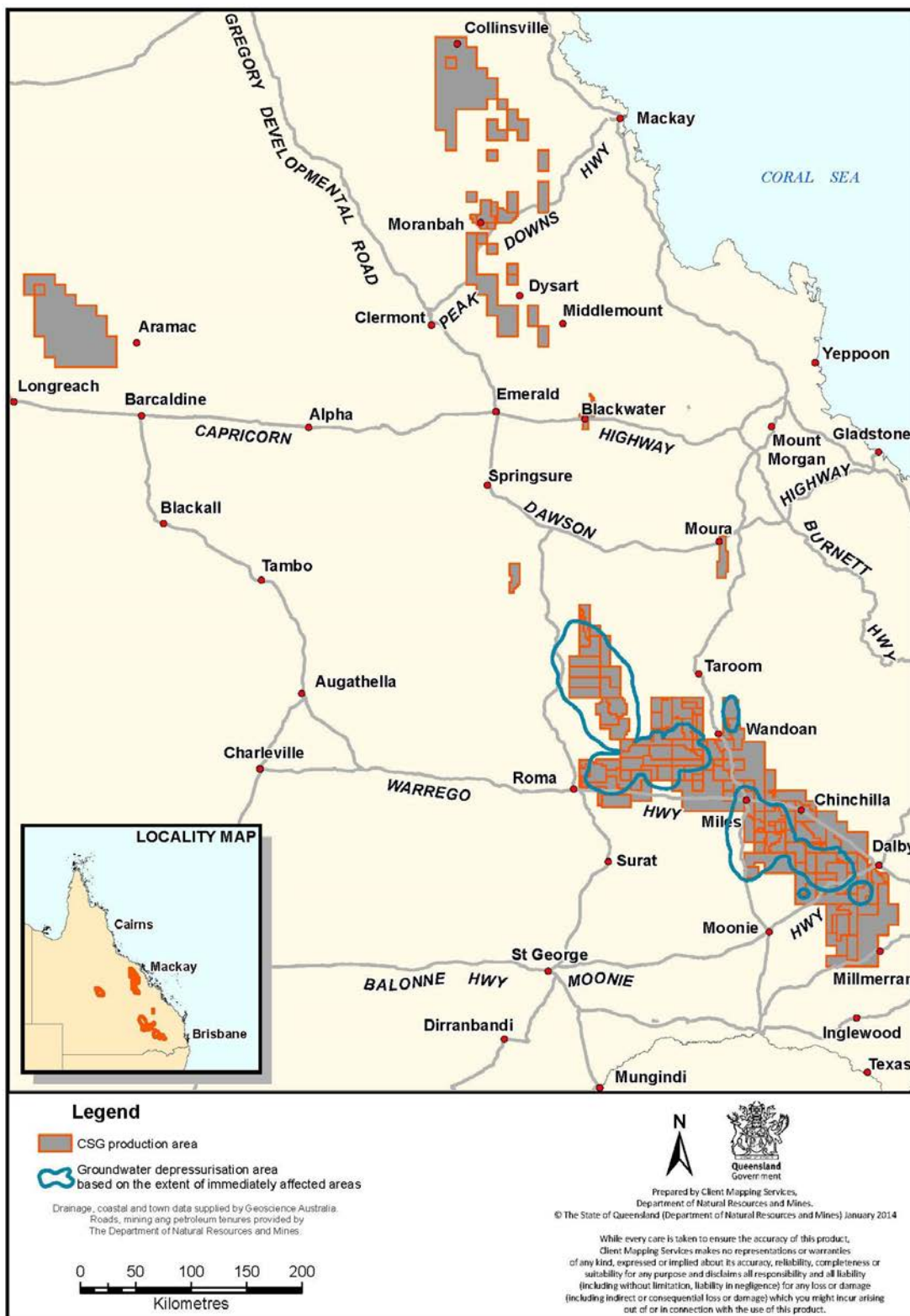
Stratigraphy showing formations where there is a potential for encountering gas is provided in Figure 1.

Figure 1: Surat, Bowen and Galilee Basin Stratigraphy showing Gas Prone Formations (red)



The gas prone areas are shown in Figure 2.

Figure 2: Gas prone areas



Gas safety management

Risk assessment

Water bore drillers are advised to assess the safety risk when planning to drill in, or in close proximity to areas where natural gas may be present, and to implement the appropriate controls to eliminate or minimise the risk, as far as is reasonably practicable.

Note: When undertaking work, water bore drillers are considered to be 'persons conducting a business or undertaking' (a PCBU) under the Work Health and Safety laws. They must ensure, so far as is reasonably practicable, that the health and safety of workers and other persons is not put at risk from work carried out as part of the business or undertaking. Further information is available at www.worksafe.qld.gov.au.

It is not advisable for water bore drillers to operate in the areas showed in Figure 2 without appropriate experience in gas reservoir drilling and suitable controls in place, including appropriate equipment and safety procedures.

Appropriate controls to address gas safety may include the use of mud drilling and/or specialised equipment such as a blow-out preventer or other flow control devices.

Hazardous areas

Combustion will take place if three elements are available:

- an ignition source e.g., generator, spark, engine, electrical equipment
- presence of a flammable gas (this constitutes a 'hazardous area')
- oxygen

Hazardous areas must be identified according to the AS/NZS 60079.10.1-Explosive atmospheres – Classification of areas.

Identified hazardous areas must be free from all ignition sources. Electrical equipment is not permitted in identified hazardous areas unless it does not provide an ignition source and is certified as 'intrinsically safe'. This includes water quality meters, water level dippers, mobile phones, GPS devices etc.

Controls

Water bore drillers may also need to consider the following controls as minimum (but not limited to):

1. using a multi-gas detector during the drilling operation to detect possible presence of flammable gases
2. using intrinsically safe electronic devices
3. conducting a check for the possible presence of horizontal wells before commencing work, so that possible intersection with water bore drilling can be avoided
4. contacting the CSG Tenure Holder to obtain information on the hazards and the controls required
5. to drill in the area (the water bore driller should provide GPS readings and accurate site information)
6. implementing an appropriate emergency plan.

Gas monitoring

It is recommended that water bore drillers use a portable multi-gas detector on site when drilling in gas areas. The detector should be, as a minimum, able to detect methane and hydrogen sulphide.

Methane concentration can be displayed as parts per million (PPM), % of methane in air or % of low explosion limit (LEL) (or low flammability limit –LFL).

Methane concentrations in air of between 50,000 and 150,000 ppm or between 5% and 15% are flammable. The table 1 below provides the conversion factors.

Note: Under section 51 of the Work Health and Safety Regulation 2011, a water bore driller who is a PCBU is required to manage the risks to health and safety of hazardous atmospheres such as the concentration of a flammable gas that exceeds 5% of the LEL.

Table 1: Conversion factors for methane concentrations

Unit	Alarm setting limit	Low explosion limit	Upper explosion limit
PPM	2500	50,000	150,000
% in Air	0.25	5	15
% of LEL	5	100	-

To ensure gas detectors provide reliable gas level readings, they must be calibrated at the frequency recommended by the manufacturer. A functional ‘bump test’ may also be required to be performed before each use. Drillers should be suitably trained and able to demonstrate they are competent in the use of the gas monitoring equipment.

As part of safe working practices, it is advisable to conduct continued gas monitoring measurements throughout the drilling operation. A risk assessment should be undertaken to determine where, when and how monitoring should be utilised. This may include monitoring at the bore hole, the operation area, or personnel, through a detector on each staff member on site.

Table 2: Hazardous concentrations and situations for methane and hydrogen sulphide

Gas	Hazardous concentration	Hazardous situation
Methane	5%–15% of methane in air	Reading greater than 20% LEL, for 15 seconds, 1m from the hole
Hydrogen sulphide	Explosive limits 4%–44% of hydrogen sulphide in air	Detection of ‘rotten egg’ smell and 5% LEL, for 15 seconds, from 1m from the hole

Water bore drillers are strongly advised to consult with the tenure holders before drilling on petroleum tenures.

Hazardous situations

Continuous readings greater than 20% LFL may be indicative of a possible sustained gas leak and the potential for build-up of a flammable atmosphere may be increased.

It is strongly advisable in these circumstances to stop drilling and shut down all the equipment (if safe to do so). Water bore drillers should not attempt to control unexpected gas leaks.

A risk assessment should then be undertaken to reassess the situation. It is not advisable for water bore drillers to continue operations without the appropriate equipment and the training/experience identified as suitable controls to operate in area where natural gas is present in the formation.

Emergency situation

Water bore drillers planning to undertake activities in areas where natural gas may be present are advised to provide for gas emergency in their emergency management and response plans.

The emergency plan should contain procedures to follow in the event of a gas kick or blowout and include an escalation procedure for a loss of well containment. The emergency plan should include the contact details of specialised services able to provide timely assistance with the deployment of well containment resources. Water bore drillers should be aware of the costs associated with such specialised services before undertaking activities in gas prone areas.

Note: Under section 43 of the Work Health and Safety Regulation 2011, a water bore driller must prepare, maintain and implement an emergency plan.

What to consider in a declared gas emergency situation

- Stop any activity.
- Shut down all equipment (if safe to do so).
- Alert other people working or present in the immediate area.
- If the gas leak does not subside or is not contained, evacuate people to a safe area upwind of the operation area.
- Immediately establish an exclusion zone around the operation area.
- Depending on the circumstances, contact the appropriate emergency services on '000' (Queensland Ambulance Service, Queensland Fire and Rescue Service, Emergency Management Queensland).
- If required, contact the specialised services that are able to provide assistance with well containment and place them on stand-by in case they are required to bring the well under control.
- As soon as the immediate emergency is under control, notify the landowner, all occupiers of the property and properties nearby, the tenure holder (if on tenure) and the Queensland Government organisations listed below.

Depending on the situation government organisations listed in table 3 require notification as soon as possible in the event of an uncontrolled blowout during a drill event.

Table 3: Notification of emergency situation

Organisation	Situation	Contact information
Police, Fire, Ambulance	Any emergency	000
Workplace Health and Safety	At a worksite	1300 369 915 www.worksafe.qld.gov.au
Department of Resources Safety and Health (RSHQ) Petroleum and Gas Inspectorate:	On a petroleum tenure	Southern Region: (07) 3330 4241 Northern Region: (07) 4936 0188 Prescribed incident notification and fuel gas emergencies: 1300 910 933 (24 hours, 7 days a week)

