Queensland Government

Application for potential commercial, geothermal or storage area

Geothermal Energy Act 2010 (s65)
Petroleum and Gas (Production and Safety) Act 2004 (s89)
Greenhouse Gas Storage Act 2009 (s101)
Form MMOL-22 Version 3

MINES ABN 59 020 847 551

You may make an application for potential commercial, geothermal or storage area electronically using the **MyMinesOnline** system. Alternatively you may complete the original of this application and submitting the application, any attachments and the prescribed fee at a Mines lodgement office.

Note: A document containing information that is false or misleading may attract a maximum penalty of 500 penalty units.

Please use a pen, and write neatly using **BLOCK LETTERS** Cross where applicable ☒. Where insufficient space anywhere on this form, attach a separate page.

Question 1 – Permit and holder details

Application type

Potential commercial area ☒	Potential geothermal area ☐	Potential storage area ☐

Permit number (eg ATP01234):	ATP645 (PCAA 3)	Current expiry date:	31-Dec-2019
Term of declaration:	15 Years		

Detail the current holder(s)

	Holder 1	Holder 2	Holder 3
Company Name/surname:	BNG (Surat) Pty Ltd		
Given name (if individual):			
ACN/ARBN	090 629 913		
% Holding:	100		

Question 2 – Details of permit area

2.1 General locality of the application: East of Surat

OFFICE USE ONLY	Fees paid:	Payment Method:	*Receiving officer*
Received at: _____	Total $ _____	Cash ☐	I confirm that:
Received by:	DNRM ☐	Credit Card ☐	• the details on application form have been checked;
Date: / /	Penalty ☐	EFTPOS ☐	• all attachments have been submitted;
Time: AM/PM	Receipt No. _____	Cheque ☐	• correct application fees have been submitted for the relevant application type
			Name: _____

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2.2 Local authority:

Maranoa Regional Council	
Western Downs Regional Council	

2.3 Specify the application area for the permit.

BIM/BLOCK	All	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
CHAR2802	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
CHAR2803	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
CHAR2875	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
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Total number of sub-blocks	75																									

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Question 3 – Application details (Authority to prospect)

3.1 Has the applicant already given the Minister a commercial viability report that is still relevant to the proposed potential commercial area OR is there attached with this application, a report that meets the requirements for a commercial viability report that is still relevant to the proposed Potential Commercial Area? ☒ Yes ☐ No

3.2 Has the Minister obtained an independent viability assessment for the authority? ☐ Yes ☒ No

3.3 Has the applicant included an evaluation program detailing the potential petroleum production or storage in the proposed potential commercial area? ☒ Yes ☐ No

3.4 Has the applicant included a statement detailing their compliance with the conditions of the current authority, or detailing and explaining any non-compliance? ☒ Yes ☐ No

Attachments required:

Geothermal and Greenhouse Gas Storage

- An evaluation report for:
  - potential geothermal production or potential GHG stream storage in the proposed application area; and ☐
  - market opportunities for potential geothermal production or GHG stream storage ☐
- A report for or that includes the proposed potential geothermal commercial, or proposed storage area that:
  - complies with the requirements prescribed under a regulation for geothermal or GHG viability reports; and
  - is still relevant to the circumstances of the proposed application area

Petroleum and Gas ☐

- (If applicable) A copy of a commercial viability report (or a report that meets the requirements for a commercial viability report) that is still relevant to the area of this application ☒
- Details about the compliance or non-compliance with the conditions of authority ☒
- An evaluation report ☒

Question 4 – Obligations and declaration

WARNING: Giving false or misleading information is a serious offence.

- I have read and understood the ***resource guides*** *and resources legislation.*
- I understand my obligations as an applicant/holder for the permit.
- I have truthfully declared all relevant details requested of me in this application.
- If any part of this form has been completed with the assistance of another person, I declare that the information as set down is true and correct and has been included with my full knowledge, consent and understanding.

Note: if this form is being signed by a person other than the current registered holder, a letter of authority or power of attorney documents must be provided with this application.

Print name:	Ryan Dreibelbis	Signature:	sch4p4(6) Personal i
Position:	Manager, Access and Authorised Representative	Date:	27. 11. 2019
Company:	BNG (Surat) Pty Ltd		
Print name:		Signature:	
Position:		Date:	
Company:			

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Print name:		Signature:	
Position:		Date:	
Company:			

Print name:		Signature:	
Position:		Date:	
Company:			

Question 3 – Payment

Application	Potential commercial, geothermal or storage area application fee	☒

OFFICE USE ONLY CHECKLIST -	
Has required attachments been provided?	YES/NO/NA
Application fee has been lodged with application?	YES/NO/NA

Receiving officer I confirm that: • The details on this form have been checked • the checklist above are complete • attachments required are correct • correct fees have been submitted. The application for a potential commercial, geothermal or storage area **has / has not** provided all the information required by the legislation to be assessed.	I recommend that the application **should / should not** be received. Name: _____ Signed: _____ Date: / /
Departmental Officer The application for a potential commercial, geothermal or storage area is **received and can be recorded on the register** or **refused to be received and can be recorded on the register** or **refused to be received** under s842 of the P&G, s412 of the GHG, s364 of the GEO Act (cross out Acts that do not apply).	**Reasons for refused to receive:** _____ _____ _____ Name: _____ Signed: _____ Date: / /

Disclaimer

The Queensland Government is collecting information provided on and with this form to assess the suitability of the application for a potential commercial, geothermal or storage area under the *Petroleum and Gas (Production and Safety) Act 2004 (P&G), Geothermal Energy Act 2010 (GEA)* and *Greenhouse Gas Storage Act 2009 (GHG)* and section 197 of the *Mineral and Energy Resources (Common Provisions) Act 2014* (MERCP). Some or all of this information may be provided to other agencies of the Queensland Government for issuing an environmental authority, to make register searches, extracts or copies or to make other approvals as required under the relevant Act. Some of this information may be provided to Queensland Treasury, the Scheme Manager under the Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act), or any advisors to the Scheme Manager to enable the Scheme Manager to carry out the Scheme Manager's functions under the MERFP Act. Your personal information will not otherwise be disclosed to any other third party without your consent, unless authorised or required by law.

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Potential Commercial Area – Initial assessment

Complete the initial assessment using the form below.

Enter permit type and number **PCA307**

For paper applications Has this application already been entered on the register and currently undergoing an assessment?	No	***For all Permits*** *If Yes – Contact the MyMinesOnline Support team for assistance to remove this application.*

Select a response from the radio buttons. Provide comments where necessary.

Run an advanced intersect report in MinesOnlineMaps remember to add dead MDLs.

MILESTONE:			**Record in working notes when complete along with date of completion**
			Comments
1	Is the area of the proposed PCA within an ATP that is administered pursuant to the P&G Act?	**Yes**	
2	Is the ATP still current at the time of the application for the PCA?	**Yes**	*Expiry:31/12/2019* *Renewal lodged: 29/11/2019*
3	Is the number of sub-blocks (or residual sub-blocks) in excess of 75? s.90(2)(a) {P&G Act 2004}	**No**	
4	Do the sub-blocks form a single parcel of land? s.90(2)(b) {P&G Act 2004}	**Yes**	*If no, this should be drawn to the attention of the Registrar (Petroleum and Gas) for this Officer's recommendation as to whether the application is to be refused.*
5	Has a description of the land been provided, including the number of sub blocks specified?	**Yes**	
6	Are the applicants and their percentage holdings in the authority, exactly the same as the details contained in department's Petroleum and Gas register?	**Yes**	

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MILESTONE: Land availability		Record in working notes when complete along with date of completion	
Layers	**Yes/No/N/A**	**Summary/Remarks**	
Mineral Development Licence Application and Granted	**No**	MDL No:	
		No. of whole sub-blocks not available:	
Mineral Development Licence – DEAD (release of land required pursuant to Section 226 of the Act)	**No**	MDL No:	
		Date land released: (refer to 'AWD' code in MERLIN)	
Mining Claim Application and Granted (excluded pursuant to Section 132 of the Act)	**No**	MC No:	
		No. of whole sub-blocks not available:	
Mining Lease Application and Granted (excluded pursuant to Section 132 of the Act)	**No**	ML No:	
		No. of whole sub-blocks not available:	
Petroleum Authority Section 3A Chapter 8	**Yes**	ATP No:645	
		PL No:	
		PPL No:	
		PFL No:	
Greenhouse Gas Authority Chapter 8	**No**	QL No:	*If yes, update MERLN with OLP record and relevant overlapping permits.*
Exploration Permit Mineral Applications and granted	**No**	EPM No:	
Exploration Permit Coal Applications and granted	**No**	EPC No:	
Exploration Permit Special Applications and granted	**No**	EPS No:	
ILUA	**Yes**		Mandandanji People– FC No:QUD366/2008, QCD:2018/001 ILUA Registerd: Mandandanji People and QGC Pty Limited ILUA (QI2010/034)
Constrained Land	**No**	Name:	
		No. of sub-blocks affected:	
Unavailable Land	**No**	Name:	
		No. of sub-blocks affected:	

MILESTONE: Restrictions/Constraints			
7	Does this application include any land covering part sub-block(s) of sterile land(s)	**No**	If yes, the written description of this sterile land and what sub-blocks of the application it partially covers should be detailed below. The Registrar (Petroleum and Gas) will determine whether these will, have to

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			be identified as “Excluded Land” for the PCA if and when it is declared.
8	Does the area of this application include any land covering whole sub-block(s) of constrained land(s)?	**No**	If **yes**, list the BIM Numbers of the whole sub-blocks that may not be accepted). The Registrar (Petroleum and Gas) will determine whether these will be included if and when the PCA is declared and, particularly if the constrained land is a conservation proposal, how the PCA is to be conditioned. (eg. There may be conditions imposed on the PCA if the area of any proposed PCA is over a proposed or existing water storage area):
MILESTONE: Unavailable Land(s) (Refer to section 44(4) of the Greenhouse Gas Storage Act 2009			
9	Does this application include any land that is also in the area of another tenure, other than the relevant ATP the application relates to?	**No**	If **yes**, please detail ATP tenure number(s) below:
10	Does this application include any land that a regulation has prescribed as land over which a potential storage area cannot be declared?	**No**	If **yes** and the area, prescribed by Regulation as land over which a potential storage area cannot be declared, is only over part sub-block(s), the written description of this area should be detailed below. The PCA cannot be declared over this area. Further, do not accept the whole sub-block(s) within the application that are covering this prescribed area, and list the BIM numbers of these whole sub-blocks NOT to be accepted

Final comments

Application accepted

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BOWEN TGS: PCA 3 (ATP 645) APPLICATION

NOVEMBER 2019

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Contents

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1 Introduction

1.1 ATP 645 Tenure History

ATP 645 is in the Surat Basin, east of the town of Surat within the Western Downs and Maranoa Regional Council areas as shown in Figure 1.

The ATP was first granted under the Petroleum Act 1923 to BNG (Surat) Pty Ltd, a wholly owned subsidiary company of QGC Pty Limited (QGC), for 4 years commencing 1 January 2000 over an area of 31 graticular blocks. BNG (Surat) Pty Ltd extended an interest of 50% to Samson-International (Australia) Pty Ltd in 2003.

ATP 645P was renewed for a further 4-year term under the Petroleum Act 1923 on 1 January 2004 over an area of 24 graticular blocks. Departmental Policy Number MIN/2003/1192 saw both mid-term relinquishments waived with a 20% relinquishment (4 graticular blocks) required prior to renewal. In 2005 Samson-International (Australia) Pty Ltd assigned its 50% interest back to BNG (Surat) Pty Ltd.

ATP 645 became a converted ATP under section 876 of the Petroleum and Gas (Production and Safety) Act 2004 (P&G Act) on 31 December 2004 thereby ceasing its administration under the Petroleum Act 1923 and becoming an ATP under the P&G Act.

On 1 January 2008, ATP 645 was renewed for a further 12-year term over an area of 475 sub-blocks. An amendment to the area of ATP 645 to include previously excluded land subject to native title was recorded on 20 May 2014 with ATP 645 being subject to the Mandandanji People and QGC Pty Limited ILUA (QI2010/034) registered with the National Native Title Tribunal on 12 May 2011. On 31 July 2014 the current approved work program and relinquishment condition was statutorily extended by 2 years from 31 December 2015 to 31 December 2017.

The tenure is currently in its third and final four-year period of this renewal term, ending 31 December 2019. ATP 645 will continue to cover an area of 300 sub-blocks upon the declaration of 5 x Potential Commercial Area applications lodged

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by BNG (Surat) Pty Ltd and operated by Shell QGC.

This PCA Application updates the resource and commercial understanding of the ATP area and is one of five PCA applications lodged to cover the whole of the area of ATP 645, shown in Figure 4. It proposes a PCA evaluation programme to support the ATP 645 LWP and help effectively address the key hurdles to economic resource development.

1.2 Compliance With Conditions of ATP 645

The approved current period later work program is shown in Table 1, extracted from the ATP instrument, reflecting the current later work program for the 2-year period 1 January 2018 to 31 December 2019. Tenure is in good standing with the current and past work programs contributing to the identification of several potential commercial areas.

Period 5	Minimum Approved Activities	Estimated Expenditure
One (1) year ending 31 December 2018	Geological & Geophysical and engineering studies	$100,000
One (1) year ending 31 December 2019	Geological & Geophysical and engineering studies Prospect selection, well planning & design	$100,000
	TOTAL	**$200,000**

The proposed later work program lodged for ATP 645 lodged on 27 October 2017 has been approved.

Table 1: ATP 645 Current Period Approved Later Work Programme.

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1.3 Bowen TGS Exploration History

Early exploration in ATP 645 was undertaken by BNG (Surat) Pty Ltd) (at the time a wholly owned subsidiary of Sunshine Gas) during the early 2000's, focussed on defining the prospectivity of Permian and Triassic tight gas sand reservoirs through acquisition of the 193km^2 Overston 3D seismic survey and drilling of the Overston-1 & -2/2A and Narrene-1 wells.

Following the acquisition of Sunshine Gas by QGC, BNG (Surat) Pty Ltd

subsequently became a wholly owned subsidiary of QGC Pty. Ltd. and from 2010, concurrent with the ongoing Surat Basin CSG activity, QGC embarked on a major exploration campaign focussing on tight gas sands (TGS) in the Permian and Triassic section within the Taroom Trough of the Bowen Basin. ATP 645 was one of a number of A's to P being assessed for TGS prospectivity, all of which were held 100% by QGC (or related entities). The project is internally referred to as Bowen TGS.

In September 2015, approval was granted to combine 100% QGC held ATP 645, ATP 785, ATP 768 and ATP 1101 into a project area, the Bowen TGS Project Area (BTPA).

In 2018, Shell entered into two non-operated joint ventures operated by Santos (QNT) Pty. Ltd. located adjacent to ATP 645 and ATP 785 with field activity commencing in 2019.

Figure 2 shows the significant amount of TGS exploration activity within the QGC operated tenures during the period from 2010 to present, whereby the presence of significant unconventional resource potential has been demonstrated in ATP 645 (by Dunk-1, Daydream-1 and Magnetic-1) and also at Fantome (ATP 632 / PCA 160)

Total expenditure over the course of this activity is in excess of AUD$ sch4p4(7)(1)(c) with work conducted in these tenures since 2010 including:

- 826km 2D seismic acquisition, initially to resolve broad geological structure for exploration planning and resource estimation, and where applicable, to calibrate the seismic with drilling results, to apply more sophisticated seismic techniques;
- 4,151km 2D seismic re-processing (plus integration of 17,800km of 2D re-processing attributable to other exploration and development projects in QGC) and 193km^2 3D seismic re-processing of legacy surveys across the project area; and
- 7 wells drilled (4 fracture stimulated and production tested) which were the first designated basin centre penetrations in the Taroom Trough with total depth ranging from 3,180-4,694m. Three of these wells were drilled in ATP

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645 (Daydream-1, Dunk-1 and Magnetic-1) testing stacked reservoirs on the western flank of the southern Taroom Trough.

This new data acquisition was in addition to information provided by legacy conventional petroleum exploration activity, and information from adjacent tenure acquired by data trade or as open file, providing significant information for QGC's initial exploration planning through to current resource understanding.

Shown in Figure 3, ATP 645 and the other Bowen TGS focus tenements are located within the Taroom Trough of the Bowen Basin with settings ranging from the western flank adjacent to the Roma Shelf, across the deepest part of the trough, through to the eastern side of the trough basinward of major basement cored anticlines along the Burunga-Leichardt Fault system.

1.4 Proposed Potential Commercial Area 3 (ATP 645)

Potential Commercial Area 3 (ATP 645) arises out of the large TGS exploration work program carried out by QGC as operator within the BTPA and non-BTPA tenures (including ATP 645). Appraisal of the Dunk-1 discovery drilled in 2014, and tested and flowed gas to surface at sustained rates of 700mscf/d in 2015, forms the basis of this application. Further support is lent to the application by the legacy wells in ATP 645, in addition to the other QGC wells; Daydream-1 which flowed gas to surface in 2013 and Magnetic-1 which confirmed gas bearing reservoir on logs.

The Commercial Viability Report (Section 2), prepared by QGC as Operator, addresses the requirements outlined in the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) for a PCA application. Figure 4 illustrates the area of this PCA application, the area of ATP 645 sought to be retained through associated PCA applications and the extent of the two primary reservoir objectives, the Tinowon Formation and Lorelle Sandstone.

The intention of the Operator is to amalgamate ATP 645 PCA applications 1-4 upon commencement of the *Natural Resources and Other Legislation Amendment Bill 2019* (NROLA) which will remove the 75 sub-block size limit. sch4p4(7)(1)(c)

sch4p4(7)(1)(c) Business/commercial/professional/financial affairs

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sch4p4(7)(1)(c) Business/commercial/professional/financial affairs

The primary TGS resource identified in ATP 645 is the Tinowon Formation, which is present across all graticular blocks in the tenure except for CHAR 2657 and CHAR 2729 (part of PCA 1). The estimate of recoverable hydrocarbons in this reservoir across ATP 645 in the area covered by PCA 1-4, on a P50 basis, is 3.0tcf sales gas and 252mmboe NGLs and condensate.

The secondary resource present in ATP 645 is the Lorelle Sandstone which is present across the western part of the tenure. The estimate of recoverable hydrocarbons in this reservoir across ATP 645 in the area covered by PCA 1-4, on a P50 basis, is 400bcf sales gas and 17mmboe NGLs and condensate.

Despite the material recoverable volumes estimated, the resource has not yet been able to be demonstrated as economically viable. sch4p4(7)(1)(c) Business/commercial/

sch4p4(7)(1)(c) Business/commercial/professional/financial affairs

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1.5 Description of Proposed PCA 3 (ATP 645)

The proposed area of PCA 3 (ATP 645) comprises 75 contiguous sub-blocks (225km^2) within the ATP 645 tenement as shown in Figure 5 and listed in Table 3. This area covers the extent of the reservoirs on tenure described in Section 2.

Block	Sub-blocks	# Sub-blocks
CHAR2802	all	25
CHAR2803	all	25
CHAR2875	all	25
TOTAL		**75**

Table 3: PCA 3 (ATP 645) sub-block listing.

1.6 PCA 3 (ATP 645) Application Rationale

sch4p4(7)(1)(c) Business/commercial/professional/financial affairs

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sch4p4(7)(1)(c) Business/commercial/professional/financial affairs

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2 Commercial Viability Report

The area extent of this PCA Application is shown in Figure 4 displayed in context with the associated ATP 645 PCA application areas. QGC, as operator of the BTPA, and ATP 632, has drilled 7 wells and acquired 4,151km of 2D seismic during exploration for deep gas resources in the Bowen Basin since 2010.

Viewed in combination with previous conventional petroleum exploration drilling, new and legacy seismic, and by extension of data from adjacent areas, QGC has identified two prospective natural underground reservoir intervals in ATP 645. These are the Permian aged Tinowon Formation and Lorelle Sandstone, both part of the Back Creek Group as shown in Figure 7.

While both of these reservoir intervals are present in the area of PCA 3 (ATP 645), commercialisation of the area under application is considered by QGC to initially rely on successful commercialisation of the primary target, the Tinowon Formation, which to date has provided the most encouraging prospectivity in ATP 645 and in surrounding areas.

2.1 Geological Model

2.1.1 Regional Geology

The Bowen Basin covers over 160,000 km^2 of southern and central Queensland and has a maximum sediment thickness of about 10,000 metres concentrated in two north-south trending depocentres, the Taroom Trough in the east and the Denison Trough in the west (Figure 3). The basin first opened as a result of an Early Permian extensional tectonic phase. This set up a series of grabens and half-grabens into which fluvial-lacustrine sediments were deposited. This episode was also accompanied by extensive volcanics throughout the basin, but particularly along its eastern margin.

Following this extensional phase, a more passive thermal sagging phase occurred. This resulted in a basin wide marine transgression, and saw a temporary cessation of volcanic activity along the eastern margin of the basin. Sediment was dominantly sourced from the west and deposited eastward over the antecedent grabens and half-grabens. Deltaic sediments prograded into the

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basin from the west, filling in the various depocentres that are associated with coal deposition. The sediments deposited during this time comprise the mid-late Permian Back Creek Group.

By the Late Permian, a compressional phase led to foreland loading on the eastern margin of the basin. This event cut the basin off from the open sea, and resulted in rapid infilling of dominantly coastal plain to alluvial plain facies. Substantial amounts of coal were cyclically deposited (the Kianga Formation and equivalents) throughout the basin. Renewed igneous activity brought about by the tectonic reactivation, several tuffaceous sediments are deposited during this time. By the middle to late Triassic, the basin was in filled with sediments although continued diastrophism was experienced resulting in further deformation of the rocks.

The southern half of the Bowen Basin, where ATP 645 is located, is overlain by the Surat Basin which most notably contains the Walloon Coal Measures underpinning supply to the various LNG projects.

2.1.2 Description of Reservoirs

2.1.2.1 Back Creek Group

The Back Creek Group is a widespread succession of marine to fluvial sands, silts, shales, coals and tuffs that predominantly represent the thermal sag phase of Bowen Basin development. Sediment input during this time was predominantly from the west and as such the best reservoir development in this interval that has been encountered in the Taroom Trough is along the western flank of the south-west Taroom Trough on the basinward margin of the Roma Shelf.

Within the Back Creek Group, there are a number of discrete reservoir targets that are economic producers or form exploration targets on the Roma Shelf. The most significant of these are:

- Lorelle Sandstone: An early-mid Permian fan-delta system penetrated on the Roma Shelf and in a small number of wells on the western flank of the Taroom Trough. This is the oldest reservoir in the Back Creek Group and to date no economic production has been achieved from this reservoir despite being found to be gas-bearing in a number of wells. Given the depositional environment for this formation, a key challenge in its exploration is

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understanding reservoir distribution and quality variation with a relatively small number of well penetrations.

- Tinowon Formation: The late Permian Tinowon Formation is divided into two distinct depositional sequences, the lower Tinowon/Wallabella Coal Member and the upper Tinowon. Both units represent separate transgressive successions separated by a sequence boundary at the top of the lower Tinowon/Wallabella Coal Member. Across the Roma Shelf, these intervals represent fluvial-alluvial deposition however moving basinward, indications of marine influence are seen with deposition interpreted to tend more coastal plain into the Taroom Trough. The upper Tinowon is the most prolific gas producing interval on the Roma Shelf with the largest gas fields in the province being reservoired in this interval. The lower Tinowon is productive but its prevalence as an economic producer is limited due mainly to localised depositional trends and generally poorer reservoir quality than the upper Tinowon.

2.1.2.2 Kianga Formation

The Kianga Formation is defined in the southern Taroom Trough and is the age equivalent to the late Permian Rangal Coal Measures and Baralaba Coal Measures in the northern Taroom Trough and Nebo Synclinorium. Deposition of the formation occurred during extensive foreland loading, in fluvial to marsh environments of a regional deltaic system. The lithology of these coal measures are predominately fine to medium grained lithic sandstones, inter-bedded with grey-brown siltstones abundant carbonaceous material and coals, tuffaceous shales and common tuff bands.

The Kianga Formation reaches a maximum thickness of over 1,000m thick in the Taroom Trough (up to 500m in the southern Taroom Trough) and thins onto the Roma Shelf. The reservoir potential on the Roma Shelf is poor with coals and carbonaceous mudstones dominating the section however, well penetrations in the Taroom Trough show sandstone beds up to 10's m thickness interbedded with coal seams generally up to several metres thick.

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2.1.3 PCA 3 (ATP 645) Geology

ATP 645 is located on the southwestern flank of the Taroom Trough with strata dipping gently down to the east (Figure 8). Drilling in the tenement area since the early-2000's has focussed on testing TGS play potential of the Permian Back Creek Group and Kianga Formations with all wells drilled outside of any known conventional structure or stratigraphic trapping feature.

Prior to grant of ATP 645, a number of deep wells were drilled during the 1980's in the southern part of present day ATP 645, with unstimulated flow tests recovering gas cut mud. These wells are in the part of ATP 645 covered by PCA 5.

The earliest activity under ATP 645 was undertaken by Sunshine Gas acquiring the Overston 3D and drilling the Overston-1, Overston-2/2A and Narrene-1/1A wells. Most recent activity has been the QGC-operated Bowen TGS Project where 2D seismic was acquired and 3 wells were drilled, Daydream-1, Dunk-1 and Magnetic-1.

Three wells (Overston-2/2A, Daydream-1 and Dunk-1) have flowed gas and condensate to surface following fracture stimulation and sch4p4(7)(1)(c) Business/comm sch4p4(7)(1)(c) Business/commercial/professional/financial affairs sch4p4(7)(1)(c) Busines PCA 3 (ATP 645) does not contain any wells but has Magnetic-1 on its northern border and the Overston 3D seismic survey covers approximately 1/6 of the PCA area.

The Dunk-1 discovery (2015) provides the impetus for further appraisal in ATP 645 and the Magnetic-1 well (2015) located 10km to the south, close to the ATP 2040 boundary provides encouragement to further explore for the Lorelle Sandstone in ATP 645. The Daydream-1 well (2012), near the eastern boundary of the area of ATP 645 covered by PCA 1-4 also flowed gas to surface from the Tinowon Formation in an unoptimized flow test.

Dunk-1 and Magnetic-1 both encountered gas-charged sandstone units within the Permian Back Creek Group. In Dunk-1 (Figure 9), the Upper Tinowon Sandstone within the Tinowon Formation was best developed, comprising a ~40 m thick

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gross interval with a N:G of almost 100%. A core was taken through ~29 m of the Upper Tinowon Sandstone, which proved critical in defining reservoir/fluid properties and depositional environment (interpreted as incised valley fill). sch4p4

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The primary target in Magnetic-1, was the Lorelle Sandstone (part of the Muggleton Formation), found to be similarly well-developed as in the Narrene-1A offset well. As predicted, the Upper Tinowon was much siltier in character and of secondary interest. 45m of core was obtained from the Lorelle in Magnetic-1, which was found to be conglomeratic in the lower part of the reservoir; this was in contrast to the high-quality sandstones prognosed predrill (note that no core was taken in Narrene-1 which was the primary offset control). sch4p4(7)(1)(c) Business/comm

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Daydream-1 was drilled to test the Taroom Trough in a not as basinal location as QGC Fantome and Tasmania wells. A secondary objective of the well was also to penetrate a package identified on seismic, interpreted to be the Bowen Basin syn-rift section. The well encountered a sandy early Permian (including Tinowon Formation) section overlying volcanics. As the well was located close to the edge of the syn-rift package on 2D seismic, it is still uncertain whether the well actually penetrated the interpreted syn-rift section and it comprises volcanics, or, the well missed the edge of the syn-rift package and penetrated the Combarngo Volcanics seen regionally. This was the first well fracture-stimulated in the QGC Bowen TGS

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Project and despite a number of issues with these operations, including recovery of unbroken gel to surface during the clean-up and one stage being perforated incorrectly at 180º rather than at 60º as planned, sch4p4(7)(1)(c) Business/commercial/profess sch4p4(7)(1)(c) Business/commercial/professional/financial affairs sch4p4(7)(1)(c) Business/commercial/professio As the well was still cleaning up when the test was stopped, a nitrogen coiled-tubing clean-out and gas lift was planned for later in the campaign but was not executed due to budget constraints.

In Q1 2019, GLNG (Santos Operator) fracture stimulated and production tested the Upper Tinowon and Lorelle Formations in the Tinowon-2 well (drilled 2015 in ATP 2017), 15km NW of Dunk-1. Results of the production test are not known, however, the reported status at the end of Q1 2019 was that the well was "shut-in for a 6-month pressure build-up test to assess the connected volume in the accumulation."

While OGIP and gas flow to surface has not been demonstrated in the PCA area, there is evidence from elsewhere in ATP 645. The Tinowon formation sand can be mapped on the Overston 3D seismic and onto the regional 2D grid (Figure 10) across PCA 3 (ATP 645). Encouraging indications of the ability to utilise seismic for reservoir characterisation have been seen but further drilling is required to provide further calibration (Figure 11). The ATP 645 LWP consists of further 2D seismic and drilling of two wells to calibrate the seismic response and allow extrapolation onto 2D seismic across ATP 645 and beyond to demonstrate materiality of the play.

To date, post-stimulation production testing has not yielded economic flow rates from vertical wells, posing a challenge to economic development of the tenure using the current drilling and completion techniques. sch4p4(7)(1)(c) Business/cor sch4p4(7)(1)(c) Business/commercial/professional/financial affairs

This PCA evaluation program supports the ATP 645 LWP to address the challenge of maturing an economic play by improving characterisation of the tight gas sand reservoirs in order to identify sweetspots and consideration of drilling and completion techniques that may unlock deliverability in tight sands.

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2.2 Resource Assessment

2.2.1 Standards for Resource Assessment

The estimate of hydrocarbon in the Tinowon and Lorelle reservoirs in ATP 645 are compiled in accordance with Shell's internal instructions and guidelines for estimation and classification of petroleum resources which are based on the Society of Petroleum Engineers' Petroleum Resources Management System (SPE-PRMS).

Estimation of hydrocarbon resources within ATP 645 has been conducted through a recognisable industry approach where available information is combined to estimate a probabilistic range of original gas-in-place (OGIP) to highlight the range in uncertainty of the OGIP, and to estimate potentially recoverable hydrocarbons by applying recovery factors derived by dynamic reservoir modelling, informed by well production testing.

2.2.2 OGIP

Shell provides the following estimates of in-place hydrcarbons in the part of ATP 645 covered by PCA Applications 1 to 4. The location and a verifiable estimate of the amount of hydrocarbon in each of the identified natural underground reservoirs is summarised in Table 4, which shows the distribution of the original gas-in-place (OGIP) estimates based on probabilistic methods.

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The data used in the generation of the estimates in Table 4 is derived predominantly from the results of Dunk-1 and Magnetic-1 and includes reinterpretation of all available pre-existing seismic and well based data surrounding the area of interest to estimate potential range of reservoir properties.

The parameters used to derive these OGIP estimates are shown in Table 5.

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2.2.3 Recoverable Resource

The provided estimate of recoverable hydrocarbons in the part of ATP 645 covered by PCA Applications 1 to 4 is estimated by applying a range of recovery factors derived from interpretation of dynamic reservoir data obtained from production testing in Dunk-1 and applying estimates of potential upside deliverability based on benchmarking against analogous North American reservoirs. Despite substantial OGIP, the challenge with commercialising tight sands in ATP 645 is that, based on current drilling and completion techniques for vertical wells, deliverability is sub-economic.

The range of recovery factors and resulting recoverable resource is based on a conceptual 160-acre horizontal development concept and is shown in Table 6. It is important to note that the recovery factor range reflects the uncertainty on interpretation of dynamic reservoir properties from one production test which, being an early-stage exploration well is recognised as being far from optimal.

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2.3 Holder's Opinion on Commerciality

On the basis of the vertical well test deliverability, QGC cannot demonstrate a commercially viable project in ATP 645 at this time and as such is making this and four associated PCA applications over the tenure.

QGC asserts that, although not currently viable, the PCA area is potentially commercially viable within a timeframe of 15 years, and this can be demonstrated through execution of the ATP 645 LWP and the proposed PCA evaluation program (in support of the ATP LWP) to address the key aspects of this large but challenging resource. Some development enablers are:

- Significant in-place resource base;
- Encouraging seismic attribute support for reservoir characterisation across ATP 645 and beyond;

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- Proximity to infrastructure given location near to existing Roma Shelf production facilities; and
- Strong demand side support, including potential smaller local domestic demand for initial development, larger East Coast domestic demand for larger development, and LNG scale demand.

The key challenges that will impact commercialisation are routine to petroleum development and will be addressed as part of the proposed ATP LWP and PCA evaluation program. These include:

- Reservoir characterisation;
- Sustained well deliverability and well cost;
- Development cost and scale;
- Utilisation of existing infrastructure; and
- Commercial aspects, such as co-ordination with neighbouring tenure holders or as part of combined development to give sufficient scale.

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2.3.1 Methodology for Assessing Commerciality

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2.3.2 Assessment of Commerciality

The results of the economic analysis show that should delineation of the resource estimated in Section 2.2.3 be successful, and with the development concept outlined above with assumed capex profiles, ATP 645 has the potential to contain commercial hydrocarbons.

Figure 12 shows a key outcome of the analysis with total project resources plotted against Value-to-Investment Ratio (VIR), a critical investment decision criteria, for the three price scenarios (base, high and low). sch4p4(7)(1)(c) Business/commercial/prof

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It shows that at base and high price outcomes, a development of the Overston 3D area would be economic and beyond that, a development of wider ATP 645 would be commercial at all assumed prices.

A key consideration is the minimum economic field size that is required to yield a commercial development. sch4p4(7)(1)(c) Business/commercial/professional/financial affairs sch4p4(7)(1)(c) Business/commercial/professional/f. With price being a key uncertainty over the timeframe of these developments, this analysis demonstrates the need to maximise the appraisal area to maximise the chances of realising a commercial development. This is the underlying rationale for applying for PCA 1-4 applications as individual PCA areas limited to 75 sub-blocks would be highly unlikely to yield a minimum economic field size on a standalone basis.

To mature ATP 645 into an economic project, it will be required to:

1) Confirm extent of the resource and calibrate reservoir parameters over the maximum possible area;
2) Optimise the drilling and completion techniques deployed to realise the modelled type curves; and
3) Demonstrate ability to execute project within capex profile assumptions in the economic analysis.

Addressing these considerations forms the basis of the ATP 645 LWP and the evaluation program in this PCA, along with integration of ongoing work in the wider BTPA and third-party tenements.

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There is also additional upside with potential for acquisition of additional resources through winning acreage release tenders, or investigating potential

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collaboration opportunities with adjacent or nearby other operators to improve development economics. These activities will also form part of the evaluation program.

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3 Evaluation Program

Shell proposes a 15-year PCA evaluation program focused on addressing the main challenges of the resource contained in ATP 645 (including the PCA 3 (ATP 645) area), described earlier in this application.

The evaluation program is in support of delivering the ATP 645 LWP for the period 1 January 2020 to 31 December 2023 and will inform future LWP scope. Separately, but giving oblique support to this program, it is recognised that this work has the added value of potential to inform, and to be informed by, evaluation of other areas within the BTPA and in Shell non-operated ventures.

This program includes multiple elements, some of which are discrete and can be proposed against a time line, (such as an update to the geological model) and some which are ongoing through the course of the entire period (such as monitoring commercial and market conditions). With this in mind, the program put forward by Shell follows the overall rationale of a robust staged review of potential commerciality of an unconventional resource discovery in conjunction with the current and subsequent Later Work Programs, as set out in Table 9.

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Year	Activity	Estimated Expenditure per PCA ($A)
1	Review and update of geological model, reservoir characterisation and in-place gas resource.	50,000
2	Review of existing and future potential technological options, including drilling, completion, stimulation and production optimisation for input into well design and program planning.	50,000
3	Review of well and seismic results and planning for future appraisal.	50,000
4	Review of well and seismic results and planning for future appraisal.	50,000
5	Studies in support of further appraisal and front-end loading development planning.	50,000
6	Studies in support of further appraisal and front-end loading development planning.	50,000
7	Studies in support of further appraisal and front-end loading development planning.	50,000
8	Studies in support of further appraisal and front-end loading development planning.	50,000
9	Studies in support of further appraisal and front-end loading development planning.	50,000
10	Studies in support of further appraisal and front-end loading development planning.	50,000
11	Selection of development concept.	50,000
12	Define development concept and update project economic evaluation.	50,000
13	Pre-FEED engineering studies. Negotiate gas sales agreement(s).	50,000
14	Pre-FEED engineering studies. Negotiate gas sales agreement(s).	50,000
15	Pre-FEED engineering studies. Reserves certification to underpin gas sales agreements and investment decision.	50,000

Table 9: Proposed evaluation program for PCA3 (ATP 645) for a 15 year PCA term.

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4 Figures

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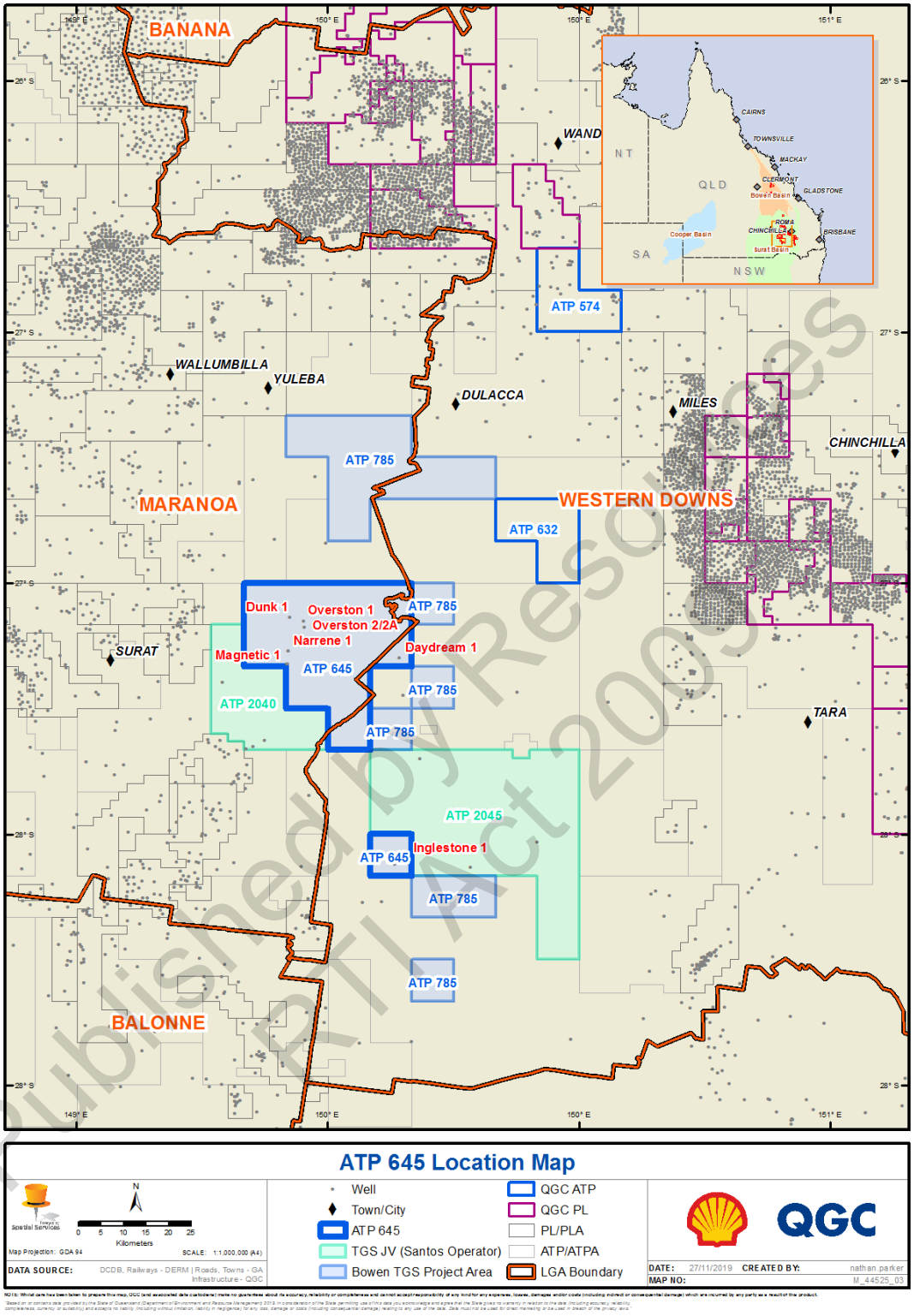

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Figure 1: Location map showing ATP 645 and other Shell interests in southern Taroom Trough.

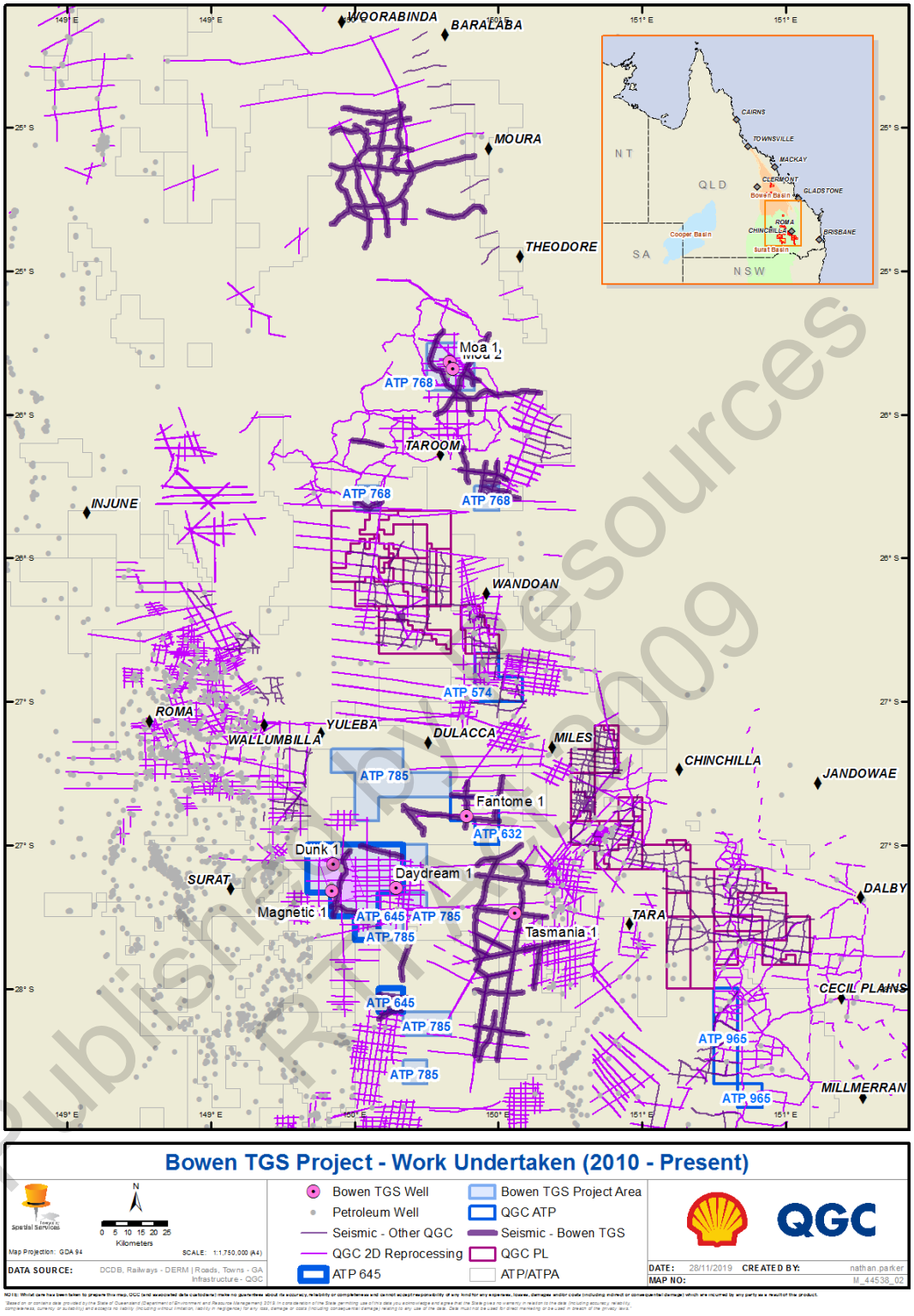

Figure 2: Summary of work undertaken as part of Bowen TGS Project, including ATP 645 since 2009.

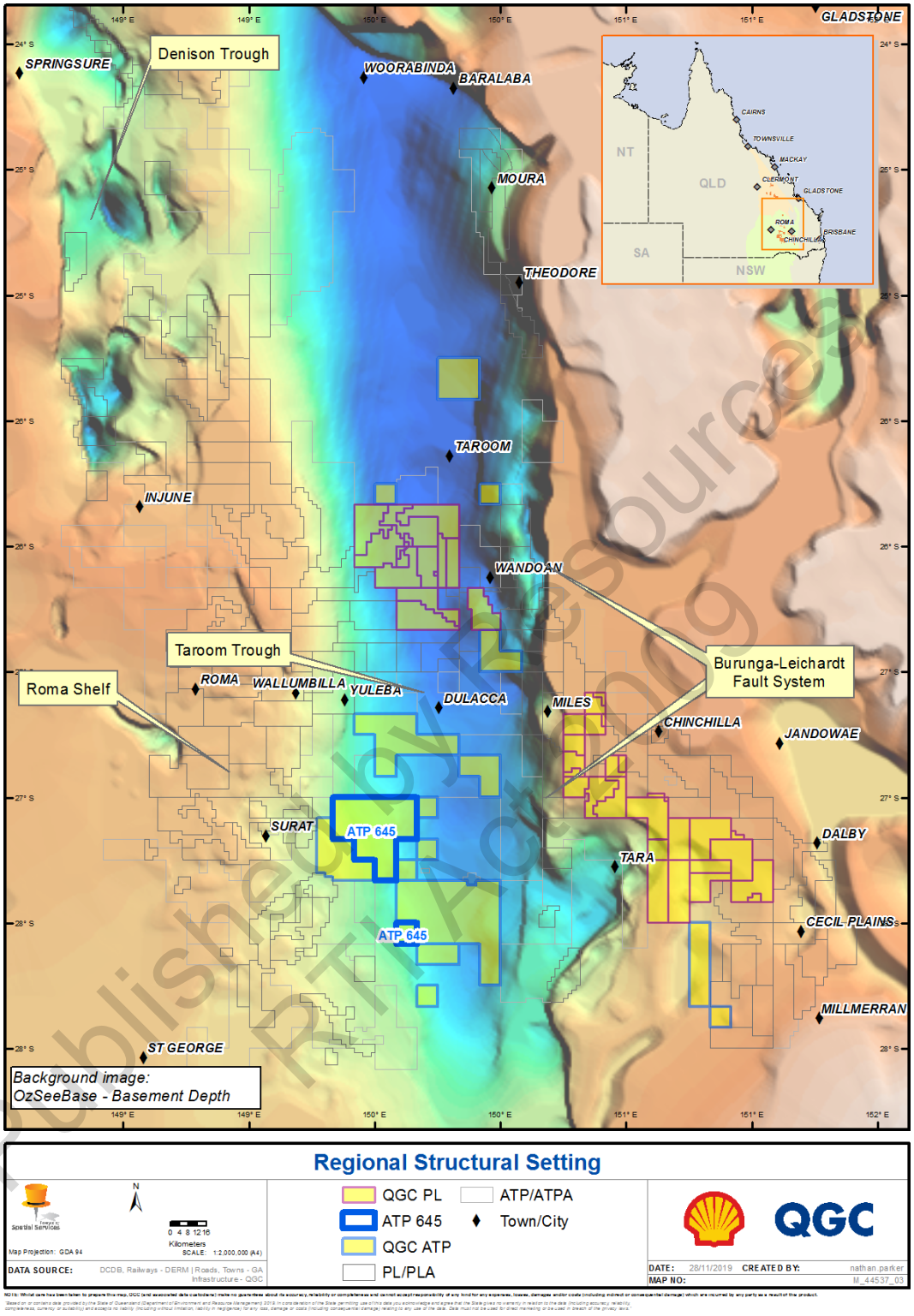

Figure 3: Geological setting of ATP 645 showing major regional features mentioned in the text.

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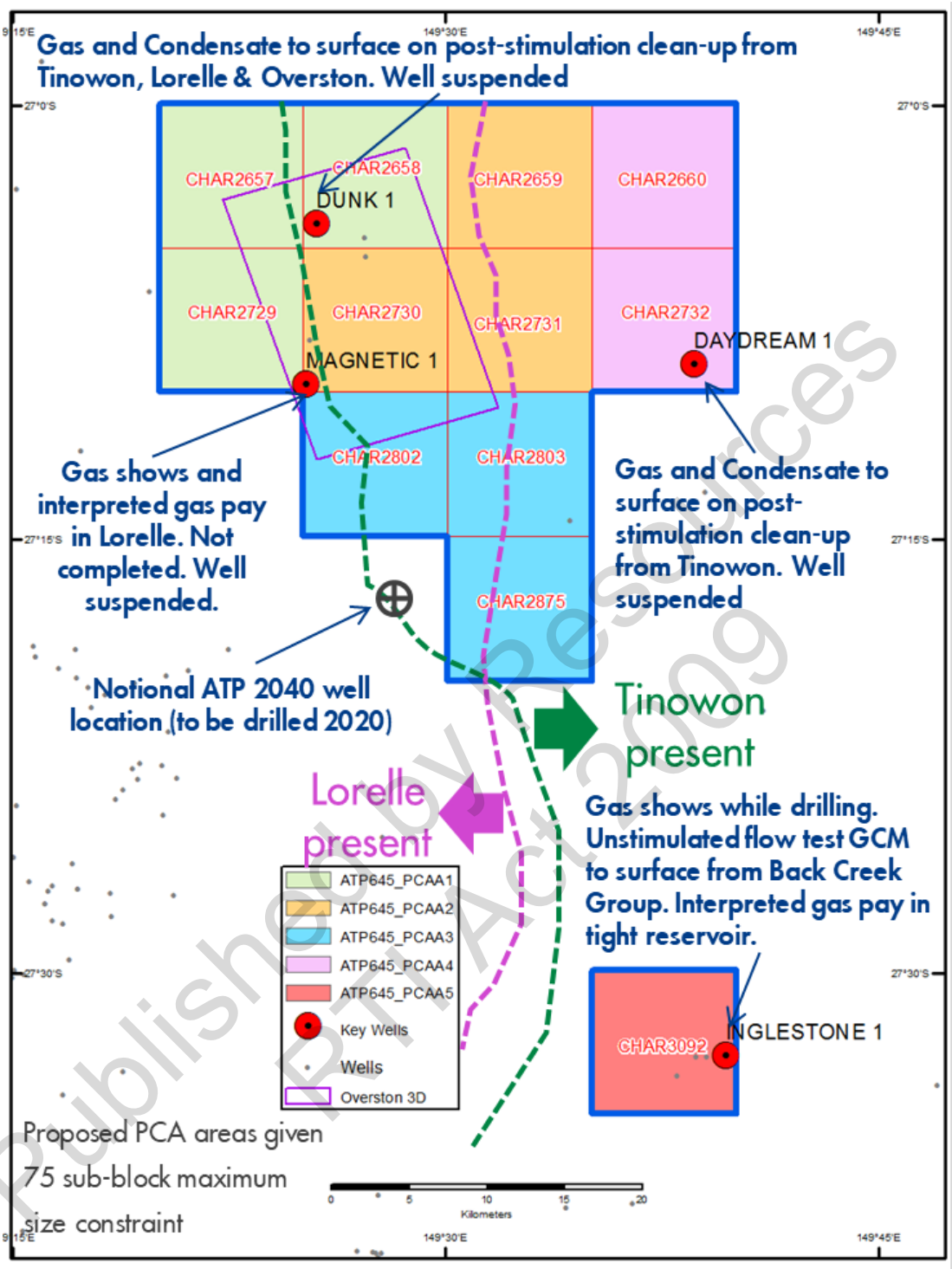

Figure 4: Area of ATP 645 to be retained showing PCA 3 in relation to other PCA applications being made over the tenure.

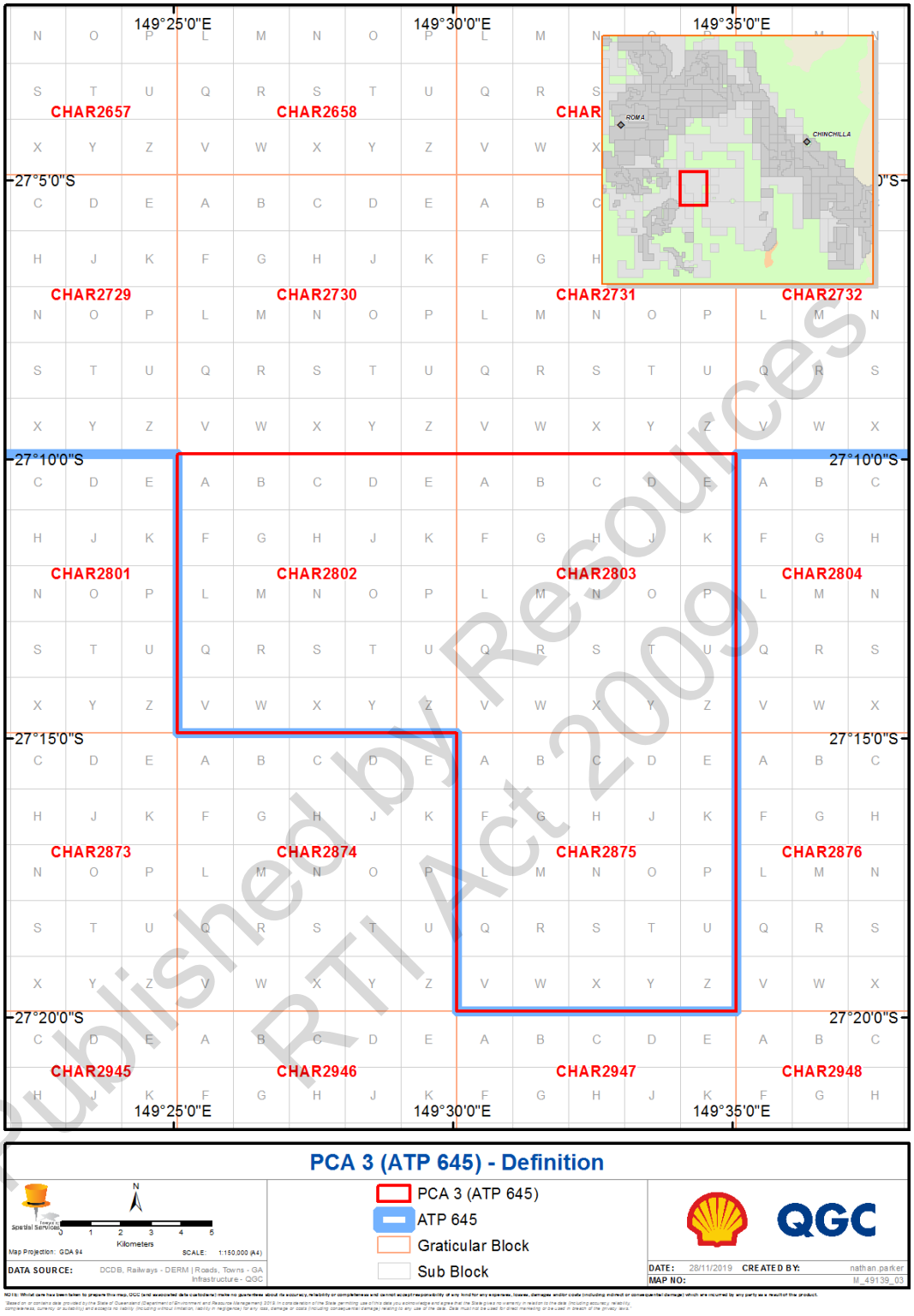

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Figure 5: Definition of PCA 3 (ATP 645) illustrating sub-blocks forming the application.

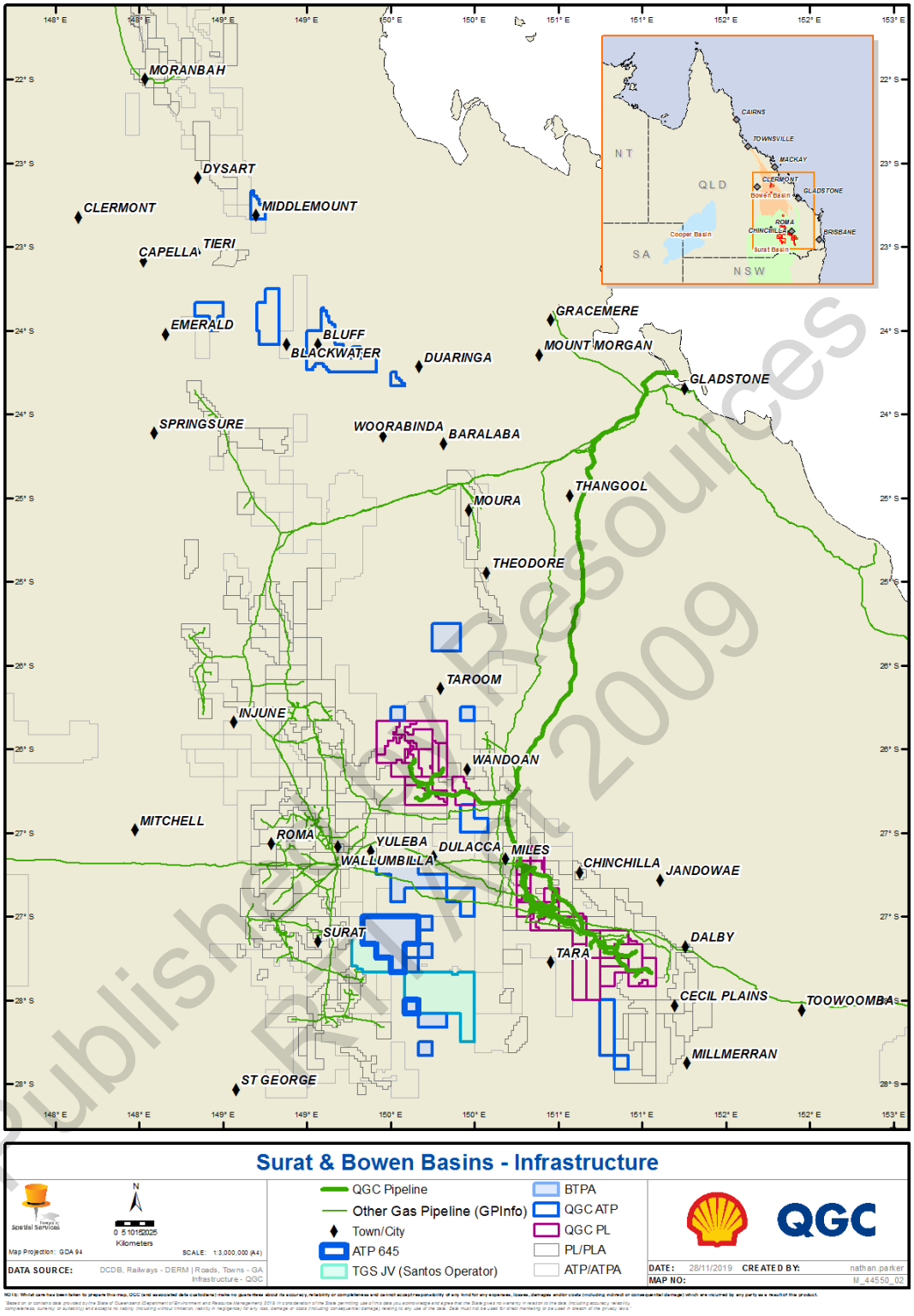

Figure 6: Surat and Bowen Basin tenure and development infrastructure in comparison to location of ATP 645.

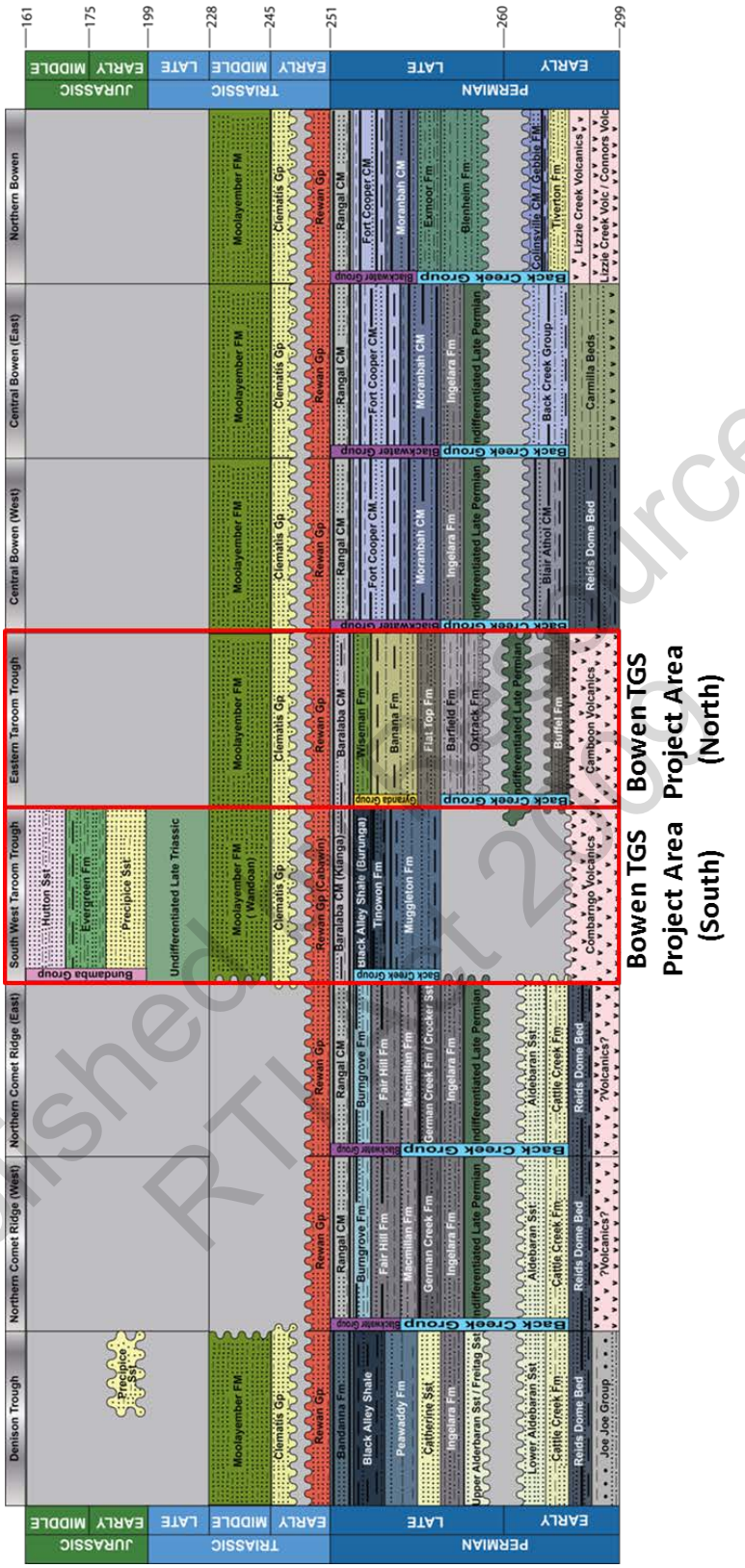

Figure 7: Stratigraphy for regions within the Bowen Basin with BTPA stratigraphy highlighted. ATP 645 is located in the south of the BTPA.

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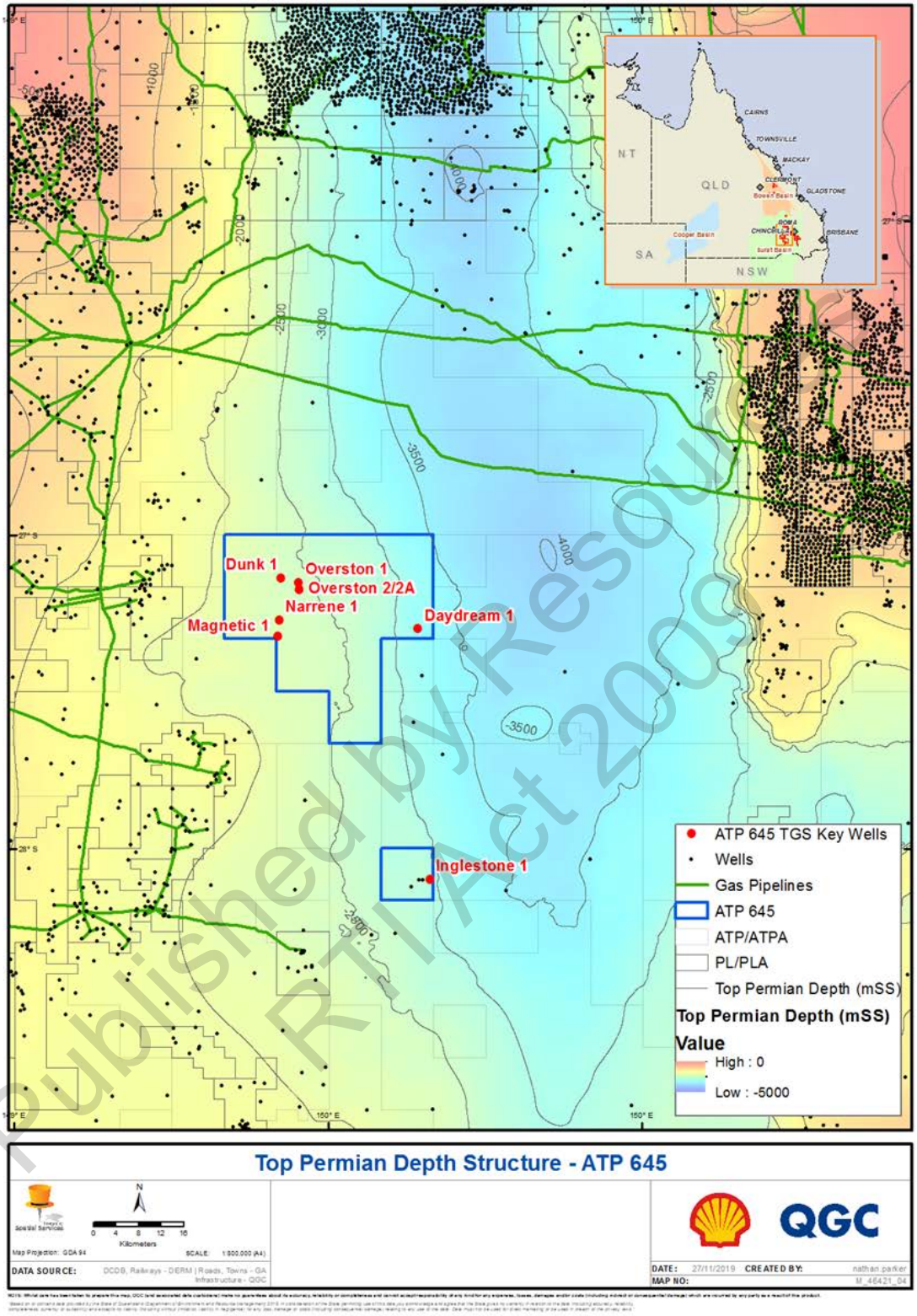

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Figure 8: Depth structure map for Top Permian (Kianga Fm) in southern Taroom Trough showing location of ATP 645.

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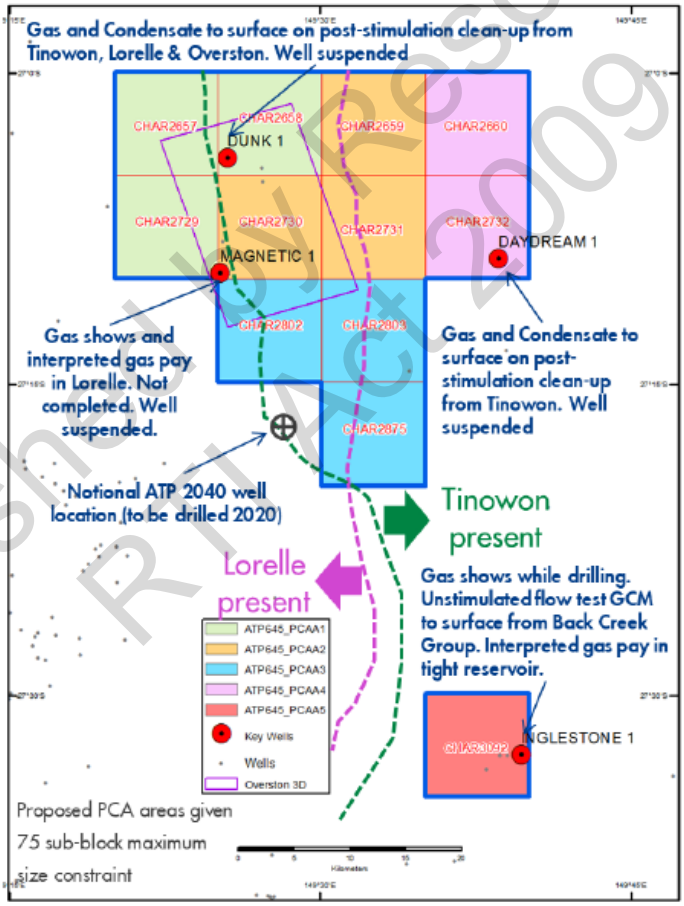
Potential Commercial Area (PCA) application – Technical Assessment

Unless otherwise stated, all references below to sections relate to the *Petroleum and Gas (Production and Safety) Act 2004 (P&G 2004)*.

Enter permit number	**PCA 10006514**
Prerequisite permit number	**ATP 645**
Applicant	**BNG (Surat) Pty Ltd**
Contact Details	

Milestone: Overview			
ATP 645 - PCA 3 project comprising 75 sub-blocks.			



Milestone: Area of proposed declaration			
1	Is the area no more than is needed to cover the maximum extent of a natural underground reservoir?	**Yes**	s.90(1)(a) and (2)
Milestone: Commercial viability			
2	Has the applicant provided details confirming:	**Yes**	s.89(4)(a) and s.231(1)(a) to (e)

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	• each natural underground reservoir in the area; • an estimate of the amount of petroleum in each reservoir; • the standards and procedures used to make the estimate; • that it is commercially viable to produce or store petroleum in the area; and • that in the holder's opinion, it will, within the next 15 years, be commercially viable to produce or store petroleum in the area.		
3	Has the applicant provided supporting data such as: • technical data relating to the geology of, and natural underground reservoirs in the area; and • market and financial data relevant to the opinions.	**Yes**	s.231(1)(f) and (2)(a) and (b)
4	Should the Minister be satisfied that petroleum production or storage in the area to be declared, is not, and will not soon be, commercially viable, but is likely to be viable within 15 years?	**N/A**	s.90(1)(b)
Milestone: Compliance with relevant ATP			
5	Has the work program of the relevant authority to prospect been substantially complied with?	**N/A**	s.90(3)
Milestone: Evaluation program			
6	Has the applicant provided an appropriate program of work to evaluate the potential for petroleum production or storage and associated market opportunities?	**Yes**	s.89(4)(b)
Milestone: Term of declaration			
7	Is the declaration for 15 years?	**Yes**	s.92(1)
8	If NO, does the shorter period consider the following: • when any petroleum discovery was made; and • any commercial viability report or independent viability assessment for, or that includes, the proposed potential commercial area.	**N/A**	s.92(2)
Recommendation			
Recommend accepting.			
Technical Assessment Officer Name: Andrew McNamara Designation: Geologist Date: 2/12/19			

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