ASX ANNOUNCEMENT

ASX: QEM

14 October 2019

Resource Upgrade – One of the World's Single Largest Vanadium Resources

62% increase to 2,760Mt with average V2O5 content of 0.30%

- **Significant Resource Upgrade has resulted in a 62% increase in size of the Julia Creek Vanadium JORC Resource**
- **Following the Resource Upgrade, the Project now holds a 2,760Mt Vanadium JORC Resource with an average V2O5 content of 0.30%**
- **The Julia Creek Vanadium Resource now consists of 220Mt in the Indicated category and 2,540Mt in the Inferred category**
- **The Project also contains 783MMBBls of Oil in the 3C category**
- **QEM's 100% owned Julia Creek Project is now one of the largest vanadium deposits in the world**

QEM Limited ("**QEM**", the "**Company**") (**ASX:QEM**) is very pleased to announce a significant Resource Upgrade at the Company's flagship Julia Creek vanadium / oil shale project ("**Project**"), covering 249.6km^2, in the Julia Creek area of North Western Queensland, Australia. Following the Resource Upgrade, the Project now holds a 2,760Mt Vanadium JORC resource, with an average V2O5 content of 0.30%, making it **one of the largest vanadium deposits in the world.**

The Resource Upgrade has incorporated historic data from drill holes in the newly granted tenement EPM 27057 (ASX Release – 7 May 2019), in addition to the data from the recent 26km 2D seismic survey data completed in May 2019 (ASX Release - 7 May 2019), and seven recently cored holes by QEM (two holes in 2018 and five holes in 2019).

QEM Executive Director, David Fitch, commented: "This resource upgrade is a huge development for the Company, making the Julia Creek vanadium resource one of the largest vanadium deposits in the world. With such a significant resource, we are continuing our metallurgical test work to identify and develop the most efficient and cost effective way to extract saleable products from the project, in the form of vanadium pentoxide, transport fuels and potentially hydrogen."

"QEM is highly committed to providing Innovative Energy Solutions, and we look forward to further advancing the flagship Julia Creek vanadium / oil shale project over the coming months."

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Table 1: Summary of JORC Mineral Resource Estimate

Total										
Resource Class	**Strat. Unit**	**Mass (Mt)**	**Average Thickness (m)**	**Insitu Density (gm/cc)**	**V2O5 (wt%)**	**Cu (ppm)**	**Mo (ppm)**	**Ni (ppm)**	**Zn (ppm)**	**Al (ppm)**
Indicated	CQLA	73	3.16	2.27	0.25	155	138	123	780	4752
	CQLB	67	2.97	2.24	0.28	182	168	142	890	5706
	OSU	40	1.94	2.08	0.33	223	153	191	1087	55317
	OSL	38	1.87	2.11	0.32	199	149	184	1015	55009
Sub-total		**220**								
Inferred	CQLA	687	2.57	2.28	0.23	154	139	121	819	2854
	CQLB	874	3.33	2.15	0.38	220	221	201	1184	5323
	OSU	504	2.01	2.11	0.30	232	147	188	1148	62477
	OSL	481	1.98	2.13	0.29	212	134	171	1058	60316
Sub-total		**2,540**								
Total		**2,760**		**2.18**	**0.30**	**201**	**166**	**170**	**1043**	**26100**

Note: 1. The estimate uses a minimum cut-off of 0.2% V_2O_5 for the oil shale units, and minimum cut-off of 0.15% V_2O_5 for the Coquina units.
2. The total resource tonnage reported is rounded to reflect the relative uncertainty in the estimate categories and component horizons may not sum correctly.

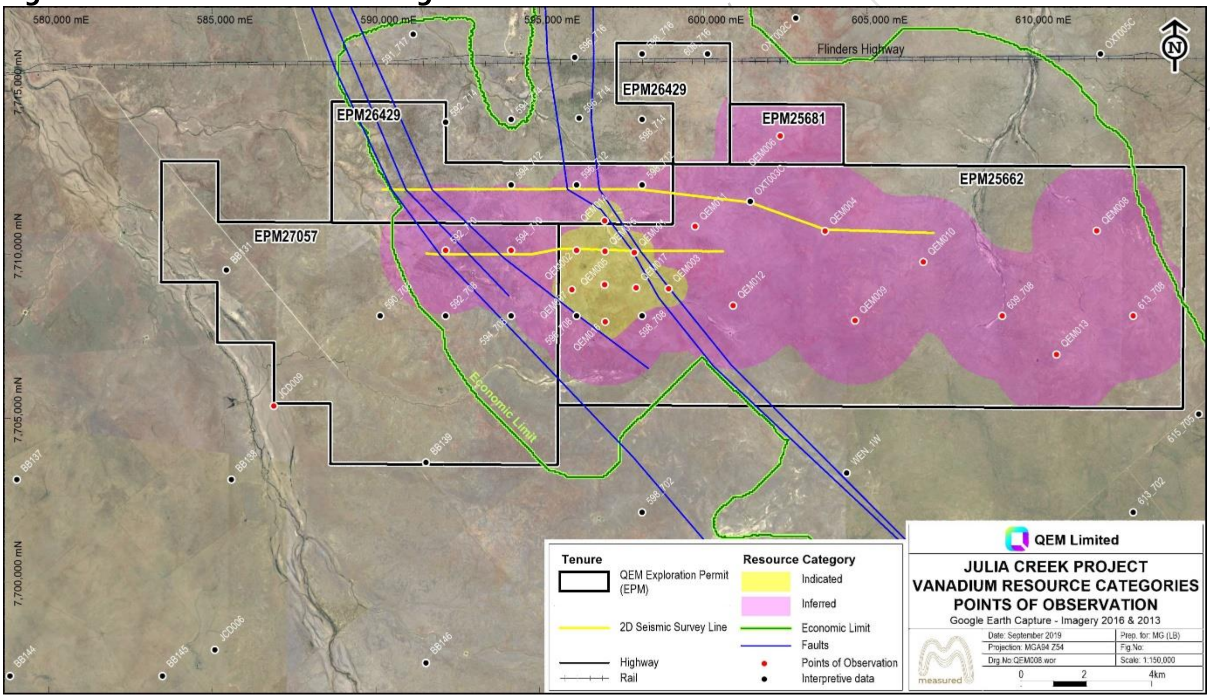
Table 2: Summary of SPE-PRMS Contingent Oil Resource

Total					
Strat.Unit	**Mass (Mt)**	**Average Thickness (m)**	**Oil Yield (L/tonne)**	**MMBarrels (insitu-PIIP)**	**MMBarrels 3C**
CQL	1,701	5.93	44	446	401
OSU	544	2.01	72	231	208
OSL	518	1.97	63	193	174
TOTAL	**2,760**		**53**	**870**	**783**

Note: 1. The total resource tonnage reported is rounded to reflect the relative uncertainty in the estimate and component horizons may not sum correctly.

2. The estimated (unrisked) 3C Contingent Oil Resource of 783 MMbbls is derived from the PIIP using a 0.9 recovery factor and is contained within Oil shale in the 2,760Mt of the Mineral Resource estimate. There are no 1C or 2C resources as the points of observation (drill hole spacing and composite intervals) of oil shale grade is insufficient to place reliable confidence on both grade and thickness continuity required for 1C or 2C resources.

Figure 1: Resource Area and Categories



Listing rule 5.8.1 information is set out below in respect of the vanadium Mineral Resource estimate:

- Geological interpretation sourced from historical mapping, drill cores, geophysical logs, 26km of 2D seismic and assays results.
- Sampling techniques were selected by lithological and geophysical boundaries which were crushed to 2mm and placed in vacuum sealed bags before sending off for analysis
- Drilling technique used was 4C core (100mm) rotary drilled on air.
- Criteria for classification has a minimum spacing between points of observation has been set to 4000m for the inferred category, and 1200m for the indicated category, based on ranges derived from variography.
- Sampling analysis were prepared by Mitra PTS for Oil using Modified Fisher Analysis completed by ALS and metals using ICP assay method completed by Bureau Veritas.
- Estimation methodology used were grid cell sizes of 20 m for the topographic model, 50 m for the structural model and 400 m for the quality model. Ordinary Kriging has been used for interpolation of V2O5 wt%. Linear interpolation (Inverse Distance power 1) was used for other grade parameters including oil grade parameters.
- A cut-off of 0.2 V2O5 wt% was used for the Vanadium resource in the Oil Shale units, and a cut-off of 0.15 V2O5 wt% was used for the Coquina Units.
- Mining parameters used a sale price of V2O5 at $8.50 USD/lb
- Metallurgical parameters incorporated processing study results showing beneficiation from floatation, wave tables, upflow classifier and Petroteq processing. This is considered a reasonable basis for eventual economic extraction.

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The vanadium Mineral Resource and oil shale Petroleum Resource are hosted by, and co-located within, the Toolebuc Formation and previous work confirms there exists a strong positive correlation between vanadium and oil grade.

At this stage, however, there has been insufficient work completed by the Company to confirm that both the vanadium Mineral Resource and oil shale Petroleum Resource can be recovered from the same ore material (i.e. host rock). As previously announced, the Company is assessing several processing options and technologies to identify the optimum methodology for the recovery of vanadium and oil, in addition to any other potential base metal bi-products (Cu, Mo, Ni and Zn).

As a result, the vanadium Mineral Resource and oil shale Petroleum Resource reported above must stand on their own. Further, it should not be assumed that both resources are currently able to be recovered from the same ore material

About QEM

QEM Limited (ASX:QEM) is a publicly listed company which is focussed on the exploration and development of its flagship Julia Creek Project, cover 249.6km^2 in the Julia Creek area of North Western Australia.

The Julia Creek vanadium / oil shale project is a unique world class resource with the potential to deliver innovative energy solutions, through the production of energy fuels and vanadium pentoxide. QEM strives to become a leading producer of liquid fuels and in response to a global vanadium deficit, also aims to become a global supplier of high quality vanadium pentoxide, to both the nascent energy storage sector and the Australian steel industry.

This globally significant JORC (2012) Mineral Resource of 2,760 Mt @ 0.30% V2O5 is one of the single largest ASX listed vanadium resource and represents a significant opportunity for development.

The tenements form part of the vast Toolebuc Formation, which is recognised as one of the largest deposits of vanadium and oil shale in the world and located less than 16km east of the township of Julia Creek. In close proximity to all major infrastructure and services, the project is intersected by the main infrastructure corridor of the Flinders Highway and Great Northern Railway, connecting Mt/ Isa to Townsville.

For Further Information

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Competent Person and Qualified Evaluator Statements

The information in this report that relates to Mineral Resources for the Julia Creek Project is based on and fairly represents information complied and reviewed by Mr. Lyon Barrett, who is a Member of the Australasian Institute of Mining and Metallurgy and is a Principal Geologist employed by Measured Group Pty Ltd, independent consultants to QEM.
Lyon Barrett has more than 20 years' experience in the estimation of Mineral Resources both in Australia and overseas. This expertise has been acquired principally through exploration and evaluation assignments at operating mines and exploration areas. This experience is more than adequate to qualify him as a Competent Person for the purpose of Mineral Resource Reporting as defined in the 2012 edition of the JORC Code. Mr Barrett consents to inclusion of the resource estimate and supporting information in the form and context in which they are presented in the announcement.

The information in this announcement that relates to Contingent Resources for the Julia Creek Oil Shale Deposit is based on and fairly represents information compiled by Mr Graham Pope, in accordance with Petroleum Resource Management System guidelines. Mr Pope has a BSc (Applied Geology) and MSc and is a Member of the Australian Institute of Geoscientists, Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Petroleum Exploration Society of Australia, he has more than 30 years' experience in the exploration, development, assessment and evaluation of oil shale deposits and is a qualified person as defined under the ASX Listing Rule 19.12. Mr Pope is an exploration consultant, Brisbane, Australia and is independent of QEM Ltd. Mr Pope consents to the inclusion in this announcement of the matters based on his information in the form and context in which is appears.

The estimates of Mineral Resources and Contingent Resources for the Julia Creek Project presented in this announcement have been carried out in accordance with the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" (2012 Edition) and SPE Guidelines for Application of the Petroleum Resources Management System respectively.

Appendix A: JORC Code, 2012 Edition – Table 1

Section 1 - Sampling Techniques and Data

Criteria	JORC Code Explanation	Details
Sampling techniques	• *Nature and quality of sampling (eg cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.* • *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* • *Aspects of the determination of mineralisation that are Material to the Public Report.* • *In cases where 'industry standard' work has been done this would be relatively simple (eg 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse*	Sampling and testing conducted by contract geologists during the 2015 drilling campaign is described below: Testing took place on the Toolebuc Formation which is the target formation. Cored intersections of the target formation were sampled in 0.5 m sections except where samples were terminated against sharp contacts between sedimentary units. All samples were double bagged on site. Samples were assigned individual sample numbers and accompanied by a sample advice sheet. Half cores were delivered to ALS Coal Division laboratory in Townsville Queensland for weighing, crushing, splitting and testing. Sampling was extensive, with standard tests for all samples including: • And contingent Resource Total Moisture; • Inherent Moisture; • Ash Content; • Volatile Matter; • ICP-AES analysis. ICPAES analysis included a suite of 33 elements, the important ones from the projects prospective being Ca, Cu, Mo and V. Combined samples selected following the above assays: • Modified Fischer Assay Industry standard coring (4C) and sampling methods have been used. Sample representivity was ensured by careful observation of the core by a trained geologist during sampling in order to ensure that samples do not cross unit boundaries and by recording and tracking core recoveries. During the 2018 and 2019 drilling campaign, sampling and testing was carried out by QEM staff geologists. A similar procedure was followed for sampling and analysis, except that the stage 1 analysis step was skipped, and the samples were combined into the relevant units (CQU, CQLA, CQLB, OSU and OSL) prior to Proximate Analysis and ICP.

Criteria	JORC Code Explanation	Details
	gold that has inherent sampling problems. Unusual commodities or mineralisation types (eg submarine nodules) may warrant disclosure of detailed information.	Sampling and testing of the Oxton Downs drillholes; OXT002C, OXT003C and OXT005C was conducted in 1981 by Pacific Coal Pty Ltd is described below: In general, all of most of the Toolebuc Formation was sampled as well as the top two meters of the Wallumbilla Formation. Samples of the Allaru Mudstone were also taken in the OXT005C drillhole. All retrieved core was sampled (whole core) on site and packed into polythene bags. Sample divisions were based on lithological variations. Maximum sample length was limited to two meters. Samples from OXT002C and OXT003C were send to ACIRL Rockhampton to be Fischer assayed, while samples from OXT005C were sent to ACIRL at Dinmore. Sampling preparation and analysis carried out by CSR Ltd is described below: Where possible cores were sampled at regular two-metre intervals with sample lengths shortened locally to coincide with lithological contacts. Whole core samples were placed in polythene bags and sent to ALS in Brisbane, where the entire core sample crushed and processed. Left over sample not used in the Fischer Analysis was stored as a standard sample for control purposes. Check assays were carried out by Tosco Laboratories in the USA as well as ACIRL in Rockhampton. All three laboratories used the Modified Fischer Retort Method as outlined in Report R.1. 4477 of the United States Bureau of Mines.
Drilling techniques	• *Drill type (eg core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (eg core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).*	2015 drilling programme involved the drilling of 10 drillholes across the tenements. These varied in depth from 72 m (drillhole QEM002) to the deepest hole at 120 m (QEM004), drilled during August 2015. drilling was completed by rotary core drilling, using 4C (100mm) core. The drill diameter for the chipped section of the hole was 124 mm where PCD bit was used for chipping. 2018 QEM commissioned two 4C drill holes (100 mm) core, with non-core sections drilled using 124 mm PCD bits for the dual purpose of infill drilling and to supply material for processing studies. 2019 QEM commissioned five 4C drill holes (100 mm) core, with non-core sections drilled using 124 mm PCD bits for the dual purpose of infill drilling and to supply material for processing studies. drill holes were geological logged on site, photographed, geophysically logged and surveyed. Cores were labelled and boxed before sending off to

Criteria	JORC Code Explanation	Details
		the Laboratory for analysis. The total cumulative drilling was 536m for all seven holes. ling of the Oxton Downs holes commenced on 28th October 1981 and was completed on 18th November the same year. holes were drilled open to the top of the Toolebuc Formation using water injection or air circulation methods and then cored through the Toolebuc Formation. The weathered section of the Allaru Mudstone was cased off with 125mm diameter PVC. A total of 17 partly cored holes were drilled, all of which intersected the Toolebuc Formation. Prior to this drilling, CSR Ltd drilled 16 holes within the confines of the current project extent. Each borehole was drilled open through the Allaru Mudstone at 115mm diameter. A 65mm core was then obtained for the remainder of the hole through the Toolebuc Formation and into the Ranmoor shales.
Drill sample recovery	• *Method of recording and assessing core and chip sample recoveries and results assessed.* • *Measures taken to maximise sample recovery and ensure representative nature of the samples.* • *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.*	Core loss has been documented in the field during logging and sampling of core. Calculations have been performed to accumulate total core loss over the sampled interval. The core recovery from the entire Julia Creek Project is >90%. Detailed records have been kept of core recoveries which have allowed for analysis of the influence of core recovery on quality during resource estimation.
Logging	• *Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.* • *Whether logging is qualitative or quantitative in nature. Core (or costean,*	Detailed logging of chips and core was conducted. Chips and core photographs were taken as well. All cores were geologically logged, marked and photographed. Final drill logs include information on detailed lithological logging of the drill core, geophysical logging, core recoveries, quality and the initial interpretation in terms of stratigraphy. All drillhole logs were corrected to down hole geophysics. The detail contained in these logs is considered sufficient for the purpose of resource estimation.

Criteria	JORC Code Explanation	Details
	channel, etc) photography. • *The total length and percentage of the relevant intersections logged.*	
Sub-sampling techniques and sample preparation	• *If core, whether cut or sawn and whether quarter, half or all core taken.* • *If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.* • *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* • *Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.* • *Measures taken to ensure that the sampling is representative of the in-situ material collected, including for instance results for field duplicate/second-half sampling.* • *Whether sample sizes are appropriate to the grain size of the material being sampled.*	No sub-sampling of the core has been carried out. All QEM core samples were double bagged on site and transported to the laboratories for testing. The labs, ALS and Mitra PTS, comply with Australian Standards for sample preparation and sub-sampling. All samples were subjected to a coarse crush and fine crush. The coarse crush size was -6mm for 70% of the sample. Samples were riffle split into 5 Kg portions. One 5 kg portion was stored and the other 5 Kg portion was subjected to fine crush. Fine crush was -2mm for 70% of the sample. The fine crushed 5 kg portion was split into 2.5 kg portions - one for the proximate analysis and the other for ICP-AES analysis. For the 2015 drilling programme, the proximate analysis was done at ALS Gladstone division and ICP-AES done at Townsville division. For the 2018 and 2019 drilling programmes, ICP-MS and ICP-AES were conducted by Bureau Veritas. For the 2015 drilling programme, following proximate analysis, Gladstone used remaining sample, combined by length density weighting into sedimentary units as instructed by contract geologists, for Modified Fischer Analysis (MFA). For the 2018 and 2019 drilling programmes, sample combination was not required before MFA testing, as original sampling was done to the lithological units. In each case of the CSR Ltd boreholes the entire core was collected for assay and sent to ALS in Brisbane. The entire core sample was: crushed in a 150 mm jaw crusher set at a nominal 50 mm opening subsampled by riffling air dried at 50 degrees centigrade reduced to minus 2 mm by further crushing in a 50 mm jaw crusher set at a nominal 6 mm opening riffled down further to about 500 gm sub-sample homogenised, rolled and dip samples to approximately 100 gm for Fischer Analysis

Criteria	JORC Code Explanation	Details
		remainder of sample was stored as a standard sample. Check assays were carried out by Tosco Laboratories in the USA as well as ACIRL in Rockhampton. All three laboratories used the Modified Fischer Retort Method as outlined in Report R.1. 4477 of the United States Bureau of Mines.
Quality of assay data and laboratory tests	• *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* • *For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* • *Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established.*	ALS Minerals and Geochemistry Laboratory (ALS Townsville and ALS Gladstone laboratory in Queensland) and Mitra PTS adhere to internal QAQC and inter-laboratory QAQC checks. All determinations performed adhere to the American Society for Testing and Materials (ASTM) guidelines. ALS and Mitra PTS comply with ASTM standards for all ore quality tests and are certified by the National Association of Testing Authorities Australia (NATA). ALS laboratories and Mitra PTS are regularly benchmarked by external auditors against the highest professional laboratory standard – ISO 17025. Accreditation to this standard provides assurance that the laboratory systems are robust and maintained at world-class level. Weatherford Wireline Services and Borehole Wireline Pty Ltd performed all downhole geophysical logging. Down hole sample spacing for all tools is 1 cm. Density, gamma, calliper, sonic, verticality and resistivity tools were run. Weatherford wire line services and Borehole Wireline Pty Ltd are ISO9001 certified and use numerous Quality Control procedures, from the set-up and calibration of down hole tools to the final delivery of client data.
Verification of sampling	• *The verification of significant intersections by either independent or alternative company personnel.* • *The use of twinned holes.*	Verification of assay data was performed by means histograms of sedimentary unit composites constructed to check for outliers. No outliers were found. Once imported into MineScape gridded assay values were visually inspected to check for anomalies. The first two 2015 holes drilled (QEM001 and QEM002) were drilled adjacent to old CSR holes (597.8_709.9 and 596_710). Intersection depths for

Criteria	JORC Code Explanation	Details
	• *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* • *Discuss any adjustment to assay data.*	the top of the Coquina agreed with CSR holes to within 1 m. Although, total thickness of the Toolebuc did differ by between 10% and 20%, when the CQU unit is discarded (as it is from the resource) the remaining thickness of the Toolebuc Formation matched the historical holes to within an acceptable margin. All results received from the laboratories were supplied in elemental format (ppm). As the Vanadium price is quoted according to the concentration of the oxide (V_2O_5), assay data in V ppm was converted to wt% oxide prior to importing into the Geological database. The ppm value was firstly divided by 10 000 to convert to wt%. The wt% of the element (V) was then multiplied by 1.7852 to convert to wt% V_2O_5.
Location of data points	• *Accuracy and quality of surveys used to locate drillholes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* • *Specification of the grid system used.* • *Quality and adequacy of topographic control.*	A differential GPS survey of all collars has been conducted upon completion of drilling by registered surveyors, M.H.Lodewyk Pty Ltd. The grid system used is MGA 94 Zone 54. Old drillhole coordinates are in AMG 84/66 Zone 54 and were transformed into MGA 94 Zone 54 prior to importing into the database. The topography surface was generated from SRTM Worldwide Elevation Data (3-arc-second or 90 m resolution). Although the absolute resolution of the elevation data is low, it is internally consistent, i.e. the degree of departure of elevation from the true elevation within a given area is consistent throughout the data set. This provides an opportunity to calibrate the SRTM data with the more accurate surveyed collar positions. It was noted that the SRTM data shows a consistent +4 m bias compared to the elevation of the surveyed collar position at the 17 drillhole locations. To correct for this bias the SRTM xyz data was adjusted by subtracting 4 m from each SRTM data point z coordinate.
Data spacing and distribution	• *Data spacing for reporting of Exploration Results.* • *Whether the data spacing and distribution is sufficient*	Data spacing is sufficient to establish continuity in both thickness and quality. Sedimentary unit composites of quality have been used in resource estimation.

Criteria	JORC Code Explanation	Details
	to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied. • *Whether sample compositing has been applied.*	
Orientation of data in relation to geological structure	• *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* • *If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	Composites used, therefore orientation of sampling not seen to introduce bias as all drilling is sub-vertical and sediments gently dipping. No bias introduced by orientation of drillholes – MineScape, the 3D modelling software used, takes into account the orientation of the layers in relation to the drilling and determines both true and vertical thickness.
Sample security	• *The measures taken to ensure sample security.*	Sample security was ensured under a chain of custody between QEM and Contract personnel on site and the laboratories.
Audits or reviews	• *The results of any audits or reviews of sampling techniques and data.*	No audits of sampling etc. done however a comprehensive set of internal company procedures exist and have been adhered to.

Section 2 - Reporting of Exploration Results

Criteria	JORC Code Explanation	Details
Mineral tenement and land tenure status	• *Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* • *The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area.*	Julia Creek Project covers EPM 25662, EPM 25681 EPM 26429 and EPM 27057. When combined, these leases cover a total area 249.6 km². A digital version of these concession boundaries were downloaded by Measured from the Queensland Government Department of Natural Resources and Mines website.
Exploration done by other parties	• *Acknowledgment and appraisal of exploration by other parties.*	In 1981 CSR Ltd. drilled a series of exploration holes within the current QEM's Julia Creek project for the measurement of oil yield and Vanadium content from the Toolebuc Formation. The drillholes reached a total depth of between 46m and 161m m, intersecting the Toolebuc Formation between 35 m to 142 m.
Geology	• *Deposit type, geological setting and style of mineralisation.*	The Julia Creek Oil Shale deposit was deposited as the basal layer to the Early Cretaceous Toolebuc Formation. The Oil Shale is described as consisting of fine grained carbonate-clay-Oil Shale (Coxhell and Fehlberg, 2000). The top part of the Toolebuc Formation consists of coarse limestone rich clay-oil-shale termed as the Coquina Limestone (Coxhell and Fehlberg, 2000). The Toolebuc Formation forms part of the greater Eromanga Basin, which covers a wide structural depression within central and northern Queensland. Up to 100m of Late Cretaceous age Allaru mudstones overlie the Coquina Limestone (also part of the Eromanga Basin). Weathered mudstones and topsoil overly the fresh Allaru mudstones.

Criteria	JORC Code Explanation	Details

Drill hole Information	• *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drillholes:*
	  ○ *easting and northing of the drillhole collar*
	  ○ *elevation or RL (Reduced Level – elevation above sea level in metres) of the drillhole collar*
	  ○ *dip and azimuth of the hole*
	  ○ *down hole length and interception depth*
	  ○ *hole length.*
	• *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.*
		See appendix C.

Data aggregation methods	• *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.* • *Where aggregate intercepts incorporate*	Sample results have been composited over full sedimentary unit thickness using length and density weighting. No metal equivalents have been used.

Criteria	JORC Code Explanation	Details
	short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail. • *The assumptions used for any reporting of metal equivalent values should be clearly stated.*	
Relationship between mineralisation widths and intercept length	• *These relationships are particularly important in the reporting of Exploration Results.* • *If the geometry of the mineralisation with respect to the drillhole angle is known, its nature should be reported.* • *If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').*	The orientation of drilling/sampling (sub-vertical) is not seen to introduce any bias as all drilling is vertical and sediments mostly gently dipping.
Diagrams	• *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include, but not be limited to a plan view of drillhole collar locations and appropriate sectional views.*	See Figure 1

Criteria	JORC Code Explanation	Details
Balanced reporting	• *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.*	All exploration results pertaining to holes drilled during 2015, 2018 and 2019 drilling at Julia Creek Project have been fully documented in this report. Holes drilled previously have been reported in QDEX reports by CSR Ltd.
Other substantive exploration data	• *Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.*	Lithological logging, sampling and assay testing of the Toolebuc Formation, down hole geophysics where available in historic holes and for all QEM drilled holes.
Further work	• *The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or large-scale step-out drilling).* • *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not*	Additional detailed exploration work inclusive of additional drilling will be required to increase confidence in local estimates of tonnes and grade. Drilling will need to define the LOX line and drill the oxidised material for testing. Updated Higher resolution topography data will be required.

Criteria	JORC Code Explanation	Details
	commercially sensitive.	

Section 3 - Estimation and Reporting of Mineral Resources

Criteria	JORC Code Explanation	Details
Database integrity	• *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.* • *Data validation procedures used.*	All data relevant to previous resource estimates was provided to Measured by QEM. This data was provided in the form of Minescape tables and design files, plus a series of Excel spreadsheets, las files etc. Measured Group have created a GDB database and loaded all relevant data into that database. GDB is a proprietary database platform, provided by ABB. It includes a standard set of data validation checks which are tested during the data loading process. Any data which fails the validation checks cannot be loaded into the database. In addition to data used for previous resource estimates, a large amount of historical and regional data was also captured, loaded to the database, and validated in a similar manner. Having a reliable database as the central repository for all relevant drillhole data is a much more efficient and secure way to store and access relevant data.
Site visits	• *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* • *If no site visits have been undertaken indicate why this is the case.*	To date, no site visits have been conducted by the competent person. The competent person is however very familiar with the regional geology, having worked on many projects throughout North and Central Queensland over the previous 20 years.
Geological interpretation	• *Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.* • *Nature of the data*	The main data sources used in the estimate are the lithological logs, core photographs, down hole geophysical logging, and assays for both base metals, proximate analysis and oil yield. Confidence in the sedimentary correlations is considered high as they are based on downhole geophysics, assays and core photographs. A

Criteria	JORC Code Explanation	Details
	used and of any assumptions made. • *The effect, if any, of alternative interpretations on Mineral Resource estimation.* • *The use of geology in guiding and controlling Mineral Resource estimation.* • *The factors affecting continuity both of grade and geology.*	secondary confirmation of the interpretation is the gridded model itself which shows good continuity between data points. Therefore, the current drilling density is considered sufficient for seam thickness and quality and has been confirmed with geostatistics for the resource classifications assigned. Closer spaced drilling will be required to upgrade the degree of resource confidence.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	See Figure 1 Target for the Resource (Toolebuc Formation) extends across the entire project area. The project area is approximately 30km wide by 12km. Target horizon (Toolebuc) found at depths of between 35 m and 140 m below surface. The Toolebuc Formation is centred around a regional basement high known as the St Elmo Structure.
Estimation and modelling techniques	• *The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.* • *The availability of check estimates, previous estimates*	The FEM interpolator was used for surface elevation, thickness and trend. Ordinary Kriging has been used for interpolation of V2O5 wt%. Linear interpolation (Inverse Distance power 1) was used for other grade parameters including oil grade parameters Grid cell sizes of 20 m for the topographic model, 50 m for the structural model and 400 m for the quality model were used. No assumptions have been made regarding correlation between grade variables or selective mining units in regard to modelling techniques, however there is good evidence to suggest that high V2O5 is related to high Oil content. Both variables are related to organic matter. Visual validation of all model grids performed to ensure extreme values have not influenced any of the grids. The entire deposit is considered a single domain for each sedimentary unit in terms of unit thickness and grade.

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	and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • *The assumptions made regarding recovery of by-products.* • *Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).* • *In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.* • *Any assumptions behind modelling of selective mining units.* • *Any assumptions about correlation between variables.* • *Description of how the geological interpretation was used to control the resource estimates.* • *Discussion of basis for using or not using grade cutting or capping.* • *The process of validation, the checking process used, the comparison of model data to drillhole data, and use of reconciliation data if*	

Criteria	JORC Code Explanation	Details
	available.	
Moisture	• *Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	All tonnages have been adjusted to insitu density, using the Preston Sanders method. 6% insitu moisture has been assumed, based on values for total moisture obtained from recent drilling, and documentation from historical reports (Coxhell and Fehlberg, 2000).
Cut-off parameters	• *The basis of the adopted cut-off grade(s) or quality parameters applied.*	The Mineral Resources contained in this report are confined within the concession boundaries. No minimum thickness cut off was used for calculating resources. No oil yield cut-off was applied to the oil shale estimate. A cutoff of 0.2 V2O5 wt% was used for the Vanadium resource in the Oil Shale units, and a cutoff of 0.15 V2O5 wt% was used for the Coquina Units. The lower cutoff for the Coquina units is based on recent and historical processing studies, which show that the limestone portion of the Coquina units can be separated from the oil shale portion of the coquina units through the use of simple beneficiation techniques. This simple beneficiation can upgrade Vanadium grade up to 3.5 times.
Mining factors or assumptions	• *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not*	Open pit mining methods are envisaged. A high level pit optimisation study has been undertaken, based on production of a Vanadium product only. A sale price of $8.50 USD/lb was assumed, which is considered to be sustainable (perhaps conservative), given the high price of Vanadium over the past 3 years. Mining, processing and transport costs and parameters were built into the optimisation using estimates based on current open cut operations in the region. The study resulted in a series of shells showing positive, break even and negative margins. The negative 15% margin shell was chosen as the limit defining "reasonable prospects of eventual economic extraction". This negative margin shell was chosen, as it represents the reasonable prospect that the sale price of Vanadium could eventually improve by 7.5% and/or the cost of mining could eventually decrease by 7.5%. Although not considered in the Pit Optimisation study, it is possible that additional by-products (other than V2O5) such as oil from oil shale, other

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	always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	base metals, and cement products could be produced as part of the Vanadium processing, which may have a positive impact on revenue assumptions.
Metallurgical factors or assumptions	• *The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.*	Processing studies have recently been completed by Brisbane Met Labs (BML), CORE resources and Petrotec. The BML and CORE studies have concentrated on separation of the limestone component of the coquina from the oil shale component, using wave table and upflow classifier techniques. The Vanadium is principally contained in the oil shale component, whilst the acid consuming Calcium is principally contained in the limestone component. Results of these studies are summarised as follows: 1. Core Resources Float 5: 74% of Vanadium was recovered in 36% of the mass with a grade of 0.61% V2O5. Calcium carbonate (as indicated by Ca and total inorganic carbon assays) was rejected with only 24% recovery in FL5. 2. Brisbane Met Labs (BML) Wave table (first pass): 54% of mass went to con and 46% mass went into the combined tail. Importantly 60% of the Ca went into the con and 67% of the V in the combined tail. This was a first pass test and involved no grinding. 3. BML Float (replicating Core Resources Float): Recovered 73% of the V to the concentrate. This is in only 45% of the mass and only 36% of the Ca. 75% of the organic carbon has floated (This includes the oil rich oil shale). It does appear like the V is associated with the organic matter, Zn, Al, Cu, and Si. 4. BML Up flow classifier (Reflux): 92% V in 64% of mass

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		5. Petroteq: Extracted 65% of the oil and retained the all the metals in the residual material which is 20% of the mass. Optimisation works are still ongoing, looking at two stage processes, Upflow Classifier→Table or Upflow Classifier→Float Previously published work by CSR (CR24927) in 1973 indicated that hydrothermal leaching of Oil Shales at 340° C recovered about 12% of the Vanadium. Hydrothermal leaching at 300° C with additives sodium bicarbonate and sodium carbonate in concentrations equivalent to 5 lbs Na_2O per lb V_2O_5 showed extraction efficiencies up to 90%. CRA took up a large tenement position around Julia Creek between 1991 and 1993. CRA drilled an additional 5 holes, compiled a database and summary report on previous Oil Shale exploration (CR24927) and conducted several technical studies into potential beneficiation options for the Oil Shale deposit. CRA concluded that treating the Oil Shales for crude oil was at that stage not a viable option given that estimated best case costs of between AUD 42 – AUD 48 per barrel were around AUD 10 – AUD 16 above the then projected long term oil price at the time. Detailed metallurgical studies will be required to identify the optimum treatment methodology for the recovery of oil and Vanadium in addition to any other potential base metal biproducts (Cu, Mo, Ni and Zn).
Environmental factors or assumptions	• *Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and*	Measured has not conducted any environmental assessment in the concession area.

Criteria	JORC Code Explanation	Details
	processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	
Bulk density	• *Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.* • *The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.* • *Discuss assumptions for bulk density*	All tonnages have been adjusted to insitu density. 6% insitu moisture has been assumed, based on values for total moisture obtained from recent drilling, and documentation from historical reports (Coxhell and Fehlberg, 2000). The Preston Sanders method has been used to convert air dried density to in-situ density.

Criteria	JORC Code Explanation	Details
	estimates used in the evaluation process of the different materials.	
Classification	• *The basis for the classification of the Mineral Resources into varying confidence categories.* • *Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).* • *Whether the result appropriately reflects the Competent Person's view of the deposit.*	Resource classification is based on an assessment of the variability of critical variables (Vanadium grade, oil grade and sedimentary unit thickness) through statistical analysis, geostatistical analysis and by an assessment of the degree of geological complexity (general dip and structure). The presence of assay results for Vanadium has been set as the minimum requirement for a point of observation. Minimum spacing between points of observation has been set to 4000m for the inferred category, and 1200m for the indicated category, based on ranges derived from variography. No attempt has been made to classify the resource at measured status, at this stage of the project. Further acquisition of data (infill drilling) will be required to obtain an upgrade in confidence of the Vanadium Resource.
Audits or reviews	• *The results of any audits or reviews of Mineral Resource estimates.*	No audits or reviews of this estimate have been done to date.
Discussion of relative accuracy/ confidence	• *Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within*	The resource classification is considered to address the level of confidence in thickness and base metal/oil yield variability across the deposit on a global basis. Faults have been well defined in the indicated portion of the deposit through use of a number of techniques, including Drilling, 2D Seismic and analysis of regional topography.

Criteria	JORC Code Explanation	Details
	stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.* • *These statements of relative accuracy and confidence of the estimate should be compared with production data, where* • *available.*	

APPENDIX B: SPE-PRMS PETROLEUM RESOURCE ESTIMATE – JULIA CREEK

The SPE-PRMS estimate for the Julia Creek Oil Shale deposit was issued in September 2019. The underlying criteria and assumptions which underpin the estimate are set out in Appendix A and constraints listed below. The Contingent Resource upgrade has incorporated historic data from drill holes in the newly granted tenement EPM 27057 (ASX Release – 7 May 2019), in addition to the data from the recent 26km 2D seismic survey data completed in May 2019 (ASX Release - 7 May 2019), and seven recently cored holes by QEM (two holes in 2018 and five holes in 2019).

The Petroleum Resource estimate is based on the discovered Petroleum Initially in Place (PIIP); estimated using a stratigraphic grid model. The methodology used is a deterministic method. The estimate is based on the following constraints and data:

- Interpretation of intersected stratigraphy and assay data in 22 pre-collared cored drill holes drilled to a maximum depth of 151 metres below surface for an aggregate of 1,934 metres.
- The maximum depth for the estimate is 120 metres.
- Oil grade has been determined by modified Fischer Assay (ASTM D3940-90) on 114 core samples representing approximately 290.7m metres of cored material.
- No grade cut-off grade has been applied to the oil grade.
- The resource is contained within an elongate surface area of 139 square kilometres within Exploration Permits for Minerals 25622, 25681, 26429 and 27057.
- A recovery factor of 0.90 has been applied to the PIIP estimate based on published recovery data from a number of conventional retort technologies both operating and under development.
- The total estimate as at 30 September 2019 are entirely 3C resources. The exploration drilling spacing and composited stratigraphic intervals for sampling is not sufficient define 1C or 2C resources (Table 1). Accordingly no 1C or 2C resources are reported, future exploration may result in 1C and/or 2C estimates that being of higher confidence.

Table 1 SPE-PRMS Contingent Petroleum Resource Estimate.

RESOURCES	Area Sq.Km	1C MMbls	2C MMbls	3C MMbls
EPM 25622	105.03	-	-	578
EPM 25681	6.41	-	-	29
EPM 26429	12.72	-	-	78
EPM 27057	15.3			96
TOTAL	139.46	-	-	783

Contingent Resources are those quantities of petroleum estimated, as of the estimate date, to be potentially recoverable from known accumulations using established technology or technology under development. Commercial recovery of oil from Julia Creek shale has not been established and as such the contingent resources cannot be classified as petroleum reserves. At Julia Creek, resource development is considered unclarified or not viable based on the current immature state of knowledge of commercial recovery due to one or more of the following contingencies.

- Development requires the application and grant of a mining lease and environmental approvals from the Queensland Government based on a commercial mine and processing proposal; i.e. legal, environmental, social and governmental factors for development have not been either established or approved.
- A commercial mine and processing development has not at this time been assessed against any current and forecast economic conditions to support commercial viability. As such, no cut-off grade has been established for future commercial recovery.
- Commercial recovery is dependent on the suitability of Julia Creek oil shale to be processed in current retorting technology or technology under development.

Note: The Petroleum Resource found in the Julia Creek Project is unconventional as it is hosted as a solid hydrocarbon (kerogen) in the Toolebuc Formation oil shales. This type of Petroleum Resource is not evaluated in the same way as conventional oil and gas, and methods used to explore and estimate this style of Petroleum Resource are similar to that of a 'hard rock' Mineral Resource. Hence, the methodology for assessment and reporting the geology and exploration results of an oil shale unconventional Petroleum Resource is more akin to JORC Code, 2012, when compared to conventional oil and gas reporting.

Appendix C: Drill Hole Data

Holename	Easting	Northing	Elevation (m)	Depth (m)
589_717	588545.4263	7716840.79	129.49	88.68
590_708	590122.4028	7708175.864	130	129.7
591_717	591134.407	7716779.773	128.63	57.91
592_708	592122.3911	7708175.854	135	95.6
592_710	592122.3911	7710175.847	140	72.9
592_714	592120.3956	7714091.81	136.21	54.7
594_708	594122.3711	7708175.834	135	72.9
594_710	594121	7710175.827	140	56.4
594_712	594122.3794	7712175.81	144	46.6
594_714	594121	7714175	135.17	14
596_708	596122.3594	7708175.814	140	61.5
596_712	596122.3677	7712175.8	141	49.4
596_714	596200.3651	7714211.786	136.16	45
596_716	596066.3701	7716073.767	138.59	40.72
598_702	598122.3312	7702175.815	142	94

598_708	598122.3395	7708175.804	142	91.9
598_712	598122.3477	7712175.79	141	52.4
598_714	598122.3477	7714175.783	142	50.6
598_716	598122.3477	7716175.776	142	45.8
600_716	600122.336	7716175.776	143	59.7
609_708	609122.2628	7708175.724	143.5	86.7
613_702	613122.2229	7702175.706	150.3	94.8
613_708	613122.2312	7708175.694	147	84.7
615_705	615122.203	7705175.675	146.5	133.7
BB131	585422.4447	7709575.899	121.9	154.5
BB137	579022.4821	7703175.962	138.7	183.5
BB138	585572.4366	7703175.912	134.1	177.4
BB139	591522.3905	7703695.866	128	141.4
BB144	578812.4852	7697175.983	126.5	186.5
BB145	583472.4509	7697175.943	137.2	209.4
BB146	591522.3822	7697575.882	129.5	172.8
JCD006	585072.4416	7697975.93	134	207.5
JCD009	586872.4352	7705425.904	124	161.7
OXT002C	602822.3141	7717275.742	148	106.66
OXT003C	601422.3181	7711675.772	142	101.36
OXT005C	612122.2494	7716175.696	142	166.59
QEM001	597885.22	7710104.42	139.33	90
QEM002	596122.23	7710174.63	139.89	72
QEM003	598926.75	7709002.55	140.14	79.15
QEM004	603710.49	7710765.38	151.03	120
QEM005	596976.27	7709123.7	141.42	79
QEM006	602341.49	7713669.43	148.52	114
QEM007	595976.84	7708972.07	140.55	78
QEM008	612012.51	7710771.56	143.1	96
QEM009	604630.41	7708033.64	150.73	108
QEM010	606710.69	7709818.82	144.48	102
QEM011	599744.72	7710909.29	139.72	90
QEM012	600902.2	7708493.37	146.4	108
QEM013	610783.17	7706998.07	148.22	96
QEM014	596978.19	7711082.97	136.28	66
QEM015	596986.8	7710142.57	138.47	75
QEM016	596993	7707990.01	140.77	75
QEM017	597941.96	7709036.66	141.59	84
WEN_1W	604372.2937	7703375.761	147	104
WEN_2E	610622.2396	7701575.718	152	104