Further information from Graeme Sawyer relating to my previous evidence.

Summary

This information is provided in follow up to my previous correspondence relating to raw data from the monitoring bores in the Beetaloo basin and subsequent information revealed by our research and communication with the NTG since the inquiry hearing in Darwin. As we get more information my concerns are escalating that problems are not being revealed and are in fact being hidden from the public.

We are aware of correspondence between the industry and government that seems to have led to watering down pepper recommendations and no explanation that actual fit the evidence have been provided to the community. As an example it is acknowledged in the answers to written questions from MLA Yingia Guyula and correspondence from Minister lauren Moss that there was correspondence to NTG in October 2019 relating to this issue yet our FOI request revealed nothing of this nature.

Key recommendations of the Pepper Inquiry, in fact 7.11 which was referred to as essential, and was to be implemented prior to any further exploration has not been implemented, and despite assurances given to the Inquiry the government appears to be moving away further from the requirements for this recommendation. This fundamentally challenges the regulation role and poses major questions as to what is happening in the Beetaloo when they say they are fully implementing the recommendations but yet they are clearly not.

The inquiry noted that groundwater was the most common concern raised with them and they put in place special monitoring provisions, 7.11, to provide some surety to the community and noted it as essential before any further exploration.

Specifically,in relation to recommendation 7.11 it is unequivocal that it has not been properly implemented. At issue is that there should have been multiple sensors in place and there was a single sensor. There are repeated mentions of being able to distinguish between the Top, middle and bottom of the bore column and multi-level arrays with EC readings from each level and yet a single sensor was used in RN040936.

The Inquiry hearing in Darwin was repeatedly told this recommendation had been done. It hasn't, and this lack of implementation is leading to confusion about raw data and impacts on groundwater by developments in the basin. There is what appears to be evidence of leaks in the monitoring data which are "contested" because the recommendation had not been followed and so the monitoring data cannot be definitively analysed.

The community and the senate inquiry have been misled. The raw data from the monitoring bores set up to monitor water quality in the Beetaloo indicate there has been a significant spike in Electrical Conductivity (EC is a proxy measure for salinity) leak in the Beetaloo basin.[1] There are unanswered questions about the process and nature of the leaks because the NT government has not fully followed through on implementing the Pepper inquiry recommendations as claimed in evidence to the Inquiry in Darwin and repeated multiple times under questioning and yet we have been told that this has been done.

The oil and Gas company and the government are claiming that the sensor has failed due to "fouling" and are claiming there is no problem because the manual monitoring, done by a party with a vested interest,(SANTOS) shows no salinity. This testing was done at a different time and using a

[1] See Appendix 1 Raw data.

different method. This claim conflicts with the evidence from the sensor manufacturer and basic information about sensors and fouling which is explained below.

Details

The response by the Government and the company show a cavalier disregard for the monitoring system that was a core of the Pepper recommendations to ensure groundwater protection. The company claims the senor failed due to fouling and the government has accepted their word without any checks that I am aware of. There is clear conflict between the sensor data and the spot data collected quarterly by the gas company. There are several issues, including the question of why the sensor was not replaced for 12 months if it was thought to be failing, showing a complete disregard for this essential recommendation.

The claims by the Government, the regulator in this case, and the company are refuted by the evidence of fouling causing these sorts of issues with sensor failure as provided by technical support from the manufacturer of the sensor in question, nor is the claim supported in the raw data.

Whatever the outcome of the specific data issue from August 2019 there are major regulatory failures in relation to one of the critical issues of the fracking industry and the Pepper report, the issue of risk to Groundwater.

We are now seeing the government not being accountable or transparent and trying to dodge questions about this issue and make excuses that do not stand up to scrutiny. The government responses to date to questions raised by the raw data from the monitoring bore raises a number of new questions and does not resolve the initial key questions. We are also seeing some alarming moves to pull back from key parts of the Pepper recommendations. Water monitoring protections are at risk.

There is also a significant Methane increase in the bore RN040936, another indicator of leaks[2]. There is no explanation from the government as to the cause of this and my understanding is that the level is continuing to rise.

There is a deal of uncertainty about exactly what is happening, and the fact the government has not set up the proper monitoring systems to allow us to understand the dynamics of the water systems and the monitoring bore elements is making this worse.

This is leaving Territorians dangerously exposed to groundwater problems in the Beetaloo as the indicators suggest debonding (leaks up the outside of the bore casing See Pepper inquiry page 60) may be the source of the salinity and methane.

Proper conduct by the regulator would remove this uncertainty.

We wrote to Minister Eva Lawler on April 14th about this issue on behalf of multiple groups and individuals, pastoralists and traditional owners. A very short and inadequate response was received on 24th June which did not address the key issues. See Appendix 3.

MLA Yingia Guyula submitted some of the questions in writing through the Questions on Notice process within the NT parliament and a response was received on June 1 2022 titled Answer to Written Questions 332.pdf – See appendix 2

[2] Quarterly groundwater monitoring reports Tanumbirini.

In May 2022 the Department added a Regulatory statement to their website in an apparent attempt to explain their perspective. Titled Regulatory Statement: Monitoring of Electrical Conductivity in the Beetaloo Sub-basin.

The issue is that your inquiry has been misled when it was told that all of the Pepper Inquiry recommendation have been implemented as claimed on the NT Government website and that the 31 recommendations that needed to be completed "before any further exploration" had all been implemented in full.

Clearly this is not the case and it is becoming increasingly clear that this is deliberate. The preamble to recommendations is clear about their intent and this has been ignored. E.g you cannot distinguish between the top, middle or bottom of a bore column with one sensor.

Recommendation 7.11 and 7.13 are the critical recommendations in relation to this matter. There are elements of relevance in other parts of the report, such as the preamble to 7.11 that help to clarify intent of the recommendations.

Recommendation 7.11 is one of the 31 "Before any Further Exploration recommendations"

> *Recommendation 7.11*
>
> *That prior to the grant of any further exploration approvals, in order to minimise the risk of groundwater contamination from leaky gas wells:*
>
> *• all wells subject to hydraulic fracturing must be constructed to at least Category 9 (or equivalent) and tested to ensure well integrity before and after hydraulic fracturing, with the integrity test results certified by the regulator and publicly disclosed online;*
>
> *• a minimum offset distance of at least 1 km between water supply bores and well pads must be adopted unless site-specific information of the kind described in Recommendation 7.8 is available to the contrary;*
>
> *• where a well is hydraulically fractured, monitoring of groundwater be undertaken around each well pad to detect any groundwater contamination using multilevel observation bores to ensure full coverage of the horizon, of any aquifer(s) containing water of sufficient quality to be of value for environmental or consumptive use;*
>
> *• all existing well pads are to be equipped with multilevel observation bores (as above);*
>
> *• as a minimum, electrical conductivity data from each level of the monitor bore array should be measured and results electronically transmitted from the well pad site to the regulator as soon as they are available. The utility of continuous monitoring for other parameters should be reviewed every five years or as soon as advances in monitoring technology become commercially available; and*
>
> *• other water quality indicators, as determined by the regulator, should be measured quarterly, with the results publicly disclosed online as soon as reasonably practical from the date of sampling. This monitoring regime should continue for three years and be reviewed for suitability by the regulator. (Pepper report page 151)*

Recommendation 7.13

> *Recommendation 7.13*
>
> *Upon a gas company undertaking any exploration activity or production activity, monitoring of the groundwater must be implemented around each well pad to detect any groundwater contamination, adopting the monitoring outlined in Recommendation 7.11. If contamination is detected, remediation must commence immediately.*

Preamble to 7.11

> *To this end, multi-level monitoring bores must be installed in advance (at least six months) prior to the drilling of a gas well and designed to ensure full vertical coverage of any aquifer(s) currently supplying, or potentially being able to supply, water for environmental or consumptive (stock or domestic) uses. The bore array must have a level of vertical resolution at least sufficient to be able to identify whether a leak of fluid or gas is occurring in the top, middle or bottom zones of an aquifer. At a minimum, electrical conductivity should be measured in real-time as an indicator providing 'early warning' of contamination, with the results telemetered from the site to the regulator and made available to the public. The use of telemetry for other parameters should be reviewed every five years or as technological improvements become available. Additionally, other water quality indicators determined by the regulator must be measured quarterly, with the results made publicly available within one month of sampling. The combination of continuous and randomised spot monitoring should continue for three years, after which time its fitness for purpose should be reviewed by the regulator. (Pepper page 150-151 preamble to 7.11)*

It is clear from this that there need to be sensors at as a minimum three levels in the bores (Top, bottom and middle) and three is the minimum number of sensors for good practice for monitoring as you need to have a minimum of three readings to clarify any changes in readings. As an example if there had been three sensors in the Tanumbirini monitoring bore as prescribed then there would be no argument about the interpretation of the data relating to the increase in EC and talk of failed sensors and possible salinity spikes.

The Pepper Inquiry was clear that we needed both constant monitoring and the manual testing and that the data was to be made available to the public.

> *At a minimum, electrical conductivity should be measured in real-time as an indicator providing 'early warning' of contamination, with the results telemetered from the site to the regulator and made available to the public[3].*

There are references to the monitoring in the Code of Practice which appears to give the requirements of 7.11 legal status and companies an obligation for follow the requirements.

In their response to Written Questions from MLA Yingia Guyula [4]the NT government seems to be backing away from key aspects of Pepper in relation to public disclosure of monitoring information and they have made a Regulatory statement which also conflicts with this recommendation further calling into question the information you were given in the Inquiry hearing in Darwin.

[3] Pepper Inquiry report page 150.
[4] See Appendix

The question was Where is the data from the other monitoring bores in the region as required by recommendation 7.11?

Response: Recommendation 7.11 does not contain such a requirement.

The pepper Inquiry was specific in saying the monitoring bores need be on all existing and new well pads and the data needed to be supplied to the public. We are very alarmed and would ask that the Senate inquiry seek the data from the other wells. This includes Carpentaria 2 which was partly funded by government subsidy but should include all the Orign and Imperial wells.

Issues

There are many issues that come from the data and the responses to the many questions that it raises.

The government responses to date have added even more doubt to what actually happened and we need some clear answers to key questions.

The government appears to have done nothing to determine if the senor failed due to fouling and if so what was the fouling in question. We see no evidence of images or other tests to show fouling or the compound involved. There is no transparency around the statements.

As the regulator it is vitally important that the government perform the monitoring tasks very diligently or at least cause them to be done. It is inadequate to rely on a vested interest for such important processes.

This raises several questions.
If the sensor failed why was it not relaced?
If fouling was a problem, why weren't self-cleaning sensors being used?
If fouling was believed to be an issue why wasn't an appropriate management regime, such as annual cleaning, required?

The evidence below from the technical support of the sensor manufacturer challenges many of the claims as does the raw data as explained below.

The events indicate the government agencies are not taking their responsibility seriously and SANTOS is also not taking the issue seriously as the sensor should have been replaced immediately if it was thought to be failing.

Regulatory Statement

This was added to the DENR website in May 2022 in response to queries and provides a number of points that seem to add to the confusion around this issue, for example,

> *The Groundwater Guideline requires a single groundwater monitoring bore to be established for each aquifer encountered. If there is more than one aquifer present, the multiple bores are termed an "array". Sampling from the entire depth of an aquifer is achieved by requiring the bore casing of a groundwater bore to be perforated and screened at the top, middle and the bottom of each aquifer encountered. It is not necessary to establish three separate bores (each targeting*

> *the top, middle and bottom of an individual aquifer) in order to obtain a representative sample of water quality in the aquifer; to do so would unnecessarily increase environmental risks. (Page 1)*

The statement that a single ground monitoring bore to be established for each aquifer encountered. If there is more than one aquifer present, multiple bores are termed an "array" is confusing as it implies multiple bores and then goes on the say a single bore is required.

There is also a confusion point is around the term "array". It seems a poor attempt to explain the away the need for a multi-level array of sensors. You cannot monitor the Top, Middle and bottom of the vertical profile of the bore with 1 sensor. The mention that and EC reading is required from each level of the array makes it clear that there needs to be multiple sensors.

The regulatory statement appears to make attempts to rationalise the failed regulatory regime. It claims that

> *the electrical conductivity sensor is very sensitive to encrustation (assume this is fouling) and in the Beetaloo this has resulted in significant drift and erroneous readings over time. It is suspected that chemical and mineral reactivity of groundwater with the sensors is the cause of the issue. This can only be resolved by high frequency maintenance and calibration, which negates the benefits of collecting data via an automated logger.*

The statement shows no evidence to support these claims and available evidence refutes them. As an example, the raw data from RN040936 shows very little drift in the readings and a slight increase if anything. This notion of fouling causing the rapid increase in EC readings does not fit with the science of the types of sensors used as fouling normally leads to a lowering of readings. It also does not fit with the significant drift claim. Fouling is a slow process and is cumulative. It doesn't usually cause sudden dramatic increases. This is because the fouling slows the electrical current flow used as the key sensor function. See figure 1 below for details

Further the raw data from RN040930 shows little change over the period from 10 December 2018 (reading 1664.7 (¬µS/cm)) until the August 24 EC increase when the reading was 1661 ¬µS/cm. The average reading across that time was 1652.7 ¬µS/cm from about 1023 readings. This does not suggest that fouling was causing issues.

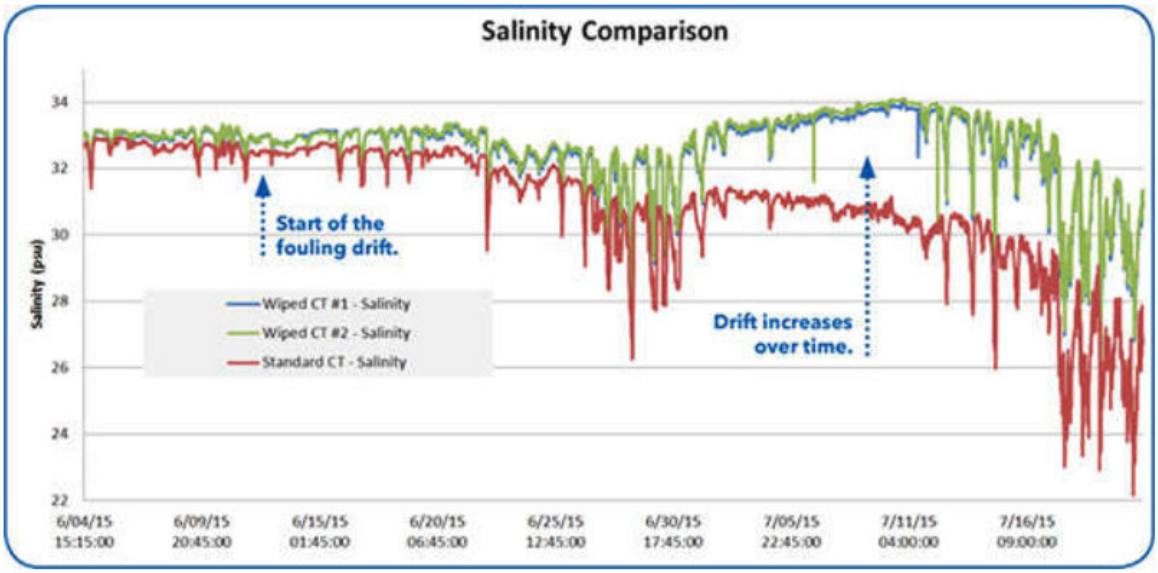
Investigation of the issue relating to RN040936 and the sensors of the type used by SANTOS, Aqua Troll 200's, have led to advice from the technical support at In-situ, the manufacturer of the sensor.

Two key points need to be made here.
1 Sensors using an electrical current to measure micro siemens as a salinity or dissolved Ions measurement typically show reduced readings when they suffer from fouling not sudden increases[5].

2 Even when they are suffering from fouling the sensor will still show the up and down movement changes in salinity readings as can be seen from the image below where the red line, the fouling sensor plot, is still showing the peaks and troughs in synch with the green and blue plots from the self-cleaning sensors. This is clear in Figure 1 below. The 28 August 2019 EC spike looks more likely to be real when this evidence is considered.

[5] https://www.ysi.com/ysi-blog/water-blogged-blog/2019/01/7-tips-to-fight-fouling-and-extend-water-quality-sonde-deployments

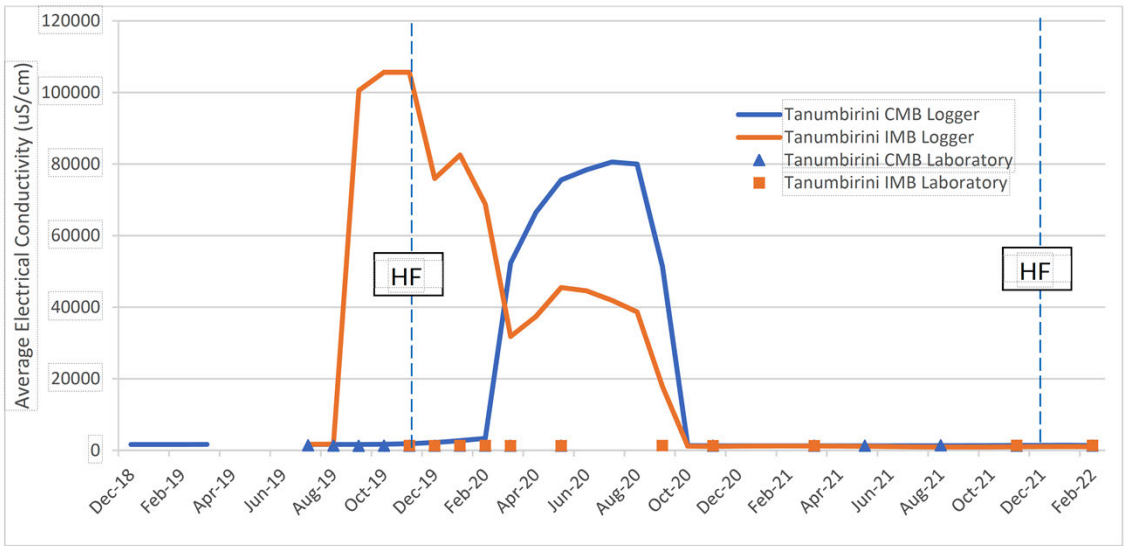
Figure 1 - Sensor fouling research data plot from salinity research.



Manual data conflict

There is a clear and unexplained discrepancy with the manual data, which has been collected in a different manner. The regulator needs to take control of this process and use independent sources for this work to meet transparency requirements and use multiple sensors as specified to develop a clear understanding of these issues relating to the water column and bores. This must be transparent. There is no manual data from RN040936 in the period leading up to the EC reading spike in Aug 2019 that I am aware of. It is strange that this graph shows no manual data (Blue triangles) from RN040930 at the time of the EC spike in that bore's data. This needs investigation.

Figure 2 Data inconsistency plot from NTG Regulatory Statement- Electrical Conductivity



The government appears to be trying to rationalise not following the Pepper recommendations even though their public statements and statements to the Inquiry say they are implementing them all.

This idea that the data from the Control bore RN040930 refutes the data from RN040936 is not supportable. The Control bore RN040930 was specifically designed and located "upstream" so as to not be influenced by the wells. So why is it claimed this data refutes the sensor data?

I have increasing concern that this monitoring data from other well pads is not being made available to the public when it clearly should be because the government and industry do not want the details revealed. I ask that the Senate Inquiry use it powers to get access to this data.

> *As the recommendation7.11 says where a well is hydraulically fractured, monitoring of groundwater be undertaken around each well pad to detect any groundwater contamination using multilevel observation bores to ensure full coverage of the horizon, of any aquifer(s) containing water of sufficient quality to be of value for environmental or consumptive use;*
>
> *• all existing well pads are to be equipped with multilevel observation bores (as above);*
>
> *• as a minimum, electrical conductivity data from each level of the monitor bore array should be measured and results electronically transmitted from the well pad site to the regulator as soon as they are available.*

This is clear that all well pads need to have monitoring bores. I can only assume the Government is trying to back away from the public availability of the data. The intent of Pepper was clear in the preamble to 7.11 on page 150

> *" The bore array must have a level of vertical resolution at least sufficient to be able to identify whether a leak of fluid or gas is occurring in the top, middle or bottom zones of an aquifer.*[6]

This clearly establishes that you need multiple sensors as you cannot check the Top, Middle and Bottom with only one sensor.
Further the preamble also says

> *At a minimum, electrical conductivity should be measured in real-time as an indicator providing 'early warning' of contamination, with the results telemetered from the site to the regulator and made available to the public".*[7]

This clearly states that the data is to be made available to the public.

I fear that the problems with the POINT.nt.gov.au website are deliberate attempts to hide unfavourable data from the public. The government supposedly the regulator, created this site to supply the data and related documents to the public. The original problem occurred in August 2019 but the site was not completed until 2021 and was not working in relation to data downloads until March 2022

Hopefully this senate inquiry can get access to that "missing data" from the Origin and the Imperial monitoring bores across the Beetaloo.

There is a clear regulatory failure here as the monitoring regime has not been set up properly to avoid problems with interpreting data. It is clearly the responsibility of the NT government as the regulator to fix this. They are also showing a great reluctance to address the issues.

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[6] Pepper Inquiry Final report page 150.
[7] Pepper Inquiry final report Page 150-151

The Pepper inquiry said there needed to be continuous monitoring and quarterly spot testing. It is not acceptable to move away from this. The regulator needs to implement 7.11 fully with multiple sensors, at least 3 in each bore as specified.

The excuses about monitoring problems in the bore columns appear to be a rationalisation to support moving away from the regulatory requirements mentioned in the Pepper Inquiry recommendations. There needs to be multiple sensors in these bores so that the exact nature of the water column dynamics and the related monitoring challenges can be determined.

Appropriate testing regimes need to be established. If there are issues with fouling then, self-cleaning sensors, designed to counter this problem or periodic maintenance such as weak acid solution baths may be required. The government as the regulator has an obligation under the pepper inquiry recommendations to see to this problem being resolved. Statements in the Regulatory Statement[8] like "This can only be resolved by High frequency maintenance and calibration, which negates the benefits of collecting data via an automated logger" are not supported by the facts. The sensors have performed well for many months at a time showing no significant changes in readings or fouling impacts. The government seems to be looking for an excuse as it is not clear what is meant by high frequency.

There are visits to the sites for manual testing every 3 months. Sensors could be cleaned every 3 or 6 months or whatever period is required, or self-cleaning sensors could be deployed. The government appears to be backing away from its regulatory role on one of the most important aspects of the Pepper recommendations. The sensors in place take 6 readings a day and so over a 3-month period some 540 readings. Pulses of salinity, as suggested by the data from RN040936, could be pushed away by underground flow before quarterly manual spot checks are conducted.

Clearly the regulatory regime is not being implemented properly. As an example the code of practice, a legally enforceable code in theory, requires "all field measurements and sampling to be undertaken by suitably qualified personnel and to utilise equipment that is suitably maintained, laboratory checked and calibrated;"[9]

Clearly this requirement has not been followed as the above questions about the sensor at Tanumbirini could be resolved with calibration but the sensor was not removed from the well for many months after it showed the spike.

I have asked a number of questions that as of 31 August 2022 have not been answered.

These include :-
Can the minister supply any information about calibration testing of the fouled sensors after they were deemed to have failed.

Can the minister advise if any testing was carried out on the "fouling" to determine what it was ?

Can the minister advise if there are any photographs of the claimed failed sensors from the Impact Monitoring bore at Tanumbirini showing fouling.

Why was the sensor not replaced until 15 Sept 2020 if it was thought to have failed in October 2019?

[8] https://depws.nt.gov.au/_ data/assets/pdf _file/0019/1107 505/regulatory-statement-electrical-conductivity. pdf
[9] Code of Practice: Onshore Petroleum Activities in the Northern Territory C.7.1.2 (a) iii

What does the department accept as evidence of "drift" in a sensor?

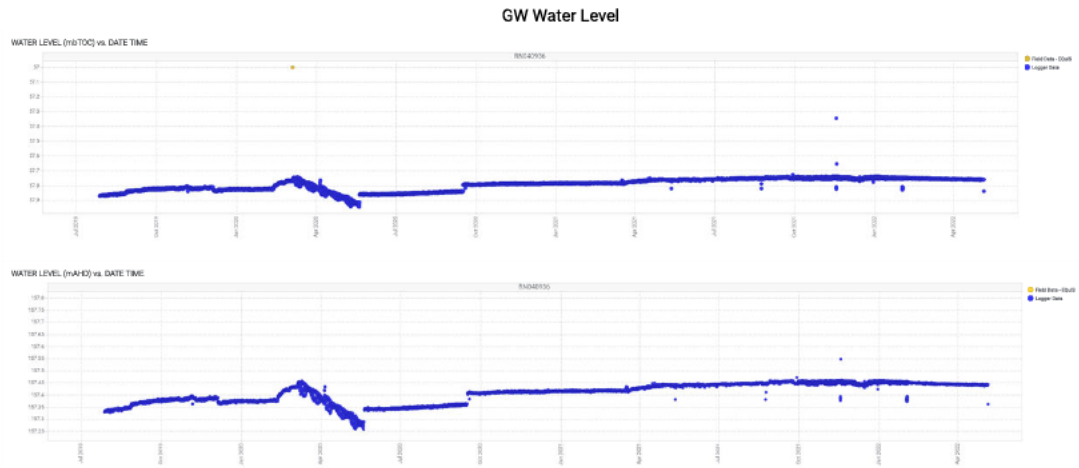
As an example, the raw data from RN040936 shows very little drift in the readings prior to the spike beginning 28 August 2019. The initial reading for this bore in 27 July 2019 was 1714.8 (¬µS/cm) the average of the 259 readings until 28 Aug 2019 was 1705.25 (¬µS/cm) and EC was 1695 (¬µS/cm) on 27th August.

Further the raw data from RN040930 shows little change over the period from 10 December 2018 (reading 1664.7 (¬µS/cm)) until the August 28 EC increase in nearby RN040936 when the reading was 1671.2 ¬µS/cm. The average reading across that time was 1653 ¬µS/cm from about 1047 readings. This does not show that fouling was causing issues with the sensors, especially since their aim was to detect major changes in EC suggesting a possible leak.

Why was the concern about sensor drift accepted when the raw data from the sensors show no statistical evidence of what could be described as drift?

Further there are concerns with other water elevation data that appears to roughly coincide with the salinity spikes in the bores. Figure 3 below shows a major change in the water elevation around the time the spike in RN040930 occurred. This indicates that there was fracking activity at the time of salinity spikes suggesting that the vibrations of operation at one well on a pad could be impacting the bonding on nearby wells perhaps calling into question the multi well wellpad concept. I do not have access to the Well Operations management plan WOMP to analyze this an would ask the senate inquiry to facilitate this.

Figure 3 Water elevation data RN040936



I am happy to provide further evidence, or any follow up to this supplementary note.

Yours truly,

[redacted]

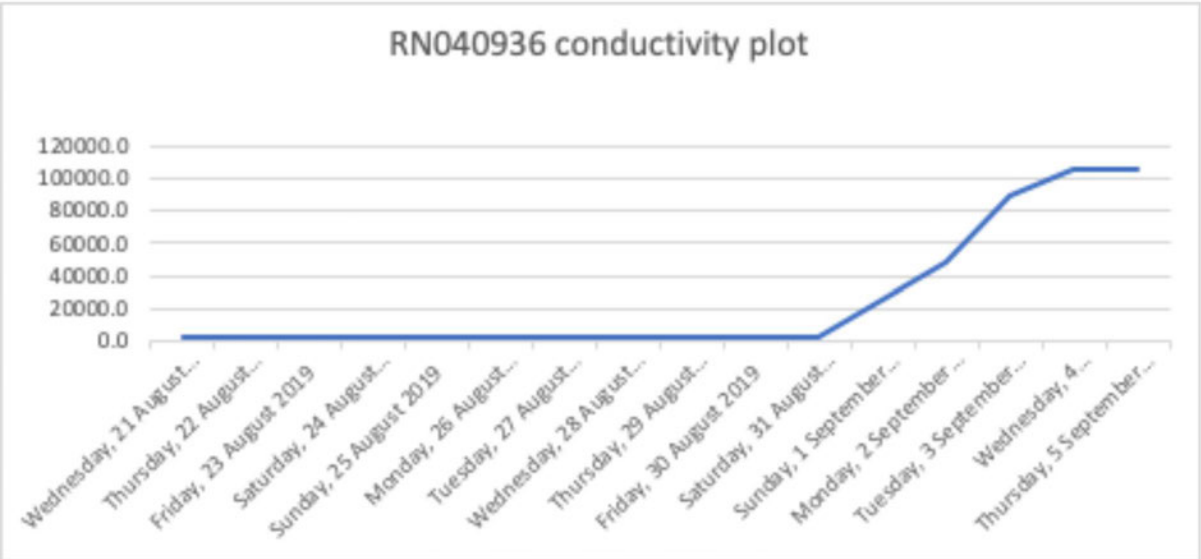
Graeme Sawyer
Mobile [redacted]

Appendix 1- Raw Data

The Electrical conductivity (EC) sensor in the groundwater monitoring bore RN040936 at the Tanumbirini well site, installed for the very purpose of monitoring the groundwater for possible changes related to fracking, recorded an increase in EC levels.

The raw data from RN090936, also known as the impact monitoring bore, reveals an approximately 50-fold increase change in the conductivity reading microsiemens/cm (µS/cm) which is a standard measure of total dissolved ion load/salinity in water, commonly used to track the salinity of freshwater.

Figure 1 - Daily Average EC plot (µS/cm) from IMB RN040936 around the time of the initial increase in EC



The conductivity µS/cm measurements began in bore RN 040936 on the 27th July 2018 with a value of 1714.8 µS/cm. For the next 13 months, until Thursday 27th August 2019 EC readings were between 1670 µS/cm and 1730 µS/cm.

The raw data shows that the conductivity measure went above 1800 (µS/cm) for the first time on Thursday 29th August with the early morning (0:00 hrs) reading of 1804.1 µS/cm. By that evening the reading was 1861.9 µS/cm . By Friday night, the reading was 2027.1 µS/cm, by Saturday night 5895 µS/cm , By Sunday night 34,473.8 µS/cm. By Monday night the reading was 62092.6 µS/cm and by Tuesday night it had reached 105651 µS/cm which is around the maximum the sensor was able to measure.