

**Submission to:
WA Scientific Inquiry into Hydraulic Fracture Stimulation in WA 2017**

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'Frack Free Central Midlands' operated for a period of around two years in a relatively informal way with a small group of concerned Moora citizens who took every opportunity to investigate 'fracking' and promote its dangers. In early 2016 the group decided to increase its community exposure and after several public meetings, a larger and more formal, 'Frack Free Central Midlands' came into being. The group adopted the motto: "Protecting our land, water and air".

'Frack Free Central Midlands' has a number of major concerns with fracking and gas exploration and production, plus further issues should it be approved and continue in this region.

A. The major issues:

1. Protection of the sole Moora town water supply at Kolburn - and regional water supplies in general.
2. Preservation of high biodiversity bushland and the impact of any losses on a variety of matters, including wildlife and specifically the endangered Carnaby Cockatoo.
3. Retention of productive farmland and the using any available quality water for the expansion of food production using groundwater
4. Risks from seismic activity given the proximity of the Darling Scarp, one of the longest earthquake fault lines in the world, and known effects of fracking on the incidence of activity (earth tremors).
5. Land owners rights.
6. Time frame over which any considerations on the future of fracking, etc are made.

B. Further Issues of concern, including those should the decision be made for having exploration, fracking and gas production continue/proceed:

1. Transport and movement of chemicals
2. The danger from fracking chemicals and fluids, whether by reinjection, trucking, or waste storage
3. Air pollution from flaring, fuming, venting, which not only could affect human but livestock and native animals and ecological systems
4. Pre and post monitoring schedules and time frames
5. Rehabilitation of gas/oil exploration, drilling and production sites
6. Potential reductions in the tourist trade given the Central Midlands is prime wildflower country

We therefore make this submission on behalf of not only 'Frack Free Central Midlands' but the 95.2% of Moora townsites residents who when surveyed said "Yes" to this being a 'gasfield free district' and who will be critically affected should further exploration and drilling proceed in the Central Midlands (and beyond).

A. MAJOR ISSUES:

A1. KOLBURN – MOORA'S SOLE TOWN WATER SUPPLY

The principal object of Frack Free Central Midlands is the protection of Moora's sole town water supply at Kolburn, which lies in the area under licence EP321.

Kolburn, West of Moora on the Dandaragan-Moora Road, is the site of groundwater extraction for Moora's current water supply. The original groundwater supply from a site east of town was replaced due

to water quantity and quality issues. Fortunately groundwater from Kolburn was already in use by the time the eastern site was closed for drinking water usage.

The Country Areas Water Supply Act (1947) protects the quality of water sources in country Western Australia. The Act's by-laws enabled the former Water and Rivers Commission to control potentially polluting activities through regulation of land and premise use (allowing inspection of premises) and to take steps to prevent or clean up pollution. The Commission developed priority classifications for lands under their control listed in 'The Moora Water Reserve Water Source Protection Plan for Moora Town Water Supply 1999'.

See https://www.water.wa.gov.au/data/assets/pdf_file/0012/4521/10107.pdf

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. P1 areas are **managed in accordance with the principle of risk avoidance** and so land development is generally not permitted. (See Land Use in Appendix 1)

Priority 2 (P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority in these areas. P2 areas are **managed in accordance with the principle of risk minimisation** and so some development is allowed under specific guidelines. (See Land Use in Appendix 1)

In addition to priority classifications, well-head protection zones and reservoir protection zones are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Well-head protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Reservoir protection zones usually consist of a 2 kilometre buffer area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Special restrictions apply within these zones. (See Appendix 1)

Of particular note are land use restriction associated with mining and mineral processing, shown as follows:

MINING AND MINERAL PROCESSING

Land Use	Priority 1	Priority 2	Priority 3
Extractive industries (sand mining, quarries)	Restricted	Restricted	Restricted
Mineral exploration	Restricted	Restricted	Restricted
Mining	Restricted	Restricted	Restricted
Mineral processing	Incompatible	Incompatible	Restricted
Tailings dams	Incompatible	Incompatible	Restricted

Gas exploration and production **is not** listed since it is not considered as mining and regulated accordingly under a different statute.

An appendice of ‘The Moora Water Reserve Water Source Protection Plan for Moora Town Water Supply 1999’, *Land use compatibility in Public Drinking Water Source Areas* , includes definitions for incompatible, restricted and compatible, together with clarifications within these categories. The Appendix continues with further tables of categories of restricted activities including industrial, education/research, processing of animals/animal products, processing of plants/plant products, urban, subdivision, sport and recreation, tourist accommodation, waste treatment and management, storage/processing of toxic and hazardous substances, as well as other developments.

Given the toxic and hazardous nature of the chemical used in and arising from gas/oil production we argue that this alone should prevent gas exploration and production in the vicinity of the Kolburn wellhead.

A further ‘Water reserve’ northwest of Kolburn should likewise be precluded from any gas exploration or production. It can further be argued that future growth in the Moora population and that of surrounding areas that currently use water from Kolburn will require additional groundwater extraction in future and hence there should be an expansion of protected land areas.

A second document, *Moora Water Reserve Drinking Water Source Protection Review – Moora Town water supply*, issued by the Department of Water, reflects changes since publication of the 1999 plan (Water Resource Protection Report No. 142, October 2013). It includes details of the closure of the Eastern Moora Water Reserve for drinking purposes and forms an **addition** to the earlier 1999 document. This document amends the original priority rating of Kolburn from a Priority 2 (P2) to Priority 1 (P1) area.

See [https://www.water.wa.gov.au/ data/assets/pdf file/001](https://www.water.wa.gov.au/data/assets/pdf_file/001)

P1 areas have a well-head protection zone of 500 metres radius. This of course is of great concern when it comes to current drilling capabilities and fracking. Despite unproven claims by the industry that “we are way below the water aquifers and there is no way that there is therefore any connection between the gas and the aquifer”, drilling activity (the well head) can occur outside sa protection zone but lateral drilling and fracking could occur well within.

Drilling must go through usually more than one aquifer to get to any depth where oil and gas (in shale deposits) are located in the Central Midlands and adjacent areas. Any drilling, whether there be fracking subsequently or not, therefore has the potential for contamination of the aquifer. When one includes fracking and the pressures involved, the possible extent of rock fracture, gas movements, etc, there is a much higher risk. Existing small fractures will be enlarged by the fracking process, in turn forcing more outward fractures to form. Multiple fracking with continue this expansion and even larger fractures to be created. Should fractures reach the aquifer layer contamination of the aquifer by gas, oil or fracking

chemicals is inevitable. Furthermore, knowledge of the extent of fracturing and potential contamination of aquifers will not be known until it is too late, with no remedial action possible.

None of the materials that can potentially be used for bore casing have an infinite life and depending on the material used bore casings will have a variable life-span. Cost will largely determine what material is used and with those of longer life generally being more expensive one expects lifespan to be on the lower scale. Consequently, there will always be the potential for the casing of bore holes passing through aquifers to corrode over time, resulting in potential contamination of aquifers in the distant future if the inner concrete lining also fails

Lining casing (or sealing failed/unproductive or depleted wells) with concrete poses further unwanted consequences. Aside from the limited life of concrete, and the risk that concrete failure provides for bore integrity, 1 kg of cement release more than 0.5kg of carbon dioxide into the atmosphere. The hundreds of tonnes of cement used in the concrete required in the drilling of wells and other structures associated with the gas industry, and in subsequent activities, will therefore contribute to atmospheric CO₂ levels and global warming.

See - <https://qz.com/1123875/the-material-that-built-the-modern-world-is-also-destroying-it-heres-a-fix/>

Other matters relating to the need to ensure protection and maintenance of potable groundwater for human use/food production

“Moora has also been identified as a Specialist Food Centre in the government’s Agricultural Policy. The Department is currently working with the Department of Agriculture and Food (DAFWA) to identify areas of high-value arable land and accessibility to water in these areas.” (Excerpt from Gingin Groundwater Allocation Plan – issued by the Department of Water March 2015)

See - https://www.water.wa.gov.au/data/assets/pdf_file/0006/5919/108802.pdf

The recent study conducted under the title “Water for Food” indicates there is the potential currently for the expansion of food production e.g., horticulture, northwest area of Moora in the Dinner Hill area. Groundwater levels in this area are still rising at a considerable rate. Several large horticultural enterprises have been successfully established west of Moora and in the Dinner Hill area in the past decade.

However, twice in just over 10 years it has officially been claimed that available water in the ‘Mid-West region’ (includes the Gascoyne) is heavily or in places fully committed, without even taking into account that further irrigation is desirable. Potential use of groundwater is also deemed to require further investigation of changes resulting from a drying climate.

“... The resources north of Perth, south of Gingin, beyond Gingin and up to Geraldton are quite heavily used at the moment. There is a lot of horticulture and so forth. It certainly is an area that we are interested in but, I guess, if anywhere is going to get hit by reducing rainfall it is the band north of Perth and south of Geraldton that is probably the most vulnerable. Before any further interest is pursued there we would want to make sure that we understood how it was going to respond to a potentially drying climate.”

(From “Standing Committee on Environment and Public Affairs, Session one: Transcript of Evidence taken in Perth Friday 20 April 2007 investigating the possibilities of alternative water sources for Perth)

See - [http://www.parliament.wa.gov.au/Parliament/commit.nsf/\(Evidence+Lookup+by+Com+ID\)/8799C1E937E83EE548257831003C10C6/\\$file/ev.049.070420.tro.iq.d.pdf](http://www.parliament.wa.gov.au/Parliament/commit.nsf/(Evidence+Lookup+by+Com+ID)/8799C1E937E83EE548257831003C10C6/$file/ev.049.070420.tro.iq.d.pdf)

Moreover, much of the available groundwater already in use by the human population in the region requires treatment to improve the aesthetic water quality

*“The Mid-West Region uses independent groundwater sources. In a region facing challenges from scarce and brackish (highly saline) water supplies, Water Corporation is working to ensure reliable access to a quality drinking water supply. At Gascoyne Junction a reverse osmosis treatment plant has been installed due to increased salinity in the bores since the December 2010 floods. In the coastal borefield schemes of Horricks, Seabird, Woodridge, Watheroo, and **Kolburn** optimisation of the treatment plants has occurred to bring improved aesthetic water quality through the removal of iron and manganese.” (From Fact Sheet “Western Australia’s Major Water Supply Schemes” 2015)*

See - <https://www.watercorporation.com.au/-/media/files/education/lessons-and-teaching-resources/lesson-plans/activity-sheets-and-fact-sheets/western-australias-major-water-supply-schemes-fact-sheet.pdf>

Given that the availability of quality groundwater in the Midwest is limited there is no justification for using very large quantities of any of this quality groundwater for exploratory drilling and fracking for short term gas production anywhere in the vicinity of the Kolburn water supply area or elsewhere in the Mid-west region.

A2. BIODIVERSITY AND LAND CLEARING

The second area of major concern locally is the loss of and risk to the high natural biodiversity of the region and the impact this may have on the integrity of local ecosystems, tourism and wildlife, including the endangered Carnaby Cockatoo.

A significant amount of land of the mid-west is world heritage listed because of its very high biodiversity. There are further large tracts of land that lie within state and national parks or shire reserves, as well as smaller remnants on private land, that, while not world heritage listed, also have very similar high biodiversity. In general the high biodiversity of native vegetation makes the mid-west, and further north, renowned for its wildflowers. Banksia woodlands on the coastal plain have also been identified as a threatened ecological community.

There is currently no serious restriction on the clearing of native vegetation for the purpose of seismic testing, and then for drilling (with fracking) and subsequent oil/gas production. Prior to the current moratorium, gas exploration companies were applying for permits to clear within reserves of high biodiversity value. They were likewise seeking the permission of landowners (farmers) to go onto their land to carry out ‘environmental surveys’ though details of the what such ‘permission’ extended to are unclear.

Changes to the Land clearing regulations in 2016 permit the clearing of up to 5 ha of bush on private land per year without restriction. Consequently exploration and production companies could clear small area of remnant vegetation on private land without the risk of sanction. Aside from the potential loss of biodiversity, bush corridors, often formed by small area of remnant bush,, are highly important for the integrity of many ecological systems (eg, for animal and bird movement, breeding and survival; as food sources, etc). Consequently small remnants should not be exposed to the risk of clearing.

The endangered Carnaby cockatoo nests in the ever diminishing number of large hollows in large woodland trees and feeds largely on the seeds and flowers of largely a variety of smaller trees and shrubs (eg, Banksia, Acacia, Hakea, Grevillia spp.) occurring predominantly on the sandplains west of Moora. The reduction in bird number that has led to them being listed as an endangered species has arisen from the loss of both nesting sites and feeding areas. A further loss of feeding habitat for Carnaby cockatoos would further reduce population number. It should be recognised there is a point (currently unknown) at which such a decline may become terminal.

Considerable sums of money (Federal, state and private) have been spent over the past few years and continue to be spent on establishing areas of diverse planting with food and other species to help lessen the loss of feeding habitat. Further funds have been spent on artificial nesting 'logs'. Allowing reduction in or any damage to feeding areas for gas exploration, drilling, etc is therefore totally illogical.

The removal of bush in some areas to the west of Moora has led to an increase in both soil and surficial aquifer salinity. Further bush removal in these areas is likely to exaggerate the issue and removal in some places could precipitate further more visible and damaging salinity.

A3. LAND & WATER USE

Aside from the issues noted in A2 and in the dangers from contamination and pollution, using land for seismic testing, and then for drilling pads, roads, pipelines, processing, etc., removes productive farm land in an area of increasing importance for food production.

Changing rainfall patterns and farming and cropping systems has seen a significant increase in grain and livestock production in the area. The high superficial water tables in some parts has allowed the successful establishment of perennial pastures and coupled with better grazing management led to substantial increases in cattle production. The extraction of the quantities of water that would be required for fracking would pose a significant risk to the maintenance of the current levels of surficial ground water or to the quality that enable this production.

Water from the deeper aquifers is already being used for intensive horticultural production, as noted above. The 'Water for Food' study, likewise noted above, has further identified the potential for increased horticultural production using groundwater northwest of Moora in the Dinner Hill area. The question must therefore be asked whether producing gas for a short term need and monetary gain outweighs the potential value of a much more important and long term requirement locally for water by an existing and growing human population. If not required immediately and directly for human use per se we would argue that any available water has a much higher value over a significantly greater time for the production of food for a rapidly growing Australian and world human population.

Any arable land taken for drilling purposes, roads, pipelines, processing plants, etc is land not available for agricultural production and will not be available for probably 50 or more years after drilling and extraction operations cease and 'rehabilitation', if possible and carried out, occurs.

A4. SEISMIC ACTIVITY

One of the longest earthquake fault lines, the 950km long Darling Fault, which originated with continental drift and stretching from north to south at the west of the Darling scarp, runs close to Moora. Another significant fault line (Dandaragan fault) is further west with extensive faulting in between and further west creating highly complex geological formations in the sedimentary layers of the region. The major and lesser aquifers lie within this geological complex and establishing the exact location, possible connection and recharge and discharge area for these aquifers has often proved difficult and is certainly not simple. Despite the area being relatively seismically benign it must not be assumed that further significant shifts in these complex formations will not occur any time soon or in the distant future.

Natural earth movements of a range of magnitudes thus pose a risk to any bores within the area and could lead to fracturing of gas lines and possible contamination of an aquifer with gas and fracking chemicals. More severe movement could also potentially create fracture linkages between the layers underlying and containing aquifers and the much deeper shale oil/gas containing sediments, with contamination of the aquifer then becoming a certainty; there may thus be a risk of aquifer contamination with gas. We are aware of bores and springs in this area which either dried up or

reduced in flow after the Meckering 1968 earthquake. Also a local pool which was a green oasis and used for swimming, no longer exists. Damage to waste storage ponds and the release of toxic waste into the landscape is a further risk, depending possibly on the nature of bunds and containment structure and their maintenance.

While industry claims that 'earthquakes' are not caused by fracking activities the American Geological Society has shown that both fracking and the reinjection of fracking fluid has caused minor earth tremors to occur in areas of the USA where no previous activity had been recorded. Depending on the geological substrate such activity, even if not of high magnitude, could prove damaging not only to gas extraction and contamination of water supplies but to man-made structures and even human life.

Earthquakes can of course occur naturally at any time, but we certainly do not need to increase the risk of 'man-made quakes' and their possible consequences. This degradation of land cannot be risked.

- See: a) <https://www.perthnow.com.au/news/wa/wa-sits-on-deadly>
b) https://www.revolv.com/main/index.php?s=Darling%20Fault&item_type=topic
c) https://books.google.com.au/books?id=4B8nrDVjaCgC&pg=PA110&dq=%22darling+fault%22&ei=mEA_S4PGHo3uzQTJ681b&cd=1&redir_esc=y#v=onepage&q=%22darling%20fault%22&f=false
d) https://www.revolv.com/main/index.php?s=Sense+of+Place&item_type=topic

A5. LANDHOLDER RIGHTS

The 'WA Mining Act' gives landholders the right to restrict and object to exploration and mining on their land and to seek/negotiate compensation if exploration/mining is agreed to and occurs. ' *The Petroleum and Geothermal Energy Resources Act 1967*' however only requires permission on "**certain types of private land**". Most landholders have little or no idea of whether or not permission is required by licence holders to enter and operate on their land. Many are of the view that permission is not required and licence holders can, if they so choose, enter private property to carry out exploration, conduct drilling activity, build access roads etc. without seeking or obtaining permission or paying any compensation for productive land loss, damage to fencing, farm roads, etc.

Companies say this won't occur and prior to the fracking moratorium some were seeking permission from landholders for entry onto their land under the guise of saying they wanted to conduct "environmental surveys". Popular opinion was that granting such "permission" then allowed licence holders to proceed with other activities if they so wished.

Some landholders with poor quality land providing low or no economic return have indicated they would readily agree to having exploration and gas production wells on their land provided they were paid and payments 'exceeded' potential returns from any existing agricultural production. Hence, companies wanting to appear as considerate and responsible would be likely to obtain written permission and make such arrangements, irrespective of whether compelled to do so by law or not.

Under the circumstances just outlined the vertical component of a well may be drilled on land with a landowner's permission but, through further lateral drilling, fracking and gas extraction could occur under the land of neighbours who opposed drilling and fracking. The same could occur if the gas company operated from crown or public land.

Landholders who oppose gas exploration and extraction activities on their land could therefore lose approved groundwater water supplies – either for household/non irrigation/stock use or extracted under licence for irrigation, should the level of the aquifer they use decrease or the groundwater quality decline (increased salinity or if it was contaminated). These could well occur given the quantities of water extracted and used for fracking. Trying to assign responsibility and to seek compensation would be

extremely difficult - and costly. (This is an issue already with water extraction on neighbouring properties when one property moves to high levels of water extraction for irrigation.)

A6. TIME FRAMES and ASSESSMENTS OF RISK

Lateral water movement in aquifers can be exceedingly slow so should single point contamination of an aquifer occur it may be multiples of years before contaminated water is detected in a bore some distance away. The movement of contaminated water will also depend on the lateral direction of water flow in an aquifer. Any assessment of the risk of gas exploration and extraction involving fracking of any sort must therefore include time frames for water monitoring that extend beyond the expiration of possible gas extraction. Time frames should also include periods preceding any exploration and drilling during which base-line monitoring is carried out

Surface recharge areas for some of our aquifers can be relatively small and often don't appear over a large section of the surface area under which an aquifer lies. Our knowledge of the locations or possible locations where aquifers may be connected and the extent of such interconnections is also often limited or poorly understood, given the complexity of the geological structure(s) in which the aquifers exist. Consequently, determination of the origin of contamination of water from a site in an aquifer overlying an active gas production field, and where the contaminated water may move to over time, is complex; it may require considerable additional research extending over a long period of time. Furthermore, contamination of any of the deeper aquifers, no matter the origin, will have long term consequences as there will be no immediate "fix" and water will remain unsuitable for human use for multiple generations.

Given these complexities and the time frames involved it behoves one to be extremely careful when assessing the risk of aquifer contamination and the means, if any, of addressing that risk. The risk of long term water contamination from an item such as a surface spill may be much lower as 'clean up' may be possible. However, there may well be a high risk of a significant economic loss if productive land is taken out of production for an extended period and under such circumstances compensation should be required.

The time frame in assessing the consequence of the risk of damage to the biodiversity of the region must also be long. Restoring vegetation can usually occur given sufficient time. Nevertheless, with climate change occurring, establishing current existing biodiversity of vegetation may prove difficult and the time to attain a new equilibrium with possibly different plant species will be long and unknown. Furthermore, the long term impacts of and risk to the ecology of the immediate area, and possibly a much larger area, as the result of removal of only small areas of remnant bush is likely to be an unknown.

B. FURTHER ISSUES OF CONCERN

B1. THE TRANSPORT & MOVEMENT OF CHEMICALS

Prior to the fracking moratorium companies involved in gas and oil exploration companies were required to provide the WA Department of Mines, Industry Regulation and Safety with a list of chemical being used for fracking. They refused to publically release this information citing it was a proprietary mix and thus confidential. One can assume however that the chemical involved are the same as those used in other parts of the world – a toxic mix.

Industry also underplays the quantity of chemicals used in fracking by quoting that it is only up to 0.5% of the overall volume of material used to frack a well. Using the oil and gas industry's average figure of 11 million litres of water for each frack, 0.5% of chemicals means around 55,000 tonnes per frack, with most wells being fracked at least 5 times, often more. While reinjection of fracking fluid is employed, additional fracking fluid (water and chemicals) would be required for each subsequent frack, indicating the figure for the quantities of chemicals used for each well would be higher than above. There is of course normally more than one well!

Only 10 wells would require the need to transport not less than one million tonnes of chemicals to the region. While this could occur using the existing railway they would then need to be trucked to well sites, often on secondary or minor roads. Railway use, or more likely road use alone, would significantly increase the number of truck movements in, through and around Moora (and other nearby towns). This is an issue of major concern to all residents, both from the possibility of the much increased risk of accidents, possibly exacerbated by the absence of any by town bypass roads, and of spills.

Thousands of tonnes of chemicals would be carried using roads that are not designed for carrying the quantities involved and at times already suffering damage from truck use for agricultural production.

Increased damage to road surfaces by the extra volumes of heavy traffic would increase the costs of road repair and maintenance for rate-payers.

B2. DISPOSAL OF FRACKING FLUIDS

The danger from fracking fluids, whether by reinjection, or disposal/storage is a serious concern.

Reinjection poses the same concern for contamination as already considered above for the initial frack – bore integrity, spills, increased seismic activity. There is also a further major risk posed by the storage or disposal of used fluid.

Removal from sites through transport to another location where storage risk may be lower would be costly and pose risks of its own. Storage of used fluid in waste ponds in close proximity to use where the water can evaporate, is more likely. These ponds would require sealing to prevent the movement of chemically contaminated water through what is often a highly porous soil profile and possibly into groundwater.

This is an area of mainly winter rains that can be extremely heavy over short periods. It is also an area that is consistently and likely to be increasingly affected by low pressure cyclonic or ex-cyclonic rain systems. These also produce large amounts of rain over short periods in the summer-autumn period. (Moora experienced the 1999 floods as a result of one such system; there have been three similar but fortunately much less intense systems this year.) High rainfalls events over short periods may well cause ponds to overflow or, under the worst circumstance, either create the risk of or cause bund rupture, allowing contaminated water to spread over the countryside.

Any consideration of the risks and benefits of fracking must include regulation of location, engineering structure, construction, and maintenance of waste storage ponds, with each requiring independent monitoring. There should be a forward provision of funds for monitoring and the upgrading of ponds if required. Monitoring and maintenance of ponds should happen over an extended period well beyond well life or until some better means of handling the toxic residues is arrived at.

B3. AIR POLLUTION

Venting and gas leakage from wells, pipelines and processing plants poses serious environmental concerns directly for air quality for life, as well as for atmospheric warming and climate change. It is now established that past practices for flaring of waste gases fails to fully remove several highly toxic chemicals. Air pollution is therefore an issue which must be addressed to safeguard both human and animal life. The frequency of south-west to north-west winds places the human population in Moora at particular risk from air pollution from venting, flaring and gas leakage.

Air quality should be monitored for a period before any exploration and fracking occurs and continue into the future if they are permitted and commercial gas extraction follows. Measurement of gas leakage should likewise be a condition of any exploration/production and gas transport.

Waste gas treatment and Flaring procedures are now available that are much more effective in removing toxic chemicals and should be the minimum permissible should fracking and gas production occur.

B4. MONITORING

Monitoring has been identified in a number of cases above as highly important in the consideration of fracking and gas production. It also the view of Frack Free Central Midlands that should fracking proceed and monitoring be required that considerable base line data be assembled before any future fracking and gas extraction occurs. For a number of items monitoring should be ongoing well into the future. The industry should be responsible for the cost of such monitoring with it being carried out by a totally independent body or bodies. Industry should likewise be required to establish a fund for monitoring of waste and waste sites and water quality (widespread) beyond the time that gas production per se ceases.

B5. SITE AND LAND REHABILITATION

Site and land rehabilitation, as with monitoring, should be a requirement in considering if fracking and gas production should proceed and again the cost of same should be met by industry. This again means having funds provided in advance to be used for same once exploration, fracking and, if successful, gas production ceases. In come cases the time frame will be in decades rather than months or years. Once again monitoring would be required to ensure rehabilitation is successful; this should take account of our changing climate and the likelihood that both farming and natural systems may not resemble those at present.

The situation cannot be allowed to occur, as has happened in the USA, where large members of the industry undertake the exploration and development of gas fields, remove the bulk of gas when gas flows and volumes are high before on-selling their licence(s) and aging infra structure to much smaller companies. They in turn recover ever reducing quantities of gas before walking away once gas removal and return on investment becomes un-economic, leaving without the funds or prior commitment to carry out any rehabilitation.

B6. TOURISM

This is Wildflower Country!

Every year a high and growing number of people – local, Perth, state, interstate and international, come to the region to see the diverse and widespread array of wildflowers. These range from just interesting to beautiful, unique to exotic, few to vast in area of display and occasionally rare (and sometimes endangered); they are a consequence of the high biodiversity in the area. While the wildflower display is normally most outstanding in the period from late winter to early summer and most tourists come in spring, closer inspection of many areas of this diverse bush reveals there is rarely a time when one or often more plant species don't provide an interesting and often beautiful display. Efforts are being made by some people to have this recognised so the period for tourism is extended.

There a distinct possibility that exploration and drilling practices would remove or damage some areas of wildflowers. However, irrespective of the extent of the direct loss of bush and its flowers, having parts of the landscape covered in a network of seismic tracks, roads, wellheads, disposal ponds, pipelines etc., and in which multiple venting and flaring, and at times 24 hour lighting and work activities are occurring, would seriously detract from the beauty of the Mid-west and beyond and deter tourism. This would have a significant effect on regional economics.

SUMMARY

- The area surrounding Moora's sole town water supply, Kolburn, is at extreme risk of having gas exploration and fracking carried out in it under Permit EP321. It is feasible that fracking within this area could also occur via horizontal drilling under Permit EP 494.
- Kolburn has a Priority 1 rating and given the movement of water in aquifers should therefore be completely off limits for drilling over identified sections of the aquifer.
- Land to the west of Moora has been identified as a special agriculture/horticulture zone because of available groundwater and should never be considered for drilling and fracking, for either conventional or unconventional gas or oil, given the long term and ongoing importance of food production. Additional, quality groundwater will also be required in future for human consumption as population increases.
- Groundwater in the whole region extending from Gingin to Geraldton has twice within the past 12 years officially been declared as close to being fully committed, without any effects of lessening rainfall as a result of climate change being taken into account.
- The endangered Carnaby Cockatoos nest in the Moora and near regions but forages further afield to the west throughout the year. No further feeding habitat area can afford to be lost, either for seismic testing or drilling/exploration (or any other purpose), if the future of this species is to be ensured and it can be removed from the endangered list.
- Moora is close to one of the longest fault-lines in the world, the Darling Fault line – 950km long from north to south. There is further complex faulting of the sedimentary rock layers to the west in which the aquifers lie with the lowest of the sedimentary layers in these geological formations being the shale sediments containing oil and gas. Minor seismic activity (earth tremors) occur naturally, but larger tremors are always a possibility. Fracking and the reinjection of waste fluid is known to cause tremors so there is the risk of having them cause an increase in the magnitude of any natural tremors to a level where physical damage to human structures (e.g, buildings, roads, pipelines, bores), as well as possible aquifer integrity, occurs.
- Danger from chemicals: If drilling and fracking was to proceed, there would be the risk of multiple thousands of tonnes of chemicals being transported through Moora (and possibly other towns) and over many secondary and minor roads to drilling sites, with a concomitant increase in the risk of accidents and of spills, as well as increased road damage and cost of repairs.
- Disposal of fracking fluids – toxic waste water. This raises multiple risks by any method of disposal: Ponding - overflowing in heavy rains, leakage, bund failure; piped – lightning strikes and leaks; trucked – accidents and spills.
- Waste gas disposal, Venting and previously used flaring practice cause air pollution with toxic chemicals that have the ability to affect human health and that of other biological creatures. These activities also contribute to (increase) atmospheric warming and climate change.
- Degradation of productive farm lands with consequent reductions in food production from this food bowl.
- Loss of tourism because of damage to highly biodiverse bushland or the generally detracting impact on the vista of gas fields and their associated structures and activities.

CONCLUSION AND RECOMMENDATIONS

Until just a few months ago, the Environmental Protection Authority (EPA) had not ever chosen to do assessments for any Permit or Licence for gas exploration or production in the Central Midlands and beyond. Public pressure appeared to have prompted at least some 'activity' and now this enquiry.

The *WA Health* and the *Water and Environmental Regulation* Departments would also have been expected to provide open comment and guidance on their views of the impact of gas exploration and extraction activities in the region given potential risks to health and water supplies. One would definitely have expected the *Department of Water and Environmental Regulation* to have seriously and openly queried or objected to the granting of an exploration permit over an area such as the Kolburn water reserve or at a minimum proposed strict guidelines on where exploration activity could be carried out therein. The *Department of Health* would likewise have been expected to prevent old fashioned flaring in the likes of the Warro gas field given the known failure to satisfactorily remove toxic chemicals from release into the environment.

Unfortunately, both Departments seem to rely on the Environmental Protection Agency and the lead agency for regulation of petroleum activities in Western Australia, the Department of Mines, Industry Regulation and Safety. However, they in turn appear to accept the assurances of the industry that “best practice management” protects the land, air and water and they always comply with said practices and the regulations set down. Further, the EPA has, through the Beeliar 8 debacle, proven in Court that it does not have to abide by its own requirements.

No amount of regulation or best practice management can stop natural events like lightning strikes, high rainfall events (and flooding) and earthquakes, yet these may well occur in the area where exploration, drilling and fracking and possibly gas extraction are proposed, thereby creating a serious risk for land, water and/or air contamination. One suggests that such a risk would again be expected to see a permit being denied for areas covering the likes of the Kolburn water reserve – and now the Dinner Hill area.

The concluding primary recommendation below is further based on the following:

- We have a basic human right to clean air, and uncontaminated land and water.
- If Moora’s sole town water supply becomes contaminated, it will be closed down immediately contamination is detected/identified. The time for this to occur could mean possible health effects were already happening.
- Should contamination occur and the water be shut off we are unaware of any plan for providing this town with water or who would pay for it.
- There is a duty of care by all levels of Government to protect this State’s land, air and water from contamination and pollution so as to maintain clean food production, clean water supplies and ensure the best health possible for the population. The requirement for and ‘possible’ income to the state from gas and oil is of low importance. Production will be relatively short term, decades at best, and income to the state relatively insignificant compared to that from mining and much less important in the long term than from sustainable agriculture.

- There are now viable alternatives to gas/oil, namely:
 - ✓ Solar power, with various types of storage
 - ✓ Wind power
 - ✓ Wave power
 - ✓ Thermal – although limited
 - ✓ Hydro – when large volumes of water available
 - ✓ Electric Vehicles
 - ✓ HyTech Power – still in developmental stage(see Appendix 2 for references)

Primary Recommendation

Frack Free Central Midlands seeks an immediately and permanent ban on all further gas/oil exploration and new drilling and fracking over the entire land mass of the whole State of Western Australia, utilising current operational wells to provide any required, transitional gas.

Secondary Recommendation:

Should the decision be made to allow gas/oil exploration and *Hydraulic Fracture Stimulation* to proceed, in areas currently under a moratorium, regulation should remain **a whole of government process** BUT

- with much improved transparency of the process to the public;
- greater requirements on monitoring of a range of items by independent bodies prior to any on-ground action, during drilling, fracking and extraction and well beyond the end of any gas extraction for some items.
- a requirement of all commercial companies involved to establish adequate secured funds prior to the commencement of any on-ground activities for the management of any unplanned consequence of their activities and rehabilitation of sites impacted by their activities;
- including significantly greater, community consultation and consideration of the public view, including that of the indigenous population.

Appendix 1.

Land Use according to Priority Classification of Areas associated with Water Well-head and Reservoir Protection Zones

AGRICULTURE - ANIMALS

Land Use	Priority 1	Priority 2	Priority 3
Animal saleyards and stockyards	Incompatible	Incompatible	Restricted
Apiaries on Crown land	Restricted	Restricted	Restricted
Aquaculture eg crustaceans, fish and algae farms	Incompatible	Restricted	Restricted
Dairy sheds	Incompatible	Incompatible	Restricted
Feedlots	Incompatible	Incompatible	Restricted
Livestock grazing – pastoral leases	Restricted	Compatible	Compatible
Livestock grazing – broad acre (extensive)	Incompatible	Restricted	Compatible
Livestock grazing (intensive)	Incompatible	Incompatible	Restricted
Piggeries	Incompatible	Incompatible	Incompatible
Poultry farming (housed)	Incompatible	Restricted	Restricted
Stables	Incompatible	Restricted	Compatible

AGRICULTURE – PLANTS

Land Use	Priority 1	Priority 2	Priority 3
Broad acre cropping (i.e. non-irrigated)	Incompatible	Restricted	Compatible
Floriculture (extensive)	Incompatible	Restricted	Compatible
Floriculture (intensive)	Incompatible	Incompatible	Restricted
Horticulture – hydroponic	Incompatible	Restricted	Restricted
Horticulture – market garden	Incompatible	Incompatible	Restricted
Orchards	Incompatible	Restricted	Compatible
Nurseries (potted plants)	Incompatible	Restricted	Compatible
Silviculture (tree farming)	Restricted	Restricted	Compatible
Turf farms	Incompatible	Incompatible	Restricted
Viticulture (wine & table grapes)	Incompatible	Restricted	Compatible

DEVELOPMENT – COMMERCIAL

Land use	Priority 1	Priority 2	Priority 3
Aircraft servicing	Incompatible	Incompatible	Restricted
Airports or landing grounds	Incompatible	Incompatible	Restricted
Amusement centres	Incompatible	Incompatible	Compatible
Automotive businesses	Incompatible	Incompatible	Restricted
Boat Servicing	Incompatible	Incompatible	Restricted
Catteries	Incompatible	Incompatible	Compatible
Caravan and trailer hire	Incompatible	Incompatible	Restricted
Consulting rooms	Incompatible	Incompatible	Compatible
Concrete batching and cement products	Incompatible	Incompatible	Restricted
Cottage industries	Restricted	Restricted	Compatible
Dog Kennels	Incompatible	Restricted	Restricted
Drive in/take-away food shops	Incompatible	Incompatible	Compatible
Drive-in theatres	Incompatible	Incompatible	Compatible
Dry cleaning premises	Incompatible	Incompatible	Restricted
Farm Supply centres	Incompatible	Incompatible	Restricted
Fuel depots	Incompatible	Incompatible	Restricted
Garden centres	Incompatible	Incompatible	Compatible
Laboratories (analytical, photographic)	Incompatible	Incompatible	Restricted
Markets	Incompatible	Incompatible	Compatible
Mechanical servicing	Incompatible	Incompatible	Restricted
Metal production/ finishing	Incompatible	Incompatible	Incompatible
Milk transfer depots	Incompatible	Incompatible	Restricted
Pesticide operator depots	Incompatible	Incompatible	Compatible
Restaurants and taverns	Incompatible	Incompatible	Compatible
Service Stations	Incompatible	Incompatible	Restricted
Shops and shopping centres	Incompatible	Incompatible	Compatible
Transport depots	Incompatible	Incompatible	Restricted
Vehicle parking (commercial)	Incompatible	Incompatible	Compatible
Vehicle wrecking and machinery	Incompatible	Incompatible	Restricted
Veterinary clinics/hospitals	Incompatible	Incompatible	Restricted

Appendix 2.

Alternative Sources of Energy/Energy Use:

Carnegie Clean Energy – solar and wave – Northam, Mackerel Islands, HMAS “Stirling” and Albany:

<https://www.carnegiece.com/>

Bombora Wave Power – wave - Albany, Portugal, Wales, Scotland: <http://www.bomborawave.com/>

HyTech Power – Hydrogen – clean fuel – zero emissions – energy storage: <https://www.hytechpower.com/>
<https://www.vox.com/energy-and-environment/2018/2/16/16926950/hydrogen-fuel-technology-economy-hytech-storage>
<https://www.businessinsider.com.au/elon-musks-tesla-battery-south-australia-responded-in-record-time-2017-12>
<http://www.abc.net.au/news/2017-12-05/yes-sa-battery-is-a-massive-battery-but-it-can-do-more/9227288>
<http://reneweconomy.com.au/tesla-battery-solar-now-significantly-cheaper-grid-power-51011/>
<http://theconversation.com/teslas-virtual-power-plant-might-be-second-best-to-real-people-power-90319>
<https://www.theverge.com/2018/2/5/16973270/tesla-south-australia-worlds-largest-virtual-power-plant>
<http://www.solarreserve.com/en/technology/molten-salt-energy-storage>
<ttps://onestepoffthegrid.com.au/solar-salt-water-battery-storage-used-create-nanogrid-future/>
<http://reneweconomy.com.au/molten-salt-storage-for-rooftop-solar-sa-invention-wins-eureka-prize-99882/>
<https://www.scientificamerican.com/article/new-concentrating-solar-tower-is-worth-its-salt-with-24-7-power/>