NORTHERN TERRITORY GOVERNMENT

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

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File Ref:

The Hon Justice Rachel Pepper
Chair
Hydraulic Fracturing Taskforce
GPO Box 4396
DARWIN NT 0801

Dear Justice Pepper

RE: HYDRAULIC FRACTURING INQUIRY – INFORMATION REQUEST

In response to your information request of 11 September 2017, the Department of Environment and Natural Resources has prepared the attached Response to Request for Information.

Should you require any further clarification or information on the response please contact this office.

Yours sincerely

JOANNE TOWNSEND
Acting Chief Executive Officer

Date: 20 September 2017

RESPONSE TO REQUEST FOR INFORMATION

Request for Information by the Hydraulic Fracturing Taskforce on 11 September 2017

1. Surface spills and groundwater contamination

a) Comment on EHS report

DENR is only able to comment on the appropriateness of the hydraulic parameters and conceptualisation applied to the Green-Ampt Infiltration model.

- The analysis presented by EHS Support appears to be highly conservative.
- The model is developed with 52m of shallow clay/claystone/siltstone overlying the permeable limestone of the Tindall/Gum Ridge Formation and assumes Tanumbirini-1 represents the geological section. There is uncertainty regarding whether the upper 52m represents Cretaceous aged sediments, Anthony Lagoon Formation sediments or both. This necessitates the assumption that the permeability of the material is similar in the horizontal and vertical directions. However, if it is predominantly Anthony Lagoon Formation, there is evidence that indicates that this Formation is vertically impermeable as it confines the underlying Gum Ridge Formation. Notwithstanding this, the hydraulic parameters used to represent this layer are appropriate for the material described.
- For the underlying limestone layer, a porosity value of 0.4 is used. This value is 10 times the actual value applied by Knapton (2009). This would result in conservative modelling outcomes (ie. the estimated travel times would be much shorter than actual).
- No comment is made regarding the VLEACH modelling except that it should be recognised that one of the functions of drilling mud is to create an impervious lining on the borehole thus limiting fluid loss. Therefore, ongoing infiltration loss from a pit should not be expected.

b) Summary of conditions overlying various aquifers.*

* It is important to note the distinction between an aquifer which will occur within permeable layers or features below the water table, and the top of the geological formation which may exist above the water table.

Beetaloo Basin (between Larrimah and Daly Waters)

The Tindall/Gum Ridge Formation hosts the only known aquifer underlying this region. The average depth to the top of the Formation is 30m. The water table lies at approximately 45m depth and an aquifer could be expected to be intersected within 15m of the top of the water table (ie. at 60m).

Most of the region is covered by a layer of Cretaceous sediments. Surface expression of collapse structures in the limestone exist. However, open sinkholes that provide a preferential pathway to the aquifer are rare.

Beetaloo Basin (between Daly Waters and Elliott)

There are two known aquifers underlying this region:

The Anthony Lagoon Formation

The Anthony Lagoon Formation hosts aquifers across the central part of the Barkly region where the Formation exists either below 50m of Cretaceous sediment, or subcrops at shallow depth. The water table is at approximately 60m and aquifers may be intersected within 60m below the water table.

The uppermost horizon covering a large part of the Barkly Tablelands area is low permeability black soils. Collapse structures generally do not develop in the underlying Anthony Lagoon Formation.

The Gum Ridge Formation

The Gum Ridge Formation hosts an aquifer across the Barkly region. In most parts, it underlies the Anthony Lagoon Formation at depth, but subcrops at shallow depth on the basin margins. Towards the centre of the basin, the top of the Gum Ridge Formation may be intersected at approximately 300m depth. On the western margin near Elliott, the top of the Formation is at 40m depth. An aquifer could be expected to be intersected within 30m of the top of the Formation (ie. at 60m).

Where the Gum Ridge Formation exists close to surface, the soprolitic horizon appears to be highly clayey with occasional disaggregated limestone beds. There is unlikely to be preferential pathways in this horizon. However, permeability will exist.

Barney Creek Formation

There are relatively few bores drilled in this region and no detailed studies have been undertaken. Aquifers overlying the Barney Creek Formation generally occur at shallow depth and may be developed in shallow Cretaceous sediments, Proterozoic sandstone or in the karstic terrain of the Karns Dolomite Formation. A water table may exist at approximately 20 to 30m depth.

There is a surface layer of sand and clay soils in this region. Open sinkholes occur on the areas underlain by Karns Dolomite and these will represent pathways to the aquifer.

Arthur Creek Formation (Georgina Basin)

No hydrogeological studies have been undertaken in this region. Aquifers overlying the Arthur Creek Formation mostly exist in limestone or sandstone. The water table lies at approximately 80 to 100m in depth.

The surface of the region is covered by a sandy and clayey weathered horizon to approximately 50m depth. However, a comment regarding its permeability cannot be made other than the existence of weathering in the upper profile implies a degree of permeability.

Bonaparte Basin

The only hydrogeological studies conducted in this region are in the vicinity of the Keep River Plains. A palaeochannel aquifer exists directly beneath the black soil floodplain and small fractured rock aquifers exist in the Proterozoic rocks surrounding the floodplain. The palaeochannel aquifer may be intersected between 20 and 30m below surface, whilst bores in the Proterozoic fractured rock aquifers typically intersect supplies below 30m from surface. The water table lies at approximately 10 to 20m in depth.

Upper soil profile studies have been undertaken to provide information regarding the potential for salinisation under irrigation of various land types in the region of the Keep River Plains. Tickell et al (2006) find that under natural conditions, the black soil areas of the plains are low in permeability (recharge rate ~ 0.1 mm/y) and receive no fresh recharge, while the red soils which generally overlie the sandstone bedrock, receive moderate recharge (~40 mm/y) through the wet season. There are no areas where sinkholes occur that represent preferential pathways to the aquifer.

Amadeus Basin

The predominant aquifers in the Amadeus Basin have developed in sandstones, dolomites and shales. They occur in primary (intergranular) and secondary porosity (fractures, karst). Depending on location, the depth to aquifers will vary from near surface (say 30m) to over 100m. Similarly, the water table may lie close to surface to below 100m.

The only study of permeability undertaken in the Amadeus Basin is by Cook (2016) over the Mereenie Sandstone in the Rocky Hill region. This region is outside the area mapped as overlying prospective shale gas source rocks. However, the results could be indicative of weathered Mereenie Sandstone across the Amadeus Basin. The drainage rate established by this study was between 80 and 130 mm/y.

There are no features such as sinkholes which could represent a preferential pathway to the underlying aquifer.

Pedirka Basin

The main aquifer overlying the Pedirka Basin comprises mainly sandstones within the sediments of the Great Artesian Basin (GAB). The permeable sediments that form the aquifer may be intersected from ground surface around the margin areas of the basin with the water table existing at approximately 60m. Fulton (2012) reports that recharge to this aquifer occurs readily through ephemeral flow in the rivers that incise the outcropping sediments, although diffuse recharge through rainfall infiltration can occur. Beyond the subcropping margins, the sediments of the GAB are overlain and the aquifer is confined by the impermeable mudstones of the Cretaceous aged Rolling Downs Group of rocks. As the mudstone layer thickens to the south-east, the depth to the top of the GAB sediments increases to hundreds of metres. In the area underlain by the Pedirka Basin, the top of the GAB sediments may be intersected from surface in the western margin to hundreds of metres beneath mudstone towards the centre of the basin.

Fulton (2012) established that the sediments of the GAB are highly permeable where they outcrop. Where they are overlain by the Rolling Downs Group, the aquifer is confined and is not susceptible to surface infiltration.

2. Oxygen

Water Resources has no record of any analysis for dissolved oxygen undertaken for bores in aquifers overlying the Beetaloo Basin. The only data available within the region is for bore RN035927 in the Tindall Limestone near Mataranka. The dissolved oxygen was 0.1 mg/L.

References

Cook PG, Knapton A and White N., 2016, *The Potential Impact of Irrigated Agriculture on Groundwater Quality in the Rocky Hill Region, Northern Territory*. National Centre for Groundwater Research and Training, Australia (not yet published).

Fulton S. A., 2012., Technical Report *Great Artesian Basin Resource Assessment*, Department of Land Resource Management, Report 14/2012A, Darwin, October 2012

Tickell, S.J., Cook, P., Sumner, J., Knapton, A. & Jolly, P., 2006, *Evaluating the Potential for Irrigation Induced Salinisation of the Keep River Plains*, Northern Territory Department of Natural Resources the Environment and the Arts, Technical Report No. 30/2006D