19 December 2018

Ms Sue Folliott
TSA Management
Level 15 Brisbane Club Tower
241 Adelaide St
Brisbane Q 4000

By email sfolliott@tsamanagement.com.au

Dear Ms Folliott

I have reviewed the Department of Industry (DOI) letter dated 4 December 2018 and offer the following:

SOIL TYPE

1. The soil types on the majority of the cultivation on this site and the Cudgen plateau (SSF region) are red to brown Kraznozems. These soil types are well suited to horticultural crop production for a broad range of crops.

2. In terms of land capability classification, as developed by the NSW Soil Conservation Service (https://www.lls.nsw.gov.au/agriculture/land-capability) the soils of the Cudgen Plateau would largely be classified as;

3. *Class 1: "Suitable for a wide range of agriculture. It may be regularly cultivated. There are few, if any constraints to production".*

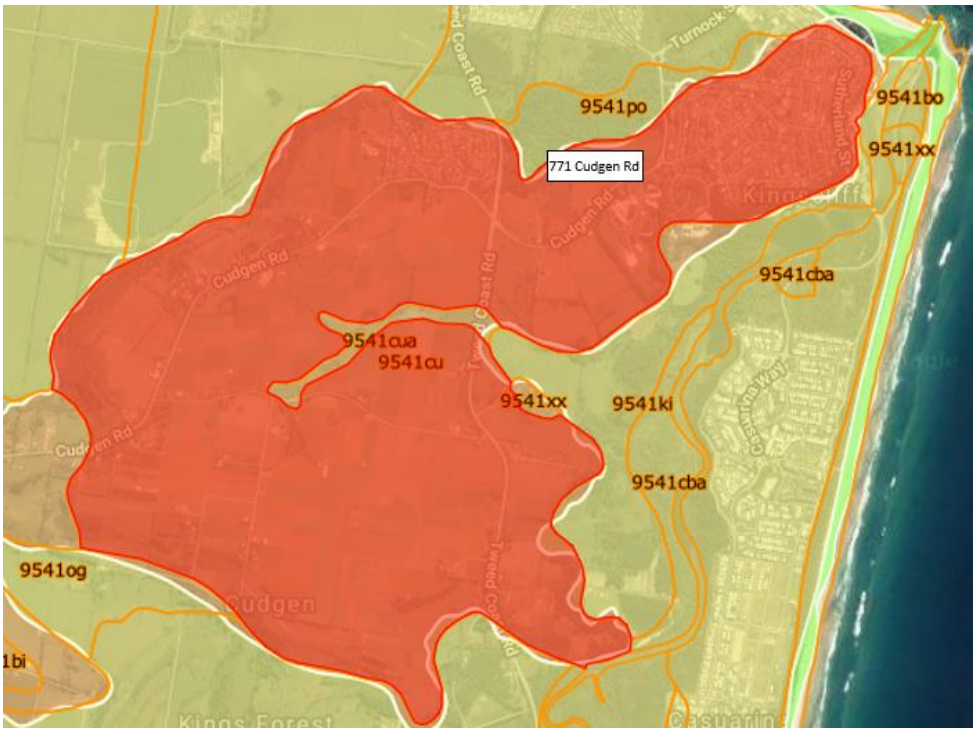
4. In respect of 771 Cudgen Rd the soils would be classed as class 1 to class 2;

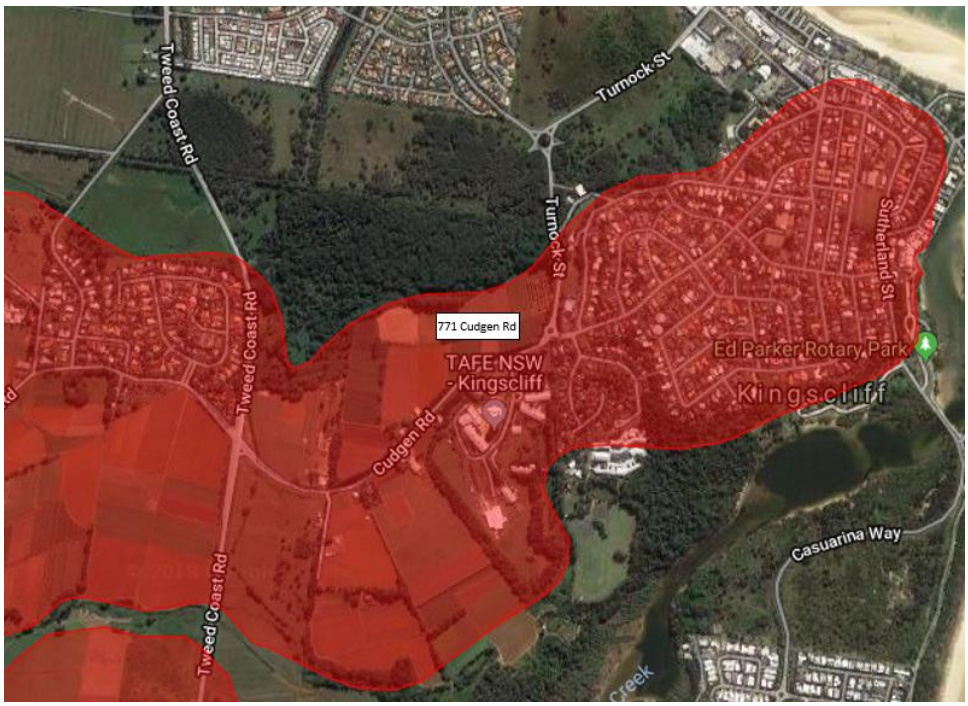
5. *Class 2: "Suited to a wide range of horticulture in rotation with pastures. Several minor constraints may limit suitability for continuous cultivation. These include stony and shallow phases of soil, moderate erosion hazard and degradation of the soil surface."*

6. The soil at 771 Cudgen Rd, particularly on the sloping blocks on the northern side of the property, has substantial amounts of surface rock present. Rock is also present on other paddocks within the property.

7. Further detail of the soil types within the Cudgen plateau (SSF region) is available in Isbell RF (2016) "Australian Soil Classification' 2nd edition and at https://www.environment.nsw.gov.au/eSpade2WebApp.

8. From the above website, the Cudgen plateau (SSF region) and the property in question has been mapped as Kraznozem soils as per the following images. Attached as ***Appendix A*** is a report relative to the Cudgen plateau vegetation and soil type.





9. If more detailed information, particularly in relation to any distinction between the soil on the top of the plateau and the surrounding escarpment, which there most probably would be, I would recommend a suitably qualified soil scientist conduct an evaluation. In saying this, typically soils on escarpments are of less quality than soils on plateaus as they are normally eroded and potentially shallow.

LOSS OF ARABLE LAND AND ASSOCIATED LOSS OF FOOD PRODUCTION VALUE

10. There is a total of 11.24 ha of cultivation that will be lost, in addition there is 0.58 ha of custard apple trees that appear to be abandoned and a 0.19 ha paddock that is unused. The total potentially arable area that will be lost is 12.01 ha.

11. Of the 11.24 ha of cultivation there is 7.02 ha of the site that is sloping from 6% to 17%. The sloping nature of these paddocks means they are prone to soil erosion and the farming of these paddocks is more difficult than the flat or moderately sloping balance of the property which is approximately 4.22 ha.

12. It is not possible to determine the precise loss of food value over the life of the project due to the following:

    a. No historic production figures or records have been provided for the land in question. Without these figures it cannot be determined what the productivity of the land area in its entirety may have been.

    b. It cannot be determined what the level of any possible future management of the property may be.

13. In considering these issues, I have put forward a number of examples that can be considered when the issue of determining the associated loss of food production over the life of the project is being considered. With the exception of sweet potatoes, the examples I have used are taken from NSW Department of Primary Industries Gross Margins for horticulture.

14. With the exception of sweet potatoes, the gross margins were established in 2009 and 2013 for the Sydney basin and inland NSW https://www.dpi.nsw.gov.au/agriculture/budgets/vegetable While they are not for the Cudgen plateau they do, however, provide an indication of what could be achieved for each of the example crops.

    Asparagus 2nd year $2,948.00/ha/annum
    Cabbage $2,315.00/ha/season
    Garlic $3,916.00/ha/season
    Lettuce $2,855.00/ha/season
    Onion $1,335.00/ha/season
    Potato winter $895.00/ha/season
    Sweet corn $10,805.00/ha/season
    Tomato (fresh) $19,353.00/ha/season

15. In relation to sweet potatoes only, and in the absence of any actual crop production information for 771 Cudgen Rd, I have assumed the following:

    a. For relatively flat ground, a marketable yield of 50t/ha/annum of sweet potatoes.
    b. For ground with a slope of greater than 5% a marketable yield of 35t/ha (50t – 30%).
    c. A selling price of $1,000.00/t.
    d. Growing, harvesting and marketing costs of $24,000.00/ha for flat ground and $20,000.00/ha for sloping ground.
    e. Due to disease management, sweet potatoes are only grown on average, every 1 year in 3.
    f. No other cash crops are grown on the 11.24ha within any relevant 3-year period.
    g. For flat ground a gross margin of $26,000.00/ha (50t x $1,000.00/t - $24,000.00 = $26,000.00) which is equal to $109,720.00 ($26,000.00 x 4.22ha).
    h. For sloping ground, a gross margin of $15,000.00 (35t x $1,000.00 - $20,000.00 = $15,000.00), which is equal to $105,300.00 ($15,000.00 x 7.02ha).

16. Based on assumptions a) to h) inclusive, the total estimated gross margin for all cultivation (11.24ha) would be $215,020.00 ($109,720.00 for flat ground GM + $105,300.00 for sloping ground GM).

17. As sweet potatoes would only be grown 1 year out of every 3, the average annual GM is therefore $71,670.00 (rounded) ($215,020.00 ÷ 3). If the entire potentially arable area of 12.01 ha was in production, the total gross margin would be $76,580.00/season or $6,376.00/ha/season.

18. Based on the above figures the range of possible loss of $10,749.00 (lowest gross margin/ha x 12.01 ha) to $232,430.00/season (highest gross margin/ha x 12.01 ha).

19. Amongst other things, the above examples do not take into account the following:

    a. The Net Present Value of gross margins relative to when the gross margins were established by NSW DPI.
    b. The possible use of double cropping such as for example, cabbage to lettuce in the same year.
    c. That the entire area of 12.01 ha may not be able to be cropped in any one year, due for example to requirements for crop rotations and or the impact of seasonal conditions.
    d. The availability of resources including machinery, finances and access to market.
    e. The impact of the sloping land on production or the cost of managing rocky ground, particularly for ground harvested crops like potato, which would incur increased labour costs to assist with harvest.
    f. The impact of the sloping land on production (yields/ha)
    g. The possibility of a tree crop being established such as avocado or macadamia.

20. There are many cropping options that could be considered in relation to the value of loss of food production over the life of the project. The value of the loss of food production is entirely dependent on the specific enterprise or enterprises that are chosen.

POSSIBLE MITIGATION OPTIONS

21. There is a total of approximately 103.15 ha of farming land that, according to the Environmental Impact Statement (EIS), is potentially underutilised. The represents approximately 20% of the Cudgen plateau (SSF region).

22. In considering the potentially underutilised farming land and options for mitigation, the Tweed Shire Council (TSC) has proposed the following:

    "Council is requesting that the state government develop and fund an agricultural support program to offset the impacts of the development including the loss of 14ha of State Significant Farmland and the associated socioeconomic impacts. The support program could identify current farming issues that impact on viability and help local farmers to overcome existing production and market access issues, create pathways for farmers to supply the new hospital with fresh food, and support the use of currently underutilised state significant farmland using mechanisms not limited to incentives, education and technical support."

23. The DOI letter also states the following:

    "DPI Agriculture considers that greater integration of local agriculture within the built form and environment of the hospital will assist with meeting the 'community asset' project aspiration

outlined on page 28 of the EIS. DPI Agriculture considers that a Statement of Commitment to utilise local produce as part of the hospital's food procurement would assist in maintaining agricultural production in the region. Hospital grounds could also be designed to include edible gardening opportunities for rehabilitating patients."

24. If the aforementioned options are implemented the hospital development may provide the catalyst for the underutilised land on the Cudgen plateau to be utilised for intensive agriculture.

Your sincerely
ARC Group

Tony Hartley
Director

Appendix A

cu CUDGEN

Landscape—low undulating hills and rises on Tertiary basalt plateau. Relief is 20–40 m; elevation 30–40 m; slopes 2–10% and steepening to 20% on plateau margins. Completely cleared closed-forest (rainforest).

Landscape Variant—cua—narrow drainage depression.

Landscape Variant—cub—sandy Krasnozems.

Soils—deep (>100 cm), well-drained Krasnozems (Uf5.12, Uf6.12, Uf6.21).

Limitations—acid and highly erodible soils with high aluminium toxicity potential.

LOCATION

Low hills and rises on Lamington Basalts forming on the north-easterly extension of the Burringbar Hills, extending into Kingscliff. Also includes Fingal Head and Cook Island. Type location is on the Cudgen Plateau (Area reference 5 55000E, 68 73000N).

LANDSCAPE

Geology

Lamington Volcanics—Tertiary basalt, with members of rhyolite, trachyte, tuff, agglomerate, conglomerate.

Topography

Very low to low undulating hills and rises on the Cudgen Plateau and nearby basalt caps. Elevation is 30–40 m on the Cudgen Plateau. Relief is 20–40 m and slopes are 2–10%, steepening to 20% on the flanks and edges of the Cudgen Plateau. Slope lengths are long (up to 1 500 m) on the plateau. Sideslopes are moderately long (150–200 m). Slope shape is simple within the plateau, progressively waxing towards the edges. Drainage is generally incipient. Drainage depressions are common.

Vegetation

Completely cleared closed-forest (rainforest). Most of this landscape is cultivated, but the original vegetation would have been be similar to that of the Limpinwood **(li)** or Green Pigeon **(gp)** soil landscapes.

Land Use

Vegetables (sweet potatoes, tomatoes, zucchinis, sweet corn, cucumbers, peas and beans) and tropical fruits (avocados, bananas, custard applies, mangoes, etc.). Residential at Cudgen and Kingscliff.

Existing Land Degradation

Topsoil erosion is a serious problem in the Cudgen area (Cole-Clark 1993). Soil structure decline is also a major problem (Riddler *et al*. 1982). Sheet and rill erosion have been observed during this survey.

Landscape Variants

The area mapped as **cua** is a narrow (up to 150 m) drainage depression. Otherwise, this variant has similar landscape features to the Cudgen soil landscape.

The area mapped as **cub** consists of Krasnozems mixed with aeolian sand, generally within the surface material.

SOILS

Detailed soil profile and distribution information can be found in Riddler *et al*. (1982).

Dominant Soil Materials

cu1—Red self-mulching light clay (topsoil and subsoil–Ap and B horizons)

Colour	dark reddish brown (2.5YR 3/3, 5YR 3/6)
Texture	light clay, often subplastic (increase <2 grades)

Structure	strong, closely packed polyhedral, 5–10 mm parting to 2–5 mm
Fabric	smooth-faced and rough-faced, distinct clay coatings are common (10–50%)
Exposed condition	self-mulching
Permeability	moderate to high
Field pH	6.0–7.0
Coarse fragments	none observed
Roots	common, 1–2 mm
Type location	cutting 100 m south of Curragundi (Grid Ref. 2 **52**900E, 68 **68**250N). Soil Data System card 32, 0–20 cm

cu2—Red medium clay (topsoil and subsoil—Ap and B horizons)

Colour	dark reddish brown (2.5YR 3/4, 5YR 3/4)
Texture	light medium to medium clay, often subplastic (increase <2 grades)
Structure	strong, polyhedral closely packed, 10–20 mm parting to 5–10 mm and 2–5 mm
Fabric	smooth-faced, occasionally rough-faced; distinct clay coatings can be common (10–50%)
Exposed condition	self-mulching
Permeability	moderate to high
Field pH	4.5–5.5
Coarse fragments	often common (10–20%) sub-angular gravels (6–60 mm) of parent material
Roots	common, 1–5 mm
Type location	cutting 100 m south of Curragundi (Grid Ref. 2 **52**900E, 68 **68**250N). Soil Data System card 32, 20–100 cm

Associated Soil Materials

The following materials from Carool **(ca)** soil landscape occur in localised steeper areas, generally on the plateau margins:
ca2—Dark friable clay
ca3—Brown crumbly clay.

Occurrence and Relationships

The soils of the Cudgen soil landscape are predominantly Krasnozems. Riddler *et al*. (1982) has a very detailed soils map and report of this area.

Plateau. Up to 40 cm of red, self-mulching light clay **(cu1)** overlies up to 100 cm or more of red medium clay **(cu2).** Boundaries are gradual to diffuse. **cu2** may often be the only soil material due to sheet and rill erosion [well-drained Krasnozems (Uf5.12, Uf6.12, Uf6.21)]. Total soil depth is 100–>200 cm.

Localised, steeper areas may have 5–10 cm of dark, friable clay **(ca2)** gradually overlying up to 100 cm of brown, crumbly clay **(ca3)** [well-drained Chocolate Soils (Uf6.21)]. Total soil depth is up to 100 cm.

QUALITIES AND LIMITATIONS

Productive arable land

Landscape Limitations

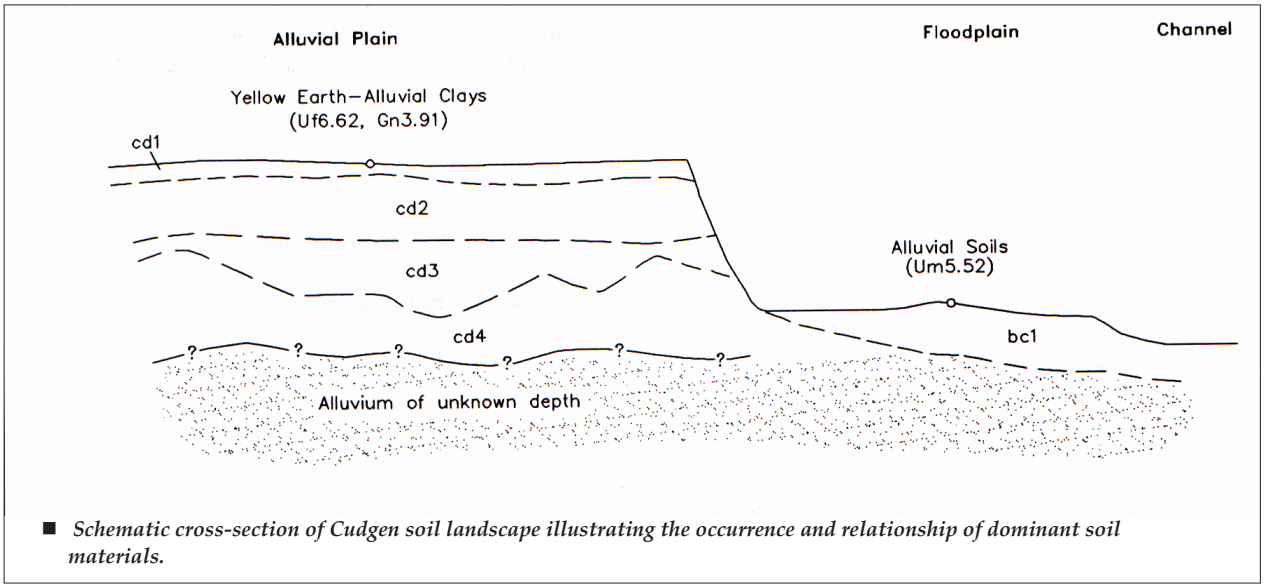
Mass movement hazard (localised)
Water erosion hazard on cultivated land

Soil Limitations

cu1	High shrink-swell High erodibility Moderate plasticity
cu2	Strong acidity High aluminium toxicity potential High erodibility Moderate plasticity

Fertility

Soil Materials as Growth Media. Krasnozems have excellent physical qualities but have some chemical problems—soil material fertility is moderate to high. Soils are strongly structured, have very high pH buffering capacities and have high organic matter contents. All soil materials have very high P sorption and therefore very low available phosphorus. Topsoil **(cu1)** is neutral and subsoil **(cu2)** is strongly acid and has a high aluminium toxicity potential. CEC ranges from low **(cu2)** to high **(cu1).** Base saturation is very high and response to fertilisers may be minimal. Riddler *et al.* (1982) note that there has been a decline in phosphorus since the 1970s and a serious recent decline in calcium levels.



■ *Schematic cross-section of Cudgen soil landscape illustrating the occurrence and relationship of dominant soil materials.*

Soil Profile Fertility. Moderate to high suitability as a growth medium for deep, well-drained Krasnozems. Soil volumes available for root penetration are high.

Erodibility

	K factor	Non-concentrated flows	Concentrated flows	Wind
cu1	0.006	very low-high	very high	high
cu2	0.015	low-high	very high	high

Erosion Hazard

	Non-concentrated flows	Concentrated flows	Wind
grazing	moderate	high	slight
cultivation	high	very high	high
urban	high	very high	moderate

Foundation Hazard

Low to moderate foundation hazard on plateau due to the shrink-swell potential of topsoils. Localised areas of moderate to high foundation hazard may exist on steeper slopes where mass movement hazard exists. Topsoil depth is 20–40 cm. Total soil depth is 100–>200 cm.

Septic Absorption

Generally low for **cu1** and **cu2. cu1** has high shrink-swell and soil materials can have high rock content and moderate to high permeability. Sites on slopes >15% should be avoided.

Urban Capability

Generally low limitations for urban development, but this land is best left under cultivation.

Rural Capability

Generally low limitations for cultivation and low limitations for grazing.

Sustainable Land Use Suggestions

This land is best retained as agricultural land due to the favourable characteristics and versatile nature of Krasnozems. Where residential development exists, appropriate waste disposal systems should be used (i.e., not septic).

Use of aggressive tillage practices should be avoided due to the associated decline in soil structure. See Cole-Clark (1993) for erosion control management recommendations.