# Is the addition of 24 T of nitrogen as a result of the Guthalungra Aquaculture Project predicted to significantly increase the nutrient load from the Don River Catchment?

## Introduction

At full operation, the Guthalungra Aquaculture project predicts **a net reduction** in sediment load on the immediate receiving environment of 4,574 T of sediment per median rainfall year and a small increase in dissolved nitrogen and phosphorus.

All changes in nutrient load are well within the natural variation observed due to annual variation in rainfall. However, it is of particular interest to know if the changes in nitrogen load (median value = 24 T/annum) released to the environment are significant and will they impact on the water quality of the receiving waters?

To determine this, an analysis of variance and power analysis of the available data was undertaken.

## Method

The mean annual volume of flows for the Elliott River for the 32 year period from 1973/74 to 2004/05 was obtained from the Qld Department of Natural Resources (http://www.nrw.qld.gov.au/watershed/precomp/121002a/afd.htm) as the *best available estimate* of runoff in the Don River Catchment. The average nitrogen load into the Don River Catchment was taken from the Great Barrier Reef Water Quality Action Plan and is 812 Tonnes/annum.

The estimate of total nitrogen loading in the Don River Catchment for each year was calculated according to the formula:

*Annual Nitrogen Load = (Annual Volume of Flow/Average Volume of Flow)*Average Nitrogen Load.*

The effect of adding 24 Tonnes of nitrogen to the loading for each year was tested for significance using analysis of variance (Zar, 1984)[1] and the capacity and number of years for which data would be required was further estimated using power analysis (Zar, 1984)[1] using the variance from the data currently available.

In accordance with a conservative approach, it has been assumed that the nitrogen load is proportional to the flow. This approach will result in an underestimation of the annual variability given that large flow events actually carry proportionally more sediment and nutrients.

## Result

We posed the question: *Would an addition of 24 T N of nitrogen lead to a significant increase in the nitrogen entering the Don River Catchment, taking into account the natural variability in runoff that occurs in this environment?*

We compared the annual loads with and without the additional 24 T with analysis of variance. The result of the analysis is shown in the table below and gives a P-value of 0.926 (a significant result would mean the P-value would be less than 0.05).

The analysis unequivocally shows that an additional 24 T of nitrogen is not significant given the variation in nitrogen input to the environment associated with variation in flow.

**Anova: Single Factor**

SUMMARY

| *Groups* | *Count* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Column 1 | 32 | 25984 | 812 | 1055201 |
| Column 2 | 32 | 26752 | 836 | 1055201 |

ANOVA

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups | 9216 | 1 | 9216 | 0.008734 | 0.925843 | 3.995893 |
| Within Groups | 65422459 | 62 | 1055201 | | | |
| Total | 65431675 | 63 | | | | |

We posed the question: *What is the additional nitrogen load before it becomes significant, given the variation in nitrogen input to the environment resulting from variation in flow and the number of years (32) of flow data available?*

To answer this question, a power analysis was conducted according to Zar (1984)[1] pp 134-135.

This analysis showed that it would take an additional 846 T of nitrogen entering the environment before there was a statistically significant increase in the load into the Don River Catchment.

To determine if the answer to this question was caused by the limited amount of data available, a further question was posed: *How many years of data would be required before the 24 T might become statistically significant?*

Power analysis is also the appropriate test for this question. The analysis showed that it would take 19,250 years of flow data before an increase of 24 T of nitrogen/annum could be detected as significant.

## Discussion

The statistical analysis clearly indicates that the addition of 24 T of nitrogen to the environment is not significant when compared with a conservative estimate of the annual variability in load. Therefore, impacts from the proposed discharge are unlikely to result in the natural assimilative capacity being exceeded. This is clearly demonstrated by the water quality modelling and supported by the advice from the Department of Primary Industries and Fisheries regarding potential impacts on seagrass, the regionally sensitive habitat most likely to be impacted. The Department with recognised expertise in the environmental impact monitoring of seagrass, have

specifically advised that the proposal (based on worst case water quality modelling) "…….may have an effect on the seagrass ecology of Abbot Bay, but that it is unlikely to be measurable or significant" (Supplementary EIS Appendix 7).

Some environmental scientists will argue that statistical significance is not a good measure of impact and present a qualitative argument along the lines of "even a small non significant addition will impact on the environment". However, the amount of nitrogen carried in the runoff in the 1990/91 year was equivalent of 203 years of net discharge from the Guthalungra Aquaculture Project, that in the 1975/76 and 1973/74 years were each the equivalent of over 100 years of net discharge from the prawn farm. On average, the nitrogen carried in the runoff each year is equivalent to 33 years of net discharge from the Guthalungra Aquaculture Project. It is therefore highly unlikely that the additional 24 tonnes of nitrogen will exceed critical thresholds for the assimilation of nutrients and result in serious, long term, or irreversible impacts on the environment. When considering such a statement, it is also important to note that the addition of some nutrients to aquatic environments is necessary for healthy ecosystems.

*It is our conclusion that an additional 24 T of nitrogen added to the environment each year as a result of the Guthalungra Aquaculture Project is statistically insignificant when evaluated in the context of annual variability in the load to the Don River Catchment. This analysis further supports the conclusions of the environmental impact assessment, that the proposed development will have no serious, long term, or irreversible impacts on the ecosystem in Abbot Bay.*

[1] Zar, J.H. (1984) Biostatistical analysis. Englewood Cliffs: Prentice Hall.