# Memorandum

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| From: | Tony McAlister | To: | Adrian Allen, Stockland |
| Date: | 8th December 2015 | CC: | |
| Subject: | Beerwah East Flood and Water Quality Constraint Report | | |

## *Executive Summary*

***Water quality poses a significant prohibitive constraint on potential urban development at the Beerwah East Identified Growth Area (IGA) site for the following reasons:***

- ***There will be a major change in pollutant export rates associated with converting forested land to urban residential land uses. This change will be too great to be managed via Water Sensitive Urban Design (WSUD) techniques to achieve no change in pollutant load from the site.***
- ***The majority of Beerwah East drains in a southerly direction into Coochin Creek. The majority of Coochin Creek is protected under State legislation as an area of High Ecological Value (HEV) – which requires a no change in water quality criteria to be upheld. Any changes in catchment pollutant exports from Beerwah East will adversely affect water quality due to the low water flows and volumes within Coochin Creek.***
- ***Coochin Creek subsequently drains into Pumicestone Passage at its most poorly flushed section ('The Skids'). This area in its current state already has the worst water quality within The Passage and has no capacity to accept any additional load from the catchment. Given its shallow depths and long water retention times, this area is the most susceptible part of the whole of Pumicestone Passage to any potential adverse water quality change.***
- ***The actual 'distance' of Beerwah East from Pumicestone Passage is irrelevant in terms of impacting the water quality of the Passage. The key determining influence is surface water run-off, with all flows from Beerwah East eventually entering, and affecting Pumicestone Passage and potentially creating adverse and detectable water quality change.***

# 1. Introduction

This report addresses a recent request made by Stockland to provide information on the overarching flooding and water quality challenges associated with urban development on the Beerwah East Identified Growth Area (IGA) site. Section 2 presents an '*Existing Situation Assessment*' which appraises and describes the relevant water-related drivers and constraints in regard to the Beerwah East IGA site, Coochin Creek and Pumicestone Passage; Section 3 presents a '*Summary of the Challenges facing Beerwah East*' and finally Section 4 outlines the relevant '*Summary and Conclusions*' of this report.

# 2. Existing Situation Assessment

Figure 1 illustrates the location of the Beerwah East IGA site. The flood and water quality related drivers and constraints in respect to this site are discussed below.

## 2.1 Flooding and Hydrology

Beerwah East drains in a south easterly direction to Coochin Creek. Coochin Creek would appear to have no significant existing flooding issues (with the possible exception of flooding of the Bruce Highway).

## 2.2 Estuarine Bathymetry and Hydrodynamics

### 2.2.1 Pumicestone Passage

Pumicestone Passage has two (2) entrances, with tidal processes propagating into the Passage respectively northward from Deception Bay and southward from Caloundra. These opposing tidal influences meet in the vicinity of an area called 'The Skids' (see Figure 2) creating a 'null' point with very low rates of tidal exchange, residence times for water in this area are considerable – often in excess of 2-3 months (dependent on catchment rainfall).

Estuarine depths within the Passage range from 8 to 10m in the south, 1 to 2m in the vicinity of 'The Skids' and 6 to 8m in the north. Tidal flows move in and out of the Passage, with there being a net northerly flow of the order of 50 $m^3/s$ along the Passage due to tidal phase differences between the two entrances and estuarine bathymetry.

As mentioned above, 'The Skids' is poorly flushed as it is located such that the tidal flows from the north and south largely cancel each other out in this area and the major water exchange influence is the above mentioned modest net northerly flow and the influence of catchment runoff in 'forcing' water from this area.

### 2.2.2 Coochin Creek

Coochin Creek is the largest catchment in the Beerwah area which ultimately drains into Pumicestone Passage. The majority of the creek is within either a freshwater or marine/estuarine High Ecological Value (HEV) area protected under State legislation.

Coochin Creek is shallow (2-3m) throughout its entire estuarine extent, with numerous rock and sand bars in the lower reaches and sand/mud banks further upstream. Tidal influences reduce with distance upstream from Pumicestone Passage.

## 2.3 Estuarine Water Quality

### 2.3.1 Environmental Values and Water Quality Objectives

Environmental Values (EV's) and Water Quality Objectives (WQO's) in Pumicestone Passage and its catchment have been scheduled by the Queensland Government. Figure 3 presents a plan illustrating the EV's while Table 1 summarises the key WQO's. The PLE1, PME1 and C1 zones are also designated as protected High Ecological Value (HEV) areas which have an overarching '**no change in water quality'** requirement that is subordinate to the scheduled (aspirational) WQO's.

Coochin Creek has no defined WQO's, however **all reaches** of this waterway downstream of (and some actually within) the Beerwah East site are designated as HEV - for which there is an overarching 'no change in water quality' requirement. The locations of the HEV areas in Coochin Creek are shown on Figure 3.

**Table 1 Relevant Estuarine Water Quality Objectives**

| Parameter | Location | | |
|---|---|---|---|
| | PLE1 - Pumicestone Passage North (enclosed coastal/lower estuary) | PME1 - Pumicestone Passage North (mid estuary) | Pumicestone Passage North - enclosed coastal/lower estuary) |
| Turbidity | 2-4-6 NTU | 5-7-10 NTU | < 6 NTU |
| Chlorophyll a | 1-1.6-2.5 µg/L | 1.3-2.7-4.0 µg/L | <2.5 µg/L |
| Total Nitrogen | 0.15-0.19-0.22 mg/L | 0.21-0.26-0.33 mg/L | <0.22 mg/L |
| Total Phosphorus | 0.015-0.018-0.021 mg/L | 0.013-0.017-0.023 mg/L | <0.025 mg/L |
| Dissolved Oxygen | 90-95-105 % saturation | 95-100-105 % saturation | 90-105% saturation |
| pH | 8-8.2-8.3 | 8-8.1-8.3 | 8-8.3 |
| Secchi Depth | 1.4-1.8-2.5 m | 0.8-1.0-1.4 m | >1.4 m |

### 2.3.2 Ambient Water Quality

Ambient water quality data collected in this region for more than 15 years by the Healthy Waterways led Ecosystem Health Monitoring Program (EHMP) and other earlier Queensland Government data collection programs were collated and analysed for this study. Figure 4 and Figure 5 presents the EHMP data for Pumicestone Passage together with relevant median water quality objectives for the area (the location at which Coochin Creek enters Pumicestone Passage is labelled). Figure 6 presents available long term nutrient data for sites in Coochin Creek and Bells Creek collected by the Queensland Government around 5 km upstream of Pumicestone Passage and Figure 7 presents longitudinal nutrient data for Coochin Creek - showing that there are far higher nutrients in the upper reaches of this waterway than further downstream.

### 2.3.3 Discussion

- When salinity and other water quality data presented in Figure 4 and Figure 5 are reviewed, it is apparent that the sections of Pumicestone Passage which receive run-off from Coochin Creek are:

  a) the most heavily affected by catchment run-off (due to the greatest range of salinities that are observed), and

  b) the parts of Pumicestone Passage which have the poorest water quality in general.

- 'Downstream' of Coochin Creek, Pumicestone Passage water quality levels are non-compliant for turbidity, chlorophyll a, total nitrogen, total phosphorus, dissolved oxygen, pH and secchi depth. Any additional pollutant load from the Coochin Creek catchment will make this non-compliance even worse.

- Coochin Creek has a **no change in water quality constraint** throughout its **entire length** downstream of the Beerwah East site. This will be extremely difficult to achieve for **any** land use change due to the long residence times and low rates of dilution and mixing which will occur within the creek. This is a totally different scenario for other sections of Pumicestone Passage such as adjacent to the mouth of Bells Creek, where the 'no change' water quality boundary is actually at the junction of Bells Creek and Pumicestone Passage, where there is much greater assimilative capacity (cleansing) and mixing and also much better water quality.

## 2.4 Catchment Condition

The majority of the Beerwah East IGA site is under a long term licence with the Hancock Timber Resources Group (expires 2109) and is used for forestry as well as recreational activities. These land use activities produce low rates of catchment run-off and pollutant export. Any potential change of land use to urban residential form would create a significant increase in catchment run-off and pollutant loads, which would create a proportionate negative impact on downstream water quality i.e. Pumicestone Passage, where the site subsequently drains into. **The relative magnitude of such changes would be far smaller and more easily managed were the site (for example) already cleared and being used for grazing or agricultural purposes.**

# 3. Summary of the Challenges Facing Beerwah East

## 3.1 Flooding

For Beerwah East, there appear to be minimal potential flooding constraints.

## 3.2 Water Quality

### 3.2.1 Land Use Change

The potential conversion of the Beerwah East site from forested to urban residential form will significantly increase stormwater flows and pollutant loads into Coochin Creek and ultimately Pumicestone Passage. In order to achieve the minimum 'no change' water quality performance criteria required to protect downstream high ecological value (HEV) waterways within the Pumicestone Passage catchment, significant water quality management intervention will be required.

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) modelling has been conducted to simulate the increase in stormwater flows and pollutant loads from a notional 1 km² parcel of land on the Sunshine Coast, which is hypothetically converted from forest to agriculture and ultimately urban land form. The respective simulated flows and pollutant loads predicted by this modelling are summarised in Table 2 below.

**Table 2 MUSIC Model Results**

| Land Use Case | Flow (ML/yr) | TSS (kg/yr) | TP (kg/yr) | TN (kg/yr) |
|---|---|---|---|---|
| Forest | 200 | 2,010 | 8.1 | 97.7 |
| Agricultural | 293 | 28,300 | 121 | 691 |
| Urban | 521 | 57,600 | 130 | 1, 100 |

In order to achieve a no change in site pollutant load scenario, which will be required in order to see no change in downstream water quality for HEV protection reasons, the significant stormwater treatment reductions summarised in Table 3 would be required.

**Table 3 Stormwater Treatment Requirements**

| Land Use Change Case | Flow (% removal) | TSS (% removal) | TP (% removal) | TN (% removal) |
|---|---|---|---|---|
| Forest to Urban | 62% | 97% | 94% | 91% |
| Agricultural to Urban | 44% | 51% | 7% | 37% |

It would be extremely difficult (if not impossible) and would require significant land take to provide the extensive stormwater storage and treatment infrastructure to achieve the stormwater load reduction requirements associated with the 'forest to urban' land use change case. The 'agricultural to urban' land use change case could be far more readily managed using conventional WSUD techniques.

### 3.2.2 Location

The critical location at which the statutory 'no change' in estuarine water quality criteria will apply in Coochin Creek is some **10 km upstream** of the junction of Coochin Creek with Pumicestone Passage and the freshwater water quality location **adjoins the boundary** of the Beerwah East landholding. These are difficult (if not impossible) locations at which to achieve a no change in water quality given the long residence times and low rates of dilution and mixing that occur at these locations and the significant proportion of the upstream catchment that will be affected by the potential development of Beerwah East.

# 4. Summary and Conclusions

## 4.1 Summary

In summary:

- **Flooding** is unlikely to be a constraint for potential development of the Beerwah East IGA site
- **Water Quality** is a prohibitive constraint to development at the Beerwah East IGA site for the following reasons:
  - There will be a major change in pollutant export rates associated with converting the site from forested to urban residential land uses;
  - The HEV boundaries within Coochin Creek are very close to Beerwah East and any minor changes in catchment pollutant export rates will adversely affect water quality within Coochin Creek and subsequently Pumicestone Passage due to the low water volumes and dilution rates that occur within the small creek; and
  - Currently, Pumicestone Passage at its junction with Coochin Creek is already showing the greatest degree of exceedances of statutory Water Quality Objectives (WQO's) of any parts of The Passage. It has no capacity to accept any additional load from the catchment and in the event of any such additional load, given its shallow depths and long residence times, this would be the most susceptible part of the entire Pumicestone Passage to adverse and detectable water quality change and associated environmental harm.

## 4.2 Conclusions

This report concludes that that no large scale urban development should be allowed on the Beerwah East site for the reasons outlined above.

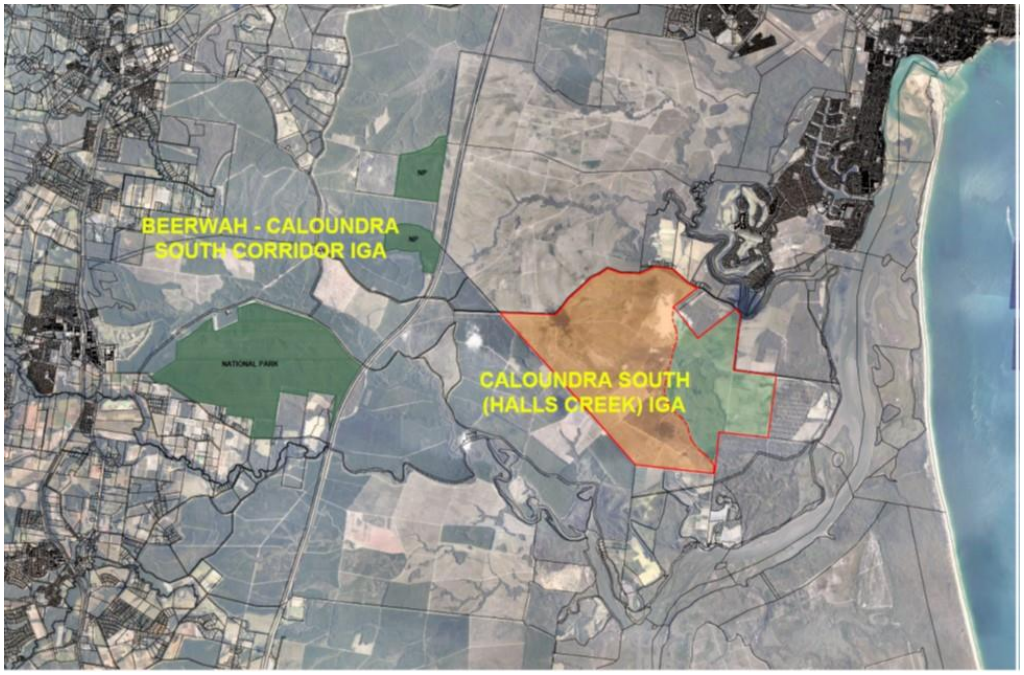


**Figure 1 Beerwah East Locality**

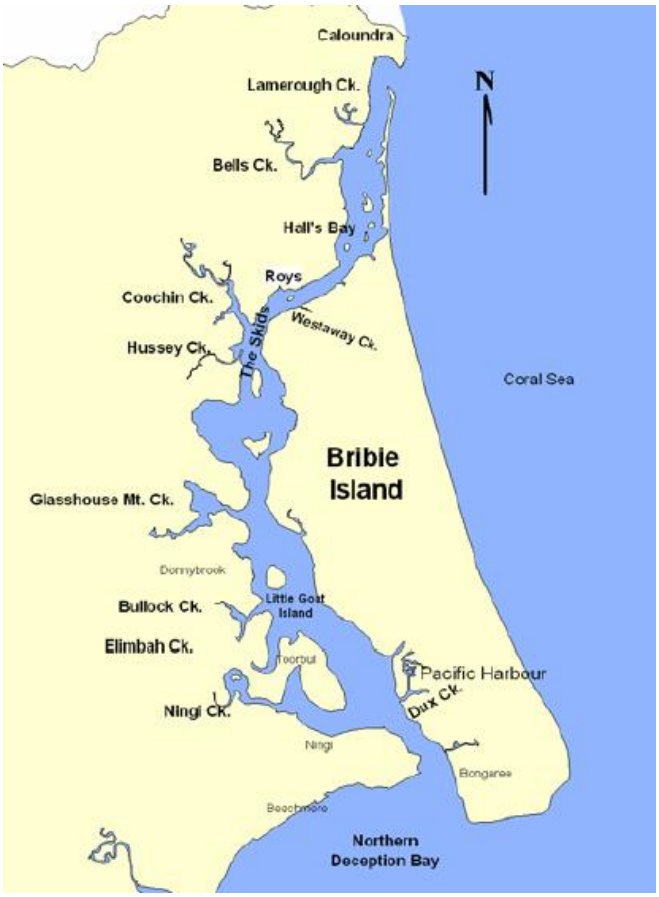


**Figure 2 Pumicestone Passage Locality**

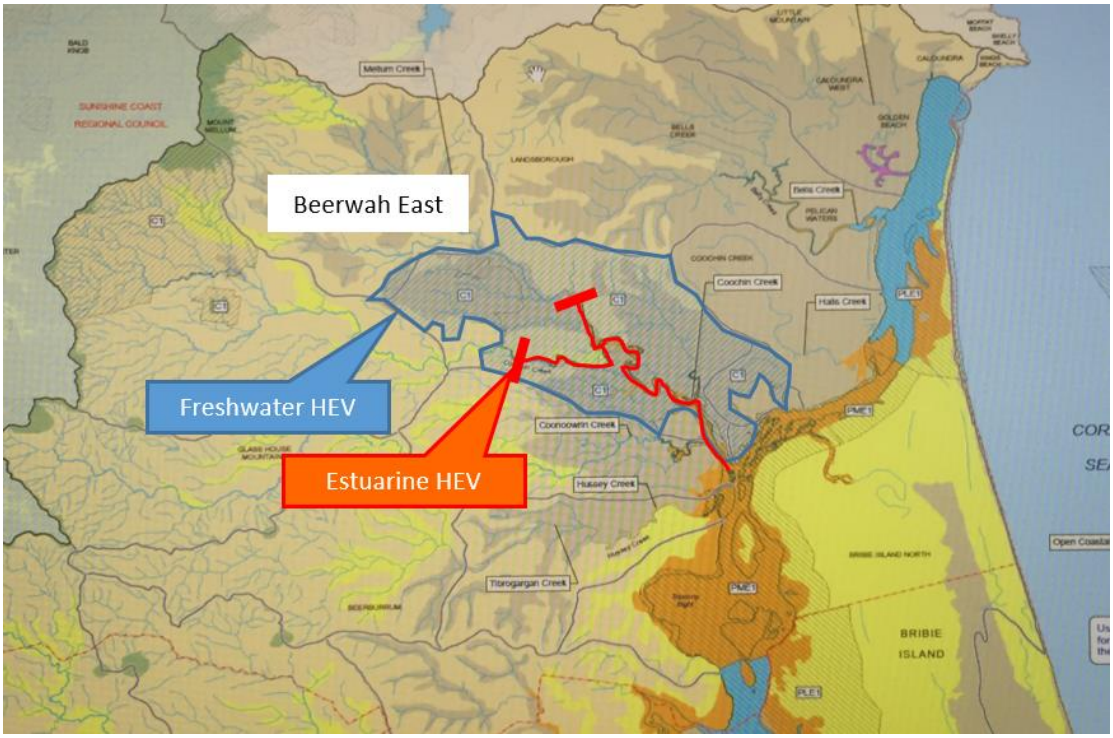


**Figure 3 Coochin Creek and Pumicestone Passage HEV and EV Locations**

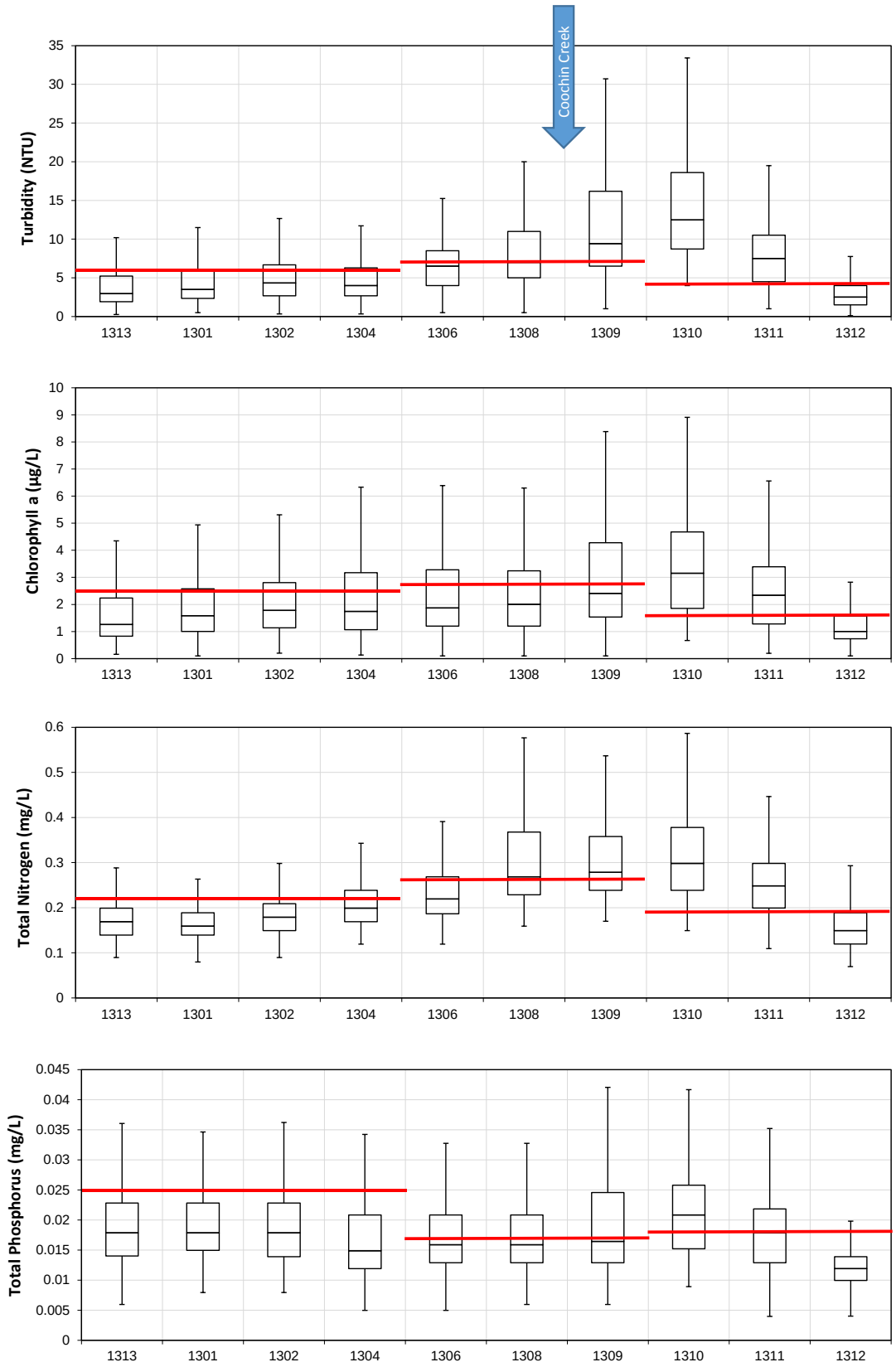


**Figure 4 Pumicestone Passage Water Quality Data (from 160 surveys collected between 4/10/2001 and 1/5/2015)**

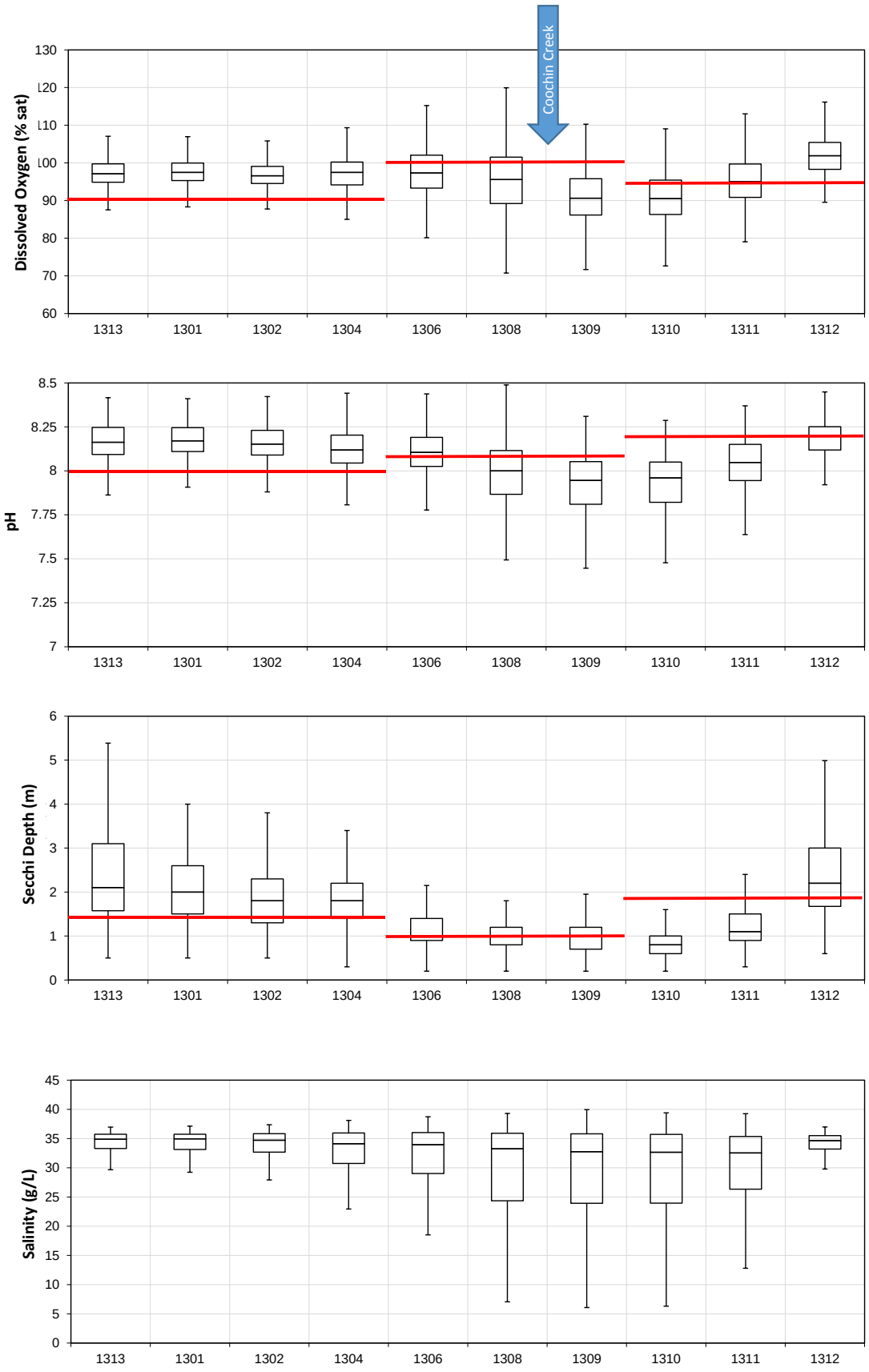


**Figure 5 Pumicestone Passage Water Quality Data (from 160 surveys collected between 4/10/2001 and 1/5/2015)**

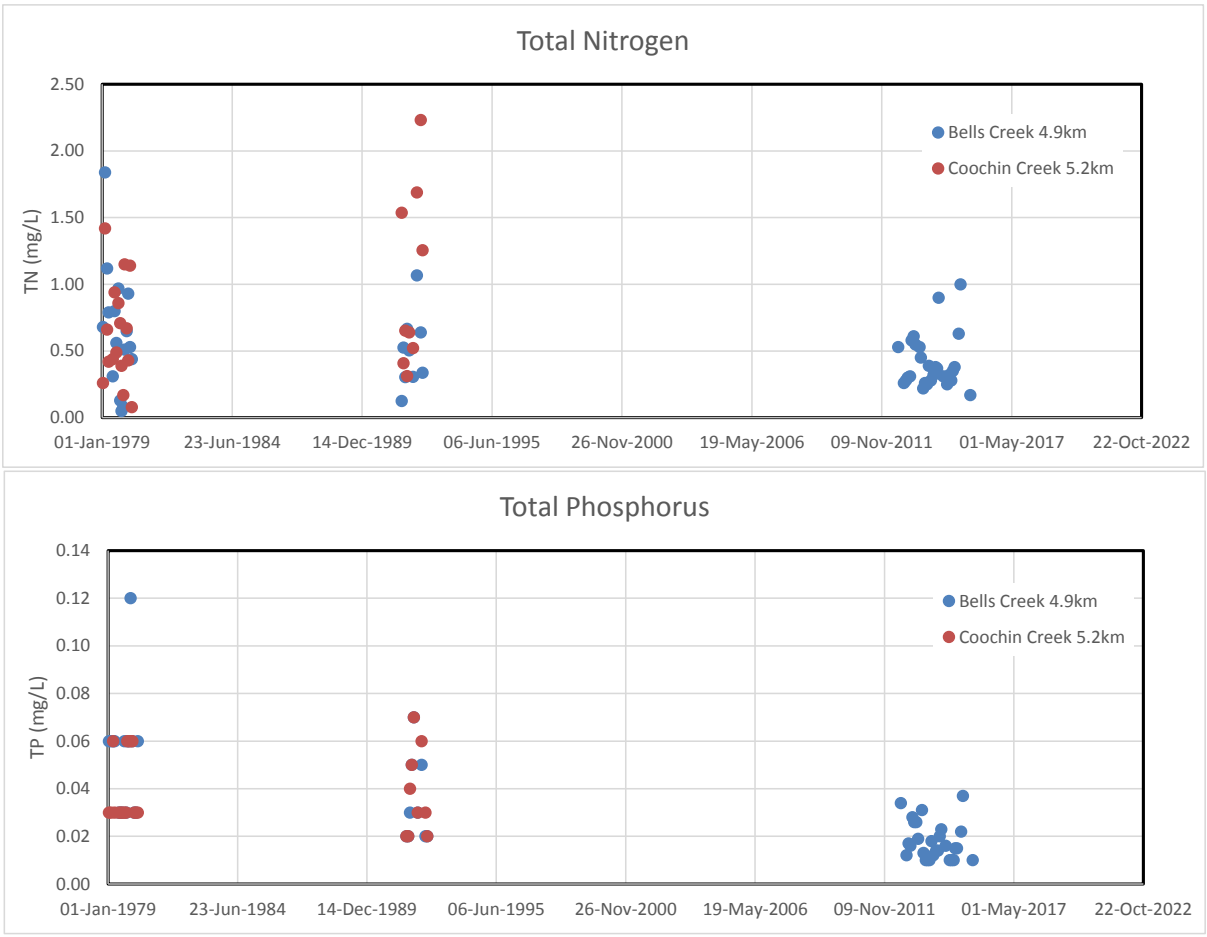


**Figure 6 Coochin and Bells Creeks Water Quality Data**

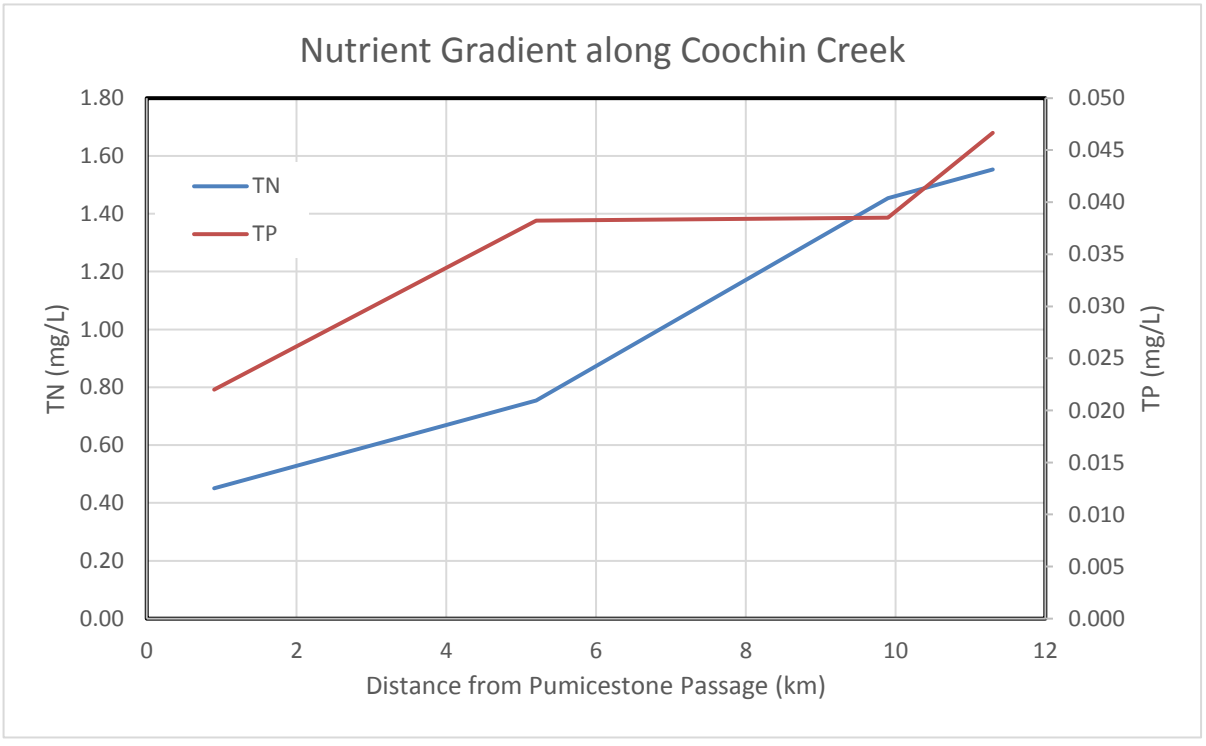


**Figure 7 Coochin Creek Nutrient Data (from up to 47 surveys collected between 7/2/1978 and 2/7/1992)**