

Our Ref LJ8827/L1902 :sge

Contact P.D. Treloar



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Attention: Ms Veronica Cavanough

Dear Veronica,

## **LAUDERDALE QUAY DIIS – COASTAL PROCESSES AND CLIMATE CHANGE SUBMISSION**

### **Preamble**

The purpose of this document is to provide detailed responses to the submission made by Mr Daniel Ray of Aquatic Science on behalf of Save Ralphs Bay Inc to the Resource Planning and Development Commission in respect to proposed development of Lauderdale Quay.

The submission from Mr Daniel Ray addresses issues of estuarine circulation, potential nutrient impacts, water column stratification and sediment transport associated with the proposed Lauderdale Quay development and in doing so makes reference to Appendix L1 of the DIIS document (coastal processes investigations) prepared by Cardno Lawson Treloar Pty Ltd. It is these points to which we respond. Where Mr Ray states that the Lauderdale Quay investigations have not drawn-on the CSIRO Derwent region investigations he is incorrect and appears to overlook the fact that the small region of northern Ralphs Bay has characteristics that are different from those of the 'wider Ralphs Bay region'; for example, the influence of Derwent River flows at the site, which is negligible there, but of some importance to the greater area.

### **Estuarine Circulation**

Estuarine circulation and flushing is discussed in the context of water quality and the effects that changes might have on those processes. Results from the CSIRO modelling are drawn-on by Mr Ray showing flushing times in the Lauderdale area of 2 – 3.5 days. It is stated that this area of the estuary is poorly flushed. However, there is some contention in this statement. This area of the estuary does not flush as quickly as other areas; however, e-folding times of less than 4 days are considered excellent for a natural system. There are many other natural estuarine and constructed waterway locations around Australia which display much larger e-folding times that do not result in adverse water quality outcomes. Brisbane Water (Gosford, NSW), for example, shows flushing (e-folding) times in some areas in excess of 30 days; however, water quality is considered good. The main issue is the limitation of nutrient loads, which is the case at Lauderdale Quay where run-off will be treated to a high degree and there will be a reduction in nutrient leakage from the existing Lauderdale sewage system as part of this development.

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The e-folding time parameter is a subjective one and is heavily influenced by the initial extent of the tracer introduced to the waterways initially and then monitored as concentration reduces. That is, different initial tracer extents will provide different flushing times of the same area. In this way, the e-folding measure is suitable only for direct comparisons of pre-and-post-scenario cases, for example, and not useful for making direct water quality conclusions. Water quality outcomes at a particular site are dependant not only on flushing time, but also nutrient loading and the ecology of the aquatic environment. This has been addressed in the coastal processes investigations and shows the canal system performs adequately in relation to Water Quality guidelines for the site.

An example site is the Port Geographe canal estate development at Busselton in Western Australia where the same Delft3D modelling system has been applied by Cardno Lawson Treloar. That canal estate, at its present stage of development, includes e-folding times up to 15 days (based on analyses of Rhodamine dye field testing and 3D modelling). To date, no adverse water quality outcomes have been recorded at the site which has existed for over 10-years. The State Administrative Tribunal of Western Australia has established a panel of experts that includes Cardno Lawson Treloar, state government representatives, Council and independent experts to oversee the management of water quality in future stages of the Port Geographe development.

### **Nutrients**

Further discussion on nutrients does not specifically relate to the coastal process investigations and hence a response to these matters is left to others of the DIIS team.

### **Salinity**

The discussion provided by Mr Ray within his submission on the existing stratification measured in Ralphs Bay is realistic, drawing upon data presented in the report prepared by Koehnken (2008) for Aquenal. This data was used also by Cardno Lawson Treloar in their investigations. That report refers to water quality sampling locations from the Derwent River to Lauderdale – RB8 being in the river and RB1 being in the inter-tidal area of Lauderdale in Ralphs Bay. During all seasons Ralphs Bay shows various degrees of stratification that decrease towards the Lauderdale shoreline. Over the intertidal flats no stratification is observed (RB1). However, the conclusion that the canals will stratify because the existing RB2 location, of similar depth to the proposed canals, is stratified is misleading. Stratification of the water column is in part a result of water depth, but is also influenced by the hydrodynamics. The development of the canal system will alter these hydrodynamics, a point which is not addressed in Mr Ray's submission.

The modelling technique adopted in the investigation made direct use of the measured data; contrary to the assertions within the submission prepared by Mr Ray. Salinity and temperature profiles from Location RB4 data were applied at the 3D model boundary and the existing case verified at the other 3 locations (RB3 to RB1). This showed that the model replicates the existing stratification within Ralphs Bay extremely well. Using this verified model setup the developed case was then simulated and no substantial stratification was observed within the proposed canal development.

The Delft3D model system has been employed at a number of estuarine and canal locations around Australia. Where available, the model has been shown to replicate measured salinity, temperature and hydrodynamic data very well. There are also examples of existing canal developments that do not show stratification propagating throughout all areas of a canal that are similar depths. Figure 1 shows an example of salinity profiles from Port Geographe measured on 9 March 2009 at three locations along a canal branch. Site 3 is near the entrance of Port Geographe in Geographe Bay, Site 2 is mid-way along a canal branch and Site 1 is near the end of a canal branch. The data clearly shows that although a vertical salinity profile is evident at Site 3 and somewhat less at Site 2, Site 1 has little to no vertical salinity profile. Whilst the Port Geographe example sited in Figure 1 is for an 'inverse' estuary summer situation; during winter Port Geographe has a more conventional estuarine salinity profile (that is, increasing salinity towards the ocean) and the outcomes are similar. At the heads of the canals there is little to no stratification whilst near the entrance stratification is present.

This example shows that while one area of a hydraulic system may exhibit stratification, due to normal hydraulic processes that stratification may not be present at another location within the system.

Another example is Lake Macquarie in NSW where stratification is caused by cooling water discharges from a power station. Attached Figure 2 compares measured and modelled temperature profiles that demonstrate good stratification agreement between the Delft3D model and recorded data. Figure 3 presents a time-series plot of measured and modelled (Delft3D) water temperature conditions at Port Geographe over a period of a few weeks. Considering the uncertainty in the input solar radiation data, the agreement between modelled and measured water temperature over time is very good.

### **Sediment Transport**

The amount of deposition cited by Mr Ray in his submission is speculative and claims of up 2m of channel infill are based on the assumption that the channel across the intertidal flats was previously dredged to -3m AHD. In any case, to gain an understanding of the potential rates of channel infill, an understanding of the sediment transport processes needs to be developed before such broad sweeping conclusions are made. It is asserted in Mr Ray's submission that sediment movement over the shallow sand-flats will cause sedimentation of any channel that is dredged through this area, with reference made to historical aerial photography. Cardno Lawson Treloar concur with this position, although would query the rates put forwards. The sand flat areas try to re-establish their equilibrium when disturbed. This process is enabled by tidal flows to some extent (although tidal currents are very low), but is predominantly due to bed shear stresses developed by wave action over the inter-tidal area. Modelling of the existing wave climate is consistent with this opinion.

However, once the development is constructed the wave climate over the intertidal area is altered. Furthermore, a section of the inter-tidal area will be reclaimed by the works, thereby removing any potential for sediment transport from north of the proposed southern canal towards the new canal. The assumption that the southern canal of the development "will be filled in from the sand flats to the south" is incorrect. The modified wave climate, post-development, will be such that waves will transport sand over the sand flats in a partly southerly direction, not northerly as would be required to cause infilling of the canal.

The predominant direction of wind within Ralphs Bay is from the south-west; as shown in Figure 3.3 of L1. Under these conditions wave refraction processes result in waves that propagate along the proposed southern canal and 'peel-off' the canal batter slopes in a southerly direction, see Figure 4 attached. This process would result in minor southerly transport of sand over the southern sand-flat area, noting that most of the time wave conditions will not cause any sediment transport. Only 13% (approximately) of the winds at Lauderdale occur from the southerly to easterly sectors, the conditions required to cause northerly transport over the southern sand-flat areas. Of these winds no wind speeds above 6m/s have been recorded (see Appendix C of DIIS Appendix L1) and under such conditions little to no sediment transport would be expected. Therefore, the sediment supply issue expressed in Mr Ray's submission is incorrect and it would be expected that once the development was constructed very little infilling of the canals would occur. This is consistent with the outcomes of the coastal processes investigations.

Vantree (2003) discusses changes to the dredged Lauderdale channel and movement of the dredged spoil that was placed in the inter-tidal zone north of the Lauderdale canal entrance. That spoil has been gradually transported shoreward (not north or south), see Figure 7 of Vantree (2003), with perhaps a minor accumulation of longshore transport on the northern side of that feature. Figures 6 and 7 of Vantree confirm the low rates of sediment transport on this area – remnants of the canal from 1927 still remain after 80 years.

## Other Canal Developments

The submission's reference to the potential negative impacts of canal developments is vague. It is our experience that the performance of canal systems varies on a case by case basis. This is confirmed in the Appleyard (2009) quotation used in Mr Ray's submission that states such outcomes are dependant on the geometry (and design) of the canals. At other locations, both in Western Australia and South Australia, there are examples of canal systems that perform in an environmentally acceptable manner, especially those that have undergone the level of investigation that has occurred in this instance.

We hope that this response is helpful.

Yours sincerely,

*P.D. Treloar*  
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for **Cardno Lawson Treloar**

## References

Cardno Lawson Treloar (2008a): Lauderdale Quay Development Integrated Impact Statement, Coastal Processes Investigations - L1. Report (LJ8827/2/R2457) Prepared for Walker Corporation.

Cardno Lawson Treloar (2008b): Lauderdale Quay Development, Coastal Processes Investigations – Climate Change Issues - L2. Report (LJ8827/2/R2473) Prepared for Walker Corporation.

Koehnken (2008): Baseline Water Quality Report, Ralphs Bay & Adjacent Derwent Estuary. Report Prepared for Aquenal Pty Ltd by Technical Advice on Water.

CSIRO (2006): Summary of CSIRO Hydrodynamic Modelling of the Derwent Estuary.

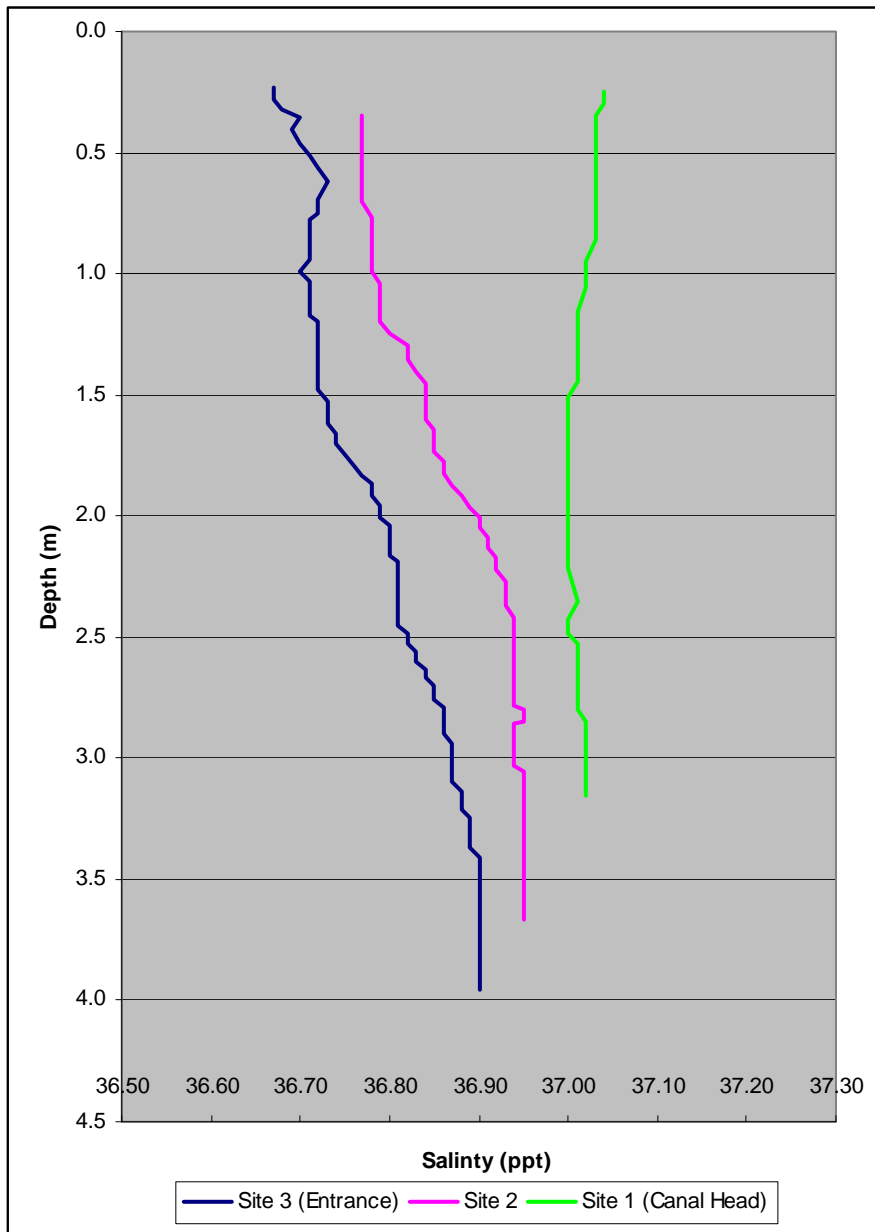
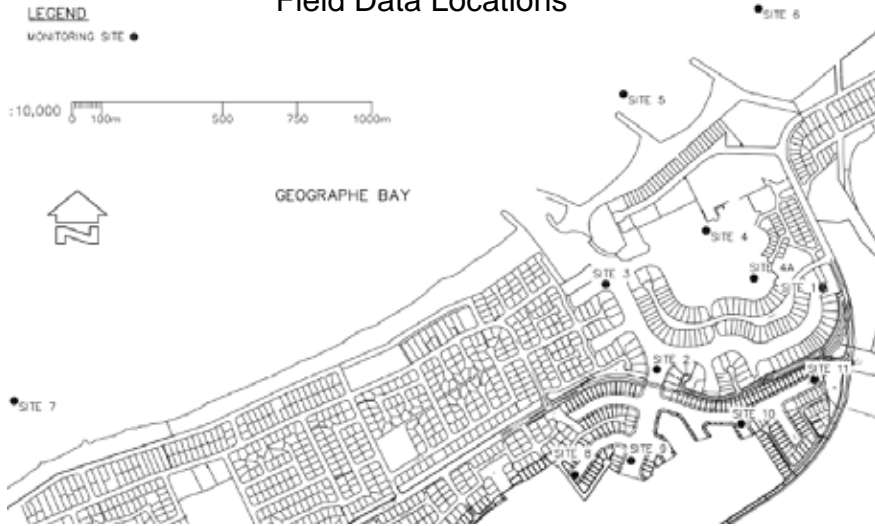
National Tidal Centre. Bureau of Meteorology (2009): The Australian Baseline Sea Level Monitoring Project. Monthly Data Report, March 2009.

National Tidal Centre. Bureau of Meteorology (2009): The Australian Baseline Sea Level Monitoring Project. Annual Sea Level Data Summary Report, July 2007-June 2008.

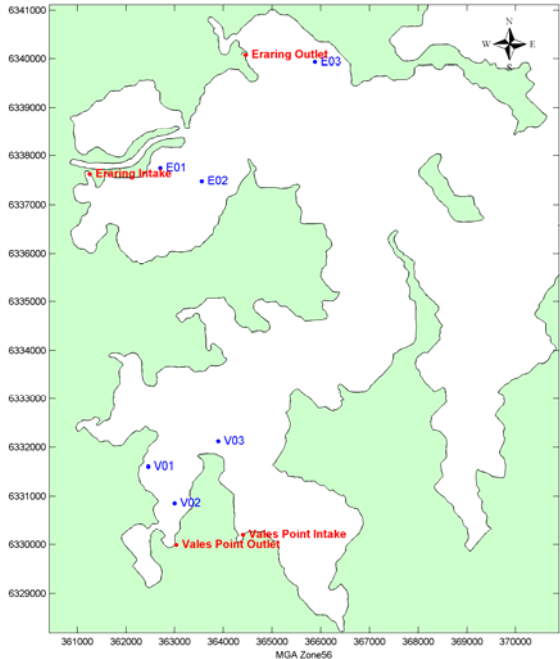
Vantree (2003): Lauderdale Marina Village, Coastal Engineering Issues. Report prepared for Walker Corporation & Tominex Holdings Pty Ltd.

Water Research Laboratory (2008): Coastal Processes, Coastal Hazards, Climate Change and Adaptive Responses for Preparation of a Coastal Management Strategy for Clarence City, Tasmania. Technical Report 2008/04, October, 2008.

# Field Data Locations



# Field Data Locations



Blue - Modelled Red - Field Measurements

