The Adelaide Coastal Waters Study is approaching the ‘home straight’. Over the next few months, most of the research tasks will draw to a close, and CSIRO’s project management team will commence collating, distilling, and synthesizing the results with two clear objectives in mind. First and foremost, we will continue to engage with our scientific teams to develop the ‘big picture’ view of Adelaide’s coastal marine environment — that is, to couple existing knowledge with new insights generated by our study to provide a clearer understanding of this complex ecosystem.

Consistent with the study objectives, we will focus our efforts on the key areas of concern: seagrass loss; water quality; and sediment stability. These are related issues and generating a detailed understanding of the complex interactions between them has proved to be a major challenge for our researchers. To assist this process we have developed a detailed conceptual model of the coastal marine environment (Refer back page) and this simple tool allows us to continually refine and update our understanding as new results and information become available. We have also developed 6 hypotheses concerning various aspects of the ecosystem that will allow us to more rigorously test critical assumptions about the system’s function.

During the synthesis phase, we will prepare responses to 31 high priority issues identified in the Stakeholder Requirement Report (2001) prior to the commencement of the research activities.

Our researchers will be meeting again in August to collate results and to document the responses to these priority issues. This is a significant undertaking; the results of which I’m sure will be eagerly anticipated by Stakeholders and the broader community.

Inside these pages you will learn more about recent study activities and outcomes. I trust you find it informative.
Since our last newsletter in Spring 2004, we have seen significant progress with all Study tasks. The remote sensing task team has delivered their Draft Technical Report which presents high-resolution marine habitat maps for the area from Port Gawler to Marino. Changes in seafloor cover and characteristics have been mapped for a number of areas of interest, in relation to human induced inputs and impacts. The SARDI Aquatic Sciences team has continued to explore interactions between the dominant seagrass species and coastal disturbances of reduced salinity, reduced light environments, and increased epiphyte loads while the hydrodynamic modeling team from the University of Western Australia has made solid progress in describing the driving forces of wind, waves and tides and how they determine the transport and fate of input waters and the distribution and movement of coastal sediments.

As mentioned in the introduction to this newsletter, we have reached a critical juncture in the Study, with the emphasis now shifting from delivery of research results to the process of integration and synthesis. Our researchers are investing considerable amounts of time analysing and interpreting, results with a view to identifying management actions that may be required to stop and reverse the degradation witnessed over the past 40 years or more.

This process was initiated in February 2005 with a series of site visits by the CSIRO project management team to meet with research groups to identify key results and understandings. The outcomes of these discussions helped shape the agendas of the next two scientific committee meetings held in Adelaide on March 23 and June 17 2005.

The remainder of this newsletter summarises the outcomes of this integration and synthesis processes.

Introduction
A clear set of hypotheses has now been developed which will allow us to test our understanding about the mechanisms which have led to the present situation. The outcomes from these evaluations are not only of scientific interest, but importantly will provide clear direction concerning remedial measures to halt and hopefully reverse the decline in ecosystem condition.

Coastal ecosystem dynamics
There are numerous families of seagrass found along the Adelaide metropolitan coastline including several species of Posidonia (P. sinuosa; P. australis), Heterozostera (H. tasmanica) and Zosteraceae. In addition, there are several forms of macroalgae present including Ulva.

It now seems clear that the abundance and vigour of one of the two more common species of seagrass has been reduced. While most of the biomass remaining is Posidonia, the Amphibolis has been severely reduced. These two species are visibly different with Posidonia shown on left of adjacent figures with long strappy leaves, and Amphibolis (on right) having shorter and more rigid leave blades. Amphibolis is thought to be an important stabilizing species. Of the two it has higher light requirements and, before human intervention in coastal waters, occurred in...
shallow water close to the beach. It may also have been responsible for the re-colonization of blow-outs and other disturbance areas. *Amphibolis* grows quickly under conditions of high light in shallow water, has a high shoot to root ratio (3:1) and is able to re-colonize disturbed areas because of its wiry roots.

*Posidonia*, on the other hand seems to be a more hardy species, having a greater resistance to low light and other anthropogenic impacts, a large storage capacity to tide it over adverse conditions (with a shoot to root ratio of 1:1.5); but it is unable to re-colonize rapidly enough to reoccupy disturbed areas.

The result is that as the underwater light climate of the near-shore and coastal area has been degraded by storm water and other inputs from urban creeks and drains, the *Amphibolis* has been reduced in abundance compared to *Posidonia* and this has compromised the ability of the entire coastal ecosystem to recover from stress. *Amphibolis* was once abundant in the (now) bare coastal strip up to 1 km from the beach. Further stress may be being placed on the seagrass community through the enrichment of coastal sediments as a result of nutrient and waste water inputs as well as storm water outflows. The following figure places major coastal developments on a time line and maps major events and estimated Adelaide population numbers against the area of seagrass lost along the Adelaide coastline.

It is interesting to note the similarities between population growth and the area of seagrass lost.

**ACWS research initiatives**

Various aspects of the ACWS are able to test this basic working hypothesis. Both mesocosm tank experiments and modelling studies will reveal what the key light requirements are for the two species. Measurements and modelling will address the sporadic inflows of storm water from the creeks and drains, the underwater light climate, the bottom stress that causes sand mobility and the health and growth rates of the two key species. Sediment chamber experiments will reveal the extent of modifications to the original sediment nutrient recycling regime. A comprehensive mesocosm experiment is currently being designed and implemented by researchers at SARDI in an attempt to tease out some of these interactions.

The changes in the relative vigour of the two key species are quite sufficient to give rise to the presently observed patterns of distribution of seagrasses in Adelaide coastal waters – loss from the coastal strip and slowly increasing areas of disturbance and “blow outs” in deeper waters. Recent ecological modelling of species interactions – by means of what are called “cellular automata” models which look at subtle changes in the spatial patterns of species after disturbance – show clearly that if the health and growth rate of the pioneer species is only slightly impaired then this can lead to major changes in the resulting ecosystem. In other words subtle changes in the vigour of key species are all that is required to produce what we presently observe.

The ACWS final report will address these issues and will make recommendations for remedial actions and ongoing monitoring to assess changes in seagrass communities, water quality, and sediments.
Nearshore hydrodynamics

In the Adelaide coastal waters region, seagrass loss in nearshore areas has occurred through a range of possible mechanisms. As a result of these losses, the local hydrodynamic and sediment transport regimes may have been altered through changes in seabed morphology.

To address this issue, Professor Chari Pattiaratchi and his team at the University of Western Australia’s Centre for Water Research have undertaken detailed studies into the wave climate of nearshore waters. Field measurements obtained from buoyant drifters (pictured below off the mouth of the River Torrens during March 2005) have been used to calibrate a sophisticated wave generation model. Output from this model has enabled researchers to construct a detailed map of seabed shear stress over the Study region.

One of our working hypotheses is that as a result of the altered seabed morphology it is possible that the shear stress exerted on the seabed is sufficiently large to prevent seagrass re-establishment in the nearshore zone. Hydrodynamic conditions, which result in bottom shear stress, experienced at the seabed are the result of water motion caused by waves and currents. In the Adelaide coastal waters, the main hydrodynamic forcing derives from the action of tides and surface gravity waves.

The results of this study along with a number of other papers from ACWS research teams will be presented during a special session of the Coasts and Ports Australasia 2005 Conference in Adelaide on Friday September 23 2005 (Refer www.plevin.com.au/coastsandports2005).