

Chapter 8

Research requirements

The purpose of this chapter is to provide recommendations and priorities for areas requiring further research. During the course of this study a number of areas in which existing data were insufficient or unavailable were identified. Many of these data gaps were not directly flow related; however, they would assist in providing a more complete information base, enabling for more comprehensive consideration of ecosystem–flow relationships.

8.1 Effects of current water resource development in the Proserpine and Kelsey Creek–Lethe Brook systems on downstream wetlands

The coastal wetlands of the Proserpine River, Lethe Brook and Goorganga Creek systems are of national significance. Existing water resource development, such as the Peter Faust Dam, construction of levees on the Proserpine River, and the Kelsey Creek Irrigation Scheme, have the potential to have effected and continue to effect the wetland areas. An assessment of the extent and nature of any changes to wetland systems as a result of these developments would provide valuable information for future management of these developments and environmental flow considerations, and also provide valuable information for assessment of the potential impacts of any future proposed developments.

8.2 Effects of current water resource development in the Proserpine and Kelsey Creek and Lethe Brook systems on estuarine and marine habitats of Repulse Bay

The estuarine and near-coastal habitats of Repulse Bay are of national significance, supporting a number of threatened species and significant conservation estate (GBRMP, Dugong Protection Area). Construction and operation of the Peter Faust Dam and associated water supply scheme has substantially altered flow and sediment delivery to the estuary and near-shore marine habitats of Repulse Bay. Significant changes to coastal geomorphological processes appear to have occurred. Given the significant ecological values of this area, a greater level of knowledge of the effects on these systems is required in order to enable more informed management of environmental flow requirements down the Proserpine River, and to assess the implications of further water resource allocations in the plan area.

8.3 Distribution, abundance and assemblage structure of macrophytes

No systematic field measurement-based information on the status of the macrophyte assemblages in the plan area was able to be obtained for this study. Macrophytes in stream systems are sensitive to flow alteration (e.g., Mackay & Thompson 2000), and can be both favoured and disfavoured by flow alteration depending on the nature of the flow alteration and the species present in the system.

Despite the general lack of information, the observations from the field inspection identified that the macrophyte assemblages in many parts of the plan area were diverse, extensive and with good assemblage structural health, with a generally low abundance of exotic species. They undoubtedly have substantial environmental value, but this cannot be

clearly quantified or demonstrated with the current knowledge base.

In the absence of any field measurements other than bankside observations during one brief period, it is not possible to adequately assess the potential consequences of any planned future flow alterations, nor the effects that have occurred as a result of the existing flow alterations.

Macrophytes form critical habitats for a wide range of other organisms during their critical life stages, such as being the preferred spawning and nursery habitats for a number of the native fish species of the plan area (e.g., rainbowfish, perchlets, hardyheads and blue-eyes). They are also important food resources for a range of aquatic animals. Therefore the alteration of the status of macrophytes can also lead to indirect alteration of the status of populations and communities of other organisms.

8.4 Distribution, abundance, age structure and variability of fish assemblages

For a region that advertises the value of its recreational fishing there were remarkably few data available on the status and composition of the fish communities of the plan area. Although no sites had quantitative data for more than two sampling events, there were no quantitative data for the Proserpine catchment apart from the limited sampling by Clayton and Skull (1994). This study is more than a decade old and represents only a small part of the Lethe Brook subcatchment in one season, but remains the best available quantitative dataset for the catchment.

The situation was only slightly better for the Andromache and O'Connell catchment, with data available for five sites from two rounds of sampling in 1999 and 2000. This still remains inadequate to describe distributions and seasonal and inter-annual variation in fish distributions, diversity and abundance.

Fishes are very sensitive to flow alterations that affect their ability to migrate between feeding, breeding, nursery and refugial habitats within the stream channel network, estuarine and coastal habitats and floodplain habitats. They are also sensitive to alterations of the persistence of perennial refugia (i.e. perennial pools), as no freshwater fish species in eastern Australia is able to survive out of water. Knowledge of the current distribution of fishes, and particularly the seasonal and inter-annual variation in distributions is essential in order to adequately assess the potential for alteration of water resource use to affect fish community health. The currently available data is inadequate for this purpose.

8.5 Clarification of phosphate concentrations across the plan area

Although the amount of data available to describe the water quality status of the waterways of the plan area was relatively extensive compared with the macrophyte and fish datasets, there was a substantial discrepancy between the ACTFR (2003) dataset and the data collected by NRW (obtained for this study) and (reported in ACTFR 2003) with regard to phosphorous readings. The water quality results of ACTFR (2003) indicated that there was a widespread elevation of phosphorous within the plan area. However, this was not reflected in the datasets collected by NRW or the EPA. It appears that the ACTFR (2003) results were also not in concordance with the known geological characteristics of the catchments. This warrants clarification, which would require collection of water quality data from the sites used by ACTFR (2003), with good documentation of quality control

and assurance results. Clearly, if nutrient concentrations in the catchment are substantially related to catchment characteristics and not wholly influenced by runoff from and dilution of inputs from agriculture and urban water use, this will have a profound effect on consideration of water resource usage impacts on water quality.

8.6 Clarification of dissolved metal concentrations, particularly downstream of Proserpine and in Dryander Creek

Another water quality anomaly was the measurement of copper concentrations above the ANZECC/ARMCANZ (2000) water quality trigger value in the Proserpine River below Proserpine and copper and zinc above trigger values in Dryander Creek near the quarry within the NRW dataset. However, the detection limits for both metals were above the trigger values, and therefore any measurements above the generated detection limit hazard quotients greater than one. It is likely that some or all of these metal concentration measurements above the trigger values were analytical errors and not indicative of real metal toxicity risk. This should be confirmed with water sampling with adequate quality control and analytical resolution to reliably report concentrations substantially below the water quality trigger values for these metals. This is a relatively minor issue, but consideration of the water quality impacts of elevated metal concentrations is flow related (via dilution of elevated concentrations) and resolution of this issue would require minimal investment over that already committed to sample collection and analysis.

8.7 Measurements of temporal variability for aquatic ecosystems

Apart from the NRW monitoring of macroinvertebrate communities in the plan area, the only repeated measurements for any aquatic ecosystem component were the two rounds of fish sampling conducted by QDPI Fisheries in 1999 and 2000. However, understanding of the inherent variability of populations and assemblages of aquatic organisms and how these respond to variable flows in the local context is necessary for developing any ability to predict the potential ecological responses to alteration of flows. Such understanding has not been possible to develop for this plan area due to the lack of repeated sampling to establish temporal variation patterns, except for macroinvertebrates. Therefore, for the purposes of this study, inference has had to be made based on general understanding of the biology of the key species and higher taxonomic groups. Specific evidence, such as variability of dispersal of catadromous fishes under differing rainfall patterns or flow regimes, has not been available and can only be speculated to be a potential issue in the catchment.

8.8 Aquatic ecological data for the estuarine and coastal waters

Except for two samples of fish in the O'Connell River at the Bruce Highway, and despite the coastal marine and estuarine parts of the plan area being heavily utilised for recreational fishing and other recreational pursuits, we were unable to obtain any quantitative data for aquatic ecosystem components of these habitats for this study at all. This is a clear data gap for the study and an impediment when considering the potential implications of water resource use on the coastal aquatic ecosystems. While there exist substantial qualitative data, and it is clear that the presence of some iconic aquatic animal species and wetland vegetational assemblages warrant classification of this area as of high environmental values, such data may not serve as an adequate basis for assessing the potential processes of impact of water resource use strategies.

8.9 Mapping and bypass flood height determination of fish passage barriers

It was evident from the brief field overview undertaken for this study that there exist a number of small fish passage barriers through the plan area, including structures such as road causeways, road crossings with small diameter culverts and gauging weirs. There may be other natural and artificial passage barriers that also impede fish movement at low to moderate flows. It is considered likely that these structures inhibit fish distribution and recruitment within the plan area, particularly during dry periods when maximum wet season flows correspond to one- to two-year ARI flood events, although the available data do not permit verification of this hypothesis. Many of the structures were of low height and probably flooded out in three- to five-year ARI floods and higher flood levels.

It would be informative for general consideration of environmental flow requirements to map the locations of these fish passage barriers and survey their bypass heights (i.e., the water level at which fish are able to negotiate past the barrier) with sufficient accuracy to then determine which stage of the hydrograph must be preserved to facilitate near natural fish dispersal within the system. This would not necessarily be an expensive exercise, and could be implemented in a staged approach, first identifying the key barriers that most limit fish dispersal and then undertaking surveying and hydrographic analysis at those sites. The resulting data would be particularly useful in both identifying structures that should be upgraded to better facilitate fish passage and assessing the potential for water resource allocation in a manner that minimally impacts fish distribution and recruitment processes.

8.10 Mapping of the status, extent and distribution of perennial aquatic habitats

Perennial habitats form the main dry-season refugia for wholly aquatic organisms and are particularly important for:

- normal ecosystem function and aquatic organism recruitment
- dispersal processes in the temporary waterways of the plan area.

Mapping the locations of these habitats, potentially from aerial photography and/or satellite imagery with some ground-truthing, combined with an assessment of likely reliance on or linkages to groundwater and surface-water resources, would be particularly useful in better defining and quantifying the potential implications for water resource utilisation within the plan area, the impacts of ground water extraction and base flow harvesting.

8.11 Evaluation and mapping of high conservation value stream reaches

Allied to the above recommendation regarding perennial aquatic habitats is the need to more comprehensively identify high conservation value stream reaches, riparian locations and other flow dependent ecosystems (e.g., wetlands). Although a list of examples of higher conservation value stream reaches and riparian sites and major wetland complexes is provided in Chapter 5, it is non-exhaustive as it was not possible within the time and resource constraints of the project to fully identify these valuable assets. Such an exercise should be the focus of a specific field- and remote-sensing based assessment project for the plan area. Outputs of such an assessment would better serve both water resource and nature conservation planning in the plan area. State-wide inventory and mapping of wetlands currently being undertaken by the Queensland EPA, when completed, will provide a

valuable information base to identify high value offstream wetlands and the outstanding information needs are primarily concerned with stream channel hosted aquatic habitats and associated riparian vegetation ecosystems.

8.12 Geomorphological implications associated with flow regulation and modified riparian vegetation condition of Proserpine River

The lower Proserpine River is a highly regulated and modified system but still retains high value aquatic habitats within many reaches and has biophysical process linkages with an extremely high value coastal and marine ecosystem complex. One of the key questions that remains poorly served in terms of available information or modelling is the implications of the modified flow regime and its interaction with emergent and riparian vegetation on basin sediment budgets, channel morphology, flooding and coastal processes. In broad terms, issues include the effect of more perennial flows on the colonisation of the river channel by exotic grasses and their sediment trapping or binding efficiency, colonisation of channel margins by woody riparian vegetation and its impact on flow constriction, channel scouring, flooding and sediment mobilisation and the net result for coastal ecosystems, particularly estuary geomorphology. This information is critical for management, which seeks to deliver optimal ecosystem and ecological value outcomes in a modified system, and particularly pertinent to management issues associated with the establishment of in channel riparian vegetation.

Studies to confirm the sediment processes of the Proserpine River estuary could include sediment sourcing studies, establishing a sediment budget for the estuary and confirmation (by flow measurement) of the balance between tidal pumping and freshwater flushing.

8.13 Implications of Proserpine basin flow regulation for in-stream ambient water quality and ecological values

As identified above, the perennial aquatic habitats of the regulated streams of the plan area (Proserpine River, Kelsey Creek) are valuable and worthy of management that seeks to deliver the best ecological value outcomes within the constraints of the modified system. Experience in other regulated streams of north Queensland (e.g., distributary channels of the Burdekin River delta) have found there to be significant interactions between regulated flow regimes, groundwater behaviour, aquatic macrophytes, nutrient availability and ambient water quality, particularly dissolved oxygen, which thereby affect aquatic biota (e.g., fish populations, Perna & Burrows 2005).

These interactions are likely to also exist in the Proserpine River system, but the specific nature of these interactions in this system remains unknown. Key issues include the water quality effects of para grass and aquatic macrophyte masses, groundwater discharge following regulated flows, diurnal cycling patterns of dissolved oxygen, critical water quality events and the merits of different flow regimes and environmental flows. To gather this information, seasonally stratified use of water quality data loggers and monitoring of specific release regime trials is required. The results of such an investigation would better serve best practice management for ecological values in highly regulated topical systems such as the Proserpine.

A separate but associated issue concerning the downstream margins of this regulated system is the hydrological and water quality impacts associated with regulated and irrigation tailwater flows to the upper catchment of the Goorganga Plain wetland via

Kelsey Creek and Lethe Brook and Lagoon Creek. Such impacts, if they exist, may not be measurably detrimental and flows that reach the system may support some of the values associated with this system's perennial in-channel aquatic habitats. A greater examination of existing or potential impacts is required.

8.14 Implications of O'Connell basin surface water resource extraction for in-stream ambient water quality

The overall impression of the O'Connell River system gained by the TAP was that of it being under ecological stress primarily due to catchment condition. However, it is also possible that existing surface and groundwater extraction practices, and associated lowered flows and eutrophication risks, may be causing additional stress for the catchment ecosystems. From the limited water quality monitoring data available for the catchment, elevated nutrient levels appear to be a justifiable concern, but temporal coverage is too limited to gauge the impacts associated with low flows, pumping pool drawdown and groundwater interactions on variable ambient water quality parameters such as temperature and dissolved oxygen. Reports of fish kills associated with drawdown of pumping pools (Broadfoot NRW pers. comm.) would suggest such issues are a relevant management concern that warrants more specific investigation to facilitate best management practice for maintaining the ecological values of the system, including populations of key recreational fish species in some reaches (e.g., OC-3 to OC-1). Precautionary application of general principles based on allowable drawdown levels would be prudent management in the first instance, while research is progressed to obtain more specific management information.

8.15 Relationship between groundwater resources and surface-water habitats

The interaction between surface water, groundwater and aquatic habitat values is a reoccurring issue identified for the management of many of the high-ecological-value assets within the plan area and specific management questions have been identified in relation to a number of them in some of the data gaps discussed above. More generally there is a need for groundwater investigations that seek to elucidate interactions with high ecological values of the plan area. This need is related to the general paucity of groundwater information for the entire plan area and highlights the need for some strategic investment in field investigations and monitoring that seeks to provide a better understanding of the groundwater resources of the plan area.

8.16 Assessment of existing groundwater data

The existing groundwater data provided by NRW and all other potential sources of groundwater data, urgently require rigorous assessment and interpretation. It is almost 25 years since this exercise was properly documented, and that was for the Proserpine River irrigation area only. It is probably more critical to undertake this research for the O'Connell and Andromache systems, because of the pressure for additional groundwater extraction from aquifers, which are localised and largely located in fractured bedrock or Recent alluvium close to existing channels. Until this research is undertaken, there is a significant risk that even a regulated extraction regime could lead to possibly irreversible collapse of the groundwater windows.