



Queensland Aquaculture Industries Federation (Inc)
World Best Aquaculture

Aquaculture Association of Queensland,
Australian Barramundi Farmers' Association,
Australian Prawn Farmers' Association,
Koorringal Aquaculture Pty Ltd, OceanXplorer, Coral Coast Mariculture,
Pristine Oceans Pty Ltd, Queensland Crayfish Farmers Association,
Queensland Pearl Industry, Watermark Seafoods.

Agriculture, Resources and Environment Committee Submission
August 2012

1.0 Document Summary & Overview

This submission provides background information on the Queensland aquaculture industry.

It reports the impacts of current regulatory arrangements on:

- existing businesses in the industry; and
- potential start up businesses that are required to grow this industry.

In its report, *Assessing Environmental Regulatory Arrangements for Aquaculture*, the Productivity Commission in February 2004 said "... aquaculture production is subject to an unnecessarily complex array of legislation and agencies" (pXXIII).

It noted (p166): "*Compared to South Australia and Tasmania, statutory marine aquaculture planning is less developed in New South Wales, Queensland and Western Australia. Slow progress with statutory marine aquaculture planning may constrain marine aquaculture development.*"

In the intervening years nothing has really changed. It has probably got worse.

The thrust of this submission is not new. These factual statements have been put to government for over a decade by this Association.

This submission incorporates information and content contained in two recent submissions to the Queensland Departments of Agriculture, Fishing and Forestry Aquaculture and the Department of Environment and Heritage.

Aquaculture is a significant industry in this State. It should be much larger. Growth in recent years has been a result of increased on-farm productivity rather than major new development.

Compared to some other States, aquaculture in Queensland has failed to realise its

enormous potential.

There are two significant reasons for this constrained development.

- First, the industry is confronted by difficult and sometimes impossible regulatory requirements.
 - These regulatory requirements impose a significant cost on the existing industry.
 - They provide a major deterrent to new investment.
 - They impose an almost impossible barrier to those who seek to navigate the requirements.
- Second, the “culture” amongst regulators is to say “no”, or to delay any new development.
 - Saying “no” or seeking more information is always easier and less risky than giving approvals.
 - Delaying and asking for more information can delay an application for a decade.

This submission argues that:

- Much of the regulation is not well founded.
 - Aquaculture should be a large industry in Queensland, perhaps eventually 5 times as large as at present to begin to match the scale of the industry found in Tasmania and South Australia.
- The cost of regulation is a major and unnecessary cost to existing businesses
 - Many regulatory requirements and associated costs could be reduced with little increase in environmental risks.

Conclusions Reached

- **There is an overwhelming case that aquaculture in Queensland is tied up in regulatory (green & red) tape.**
 - **Industry believes that this can be addressed by providing a coherent regulatory framework (a single Act) that would meet the overlapping Commonwealth requirements.**
- **Many current regulatory requirements are burdensome, costly and do not add to environmental outcomes.**
 - **Industry believes a full review and risk assessment of the regulatory arrangements would simplify requirements and reduce costs to industry.**

2.0 We Do Not Exaggerate

We have a member, a very small business, working extremely hard to establish a new aquaculture venture growing sea cucumbers. It is environmentally benign. He is prepared to invest his life savings. There is a huge market for the product. He has been trying for at least a couple of years to get an approval.

This is the email I received in response to the advice to members that we would be making a submission to this Committee:

Hi Graham

I really don't know where to begin...

Put simply... I wanted to start a new aquaculture business in the Bay, employ people and export a domestic product. I can't believe that I have to correspond with so many Govt. departments just to obtain permission to operate. I wonder if I'll ever start growing a thing at this rate!

There should be one department and not this many... This is NOT SMART thinking ! I have to correspond with

- DERM
- DEEDI
- DAFF
- DPI
- MSQ
- TMR
- EHP
- Redland Council.

It's simple **TOO MANY FENCES and not enough GATES!**

So who's kidding themselves that they are reducing the regulatory burden!

Given the difficulties I have personally experienced in the past 3 years while applying to establish a benign sea cucumber hatchery, I don't feel confident that anyone would have the stamina or the drive to start up a new aquaculture business, any time soon.

I find it hard to comprehend how there will actually be an aquaculture industry in Qld in 2032, especially when the average age of operators in the aquaculture industry is about 50.

Suggestions:

- Simplify the application process down to only one department, with 2 branches – Fresh Water or Marine (Sea/Ocean).
- Allocate a relevant, experienced aquaculture industry professional, i.e. a 'case manager' to assist the applicant and offer opportunities rather than hurdles.
- Establish a fisheries / aquaculture 'resource portal' to assist applicants with research – use of chemicals, pest control, net design, water quality, tidal effect. DPI / CSIRO and various other

Govt. Departments and Universities have invested many hours and 'dollars' in marine research, but it's so difficult to find any research that has been done in Moreton Bay in the past 30 years.

- As the Govt, coordinate all research thru the issuing of Permits to conduct research. It's only fitting that the Govt digitize the information and establish an online portal of the 1000's of research projects/ papers that are relevant to future aquaculture applications and production enhancement. The Govt Department who establishes the portal needs to make information more openly available to access or purchase for applicants and individuals wishing to join the industry.
- Establish a 'seedling funding' grant system, where individuals new into aquaculture can apply to borrow funds for their setup.

Cheers Jon

This really says it all. It is a story repeated over and over by large and small businesses in this industry for a couple of decades.

I am pleased to advise that the Minister for Environment and Heritage Protection has agreed to review some of the green tape issues being raised.

But the development above is being stopped by public servants responsible for small boat harbours. Wow!

Later in this submission we reference a very large scale development approval process, but involving GBRMPA and the Federal Environment Department. Even more layers of government and agencies – same end result. It has not happened.

3.0 Aquaculture in Queensland

Aquaculture in Queensland is a regionally significant industry, located in rural and sometimes, remote communities. The industry is located mainly on the Eastern coast; from the Gold Coast through to Sabai Island just a few km from PNG; and west of the Great Dividing Range where freshwater species are produced.

Species being grown are:

- Silver and Jade perch
- Murray Cod
- Barramundi
- Several species of prawns
- Tropical abalone
- Crabs
- Whiting
- Oysters
- Red claw crayfish
- Pearls
- Scallops
- Edible algae
- Other shell fish

The aquaculture industry in Queensland produces about \$100 million annually and represents a gradually growing percentage of the total seafood produced. All species grown are native to Australia. The industry is committed to and does meet world-class environmental standards.

A recent analysis of one business in North Queensland found that 10% of non-wage and salary expenditure was spent in the local and regional economy and 93% of the non-wage expenditure was spent in Queensland (Anderson, pers. comm).

Queensland is third in Australia for production of farmed seafood but has experienced no substantial industry expansion for over a decade, primarily due to the prohibitive legislative and regulatory frameworks that exist within this State. Despite this lack of expansion in the number of farms, the industry has increased production tonnage by almost 50% during the past five years (see Table 1 below) with significant improvements in knowledge, skills and production technology. Queensland has an enormous opportunity to rapidly expand production of farmed seafood if it is “allowed”, which would greatly contribute to both the State and Nation’s food security goals.

Table 1: Queensland aquaculture production (tonnes) by sector

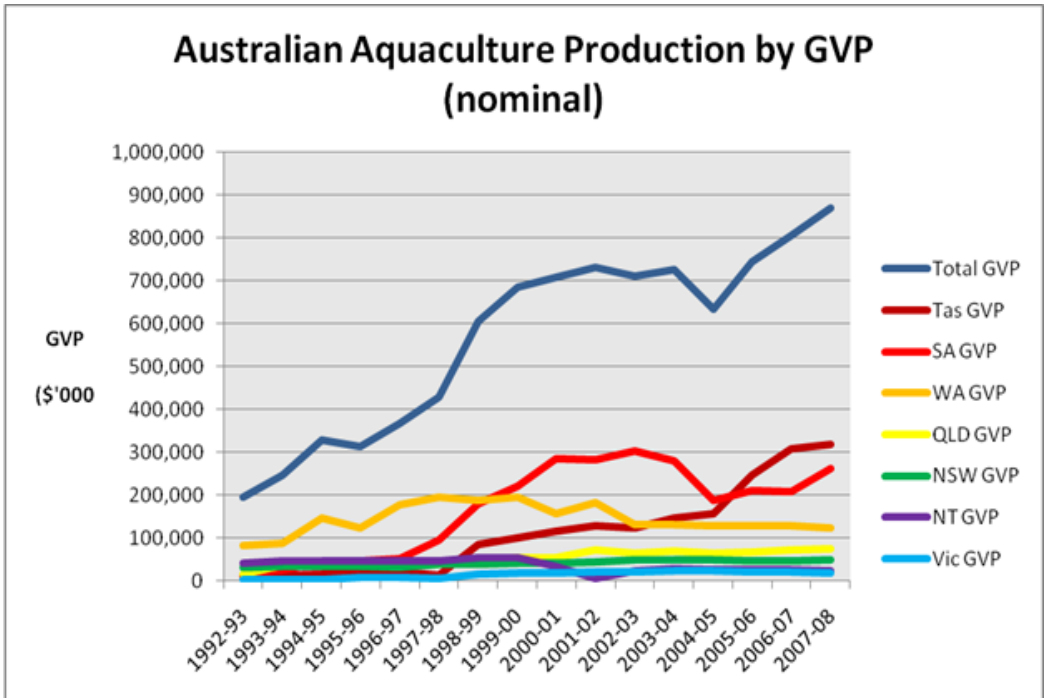
(from Ross Lobegeiger Report to farmers – Aquaculture production survey Queensland 2009–10, DEEDI 2011.)

	2005–06	2006–07	2007–08	2008–09	2009–10
Marine prawns	3,300	3,085	2,888	3,821	5,115
Barramundi	1,745	2,091	2,464	2,400	2,410
Redclaw crayfish	105	100	65	68	57
Freshwater fish	152	210	198	192	177
Other*	25	64	58	39	63
Total	5,328	5,550	5,673	6,520	7,822

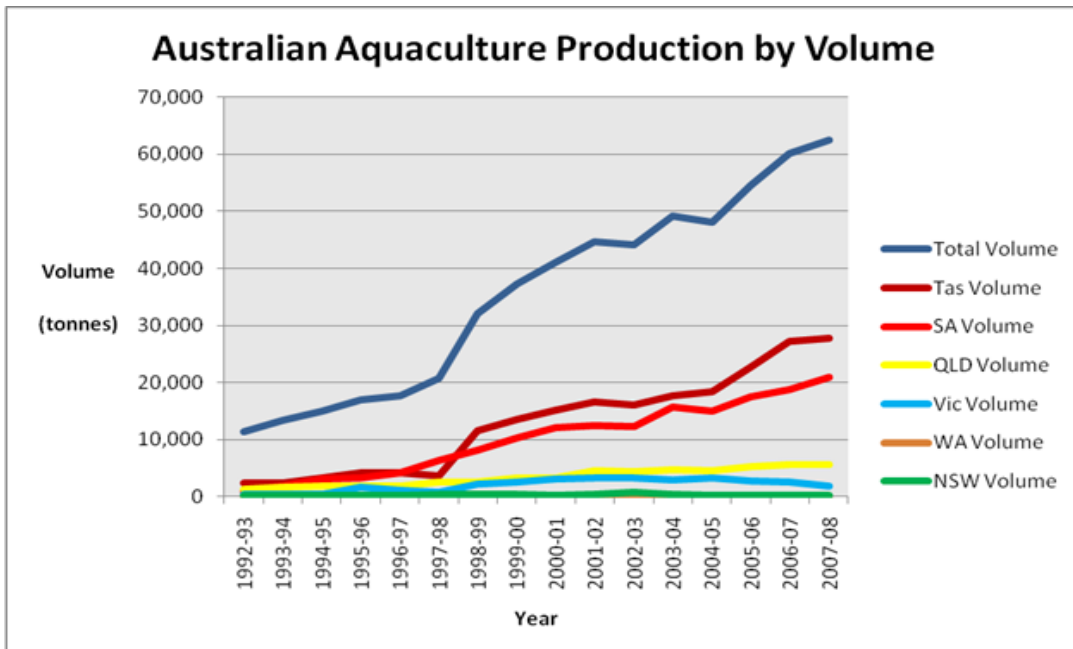
* ‘Other’ includes marine fish, eels, sea scallops and crabs.

The two most successful States in Australia for farmed seafood are South Australia and Tasmania, both in terms of \$ value and production tonnage. (**Graphs 1 & 2**)

Graph 1 (source FRDC)



Graph 2 (Source: FRDC)



The Queensland aquaculture Industry strongly believes that the greatest contributing factor to this rapid expansion in those two states is a robust suite of aquaculture related policies that are underpinned by a specific *Act of Parliament* that focuses upon promoting, regulating, monitoring and reporting commercial aquaculture activities. An example of this is the *South Australian Aquaculture Act 2001* and the associated *South Australia Aquaculture Regulations 2005*.

Currently, the Queensland aquaculture approval process is handled by multiple departments and agencies in a largely ad hoc fashion, which is expensive, time consuming and almost impossible to navigate for new investors in the industry. It has been sufficient to stifle new development. It has added excessive costs to existing participants.

4.0 Another Case Study - a Large Investment

Despite the licensing of 36 prawn farms in Queensland prior to 2000, no new prawn farm has been approved or built in Queensland in the past 13 years.

One major new development was proposed for Guthalungra near Bowen. The proposed development was to be a 259 Ha hectare, state of the art prawn and fish farm. (By comparison, one of the world's largest prawn farms in Saudi Arabia is 21,000 ha.) The application process has taken 13 years and application costs to date ~ \$3 million. The ultimate approval in 2011 from then Federal Environment Minister Garrett required the farm to operate a zero net discharge regime.

Zero net discharge is not achievable economically anywhere in the world. In fact, the discharge levels from Queensland aquaculture farms have been scientifically shown to be extremely low and, within the Australian context, operating standards have negligible environmental impact. The policy applied in Queensland clearly does not match the science and associated environmental risks.

In contrast, the Abbot Bay terminal expansion, which is in exactly the same receiving environment as the pending Guthalungra aquaculture proposal, is a coal-loading terminal. Associated dredging in the Marine Park for will dump thousands of tonnes of sediment within the bay and marine park.

5.0 The Burden of Regulation

The Issues Paper distributed by the Committee asks "*What is good regulation?*". It refers to the "*COAG principles of best-practice regulation*". The following principles are particularly relevant :

“6. Ensuring that regulation remains relevant and effective over time... ; and

8. Government action should be effective and proportional to the issue being addressed”.

This document is not the place to lodge the overwhelming scientific evidence that aquaculture in Australia and in Queensland in particular **does not** damage the environment. CSIRO, universities and our own members' monitoring demonstrate this. A copy of a CSIRO summary covering prawn farms (the largest aquaculture sector in Queensland) is attached to address this point.

This submission makes the case that neither of these COAG criteria are being met. The Paper also refers to the OECD Guiding Principles. We would like to point out that aquaculture development in most OECD countries is dramatically greater than in Queensland.

Not only does the current level of regulation impact on and prevent development. It is also a major and ongoing impost through compliance and monitoring costs. For instance, farms undertake mangrove and environmental monitoring surveys that cost each farm in the vicinity of \$7,000 per annum, for a report that each year demonstrates that there is no effect on the receiving environment.

It is to the credit of the new Minister that he has agreed to review the issues. These are:

5.1 Environmental License Fees

Fees for different sectors are different despite their similar and low impacts. Farms switching between species pay different and often higher charges with no actual scientific basis for this changed status. Theoretically, one farm can be growing prawns and barramundi and is charged less than a farm growing barramundi and prawns.

The bio-mass per hectare can be similar between species. Feed conversion rates are similar. Diets are similar. Discharge of nutrients and sediment are also similar between species. In fact farms do shift between species based upon price and returns. Moreover, some farms can have prawns and barramundi production in adjacent ponds using much of the same infrastructure. The basis for calculation for the charging of fees is very questionable.

5.2 Water Quality Monitoring

Aquaculture farmers are required by the regulators to undertake frequent tests of water quality parameters. This is done daily for some parameters, monthly for others, sometimes testing is required hourly during harvest. Not only are tests required at the point of discharge, with some farms having multiple points of discharge, each requiring monitoring and reporting, tests are also required for the receiving waters in multiple sites. There is little uniformity in requirements for different aquaculture farms.

The testing is for a range of water qualities and in some cases include pH and oxygen on a daily basis. Monthly testing is usually for dissolved nitrogen and phosphorus, and suspended solids. Some licenses also require chlorophyll A and BOD.

Monitoring and testing requires a major commitment of staff time. Laboratory testing costs at least \$7,000 pa. To put this in perspective, it takes about 10 tonnes of fish to pay for the testing alone, let alone staff time etc.

Monitoring of the impact of discharge on the receiving environment is also required. There has never, to our knowledge, been a demonstrated downstream impact from aquaculture in Queensland. In fact, the detailed scientific research clearly demonstrates that farms are undetectable within a few hundred metres of the discharge point.

Data from the monitoring and testing has been submitted as required to the EPA from some farms for more than 25 years.

The rare cases where there have been issues of thresholds being exceeded have been in major cyclone events, when rain events have put excess nutrients into a farm's intake water. These nutrients will have come from upstream agriculture or even from the rainforest.

To our knowledge, the submitted records are never looked at, never checked. To our knowledge, the data have never been analyzed. Industry has sought access to the data in the belief that aggregated it will set to rest concerns about discharge and environmental impacts.

Industry now feels that the intensity and expense of current monitoring requirements can be reduced. It is very costly to provide, is not reflected in regulation change and therefore adds little value.

5.3 Cleaning up Intake Water

A major problem with license conditions relates to discharge requirements.

For existing farms, permits can in some circumstances (and for some farms always), require the farm to actually clean up water taken from the environment before discharge.

One could even make the case that environmental harm is occurring because naturally occurring nutrients are required to be stripped from water flows.

Nutrient levels in intake water fluctuate naturally with weather conditions and can fluctuate as a result of agricultural operations further up the catchment. In other words, the farm treatment levels are supposed to fluctuate in intensity depending on exogenous conditions.

Quoting one of our farmers: "It is a crazy situation. Down stream monitoring has not shown any impacts from the farm. Local staff are not interested in rectifying this, only compliance. Who do we have to discuss this with to have it sorted out? Many studies have been done by scientists. No damage has been demonstrated. Why is regulation such a burden?"

Marty Phillips, President of the Australian Barramundi
Farmers Association, Personal communication: 13 May 2012.

Producers point out that unrealistic, impossible to achieve, discharge parameters that are far outside what is achievable and required elsewhere in the world, only result in non-compliance. Even if the product and its environmental credentials are better than achieved elsewhere in the world, any non-compliance severely reduces our ability to market and promote our product as the 'clean and green' product it is. Our overseas competitors are certainly doing this; we will be left behind in the market place on this front. This will further reduce our viability short and long term.

“At the recent World Aquaculture Society conference in Melbourne, a speaker from China was telling about how most of their farms were in the process of gaining environmental certification. Less than one minute later he was explaining how much of the sea cage production was moving further off shore to move away from the pollution! This is what we are up against”.

Marty Phillips, President of the Australian Barramundi
Farmers Association, Personal communication: 13 May 2012.

Industry has been seeking for years to have license conditions providing for discharge limits to be set at a certain level above background. Such limits would be based upon proper scientific assessment of the impact on the receiving environment.

We submit that our industry faces all of the problems identified in the discussion paper and noted by the Taskforce on Reducing Regulatory Burdens on Business (2006):

- Excessive coverage and regulation creep

No prawn farm license has been issued in Queensland for 13 years. If anything the industry has got better at environmental management technology and reducing impacts but the regulatory requirements have risen despite any scientific evidence of impacts.

GBRMPA has become a major player with a new set of ideologies.

- Regulation that is redundant

Development proponents need to deal with local government; a multitude of State agencies and regulators often with quite different and competing requirements including ports and other statutory bodies; Great Barrier Reef Marine Park Authority; and the Commonwealth Department of Environment. Our experience is that the assessment officers in each of these agencies seem to want to out compete themselves on their green credentials. Pass one hurdle and the next agency raises the bar.

One of the marine biologists who has worked in government and industry in Queensland and overseas said in response to the Committee Paper:

“Queensland might just have the most prescriptive and difficult environmental regulations for aquaculture on earth.” (per.comm.)

- Excessive Reporting

We have documented above the issue of excessive reporting and the imposed cost. When the regulations and monitoring were first imposed, aquaculture was a new industry. Regulators were risk averse – perhaps rightly so. Two decades later with no demonstrated impacts, with 20 years of data, surely the cost of collection can be taken into account.

In fact, there is considerable doubt that the data is collated systematically by the regulator. There is certainly no systematic feedback regarding performance.

- Variation in Definitions and Reporting Requirements/Inconsistent and overlapping regulatory requirements

The problem from differing and inconsistent requirements impacting on this industry arises principally from the overlapping jurisdictions – Federal and State.

6.0 Why is Aquaculture Industry Development Important to Queensland and what is the cost of Regulatory Burdens on this Industry?

- Demand for seafood globally and in Australia is growing, but even with the best environmental regulation, the production of seafood from the wild caught sector is limited.
- Only farmed seafood can provide the future supplies of seafood needed by a growing world economy; and Queensland provides outstanding quality product to the domestic and export markets.
- Queensland has a well-established farmed seafood industry growing native species.
- Queensland has outstanding sites for aquaculture development.
- But, over 70% of the seafood consumed in Australia is imported, much of it from countries with poorer environmental management than Australia. Price is only part of the reason. The other significant reason is the constraints placed on wild harvest and particularly on aquaculture development in Queensland which limits local supply.
- Queensland has world-class research capability in animal husbandry and genetics including research which is being applied to intensive seafood production.
- The industry can prosper in remote and regional Queensland leading to valuable and diverse economic development.
- The technical potential for a large aquaculture industry exists. Aquaculture is capable of becoming a large primary producer in Queensland.

Yet despite a profitable industry, with world class technology, world class genetics,

world class environmental management the industry is actually shrinking. There has been no new significant license issued for 13 years. There is a major lost economic and regional development opportunity.

The Queensland aquaculture industry could be producing \$100's of millions more seafood each year. But the regulators will not allow the expansion of aquaculture. Now, the situation exists where no-one in their right mind would invest in a start up venture in this industry in this State.

7.0 What to Do? The Model of South Australia and Elsewhere

Presently, almost no-one would invest in new aquaculture development in Queensland and certainly large investors are being deterred from investing. For large investors requiring Federal and State approval:

- The time required to go through the approval process can take well over a decade.
- The cost in responding to queries and undertaking environmental studies can be in the millions of dollars for the proponent.
- The outcome is uncertain.
- The requirements imposed by an approval may not be achievable in practice.
- The constraints and the cost of requirements imposed on the development do not appear to be related to the risks to the environment or to the substantial economic benefit from the development.
- As the decision of two Minister is required, there has been a major political risk for applicants.

For smaller business investors:

- The time can still be measured in years;
- There are a multitude of authorities;
- What is allowed in one place is not allowed in another with no apparent reason.

We think that two matters need to be taken up:

- The first is a culture amongst regulators. It is easier and safer in terms of career prospects to say no to, or to delay development applications and proposals, or to impose excessive regulatory requirements. And that is what happens.
- The second is the complex web of legislation that confronts applicants.

As an example cited earlier, what is the fundamental organisational and environmental difference between growing larvae in a tank using harbour water and holding live coral trout in a tank in a harbour? We understand that one is allowed, the other is being refused.

For Queensland to achieve a rapidly growing, prosperous aquaculture industry on the scale of the other major States in Australia, it does not require major government financial support.

But, it does require government to cut through the restricting statutory approval process.

South Australia's aquaculture industry is regarded as a role model of economic and environmental sustainability (Alana Mitchell, Seasick 2008). Central to South Australia's management framework is the Aquaculture Act 2001 (the Act), a single, dedicated piece of legislation that governs aquaculture in the state. The Act was the first of its kind in Australia and has as its primary objective the ecologically sustainable development of aquaculture - this means aquaculture must be undertaken in a way that recognises and balances environmental, social and economic benefits.

Leases and licences are an integral part of the Act. Aquaculture leases give secure access and exclusive occupation rights on defined areas of the seabed, providing protection to the infrastructures and stock on site. Aquaculture licences permit certain farming activities (be it marine or land-based) through specified licence conditions. A risk assessment is undertaken for each new licence application.

But it's not only South Australia. Tasmania has enabling legislation and recent significant expansion of its industry. New Zealand now has an Aquaculture Act and its own Minister for Aquaculture. Aquaculture is expanding in that country. Numerous other jurisdictions around the world, intent on building sustainable aquaculture industries support those industries with enabling legislation.

The Queensland industry has put the view to the new Queensland Government that it should adopt some demonstrated "best practice" areas of legislation that have made South Australia and Tasmania so successful in farming seafood and attractive to investment into their aquaculture industries. But any red-tape reduction would be invaluable.

Our industry also recognises that State legislation needs to meet Commonwealth requirements. This will necessarily involve negotiations and agreement across jurisdictions.

8.0 Why Not Work Within Current Legislation?

It has been suggested that inter-departmental committees and working groups can overcome the legislative hurdles.

The industry now holds the view strongly that such committees are temporary, provide no comfort or assistance to proponents and really do not work.

The Guthalungra Aquaculture Project was designated a "Project of State Significance". Officers of the Department of State Development were tasked with helping the

proponents work through the red tape. Those officers were not able to prevent:

- issues of seagrass being considered by two separate sets of “experts” with disparate views from two different State Departments,
- issues of groundwater also being considered by three different State Departments,
- issues of water quality being considered by three different State Departments.

At last count, there are 34 Acts and Regulations that impact on an Aquaculture development in Queensland, excluding additional impacting government policies and guidelines.

Only a single enabling piece of legislation administered by a single authority would provide the clarity of process required by industry to invest. Similarly, a single enabling piece of legislation allows Commonwealth authorities to simply and easily accredit State processes for aquaculture development.

9.0 A History of Representations

Industry has been calling for red and green tape reductions for over a decade. The issue has been inquired into, delayed, reviewed, been subject to public service objections about difficulties and complexities, and avoided with relief as Ministers have come and gone.

- Aquaculture was included in the “Smart State” suite of programs of the Beattie government. But projects were delayed by competing environmental regulations.
- Guthalungra was nominated as a “Project of State significance” for expedited approval processes. But 13 years later it is still not happening.
- In 2003, in response to ongoing representations about statutory inadequacy of the regulation of the industry, Minister Henry Palaszczuk used his backbench committee to report on a review of options for a separate aquaculture act. We understood that the proposal was to review the Fisheries Act to become a “Fisheries and Aquaculture Act”.
- Industry supported this and urged rapid implementation.
- But Departmental officers advised that no action would be taken until the IPA was bedded down. To our knowledge nothing followed.
- In 2004 the Productivity Commission reported on aquaculture noting the very heavy regulatory burden. QAIF made submissions to that Inquiry. (Assessing Environmental Regulatory Arrangements for Aquaculture: Productivity Commission Research Paper February 2004, Australian Government)
- In 2008 the Department undertook a review of the Fisheries Strategy. Industry strongly supported the document in its recognition of the potential for aquaculture development in Queensland and the thrust of the strategy for development of aquaculture.
- In October 2008 we wrote to the both the Minister and to Premier Anna Bligh saying that we understand that “your Department is considering undertaking a

review of the benefits and options for an aquaculture development Act.” We said that: *“The development of this potentially very large industry has been hampered by the lack of clear development guidelines. Many government agencies are involved in the development approval process and approvals have taken an enormous amount of time with uncertain outcomes.*

The development of large sustainable aquaculture industries in Tasmania and South Australia has been significantly attributable to the strong support and clear directions provided by appropriate legislation.”

- In 2011 QAIF responded to the “draft Queensland Aquaculture Policy Statement”. This proposed, and industry supported, the establishment of Aquaculture Development Areas (ADAs), but the policy did not address many issues requiring statutory change. As an example, the potential for sea cage aquaculture was set aside.
- We live in hope this Committee may actually achieve something.

QAIF
July 2012

The environmental management of prawn farming in Queensland – worlds best practice

Research Summary

The environmental management of prawn farming in Queensland – worlds best practice

The emergence of prawn farming as an economically successful industry in coastal regions of Queensland over the past two decades prompted a comprehensive, multi-disciplinary study of intensive prawn pond ecosystems, their ecological impacts on downstream environments and the development of cost-effective effluent treatment systems.

The seven year study (1995-2002) focussed on the largest prawn farms in Queensland and New South Wales throughout the production cycle for several successive years. The study encompassed a range of latitudes, discharge environments (e.g. tidal creeks and estuaries) and both flow through and recirculating water management systems.

The study integrated the research skills of 30 scientists from several institutions including CSIRO, Australian Institute of Marine Science, University of Queensland, Queensland Department of Environment and Heritage, New South Wales Environment Protection Authority, Griffith University, University of Sydney, University of Technology, Marine and Freshwater Resources Institute, Victoria and the University of Maryland, U.S.A.

The multidisciplinary study was the most comprehensive analysis of the environmental management of prawn farming ever conducted. The team developed rigorous techniques for sampling eutrophic pond ecosystems including sediment and water column nutrients and microorganisms, pond biota and abiotic variables. The application of enriched isotope nutrient labeling techniques, pioneered by the team, permitted the first accurate quantification



of the fate of feed nutrients in an intensive prawn farming system and downstream from the farm. The integrated approach adopted throughout the study also permitted the team to produce a multi-author synthesis of the dominant ecological processes in intensive shrimp ponds and adjacent coastal environments. Beyond developing a quantitative understanding of these processes the team analysed pond effluent composition and designed a cost-effective effluent treatment system based on sedimentation processes. The introduction of settlement ponds has also provided industry the opportunity to recapture water nutrients using natural biological filters.

The results of the project have been communicated via 42 refereed scientific publications and four final reports (see references).

The key elements of the study were:

- prawn pond sediment and nutrient processes (*references 1-22*)
- composition of prawn pond discharges (23)
- discharge treatment systems and environmental management (23-29)
- receiving waters - assimilation and monitoring (30-40)
- synthesis of pond processes and environmental management (41-45)
- aquaculture land use planning (46).

The key outputs of these studies were:

- Prawn pond sediment and nutrient processes rigorously quantified and modelled (1, 18)
- Pond discharge composition rigorously quantified (22, 23)
- Published the first synthesis of the dominant ecological processes in ponds and adjacent coastal environments (30)
- In collaboration with industry, designed and implemented cost-effective treatment system based on sedimentation processes (24, 25, 27).

Outcomes and implications:

- All Australian prawn farms use environmental management practices, including discharge treatment systems, which enable them to meet world best practice discharge water quality.
- Progressive advances in treatment systems and practices have enabled some farms to increase their total production area with no net increase in sediment and nutrient loads discharged into receiving waters.
- Increasing production area without increasing sediment and nutrient outputs has been achieved by increasing the area of treatment ponds (in some cases up to 35% of the total pond area). There is a major opportunity to develop the next generation of discharge treatment technology to reduce the required area of treatment ponds.
- The prawn farming industry has achieved an effective balance between economic gains and conserving ecosystems, including the world heritage listed Great Barrier Reef.

- With these operating practices and regulations in place, there is significant opportunity for the industry to expand without compromising the economic and environmental sustainability of the industry.
- Broad scale desktop analysis identified 594,000 hectares of potentially optimal pond aquaculture land along the Queensland coast that would not compromise the environmental standards for the region (46).
- A fine scale land use modelling case study that enabled the expansion of an existing prawn farm adjacent to the Logan River, optimising the economic benefits of land use in the regions with no increase in nutrient or sediment discharges to the Logan River (commercial in confidence).
- For example an increase from the current 717 hectares of prawn ponds, producing 2,940 tonnes valued at \$40 million to 5,000 hectares of ponds producing 30,000 tonnes valued at \$400 million - would correspond to less than 1.4% of the existing sugar cane production area. The 5,000 hectares could be located within any of the 594,000 hectares of potentially suitable land between the border of New South Wales and Northern Territory border (a total distance of 13,347 km).



Scientific publications and reports - Prawn pond nutrient process, downstream impacts and environmental management options

In ponds

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3. Burford, M. A. and Glibert, P. M., 1999. Short-term nitrogen uptake and regeneration in early and late growth phase shrimp ponds. *Aquaculture Research* 30, 215-227.
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