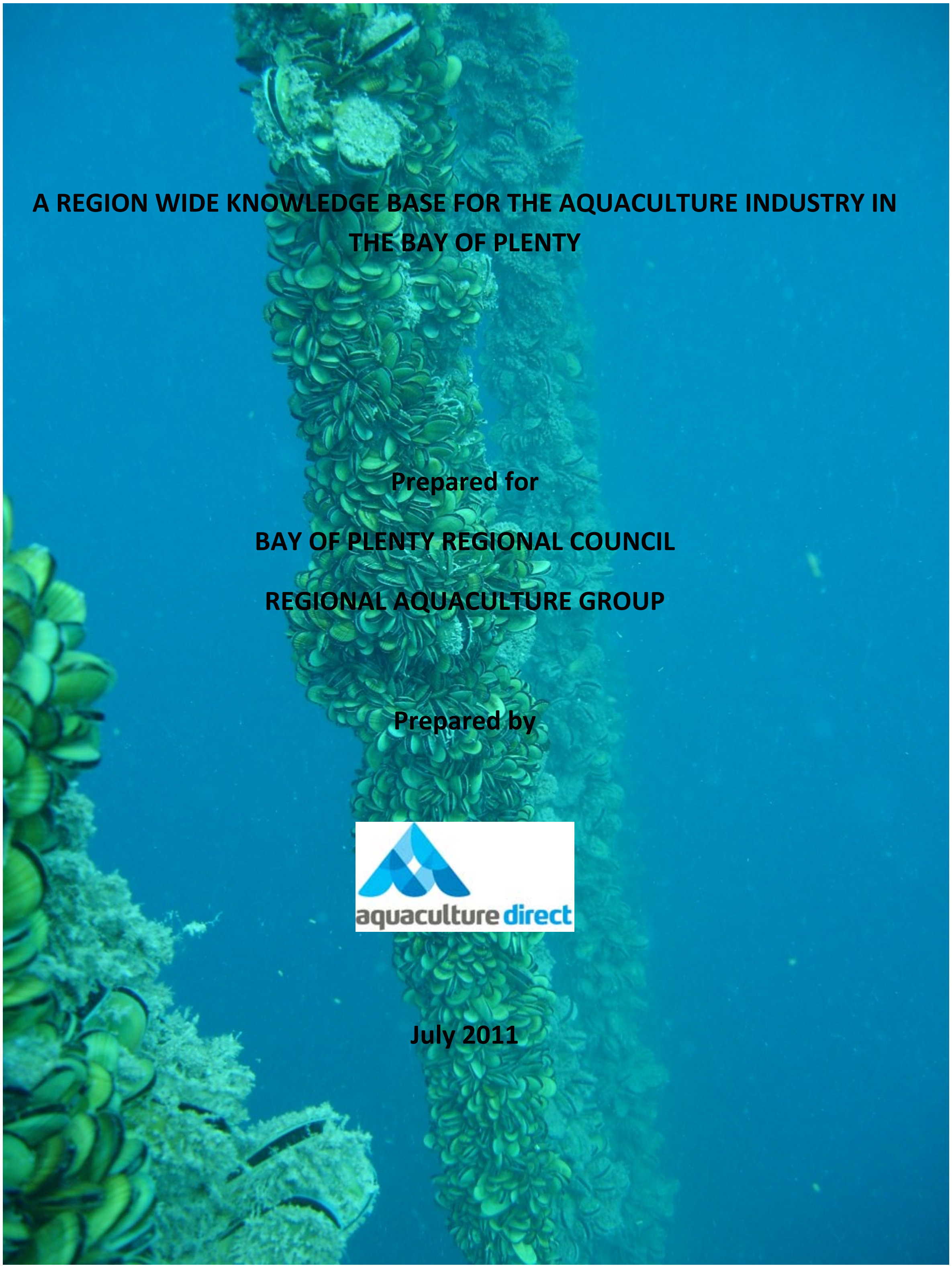

A REGION WIDE KNOWLEDGE BASE FOR THE AQUACULTURE INDUSTRY IN THE BAY OF PLENTY

Prepared for

BAY OF PLENTY REGIONAL COUNCIL

REGIONAL AQUACULTURE GROUP

Prepared by

aquaculture direct

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Thank you to Opotiki District Council and the Cawthron Institute for supplying the photos throughout this report.

1. Introduction

Over the past five years, Bay of Plenty Regional Council has carried out substantial research, including holding four forums since 2006, into the potential for developing the aquaculture industry in the Bay of Plenty. Research has found that the Bay of Plenty waters are among the most productive in New Zealand. Opportunities exist for large scale marine farms off the coast and other aquaculture ventures using the district's waterways and lakes to farm eels and other species for local consumption and export. In addition to the existing aquaculture venture in the Ohiwa Harbour, Whakatane, there are 8,000 hectares of aquaculture potential in the Eastern Bay of Plenty, including a marine farm of 3,800 hectares off Opotiki.

This document forms a part of the actions identified under the Bay of Plenty Aquaculture Strategy. The Aquaculture Strategy was launched in November 2009. Aquaculture is one of the key focus areas under the Region's economic development strategy – Bay of Connections.

The Aquaculture Strategy recognises that Bay of Plenty will benefit greatly from the development of an aquaculture industry. The need for a region-wide knowledge base to address the growth and infrastructure requirements of the local aquaculture industry was identified as part of the strategy. This document should be treated as an initial reference point for those wishing to establish an aquaculture business in the region. The report is a 'living' document and the information provided here will change over time.

2. Possible Future Strategies - Overview

The vision of the Aquaculture Strategy is that the Bay of Plenty is a world-class aquaculture region, with a goal to grow an integrated and sustainable aquaculture industry in the Bay of Plenty with export sales of $250m by 2025[1].

New aquaculture developments in the Bay of Plenty region are most likely to achieve long-lasting commercial success if they are a collaborative venture. Building Relationships between research and training providers in the Region, such as Bay of Plenty Polytechnic, University of Waikato Marine Centre in Tauranga and Iwi training organisations will provide access to a knowledge base to support any new aquaculture operation.

There are three types of water resources in the Bay of Plenty region, which over time will be used for aquaculture development; these are as follows:

- Coastal Marine Area (CMA);
- Freshwater rivers and lakes;
- Residue heat from discharge water associated with geothermal power station activities.

Each water resource (and associated temperature regimes) will provide potential for the farming of different fish and shellfish species. For example the CMA can be used for mussels and oysters; rivers and lakes can be used for growing eels and koura, and prawns can be grown using geothermal resources. Prospective aquaculturalists in the Bay of Plenty region should carefully review the properties of their water resource so that the most appropriate species are farmed.

[1] World Class Aquaculture - Bay of Plenty Aquaculture Strategy. November 2009.

3. Current Aquaculture Ventures

The Bay of Plenty currently has one major operational aquaculture site; a 3,800ha farm, off the coast of Opotiki. A larger 4009ha site is also proposed, however this application is currently on hold. If both these farms are developed to full scale, they will represent around one third of the total consented aquaculture space in New Zealand. There are also some small scale oyster farms in Ohiwa Harbour (near Whakatane) which have been successfully operating for a number of years (Table 1).

Fish & Game New Zealand currently operates a freshwater trout hatchery at Waimataa Spring, where research on a variety of breeding and animal husbandry, nutrition and growth, production technology, live feed production, whole organism bioassays, post harvest product quality research, ecological monitoring and research design is undertaken. In addition crayfish and paua are also permitted to be grown at land-based seawater farms in the Bay of Plenty.

Table 1: Aquaculture licences/permits and applications in the Bay of Plenty Region.

Consent Number	Location	Size (ha)	Saltwater / Freshwater	Permitted Species	Operating Status
40032	Factory Bay	4.6	Saltwater	Mussels	Unimplemented; consent lapsed
61085	Waimataa Spring	N/A	Freshwater	Trout	Operational
61234 MF915 MF916	Opotiki	3,800	Saltwater (offshore)	Mussels, scallops, Pacific Oysters, flat oysters	Commercial trials underway
63054 LE25	Ohiwa Harbour	2.007	Saltwater	Oysters	Operational
63056 LE43	Ohiwa Harbour	2.023	Saltwater	Oysters	Operational
63058 MF243	Ohiwa Harbour	2.01	Saltwater	Oysters	Operational
64916	Sulphur Point, Tauranga	N/A	Land-based saltwater	Crayfish	Holding facility
40259 FW112	Waikawa Point	N/A	Land-based saltwater	Black-foot paua	Trial facility
FW114	Mamaku	N/A	Land-based seawater	Black-foot paua	Trial facility
N/A	Otamarakau	4009	Saltwater (offshore)	Mussels	Application on hold

4.

4. Assessment of Future Aquaculture Opportunities

Aquaculture presents a viable opportunity to substantially contribute to the economy of the Bay of Plenty; in fact no other sector currently offers the potential for such growth. To date, there is no large scale commercial aquaculture in the Bay of Plenty; this is in part due to knowledge and technology gaps around farming in the exposed offshore environment. However significant amounts of initial work on aquaculture development in the Bay of Plenty have been undertaken by a variety of stakeholders, including:

- Eastern Seafarms Ltd (consent holders for 3,800ha farm) in preparing the original application and subsequent research and testing.
- Bay of Plenty Regional Council on initial investigations and scientific work, processing of applications and regional forums to progress development.
- Opotiki District Council on aquaculture-specific research and other studies on a harbour entrance for Opotiki which is necessary to service a large offshore farm.
- Whakatohea Maori Trust Board on research and development of the most suitable species for farming in the Bay.
- Bay of Plenty Polytechnic on equipment, teaching and research resources related to aquaculture.
- Central government agencies (NZ Trade & Enterprise, Ministry for the Environment) on investigations into the potential and efficacy of offshore aquaculture in the Bay.
- Te Runanga o Ngati Whakaue ki Maketu on research into onshore marine farming possibilities and the most suitable species for the Maketu area.

In 2007, the Bay of Plenty Regional Council undertook an aquaculture constraints mapping project; the main output from which was a series of maps which intend to provide spatial constraints to aquaculture development within the region. The maps should be treated as general indicators of some of the uses and values associated with the Bay of Plenty coastal marine area, rather than a determination of the best locations for aquaculture development. Nevertheless, the document 'Aquaculture Management Areas Coastal Use and Value Maps' is a good starting point when considering a new aquaculture venture in the region. Hard copies of these maps can be obtained by contacting the Bay of Plenty Regional Council (http://www.boprc.govt.nz/environment/coast/aquaculture/ama-project.aspx).

Prior to developing an aquaculture venture, it is recommended that prospective aquaculturalists consult the Bay of Plenty Regional Coastal Environment Plan (http://www.boprc.govt.nz/knowledge-centre/plans/regional-coastal-environment-plan/). This plan does not prohibit aquaculture in any areas of the coastal marine area; however structures are prohibited within permanently navigable harbour waters.

In general, species suitable for aquaculture have defined temperature ranges where they will achieve optimum growth. To complicate matters, there are a number of species where their biological limits for optimum growth are not yet known, and some species are more temperature dependent than others.

Table 2 provides a summary of the current understanding of species thought to have potential for culture in the Bay of Plenty region (classified as temperate), where average marine surface water temperatures range from a maximum of ~21°C in February to a minimum of ~14°C in July/August (data provided by Bay of Plenty Regional Council).

Table 2: Species with potential for aquaculture in the Bay of Plenty Region

Species	Temperature Range (Ideal)	Saltwater/ Freshwater	Comments
Butterfish	Unknown	Saltwater	Found around entire NZ coastline and considered to have good potential for aquaculture. Research is in early stages and is predominantly funded by private industry groups, so currently unavailable for public consumption.
Eel	20-28°C	Freshwater	Potential for enhancement or farming. Refer National Eel Workshop proceedings http://www.wananga.ac.nz/Research/Documents/National%20Eel%20Workshop%20Proceedings%202010.pdf.
Kingfish	>15°C	Saltwater	Global kingfish aquaculture industry is steadily growing. Increasing market demand from Japan and USA. Kingfish farming has yet to achieve commercial success in New Zealand.
Koura	15-18°C	Freshwater	Currently farmed on a small scale in New Zealand. Sold as a quality niche product with steadily increasing market demand.
Mussels	Natural temperature range	Saltwater	Grow in waters throughout the country and is an established industry in New Zealand. Growth trials at offshore site have shown favourable results.
Pacific Oyster	15-18°C	Saltwater	Established industry in New Zealand. Currently farmed on a small scale in Ohiwa Harbour.
Paua	Optimal: 16°C	Land-based saltwater	Established aquaculture and wild catch industries in New Zealand, with two small farms in Bay of Plenty. High costs associated with pumping seawater onto land.
Scallops	Natural temperature range	Saltwater	Early investigations have suggested that scallops have potential for aquaculture, and they grow in waters throughout the country. Still a number of technological and biological issues to be addressed.
Sea cucumber	13-22°C	Saltwater	Investigations of sea cucumber aquaculture in early stages. Can be farmed in saltwater ponds or as a form of poly-culture under marine farms.

Macroalgae /Seaweeds	Natural temperature range	Saltwater	A promising aquaculture activity especially for offshore sites. Important to grow seaweed that is naturally found in the region. Extracts are used as bio-stimulants by horticulturalists, and for nutraceutical purposes.
Rainbow Trout	9-14°C	Freshwater or Saltwater	Although not yet legal to farm trout in NZ, although Fish & Game have a trout hatchery in the region. There is also some desktop work currently underway to ascertain the potential for sea cage farming of trout in New Zealand. However there are issues associated with obtaining juveniles. Likely to face strong opposition from local anglers.

Other forms of aquaculture that have potential in the Bay of Plenty include:

- Land-based seawater: there are two types of land-based seawater farms; extensive ponds (e.g. those used to farm sea cucumber and mullet) and intensive tank farming (e.g. marine finfish hatcheries).
- Geothermal: Latent heat produced from geothermal power station activities can be used with exchangers in a separate water system. Discussions are currently underway between Bay of Plenty Regional Council, local Iwi and power companies in the region, with the intent of developing a strategy for the utilisation of geothermal resources in the Region.
- Enhancement of wild species (e.g. eels). This is an important genre of aquaculture, particularly for species such as eels, which spend most of their lives in freshwater and then migrate to the sea to breed (catadromous). Glass eel and elvers require clear passage from the sea to their home rivers; however their travel upstream can be blocked by hydro dams or impacted by irrigation intakes and other discharges. Enhancement of the eel population may involve catching glass eels as they enter rivers from the sea, and transporting them safely above human-made barriers.

5. Capital Equipment Requirements

Capital equipment requirements for aquaculture ventures vary markedly depending on the species being farmed, the growing environment and the structures being utilised. Table 3 provides an indication of the type of capital equipment required to establish an aquaculture operation.

Table 3: Capital Equipment Needs for each of the Main Growing Environments

Location	Growing Structures	Species	Capital Equipment Needs
Intertidal marine	Baskets/racks/sticks	Pacific oysters	• Sticks/racks • BST baskets • Ropes

			• Service vessel • Navigational lighting
Marine	Suspended long-lines	Mussels, Pacific oysters, scallops, paua	• Mooring structures (anchors, warps) • Ropes (backbone, lashing, culture, spat) • Floats • Socking • Service vessel equipped for seeding, harvesting • Navigational lighting
Marine	Cage farming	Kingfish, butterfish	• Mooring structures • Sea cages • Nets • Net cleaning system • Feed systems (hoppers, distribution & monitoring systems) • Water quality monitoring equipment • Fish handling equipment • Accommodation barge • Service vessels for transporting staff, feed, services as well as harvest vessels • Navigational lighting
Land-based seawater or freshwater	Pond/raceway/hatchery	Seawater: kingfish, paua, sea cucumber, mussels, oysters Freshwater: eels, koura, trout	• Pond/raceway structures (including water take and discharge consents) • Water pumps • Grading/sorting equipment • Buildings (sheds, offices, hatchery) • Lighting • Growing tanks • Piping • Aeration systems

In addition to the capital equipment requirements listed above, each type of farming has various consumables that are also required. There are a number of companies who specialise in supplying products for aquaculture, both in New Zealand and internationally. Information about these stockists can be found on their company websites, and also in two useful directories:

- The Marine Farming Association's (www.marinefarming.co.nz) annual 'Aquaculture Directory' includes a current list of aquaculture service providers. The details of these

providers can be obtained by contacting the MFA office (03 578 8044) and asking for a copy of the aquaculture service providers list.

- The annual Austasia Aquaculture Trade Directory (www.austasiaaquaculture.com.au).

6. Investment/Funding Requirements

Due to the variation in capital equipment required, the amount of upfront investment for an aquaculture venture also varies markedly depending on the species and growing environment and structures being utilised. Marine finfish farming, for example, requires a substantially greater infrastructure, and therefore a higher level of investment, than for example, intertidal bivalve farming. There are also numerous ongoing funding needs, which are dependent on the type of aquaculture.

The following examples provide an idea of the approximate costs for intertidal farming, suspended longline farming, marine finfish farming and land-based farming. These costs are based on information provided in a report for Ministry for the Environment on aquaculture risk management[2].

- Intertidal farming. Generally considered to be a low cost aquaculture operation, predominantly used for growing oysters, the capital set up costs associated with establishing an intertidal oyster farm are $20-$40,000 per hectare (this range reflects the use of sticks or bags for growing the oysters).

- Open ocean longline farming. Considered to require a medium level of financial input, the capital cost of long line farming will vary according to location, but it is likely to cost $12-$15,000 to set up one line (includes anchors, warps, floats etc), with three to four long-lines per hectare. There is an additional cost of approximately $15,000 to seed the line. The seeding cost will be incurred for each growth cycle (12+ months); however the setup costs are a one off with equipment lasting for some 20 years. The annual operating cost for longlines is $10-12,000 per cycle in sheltered waters, but will costs will increase in exposed sites.

[2] Stimpson & Co. December 2007. Aquaculture Risk Management Options. Produced for the Ministry for the Environment.

- Marine finfish farming. Due to the initial capital outlay required to set up a finfish farm, and the ongoing feed costs, finfish farming is recognised as a high cost operation. A 1000 tonne finfish farm will require approximately $3.5-4m investment (including installation costs). In addition, during the establishment phase, sufficient working capital is required to get the farm through one full year, plus a further six months (as fish are harvested at 18 months). Annual costs of approximately $650,000 to raise 100 metric tonne of fish using large steel cages. The costs of feeding the fish range from $2.50-$2.80/kg of feed; this cost will change with exchange rates and least cost ingredient formulas. Finfish farmers also require a consistent supply of juvenile fish, so a hatchery source is required.

- Land-based farming: There are a large number of variables associated with developing a land-based aquaculture operation, including the site location, soil type, slope, layout, species farmed, marine or freshwater growing waters, etc. It is therefore recommended that detailed functional specifications, design studies and quotes are obtained prior to developing a land-based aquaculture operation.

To provide an idea of the variation in running costs between farm types, Table 4 provides an estimate of the cost proportions associated with feed supply and labour for three different types of farming.

Table 4: Food and labour cost proportions of total running costs for different types of farming.

Farming Type	Food	On-the-farm Labour
Intertidal marine	0% Phytoplankton occurs naturally in water	60% General husbandry, cleaning, grading, declumping, repairs & maintenance.
Suspended marine - bivalves	0% Phytoplankton occurs naturally in the water	50% Seeding, thinning, reseeding repairs & maintenance.
Tanks/Cages - finfish	66% Imported extruded food and local pressed pellets	10% General husbandry, diving, feed supervisory, animal health, water

		quality, repairs & maintenance.

7. Operating Requirements

Operating requirements for an aquaculture venture vary markedly depending on the species and growing environment and structures being utilised, and as such it is difficult to provide detailed information on the specific operating needs. Figure 1-Figure 3 on the following pages are intended to provide guidance on the factors that need to be considered when establishing an aquaculture operation.

The presence of an established aquaculture industry nationally means that, while not necessarily available in the Bay of Plenty region, the majority of the equipment required for an aquaculture operation can be supplied and/or manufactured within New Zealand.

Once successfully grown, the harvested species need to be processed. As per New Zealand food safety standards, this needs to be undertaken in a registered pack house or factory licensed for the processing of food products. (Check NZFSA website) The Bay of Plenty currently has one specialist factory dealing with aquaculture products grown locally - North Island Mussel Processors Ltd (NIMPL) factory which is located in Greerton, Tauranga. This factory has a design processing capacity of 100 green weight tonnes (GWT) of mussels per day.

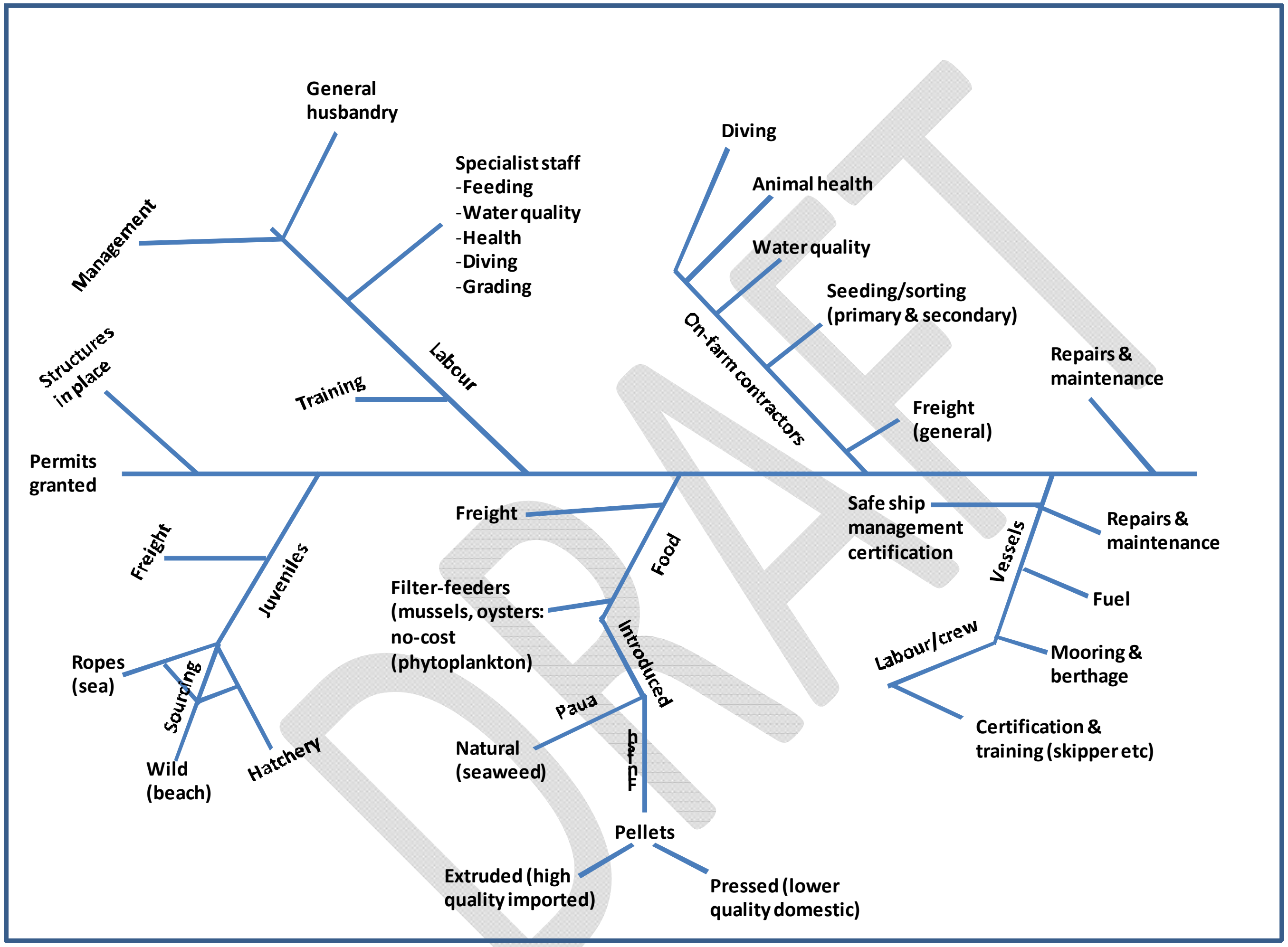

Figure 1: Operational considerations for on growing shellfish and finfish at a marine farm.

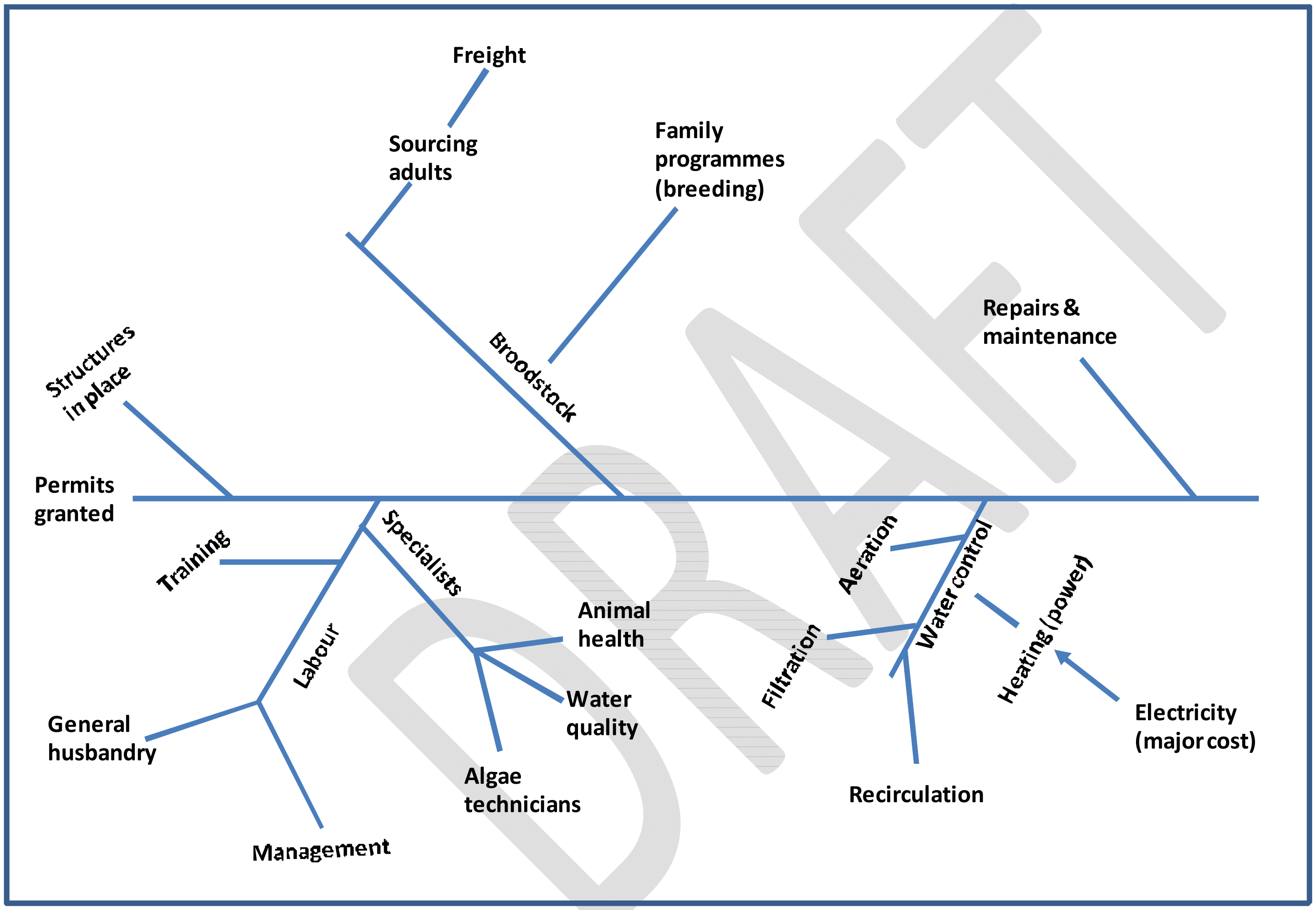

Figure 2: Operational considerations for a land-based finfish hatchery.

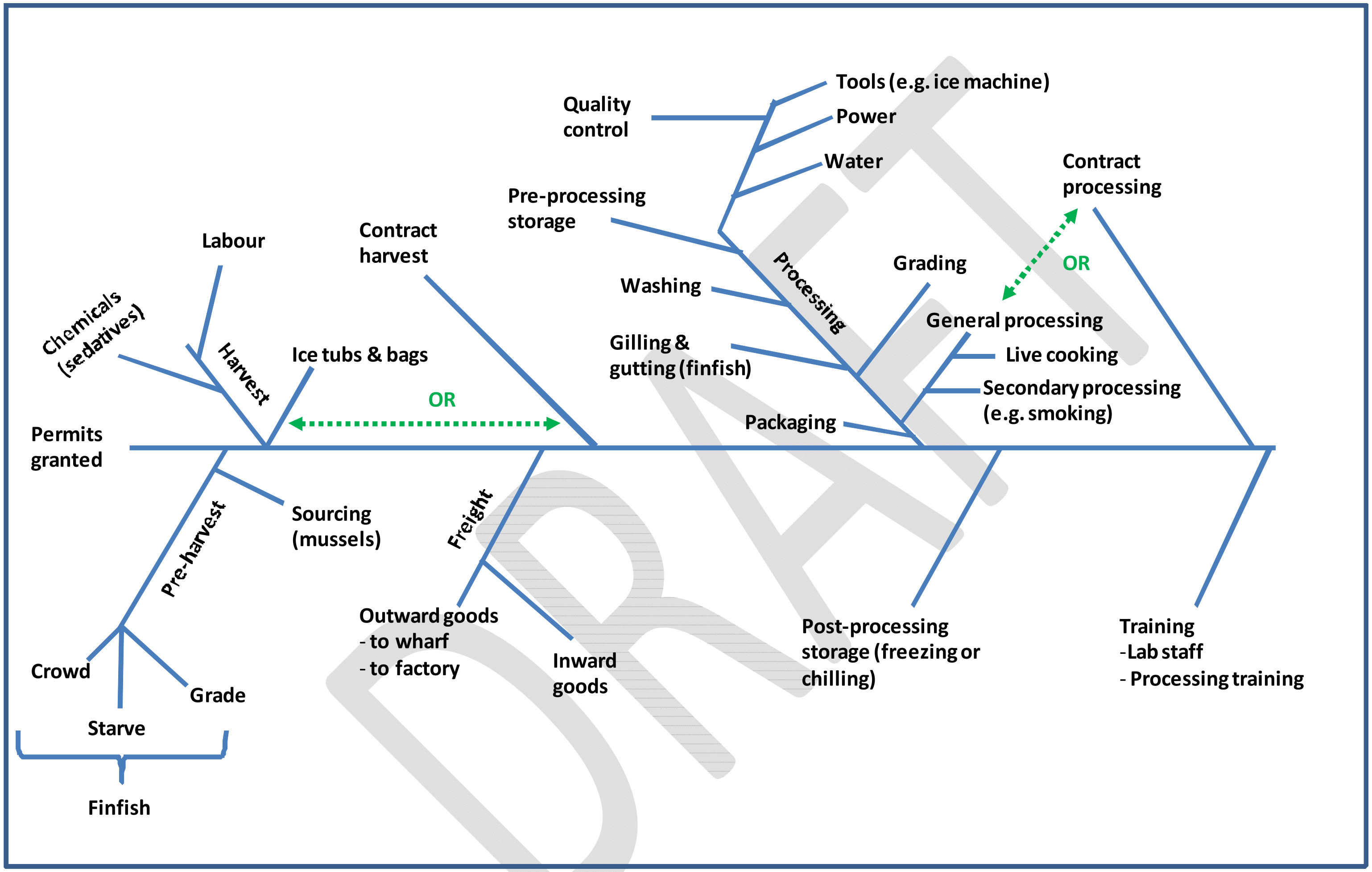

Figure 3: Operational considerations for harvesting and processing operations.

8. Infrastructure Requirements

The specific infrastructure requirements associated with aquaculture are reasonably well known, and the Bay of Plenty region is, on the whole, well placed with regards to the infrastructure required for the successful operation of an aquaculture venture. In fact it is better serviced than in some regions where aquaculture is currently undertaken.

The four key infrastructure areas are transport, processing, electricity and water supply (these latter two relate to land-based operations). Specific infrastructure requirements that need to be considered when establishing a full scale commercial aquaculture operation are discussed below.

- Road Network

  Figure 4 (on page 18) shows the Bay of Plenty road network, which particularly in the western side of the region is excellent and sufficient to service a fully developed aquaculture industry in the region. If however, a wharf and processing facilities are developed in Opotiki, it is possible that some road upgrades may be required. An example of likely product movement is as follows: if the Opotiki offshore site is developed to the full production capacity of 20,000 tonnes (t) mussels per annum, and the standard mussel industry assumption of 35% recovery to frozen half shell is achieved, this means that 7,000t frozen half shell will be transported by road from the region annually. The B-train truck and trailers take 20t containers, equating to approximately 300, 20 foot containers travelling on the regional roads annually, less than one per day.

- Wharf facilities

  Service vessels can utilise Whakatane Harbour, however the bar at the entrance presents safety issues, and Whakatane has up to 60 closures per year as a result. The wharf at Opotiki is currently unsuitable for full scale commercial use, but is suitable for use at the trial stage of farming. Opotiki District Council has consented the development of the Opotiki Harbour which will provide safe, all weather, port facilities for servicing offshore marine farms.

  Currently the only safe all weather wharf facilities suitable for harvesting, servicing the farms, and in particular landing product from marine farms are at Tauranga, which while close to the NIMPL factory, does require a lengthy boat trip from the offshore site. As a comparison, the travelling distances from this site to the ports in the region are shown below:

  - Offshore site to Opotiki: 5 nautical miles;
  - Offshore site to Whakatane: 12 nautical miles;
  - Offshore site to Tauranga: 51 nautical miles.

- Electricity

  The Bay of Plenty region is well serviced by electricity companies, who are based in Whakatane and Tauranga, and electricity providers have indicated that they currently have sufficient supply to support land-based aquaculture operations. If, however, a processing factory is developed at Opotiki, electricity suppliers have indicated they will need one to two years lead in time to provide sufficient supply.

In more isolated areas of the Bay of Plenty, prospective aquaculturalists should investigate the availability and capacity of three phase power. Three phase power supply will be critical for land-based farms using pumped water.

- Industrial Water Supplies

Potable and industrial water for land-based processing facilities will be an issue in areas not well served by mains water supply. Any prospective aquaculturalists wishing to process their product in an isolated location will need to seek assurance from the appropriate authority that the local water source is suited to purpose.

- Geothermal

Unutilised geothermal heat from power stations is a novel source of warm water in the Bay of Plenty region, which is well supplied with geothermal resources (Figure 5). There are still a number of issues to be resolved before the residue heat from geothermal activities can be utilised for aquaculture. In addition to engineering issues associated with utilising geothermal sources; other issues include:

  - The water currently can't be used directly for aquaculture due to the chemical nature;
  - Aquaculturalists currently cannot be assured that the water can be delivered constantly at the desired temperature.

These issues are part of the focus of a team comprising members from Mighty River Power, Contact Energy, Bay of Plenty Regional Council, Iwi and relevant territorial authorities, who are currently working together to develop a strategy for utilising geothermal energy.

Figure 4: Map of the Bay of Plenty region showing the main arterial road network.

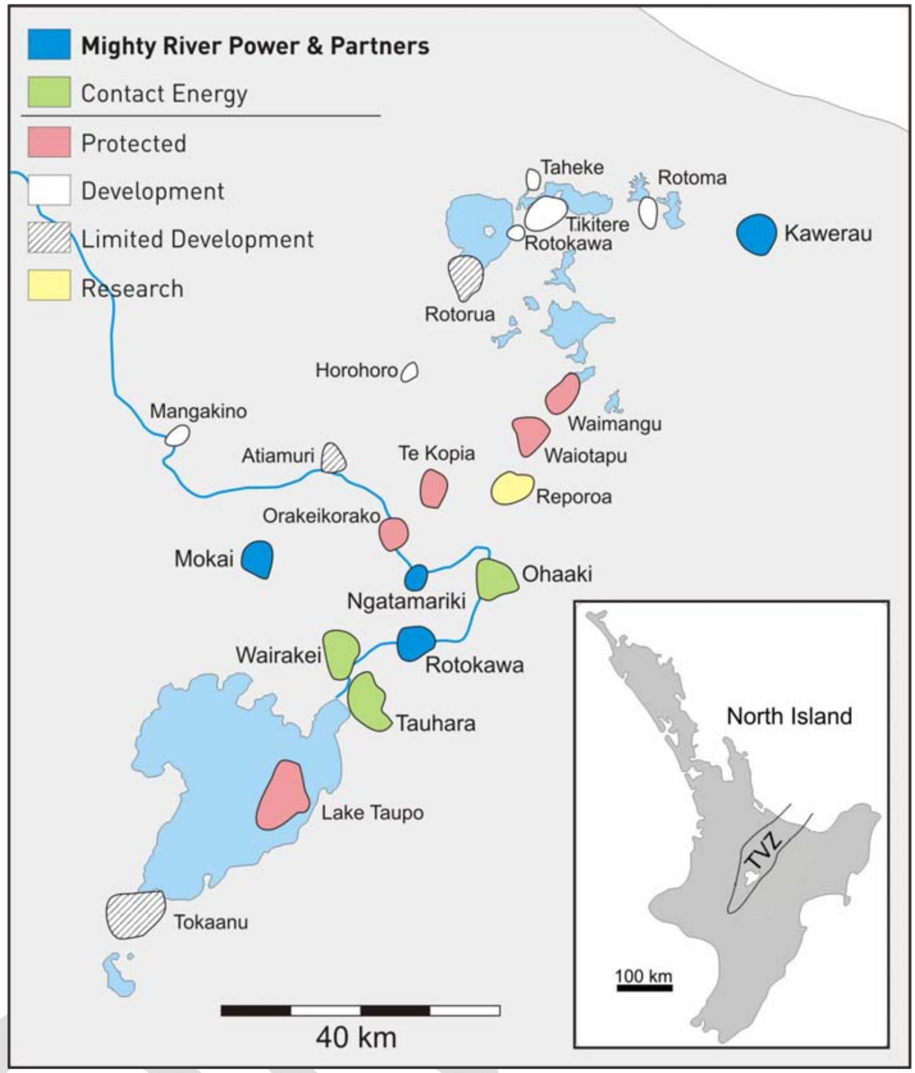

Figure 5: Location and development classification of high temperature geothermal resources in the Taupo volcanic zone of the North Island.

9. Skill Base Requirements

A skilled and engaged workforce is vital for the success of the aquaculture industry. The skill set requirements associated with aquaculture are wide-ranging and, in some cases, unique. The main types of jobs are summarised below, by farming method:

- **Intertidal marine farms (e.g. oysters):** farm staff, leading hand, farm manager, splitters/sorters, truck driver, maintenance, depot/yard manager.
- **Suspended marine farms (e.g. mussels):** skipper, deckhands, farm manager, truck driver, rope/float/stocking technicians, depot/yard manager, operations manager, engineer.

- **Marine cage farms (i.e. fish):** farm workers, harvest team, fish performance manager, divers, supervisor, farm manager, store/net loft workers, depot/yard manager, engineer, truck driver.

- **Land-based farms/hatcheries:** hatchery technician, hatchery data technician, hatchery supervisor, truck driver, engineer.

- **Processing:** machine operators, knife hands/openers, packers, graders, cooks, quality control, leading hand, supervisor, bale store / cold store workers, hopper operations, forklift driver, dispatch driver, supervisor, logistics manager.

Each of these roles requires a unique set of skills, which in some cases can be learned on the job. In the aquaculture industry, there is a high level of on-the-job training, and early on, companies tend to identify motivated, enthusiastic people who show strong leadership skills to move up from the shop floor, or a deckhand position, to become a team leader, skipper or supervisor. At this stage these people will be trained appropriately, and if relevant, assisted through the various unit standards. Progression through the ranks in the aquaculture industry has as much, if not more, to do with skills and experience in the industry than with formal qualifications.

In addition to the key roles identified above, there are a number of supporting skill sets which are not directly related to day-to-day farming, but which are important to ensure the ongoing success of an aquaculture operation. These include the following:

- Structural marine engineers, with a focus on the requirements of marine farms
- Vessel operators
- Marine biologists
- Shellfish and finfish husbandry experts
- Fish veterinarians
- Experienced hatchery operators, with a knowledge of pond and raceway systems
- Managers and administrators
- Transport operators (vessels, trucks)
- Electricians
- Plumbers

10. Training Facilities

Traditionally the aquaculture industry has a preference for 'on the job' or 'in-house' training of farm and processing workers, however there a number of aquaculture qualifications which are nationally recognised and are based on unit standards (the building blocks of each qualification). Each unit standard is specifically designed to recognise what is required for that specific role within the industry. These standards have been developed by industry for industry and are offered by the Seafood Industry Training Organisation (SITO) http://www.sito.co.nz/Aquaculture-qualifications. The following aquaculture related national certificate qualifications can be obtained via SITO:

- Aquaculture (Levels 2, 4)
- Aquaculture Diving (Level 4)
- Caged Fish Farming (Level 3)
- Commercial Inshore Vessel Operations with optional strands in business operations (Level 3)
- Diving – Foundation Skills (Level 3)
- Farm Management of Single-seed Pacific Oysters (Level 4)
- First Line Management (Levels 3, 4)

- Introductory Fish Farming (Level 3)
- Seafood with optional strands in aquaculture and processing (Levels 3, 4)
- Seafood Processing (Level 2)
- Seafood Risk Management – Compliance (Levels 4, 5, 6)
- Workplace Safety (Level 3)

The Bay of Plenty Polytechnic is recognised by SITO as one of the main external providers of aquaculture training, offering National Certificates (and associated unit standards) in Aquaculture (Level 4) and Seafood Processing (Level 2). While not located in the Bay of Plenty, the other recognised key providers of aquaculture training are as follows:

- Solutions in Seafood (SIS): various aquaculture related training, including HACCP and risk management.
- Employers and Manufacturers Association (EMA): management, leadership and first-line training for supervisors and skippers.
- Mahurangi Technical Institute: National Certificate in Aquatic Studies, which includes National Certificates in Aquaculture (Level 4), Seafood – Aquaculture Strand (Level 3) and Seafood Generic (Level 4).
- Queen Charlotte College Aquaculture Academy (QCCAA): various aquaculture unit standards from Level 1-4.

In addition to the main providers, the following organisations also offer aquaculture related qualifications:

- Aoraki Polytechnic: National Certificate in Seafood Processing (Level 2).
- Auckland University of Technology: Bachelor of Applied Science, Aquaculture.
- Nelson Marlborough Institute of Technology: Certificate in Marine Studies.
- Timaru Fishing School: National Certificates in Seafood Processing Strand (Levels 2 and 3).
- Turanga Ararau (Gisborne): National Certificate in Seafood Aquaculture Strand (Levels 3 and 4).
- University of Canterbury: post-graduate paper in Aquaculture, as part of the MSc programme.
- University of Otago: Bachelor of Applied Science, Aquaculture and Fisheries.
- Westport Deep Sea Fishing School: National Certificates in Seafood Processing (Level 2).

11. Discussion of Science Requirements

The New Zealand aquaculture industry has been built on innovation and research and development. To enable further expansion of the industry in the Bay of Plenty region (and nationally), one of the major science needs is the ability to fully "crack the technological threshold" around the feasibility of offshore aquaculture. Other regional and national science needs required to support the growth of aquaculture include the following:

- New species research, including selective breeding and animal husbandry for species such as sea squirts, sea cucumbers, butterfish etc;
- Development of robust sustainable management practices for the whole marine ecosystem, including addressing biosecurity issues (refer Appendix 1:
- Value added product research;
- Hatchery operation research;
- Land-based aquaculture viability research and technology development.

In addition to the national research needs listed above, to ensure that the science needs of the developing aquaculture industry are met, the Bay of Plenty region needs people with the ability to undertake the following work:

- Spat identification and counts;
- Water quality sampling and analysis (including phytoplankton identification);
- Flesh testing and analysis;
- Identification and monitoring of fouling species and other biosecurity threats;
- Assessments of environmental effects (AEEs) and ongoing monitoring of aquaculture operations, including the development of adaptive management plans;

- Marine structural engineering;

Hatchery operations, including selective breeding, expertise.

The Bay of Plenty region has the following organisations where existing facilities and staff can be utilised to meet some of the science needs listed above[3], as follows:

- Bay of Plenty Polytechnic: general marine biological expertise; marine and freshwater recirculation and production; AEE preparation and monitoring; development of hatchery operations (marine, freshwater and land-based marine); basic laboratory work associated with hormone extraction, tissue preparation, bioassays.
- Boffa Miskell: AEE preparation (in partnership with Bay of Plenty Polytechnic).
- Hills Laboratory: water chemistry analysis.

Experts from other parts of New Zealand are subcontracted to address the science needs that cannot be addressed within the region.

A detailed bibliography of relevant aquaculture publications was prepared during the development of the World Class Aquaculture (the Bay of Plenty Aquaculture strategy). A copy of this bibliography can be found *(Cheryl do you have a link for the bibliography?)*.

12. The Maori Commercial Aquaculture Claims Settlement Act 2004

At the time of writing this report, the Maori Commercial Aquaculture Claims Settlement Act (2004) is being reviewed under the current aquaculture law reforms. It is anticipated that any changes to the Maori Commercial Aquaculture Claims Settlement Act will be complete by the end of 2011.

The intent of the original 2004 Act was that the Crown would provide Maori with the equivalent of 20% of all marine farming space created around New Zealand's coasts and harbours since 21 September 1992. The Aquaculture Claims Settlement Act sets out two ways the Crown will do this:

1. It will provide water-space rights for 20% of all 'new' space created;
2. It will provide either equivalent water-space rights of the financial equivalent for 20% of the 'pre-commencement space'. Pre-commencement space is defined as any marine farming space covered by permits, leases, or licences first issued between 21 September 1992 and 1 January 2005.

Figure 6 and shows the regional boundaries and settlement obligations under the Maori Commercial Aquaculture Claims Settlement Act. Further information on the Act can be found on the Ministry of Fisheries website: http://www.fish.govt.nz/en-nz/Maori/Details+of++Settlement/default.htm.

[3] Thanks to Dr. Andrew Morgan (Bay of Plenty Polytechnic) who provided this information.

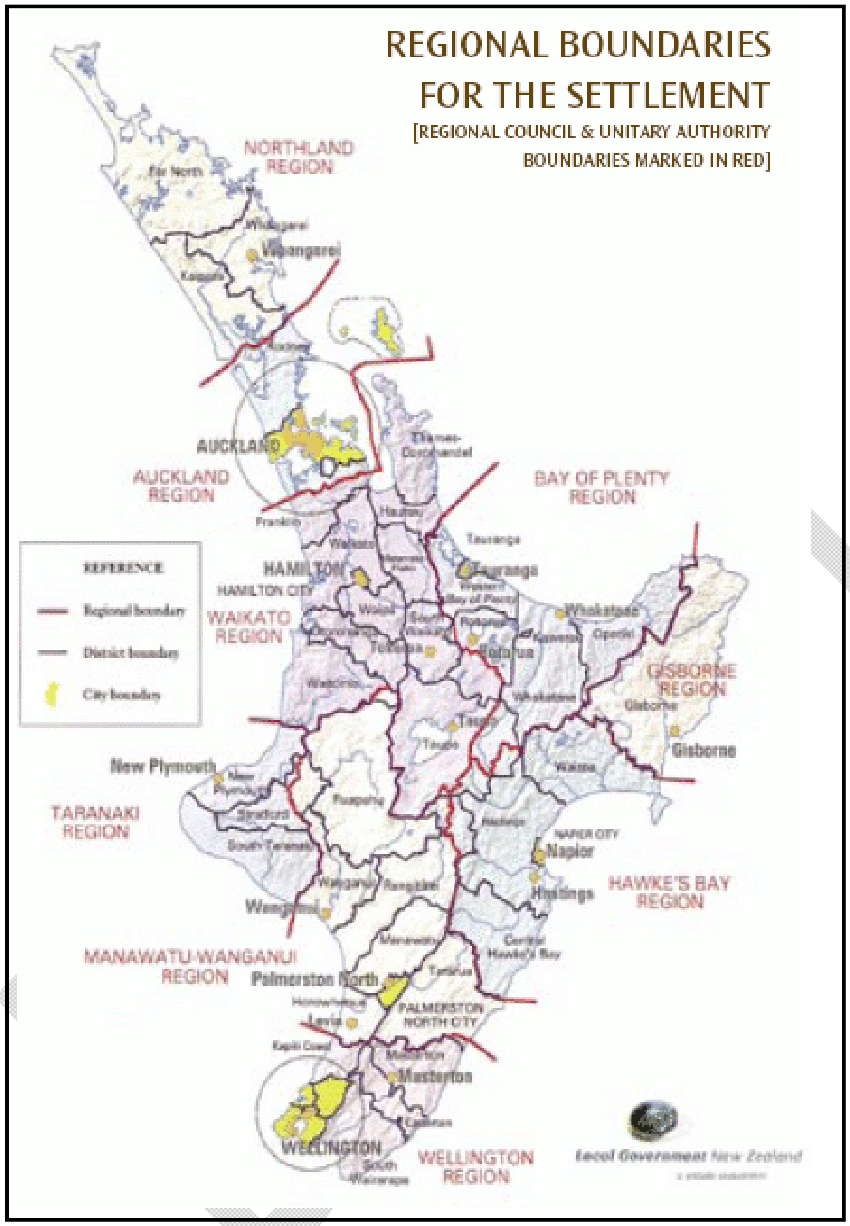

Figure 6: Regional boundaries for the Maori Commercial Aquaculture Claims Settlement Act.

Table 5: Interim harbour and coastal settlement obligations under the Maori Commercial Aquaculture Claims Settlement Act (Bay of Plenty is shaded green).

Regional Authority	Harbour Name	Area (ha)	20% Allocation (ha)
Coastal Settlement Assets			
Auckland Regional Council		21.00	4.20
Bay of Plenty Regional Council		3,804.00	760.80
Chatham Island Council		-	-
Canterbury Regional Council		2,695.00	539.00
Hawke's Bay Regional Council		2,465.00	493.00
Marlborough District Council		1,194.57	238.91
Northland Regional Council		2.50	0.50
Southland Regional Council		-	-
Tasman District Council		-	-
Wellington Regional Council		4.31	0.86
Waikato Regional Council		-	-
West Coast Regional Council		-	-
Harbour Settlement Assets	*North Island*		
Auckland Regional Council	Kaipara	-	-
Bay of Plenty Regional Council	Ohiwa	2.02	0.40
Northland Regional Council	Parengarenga	56.80	11.36
Northland Regional Council	Houhora	42.49	8.50
Northland Regional Council	Rangaunu	22.16	4.43
Northland Regional Council	Whangaroa	8.00	1.60
Northland Regional Council	Te Puna Inlet (BOI)	3.80	0.76
Northland Regional Council	Waikare Inlet (BOI)	11.61	2.32
Northland Regional Council	Kaipara	-	-
Waikato Regional Council	Aotea & Kawhia - Kawhia	2.82	0.56
	Marlborough Sounds		
Marlborough District Council	Pelorus Sound	2.75	0.55
Marlborough District Council	Queen Charlotte Sound (northern ent)	6.05	1.21
Marlborough District Council	Queen Charlotte South (E & W ent)	-	-
Marlborough District Council	Croisilles Harbour	-	-
	Additions s.59(1)		
Marlborough District Council	Admiralty Bay	13.94	2.79
Marlborough District Council	Port Gore	-	-
Marlborough District Council	Port Underwood	-	-
Total		**10,358.82**	**2,071.76**

13. Support Industry Required

The aquaculture industry requires a diverse range of supporting industries, which vary with the farming location. Some of the key industries required to support the successful development of aquaculture in the Bay of Plenty include:

- Marine engineering (vessels, structures);
- Vessel servicing;
- Vessel operators;
- Rope makers (warps, backbones, longlines, lashing etc);
- Socking fabricators;
- Plastic fabrication (floats);
- Port infrastructure (including industrial storage, cool stores, fuel depot);
- Electricity suppliers;
- Plastic pipe manufacturers;
- Trucking/freighting firms;
- Ice machines

While initially support can be provided from surrounding regions, as the aquaculture industry develops in the region, the need for local suppliers will become more pressing.

14. Current Infrastructure Summary

The Bay of Plenty region has an excellent infrastructure base to support the development of a vibrant aquaculture industry. Improved access to adjacent Ports would be desirable but not essential until full development of the large offshore site occurs. Aquaculture development is a natural extension to the Bay of Plenty's existing business and infrastructure. The region has the necessary technical and engineering support, education programmes, Iwi participation, processing options, energy and roading requirements, route to market, council support and a history of maritime activity. As such, the Bay of Plenty region is well placed to support the development of aquaculture, and is in many ways better placed than existing aquaculture areas including Marlborough and Golden Bay.

Supporting infrastructure is critical to enable the aquaculture industry in the Bay of Plenty region to meet the stated regional goals. Currently, the three main infrastructure gaps are:

- Safe, all weather port facilities close to the consented marine farms – the development potential of aquaculture offshore from Opotiki is currently compromised by safety (access to a safe water port). However the existing port infrastructure is adequate to service operations during the trial stage.

- Power supply issues for development of a processing factory adjacent to the Opotiki marine farm site – electricity suppliers have indicated it will take one-two years to increase the output level required to support a processing factory.

- Complexities surrounding the use of geothermal water resources need to be resolved.

Appendix 1: Notes to Regional Aquaculture Group on Matters Relating to Biosecurity and Biodiversity in the Bay of Plenty

Biosecurity and biodiversity are two subjects of growing interest to the aquaculture industry

Biosecurity issues revolve around;

- Breaches of NZ's international border security
- Ballast water discharge from international vessels
- Exotic pest introductions
- Hull and mooring fouling
- Impacts of pest species on the receiving environment
- Impacts of pest species on aquaculture activities
- Movements of aquaculture equipment and species within NZ

Biodiversity issues revolve around;

- Impacts of pest species on the receiving environment (smothering, replacement of native species)
- Impacts of pest species on marine aquaculture activities (smothering or competition for space growing structures)
- Species diversity changes (fish diversity may increase around a marine farm, organisms diversity may decrease and/or increase under a marine farm)
- Alterations to the genetic traits of wild populations of plants and animals which may cross with plants and animals bred in selective breeding programmes (hatchery reared species)
- Transferring natural spat from one area of the country to another
- Introductions of new farmed species into areas where they don't naturally occur

Aquatic diseases are often considered part of the biosecurity/biodiversity picture. Diseases may be introduced or endemic. Aquaculture facilities do not create diseases however species that are in farms and are stressed beyond natural stress levels may become subject to a pathogen which is present but does not affect wild stocks. The principals of managing disease outbreaks are similar to managing biosecurity failures and biodiversity threats.

In New Zealand exotic organisms that have traditionally posed the greatest threat to marine biosecurity and the aquaculture industry are those which smother or replace either standing crops or marine farm growing structures (e.g. Undaria, Didendum vexillum, Styela clava, Dydimo and Pyura). Local varieties of ascidians (sea squirts) tend to come and go in cycles depending on levels of nutrients and micro nutrients in the water. These may become pests because of the share weight of material (e.g. Ciona intestinalis) . Identifying smothering sea squirts is often difficult because they are primitive organisms and in situ identification is problematical.

Marine farm structures generally provide an ideal habitat for invasive and smothering organisms. They are generally located in the photic zone and rise and fall with the tide. Organisms that may normally perish in the intertidal zone survive and flourish being continuously underwater. The material used for growing marine organisms (e.g. mussels) is also inductive to the settlement of larvae and spat of pest species drifting in the water column.

Where the shoreline adjacent to a marine farm is influenced by the tide or composed of a moving substrate (sand) then the chances of the survival of smothering organisms is greatly reduced.

The spread of pest organisms from a marine farm can come about by

- Biological reproduction (gametes, larvae or vegetative dispersal)
- Transfers of farm stock
- Movement of uncleaned farm equipment
- Hull fouling

Biological dispersal is very difficult to manage and control however thorough industry Codes of Practice can be effective in stemming the transfer of pest organisms from affected areas to adjacent unaffected areas (e.g. Catenatum).

In the Bay of Plenty sites and activities of greatest Biosecurity/biodiversity risk are;

- International shipping movements (ballast water, hull fouling)
- Leisure vessel (local and international) movements (hull fouling)
- Swing moorings and marinas
- Dumb barges and seldom moved vessels (lack of antifouling treatments)
- Marine farm stock and equipment movements

Marine Biosecurity is a relatively new field of interest in New Zealand and many of the old pest management procedures do not work because the events occur in the public domain and largely go unseen until they reach a significant mass. Despite major efforts most eradication efforts in NZ to date have not been successful (e.g. Undaria, Didendum vexillum). MAF Biosecurity is the Ministry responsible for marine Biosecurity and over recent years have developed a better understanding of the issues. Despite this involvement, Regional Council's remain at the forefront of marine pest management through their Regional Pest Management Strategies. 'Keeping Pests Out' a Regional Pest Management for the Bay of Plenty is currently being prepared by the Council staff.

G Coates
February 2011.