LECG

Proposed methodology

For use in the Maori Commercial Aquaculture Claims Settlement Valuation
Working paper to the Ministry of Fisheries

About LECG

LECG is a global expert services firm with highly credentialed experts and professional staff with specialist knowledge in regulation, economics, financial and statistical theories and analysis, as well as in-depth knowledge of specific markets and industries. The company's experts provide independent testimony, original authoritative studies and strategic advice to both public and private sector clients including legislative, judicial, regulatory, policy and business decision-makers.

LECG is listed on the NASDAQ Stock Exchange and has approximately 1000 experts and professional staff worldwide. These experts are renowned academics, former senior government officials, experienced industry leaders and seasoned consultants.

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Definitions

Word	Definition	Statutory Reference
AMA	Aquaculture Management Area (a)means a coastal marine area described as an aquaculture management area and included in a regional coastal plan or proposed regional coastal plan in accordance with section 165C; and (b)includes— (i)an interim aquaculture management area that becomes an aquaculture management area under section 44 of the Aquaculture Reform (Repeals and Transitional Provisions) Act 2004; and (ii)part of an aquaculture management area.	Section 2(1) of the Resource Management Act 1991.
Aquaculture Activities	Means: (a) the breeding, hatching, cultivating, rearing, or on-growing of fish, aquatic life, or seaweed for harvest if the breeding, hatching, cultivating, rearing, or on-growing involves the occupation of a coastal marine area; and (b) includes the taking of harvestable spat if the taking involves the occupation of a coastal marine area; but (c) does not include an activity specified in paragraph (a) if the fish, aquatic life, or seaweed— (i) are not in the exclusive and continuous possession or control of the person undertaking the activity; or (ii) cannot be distinguished or kept separate from naturally occurring fish, aquatic life, or seaweed.	Section 2(1) Resource Management Act 1991
CMA	Coastal Marine Area means [the foreshore, seabed, and coastal water, and the air space above the water] — (a) Of which the seaward boundary is the outer limits of the	Section 2(1) of the Resource Management Act 1991.

Definitions

Word	Definition	Statutory Reference
	territorial sea: (b) Of which the landward boundary is the line of mean high water springs, except that where that line crosses a river, the landward boundary at that point shall be whichever is the lesser of — (i) One kilometre upstream from the mouth of the river; or (ii) The point upstream that is calculated by multiplying the width of the river mouth by 5.	
Coastal Permits	Coastal permits are the bundle of resource consents needed to occupy and use a site for Aquaculture Activities in New Zealand, and include authorisations to have an effect on the environment, subject to conditions to remedy or mitigate those effects.	Crown's definition
Coastal Permit Space	An area in the water column which is currently being used, or has potential to be used, for commercial Aquaculture Activities, the rights for which are defined by the coastal permits relating to the site. Dimensions of the rights attaching to Coastal Permit Space for the purposes of estimating financial equivalent under this *Methodology* are set out in an associated paper by LECG, the *Statement of Valuation Objectives*.	Crown's definition.
DCF	Discounted Cash Flow. A valuation methodology which calculates the value of an asset using the present value of forecast cash flows.	
DRC	Depreciated Replacement Cost.	
EBIT	Earnings Before Interest and Tax. A measure of operating earnings.	
EBITDA	Earnings Before Interest, Tax, Depreciation and Amortisation. A	

Definitions

Word	Definition	Statutory Reference
	measure of operating earnings.	
Farm Gate	The nearest wharf to the Marine Farm.	
Farm Gate Price	Farm gate prices should be moderate and reasonable prices, at levels likely to be achieved at the time of maturity by a competent sales agent.	
Harbour	A harbour area as defined in Schedule 2 of the Act.	Schedule 2 of the Act
Improvements	All assets that can be transferred as part of a Marine Farm that are not Coastal Permit Space.	Crown's definition
Marine Farm	An entity that undertakes commercial Aquaculture Activities. Its activities end at the Farm Gate. A Marine Farm is an entity that is assumed to be a going concern and consist of a combination of assets, including a coastal permit(s) and may include crop, structures, machinery, removable tangible assets and intangibles.	Crown's definition
Market Value	Market Value is the estimated amount for which a Marine Farm or its Improvements should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently, and without compulsion. If there is no actual well functioning market it is an estimate of the value at which the property would sell if there were such a market. A Marine Farm may possess an additional, or special, value above its value as a commercial aquaculture entity by reason of its physical or functional association with an adjoining property or its attractiveness to a purchaser with other special interests. Any such additional or special value should not be included in an assessment	Derived from PINZ valuation standards

Definitions

Word	Definition	Statutory Reference
	of Market Value.	
Net Realisable Value	Net Realisable Value. The estimated selling price in the ordinary course of business, less the estimated costs of completion and the estimated costs necessary to make the sale.	PINZ valuation standards
Occupation	The use of space to the exclusion of others.	Resource Management Act 1991
Pre-Commencement Space	All marine farming space created between 21 September 1992 and 31 December 2004, including space first approved under old legislation after 31 December 2004.	Section 20 of the Act
Productivity or Production	This refers to production from the Marine Farm that is saleable. Production excludes 'shrinkage' from additional catch. Sometimes referred to as 'bagged amount'.	
Region	A regional coastline as defined in Schedule 1 of the Act.	Schedule 1 of the Act
Real Settlement Assets	Authorisations and Coastal Permits. Technically, neither are 'real' assets in the legal sense because neither Authorisations nor Coastal Permits give an interest in land, and the rights included in each will only work to exclude others if exclusion is specified in the permit or it is a physical fact.	
Settlement Assets	Authorisations, Coastal Permits and the financial equivalent of Coastal Permits.	Section 5 of the Act
Space	Same as Coastal Permit Space	Crown's definition
The Act	The Maori Commercial Aquaculture Claims Settlement Act 2004.	
The Ministry	The Ministry of Fisheries.	
The Methodology	An approach in compliance with the Act for valuing Marine Farms, Coastal Permit Space and	The Act

Definitions

Word	Definition	Statutory Reference
	Improvements.	
TOKMTL	Te Ohu Kaimoana Trustee Limited (Te Ohu Kaimoana is the corporate trustee of the Takutai Trust).	Section 34 of the Act
The Trustee	The Maori Commercial Aquaculture Settlement Trust (Takutai Trust)	Section 34 of the Act
The valuer	Persons employed to perform valuations of Marine Farms and Coastal Permit Space for the purposes of the Act. This could potentially encompass professionals from a range of different backgrounds, but who have competence in valuation and corporate finance.	
Value	Market Value (as above).	

Executive Summary

LECG was engaged by the Ministry in March 2007. In May 2007, we completed a discussion document *Statement of Valuation Objectives* that set out the requirements for a valuation methodology to effect settlement of the Crown's obligations and provided a high level outline of the methodology. A legal opinion was obtained as input to the Statement.

A draft *Statement of Valuation Objectives* was distributed to a number of stakeholders who participated in either a focus group or targeted interviews with the LECG team. The focus group and interview processes were highly valuable as they ensured that the team was exposed to a range of views in developing the valuation methodology.

LECG prepared a summary document *Statement of Issues* in July 2007 which analysed the responses received from stakeholders. A new version of the *Statement of Valuation Objectives* was agreed with the Ministry before work on the *Methodology* commenced. During August and September 2007, LECG conducted desk and interview research to develop the methodology and illustrative examples.

A series of pilot studies to test this *Methodology* were performed from October 2007 to January 2008. The *Methodology* and the pilot studies underwent peer review. During this stage the *Methodology* was refined.

Valuation purpose

The Crown's settlement obligation is to provide the Trustee with the equivalent of 20% of all aquaculture space created between 21 September 1992 and 31 December 2004, including space first approved under old legislation after 31 December 2004, or its financial equivalent. The obligation to provide space, or its financial equivalent, applies on a regional basis, i.e. the obligation must be satisfied on the basis that it applies separately to each Region and each Harbour as defined in Schedule 1 of the Act. Space, or Coastal Permit Space, is

> *An area in the water column which is currently being used, or has potential to be used, for commercial Aquaculture Activities, the rights for which are defined by the coastal permits relating to the site.*

This obligation can be satisfied in any one or more of the ways set out in section 22 of the Act. As part of the process for determining the value of the coastal permits that might be purchased and transferred under the Coastal Permit Option, the Crown must value the various components of the marine farms that have met the criteria to be purchased. In other words, the Crown will need to value the Marine Farm, the Improvements and the Coastal Permit Space. Under the Act, the Crown also assess the value of Coastal Permit Space in the surrounding area, and must use its best endeavours

to ensure that on 31 December 2014 the value of all the permits transferred is not less than the average value of all the Coastal Permit Space in the Region or Harbour.

The process for determining the financial equivalent of space requires the Crown to estimate of the value of the Coastal Permit Space in the Region or Harbour that is not satisfied by Real Settlement Assets.

Uses for this valuation methodology

This valuation methodology is intended as a guide for the Crown and the valuation professionals ("the valuer") employed to perform valuations of Marine Farms and Coastal Permit Space for the purposes of the Act. The valuer could be a single party with competence in valuation and corporate finance or multiple valuers. The valuation process may be spread across a number of years. The methodology is intended to be sufficiently specific to give useful guidance but also sufficiently broad to cover a range of marine farm types and possible variations on the Settlement theme.

Valuation approach

The attribute to be estimated in the valuation is value in exchange – Market Value. The presence of a thin (or unobservable) market for Marine Farms creates a particularly challenging valuation problem. In the absence of suitable transaction data from which market value can be observed, the valuer must turn to economic fundamentals in order to form a view of value.

This methodology outlines an approach based on economic fundamentals: the Discounted Cash Flow ('DCF') method. Under the DCF method, a Marine Farm is valued on the basis of the present value of the expected future free cash flows to the owner (including, in limited circumstances, the value of real options). The proposition of this approach is that over time, the value of Coastal Permit Space will reflect the ability of the space to generate cash returns to those who occupy and use it. In this way, the settlement is a settlement that reflects the commercial value of space.

Coastal permits authorising the occupation and use of space are just part of the total set of assets employed in a Marine Farm. The *Methodology* estimates the value of the Coastal Permit Space as a residual – the difference between the market value of the Marine Farm and the market value of the other assets employed in the business – the Improvements. The same residual approach is taken for estimating the market value of a bare permit except that the farm and improvements are notional.

The market value of infrastructure such as lines, buoys and posts is estimated using a Depreciated Replacement Cost measure, or, in the case of a valuation for payment of financial equivalent, a simplified proxy. Crop is valued at net realisable value, or, in the case of a valuation for payment of financial equivalent, a simplified proxy. Goodwill and intangible assets are valued only in the event that the marine farm is being valued for the purposes of purchase and transfer and where these assets are judged to be transferable and valuation is required.

In mass valuations, thought must be given to how valuation exercise can be implemented in a cost-effective and transparent manner. In addition to simplified valuation rules, a qualitative method involving a group of experts, the Delphi method, is outlined. This method can be used to assist the Crown to obtain standardised information suitable for conducting a mass valuation in order to estimate the Financial Equivalent. For example, the Delphi method will be used to identify reference sites, and then obtain key inputs for valuing those sites including production, prices and operating costs. The valuer will utilise this information as inputs into the valuation of Coastal Permit Space for the region. The Delphi method may also be used to identify relativities between reference sites: nationally and regionally.

Key assumptions for valuing marine farms

The *Methodology* makes a number of assumptions in the valuation of marine farms, including the following:

- Transaction data is the best indicator of market value but generally speaking, the available data set is likely to be inadequate to base valuations on transactions alone. Therefore, the valuer should triangulate between transactions data (where suitable), a Discounted Cash Flow estimate, and other cross-checks such as capitalisation of leases, EBIT multiples or multiples between production and value.
- A Discounted Cash Flow model (with consideration given to real options) will result in a reasonable approximation to market value of the combined assets of marine farms, given economic rationality with regards to systematic risk.
- A standardised Weighted Average Cost of Capital (WACC) can be applied in Discounted Cash Flow models as a measure of systematic risk. This standardised rate will apply to all marine farms.
- Any marine farms targeted for purchase by the Ministry would normally be a going concern and that the Ministry would normally purchase only the assets of the farms, not companies, their liabilities or intangible assets. The assets of a marine farm consist of Coastal Permit Space and Improvements (i.e. crop and infrastructure).
- A marine farm's activities end "at the farm gate". The farm gate is the nearest working wharf or shore. (The cost of operating the farm may include certain necessary land-based activities, however). For example, when forming revenue forecasts to value the marine farm, the prices relate to the product in the form it would be in before it is loaded at the wharf.
- It is possible to derive the 'farm gate' price for all aquaculture products through observable contract prices or by applying pricing assumptions.
- Ongoing compliance with coastal permit conditions is assumed; therefore Coastal permits are renewable into perpetuity and cash flows are forecast into perpetuity.
- Marine farms and their assets will be valued by the market with a view to their potential, which may differ from the current use.

Key assumptions for valuations of Coastal Permit Space and Improvements

The *Methodology* makes a number of assumptions in the valuation of space and improvements, including the following:

- Coastal Permit Space is the space defined by the coastal permits to be used for the marine farm's occupation and use.
- Coastal Permit Space is valued as a residual between the value of a marine farm and the sum of the values of its improvements (i.e. infrastructure and crop).
- Actual infrastructure and levels of crop on the farm in question should be observed and valued using the Depreciated Replacement Cost method if the valuation is of a farm intended for purchase under the Coastal Permit Option. Otherwise, standardised assumptions may be used.
- The market value for crop is its Net Realisable Value, which relates to its estimated date of harvest. As a starting rule, any crop less than two thirds of the way through the rotation period (as assessed for that site) should be valued at cost, whereas any crop more than two thirds of the way through the rotation period should be valued at market value (realisable value).
- The market value of intangibles (such as goodwill) is assumed to be nil unless the asset is judged to be transferable, in which case separate valuation will be required.

Key assumptions for mass valuations and identification of missing data

In processes for simplification of mass valuations needed in order to estimate Financial Equivalent, the *Methodology* assumes:

- In performing a valuation for the purposes of estimating Financial Equivalent, the valuer may rely on valuation assumptions provided by the Crown or the Ministry, which may have been obtained using a Delphi process.
- The level of crop on site is assumed to be sufficient to supply the next year's annual average production.
- Valuation of site infrastructure is performed according to an assessment of age and condition. Any infrastructure less than five years old it is valued at 75% of its new replacement cost. Any infrastructure older than five years old is valued at 50% of its new replacement cost, unless it is deemed to be obsolete in which case it is valued at zero.
- That all valuations for the purposes of estimating financial equivalent will be as at 1 January 2013.

- That all coastal permits for a particular species within a region or harbour will share the same, or equivalent, terms and conditions relating to monitoring, renewal term and discharge, but that if significant variations are found to exist within a region or harbour, these will be dealt with in the selection of reference sites;
- Extrapolation of values of key reference sites will provide reliable estimates of the aggregate values required for estimation of Financial Equivalent and the average value checks.
- The Delphi method is a means to draw on expert opinion. The *Methodology* suggests that possible uses for the Delphi method may be to identify reference sites, standardise data and identify missing information, such as site productivity, improvements values and operating costs. The Delphi method assumes that expert input is independent and unbiased.

Guidance regarding the DCF valuation model

The *Methodology* provides guidance to the valuer on implementing the DCF approach. This guidance is summarised below.

Time horizon

With regards time horizon, the *Methodology* assumes:

- The valuer will perform an annual forecast for ten years, followed by a calculation of terminal value.
- The valuer will apply a yearly average farm gate price to avoid seasonal variations in prices.
- The valuer will perform the forecast in nominal terms rather than real, with an assumption of inflation at the top of the statutory band (3% at present).
- The tax environment will not change over the ten year time horizon.

Production

With regards farm production, the *Methodology* assumes:

- The valuer will forecast annual average production for the farm.
- If the valuation is for the purposes of estimating value of a reference site for financial equivalent the Delphi method can be used to source estimates of productivity. Otherwise, historical production data should be used, alongside a view of production under highest and best use.
- Production is to be estimated at the farm gate and relate to the farm gate price, i.e. if farm gate price relies on weights or measures of saleable product, the production must be net of any shrinkage or loss that can be expected after sorting.

Price

With regards farm gate price, the *Methodology* assumes:

- The Delphi method can be used to source price data if needed, but only if the valuation is for the purposes of estimating value of a reference site for financial equivalent. Otherwise, realistic farm gate prices for the farm in question should be used.
- The valuer will apply moderate and reasonable farm gate price offered by all potential purchasers of the product, per grade
  - For mussels - Price per kg or tonne of Greenshell mussels, harvested whole and cleaned on-site (green weight tonnes), adjusted for costs of transport to the purchaser and for production losses experienced during harvest and transport
  - For mussel spat - Price per meter of seeded spat rope
  - For oysters – Price per dozen oysters, harvested whole, adjusted for costs of transport to the purchaser and for production losses experienced during harvest and transport
  - For finfish such as salmon – Price per kg of gilled and gutted fish, less cost of gilling and gutting, adjusted for costs of transport to the purchaser and for production losses experienced during harvest and all other costs incurred once the fish leaves the farm gate.
- On exchange rates:
  - Exchange rates impact prices paid for aquaculture products at the farm gate, and are therefore relevant to the valuer's assessment of whether current farm gate prices are likely to be sustainable throughout the forecast period
  - The valuer should observe the average of the past 10 years of exchange rates (using a trade-weighted basket of exchange rates, at the mid-point between buy and sell rates quoted by the Reserve Bank of New Zealand) and consider whether current export prices (and therefore farm gate prices) are representative
  - The valuer will assume that Purchase Power Parity holds for future exchange rates, and therefore future farm gate prices are determined only by domestic inflation.

Marine Farm operating costs

With regards operating costs, the *Methodology* assumes:

- The Delphi method can be used to source operating cost data if needed, but only if the valuation is for the purposes of estimating value of a reference site for financial

equivalent. Otherwise, realistic operating costs for the farm in question should be used, based on historic financial accounts and other records obtained during due diligence.

- The cost of operating or owning land bases are operating costs relevant to Marine Farms if they are essential to the operation of the farm and no water-based alternative for the land base has been included as an improvement.
- For owner operators, owner remuneration should be calculated at rates paid to staff doing the same sorts of work or contractors.
- Costs of consent renewal will be spread over the cash flows evenly according to the term of renewal on the coastal permit for occupation.
- Cost of adverse events will be spread over the cash flows evenly according to the risk present in the particular harbour or region – but the assumption of optimal management alleviates the losses when events occur.
- An allowance for additional working capital should be included in the cash flow forecasts if the farm is expanding operations.

Finance and discount rate

With regards construction of the discount rate for the DCF model, the *Methodology* assumes:

- Discount rate is estimated by the Weighted Average Cost of Capital (WACC).
- The form of WACC adopted is an after tax form, based on the Capital Asset Pricing Model.
- The ownership (debt to equity) structure of the entity will not change over time.
- Equity beta for all aquaculture firms of 0.86.
- Investor tax on interest 33%, corporate tax 30%.
- Tax Adjusted Market Risk Premium of 8%.
- Debt margin of 2%.
- Indicative Weighted Average Cost of Capital (WACC) calculated for aquaculture businesses in August 2007 as 8.8% to 9.8%.
- An additional margin to be added to WACC of 2% to compensate for limitations on the method of estimation.

On real options

The *Methodology* assumes:

- That the value of "real options" has potential to be significant in some instances, particularly if there is clear potential for development or change of use on the site within the forecast period.
- That binomial or Black-Scholes option valuation may be used by the valuer in order to estimate options value, but only if the valuer feels that options are likely to add significantly to value and that explicit measurement of options is justified.

The Ministry's role

In the period 2008 - 2014 if a Marine Farm is offered for Crown purchase under the Coastal Permit Option and the offer has met the other criteria for purchase established by the Crown, the Ministry will have a valuer conduct a valuation of the Marine Farm applying the *Methodology* . The Ministry will prepare for the necessary average value checks.

In 2012 the Ministry will prepare for the mass valuations process by breaking down the statutory regions and harbours into smaller, geographically defined areas, and by facilitating Delphi sessions in order to identify reference sites in those areas and obtain valuation information. The Ministry will also contract the valuer(s) who will prepare the valuations.

In 2013, the Ministry will facilitate valuations, gather them and review them. The Ministry may form a Valuation Review Panel to ensure consistency across assumptions and results as the valuations are performed.

In 2013-14 the Ministry will assist the Crown to facilitate settlement with the Trustee.

1 Summary of objectives

1.1 Background

LECG has been engaged by the Ministry of Fisheries to prepare a valuation methodology to enable the Crown to give effect to its "Pre-Commencement Space" settlement obligations under the Maori Commercial Aquaculture Claims Settlement Act 2004 ("the Act").

The Crown's settlement obligation is to provide the Trustee with the equivalent of 20% of all aquaculture space created between 21 September 1992 and 31 December 2004, including space first approved under old legislation after 31 December 2004, or its financial equivalent. The obligation is for space and it must be satisfied separately in each Region and each Harbour.

This obligation can be satisfied in any one or more of the following three ways (section 22 of the Act):

- Identifying and allocating authorisations for new space to the Trustee ('Authorisation Option').[1]
- By purchasing Coastal Permits, either underlying Marine Farms or in bare form, and transferring the Coastal Permits to the Trustee on or after 1 January 2008 ('Coastal Permit Option').[2]
- By paying to the Trustee the financial equivalent, in part or in full, to the value of the Pre-Commencement Space on or after 1 January 2013 ('Financial Equivalent Option').

[1] Councils must make available to the Trustee up to 20% of any new AMA space that is created through a Council-initiated Plan Change or Private Plan Change. This allocation is additional to the 20% of space in new AMAs created after 1 January 2005.

[2] The Crown has no obligation to transfer the infrastructure at the site, but must offer a first right of refusal to the infrastructure to the Trustee.

1.2 Valuation needs

Settlement of the obligation, in whole or in part, by the Authorisation Option can proceed without any reference to value. However, whenever the Crown settles the obligation, in full or part, by the Coastal Permit Option or the Financial Equivalent Option, a valuation methodology is required. Specifically, the methodology should provide the Crown with the means to assess:

(a) for the Coastal Permit Option

- the Market Value of any marine farm business ("Marine Farm")[3] it might acquire in order to transfer the underlying Coastal Permit(s) to the Trustee;
- the Market Value of the improvements associated with a Marine Farm ("Improvements") that the Crown would offer to the Trustee;
- the Market Value of any Coastal Permit Space, either underlying a Marine Farm or in bare form, that is targeted for purchase for transfer to the Trustee; and
- the Market Value of the Coastal Permit Space that it transfers to the Trustee relative to the Market Value of all the Coastal Permit Space in the part of the CMA concerned (before transfer) and in the Region or Harbour as a whole (on 31 December 2014); and

(b) for the Financial Equivalent Option

- for every Region and Harbour the amount required to settle the obligation to provide the financial equivalent of the 20% of Pre-Commencement Space not satisfied by real settlement assets – this requires an assessment of the Market Value of Coastal Permit Space included as Pre-Commencement Space.

1.2.1 Consistency between valuations and mass valuations

The *Methodology* aims to provide consistency between valuations, if they are performed by different valuers or at different points in time and in different parts of the New Zealand coastline for the purposes of the Act.

[3] For the purposes of valuation, a Marine Farm is an entity that undertakes Aquaculture Activities. It is assumed to be a going concern and consist of a combination of assets, including Coastal Permit Space, crop, structures, machinery, removable tangible assets and intangibles.

1.2.2 Cost-effectiveness

Implementation must reflect a suitable benefit cost trade-off between the quality of the valuation and the cost of achieving that quality.

The Financial Equivalent Option is likely to be the most significant component of the settlement in most, if not all, regions. The Financial Equivalent Option could be interpreted to require valuation of every site in the Pre-Commencement Space. Valuing every site in some regions or harbours could clearly be costly. For this reason, this *Methodology* sets out a simplified methodology based on:

- standardisation of key valuation inputs and assumptions using input from a group of subject-matter experts; and
- extrapolation of the values assessed for key reference sites.

This element of the methodology is set out in Sections 13 and 14.

1.3 Process undertaken to prepare the methodology

LECG was engaged by the Ministry in March 2007. In May 2007, we completed a discussion document *Statement of Valuation Objectives* that set out the requirements for a valuation methodology to effect settlement of the Crown's obligations and provided a high level outline of the methodology. Two legal opinions were obtained as input to the Statement.

The *Statement of Valuation Objectives* was distributed to a limited number of stakeholders who participated in either a focus group or targeted interviews with the LECG team. The focus group and interview processes were highly valuable as they ensured that the team was exposed to a range of views in developing the valuation methodology.

A summary document *Statement of Issues* was prepared in July 2007 which analysed the responses received from stakeholders. An amended *Statement of Valuation Objectives* was agreed with the Ministry before work on the *Methodology* commenced. During August and September 2007, LECG conducted desk and interview research to develop the methodology and illustrative examples.

A series of pilot studies to test this *Methodology* were performed from October 2007 to January 2008. The *Methodology* and the pilot studies underwent peer review. During this stage the *Methodology* was refined.

1.4 Companion materials

This *Methodology* should be read in conjunction with the separate paper, *Statement of Valuation Objectives*, also prepared by LECG for the Ministry.

The glossary in the first section of this paper provides definitions of the terms used in the Act.

1.5 This methodology is a guide for professional valuers

This *Methodology* is intended as a guide for any valuation professional ("the valuer") employed to perform valuations of Marine Farms and Coastal Permit Space for the purposes of the Act. The valuer will be competent in business valuation and corporate finance. The methodology is intended to be sufficiently specific to give useful guidance but also sufficiently broad to cover different types of marine farm and possible variations on the Settlement theme.

We note that all figures and examples given in this paper are illustrative only. They should not be relied upon as determinative.

2 The structure of this methodology paper

This paper is structured into four parts to reflect the objectives set out above, and is supplemented by four appendices.

Part 1 – Key foundations for the valuations including valuation standards

Part 2 – Guidance for Market Valuation of Marine Farms

Part 3 – Guidance for Market Valuation of Improvements and Coastal Permit Space

Part 4 – Guidance for performing mass valuations and using the Delphi method for estimating Financial Equivalent and conducting the Average Value Check

App. 1 – Profile of Pre-commencement space

App. 2 - Background information for the settlement including a description of the industry, and a national and regional profile of coastal space used for Aquaculture

App. 3 -Derivation of the Weighted Average Cost of Capital

App. 4 – Guidance on Real Options Valuation

PART ONE - Key foundations for the methodology

3 Valuation foundations

This section sets out the key foundations to the methodology, including valuation dates, the basis for the valuation estimates and a description of cross–checks required.

3.1 Valuation standards

Currently in New Zealand valuation practice standards are not mandatory but the valuer should nevertheless follow the International Valuation Standards (2005), International Valuation Guidance Notes and various Guidance Notes issued by the Property Institute of New Zealand (2006) when preparing any valuation under this methodology.

Given that the Crown is required to prepare its financial statements in compliance with the New Zealand equivalents of the International Financial Reporting Standards (NZIFRSs) it is desirable that any valuation prepared under this *Methodology* should also comply.[4,5] Given that the *Methodology* assumes Market Value (the equivalent of 'fair market value' in financial reporting), then if valuers comply with the standards on disclosure and reporting, application of the *Methodology* will result in valuations that can be applied directly in the Crown's financial reporting.

[4] International Financial Reporting Standards (IFRSs) are published by the International Accounting Standards Board (IASB) and are the basis for New Zealand Generally Accepted Accounting Practice (NZ GAAP).

[5] Market-based definitions, objectivity, and full disclosure of relevant matters within a pertinent and user-friendly format are fundamental to the requirements of valuation for financial reporting. The Standards will be met if the Market Value definition is used as the basis for the valuation of Settlement Assets and Obligations, if Highest and Best Use is assessed and reported, if the (un)availability of market-based evidence is reported.

3.2 Valuer's reports

Under International Valuation Standards a valuer's report must set out the following:

- Conclusions of the valuation in a manner that is not misleading. In New Zealand, it is usual to report a single valuation figure, which can be apportioned between Coastal Permit Space and Improvements
- Instructing Party, Client
- Statement of the Purpose of the Valuation
- Relevant dates: Date of Valuation, Date of the Report, Date of Inspection (if any)
- Basis of Valuation (i.e. fair market value)
- Description of the property rights or interests to be valued, physical and legal characteristics of the property, e.g.:
    - Dimensions of the Coastal Permit Space
    - Description of location and surrounding amenities
    - Coastal permits
    - Significant hazards, contamination threats
    - Structural improvements
- Outline the methodology(ies) employed, with a reconciliation of differences between each method
- Specify all assumptions and limiting conditions upon which the value conclusion is contingent, including instructions given by the Crown.

3.3 Market value

The attribute to be estimated in the valuation is value in exchange –Market Value. The definition of 'Market Value' employed in the International Valuation Standard 1 is as follows:

> *Market Value is the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently, and without compulsion.*

A full description of these terms is included below.

3.3.1 Terms in the definition of Market Value

Explanations of the clauses from the International Valuation Standard 1 are set out below:

"The estimated amount..." refers to a price expressed in terms of money (normally in the local currency), payable for the property in an arm's-length market transaction. Market Value is measured as the most probable price reasonably obtainable in the market on the date of valuation in keeping with the Market Value definition. It is the best price reasonably obtainable by the seller and the most advantageous price reasonably obtainable by the buyer. This estimate specifically excludes an estimated price inflated or deflated by special terms or circumstances such as atypical financing, sale and leaseback arrangements, special considerations or concessions granted by anyone associated with the sale, or any element of Special Value (defined in IVSC Standard 2, para. 3.8).

"...a property should exchange..." refers to the fact that the value of a property is an estimated amount rather than a predetermined amount or actual sale price. It is the price at which the market expects a transaction that meets all other elements of the Market Value definition should be completed on the date of valuation.

"...on the date of valuation..." requires that the estimated Market Value is time-specific as of a given date. Because markets and market conditions may change, the estimated value may be incorrect or inappropriate at another time. The valuation amount will reflect the actual market state and circumstances as of the effective valuation date, not as of either a past or future date. The definition also assumes simultaneous exchange and completion of the contract for sale without any variation in price that might otherwise be made.

"...between a willing buyer..." refers to one who is motivated, but not compelled to buy. This buyer is neither over-eager nor determined to buy at any price. This buyer is also one who purchases in accordance with the realities of the current market and with current market expectations, rather than in relation to an imaginary or hypothetical market that cannot be demonstrated or anticipated to exist. The assumed buyer would not pay a higher price than the market requires. The present property owner is included among those who constitute "the market." The valuer must not make unrealistic assumptions about market conditions nor assume a level of market value above that which is reasonably obtainable.

"...a willing seller..." is neither an over-eager nor a forced seller, prepared to sell at any price, nor one prepared to hold out for a price not considered reasonable in the current market. The willing seller is motivated to sell the property at market terms for the best price attainable in the (open) market after proper marketing, whatever that price maybe. The factual circumstances of the actual property owner are not a part of this consideration because the 'willing seller' is a hypothetical owner.

"...in an arm's-length transaction..." is one between parties who do not have a particular or special relationship (for example, parent and subsidiary companies or landlord and tenant) that may make the price level uncharacteristic of the market or inflated because of an element of Special Value (see IVS 2, para. 3.8).The Market Value transaction is presumed to be between unrelated parties, each acting independently.

"...after proper marketing..." means that the property would be exposed to the market in the most appropriate manner to effect its disposal at the best price reasonably obtainable in accordance with the Market Value definition. The length of exposure time may vary with market conditions, but must be sufficient to allow the property to be brought to the attention of an adequate number of potential purchasers. The exposure period occurs prior to the valuation date.

"...wherein the parties had each acted knowledgeably and prudently..." presumes that both the willing buyer and the willing seller are reasonably informed about the nature and characteristics of the property, its actual and potential uses, and the state of the market as of the date of valuation. Each is further presumed to act for self-interest with that knowledge, and prudently to seek the best price for their respective positions in the transaction. Prudence is assessed by referring to the state of the market at the date of valuation, not with benefit of hindsight at some later date. It is not necessarily imprudent for a seller to sell property in a market with falling prices at a price that is lower than previous market levels. In such cases, as is true for other purchase and sale situations in markets with changing prices, the prudent buyer or seller will act in accordance with the best market information available at the time.

"...and without compulsion..." establishes that each party is motivated to undertake the transaction, but neither is forced or unduly coerced to complete it.

3.3.2 Summary of Market Value definition

Market Value is understood as the value of an asset estimated without regard to costs of sale or purchase and without offset for any associated taxes. It is estimated through application of methods and procedures that reflect the circumstances under which Marine Farms, Improvements or Coastal Permit Space would most likely trade in the market (taking account of the productive capacity of the site and the restrictions on its use).

Market Value is a representation of value in exchange, or the amount the asset would bring if offered for sale in the market at the date of valuation. If there is no actual well functioning market it is an estimate of the value at which the asset would sell if there were such a market.

Market Value assumes that parties are transacting with one another on an arms length commercial basis, and not as a result of any special relationship that may exist between them. For example, a Marine Farm may possess an additional, or special, value above its value as a commercial entity by reason of its physical or functional association with

an adjoining property or its attractiveness to a purchaser with other special interests. Any special value should not be included in an assessment of Market Value.[6]

3.4 Standard for highest and best use

All Marine Farms and assets on Marine Farms should be valued at their highest and best use.[7] The highest and best use is the use that will render the maximum Market Value of the asset, based on market evidence.[8] This use is based on four parts:

i Physically possible,

ii Appropriately justified,

iii Legally permissible, and

iv Economically feasible.

3.4.1 Coastal permits and the meaning of legally permissable

In the context of valuation of marine farms, the criteria "legally permissible" means allowed within the constraints of the coastal permits that exist for the site at the valuation date and all relevant statutes, regulations and rules including the Coastal Plan, the Resource Management Act and fisheries permits that apply at the valuation date. Therefore, any assessment of highest and best use for Coastal Permit Space requires a detailed understanding of the site characteristics and the institutional context.

Changes to site configuration, structures or use may be physically possible, justified and economically feasible, but if they are restricted by the existing coastal permits then the cost of applying for a change to the permits and an assessment of the likely success of that application are necessary as part of the valuation. In most cases highest and best use for the Coastal Permit Space will be to continue to farm the species that is farmed there currently (or for bare space, the species for which the coastal permits refer). This is because in most cases, changes to site use are uneconomic given the costs of applying, the risk of a failed application (the perceived environmental effects of the proposed change and the risk of successful challenge) and the cost of removing or re-building improvements. However this needs to be assessed on a case-by-case basis.

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[6] Special Value is defined in IVSC Standard 2, para. 3.8.

[7] The Ministry may not necessary purchase the farm at the highest and best use value if the farm is not managed optimally at the time of valuation. Instead, the valuation will give a guide as to value and the price will be subject to negotiation with the seller.

[8] This description is based on International Valuation Standards.

Changes to layout, numbers of lines or harvest methods might be considered if the site is not considered to be operated optimally. In this event, the valuer should account for the cost of these changes in the valuation, including the cost of removing current site improvements (possibly as scrap) and building new improvements.

3.5 Triangulation between valuation methods

The valuer should attempt to triangulate between the following methods for valuing Marine Farms, Improvements and Coastal Permit Space:

- **For Marine Farms:**
  - Valuation based on an economic value model (DCF), given a farm that is operational and improved;
  - Valuation based on comparable transactions of going concern entities, where information exists to a depth sufficient to enable informed judgements to be made;
  - Valuation based on capitalisation of net rental on lines (including rental on marine farm equipment), where information exists to a depth sufficient to enable informed judgements to be made;
  - Valuation based on valuation multiples such as value to earnings (EBITDA multiples, for example) or other variables, where information exists to a depth sufficient to enable informed judgements to be made.
- **For Improvements:**
  - Valuation based on comparable transactions information - Net Realisable Value - particularly for crop and removable improvements;
  - Valuation based on cost - Optimised Depreciated Replacement Cost – particularly for improvements that have a specialised use.
- **For Coastal Permit Space:**
  - Valuation based on an economic value model. The value of the Coastal Permit Space is estimated as a residual – the difference between the market value of the Marine Farm (using DCF) and the market value of the other assets employed in the business – the Improvements. Bare space is valued as if it were improved with hypothetical improvements.
  - Valuation based on comparable transactions information for bare space, where information exists to a depth sufficient to enable informed judgements to be made.
  - Valuation based on capitalisation of net rentals for bare space, where information exists to a depth sufficient to enable informed judgements to be made.

3.5.1 A comparable transactions approach may be used if sufficient information to enable informed judgements to be made is available

A history of actual sales most closely reflects the opinion of the market and an approach based on comparable transactions is the preferred method of valuation. However, comparable transactions information should only be used if the information:

- is verifiable, such that the valuer would be able to defend the validity of the information in a court process;
- relates to transactions that are arms-length in nature (and do not allow actual or perceived bias to enter into the Crown's estimate of value);
- relates to transactions that have records that allow location, productivity, and marine farm size to be recorded and analysed;
- relates to transactions that are sufficiently recent to be comparable;
- is sufficiently deep in any given region or harbour to allow for genuine comparison that allows outliers to be identified; and
- is sufficiently detailed to enable synergy gains or other considerations influenced the price at which the transaction took place to be identified.

At the time of writing, transaction information meeting the criteria set out above does not currently exist in any publicly accessible form for Marine Farms, Improvements or Coastal Permit Space. We are not confident that sufficient transaction information will be available by 2013-14 to rely only on comparable sales as the primary valuation method.[9]

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[9] This approach reflects the author's discussions with valuers and practitioners in the industry with the consensus being that very little transactions information that relates to aquaculture (Coastal Permit Space or Marine Farms) is accessible at present. Transactions do not happen frequently and the only databases of transactions information are confidential and may be commercially sensitive. Some valuers have kept databases of the marine farms they have valued, but the bulk of these valuations were performed for purposes such as loan security and insurance rather than for sale and purchase transactions. There is no obligation to disclose sales figures for Marine Farms to local or central government and as such, few processes for brokering sales or recording data from marine farm transactions have emerged. Furthermore, in working through the process we have discovered that what does exist is neither highly robust nor particularly relevant to a market valuation. Owners of marine farms who have formed a view of value may based their view on informal criteria rather than systematic analysis of their economic returns.

3.5.2 The Discounted Cash Flow method

Because of the limitations on available data, it is likely to be necessary to estimate value using an economic value model, the Discounted Cash Flow ('DCF') method. The proposition is that the market value of marine farms will reflect their ability to generate cash returns for owners. The method values Marine Farms and Coastal Permit Space on the basis of the present value of the expected future free cash flows[10] to the owner.

3.5.3 May be difficult to triangulate between values

Differences between transacted prices and estimates of economic value, as estimated using the DCF method, may occur. This is because:

- The assumptions applied in a DCF model may not reflect the perceptions held by market purchasers (for example, the allowance for systematic risk present in the estimate of WACC may not reflect current market sentiment).
- The purchasers in the market may not actively seek to apply considerations of economic value in their purchasing decisions. That is, they may rely heavily on past transactions information without considering changed economic circumstances.
- Returns observed in the agriculture and horticulture industries are often low relative to the opportunity cost of investment, suggesting that there are benefits to the investor (i.e. lifestyle choices) in addition to the intrinsic value of the asset. If this principle applies to the aquaculture industry, then the value of a marine farm using the DCF approach (which does not capture these additional benefits) will differ to the value derived from transaction data in some instances (which may include additional benefits in transaction prices).
- The cash flow based approach will not capture the scarcity value of a Coastal Permit. We understand that no further AMAs are expected to be created in the foreseeable future. Transaction data may include additional value due to the perceived scarcity of coastal permits that is not recognised in the DCF approach.
- The purchasers in the market may be in a position where they have significant 'sunk' investment throughout the aquaculture industry value-chain, and because of this entrenched position, may be adding farms on the basis that additional sites add volume and thus lead to various economies.

[10] Free cash flow for a period is the amount of cash left over after meeting all operating expenses for a period and the capital outlays made in that period to sustain operations. It is thus equal to the payments made to the entity's capital suppliers – the distributions to equity holders and payments to debt holders.

3.6 Valuation dates

The table below sets out the valuation dates for use under this *Methodology*. The reasons for adopting these dates are set out in the *Statement of Valuation Objectives*.

Figure 1 Valuation Dates

Valuation Dates	
Trigger **Upon…**	**Recommended valuation date**
… purchase of marine farms under the Coastal Permit Option	Valuation date = According to instructions from the Ministry. The valuation date is likely to be immediately prior to the date of purchase, which can be any time after 1 January 2008 until 31 December 2014. [11]
…cash settlement under the Financial Equivalent Option	Valuation date = All valuations to be performed as at 1 January 2013, with settlements occurring throughout 2014, until 31 December 2014.
….performance of the average value checks for the Coastal Permit Option	Performed on an ongoing basis (at time of purchase), with a final check on 31 December 2014 of the average value of all permits transferred in region or harbour.

3.7 Criteria for purchase or for recording value

Under the Coastal Permit Option, the Ministry should only purchase a Marine Farm if the estimated value of the Marine Farm under this *Methodology* is greater than (or not materially less than) the price, and the value of the Coastal Permit Space is positive. However, if the value deduced is negative then prima facie the Ministry should not purchase the farm.

3.7.1 Value of Coastal Permit Space could be less than zero

Under this *Methodology,* the Market value of Coastal Permit Space could potentially be less than zero. In this instance:

- For the Coastal Permit Option - The Ministry will not purchase or transfer any Marine Farms, or underlying Coastal Permit Space that is valued at less than zero.

[11] The Ministry may wish to re-value the farm's Improvements before offering them for sale to the Trustee if there is a significant lapse of time between date of purchase and the offer date.

- For the Financial Equivalent Option – The Ministry will record the value of the space as zero.

PART TWO - Market valuation of marine farms

4 What is a marine farm?

A marine farm is an entity that undertakes Aquaculture Activities.[12] A marine farm can be seen as a combination of assets used to run a business. The assets comprise of Coastal Permit Space and Improvements, which may include Crop, Structures, Boats, Machinery and Removable Assets.

The market value of a marine farm is the value that could be realised by the sale of the assets, that is, effectively the Coastal Permit Space and the Improvements together, in an arm's length transaction between a willing buyer and a willing seller.

Under the *Methodology*, the value of the Coastal Permit Space is estimated as a residual, that is

Market value of Coastal Permit Space =

Market Value of the Marine Farm ─ Market Value of the Improvements

4.1 Valuing the pre- 'farm gate' activities

For the purposes of the Settlement, a marine farm's activities end at the farm gate and are for commercial gain. The marine farm's assets and profitability are separate from processing and marketing activities that occur further along the value chain. A marine farm's commercial activities, in other words, end at the farm gate. The farm gate is the nearest servicing wharf to the farm.

4.2 Valuing the assets of a going concern business

The *Methodology* assumes that any valuation of a marine farm for estimating financial equivalent is based on the market value of its assets as part of a going concern business. The market value of the Coastal Permit Space relates to the marine farm's ability to generate cash returns for its owners.

[12] as defined in the Act and summarised in the glossary.

The *Methodology* assumes that any marine farms targeted for purchase by the Ministry would normally be a going concern and that the Ministry would normally just purchase the farm's assets, not a company or its liabilities.[13] We have assumed that there will be an opportunity for the Crown to perform full due diligence on any marine farms targeted for purchase.

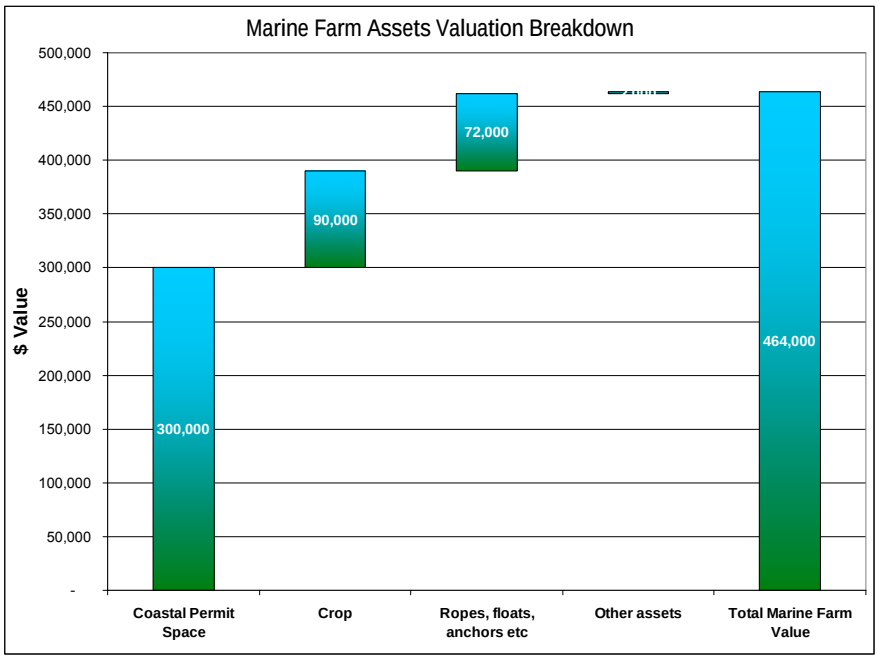
The figure overleaf provides an illustration of the assets of a marine farm. The values are illustrative only.

Figure 2 The assets of a Marine Farm (Illustrative)

[13] The Ministry would not purchase a farm under the Coastal Permit Option unless it was confident of being able to sell the Improvements to the Trustee after transferring the permit to the Trustee. That would be unlikely in the case of a business heading for liquidation as there would be uncertainty as to whether the financial distress was due to poor management or just limitations on the permit area for aquaculture purposes.

Where the farm operates as a company, the Ministry could in principle acquire less than full ownership. However, it is unrealistic to assume that another party would be willing to stay on as a minority member of the company knowing that the purpose of the purchase was to transfer the permit to the trustee and offer the improvements for sale to the Trustee. In any case, such action would constitute a major transaction requiring special resolution. Purchase of full ownership of the shares would leave the Crown indirectly exposed to contingent liabilities and potential tax problems. Although the Ministry could seek guarantees from the vendor shareholder to cover such issues that would not eliminate risk. Therefore, the valuation methodology is based on the assumption that the Ministry will purchase just the assets of the company and leave the shareholders to deal with the company and its liabilities.

Similarly, where the farm business is not incorporated, it is also assumed that the Crown will acquire only the assets of the business. The vendor may thus be left to settle from the sale proceeds any borrowings used to finance the business.



4.3 All assets valued in their Highest and Best Use

All marine farm assets, including the Coastal Permit Space, should be valued at their highest and best use. The standard for highest and best use is set out in section 3.4.

When preparing a valuation for the Coastal Permit Option, the valuer should consider alternative uses for removable business assets such as barges.

4.4 Sources of information

Any valuation involves a combination of analysis of quantitative data and understanding of the drivers of value. The valuer's analysis should comprise both financial and non-financial information, some of which may be highly confidential and specific to the subject business, whereas other information will be more general in nature, much of which will be publicly available.

4.4.1 Information gained in due diligence

In performing a valuation under the Coastal Permit Option, the valuer may have access to information gained during due diligence. This may include farm accounts, production records, receipts, invoices and so on. The valuer may also have access to information regarding comparable transactions.

In forming a view of potential production, the valuer may have reference to schedules of harvests and re-seeds provided by the current owner (as past yields will generally be a good indicator of future yields). Where possible, a three-year history is preferable.

Discussions with current owners and management personnel are vital in order to obtain a thorough understanding of the marine farm's position in the aquaculture market as a whole; where its advantages lie and what its strengths and weaknesses are. Importantly, the valuer has to form a view on which current practices and competitive advantages that occur before the farm gate are sustainable and transferable to a new owner. A checklist of core items of information is included in Appendix 1 for guidance. The checklist would typically only be a starting point, and there will inevitably be numerous items of additional information required as the valuation progresses.

Whether using a valuation model or other method, the valuer should review the assets and liabilities employed by the marine farm. Examples of the reasons for such a review include the need to:

- assess whether there is the basic culture technology in place to support the expected future growth and thus sustain the projected level of earnings and cash flows; and
- identify any surplus assets or assets that are not utilised to their full capacity.

Surplus assets may comprise ropes, buoys, baskets, boats, land and buildings not fully utilised in the business. In many instances these assets no longer contribute at all or do not contribute sufficiently to the earnings or cash flow of the business. Such assets should not be valued as part of the business.

In every valuation, caution should be exercised in use of anecdotal or confidential information. This is not only to protect the source of that information, but to protect the Crown's interests should the valuation be subject to challenge.

4.4.2 Information gathered using the Delphi method

In performing a valuation of financial equivalent, the valuer may have access to information gathered by the Ministry through a Delphi process, (guidance on the Delphi process is set out in section 13.7). This information may include productivity rates, cost parameters and so on.

4.4.3 Publicly available information

A broad understanding of the aquaculture market and industry trends is essential for forming a view of the environment in which marine farms operate. Many factors that are outside the control of farmers will nevertheless influence farm values. For example, the valuer should be aware of improvements in the market relating to site stocking densities, grading facilities and selective breeding practises for shellfish. The valuer should also be aware of the external risks facing the industry, such as the risk of fouling and biotoxin blooms, for example.

4.4.4 Information from real estate agents, corporate farmers and regional valuers

It may be possible for the valuer to source information about local transactions from real estate agents, corporate farmers and regional valuers. Where this information is relied on to form a view of value, the source must be disclosed and meet the criteria set out in section 3.5.1.

5 Market valuation of a Marine Farm using a valuation model

This section sets out guidance to the valuer on using the Discounted Cash Flow ("DCF") method, and the economic rationale for this method.

5.1 Overview of the DCF method

5.1.1 The DCF method gives an estimation of value based on economically rational assumptions

The basic premise of the DCF method is that the amount at which a Marine Farm would trade in a well functioning market between an informed buyer and an informed seller can be estimated by calculating the Present Value ("PV") of the free cash flows generated by the Marine Farm's assets.

The DCF method explicitly recognises that equal cash flows received at different points in time have different values. The cash flow received earliest can be invested, and therefore at the date at which the later cash flow is received it will have grown to a larger amount than that of the later cash flow. Thus the earlier a given cash flow occurs the greater is its value and in order to add cash flows received at different points in time they need to be converted to equivalent amounts at the same point in time. This common point in time can be arbitrarily chosen but the common approach is to choose time 0 ("now") and the time 0 equivalent amount of a future cash flow is then referred to as the present value of the cash flow. "Discounting" refers to the process of converting value of expected future cash flows to today's value to obtain the PV. That is:

$$PV = C_t /(1 + r)^t$$

where C_t is the cash flow received at time t and r is the assumed rate at which funds could be invested – the 'discount rate'. The discount rate is the opportunity cost and thus reflects the risk profile associated with a cash flow. The DCF value of a given set of cash flows is simply the sum of their present values.

DCF valuations can be applied to any pattern of cash flows and can thus handle valuation of businesses with "lumpy" cash flows such as Marine Farms, which harvest periodically and may invest in new culture technology.

The assumption is made that the owner of the Marine Farm can continue indefinitely to renew the Coastal Permits on which the farm is based and thus the cash flows are assumed to continue indefinitely.

The valuation method distinguishes, for forecasting purposes, between operating cash flows (such as sales and payment for wages) and capital cash flows (such as payments for new equipment and receipts from disposal of worn out equipment). However, "cash is cash" and thus the net cash flows that enter the discounting calculation are just the sum of the various cash flows without regard for the source of the flows. The net amount, if positive, is the amount distributed to owners of the business and/or used to reduce debt. If negative, it reflects the additional investment by owners and/or additional debt. The net amount is called the 'free cash flow'.

Uncertainty regarding business outcomes is typically such that it is unrealistic to attempt to forecast the results year by year beyond the medium term (in this *Methodology*, the medium term is 10 years). A simple pattern of variation is assumed for the cash flows expected beyond the forecast period. The value of those cash flows at the conclusion of the forecast period is called the continuing value and its present value is called the terminal value.

A shortcoming of assessing value as simply the sum of the present values of the expected future cash flows is that it assumes that the owner is committed to the set of actions assumed in the forecasts of the future cash flows. In reality, a farm owner is able to take advantage of information that resolves uncertainty or react to unanticipated events and circumstances (that is, the owner has real options). The real options have value. This *Methodology* takes a pragmatic approach to measuring this value. In most instances, options value can be assumed to be immaterial. The valuer should only attempt to value options if the Coastal Permit Space or Marine Farm has significant projects or development opportunities attached.

5.1.2 The DCF model

The DCF value of a Marine Farm is thus the PV of the expected future free cash flows[14] plus the value of its real options (where material), that is:

$$V_{Farm} = \sum_{t=1}^{T} \frac{C_t}{(1+WACC)^t} + V_T + V_{RO}$$

where

C_t = free cash flow for period t

T = duration of the forecast period

WACC = weighted average cost of capital, the discount rate

V_T = terminal value

V_{RO} = value of real options, where the valuer deems these to be material

5.1.3 Cash flows are after tax, before interest

The basis for a DCF valuation is that the value of the business depends on the amount and timing of the cash flows that it is capable of producing. Future cash flows are discounted at the WACC and therefore should be determined on an after tax but before interest basis as the tax effect of interest is taken into account in the WACC.

5.1.4 Only cash inflows and outflows are included

Generally all non-cash charges should be excluded from calculation of cash flows, but depreciation enters the calculation in respect of the tax deduction resulting from depreciation. However, ongoing depreciation may be used as a proxy for cash expenditure on capital items and we recommend that approach in the estimation of the cash flows beyond the 10 year forecast period. For the purpose of calculating the tax shield from depreciation the valuer must of course use the depreciation rates specified

[14] Instead of calculating value as the sum of the PVs of the free cash flows, the value could alternatively be calculated as the book value of opening assets plus the sum of the present values of the accounting based residual income stream. However, the DCF method is the most commonly adopted method of valuation in New Zealand at present and therefore we recommend that method be applied to aquaculture.

by Inland Revenue ('IRD').[15] However, for estimation of future capital expenditure needs, particularly in the years beyond the forecast period, while the rates may be indicative the valuer should assess actual needs.

5.1.5 Cash flows are nominal

It is sometimes suggested that DCF valuation should be based on real cash flows discounted at the real WACC. However, we recommend the use of nominal[16] cash flows and nominal WACC as tax is based on nominal flows. The forecasts of cash flows should therefore be in nominal dollars. This requires an assumption of forecast inflation.

In the current conditions, we recommend applying a rate of 3% as the forecast inflation rate. This is the maximum of the statutory band for Consumer Price Inflation currently set at 0 - 3% per annum. Core inflation (weighted median) for the previous four quarters has ranged from 2.4% to 2.9% per annum. www.reservebank.govt.nz but 3% appears to be reflected in the yield on government stock – the proxy for the risk free rate. An inflation assumption of 3% is consistent with our current estimate of WACC.

5.1.6 Deriving free cash flow from accounting information

Where forecasts of free cash flows are based on historic and forecast accounting information it will be necessary to adjust the information from the accounting accrual basis to the cash basis.

Where a Statement of Cash Flows prepared in accordance with Generally Accepted Accounting Practice ("GAAP") is available, free cash flow can be derived from the reported Cash Flow from Operations as follows:

- Add back interest payments after tax;
- Deduct reported cash Flow to Investing (net of investments in financial assets).

Where the financial statements do not include a Statement of Cash Flows, the Cash Flow from Operations can be derived from after tax profit or loss, as reported in the Statement of Financial Performance (Profit and Loss Account), as follows:

- Add back tax expense
- Add back non cash expenses such as depreciation, amortisation of intangible assets and impairment loss on goodwill;

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[15] See the schedule at section 9.1.2 below.

[16] Nominal means adjusted for inflation.

- Deduct gains on disposal of fixed assets;
- Adjust for changes in working capital by deducting increases in the value of crop and/or stock, deducting increases in accounts receivable, deducting increases in prepaid expenses, adding back increases in accounts payable and adding back increases in accrued expenses;
- Deduct tax paid.

5.1.7 Modelled amount may differ from transacted amount

A valuation model could produce an estimate of value that differs from the amount at which an immediately subsequent transaction takes place. This difference could arise because assumptions made in the valuation were not reflective of the assumptions made by the individual transacting parties. However, the difference could also arise from factors specific to the parties transacting or from thinness in the market. The realism of the assumptions is within the control of the valuer but a model-based valuation does not aim to deal with factors specific to the transacting parties or imperfections in the functioning of the market.

5.1.8 Rarely possible to compartmentalise values from identified income streams

It is very difficult, if not impossible, to assess values for individual business assets (such as coastal permits, specialised equipment, crop and so on) using an income-based method. This is because a business generates income from the whole combination of assets, and so attributing income to a single asset is artificial. The estimate of value is for the Marine Farm as a whole and as a going concern, from which the value of Coastal Permit Space is implied.

5.1.9 Worked example of DCF valuation

The following example is designed to illustrate a DCF valuation of expected cash flows for the forecast period. The valuation cash flow is set out in the top line, with the discounting mechanism below. Two PV factors ($1/(WACC)^t$) are shown: incorporating a high and a low WACC figure. Cash flows are multiplied by the PV factor to obtain a value in PV terms, and then PVs are summed together to get total PV. For illustrative purposes, the cash flows are lumpy (some years are profitable, and some are not, depending on when harvests occur).

Figure 3 Worked example of DCF valuation

EXAMPLE ONLY		Dec 2008	Dec 2009	Dec 2010	Dec 2011	Dec 2012	Dec 2013	Dec 2014	Dec 2015	Dec 2016	Dec 2017
		$	$	$	$	$	$	$	$	$	$
Valuation Cash Flow		**(18,748)**	**33,540**	**(24,862)**	**24,257**	**1,201**	**(38,362)**	**44,510**	**(29,159)**	**22,097**	**9,785**
WACC (Low) (after tax, nominal)		10.50%	10.50%	10.50%	10.50%	10.50%	10.50%	10.50%	10.50%	10.50%	10.50%
WACC (High) (after tax, nominal)		11.40%	11.40%	11.40%	11.40%	11.40%	11.40%	11.40%	11.40%	11.40%	11.40%
PV Factor (Low WACC)	*1.0000*	0.9050	0.8190	0.7412	0.6707	0.6070	0.5493	0.4971	0.4499	0.4071	0.3684
PV Factor (High WACC)	*1.0000*	0.8977	0.8058	0.7233	0.6493	0.5829	0.5232	0.4697	0.4216	0.3785	0.3397
PV of Valuation Cash Flows (Low WACC)		(16,966)	27,469	(18,427)	16,270	729	(21,073)	22,127	(13,118)	8,996	3,605
PV of Valuation Cash Flows (High WACC)		(16,829)	27,027	(17,984)	15,751	700	(20,072)	20,906	(12,294)	8,363	3,324
PV of Forecast Cash Flows (Low WACC)	**9,613**										
PV of Forecast Cash Flows (High WACC)	**8,892**										

5.2 Steps in conducting a DCF valuation

The valuer will take the following steps in preparing a DCF valuation of a Marine Farm (the first three steps may be provided to the valuer by the Ministry):

- Determine the highest and best use for the Marine Farm assets.
- Identify whether there is likely to be material options value as a result of significant change of use or development projects.
- Identify and catalogue the valuation inputs including product prices, annualised site production and operating costs.
- Prepare forecasts of operating cash inflows and outflows for the Marine Farm. As noted in section 5.1.6, this may be done with reference to accounting information if it is available.
- Prepare a forecast of capital outlays and working capital requirements for the Marine Farm.
- Combine the operating and capital flows to calculate the free cash flows for the forecast period.
- Determine the cash flow pattern for beyond the forecast period.
- Estimate the weighted average cost of capital ("WACC") or the business – the discount rate. The method of estimation is set out in Appendix 4 and is summarised in section 8.
- Perform the valuation –calculate and add together the present value of the forecast period cash flows and the terminal value. Where material, add the value of the real options.
- Check against the market view of the separate net assets of the business.

- Check against any other feasible methods of valuation.
- Prepare a sensitivity analysis.

5.3 Applying site specific elements including productivity and rotation length to the DCF model

5.3.1 Typical cycles, production and assets for Marine Farms

As guidance to the valuer, the tables below show typical operational cycles and assets, and indicative production levels, for marine farms. The tables are for three species groups: Greenshell mussels (longline method), Pacific oysters (hatchery spat and purse culture)[17] and King salmon (marine farmed).

[17] Current oyster culture is dominated by stick technology. Marine Scientists fromThe Cawthron Institute see singles culture using purses as the future of the industry, which is why we set out this method here.

Figure 4 Operational cycles, production levels and assets for mussel farms

Mussel farms		
Operational cycles		
Phase	**Period and Description**	**Typical Production**
Spat catching (during juvenile drift phase)	Happens year round Crop ropes for mussels are seeded with mussel spat. Most (80%) of spat comes from Kaitaia, where spat from extensive offshore mussel beds settles on drifting seaweed which periodically washes up on Ninety Mile Beach, allowing easy harvest. The remainder of the spat is collected in spat catching farms. (It is becoming more and more likely that spat may be sourced from land-based producers using selective breeding techniques, but this is not yet a commercial reality). The structures of spat farms vary considerably. Typically, they resemble mussel farms on the surface. However, below the surface there is a second backline holding spat catching lines, for spat to settle on, 15-20 meters below the water. Materials used for spat collection include plastic mesh and fibre rope weighted to sink. Spat catching lines may be hung in rows or be wrapped around box-like structures. They remain in place for 4 – 8 weeks. Spat, either from spat catching farms or from Kaitaia, are seeded on to growing ropes by holding them against the ropes with light tubular stocking, until they attach themselves. This is called a seeded line. (Seed farmers can purchase spat from spat farmers).	Variable
Nursery lines (in cotton stocking)	This phase lasts until mussels are approx 10-30mm. The length of this phase is 3 – 6 months. (Farmers can purchase nursery lines)	Mussel spat is fixed onto the rope at the rate of approximately 1000 to 5000 per metre.

Re-seeding to pre-harvest	This phase lasts until mussels are approximately 90mm - 120mm. Re-seeding is when the mussels are taken from the nursery stocking and put into larger diameter cotton stocking at a rate of approximately 150 - 200 per metre. The stocking eventually rots away in the seawater. (Farmers can purchase seed lines) The period between seeding and pre-harvest takes between 12 and 24 months. The length of the growing cycle following seeding varies from site to site and depends on the number of mussels growing per metre of rope. The number of microscopic organisms that the mussels filter out as food being carried by tidal currents through the farm will also vary from time to time and site to site. Some indicative times from seed to harvest: Waikato / Coromandel: 12 – 15 months Stewart Island: 36 months Marlborough (the region with greatest variation): 15-24 months with varying condition	6 – 8 (greenweight) kilograms of mussels per meter of crop rope per cycle, variable by region So, for example, on a site with 47,000 meters of crop rope where production is estimated to be 7.0 kgs per meter per 18 month cycle, the annual average production will be: 47,000 x 18/12 x 7.0 = 219 tonne (GWT)
Sample inspection	Nearing the end of the growing cycle, farmers test if the mussels are ready for harvest (ie in optimal condition). Repeats every 12 – 18 months, according to cycle length.	N/A
Harvest and sort	When it is time to harvest, farmers harvest and sort the mussels into one tonne bags (or 25kg bags for the local market). Repeats every 12 – 18 months, according to cycle length.	N/A
Capital expenditure cycles		
Phase	**Period and Description**	**Typical uses**
Coastal Permit renewal	Coastal permits need renewing every 10- 35 years. The current holder of the permit has the first right of refusal over coastal permits, making the process of renewal relatively straight-forward if the owner has complied with permit conditions.	Coastal permits are issued by the district or regional council and are required in order to occupy and use space for marine farming.
Replacing floats	Floats need to be replaced every 7 years	Floats are spaced out evenly along the length of the backline, generally about one every 10 meters (this does vary), with larger floats at both ends of the backline.

Replacing backlines (or backbones)	Backlines need to be replaced every 10 - 15 years	Backlines are generally positioned in parallel rows 15-20 meters apart (for sheltered in-shore areas) and 50-60 meters apart in exposed situations.
Replacing screw anchors	Screw anchors need to be replaced every 10 -15 years	Screw anchors and concrete blocks retain the backlines in place. Two anchors (one on each end) are needed for every parallel backline row.
Replacing crop rope	Crop rope is suspended from the backbone down into the column in a series of loops, which hang under the weight of the mussel crop Crop rope needs to be replaced every 4 years (this varies according to conditions, between 4 – 8 years)	Crop rope is hung in loops spaced about .75 – 1 meter apart, and depending on water depth, may extend down as far as 30 metres, but are normally kept clear of the bottom.
Replacing harvest vessels and machinery	Harvest vessels need to be replaced every 30 years Sorting machinery needs to be replaced every 8 years	Sorting machinery is used to strip mussels from the rope. The mussels are then washed and any natural detritus is discarded overboard.

Figure 5 overleaf sets out typical cycles, production and assets for a farm employing purse (single seed) culture and using hatchery spat. The alternative, and more common, method of oyster farming in New Zealand is stick culture with wild caught spat. Growing times are similar, but product quality is significantly better with purse culture and hatchery spat. This is because the shell shape is more predictable and the product can be sold in the half shell. Current predictions are that farms will predominantly use purse culture and will purchase hatchery produced spat by 2013.

Figure 5 Operational cycles, production levels and assets for an inter-tidal oyster farms employing purse culture and using hatchery spat

Intertidal oyster farms employing purse culture and using hatchery spat		
Operational cycles		
Phase	**Period and Description**	**Typical Production**
Hatchery spat	Hatchery spat is available for purchase year round	Hatchery produced spat is purchased by the thousand
Grow on period	The grow-on period takes 10-12 months, depending on location and season The oysters may be moved into a preferred fattening area during this phase The use of hatchery spat requires a more sophisticated operation in order to realise the potential gains. A more informed husbandry is required than for stick farming. This in turn produces a change in the character of the labour force, characterised by a shift from seasonal to full time labour, and by a labour force with greater depth of education in culture techniques	20,000 – 35,000 dz. per hectare per annum. (using stick production methods, production can be as low as 8,500 dz per hectare per annum, ranging up to 20,000 dz per hectare per annum).
Harvesting	Harvesting takes less than 1 day, and repeats every 10-12 months	N/A
Washing and culling, grading & packing	Washing, culling, grading and packing takes place at an on-shore facility or on a barge. It takes less than 1 day.	N/A
Capital expenditure cycles		
Phase	**Period and Description**	**Typical uses**
Coastal Permit renewal	A Coastal Permit needs renewing every 10- 35 years. The current holder of the permit has the first right of refusal over coastal permits, making the process of renewal relatively straight-forward if the owner has complied with permit conditions.	Coastal permits are issued by the district or regional council and are required in order to occupy and use space for marine farming.

Replacing posts and wire	Posts and wires need to be replaced every 15 years	Posts and wires provide a place for the purses to hang in, or just out of, the water. The posts are typically wooden, and are laid out in parallel rows about 50cm apart (according to the width of the purses used). Wire is strung between them. Each row of posts and wires is spaced far enough apart for a boat to run between them.
Replacing bags / purses that contain oysters	Bags and purses need to be replaced every 5-7 years	Durable plastic purses contain oysters. Stocking rates vary.
Boats and barge	Boats and barges need to be replaced every 30 years	Barges are used for washing, culling, grading and packing if there is no on-shore facility. Boats are used as runabouts, for example, to run between the rows to lift baskets or check on crop.

Figure 6 Operational cycles, production levels and assets for a salmon farm

Salmon farms		
Operational cycles		
Phase	**Period and Description**	**Typical Production**
Hatchery smoult	Hatchery smoult is available for purchase year round. The fish are 65 – 200 grams when they leave the hatchery.	Hatchery smoult are purchased by the thousand
Marine farm phase	The marine farm phase takes 12 – 18 months. The fish are raised in nets which hold approx 15kg of live weight fish per cubic meter of net. In this phase, the fish are grown from 65-200grames to approx 4kg live weight. Fish food needs are determined with reference to the Food Conversion Ratio (the ratio between food inputs and fish weight).	Varies significantly by site and management technique

Harvesting	Harvesting takes about 6 hours, where fish are transported to the shore.	N/A
Processing	Processing takes less than 3 hours, where fish and gilled and gutted.	N/A
Capital expenditure cycles		
Phase	**Period and Description**	**Typical uses**
Coastal Permit renewal	A Coastal Permit needs renewing every 10- 35 years. The current holder of the permit has the first right of refusal over coastal permits, making the process of renewal relatively straight-forward if the owner has complied with permit conditions.	Coastal permits are issued by the district or regional council and are required in order to occupy and use space for marine farming.
Replacing farm structures, pens and cages	Farm structures need to be replaced every 10 - 30 years, depending on the emergence of new farming technology. Structures tend to consist of a floating barge with pipes and cages, but different feed out methods, types and sizes of cage, moorings and predator nets are used.	Fish are farmed in nets attached to pens on a floating barge structure.
Replacing nets	Nets need to be replaced every 3 -5 years (depending on maintenance), and require ongoing maintenance.	Nets hold the fish.
Replacing electronics and feeders	Electronics and feeders need to be replaced every 3 – 5 years (depending on maintenance), and require ongoing maintenance.	

5.4 Model construction using standardised revenue and expenditure categories

5.4.1 Model construction and chapter references

For consistency, the valuer should construct a DCF model for a Marine Farms using the revenue and expenditure categories set out in the figure below:

Figure 7 Model construction

Heading	Inputs	*Methodology* chapter reference
Cash Revenue		5.6
Sales receipts	*Production x Farm Gate Price x Inflation Index*	5.6.1, 5.6.3

Less impact of adverse events (e.g. bounamia)	*Lost Production x Farm Gate Price x Inflation Index* *And Lost Production = annual probability of outbreak (%) and Production*	5.6.5
Other farm income	*$ Figure*	5.6.7
TOTAL REVENUE	*Sum of cash revenues*	
Cash costs		5.7
Spat / seeding / cost of smoult / other inputs	*Spat Unit Cost x Forecast Production for following Year x Inflation Index*	5.7.1
Maintenance and other costs of growth period (includes labour, food (for finfish farms) and other costs such as transport or routine maintenance of assets)	*Maintenance Unit Cost x Production x Inflation Index* *OR* *$ Figure, broken into component parts*	5.7.2
Harvest cost	*Harvest Unit Cost x Production x Inflation Index*	5.7.3
Monitoring, consent conditions and water testing	*$ Figure*	5.7.4
SeaFIC / Aqua NZ Levies	*Levy Unit Cost x Production x Inflation Index*	5.7.5
Other costs, including cost of land base if applicable	*$ Figure*	5.7.6
TOTAL OPERATING COSTS	*Sum of cash costs*	
Operating profit (cash)	*Total Revenue minus Total Operating Costs*	
Less Taxation	*30% x Accounting Profit (Operating Profit less Depreciation)*	5.7.7
NOPAT	*Operating Profit less Taxation*	
Capital costs		5.8
Additional or replacement fixed infrastructure	*$ Figure*	5.8
Additional or replacement moveable infrastructure	*$ Figure*	5.8

Working capital	*Working Capital % x Total Costs*	5.8.3
TOTAL CAPITAL COSTS	*Sum of capital costs*	
Valuation Cash Flow	*NOPAT (cash) less Total Capital Costs* *(Annual forecast for no more than 10 years)*	

5.5 Forecast period and timing assumptions

The valuer should forecast expected net cash flows on an annual basis, with cash flows at mid-year. Forecasts should be for no more than 10 years (referred to as "the forecast period"). Forecasts beyond ten years for factors such as farm use, exchange rates and business costs are extremely subjective. This uncertainty is general to nearly all businesses and therefore it is unusual to make explicit year by year forecasts beyond ten years. The impact of those cash flows on the valuation should be assessed on the basis of simplifying assumptions for terminal value. This is seen as a reasonable trade-off between the benefit gained from explicit consideration of these cash flows and the cost of doing that. This is described in section 5.10, "Estimation of the Terminal Value".

5.6 Cash revenues

Cash revenues are a function of production and (nominal) farm gate price.

5.6.1 Production

The valuer will need to forecast how much of each type of product a Marine Farm will harvest and sell and how much the farm will have growing on site. Production forecasts should rely on information provided to the valuer (see section 4.4). Any forecasts of production or crop should:

- form a view of on annual average production - metrics such as typical production per metre of crop rope, typical length of crop rope and typical rotation period (the length of time between stocking the site and harvest) for the site are useful for this task;
- take into account past production levels (previous three years history is preferable);
- take into account any down time between harvest and re-stocking the site with spat;
- be based on the amount of product that is "packed out" and not count product that is sorted and thrown away;
- be based on a view of the best available harvesting and cropping strategy for the site, as developed;

- be conservative about production growth over the forecast period.[18]

The product is the product in the form it arrives at the farm gate. The farm gate is the nearest wharf to the farm. As a guide, the form of the product used in the forecast should be as follows:

- For mussels - Tonnes of Greenshell mussels, harvested whole and cleaned on-site (green weight tonnes or GWT), adjusted for losses during harvest and transport to the purchaser
- For mussel spat on rope (seeded) - Meters of seeded spat rope
- For mussel spat in any other form – Thousand spat
- For oysters – Dozens of oysters, harvested whole, adjusted for losses during harvest and transport to the purchaser
- For finfish such as salmon – Kilograms of gilled and gutted fish, adjusted for losses during harvest, transport to the purchaser and during gilling and gutting.

The valuer should take care to match operating cost assumptions (section 5.7) to the form of the product at the farm gate. For example, if the sold product is sorted and cleaned greenshell mussels, then the costs of cleaning and sorting should be included as operating costs but a cost of freezing or processing the mussels, for example, should not be.

5.6.2 Productivity varies

The productivity of marine farms varies significantly. The Valuer should be aware of the variables that influence productivity of marine farms. For mussel and oyster farms, these factors include:

- Restrictions on the Coastal Permits and in the Coastal Management Plan (restrictions are known by Regional Council Staff and individual site owners).
- Chlorophyll-a (this is measured once a week by NIWA in the Marlborough Sounds[19] but consistent monitoring is not available in other regions at present).

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[18] Our view is that production growth on established sites will be marginal, unless significant gains in technologies for selective breeding are made in the next few years.

[19] Marlborough Sounds Environmental Monitoring Project, http://www.niwascience.co.nz/services/sounds

- Temperature (temperatures are measured once a week by NIWA in the Marlborough Sounds but consistent monitoring is not available in other regions at present).
- Salinity (salinity is measured once a week by NIWA in the Marlborough Sounds but consistent monitoring is not available in other regions at present).
- Depth (this can be measured fairly easily using GIS mapping tools).
- Fouling and flow (these factors are known by Regional Council Staff and individual site owners, but not easy to measure or compare consistently).

The site-related variables that influence productivity of finfish (in the marine zone) are:

- Temperature
- Fouling and flow
- Depth

5.6.3 Farm gate price

Farm gate prices should be moderate and reasonable prices, at levels likely to be achieved at the time of maturity by a competent sales agent. Prices should be from transactions conducted at arms length, on ruling terms of trade, in the available and practical markets, to give conservative total revenue for the farm.

If a Marine Farm is managed in a way that poor prices had been received by the current owner or the quality of the product was not what could reasonably be expected from that site under good management, then the valuer will need to adjust the price accordingly. An example might be a farmer who has harvested mussels in a non-spawning period, thus reducing the mussels' palatability and sale price.

Unless the valuer has specific information to indicate the evolution of future prices, it should be assumed that prices will be constant in real terms. Therefore, the valuer will need two assumptions:

i An estimate of the base price at farm gate; and

ii A forecast of exchange rates and/or inflation in the country of sale.[20]

[20] With the assumption of Purchasing Power Parity, the valuer will only need to apply domestic inflation as a proxy for inflation in the country of sale. A more detailed discussion follows.

All price assumptions disclosed

All price assumptions must be disclosed in the valuation report with a full discussion of reasons why the price was adopted. All price assumptions should be disclosed in New Zealand dollars ("NZD"). The marketing scenario for the products produced by the Marine Farm must be realistic and well-described in the valuation report.

Net price

If the product is not sold at the farm gate, the valuer should take care that all selling costs, costs between harvest and selling point, and marketing and commissions are to be netted off the purchase price. For example, if a mussel processor pays for greenshell mussels transported to the factory, the cost of transporting the mussels to the factory from the wharf should be deducted from farm gate price.

The farm gate price should not reflect any value added from processing or sorting, for example if processing and sorting occurs off-site using assets not owned by the Marine Farm.

Sources of information regarding farm gate prices

Farm gate prices may be observed in one of five following ways, in order of preference:

- Prices have been derived by Delphi method, as set out in section 13.6.1;
- The farmer, or other farmers of the same product from the same geographic area, sells the product at the farm gate to arm's length parties and the price is observable;
- The farmer, or other farmers of the same product from the same geographic area, sells the product in its farm gate state to arm's length parties beyond the farm gate and the cost of getting the product to market is observable;
- An assumed price where the transactions value is inobservable and the valuer deems it appropriate.

Where there is a genuine divergence in prices and all transactions would meet the criteria set out above, the mid-point price should be taken in order to be conservative.

Further discussion of these methods is provided in the paragraphs below.

5.6.4 Observable farm gate prices

This section describes how a valuer would deal with observable arms length prices.

The valuer's observations of prices should ideally be taken from a broad base of purchasers, including exporters. Price observations should be taken for a full year prior

to the valuation date under the prevailing exchange rate conditions, provided the prices received in the previous year have been reasonably typical.[21]

For example, say a mussel grower in the Marlborough Sounds could sell to one of three purchasers: Purchaser A, Purchaser B and Purchaser C. The purchasers paid different prices but on the same terms, which is net of transport from the wharf to the factory:[22]

Figure 8 Prices for a Greenweight Tonne of mussels at the farm gate

GWT Prices for Mussels at the farm gate (excl. GST)				
	Top Grade	**Medium Grade**	**Bottom Grade**	**Range**
Purchaser A	$740	$665	$450	$290
Purchaser B	$770	$715	$580	$190
Purchaser C	$730	$730	$550	$180

Source: Based on actual LECG research during August and September 2007

[21] The reason for taking a full year average is to account for the seasonal variation in price. Our understanding is that there are significant seasonal variations in prices for all aquaculture products cultivated in New Zealand, with predominant spikes around Christmas time, for example. However, we have not been able to obtain data to verify this understanding because the only consistently measured price series available at the time of writing was for mussel exports, provided by NZ Agrifax.

[22] Payments to suppliers for harvesting cost and transport differ between the purchasers.

In this case, the valuer would take the mid-point price for each grade (excluding GST), and present the assumptions in his report, i.e.

	Top Grade	Medium Grade	Bottom Grade	Range
Price assumption	$740	$715	$550	$110
Proportion sold in this grade	20%	80%	0%	

Observing prices for exported products and forecasting exchange rates

With the exception of spat, all aquaculture products in New Zealand have potential to be exported. Fluctuations in exchange rates will affect the valuation to the extent that the fluctuations are carried through to the price assumptions used in the cash flow forecast.

The valuer must be satisfied that the farm gate price being applied suitably reflects export price trends, given prevailing exchange rates. The principle is that an optimally managed farm will be able to negotiate an arms length price for its product such that processors will not capture all of the value from changes in price driven by exchange rate.

Where export prices form part of the valuer's research, FOB[23] prices are preferred. CIF prices are generally highly transaction specific, and are therefore less suitable.[24] If CIF[25] prices are used the valuer will need to adjust the prices by deducting the cost of insurance and freight to the export market, and any items that are transaction specific. From FOB price, the valuer will then need to convert the prices to NZD (set out below), and then make appropriate conversions to derive a suitable farm gate price.

[23] FOB is Free On Board. When a price is quoted FOB, it means that the selling price includes the cost of the goods and loading them on to the ship at port (Incoterm).

[24] If the farm is a mussel farm, CIF contract prices can be assessed with reference to NZX Agri-Fax database for Frozen Half-shell Greenshell Mussels.

[25] CIF is Cost, Insurance, and Freight. It means that insurance and freight is paid to a point of destination and is included in the price quoted (Incoterm).

If the valuer chooses to derive farm gate prices with reference to a history of export prices, an assumption is required for converting foreign currency receipts into NZD and for forecasting exchange rates.

Given the absence of established credible models for forecasting exchange rates we recommend adoption of Purchasing Power Parity. That is,

$$\frac{E(S_1)}{S_0} = \frac{(1+i_F)}{(1+i_N)}$$

where

$E(S_1)$ = expected spot rate at time 1 in units of foreign currency per NZD

S_0 = spot rate at time 0

i_F and i_N = are the expected inflation rates in the foreign country and New Zealand respectively

If, as recommended above, the valuer assumes that the product price in foreign currency units, P_t^F, increases at the expected inflation rates in the foreign country, then

$$P_t^F = P_0^F \prod_{j=1}^{t} (1+i_{F,j})$$

Therefore

$$P_t^N = \frac{P_0^F}{S_0} \prod_{j=1}^{t} (1+i_{N,j})$$

where

P_t^N = product price converted to NZD at time t

We recommend using a constant WACC as the discount rate and, therefore, it is consistent to assume a constant inflation rate. Hence, if the rate is assumed to be 3%, then:

$$P_t^N = \frac{P_0^F}{S_0} (1+0.03)^t$$

Therefore, if it is assumed that foreign product prices increase at the expected inflation rates in the foreign country and that Purchasing Power Parity hold then all that is required to forecast the NZD price over time is the current product price in foreign currency, the current exchange rate and a forecast of the New Zealand inflation rate. This method avoids the need to forecast exchange rates.

This method can be applied to each product type in each market, or a weighted market average export price could be used as a starting point for deriving farm gate price.

However, estimation of the future prices by this method assumes that it is reasonable to base the forecasts on the current combination of price and exchange rate. If the valuer is of the view that the current relationship between price and exchange rate reflects unusual short term factors then it would be appropriate to adjust for that condition. One method of doing so would be to adopt the current price for the first period but then have the price revert to a typical price over say the next two years.

5.6.5 Unobservable prices

Where farm gate transactions are unobservable, say because the processor and the farmer are integrated, farm gate prices can be established by working backwards from arms length transactions of processed aquaculture products. The valuer would take the transacted price of the processed product and deduct the cost of processing x (1 + mark up %).

The required mark-up percentage can be determined by comparing the mark-ups (revenue over total cost) earned by the processor for other products. For example, the valuer may derive a farm gate salmon price by observing that filleted fish tends to be priced at 30% more than its cost. He can observe the direct cost of filleting fish. He would obtain the farm gate price of salmon by observing the market price of filleted salmon and then deducting the direct cost of filleting x (1 + 30%). Further deductions would be made to reflect the transport required from the farm gate to the processing facility.

Other transfer pricing rules may be helpful. [26]

5.6.6 Accounting for adverse events

Adverse events, such as bounamia outbreaks, should be assumed to be fully covered by insurances. If insurance is not included as an operating cost elsewhere in the forecast, then an appropriate proxy for an insurance cost is to spread the expected cost of an outbreak using an annual average cost as follows:

Probability of outbreak in the region or harbour concerned (%) x extent of stock losses (tonnes, kgs or dozens) x net realisable value of stock lost ($ per tonne, kg or dozen)

[26] Transfer pricing refers to the pricing of assets transferred within an organization. For example, goods from a farm in a vertically integrated firm are not typically sold to the processing division. Because of this, the typical market mechanisms that establish market price may not apply. There are detailed tax rules that spell out how transfer prices can be estimated and the valuer may wish to refer to these.

5.6.7 Other income

Any other income that is attributable to the farm should be added to the forecasts and detailed in the valuer's report.

5.7 Key operating expenditure assumptions

All expenditure should be assessed on a cash basis, rather than an accrual basis.

Where possible, expenditure should be broken down into on-site expenditure and expenditure that occurs beyond the farm gate.

Expenditure can often be analysed in terms of relationships with cost drivers, for example:

- Relationship between categories of expenditure and production, such as
  - Labour cost and production
  - Harvest cost and production
  - Transport cost and production
- Relationship between number of lines / bags / buoys / sticks and maintenance expenditure.
- Relationship between revenue and total operating cost.

5.7.1 Spat / seeding / cost of smoult / other inputs

Mussel spat / seed

Mussel spat is either developed by the farmer on-site or purchased by meter of seeded line. If the spat is developed on-site the valuer should use the cost of a seeded line in an arms-length transaction:

- as a cross-check for any costs of growing spat provided by the farmer for the Coastal Permit Option;
- as the cost input for a model used for the Financial Equivalent Option.

5.7.2 Maintenance and costs of growth period

Routine maintenance

Routine maintenance consists of repairing or replacing posts or lines or checking crop as it is growing. It may include re-seeding lines for mussel farms or moving oysters from place to place. It may include the cost of transport to and from the farm from the farm gate (i.e. the nearest wharf). Often the cost of routine maintenance on farms is included in maintenance contracts or in labour costs, so the valuer should be careful not to double-count.

Labour

In the case of mussels, oysters and other shellfish, labour will likely be the largest component of maintenance expenditure. There is a high rate of owner-operator labour in the industry at present, but this is changing. There is a trend toward larger corporate entities operating aquaculture farms.[27]

In entering an assumption about the cash expenditure associated with labour, the valuer should use observed contract rates for farm maintenance:

- as a cross-check for any costs of labour and maintenance provided by the farmer for the Coastal Permit Option;
- as the cost input for a model used for the Financial Equivalent Option.

Cost of food

Cost of food is a major expense for fish farmers. A key driver for the cost of food is the food conversion ratio, which for King salmon ranges from 1.15 – 1.35 kgs of food per kg of live weight and for kingfish around 1.5 kgs of food per kg of live weight. Cost of food can be assessed by looking at prices per kilo of food from major suppliers such as Skretting.

Overheads

Where a Marine Farm is pert of a vertically integrated business that is being purchased as part of the Coastal Permit Option, overheads should be allocated between factory and on-site expenditure, using the principle that any cost that the business incurs that relates, directly or indirectly, to the activities on the marine farm site, should be treated as a relevant cost of producing the product.

5.7.3 Harvest cost

A Marine Farm incurs additional cost when it harvests the product. With mussels, this involves hauling the mussel-laden ropes onboard the harvest vessel, where the mussels are stripped from the rope. The mussels are then washed and cleaned of detritus, bagged and taken to wharf. With oysters, this involves stripping the sticks of the oysters or removing the baskets from the racks and taking them to the barge or ashore. The oysters are then cleaned and sorted. With salmon, this involves lifting the nets out of the water

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[27] In Donnelly, P. *Economic Study of the Mussel Industry Financial Year Ending March 1998*, it was reported that 62% of respondents managed their own farms personally but arranged contractors for some operations. 14% had a combination of management arrangements, 13% were absent owners who contracted all work, 9% were share farmers and 1% leased space to other farmers. Management of own farms was lowest in Nelson, with 50% of respondents and 40% of farms managed by owner-operators. Hauraki had very high rates of owner-operators, with 85% of farms operated by owners.

and carefully guiding the fish into transport tanks, where they are taken to wharf. Harvest costs are usually obtainable as a unit cost, i.e. cost per greenweight tonne or cost per dozen.

5.7.4 Monitoring, consent conditions and water testing

Monitoring

Because aquaculture products feed directly from the sea (i.e. for mussels and oysters, by filtering plankton as they pass through their bodies), it is important that the marine environment in which they grown remains free of pollution. Pollution and bacteria can cause severe illness in humans. Countries which receive aquaculture products from New Zealand such as the USA, the EU, Australia and Japan insist on regular monitoring programmes. A shellfish quality programme is set up to monitor and maintain water quality standards for aquaculture. This programme involves water sampling (i.e. for biotoxins) and rainfall monitoring. This has a cost, which is usually obtainable as $ amount for each farm.

Cost of consents

The *Methodology* assumes that each farm's coastal permits are renewed into perpetuity, and that there is full compliance with consent conditions, for the purposes of forecasting. However, costs for renewing the permits should be included as an annual average operating cost, i.e. renewal cost % number of years validity. The amount of the cost will vary according to the current applicable renewal period (between 5 and 35 years). Sites further away from shore will cost more because of the need for Council officers to visit sites by boat.

5.7.5 SeaFIC and Aquaculture NZ levies

SeaFIC and Aquaculture NZ represent the interests of marine farmers at a national level. They charge an annual levy. In 2007, the cost for mussel farmers was $6.00 per green weight tonne produced and 0.525% of farm gate revenue for oyster farmers.

5.7.6 Other costs

From time-to-time other categories of expenditure will be relevant for forecasting cash flows to Marine Farms. These should be included as line items. One example is the cost of operating a land-based facility. This should be included as an annual expense item for the farm, but only if it is essential to the operation of the farm. For example, a lease cost over a land-base for cleaning and sorting oysters is essential for the operation of an oyster farm if the farm does not have the use of a barge.

5.7.7 Taxation assumptions

The tax circumstances of the Crown as purchaser of a Marine Farm are not relevant to a market valuation.[28] Instead, a generalised construct for all potential purchasers in the market must be applied.[29]

The valuer should apply a standard set of tax environment assumptions:

- The Marine Farm is always paying tax in the future on income at the standard corporate tax rate (30%).[30]
- Obligations for other taxes, such as GST, are paid as they accrue.
- The Marine Farm will always claim losses in cash and pay tax in cash in the period which the obligation applies.
- The tax rates and state of law at the time of the valuation apply into perpetuity (aside from known changes, such as the forthcoming change to 30%).
- The owning entity has no tax losses or other deductibles at the date of the valuation available for transfer to a new owner.

Taxation assumptions in the discount rate

The dividend imputation tax structure and the tax shield from interest are both reflected in the WACC used as the discount rate. The estimated parameters of WACC are set out in section 5.9.

5.8 Capital requirements

Capital expenditure on marine farms is required to deal with the effects of wear and tear and provide for changes such as increased scale, new technologies or new use of the site. Free cash flow is the cash flow from operations less the cash flow for investing in new or replacement capital assets.

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[28] The Crown, which has no tax liability, could be expected to have a greater ability to pay than the market.

[29] There is no easily discoverable norm for tax exposure in the market. Entities will have widely different tax exposures and available deductions, as the tax liabilities of an entity do not necessarily arise solely from the aquaculture asset. The funding arrangements adopted will also impact on taxation. It is, however, reasonable to assume that the market price will reflect standard tax rates.

[30] Note, the current rate is 30% but the rate of 30% is due to take effect from the 2008/09 income year.

5.8.1 Capital expenditure for valuations for the Coastal Permit Option

For valuations for the Coastal Permit Option, forecasts of major capital expenditure should be included in the forecasts of cash flow at the date that the expenditure is most likely occur. The valuer will need to form a view in order to compile forecasts that involve development or redevelopment of the site.

For smaller capital expenditures (such as to replace worn ropes or poles), it is acceptable to use depreciation expense as a proxy for capital expenditure. This prevents the need to forecast exactly when these expenditures will occur in the future.

The impact of capital expenditure on net operating cash flows should also be considered. Some capital expenditure will be justified on the basis of maintaining the business infrastructure and may therefore produce no increase on cash flows; whereas other capital expenditure will serve to expand capacity and increase cash flows in future periods.

Any capital expenditure should be net of any associated realisations. For example, if new purses are purchased for an oyster farm, any revenue generated by selling the old ones should be included in the cash flow forecast. New farm resource consent applications can provide details on the cost of establishing the farm infrastructure, otherwise local suppliers can be surveyed.

5.8.2 Capital expenditure for valuations for the Financial Equivalent Option

For the Financial Equivalent Option, it is acceptable to use straight line depreciation expense as a proxy for required capital expenditure. That is, capital expenditure in any given year is assumed to be the replacement cost of the infrastructure divided by the number of years useful life for that infrastructure.

5.8.3 Movements in net working capital

A base level of working capital is already invested in any going concern business, and as such additional cash is not needed to finance working capital. In other words, the valuer does not need to include working capital as a cost in a forecast for an established going concern marine farm.

However, if a marine farm is expanding and its revenues growing there is likely to be a requirement for additional working capital. Therefore, valuers of farms on which development is to occur need to reflect changing working capital needs in cost forecasts. For example, the valuer may find in looking at marine farms' accounts that for every dollar of additional revenue generated per annum by a farm, an additional 30 cents of working capital investment was required in the previous year when development occurred. Thus 30% of the additional expected revenue would be deducted as a cost in the year of development.

5.9 Discount rate assumptions

5.9.1 WACC

The Weighted Average Cost of Capital ('WACC') is a measure of opportunity cost of the equity and debt capital supplied by investors to a business – the return investors could earn in alternative investments carrying the same level of risk.

The methodology adopts the following definition of WACC:

$$WACC = W_e K_e + W_d K_d(1-t_c) \quad (1)$$

where: W_e = proportion (weight) of equity funding;

K_e= cost of equity (estimated using the Capital Asset Pricing Model);

W_d = proportion of debt funding;

K_d = cost of debt; and

t_c = corporate tax rate (= 0.30).[31]

That is, WACC is the weighted average of the cost of equity and the after tax cost of debt. Neither of these costs can be directly observed in the market and must therefore be estimated. For brevity, we have only repeated a summary of parameter estimates in the body of the report. A full discussion on WACC is included as Appendix 4.

Figure 9 Summary of parameter estimates for WACC as at August 2007

Summary of parameters and resulting estimates of WACC, August 2007			
Parameter	**Low**	**Midpoint**	**High**
R_f	6.50%	6.50%	6.50%
TAMRP	8.00%	8.00%	8.00%
DM	1.50%	2.00%	2.50%

[31] The current company tax rate is 0.33 but the estimate of WACC has been assessed on the basis of the rate of 0.30 which ids due to take effect from the 2008/09 income year. The impact of this change is currently assessed as being an increase in WACC of the order of 0.1%.

$ß_a$	0.50	0.55	0.60
W_d	0.36	0.36	0.36
$ß_e$	0.78	0.86	0.94
t_p	33%	33%	33%
t_c	30%	30%	30%
t_d	4%	4%	4%
D, D_m	3%	3%	3%
K_e	10.6%	11.2%	11.9%
K_d	8.0%	8.5%	9.0%
WACC	8.8%	9.2%	9.8%

Source: LECG estimates

5.9.2 Traditional approach underestimates WACC

There is growing evidence in the finance literature that the traditional approach to estimation of WACC, as used in this report, does not fully capture the true costs facing a company when making investment decisions. That is, in the real world there are significant departures from the assumptions of the Capital Asset Pricing Model ("CAPM") used in estimation of the cost of equity. These relate principally to market frictions, irreversibility and timing flexibility, and firm resource constraints.

There is considerable evidence that competitive firms require a significant margin for exposure to risk other than market (systematic) risk and therefore require a minimum-acceptable expected rate of return on investments that exceeds their WACC as based on the CAPM.

Also, because the WACC is based on an assumption of perfect markets, it does not reflect the illiquidity of investment in smaller companies, which are common in aquaculture in New Zealand. This supports the need to include an additional margin over WACC.

However, the challenge in allowing an additional margin over WACC is to decide on the size of the margin. Given that research in this area is still in its very early stages the size of the margin is highly uncertain but, as a minimum, a margin of 2% would appear to be appropriate. Using the WACC assumptions set out above results in a midpoint estimate of 11.2 % for WACC with a range of 10.8% - 11.8%.

5.9.3 Appropriate WACC for different businesses?

The discount rate applied in a DCF valuation should as much as possible represent the characteristics of the target business being valued. Thus, in principle, if the business being valued consists of farming algae to supply a pharmaceutical manufacturer, the estimated rates of return required by providers of equity and debt capital would be significantly different to those that would apply to a business engaged in just spat farming.

The beta coefficient is the key parameter of WACC that reflects such differences. The value adopted here for beta is intended to reflect as closely as possible the characteristics of a medium sized aquaculture business that supplies global food markets. Unfortunately, as explained in the paper on WACC in Appendix 4, the data limitations on estimation of beta are such that it is not possible to establish with any reasonable degree of confidence different estimates of beta for all the different types of aquaculture businesses. Therefore, we recommend that all aquaculture farming businesses be valued using the estimate of WACC set out above.

5.10 Estimation of the terminal value

The terminal value is the contribution to value from the cash flows that occur after the forecast period (ten years) into perpetuity. The methodology assumes that cash flows beyond the forecast period evolve at a constant rate. Therefore, the continuing value, V_c, the PV of the cash flows at time T, can be calculated using a constant growth model. The terminal value is then obtained by discounting this value back to time 0. That is:

$$V_C = \frac{CF_T(1+g)}{WACC - g}$$

and

$$V_T = \frac{1}{(1+WACC)^T} V_C$$

where:

CF_T is an estimate of maintainable net cash flow

g is the assumed growth rate

WACC is the weighted average cost of capital

5.10.1 Maintainable net cash flow figure

The cash flows beyond the forecast period can be estimated with reference to the cash flows that occur at time T, CF_T . The valuer should, however, consider adjustments to the net cash flow figure to ensure that the amount reflects a reasonable view of net cash flows going forward. This may include adjustments to 'smooth' out fluctuations in revenue and expenditure.

5.10.2 Growth beyond the forecast period is constant in real terms

We recommend that the future cash flows be assumed to be constant in real terms (ie, not growing). The growth rate, g, therefore is just the assumed rate of inflation. This seems a reasonable assumption as growth in production will be restricted by the extent of the Coastal Permits that the business currently owns and continuous productivity improvement is unlikely.

5.10.3 Terminal value not less than zero

The terminal value will generally not be less than zero. This assumption is appropriate, given that no rational person would continue to farm a site if they were likely to continue to generate negative returns.

5.10.4 Worked example

For example, if the net cash flow for year ten of a ten year forecast period was $100,000 and growth was assumed to equal the inflation rate of 3%, then with a WACC of 11%, the continuing value, V_C , is given by:

$$V_C = \frac{100{,}000(1+.03)}{0.11-0.03}$$

$$= \$1{,}287{,}500$$

and the terminal value is:

$$V_T = \frac{1}{(1+0.11)^{10}} V_C$$

$$= \$453{,}438$$

5.11 Sensitivity analysis

The valuer should conduct a sensitivity analysis to determine the impact of the various assumptions made on the DCF value, namely:

- Product price (this may involve analysis of the exchange rate)
- Site production (this may involve analysis of the rotation length)
- Inflation
- Operating costs

Ideally the sensitivity analysis should comprise of a full Monte Carlo Analysis.[32] This results in a probability distribution for the DCF value and hence indicates the degree of confidence that can be assigned to the DCF value used in the estimate of the value of the farm.

5.11.1 Valuer to judge whether options value is likely to be significant

The valuer should attempt to identify where there is genuine flexibility to depart from the highest and best use strategy underpinning the cash flows and take note of this flexibility in forming a view of value. If a significant conversion or expansion project is a foreseeable reality within the 10 year forecast period, then the value placed on the farm using the series of highest and best use cash flows may fall short of market value. For example, a company with a coastal permit for mussels may decide to set mussel lines in an area only when the farm gate price rises above the cost of farming that area. Or, a salmon farmer could decide to suspend a development project if the price falls below the harvest cost. If the valuer suspects this is the case, he may attempt to perform a real options valuation. Guidance for performing a real options valuation is presented in Appendix Five. Generally, options value is likely to be immaterial.

5.12 Check against net realisable value of the assets

This check is, in principle, the final stage of the valuation of a Marine Farm.

The Market Value of a business cannot be less than the net realisable value (exit value) of the components of the business. Thus the approach followed by a valuer is to complete the DCF valuation and estimate the net realisable value[33] of the assets of the

[32] Monte Carlo Analysis involves repeated sampling from assumed probability distributions for each of the key valuation variables.

[33] Net realisable value is the value the assets would receive in an arms length transaction, less any costs likely to be incurred in completing the transaction.

business.[34] The value of the business will then be the greater of the DCF value and the net realisable value of its assets. In some cases the assets on a marine farm will be specialised, and may only be realisable at scrap value if market conditions are such that marine farming is no longer a viable business.

[34] It may not be possible to value the Coastal Permit Space as a realisable asset without comparable transaction information. However, the presence of leasing of Coastal Permit Space and its scarcity suggests the value of Coastal Permit Space is unlikely to be zero.

6 Cross-checking and triangulation of results

Section 3.5 suggests triangulation between different valuation types. This section is intended to assist the valuer with considering the final valuation figure for valuing a marine farm.

6.1 Capitalisation of leases

It is possible to check the valuation using a method of capitalisation of net rental on lines (including rental on marine farm equipment). However, sufficient information must exist to a depth sufficient to enable informed judgements to be made.

Capitalisation of leases is common in valuation of commercial properties. The form of capitalisation is:

Value of going concern marine farm = net rental / required rate of return

Where

net rental = annual rental (1-tax rate)

Required rate of return = expected returns from investments in similar real assets. Where the required rate of return is not transparent, the valuer can look to comparators, provided the level of risk is similar.

For example, say each line on a marine farm including gear is leased at $5200 per annum for five years. The valuer may consider that a five year term deposit provides a suitable required rate of return for the lessee. If current term deposit rates are 7.5%, then the value of an 8-line farm, including coastal permit space and equipment, would be $401,600. That is [$5,200 x 8 x (1-0.30)]/0.075.

Caution must be exercised by the valuer:

- This specification assumes that the current real rental continues into perpetuity. That assumption may not be relevant to the site being valued.
- Any lease information must be from arms-length, verifiable and commercial transactions. Transactions that incorporate services or goods in-kind are not strong evidence of market rentals.
- If the site being valued is not the same as the site from which the information about rental income has been generated, the valuer has to ensure that there is sufficient information about arms-length leases of space with similar productivity characteristics to the site being valued.

- The valuation is highly sensitive to the required rate of return. The valuer needs to ensure that the rate of return reflects required market returns on leased marine space. Generally speaking, this requires a depth of information about the market value of space and the lease rates or an assumption about returns earned by similar assets. In the absence of this depth of information, a valuation on the basis of capitalisation of leases can only be roughly informative at best.
- The valuer needs to ensure that any return on the lease of equipment is unbundled from any returns from the lease of space.

6.2 Multiples

The method of multiples to provide a check on the DCF method of valuation is commonly applied in the valuation of large corporates in the context of takeover offers. The basic approach relies on the identity:

$$V = (V / X)X$$

where V is the value of the business and X is a variable, such as production, farm area or earnings. Thus if a reasonable estimate of the multiple can be obtained from information on comparable businesses or the industry, then the value of the farm in focus can be simply obtained by multiplying the estimate of the multiple by the value of X for the farm.

In some applications of the method the choice of multiple used appears to be fairly arbitrary (but nevertheless effective). For example, in aquaculture valuation practise at present, the relationships tend to be between a site's productivity (as assessed by the valuer) and value.

In other cases there is a strong theoretical basis for the use of multiples. For example, the well known Price / Earnings (P/E) ratio is a commonly used multiple to apply to an estimate of earnings and hence provide an estimate of the price of a share. Earnings is often expressed as Earnings Before Interest and Tax (EBIT) or Earnings Before Interest Tax Depreciation and Amortisation (EBITDA). It can be shown that in the case of a no growth firm, the P/E ratio is the reciprocal of the cost of capital. Hence the P/E approach is the equivalent to using data on other entities for an estimate of the cost of capital and then capitalising earnings at that rate to give an estimate of price.

6.2.1 Detailed information is needed in order to use multiples as a method of valuation

A multiples-based valuation relies on the estimate of V/X being applicable to the business in focus. Businesses may differ on a number of different dimensions. A valuer's judgment that one marine farm is similar to another requires simultaneous assessment across all those dimensions and involves tradeoffs between the different differences that may occur across those dimensions.

Using multiples to check the DCF is unlikely to be feasible or cost effective unless the valuer has fairly detailed information relating to a number of marine farms, which would enable him to judge the comparability of one farm with another. Any valuer choosing to apply the method should exercise caution as in the case of marine farms there is unlikely to be satisfactory data on which a valuer could realistically attempt such judgments.

6.2.2 Multiples might be used to ensure consistency between valuations

The Ministry will keep a record of all valuations performed and the key parameters of those valuations: location, species, production, earnings, and farm size. After a number of valuations have been performed, it will be possible to compare the implied multiples such as the EBIT: Value. Reasons for differences between values for comparable farms should be explained.

PART THREE – Market Valuation of Improvements and Coastal Permit Space

7 Introduction

This section sets out how to value the Improvements separately from the Marine Farm. Improvements are defined as follows:

> *All assets that can be transferred as part of an Established Marine Farm that is not Coastal Permit Space*

That is, Improvements comprise of Crop, Structures, Boats, Machinery and Removable Assets.

There are two reasons for estimation of the value of the Improvements. Firstly, the Crown requires an estimate of the value when offering the Improvements for sale to the Trustee (or possibly other parties)[35]. Secondly, a value for the Improvements together with a value for the Marine Farm enables the value of the Coastal Permit Space to be estimated as a residual, that is:

Market value of Coastal Permit Space =

Market Value of the Marine Farm ─ Market Value of the Improvements

7.1 Components of Improvements

The valuer should not value assets that do not form an integral part of the Marine Farm. Otherwise, the residual estimate of the value of the Coastal Permit Space would be understated. The Valuer should divide the set of improvements into the following categories:

- Crop
- Structures (including ropes, frames and sticks)

[35] It would seem reasonable to assume that the Ministry before committing to purchase would confer with the Trustee to obtain an undertaking for sale of the improvements. If not then the Crown would carry the risk of having to dispose of the improvements to other parties for use in other locations and inevitably the prices obtained would reflect exit values rather than the going concern value underlying an estimate of market value.

- Boats, Machinery and Removable Assets
- Intangible assets and current assets (only for purchase and transfer of Marine Farms under the Coastal Permit Option where these assets are judged to be transferable and valuation is required)

8 Valuing crop or stock

Definition of crop:

> *Crop is a biological asset. Crop is the sum of the products that are currently growing on site and are intended to be converted to cash once they are harvestable. Source: Property Institute of New Zealand, Professional Practice (2006)*

8.1 Market value, based on harvest date

The valuer should value crop, as with all other assets, at Market Value. It is possible that accounting information may be of some help in this task as entities complying with *IAS 41 Agriculture* would endeavour to report the crop at fair (market) value. In the early stages of the life cycle the crop value is likely to approximate cost but as maturity approaches, fair value would be expected to exceed cost. This is because as time goes on, the probability of a successful harvest and profitable returns increases.

Valuation of the value of a mussel or oyster crop might be approached in the following way:

- Form a view about the amount of crop expected in the next rotation period per line or rack (e.g. expected GWT per line or expected dozens per rack)
- Observe the stage of growth of each line (months since the seeded lines were set or spat was distributed);
- Attribute a value to each line according to the following simple rules:
  - any crop less than two thirds of the way through the rotation period (as assessed for that site) should be valued as
    (Elapsed months since seeding / rotation period) x total expected cash cost to set lines and maintain them till harvest date
  - any crop more than two thirds of the way through the rotation period should be valued as
    (Elapsed months since seeding / rotation period) x total expected net cash return from crop at time of harvest
- Sum the values to get an estimate of the crop value.

For example, assume there are eight long-lines on a mussel farm with a standard rotation period of 18 months. The lines are expected to produce 215 GWT (26.875 GWT each)

at the end of the rotation period. Seven of the lines have one month to maturity and the other line has 12 months to maturity. Say the net cash value of each GWT at harvest date is expected to be $100 and the total cost to set the lines and maintain them till harvest date equates to $80 per GWT. As the total cycle to maturity on this farm is 18 months, in the first 12 months the crop is to be valued at a portion of cost, but after that it should be valued as a portion of value. The crop value is as follows:

Figure 10 Calculating Crop Value for Coastal Permit Option

Calculating Crop Value of Four Lines		
Line number	**Months since seeding**	**Value Calculation**
1,2,3,4,5,6,7	17 out of 18 => 94%	Rule: Value at proportion of net cash revenue $100 x 26.875 x 7 x 0.94 = $17683.75
8	6 out of 18 => 33%	Rule: Value at proportion of total cost till harvest $80 x 26.875 x 0.33 = $709.50
ESTIMATED MARKET VALUE OF CROP		**$18,393.25**

For the purposes of valuing financial equivalent, it would be reasonable to assume that there will be sufficient crop on site to meet this year's annual average production level, and that crop was set at evenly spaced monthly intervals.

That is, if annual average production on a site is 215 tonnes and the rotation period is 18 months, then on average 322.5 (215 x 18/12) tonnes of crop potential will be held on site at any one time.

For simplicity, an assumption that crop value increases linearly with time can be used (as the differences are not material between a linear model and an exponential one for individual sites).

Approximately two thirds of this crop potential (322.5 x 0.66 = 215 GWT) will be less than 12 months old, and because of the linear growth assumption on average this part of the crop is six months old. This part of the crop should be valued at proportion of total cost. So, using our example above, the value of this crop is 212.85 x 6/18 x $80.

The other third of this crop potential (322.5 x 0.33 = 107.5 GWT) is older than 12 months old, and on average, given the linear growth assumption is on average as valuable as if it were 15 months old. All crop older than 12 months old should be valued at proportion of net cash revenue at harvest. So the value of this crop is 107.5 x 15/18 x $100.

In sum, the value of the crop on this site is $14,634.

9 Valuing marine farm structures and on-site improvements

9.1 Depreciated replacement cost method for coastal permit option

When undertaking a valuation of Improvements for the purposes of the Coastal Permit Option, the valuer must have regard to the nature of the assets on site. In estimating value, the valuer should have regard to all sources of information, in particular, book value and market transactions for similar items of the same condition. The primary valuation will be according to the depreciated replacement cost method set out below.

Improvements should be valued on the basis that they are in-situ (in place) and as part of the business as a going concern. It is artificial to separate the value of the physical assets from the current marine farming uses. For example, the onsite assets of a mussel farm will be made up of: anchors, warps, backbones, floats, culture rope and marine lighting (where required). Overall, farm gear depends on backbone lengths, site, exposure and general layout.

The value of assets in situ is best assessed using the Depreciated Replacement Cost method. The valuation will be performed in accordance with Property Institute of New Zealand standards. This method reflects the fact that the value of assets in a going concern reduce largely in accordance with the wearing out or consumption of benefits from use, the passage of time, or obsolescence.

> *Depreciated Replacement Cost is the Gross Replacement Cost of improvements less allowances to reflect physical deterioration, functional, or technical obsolescence and economic, or external obsolescence.*

where:

- The Gross Replacement Cost is determined as the cost of replacing assets with Modern Equivalent Assets;[36]

[36] To avoid double counting, any estimate of Gross Replacement Cost should be careful not to include the costs associated with coastal permits to erect structures.

- Allowances for deterioration are calculated using depreciation rates. This percentage varies for each asset type, but common rates for marine farms are set out below.
- Assets that are judged to be obsolete will be valued at 'exit value'.

For an estimate under the Coastal Permit Option, it may be possible for the valuer to rely on reported asset values. However, the valuer should be aware that the asset valuations in an entity's financial statement under International Financial Reporting Standards and other reporting regimes may be different from those appropriate for estimating market value. Even where an entity reports assets at fair market value, care should be taken to ensure that the valuation is recent. In any event, an estimate of the age of each asset owned by the business, and a judgement call made on the remaining useful life of the asset, is needed.

9.1.1 Worked example

Consider an oyster farm that has stakes that were bought in 2003 for $1000. To replace them now with a modern equivalent would cost $3000. They are now 4.5 years old, are still appropriate for the farm in its current use and the wear is consistent with our recommended depreciation rate. The asset is reported in the books of the farm business at $733 representing historical cost less four years of accumulated depreciation. Given an age of 4.5 years and current new replacement cost of $3000 the estimate of DRC would be $2100. That is, $3000 x [(15-4.5)/15].

9.1.2 Depreciation rates for physical assets associated with Marine Farms

Depreciation is calculated using straight-line rates to write off the cost of depreciable assets over their expected useful lives.

For an estimate under the Coastal Permit Option, the valuer may elect to rely on the accumulated depreciation for the assets on the farm's asset register. Or, the valuer may refer to useful lives and depreciation rates for assets which have been sourced from the IRD. This information is appropriate in most instances for estimation of the useful life of marine farm infrastructure. However, we consider that in some cases the IRD rates are either too optimistic or pessimistic. The table below sets out the IRD useful life assumptions and implied rates, with our recommended rates alongside.

Figure 11 Useful life

Useful Lives of Marine Farm Assets				
	IRD Rates		Recommended Rates	
	Years of Life	Straight Line Depreciation Rate	Years of Life	Straight Line Depreciation Rate

Shellfish nets	2.5	40%	4	25%
Shellfish ropes	2.5	40%	4	25%
Shellfish stakes, posts and wire	2.5	40%	15	6%
Oyster bags / purses	No published rates		5-7	17%
Machinery on site such as feeders and sorters (fishing equipment default class)	15	6.5%	3-5	26%
Finfish farm nets	2.5	40%	3-5	26%
Finfish farm pens and cages (fishing equipment default class)	15	6.5%	15	6.5%
Other marine farm assets (fishing equipment default class)	15	6.5%	15	6.5%
Boats, barges	14	7% (not steel hulled) 8.5% (steel hulled)	30	3.33%
Shore based facilities	40	4%	30	3.33%

Source: Inland Revenue, LECG research

9.2 Valuation of assets using rule of thumb for Financial Equivalent Option

If the valuation is for the Financial Equivalent Option, the valuer must have regard to the generic assumptions provided by the Ministry in relation to the presence of site improvements, and their age and condition.

The following rules of thumb shall be used to value site improvements:

- All assets newer than five years old shall be valued at 75% of the new replacement cost of that asset;
- All assets older than five years old shall be valued at 50% of the new replacement cost of that asset, unless judged to be deteroriating or obsolete in which case they are to be valued at zero.

10 Valuing boats, machinery and removable assets

10.1 Market value based on observed transactions for similar assets

Assets that are not attached to the site, but that are nevertheless included in the set of assets of the Marine Farm, should be valued at Market Value based on observed transactions for similar assets.

Any assets that are specialised to such an extent that no open market for them exists (such as specialised processing equipment), the Optimised Depreciated Replacement Cost method set out above can also be used.

11 Valuing intangible assets and current assets

Intangible assets comprise of identifiable intangible assets and goodwill. Identifiable intangible assets are assets such as special permits, patents, and brands. Goodwill represents such features as entity knowledge, special relationships forged with customers and factor suppliers, and any natural monopoly advantages. The Crown, or any other potential purchaser, would not pay for most intangibles on a Marine Farm because intangibles often cannot be transferred to a new owner. For example, management knowledge, while it may have been costly to acquire, is likely to be largely public and, in any case, prospective purchasers in the same business are likely to have the same knowledge. Furthermore, knowledge, along with special relationships is likely to depreciate fairly rapidly. Such knowledge is therefore likely to have zero value in exchange. Therefore in most instances, intangibles will not enter the estimation of the market value of the Improvements.

Similarly it should not enter the estimation of the cash flows but, as a practical valuation matter, if the valuer relies on past performance data to forecast the future cash flows, the forecasts must appropriately discount for the contribution of personal goodwill to that past performance.

Should the Ministry require a valuation of an intangible asset for any reason, a specialist valuer is likely to be required.

Similarly, the Crown, or any other potential purchaser is likely to exclude Current Assets from the purchase agreement. (For example, this way, the Crown would avoid the risk of bad debts in relation to receivables). If Current Assets are included, their market value would generally be well approximated by book value although receivables would need to be reviewed to test the adequacy of the allowance for bad debts.

Current assets should be included as Improvements only if they have been included in the cash flow forecasts. Current assets are assets such as cash, receivables, prepayments and short term investments which would in the ordinary course of the entity's operations be consumed or converted into cash within twelve months after the end of the last reporting period of the entity. The book value of these assets should thus provide a reasonable estimate of market value.

12 Market Valuation of Coastal Permit Space

12.1 Residual value

As noted in previous chapters, the value of the Coastal Permit Space is to be estimated as a residual, that is:

Market value of Coastal Permit Space =

Market Value of the Marine Farm ─ Market Value of the Improvements

12.2 Valuing bare space

Coastal Permit Space comes in two types – utilised space and bare space. Where bare space is to be valued, it is important that the valuation is conducted using the same basis as for utilised space. The sources of information and the valuation techniques are the same.

12.2.1 Transactions data

The valuer is likely to find that transaction details relating to bare Coastal Permit Space is less easily found than transaction details for utilised space.

12.2.2 DCF model of notional farm

Applying the DCF model requires modelling of a notional farm which is developed in the site's highest and best use with hypothetical improvements. The valuer should employ the same methodology as has been described above for an actual farm, aside from two key differences. In forming a view on value for a notional farm:

- the valuer should allow for the cost of construction and delay in cash inflows to accommodate a construction phase before commencement of operations; and
- the valuer may be more uncertain about the suitability of the space for marine farming because operating information for the site is unavailable. Hence the valuer should treat the resulting estimate of the value of a bare permit as being less certain than for the value of an actual farm. Of course, if the bare space is in close proximity to an actual farm engaged in the same activity as assumed for the notional farm and the valuer has knowledge of the results of the farm's operations, the valuer's opinion may be less uncertain.

12.3 Cross-checking and triangulating valuations of coastal permit space

12.3.1 Capitalisation of leases

Some farmers enter into leases where an annual rental is paid to the site owner in exchange for exclusive occupation and use of marine space. In order to apply a triangulation method based on commercial lease rates, the valuer would assess the rental income earned by the site owner, taking care to exclude any rental on equipment.

The valuer would capitalise the lease payments for the space using the method described in section 6.1. A suitable capitalisation rate might be the returns received on similar assets, or the market rate of interest for a term deposit of the same term as the lease.

The valuer must exercise caution, taking into account the cautions stated in section 6.1.

12.3.2 Tender prices

The valuer could refer to tender prices received by Regional Councils under section 165E of the Resource Management Act 1991 for authorisations if this information is available and the valuer has made suitable adjustments.[37] Caution is advised.

12.3.3 Not recommended

Two methods are not recommended as cross-checks:

- Cost-based valuation is not recommended (ie, the costs that were incurred in acquiring the coastal permits through the resource consent process). We recommend against this approach because the procedures for granting Coastal Permits do not attempt to set the costs of a permit at the commercial value of the space they relate to. Therefore the estimate of value based on cost might actually outweigh the value of space in the area at the date of the valuation.[38]

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[37] As tenders are only applicable to new space, there is a high likelihood that no tender prices will be available to the valuer, as at the time of writing, no council was actively creating a new AMA. The only AMAs considered possible in the next few years would be most likely to come about as a result of private plan changes. Any cross-check using tender prices must have followed an open-market tender process. Further, the valuer will need to make an adjustment for the fact that tenders are for authorisations, not for coastal permits. The prices received will therefore be less than the true value of the coastal permits and will need to be adjusted by the valuer to reflect this fact.

[38] Cost-based measurement is acceptable for coastal permits in financial reporting. Both Sanford Limited and Aotearoa Fisheries Limited value their Marine Farming permits at cost in their 2006 Annual Reports. Financial reporting standards allow (and sometimes require) an entity to revalue

- Ratings-based valuation is not recommended. Quotable Value Limited performed a number of valuations of oyster and mussel farm leases in the Bay of Plenty and Marlborough regions for ratings purposes. However, this is not a useful source of information for three reasons. Firstly, the information set is dated because the last valuation date was May 2005. Secondly, Quotable Value Limited's valuation method does not always reflect the economic uses of the site (in some cases, the leases are valued on the basis of the value of the adjoining land) and Quotable Value Limited relies heavily on word of mouth reports of prices paid in transactions of leases and licenses. Lastly, the information is unlikely to be updated before 2013: in the recent case of Marlborough District Council v Valuer General[39] the Court found that s 122(1) of the Resource Management Act 1991 prevented coastal permit space from being or becoming rateable.

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assets at Market Value if there is an active market for the asset, but this is not the case with Coastal Permits at present.

[39] *Marlborough District Council v Valuer General*, High Court Wellington, 3 September 2007, CIV 2006-485-933.

PART FOUR – Estimation of the Financial Equivalent and conducting the Average Value Checks

13 Estimating Financial Equivalent

13.1 What is Financial Equivalent

Financial Equivalent, in respect of a region or harbour, is the sum of money the Crown could pay to the Trustee on or after 1 January 2013 in order to satisfy its then remaining obligation under the Act in respect of that region or harbour. Financial Equivalent is equal to 20% of the value of space in the Pre-Commencement Space of the region or harbour (equal to the area of the Pre-Commencement Space less the total area of space satisfied by transfers of real settlement assets). For example, if in respect of a particular region or harbour, the area of the Pre-Commencement Space is 600 hectares and there have been allocations of authorisations of new space totalling 100 hectares and transfers of coastal permit space totalling 300 hectares, then the Financial Equivalent would be equal to the value of 200 hectares of space in the Pre-Commencement Space of the region or harbour. Thus, if it had been established that the value of the Pre-Commencement Space was $4.2m, that is, $7000 per hectare, then the Financial Equivalent would be $1.4m (= 200 hectares x $7000 per hectare).

13.2 Estimating the value of Coastal Permit Space for the Financial Equivalent Option using standardised assumptions

When estimating the value of Coastal Permit Space for the Financial Equivalent Option, the methodologies are the same as those set out in previous chapters. For an estimate for the Financial Equivalent Option, the valuation assumptions necessary for performing a DCF valuation may have been gathered using a Delphi process, or may be otherwise standardised.

The valuation should attempt to triangulate between three methods, as before: first, DCF, second, transactions values, third multiples (e.g. an EBITDA multiple or production to value). Multiples and transactions values should be applied with caution and should only drive a valuation where sufficient information exists to make an informed judgement.

13.3 Using reference sites as the basis for Financial Equivalent in some regions and harbours

The per hectare value of the Pre-Commencement Space in a region or harbour could, in principle, be established by valuing each site in the Pre-Commencement Space, adding the values together and dividing by the total area of the Pre-Commencement Space. However, the cost of this method would be prohibitive in some regions or harbours, particularly those where there are numerous farms.

In the regions for which explicit estimation is not financially feasible, we recommend that the per-hectare value of each Pre-Commencement Space instead be estimated by extrapolation from the value of a small number of reference sites. i.e. the Pre-Commencement sites in each region would be broken down into clusters of sites, based on species, and a reference site identified for each cluster. The reference site would then be valued.

13.4 Identification of the reference sites

It will be for the Ministry to determine the balance between internal and external involvement in the identification of reference sites and the degree of formal structure in the process of identifying reference sites and relative values. A suggested method for drawing on the knowledge of external experts, the Delphi method, is set out in section 13.6.

The process for identifying reference sites assumes, at the minimum, that basic information about all the sites in a region is available. This would include for each site the species farmed, the farmed hectares, the permitted hectares, and whether or not they are Pre-Commencement Space sites.

The reference sites can be identified from a three step process. The first step would be to break down the statutory regions and harbours into smaller, geographically defined areas. For example, those involved in selecting reference sites may elect to divide the Pelorus Sound region into five areas: Central Pelorus East, Central Pelorus West, Inner Pelorus, Kenepuru and Outer Pelorus. The Waikato region could be broken down into Wilson's Bay, other Coromandel sites and Kawhia.

The second step would be to break down these areas into clusters based on current use. For example, in Central Pelorus East (principally Crail Bay and Beatrix Bay in Pelorus Sound) there are 121 marine farms, around 65 of which are included in the definition of Pre-Commencement Space (as at 16 July 2007).[40] Thus selection of the clusters would

[40] Indicative analysis based on Aquaculture Settlements Register dated 16 July 2007.

initially result in 65 farms categorised into three clusters: mussel farms, salmon farms and pacific oyster farms.

The third and final step is to select a reference site for each cluster.

13.5 Applying relativities between sites

The values for other sites in the cluster would be estimated by taking the per hectare value of the reference site and the panel's or the Ministry's determinations about relative value. For example, if the reference site has value of $100,000 per hectare and a site nearby is judged to be 80% as valuable as the reference site, then the value of that site would be recorded to be $80,000 per hectare.

The values of the sites in each cluster would then be added together to give the value of the Pre-Commencement Space in the area. Then, dividing by the total area gives the weighted average value-per-hectare for the area. The example below illustrates this process for a region with three 'clusters'.

Estimating Financial Equivalent, Calculating Weighted Average Value Per Hectare

	Bay	Farm types in Pre-Commencement Space	Value per hectare of Coastal Permit Space in the cluster	Number of hectares in Pre-Commencement Space	Total Value of Pre-Commencement Space in the cluster
Cluster 1	Bay 1	14 mussel farms	$80,000	21.0	$1,680,000
Cluster 2	Bay 1	1 Salmon farm	$100,000	2.0	$200,000
Cluster 3	Bay 2 and 3	32 mussel farms	$30,000	64.2	$1,926,000
				87.2	$3,806,000
			WEIGHTED VALUE PER HECTARE		$43,647 per hectare

The Financial Equivalent for the Region or Harbour would then be calculated by applying the per hectare value for the Pre-Commencement Space to the notional number of hectares of space remaining to be transferred to satisfy the Crown's obligation under the Act, as illustrated in the example at section 13.1 above. The Ministry would then calculate the Financial Equivalent obligation as follows:

Estimating Financial Equivalent, Calculating Remaining Obligation	
Number of hectares of obligation for the region	87.2 x 20% = 17.44 hectares
***Less* Coastal permits and authorisations transferred to the Trustee**	4.2 hectares
***Equals* Remaining obligation**	13.24 hectares
Financial Equivalent	13.24 x $43,647 = $577,886

A similar method could be applied in conducting the average value checks under the Coastal Permit Option. The use of such a method is consistent with the requirement of the Act (s27(4) that the processes and methods used be cost effective for the Crown.

13.5.1 Relative site productivity is a good proxy for the relative value of coastal permit space

Relative site productivity tends to be the best proxy for relative value of coastal permit space, but other factors do come into play, such as distance from the closest wharf.

If the Ministry wishes to gain a proxy for relative value, an index ranking average annual production levels (observed or estimated, assuming current use for improved farms and optimal use for unimproved farms) against each other may be used. This would allow the value for the reference site to be attributed to other sites in the cluster on the basis of relationships between productivity and value. The availability of productivity data will determine whether this is possible.

13.5.2 Draw on experts' knowledge

It is our view that the identification of reference sites and relative values would benefit from consultation with the various parties engaged in aquaculture activities in the local area. This is summed up in a quote from one of our interviews:

> *With the knowledge farmers have of each other's performance the productive potential of farms is quite well known within individual regions. Sellers know what their farm's productive potential is and would have an idea of others' values.*

There are currently no reliable models publicly available that would allow prediction of differences in yields for the relevant shellfish species on the basis of the production fundamentals, such as chlorophyll a and so on. The Cawthron Institute is currently developing a kind of triangulation approach that combines a number of approaches for each of the three species, mussels, oysters and scallops. Even if such prediction models were currently available, the data collection exercise to inform the models would be

huge because of the number of unique data points needed. It is not simply a matter of taking one-time readings of each of the relevant variables. There is considerable variation in the biological and oceanographic parameters across days, months and seasons, so representative data would need to be extensive and thus very costly to obtain. In addition, any such model would be experimental and unproven and has potential to be challenged.

Much of the information required to assess productivity potential is currently held only by people who own farms or are in the market to buy them. Our experience in requesting data from such sources has been mixed - people are either very open to sharing information or utterly closed. We recognise that in some cases productivity data is highly sensitive commercial information and may be the cause for tension in the Settlement process. For example, in Hawke's Bay the settlement beneficiaries are the same as the owners of the existing sites. However, even in such cases the parties involved may not actually have the relevant information.

There is a risk in relying on competitive businesses to provide productivity information, but unfortunately, this may be the only option. This opens two possible risks:

- reliance on local producers and farmers creates potential to distort the valuation inputs; and
- there is no ongoing obligation or incentive to share the information (say if the disclosures were challenged).

Equally, however, there would be concern at relying only on the opinion of one Ministry analyst or other expert to identify the productivity characteristics of each site. One person's view is likely to be open to challenge whereas the views of many are less likely to be challenged.

We outline a method below for involving a group of individuals in an independent assessment of productivity and relative value. Because of our concerns about potential bias and gaming, this group will include non-local and independent experts alongside local farmers and processors. Each individual would bring valuable unique knowledge or perspective about the industry.

13.6 Independent assessment of productivity and valuation inputs using the Delphi method

13.6.1 Delphi method

The Delphi method is a disciplined process that is used to tap into the wisdom and relevant expertise of a group of individuals. The method involves a systematic interactive method for obtaining and aggregating forecasts from a panel of independent experts. The process works through a number of cycles, managed by a facilitator, who manages the flow and consolidation of information. The process involves carefully selecting experts to answer questionnaires in two or more rounds. The experts answer

the questions individually. By using a remote and anonymous approach, it avoids the problems of groupthink and personality conflict that can lead to poor group decision making.

In the Maori Commercial Aquaculture Treaty Settlement context the process involves:

- assembling a balanced panel of experts from relevant contributory sectors,
- supplying them with an initial set of information, then
- asking them to integrate that information with their own experience to derive a set of indicative productivity statistics and cluster groups for Pre Commencement Sites, then
- asking them to identify reference sites,
- asking them to identify relative values between sites, based on all factors that affect value (e.g. depth, location, coastal permit conditions etc); and
- asking them to identify relevant assumptions for the valuation of those sites.

Early iterations would usually involve confirming or re-setting the Ministry's existing information sets, allowing all panel members to operate from a consistent information base. Independent point estimates of productivity for each site in the region and relative value rankings may be elicited from individual panel members, and aggregated through assessment measures of median and spread, to form final estimates of productivity and relative value.

After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments. Thus, participants are encouraged to revise their earlier answers in the light of the replies of other members of the group. It is expected that during this process the range of the answers will decrease and the group will converge towards the "correct" answer. Finally, the process is stopped after a pre-defined stop criterion (for example, number of rounds, achievement of consensus, or stability of results) and the mean or median scores of the final rounds determine the results.

It should be stressed that the outcome of a Delphi sequence reflects opinion. The results of the sequence are only as valid as the opinions of the experts who made up the panel. The panel viewpoint is summarised statistically rather than in terms of a majority vote.

Possible disadvantages of the Delphi method are the following:

- Future developments in an industry are not always predicted correctly by iterative consensus of experts, but instead perhaps by unconventional thinking of amateur outsiders
- The simplification urge: Experts tend to judge the future of events in isolation from other developments. A holistic view of future events where change has had a

pervasive influence cannot be visualised easily. At this point cross-impact analysis might be of some help.

- Illusory expertise: Some of the experts may be poor forecasters. The expert tends to be a specialist and may view the forecast in a setting which is not the most appropriate one.
- Sloppy execution: Execution of the Delphi by an expert facilitator is crucial.
- Format bias: It should be recognised that the format of the questionnaire may be unsuitable for some potential participants.
- Manipulation: The responses can be altered by the monitors in the hope of moving the next round responses in a desired direction.

13.6.2 Rules for forming the expert group

The literature suggests that the following requirements should be met.

- Intellectual diversity: Different opinions and perspectives on the problem (but an ability to respond to the questions being asked);
- Independence: Freedom from the tendency to want to agree automatically with others;
- Decentralisation with Aggregation: Individual access to different, specialised knowledge;
- Clarity in the research question: People need to be given a problem with a discrete or quantifiable set of possible answers from which to choose;
- Non-bias: Participants must understand the problem, be diverse in their perspectives, independent of groupthink tendencies and each able to bring a bit of unique knowledge to the problem. Importantly, they must not be allowed to 'vote' on issues where they have a conflict of interest (e.g. each person can give a perspective on value at others' sites but not on their own);
- Incentives: There needs to be some incentive for people to participate.

13.7 Delphi facilitation in practice

13.7.1 Articulate the problem and plan the method

We recommend that the Ministry take Expressions of Interest for specialist facilitators who would articulate the research question and plan the research method.

13.7.2 A qualified group of people

A starting point is to identify people qualified to participate in the experiment for each harbour or region. The group should include individuals who were reasonably able to form a view on site productivity and value, for example:

- Marine farm owners from the region (but who would not assess their own site)
- Marine farm owners from other regions
- Staff from the Cawthron Institute and NIWA
- Others who might be able to provide a perspective on value or productivity, such as suppliers of marine farming equipment, exporters of aquaculture products, wholesalers of aquaculture products, those who lend to or insure marine farm(ers), valuers.

We can provide a list of names of individuals we have spoken to or met with in connection with this assignment who may be suitable participants in a Delphi process.

13.7.3 Example of desired outcome

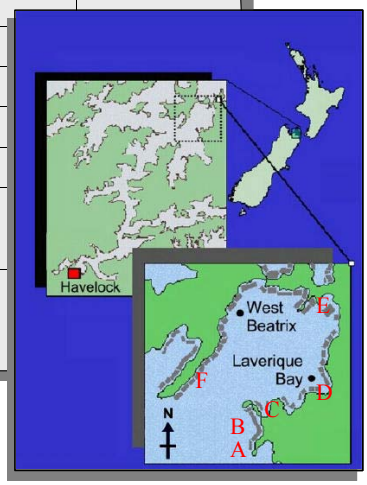
For example, if a group were established to assess the Pre-Commencement sites in Central Pelorus East (Crail Bay and Beatrix Bay) they would be given a card setting out key known parameters by the facilitator, and a map of the region (Figure 12).

Figure 12 Example of the information card and map the participants would be given (Data is for illustrative purposes only)

Information Card for sites in Central Pelorus East

SAMPLE ONLY

Map reference	Size (ha)	Restrictions in Coastal Permit.	Temperature range at surface over a calendar year (oC)	Depth (metres)	Salinity	Etc…
Site A	4	None	12 -18	3	Unknown	
Site B	5	None	12 - 20	4	Unknown	
Site C	13	None	10 - 18	7	Unknown	
Site D	23	None	8 - 15	8	Unknown	
Site E	15	Mussels only	12 - 15	2	Unknown	
Site F	2	Spat catching only	13 - 18	6	Unknown	



The group participants would then be asked over successive rounds to:

- confirm or add to the known data
- form clusters of sites based on similar characteristics
- confirm the cluster groups or suggest alternative clusters
- on the basis of this, choose a reference site
- estimate the relative value of each of the sites, under highest and best use, given all the possible influencers of value (i.e. depth, location, vulnerability to biotoxins etc)

- nominate key valuation statistics for reference sites (such as farm gate price, production, operating costs, infrastructure values), if required.

Figure 13 shows the result of the Delphi ranking process. Below it, Figure 14 shows an example of the group's assessment of key valuation parameters.

Figure 13 Example of result of Delphi Process – Relative values of sites in a cluster group

Site	Relative Value (Base unit 100)	Conclusion
Site A	105	
Site B	100	Use as reference site
Site C	95	
Site D	90	
Site E	100	
Site F	35	

Figure 14 Valuation statistics for the reference site, Site B

Site B – mussel farm	(Illustrative only)
Production (annual average)	7.5 kg per meter of line per rotation cycle of 18 months = 5 kg per annum
Meters of line per hectare under Highest and Best Use	4,650 meters
Production per hectare per annum (GWT)	23 GWT
Farm gate price ($ per GWT)	$683 per GWT
Spat and seeding cost per meter, annual average	$1.00 per meter
Maintenance (includes labour and transport) cost per GWT, annual average	$1,000 per line
Harvest cost per GWT, annual average	$100 per GWT
Monitoring, consent conditions and water testing, annual average	$2,000
New infrastructure replacement cost	$15,000 per line
Age of infrastructure on reference site	3 years

If using this information, the value of the Coastal Permit Space for the reference site was $80,000 per hectare, for example, the value of the cluster would be calculated as follows:

Figure 15 Calculating the value of Coastal Permit Space in a cluster

Site	Relative Value (Base unit 100)	Value per hectare
Site A	105	84,000
Site B (reference site)	100	80,000
Site C	95	76,000
Site D	90	72,000
Site E	100	80,000
Site F	75	60,000

14 Average value checks

14.1 What are the average value checks

The average value checks form part of the process for implementing the Coastal Permits Option. There are two types of average value checks:

- Ongoing checks: the Act (s27(4)(d)) requires that the process of valuing sites targeted for purchase should include assessment of the average market value of all the sites in the part of the CMA concerned. This is a practical mechanism in the Act to ensure that the Crown's valuation process takes into account regional variations in value. It will also help the Crown with the performance of the obligation in s27(4).
- Final check: The Act (s27(4)) requires that the Crown must use its best endeavours to ensure that on 31 December 2014 the average value of all the permits transferred to the Trustee is not less than the average value of all the permits in the region or harbour. This requirement protects against the permits transferred being less valuable than the other permits in the region or harbour. This is a protection mechanism in the Act to ensure that the space transferred to the Trustee is on the whole not less valuable than other space in the region.

14.2 Performing the average value checks

As with estimation of the Financial Equivalent, the cost of conducting the average value checks by considering the values of all the sites would be prohibitive. In fact, for the final check there would be even more sites to value than in the case of the Financial

Equivalent as the final check is based on all the sites in the region or harbour and not just those in the Pre-Commencement Space.

We recommend that the checks be performed using the method of extrapolation from the values of a small number of reference sites as also recommended for estimation of Financial Equivalent (section 13.4). However, while the starting set of sites for estimation of Financial Equivalent is all the sites in the Pre Commencement Space, the starting set of sites for the ongoing check would be the set of sites in the "CMA concerned" and the starting set for the final check would be all the sites in the region or harbour. In order to contain costs, there should be careful planning of the estimation of Financial Equivalent and the conduct of the average value check so as to ensure maximum overlap across the three tasks. For example, the choice of reference sites for the ongoing checks should, as far as possible, be made so that the same sites, with updated relevant information, can be used in the estimation of Financial Equivalent and the conduct of the final check.

Appendix 1: Information checklist

Core items of information that would generally be required for any valuation include:

- Details about the coastal permits
  - area allowed vs. current area farmed
  - current species types farmed
  - restrictions on the use of the site
- Details about rotation length (that is time between stocking and harvest)
- Details about production infrastructure
  - For mussels and mussel spat, number of lines supported, length of backline, length of crop-rope on each backline
  - For oysters, number of baskets or number of sticks
  - For scallop spat, number of lines supported, number of catchers on each
- Productivity information (annual averages for more than three years), in terms of either:
  - For mussels, Greenweight kg harvested per meter of rope
  - For spat, ratio between seeded line and length of catch rope
  - For oysters in shallow estuarine areas, dozen oysters per hectare farmed
  - For oysters farmed using deep water cages, dozen oysters per month per M^3 of cage utilised
  - For fish farmers, live mass (kg) per M^3 of farm
  - Or other production figures.

For a Marine Farm valued under the Coastal Permit Option, core items of information that would generally be required for any valuation include:

- The information set out above; and
- Current year financial statements, ideally completed to the most recent month-end and historic financial statements, preferably for at least 3-5 years
  - make up of cost of sales and gross profit contribution
  - historic trends in margins

  - fixed asset register
  - details of capital expenditure requirements
  - details of any non-arms' length transactions
  - details of any non-recurring items of income or expenditure
- Details about any processing and manufacturing facilities owned by the business, or key relationships with processors and manufacturers
- Strategic options for the farm, for instance:
  - opportunities for investment in new species or other opportunities for growth
  - major sales contracts
  - reliance on major customers and potential gains and losses of customers
  - geographic considerations
- Information from farm managers including
  - labour costs and the degree of flexibility available
  - product sourcing or supply arrangements, including distribution agreements, etc
  - copies of key legal documents, including property leases, financing terms, intellectual property ownership, employment contracts and such like
  - details of any actual, pending or threatened litigation
  - comparison of actual historic results against prior year forecasts
  - current year budget and comparison of actual year to date results against budget
  - ownership details and capital structure

Appendix 2: Profile of pre-commencement space

The table below shows the Settlement Register as at July 16 2007. The obligation amounts are not fixed in time, as pre-moratorium permit applications continue to be processed and added to the Pre-Commencement Space area. The estimated number of sites in the pre-commencement space in those regions and harbours is also listed.

Settlement Register as at 16 July 2007				
Regional Council	**Harbour Name**	**Pre-Commencement Space Area (ha)**	**20% Allocation (ha)**	**Number of Sites in Pre-Commencement Space***
		North Island - Harbours		
Bay of Plenty Regional Council	Ohiwa	2.02	0.40	1
Northland Regional Council	Parengarenga	56.80	11.36	12
Northland Regional Council	Houhora	34.99	7.00	8
Northland Regional Council	Rangaunu	22.16	4.43	4
Northland Regional Council	Whangaroa	8.00	1.60	1
Northland Regional Council	Te Puna Inlet (BOI)	3.80	0.76	1
Northland Regional Council	Waikare Inlet (BOI)	11.61	2.32	12
Northland Regional Council	Kaipara	20.79	4.16	6

Settlement Register as at 16 July 2007				
Regional Council	**Harbour Name**	**Pre-Commencement Space Area (ha)**	**20% Allocation (ha)**	**Number of Sites in Pre-Commencement Space***
Waikato Regional Council	Aotea & Kawhia - Kawhia	2.82	0.56	1
Marlborough Sounds - Harbours				
Marlborough District Council	Pelorus Sound	1,107.96	221.59	335
Marlborough District Council	Queen Charlotte Sound (northern ent)	9.30	1.86	3
Marlborough District Council	Queen Charlotte South (E & W ent)	64.92	12.98	13
Marlborough District Council	Croisilles Harbour	83.44	16.69	24
Marlborough District Council	Admiralty Bay	72.25	14.45	20
Marlborough District Council	Port Gore	58.19	11.64	10
Marlborough District Council	Port Underwood	72.56	14.51	30
Total - Harbours		**1,631.60**	**326.32**	**481**
Coastal Settlement Obligation (Interim)				
Auckland Regional Council		21.00	4.20	9
Bay of Plenty Regional Council		4.00	0.80	1

Settlement Register as at 16 July 2007				
Regional Council	**Harbour Name**	**Pre-Commencement Space Area (ha)**	**20% Allocation (ha)**	**Number of Sites in Pre-Commencement Space***
Chatham Island Regional Council		8.00	1.60	1
Canterbury Regional Council		171.61	34.32	15
Hawke's Bay Regional Council		2,465.00	493.00	1
Marlborough District Council		96.71	19.34	22
Northland Regional Council		2.50	0.50	2
Southland Regional Council		188.38	37.68	21
Tasman District Council		5,292.15	1,058.43	20
Wellington Regional Council		3.09	0.62	2
Waikato Regional Council		730.20	146.04	38
West Coast Regional Council		45.60	9.12	1
Total - Regions		**9,028.24**	**1,805.65**	**133**
Total		**10,659.84**	**2,131.97**	**614**

*This count could include non-operational sites, sites that have coastal permits but which do not have Fisheries permits, lapsed, surrendered or expired permits and merged sites.

Appendix 3: The wider valuation picture

This section draws a picture of the assets that will be valued in 2008 - 2014.

National overview

The settlement is for Pre-Commencement Space, on a harbour and region basis. The number of hectares in the Pre-Commencement Space in each identified harbour and region is set out in the table in Appendix 2. The table shows that there are around 614 aquaculture sites included in the Pre-Commencement Space (as at June 2007).[41]

Marlborough, Waikato, Tasman and Northland are the main areas for the settlement. The first three areas are predominantly mussel-growing areas, and they dominate the mussel industry in New Zealand. Therefore, valuation of mussel farms will be the most common valuation exercise. Northland is predominantly an oyster growing area, so valuation of oyster farms will be common for that region. Spat catching sites exist in Marlborough and Tasman, and salmon farms exist in Marlborough.

The number of aquaculture sites in each location can be determined from regional councils' Coastal Plans, Ministry of Fisheries information such as the FishServe register and from information available from operators and others who have local knowledge. Using this information and other sources, the Ministry will build a detailed profile of each region and harbour in which the Crown has a settlement obligation by 1 January 2013. There is considerable variation in productivity and species between the regions.

The table overleaf sets out a national-level estimate of the types of aquaculture sites and their hectarage and revenue, in mid-2007. The definition of aquaculture is included in the glossary. The table shows that in total, there are around 1166 aquaculture sites in coastal marine areas in New Zealand just over half of which are in the Pre-Commencement Space. The major aquaculture species are greenshell[42] mussels, Chinook salmon[43] and pacific oysters[44]. Some farms cultivate more than one species or mix spat catching or spat refridgeration with other uses.

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[41] The estimate of Financial Equivalent relates to Pre-Commencement Space, but the average value check relates to all space in the CMA concerned.

[42] *Perna canaliculus.* Greenshell Mussels is a trademark. Also known as Green-lipped mussels.

[43] *Oncorynchus tshawytscha.* King salmon is a trademark. Also known as Chinook salmon.

Figure 16 Profile of Marine Farms in New Zealand

Profile of Marine Farms in New Zealand, estimates				
Aquaculture Activity[45]	**Total number of marine farms (2007)**	**Hectares of Marine Farm**	**Total export revenue from farmed product (FY 2006 FOB) ($NZD)**	**Estimated domestic revenue (FY 2006) ($NZD)**
Mussels	645*	4747*	$181.7m***	$43m*
Salmon	7**[46]	66**	$35.2m**	$43.5m**
Oysters	230*	750*	$14.0m****	$11.9m****
Other[47]	18**	2022**	Negligible	$1m*
Total	1166			

*** New Zealand Aquaculture Council Annual Report 2006-07**
**** Estimated by LECG, based on Ministry of Fisheries FishServe Register and Settlement Register and other sources**
***** Seafood Industry Council Export Statistics, 2006**
****** Investment New Zealand, *Aquaculture In New Zealand Market Intelligence Report* PricewaterhouseCoopers, 2006**

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[44] *Crassosstrea gigas*. Pacific oysters are also known as Japanese oysters.

[45] Aquaculture Activities as defined by the Act. The Act excludes paua farms, which are land-based and the scallop fishery, which is a capture fishery. Mussel spat catching and oyster spat catching qualifies under the definition of Aquaculture Activities if the taking of spat involves the occupation of a coastal marine area using fixed facilities and so on, such that it is possible to distinguish between what is farmed and what is naturally occurring in the region.

[46] In addition, there are 12 hatcheries and freshwater sites associated with salmon farming, which do not qualify in the definition of Aquaculture Activities in the Act.

[47] Primarily mussel spat catching and scallop spat catching.

Industry in a state of change

At present, the aquaculture industry in New Zealand is dominated by high-volume, high quality but moderate-value products such as greenshell mussels and pacific oysters.

In the past year or so with the high dollar the mussel farming industry has found it difficult to achieve a reasonable rate of return. Oyster and salmon industries have fared better. Although New Zealand is the only country where greenshell mussels are produced on a large scale, they are a commodity product with high non-functional basis for demand: cultural values are high in product consumption. This explains difficulties in persuading European consumers to substitute greenshell mussels with smaller blue mussels. Low returns from farm space of existing mussel aquaculture, combined with regulatory constraints on expanding aquaculture farm space, means that the industry's focus is on attempting to improve the return per unit of farm space. While it is indeed possible that some incremental gains in production efficiency may be achieved in mussel aquaculture, a greater opportunity lies in converting some of the existing space to higher value aquaculture species, particularly farmed fish.

However, while conversion to farmed fish is profitable, the rate of conversion of existing farms has been slow. This results from a number of factors, such as:

- an unsupportive institutional environment (e.g. time, expense and risk in obtaining resource consents);
- fish farming requires a higher level of management and husbandry than mussel farming;
- higher ongoing input costs such as feed;
- higher perceived risk (the industry has seen failures through disease, sub-optimal stocking rates, cage fouling and so on);
- lack of suitable space in existing AMA areas;
- a large number of owner-operators who lack resources to pay for the conversion.

There is a strong trend towards agglomeration in the aquaculture industry. Larger companies are increasingly looking to vertically integrate with farmers (either through purchase of farms, or through long term supply contracts) to create economies of scale. Increasingly, it is not possible to generate reasonable rates of return through farming alone. Instead, reasonable returns are only possible where the strategy includes export marketing of value-added products. The industry is increasingly seeking to capitalise on the 'clean green' and 'no additives' marketing message.

In summary, direct producers appear currently to be generating less than reasonable cash returns (in 2007). Moderate returns are being earned by producing and exporting value-added products, but this is highly dependent on the exchange rate. Observers may conclude on the basis of these low returns that the value of space ought to be low.

However, this overlooks the fact that strategic potential to improve productivity or change the site to an alternative use may add value.

Industry highly vulnerable to variation in exchange rates

New Zealand aquaculture is heavily dependent on export revenues. For example, in 2004, the split between export and domestic consumption for the three major species grown in New Zealand was as follows:

Split between exported and domestic consumption (by value), 2004

	Est. % exported (by value)	Est. % consumed domestically (by value)
Greenshell Mussels	78%	22%
King Salmon	44%	56%
Pacific Oysters	54%	46%

Source: NZ Aquaculture Strategy, based on data from NZ Mussel Farming Association.

The table illustrates that the returns earned by all participants in the aquaculture industry are highly dependent on exchange rates, the opportunities for selling product in New Zealand without reaching saturation and the export destination.

The key export markets for New Zealand's aquaculture products are Japan, the United States, the European Union and Australia. These export markets are similar to those of New Zealand's agricultural sector. The contract prices for aquaculture products tend to be set in US dollars for the United States and Asian markets, in Australian dollars for the Australian market and in Euro for European buyers.

Export prices for mussels are significantly lower than domestic prices (export prices were running at about 65% of local prices in 2007).[48] This is perhaps in due to the fact that mussels tend to be sold as a commodity product. The export market for mussels and oysters is dominated by large volume exporters such as Sanford and Sealord and some forward contracting is taking place. There is, therefore, a buffer between the prevailing exchange rate and negotiated supply contracts with marine farmers. However, over time, farm gate prices negotiated by marine farmers have to be adjusted to reflect medium- to long-term trends in the prices for exported product.

[48] according to industry sources.

Due to commoditisation, international export prices tend to converge over time. At any point in time, however, prices received in each market will differ. Historically, the market power over mussel prices has been driven by purchasers in the United States and so commodity prices have converged to a US dollar price. Australia is a major export market for New Zealand so Australian prices and the exchange rate are equally important. Increasingly, the European Union is influencing the market, particularly for smaller exporters.

The consequence of the aquaculture industry's high exposure to foreign markets and the practice of accepting supply contracts fixed in foreign currency is that the value of Marine Farms is vulnerable to changes in the foreign price of the products sold and the high variability of the New Zealand exchange rate.

The vulnerability of farm value to foreign markets is reflected in the *Methodology* in the following ways:

- The valuer is required to consider current foreign product prices and exchange rates when determining whether a farm gate price for the farm's products is a representative and sustainable price.
- In respect of the cash flow forecast we recommend that it be assumed that foreign product prices increase at the expected rate of inflation in the foreign market and that Purchasing Power parity holds. The combination of these assumptions is equivalent to assuming that the prices when translated into NZD increase at the expected rate of inflation in New Zealand.
- The discount rate reflects the systematic risk of aquaculture firms to which fluctuations in exchange rates may contribute depending on the ability to diversify this risk.
- The value of options to develop or change use of a particular site increases with variability in outcomes. While in most cases, options values will be immaterial, the high exposure to foreign markets could increase the significance of real options for sites with development potential.

The industry has potential to increase production and grow revenues

New Zealand's aquaculture industry currently generates sales of approximately $350m a year. The goal of the *New Zealand Aquaculture Strategy* is that by 2025 the New Zealand aquaculture sector will have sales of over $1.0 billion per annum. This goal is supported by Central Government as outlined in its strategy – *Our Blue Horizons – He Pae Kikorangi.* If these targets are to be met, either aquaculture space will need to expand or production on existing farms will need to increase markedly.

Current trends suggest that there is potential to increase the production on oyster and mussel farms using selective breeding and improved growing technologies such as baskets (for oysters). [49]

The studies undertaken on demand elasticity[50] of seafoods suggest that increasing production quantities of seafoods will not result in an overall reduction of revenue for the industry.[51] This is good news for the seafood industry in general, if one still regards it as a growing industry, as it implies that the total revenues are likely to increase if production continues to increase.

Supply of greenshell mussels from New Zealand appears to be relatively inelastic, that is, farmed supply is unresponsive to prices received in export markets. This is illustrated by the chart below which shows the relationship between mussel export prices and domestic production. The reason for this is the long harvest period for aquaculture products (on average 18 months for mussels) and the narrow window when the products are in condition and may be harvested. Supply of salmon and finfish is likely to be significantly more responsive to export prices, as fish can be harvested at any time in the production cycle. [52]

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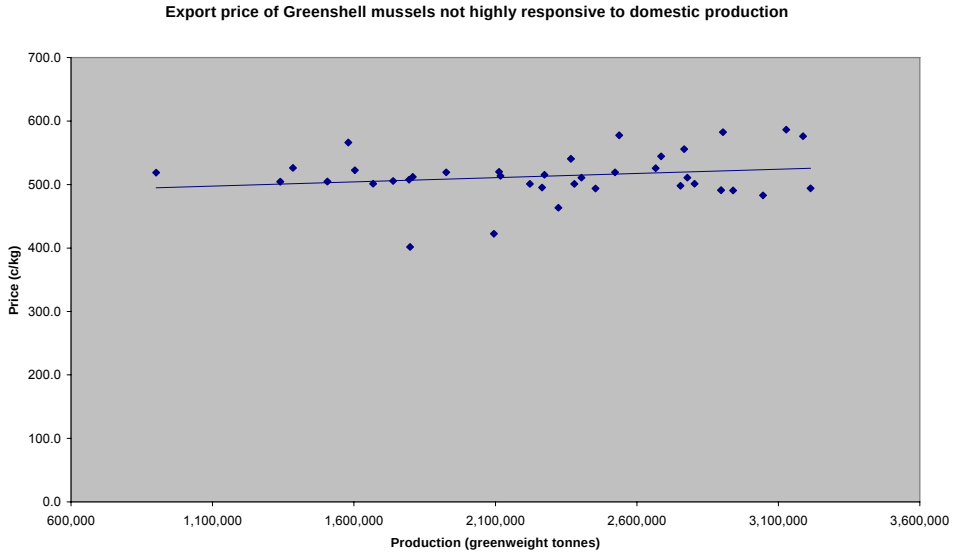
[49] According to research by Cawthron Institute, the improvement possible on a mussel farm from using selective breeding is a 10-15% one-off improvement in growth rate within one growth cycle. This is because the breeding practices select mussels that maintain their condition for longer. But this is not a current production reality as commercialisation is required in order to produce suitable spat. According to industry sources, production could improve 20 – 50% when basket culture is used for growing and harvesting oysters.

[50] Elasticity of demand (supply) describes the degree of responsiveness of the demand for (supply of) a good to a change in price and is measured by the proportionate change in quantity demanded (supplied) relative to the proportionate change in price.

[51] Asche, F. and Bjorndaal T. (2003) *Demand elasticities for fish and seafood: A review* Centre for Fisheries Economics, Norwegian School of Economics and Business Administration.

[52] Ibid.

Commodity prices and domestic production



Regional profiles

This section describes four regions in which the Crown's obligation is the most significant:

- Marlborough
- Waikato
- Northland
- Hawke Bay

Each profile contains details about the marine farms in the region, both pre-commencement and otherwise: their location, the number of farms, the permitted size (the total hectares of farms with marine farming permits and coastal permits), and the primary use of the farms. The profile then identifies the locations of pre-commencement farms and provides a list of the largest holdings of pre-commencement space in the region.

Maps showing the locations of the farms may be added to the regional profiles in the future.

Profile of the Marlborough region

Overview of marine farming in the Marlborough region

The Marlborough region is made up of a number of harbours and sounds containing around 565 operational marine farms[53] (around 478 of which are mussel farms[54]). The area occupied by marine farms in the Marlborough Sounds is approximately 2,800 hectares. The median sized farm is 2.38 hectares.

Marine Farms in the Marlborough Sounds

Settlement region	Location	No of Farms	Permitted size	Primary use
Pelorus Sound	Central Pelorus East	121	357.7487	Mussels, Salmon, Pacific Oysters, spat catching
Pelorus Sound	Central Pelorus West	73	272.517	Mussels, Salmon, Pacific Oysters, spat catching
Pelorus Sound	Inner Pelorus	46	61.054	Mussels, spat catching
Pelorus Sound	Kenepuru	44	127.5077	Mussels, Oysters
Pelorus Sound	Outer Pelorus	110	302.332	Mussels, spat catching
Queen Charlotte Sounds (northern ent)	Inner Queen Charlotte Sound, Ruakaka	1	4.5	Salmon
Queen Charlotte South (E&W ent)	Outer Queen Charlotte Sound	11	13.105	Mussels, Salmon
Croisilles Harbour	Croisilles	40	864.535	Mussels, Pacific Oysters

[53] Source: Marlborough District Council, August 2007.

[54] Source: Donnelly, P. *Economic Study of the Mussel Industry*, March 1998.

Marine Farms in the Marlborough Sounds				
Settlement region	**Location**	**No of Farms**	**Permitted size**	**Primary use**
Admiralty Bay	Admiralty Bay	42	104.941	Mussels
Port Gore	Port Gore	18	88.1328	Mussels
Port Underwood	Port Underwood	41	80.647	Mussels, Oysters
Coastal	D'Urville Island	8	42.325	Mussels, Oysters
Tory (No Pre-Commencement Space)	Tory Channel	10	21.36	Mussels, Oyster, Salmon

Source: Marlborough District Council and Ministry of Fisheries

Greenshell mussels, King salmon, Pacific oysters, Kingfish and seaweed all are grown in the region. Over 80% of the country's aquaculture exports are grown in Marlborough. Export earnings from Marlborough produce exceed $200 million annually.

The majority of farms are located in the Pelorus Sound with smaller production bases in the Croiselles Harbour, East Bay (Queen Charlotte Sound) and Port Underwood. Support and infrastructure facilities for the industry are centred on local ports such as Picton, Havelock and Elaine Bay. Boat building and equipment supply services are located in Blenheim, Renwick, Havelock, Picton and Rai Valley.

Greenshell mussels in the Marlborough region

Greenshell mussel farming is the largest segment of the aquaculture industry in Marlborough. Product is processed locally at factories located in Picton, Havelock, and Blenheim or sent to Nelson and Christchurch. Product from mussel farms in Marlborough account for 80% of the country's export production. Almost all of the mussels grown in Marlborough are exported.

Salmon farming in the Marlborough region

Salmon farming is centred on the cooler waters of Queen Charlotte Sound. Currently 5,000 tonnes of King salmon are harvested from four farms. This constitutes more than 75% of New Zealand's production of farmed salmon and more than 50% of the salmon consumed in New Zealand.

New Zealand King is known for its firm, highly coloured flesh and rich flavour. It grows particularly well in the Marlborough Sounds, where the water temperature and purity are optimum. Due to favourable water temperatures, King salmon grow faster in Marlborough than in any other area of New Zealand. For two months of the year, the

Marlborough farms are the only ones in the world harvesting prime quality salmon. Production is increasing as advanced technology has seen a move from the sheltered waters of the inner Sounds to more exposed sites in the outer Sounds, and the use of larger cages.

Oyster farming in the Marlborough region

Croisilles Oysters Limited holds 6 hectares of Pre-Commencement Space and operates a Pacific Oyster farming operation using longline culture techniques. Dredge Oysters are managed by the Quota Management System and the statistics for exports do not differentiate between farmed product and dredged product.

Pre-Commencement Space in the Marlborough region

Of the Pre-Commencement Space, 1,468.61 hectares is in harbour areas. A further 96.71 hectares is in the regional coastal zone. According to Ministry of Fisheries records the leases licenses and permits in the Pre-Commencement Space were distributed as follows:

- Marlborough Mussel Co. (181.37 permitted hectares, mostly in the inner and outer Pelorus Sounds, with some in Beatrix Bay and Kenepuru).
- New Zealand Marine Farming Inc (117 permitted hectares in the Outer Pelorus Sounds, Beatrix Bay, Crail Bay, Port Underwood and Croiselles Harbour). Some of this is for dedicated spat-catching sites.
- Sanford Limited (125.7 permitted hectares, mostly in the inner and outer Pelorus Sounds, with some in Beatrix Bay, Crail Bay and Kenepuru – a further 7.2 hectares is held by Sanford in the Coastal Zone).
- Sealord Marine Farms Limited (and associated companies) (62.321 permitted hectares, in Admiralty Bay, Croiselles Harbour, Inner and Outer Pelorus Sounds, Golden Bay, Beatrix Bay and Kenepuru).
- The NZ King Salmon Company has 47.7 permitted hectares in Queen Charlotte Sound.

The regional coastal zone is made up of small holdings, the largest of which are Rangitoto Mussels Ltd with 12.35 hectares and Golden Bay Marine Farmers consortium with 12 hectares.

Profile of the Waikato (Coromandel) region

Overview of marine farming in the Waikato (Coromandel) region

At present, there are 246 marine farm leases, licenses and permits in the Waikato region comprising over 920 active hectares of farm and 83 inactive hectares.[55] The majority of farms are mussel farms, which account for 850 active hectares, and produce 21,000 tonnes annually. Oyster farms account for 70 active hectares, producing around 640,000 dozen oysters annually.[56] At present, the two major types of marine farming within the Waikato region are conventional mussel longlines and inter-tidal oyster rack farms, although scallops, sponges and seaweeds are also harvested.

Marine Farms in Waikato region

Settlement area	Location	Number of leases, licenses or permits	Permitted Size Hectares	Primary use
Coastal	Wilson's Bay – Current	18	220	Mussels
	Wilson's Bay – Area A	171	470	Mussels
Coastal	MacGregor Bay & Coromandel Islands	21	104.087	Rock Oyster, Mussels
Coastal	Coromandel Harbour	10	56.639	Rock Oyster, Mussels
Coastal	Te Kouma[57] and Manaia	13	65.28	Mussels, Scallops
Coastal	Aotea Harbour (Pourewa Point)	1	3.75	Mussels

[55] Environment Waikato.

[56] Environment Waikato planner, and information from Technical Report 2007/33, *Economic Impact of Aquaculture in the Waikato Region* , prepared by Covec Limited for Environment Waikato, June 2007.

[57] A site of 22.5 hectares in Te Kouma is currently under appeal to the Environment Court.

Marine Farms in Waikato region				
Settlement area	**Location**	**Number of leases, licenses or permits**	**Permitted Size Hectares**	**Primary use**
Coastal	Whangapoua	2	8	Rock Oyster
Coastal	Moturoa Island	3	18.5	Mussels
Coastal	Whitianga	1	12.08	Rock Oyster
Coastal	Kennedy Bay	5	25.2	Mussels
Kawhia	Kawhia	1	2.82	Pacific and Rock Oyster

Source: Waikato Regional Council, September 2007.

In Wilson's Bay there are two marine farming areas: Area A and Area B. Area A is currently under development, and is about half developed. Area B contains 520 farmable hectares and will become an AMA (and therefore able to be developed) after the moratorium is lifted. It is not pre-commencement space.

Mussel farming in the Waikato region

Most farms use conventional longlines for mussels. The coastal plan specifies that only mussel longlining and shellfish research is allowed in Wilson's Bay; all other methods are prohibited. The Council expects the number of mussels produced in Area A to increase markedly over the next 12 – 18 months as the second and final stage of development has been approved.

Oyster farming in the Waikato region

Oyster farming began in the Waikato region in the late 1960s with the establishment of inter-tidal oyster farms. Oyster farms in Waikato account for 10% of national production.

Finfish farming in the Waikato region

There is currently no fish farming in the Waikato region. Environment Waikato is currently preparing a plan change to allow for new types of aquaculture, including fish.

Future developments in the Waikato region

There is a Marine Farm Zone in Wilson's Bay, with aquaculture prohibited in all areas outside the zone. The plan also has rules for oyster farms and spat catching. No further aquaculture developments are planned for 5 years.

Pre-Commencement Space in the Waikato region

730.2 hectares of the space in the coastal region is Pre-commencement Space and a further 2.82 hectares is in Kawhia. According to Ministry of Fisheries records the leases licenses and permits in the Pre-Commencement Space are distributed as follows:

- Tikapa Moana Enterprises have permits for the largest number of hectares in the pre-commencement space, 170 permitted hectares in Area A, Wilson's Bay.
- Ihapera Lully Waten Heemi, Stephen Ngeungeu Zister, Caroline Karu, Haerengarangi (Harry) Mikaere and David Peka held 93.1 permitted hectares in Area A, Wilson's Bay.
- Mikaere, Ruth & Hollis, Tahu Richmond Hector & Mikaere-Hollis, Jocelyn Anne as Trustees of the Tahu & Jocelyn Hollis Family Trust held 27.5 permitted hectares in Area A, Wilson's Bay
- Biomarine Mussels Limited used to hold 60.5 permitted hectares of Pre-Commencement Space in Area A, but some of this has now been transferred to Sanford Limited and Sealord Marine Farms Limited. Its remaining holding is 35.75 hectares in Area A.
- Sanford Limited held 89.75 permitted hectares in Area A, but its holdings in Area A have since increased to 99.375 hectares following purchases from Biomarine Mussels Limited.
- Sealord Marine Farms held 55 permitted hectares in Area A, Wilson's Bay, but its holdings have since increased to 70.125 hectares following purchases from Biomarine Mussels Limited.
- Hauraki Fishing Group was recently granted 41.25 permitted hectares for mussels, with a spat permit over the same area.
- The 2.82 hectares in Kawhia is owned by the Nicholson family.

Profile of the Tasman region

Overview of marine farming in the Tasman region

In Golden Bay and Tasman Bay, 5352 hectares are currently being used for aquaculture - 2540ha in Tasman Bay and 2812ha in Golden Bay. Of this, about 80ha near Pakawau in Golden Bay is used to grow mussels, producing about 4000 tonnes a year. The rest is used for seasonal and rotational scallop and mussel spat catching, mainly by the Challenger Scallop Enhancement Company and Ringroad Consortium, a large group that includes Sealord, Talley's, iwi and the New Zealand Marine Farming Association.

Twenty percent of the mussel industry's mussel spat comes from Golden Bay. In future, the amount of marine farming in both bays could increase, with an extra 5036ha already proposed for mussel farming and spat catching - 3312ha in Golden Bay and 1724ha in Tasman Bay.

Pre-Commencement Space in the Tasman region

The Crown's obligation in the Tasman region is 1058.43 hectares (20% of 5,292 hectares of pre-commencement space). According to Ministry of Fisheries records the 5,292 hectares of Pre-Commencement Space leases licenses and permits were distributed as follows:

- Challenger Scallop Enhancement Company Limited (4011 hectares in the coastal zone (split between Tasman Bay and Golden Bay)) – the coastal permits are scallop spat catching permits, but the company can only use 500 hectares in each bay each year for this purpose.
- Ringroad Consortium (1200 hectares in the coastal zone, namely Tasman Bay and Golden Bay) – these permits are for mussel spat catching and holding and they can only use part of the area in any given year.
- Golden Bay Marine Farmers Consortium (40 hectares in the coastal zone) for mussel farming.
- There are 13 x 4 hectare sites for spat catching in the region.
- Multiple small holders, between 2 and 4 hectares in size (41 hectares in the coastal zone). This is mostly for mussel farming.

Profile of Northland

Overview of marine farming in the Northland region

There are 136 marine farms in Northland. There are 126 oyster farms (9 of which are under forfeiture action) 9 mussel and spat farms, and a seahorse permit in Pahia.

Marine Farms in Northland

Settlement region	Location	No of Farms	Permitted size	Primary use
Parengarenga	Parengarenga	21	112.71	Oysters
Houhora	Houhora	15	72.87	8 Oysters, 7 Mussels
Rangaunu	Rangaunu	5	31.16	Oysters
Whangaroa	Whangaroa	12	121.45	Oysters
Te Puna Inlet	Bay of Islands	4	23.72	Oysters

Marine Farms in Northland				
Settlement region	**Location**	**No of Farms**	**Permitted size**	**Primary use**
Waikare Inlet	Bay of Islands	17	48.3	Oysters
Kaipara	Kaipara	25	179.7	23 Oysters, 2 Mussels
Coastal	Whangapei	1	2.4	Mussel spat
Outside settlement region	Whangarei	1	5.718	Oysters
Outside settlement region	Paroa Bay	1	2.096	Oysters
Outside settlement region	Hokianga	2	13.89	Oysters
Outside settlement region	Paihia	1	0.1	Seahorse
Outside settlement region	Orongo Bay	23	25.79	Oysters
Outside settlement region	Keri Keri	8	43.8	Oysters

Source: Northland Regional Council, October 2007.

Pre-Commencement Space in the Northland region

The pre-commencement space in Northland is 160.65 hectares. According to Ministry of Fisheries records the largest holdings of pre-commencement space were as follows:

- Aotearoa Fisheries Limited 35.2 hectares
- David Olsen and associated persons 13 hectares
- Sanford Limited 11.4 hectares
- Otamatea Aquaculture Limited 9.7 hectares
- NZ Native Fisheries Limited 9 hectares

Profile of Hawke Bay

The Crown has a large space obligation in Hawke Bay equal to 493 hectares. However, the region only has 1 coastal permit in Pre-Commencement Space.[58] There is no development on the site at present, aside from test lines. Another AMA exists for the much smaller 4ha area on the western coast of Mahia Peninsula (near Long Point), but this is not Pre-Commencement Space.

Hawke's Bay is unique because its farms are deep-water farms. Though deep water marine farming does occur elsewhere in the country, it is not common, and it is therefore likely that there will be few future applications for marine farming in this region, at least until the technology and economic viability of open coast marine farming are tested. It is highly unlikely there will be any additional AMAs planned for Hawke Bay before 31 December 2013.

The Permits allow development in 5 stages over 20 years if monitoring shows no adverse effects on the environment at each stage. Three stages are pre-approved. (Stage 1 = 24 mussel bearing lines, Stage 2 = 99 mussel bearing lines, Stage 3 = 243 mussel bearing lines, Stage 4 = 486 mussel bearing lines, Stage 5 = 918 mussel bearing lines).[59]

[58] The site is owned by Napier Mussels Limited, which is 40% owned by Ngati Kahungungu Iwi Incorporated, 20% by NZ Seafarms and 40% by Tasman Mussels (TML) which in turn is 68% owned by Sealord Shellfish. Ngati Kahungungu are one of the beneficiaries of the settlement for the Takitimu region.

[59] According to the Hawke's Bay Regional Council, the conditions of the coastal permit may change, in particular the time frames for development may be postponed.

Appendix 4: Derivation of WACC

The Weighted Average Cost of Capital ('WACC') is commonly used as the discount rate in valuation models to evaluate proposed investments. WACC is a measure of the opportunity cost of the equity and debt capital supplied by investors to a business. Neither of these costs can be directly observed in the market and must therefore be estimated. There are many possible ways to estimate WACC.

This paper sets out a recommended methodology for making the estimate for the purposes of the Settlement. By way of illustration, it applies the methodology to current conditions in the aquaculture industry to obtain an estimate of WACC for investments in aquaculture.

The estimate is intended for application after the reduction in the corporate tax rate from 33% to 30% due to take effect from the 2008/09 income year.

Methodology used to estimate WACC

We adopt the following definition of WACC:

$$WACC = W_e K_e + W_d K_d(1 - t_c) \quad (1)$$

where: W_e = proportion (weight) of equity funding;

K_e = cost of equity;

W_d = proportion of debt funding;

K_d = cost of debt; and

t_c = corporate tax rate

That is, WACC is the weighted average of the cost of equity and the after tax cost of debt. This is the definition of WACC commonly used in New Zealand in applications of the cost building block model in regulatory settings and for evaluation of proposed investments. However, there is no unique definition of WACC. The definition can be changed in a variety of ways from that adopted here and the result of application to purposes such as valuation does not change provided that there are compensating changes in the definition of the cash flows.

We recommend that the cost of equity be estimated by use of the Capital Asset Pricing Model (CAPM). There are different forms of the CAPM for different assumed tax structures. The best known form of the CAPM is that due to Sharpe (1964), Lintner (1964) and Mossin (1965):

$$K_e = R_f + MRP\ ß_e$$

where:

R_f = risk-free rate;

$ß_e$ = equity beta; and

MRP = market risk premium

= $(R_m - R_f)$

However, this form of the CAPM applies only if it is assumed that capital gains taxes are zero and the investor tax rates on dividends, t_d , and interest income, t_p , are equal. It is easily shown that if instead it is assumed that capital gains taxes are zero but the dividend and personal tax rates are not equal, then the CAPM becomes:

$$K_e = R_f(1 - t_p) + ß_e(ATMRP) + (D - D_m ß_e)t_d \quad (2)$$

where

ATMRP = tax adjusted market risk premium;

= $R_m - R_f(1 - t_p)$

= $(R_m - R_f) + t_p R_f$.

= MRP $+ t_p R_f$.

D = dividend yield on equity

D_m = dividend yield on the market

However, under New Zealand's form of dividend tax imputation the effective tax rate on dividends is given by:

$$t_d = t_p/(1 - t_c) - t_c/(1 - t_c)$$

and therefore if it is assumed that the effective tax rate on interest is 33%, that is, equal to the current corporate tax rate, then the dividend tax rate is zero and therefore equation (2) reduces to:

$$K_e = R_f(1 - 0.33) + ß_e(TAMRP) \quad (3)$$

This is the form of the CAPM that has generally been used in New Zealand for estimation of the cost of equity since the time of introduction of the dividend imputation tax system and it is generally known as the 'after tax' form of the CAPM. Once the corporate tax rate decreases to 30%, if we continue to assume that the tax rate on interest is 33%, then the dividend tax rate will be approximately 4%. Therefore, at least in

principle, once the new corporate tax rate applies it will be necessary to use the form of the CAPM given by equation (2). However, comparison of (2) and (3) shows that the only difference is:

$$\Delta = (D - D_m ß_e)t_d$$

and the value of Δ will in many cases be very small.[60] In fact, for the 'average' investment ($D = D_m$ and $ß_e = 1$), $\Delta = 0$. For the extreme dividend yield cases, $D = 0$ and $D = 10\%$ (and $D_m = 0.03$, $ß_e = 1$), $\Delta = -0.1\%$ and $\Delta = 0.3\%$ respectively. Given that these values are small and that there is significant uncertainty associated with the estimates of the CAPM parameters, a consensus may emerge to just continue using the CAPM with equation (3) unless the investment concerned has a very high dividend yield.[61]

The conversion from asset beta to equity beta is not affected by the change in the corporate tax rate. In the context of equation (3) the conversion formula is given by :

$$ß_e = ß_a (1 + W_d/W_e) \qquad (4)$$

where

$ß_a$ = asset beta

However, this is just a special case of the formula:

$$ß_e = ß_a (1 + TW_d/W_e)$$

where

$$T = [(1 - t_c)(1 - t_d)]/(1 - t_p)$$

[60] If the decrease in the corporate tax rate results in the effective rate of tax on interest also moving to 30%, then Δ would be zero and hence equation (3) could continue to be used but the coefficient of R_f would increase to 0.7.

[61] The Commerce Commission has to date applied the after tax form of the CAPM in all its reports on regulation/control of airport, electricity, gas and telecommunications companies and refers to it as the Brennan-Lally form of the CAPM. The Commission also proposed in its Draft of Guidelines for the estimation of WACC to continue with the use of this form of the CAPM (Commerce Commission, Draft Guidelines, The Commerce Commission's Approach to Estimating the Cost of Capital, October 2005). The Commission has since appointed a panel of experts to prepare the final Guidelines. The Guidelines are expected to be released in October 2007 and presumably will also address the issue of the change in the corporate tax rate.

but with New Zealand's form of tax imputation,

$$(1 - t_d) = (1 - t_p)/(1 - t_c)$$

and therefore

$$T = 1$$

irrespective of the values of the tax rates. Thus (4) continues to apply.

We recommend that the cost of debt be estimated as the sum of the risk free rate plus a debt margin:

$$K_d = R_f + DM \qquad (5)$$

where:

DM = debt margin.

The debt margin reflects the cost of raising debt and the additional compensation investors require for lending to an aquaculture business, which will vary with the likelihood of default (compounded by leverage) and liquidity.

Risk-free rate

The risk-free rate, R_f, refers to the rate of return in the market on a riskless security. It appears in two of the equations stated above; in equation [2] to estimate the cost of equity and in equation [4] to estimate the cost of debt. The same value of the risk-free rate should be used in both instances.

There is of course no riskless security, but the yield on Government bonds is commonly regarded as an acceptable estimate of the rate on such a security. In determining the appropriate estimate of the risk-free rate there are two factors to consider, namely the period of averaging and the term of the risk free rate.

In principle, the estimate of the risk free rate should be taken as the yield operative at the application date. However, to ensure that the estimate is free of the effects of unusual volatility in daily rates it is commonly accepted practice to take the average over a period of up to six months around the relevant application date.

It is common practice to match the term of the estimate of the risk free rate to the life of the entity's assets. Given that we are assuming aquaculture businesses to have a perpetual life, and that the assets employed have long lifetimes (particularly in

harvesting and processing) it would be appropriate to use the long term yield for Government Bonds in New Zealand.[62]

Accordingly, we recommend the use of the yield on 10-year Government bonds (corrected for semi-annual compounding), as averaged over 1 month prior to the relevant pricing date, as a suitable estimate for the risk free rate. For the sake of forming a current estimate of WACC, we propose an annually compounded rate of 6.5%, based on the semi compounded yield of 6.4% for August 2007.

Leverage and debt margin

As the degree of leverage is reflected in the debt margin, the two parameters are addressed together.

Leverage

There is no analytical basis for determining an optimal capital structure and therefore what is optimal is best inferred from practice. Accordingly, we would recommend that the leverage should be taken from the leverage observed for comparable companies or from company target levels of leverage.[63] The comparable company set shows considerable variation in the level of leverage from 0.12 to 0.63. The median value is 0.36. This also happens to be the leverage ratio for Sanford, the only New Zealand company in the set. Given the absence of better guidance on leverage, we adopt this value of 0.36.

Leverage has a significant impact on the cost of equity. However, given the New Zealand imputation tax system, the averaging of the costs of equity and debt is such that the impact of variation in leverage on WACC is close to zero.

Debt margin

The best estimate of this margin is that which in practice would be charged to an independent stand alone aquaculture company operating at the assumed 0.36 level of leverage. For large companies this margin is currently around 1.5%. Given that most

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[62] Shellfish nets, stakes and ropes have an expected life of 4 years, refrigeration systems have an expected life of 10 years, while expected life for fishing vessels is between 15.5 and 20 years (from www.ird.govt.nz).

[63] We have calculated leverage as Total Liabilities (from last available audited accounts) / Equity Value. Some practitioners estimate leverage by excluding non-interest bearing liabilities from the calculation.

aquaculture businesses in New Zealand are relatively small,[64] a reasonable estimate for the margin would be around 2%.

Beta

Beta is a measure of the expected volatility of a company's returns relative to the market and is an index of the level of systematic risk faced by investors. In general, beta can be estimated from a regression analysis of returns on the market and returns on the security in question. However, where such information is not available or, for example, suffers from either low trading volumes or insufficient data points for statistical veracity, the beta is estimated from the betas of comparable companies for which market based estimates of beta are available. Given that there is just one listed business with aquaculture operations in New Zealand (Sanford Limited), we apply this method (known as the pure play method) to estimate the beta for aquaculture.

When determining the set of appropriate comparable companies, the following key relevant factors need to be considered:

- The nature of the products (industry), and the extent to which demand for the products varies with the strength of the economy (the income elasticity of the demand for the company's products). The more demand varies with general economic activity, the higher the beta.
- The extent to which the company's costs vary with demand (operating leverage). The greater the proportion of costs that are fixed, the greater the variation in the company's profits with changes in demand, and thus the higher the beta.
- The extent to which the company's pricing structure translates changes in demand and costs into changes in revenue. This depends on factors such as the balance between fixed and variable costs and the way in which prices are adjusted over time in response to changes in demand and costs. The contractual arrangements governing the company's pricing are thus crucial. The greater the dominance of fixed costs, and the less prices adjust to compensate for changes in costs and demand, the higher the asset beta.

Other factors commonly mentioned in the finance literature include the duration of contract prices with suppliers and customers, the degree of market power, the level of industry regulation, and real options. Thus, in adopting the pure play method, selection of the appropriate companies requires simultaneous judgments of comparability on a wide range of different factors.

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[64] Of 338 enterprises in aquaculture in New Zealand, only 6 enterprises employ more than 20 people and only one employs more than 50. www.stats.govt.nz

Based on consideration of these factors, and availability of beta estimates from Thomson Financial, the set of companies listed in Table 1 was used as the set of comparable companies for estimation of beta. The companies and the data sources are described in Appendix One. The companies differ in a variety of ways but, viewed as a set, probably provide a reasonable basis for estimation of the beta for aquaculture in New Zealand.

The betas available from Thomson are equity betas, that is, betas that reflect the actual capital structure of the firms. Capital structure varies across the firms but this source of difference is simple to accommodate. The individual equity betas (or levered betas), are first converted to asset betas, that is, betas that would apply if the companies had no debt in their capital structure. The set of asset betas is then used to provide an estimate of the asset beta for an aquaculture business. In turn, in order to accommodate the specific leverage assumed for New Zealand aquaculture businesses, that asset beta is converted to an equity beta that becomes the estimate of beta applied in the estimate of the cost of equity.

Table 1 shows the implied asset betas for each of the comparable companies and also the median value for the set of companies. Based on consideration of the factors discussed above and the implied asset betas, we adopt 0.55 as our midpoint estimate of the asset beta for an aquaculture business, with a range of 0.50 to 0.60. This choice results from focus primarily on the Australian, Norwegian, New Zealand and US companies which in terms of their operations and listing are probably the best basis for assessment of the beta of a New Zealand aquaculture business. It is slightly higher than the median for this subset but that may not be inappropriate given the small size of the typical New Zealand aquaculture businesses and the exposure to foreign currency fluctuations which may not all be diversifiable. Using equation (4) above for conversion of the asset beta to an equity beta, results in a midpoint estimate of 0.86 for the equity beta and with a range of 0.78 to 0.94.

Table 1. Implied asset betas of comparable companies

Company name	Country of listing	W_d	Asset Beta[65]
Cermaq ASA	Norway	0.24	0.69
Charoen Pojphand Foods Public Company Limited	Thailand	0.63	0.20

[65] See Appendix One.

Clean Seas Tuna Ltd	Australia	0.14	0.27
HQ Sustainable Maritime Industries Inc	ASE (USA)	0.16	0.43
Kiang Huat Sea Gull Trading Frozen Food Public Company Limited	Thailand	0.22	0.18
Leroy Seafood Group ASA	Norway	0.38	0.48
Marine Produce Australia Limited	Australia	0.12	0.51
Nirefs Aquaculture S.A.	Greece	0.57	0.68
PT Inti Kapuas Arowana Terbuka	Indonesia	0.01	0.60
Sanford Limited	New Zealand	0.36	0.52
Webster Limited	Australia	0.38	0.52
MEDIAN		**0.24**	**0.51**

Tax adjusted market risk premium

The market risk premium, MRP, is the margin of the expected rate of return on the market portfolio of risky assets over the risk free rate. This cannot be observed directly and must be estimated. The estimation is subject to considerable uncertainty and has been a matter of considerable controversy in finance.

The after tax market risk premium, ATMRP, reflects the New Zealand income tax structure. As stated above, the ATMRP is calculated as:

$$ATMRP = MRP + t_p R_f$$

The following approaches have been used in the finance literature to estimate the market risk premium:

a. Extrapolation of the historical margin earned from investment in some suitable proxy for the market portfolio in excess of the return on a proxy for a risk-free investment.

b. Use of economic models, which include the expected rate of return on the market portfolio as one of the variables.

c. Extrapolation from surveys of opinion on the premium.

We regard extrapolation of the historical margin as being likely to provide the most reliable estimate of the MRP. Of the various sources of information available for this approach, we believe that the data reported in Dimson *et al* is currently the superior source.[66] The latest data from Dimson *et al* indicates an after tax market risk premium of about 8%.[67]

Summary

The above parameter estimates combine to provide the following estimated range for WACC.

Table 2. Summary of parameters and resulting estimates of WACC

Parameter	Low	Midpoint	High
R_f	6.50%	6.50%	6.50%
TAMRP	8.00%	8.00%	8.00%
DM	1.50%	2.00%	2.50%
$ß_a$	0.50	0.55	0.60
W_d	0.36	0.36	0.36
$ß_e$	0.78	0.86	0.94
t_p	33%	33%	33%
t_c	30%	30%	30%
t_d	4%	4%	4%

[66] Dimson, E., Marsh P. and M. Staunton (1) *Triumph of the Optimists – 101 Years of Global Investment Returns*, Princeton University Press, 2002, *The Worldwide Equity Premium: A Smaller Puzzle*, London Business School, Working Paper, April 2006, and *Global Investment Returns Yearbook*, ABN AMRO , February 2007.

[67] A value of 8.15% is arrived at using the tax rate of 0.33 and applying the formula ATMRP = MRP $+ t_p R_f$., with an MRP of around 6% and R_f of 6.5%. Given the level of uncertainty around the estimate, adoption of ATMRP = 8% seems reasonable.

D, D_m	3%	3%	3%
K_e	10.6%	11.2%	11.9%
K_d	8.0%	8.5%	9.0%
WACC	**8.8%**	**9.2%**	**9.8%**

Limitations of method

There is growing evidence in the finance literature that the traditional approach to estimation of WACC, as used in this report, does not fully capture the true costs facing a company when making investment decisions. That is, in the real world there are significant departures from the assumptions of the CAPM used in estimation of the cost of equity. These relate principally to market frictions, irreversibility and timing flexibility, and firm resource constraints.

There is considerable evidence that competitive firms require a significant margin for exposure to risk other than market (systematic) risk and therefore require a minimum-acceptable expected rate of return on investments that exceeds their WACC as based on the CAPM.

It is thus appropriate to include an additional margin over WACC. However, the challenge in doing so is to decide on the size of the margin. Given that research in this area is still in its very early stages the size of the margin is highly uncertain but, as a minimum, a margin of 2% would appear to be appropriate.

Conclusion

In our view, given the range estimate of WACC developed above and the evidence that an estimate of WACC based on the CAPM understates a company's true cost of capital, a reasonable approach would be to add a 2% margin, thus resulting in a midpoint estimate of 11.2% for WACC with a range of 10.8 – 11.8%.

Additional information – deriving beta estimates

This section describes the sample of companies that were considered for estimation of the asset beta for investment in aquaculture.[68] The data was obtained from Thomson ONE Analytics and downloaded on 25 July 2007.

The following table summarises the sample and key data that was used to estimate the asset beta. The table also provides a general description of each of the companies used in the sample. For each case the general description was sourced from Thomson.

Comparable Company name	Exchange Listing	Description	Thomson Equity Beta	Wd
Cermaq ASA	Norway	The Group's principal activity is the production of salmonid feed and farmed salmon and trout and the research of aquaculture. The Group operates in three business segments: Fish Feed, Fish Farming and Agriculture. Fish Feed involves the production of fish feed and the processing of by-products from the fish farming industry. Fish farming involves the on-growing of salmon and trout from smolts, as well as the slaughtering, processing, sale and distribution of salmon and trout. The Group operates through subsidiaries in Norway, Scotland, Canada and Chile. In 2006, the Group acquired Langfjordlaks A.S.	0.94	0.24
Charoen Pojphand Foods Public Company Limited	Thailand	The Group's principal activities are carried out through two business segments: Livestock: comprising chicken, duck, swine and chicken egg; and	0.53	0.63

[68] Other companies were identified in the research as potentially comparable, but at the time of download, relevant key financial information was unavailable or unreliable. These companies were Alfesca HF (an Isreali seafood and specialty foods company), Asian Seafoods Coldstorage Company (a Thai frozen seafoods company), Cell Aquaculture Limited (an Australian aquaculture technology company), Edgewater Foods International Limited (a US-based scallop farming and marine hatchery business), Pesquera Inquique (a Chilean seafood processing company) and Sowbhaqua Exports Limited (an Indian shrimp export company).

		Aquaculture: comprising shrimp and fish.		
Clean Seas Tuna Ltd	Australia	The Company's principal activities are propogating of kingfish, producing fingerlings for sale as well as the growout of kingfish and mulloway. In addition, the company commenced a project with the aim to commercialise the production of Southern Bluefin Tuna. It operates out of Australia.	0.31	0.14
HQ Sustainable Maritime Industries Inc	ASE (USA)	The Group's principal activity is to provide aquatic products through an integrated business of aquaculture. This is done through cooperative supply agreements, ocean product harvesting, and processing and sales of farm-bred and ocean harvested aquatic products. It operates two segments: Aquaculture products and Health and Bio Products. It covers value-added key areas along the production chain from a bio-secure and stable supply of tilapia and shrimp under stringently monitored conditions, processed in accordance with internationally recognised standards of hygiene. The Group's principal products are cross-bred hybrid of tilapia and white-legged shrimp for exporting. It operates in the US, Canada, Japan and European countries.	0.5	0.16
Kiang Huat Sea Gull Trading Frozen Food Public Company Limited	Thailand	The Group's principal activity is the distribution and selling of frozen seafood products such as shrimp, fish and cuttlefish. The Group exports its products to overseas markets such as Japan, Europe and the US. The products are produced under the Group's brands such as Sea Champion, Sea King, Sea Queen, Sea Flower and Sea Star.	0.23	0.22
Leroy Seafood Group ASA	Norway	The Group's principal activity is marketing and distribution of seafood. The Group operates	0.83	0.38

		through two segments namely: Sales and Distribution and Production. The products of the Group include whole salmon, processed salmon, whitefish, salmon, trout, shellfish and pelagic. The Group has operations in Norway, Western Europe, Asia, the US, Canada, Eastern Europe and other countries.		
Marine Produce Australia Limited	Australia	The Group's principal activities are the growing and selling of prawns and barramundi by aquaculture means. This required further investment in aquaculture assets and continuing research of technologies and market developments to cultivate prawns and fish.	0.58	0.12
Nirefs Aquaculture S.A.	Greece	The Group's principal activity is the manufacture, trade and distribution of fish products. It is also active in the production of diary products, confectionary products, fish farming equipment and fresh and frozen foods. Major brands include Thalassa frozen fish, Sarantis confectionary products and Alpino diary products. The Group distributes its products in 25 countries.	1.79	0.57
PT Inti Kapuas Arowana Terbuka	Indonesia	The Company's principal activity is rearing and trading Koi fish. The Company has opened retail shops in Jakarta and Solo to sell the fish. The company used to manufacture plastic bags, but no longer does this.	0.6	0.01
Sanford Limited	New Zealand	The Group's principal activities are harvesting, processing and selling seafood products. It operates in New Zealand	0.81	0.36
Webster Limited	Australia	The Group's activities are in three divisions: industrial services, horticulture and aquaculture. Industrial services involves wholesaling of a range of finished goods including industrial supplies, heavy machinery and automotive parts	0.84	0.38

		throughout Tasmania, Australia. Horticulture involves growing, processing, packing and marketing of fruit, vegetables and nuts for export and domestic markets. Aquaculture involves production, processing, value-adding and marketing of salmon for export and domestic markets and the harvesting and processing of kelp.		

Implied asset betas

The implied asset beta is calculated from the observed equity beta using the following form of the Hamada equation:

$$\beta_e = \beta_a (1 + TW_d / W_e)$$

where

The marginal tax rates (based on the maximum tax band) are summarized below for each region[69].

Country	t_c	t_d	t_p	T
Japan	0.46	0.20	0.37	0.69
Norway	0.28	0.00	0.40	1.20
Thailand	0.30	0.10	0.37	1.00
Australia	0.30	0.00	0.30*	1.00
USA	0.35	0.15	0.35	0.85
Indonesia	0.30	0.15	0.35	0.92
New Zealand	0.30	0.04	0.33*	1.00

[69] This information was sourced from:
http://www.deloittewebguides.com/index.asp?layout=countryAllDtt

Appendix 5: Guidance on real options valuation

In estimating the expected cash flows from an investment it is assumed that once the project commences management has no flexibility to depart from the actions assumed in the estimation of the cash flows. In fact, however, there is usually significant flexibility to depart from those assumed actions, and this flexibility has a value. That is, there are real options and, where practicable, these should be recognised in the valuation. Typically, real options on Marine Farms are options to defer making an investment, diversify the product range, to switch production techniques, and to expand, contract, shelve or abandon operations. Just like financial options, a real option provides an opportunity to do something but does not require that it be done.

If the Highest and Best Use strategy involves forecasting a change in use of the site to another species, then the cash flows generated by following this strategy would already have been included in the forecasts of cash flows. As such, this change of use is not a real option. Rather, a real option exists and will be exercised if it is rational to do so once uncertainty is resolved by the information that comes forth as an investment is implemented.

Estimation of the value of real options associated with an aquaculture operation starts with estimation of the value of the underlying asset by the DCF method. Next, the valuer should form a view on whether the options value is likely to be material. In most instances, options value will be immaterial. In our view, the only material options values will be where there are clear development opportunities for the site in question.

If an options valuation is to be included in the valuation, is necessary to specify:

- the details of the option
- the cost to implement the option (the 'strike price')
- the volatility of the underlying cash flow returns
- the time to expiration of the option, and
- the risk free rate.

The volatility may be estimated using a decision tool such as PALLISADE @Risk, and may take into account sources of risk such as exchange rate fluctuations. Volatility is a key parameter as the higher the uncertainty the greater the value of the option.

The set of options available for a Marine Farm will be subject to the site's physical limitations. For illustrative purposes, some examples of strategic options for a Marine Farm producing mussels could be as follows:

- **Option to abandon planned investment (which may extend to abandoning a site and abandoning the coastal permits)**. This option presents itself if exchange rates increase, or if disease or algal blooms occur, or if the market for aquaculture products drops away.
- **Option to invest in different technologies to improve on-site productivity (eg selective breeding or basket technology for oysters).** This option (and the next one) derive from possible development of farming techniques used.
- **Option to invest in different technologies to improve marketability (eg colour change, diversified product, different sizes**). This potential is not always possible as a Highest and Best Use, because of restrictions in coastal permits in some areas and the fact that markets are not yet established. Current trends show that the market prefers larger sizes and that sellers of smaller sizes may have to sell below cost. This preference may change and the farmer will have flexibility to respond to these trends. This flexibility is restricted, however. Shellfish crops, unlike finfish, only has a market value at market size and condition, which occurs only once per cycle in a narrow condition window
- **Option to invest in infrastructure to convert to oysters and scallops (which may require a change in the coastal permits).** This potential presents itself if the market for mussels drops away. There is high inertia for change of species – a firm has to have the ability to change in its consent, then obtain managerial skill and know how. On top of which, processes need to be put in place to obtain seed, processing capability and a suitable supply chain. All in all, conversion is slow and with it comes a loss in revenue. Therefore, this option is unlikely to be taken up following short term market fluctuations. Industry participants are more likely to stay the course, under an assumption that the market is more likely to improve in that period.
- **Option to invest in infrastructure to convert to finfish (which may require a change in the coastal permits).** This potential presents itself if the market for mussels drops away. While conversion to finfish is more likely given the relative economic returns possible, it is unlikely to form a strategic option in many instances because of the environmental requirements (sites would need to be at least 15 metres deep, for example, and have good flushing characteristics (water current speed of 0.5 – 1 knot). Finfish farming requires a much higher capital outlay and a higher level of investment in management capability than mussel farming. Like conversion to oysters and scallops, processes would need to be put in place to obtain processing capability and a suitable supply chain.

Black-scholes or binomial method

Simple financial options can be valued with closed form formulas such as the Black Scholes option valuation formula based on analytical methods.[70] However, few real options can be valued by such methods and therefore most are valued by numerical methods. The binomial method is the most common of these. The binomial method uses two lattices[71] - one for the underlying asset and one for the real option valuation.

Example of the binomial method

The following extremely simple example illustrates the essence of the binomial method. The potential purchaser of an aquaculture farming business recognises that the scale of the current business could be expanded. If implemented the expansion would come on stream in 2 years time with cash flows equal to $10m or $0.5m in present value terms at that date with probabilities of 70% and 30%. The expansion could be abandoned at that time with salvage value of $2.5m. This opportunity is a real option – the abandonment option.[72] The proposal requires outlays during the two year construction phase with PV of $6m at time 0. Assume the WACC is 11% and the risk free rate is 8%.

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[70] For example, assume a marine farmer holds a permit to farm coastal space requiring an outlay of X=$6m for anticipated benefits of only S=$5m. The permit will lapse if not utilised within T= 5 years. Assume σ = 30% and r = 6%. The flexibility is the equivalent of a simple American Call option which can be valued using the Black Scholes formula:

$$V = SN(d_1) - X\exp(-rT)N(d_2)$$

where $d_1 = \{\ln(s/X + [r + \sigma^2/2]T\}/(\sigma\sqrt{T})$ and $d_2 = d_1 - \sigma\sqrt{T}$ and

$N(di)$ is the normal probability that $z < d_i$. Then V = $1.536 and therefore

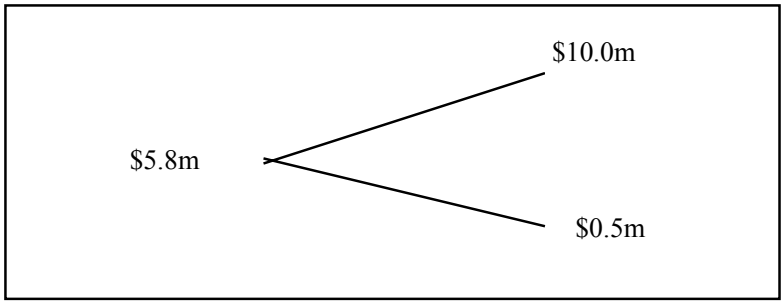
recognising the flexibility gives NPV=$0.536m. [In this case, estimation by the binomial method using 5 steps gives V=$1.528m]

[71] A lattice is a set that contains elements that represent the potential future states.

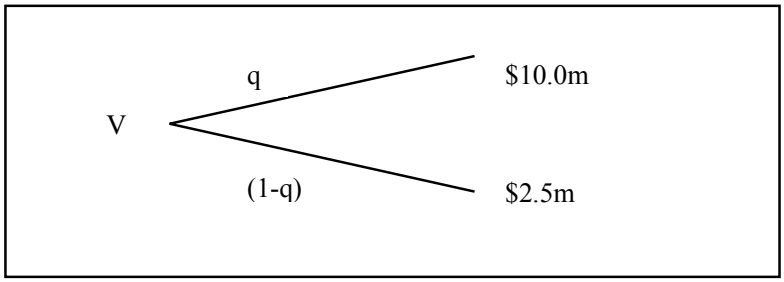
[72] The option in this case is in fact a simple example of a European put option – an option to "sell" something at a specified price at a specified date. An option to purchase something is a call option. If the option can be exercised at any time up to the expiration date it is an American option.

The present value of the cash inflows is \$5.8m ($= [10.0(0.7) + 0.5((0.3)]/(1 + 0.11)^2$ and therefore a simple NPV calculation would indicate that the proposal should not proceed as the NPV is negative \$0.2m (= \$(5.8 – 6.0)m).

The lattice for the underlying asset is:



The lattice for the real option valuation is:



The expansion project would not be abandoned in the favourable state of the project where cash flows have Present Value (PV) = \$10m but it would be abandoned if the project had cash flows with PV = \$0.5m. The expansion proposal thus has payoffs of \$10.0m and \$2.5m.

The proposal can be valued by utilising the fact that the PV of a set of risky future cash flows can be obtained by discounting the expected value of the set of cash flows at the expected rate of return or by discounting the certainty equivalent of the set of cash flows art the risk free rate. Thus the payoffs from the option can be valued as though the potential investor is risk neutral. Thus, V, the value of the proposal can be calculated as:

$$V = [10.0(q) + 2.5(1 - q)]/(1 + 0.08)^2$$

where q and (1-q) are the path probabilities as though the investor was risk neutral. These probabilities can be obtained from the underlying asset lattice as:

$$5.8 = [10.0(q) + 0.5(1-q)]/(1+0.08)^2$$

and therefore

$$q = 0.66\,,\ (1-q) = 0.34\,,$$

Hence $V = 6.38$.

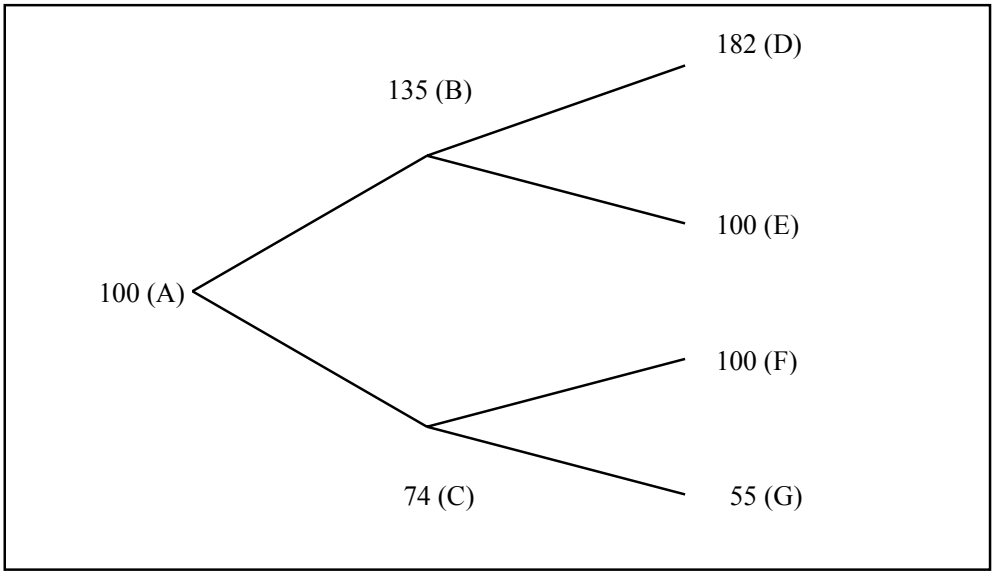
Thus with recognition of the flexibility in the expansion proposal, the value rises by $0.58m and the proposal now has a positive NPV of $0.38m which the potential purchaser should add to the valuation of the existing business.

More realistic example of the binomial method

In more realistic examples the values of the underlying asset over time are obtained from the estimate of the volatility, σ. If the value of underlying asset can be assumed to follow geometric Brownian motion then the binomial method provides a discrete simulation of the pathway with the value increasing or decreasing over any interval of length Δt by the factors u and d respectively where

$$u = \exp(\sigma\sqrt{\Delta t}) \text{ and } d=1/u.$$

For example, the value of a business with volatility of 30% per year would over a year either increase by a factor of $u = \exp(0.3\sqrt{1.0}) = 1.35$ or decrease by a factor of $d = 1/1.35 = 0.74$. Thus an asset with initial value of $100m would evolve over 2 years as shown below:

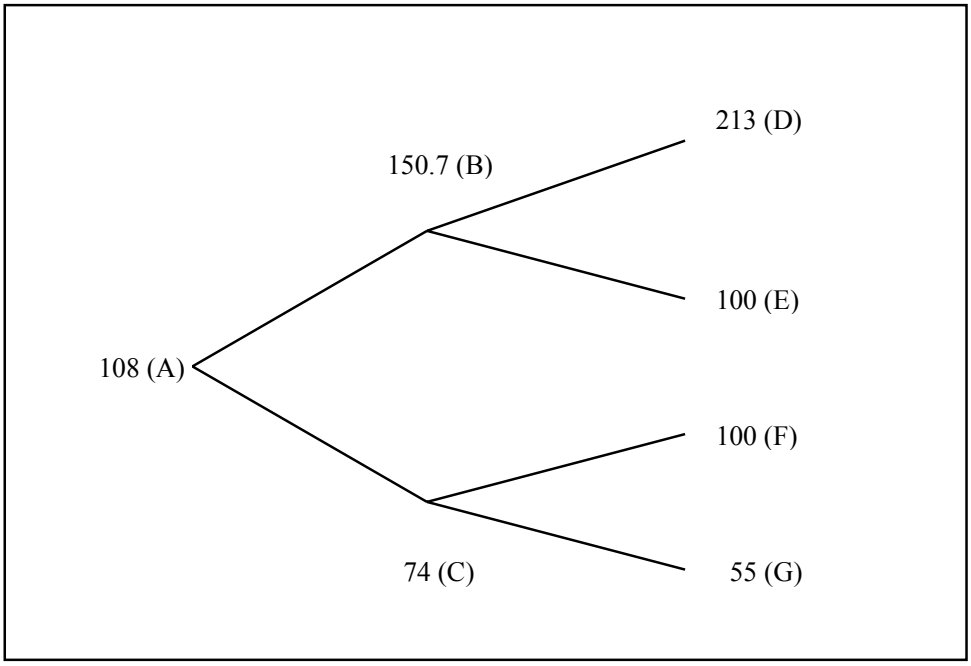


Now assume that the firm has flexibility in terms of expanding its size, specifically it has a real option to expand its operations by a factor of 50% at a fixed cost of $60m. Then in the state denoted by node D it would choose to expand as the value after expansion is 1.5(182) – 60 = $213m which is greater than the present value of $182m. However, at node E the firm would not choose to expand as the value after expansion is only $90m, which is less than the present value of $100m. Similarly, in the states denoted by nodes F and G the firm would not expand. These payoffs are noted on the real option valuation lattice (see below) and the valuation is then performed by working backwards from right to left through the lattice using the risk neutral probabilities, q and (1-q) where

$$q = [\exp(r\Delta t) - d]/(u-d)$$

and where r is the risk free rate. Assuming that the risk free rate is 8%, then

$$q= [\exp(0.08(1)) - 0.74]/(1.35 - 0.74) = 0.56 \text{ and } (1-q) = 0.44.$$



Thus at node B the result of exercising the option is 1.5(135) – 60 = 142.5 but if the option is not exercised the value in that state is [213(0.56) + 100(0.44)]/exp[0.08(1)] = 150.7. Thus the firm is best to leave the option open. Similarly the option is best left open at node C. At node A the value is $108m and comparison with the value of the underlying asset thus shows that the value of the flexibility is $8m. This calculation is illustrative of the binomial method but a realistic estimate of the value of the option

should be based on a larger number of steps in the lattice. However, recognising the uncertainty that exists on the estimates that enter the DCF calculation, the pursuit of a high level of accuracy on the option valuation is not justified and usually around 5 steps provides a good satisfactory level of accuracy. (In the case of this example, calculation of the option value with 5 steps results in an estimate of 7.8).

The binomial method can handle a wide variety of options including complex options such as chooser options (where there is simultaneously choice of deferral, contraction, expansion or abandonment) and compound options (where value depends on the value of another option rather than the underlying asset value). Where the uncertainty is separated into different sources the options are called rainbow options. A volatility factor is estimated for each source of uncertainty and thus for the case of two sources a quadranomial rather than a binomial lattice is used. However, the method of valuation is otherwise similar to that used in the binomial valuation.

As noted above, valuation of flexibility requires having an estimate of the volatility – the standard deviation of the logarithmic cash flow returns. This could be estimated by rough and ready methods such as management guesstimates of key points on a normal distribution. However, it is best estimated by simulation and this can be carried out as part of the simulation to determine the sensitivity of the DCF value to the assumptions made. The value of the ratio of year 2 DCF value to the year 1 DCF value is calculated, that is

$$X = \ln\left[\sum_{t=2} \frac{C_t}{(1+\text{WACC})^t} \Big/ \sum_{t=1} \frac{C_t}{(1+\text{WACC})^t}\right]$$

This calculation is repeated a large number of times for different values of the numerator to produce a probability distribution for X. The standard deviation of this distribution can then be used as an estimate of the required volatility for estimation of real option values.