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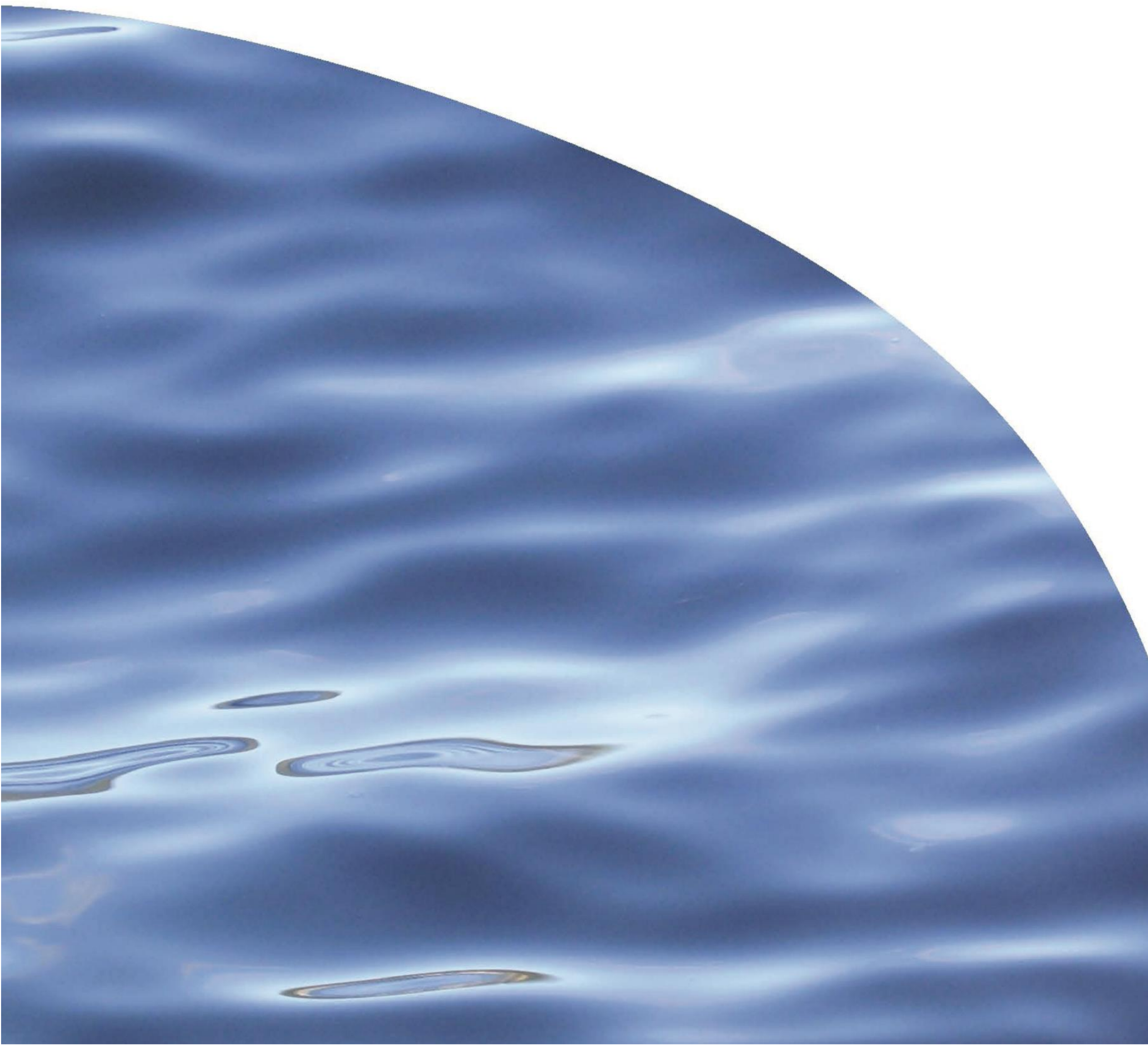
REPORT NO. 2863

MARINE ENVIRONMENTAL MONITORING - ADAPTIVE MANAGEMENT PLAN 2016–2017 FOR SALMON FARMS: CLAY POINT, RUAKAKA, OTANERAU, FORSYTH, AND WAIHINAU



MARINE ENVIRONMENTAL MONITORING - ADAPTIVE MANAGEMENT PLAN 2016–2017 FOR SALMON FARMS: CLAY POINT, RUAKAKA, OTANERAU, FORSYTH, AND WAIHINAU

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1. INTRODUCTION

The New Zealand King Salmon Company Limited (NZ King Salmon) operates eleven consented farm sites in the Marlborough Sounds (Table 1 and Figure 1). Each site is monitored pursuant to a marine environmental monitoring adaptive management programme (MEMAMP). NZ King Salmon has requested that Cawthron Institute (Cawthron) provide an overview of the monitoring that will be undertaken at five of these farm sites (Clay Point, Ruakaka, Otanerau, Forsyth and Waihinau; Table 1) from August 2016–July 2017. Monitoring will be consistent with that undertaken in 2015 / 2016, except for the alterations that this report outlines.

The Te Pangu, Waitata, Ngamahau, and Richmond sites are monitored under separate monitoring programmes. Sites MFL-032 and MFL-048 have been fallowed and are not planned to be stocked in the near future, therefore monitoring at these sites is not required at this time.

Table 1. List of NZ King Salmon's marine farm sites in the Marlborough Sounds, including the associated monitoring plan they are covered under, number of the Consent relating to environmental monitoring where applicable, and the sites' anticipated operational status at the time of the proposed monitoring under this MEMAMP.

Site location	Monitoring plan	Consent #	Operational status
Clay Point (CLA)	Current report	U060926	Stocked
Ruakaka (RUA)	Current report	U021247	Stocked
Otanerau (OTA)	Current report	U040217	Stocked
Forsyth (FOR)	Current report	U040412	Fallowed Jan. 16
Waihinau (WAI)	Current report	MFL456*	Fallowed Jan. 16
Waitata (WTA)	Elvines et al. 2016	U140294	Stocked
Ngamahau (NGA)	Elvines et al. 2016	U140296	Stocked
Richmond (RIC)	Elvines et al. 2016	U140295	Stocked
Te Pangu (TEP)	Elvines & Taylor 2016	U150081	Stocked

*There is no requirement for environmental monitoring in the conditions of this Consent (*i.e.* monitoring at this site is voluntary).

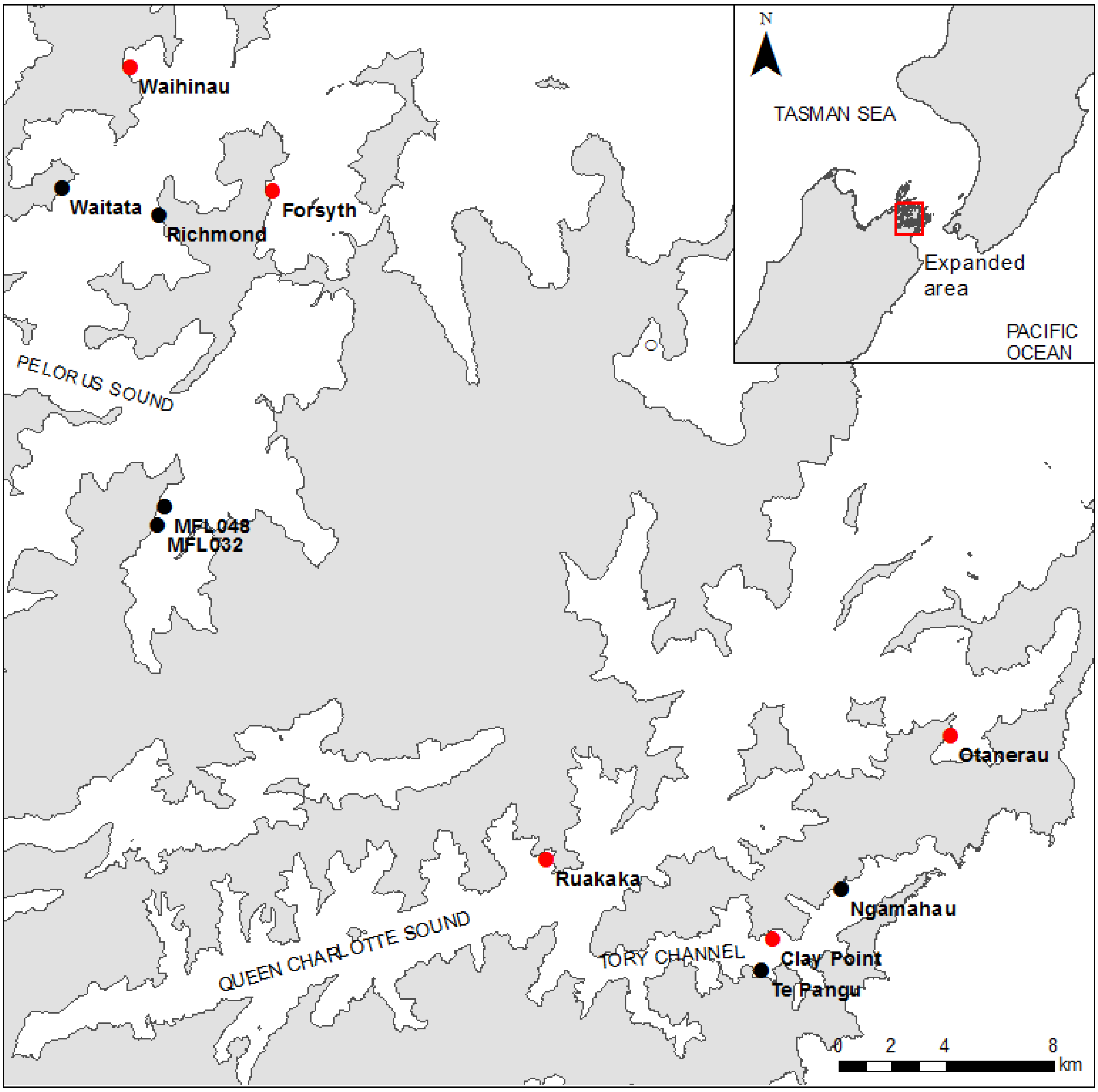

Figure 1. Locations of the NZ King Salmon farm sites in the Marlborough Sounds. Farm sites covered under this monitoring plan are shown as red dots. Remaining sites are shown as black dots.

2. PROPOSED MONITORING PROGRAMME FOR 2016-2017

2.1. Overview

The monitoring programme assesses two main components: effects of deposition on the seabed and foreshore, and effects on water quality. Environmental performance for these components will generally be measured against environmental quality standards (EQS; Section 2.3.5). The types and levels of monitoring that will be conducted at each of the five farm sites during the 2016 / 2017 monitoring is summarised in Table 2. For Clay Point, monitoring for lighting and additional water column monitoring is required under the consent (see Section 2.2).

The Forsyth and Waihinau Bay farms were fallowed in January 2016.

Table 2. Summary of monitoring components and 'level' of copper (Cu) and zinc (Zn) sediment monitoring for the upcoming year at each site. Sampling intensity and investigation for Cu and Zn are based on the results of the 2015 annual monitoring (see Appendix 2 for decision tree).

Site	Water column	Seabed	Cu & Zn	Reefs	Inshore habitat
CLA	Yes	Yes	Level 1	Yes, quantitative	-
OTA	Yes	Yes	Level 3	-	Yes
RUA	Yes	Yes	Level 3	-	Yes
WAI	Yes*	Yes	Level 3	-	Yes
FOR	Yes*	Yes	Level 3	-	Yes

* If site is fallowed, only the net pen stations will be sampled.

2.2. Clay Point Resource Consent conditions 38d and 38e

The Clay Point farm has two additional conditions that require monitoring of potential effects in the water column at the nearby Ngaruru Bay mussel farm (condition 38d), and the effects of lighting on benthic and pelagic species (38e). A report considering these effects was prepared in 2015 (Taylor et al. 2015).

2.2.1. Condition 38d

Potential water column effects at the Ngaruru Bay mussel farm relate to nutrient (nitrogen) enrichment. Although elevated nitrogen levels around the Ngaruru farm are a possible result of Clay Point farming effects, elevated nitrogen levels are unlikely to affect the phytoplankton biomass or composition at Ngaruru Bay because the phytoplankton in this region are not likely to be nitrogen limited (Taylor et al. 2015). As such, any potential water column effects from the Clay Point salmon farm on the Ngaruru Bay farm are unlikely. Further, in the event that effects do occur, they are considered likely to be only minor. Accordingly, consistent with the previous MEMAMP, no further monitoring is proposed under this MEMAMP.

2.2.2. Condition 38e

Taylor et al*.* (2015) concluded that effects of lighting are no more than minor, suggesting that further field surveys of lighting effects at Clay Point are unnecessary. However, the report also indicated that it would be beneficial to include Clay Point in the study investigating lighting effects for the salmon farm in Ngamahau Bay, once the latter is in full production. As the Ngamahau farm will not be in full production during the term of this MEMAMP, no monitoring related to lighting is proposed at Clay Point at this time.

2.3. Seabed sampling

2.3.1. Sampling locations

The proposed sampling locations for the upcoming year are summarised in Table 3. Maps for each site are in Appendix 1.

Table 3. Summary of proposed benthic monitoring stations at each farm site during the 2016/2017 annual monitoring surveys. NF = Near field, FF = Far field. The number of replicates collected and the number of replicates analysed initially for each station is indicated in brackets (i.e. [n=3-5] indicates 5 will be collected, but only 3 will be analysed initially).

		Farm stations			**Reference stations**	
Farm	**Transect**	**Pens** or Zone 1/2 if 4-Zone	**Zone 1/2** or 2/3 if 4-Zone	**Zone 2/3** or 3/4 if 4-Zone	**Ref-NF** **(n = 3)**	**Ref-FF** **(n = 3)**
CLA	E W	Pen 1 (n = 3-5) Pen 2 (n = 3-5)	90 m (n = 3-5) 90 m (n = 3)	300 m (n =3-5) 300 m (n= 3)	TC-Ctl-1 TC-Ctl-4	TC-Ctl-3
OTA	E	Pen 1 (n = 3-5) Pen 2 (n = 3-5) Pen 3 (n = 3-5)	50 m (n=3)	150 m (n = 3)	QC-Ctl-1	QC-Ctl-2
RUA	S	Pen 1 (n = 3-5) Pen 2 (n = 3-5)	50 m	150 m	QC-Ctl-3	QC-Ctl-4
FOR	NE	Pen 1 (n = 3-5) Pen 2 (n = 3-5) Pen 3 (n = 3-5)	50 m (n=3)	150 m	PS-Ctl-2	PS-Ctl-3
WAI	SE	Pen 1 (n = 3) Pen 2 (n = 3)	-	180 m (n = 3)	PS-Ctl-1	

2.3.2. Sampling design and adjustments

Clay Point

Other than increased replication at some stations (two additional replicates for archive at Pen stations, and eastern transect stations), no changes are proposed from the sampling conducted in 2015. Copper and zinc results from 2014 warrant the continuation of Level 1 monitoring for these elements, however archive triplicate samples will be taken in case further copper and zinc analyses are required.

Notes on existing sampling design:

- *The Clay Point farm is monitored along the east and west transects because these down-current directions were selected from predictive modelling and subsequent effects monitoring. For the first three years after farm establishment a NE transect was also monitored, but this was discontinued in 2009.*

Ruakaka

Given that the high levels of zinc and copper are localised to beneath the farms as shown by the 2015 sampling at the 50m station, sampling for these contaminants will be maintained only beside the net pens. These analytes will be sampled to at least Level 3 for both metals.

Five replicate samples will be taken at net pen stations for enrichment indicators. Two of these samples will be archived in case the need for further analysis arises.

Notes on existing sampling design:

- *Sampling stations at this farm are aligned with the down-current direction (south).*

Otanerau

Given that the high levels of zinc and copper are localised to beneath the farms as shown by the 2015 sampling at the 50m station, sampling for these contaminants will be maintained only beside the net pens. These analytes will be sampled to at least Level 3 for both metals.

Five replicate samples will be taken at net pen stations for enrichment indicators. Two of these samples will be archived in case the need for further analysis arises.

Notes on existing sampling design:

- *The Otanerau farm is sampled along an eastern transect, as opposed to the northern down-current direction because the farm structures are occasionally extended or contracted in the northern direction. Sampling is required to be oriented in relation to the net pen edge and therefore the 50 m site has historically been situated either in recovering sediments (beneath where the pens had recently been) or further away in an area that has had very little recent deposition.*

- *As Otanerau is a low-flow site, footprint deformity is considered negligible and therefore a perpendicular transect has been utilised to overcome the problem posed by altering pen configurations*.

Forsyth

Given that the high levels of zinc and copper are localised to beneath the farms as shown by the 2015 sampling at the 50m station, sampling for these contaminants will be maintained only beside the net pens. These analytes will be sampled to at least Level 3 for both metals.

Five replicate samples will be taken at net pen stations for enrichment indicators. Two of these samples will be archived in case the need for further analysis arises.

Notes on existing sampling design

- *Forsyth is monitored at 50 m and 150 m in an offshore direction to account for bathymetry and proximity to neighbouring mussel farms, both of which can confound results.*
- *Forsyth is a very low-flow site, with correspondingly low footprint deformity; therefore the transect direction is not critical.*

Waihinau

No changes are proposed from 2015.

Notes on existing sampling design:

- *There are no existing benthic environmental quality standards at this site and NZKS commission monitoring at the site on a voluntary basis.*

2.3.3. Sampling protocol

At each sampling station, sediment samples will be collected using a suitable grab operated from a boat. Each successful (full) grab will constitute a replicate (i.e. three independent grabs (replicates) are required when sampling in triplicate[1]) that will be sub-sampled for the required parameters as below:

- A **sediment core** sample (63 mm diameter): qualitatively assessed for sediment colour, odour and texture. The top 30 mm will be quantitatively analysed for organic content as ash-free dry weight (AFDW).
- **Redox and sulphides:** Redox potential will be measured directly from the grab at 1 cm depth using a probe. Total free sulphides will be ascertained from a 5 ml syringe driven at a 45º angle into the surface sediment.
- A **macrofaunal core** sample (130 mm diameter, approx. 100 mm deep): the core contents will be gently sieved through a 0.5 mm mesh and animals retained will be

[1] Additional grabs will be required for archive samples.

preserved, identified and counted under a microscope by a suitably trained taxonomist.

- **Sediment photo-quadrats** and/or video footage will also be taken at each station to assess bacterial mat coverage, general seabed condition and presence of sediment out-gassing. The sea surface will also be scanned for visible sediment outgassing.

Following the Best Management Practice (BMP) guidelines (MPI 2015), pen station samples will also be subsampled for:

- An **additional sediment core** (63 mm diameter): the top 30 mm will be quantitatively analysed for copper and zinc concentrations as below (see Table 2 and Appendix 2):
    - Level 1: composited triplicates for total concentrations. Individual replicates from the first three pen station samples will also be collected for archive purposes.
    - Level 3: individual triplicates analysed for both total recoverable and dilute acid extractable fractions.

2.3.4. Data analysis

Enrichment stages

Benthic enrichment can be graded along a 7-stage Enrichment Stage (ES) scale (Figure 2) as detailed in the BMP guidelines (MPI 2015).

Following the best management practice guidelines, each environmental result (raw data) will be converted into an equivalent ES score using previously described polynomial relationships (MPI 2015). Average ES scores will then be calculated for the sediment chemistry variables (redox and sulphides), the infauna composition variables (abundance, richness, diversity and biotic indices; Appendix 3) and organic content (as % AFDW). However, where best professional judgement needs to be employed, the equivalent ES score is manually allocated (MPI 2015). The overall ES for a given sample is calculated by determining the weighted average of those three groups of variables. Finally, the overall ES for the sampling station is calculated from the average of the replicate samples with the degree of certainty reflected in the associated standard error.

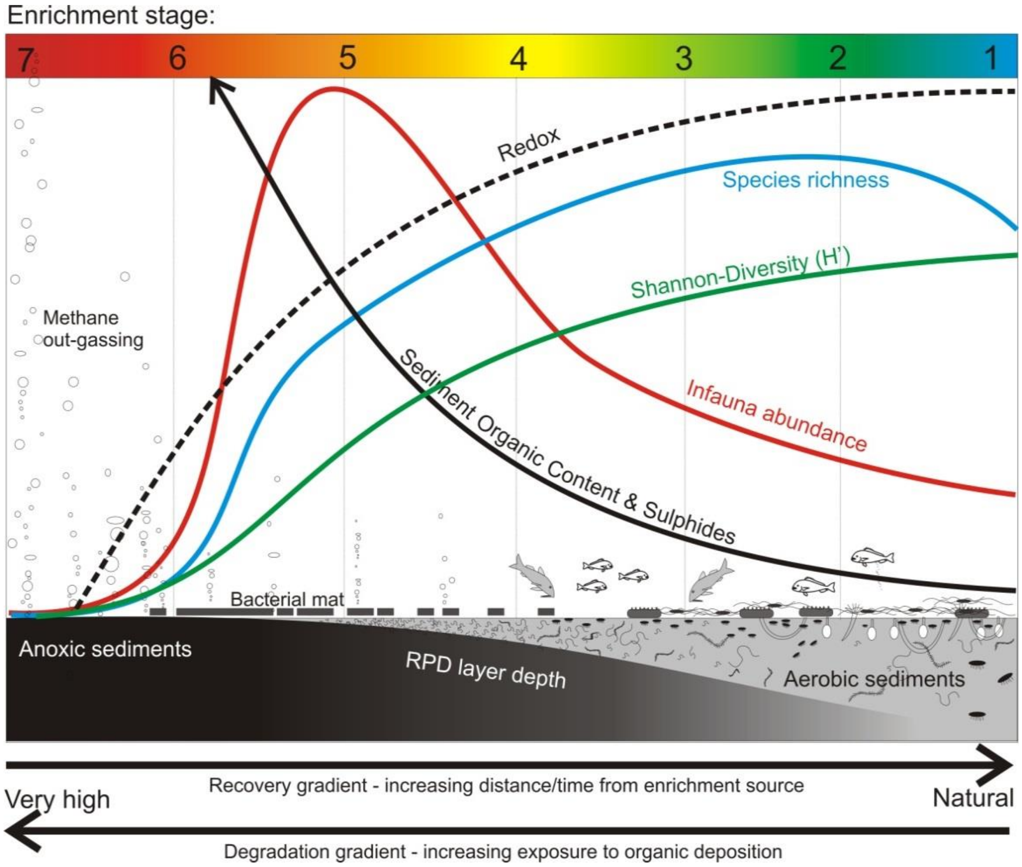

Figure 2. Stylised depiction of a typical enrichment gradient, showing generally understood responses in commonly measured environmental variables (species richness, infauna abundance, sediment organic content and sulfides and redox). The gradient spans from natural or pristine conditions on the right (ES = 1) to highly enriched azoic conditions on the left (ES = 7).

Copper and zinc

The BMP guidelines names the ANZECC (2000) ISQG-Low criteria for copper and zinc as the most appropriate trigger values for sediments beneath farms (MPI 2015), and therefore they should be used as the first tier trigger level for further actions (Table 4). For more information regarding the ecological effects of copper and zinc and the EQS, readers are referred to the BMP guidelines (MPI 2015).

Table 4. ANZECC (2000) Interim Sediment Quality Guideline (ISQG) concentrations for copper and zinc (mg/kg).

	ISQG-Low	ISQG-High
Copper	65	270
Zinc	200	410

2.3.5. Interpretation for compliance

Enrichment stages

The permitted levels of effect on the seabed are 'zoned' around each farm in accordance with pre-specified (and generally narrative) EQS detailed in the Consent for that site. The EQS relate to the magnitude (or 'severity') and spatial extent of effects.

Some consent conditions set precise parameters for the allowable environmental states within the zones. However, it is acknowledged that others have some ambiguity around how EQS translate to the ES scale. In these cases, reference is made to the BMP guidelines (MPI 2015).

Copper and zinc

Although an adaptive management decision tree (Appendix 2) was developed in conjunction with the NZKS application for new farm space in 2012, the monitoring of copper and zinc sediment concentrations is not a requirement of the conditions of consent for the existing low-flow farms (Forsyth, Waihinau, Otanerau and Ruakaka), and is therefore done on a voluntary basis.

2.4. Inshore / reef habitats

2.4.1. Qualitative assessment

Farming sites at Ruakaka, Otanerau, Forsyth and Waihinau have no significant reef habitats within their primary depositional footprint. However, inshore habitats are qualitatively assessed for general health with respect to signs of excessive organic deposition and obvious changes in visual characteristics over time. This assessment is undertaken biennially, and was last undertaken in 2014. As such, this component will be undertaken in the 2016 / 2017 monitoring year, concurrent with the sites' benthic monitoring. Video footage will be collected perpendicular to shore, along transects running from the shore toward the net pens. Transects will follow those surveyed in 2014 (see Appendix 1). Footage will be reviewed and compared with that collected during the previous survey to assess any potential changes.

2.4.2. Quantitative assessment

The farm site at Clay Point is located in proximity to significant reef habitat. An ongoing reef monitoring programme (undertaken in conjunction with the Te Pangu farm site) surveys the Clay Point reef habitat annually (*e.g.* Dunmore et al. 2016).

Sampling design

The sampling design detailed in this section is based on the existing reef monitoring programme (*e.g.* Dunmore et al. 2016). Reef monitoring for the Te Pangu farm is undertaken jointly with that for the Clay Point farm. However, the following summarises only the monitoring design for the Clay Point site.

There are four reef sampling sites established for the Clay Point reef monitoring, as follows:

- Three potential ‘impact’ sites at Clay Point (CP1, CP2 and CP3) located ~60–200 m away from the pens.
- Three reference sites (CP4, TP 3 and TP4) that lie outside the primary depositional footprint and are established on areas of reef that are as comparable as possible to impact sites in terms of depth, substrate, aspect and habitats.

To maintain consistency with historical timing for the reef monitoring, monitoring will continue to be undertaken in October / November.

Sampling protocol

At each reef site, four replicate stations are permanently marked with a pair of pins cemented into the rock at a distance apart that corresponds to the short side of a rectangular 0.25 m^2 photo-quadrat. The pins are identified with yellow cattle tags (marked with the site and station name, and upper or lower pin relating to position) and some of the pins are marked with a float on a short nylon cord (Figure 3). This set-up aids relocation of the stations and allows the precise repositioning of six 0.25 m^2 photo-quadrats such that the same exact patch of reef, and individual, sessile (attached) macrobiota, can be monitored through time.

Six photo-quadrats will be taken at each station, producing four replicate clusters of six per site (*e.g.* Figure 3). Photos will be taken with a 10-megapixel digital SLR camera attached at a set distance from the 0.25 m^2 quadrat. Each photo will be qualitatively compared to the photos from the same position in previous years, and quantitatively analysed (see next section). Randomly positioned photo-quadrats will also be taken in the general vicinity of each sampling station, to encompass larger spatial extents and taxa that may be sensitive to disturbance caused while finding tags and collecting photographs. These photographs will be archived and can be used at a future date if necessary. As a recommendation from the 2014 report (Dunmore et al. 2015), video footage will continue to be collected around the potential impact sites to characterise the general areas, encompassing a larger spatial extent than that captured by photo-quadrats. Footage will be reviewed and archived for the assessment of any obvious visual changes over time.

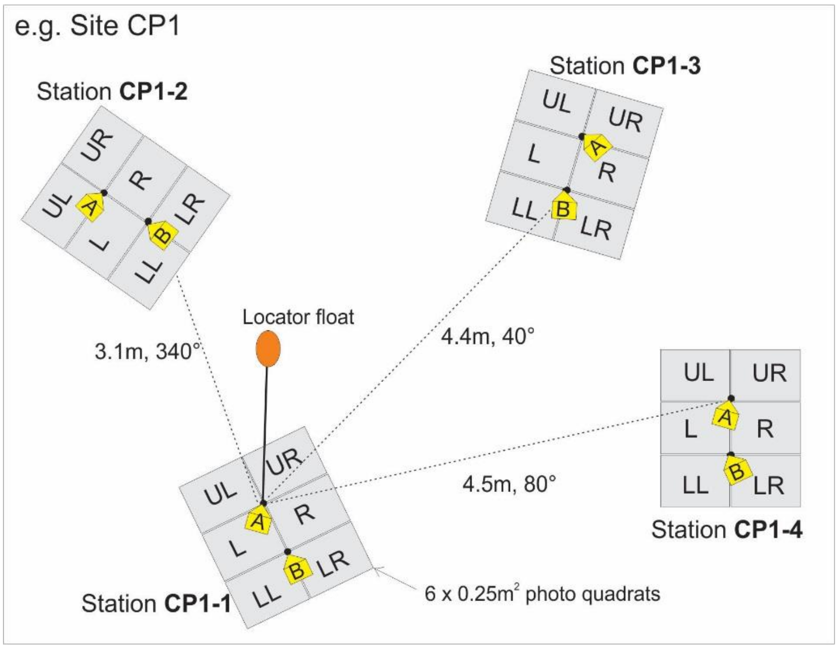

Figure 3. Example of the arrangement of the four photo-quadrat stations that are set up at each sampling site. Each rectangular sampling station comprises a 2 × 3 cluster of 0.25 m^2 photo-quadrats, aligned according to the two permanent marker pins. UL, UR, L, R, LL and LR denote upper-left, upper-right, left, right, lower-left and lower-right, respectively.

Data analyses

The primary purpose of the reef monitoring is to track the fate of a few representative sessile organisms (*e.g.* hydroids and sponges) that are considered potentially sensitive to deposition of organic material over time. This is achieved by obtaining sequential images for each site and assessing them qualitatively for presence / absence and any changes in composition or sedimentation. Additionally, abundance and area occupied (in the case of encrusting species) by conspicuous resident biota, will be determined using purpose-designed spatial referencing software (i.e., analysis software designed for use in ArcGIS). Two of the six photoquadrat images per station will be analysed (L and R images), with the other four images archived.

A variety of graphical and statistical comparisons will be used to compare between sites and years (e.g. PERMANOVA+ (in PRIMER v7, Anderson et al*.* 2008)). Adverse impact may be determined by a significant deterioration in community structure and/or notable die-off of conspicuous macrobiota at impact sites relative to control sites.

2.5. Water column sampling

2.5.1. Sampling locations

The overall sampling design is based on monitoring the 'worst-case scenario' at the pen edges, and then along the anticipated gradient at the Zone 2/3 and 3/4 boundaries (e.g. 50 m and 150 m down-current for the RUA farm) to evaluate near-farm mixing. As a continuation of the 2014 sampling regime[2], full-scale water column monitoring during 2016 / 2017 will be undertaken at all of the currently stocked farm sites, while the fallowed sites will have a lower intensity of sampling (net pen stations only).

At each site, sampling stations (listed by site in Table 5) will be selected along transects orientated according to the tidally reversing current flows (determined at the time of sampling).

Table 5. Stations to be sampled as part of water column monitoring during the 2016–2017 annual monitoring.

Farm	Pens (or Zone 1/2 if 4-Zone)	Zone 1/2 (or 2/3 if 4-Zone)	Zone 2/3 (or 3/4 if 4-Zone)	Ref
CLA	Pen 1	90 m (W or E)	300 m (W or E)	TC-Ctl-2
OTA	Pen 1	50 m	150 m	QC-Ctl-2
RUA	Pen 1	50 m	150 m	QC-Ctl-3
WAI*	Pen 1	-	180 m	PS-Ctl-1
FOR*	Pen 1	50 m	150 m	PS-Ctl-3

*If site is fallowed, only the net pen stations will be sampled.

2.5.2. Sampling protocol

At each station, the following parameters will be measured across the depth profile, *in situ* using a submersible sensor array (CTD: conductivity, temperature and depth):

- salinity
- temperature
- fluorometry (a proxy for chlorophyll-*a*)
- optical backscatter (a proxy for turbidity)
- dissolved oxygen (DO).

2 which was agreed upon with Marlborough District Council (MDC) and NZ King Salmon

Monitoring will occur at the same time as the benthic monitoring component for these sites. Results will be used to quantify the effect of individual farms on the surrounding near-field water column environment where the potential for detecting change / effects is greatest.

2.6. Reporting and recommendations

Annual monitoring reports will be provided to Council as soon as practically possible following the completion of the monitoring, and no later than 1 March 2017. The reports will include the following as per the consent conditions:

1. Presentation and interpretation of the monitoring results.
2. A comprehensive and integrated report on the effects of the development and operation of the farm to date; this includes incorporating data on the maximum biomass of fish and feed volumes for the past year into farm operations to date.
3. An assessment as to whether or not the farm is having a significant adverse effect on the environment.

Additionally, the consent holder and / or the research provider will provide:

4. Recommendations to avoid, mitigate or remedy environmental effects (if required).
5. Comments on the adequacy of the monitoring program and any recommendations relating to changes and/or improvements (*e.g.* frequency, parameters to be measured *etc.*).

The reef habitat monitoring data from the Clay Point site will be combined with those from the Te Pangu site (as in previous years). These results will be provided in a separate report to Council no later than 30 April 2017.

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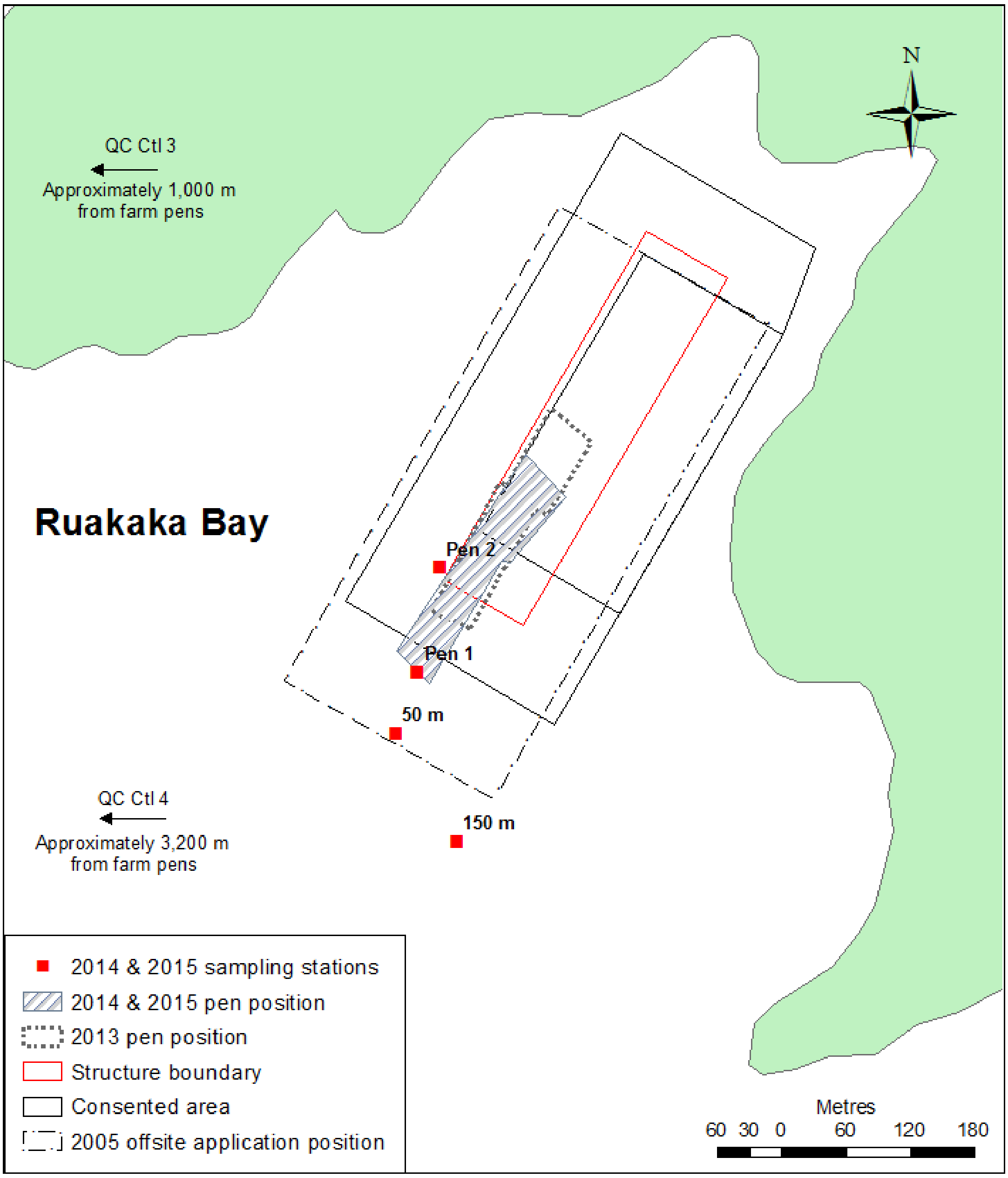
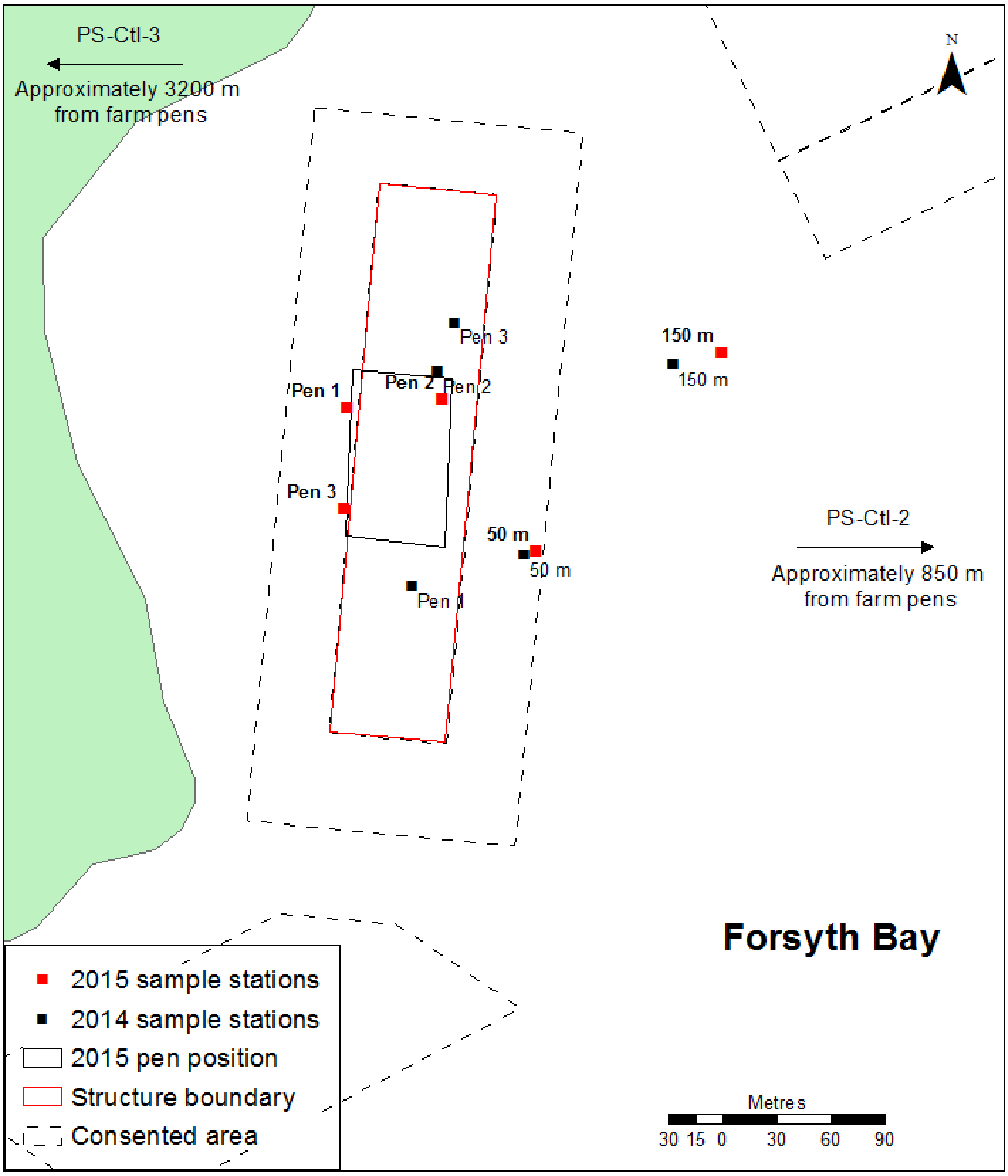
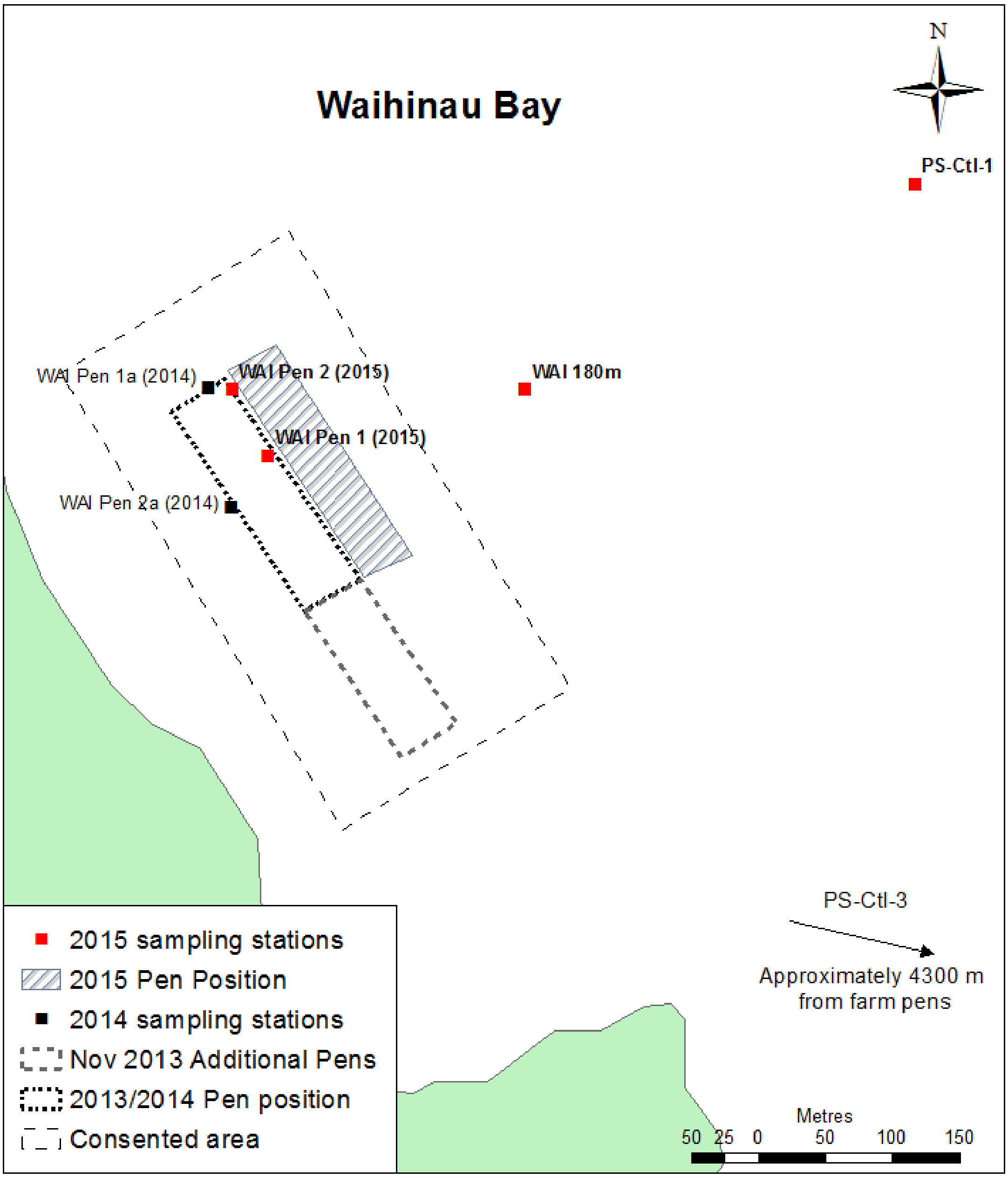
4. APPENDICES

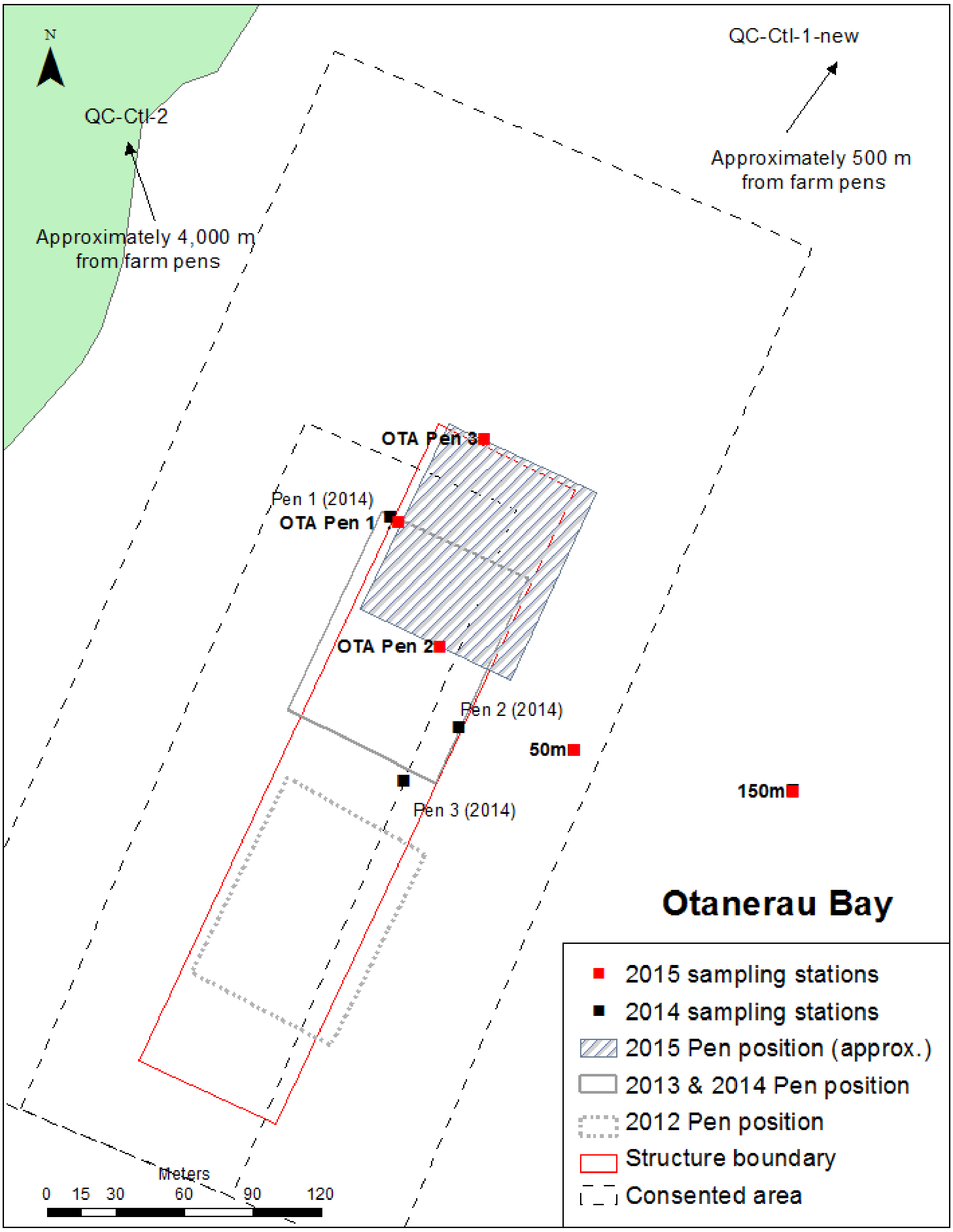
Appendix 1. Map of soft sediment sampling locations for the 2015 annual monitoring. Inshore video transects are not shown. Permanent reef monitoring sites for Clay Point are also shown (last map). Note sampling locations do not necessarily reflect exact locations for planned 2016-2017 monitoring (due to farm movements).

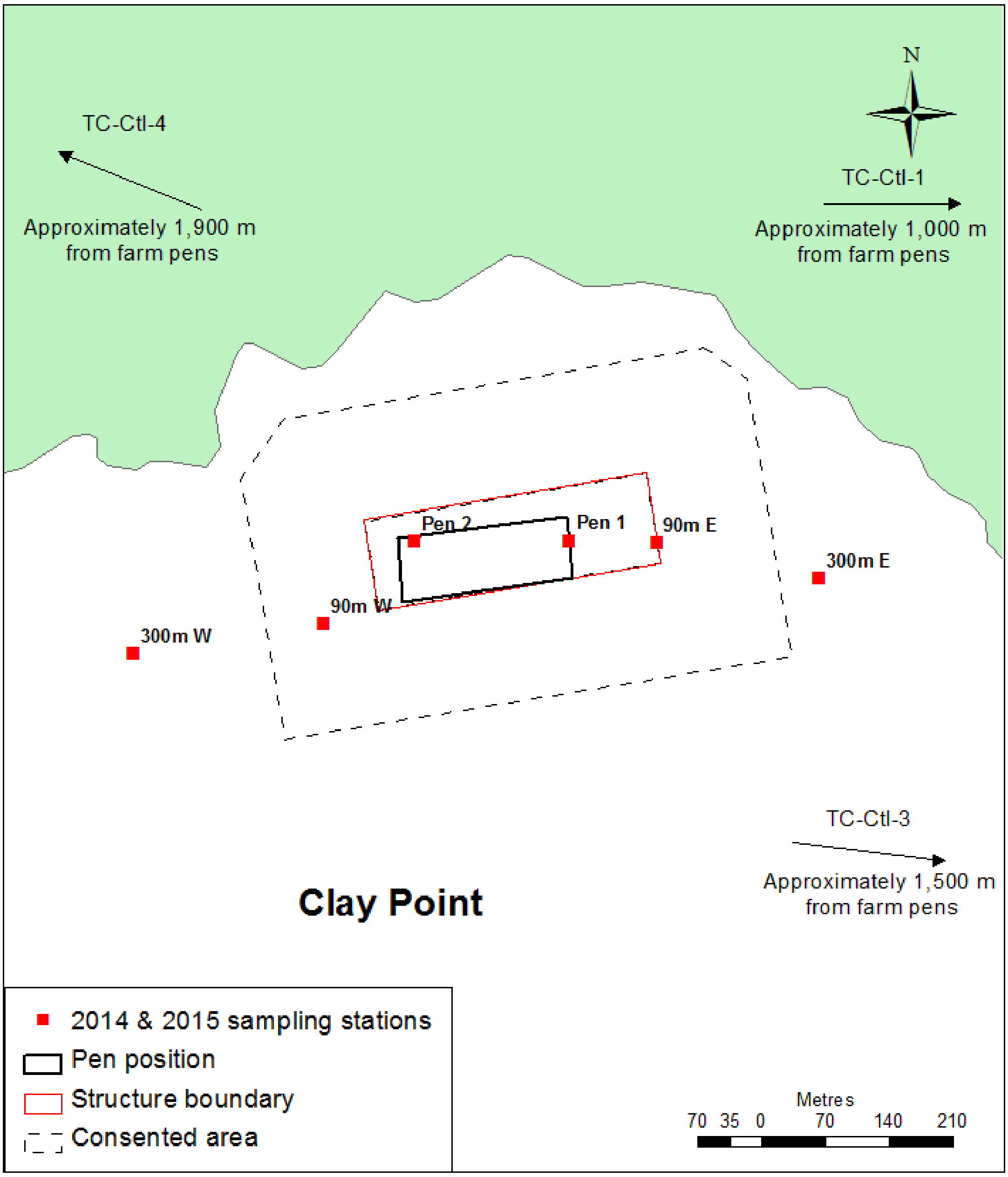


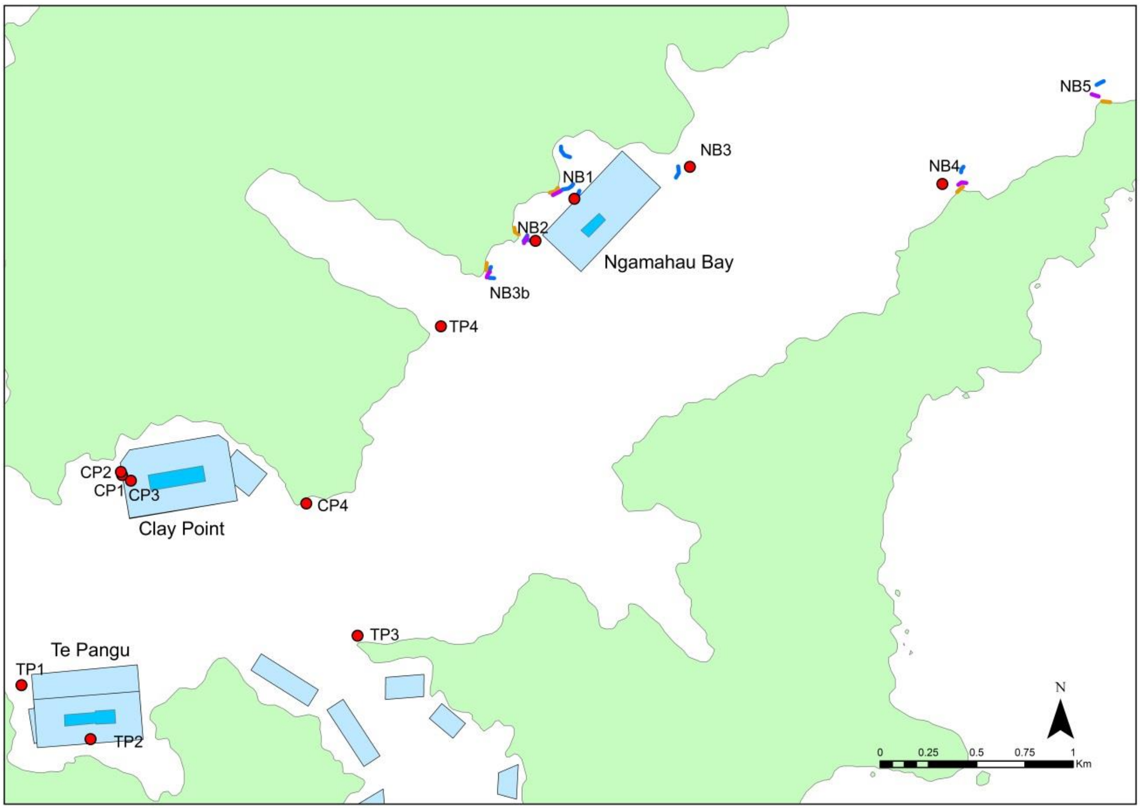

PS-Ctl-3
Approximately 3200 m from farm pens
Pen 3
150 m
150 m
Pen 1
Pen 2
Pen 2
Pen 3
50 m
50 m
Pen 1
PS-Ctl-2
Approximately 850 m from farm pens
Forsyth Bay
2015 sample stations
2014 sample stations
2015 pen position
Structure boundary
Consented area
Metres
30 15 0 30 60 90
N



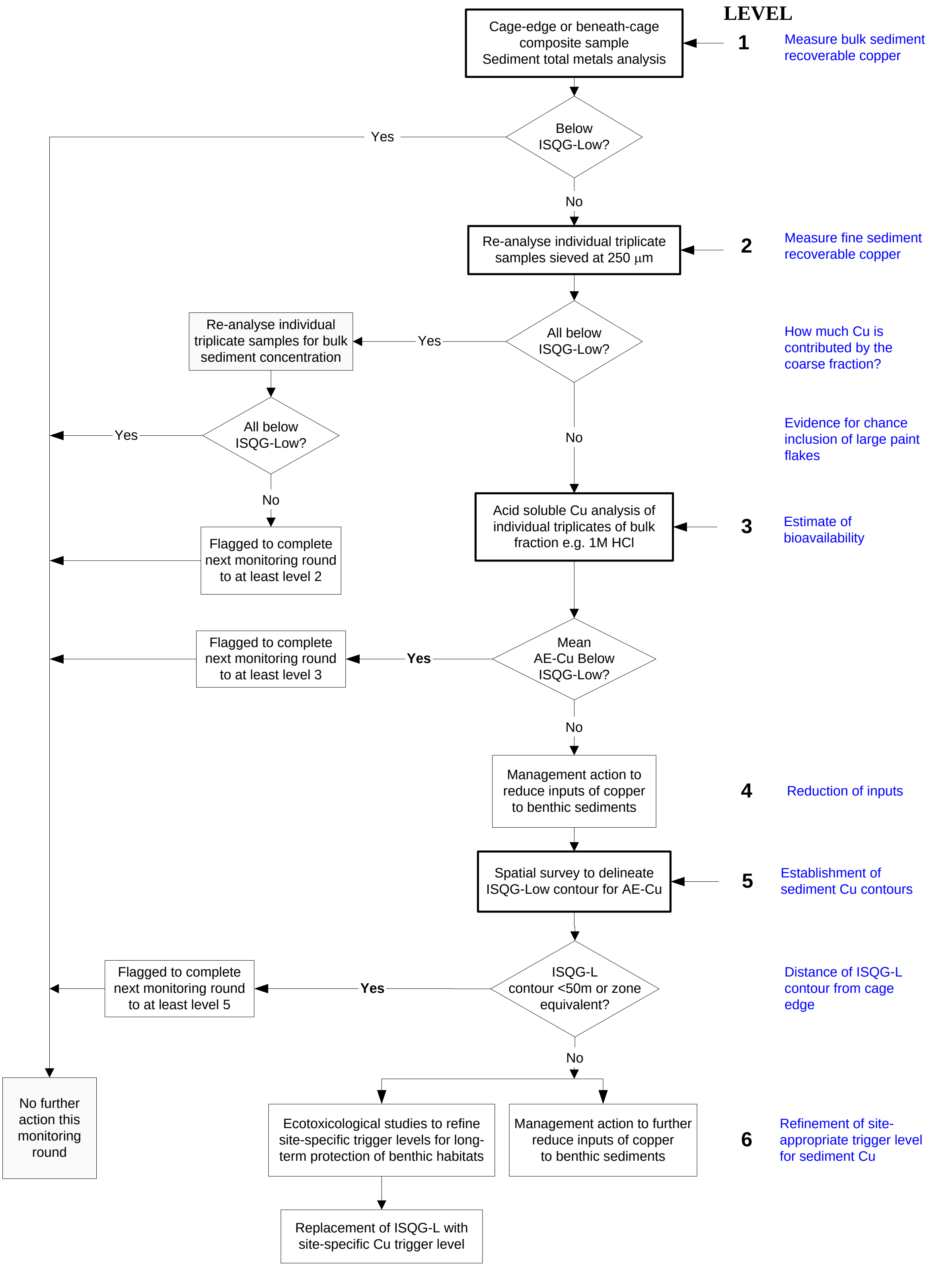
Waihinau Bay
N
PS-Ctl-1
WAI Pen 1a (2014)
WAI Pen 2 (2015)
WAI 180m
WAI Pen 1 (2015)
WAI Pen 2a (2014)
PS-Ctl-3
Approximately 4300 m
from farm pens
2015 sampling stations
2015 Pen Position
2014 sampling stations
Nov 2013 Additional Pens
2013/2014 Pen position
Consented area
Metres
50 25 0 50 100 150


N
QC-Ctl-2
Approximately 4,000 m from farm pens
QC-Ctl-1-new
Approximately 500 m from farm pens
OTA Pen 3
Pen 1 (2014)
OTA Pen 1
OTA Pen 2
Pen 2 (2014)
50m
150m
Pen 3 (2014)
Otanerau Bay
2015 sampling stations
2014 sampling stations
2015 Pen position (approx.)
2013 & 2014 Pen position
2012 Pen position
Structure boundary
Consented area
Meters
0 15 30 60 90 120


N
TC-Ctl-4
Approximately 1,900 m
from farm pens
TC-Ctl-1
Approximately 1,000 m
from farm pens
Pen 2
Pen 1
90m E
300m E
90m W
300m W
TC-Ctl-3
Approximately 1,500 m
from farm pens
Clay Point
2014 & 2015 sampling stations
Pen position
Structure boundary
Consented area
Metres
70 35 0 70 140 210


NB5
NB3
NB4
NB1
NB2
Ngamahau Bay
NB3b
TP4
CP2
CP1
CP3
Clay Point
CP4
TP3
Te Pangu
TP1
TP2
N
0
0.25
0.5
0.75
1
Km

Appendix 2. Decision response hierarchy for metals tiered monitoring approach (from MPI 2015).



Appendix 3. Definitions of selected biological indicators.

Indicator	Calculation and description	Source reference
N	Sum (n) Total infauna abundance = number of individuals per 13 cm diameter core	-
S	Count (taxa) Taxa richness = number of taxa per 13 cm diameter core	-
d	(S-1) / log N Margalef's diversity index. Ranges from 0 (very low diversity) to ~12 (very high diversity)	Margalef (1958)
J'	*H'* / log S Pielou's evenness. A measure of equitability, or how evenly the individuals are distributed among the different species. Values can range from 0.00 to 1.00, a high value indicates an even distribution and a low value indicates an uneven distribution or dominance by a few taxa.	Pielou (1966)
H'	$- \sum_i p_i \log(p_i)$ where p is the proportion of the total count arising from the *i*th species Shannon-Weiner diversity index (SWDI). A diversity index that describes, in a single number, the different types and amounts of animals present in a collection. Varies with both the number of species and the relative distribution of individual organisms among the species. The index ranges from 0 for communities containing a single species to high values for communities containing many species with each represented by a small number of individuals.	-
AMBI	= [(0 × %GI + 1.5 × %GII + 3 × %GIII + 4.5 × % GIV + 6 × %GV)]/100 where GI, GII, GIII, GIV and GV are ecological groups (see Section 2.3). Azites Marine Biotic Index: relies on the distribution of individual abundances of soft-bottom communities according to five Ecological Groups (GI to GV). GI being species sensitive to organic pollution and present under unpolluted conditions, whereas, at the other end of the spectrum, GV species are first order opportunists adapted to pronounced unbalanced situations (*e.g. Capitella capitata*). Index values are between 1 (normal) and 6 (extremely disturbed)	Borja et al. (2000)
M-AMBI	Uses AMBI, S and H', combined with factor analysis and discriminant analysis (see source reference). Multivariate-AMBI. Integrates the AMBI with measures of species richness and SWDI using discriminant analysis (DA) and factorial analysis (FA) techniques. Utilises reference conditions for each parameter (based on 'pristine conditions') that allows the index to be tailored to accommodate environments with different base ecological characteristics. Scores are from 1 (high ecological quality) to 0 (low ecological quality).	Muxika et al. (2007)
BQI	$= (\sum_{i=1}^{n}(\frac{A_i}{totA} \times \mathrm{ES50}_{0.05i})) \times {}^{10}\log(S+1)$ Where ES50 = expected number of species as per Hurlbert (1971) And, $\mathrm{ES50}_{0.05}$ the species tolerance value, given here as the 5th percentile of the ES50 scores for the given taxa as per Rosenberg et al. (2004). Benthic quality index: uses species specific tolerance scores ($\mathrm{ES50}_{0.05}$), abundance and diversity factors. Results can range from 0 (being highly impacted) and 20 (reference conditions).	Rosenberg et al. (2004)