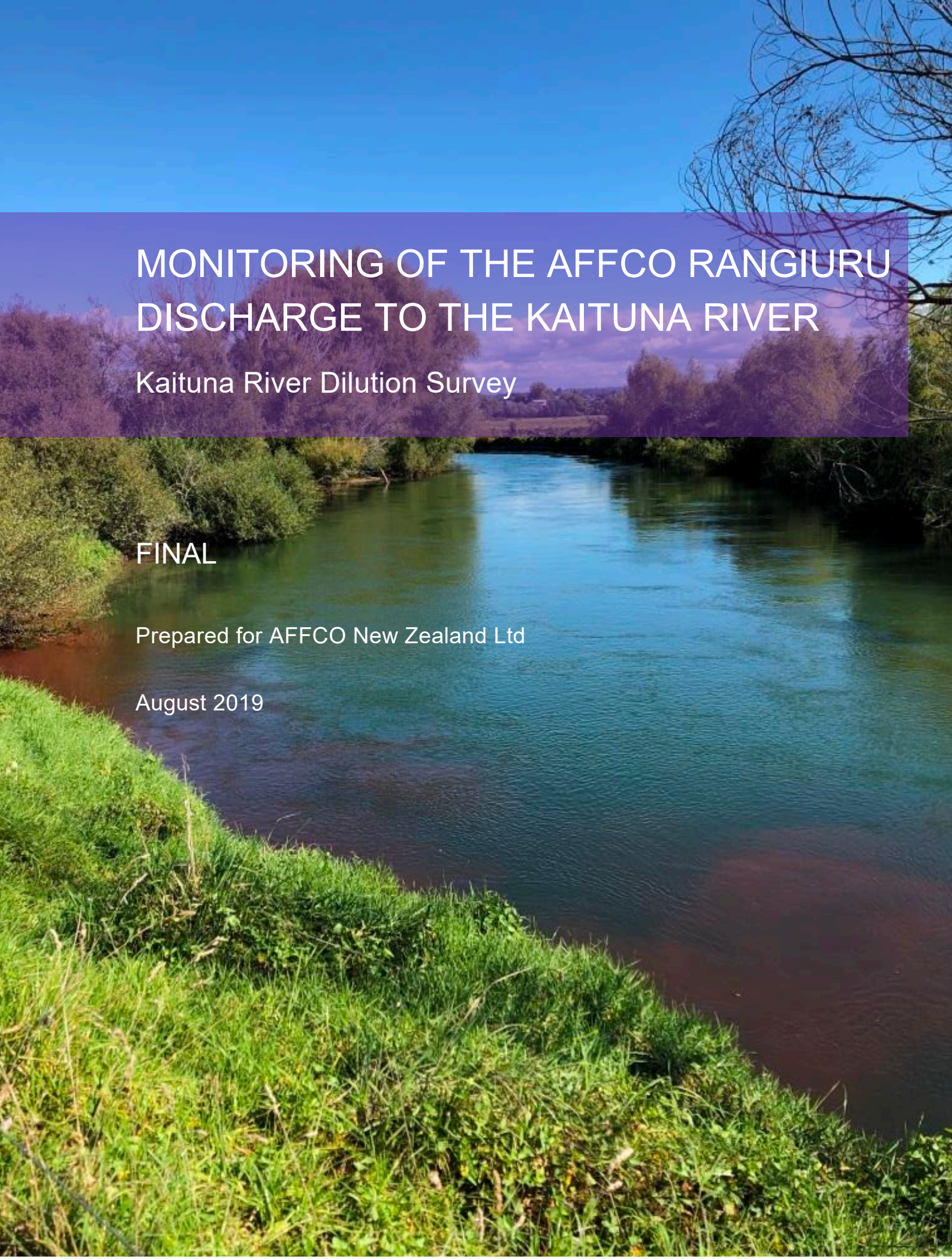

MONITORING OF THE AFFCO RANGIURU DISCHARGE TO THE KAITUNA RIVER

Kaituna River Dilution Survey

FINAL

Prepared for AFFCO New Zealand Ltd

August 2019

argoenvironmental

AFFCO NEW ZEALAND LIMITED – RANGIURU

Kaituna River Dilution Survey

Te Puke, Bay of Plenty

Prepared for

By

argoenvironmental

FINAL

August 2019

argoenvironmental

DOCUMENT REVISION SCHEDULE

Revision Status / Number	Revision Date	Description of Revision	Approved By
Rev0	August 2019	Final Draft	Luke Gowing (Director)
Rev1	August 2019	Final	Garry Venus (Director)

Statement of Limitations

This report is not to be used for purposes other than those for which it was intended.

This document has been prepared based on site observations, assessments and data collection undertaken by Argo Environmental Ltd and the information provided by the Client regarding the activities associated with the proposed Project.

Environmental conditions change with time. Argo Environmental Ltd do not imply that the site conditions described in this report are representative of past or future conditions.

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Where this report is to be made available, either in part or in its entirety, to a third party, Argo Environmental Ltd reserve the right to review the information and documentation contained in the report and revisit and update findings, conclusions and recommendations.

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EXECUTIVE SUMMARY

AFFCO New Zealand Limited operates a meat processing facility at Rangiuru in the Bay of Plenty. The facility discharges treated wastewater to the Kaituna River. AFFCO is authorised discharge wastewater pursuant to Consent 02 4932 which is currently undergoing renewal.

A study undertaken to assessing the mixing and dilution of treated AFFCO wastewater to the Kaituna River conducted in March 2019 indicates that wastewater is fully mixed at 100m (total ammonia) and 300m (rhodamine) based on the theoretical dilutions.

In addition, all measured River concentrations of total ammonia are well below ANZECC 2000 guideline concentrations based on River pH.

CONTENTS

APPENDICES

1. Introduction

AFFCO New Zealand Limited operates a meat processing facility at Rangiuru in the Bay of Plenty. The facility discharges treated wastewater to the Kaituna River. AFFCO is authorised discharge wastewater pursuant to Consent 02 4932 which is currently undergoing renewal.

Wastewater generated by the plant is biologically treated in three anaerobic ponds, two oxidation ponds and four constructed wetlands prior to discharge to the River via an outfall.

This report presents the results of a study that was commissioned to confirm the rates of dilution of discharged treated effluent being achieved by the diffusers in the River.

2. Methodology

2.1 Introduction

The River sampling was designed to determine the 'worst case' potential for mixing of the effluent with River waters i.e., at Low Tide and at MALF. The flow gauge at Te Mata, located 1.75 km downstream, is known to be tidally influenced but the upstream tidal influence is uncertain.

Prior to sampling a tracer (Rhodamine RT) was added into the final effluent stream from the wetlands just prior to discharge to the River using a peristaltic pump to provide a constant flow. Samples of effluent collected approximately at ½ hourly intervals for 2 hours (5 samples) from 1530 indicate providing a mean concentration of 2.9 ± 2.6 mg/L. Figures provided in Appendix A show the experimental set-up.

2.2 Timing of Sampling

On 21st March 2019 Low Tide at Maketu Estuary was predicted to be at 1340 based on the LINZ tide chart with a typical lag of 1 ½ - 2 hours being experienced at the Te Mata gauging site. The sampling exercise commenced at 1530 and finished at 1730 (Table 1).

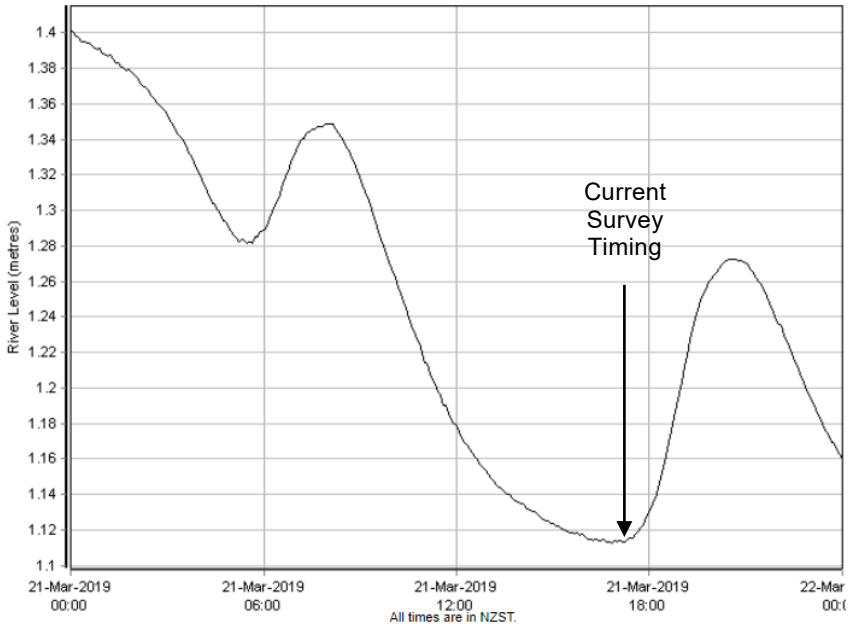

Figure 1: Water levels recorded at Te Mata on the Kaituna River

Figure 1 presents flows on the day of sampling. On the day of sampling the flow[1] in the Kaituna River was 33.0 m^3/s slightly higher than the MALF of 29.1 m^3/s.

Based on the cross sectional area of the River at both the 100m (35 m^2) and 300m (59 m^2) sites, flows at both sites of 0.94 and 0.56 m/s respectively were calculated. This implies that from the point of discharge it would take the effluent stream approximately 2 minutes to reach the 100 m site and between 5 and 9 minutes to reach the 300 m site. The 100m and 300m sites were sampled approximately 45 and 125 minutes respectively after the injection of tracer, allowing sufficient time for a 'steady state' condition to develop.

Table 1: Key statistics

River statistics	**MALF**	29.1
	Mean Flow	39.5
	Flow @ 1600 on 21/3/19	32.8
Discharge	**Volume**	2,382-2,488
Tracer injection Time		1530-1730
Sampling Times	**Control**	1530-1600
	100m	1605-1650
	300m	1655-1730
Sampling Locations (NZTM North & East)	**Control**	5811880 1897275
	Outfall	5811815 1897235
	100m	5811907 1897250
	300m	5812000 1897035

2.3 Sampling Sites

Three cross river transects were sampled: one was located upstream of the diffuser (control); and two at 100m and 300m downstream of the discharge to the River (see Figure 2). GPS co-ordinates of individual sampling sites are presented in Table 1.

The rationale for selecting these sites was as follows:

- 100m site to confirm the extent of initial mixing and dispersion of the effluent.
- 300m site was used as it has been previously considered to be the end of the mixing zone[2].

[1]Based on the ratings curve provided G Ellery, Data Services Manager @ BOPRC. November 2016.

[2]Bioresearches 1998. A review of the effects of AFFCO Rangiuru discharge on the Kaituna River. Report prepared for AFFCO Rangiuru.

Samples of treated effluent were also collected 50m upstream of the discharge as a control, and from the outlet at regular intervals during the discharge event to confirm discharge concentrations of total ammoniacal nitrogen and tracer.

Sampling locations for both transects were positioned 0.5m from each bank, the mid-point of the River and then mid-way between the 0.5m location and the River mid-point. A total of 5 locations on each of the two transects were sampled.

Water samples were collected at surface (0m) and at 0.5m depth intervals, with the total number of samples collected dependant on water depth at each site.

Due to time constraints a single sampling run was conducted. Sampling was conducted from a boat working from the true right banks to the left. Water samples were collected using a continuous water sampler.

Sampling locations along the Control transect were positioned at the mid-point of the River (15m) and then either side of mid-point halfway to the River bank (7.5m and 22.5m). Samples were collected at surface (0 m) and at 1m depth intervals to provide a total of 6 samples.

Sampling commenced at the 1000m transect first based on determining the extent of the discharge plume at the surface and river water velocities.

Figure 2: Approximate locations of outfall, transects and sampling sites

Figures provided in Appendix A show the extent of the plume shortly after discharge to the River.

2.4 Water Quality Parameters

The following parameters were recorded in the field and analysed in the laboratory:

- Conductivity;
- Total ammoniacal nitrogen; and
- Rhodamine WT dye, which was added to the effluent in the final point of discharge to the River from the wetlands to determine the dilution of the effluent in the River and to track the progress of the discharge plume.

The conductivity probe was calibrated prior to use in the field. Appendix B presents the laboratory report.

2.5 Sample & Data Analysis

All total ammonia and rhodamine data were used to calculate a mean and 90th percentile. The mean and 90th percentile respectively for the upstream control data (for ammonia) has been subtracted from their downstream totals. This concentration was then compared to the final effluent concentration data.

At the time of sampling the theoretical dilution at complete mixing is approximately 2,484x based on the mean discharge flow (13.2-13.3 L/s between 1530 & 1730) and the flow in the River (32.8 m^3/s) at the time of sampling.

3. Results

3.1 General Parameters

The following tables set out measured in-river conductivity (mS/cm) and pH levels. The key points to note are as follows:

- Upstream, 100m and 300m mean conductivities are 116.0 ± 0.5, 116.0 ± 0.8 and 115.7 ± 0.5 mS/cm respectively. Given the low conductivities at all sites there is no evidence of saltwater intrusion at any site.
- Upstream, 100m and 300m median pHs are 6.38, 6.40 and 6.0 respectively.

			Distance from True Right Bank			
Site	**Depth**	**0.5m**	**7.5m**	**15m**	**22.5m**	**29.5**
Control	**0m**		115.5	116.7	115.5	
	1.0m		116.1	116.4	115.9	
100m	**0m**	116.2	116.9	116.4	116.5	115.8
	0.5m	115.4	116.4	113.7	116.2	
	1.0m	115.6	116.1	116.4	115.2	
	1.5m		115.5	117.0		
	2.0m		116.7			
300m	**0m**	116.1	116.5	116.5	115.6	115.6
	0.5m	115.2	115.8	115.9	115.9	
	1.0m	115.1	115.4	115.1	115.2	
	1.5m	116.1	115.1	116.2	116.1	
	2.0m		115.3	115.7		
	2.5m		115.7			
	3m		115.1			
	3.5m		116.1			
	4m		115.2			

			Distance from True Right Bank			
Site	**Depth**	**0.5m**	**7.5m**	**15m**	**22.5m**	**29.5**
Control	**0m**		6.43	6.14	6.09	
	1.0m		6.33	6.81	6.45	
100m	**0m**	6.27	6.36	6.44	6.40	6.40
	0.5m	6.43	6.37	6.39	6.40	
	1.0m	6.46	6.36	6.36	6.40	
	1.5m		6.35	6.40		
	2.0m		6.35			
300m	**0m**	6.09	5.55	6.49	5.85	5.85
	0.5m	5.7	5.57	6.47	6.1	
	1.0m	5.73	5.57	6.48	6.3	
	1.5m	5.82	6.0	6.47	5.77	
	2.0m		5.95	6.46		
	2.5m		6.1			
	3m		6.0			
	3.5m		6.07			
	4m		6.2			

3.2 Ammonia

3.2.1 AFFCO Routine Monitoring Ammonia Concentrations

AFFCO routine effluent and River monitoring indicates the following ammonia concentrations around the time of the March 2019 survey.

Date	Effluent	Upstream	Downstream
8th March 2019	59.5 mg/L	0.01 mg/L	0.05 mg/L
15th March 2019	67.1 mg/L	0.01 mg/L	0.05 mg/L
29th March 2019	61.4 mg/L	0.02 mg/L	0.09 mg/L
Mean Concentration:	62.7 ± 4.0 mg/L	0.013 ± 0.06 mg/L	0.063 ± 0.023 mg/L

3.2.2 Wastewater ammonia during Survey

Measured Ammonia concentrations during the March 2019 survey were as follows:

Effluent 1530	65
Effluent 1600	66
Effluent 1630	66
Effluent 1700	66
Effluent 1730	66
Mean Concentration:	65.8 ± 0.4 mg/L
90th Percentile	66

3.2.3 In-River Ammonia Concentrations

The following table sets out measured in-river ammonia levels all as mg/L.

		Distance from True Right Bank				
Site	**Depth**	**0.5m**	**7.5m**	**15m**	**22.5m**	**29.5**
Control	**0m**		0.024	0.024	0.028	
	1.0m		0.051	0.018	0.013	
100m	**0m**	0.063	0.065	0.054	0.051	0.044
	0.5m	0.045	0.06	0.054	0.062	
	1.0m	0.047	0.067	0.048	0.053	
	1.5m		0.054	0.06		
	2.0m		0.06			
300m	**0m**	0.057	0.056	0.05	0.05	0.049
	0.5m	0.047	0.051	0.052	0.047	
	1.0m	0.062	0.048	0.056	0.05	
	1.5m	0.046	0.05	0.052	0.062	
	2.0m		0.051	0.042		
	2.5m		0.055			
	3m		0.055			
	3.5m		0.053			
	4m		0.052			

The upstream control mean ammonia concentration is 0.026 ± 0.013 mg/L (90th percentile is 0.040 mg/L).

Downstream total mean Ammonia concentrations (and 90th percentile) are as follows derived on an assumed in-plume basis:

- 100 m 0.056 ± 0.007 mg/L (90th percentile is 0.064 mg/L)
- 300 m 0.052 ± 0.005 mg/L (90th percentile is 0.057 mg/L)

Following subtraction of upstream concentrations and based on mean ammonia concentration in the treated effluent of 65.8 ± 0.4 mg/L (90th percentile 66 mg/L), the following dilutions are estimated:

- 100 m 2,193x (2,750x (90th percentile))
- 300 m 2,990x [Fully mixed] (3,882x (90th percentile))

ANZECC 2000[3] guideline concentrations for total ammonia at measured River pHs of 6.0 - 6.4 are 2.49 - 2.57 mg/L. All River concentrations are orders of magnitude below guideline concentrations'

3.3 Rhodamine

3.3.1 Wastewater Concentrations

Measured Rhodamine concentrations are as follows:

Effluent 1530	7.2
Effluent 1600	3.2
Effluent 1630	2
Effluent 1700	0.21
Effluent 1730	1.8
Mean Concentration:	2.9 ± 2.6 mg/L

3.3.2 In-River Concentrations

The following table sets out measured in-river Rhodamine levels all as mg/L. Downstream total mean rhodamine concentrations are derived as follows on an assumed in-plume basis:

- 100 m - 0.0020 ± 0.0012 mg/L (90th percentile is 0.0040 mg/L)
- 300 m - 0.0012 ± 0.0010 mg/L (90th percentile is 0.0020 mg/L)

Based on a mean rhodamine concentration in the treated effluent of 2.9 ± 2.6 mg/L (and 90th percentile 5.6 mg/L), the following dilutions are estimated:

- 100 m - 1,450x (1,400x (90th percentile))
- 300 m - 2,416x [Fully mixed] (2,800x (90th percentile))

[3]ANZECC & ARMCANZ 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1; The Guidelines, Australia and New Zealand Environment and Conservation Council (ANZECC), Wellington.

		Distance from True Right Bank				
Site[4]	Depth	**0.5m**	**7.5m**	**15m**	**22.5m**	**29.5**
100m	0m	0.002	0.001	0.002	0.002	0.001
	0.5m	0.003	0.002	0.002	0.001	
	1.0m	0.001	0.003	0.001	0.001	
	1.5m		0.001	0.004		
	2.0m		0.005			
300m	0m	0.001	0.001	<0.0005	0.003	<0.0005
	0.5m	<0.0005	0.001	<0.0005	0.002	
	1.0m	0.001	<0.0005	<0.0005	0.002	
	1.5m	<0.0005	0.002	0.002	<0.0005	
	2.0m		0.003	0.002		
	2.5m		0.0005			
	3m		0.002			
	3.5m		0.002			
	4m		0.002			

4. Conclusion

The study assessing the mixing and dilution of treated AFFCO wastewater to the Kaituna River conducted in March 2019 indicates that wastewater is fully mixed at 100m (ammonia) and 300m (rhodamine) based on the assessed dilutions.

In addition, all measured River concentrations of total ammonia are well below ANZECC 2000 guideline concentrations based on River pH.

[4] Control data not included as these were not below the detection limits of the analysis (<0.0005mg/L) as expected. This was thought to be due to the sampler not wearing gloves at the time of sample collection. Gloves were worn for all subsequent downstream sampling.

Appendix A Site photographs

Photos showing the experimental set-up (top left) and rhodamine in the Kaitina River shortly after discharge

Appendix B Laboratory Data

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Certificate of Analysis
Laboratory Reference:190322-137

Attention:	Daniel Gulliver	*Final Report:*	**311642-0**
Client:	**ARGO ENVIRONMENTAL**	*Report Issue Date:*	**01-Apr-2019**
Address:	**101 Customs Street East, Auckland Central, 1010**	*Received Date:*	**22-Mar-2019**
Client Reference:	**Affco Rangiuru**		
Purchase Order:	**Not Available**	*Quote Reference :*	**10203**

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-1**	**190322-137-2**	**190322-137-3**	**190322-137-4**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		Effluent 1530	Effluent 1600	Effluent 1630	Effluent 1730
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	65	66	66	66
Rhodamine	mg/L	7.2 *	3.2 *	2.0 *	1.8 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-5**	**190322-137-6**	**190322-137-7**	**190322-137-8**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		Control/7.5/0	Control/7.5/1	Control/15/1	Control/22.5/0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.024	0.051	0.024	0.028
Rhodamine	mg/L	0.001 *	0.003 *	0.002 *	0.002 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-9**	**190322-137-10**	**190322-137-11**	**190322-137-12**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		Control/22.5/1	100/0.5/0	100/0.5/0.5	100/0.5/1.0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.013	0.063	0.045	0.047
Rhodamine	mg/L	0.002 *	0.002 *	0.003 *	0.001 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-13**	**190322-137-14**	**190322-137-15**	**190322-137-16**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		100/7.5/0	100/7.5/0.5	100/7.5/1.0	100/7.5/1.5
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.065	0.06	0.067	0.054
Rhodamine	mg/L	0.001 *	0.002 *	0.003 *	0.001 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-17**	**190322-137-18**	**190322-137-19**	**190322-137-20**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		100/7.5/2.0	100/15/0	100/15/0.5	100/15/1.0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.06	0.054	0.054	0.048
Rhodamine	mg/L	0.005 *	0.002 *	0.002 *	0.001 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-21**	**190322-137-22**	**190322-137-23**	**190322-137-24**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		100/15/1.5	100/22.5/0	100/22.5/0.5	100/22.5/1.0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.06	0.051	0.062	0.053
Rhodamine	mg/L	0.004 *	0.002 *	0.001 *	0.001 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-25**	**190322-137-26**	**190322-137-27**	**190322-137-28**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		100/29.5/0	300/0.5/0	300/0.5/0.5	300/0.5/1.0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.044	0.057	0.047	0.062
Rhodamine	mg/L	0.001 *	0.001 *	<0.0005 *	0.001 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-29**	**190322-137-30**	**190322-137-31**	**190322-137-32**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		300/0.5/1.5	300/7.5/0	300/7.5/0.5	300/7.5/1.0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.046	0.056	0.051	0.048
Rhodamine	mg/L	<0.0005 *	0.001 *	0.001 *	<0.0005 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-33**	**190322-137-34**	**190322-137-35**	**190322-137-36**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		300/7.5/1.5	300/7.5/2.0	300/7.5/2.5	300/7.5/3.0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.05	0.051	0.055	0.055
Rhodamine	mg/L	0.002 *	0.003 *	<0.0005 *	0.002 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-37**	**190322-137-38**	**190322-137-39**	**190322-137-40**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		300/7.5/3.5	300/7.5/4.0	300/15/0	300/15/0.5
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.053	0.052	0.05	0.052
Rhodamine	mg/L	0.002 *	0.002 *	<0.0005 *	<0.0005 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-41**	**190322-137-42**	**190322-137-43**	**190322-137-44**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		300/15/1.0	300/15/1.5	300/15/2.0	300/22.5/0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.056	0.052	0.042	0.05
Rhodamine	mg/L	<0.0005 *	0.002 *	0.002 *	0.003 *

Sample Details		WATERS	WATERS	WATERS	WATERS
Lab Sample ID:		**190322-137-45**	**190322-137-46**	**190322-137-47**	**190322-137-48**
Client Sample ID:					
Sample Date/Time:		21/03/2019	21/03/2019	21/03/2019	21/03/2019
Description:		300/22.5/0.5	300/22.5/1.0	300/22.5/1.5	300/29.5/0
General Testing					
Ammoniacal Nitrogen (as N)	mg/L	0.047	0.05	0.062	0.049
Rhodamine	mg/L	0.002 *	0.002 *	<0.0005 *	<0.0005 *

Sample Details		WATERS	WATERS
Lab Sample ID:		**190322-137-49**	**190322-137-50**
Client Sample ID:			
Sample Date/Time:		21/03/2019	21/03/2019
Description:		Control/15/0	Effluent 1700
General Testing			
Ammoniacal Nitrogen (as N)	mg/L	0.018	66
Rhodamine	mg/L	0.001 *	0.21 *

*Results marked with * are not accredited to International Accreditation New Zealand*

Where samples have been supplied by the client they are tested as received. A dash indicates no test performed.

Reference Methods

The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
General Testing				
Ammoniacal Nitrogen (as N) by Flow Analysis	APHA (online edition) 4500-NH3 H	0.005 mg/L	All	Auckland
Rhodamine by Fluorometry	In House Procedure	0.0005 mg/L	All	Auckland

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher. For more information please contact the Operations Manager.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

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ilac-MRA IANZ ACCREDITED LABORATORY

Report Signatory 01/04/2019

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