

Lorneville Wastewater Discharge Environmental Monitoring Plan

Document Reference LNV EFT 005
Revision 001
Issued By
Date 2015
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1.0 Purpose

The purpose of this plan is to describe the management processes to deliver the required monitoring programme for physical characteristics and water quality parameters of the discharge, and the physical, water quality and biological characteristics and parameters of the Makarewa River receiving waters. Additional requirements for stakeholder liaison are also described. This plan is a requirement of Consent No XXXX, Conditions 3 and 4.

2.0 Scope

This plan applies to aspects associated with the discharge of treated wastewater from the Lorneville Wastewater Treatment Plant to the Makarewa River as required by Consent No XXXX.

3.0 References

Environmental Management System Programme Manual	LNV PGM 009
Environment Southland Wastewater Discharge Permit	XXXX
Lnv Wastewater Treatment Plant Work Instruction	LNV EFT 001
Lnv Land Irrigation Management Plan	LNV EFT 002
Lorneville River and Effluent Monitoring	Form LNV 1102
Fish health profile manual. NIWA Technology Report 38.	Richardson, J. (1998).
Assessment of Ecology, Water Quality and Recreation in the Makarewa River, Oreti River and New River Estuary	FWS: November 2015
Assessment of Effects of the Wastewater Discharge on the Makarewa and Oreti Rivers and New River Estuary	AES / FWS: November 2015
Monitoring of the Alliance Lorneville Wastewater Discharge and the Makarewa River	AES / FWS: November 2015
Wastewater Treatment Issues and Options	PDP: October 2013

4.0 Definitions

WWTP	Wastewater Treatment Plant
Boiler Ditch	Formed ditch that runs adjacent to the WWTP and receives the discharged wastewater
cBOD ₅	5 day Carbonaceous Biochemical Oxygen Demand
TSS	Total Suspended Solids
DO	Dissolved Oxygen
TN	Total Nitrogen
TP	Total Phosphorous
ES	Environment Southland / Southland Regional Council
RWP	Regional Water Plan for Southland
NPS	National Policy Statement for Freshwater Management
TWP	Technical Working Party

5.0 Actions and Responsibilities

5.1 Responsibilities

The Engineering Manager has overall responsibility for the operation and maintenance of the Wastewater Treatment Plant (WWTP).

The Environmental Coordinator is responsible for the maintenance and implementation of this plan, compliance with it and its annual review.

The Water Services Supervisor or designate is responsible for the day to day operation of the Wastewater Treatment Plant (WWTP), the discharge from it and environmental sampling.

5.2 Discharged Treated Wastewater

5.2.1 Discharged Treated Wastewater Outlets

Wastewater discharge to the river is from either or both of the metered discharge points from Pond 5 and Pond 6 into the Boiler Ditch which runs adjacent to the south end of the WWTP and then into the Makarewa River as shown in Figure 1 below.

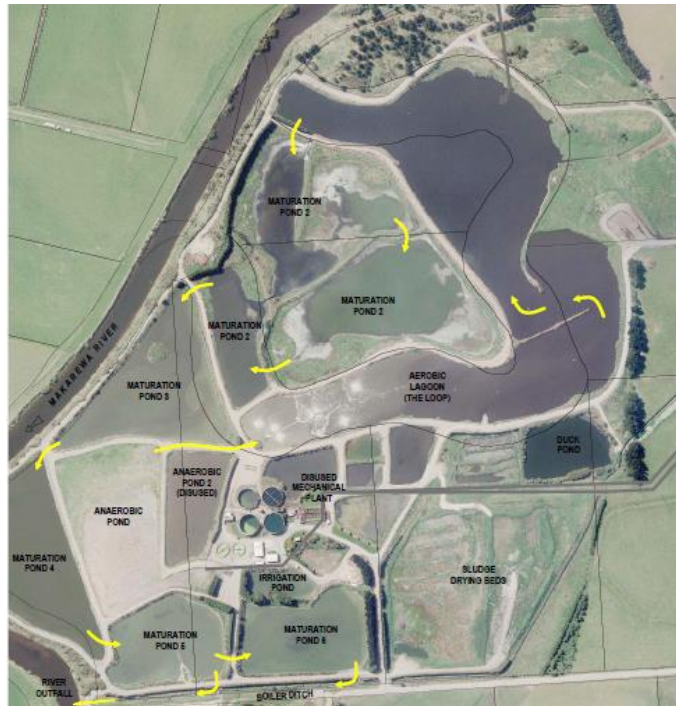


Figure 1: Lorneville Wastewater Treatment Plant showing discharge outlets from Pond 5 and Pond 6

5.2.2 Discharged Treated Wastewater Volume

Resource Consent **XXXX** permits the discharge of up to 22,730 m³/day to the Makarewa River (Condition 2).

The discharge outlets from Pond 5 and Pond 6 are controlled by gate valves which allow the manual management of the discharge rate.

When discharge is occurring the flow meters at either or both of the discharge outlets as required are read each morning and the totalised flow is recorded on Form 1102. This record is transferred to the current “Lnv Data” spreadsheet maintained on P drive / Public / Environmental Management where the daily volume is calculated and checked for compliance with the consented limit.

5.2.3 Discharged Treated Wastewater Quality

The following concentration limits apply at the monitoring site at the point of discharge to the Boiler Ditch from Pond 6. These limits apply prior to the intended wastewater treatment upgrade described in Section 5.5 (Condition 8).

Parameter	Limit
Carbonaceous BOD ₅	30 g/m ³
Total Suspended Solids	110 g/m ³
Total Nitrogen	180 g/m ³
Total Phosphorous	20 g/m ³
Faecal Coliforms	45,000 cfu/100mls

Compliance with these discharge limits is assessed against monitoring results as they are received from the testing laboratory. If two consecutive samples exceed these limits this is to be reported to ES as described in Section 5.7.2 (Condition 8b).

These limits are designed to ensure the quality of the wastewater does not deteriorate from the levels existing at the time Consent XXXX was granted. They have been derived from the 95th %ile of the 5 season database covering the period 1 October 2010 to 30 June 2015, a period that encompassed a range of climatic and processing variances.

5.3 Makarewa River

5.3.1 Receiving Water Monitoring Sites

For the purpose of monitoring compliance two river sites are sampled. The up-stream or “control” site is located beyond the point in the river which is subject to tidal influences, approximately 2,000 metres above the treated wastewater outfall into the river and close to the upstream boundary of the Lorneville property. The “compliance” site is located immediately downstream of the zone of reasonable mixing approximately 350 metres below the discharge outfall. (Condition 9) These monitoring sites are shown as “compliance control” and “350 m compliance” in Figure 2 below.



Figure 2: Makarewa River showing locations of monitoring sites.

5.3.2 Receiving Water Quality

The following limits apply prior to the intended upgrade as described in Section 5.5. They apply immediately downstream of the zone of reasonable mixing at the compliance monitoring site 350 metres downstream of the treated wastewater outfall into the river. Where comparison with upstream receiving water quality is required, the results from immediately downstream of the zone of reasonable mixing shall be compared with results from monitoring the river at the site upstream which is beyond the point in the river which is subject to tidal influences (Condition 10). The sites are shown in Figure 2 above.

- (a) Daily maximum temperature of the receiving water shall not be increased by more than 3°C when the natural temperature is <16°C, and not more than 1°C when the natural temperatures is >16°C when compared with the upstream control monitoring, and shall at no time exceed a maximum temperature of 23°C.
- (b) The pH of the water shall be within the range of 6.5 – 9.0.
- (c) Water clarity tube measurements shall not be reduced by more than 33% when compared with the upstream control monitoring site.

- (d) The dissolved oxygen (DO) concentrations of the receiving water shall be consistently maintained at not less than 6g/m³ and shall not on any occasion be less than 5g/m³. For the purposes of this condition, the term “consistently maintained” shall mean at the required level for 96% of the samples taken in any year.
- (e) There shall be no production of any conspicuous oil or grease films, scums, foams, or floatable or suspended materials.
- (f) The concentration of total oxidised nitrogen shall not exceed an annual median of greater than 2.4 g/m³ and 95%ile of greater than 3.5 g/m³ within the receiving water.
- (g) The concentration of total ammonia nitrogen within the receiving water shall not exceed the following values at the appropriate pH and temperature (prior to the proposed WWT upgrade):

Ammonia Limits:

pH	Temperature °C						
	0	5	10	15	20	25	30
6.5	29.0	26.0	25.0	25.0	24.0	16.4	11.8
6.75	26.0	25.0	23.0	22.0	22.0	15.3	10.9
7.0	23.0	21.0	21.0	20.0	18.9	13.5	9.5
7.25	19.0	18.0	16.0	16.2	15.8	11.0	7.8
7.5	14.3	13.4	12.7	12.2	12.0	8.4	6.0
7.75	10.0	9.4	9.0	8.6	8.5	5.9	4.3
8.0	6.6	5.6	5.8	5.7	5.6	4.0	2.9
8.25	3.7	3.5	3.4	3.3	3.2	2.3	1.72
8.5	2.1	2.0	1.89	1.89	1.89	1.41	1.05
8.75	1.21	1.15	1.12	1.13	1.16	0.88	0.68
9.0	0.71	0.68	0.68	0.71	0.75	0.59	0.48

Compliance with these requirements is assessed against monitoring results as they are observed or measured in the field (temp, pH, clarity, and foams), tested in the on-site laboratory (DO) or received from the external testing laboratory (currently Watercare). Field measurements are recorded on Form 1102. This record is transferred to the current “Lnv Data” spreadsheet maintained on P drive / Public / Environmental Management.

5.4 Discharge Management

5.4.1 Pond Capacity

Facultative ponds 2 -6 have a total area of approximately 150,000m² and an estimated depth of 1.8m equating to a volume of 270,000m³.

Aerobic Pond 1, the Loop has an area of approximately 92,000m². Sufficient water depth always has to be maintained for effective operation of the aerators. Leading into a processing season consideration can be given to maintaining a slightly reduced operating depth by leaving one “board” out of the discharge weir. This creates an available increase in depth of 300mm or approximately 27,500m³ additional capacity.

In total this provides approximately 300,000m³ storage capacity, sufficient for approximately 3 weeks processing waste if no discharge at all is possible.

5.4.2 Seasonal Management

In anticipation of the main processing season and potential summer low flows, the early season (pre-Christmas) discharge should be managed to ensure Ponds 2 – 6 are empty or close to empty in early January to ensure maximum storage is available. Beyond that period, opportunities to discharge compliantly during good river conditions should always be taken to ensure maximum possible storage capacity remains should a low flow period eventuate.

5.4.3 Daily Discharge Management

The discharge rate on any day is selected based on an understanding of the river condition which is maintained through daily monitoring and observations, analytical results and by checking the river flow at the Counsell Rd site on the ES website. The discharge rate is manually controlled by the discharge gate valves and displayed on the discharge flow meters.

During good river conditions discharge may be through both Pond 5 and Pond 6 outlets. If river conditions deteriorate (particularly reducing flow and increasing temperature) then discharge should initially be limited to discharge from one Pond outlet only and if further reduction is required then the rate further reduced manually.

As an indication only and dependent on other factors such as wastewater strength and river temperatures it is expected that the daily discharge in good river conditions will average 15-18,000 m³/day. As flows reduce to below 10m³/sec it is likely that the discharge should be reduced to approximately 10-12,000 m³/day and reduced further to approximately 7 – 8,000 m³/day as river flows drop to below 3 m³/sec. Should the river deteriorate to a point where it cannot assimilate even a reduced volume of wastewater then the discharge should cease.

Field monitoring provides an early indication of the river's ability to assimilate the discharge. Particular attention should be given to compliance limits, day by day variations and overall trends. Any non-compliant result should be responded to immediately (refer Section 5.7.2) and consideration given to a response when other indicators suggest an issue (refer LNV EFT 001).

Key indicating parameters are:

Dissolved Oxygen – first response if DO is less than 6.0g/m³

Conductivity – relationship to ammonia concentration, increasing trend or an elevated result should be investigated.

pH – affects ammonia toxicity, increasing trend or an elevated result should be investigated.

5.4.4 Irrigation

Irrigation of treated wastewater as authorised by Consent No XXXX and as described in LNV EFT 002 should be maximised during dry, low flow, summer conditions.

5.4.5 Contingency Lagoon

Should an extended period occur where discharge has been restricted and there is little available storage in the treatment ponds preparation should be made to utilise the consented emergency storage lagoon (Consent No XXXX). The integrity of the southern bund should be checked and provision made to block the exit of the drain to the river. A facility should be prepared to gravity transfer treated wastewater from Pond 5 to the adjoining "lagoon" area.

It is estimated that the lagoon area of approximately 8.3 ha will provide storage for about 83,000m³ of wastewater which would extend the ability to process stock in extreme dry conditions for a week.

Wastewater must not be continuously stored in the lagoon for longer than three months. When river conditions are restored sufficiently to assimilate wastewater and storage capacity is again available in the treatment ponds, the stored wastewater should be pumped back to the treatment ponds and discharged by the normal means.

While wastewater is stored in the lagoon weekly checks are to be carried out, the following recorded and each weekly inspection report provided to ES:

- (a) Date, time, wind direction and a description of wind strength;
- (b) Whether or not odour was detected and, if detected, the location;
- (c) The offensiveness and intensity of the odour; and
- (d) Whether or not the odour was, in the opinion of the consent holder, attributable to the wastewater in the storage area.

5.5 Wastewater Treatment Upgrade:

5.5.1 Up-grade Plan

Within five years of the commencement of Consent Number XXXX, a Wastewater Treatment Upgrade Plan identifying the technology and waste water treatment plant upgrades necessary to improve the quality of the wastewater discharged to the Makarewa River in order to meet the limits and limits set out in Section 5.5.2 and 5.5.4 below is to be prepared. The Plan shall be submitted to ES (Condition 12). Advice from an appropriate wastewater engineering consultancy (likely to be Pattle Delamore Partners (PDP)) should be sought well in advance of the requirement to provide an Upgrade Plan and full consideration should be given to the wastewater and treatment assessments carried out by PDP prior to the application for the current consent.

- (a) The Wastewater Treatment Upgrade Plan shall include, but not be limited to, the following matters:

- i. A description of the proposed technology and wastewater plant upgrades to be installed;
- ii. A description of the methodology of how the wastewater plant upgrades will be installed and a staged work plan describing the timing associated with the progressive implementation of these works;
- iii. The monitoring and reporting obligations associated with the wastewater treatment plant upgrades

Following preparation and submission to ES of this plan, reports are to be provided to ES on a bi-annual basis identifying progress towards implementation and commissioning of the wastewater treatment upgrade in accordance with the upgrade work plan. The reporting shall include any interim measures undertaken to improve the quality of the discharge, or physical plant works or operational changes associated with the upgrade (Condition 13).

The upgrade is to be fully operational prior to the 15th anniversary of the commencement of Consent No **XXXX**.

5.5.2 Discharged Treated Wastewater Post Upgrade

The following concentration limits apply at the monitoring site at the point of discharge to the Boiler Ditch from Pond 6 (Condition 16) after the intended wastewater treatment upgrade described in Section 5.5.1. The limits for TN (75% reduction) and TP (45% reduction) are derived from the expected reduction in these parameters assuming the up-grade consists of the flow separation of nitrogenous wastestreams contributing to around 25% of the site wastewater volume that contains approximately 75% of the nitrogen load. It assumes a parallel wastewater treatment system that would include a fully covered anaerobic reactor with biogas management, biological nitrogen removal reactor which would be operated as an activated sludge plant and a clarifier.

Parameter	Limit
Carbonaceous BOD ₅	30 g/m ³
Total Suspended Solids	110 g/m ³
Total Nitrogen	45 g/m ³
Total Phosphorous	11 g/m ³
Faecal Coliforms	45,000 cfu/100mls

As with the limits prior to the upgrade, compliance with these discharge limits is assessed against monitoring results as they are received from the testing laboratory. If two consecutive samples exceed these limits this is to be reported to ES as described in Section 5.7.2 (Condition 16b).

Within one year of the upgraded treatment plant being fully operational post up-grade, these limits for TN and TP shall be reviewed. The purpose of the review is to identify if the TN and TP limits above remain appropriate and if necessary recommend changes. The recommendations are to be provided to ES (Conditions 17).

Within 3 months of the receipt of the recommendations ES may then serve notice of its intention to review the post upgrade discharge limits for TN and TP (Condition 34).

Microbial limits should be reviewed as described in Section 5.5.3 below.

5.5.3 Microbiological Discharge

Within 10 years of the commencement of Consent No **XXXX** a review is to be undertaken to assess whether it is practicable and necessary to disinfect the waste stream to reduce the discharged microbial load. This review should consider at a minimum the existing faecal coliform / e coli discharged load, the upstream microbial contamination and catchment progress in reducing this, the effect of the discharge on the in-river load and in-river compliance with the current relevant regulations such as the Regional Water Plan and the NPS (Condition 18).

The result of this review is to be provided to ES. If this first review determines that it is not necessary at that stage to disinfect the discharged wastestream, or revise the faecal coliform or e coli limit then this is to be reassessed at 5 yearly intervals for the duration of the consent, or until disinfection is implemented.

When an assessment concludes that further treatment by way of disinfection is required then ES may, within 3 months of the receipt of the assessment, serve notice of its intention to review the conditions of the consent with the express purpose of imposing revised faecal coliform or e coli limits described in Section 5.2.3 and 5.5.2 above (Condition 33).

5.5.4 Makarewa River Post Up-grade

Receiving water limits to be achieved at the compliance site, 350 metres below the discharge, prior to the fifteenth anniversary of the commencement of Consent No XXXX are (Condition 15):

- (a) Daily maximum temperature of the receiving water shall not be increased by more than 3°C when the natural temperature is <16°C, and not more than 1°C when the natural temperatures is >16°C when compared with the upstream control monitoring site referred to as part of the EMP (condition 4), and shall at no time exceed a maximum temperature of 23°C.
- (b) The pH of the water shall be within the range of 6.5 – 9.0.
- (c) Water clarity tube measurements shall not be reduced by more than 33% when compared with the upstream control monitoring site.
- (d) The concentration of total ammonia nitrogen within the receiving water shall not exceed the following values at the defined pH.

Total Ammonia Concentration g/m ³			
pH	30 day Rolling Average and Annual Median (1.9 g/m ³ @pH 8.0)	4 day Rolling Average Maximum (4.75 g/m ³ @pH 8.0)	Annual 95 th % ile (2.4 g/m ³ @pH 8.0)
6.5	5.2	13.0	6.6
6.6	5.1	12.8	6.5
6.7	5.0	12.6	6.3
6.8	4.9	12.3	6.2
6.9	4.8	11.9	6.0
7.0	4.6	11.5	5.8
7.1	4.4	11.1	5.6
7.2	4.2	10.5	5.3
7.3	4.0	9.9	5.0
7.4	3.7	9.2	4.7
7.5	3.4	8.5	4.3
7.6	3.1	7.8	3.9
7.7	2.8	7.0	3.5
7.8	2.5	6.2	3.1
7.9	2.2	5.5	2.8
8.0	1.9	4.7	2.4
8.1	1.6	4.1	2.1
8.2	1.4	3.5	1.8
8.3	1.2	3.0	1.5
8.4	1.0	2.5	1.3
8.5	0.8	2.1	1.1
8.6	0.7	1.8	0.9
8.7	0.6	1.5	0.8
8.8	0.5	1.3	0.7
8.9	0.4	1.1	0.6
9.0	0.4	0.9	0.5

- (e) The concentration of total oxidised nitrogen shall not exceed an annual (1 Oct – 30 Sep) median of greater than 2.4 g/m³ and 95%ile of greater than 3.5 g/m³ within the receiving water.

Note that these are unchanged from the pre-upgrade limits except for the ammonia-nitrogen limits.

5.5.5 Post Up-grade Review

It is anticipated that post up-grade, the discharge outlets, volume limits, discharge and receiving water sampling sites and sampling frequency, analytical parameters, discharge limits for cBOD₅, TSS and faecal coliforms (subject to reviews as described in Section 5.5.3) and in-river limits except for ammonia-nitrogen will remain the same as those in place prior to the Wastewater Treatment Upgrade and as described in Sections 5.2, 5.3 and 5.6. If it is identified that changes to any of these consent described aspects will better

meet the intent of the consent then application can be made to ES to change or cancel conditions of the consent within 2 years of the upgraded wastewater treatment plant being fully operational (Condition 31).

5.6 Monitoring

5.6.1 Monitoring Frequency and Analytical Parameters

The frequency of monitoring and the required analytes in relation to the discharge to the river are tabled below (Condition 5 and Schedules A and B).

**Schedule A1. Treated Wastewater Discharge Monitoring Schedule for the Period
1 October to 31 May each year when discharging**

Parameter	Daily (When discharging)	Weekly (when discharging)
Volume *	X	
Electrical Conductivity *	X	
pH*	X	
Temperature*	X	
Dissolved oxygen concentration*	X	
Total ammoniacal nitrogen	X	
Total nitrogen		X
Total oxidised nitrogen		X
Total phosphorus		X
Dissolved reactive phosphorous		X
Total suspended solids		X
Volatile suspended solids		X
Carbonaceous BOD		X
Faecal coliforms		X
E-coli		X

**Schedule A2. Treated Wastewater Discharge Monitoring Schedule for the Period
1 June to 30 September each year when discharging**

Parameter	Daily (When discharging)	Weekly (when discharging)	Monthly (when discharging)
Volume *	X		
Electrical Conductivity *		X	
pH*		X	
Temperature*		X	
Dissolved oxygen concentration*		X	
Total ammoniacal nitrogen		X	
Total nitrogen		X	
Total oxidised nitrogen		X	
Total phosphorus		X	
Dissolved reactive phosphorous			X
Total suspended solids			X
Volatile suspended solids			X
Carbonaceous BOD			X
Faecal coliforms			X
E-coli			X

**Schedule B1. Receiving Water Monitoring Schedule for the Period
1 October to 31 May each year: Upstream Control site and Compliance site**

Parameter	Daily	Weekly	Weekly	Monthly
	When discharging		No discharge	
Electrical Conductivity *	X		X	
pH*	X		X	
Temperature*	X		X	
Dissolved oxygen concentration *	X		X	
Foams and scums*	X		X	
Total ammoniacal nitrogen	X		X	
Total oxidised nitrogen		X	X	
Total nitrogen		X	X	
Total phosphorous		X	X	
Dissolved reactive phosphorous		X		X
Total suspended solids		X		X
Carbonaceous BOD		X		X
Soluble carbonaceous BOD		X		X
Faecal coliforms		X		X
E-coli		X		X
Turbidity		X		X
Clarity Tube *		X		X

**Schedule B2. Receiving Water Monitoring Schedule for the Period
1 June to 30 September each year: Upstream Control site and Compliance site**

Parameter	Weekly	Monthly
	Discharge / No discharge	
Electrical Conductivity *	X	
pH*	X	
Temperature*	X	
Dissolved oxygen concentration*	X	
Foams and scums*	X	
Total ammoniacal nitrogen	X	
Total oxidised nitrogen	X	
Total nitrogen	X	
Total phosphorous	X	
Dissolved reactive phosphorous		X
Total suspended solids		X
Carbonaceous BOD		X
Soluble carbonaceous BOD		X
Faecal coliforms		X
E-coli		X
Turbidity		X
Clarity Tube *		X

* Parameters analysed by AGL wastewater treatment personnel

5.6.2 Sampling Methodology

Samples are to be collected from the final treated wastewater (from the sampling structure at the outlet of Pond 6) and from the Makarewa River upstream control site and the compliance site 350 metres below the discharge outfall (refer to Figures 1 and 2).

Samples collected on each occasion are to consist of a single grab sample from each site and shall be taken as far as is practicable at the same time each day and should always occur before 9.00 am. The stage of the tide shall be recorded.

At the time of sample collection and at a frequency as described above, the sample collector shall analyse the sample for pH, temperature, conductivity, clarity and Dissolved Oxygen. All results are to be recorded on Form LNV 1102. The sample shall then be packed in a chilly bin and sent to an IANZ Registered Laboratory (currently Watercare) for analysis of the parameters required by the Schedules in Section 5.6.1 above.

5.6.3 Data Management

The wastewater treatment operator responsible for sample collection transcribes the field data from Form 1102 into the current "Lnv Data" spreadsheet maintained on P drive / Public / Environmental Management. External laboratory results are received by the Environmental Coordinator and the Water Services Supervisor, with ammoniacal nitrogen results emailed to both daily and full results emailed on completion of the analyses. The Environmental Coordinator enters the external lab results into the "Lnv Data" spreadsheet and confirms compliance.

5.6.4 Ammonia Compliance Assessment

Compliance with:

- (a) The 30 day rolling average concentration of total ammonia nitrogen of the receiving water shall not exceed 1.9g/m^3 (at pH 8) and the rolling 4 day average concentration of total ammonia nitrogen within the receiving water over any 30 day period shall not exceed a maximum of 4.75g/m^3 (at pH 8) more than once over a three year period. (Refer to Section 5.5.4 (d)). (*Note: 4.75 is 2.5 times 1.9*)

shall be determined by the maintenance of database that:

1. Records the pH and ammonia-N concentration at the compliance site every day it is sampled
2. Records the daily compliance limit adjusted for the measured pH for both:
 - a. 1.9g/m^3
 - b. 4.75g/m^3
3. Calculates the daily quotient of the measured ammonia-N value divided by the pH adjusted compliance limit for both:
 - a. 1.9g/m^3
 - b. 4.75g/m^3
4. Calculates the 30 day rolling average of the quotients derived from the 1.9g/m^3 limit and:
5. Calculates the 4 day rolling average of the quotients derived from the 4.75g/m^3 limit.
6. Compliance with the 1.9g/m^3 limit is achieved if the 30 day rolling average of the quotients is not greater than 1.
7. Compliance with the 4.75g/m^3 limit is achieved if no more than one 4 day rolling average of the quotients within any 30 day period exceeds 1 over a three year period.

5.7 Reporting

Key components of the reporting requirements are described in this section. These are expected to remain the same following the wastewater treatment up-grade but can be reviewed after the implementation of the up-grade and as described in Section 5.5.5.

5.7.1 Routine reporting

Data for each calendar month are collated and reported to ES within 20 working days of the receipt by the Environmental Coordinator of the external laboratory results (Condition 24).

5.7.2 Exceedance reporting

ES are to be notified within 24 hours of the identification of any exceedance of any limit contained within Resource Consent No XXXX. This notification is to include advice of any corrective actions taken in response to the exceedance (Condition 25).

Within 20 working days of the identification of an exceedance an incident report is to be provided to ES. This report is to include:

- (a) Identification of the likely cause of the exceedance;
- (b) The resulting effects on the receiving environment likely to arise because of the exceedance;
- (c) The management responses undertaken or which may be necessary to prevent any further exceedances occurring.
- (d) Remedial action undertaken or which may be necessary.

5.7.3 Annual reporting

An Annual Monitoring Report covering the 1 October to 30 September period shall be provided to ES by 30 November each year (Condition 26). Pre and post-upgrade this report shall include:

- (a) A summary of receiving water monitoring results and assessment of compliance with the limits prescribed by Consent No XXXX.
- (b) An assessment of the annual median and 95%ile of the total ammonia nitrogen concentrations in the receiving water against an annual median of 1.9 g/m³ and an annual 95%ile of 2.4g/m³ (both at pH 8.0). The database referred to in 5.6.4 is to be used for this purpose. This section should include a discussion about the outcome of this assessment.
- (c) An assessment of the annual median and 95%ile of the total oxidised nitrogen concentrations in the receiving water against an annual median of 2.4 g/m³ and an annual 95%ile of 3.5 g/m³.
- (d) A calculation of the annual discharged loads of ammonia nitrogen, total oxidised nitrogen, total nitrogen and total phosphorous and a comparative analysis of these loads against preceding seasons. A discussion about any seasonal differences should be included.

5.8 Biological Monitoring

The purpose of the monitoring shall be to undertake a quantitative assessment of macrophyte cover, species diversity, benthic invertebrate diversity and abundance living on submerged macrophytes in order to identify what if any improvement in benthic invertebrate community health occurs post upgrade of the wastewater treatment plant. The monitoring shall be undertaken during the period 1 October to 30 April following a period of at least 20 consecutive days below annual median river flow (7.7 m³/sec @ 2015) at the locations U1, U2, D1 and D2 as shown in Figure 2. The monitoring shall comprise the following:

- (a) Description of the physical habitat.
- (b) Quantitative assessment of periphyton (if present), macrophyte cover and species diversity.
- (c) Quantitative assessment of benthic invertebrates living on the substrate and semi-quantitative sampling of invertebrates on submerged macrophytes.

5.8.1 Pre-Upgrade

Biological monitoring shall occur once within 5 years of the commencement of Consent Number XXXX and then again immediately prior to the Wastewater Treatment Upgrade described in Section 5.5 (Condition 6).

5.8.2 Post-Upgrade

Following the WWTP up-grade being operational, further biological monitoring shall be undertaken on an annual basis for three consecutive years (Condition 19).

The results of this monitoring in comparison with the monitoring carried out prior to the wastewater treatment upgrade shall be reported to ES upon completion of this three year monitoring cycle.

5.9 Fish Health Surveys

Fish health monitoring surveys assessing resident species such as eel / tuna are to be carried out. The purpose of the surveys is to determine what if any improvement in fish health occurs post upgrade of the wastewater treatment plant. Guidelines for monitoring tuna health are still being developed but it is recommended that consideration be given to the approach taken by Richardson (1998). This would involve the following:

- Collection of a minimum of 10 fish of similar size and age.
- Recently killed fish are processed and the following measurements taken:
 - Length and weight.
 - External examination and assessment of eyes, fins, opercules, gills, pseudobranchs and thymus (see Richardson (1998) for parameters/features to assess)
 - Internal examination of liver, spleen, hind gut, kidney, mesenteric fat, bile, parasites and gonad stage (see Richardson (1998) for parameters/features to assess)
- Blood samples for haematocrit (% red cells), leucocrit (white cells) and plasma protein (weight/volume).
- Data is processed and indices developed for each component as per Richardson (1998) and compared with acceptable values tabulated by Richardson (1998) which includes acceptable values for long and short-fin eels.

Full procedures and protocols are provided in Richardson (1998).

5.9.1 Pre-Upgrade

A fish health survey shall occur once within 5 years of the commencement of Consent Number XXXX and then again immediately prior to the Wastewater Treatment Upgrade described in Section 5.5 (Condition 7a).

5.9.2 Post-Upgrade

The fish health monitoring survey shall be repeated within two years of the implementation of the Wastewater Treatment Upgrade. (Condition 20)

The results of this survey in comparison with the survey carried out prior to the wastewater treatment upgrade shall be reported to ES upon completion of this survey.

5.10 Sediment Surveys

Sampling will be carried out to survey sediments at the upstream compliance control site and the downstream 350m compliance site in order to determine levels of TN, TP and TOC every 5 years after the commencement of Consent No XXXX. Results are to be compared with surveys carried out during the term of the previous consent and reported to ES within one month of receiving each survey's results.

5.11 EMP Review

In addition to the post-upgrade review (Condition 17) described in Sections 5.5.2 and 5.5.5, the Lorneville Plant Environmental Coordinator is responsible for reviewing this Environmental Monitoring Plan at least at five yearly intervals (Condition 3).

The primary purpose of the review is to identify any amendments necessary to the EMP to ensure it is effective in meeting its purpose (Sec 1). The TWP should be consulted during this review (Condition 30). Should amendments be made then a revised version of the EMP is to be provided to ES.

5.12 Stakeholder Liaison

5.12.1 Technical Working Party

The TWP established leading up to the renewal of consents consists of representatives from Fish and Game, Department of Conservation, Te Ao Marama, Public Health South, Invercargill City Council, Southland District Council and ES. At least annual meetings of this group is to be facilitated by Alliance with the purpose of receiving reports, reviewing results, initiate meetings as required and identify any required reviews of consent conditions. The TWP is to be consulted with respect to the reviews required in Conditions 3 and 17.

The Annual Report described in Section 5.7.3 is to be provided to members of the TWP.

5.12.2 Habitat Enhancement Plan

A Habitat Enhancement Plan is to be developed in conjunction with representatives of Te Ao Marama within one year of the commencement of Consent No XXXX and is to be provided to ES (Condition 22). This plan is to identify habitat enhancement priorities to be implemented within the Lorneville property and is to include:

- a. The methods to ensure ongoing liaison between the consent holder and Te Ao Marama in the development and maintenance of the Habitat Enhancement Plan. This should include anticipated meeting attendees and frequencies.
- b. The protocols to be followed to identify areas for habitat enhancement and the development of a prioritised work programme.
- c. Details about the work programme and habitat enhancement priorities and how these will be implemented over a series of defined stages and adapted over time. Likely habitat enhancement priorities will include planting and ecological restoration work at the ox-bow area located just below the upstream compliance control site, riparian planting at appropriate places on the margin of the Makarewa River and at other surface water bodies on the consent holder’s site.
- d. Specific monitoring that is required to ensure that the habitat enhancement work is successful.
- e. Reporting and review protocols.

It is expected that this Plan will be a living document and should be updated and strengthened as opportunities particularly for enhancement and effective monitoring are identified.

5.13 Formal Review

As described in various preceding sections opportunity exists for formal review of the requirements of Consent No XXXX.

5.13.1 RMA Section 127 Review

Within 2 years of the wastewater treatment plant upgrade being fully operational Alliance can apply to change or cancel consent conditions to reflect the measured performance and on-going monitoring and reporting obligations associated with the upgrade (Condition 31).

5.13.2 RMA Section 128 Reviews

- a. Within 3 months of receiving an annual monitoring report ES can serve notice that they intend to review the conditions of the consent to assess the significance of any exceedance of limits, whether this has resulted in significant adverse effects and if the limits should be altered (Condition 32).
- b. Within 3 months of receiving a review of whether it is practicable and necessary to disinfect the discharged wastestream ES can serve notice that they intend to review the relevant conditions of the consent with the express purpose of imposing new limits to complement additional treatment measures and to further reduce the microbial load in the wastewater (Condition 33).
- c. Within 3 months of receiving recommendations regarding appropriate post up-grade limits for TN and TP, ES can serve notice that they intend to review those conditions of the consent to ensure the limits in Condition 16 remain appropriate and whether any changes are necessary (Condition 34).
- d. Within 3 months of receiving the review report required by Condition 21, ES can serve notice that they intend to review the conditions of the consent to assess the improvements made to the quality of the discharge while having regard to the overall quality of the water in the Makarewa River as a result of ES’s programme of catchment improvement and to require any amendments to the discharge and/or receiving water limits (Condition 35).

6.0 Attachments

NIL

7.0 Document Amendment Register

Revision	Date	Description
001	2015	