**BEFORE ENVIRONMENT SOUTHLAND**

**IN THE MATTER** of the Resource Management Act 1991

**AND**

**IN THE MATTER** of Lorneville Processing Plant Resource Consent Applications (APP-20158595)

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**STATEMENT OF EVIDENCE OF AZAM KHAN**
**ON BEHALF OF ALLIANCE GROUP LIMITED**

**4 July 2016**

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**QUALIFICATIONS AND EXPERIENCE**

1 My full name is Azam Khan. I hold the degrees of Bachelor of Engineering (Natural Resources) from the University of Canterbury and Master of Engineering (Waste Treatment) from Lincoln University. I am a Chartered Professional Engineer and I am on the International Professional Engineers Register (New Zealand). I hold membership with the Institution of Professional Engineers New Zealand (**IPENZ**), Water NZ, Resource Management Law Association (**RMLA**), International Water Association, and NZ Institute of Directors. I am a RMA decision maker certificate holder as a Hearing Commissioner. I am also a party to New Zealand Patent 539117 and Australian Patent 2006201373 for inventions related to wastewater treatment.

2 I am a director of the consulting firm Pattle Delamore Partners Limited (**PDP**), specialists in water resources and environmental engineering.

3 Over the last 25 years my experience has been in the general area of environmental engineering managing the wastewater, solid waste and resource consenting projects that are carried out by PDP. While I have broad experience in a range of disciplines including wastewater, solid wastes, stormwater and environmental resource consenting, my principal area of specialisation relates to treatment and disposal of high strength wastewaters.

4 In the course of my work, I have conducted investigations, undertaken environmental assessments and overseen design and construction of a number of wastewater treatment systems for the treatment of meat processing wastewater. These include work undertaken for Alliance Group Limited for their wastewater treatment systems at Mataura and Pukeuri. I have also assisted Silver Fern Farms Limited on their plants at Dargaville, Finegand, Paeroa, Pareora, Te Aroha, Takapau and other plants that are now mothballed (Oringi, Shannon, Tirau). I have undertaken work for Greenlea Premier Meats (Hamilton and Morrinsville), Hawkes Bay Proteins (Napier), Taranaki By-Products Ltd (Hawera), Tuakau Proteins Ltd (Tuakau), Riverlands (Bulls and Eltham), Wallace Corporation Ltd (Waitoa) and other independent plants like Te Kuiti Meat Processors Ltd and Universal Packers Ltd (Te Kuiti).

5 I have visited the Alliance Lorneville processing plant on numerous occasions and am familiar with the site operations.

6 In preparing this evidence I have relied on other technical investigations carried out by Aquatic Environmental Sciences Limited, Freshwater Solutions Limited and SoilWork Limited for various activities.

7 I have reviewed the S42A Report prepared by Ms Sarah Smith and technical input to S42A report by Mr Robb Potts.

8 I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses (Environment Court Practice Note 2014). This evidence is within my area of expertise except where I state that I am relying on facts or information provided by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

**INVOLVEMENT WITH ALLIANCE GROUP LIMITED**

9 My involvement with Alliance Group Ltd dates back to 2002 when PDP was engaged to provide engineering and environmental assistance for the consent application to discharge treated wastewater from the Alliance Mataura plant into the Mataura River. The key outcome of this work was upgrading of the treatment facilities to substantially reduce phosphorus loads discharged into the Mataura River.

10 In 2006, I was retained to assist Alliance Lorneville in the investigations related to sludge accumulation in the onsite anaerobic lagoon. This investigation also examined options for covering the lagoon and management of the biogas.

11 In 2011, I was retained to investigate options for microbial disinfection of wastewater discharged from the wastewater treatment plant at the Alliance Pukeuri plant. The outcome of this work was the design and construction of a UV disinfection facility.

12 In June 2012, PDP was commissioned to assist with the replacement consenting programme for Alliance Lorneville. In summary, I have either been directly involved and/or overseen the following investigations and assessments:

(a) Undertaking comprehensive wastewater surveys to identify, quantify and verify the flows and contaminant loads from the plant and to assess the performance of the existing wastewater treatment system;

(b) Identifying and evaluating issues and options related to wastewater generation and management at the site;

(c) Developing a preliminary design for an upgrade of the primary wastewater treatment system;

(d) Assessing the feasibility of land treatment and disposal of all wastewater generated from the site as an alternative to the discharge of treated wastewater to the Makarewa River;

(e) Identifying and evaluating options for managing residual solids generated from a biological nitrogen removal (**BNR**) wastewater treatment plant upgrade;

(f) Undertaking a comprehensive assessment of the environmental effects for disposal of BNR solids to the Alliance Lorneville Farm; and

(g) Assessing the feasibility of removing sulphide from high-sulphide waste streams from the fellmongery.

13 I have ongoing involvement assisting Alliance Lorneville in providing engineering advice related to resource consent issues, assisting with the upgrade programme and commissioning and optimisation of the upgraded primary wastewater treatment system.

**SCOPE OF EVIDENCE**

14 I have prepared this statement of evidence to provide a general overview of the engineering and technical investigations carried out to develop options for the continued discharge of treated wastewater into the Makarewa River.

15 I will discuss the proposed treatment plant upgrade as well as the feasibility of alternative land based wastewater treatment/disposal options.

16 I will also outline the assessment of environmental effects of the proposed disposal of BNR solids onto land and into the contingency monofill.

**EXECUTIVE SUMMARY**

17 Alliance Lorneville plant is seeking replacement consent for the discharge of treated wastewater and new consent for the disposal of generated microbial biomass (**BNR solids**) from the proposed upgraded wastewater treatment plant onto Company owned land. As a contingency, a consent for the disposal of BNR solids to a dedicated monofill is also being sought.

18 The technical investigations for determining the preferred wastewater treatment plant upgrade path involved undertaking comprehensive wastewater surveys to determine the actual flows and loads arising from the existing operations, optioneering, developing estimates of capital and operating costs, alternatives investigation for disposal of treated wastewater onto land, BNR solids management and developing the assessment of effects and management plan for land disposal of BNR solids and contingency monofilling.

19 The waste surveys established that up to 75% of nitrogen load generated from the site is produced by 34% of the total volume and arises from several discrete process waste streams. This provides an opportunity to separate these specific waste streams and provide targeted treatment in a parallel new wastewater treatment plant.

20 To this end, I have recommended to the site that as an initial step, further improvements in primary treatment is undertaken to allow recovery of proteins that contribute to nitrogen. Alliance Lorneville has already started waste minimisation works and targeted primary treatment which, in 2016, has resulted in an approximate 35% reduction in the median final discharge nitrogen concentration from 2013 levels.

21 Following waste minimisation and primary treatment initiatives, PDP has recommended that the most efficient way to achieve the required

discharge quality is to treat separated waste streams utilising a combination of anaerobic and aerobic biological wastewater treatment technologies. In addition, the high strength sulphide laden waste stream generated from the fellmongery is to be treated via separate chemical treatment prior to aerobic biological treatment. BNR solids from the treated wastewater will require dewatering prior to disposal onto Company owned land or alternatively diverted to a contingency on-site monofill. The biogas generated from the new covered lagoon will be collected and then thermally combusted.

22 Some additional controls for microbial disinfection and phosphorus removal were also investigated and these may need to be implemented in order to meet any future catchment based compliance limits.

23 PDP has outlined a preliminary implementation master plan that would need to be put in place to allow Alliance Lorneville to meet the compliance date at start of Year 15. The capital costs for implementation of the proposed upgraded facilities are estimated to be in the order of $19M. Additional costs for filtration, UV disinfection and chemical phosphorus removal is estimated at up to $4.5M. Operating costs are expected to be in the order of $1 - $1.5M per year.

24 The dewatered BNR solids are proposed to be disposed onto Company owned farmland as a slow release fertiliser at a total nitrogen loading rate of 250 kg N/ha/yr, which corresponds to an estimated plant available nitrogen (**PAN**) loading rate of around 140 kg PAN/ha/yr. At this nitrogen loading rate onto land I expect that the effects will be no more than minor.

25 In the event the dewatered BNR solids cannot be disposed of onto land as a result of inclement weather conditions or various other factors, PDP has recommended establishing an on-site monofill that would also assist in stabilisation of the material. BNR solids would be subsequently removed from the monofill and applied onto land. I consider that there will be no more than minor effects as a result of the monofill operations.

26 PDP investigated the suitability of land treatment/disposal of wastewater as an alternative option to providing a higher level of

treatment and continued discharge to the Makarewa River. The amount of land required would be in excess of 1,000 ha despite additional wastewater treatment. Based on this assessment I consider that land treatment is not a viable option.

27 I have reviewed the S42A Officer's Report and I comment specifically on key areas of disagreement as follows:

(a) The Officer's Report concludes that there is "*lack of certainty regarding the proposed upgrade of the wastewater treatment plant*"[1]. I refute this conclusion as proposed draft Conditions 12 - 16 (treated wastewater discharge to Makarewa River) sets an agreed timeframe for the upgrade to be completed and the requirement to meet the final discharge nitrogen compliance limits. To effectively meet the requirements of these two conditions, a substantial upgrade of the existing wastewater treatment system will be required. A preliminary implementation timeline is also provided as part of the application to set out the requirement to meet compliance. It is acknowledged that specific detailed design elements are not provided as this will get confirmed once further waste minimisation works are completed and the basis of design realised.

(b) A key issue with the proposal identified in the Officer's Report is the long lead time before there is an improvement in the quality of the discharge. The waste minimisation initiatives currently being undertaken and primary treatment upgrades implemented since 2013 have already reduced median concentrations of nitrogen in the discharge by approximately 35%. I envisage that additional upgrades that are scheduled in the immediate to short term will result in further reductions in nitrogen in the final discharge.

(c) The Officer's Report recommends granting a short term (five year) consent with conditions similar to the existing consent. In my opinion, a short term consent undermines the certainty of investment. I consider that granting a long term consent, with

[1] S42A Staff Report for Hearing, pp. 67. 27 June 2016.

targeted review and upgrade requirements to be delivered within clearly defined timeframes provides a better outcome. This provides the consent holder with reasonable certainty, security and confidence that large capital investment to treat wastewater to a high degree can be made with an appropriate return period on that investment. Large wastewater treatment systems treating complex waste streams require considered and careful planning so that capital cost regret is eliminated during the design phase. The commitment shown by Alliance Lorneville during the re-consenting phase in terms of reducing nitrogen prior to any substantive end-of-pipe upgrades through waste minimisation and targeted primary treatment upgrades shows that Alliance Lorneville is committed to reducing the level of nitrogen discharged into the Makarewa River. Alliance Lorneville has commissioned a new rendering plant to ensure by-product recovery can be optimised as well to ensure reduction in contaminants in the discharged wastewater.

(d) If a long term consent is to be granted by the Hearing Panel, then the Officer's Report recommends that the timeframe for implementing the proposed treatment upgrade is reduced to eight years[2]. From a purely engineering perspective, the minimum timeframe to complete the waste minimisation and primary upgrades, confirm the design requirements, undertake design, tendering, equipment procurement, construct and successfully commission the treatment upgrade would be at least 10 years. I understand that there are other factors at play which have led Alliance Lorneville to request a 15 year time frame for making this upgrade, including the improvements already made, the forecast state of water quality in the catchment over time and the considerable cost commitments involved. Compressing implementation timeframes can result adoption of a conservative design that may not be necessary and can result in capital cost regret, where components are oversized but will get underutilised.

[2] Potts, R. Alliance Lorneville Technical Input to S42A Report, pp. 5. 21 June 2016.

28 It is my overall view that the proposed design for the wastewater treatment plant and BNR solids management with adequate proposed monitoring controls will result in the final discharge to have low level of contaminants.

## OVERVIEW OF WASTEWATER GENERATION

29 The Lorneville plant produces several waste streams, including slaughter floor, boning room, edible by-products processing (soup stock and tripe/casings), rendering plant, fellmongery, stockyards and truckwash, water treatment plant backwash and domestic waste.

30 The wastewater flows and loads generated from the processing plant are directly related to the plant production rate. The main production season typically begins in late November and continues through to June or July, with the total annual production typically around 3 million lamb equivalents (**LE**) over a 36 week period. Peak processing typically occurs from February to April when daily processing is around 24,500 LE per day. Minor levels of processing continue to occur in winter.

31 In the waste survey undertaken in 2013/14, an assessment of the wastewater production was undertaken and this was determined to be 17,100 $m^3$/d for normal peak processing, with extended peak processing increasing the discharge volume to around 19,800 $m^3$/d. Allowing for an additional 10% water use, I have assessed the peak design discharge volume at 21,780 $m^3$/d. The site holds a resource consent to discharge treated wastewater at a maximum discharge volume of 22,730 $m^3$/d. This consented maximum discharge volume includes domestic sewage from the site and from Wallacetown (as discussed in Frances Wise's evidence) and also accounts for attenuated rainfall inputs into the existing lagoon based treatment system. Based on the results of the waste surveys, I recommend that the present consent discharge volume is retained.

32 One of the key outcomes that I needed to determine in the waste survey was the relative load contributions from various specific waste streams from different areas of processing within the meat plant as well as the fellmongery and the rendering plant. The reason for this type of waste survey characterisation is that I have seen at other integrated meat and by-products processing plants that a large

proportion of the load contribution is from some discrete sources. There can be enormous gains in waste minimisation and load reduction when specific waste streams are targeted.

33 Being a meat processing and by-products processing plant, one of the key contaminants in the discharge is proteins, which mineralise to form ammoniacal nitrogen. However, in the waste survey a full and comprehensive wastewater characterisation for various contaminants was undertaken. These included total suspended solids (**TSS**), biochemical oxygen demand (**$cBOD_5$**), total and soluble chemical oxygen demand (**COD and CODs**), oil & grease (**O&G**), total Kjeldahl nitrogen (**TKN**), ammoniacal nitrogen (**$NH_4$-N**), total and dissolved reactive phosphorus (**TP and DRP**) and sulphide.

34 The waste surveys quantified the overall peak volume and contaminant loads from the processing plant post primary which are summarised **Table 1**.

**Table 1: Raw Wastewater Characteristics Post Primary Treatment**

| Parameter | Typical Conc. ($g/m^3$) | Design Peak Load (kg/d) |
|---|---|---|
| Biochemical oxygen demand ($cBOD_5$) | 1,760 | 34,900 |
| Chemical oxygen demand (COD) | 3,450 | 68,100 |
| Soluble COD (CODs) | 1,580 | 31,100 |
| Total suspended solids (TSS) | 1,480 | 29,200 |
| Total Kjeldahl nitrogen (TKN) | 190 | 3,660 |
| Ammoniacal nitrogen ($NH_4$-N) | 50 | 1,040 |
| Total Phosphorus (TP) | 25 | 485 |
| Dissolved reactive phosphorus (DRP) | 20 | 420 |
| Oil & Grease (O&G) | 800 | 15,500 |
| Total Sulphide | 30 | 670 |

*Note:*

1. *The design processing wastewater flow is based on 21,780 $m^3$/d and excludes stormwater and sewage.*

35 The waste surveys also determined that some specific waste streams contribute large contaminant loads within relatively small volumes. As an example, I have shown in **Figure 1** the load contribution of nitrogen from various waste streams. In general terms the waste streams from casings, stockyards, lime wash, soup stock and the raw

material bins result in 34% of the total daily volume of the discharge, but contribute to 75% of the nitrogen load. I will discuss later in my evidence, how this information has allowed for the targeted treatment of specific high strength waste streams which has occurred at the site since 2014. This information will also inform the future upgrades which are proposed to meet the lower discharge quality limits.

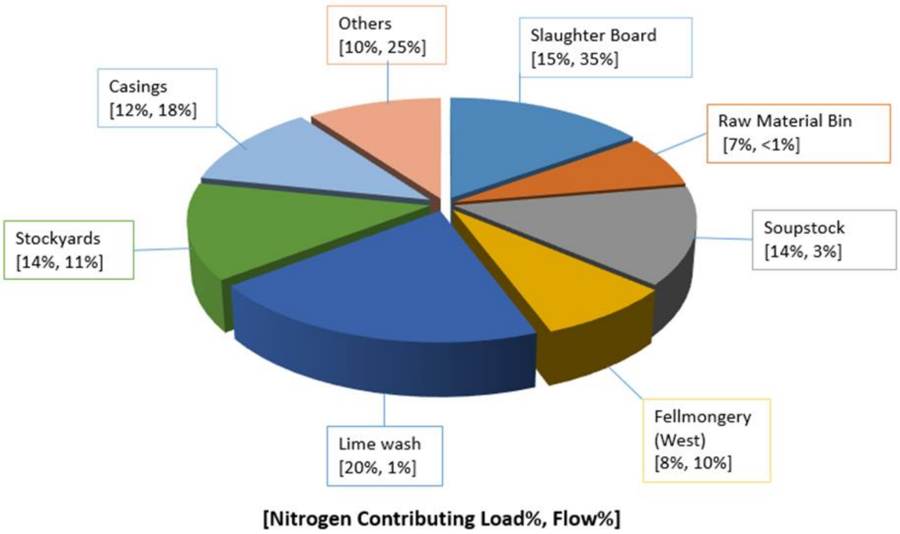


**Figure 1: Waste Streams Contribution to Plant Nitrogen Load**

**EXISTING WASTEWATER TREATMENT PLANT**

36 The existing wastewater treatment system comprises of primary treatment devices located within the processing plant followed by secondary treatment via a series of seven lagoons located adjacent to the Makarewa River. These lagoons include an anaerobic lagoon, an aerobic lagoon aerated via mechanical aerators followed by five maturation ponds. Each of these lagoons is connected in series and the total area occupied by the lagoon based treatment plant is around 25 ha. A layout plan showing the existing wastewater treatment plant is shown in **Attachment E1**.

37 Within the meat processing plant gross solids are removed and recovered for rendering by milli-screening units. Further solids and floatable material are removed by a non-chemically assisted Dissolved Air Flotation (**DAF**) system for the waste streams discharged from the meat processing plant.

38 All wastewater is conveyed by two pipelines (identified as North and South Drains) to Anaerobic Lagoon 1 which has a surface area of

around 1.9 ha and an average depth of around 2.5 m. Wastewater enters Anaerobic Lagoon 1 through a channelised section 50 m long by 15 m wide which collects fat and floatable material which is removed by a mechanical excavator at the end of each processing season. The hydraulic residence time in Anaerobic Lagoon 1 is around 2 to 3 days. Historical sampling and analysis shows that Anaerobic Lagoon 1 removes up to 95% of the $cBOD_5$ and up to 85% of TSS from the wastewater. Proteinaceous organic nitrogen is converted to $NH_4$-N in Anaerobic Lagoon 1. Of note is that the Anaerobic Lagoon 2 located adjacent to Anaerobic Lagoon 1 is presently disused.

39 Effluent from Anaerobic Lagoon 1 is conveyed to a large shallow aerated lagoon with a surface area of around 9.4 ha and an average depth of around 1.2 m. The average hydraulic retention time in the aerated lagoon is around 5 to 7 days. The aerated lagoon was formed from the remnant of a realigned section of the Makarewa River and is referred to as the ‘Loop’. Floating mechanical axial flow type aerators with a combined capacity of 315 kW are installed within the aerated lagoon. The aerated lagoon provides further $cBOD_5$ removal, however, historical data shows that minimal oxidation of $NH_4$-N is achieved in the aerated lagoon.

40 Effluent from the Loop passes through a series of five maturation ponds with a combined surface area of around 13.4 ha. The average hydraulic retention time in the maturation ponds is around 8 to 10 days. These ponds rely on natural processes for the diffusion of oxygen to the wastewater for further aerobic treatment and the maturation ponds provide some reduction in microbial contaminants. There is minor removal of phosphorus as a result of algal synthesis. The water level in these ponds can be varied to provide storage when conditions in the Makarewa River limit discharge of treated wastewater.

**DEVELOPING UPGRADE OPTIONS FOR AN IMPROVED DISCHARGE**

41 The optioneering study undertaken by PDP utilised the findings of the February 2013 waste survey and long-term monitoring data provided by Alliance Lorneville. The outcome sought for developing the options was to establish the level of treatment requirement in the absence, at that time, of the likely acceptable in-stream $NH_4$-N

threshold limits. Therefore, in the absence of discharge quality requirements, we progressed on reporting on a range of treatment upgrade options capable of achieving a range of discharge concentrations.

42 From our review of the existing and historical discharge quality data as outlined in Richard Montgomerie's evidence, nitrogen was assessed as a key contaminant of concern. Therefore, the assessment focused on removing nitrogen from the wastewater, but also considered removal of TSS, $cBOD_5$, phosphorus and *E. coli.*

43 In determining the appropriate wastewater treatment technologies, PDP considered a range of options, however, we relied on existing technologies widely used in the meat industry and Alliance Group Limited is already familiar with some of these.

44 The shortlisted options were selected on the basis that nitrogen concentrations could be required to be reduced substantially. We developed a matrix of combinations of waste separation and targeted nitrogen reductions that would provide a series of treatment options and combinations.

45 The shortlisted options included a complete secondary treatment plant replacement for 90% nitrogen removal, as well as options involving separating higher strength waste streams for targeted improved secondary treatment and blending with the treated lower strength waste streams treated in the existing lagoon based system. The shortlisted options included:

(a) ***Primary Treatment System Upgrade*** - targeted treatment of high-strength waste streams including a new chemical assisted DAF plant;

(b) ***High Strength Flow Separation and Ammonia Stripping*** - Primary treatment upgrade and separated high-strength waste streams to a new covered anaerobic lagoon, filter and ammonia stripper;

(c) ***Medium Strength Flow Separation – New BNR Plant*** - Primary treatment upgrade and separated medium-strength waste streams to a new secondary treatment plant comprising of a covered anaerobic lagoon and aerobic BNR activated sludge plant;

(d) ***Half Flow Separation – New BNR Plant*** - Primary treatment upgrade and separated higher strength waste streams making up half of the total flow to a new secondary treatment plant comprising of a covered anaerobic lagoon and aerobic BNR activated sludge plant; and

(e) ***Complete Replacement – New BNR Plant*** - Primary treatment upgrade and a complete replacement secondary treatment plant comprising of a covered anaerobic lagoon and aerobic BNR activated sludge plant;

46 The primary wastewater treatment upgrade was common to all options as this was considered this to be the most cost effective approach to remove around 15% of the overall nitrogen from the discharge. As this upgrade was common to all options, Alliance Lorneville commenced the implementation of this upgrade during the non-processing season in June 2014. I will further describe the details of the primary treatment upgrades later in my evidence and these are also discussed in the evidence of Ms Frances Wise.

47 For each of the shortlisted options identified for nitrogen removal, additional bolt-on treatment processes which could be added to remove phosphorus, microbial contaminants and sulphide from high sulphide fellmongery waste streams were investigated.

48 A certain level of phosphorus removal will be achieved with each of the BNR treatment options, however, if further phosphorus reduction was required then this would require chemical phosphorus removal.

49 When considering the requirements for microbial disinfection, a number of options were considered, however in my opinion UV disinfection is the preferred option as its operation results in no harmful chemical by-products. For effective disinfection using UV, the level of suspended solids need to be low and the treated wastewater needs to have good clarity and transmittance. In the existing wastewater treatment system, as a result of maturation ponds a significant amount of algae is present and this would require considerable filtration. We determined that chemical assisted filtration or flotation separation would be required if the final discharge

passed through the maturation lagoons and this would incur additional capital/operating cost.

50 As an alternative option to the shortlisted wastewater treatment plant options I have outlined for continued discharge to the Makarewa River, PDP investigated the feasibility of disposing of all wastewater from the site to land. An assessment of the land within a 5 km radius of the site and areas identified as potentially suitable for wastewater irrigation is shown in **Attachment E2**. Having investigated the hydraulic and nitrogen loading constraints, two options were considered potentially feasible. The first option was discharging the final treated wastewater from the existing treatment plant, and the second option was the treated wastewater after an upgraded treatment plant. Even when considering the discharges from a future upgraded treatment plant, the minimum amount of land required would exceed 1,000 ha. Based on likely acquisition and land treatment development costs, I consider land treatment is not a feasible option.

51 For the treatment options that have been examined for continued discharge to the Makarewa River, the estimated capital costs are up to $23M for the *Complete Replacement – New BNR Plant* option. Additional estimated capital costs for UV disinfection and chemical phosphorus removal are considered to be around $2.5M.

**PROPOSED UPGRADE APPROACH**

52 In order to establish the basis of design, the site specific assessment undertaken by Freshwater Solutions Ltd (**FWS**) and Aquatic Environmental Service Ltd (**AES**) concluded that to manage the effects of the discharge on the receiving environment the final treated wastewater total nitrogen discharged to the Makarewa River must be limited to 45 $g/m^3$ (see proposed Condition 16 of the Discharge of Treated Wastewater Permit). At this level of discharge concentration, there is a required reduction of more than 75% of the total nitrogen concentration from 2013 levels.

53 Based on the findings of FWS and AES, PDP recommended that the preferred option for nitrogen removal would be *Medium Strength Flow Separation - New BNR Plant*. Additional waste streams could be diverted to the new BNR Plant if required.

54 I will now discuss the proposed treatment plant upgrades. I must point out that the preliminary waste stream separation and sizing of secondary treatment equipment which I will discuss is based on results of the 2013 and 2014 waste surveys. However, as a result of the recent primary treatment upgrades, and the corresponding reduction in contaminant loads as discussed in the evidence of Frances Wise, the sizing of secondary treatment plant could be further optimised.

**Waste Minimisation and Primary Treatment Plant Upgrades**

55 The 2013 waste survey identified various low volume waste streams that contribute significant nitrogen loads to the secondary treatment plant as I have indicated earlier in Figure 1. Within these waste streams, there is an opportunity for targeted primary treatment of the high-load low-volume waste streams.

56 Bench scale testing by PDP in February 2014 determined that the overall nitrogen load from the processing plant could be reduced by around 15% by diverting specific waste streams making up only 3% of the total volume to a new acid-DAF plant. PDP developed a preliminary design for this upgrade and Alliance Lorneville implemented the upgrade in the 2014 shut-down period.

57 In addition, Alliance Lorneville has commissioned a new meat rendering facility and are diverting a high strength rendering waste stream to a new waste heat evaporator. For the wastes generated in the stockyards, the site has improved the collection of the solid wastes and minimising fugitive losses to the general waste stream. The stockyard solids are increasingly being directly disposed onto land. These initiatives have resulted in considerable reduction in the end-of-pipe nitrogen loads that would require treatment in future. The waste minimisation improvements and primary treatment upgrades have resulted in the 2016 median $NH_4$-N concentration discharged to the Makarewa River reducing by approximately 35% from 2013 levels.

58 I gather that Alliance Lorneville is planning to implement a number of additional waste minimisation and primary treatment upgrades in the short term. In my opinion these upgrades will further reduce nitrogen discharged to the existing wastewater treatment plant and will

continue to reduce $NH_4$-N discharged to the Makarewa River in the short term.

**Secondary Treatment Plant Upgrades**

59 Once the waste minimisation initiatives and primary treatment upgrades have been completed, further waste surveys will be required to quantify end-of-pipe design loads and to confirm the basis of design that was set against the 2014 waste survey (Table 1) and as set out below.

60 In my opinion there are significant cost and environmental advantages in reducing the up-stream loads as much as practicable prior to design and implementation of any end-of-pipe wastewater treatment system. Advantages include maximising product recovery at the processing site, reducing the sizing of secondary treatment plant equipment and reducing the consequential production of BNR solids which must be managed appropriately.

61 Based on the 2013 waste survey, PDP has estimated that around 30% to 40% of the total volume containing the higher strength waste streams will need to be separated and diverted into the new BNR plant to achieve a final combined discharge total nitrogen concentration of 45 $g/m^3$. The estimated loads and removal rates associated with the preferred upgrade is outlined in **Attachment E3**. Final discharge concentrations from the proposed secondary treatment plant have been based on preliminary process calculations and modelling by PDP using the BioWin wastewater treatment process simulation software package. This analysis shows that by diverting 34% of the total flow post primary treatment through the proposed secondary treatment plant, 76% reduction in TN and up to 45% reduction in TP is achievable. A process flow diagram for the proposed treatment plant upgrades is shown in **Attachment E4**.

62 As I have mentioned previously, the waste stream separation for diversion to the new secondary treatment plant will need to be confirmed once the discharge limits have been agreed and the results of pre-design waste survey are available following completion of the primary treatment upgrades.

63 The waste stream separation will also consider future upgrades beyond the lifetime of the new consent. For example, future consent

requirements may require the new secondary treatment plant to be expanded to accommodate all wastewater from the processing plant. Therefore, in my opinion it is beneficial to consider a modular upgrade route that can easily accommodate increased flows or alternatively, if the opportunity exists, to allow for an increased plant sizing that can accommodate more of the weaker waste streams as part of the initial upgrade programme.

64 Although the exact sizing of plant and waste stream separation is yet to be confirmed (given 35% reduction in nitrogen was realised at the end of 2016 season), the proposed new secondary wastewater plant will consist of a covered anaerobic lagoon and an activated sludge treatment plant comprising of a reactor and a clarifier configured for biological nitrogen removal (**BNR**).

65 Alliance Lorneville favours the proposed system with both anaerobic and aerobic systems for several reasons including minimising energy demand, managed air emissions, and minimising chemical use, BNR solids production and allowing for potential future reuse of biogas generated from the system. Alliance Lorneville also has confidence that a BNR reactor and clarifier system can deliver a high quality discharge and reliable performance based on the track record of this technology utilised at Alliance Pukeuri.

66 Although detailed geotechnical investigations have not been undertaken at this stage, the proposed treatment plant will probably be established between the processing plant and the existing wastewater treatment plant, most likely at the location shown in **Attachment E1**. This location is undeveloped and has a reasonable set-back distance to the site boundary.

67 The secondary treatment plant will comprise of earthen constructed lagoons and a reinforced concrete clarifier. The first lagoon will be fully lined and covered with a synthetic high-density polyethylene (**HDPE**) liner and operated as a plug-flow anaerobic reactor. The second lagoon will be lined with HDPE and will have mechanical aerators installed and will be operated in a continuously mixed aerobic/anoxic reactor. Multiple reactors may be utilised to optimise the treatment sequencing.

68 Based on preliminary sizing utilising flow and load data from the 2013 waste survey the covered anaerobic lagoon is likely to have a 5,000 $m^2$ footprint, with an operating depth of 4 – 6 m with a minimum active volume of approximately 15,000 $m^3$. The anaerobic lagoon will assist in the reduction of solids and organic loads and with the mineralisation of proteins into ammoniacal nitrogen. Gaseous by-products referred to as biogas generated from the anaerobic treatment will be collected and thermally combusted.

69 A biogas flare unit will need to be installed to manage the combustion of the biogas. Once the plant is operational for a period of time, Alliance Lorneville may consider recovery of energy from the biogas.

70 A biofilter will also be constructed as a contingency measure, to provide for standby biogas odour treatment in the event that the biogas flare or extraction blower is malfunctioning or not operational.

71 Following treatment in the covered anaerobic lagoon, effluent will be discharged into the adjacent BNR reactor. Various process waste streams will bypass the anaerobic lagoon and discharge directly into the BNR plant in order to maintain an appropriate carbon-to-nitrogen ratio for optimal biological nitrogen removal.

72 High sulphide and sulphate waste streams from the fellmongery will also bypass the anaerobic lagoon in order to minimise hydrogen sulphide generation in the anaerobic lagoon. The lime wash and pickle liquor high-sulphide fellmongery waste streams will be separated for targeted catalytic oxidation of sulphides in a new batch treatment facility prior to discharge to the BNR reactor. Based on preliminary sizing this facility may utilise a series of covered tanks to provide 450 $m^3$ reaction volume capacity, chemical dosing system and in excess of 70 kW of mechanical aeration for chemical oxidation. All gases stripped during sulphide oxidation will be treated through a dedicated biofilter.

73 Based on preliminary sizing, utilising flow and load data from the 2013 waste survey the BNR reactor will require around 8,000 $m^2$ footprint, operating at a depth of 4 – 4.5 m and with a minimum reactor volume of 25,000 $m^3$. The aeration capacity installed in the BNR reactor will be around 1.1 MW. The aerators will be controlled

to maintain an optimal reduction-oxidation-potential (**ORP**) for simultaneous biological nitrification denitrification (**SND**).

74 In order to keep the biological treatment process in balance, excess microbial biomass must be removed from the process on a regular basis. The BNR solids will be separated from the treated wastewater in the clarifier by settling under gravity, with the majority of the BNR solids returned to the BNR reactor to maintain biological treatment, and with a portion of the BNR solids diverted or wasted from the system. A storage tank is likely to be considered to manage the BNR solids prior to dewatering.

75 Treated wastewater from the clarifier will either discharge into the aerobic part of the existing lagoon based treatment plant or combined with the treated wastewater from the existing treatment plant at the final maturation pond or at the Boiler Ditch. The decision to discharge the treated wastewater from the proposed treatment plant into or after the existing treatment plant will depend on various factors including possible requirements for microbial disinfection which will be confirmed during the planning and detailed design stage.

**BNR Solids Management**

76 The BNR solids storage tank will be sized to provide for thickening and conditioning opportunity. The tank will include mechanical mixing and aeration to maintain fully mixed conditions and a positive oxidation-reduction-potential to avoid the onset of anaerobic conditions.

77 BNR solids will be pumped from the tank to a dewatering facility where it is expected that the solids content will increase to a minimum of 12%.

78 Dewatered solids from the centrifuge discharge chute will be mechanically transferred to a covered hardstand loading and day storage area which will be sized to provide two days of storage at peak load. Dewatered BNR solids will preferentially be loaded directly into a spreading wagon or tipper truck parked within the covered area. Alternatively, a front end loader will be used to load dewatered BNR solids from the covered area to the spreader or truck.

79 Dewatered BNR solids will be spread directly to Alliance Lorneville land by a specialised Company owned or contracted tractor hauled universal solids spreader when weather, soil moisture and farming operations allow. Alternatively, dewatered BNR solids will be transported via tipper truck to the proposed contingency monofill comprising of disused cells within the existing treatment plant. I will further discuss the proposed management of the BNR solids later in my evidence.

**Microbial Disinfection**

80 In the event microbial in-stream limits are set for the Makarewa River in the intervening period between the granting of the consents and implementation of the upgrade works then the design will be amended to include disinfection if required in order to meet the in-stream microbial limits. As I have discussed previously in my evidence, if disinfection is required then the preferred method for Alliance Lorneville will likely involve UV disinfection.

**PROPOSED TIMEFRAME AND SEQUENCE OF WORKS**

81 If the consents are granted, then Alliance Lorneville is proposing that the upgraded treatment plant will be operational and compliant with the proposed discharge quality limits by the Year 14 end following the granting of the consents.

82 We have prepared a Wastewater Treatment Plant Upgrade Design and Implementation Master Plan which is shown in **Attachment E5**. The Master Plan outlines the sequencing of works over six project phases and also outlines the documentation proposed to be delivered for each project phase.

83 As shown in the Master Plan, a 15-year implementation period will allow Alliance Lorneville to complete the primary treatment upgrades, undertake pre-design waste surveys and develop upgrade strategy. The 15-year period also allows adequate time to stage the design, procure, construct and commission the proposed significant upgrade works.

84 In my opinion it is beneficial to allow adequate time in the programme to complete the primary treatment upgrades as this will reduce the sizing of secondary treatment components, minimise energy use and

BNR solids production during operations, and avoid over-design and potential capital cost regret. Since the primary upgrades need to be undertaken during the non-processing periods, the reductions in the peak loads will not be realised until the following peak summer processing period.

85 Alliance Lorneville has proposed that a comprehensive Wastewater Upgrade Plan will be delivered in Year 5 which will outline details of the up-to-date waste survey and outcomes of the primary treatment upgrades. The Wastewater Upgrade Plan will detail the finalised basis of design and conceptual design of the secondary treatment plant upgrades including waste stream separation, technology selection and implications to the existing treatment system.

86 Preliminary design of the secondary treatment upgrade will be completed by Year 7 by which time all optioneering, geotechnical investigations and preliminary hydraulic, civil and safety in design work will be completed.

87 Enabling works will be completed by Year 9 including all waste stream separation, pre-loading and/or any other ground treatments required for lagoon construction and any relocation of existing services.

88 Detailed design, contract documentation and procurement of principal supplied equipment will be completed by Year 10. All construction consents will also be obtained by Year 10 including land-use consent, building consents and earthworks consent.

89 Given the scale of the project with a significant earthworks component, in my opinion a two-year construction period will be required. On this basis the tie-in to existing wastewater pipelines to divert flow to the new secondary treatment plant will be undertaken in the winter shut-down period in Year 12 to 13.

90 In my opinion a two-year commissioning and validation period is critical to ensure that the proposed secondary treatment plant will be compliant with the proposed discharge quality limits by Year 15. An anaerobic lagoon typically requires at minimum one year of continuous operation to achieve steady state conditions and reliable performance. A large aerobic reactor as proposed will also take time before reliable BNR performance is achieved. Successful process

commissioning is further complicated by the variability of the influent load, which varies on a seasonal basis and during normal weekly processing, with peak loading conditions only occurring for a three-month period each year. Successful integration and commissioning of the proposed fellmongery waste stream catalytic sulphide oxidation process is also a significant undertaking. In my opinion a two-year commissioning period is the minimum amount of time required for this task.

91 I consider that large capital works projects need to be fitted in and around the active production cycle to ensure that an economic and best fit design is implemented without having to rely on an overly conservative solution.

**BNR SOLIDS DISPOSAL TO LAND AND MONOFILL**

92 In an activated sludge treatment plant the solids are normally referred to as waste activated sludge (**WAS**). However, the term sludge in an industrial site could refer to various different types of waste, especially when some chemical wastes are generated from the fellmongery. In order to ensure that the solids are referred to correctly, the naming of source of the solids is a good practice. In our technical reports prepared for Alliance Lorneville, we have referred to the solids generated from the **bio**logical nitrogen removal plant **solids** as "*biosolids*" to clearly denote that the solids were entirely bacterial in origin and post aerobic treatment. On further discussions with Southland Regional Council and its experts and to avoid any confusion, any reference to biosolids is replaced with '*BNR solids*'. When referring to the New Zealand Biosolids Guidelines[3], the term biosolids is defined as sewage or human waste derived solids and not solids generated from a meat processing facility. In my evidence, I have adopted the term 'BNR solids' rather than biosolids to refer to bacterial solids generated from the aerobic treatment facility.

93 As I have outlined earlier in my evidence, BNR solids will be generated as a by-product from the proposed BNR treatment plant and comprises of excess microbial biomass used for the biological treatment of the wastewater.

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[3] MfE (2003). *Guidelines for the Safe Application of Biosolids to Land in New Zealand*. Ministry for the Environment.

94 Anaerobic solids from the anaerobic lagoon will discharge to the BNR reactor within the main process pipeline as carryover in the anaerobic lagoon discharge. Anaerobic solids carryover to the BNR will be promoted during low processing periods using controlled pumping from the anaerobic lagoon. In the event that excess anaerobic solids need to be removed from the anaerobic lagoon, then this operation will be subject to a separate consent application. Bulk sludge removal from the anaerobic lagoon is likely to be required approximately every 10 to 15 years.

95 The BNR solids contain organic material and a variety of nutrients which are essential for plant growth, including nitrogen, phosphorus, calcium, magnesium, sulphur and various trace elements.

96 After considering a number of alternatives, the recommended approach to manage BNR solids, is the disposal onto land as a slow release fertiliser. A contingency monofill option was also developed to ensure that the land application of BNR solids could be managed adequately under wet weather conditions.

97 In the absence of an operational BNR treatment plant at Alliance Lorneville, we have relied on BNR solids characteristics from Alliance Pukeuri. In my opinion the Alliance Pukeuri BNR solids characteristics are representative of the expected Alliance Lorneville BNR solids characteristics as the processing plants are similar and the proposed Alliance Lorneville treatment plant is similar to the Alliance Pukeuri treatment plant. I would like to point out that chromium is not utilised at the Lorneville plant fellmongery, so this contaminant is not expected in any BNR solids generated at the site.

98 A summary of monthly Alliance Pukeuri BNR solids testing for key nutrient parameters from December 2003 to June 2012 is shown in **Table 2**. The BNR solids will contain around 6% nitrogen, 1.2% phosphorus, 1.1% potassium and 0.9% sulphur.

| Table 2: Alliance Pukeuri BNR Solids Characteristics | |
|---|---|
| **Parameter[1]** | **Concentration** |
| Total Nitrogen (%) | 6.6 |
| Total Potassium (%) | 1.1 |
| Total Calcium (%) | 2.5 |
| Total Magnesium (%) | 0.2 |
| Total Sodium (%) | 8.3 |
| Total Copper (mg/kg) | 37 |
| Total Phosphorus (%) | 1.2 |
| Total Sulphur (%) | 0.9 |
| Total Lead (mg/kg) | 5 |
| Total Zinc (mg/kg) | 286 |
| Total Nickel (mg/kg) | 5 |
| Total Arsenic (mg/kg) | 6 |
| Total Cadmium (mg/kg) | 0.3 |
| Total Chromium[2] (mg/kg) | 117 |
| Sodium Adsorption Ratio | 13 |

*Notes:*

1. *BNR Solids concentrations reported are average concentrations from monthly sampling and analysis from December 2003 to June 2012 with the exception of phosphorus, sulphur and heavy metals which have been obtained from one-off sampling in September 2014;*
2. *Chromium is not expected in the Alliance Lorneville BNR solids as it is not utilised at the fellmongery.*

99 Heavy metals can be a concern for land application of BNR solids, although elevated heavy metals are typically not a problem for meat processing wastewater plant derived solids. Additional testing of solids generated from the Pukeuri BNR plant showed low levels of heavy metal concentrations (noting that chromium is not a chemical utilised at Lorneville) as shown in **Table 2**. In the absence of heavy metal guideline limits for land application of meat processing derived BNR solids, the New Zealand Biosolids Guidelines have been applied. All heavy metal concentrations in the Pukeuri BNR solids achieve the highest '*grade a*' quality standard, with zinc concentrations approaching the limits for *grade b*. The Biosolids

Guidelines permit *grade b* biosolids to be applied to land, but require this to be monitored and applied in a controlled manner, where *grade a* is permitted to be disposed offsite in a less controlled manner. I recommend annual monitoring to confirm that the either *grade a* or *grade b* guideline limits in relation to heavy metals are achieved.

100 On the basis of 2013 waste survey, the peak daily generation of BNR solids from the treatment plant is estimated at 700 $m^3$/d at 1% dry solids. It should be noted that with load reductions as a result of the recent primary treatment upgrades and initiatives such as the disposal of stock yards waste, as discussed earlier in my evidence, the volume of BNR solids generated will reduce from these preliminary estimates.

101 After undertaking soil investigations at the Alliance Lorneville Farm, SoilWork Ltd recommended that there was insufficient land available with suitable soils for continuous irrigation of liquid BNR solids and I have relied on this assessment. I have considered that to reduce the hydraulic loading effects onto soils, further dewatering of the BNR solids to between 12% - 18% dry solids will be necessary. Once dewatered adequately, the peak daily volume will be around 39 $m^3$/d at 18% dry solids.

102 Dewatered BNR solids at around 18% dry solids is ‘spadeable’ and has a similar moisture content to sheep manure. This material is proposed to be spread to land using dedicated specialised equipment (Strautmann Universal Spreader or similar). I envisage that the equipment will allow small clumps of not dissimilar in size to natural sheep faecal matter deposition to occur. I will outline details of the proposed loading rate and measures to mitigate potential adverse effects later in my evidence.

## DESCRIPTION OF THE BNR SOLIDS DISPOSAL AREA

103 The Alliance Lorneville Farm comprises of 300 ha of pastoral land excluding the processing plant, key stock holding paddocks to the east of the plant and the existing treatment plant.

104 The farmland is used to manage stock overflow at the processing plant, with the stocking rate typically high at the start of the season and reducing to low levels at the end of the season and through the

winter. The annual average stocking rate over the 300 ha farm is around 21 animals/ha.

105 The site consists of two terraces, with the processing plant situated on the upper terrace above a lower river terrace. Both areas are generally flat with some undulations and hollows. Between the terraces there is a large area of moderately sloping ground. There are a number of drains within the farm to direct surface water from low lying areas to the river. Details of the geology and hydrogeology at the site is outlined in Mr Callander's evidence.

106 The annual rainfall at the site is typically 1,100 mm with potential evapotranspiration of 770 mm. The mean daily average temperatures range from around 5 ˚C in July to 14 ˚C in January. The predominant wind direction is south-westerlies to westerlies for higher intensity winds and north-westerlies for low-intensity winds.

107 I have relied on the soil assessment by SoilWork Ltd and based on SoilWork's investigations a soil map of the Alliance Lorneville Farm is shown in **Attachment E6**. The soil zones and areas identified by SoilWork are:

(a) Zone 1: 175 ha - well/moderately drained soils;

(b) Zone 2: 51 ha - poorly drained soils, and;

(c) Zone 3: 74 ha - very poorly drained soils.

108 At present the site holds a resource consent to discharge treated wastewater to an area located on the upper farm terrace comprising of around 100 ha of Zone 1 and Zone 2 soils. The wastewater volumes, nitrogen loading and nitrogen leaching from the site as determined from lysimeter motoring has been assessed annually. From 2006 to 2013 the annual nitrogen loading rate applied to the irrigation area varied between 26 kg N/ha/yr to 236 kg N/ha/yr. I understand that Alliance is now proposing to avoid irrigating treated wastewater to Zone 2 soils.

**Consideration of Alternatives to Land Disposal of BNR Solids**

109 PDP has investigated alternative BNR solids management options to ensure that the proposed activity is consistent with good practice. Alternatives include:

(a) Disposal to sanitary landfill;

(b) Composting for agricultural or garden use;

(c) Disposal to monofill.

110 Based on the estimated annual production of 3,900 tonnes of dewatered BNR solids generated at the site, up to 400 articulated truck movements would be required each year to transport the material to the regional landfill in Winton some 25 km away. In my opinion the transportation and disposal to a landfill of material which can be used beneficially as a soil amendment is a poor alternative.

111 The direct disposal of BNR solids onto land can bypass a composting process when managed appropriately and provide flexibility to site operations. While the New Zealand Biosolids Guidelines require further treatment of sewage derived solids such as via composting in order to destroy pathogens prior to land disposal, composting is not necessary for meat plant derived BNR solids. In my opinion, for this application composting does not offer any significant advantages over direct disposal to the Alliance Lorneville Farm.

112 Alliance Lorneville is proposing to monofill dewatered BNR solids on a contingency basis to support the continued use as a soil amendment. After storage within the monofill for a period of time, the BNR solids will eventually be applied to Company farm land. In my opinion, this contingency use of a monofill provides a reasonable security to manage the land disposal of BNR solids.

113 In addition once the land disposal of BNR solids is in place and Alliance Lorneville has demonstrated a track record to its neighbours, there may be an opportunity for district wide disposal to free up Alliance Lorneville farmland for land treatment of wastewater under very low river flow conditions.

**BNR SOLIDS PROPOSED LOADING RATE**

114 SoilWork Ltd has determined that Zone 3 soils are unsuitable to receive dewatered BNR solids due to low soil permeability. However, the remaining 226 ha of Alliance Lorneville farm land has suitable permeability to receive dewatered BNR solids.

115 As I have discussed previously in my evidence, an appropriate nitrogen loading rate is critical to avoid adverse effects to groundwater and surface water. I will now discuss the mineralisation of nitrogen contained within the BNR solids and discuss how an appropriate nitrogen loading rate has been determined for the site.

116 Whereas the nitrogen contained within wastewater from the existing treatment plant or within dairy shed effluent is mostly in mineralised form, the nitrogen contained within the BNR solids will be in the form of organic nitrogen which will mineralise slowly over time before it is available for plant uptake as plant available nitrogen (**PAN**).

117 Based on a wide range of literature sources, we have conservatively assessed that only 40% of the total nitrogen content of the BNR solids will be available for plant uptake in the first year and the ultimate plant available nitrogen content of the BNR solids is likely to be 55%[4][5]. On this basis we have recommended a nitrogen loading rate of 250 kg N/ha/yr corresponding to 140 kg PAN/ha/yr, consistent with recognised allowable nitrogen application onto land.

118 Based on a total nitrogen content of 6% of the dry weight and assuming that the material will be dewatered to 18% dry solids, the proposed total nitrogen loading rate of 250 kg N/ha/yr results in a bulk gross solids loading of 23 t/ha/yr. Based on the estimated annual BNR solids production, the land area required is likely to be around 180 ha. During deposition the likely solids distribution is assessed as 1 kg/m$^2$ each event based on a 2 to 3 applications to land each year.

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[4] Sommers LE, Parker CF, and Meyers GJ (1981). *Volatilization, Plant Uptake And Mineralization Of Nitrogen In Soils Treated With Sewage Sludge*. IWRRC Technical Reports. Paper 133.

[5] Dodd, DR (2012). *Laboratory Analysis to Estimate Plant-Available Nitrogen in Land-Applied Biosolids*. MSc Thesis, North Carolina State University.

## ASSESSMENT OF OTHER EFFECTS ON LAND DISPOSAL

### Nitrogen Loading Effects

119 PDP has used two different models to estimate nitrogen leaching from the Alliance Lorneville Farm. A conceptual nitrogen mass-balance model was developed which considered all the nitrogen inputs, transformations and outputs for the sheep grazed pasture system. The nitrogen mass balance model was validated using results from historical lysimeter monitoring by SoilWork Ltd.

120 The model was then used to predict nitrogen leaching from the sheep grazed system based on the proposed nitrogen loading rate of 140 kg PAN/ha/yr. The model predicts an average annual leaching rate of 13 kg N/ha/yr. In order to support the findings of the conceptual nitrogen balance model, PDP has also used the Overseer® nutrient budget (Version 6.1.3 – 2014) tool to estimate leaching losses. Using the Overseer® model the predicted nitrogen leaching rate is 17 kg N/ha/yr.

121 The predicted nitrogen leaching rate of around 13 to 17 kg N/ha/yr is within the typical range[6] for lowland sheep grazed pastures in Southland reported at 10 to 20 kg N/ha/yr.

### Other Effects

122 Heavy metal concentrations are expected to be well within guideline limits for safe application to land based on Alliance Pukeuri BNR solids analysis. In order to mitigate against potential effects from heavy metals, Alliance Lorneville is proposing annual sampling and analysis and reporting to confirm that guideline heavy metal limits are achieved.

123 The potential for soil structure damage through vehicle compaction when soil conditions are saturated will be avoided. BNR solids will not be applied when there is a risk that soil will be damaged by spreading equipment traffic.

124 Excessive sodium in the BNR solids has potential to impact on soil structure and permeability. The sodium adsorption ratio (**SAR**) of the

[6] AgResearch (2010). *Land Use and Land Management Risks to Water Quality in Southland*. Report prepared for Environment Southland.

BNR solids will be monitored by monthly sampling and analysis. Six monthly soil sampling for soil exchangeable sodium percentage (**ESP**) will also be undertaken to assess the impact of sodium. I will outline the proposed mitigation against the effects of sodium later in my evidence.

125 I consider that Alliance Lorneville has proposed a reasonable setback distance to surface watercourse to avoid any potential mobilisation of the BNR solids to any drains that will lead to the Makarewa River.

126 I believe that the proposed BNR solids land disposal activity is consistent with the land use of the surrounding area which is characteristic of a rural farm environment. The proposed BNR solids spreading equipment will be similar to activities typical to farms such as manure spreading.

127 Public contact with the BNR solids will be avoided as application will only be to the Alliance Lorneville Farm where public access is restricted. Appropriate setback distances to neighbouring properties are also proposed, and BNR solids application will not occur near a downwind boundary during windy conditions. In my opinion the risk to public health from the proposed activity is minimal.

128 Within the land disposal area itself, I have recommended a 14-day stock-withholding period to minimise any risk to animal health.

**PROPOSED MITIGATION OF BNR SOLIDS DISPOSAL**

129 In the unlikely event that any adverse effects are experienced as a result of BNR solids application to the Alliance Lorneville Farm, then steps will be taken to mitigate the effects in accordance with the BNR Solids Draft Management Plan that has been prepared at the request of the Southland Regional Council and a copy of this Plan is attached as **Appendix 1**. This draft plan will need to be updated once detailed design of the treatment plant upgrades is complete and prior to commencement of the dewatering and disposal.

130 The BNR Solids Management Plan outlines a comprehensive monitoring programme including monitoring of BNR solids characteristics, applied gross bulk and nutrient loads, monitoring of soils where BNR solids have been applied including lysimeter monitoring and surface water and groundwater monitoring. I have

recommended to Alliance Lorneville to undertake a site specific mineralisation study to confirm the basis of mineralisation utilised for loading assessment and to adjust the solids loading in the event the mineralisation rate is higher than what we have assessed.

131 The BNR Solids Management Plan is an adaptive plan which outlines procedures to mitigate against adverse effects resulting from the land disposal and the contingency monofill activities. Procedures are outlined to mitigate against excessive nitrogen leaching, odour, noise, dust nuisance, vector attraction, risk to animal health and runoff and leachate management. Health and safety requirements to minimise the risk to onsite workers are also outlined.

132 In the unlikely event that groundwater and/or lysimeter monitoring identifies higher than anticipated nitrogen leaching then Alliance Lorneville proposes to reduce the nitrogen loading rate. In my opinion the proposed monitoring will allow nitrogen effects to be identified and the BNR Solids Management Pan to be adapted as required to mitigate effects.

133 In the event that annual soil monitoring identifies excessive sodium expressed as exchangeable sodium percentage (**ESP**) then the proposed mitigation is to apply calcium in the form of lime or gypsum. Lime will be applied where soil testing indicates that pasture growth will benefit from elevating soil pH whereas gypsum will be applied where soil pH adjustment is not needed. In my opinion lime or gypsum application will be effective at mitigating against the effects of sodium as they are commonly used in New Zealand and overseas for this purpose and these measures are effectively implemented at Alliance Pukeuri.

134 In the unlikely event that various other management checks are triggered, such as heavy metals concentrations exceeding guideline limits, or odour and/or vector attraction is found to be problematic then land application will cease immediately and BNR solids will be diverted to the contingency monofill until the issue is resolved.

135 The BNR Solids Management Plan outlines specific measures to mitigate against odour and/or vector attraction issues associated with the contingency monofill including lime spreading and covering of the active monofill surface with topsoil. In my opinion these measures

are appropriate to mitigate effects in the unlikely event that odour or vector attraction issues arise. Further discussion around odour potential and proposed mitigation measures are outlined in Roger Cudmore's evidence.

136 Rainfall that falls on the active monofill cells and the resultant leachate will be collected by a sump formed at a low point in the cell. A pump will be used to automatically pump leachate to the adjacent existing lagoon based treatment plant. Testing undertaken in 2015 indicated that there was no seepage to the proposed monofill cells and groundwater monitoring has indicated that there is no observed negative effects on the surrounding groundwater from the lagoons as outlined in Peter Callander's evidence. Based on this information, in my opinion there is likely a reasonable barrier which will contain the contaminants within the proposed monofill cell.

137 Overall, in my opinion the risk of adverse effects associated with the proposed land disposal and contingency monofill is low, and appropriate mitigation measures are identified to address any issues that could potentially occur.

## COMMENTS ON COUNCIL OFFICER'S REPORT

138 I have reviewed the S42A Officer's Report prepared by Ms Sarah Smith and the technical support document [prepared by Mr Robert Potts. I have also reviewed the staff recommended consent conditions. I consider that the Officer's Report fails to appreciate the integrated nature of the plant processes at the site that result in a complex wastewater stream that requires considerable effort in determining the best approach to manage treatment.

### Lack of Certainty

139 The Officer's Report states that a key issue with the consent application is the *"...lack of certainty surrounding the effects of the proposed wastewater treatment system upgrade, given the actual treatment option has not been finalised and the actual reduction in nitrogen in the discharge is not currently known."* Alliance Lorneville has proposed a total nitrogen concentration limit in the final discharge of 45 g/m$^3$ following the commissioning of the upgraded plant.

140 I believe this proposed nitrogen limit provides absolute certainty with

regard to meeting the discharge criteria and establishes the likely actual effects downstream of the discharge point. Furthermore, Alliance Lorneville is proposing an interim ammonia limit (i.e. pre wastewater treatment upgrade) with a 4 day rolling average maximum of 4.75 g/$m^3$ at pH 8.0 and this provides certainty for an improvement during the pre-upgrade period as well.

141 As I have discussed in my evidence, the proposed treatment system will comprise of an anaerobic and aerobic activated sludge based BNR treatment system, with dedicated treatment of the high sulphide fellmongery waste streams. Microbial disinfection and additional phosphorus removal using chemical precipitation will be included if required by future catchment wide limits for the Oreti River.

142 The uncertainty with the upgrade to meet the discharge limits proposed is limited to the extent of detailed sizing and specification of the unit processes for treatment following the completion of waste minimisation and primary upgrade and subsequent outcomes. For example, the lime wash waste stream in the fellmongery contributes to 20% of the plant nitrogen load with a volume contribution of 1% (see Figure 2). A specific and reliable mechanical/chemical treatment of this waste stream could result in a waste stream that would not require substantive downstream biological nitrogen removal. Further work is required to determine the suitability of such intervention given that a high level of sulphide is present in this waste stream.

143 In my opinion, it is important to tackle the high nitrogen laden contributory loads from specific waste streams prior to confirming the final end-of-pipe treatment system. Completing the already started waste separation work at the site and confirming the resultant waste loads is critical in establishing a reliable and best fit treatment solution for the site.

144 Alliance Lorneville has proposed conditions and milestone reporting dates that require satisfying Environment Southland of the progress in developing the upgrade plan for the design, construction and commissioning of the upgraded wastewater treatment system.

**Implementation Time Period**

145 The Officer's Report has flagged another key matter as *"...the long time period (15 years) before any improvement in the quality of the*

*discharge to the Makarewa River occurs."* As I have outlined in my evidence, Alliance Lorneville has undertaken a number of upgrades since 2013 which have resulted in a considerable reduction in the end-of-pipe nitrogen loads.

146 The waste minimisation improvements and primary treatment upgrades have resulted in the 2016 median $NH_4$-N concentration discharged to the Makarewa River reducing by 35% from 2013 levels and I gather that further improvements are scheduled for the short term.

147 In my opinion these upgrades will further reduce $NH_4$-N discharged to the Makarewa River. The work undertaken is already providing a de-facto staged reductions in the level of nitrogen discharged and it is expected that further reduction can be realised with continued efforts. These reductions are realised well before the 15-year timeframe proposed by Alliance Lorneville.

**Short Term Consent**

148 The Officer's Report recommends that the discharge of treated wastewater to water consent is granted for a short term (five years), with conditions similar to those for the current consent. Ms Smith states that *"…this would allow the applicant to confirm its proposed upgrading option and subsequently provide an application which fully outlines the effects of the selected option…"*

149 Alliance Lorneville has already outlined the treatment upgrade path as discussed in my evidence. Alliance Lorneville has also outlined the effects of the discharge based on the discharge concentrations for the relevant parameters as proposed in Condition 16(a) of the draft consent conditions and this is demonstrated in various other supporting evidences. On the basis of this, I have the confidence that following the initial waste minimisation work and primary treatment system upgrading works, the necessary level of treatment using the proposed biological treatment system will be fully determined.

150 It is not necessary to confirm the specific upgrade route in comprehensive detail to provide additional confidence of whether the treatment target will be achieved or not. It is already demonstrated by Alliance Lorneville that a substantial reduction can be achieved by optimising recovery of product that would otherwise require

downstream wastewater treatment.

151 A shorter term consent will not change the outcome, but is likely to delay the upgrade programme as certainty in large investment is at risk. I do not consider that granting a shorter term consent will provide Environment Southland any more surety on the upgrade pathway than what has already been proposed by Alliance Lorneville.

**Upgrade Timeframe**

152 If a long term consent is to be granted then the Officer's Report recommends *"…shorter timeframes for selection and implementation of the wastewater upgrade (total period of eight years)".* In the event the timeframe for implementation needs to be compressed, I maintain that adequate time should be allowed for the waste minimisation and primary treatment upgrades to be undertaken in a measured and controlled manner.

153 In my opinion, the minimum time allowed for this is two processing seasons, effectively taking two years and ideally the third season for validation of pre-design parameters. I consider that as a minimum one year will be required to implement the strategy phase as this phase essentially commits Alliance Lorneville on the capital works expenditure programme. For the design phase, in my opinion this could be compressed over two years if required. Shorter design phases lean towards very conservative design outcomes and large capital projects can impose unnecessary additional capital expenditure. The construction phase as a minimum will require two summers as Alliance Lorneville would aim to use local contractors to assist in the construction. As I have discussed previously, the commissioning phase would require a minimum of two years if all construction works are undertaken sequentially, including allowing adequate time for the anaerobic lagoon to reach steady state operation and reliable performance. It would be prudent to allow at least one year float in the implementation phase.

154 Therefore, in my opinion, from entirely an engineering perspective, the minimum timeframe for design and implementation of a comprehensive wastewater treatment upgrade for the site before compliance limits can be reliably achieved is 10 years.

**BNR Solids Disposal and Contingency Monofill**

155 I concur with the conclusion of Mr Robert Potts that provided the recommended consent conditions are imposed and the proposed mitigation measures are undertaken, the effects of the application of BNR solids to land and into the contingency monofill on soil, groundwater, odour and vector attraction will be minor.

156 Mr Potts has stressed the importance of a management plan to ensure contingency measures are triggered and implemented to mitigate effects. A Draft BNR solids management plan has been prepared to support the application. The Draft BNR solids management plan includes instructions with regard to the handling of material and decision making for land application or monofill storage, management procedures to ensure consent compliance, health and safety related aspects and monitoring and reporting requirements. Prior to undertaking land disposal, I recommend that an updated management plan is developed.

**Offsite BNR Solids Disposal and Land Treatment of Wastewater**

157 Mr Potts has also suggested that the overall wastewater strategy could consider disposal of dewatered BNR solids to onsite Zone 2 (poorly drained) soils and to higher permeability soils at neighbouring properties, while utilising onsite higher permeability Zone 1 (well/imperfectly drained) soils for land treatment of wastewater. Based on the amount of land required to manage BNR solids and the stockyards solids on an annual basis, the long-term land treatment option is not viable on Company owned land

158 Access to neighbouring landowners farms land for the disposal of BNR solids will need to be examined once Alliance Lorneville has established a track record for the disposal activities on its own farmland. A separate consent will be required in future for extending this activity.

## CONCLUSION

159 Resource consents are being sought by Alliance Lorneville for various activities including discharge of treated wastewater and disposal of BNR solids onto land and into a monofill.

160 A number of technical investigations were carried out by PDP either directly supervised and/or managed by me to progress comprehensive feasibility investigations for the options for the upgraded wastewater treatment facilities to meet the expected tightening of the limits for continued discharge of treated wastewater into the Makarewa River. A comprehensive assessment of effects for the disposal of BNR solids onto land and into a contingency monofill was also undertaken.

161 The proposal for the upgraded treatment plant has targeted substantial reduction in ammoniacal nitrogen concentrations to meet the limit proposed by Alliance Lorneville.

162 I consider that the feasibility options investigation and the preferred option selection for the proposed wastewater treatment system is well thought out, is robust and represents industry accepted good practice.

163 The disposal of BNR solids to land at the loadings proposed by Alliance Lorneville will result in no more than minor effects. In my view the proposed BNR Solids Management Plan and on-going monitoring programme will ensure that the effects are well managed.

164 It is my overall view that the proposed design for the wastewater treatment plant, BNR solids management and ongoing monitoring programme, which I have outlined in my evidence, will result in discharges that can be well managed and comply with the proposed conditions.

**Azam Khan**
4 July 2016

## LIST OF ATTACHMENTS

E1 – Wastewater Treatment Plant Layout

E2 – Potential Land Disposal Areas for Alliance Lorneville Wastewater

E3 – Medium Stream Flow Separation – Estimate of Loads and Removal Rates

E4 – Medium Stream Flow Separation – New BNR Plant Process Flow Diagram

E5 – Treatment Plant Upgrade Design and Implementation Master Plan

E6 – Alliance Lorneville Farm Soil Types

## LIST OF APPENDICES

Appendix 1 – BNR Solids Management Plan [Draft for Consenting – 28 June 2016]


SOURCE:
1. AERIAL IMAGERY (FLOWN FEB-MAR 2011) SUPPLIED BY INVERCARGILL CITY COUNCIL.
2. CADASTRAL INFORMATION DERIVED FROM LINZ.

| NO. | REVISION | DATE | APP. |
|---|---|---|---|
| A | ISSUED FOR EVIDENCE | JUN 16 | |

| | BY | CHECKED | DATE |
|---|---|---|---|
| DESIGNED | D.G. | A.K. | JUN 16 |
| DRAWN | L.Y. | D.G. | JUN 16 |
| APPROVED ISSUE FOR : | | | |
| APPROVED : | | | |

THIS DRAWING IS NOT FOR CONSTRUCTION UNLESS SIGNED AS APPROVED



CLIENT: Alliance Group

PROJECT: LORNEVILLE PLANT RESOURCE CONSENT PROGRAMME

TITLE: WASTEWATER TREATMENT PLANT SYSTEM LAYOUT

PROJECT NO. : A01856217 | SCALE 1:5,000 (A3) | SHEET : - OF : - | FIGURE NO. : E1 | REV : A

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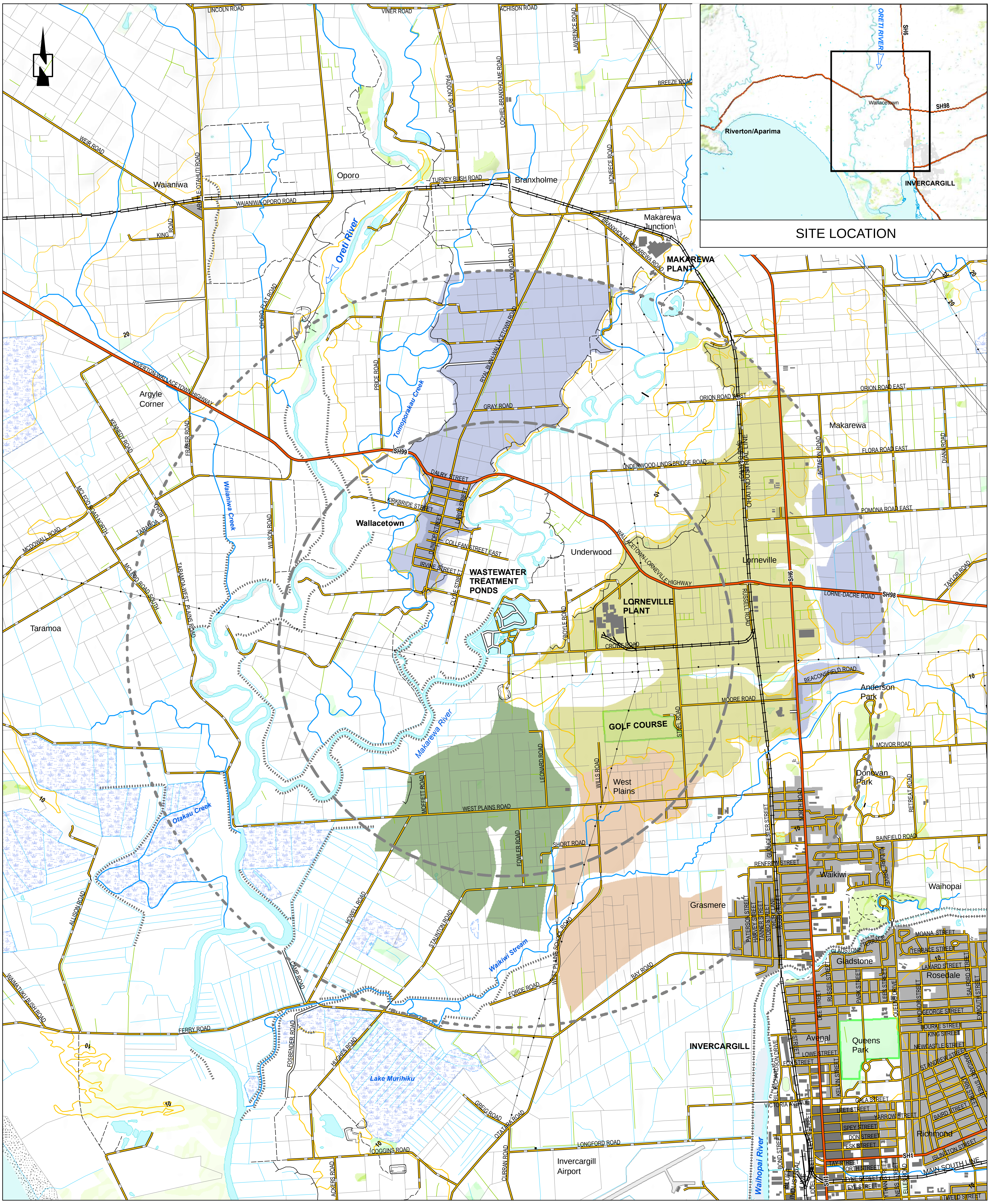
P.O. Box 9528, Auckland 1149, New Zealand.
Telephone : +9 523 6900 Fax : +9 523 6901
Auckland Wellington Christchurch

FILED: A01856217D001.dwg
IMAGE :




KEY :

ZONE 1: SOIL TYPES POTENTIALLY SUITABLE FOR WASTEWATER DISPOSAL

- EDENDALE (743ha)
- EDENDALE + MOKOTUA (444ha)
- MOKOTUA + EDENDALE (399ha)
- MOKOTUA + WAIKIWI + WOODLANDS (1041ha)
- RESIDENTIAL AREA
- 3km RADIUS FROM SITE
- 5km RADIUS FROM SITE

SOURCE:
1. SOIL TYPES DERIVED FROM ENVIRONMENT SOUTHLAND SOIL INFORMATION MAPS (BASED ON THE TOPOCLIMATE SURVEY OF SOUTHLAND AND SOUTH OTAGO).
2. CADASTRAL INFORMATION SUPPLIED BY LINZ 29/11/13.

| NO. | REVISION | DATE | APP. |
|---|---|---|---|
| A | ISSUED FOR EVIDENCE | JUN16 | |



CLIENT : Alliance Group

PROJECT : LORNEVILLE PLANT LAND TREATMENT AND DISPOSAL PRE-FEASIBILITY STUDY

TITLE : POTENTIAL LAND DISPOSAL AREAS FOR LORNEVILLE WASTEWATER

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Auckland Wellington Christchurch

SCALE : 1:50,000 (A3)

0 0.5 1 2 Kilometers

| PROJECT NO. : | FIGURE NO. : | REVISION : |
|---|---|---|
| A01856217 | E2 | A |

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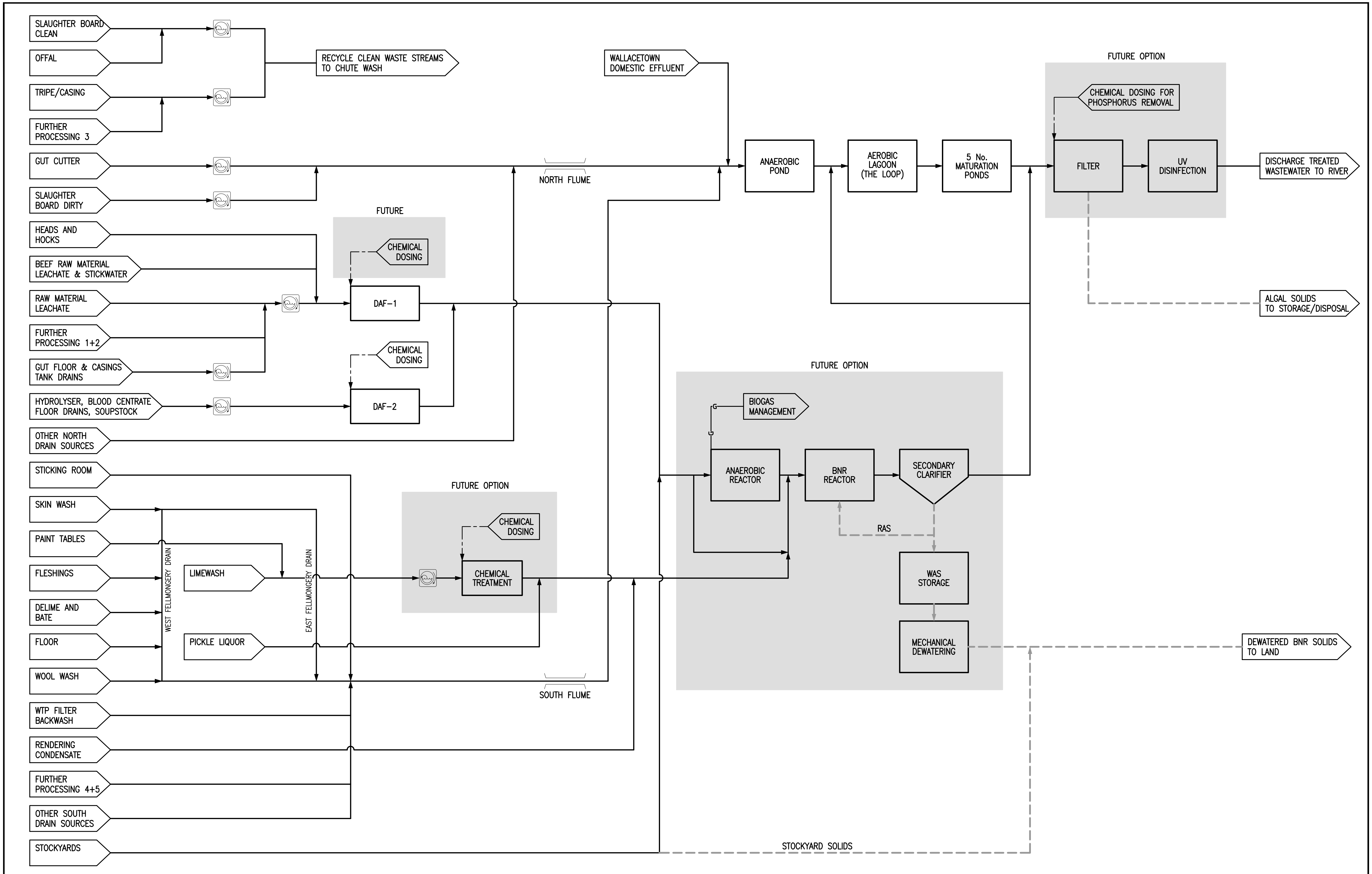
| **E3: Medium Strength Flow Separation – Estimated Loads and Removal Rates** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Raw Influent** | **Post Primary Treatment** | **Medium Strength Flow Separation & New BNR Plant** | | | | **Existing Final Effluent** | **Proposed Final Effluent** | **Overall Nutrient Reduction** |
| | | | **Influent** | | **Effluent** | | | | |
| Unit | [kg/d] | [kg/d] | [kg/d] | [%] Raw | [kg/d] | [g/m$^3$] | [g/m$^3$] | [g/m$^3$] | [%] |
| Flow [m$^3$/d] | 21,780 | - | 7,400 | 34 | 7,400 | - | 22,300 | 22,300 | - |
| TSS | 29,200 | 20,100 | 11,500 | 39 | 250 | <50 | 80 | <80 | - |
| cBOD$_5$ | 34,900 | 25,000 | 18,400 | 53 | 150 | <30 | 35 | <30 | - |
| TN | 3,660 | 3,300 | 2,700 | 74 | 300 | <60 | 210 | <45 | 79 |
| TP | 485 | 440 | 360 | 74 | 150 | <30 | 22 | <11 | 50 |

*Notes:*

1. *TSS = total suspended solids, cBOD$_5$ = carbonaceous biochemical oxygen demand, TN = total nitrogen, TP = total phosphorus;*
2. *Raw influent loads are peak loads and allow for 10% factor of safety for a processing rate of 28,000 lamb equivalents;*
3. *The design raw influent flow is based on 21,780 m$^3$/d and excludes stormwater and domestic effluent;*
4. *Peak domestic effluent volumes from the processing plant and Wallacetown are estimated at 220 m$^3$/d and 300 m$^3$/d respectively;*
5. *Medium strength flow separation shows the estimated proportion of loads diverted from the raw influent as kg/d and percentage;*
6. *The existing discharge concentrations are based on maximum values for the 2013 season;*
7. *The final discharge nitrogen concentrations are assessed as $NH_4$-N although some oxidised nitrogen may be present on occasions but has not been quantified.*




KEY:

- MECHANICAL SCREEN
- WASTEWATER STREAM
- SOLIDS STREAM
- GAS STREAM
- CHEMICAL DOSING

| NO. | REVISION | DATE | APP. |
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| A | ISSUED FOR EVIDENCE | JUN 16 | |

| | BY | CHECKED | DATE |
|---|---|---|---|
| DESIGNED | D.G. | A.K. | JUN 16 |
| DRAWN | D.R. | D.G. | JUN 16 |
| APPROVED ISSUE FOR : | | | |
| APPROVED : | | | |

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CLIENT: Alliance Group

PROJECT: LORNEVILLE PLANT WASTEWATER - SUMMARY REPORT ON ALTERNATIVES AND PROPOSED UPGRADING OF WASTEWATER TREATMENT PLANT

TITLE: MEDIUM STRENGTH FLOW SEPARATION - NEW BNR PLANT

PROJECT NO. : A01856217 | SCALE NTS (A3) | SHEET : - OF : - | FIGURE NO. : E4 | REV : A

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PRELIMINARY

# ALLIANCE LORNEVILLE CONSENTING PROGRAMME
# E5: WASTEWATER TREATMENT PLANT UPGRADE DESIGN & IMPLEMENTATION MASTER PLAN

Prepared by PDP (5 April 2016)
(A01856202G002)

## PHASE 1 – Optimisation of Primary Upgrades

- Addition of chemical flocculation to Dissolved Air Flotation (DAF) facility
- Improve solids capture at primary solids dewatering
- Improve separation of stockyards solids

## PHASE 2 – Confirm Strategy

- Review consent implications
- Waste survey
- Confirm waste source separation
- Confirm wastewater treatment technologies
- Existing wastewater treatment plant implications
- Conceptual design development
- Cost estimates (CAPEX, OPEX)
- Early contractor involvement
- Risk analysis

## PHASE 3 – Preliminary Design

- Site selection
  - Geotechnical investigations
  - Hydraulic assessment
- Preliminary design development
- Safety in design
- Refine cost estimates (CAPEX, OPEX)
- Risk analysis

## PHASE 4 – Detailed Design

- Selection & procurement of Principal Supplied Equipment
- Enabling works
  - Electrical supply upgrades
  - Water supply upgrades
- Detailed design development
- Engineers Estimate (CAPEX)
- Risk analysis

## PHASE 5 – Construction

- Tender & Contract Award
- Delivery of Principal Supplied Equipment
- Construction works
  - Bulk earthworks for Anaerobic/BNR Lagoons
  - Liner installation
  - Pipe works & pump stations
  - BNR mechanical installation
  - Sludge handling facility
  - Sulphide stream oxidation facility
  - Biogas flare facility
- Contract Administration
- Risk analysis

## PHASE 6 – Commissioning/Validation

- Commission anaerobic pond & biogas facilities
- Commission BNR & biosolids management facility
- Biogas characterisation & utilisation assessment
- Odour assessment
- Residual load impacts on existing wastewater treatment
- Handover/Close-off

## Deliverables

**Phase 1**

- Primary upgrades outcomes report

**Phase 2**

- Wastewater Upgrade Plan
  - Sequencing
  - Basis of design
  - Management Plan Requirements
  - Enabling Works
  - CAPEX expenditure triggering
- CAPEX Appraisal

**Phase 3**

- Preliminary Design Package
  - Preliminary design drawings
  - Preliminary design report
  - Safety in design report

**Phase 4**

- Enabling Works Package
- Detailed Design Package
  - Complete design drawings
  - Specifications, Schedules & Tender Documents
- Contract Documentation for Principal Supplied Equipment
- Erosion & Sediment Control Plan
- CAPEX Approval
- Construction Consent
  - Land Use Consent
  - Building Consent
  - Earthworks Consent

**Phase 5**

- Contractor Project Plans
  - Safety plans
  - Methodologies
  - Environmental Quality Plan
  - Contractor design documentation
- Operating Manual
  - Wastewater Treatment Plant
  - Solids dewatering/disposal
  - Management Plan Implementation

**Phase 6**

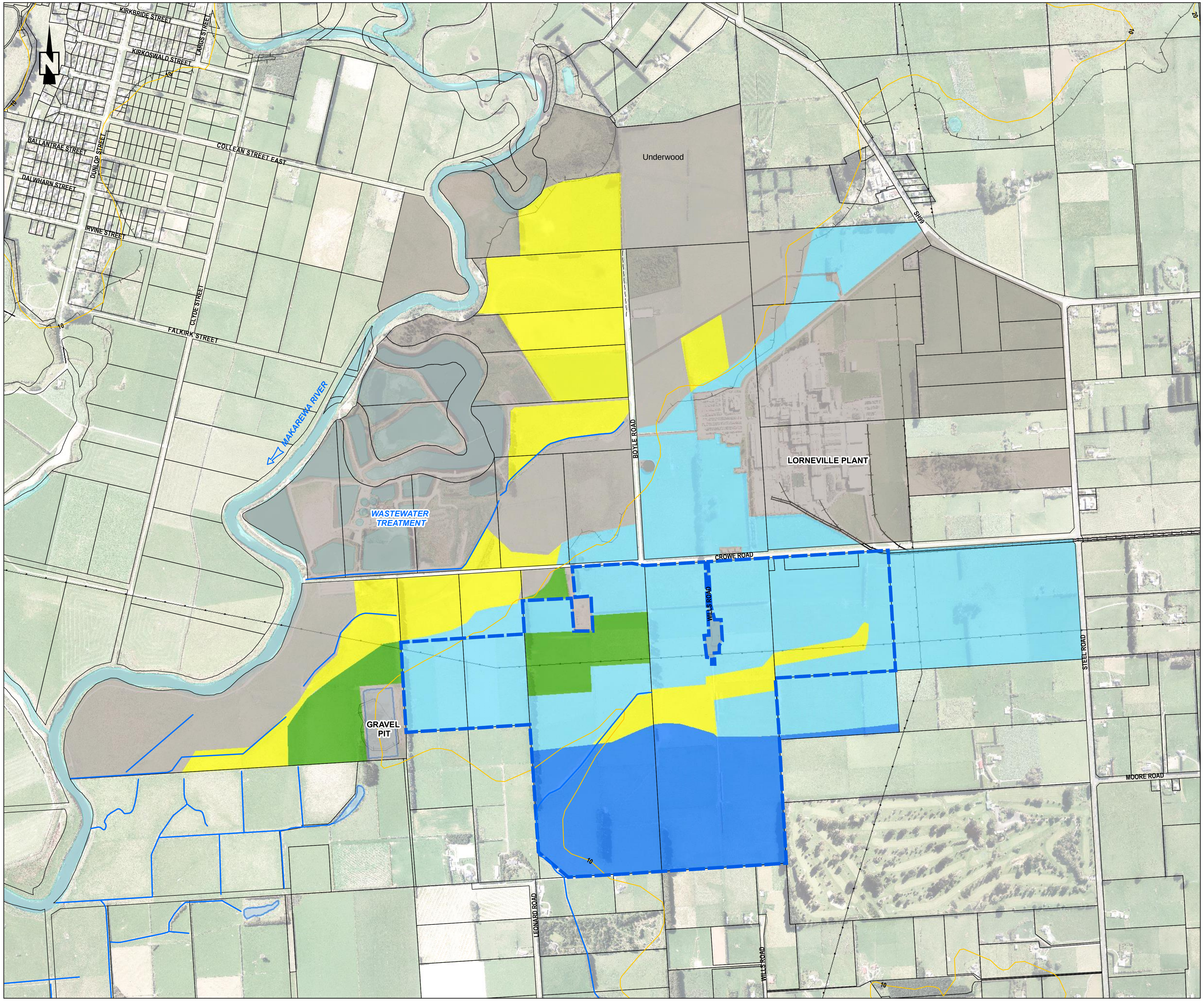
- Commissioning Report
- As-built documentation
- Wastewater monitoring & reporting
- Review WWTP Operating Manual
- Handover Report
- Biogas Reuse Investigation Report
- Review Operating Manual

Note: Phase 1 may extend beyond Year 3

Year

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

COMMENCEMENT OF CONSENT — COMPLIANCE WITH CONSENT




KEY :

**PROPOSED BIOSOLIDS DISPOSAL AREAS - SOIL TYPES:**

**ZONE 1**

- 36ha of EDENDALE (WELL DRAINED)
- 118ha of WAIKIWI + WOODLANDS (WELL DRAINED AND MODERATELY DRAINED)
- 16ha of MOKOTUA (IMPERFECTLY DRAINED)

**ZONE 2**

- 56ha of TISBURY + DACRE + MAKAREWA (POORLY DRAINED)

- EXCLUDED AREA
- EXISTING WASTEWATER IRRIGATION AREA

SOURCE:
1. URBAN AERIAL IMAGES (FLOWN FEB 2011) SUPPLIED BY INVERCARGILL CITY COUNCIL.
2. SOIL TYPES DERIVED FROM SOIL WORK LTD. SOIL MAP DATED 25/02/2014.
3. CADASTRAL INFORMATION SUPPLIED BY LINZ 29/11/13.

| NO. | REVISION | DATE | APP. |
|---|---|---|---|
| A | ISSUED FOR EVIDENCE | JUN 16 | |



CLIENT : Alliance Group

PROJECT : LORNVILLE PLANT BIOSOLIDS MANAGEMENT OPTIONS

TITLE : LORNEVILLE FARM SOIL TYPES

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Auckland Tauranga Wellington Christchurch

SCALE : 1:12,500 (A3)

0 100 200 400 600
METRES

| PROJECT NO. : | FIGURE NO. : | REVISION : |
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**ALLIANCE GROUP LIMITED**
**Lorneville Plant**

# Lorneville Dewatered BNR Solids to Land BNR Solids Management Plan

| | |
|---|---|
| Document Reference | [XX] |
| Revision | 001 |
| Issued By | PDP – Draft for Consenting |
| Date | 28 June 2016 |
| Page | 1 of 19 |

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## 1.0 Purpose

The purpose of this plan is to describe the management procedures and controls to be applied during BNR solids disposal operations at Alliance Lorneville to ensure that BNR solids are handled in a safe, environmentally responsible manner, in compliance with the conditions of the resource consent.

This plan includes procedures to be undertaken to limit any negative environmental impacts in accordance with Environment Southland Resource Consent No. [insert consent number] ('resource consent') which is attached as Appendix A.

This plan also describes the countermeasures which shall be used to remedy and/or mitigate any adverse environmental effects or nuisance effects from the BNR solids handling and disposal process.

## 2.0 Scope

This plan applies to all aspects associated with the management of BNR solids generated from the onsite biological nutrient removal (BNR) wastewater treatment plant as required by the resource consent, including but not limited to:

a) Production, day storage and decision making for land application or monofill storage of BNR solids;

b) Management procedures for the land applications of BNR solids including testing, mapping/logging runs and rates of application and stock withholding period;

c) Management procedures for the monofill storage of BNR solids including leachate management;

d) The measures to be taken to mitigate the potential for odour, noise, dust and vector nuisance;

e) Measure to be taken with regard to minimise risk to health and safety;

f) Monitoring and reporting procedures.

## 3.0 References

| | |
|---|---|
| Environmental Management System Programme Manual | LNV PGM 009 |
| Environment Southland Consent to Discharge Dewatered Biosolids to Land | [insert consent number] |
| BNR Solids Dewatering Operations Manual | [to be developed] |
| Wastewater Treatment Operating Manual | [to be developed] |
| Farm Overflow Stock Management | [to be developed] |
| Appendix J – Biosolids Land Disposal Assessment | PDP (2015) |
| Appendix S – Proposed Contingency Biosolids/Sheep Manure Solids Monofill (Technical AEE) | PDP (2015) |

## 4.0 Definitions

| | |
|---|---|
| WWTP | Wastewater Treatment Plant |
| WAS | Waste Activated Sludge |
| Boiler Ditch | Formed ditch that runs adjacent to the WWTP and receives the discharged wastewater |
| TS | Total Solids |
| TN | Total Nitrogen |
| $NH_4$-N | Ammoniacal Nitrogen |
| PAN | Plant Available Nitrogen |
| TP | Total Phosphorous |
| ES | Environment Southland / Southland Regional Council |

# 5.0 Responsibilities

The Alliance Lorneville **Engineering Manager** has overall responsibility for the operation and maintenance of the Wastewater Treatment Plant (WWTP). The Alliance Lorneville Engineering Manager [insert name] can be reached on: [insert ph number].

The Alliance **Lorneville Environmental Coordinator** has the ultimate responsibility for the operation of the WWTP and the BNR solids handling operations, including the implementation of this plan, compliance and annual review. The Alliance Lorneville Environmental Coordinator [insert name can be reached on: [insert ph number].

The Alliance Lorneville **Water Services Supervisor** or designate is responsible for the day to day operation of the WWTP and BNR handling operations including environmental sampling. The Alliance Lorneville Environmental Water Services Supervisor [insert name] can be reached on: [insert ph number].

**Environment Southland** is the regulatory authority that deals with compliance matters. Environment Southland can be reached on (0800) 76 88 45.

# 6.0 BNR Solids Handling

The BNR solids will be generated in the proposed aerobic BNR activated sludge WWTP when the processing plant is operational.

## 6.1 Volume

BNR solids production is directly related to production at the Lorneville Processing Plant, with production commencing in November, with peaking processing from February to April, and little or no processing during winter.

BNR solids from the clarifier will be 'wasted' by manual control of a waste activated sludge (WAS) pump to maintain the required solids inventory in the BNR treatment system. BNR solids will be discharged from the clarifier to a BNR solids storage tank.

The expected peak daily volume of BNR solids generated will be around 700 $m^3$/d at 1% dry solids.

Once dewatered to around 18% dry solids the peak daily volume of BNR solids generated will be around 39 $m^3$/d.

The annual volume of dewatered BNR solids produced will be around 3,900 $m^3$ at 18% dry solids.

## 6.2 Dewatering and Day Storage

BNR solids shall be mechanically dewatered to increase the dry solids content to a minimum of 12% prior to disposal to land or to the Monofill.

Dewatered BNR shall be pumped/conveyed to a covered hardstanding day storage area.

Dewatered BNR solids shall be preferentially loaded directly into a spreading wagon or tipper truck parked within the covered area. Alternatively, a front end loader shall be used to load dewatered BNR solids from the covered area to the spreader or truck.

Dewatered BNR solids shall be stored within the hardstanding area, either within the spreader, truck or on the ground in the hardstanding area for a maximum period of 48 hours.

Dewatered BNR solids shall be preferentially spread directly to the Alliance Lorneville Farm when possible or alternatively transported to the monofill.

## 6.3 Decision Making for Land Application or Monofill Storage

BNR solids will be preferentially applied to land at all times.

BNR solids shall not be applied to land and will instead be transported by tipper truck to the Contingency Monofill if triggered by any one of the following:

a) There has been a cumulative rainfall of 20 mm or more within 24 hours of the planned application;

b) There is rain forecast within 24 hours of the planned application which is predicted to exceed 20 mm over 24 hours;

c) There is a high risk of soil damage due to wheel loading from spreading equipment;

d) There are no farm paddocks available for BNR solids spreading due to high stocking and/or other farming activities;

e) There is a breakdown of the machinery used for land spreading of the BNR solids.

A flow chart summarising the decision making for BNR solids application is shown in **Figure 1**.

## 6.4 Land Application

Designated areas within the Alliance Lorneville Farm for land application of BNR solids are shown in **Figure 2**.

The Alliance Lorneville Water Services Supervisor and Farm Manager shall undertake monthly forward planning meetings to identify farm blocks to receive BNR solids.

The area for BNR solids disposal is to be calculated as outlined in Section 8.2.

When permitted under Section 6.3 the dewatered BNR solids will be applied to land using a specialised computer controlled tractor hauled ‘Strautmann Universal Spreader’ or equivalent with capability to automatically adjust the spreading to maintain a constant application rate as the speed of the tractor varies.

On a weekly basis the mass of BNR solids in the spreader unit will be weighed using the onsite weighbridge located within the processing plant to enable the operator to assess the mass of BNR solids being applied to land at each application.

Records of the following information are to be kept for each spreader load applied to land:

a) Date of land application;
b) Paddock number;
c) The bulk mass of spreader load (tonnes) – based on operator 'best estimate' calibrated by weekly weigh-ins;
d) Bulk application rate (t/ha);
e) Nitrogen application rate (kg N/ha) – calculated as outlined in Section 8.2.

Appropriate buffer distances will be provided for each BNR solids application as detailed in Section 8.1.

Daily checks shall be undertaken of the disposal activity by the operator as outlined in Section 10.1.

## 6.5 Monofill Storage

The disused lagoon cells located within the existing WWTP site will be utilised as monofill cells.

Dewatered BNR solids will be transported and tipped into the monofill from the day storage hardstand area using a tipper truck.

On a weekly basis the mass of BNR solids tipper truck will be weighed using the onsite weighbridge located within the processing plant to enable the operator to assess the mass of BNR solids being applied to the monofill for each load.

After material has been transported to the monofill, provided conditions permit land application of BNR solids, then at a convenient time the material will be removed from the monofill using an excavator and loaded into the spreader and applied to land in accordance with Section 6.4.

Records of the following information are to be kept for each tipper truck depositing material to the monofill **and** each spreader load of material removed from the Monofill for application to land:

a) Date of monofill/land application;
f) The bulk mass of truck/spreader load (tonnes) – based on operator 'best estimate' calibrated by weekly weigh-ins;

When required, in order to make room available for further material to be tipped into the monofill from trucks tipping from the tracks located around the perimeter of each cell, the material will be shifted within the monofill cell using an excavator.

If objectionable odour and/or vector attraction arises during the removal of mono-filled BNR solids the removal of that material will cease immediately and hydrated lime shall be applied to the active monofill surface as outlined in Section 8.3.

As an alternative to hydrated lime application or to supplement lime application, soil cover will be placed on the active monofill surface using an excavator as outlined in Section 8.3.

In the event that objectionable odour and/or vector attraction triggers lime or soil treatments then the BNR solids will be left in the monofill for a minimum period of 1 year before being removed and applied to land.

Daily checks shall be undertaken of the monofill by the operator as outlined in Section 10.1.

## 6.6 Monofill Capacity

A plan showing the layout of the proposed monofill cells utilising disused lagoon within the existing wastewater treatment is shown in Figure 3.

The approximate dimensions and capacities of the 4 No. monofill cells are outlined in the following table.

Separate monofill cells will be used for BNR solids and stockyards solids disposal. The larger cells (‘A1’ and ‘A2’) will be used for WAS disposal and smaller cells (‘B1’ and ‘B2’) for stockyards solids disposal.

| **Monofill Cells** | **Area ($m^2$)** | **Depth (m)** | **Capacity ($m^3$)** |
|---|---|---|---|
| A1 | 3,500 | 2.0 | 7,000 |
| A2 | 3,500 | 2.0 | 7,000 |
| B1 | 1,200 | 2.0 | 2,400 |
| B2 | 1,200 | 2.0 | 2,400 |
| | | **Total Capacity** | 18,800 |

If any monofill cell reaches capacity it shall be capped with a 0.3 m thick clay/soil layer or other suitable capping as may be agreed with the consent authority in writing.

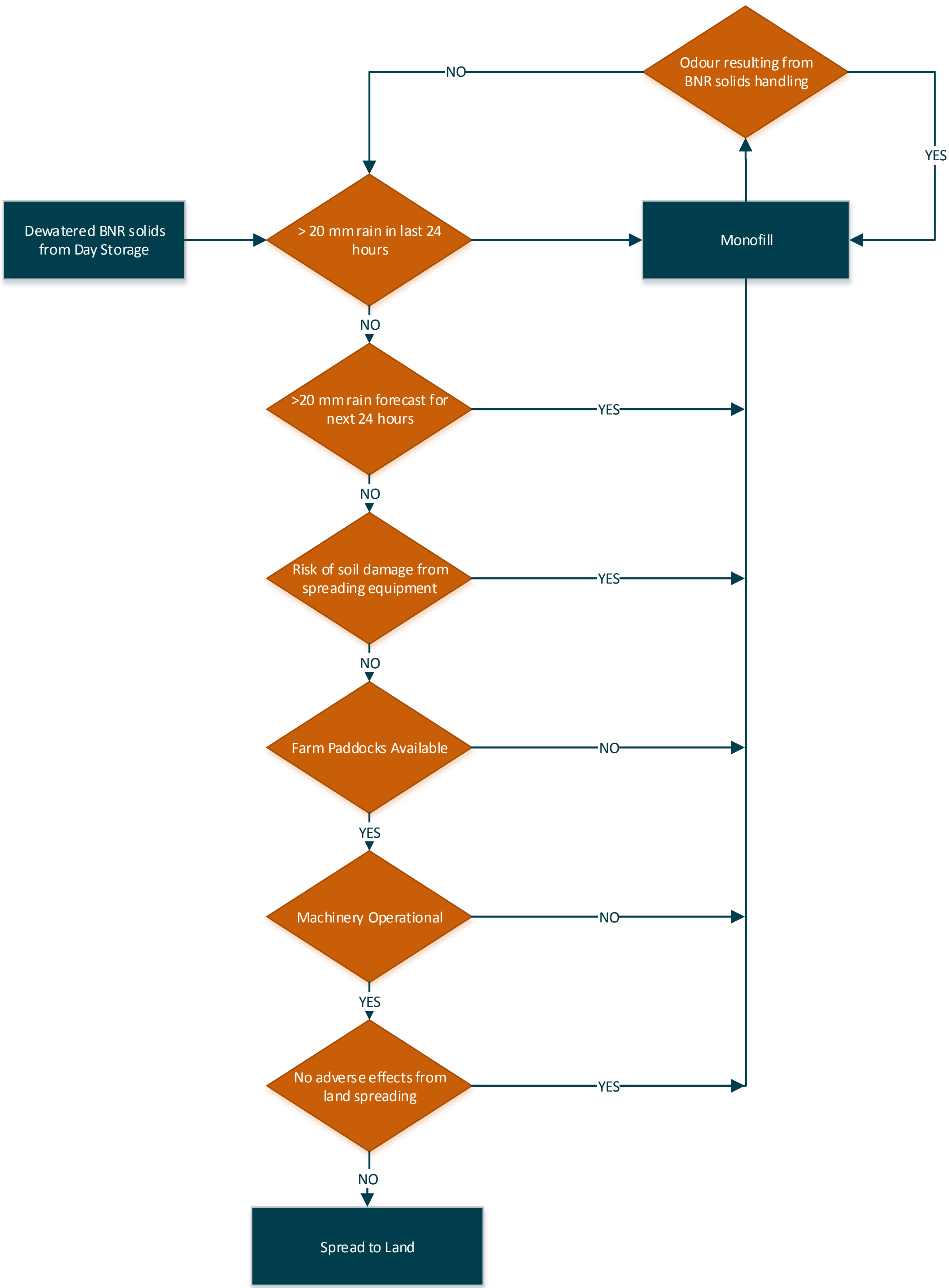


**Figure 1 : BNR Solids Disposal Decesion Making Process Flow Chart**

Figure 2: Alliance Lorneville Farm Layout Showing Designated Areas for BNR Solids Disposal
[to be added at a later date]

Figure 3 – Monofill Layout Plan [to be added at a later date]

# 7.0 BNR Solids Characterisation

This section outlines the procedures for characterising the nutrient content of the BNR solids.

## 7.1 Sampling

At all times when BNR solids are being applied to land, a fortnightly composite sample of dewatered BNR solids shall be collected and analysed for Total Solids (%).

At all times when BNR solids are being generated, a composite sample of dewatered BNR solids shall be collected on a monthly basis and analysed for:

| **Parameter** | **Unit** |
|---|---|
| Total Solids | (%) |
| Total Nitrogen | (%) |
| Total Phosphorus | (%) |
| Total Ammoniacal Nitrogen | (%) |
| Total Potassium | (%) |
| Total Calcium | (mg/kg) |
| Total Magnesium | (mg/kg) |
| Total Sodium | (%) |

Once per year a sample of dewatered BNR solids will be collected and analysed for:

| **Parameter** | **Unit** |
|---|---|
| Total Copper | (mg/kg) |
| Total Sulphur | (mg/kg) |
| Total Lead | (mg/kg) |
| Total Zinc | (mg/kg) |
| Total Nickel | (mg/kg) |
| Total Arsenic | (mg/kg) |
| Total Cadmium | (mg/kg) |
| Total Chromium | (mg/kg) |

Records shall be kept for BNR solids sampling and analysis and reported as outlined in Section 10.

## 7.2 Nitrogen Mineralisation Study

The assessment of environmental effects for BNR solids application to land has assumed that the TN content of the dewatered BNR solids is 6%. The assessment of effects has also assumed that the nitrogen will initially be in the form of organic nitrogen and 55% will ultimately mineralise to $NH_4$-N and becoming available for plant uptake over a 3-year period.

To confirm the nitrogen mineralisation of BNR solids a mineralisation study shall be undertaken during the first five (5) years of BNR solids production.

The mineralisation study will involve storage and periodic analysis of BNR solids samples located within a dedicated area within the monofill. The mineralisation study will be undertaken as follows:

a) On the first month of BNR solids generation, 1 $m^3$ of dewatered BNR solids shall be stockpiled and clearly labelling with the date of application. At the time of placement of the stockpile, a sample shall be collected and analysed for TN and TS. From then on, a sample shall be collected every two (2) months and analysed for these parameters.

b) A second stockpile shall be created from dewatered BNR solids generated on the third month of the study which shall be sampled and analysed for TN and TS. From then on, a sample shall be collected every two (2) months and analysed for these parameters.

c) A third stockpile shall be created from the dewatered BNR solids generated on the fifth month of the study. Samples shall be collected and analysed as in a) and b).

d) Each stockpile shall be sampled for a total duration of five (5) years, with the sampling frequency reducing from every 2 months to every 6 months after the end of the first year. No lime or topsoil shall be applied to the three stockpiled samples during the study period.

Following the completion of the study the results shall be plotted in a graph in accordance with **Figure 4**.

Following the completion of the study in Year 1, the BNR solids TN loading rate shall be adjusted accordingly for subsequent BNR solids applications to ensure that the maximum PAN loading rate is below 140 kgN/ha/yr.

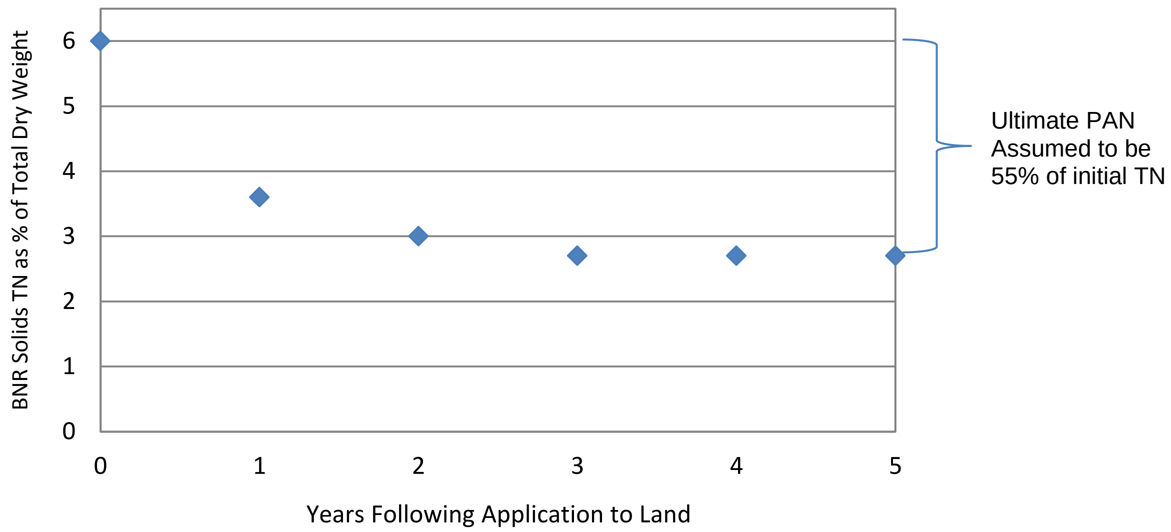


**Figure 4: BNR Solids Nitrogen Mineralisation**

# 8.0 Management Procedures to Ensure Compliance

This section outlines the management procedures to be undertaken to ensure compliance with the consent conditions.

## 8.1 Land Disposal Areas and Buffer Distances

BNR solids shall only be applied to the Alliance Lorneville Farm to areas with Zone 1 or Zone 2 soils as detailed on Figure 2.

Other farm paddocks not shown in Figure 2 belonging to Alliance Group or any other landowner shall not receive BNR solids.

BNR solids will be applied on a paddock-by-paddock basis and the Alliance Lorneville Farm Map outlined Figure 3 will be developed with clearly labelled paddocks to assist with record keeping for BNR solids applications.

No BNR solids shall be applied closer than:

a) 100 m of any residential dwelling (excluding those owned by Alliance Lorneville;
b) 50 m of any surface watercourse; and
c) 20 m of any property boundary.

## 8.2 Applied Load Calculations

The consented maximum nitrogen loading rate onto designated Company owned land shall not exceed 250 kg TN/ha/yr. This nitrogen limit shall include any other nutrient inputs such as application of mineral fertiliser.

The applied BNR solids nitrogen loading rate shall be calculated using the following formula:

$$\text{TN loading rate (kg N/ha)} = \frac{[\text{Total wet weight of BNR solids (kg) x solids content (\%) x (total nitrogen content \%)}]}{\text{Area of application (ha)}}$$

The solids content used shall be the annual average of the fortnightly analyses. The total nitrogen content used shall be the annual average of the monthly analyses.

The consented nitrogen loading rate of 250 kg N/ha/yr is based on an ultimate PAN loading rate of 140 kg PAN/ha/yr which has assumed the following:

- 40% of organic nitrogen is PAN in the first year of application;
- 10% of organic nitrogen is PAN in the second year following application;
- 5% of organic nitrogen is PAN in the third year following application;
- Mineralisation will be negligible four years after application.

The assumed nitrogen mineralisation rates outlined above shall be confirmed by a mineralisation study as outlined in Section 7.2.

If the mineralisation study determines that mineralisation rates differ from the rates outlined above then the TN loading rate of 250 kg N/ha/yr will be adjusted in subsequent years to ensure that the PAN loading rate is restricted to 140 kg PAN/ha/yr.

Estimates of nitrogen leaching using lysimeter and groundwater monitoring shall be undertaken as outlined in the Section 11. In the event that excessive nitrogen leaching and/or elevated groundwater nitrate-nitrogen concentration are found on two consecutive samples as outlined in Condition 18 of the Consent, then the nitrogen loading rate shall be reduced.

## 8.3 Odour Management

BNR solids disposal shall be managed in such a way that there is no offensive or objectionable odour beyond the property boundary.

In the event that an objectionable odour being is reported then the following actions shall be taken:

a) Identify the source of the odour and fill in a **Complaint Incident Report** form (refer to Appendix B) in the complaints register and advise the Alliance Lorneville Environmental Coordinator.
b) If the odour is from land application activity then immediately cease BNR solids application to land and divert BNR solids to the Contingency Monofill.
c) If odour is from the monofill then apply hydrated lime to the active monofill surface at a rate of approximately 1 kg of $Ca(OH)_2$ per square metre of active monofill surface.
d) As an alternative to lime application or to supplement lime application, apply a 100 mm layer of soil over the activate monofill material.
e) In the event that objectionable odour and/or vector attraction triggers lime or soil treatments then the BNR solids will be left in the monofill for a minimum period of 1 year before being removed and applied to land.
f) Advise Environment Southland of any complain incidents. This must be reported as soon as practicable after the odour incident but not later than 2 working days after the incident.

## 8.4 Noise Management

The following management practices shall be undertaken to keep noise at or below the allowable noise limits:

a) All reasonable steps shall be undertaken to minimise noise associated with monofill and land application works.
b) Any BNR solids land applications or monofill work shall be limited to the hours between 7:00 am and 7:00 pm.
c) In the event of a noise complaint being reported from the site, the following actions are to be taken:
    i. Fill in a complaint **incident report** form in the complaints register (refer to Appendix B) and advise the Alliance Lorneville Environmental Coordinator;
    ii. Identify the source of the noise;
    iii. Implement appropriate measures to reduce the noise.

## 8.5 Dust Management

Dewatered BNR solids (12–18% solids) will not be dry enough to generate dust, therefore, nuisance dust is unlikely.

In the unlikely event that nuisance dust is generated as a result of spreading or monofilling top soil covering activities during very dry and high wind conditions, then these activities shall cease until weather conditions improve.

### 8.6 Vector Attraction

The following management practices shall be adopted to prevent an increase in flies, mosquitoes, midges, rodents and birds on the disposal site:

a) All machinery used for the solids handling process should be washed down if it is going to be left unused for a period of more than 24 hours.

### 8.7 Stock Withholding Period

No stock are to be grazed on the area used for the application of BNR solids for a minimum period of fourteen **(14) days** after each application is completed or on areas where the pasture is visually contaminated with BNR solids residuals.

### 8.8 Ponding and Runoff Management

BNR solids shall only be applied to land when weather conditions permit as outlined in Section 6.3 to minimise ponding and surface runoff of BNR solids.

### 8.9 BNR Solids Impoundment

The application shall be undertaken in a manner that bulk deposition in an area is to be avoided at all times. There shall be no filling of any hollow areas on the land. There shall be no spreading when the vehicle is stationary.

### 8.10 Monofill Leachate Management

All the rainfall that falls on the active monofill cells and the resultant leachate shall be collected by a sump and pumped to the wastewater treatment plant.

Two (2) pumps shall be provided to operate on a duty/standby basis.

The sump and pumps shall be checked regularly and any solids causing blockages shall be removed as soon as possible.

Regular surface water and groundwater monitoring shall be undertaken as detailed in Section 10.1.

## 9.0 Health and Safety

### 9.1 General

Work practices at the site shall comply with all regulations set out under the Health and Safety in Employment (HSE) Act 1992 and its amendments. Some of the areas of note for health and safety awareness are outlined below.

### 9.2 Machinery Use

a) Access around to the mechanical dewatering building will be restricted.

b) BNR solids spreading equipment and tipping trucks traffic shall be limited to designated routes within the Alliance Lorneville Farm site.

## 9.3 Training

All staff involved in handling of the BNR solids shall be trained in:

a) The safe handling of BNR solids.

b) The location and operation of safety and spill containment equipment.

c) Location of First Aid Facilities and the identity of trained first aid personnel.

## 9.4 First Aid Facilities and Trained Personnel

Appropriate First Aid facilities and trained first aid personnel shall be available on site at all times.

## 9.5 Hygiene

BNR solids and wastewater can be a human health hazard if not handled appropriately. Care should be taken to avoid ingestion or inhaling spray. Appropriate hygiene standards shall apply at all times.

# 10.0 Monitoring and Reporting

## 10.1 Monitoring Programme

Monitoring shall be carried out as outlined in the resource consent conditions (Appendix A) and as summarised below.

| **Summary of BNR Solids Disposal Monitoring Programme** | |
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| **Activity** | **Monitoring Requirements** |
| General Disposal Activity and Logging of Information | Weather data shall be recorded every day of BNR plant operation. This shall include 24 hour rainfall data and the wind speed and direction.<br>When conditions allow land application of dewatered BNR solids, Alliance Lorneville shall log the following data in the Daily Disposal Log Sheet (refer to Appendix C):<br>a) The date of land application;<br>b) Location of the land application area (on a paddock basis), and the size of the land area in hectares;<br>c) The weight of the dewatered BNR solids applied.<br>When conditions do not allow land application, contingency actions shall be documented, including date, weight and truckloads to monofill. |
| Daily Checks | During land application and monofill storage/earthmoving events, regular checks will be conducted including:<br>a) Daily visual inspection and monitoring of the disposal areas and monofill cells for any instances of ponding, odour generation and vector attraction; |

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| | b) Daily checks for machinery failure.<br>Any malfunctions of equipment shall be repaired immediately, or if this is not possible, disposal shall cease. In this event an incident report form shall be filled out (refer to Appendix C). |
| BNR Solids Sampling | **Fortnightly** analysis of a composite sample of dewatered BNR solids for Total Solids.<br>**Monthly** sampling of dewatered BNR solids to determine:<br>a) Total Solids;<br>b) Total Nitrogen;<br>c) Total Ammoniacal nitrogen<br>d) Total Phosphorus;<br>e) Total Potassium;<br>f) Total Calcium;<br>g) Total Magnesium;<br>h) Total Sodium.<br>This data shall than be utilised to establish nitrogen loading rates and the sodium adsorption ratio (SAR).<br><br>In addition to the above, **Yearly** sampling of the dewatered BNR solids to determine:<br>a) Total Copper;<br>b) Total Sulphur;<br>c) Total Lead;<br>d) Total Zinc;<br>e) Total Nickel;<br>f) Total Arsenic;<br>g) Total Cadmium;<br>h) Total Chromium. |
| Soil Sampling and Assessment | Alliance Lorneville shall carry out assessments of the soils within the land application areas, in June each year, at a minimum of **four (4)** sites, one of which shall be a control site, i.e. a site on which application of dewatered BNR solids does not occur. The remaining monitoring sites shall be in areas where dewatered BNR solids application has occurred in the previous year. The assessments are to include infiltration rate, soil structure (0-20 cm soil depth), and soil aeration status (0-20 cm soil depth).<br>Alliance Lorneville shall carry out sampling (from the 0-7.5cm soil depth) of the soils in December and June each year at a minimum of three sites, one of which shall be a control site where dewatered BNR solids |

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| | application does not occur. The remaining monitoring sites shall be in areas where dewatered BNR solids application has occurred in the previous year. The samples shall be analysed for:<br>a) pH;<br>b) exchangeable calcium;<br>c) exchangeable magnesium;<br>d) exchangeable potassium;<br>e) exchangeable sodium;<br>f) total phosphorous;<br>g) total organic carbon;<br>h) total nitrogen;<br>i) anaerobically mineralisable nitrogen;<br>j) nitrate nitrogen. |
| Nitrogen Leaching Assessment | Estimates of nitrate leaching using **lysimeters** shall be made **monthly**, at **eight (8)** sites throughout the application area, to assess nitrate losses.<br>Nitrate-N concentrations are to be measured on leachate samples, and estimates are to be made using a daily water balance model for the periods between sampling dates.<br>Nitrate leaching shall be calculated monthly using the nitrate-N concentrations and drainage data. |
| Surface Water and Groundwater Monitoring | Alliance Lorneville shall monitor the effects of the discharge on Bateman's Drain at the point that it exits the dewatered BNR solids application area, or at another point agreed in writing by the consent authority, by taking representative grab samples of water from the drain, at **monthly** intervals, and analysing those samples for:<br>a) Electrical Conductivity;<br>b) Total Nitrogen;<br>c) Dissolved Reactive Phosphorus.<br>Alliance Lorneville shall monitor groundwater in two bores on the site, one of which shall be a control site (upstream of the dewatered BNR solids application area), and the other shall be at the downstream end of the dewatered BNR solids application area located at about map reference NZTM [XXXXXX]:<br>a) By measuring and recording the depth to groundwater at the two on-site monitoring bores immediately before purging the bores and extracting the samples under (b);<br>b) By taking representative samples of the groundwater at each site at three monthly intervals, and analysing those samples for:<br>i. pH;<br>ii. Chloride; |

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| | iii. Electrical Conductivity;<br>iv. Nitrate Nitrogen;<br>v. Nitrite Nitrogen;<br>vi. Ammoniacal Nitrogen;<br>*vii. E. coli.* |

## 10.2 Reporting

By the 15 December each year of operation, Alliance Lorneville shall prepare a monitoring report relating to the activities authorised by this consent over the preceding 1 October to 30 September period. This report shall be submitted to Environment Southland.

The monitoring report shall include but not be limited to:

a) Detailed assessment of the nitrogen loading rates and an assessment of compliance of the resource consent;

b) Annual summary and discussion of all data collected as required under the conditions of this consent as relating to both disposal of dewatered BNR solids to land and to monofill;

c) Description of the effects on soil and groundwater resources arising from the application of dewatered BNR solids, any breaches of the trigger identified in the resource consent and the mitigation measures undertaken;

d) Report and discuss any complaints received regarding the application of dewatered BNR solids;

e) Critically evaluate the performance of any managerial procedures and physical mechanisms in place to avoid, remedy or mitigate adverse effects on the environment, identify any improvements undertaken and make recommendations on any additional improvements needed.

## 10.3 Complaints Register

A complaint register will be maintained on the site (refer to Appendix B)

a) Fill in a complaint incident report form in the complaints register.

b) Record the following details in the complaints register:

    i. Name and address of the complainant (if given);

    ii. Location where the incident was detected by the complainant;

    iii. Date and time when the incident was detected;

    iv. A description of the wind speed and wind direction when the incident was detected by the complainant;

    v. The most likely cause of the incident detected; and

    vi. Any mitigation measures undertaken to avoid, remedy or mitigate the incident detected by the complainant.

c) Advise the Alliance Lorneville Environmental Coordinator regarding the nature of the complaint.

d) If necessary, undertake corrective action to reduce the effect of the incident that resulted in the complaint.

e) The register shall be made available to the Environment Southland upon request.

## Appendix A
## Consent [XX] for Discharge of BNR Solids from the Wastewater Treatment Plant and Stockyards to Land

## Appendix B
## Complaint Incident Form

## Appendix C
## Daily Disposal Log Sheet