HENDERSON POULTRY PRODUCTION FARM

Drainage and Nutrient Management Plan

Prepared for:

ProTen Limited

SLR Ref: 675.30036.00000-R02
Version No: v1.0
June 2021

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with ProTen Limited (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.11395.00000-R02-v0.1	July 2016	Samantha Roberts	Sophie Nicholas	Sophie Nicholas
675.30036.00000-R02-v1.0	June 2021	Julia Curran	Angus McFarlane/Kate Singh	Colin Davies

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APPENDICES

Approved Operating Strategy for Groundwater Bores (2021)

1 Introduction

ProTen Ltd (ProTen) obtained Development Approval (DA) from the Shire of Serpentine Jarrahdale for 16 poultry sheds and associated infrastructure on Lot 701 Henderson Rd, Hopeland (reference P02435/02). The site is approximately 39.2ha in area and the facility has 16 sheds, each housing 60,000 birds, with a total poultry capacity of 960,000 birds for meat production.

Condition 14 of Development Approval P02435/02 states

> *The proponent shall prepare a Drainage and Nutrient Management Plan for approval by the Shire prior to the issue of a building licence for the new sheds and thereafter implement the approved Drainage and Nutrient Management Plan in its entirety..*

This *Drainage and Nutrient Management Plan* (DNMP) is based on the previous version of the DNMP developed by GHD in 2007. Sections one to three remain in accordance with the 2007 version. However, sections four and five have been updated to reflect the changes to groundwater monitoring in accordance with the approved *Operating Strategy for Groundwater Bores* PB1 and PB2 (SLR, 2021).

1.1 EMP Objectives

The main objectives of this DNMP are to:

1. Comply with the approved DNMP at all times;
2. Show how the capacity of the settling pond (detention basin) will cope with stormwater and shed wash-down water in all but 1:100 year storm events (**Section 3.1**);
3. Show how chemicals from disinfectants used, and nutrients from wash-down water are treated so that no pollution can impact ground water resources or drain to the conservation category wetland (**Section 3.2**);
4. Describe and commit to best management practice (BMP) of swales (**Section 4**); and
5. Prepare a monitoring plan for quarterly measurements to be reported to The Shire to ensure there is no increased export of nutrients, sediments or other contaminants from the Site (**Section 5**).

1.2 Site Description

The site is located on Lot 701 Henderson Road in Hopeland (Figure 1) and is approximately 39.2 hectares. Configuration of the site is rectangular and runs approximately 392 m east to west and 1020 m north to south.

The site is relatively flat, with elevations varying from 16 mAHD (Australian Height Datum) to 18 mAHD (excluding drains). There are slightly elevated sections in the south-east and north-west corners of the site. There are three soak dams currently on the site. The material removed has been stockpiled next to each dam.

Bunding has been developed along the southern boundary that prevents drainage from the site into Dirk Brook, which has been diverted along the southern edge of the property. Drains are located along the northern and eastern edges of the boundary. A Water Corporation owned drain runs in the westerly direction through the centre of the site.

The geology of the site is white to pale grey sand at the surface, and fine- to medium grained overlying sandy clay to clayey sand of the Guildford Formation. The groundwater level of the superficial aquifer beneath the site is typically around 2.5m below ground level (BGL). However, the Guildford Clay formation beneath the site forms a perched aquifer, which can result in seasonal inundation for low lying areas on the site.

Figure 1 - Site Location

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REGIONAL LOCALITY

FIGURE 1

2 Drainage Management

2.1 Flood Level Design

To prevent flooding of the broiler sheds, the finished floor level of the sheds is greater than the 1 in 100 year ARI flood level. Vegetated drainage swales at the base of the sheds have been designed to manage the 1 in 100 year ARI five minute storm event. The process water volumes resulting from the operations of the broiler shed are unlikely to produce volumes of water that would impact upon the drainage of the site.

The swales convey stormwater, promote infiltration and reduce stormwater run peak flow, velocity and volume. The swales are also effective at removing pollutants, such as suspended solids, and thereby reduce the nutrient content (predominantly the particulate nutrients) and turbidity of the water as it enters the detention basin. The selection of appropriate swale slopes and widths, in addition to the use of kikuyu grasses and sedges within the swales has increased roughness within the swales which reduces the velocity of the water passing through the swale.

The key design parameters of the vegetated swale drains located between the sheds are presented in Table 1.

Table 1 - North to South Vegetated Swales Key Parameters

Parameter	Units	Northern Shed Swales	Southern Shed Swales
Length	m	160	160
Fall	m	0.5	0.5
Longitudinal Slope		0.0036	0.0036
Base Width	m	3	3
Depth during 100 Yr ARI	m	0.16	0.16
Flow Rate during 100 Yr ARI	kL/s	0.25	0.25
Flow Velocity of 100 Yr ARI	m/s	0.39	0.39

The detention basins have been designed to manage a 1 in 100 year ARI 72 hour storm without over-topping, using the approach presented in the Stormwater Management Manual of Western Australia (DoW, 2007). The invert levels of outlet pipes have been set at 200 mm from the base of the basins. This allows for the storage of the 1 year ARI 72 hour storm for treatment purposes. The basins have controlled outlets, so in the event of a wash-down during wet conditions, the outlet can be closed to increase the detention time for treatment purposes. In normal conditions, a detention time of less than 3 days is required to prevent mosquito breeding, whilst allowing for sufficient detention for sedimentation to occur.

The invert and levels of the inlet drains and the spillway of the detention basin have been established such that there is no reverse flow effect.

The key design parameters for the detention basin are presented in Table 2.

Table 2 - Key Design Parameters for Detention Basins

Parameter	Units	Northern Basin	Southern Basin
Contributing Catchment Area	ha	4.9	4.9
Runoff Coefficient		0.95	0.95
Surface Area	m^2	12,010	17,250
Outlet Pipe Diameter	mm	225	225
Depth for Storage of 1 Year ARI	m	0.2	0.2
Invert of Outlet	m	0.2	0.2
Storage Volume (at 0.2 m depth)	kL	2,402	3,450
Maximum Storage Volume	kL	3,603	5,175

2.2 Inlet Points

A Water Corporation Open Unlined Drain (OUD) passes through the site. It is understood that this drain collects stormwater from other agricultural properties in the region. The OUD currently receives water from the drain that passes along the eastern boundary of the site.

2.3 Outlet Points

To reduce the risk of infection from migratory birds, it is undesirable to have standing water in the detention basins during the dry months. The northern detention basin has an outlet at the northern end of the basin, which allows the water to drain over land through a grassed channel to the open drain located on the northern boundary of the site. The water then drains into the wetlands to the west of the site, and eventually into Dirk Brook. That water then leaves the northern detention basin for at least 6 months of the year during average rainfall conditions. During the remainder of the year, water is removed through evapotranspiration and infiltration.

The southern detention basin has an outlet at the eastern end of the basin, which reports to the open drain located on the eastern boundary of the site, which feeds into a Water Corporation drain. A spillway has been installed to avoid the risk of flooding impacting upon the broiler shed. The water then leaves the southern detention basin for at least 6 months of the year. During the remainder of the year, water is removed through evapotranspiration and infiltration. For most years, the detention basins are dry during summer months.

3 Wastewater Sources and Management

3.1 Stormwater

This section addresses stormwater generated within the ring road areas and between the noise bunds. This area generates stormwater from roof runoff, roads and the vegetated swales within the area. The remaining site drainage will continue to remain the same for all intents and purposes and will be managed as currently occurs at the site.

3.1.1 Stormwater Volume

Precipitation rates for event based modelling were calculated using *AusIFD*, a program developed by Engineers Australia for the determination of design average rainfall intensities and temporal patterns for locations within Australia. The Intensity-Frequency-Duration rainfall graph utilised for the assessment is shown below as Figure 2.

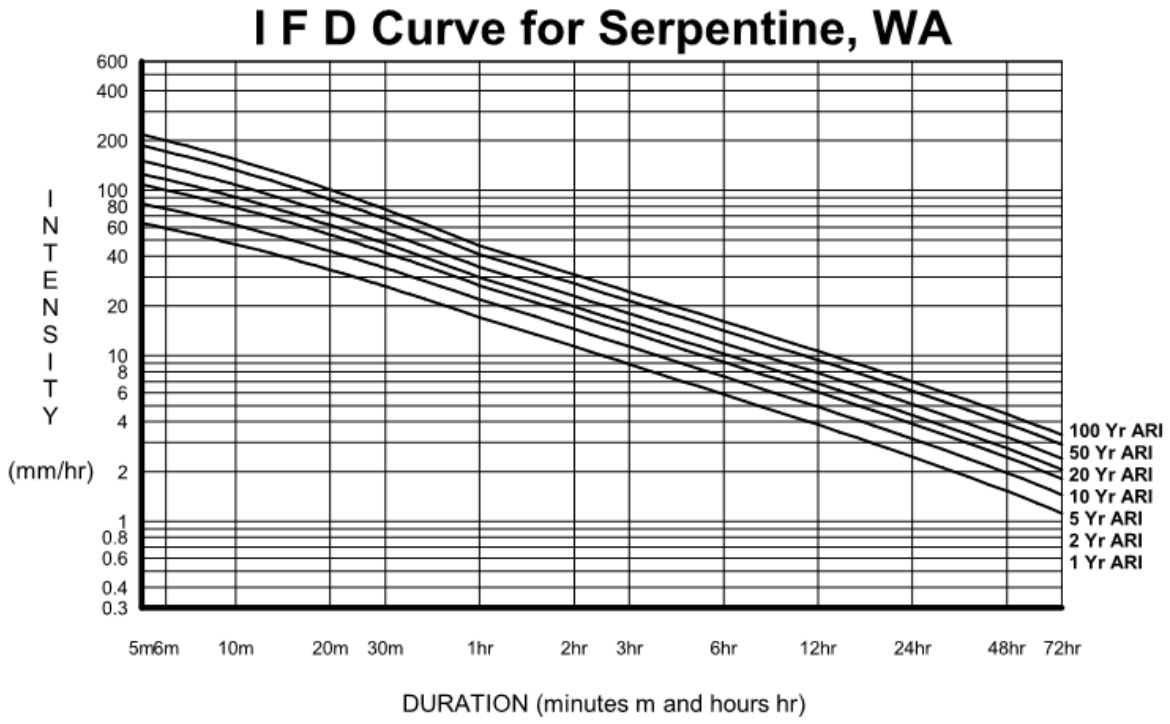

Figure 2 - Intensity-Frequency-Duration of Rainfall

For each unit, the 1 year ARI 72 hour duration event will generate 3,150 kL of runoff. Throughout the course of a year, the volume of stormwater that can be expected under different conditions is presented in Table 3.

Table 3 - Annual Water Inputs Received by Detention Basins

ARI	Rainfall (mm)	Northern Basin (kL)	Southern Basin (kL)
1 Year	850	51,144	46,477
10 Year	1015	60,680	55,042
100 Year	1165	71,533	64,885

The composition of catchment area is detailed in Table 4 below.

Table 4 - Catchment Composition

Area Type	Runoff Efficiency	% of Catchment Area	% of Contribution
Roof	95%	75	75
Road	95%	25	25

3.1.2 Stormwater Quality

During the wet season, there is generally three wash-down periods. During a 1 Year ARI year, there is a modelled total outflow of approximately 39,000 kL from each detention basin. Table 5 presents the annual average water quality from the detention basins.

Table 5 - Annual Average Water Quality at Detention Basin Outlet

Flow Regime	Volume	% Annual Flow	Pollutant	Concentration (mg/L)
Stormwater Runoff Only	31,111 kL	80%	TSS	8.4
			TN	1.26
			TP	0.08
Combined Stormwater and Washdown Water	7,800 kL	20%	TSS	31
			TN	3
			TP	1.09
Annual Average	38,911 kL	100%	TSS	12.9
			TN	1.6
			TP	0.28

The comparison of the average pre-development and predicted operational water quality at the detention basins is presented in Table 6. The results indicate that the predicted operational water quality is an improvement on the pre-development water quality for the three key parameters of total suspended solids, total nitrogen and total phosphorous.

Table 6 - Comparison of Detention Basin Quality

Parameter	Pre-Development Quality	Predicted Operational Quality
Total Suspended Solids (TSS)	180 mg/L	12.9 mg/L
Total Nitrogen (TN)	4 mg/L	1.6 mg/L
Total Phosphorous (TP)	0.45 mg/L	0.28 mg/L

The nutrient load generated by stormwater is minimal. The peak loads are associated with roof runoff from the site and from the roads. The contaminant concentration typically observed from these sources, as listed in Australian Runoff Quality (ARQ) (Engineers Australia, 2006) is presented in Table 7. The potential for dust generation resulting from the broiler shed operations and loadings have resulted in the mean value being used for the road stormwater quality rather than a lower end value. It has been assumed that the water collected over the swale and detention basin will have no suspended solids or nutrients.

Table 7 - Mean Roof and Road Stormwater Quality

Parameter	Roof Runoff	Rural Road Runoff
Total Suspended Solids (TSS)	70 mg/L	70 mg/L
Total Nitrogen (TN)	NA	2.1 mg/L
Total Phosphorous (TP)	0.13 mg/L	0.25 mg/L

The catchment area of the sheds is made up of the different areas of roofing, roads and grassed areas, as presented in Table 8. The stormwater runoff concentration was determined as weighted average concentration of these sources, based upon their likely contribution to the stormwater.

Table 8 - Anticipated Stormwater Quality (Prior to Treatment)

Parameter	Roof Quality
Total Suspended Solids (TSS)	42 mg/L
Total Nitrogen (TN)	2.1 mg/L
Total Phosphorous (TP)	0.16 mg/L

3.2 Process Water

3.2.1 Process Water Sources

Process water flows associated with the broiler operations are:

- Wash-down water;
- Evaporative cooler condensate; and

- Drinking water for the chickens.

The water released during the operation of the evaporative coolers is not present in quantities significant enough to impact upon the drainage system.

The drinking water from the chickens is excreted as chicken manure, which is incorporated into the poultry litter (the chicken manure combined with the sawdust). Therefore, this process water stream does not end up in the drainage system. The only process water stream that is passed through the drainage management system is the shed wash down water. The sheds are washed down following each cycle, with around six cycles occurring annually. Wash-down process occurs over a period of 7 to 10 days. The process employed at the site is consistent with the approach recommended in *the Environmental Code of Practice for Poultry Farms in Western Australia* (WABGA et al, 2004). This includes:

- Collecting the poultry litter by skid steer loader or similar and loading into a covered truck (avoiding any preventable spillage or dust creation) for offsite disposal as a fertiliser;
- Remaining litter collected through sweeping and blowing;
- Final wash-down using a high pressure spray to remove any residual material; and
- Disinfection using formaldehyde prior to the next batch of chickens.

3.2.2 Process Water Volume

Approximately 15 kL of water is required for each shed during wash-down. Allowing for 1 mm of wetting losses, approximately 12.3 kL of water is discharged from each shed. Therefore, each PPU will discharge around 98 kL of wash-down water over a period of 3 - 5 days. The wash-down water is released over a nine hour period.

3.2.3 Process Water Quality

ProTen utilises a wash-down process consistent with the methodology presented in the *Environmental Code of Practice for Poultry Farms in Western Australia*. According to this document, this process results in "a very low level of nutrients in wash-down water", and this was confirmed in discussion with the Department of Water (Pers Comm. Peter Ryan, 22/10/2007). Although the *Environmental Code of Practice for Poultry Farms in Western Australia* provides values for the concentrations of litter at harvesting, it has not been possible to locate literature that indicates the likely nutrient constituents of the wash-down water.

The typical concentration of nutrients within the broiler shed-wash down water at removal is presented in Table 9 below:

Table 9 - Nutrient Concentration of Wash-Down Water

Pollutant	Concentration
Total Suspended Solids (TSS)	2,500 mg/L
Total Nitrogen (TN)	65 mg/L
Total Phosphorus (TP)	45 mg/L

4 Management Measures

4.1 General Management

The following general management measures will be implemented at the site to minimise the potential for adverse impacts on the environment:

- Maintenance and management of the stormwater treatment system using best management practice;
- All staff are to be made aware of the appropriate nutrient management procedures including:
  - Cleaning and disposal off-site of any spillages during the cleaning procedures;
  - Appropriate disposal of dead birds;
  - No parking or driving on swales; and
  - Appropriate housekeeping procedures regarding littering and fertiliser usage on-site;
- Bunds will be routinely inspected for erosion and repaired as required;
- Additional mowing may be necessary before or during summer to reduce the risk posed by fire, but the minimum length of 90 mm should be maintained throughout if possible;
- Swales will be grassed with kikuyu grass to reduce the velocity of water passing through the swale system;
- Clippings of kikuyu grass will be disposed of away from water systems and preferably exported off site to be composted with shed litter;
- Swales will have periodic replacement of yellow sand lining, as required;
- Herbicides will not be used within 10 metres of the stormwater management facilities;
- Glyphosate will be used as the selected herbicide;
- Spraying will be avoided during windy conditions;
- No replanting of native species will be undertaken during two weeks of spraying;
- Any noxious weeds observed at the Site should be reported to the Department of Primary Industries and Regional Development via the MyPestGuide Reporter app;
- Wastes with significant quantities of nutrients will be transported in covered vehicles;
- Any onsite fuelling will take place on hardstand areas, preferably bunded to manage spills;
- The washing of vehicles will be undertaken on bunded hardstand areas to prevent the release of nutrients and chemicals into the waterways; and
- Formaldehyde used to disinfect the broiler sheds following the wash-down will be applied with shed doors closed, to prevent the chemical entering the stormwater treatment system.

4.2 Inspection Routines

4.2.1 Swales

The swales will be inspected during late summer/early autumn each year, prior to the autumn flush. Each inspection will involve the following:

- Removal of litter for appropriate off-site disposal;
- Mowing to a length to match the design flow depth of 90 mm (the 1 in 1 year ARI storm design flow levels through the drainage swales) – the grass clippings are to be disposed of off-site;
- Trimming of any sedges present within the swale, with offsite disposal of the clippings;
- Weed control;
- Inspect the swales for evidence of ponding, and remove blockage or fill as necessary with soil that is properly tamped and seeded; and
- Inspection for erosion. Where erosion has occurred, addressed using fill material and appropriate stabilising material (geotextiles, etc.), and replant.

Maintenance will be carried out on the swales prior to winter (April - May) and following major storm events (those with >58 mm/yr in 24 hours – the equivalent to a 1 in 1 year ARI storm event), including:

- Clear any accumulated debris and blockages; and
- Repair any damaged areas within the channel (such as repairing ruts or holes with soil that is properly tamped and seeded).

4.2.2 Detention Basins

Accumulated litter and debris in the detention basin will be removed prior to winter, and then during the middle and end of the wet season, where it is safe to do so. Biannual inspections and maintenance will be undertaken to assess the following:

- Sediment accumulation (accumulated sediment will be removed from the basin once the accumulated sediment volume exceeds 10% of the basin volume);
- Pest burrows will be filled and sealed as appropriate; and
- Structural integrity and blockages of the outlet (blockages will be removed through the use of suction wherever possible as opposed to flushing). Where flushing is utilised, the slurry will be dried on a sealed area and disposed of off-site at an appropriate facility.

5 Monitoring Program

The purpose of the monitoring program is to ensure that there is no decrease in the quality of both surface water and groundwater as a result of operations at the Henderson poultry production farm.

The area which poses most likely risk to the surface water quality is the water sourced from the broiler sheds. As a result, the monitoring program focuses on the two units of broiler sheds and their receiving drains.

The groundwater monitoring program aligns with the *Operating Strategy for Groundwater Bores PB1 and PB2* (SLR, 2021).

5.1 Objective

The objective of the monitoring program is to assess the quality of both surface water and groundwater, to ensure no detrimental impacts to the environment occur as a result of the operational activities at the site.

5.2 Sampling Location and Methodology

Figure 3 details the sampling locations for both surface water and groundwater monitoring.

5.2.1 Surface Water

Sampling is undertaken at the two drainage basins onsite - Detention Basin 1 (DB1) and Detention Basin 2 (DB2) (see Figure 3). The detention basins collect the stormwater and wash down runoff from the poultry production sheds.

Surface water sampling is conducted (when water is present) from three locations at each detention basin. These include:

- The outlet point of the basin;
- Upstream of the basin within the receiving drain; and
- Within the receiving drain downstream of the basin.

The results are assessed against the criteria set out in Table 10 below.

Table 10 - Surface Water Detention Basin Runoff Criteria (GHD, 2007)

Pollutant	Concentration
Total Suspended Solids (TSS)	180 mg/L
Total Nitrogen (TN)	4 mg/L
Total Phosphorus (TP)	0.45 mg/L

Figure 3 - Sampling Locations

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LOT 701 HENDERSON ROAD, HOPELAND, WA
SAMPLING LOCATIONS

FIGURE 3

5.2.2 Groundwater

Groundwater monitoring is undertaken at the two production bores (PB1 and PB2) to monitor the impacts of water extraction from the bores on the Leederville Aquifer groundwater levels and quality (see **Figure 3**). The results of the sampling are assessed against the criteria listed in **Table 11.**

Table 11 - Groundwater Criteria, Frequency and Reporting

Parameter	Criteria	Frequency	Reporting
Groundwater Level		**Quarterly**	**Quarterly**
Groundwater Level - PB1 and PB2	Below 1 metres AHD		
Groundwater Level Drawdown - PB1	More than 4.8 metres drawdown		
Groundwater Level Drawdown - PB2	More than 12.6 metres drawdown		
Groundwater Quality		**Quarterly**	**Quarterly**
pH	5.5 - 8.5		
Total Dissolved Solids	1,090 mg/L		
Electrical Conductivity	1,650 mg/L		
Total Nitrogen	-		
Total Phosphorus	-		
Total Kjeldahl Nitrogen (TKN)	-		
Nitrate + Nitrite (NOx)	-		
Ammonia as N	-		
Major ions (Na, K, Ca, Mg, NH_4, Cl, SO_4, NO_3, HCO_3, CO_3)*	-	Annually (within one of the quarterly events)	Annually

5.3 Frequency

As per Table 11, sampling of the two production bores for total nitrogen (TN), total phosphorous (TP), electrical conductivity (EC), pH and total dissolved solids (TDS) occurs on a quarterly basis, during the months of March, June, September and December, to identify potential impacts on groundwater quality. All results are recorded in a site database and reviewed every six months.

On the recommendation of DWER, major ions analysis is required for a short period (as determined appropriate by DWER) with a sampling frequency of once per year.

Meter readings are also recorded at each bore on a monthly basis to calculate extraction volumes and ensure the Department of Water licence allocation of 115,500 kL/annum is not exceeded.

5.4 Reporting

Following each quarterly sampling event, a report is prepared, and a copy is sent to The Shire.

An annual water quality report is also prepared for DWER detailing the surface water and groundwater results throughout the year. This is also sent on to The Shire.

6 References

Department of Water (2009) Operational Policy No. 5.12 – Hydrogeological Reporting Associated with a Groundwater Well Licence

Department of Water (2010) Operating Policy 5.08 – Use of Operating Strategies in the Water Licensing Process

Engineers Australia (2006) Australian Runoff Quality

GHD (2007) Drainage and Nutrient Management Plan

SLR Consulting (2021) Drainage and Nutrient Management Plan

GHD (2008) Groundwater Investigation and Hydrogeological Assessment

GHD (2008) Operating Strategy for Groundwater Bores PB1 and PB2

SLR (2017) Operating Strategy for Groundwater Bores PB1 and PB2

SLR Consulting (2021) Operating Strategy for Groundwater Bores

Western Australian Broiler Growers Association Poultry Farmers Association of Western Australia (2004). Environmental code of practice for poultry farms in Western Australia.

APPENDIX A
APPROVED OPERATING STRATEGY FOR GROUNDWATER BORES (2021)

OPERATING STRATEGY FOR GROUNDWATER BORES

Henderson Poultry Production Farm

Prepared for:

ProTen Limited

SLR Ref: 630.11395
Version No: V7
November 2020

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BASIS OF REPORT

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Reference	Status	Date	Prepared	Checked	Authorised
630.11395	Version 1	June 2011	Eryn Bath	Eryn Bath	Eryn Bath
630.11395	Version 2	July 2016	Andrew Macdonald	Derwin Lyons	Eryn Bath
630.11395	Version 3	September 2016	Andrew Macdonald	Derwin Lyons	Derwin Lyons
630.11395	Version 4	January 2017	Andrew Macdonald	Derwin Lyons	Samantha Roberts
630.11395	Version 5	February 2017	Samantha Roberts	Derwin Lyons	Samantha Roberts
630.11395	Version 6	October 2019	Samantha Hayes	Nathan Archer	Nathan Archer
630.11395	Version 7	November 2020	Ashish Mishra	Angus McFarlane	Angus McFarlane

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Licence details	Name(s)
Name of licence applicant/ licensee	ProTen Investments Managements Pty Ltd
Name of development project or purpose	The Henderson Poultry Production Farm
Legal description and address of where: a) water is taken	Lot 701 Henderson Road, Hopeland, Western Australia
b) water is used	Lot 701 Henderson Road, Hopeland, Western Australia

"I understand that the commitments given in the attached operating strategy will be a condition of an associated water licence if approved and that a breach of a commitment or any licence condition may be an infringement of the Rights in Water and Irrigation Act 1914":

	Signature	Date	Printed name
Person Legally responsible for water licence		16/3/2021	JULIAN JOHNSON
Approved by Department of Water and Environmental Regulation delegated authority			

1 Introduction

1.1 Background

The Henderson Poultry Production Farm (the "Development") was granted Development Approval PO 2435/02 on the 14 September 2007 by Serpentine Jarrahdale Shire located within Lot 701 Henderson Road, Hopeland, Western Australia (WA), approximately 50 kilometres (km) south-southeast of Perth (the "Development Site"). The Development comprises two poultry production units (PPU), where broiler birds are grown for human consumption. Each PPU comprises eight tunnel-ventilated fully-enclosed climate-controlled poultry sheds, with associated support infrastructure and staff amenities, and has the capacity to house up to 480,000 birds (combined total site capacity of 960,000 birds). The layout of the development is shown in Figure 1.

This Operating Strategy for Groundwater Bores (Strategy) applies to the extraction of groundwater from the two production bores PB1 and PB2 within the Development Site that service the water requirements of the poultry farm, along with associated operational and management issues. This Strategy has been prepared in consideration of the Western Australian Department of Water and Environmental Regulation (DWER) Operational Policy 5.08 – Use of Operating Strategies in the Water Licensing Process (2011). The Strategy will remain in force for the operating life of the licence held under Section 5C of the Western Australian Rights in Water and Irrigation Act 1914 (RWI Act) for the groundwater production bores identified as PB1 and PB2.

This revision to the Strategy has been prepared to incorporate the new regulations for metering the taking of water as required under the Rights in Water and Irrigation Amendment Regulations 2018 (Department of Water and Environmental Regulation, 2018).

1.2 Key Contacts

1.2.1 ProTen

The implementation of this Strategy is to be undertaken by the ProTen staff members listed in Table 1.

Table 1 ProTen Contacts

Key Contact	Company Position	Contact Details
Joubert De Lange	Farm Manager	Ph: 0438 679 043 Email: henderson@proten.com.au
Julian Johnson	WA Regional Manager	Ph: 0406 484 474 Email: julianj@proten.com.au
Bill Williams	Chief Executive Officer	Ph: 02 6964 2346 / 0447 062339 Email: bwilliams@proten.com.au

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REGIONAL LOCALITY

FIGURE 1

1.2.2 Regulatory Authorities

Table 2 lists the contact details for the regulatory authorities that have an interest in the water management aspects of the development.

Table 2 Regulatory Authorities and Stakeholders Contacts

Regulatory Authority	Key Contact	Contact details
Serpentine Jarrahdale Shire	Matt Sargenson Manager Heath	Ph: 08 9526 1107 Email: msargeson@sjshire.wa.gov.au
	Rachel Hellema Environmental Health Officer	Ph: 08 9526 1111 Email: rhellema@sjshire.wa.gov.au
Department of Water and Environmental Regulation	Carlie Slodecki A/Program Manager – Water Licensing, Peel Region	Ph: 08 9550 4210 Email: carlie.slodecki@dwer.wa.gov.au
	Tavonga Chipangura Natural Resource Management Officer, Water Licensing	Ph: 08 9550 4217 Email: tavonga.chipangura@dwer.wa.gov.au

1.3 Reporting

The Annual Monitoring Summary Report will be submitted to the DWER by the 31 December of each year and will reflect the reporting period from the 1 December to the 30 November. The Annual Monitoring Summary Report will be prepared in compliance with the Operational Policy No. 5.12 – Hydrogeological Reporting Associated with a Groundwater Well Licence (DWER 2009).

Water meter readings for each water year are reported to the DWER by the 31 December of each year and also included in the Annual Water Monitoring Report that is submitted to the DWER by the 31 December each year. As recommended by DWER, the meter readings must be submitted via the department's Water Online portal, unless otherwise approved by the department. To enable the online submission of meter readings, meters must be registered in the Water Online portal against the relevant water licence.

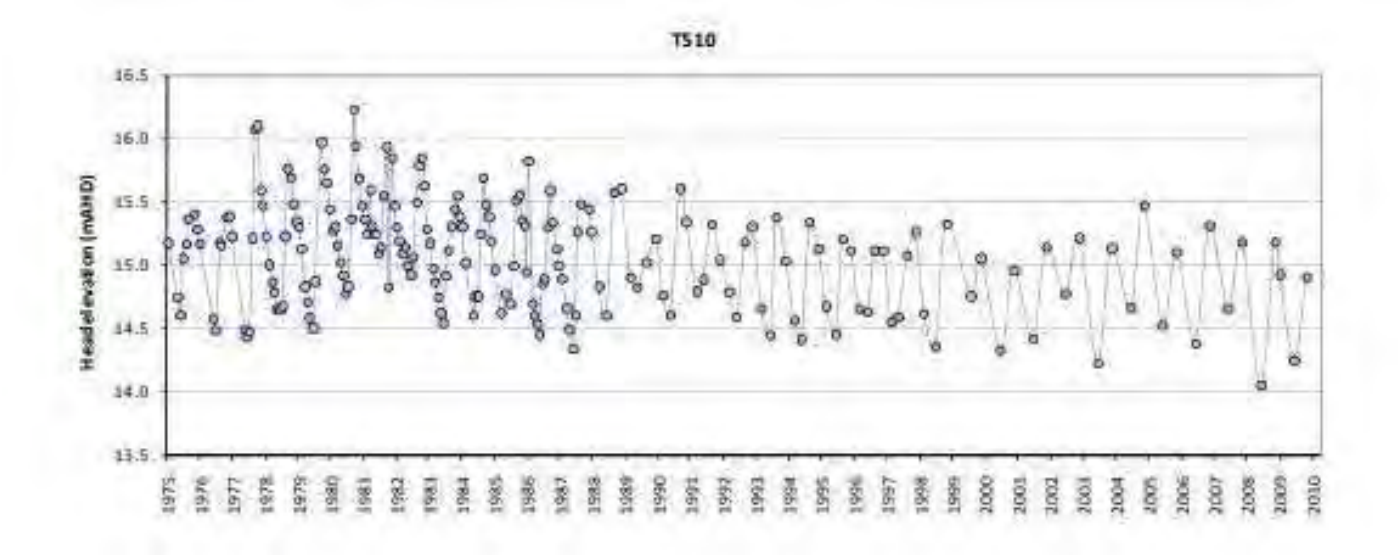
2 Operational Water Supply

2.1 Hydrogeological Setting

The site is located within Serpentine Groundwater Management Area, on the Swan Coastal Plain between the Darling Scarp and the Serpentine River. There are two major aquifers present at the location that are relevant to the site operations, the Superficial Aquifer and Leederville Aquifer.

The average saturated thickness of the Superficial Aquifer is about 10 m and consists mainly of sandy sediments of the Bassendean Sand with an average transmissivity of less than 100 m^2/day (Davidson, 1995). The salinity levels are observed between 500 to 1,000 mg/L (measured as total dissolved solids). Groundwater recharge of the superficial aquifer is predominantly via direct rainfall infiltration (Davidson, 1995). The Superficial Aquifer at the site location is comprised of the Quaternary Guildford Formation (Qg) (or Guildford Clay). The Guildford Clay is predominately of alluvial origin and described as pale grey, blue, but mostly brown silty and slightly sandy clay. It commonly contains lenses of fine-to coarse-grained very poorly sorted conglomeratic sand at its base (Davidson & Yu 2008). The bore construction and lithology log from the closest DWER monitoring bore T510 (AWRC:61410115) shows that the base of the Guildford Formation in the area is 12 m below ground level (mBGL). The Hydrograph monitoring bore T510 (AWRC:61410115), constructed in the Superficial Aquifer, displayed in Figure 2 shows a shallow water table that is generally between 14 to 16 m AHD and displays seasonal water level variation. Monitoring at the site has shown that the site is subject to inundation, with the water table rising to the ground surface during periods of increased rainfall recharge in winter.

Figure 2 Hydrograph of bore T510 (AWRC:61410115)



Underlying the superficial aquifer is the Leederville Aquifer. The Leederville Aquifer is a major aquifer present beneath the entire coastal plain except near the Swan Estuary. It has a maximum saturated thickness of about 550 m and salinity levels of between 500 to 1,000 mg/L (Davidson, 1995). The Leederville Aquifer is a multilayer groundwater flow system consisting of discontinuous interbedded sandstone, siltstone and shales. Recharge is from the superficial aquifer where the two aquifers are in direct contact and from upward flow from the underlying Yaragadee Aquifer where the deeper confining layer is absent (Davidson, 1995).

Groundwater is anticipated to be encountered at approximately 2.5 meters below ground level (mbgl) in the Superficial Aquifer (SLR, 2017a). The clay layer beneath the site (approximately 12 to 14 m thick) consists of sand and clay associated with the Guildford Clay, and has resulted in the development of a perched aquifer which can lead to the inundation of low-lying areas on a seasonal basis (SLR, 2017a). Inundation occurs because the aquifer fills to capacity in winter.

2.2 Groundwater Extraction

A water supply is required to meet the operational requirements for the Development Site. The water supply is extracted from groundwater resources at the Site by two production bores known as PB1 and PB2. Approximately 115 ML of potable water is required for the site, which is sourced from the Leederville Aquifer.

Extracted groundwater is temporarily stored in a storage tank and distributed through the water supply network across the site. The following table contains a summary of the bore details. In accordance with the requirements of the Rights in Water and Irrigation Amendment Regulations 2018 licensees must install a water meter on each water draw-point to accurately measure the quantity of water being extracted.

Details of the production bores and associated water meters are included in Table 3.

Table 3 Production Bore and Water Meter Details

		Bore ID	
		PB1	PB2
Location	Easting	396,560	6,414,489
	Northing	396,589	6,414,778
Date Constructed		April 2008	April 2008
Main Casing	Drilled (mbgl)	98	85
	Blank Interval (mbgl)	0 to 80	0 to 69
	Slotted Interval (mbgl)	80 to 98	69 to 85
Airlift Data	Discharge (L/s)	10	8
	Total Dissolved Solids (TDS) (mg/L)	980	900
	pH	6.4	6.5
	Stick-up (mbgl)	0.3	0.6
	Depth to Water (mbgl)	12.94	11.94
Water Meter Details	ID/Serial Number#	BP1 / 060925105	BP2 / 060925085
	Installation Date	April 2008	April 2008
	Meter Reading at Time on Installation (kL)	18,356	18,747
	Reading frequency	Monthly	Monthly

Note: mbgl metres below ground level; L/s litres per second; mg/L milligrams per litres
There is no type or brand name marked on the meters.

Table 4 lists the pump settings, maximum installed capacity and maximum monthly extraction from each of the production bores.

Table 4 Bore Specifications and Capacities

Bore ID	Installed Capacity			Maximum Annual Extraction (ML)
	Pump	Pump Setting (mbgl)	Design Yield (L/s)	
PB1	2*CRE 20-7	45	5.8	115
PB2	2*CRE 20-7	60	5.8	115

Note: mbgl metres below ground level; L/s litres per second; ML megalitres

Water meters are serviced and calibrated according to the installation guidelines every three years and water use is recorded on a monthly basis. The DWER will be notified within seven days if a malfunction of a meter is detected.

3 Groundwater Monitoring

The groundwater monitoring program is designed to monitor the impacts of bore operations on local groundwater levels and quality, and identify potential impacts on groundwater dependent vegetation within the vicinity of the production bores. The monitoring data is recorded in a database and reviewed every six months to identify any potential impacts from the groundwater extraction. The monitoring results and interpretation of the results are reported to the DWER annually within the Annual Aquifer Review.

3.1 Production Bores

The monitoring program for the production bores follows the method set out in the Drainage and Nutrient Management Plan (SLR, 2017a). As listed in Table 5, parameters are measured on a regular basis within the two production bores (PB1 and PB2).

3.1.1 Groundwater Level Monitoring

Water meter readings for each water year are reported to the DWER by the 31 December of each year and also included in the Annual Water Monitoring Report that is submitted to the DWER by the 31 December each year.

Water levels are monitored quarterly within the two production bores, which were installed prior to the commencement of the poultry development, to identify potential impacts from the extraction on regional groundwater levels. All results are recorded in a site database and reviewed every six months.

3.1.2 Groundwater Quality Monitoring

Sampling of the two production bores for total nitrogen (TN), total phosphorous (TP), electrical conductivity (EC), pH and total dissolved solids (TDS) occurs on a quarterly basis, during the months of March, June, September and December, to identify potential impacts on groundwater quality. All results are recorded in a site database and reviewed every six months.

On recommendations of DWER, the concentration of TP and TN at the production bores has been reviewed. The time-series plots of TP at the production bores PB2 And PB2 indicates an increasing trend over last 5 years (Figure 3). DWER recommended that the Leederville aquifer production bores are generally not useful for monitoring nutrient (TN, TP) outputs given their depth and confined nature. DWER also indicated that there may be leakage occurring from the overlying superficial aquifer or vertical flow within the annulus of the bores. On the recommendation of DWER, the major ions analysis is also proposed to be undertaken with the addition of TP, for a short period given the increase identified. DWER agreed that given the volume of the licence, the frequency can be reduced to one sampling event per year.

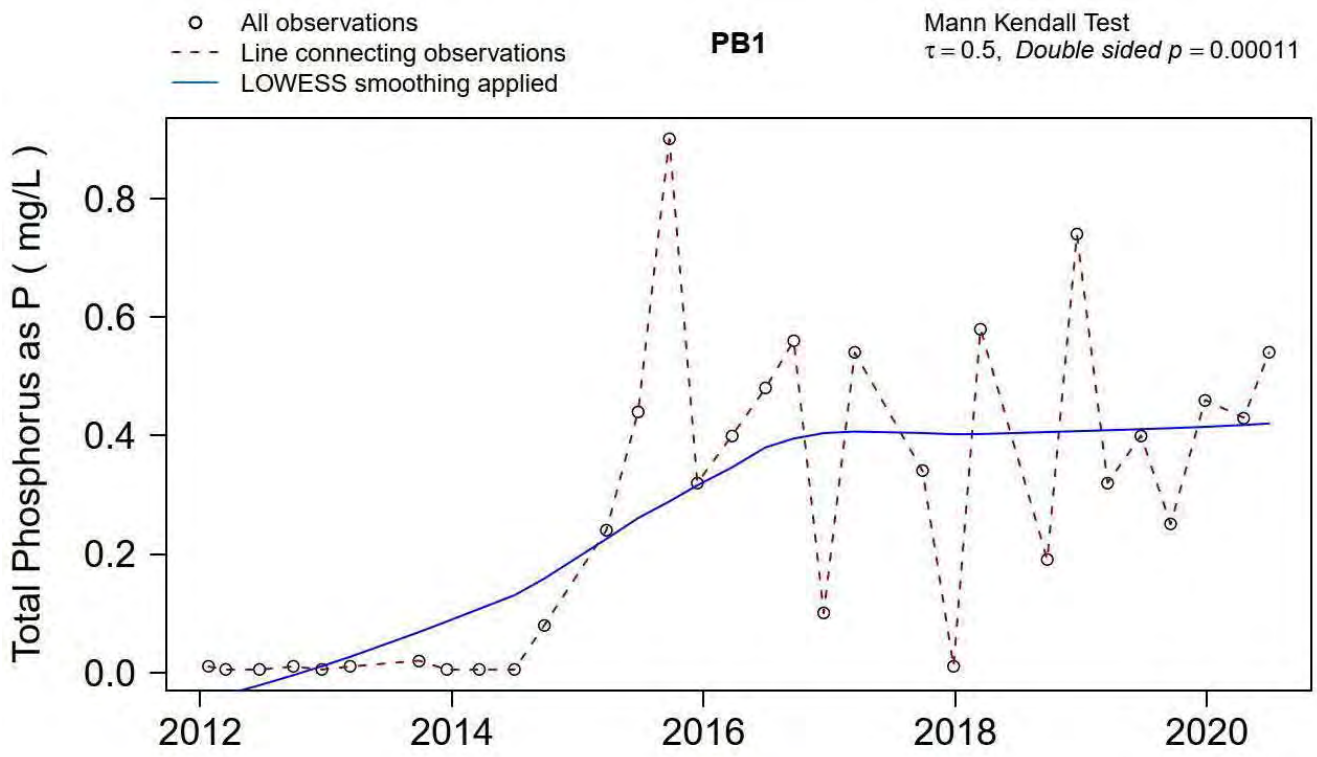
Therefore, it is proposed that the major ions at the production bores should also be analysed once a year.

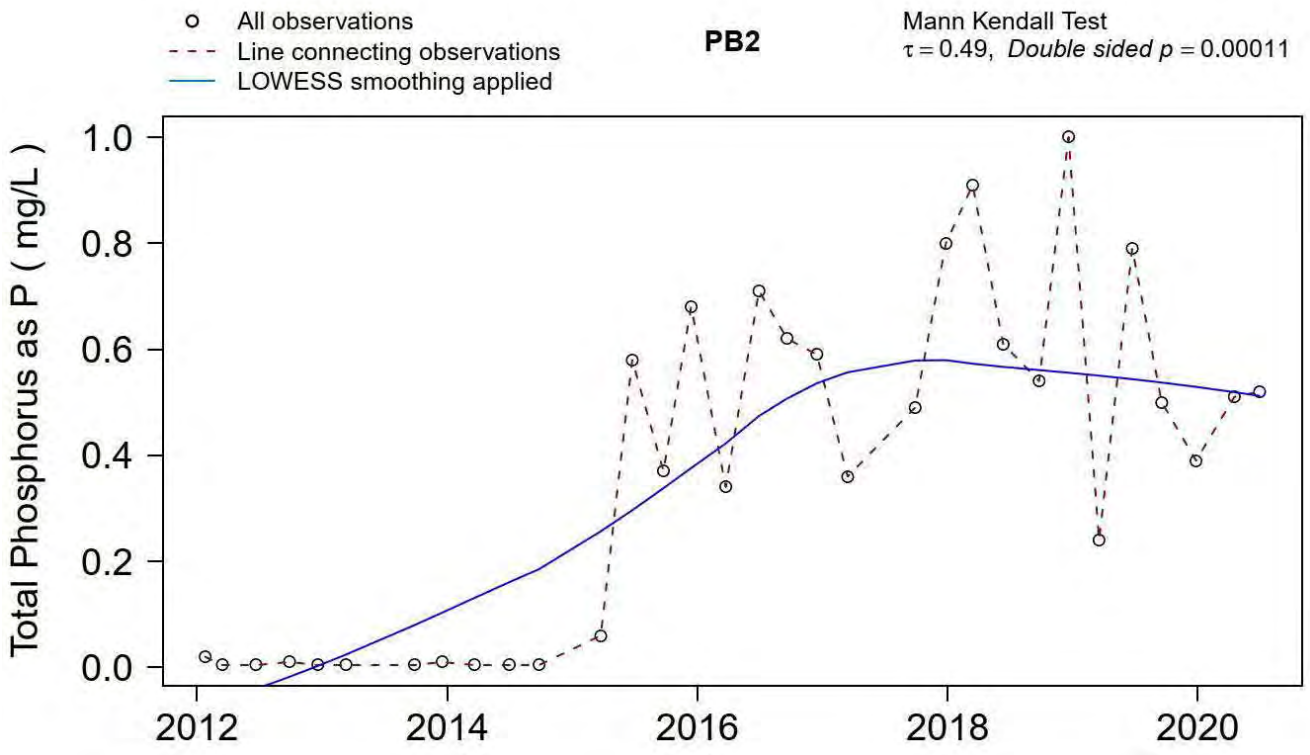
Table 5 Groundwater Monitoring Program - Production Bores

Sampling Site	Parameter	Frequency	Reported
PB1 and PB2	Water Use (Meter Readings)#	Monthly	Annually
	Water level	Quarterly	Quarterly
	Electrical conductivity (EC)		
	pH		
	Total dissolved solids (TDS)		
	Total phosphorus (TP)		
	Total nitrogen (TN)		
	Total Kjeldahl Nitrogen (TKN)		
	Nitrate + Nitrite (NOx)		
	Ammonia as N		
	Major ions (Na, K, Ca, Mg, NH_4, Cl, SO_4, NO_3, HCO_3, CO_3)*	Annually (with one of the quarterly events)	Annually

If a malfunction of the meter is detected the DWER will be notified within seven days. *These analytes are added recently (November 2020) on recommendation by DWER.

Figure 3 Time-series plots of total Phosphorus at PB1 and PB2





3.2 Monitoring Bores

Four superficial monitoring bores (GW1-4) were installed when the property was developed (GSS Environmental, 2011) as detailed in the original Operating Strategy. Monitoring was discontinued in 2016 based on advice from the department given the lack of bore construction information. DWER recommended that monitoring of groundwater levels and basic groundwater quality is to be re-established in the superficial monitoring bores (at least one upstream and one downstream) in an email from Carlie Slodecki (DWER) to Samantha Hayes (SLR) dated 13 August 2020. Following recommendations of DWER, these superficial monitoring bores will be readded in the groundwater monitoring network. The water level and nutrients (TN and TP) will be measured at an upstream bore (GW01) and downstream bore (GW02). The parameters to be measured on a regular basis within the two monitoring bores (GW01 and GW02) have been listed in Table 6.

Table 6 Groundwater Monitoring Program - Monitoring Bores

Sampling Site	Parameter	Frequency	Reported
GW01 and GW02	Water level	Quarterly	Quarterly
	Total phosphorus (TP)		
	Total nitrogen (TN)		
	Major ions (Na, K, Ca, Mg, NH_4, Cl, SO_4, NO_3, HCO_3, CO_3)*	Annually (with one of the quarterly events)	Annually

The sampling locations are presented in Figure 4.

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SAMPLING LOCATIONS

FIGURE 4

4 Contingency Plan

Given the nature and scale of the farm and groundwater extraction, we do not believe that a detailed contingency plan is required within this Operating Strategy. However, contingency actions have been identified below to minimise the potential for adverse impacts if there is a need to reduce the volume of groundwater that can be extracted. Possible triggers for a reduction in water allocation include, but are not limited to, the following:

- Drought;
- Unexpected aquifer response;
- Decline in groundwater levels;
- Changes to groundwater quality; and
- Degradation or evident stress of the surrounding environment.

Table 7 contains updated triggers levels for groundwater levels and groundwater quality at which the implementation of contingency actions would be considered. On recommendation from DWER, the groundwater level trigger for PB1 and PB2 was reviewed and revised. Water levels in the production bores have historically ranged between 1 m AHD and 8 m AHD, and no decreasing trend in water level is observed (Figure 5). As such, the 3 m AHD trigger, which has been breached each year, is not an appropriate trigger level. Therefore, as recommended by DWER, the trigger level is amended to 1 m AHD. Similarly, water level at GW01 and GW02 have historically ranged from 15 m AHD to 18 m AHD. As such, the water level trigger for GW01 and GW02 has been set at 15 m AHD. The water level readings must be taken at least 8 hours after cessation of pumping to avoid pump influence causing non-representative groundwater level trigger exceedance.

DWER also recommended reviewing the trigger levels for EC and TDS. On reviewing it was observed that the changes in the EC and TDS are within historical range and the current trigger levels are appropriate and suitable (Figure 6).

Figure 5 Groundwater levels at PB1 and PB2 in mAHD

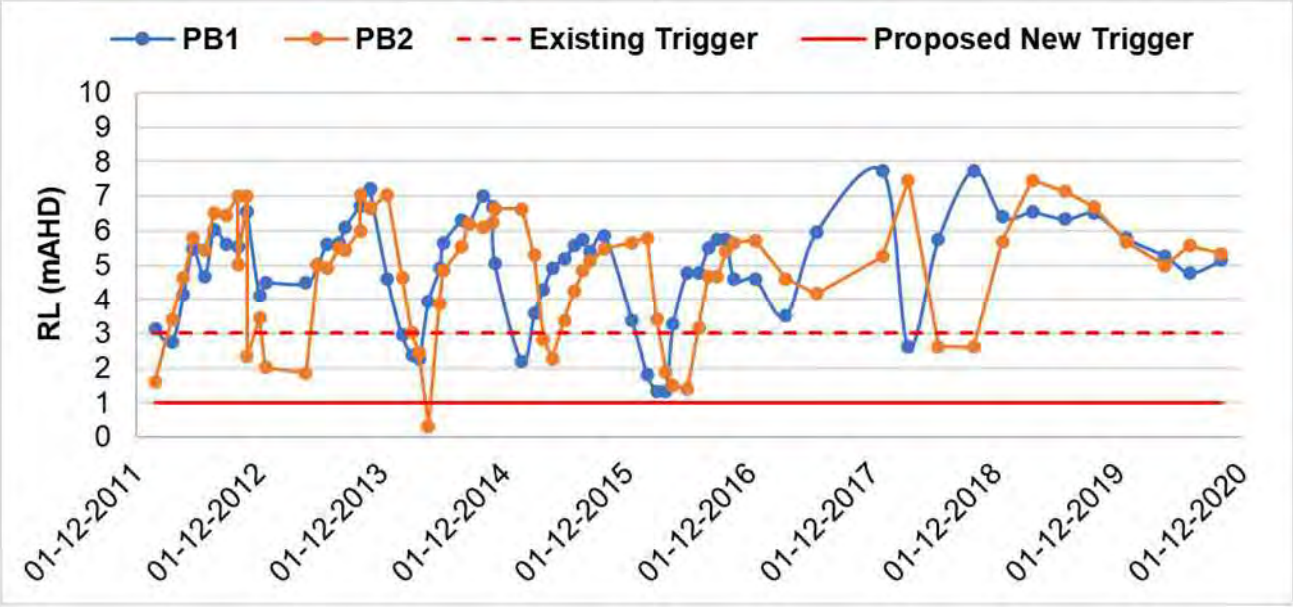

Figure 6 EC and TDS at PB1 and PB2 along with the Current Trigger

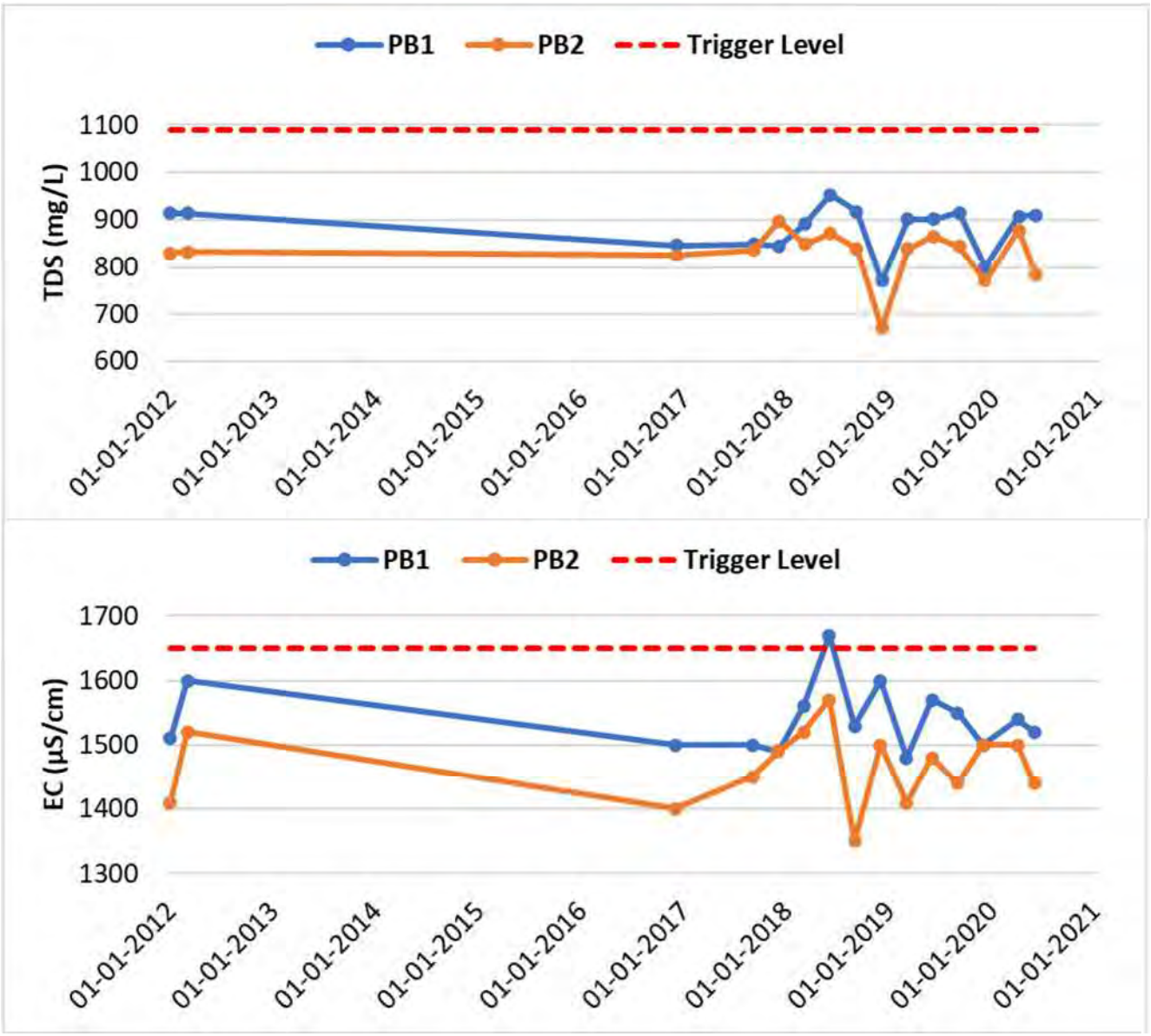

Table 7 Trigger Levels for Contingency Actions

Parameter	Trigger Level	Comment
Groundwater Level		
Groundwater Level – PB1 and PB2	Below 1 metres AHD	
Groundwater level – GW01 and GW02	Below 15 metres AHD	
Groundwater Quality		
pH	Outside range – 5.5 to 8.5	Neutral pH range
Total Dissolved Solids	Above 1,090 mg/L	10% above background level[1]
Electrical Conductivity	Above 1,650 mg/L	10% above background level[1]
Total Nitrogen	Increasing long-term trend or significant spike	No background level[1] or guideline value available
Total Phosphorus	Increasing long-term trend or significant spike	No background level[1] or guideline value available

[1] – as reported in the Hydrogeological Assessment (GHD 2008)

Contingency actions have been identified to minimise the potential impacts on groundwater resources. A tiered approach to contingency actions will be implemented as outlined below:

- Tier 1 – At a point where a parameter is outside the specified range or exceeds the relevant trigger level, the affected bore(s) are to be resampled immediately. If the follow up result remains outside the specified range or still exceeds the relevant trigger level, Tier 2 will be implemented. If the follow up result is within the specified range or does not exceed the relevant trigger level, a return to routine monitoring will occur; and
- Tier 2 – Further investigation in consultation with the DWER is required regarding the trigger breaches. Monthly monitoring will be undertaken until the parameter is inside the specified range/below the relevant trigger level, until investigation into the cause of the breaches is concluded as agreed with the DWER, or other contingency actions such as those outlined below are implemented in consultation with the DWER.

It is emphasised that the fact that the licensed water allocation may not be guaranteed at all times is a commercial risk of the operator (ProTen). If such a time presents itself, the following contingency actions will be considered for implementation in consultation with the DWER:

- Investigation – engaging a suitable and experience specialist/consultant to undertake a groundwater investigation and hydrogeological analysis in order to investigate the cause of the issue and the extent of the impact(s), as well as identify possible mitigation measures to remedy the cause, ameliorate the impact(s) and/or avoid re-occurrence;
- Shutting Down the Affected Bore – the cumulative annual extraction rate from the bores is 115 megalitres, which is less than half the rate modelled by GHD in 2008 prior to the establishment of the bores. On this basis, GHD (2008) concluded that either bore is capable of supplying the fully 115 megalitre allocation with minimal implications (including increased drawdown and environmental impacts);

- Destocking – reducing the operating capacity of the poultry complex until the required water supply can be obtained. The poultry sheds can be gradually destocked to reduce the demand and utilisation of water. In the unlikely event that water availability ceases all together and an alternative water source can be accessed, the complex will likely be forced to cease operating until such time that acceptable water supply become available; and
- Alternative Water Sources – the purchase of water from off-site is also an option while the licensed allocation is reduced.

Based on these available contingency actions, there should not be any impact or disadvantage to other local water users should the licensed allocation to the poultry complex be reduced.

The groundwater monitoring program, along with the six monthly review of monitoring data and the Annual Aquifer Review, will help to ensure that any unacceptable or unexpected changes to the groundwater system are identified. In the event that any of the triggers are identified as part of the regular monitoring activities, ProTen will notify DWER and any instructions will be adhered to.

5 Water Use Efficiency Measures

While the production bores have been installed and equipped to sustain the total water demand of the project, the water supply system has a number of water efficiency measures built into it. The key measures are outlined below:

- Water lines, with nipple drinkers and drip trays, run the length of each poultry shed and are automatically supplied by the external water storage tanks. This method of providing drinking water, as opposed to traditional cup drinkers, minimises water consumption by reducing water spillage and evaporation;
- The poultry sheds are cleaned and sanitised at the end of each production cycle using high-pressure low-volume hoses. With only six production cycles occurring each year, the volume of water utilised for cleaning purposes is minimal;
- Automatic control systems continuously monitor internal shed conditions and adjust the ventilation system to suit ensuring that water is only used for cooling when necessary; and
- Regular inspections and maintenance of water supply infrastructure is undertaken to identify and make repairs.

6 Summary of Commitments

The following summarises the previous commitments outlined in this report:

- The licensee will comply with this operating strategy as a condition of Water Resource Licence No. GWL172830(2) for the taking of water from the Serpentine (Perth - Leederville) Water Resource Management Area;
- The licensee will carry out and report to the department on the following monitoring program:

Table 8 Monitoring Program (summary of Section 3)

Sampling Site	Parameter	Frequency	Reported
PB1 and PB2	Water Use (Meter Readings)#	Monthly	Annually
	Water level	Quarterly	Quarterly
	Electrical conductivity (EC)		
	pH		
	Total dissolved solids (TDS)		
	Total phosphorus (TP)		
	Total nitrogen (TN)		
	Total Kjeldahl Nitrogen (TKN)		
	Nitrate + Nitrite (NOx)		
	Ammonia as N		
	Major ions (Na, K, Ca, Mg, NH_4, Cl, SO_4, NO_3, HCO_3, CO_3)	Annually (with one of the quarterly events)	Annually
GW01 and GW02	Water level	Quarterly	Quarterly
	Total phosphorus (TP)		
	Total nitrogen (TN)		
	Major ions (Na, K, Ca, Mg, NH_4, Cl, SO_4, NO_3, HCO_3, CO_3)	Annually (with one of the quarterly events)	Annually

- The licensee shall inform the DWER of any likely breach in the commitments of this operating strategy within 14 days of the licensee being aware of the possible breach. This also includes the implementation of a contingency response; and
- An annual water use (metering) report and the compliance (monitoring) report to be reported within 30 days after the end of the water year in accordance with the regulations, in formats described in Strategic policy 5.03 and Operational policy 5.12 respectively.

7 References

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Davidson, W.A. (1995). Hydrogeology and Groundwater Resources of the Perth Region Western Australia. Geological Survey of Western Australia. Department of Minerals and Energy.

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SLR (2017b). Henderson Poultry Production Farm. Operating Strategy for Groundwater Bores PB1 and PB2.

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