29 Hercules Crescent
Albany WA 6330
98421575
Denmark Office: Unit 7, 40 South Coast Highway
Denmark WA 6333
98481309
Esperance Office: Unit 2A, 113 Dempster Street
Esperance WA 6450
enquiry@biodiversesolutions.com.au
ABN 46 643 954 929
Ref: MSC00429

15th June 2021

Department of Water and Environmental Regulation
Prime House
8 Davidson Terrace
Joondalup, WA 6027

Application to Clear Native Vegetation – Supporting Information

Lot 56 Diagram 61012, Big Grove WA

Soil testing results

To whom it may concern,

Bio Diverse Solutions has been engaged by Jonathan Rowe (the applicant) to analysis soil testing results to support a clearing permit application at Lot 56 Diagram 61012, Big Grove WA (here in referred to as the Subject Site). The client submitted a clearing permit application for the Subject Site which was received by the Department of Water and Environmental Regulation (DWER) on the 9th October 2020.

1. Methodology

Soil samples were taken from various depth increments at two locations within the Subject Site (Lot 56 Quaranup Road, Big Grove WA). The sampling locations are shown on Figure 1.

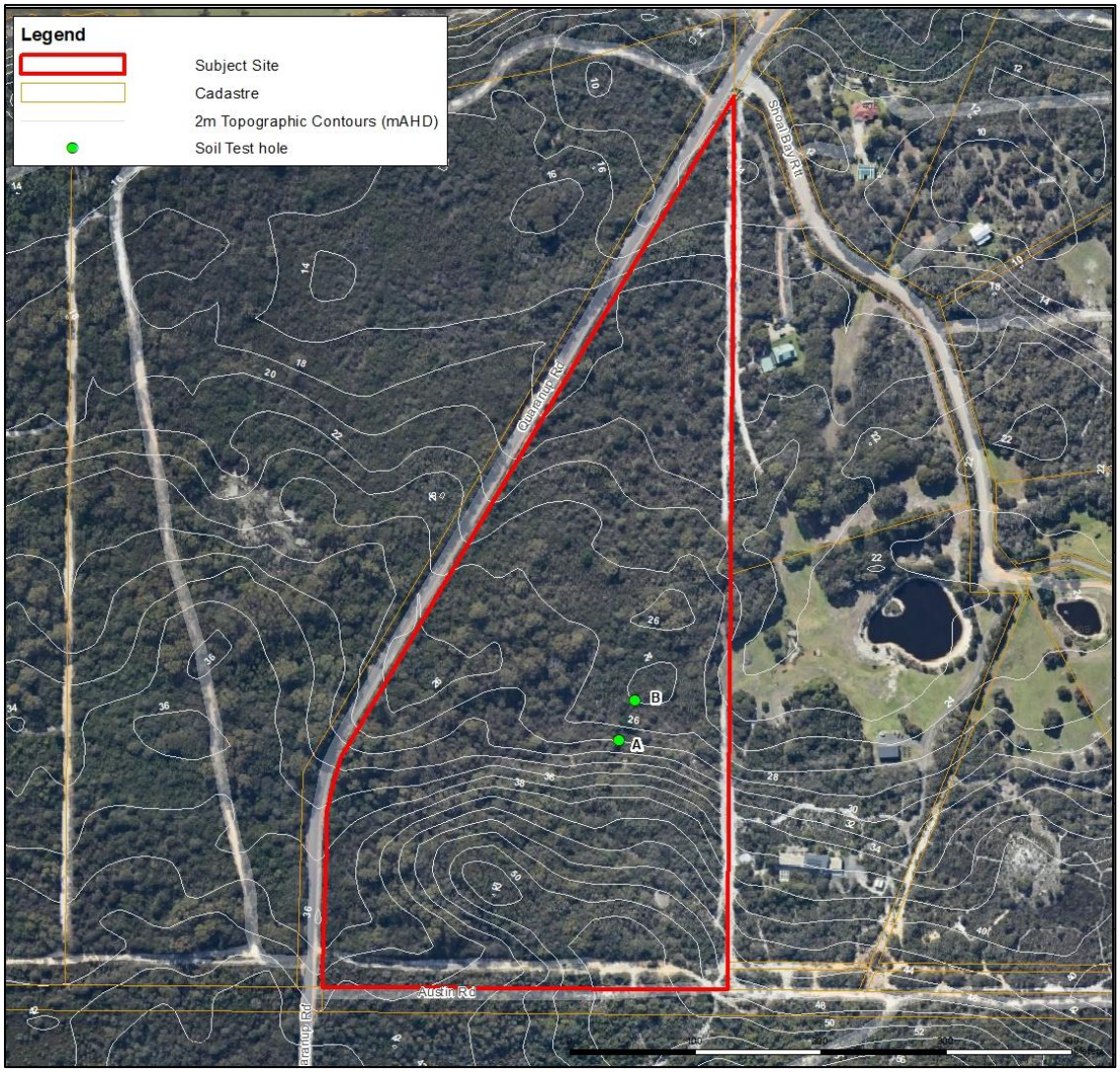

Figure 1: Soil sampling locations

Soil samples were taken at various depth increments up to 80cm below ground level (BGL). Soil samples from the topsoil, 40-50cm BGL and 70-80cm BGL were sent to CSBP for testing, testing parameters included Phosphorus (Colwell), Potassium (Colwell), Sulfur (KCl 40), Organic Carbon (Walkley-Black), Nitrate Nitrogen, Ammonium Nitrogen, Electrical Conductivity, pH (water), pH (CaCl2) and Texture (In-house method), phosphorus retention index and phosphorus buffering index.

2. Soil testing results

Soil testing results are presented in Table 1, with the raw data results shown in Appendix A.

Table 1: Soil testing Results

Test Hole	Soil depth (cm)	Ammonium Nitrogen (mg/kg)	Nitrate Nitrogen (mg/kg)	Phosphorus Colwell (mg/kg)	Potassium Colwell (mg/kg)	Sulfur (mg/kg)	Organic Carbon (%)	EC (dS/m)	pH Level ($CaCl_2$)	pH Level (H_2O)	PRI	PBI
A	10-20	4	< 1	< 2	29	2.4	2.67	0.043	3.9	5.4	0.4	< 1.0
	40-50	< 1	< 1	< 2	< 15	0.6	0.38	0.016	4.2	5.9	0.6	7.1
	70-80	< 1	< 1	2	< 15	< 0.5	0.13	0.010	4.6	6.1	0.4	4.4
B	0-10	2	< 1	3	42	1.8	2.42	0.032	4.7	5.8	1.7	4.7
	40-50	1	< 1	< 2	< 15	2.9	0.72	0.034	5.1	6.1	66.4	95.4
	70-80	< 1	1	< 2	< 15	2.8	0.51	0.099	6.6	7.5	26.9	96.6

3. Soil testing analysis

Nitrate Nitrogen

Nitrate is the form of soil nitrogen that is most readily available for plant uptake. The optimal range for plants is between 10 to 50mg/kg.

The Nitrate nitrogen at both test holes at the Subject Site was very low typical of sandy soils in the Great Southern area.

Ammonium Nitrogen

Ammonium nitrogen is also a form of soil nitrogen available to plants. The optimal range for ammonium nitrogen in soil for plants is between 0 to 5mg/kg.

The Ammonium nitrogen concentration found at both Test Hole A and Test Hole B are within the optimum plant growing range.

Colwell P

Colwell P is a measure of the phosphorus that is available for plant uptake. The optimum range is between 20-30mg/kg.

The available P at both test holes at the Subject Site was very low typical of sandy soils in the area.

Colwell K

Colwell K is a measure of potassium that is available for plant uptake. The optimum range for plant uptake is between 60-160mg/kg.

The available K at both test holes is considered low. Available K concentrations are considerably higher in the topsoil compared to the deeper soil horizons.

Sulfur

This is a measure of Sulfur that is available to plants. The values can vary due to seasonal and soil environmental conditions. Recommended ranges are therefore broad for this test. As a guide optimum ranges for topsoil are 5 to 6mg/kg and for deeper subsoil tests are <2.

The available S in the topsoil at both test holes is considered to be low. The available S in the subsoils at Test Hole A is also considered low, where as the available S in the subsoil at Test Hole B is considered optimal for plant growth.

Organic Carbon

Organic carbon (OC) varies, depending on soil type and management. Highest OC% comes from clay soils under long-term pasture. The optimum range for OC% is 0.9-1.5.

The OC% in the topsoil at both test holes is considered optimum for plant growth.

Electrical Conductivity

The optimum range for EC is <0.2-0.4 dS/m (depending on soil type). The EC at both test holes ranged from 0.01 to 0.1dS/m and therefore is considered low and optimum for plant growth.

pH (H_2O)

pH (H_2O) is the measure of the acidity / alkalinity of the soil. In this method, soil is shaken in water. The results showed soil in both test holes was slightly acidic which is fairly typical of the Western Australian soils. Generally, the ideal pH range is between 6.0 and 7.0 for most crops (DPIRD).

pH ($CaCl_2$)

pH ($CaCl_2$) is the measure of the acidity or alkalinity of the soil. In this method, soil is shaken in a calcium chloride solution, which resembles the natural 'saltiness' of soil water. Neutral = pH 7 but values are lower in acidic soils compared with the pH H20 method.

The results showed soil in both test holes was acidic, and lower than that of the pH (H_2O). Acidity was significantly lower at Test Hole A compared to B.

Phosphorus Retention Index

Phosphorous retention Index (PRI) is the ability of soils to absorb and retain nutrients within the soil. Soils with a PRI less than 1 have a very poor ability to retain nutrients, whilst soils with a PRI of >5 having a high ability to retain nutrients.

PRI results at Test Hole A were found to be less than one at each sampling depth, indicating the soil has poor ability to retain nutrients.

The PRI at Test Hole B was found to be high (>1) particularly deeper in the soil profile below the topsoil where results were found to be 66.4 (40-50cm depth) and 26.9 (70-80cm depth).

Phosphorus Buffering Index

Phosphorus buffering Index (PBI) measure of the soil's ability to bind and release phosphorus generally measured for plant uptake. Soils with a high PBI require more applied P to achieve an increase in soil P test value because much of the applied P is bound to the soil. Soils with a low PBI need more regular P applications because P readily leaches. From an environmental aspect a high PBI is favourable to prevent leaching of nutrients into waterways and environmentally sensitive areas. The PBI classifications are shown in Table 2.

Table 2: PBI classification

PBI Category	Classification	Colwell P indicating good soil P status
<15	Extremely low	20-24
15-35	Very very low	24-27
36-70	Very Low	27-31
71-140	Low	31-36
141 - 280	Moderate	36-44
281-840	High	44-64
>840	Very High	64+

PBI was found to be extremely low at each tested depth increment at Test Hole A and low at Test Hole B.

Appendix A

CSBP Soil Analysis Data

Customer Bio Diverse Solutions

Job Chiquita Crames

Date Rec'd 3/06/2021

Lab Number	Name	Code	Customer	Depth	Colour	Gravel	Texture	Ammonium Nitrogen	Nitrate Nitrogen
						%		mg/kg	mg/kg
YAS21127	Lot 56	A	Bio Diverse Solutions	10-20	DKGR	0	1.5	4	< 1
YAS21128	Lot 56	A	Bio Diverse Solutions	40-50	GR	0	1.5	< 1	< 1
YAS21129	Lot 56	A	Bio Diverse Solutions	70-80	LTGR	0	1.5	< 1	< 1
YAS21130	Lot 56	B	Bio Diverse Solutions	0-10	DKGR	0	1.5	2	< 1
YAS21131	Lot 56	B	Bio Diverse Solutions	40-50	BR	0	1.5	1	< 1
YAS21133	Lot 56	B	Bio Diverse Solutions	70-80	GRBR	35-40	1.5	< 1	1

Phosphorus Colwell	Potassium Colwell	Sulfur	Organic Carbon	Conductivity	pH Level (CaCl2)	pH Level (H2O)	Phosphorus Retention Index	PBI
mg/kg	mg/kg	mg/kg	%	dS/m				
< 2	29	2.4	2.67	0.043	3.9	5.4	0.4	< 1.0
< 2	< 15	0.6	0.38	0.016	4.2	5.9	0.6	7.1
2	< 15	< 0.5	0.13	0.010	4.6	6.1	0.4	4.4
3	42	1.8	2.42	0.032	4.7	5.8	1.7	4.7
< 2	< 15	2.9	0.72	0.034	5.1	6.1	66.4	95.4
< 2	< 15	2.8	0.51	0.099	6.6	7.5	26.9	96.6