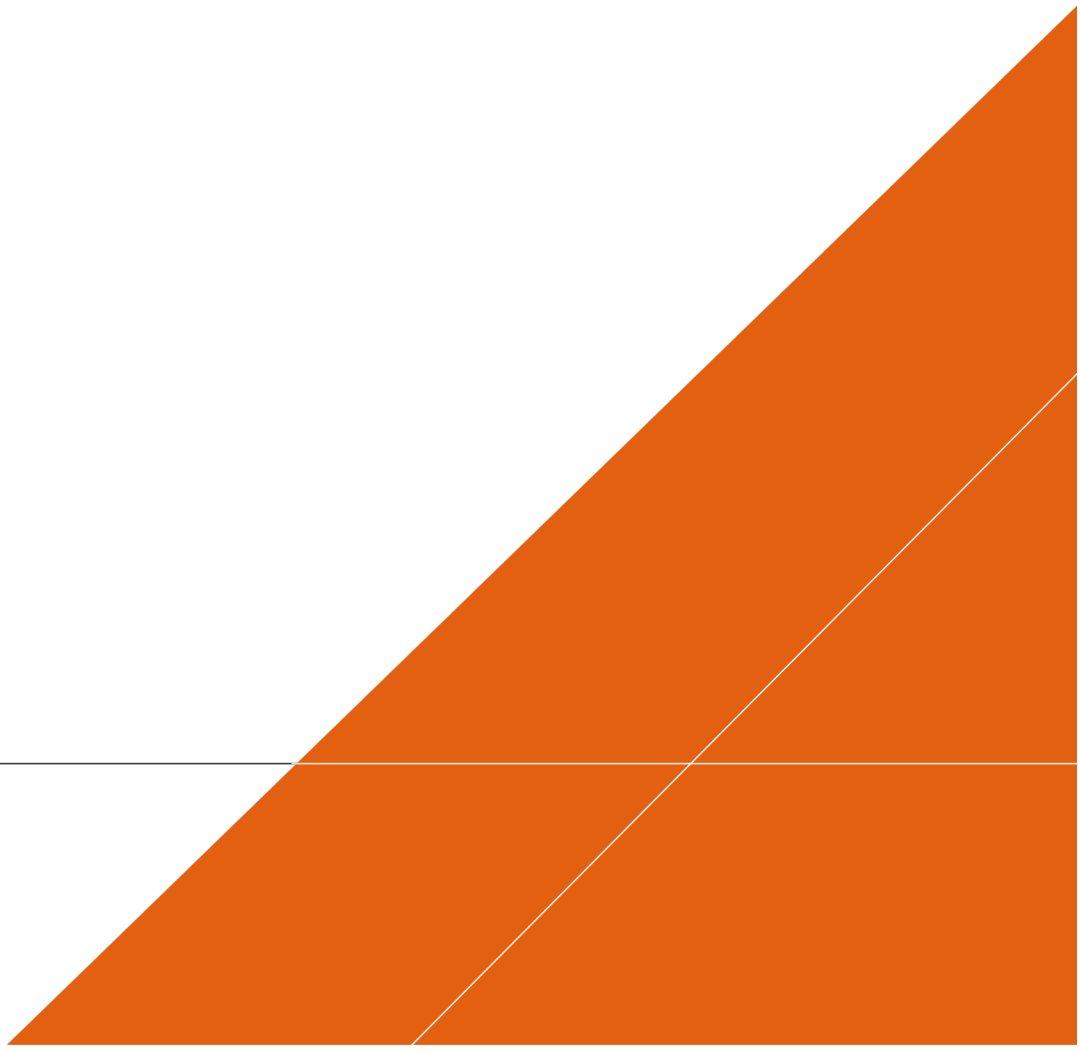
ARCADIS Design & Consultancy for natural and built assets

WALLERAWANG BATTERY ENERGY STORAGE SYSTEM

Water Quality Assessment – NorBE

03 NOVEMBER 2021



Incorporating Hyder

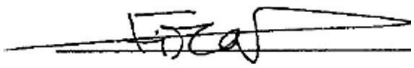
CONTACT

FIRAS NAJI
Principal Engineer, Water

T 02 8907 9209
M 0431 183 984
E firas.naji@arcadis.com

Arcadis
Level 16, 580 George Street
Sydney NSW 2000

WALLERAWANG BATTERY ENERGY STORAGE SYSTEM
Water Quality Assessment - NorBE

Author	Firas Naji	
Checker	Darlan Castro	
Approver	Sean Fishwick	

Report No 30076781_Water_Quality_Assessment_R0

Date 3/11/2021

Revision Text 1

This report has been prepared for Greenspot in accordance with the terms and conditions of appointment for Wallerawang 9 Battery dated 18 May 2021. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

No	Date	Description	Prepared by	Approved by
0	05/10/2021	Final document	FN	SF
1	03/11/2021	Updated to address DPIE comments	HT	HT

CONTENTS

APPENDICES

TABLES

FIGURES

1 INTRODUCTION

Greenspot Wallerawang Pty Ltd (Greenspot) is commencing a decommissioning, demolition, and rehabilitation (DDR) project on the former Wallerawang Power Station site in the first half of 2021 (separate from this project) and plans to repurpose the power station site and buffer lands. It proposes that the rejuvenated site will attract energy and water intensive businesses, serving to generate sustainable economic activity and helping to create long term employment growth in the Lithgow area and the NSW Central-West region more broadly. In acknowledgment of the community in which the repurposing project is to take shape (Wallerawang, postcode 2845), the working name for the project is the 'Greenspot 2845 Activity Hub'.

As an important component of its vision for the Greenspot 2845 Activity Hub, Greenspot is seeking development consent for the construction, operation and maintenance of a Battery Energy Storage System (BESS). The BESS will be up to 500 Megawatts (MW) and would provide up to 1,000 Megawatt hours (MWh) of battery storage capacity (two hours of storage at maximum discharge rate).

The Project Site is located around 10 kilometres north-west of Lithgow and around one kilometre east of the main township of Wallerawang, within the buffer lands of the decommissioned Wallerawang Power Station site. The Project Site is bounded by:

- The Main Western Railway Line and the former Wallerawang Power Station to the north
- Castlereagh Highway to the east
- Coxs River and the TransGrid Wallerawang 330 kV Substation to the west.
- Cleared grassland with patches of remnant vegetation to the south.

The buffer lands of the Former Wallerawang Power Station are largely rural in nature and have been modified by historic industrial and agricultural land uses. The buffer lands currently comprise cleared paddocks featuring exotic and native grasses and patches of remnant native vegetation. Several forestry areas, subject to Pine Plantation Deeds are also located in the local area including within the bounds of the Project Site (1983 forestry block) as shown in Figure 1-1. These areas largely comprise plantations of Radiata Pine (Pinus radiata) managed and harvested by the Forestry Corporation of NSW. The harvesting of this area would be undertaken under separate approval and would involve tree removal only. Removal of stumps or any residual vegetation and earthworks for the development of the built form of the Project would be undertaken in this area

The Coxs River is located to the east of the Project Site and would be traversed by the transmission line connection between the Project and the TransGrid Wallerawang 330 kV Substation. The Coxs River originates within Ben Bullen State Forest to the north, and flows through the Megalong Valley and parts of the Greater Blue Mountains Area World Heritage site including the Blue Mountains and Kanangra-Boyd national parks, joining a number of other tributaries before flowing into Lake Burragorang (Warragamba Dam). Lake Burragorang forms a major water supply source for greater metropolitan Sydney. The river is also impounded at Lake Wallace where it was formerly used as a cooling source for Wallerawang Power Station and at Lake Lyell where it is used for water supply for the city of Lithgow. Areas around the Coxs River and Lake Wallace to the west, are used recreationally for camping and fishing (note there is no private access permitted from the Power Station site and buffer lands to the Coxs River).

The 330 kV power lines associated with the Mount Piper Power Station also traverse the western side of the Project Site in a north south direction.

The Project Site is currently accessed from an unsealed access road off the Castlereagh Highway, a two-lane 100 km/hr highway that connects Lithgow to Mudgee and greater western NSW.

This report provides water quality assessment of the proposal that forms part of the EIS Arcadis is preparing in support of the SSD application for the project.

Figure 1-1 Local context of the Project Site

2 OBJECTIVES AND REQUIREMENTS

This water quality assessment report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD 14540514) for the Proposal, issued by NSW Department of Planning, industry and Environment (DPIE) in March 2021, in relation to potential impacts of the development on the Sydney drinking water catchment. This includes the consideration of Water NSW's current recommended practices and standards, stormwater quality modelling (MUSIC), and whether the development can be constructed and operated to have a neutral or beneficial effect (NorBE) on water quality consistent with the provisions of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011.

In their publication *Using MUSIC in the Sydney Drinking Water Catchment* (2012), Water NSW provides guidance on the NorBE criteria and how proposed developments in the Sydney drinking water catchment demonstrate achieving it, which includes the following:

- The mean annual pollutant loads for the post-development case (including mitigation measures) should aim for 10% less than the pre-development case for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). For gross pollutants, the post-development load only needs to be equal to or less than pre-development load.
- Pollutant concentrations for TP and TN for the post-development case (including mitigation measures) must be equal to or better compared to the pre-development case for between the 50th and 98th percentiles over the five-year modelling period when runoff occurs. Periods of zero flow are not accounted for in the statistical analysis as there is no downstream water quality impact.
- To demonstrate this, comparative cumulative frequency graphs, which use the Flow-Based Sub-Sample Threshold for both the pre- and post-development cases must be provided. As meeting the pollutant percentile concentrations for TP generally also meets the requirements for TSS, cumulative frequency analysis is not required for TSS. Cumulative frequency is also not applied to gross pollutants.

3 STORMWATER QUALITY MODELLING

A MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model has been developed for the proposed development and utilised to assess its potential water quality impacts. The model considers the effectiveness of the proposed water quality treatment measures in mitigating those impacts and aims to demonstrate achieving the NorBE criteria outlined above.

3.1 Metrological data

As the proposed development site is located in the Upper Cox River catchment, Water NSW meteorological template file for Zone 4 is used in the developed MUSIC model for the site. This meteorological template file contains 6-minute time step data over a period of five years, which includes a range of wet and drier years to ensure conditions simulated are realistic.

Table 3-1 Meteorological data statistics for the Upper Cox River catchment (Zone 4)

	Rainfall	Evapo-Transpiration
Mean	0.010	3.210
Median	0.000	2.700
Maximum	12.500	5.29
Minimum	0.000	1.300
10 Percentile	0.000	1.320
90 Percentile	0.000	5.000
Mean annual (mm)	883	1172

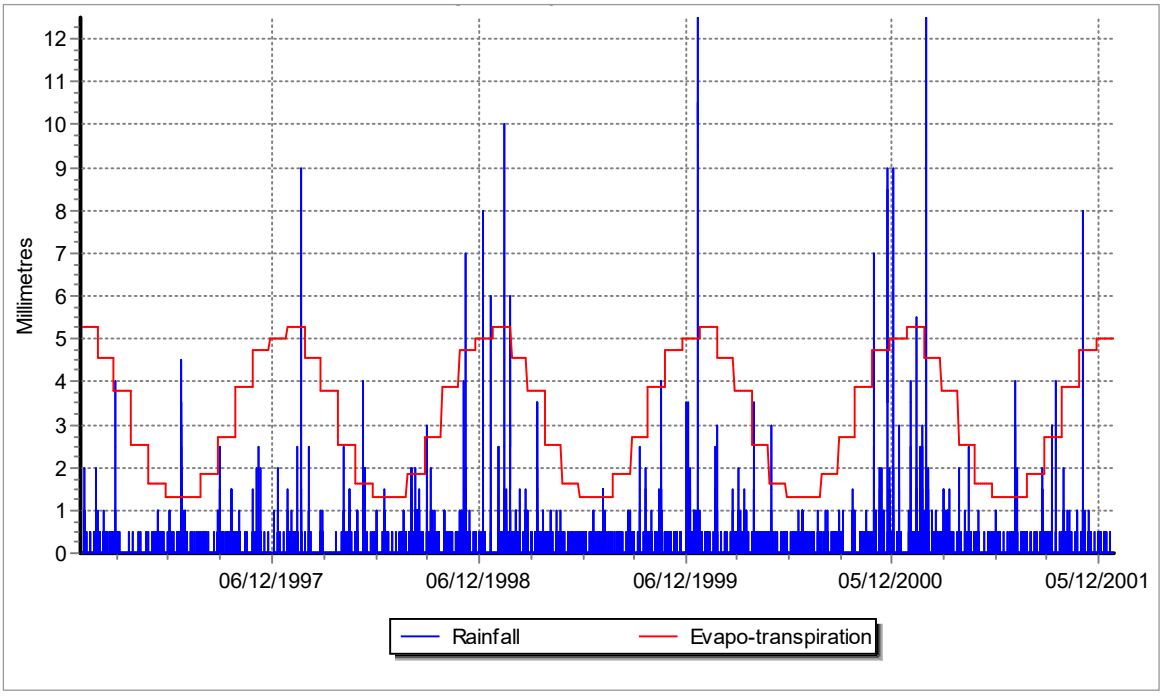


Figure 3-1 Rainfall and evapo-transpiration chart used in the MUSIC model

3.2 Rainfall runoff parameters

The rainfall runoff parameters adopted in the proposal site's MUSIC model are based on the guidance provided in Water NSW's *Using MUSIC in the Sydney Drinking Water Catchment (2012)*.

The site's soil type is mainly Kurosol based on the SEED site (The Central Resource for Sharing and Enabling Environmental Data in NSW). According to the Australian Soil Classification, Kurosols have a strong texture contrast and are formed from parent material that are highly siliceous or siliceous to intermediate in composition. Based on the eSPADE site, which provides access to soil profile and soil map information published by the NSW DPIE, soils in the vicinity of the site, of the same Kurosol soil type are described as sandy loam on top of fine sandy clay loam with massive earthy structure and are moderately permeable (Soil Landscapes of the Wallerawang 1:100 000 Sheet Survey (1000227), profiles 6, 87 and136). Thus, a sandy clay loam soil description is adopted

for the site for the sake of MUSIC modelling parameters as shown in Table 3-2. Table 3-3 shows the rainfall-runoff parameters for the impervious areas within the proposal site.

Table 3-2 MUSIC rainfall-runoff parameters for pervious areas of the development site

Parameters	
Pervious Area Parameters	
Soil Storage Capacity (mm)	108
Initial Storage (%)	25
Field Capacity (mm)	73
Infiltration Capacity Coefficient – a	180
Infiltration Capacity Exponent - b	3
Groundwater Properties	
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	25
Daily Deep Seepage Rate (%)	0

For impervious areas, Table 3-3 shows the rainfall-runoff parameters for the impervious areas within the development site.

Table 3-3 MUSIC rainfall-runoff parameters for impervious areas of the development site

Surface type	Rainfall threshold (mm)
Sealed/unsealed roads, concrete pavement	1.5
Roof	0.3

3.3 Pollutant concentrations and source nodes

The development site was broken-down into source nodes to reflect the various surface types with their respective pollutant concentration parameters as shown in Table 3-4. These pollutant concertation parameters were adopted from the Water NSW's *Using MUSIC in the Sydney Drinking Water Catchment (2012)*.

Table 3-4 MUSIC pollutant concentration parameters for the development site

Surface type		Log_{10} TSS (mg/L)		Log_{10} TP (mg/L)		Log_{10} TN (mg/L)	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Industrial	Mean	2.15	1.2	-0.60	-0.85	0.3	0.11
	Std Dev.	0.32	0.17	0.25	0.19	0.19	0.12
Sealed road	Mean	2.43	1.2	-0.30	-0.85	0.34	0.11
	Std Dev.	0.32	0.17	0.25	0.19	0.19	0.12
Unsealed road	Mean	3.00	1.2	-0.30	-0.85	0.34	0.11
	Std Dev.	0.32	0.17	0.25	0.19	0.19	0.12
Rural	Mean	1.95	1.15	-0.66	-1.22	0.30	-0.05
	Std Dev.	0.32	0.17	0.25	0.19	0.19	0.12
Revegetated land	Mean	1.95	1.15	-0.66	-1.22	0.30	-0.05
	Std Dev.	0.32	0.17	0.25	0.19	0.19	0.12
Agricultural	Mean	2.15	1.30	-0.22	-1.05	0.48	0.04
	Std Dev.	0.31	0.13	0.30	0.13	0.26	0.13
Roof	Mean	1.30	-	-0.89	-	0.30	-
	Std Dev.	0.32	-	0.25	-	0.19	-

3.4 Catchment Details

The development site's catchment details used in the MUSIC modelling for pre-development and post-development conditions are presented in Table 3-5 and Table 3-6 respectively. Site layouts for pre-development and post-development conditions are presented in Appendix A and Appendix B respectively.

Table 3-5 MUSIC catchment details for pre-development site conditions

Catchment node/ Landuse	MUSIC surface type	Area (ha)	% Imperviousness
Substation	Industrial	3.918	100%
Vegetated rural land	Rural	4.606	0%
Pine plantation[1]	Agricultural	22.539	0%
Access road	Unsealed road	2.01	50%
Total Area		**33.073**	

[1] Prior to commencement of construction of the Project, the pine plantation on the Project site would be harvested under a Pine Plantation Deed (a separate approval). The harvesting of this area would leave it with tree stumps and vegetation closer to rural grazing. As such. The pine plantation area is assumed to be agricultural MUSIC surface type.

Table 3-6 MUSIC catchment details for post-development site conditions

Catchment node/ Landuse	MUSIC surface type	Area (ha)	% Imperviousness
Substation	Industrial	3.918	100%
Transmission line corridor	Industrial	6.57	0%
Switching yard	Industrial	3.996	100%
BESS facility (concrete)	Industrial	5.014	100%
BESS facility (gravel)	Industrial	5.169	100%
Carpark	Sealed road	0.113	100%
Office	Roof	0.113	100%
Access road corridor	Sealed road	2.262	50%
Revegetated area (draining to bioretention basin)	Revegetated land	2.140	0%
Bypass area 1	Sealed road	0.527	50%
Bypass area 2	Revegetated land	3.251	0%
Total Area		**33.073**	

3.5 Treatment Nodes

A treatment train is utilised to treat runoff from the BESS facility, switching yard, office/carpark and the majority of the access road as shown in the post-development layout in Appendix A. This was based on a preliminary earthworks layout shown in Appendix D. The treatment train layout in the MUSIC model is presented in Appendix C, while the details are presented in Table 3-7. Below are some modelling notes for consideration:

- All post-development roads are provided with grassed swales.
- Collected runoff from the BESS facility, switching yard, office/carpark and the majority of the access road is treated by a Gross Pollutant Trap (GPT) before entering the bioretention basin.
- The bioretention basin is modelled without exfiltration through its base to the natural soil (i.e exfiltration rate = 0.0).

Table 3-7 Details of treatment nodes utilised in MUSIC modelling for the development site

Treatment measure	MUSIC treatment node details
Grassed swale	• Length is 400 m for the access road draining to the bioretention system treatment train. • Length is 120 m for the access road bypassing the site's treatment train. • 1% bed slope • 1 m base width • 5 m top width • 0.25 m vegetation height • 0.00 mm/hr exfiltration rate
Gross Pollutant Trap (GPT)	• Assumed Humegard HG35 unit or similar with the following efficiency: • 1.54 m^3/s treatable flow rate • 90% Gross Pollutants reduction efficiency • 49% TSS reduction efficiency • 40% TP reduction efficiency • 26% TN reduction efficiency
Bioretention basin	• 2821 m^2 average surface area • 2256 m^2 filter area • 0.3 m extended detention depth • 0.01 m unlined filter media • 100 mm/hr saturated hydraulic conductivity • 0.5 m filter depth • 400 mg/kg TN content of filter media • 40 mg/kg Orthophosphate content of filter media • 0.0 mm/hr exfiltration rate representing lined basin. • The system is vegetated with effective nutrient removal plants, with underdrain present and no submerged zone.

4 NORBE ASSESSMENT

As shown in Table 4-1, MUSIC modelling results for the proposed development indicate that the adopted best practice measures in stormwater treatment – the grassed swales, GPT and bioretention basin incorporated in this assessment – successfully achieve the set NorBE criteria in relation to mean annual pollutant loads.

Table 4-1 MUSIC modelling results for NorBE assessment

Condition	Gross Pollutants Kg/year	TSS Kg/year	TP Kg/year	TN Kg/year
Pre-development	978	22,800	40	235
Post-development	721	8,900	23	207
Reduction achieved	26%	61%	43%	12%
Reduction required	0%	10%	10%	10%

NorBE criteria also include the requirement that pollutant concentrations for TN and TP for the post-development case (with mitigation measures) to be equal or better compared to pre-development levels for between the 50th and 98th percentiles over the 5-year modelling period when runoff occurs. This is presented in Figure 4-1 and Figure 4-2, which show that the proposed development meets this criteria for TN, however results in post-development TP concentrations very marginally higher than pre-development conditions. This will be further assessed during the refined concept and detailed design stages of the development.

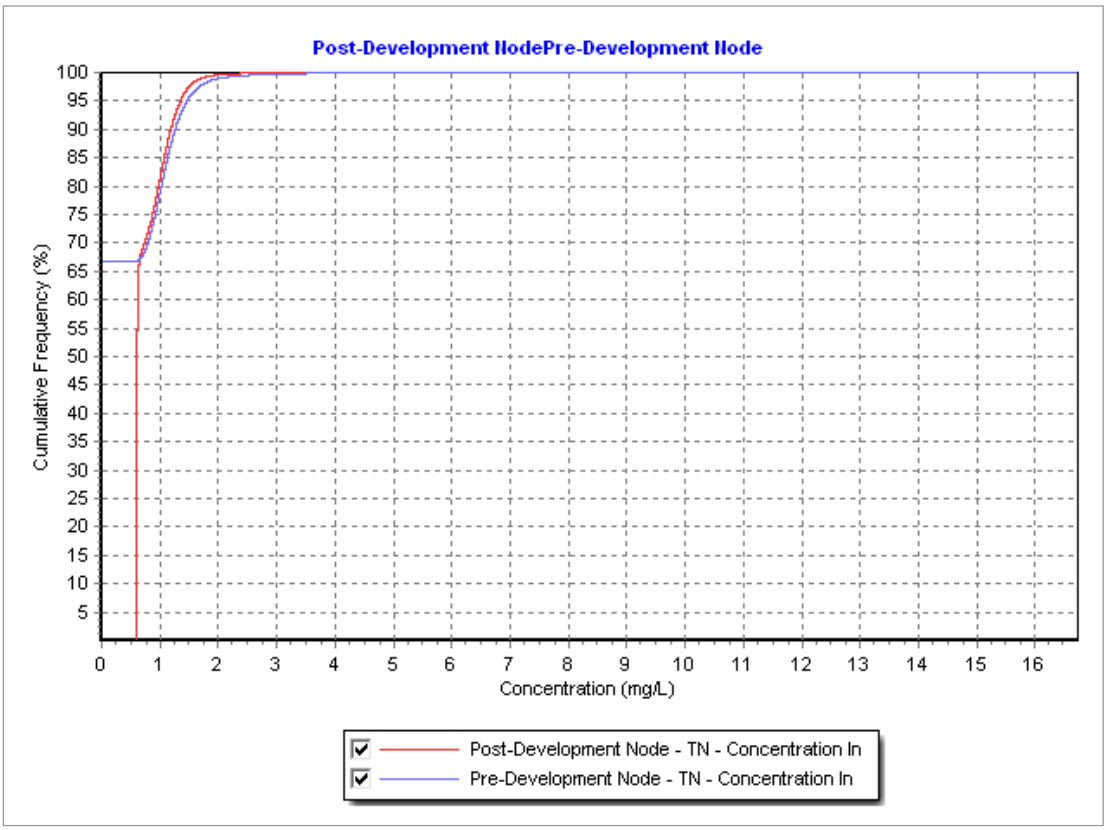


Figure 4-1 Pre and post-development cumulative frequency plots for TN concentration in the MUSIC model.

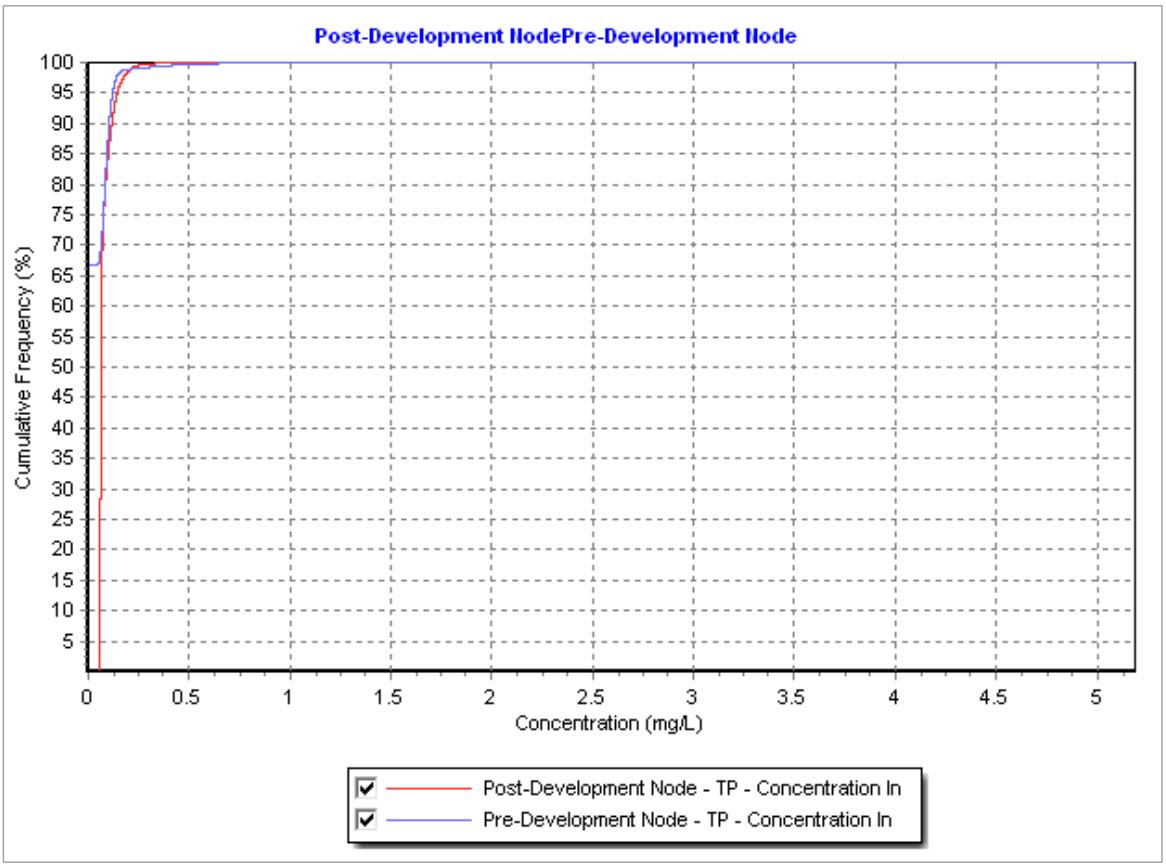


Figure 4-2 Pre and post-development cumulative frequency plots for TP concentration in the MUSIC model.

5 CONCLUSION

This assessment concludes that the proposed stormwater mitigation measures for the proposed development involving:

- Grassed swales for all paved access roads to the proposed development
- A treatment train of Humegard GPT and bioretention basin – with details as shown in Table 3-7 – treating stormwater runoff from the BESS facility, switching yard, office/carpark and the majority of the access road.

Would meet the required NorBE criteria in relation to stormwater management as set by Water NSW.

APPENDIX A SITE PRE-DEVELOPMENT LAYOUT

Figure 2
- Pre-Development Layout Plan

APPENDIX B SITE POST-DEVELOPMENT LAYOUT

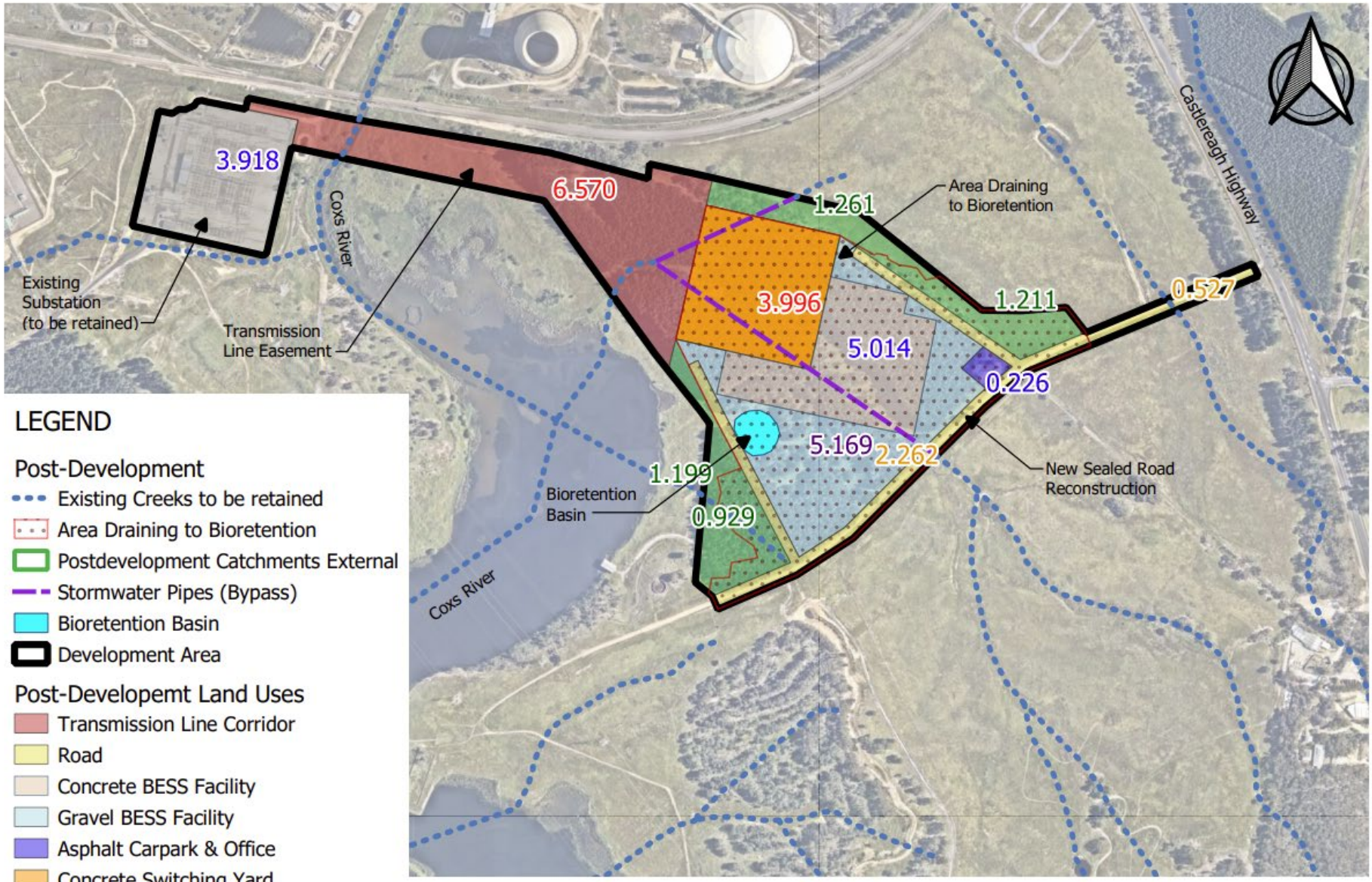
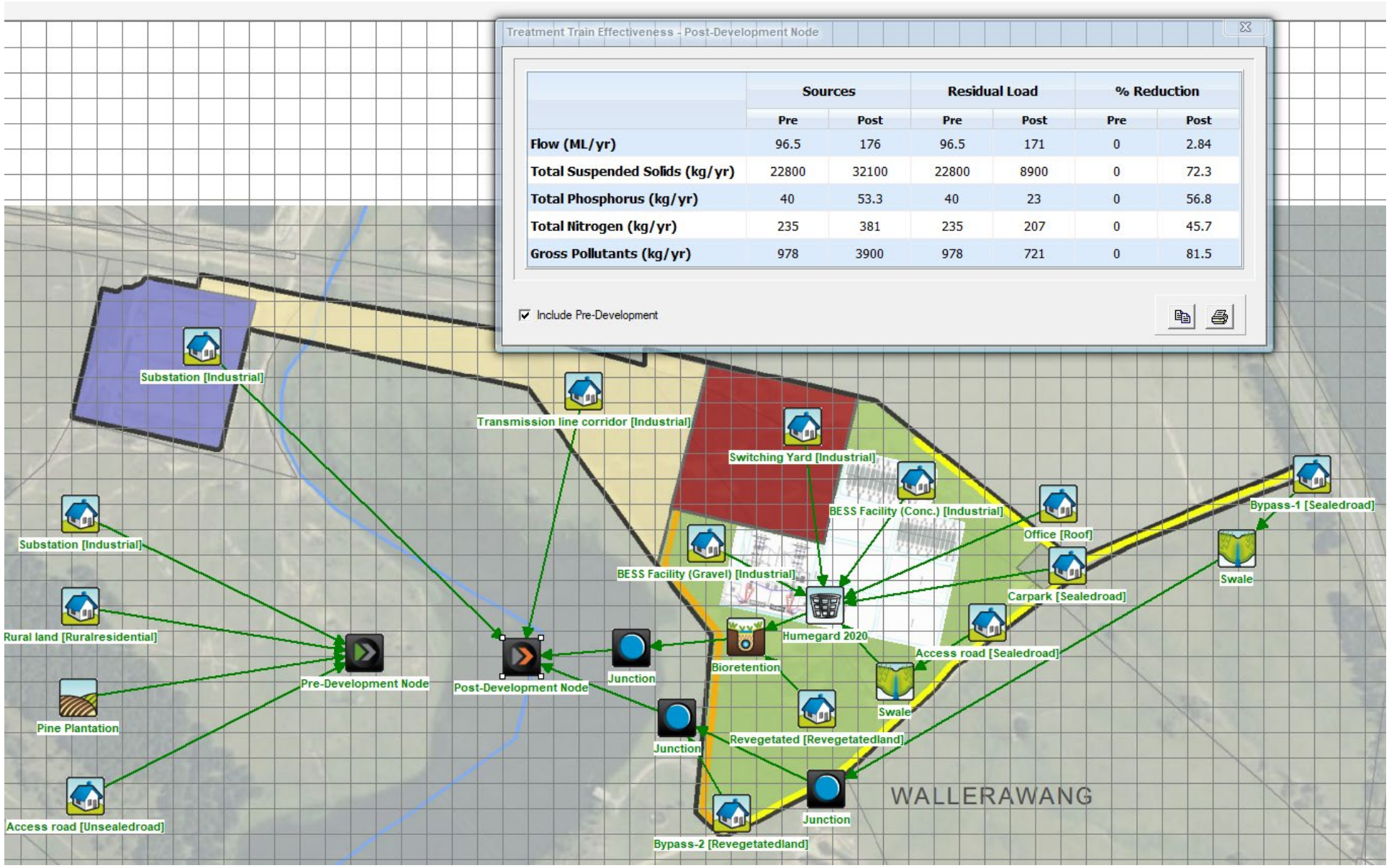
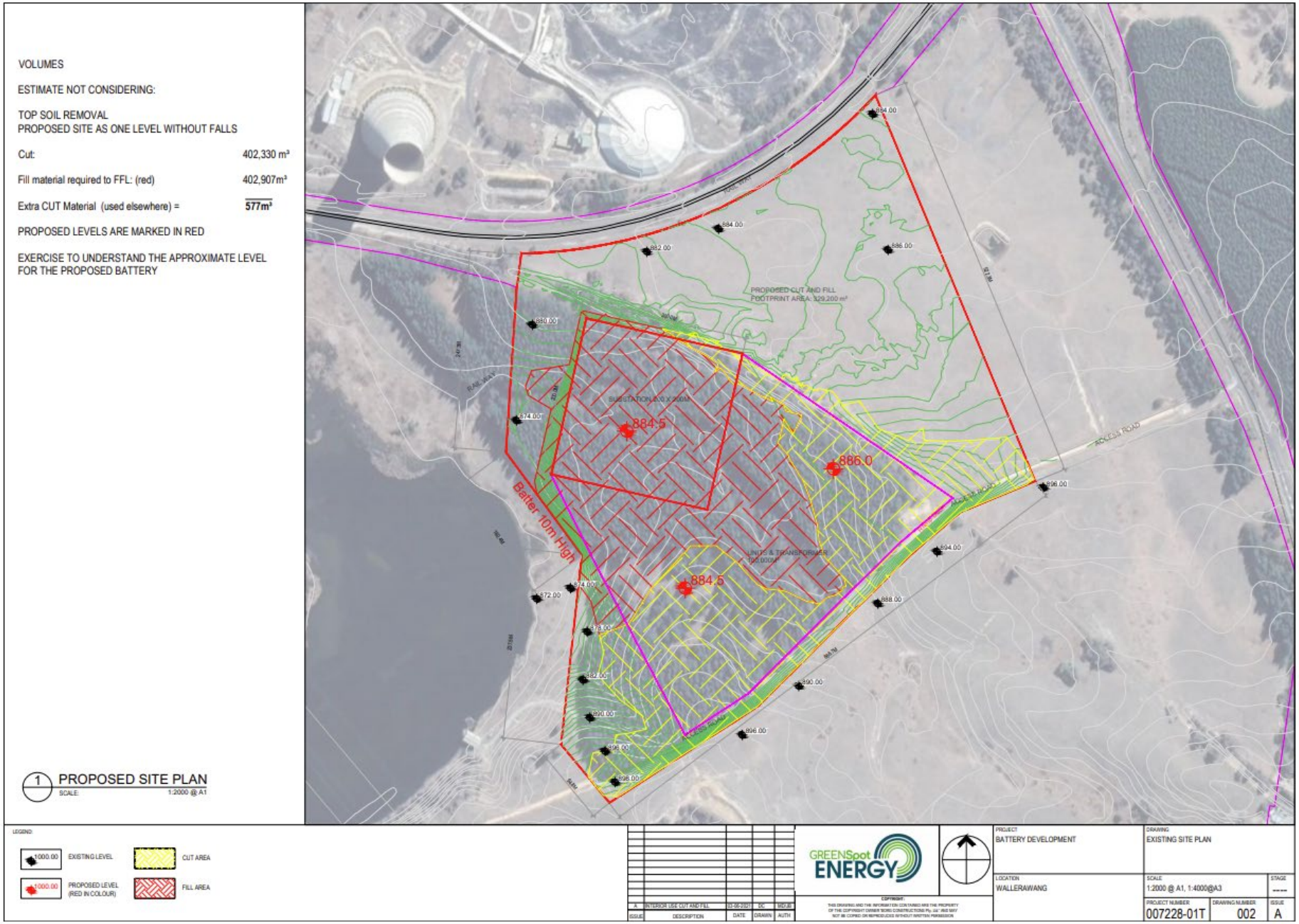


Figure 1
- Post-Development Layout Plan

APPENDIX C MUSIC MODEL LAYOUT


Treatment Train Effectiveness - Post-Development Node
Sources
Residual Load
% Reduction
Pre
Post
Pre
Post
Pre
Post
Flow (ML/yr) 96.5 176 96.5 171 0 2.84
Total Suspended Solids (kg/yr) 22800 32100 22800 8900 0 72.3
Total Phosphorus (kg/yr) 40 53.3 40 23 0 56.8
Total Nitrogen (kg/yr) 235 381 235 207 0 45.7
Gross Pollutants (kg/yr) 978 3900 978 721 0 81.5
Include Pre-Development
Substation [Industrial]
Transmission line corridor [Industrial]
Switching Yard [Industrial]
BESS Facility (Conc.) [Industrial]
Office [Roof]
Bypass-1 [Sealedroad]
Substation [Industrial]
BESS Facility (Gravel) [Industrial]
Swale
Carpark [Sealedroad]
Rural land [Ruralresidential]
Humegard 2020
Access road [Sealedroad]
Bioretention
Junction
Pre-Development Node
Post-Development Node
Swale
Pine Plantation
Revegetated [Revegetatedland]
Junction
Junction
WALLERAWANG
Access road [Unsealedroad]
Bypass-2 [Revegetatedland]

APPENDIX D SITE PRELIMINARY EARTHWORKS LAYOUT


VOLUMES
ESTIMATE NOT CONSIDERING:
TOP SOIL REMOVAL
PROPOSED SITE AS ONE LEVEL WITHOUT FALLS
Cut: 402,330 m³
Fill material required to FFL: (red) 402,907m³
Extra CUT Material (used elsewhere) = 577m³
PROPOSED LEVELS ARE MARKED IN RED
EXERCISE TO UNDERSTAND THE APPROXIMATE LEVEL FOR THE PROPOSED BATTERY
PROPOSED CUT AND FILL FOOTPRINT AREA: 329,200 m²
SUBSTATION 100 X 100M
UNITS & TRANSFORMER 100.000M²
884.5
886.0
884.5
Batter 10m High
ACCESS ROAD
884.00
882.00
886.00
880.00
874.00
872.00
894.00
888.00
890.00
896.00
LEGEND:
EXISTING LEVEL
PROPOSED LEVEL (RED IN COLOUR)
CUT AREA
FILL AREA
1 PROPOSED SITE PLAN
SCALE: 1:2000 @ A1
GREENSpot ENERGY
PROJECT: BATTERY DEVELOPMENT
DRAWING: EXISTING SITE PLAN
LOCATION: WALLERAWANG
SCALE: 1:2000 @ A1, 1:4000@A3
STAGE: ---
PROJECT NUMBER: 007228-01T
DRAWING NUMBER: 002
ISSUE: A
A INTERIOR LOS CUT AND FILL 02-05-2025 DC
ISSUE DESCRIPTION DATE DRAWN AUTH