Proposed Bark Processing Facility

Water Cycle Impact Asessment

Report Prepared for: Borg Plantations Pty Ltd

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Prepared by:
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EXECUTIVE SUMMARY

The Sustainability Workshop (TSW) was commissioned by Borg Plantations Pty Ltd (Borgs) to undertake a water cycle impact assessment of a proposed bark processing facility located off Maher Drive at Oberon in NSW. The development is on Lot 34, DP 1228591 and the developable area is about 5 hectares (ha).

The intent of the facility is to provide a best practice, sustainable and well-designed facility to enable the recycling of pine bark, (clean, heat treated) pallets and clean untreated timbers into value-added landscape materials, with a focus on quality horticultural mulches for gardens and landscaping.

The proposed development is located within the broader industrial timber processing estate at Oberon and will make a meaningful contribution to the State's broader recycling challenges by accepting sawn timber waste product (waste pallets) and waste bark for reprocessing into blended landscape products.

The proposed development, being best practice, will see concrete hardstand areas created to form a sealed, stable working environment that would protect local groundwater resources. However this sealed working platform would result in an increase in impervious area of approximately 2.64 hectares.

The proposed development includes an office building, sealed storage bays and sealed concrete hardstand areas constructed in trafficked areas and under product blending areas. Raw materials will also be stored on concrete hardstand prior to reprocessing. A detailed description of the proposed development is included in Section 3 of this report.

A preliminary grading indicates gentle slopes for the working platform of the proposed operation which would match existing land levels in the west and be approximately 2m to 5m depth above the existing levels on the eastern side of the development. The site generally slopes to the north east. There will be an earth mound for noise and visual mitigation placed around each side of the proposal – broken only in the south where the entry to the site is located.

Guidance for the development of this site is drawn from NSW EPA guidance documents for composting facilities. The site however won't be composting any food or green waste – it will largely be processing or reprocessing raw timber resources into blended landscape products.

In accordance with EPA guidance, groundwater will be protected by compacting site clay soils to stop downward movement of stormwater. The working part of the site will be sealed with a concrete pavement which will also have subsurface drainage so that any seepage water is directed into swales and into a treatment pond. Because the site is raised above existing levels there will be no interception of groundwater and consequently no expected impacts on groundwater. Groundwater, locally, is an important resource for Borgs and other licenced groundwater users.

Currently overland flows would be directed onto the site from the existing Borgs and ANL developments located to the west of Lot 34. These flow paths would be intercepted in a diversion swale which is proposed to run in a northerly direction along the western boundary of the site (in a 5m wide easement) and is then directed east along the northern boundary (in a proposed 10m wide easement) toward to King's Stockyard Creek.

Some minor run-on flows from the adjacent lots on Maher Drive will be conveyed under the site in a culvert and discharged on the eastern side of the site. At no point will clean run-on water from off the site mix with "dirty" Lot 34 site water.

Where runoff from this site joins Kings Stockyard Creek, 580m downstream of the site, it is a second order Strahler creek with two separate upstream reaches. It has a defined bed and bank and intermittent flow. Though it has not been considered in any water quality modelling of the site, the 580m overland flow path to the creek will provide additional substantial polishing of the flow and assimilation of any exported pollutants.

The existing creek is denuded of riparian vegetation, a highly modified ecosystem, though it is well sealed and stable with a mildly incised bed typical of most rural creeks. Local soils tend to be stable with steep batters possible, i.e. this is a low erosive environment typical of the soils on the Great Dividing Range.

Key sources of stormwater pollution will arise from:

- An increase in impervious areas
- Storage of raw materials and blended landscape products
- Handling and transport of shredded timber and bark including mulch created from recycled timber sources as well as new sources
- Vehicular traffic – truck movements each day

The key stormwater pollutants of concern will be:

- Total suspended Solids (TSS)
- Total Phosphorus (TP) – mostly particulate and correlated with TSS
- Total Nitrogen (TN) – mostly particulate but some dissolved N. Little ammonia produced as gross pollutants will keep captured solids in a dry state. Dissolved N would be in the nitrate and nitrite form. Organic N would be the dominant form of N.
- The risk of other toxic pollutants entering the receiving waters will be minimised by best practice such as self-bunded fuel tanks with drip trays and covered refuelling area as well as the ability capture all fire-fighting water on-site within a proposed water quality pond.

Therefore, the key pollutants of concern and potential surface water impacts are from chronic, non-toxic pollutants. Nutrients (nitrogen and phosphorus) are often called nuisance plant growth stimulators, i.e. food/fertiliser for algae. In summary the proposed development would generate, if left unmitigated, non-toxic pollutants which can contribute nutrient loads in catchments leading to an increase in nuisance plant growth (algae). TSS could smother benthic organisms and lead to siltation of receiving waters.

In addition to compliance with EPA Guidelines for Composting Facilities, the proposed mitigation measures include:

- Construction of 4 dry gross pollutant traps strategically placed. Dry sump gross pollutant traps (GPTs), in this context are preferable to wet sump GPTs as they avoid nitrification which converts particulate nitrogen into dissolved nitrogen in a wet environment. It is relatively hard to remove dissolved nitrogen and easy to remove particulate nitrogen.
- Wherever possible stormwater is conveyed from the GPTs into grassed swales. The swales are good at removing particulates (TSS) including particulate bound nitrogen and phosphorus.
- Where it is not possible to treat the stormwater in swales it is treated in a dry GPT first and then directed to a stormwater pond.
- Creation of a stormwater treatment pond with a storage volume of 1.5 ML. The pond is to be edged with macrophytes with an open water body in the middle.
- The new pond is located downstream of all treatment measures and is the final stage of treatment for most stormwater. 40% of the stormwater however is to be further treated (in a skid mounted state of the art, media filtration process, dosed with chlorine for safety and reused on site). Reuse of the water is maximised by irrigating all landscape mulches to keep them at optimum moisture content to suppress dust as well as irrigating the extensive pervious areas on the site – simply to dispose of as much polluted stormwater as practical on-site and equally without causing a problem by over irrigating. The irrigation will also help to keep the swales in good condition through dry periods.
- The total demand for stormwater on the site was estimated to be 9 ML/year. The pond can supply about 77.5% of this demand or 7 ML/annum. This helps to reduce the mean annual volume of runoff (MARV) which will mitigate against the additional impervious area created by the development.
- The development will increase the MARV from 6.67 ML/a predevelopment to 17.6 ML and the harvesting helps to mitigate the increased post development MARV by 45%. The post development MARV after harvesting is 9.64 ML.
- Stormwater from the proposed pond will be pumped to a filtration system which will include UV and possibly chlorination. The chlorination will assist with reduction of tannins and disinfection.
- Once water is discharged from the site onto adjoining rural land, a series of leaky weirs will see the flow spread out wide on the floodplain to remain shallow and to reduce velocities and further settle out any suspended solids and nutrients. Modelling the benefit of the floodplain treatment has not been undertaken.
- Emergency spill prevention controls would include water tight penstocks which would prevent spilled material from leaving the site. Based on NSW Fire and Rescue Guidelines which require up to 4 hours of fire-fighting water to be stored it would be necessary to contain 330 m^3 of fire-fighting water on site and sufficient freeboard shall be allowed for this purpose. In the 1,000m^2 proposed pond this equates to a depth of 330mm.

A MUSIC water balance and quality model for the site was constructed to assess the potential impacts of the proposed 5 hectare development and to help design appropriate mitigation measures.

Water quality objectives for the Macquarie Bogan Catchment, simply adopt default ANZECC trigger values for upland rivers. The trigger values are to be determined by analysing the median concentration at low flows. Because of the stormwater harvesting proposed, the site has no low flow discharge. In fact 45% of the time its raining, the site has no discharge. Therefore at low flows the median concentrations of TN and TP would be zero with the WQOs achieved. This is a somewhat misleading approach, as it implies that water quality leaving the site would have no detrimental effect. Therefore application of DGVs to an isolated urban development with stormwater harvesting is not appropriate.

In accordance with the ANZECC Guidelines assessment of the impact on the receiving water under the full range of flow conditions must be undertaken. Especially so for urban development where it is understood that very few storms can contribute most of the pollutant load (ANZECC, 2000).

Licence conditions for similar composting facilities, at Oberon and elsewhere, include an EPL limit of 50 mg/L for TSS.

Predicted maximum concentration values for TSS are predicted to be less than 31 mg/L while the 90th percentile TSS concentration would be in the order of 13 mg/L which for any industrial development would be considered an excellent outcome.

The proposed development is therefore likely to meet an EPL limit at the 100th percentile for TSS of 50 mg/L.

Total Suspended solids and Total Phosphorus loads are predicted to decline as a result of the proposal and if anything, this would be beneficial for receiving waters.

The proposal will see an increase in the level of TN discharged from the site with an additional 13 kg discharged from the site. The predevelopment level of 12kg/annum would therefore increase to about 25 kg/annum after development.

TN is not a toxicant and its effects, in this context, would be load based – i.e. on a reservoir or water storage but not on the flowing creeks or rivers in between. The proposed development is located 5 km upstream of the Fish River which has a catchment area of approximately 9,000 hectares. Using typical rural EMC values for TN, the TN load in the Fish River would be in the order of 21,960 kg/annum of TN. An addition of 12 to 13 kg which equates to about 0.05% of the annual load, would, with a high degree of certainty, have no detectable impact.

We conclude that the proposal would be highly unlikely to impact on ambient water quality in the Fish River or Macquarie Bogan catchments.

King's Stockyard Creek is a highly disturbed ecosystem. Flows in King's Stockyard Creek upstream of the proposed development would help dilute site discharge concentrations and reduce them.

Given the level of treatment proposed and the surrounding industrial context it is concluded that it is highly unlikely that the proposed development would result in a decline in the presence of aquatic organisms locally, i.e. cause pollution (defined as a change in ecological stressors) within Kings Stockyard Creek prior to its confluence with the Fish River.

The site is located at an elevation of 1100m above sea level in the headwaters of the Macquarie catchment. The proposed development will not have any floodplain or flooding impacts either upstream or downstream.

A site as large as this would require management of construction phase water quality within a dedicated sediment basin and preparation of soil and water management plan for the site is essential.

It is therefore recommended that the proposed permanent water quality pond be constructed prior to site stripping and used as a temporary sediment basin during construction and converted to a permanent water quality pond only once the site has been effectively sealed.

In conclusion the proposed stormwater treatment and harvesting and reuse scheme will see the impacts of the proposed development reduced to levels which will see it comply with an EPL licence limit for TSS of 50 mg/L. The proposal will see about 7ML/year of stormwater harvested and treated on-site and used for keeping the landscape products moist, for dust suppression and for irrigating up to 1.78 Ha of selected landscaped areas.

The proposal, if approved, with the proposed mitigation measures, would have minimal impact on the geomorphology of Kings Stockyard Creek, no discernible impact on aquatic health of King's Stockyard Creek and meet its likely EPL condition for TSS through best practice on site management of its stormwater. The proposal will not impact on ambient water quality within the Macquarie Bogan or Fish River catchments.

.TABLE OF CONTENTS

1.0 INTRODUCTION

1.1. Background and Context

The Sustainability Workshop (TSW) was commissioned by Borg Plantations Pty Ltd (Borgs) to undertake a water cycle impact assessment of a proposed bark processing facility on Lot 34, DP 1228591, with proposed access off Maher Drive at Oberon, NSW.

The proposed development is located within the broader industrial timber processing estate at Oberon and will make a meaningful contribution to the State's broader recycling challenges by accepting sawn timber waste product for reprocessing into blended landscape products.

The intent of the facility is to provide a best practice, sustainable and well-designed facility to enable the beneficial recycling of pine bark, (clean, heat treated) pallets and clean untreated timbers into value-added landscape materials, with a focus on quality horticultural mulches for gardens and landscaping.

The proposed development, being best practice, will see concrete hardstand areas created to form a low dust, stable working environment. Therefore, this quality working platform would result in an increase in impervious area of approximately 2.64 hectares.

This will be in the form of a small office building and weighbridge with wheel wash, staff parking, concrete bays for storage of both incoming raw materials and final outgoing product and sealed concrete pavement to support trafficked areas. Product blending areas, trafficked by front end loaders, would also be founded on concrete pavement with subsurface drainage to collect any permeate in place.

Guidance for the development of this site is drawn from the SEARs and NSW EPA guidance documents for composting facilities[1]. The site however won't be composting any waste – it will be processing raw timber or reprocessing swan timber into blended landscape products. These are substantially drier and with substantially less leachate produced than a composting facility which handles food or mixed waste.

In accordance with EPA guidance, groundwater will be protected by creating an impermeable barrier through compaction of site clays. The proposed pavement areas will therefore need to be drained (if bound below by compacted clay) so that any seepage water is directed into swales and then into a proposed treatment pond.

A comprehensive treatment train is proposed to service the development and will include dry GPTs keeping bark and timber fibres dry and ready for recovery on-site back into product. The GPTs are proposed to discharge into grass swales which in turn discharge into a treatment pond. The proposed operation would draw stormwater from the pond, treat it further to make it for purpose and then reuse it on-site to help reduce both the frequency and volume of runoff.

A detailed description of the proposed development is included in Section 3.0 of this report.

[1] Environmental Guidelines – Composting and Related Organics Processing Facilities, NSW DEC, 2004.

A preliminary grading of the site indicates mild slopes can be achieved with earth batters excavated on the western side and filling to generally balance earthworks on the eastern side to form a mildly sloping bench and working platform for the operation. The site generally slopes to the north east.

Where runoff from this site joins Kings Stockyard Creek it is a second order Strahler creek with three separate upstream reaches. It has a defined bed and bank and intermittent flow. The existing creek is somewhat denuded of riparian vegetation though it is well sealed and stable with a mildly incised bed typical of most disturbed rural creeks.

Local soils tend to be stable with steep batters possible, i.e. this is a low erosive environment typical of the soils on the Great Dividing Range. Site soils are clay based which can be mildly dispersive under construction phase conditions and which would require the addition of flocculant to aid in construction phase sediment and erosion control works. The site clays have been used extensively by Borgs on the adjacent site to create stormwater runoff treatment ponds and when compacted would form a sufficiently impervious barrier to protect groundwater.

1.2. Scope of Works

Sustainability Workshop has been commissioned to assess the water quality impacts of the proposed development. This document assesses the following water cycle impacts:

- Long term surface water quality impacts associated with the development
- Recommended mitigation measures to comply with an environmental pollution licence (EPL) required to ensure the site does not breach the Protection of the Environment Operations Act.
- Assessing the impacts of the proposed development on the stability of Kings Stockyard Creek, i.e. assessing potential geomorphic impacts.
- Flood risk and drainage – flood risk is qualitatively discussed in this report. The report and work identify the need to manage run-on water from adjacent land and importantly to allow overland flows through the northern end of the site.
- Soils and water management during construction – largely this is a detailed design issue but is commented on in this report.

1.3. Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARS) detail what is required to be included in the Environmental Impact Assessment (EIS).

Table 1 summarises the relevant requirements (pertaining to water issues) and identifies the location in this report where each SEAR has been addressed.

Table 1: SEARS pertaining to water issues

SEARs	Relevant report section
Water usage, including location of intakes and discharges, volumes, water quality and frequency of discharge	Section 5 and 6.
Options considered to minimise discharge, and environmental impact due to discharge	Section 5 and 6.
Relevant water balance including requirements, sources, disposal, treatment and re-use options	Section 5 and 6.
Existing surface and groundwater quality considered and analysed where necessary	Section 2.4 deals with existing water quality and Water Quality Objectives for the Macquarie Catchment, while Section 4.4.3 discusses groundwater implications.
Impact of discharges on receiving environment including assessment against water quality objectives and environmental values. The water quality objectives are the same as ANZECC default trigger values (DGVs)	Section 5.2.1 discusses discharge water quality results and the impact on the receiving creek, while 5.2.2 deals with the impact of increased quantity of discharge.
Management of stormwater during and after construction	Section 6 outlines the proposed measures to manage stormwater during and after construction.
Monitoring and assessment of predicted impacts	Section 6.

2.0 EXISTING ENVIRONMENT

2.1. Description of Existing Environment

The existing manufacturing plant is shown in Figure 1 below:

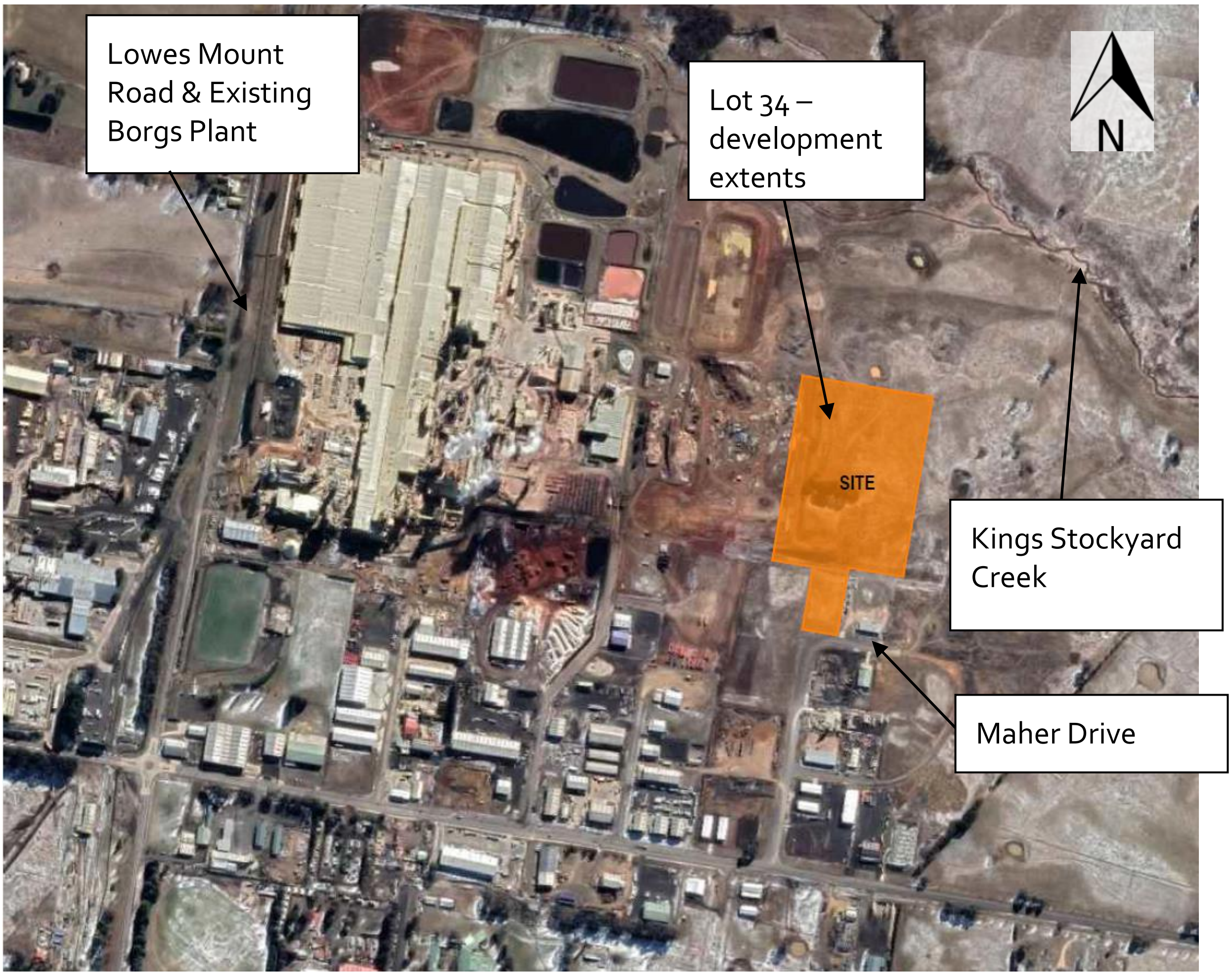


Figure 1: Proposed Bark Processing Site at Oberon (in orange)

Figure 1 shows the existing heavy industrial context at Oberon with the proposed development site show in orange. The site is cleared except for a small stand of conifers.

2.2. Existing Conditions

The development site is currently grassed with no incised flow paths. Overland flows would be characterised as broad shallow, low velocity flows.

There is an existing dam located to the east of the site. Two overland flow paths are visible in Figure 2 flowing east toward their confluence with Kings Stockyard Creek. These overland flow areas are partly within the floodplain and function as ephemeral wet areas linking Lot 34 with the creek. It would be of value to maintain the broad shallow overland flow connection to the creek and not to create an incised high velocity drain.

The distance between the point of discharge from the proposed development and the nearest waterfront land is approximately 575m. The flow path to the creek is sinuous and well vegetated with a mix of exotic and native grasses. Substantial assimilation of pollutants will occur between then site boundary and the receiving water.

Figure 2 Overland flow paths (not creeks as defined in the Water Management Act) adjacent to Lot 34.

This area is also shown below in Plate 1.

Plate 1 Looking north east toward King Stockyard Creek.

2.3. Ambient Water Quality

No existing water quality data for this site exists however its water quality would be typical of a similar rural pastoral site.

Some recent testing of water quality from within Kings Stockyard Creek at Hazelgrove Road is shown below:

Table 2 Recent Water Quality Results from Hazelgrove Road downstream of the industrial estate

Parameter	Value Measured 10 Sept 2018 (mg/L)	ANZECC Default Guideline value (DGV) – upland rivers (mg/L)
TSS	7 mg/L	N/A
TP	0.01	0.02
TN	1.5	0.25

These results provide a single snapshot of water quality in the creek. Knowing the EPL limits for ANL, Borgs, CHH and HPP (with TSS set at 50 mg/L) upstream this clearly demonstrates the benefit of dilution in Kings Stockyard.

7 mg/L TSS typically indicates low TSS values with clear water. The TP is below ANZECC guidelines and considered good quality. TN is 6 times higher than the default ANZECC limit. There is no known reference creek (an undisturbed analogous creek in this locality) against which the TN value can be benchmarked and therefore we can't advise if its high or low or typical. We can advise its considered low for a highly disturbed creek downstream of a substantial and highly productive industrial estate. By comparison typical event mean concentration values for TN from a typical roof (of any land use) are 2.0 mg/L, i.e. driven by atmospheric deposition.

2.4. River Water Quality Objectives for the Macquarie Bogan Catchment

NSW River water quality objectives (WQOs) for the Macquarie Bogan catchment reflect default ANZECC guideline values (DGVs).

The key parameters for assessment in this Impact Statement are the default guideline values (DGV) for TN and TP. TSS has no DGV.

The DGV for TN for upland rivers is 250 micrograms per litre.

The DGV for TP for upland rivers is 20 micrograms per litre.

The objectives include turbidity and dissolved oxygen objectives too and while these are certainly important there is currently no way of assessing the impact of the proposed development on either of these except qualitatively.

It is also stated on page 8.2-9 within the ANZECC Guidelines that river flow objectives for N and P are to be applied to the median concentration occurring during low flows. Low flows are not defined in the ANZECC guidelines, however the 10th percentile flow is frequently considered to be a low flow indicator. More importantly however "ambient" water quality is defined as follows:

"Ambient water quality refers to the quality of water when all the effects that can impact on a waterbody are considered not just the effects of a particular discharge."

Applying these guidelines and WQOs to a relatively small impervious development is for practical reasons not feasible. This is explained further. With stormwater harvesting, the development in question has no discharge more than 90% of the time. Even if one only considers periods of flow generation greater than 1 L/s, i.e. during rainfall runoff events, more than 45% of the time it is raining, there is no discharge from the site. The 45th percentile site flow (which is considered much more than a low flow event) median concentrations are therefore zero. Strictly, this indicates that the site would discharge water quality compliant with the DGVs.

It would therefore be feasible to demonstrate compliance with the DGVs because there is no low or even medium flow discharge from the site due to harvesting of stormwater.

This however would be a somewhat misleading approach and serves to demonstrate why DGVs should not be used to guide assessment of water quality impacts from such developments.

To assess the impact on ambient water quality we must assess the impact from flows greater than the 50th percentile outflow, i.e. flows above 2 L/s as these will carry most of the pollutant load from the site. WQOs are therefore discarded in favour of a body of evidence approach to risk assessment as demanded by the guidelines.

What is clear is that, due to harvesting of stormwater, as required by the SEARs, the only time runoff leaves the site is during larger storm events where pollutant concentrations would be diluted by catchment flows. This is a key part of the best practice approach on the proposed development.

2.5. Existing Groundwater Data – Depth and Quality

Borgs operate several bores close to the proposed development and data from these bores has been investigated to provide background data indicative of groundwater quality and depth on the proposed development site.

There are two types of aquifers present in the area. A deep aquifer is present at depth nominally 10m below the surface and this is very unlikely to be affected by the proposal and so data on the deep aquifer has not been included in this report. For information purposes the deep aquifer is located approximately 10m to 15m below the existing surface.

A shallow perched groundwater table is also present across the area. Should any groundwater impacts be experienced as a result of this proposal, this aquifer, being closest to the surface would experience potential impacts.

Groundwater depth of the shallow surficial aquifer varies depending on slope and proximity to Kings Stockyard Creek. No direct measures of groundwater depth were available over the proposed development site. Based on extensive measurement of groundwater depth on the adjacent Borgs site, nominally 300m away, groundwater could be expected to be present at approximately 2m below the existing natural surface of the site.

Groundwater quality measured at a bore labelled GW02 is presented below in Table 3. GW02 was chosen as it is close to the site (300m from the north western corner of the site) and within the shallow surface aquifer.

The location of GW02 is shown below in Figure 3.

Table 3 Groundwater Quality at GW02

Analyte	Units	2018	2017	2016
Aldrin	µg/L	ND	ND	ND
Ammonia	mg/L	0.03	0.08	<0.01
Chemical Oxygen Demand	mg/L	15	56	<10
EC	µS/cm	1032	1007	1071
Delidrin	µg/L	ND	ND	ND

Analyte	Units	2018	2017	2016
Formaldehyde	µg/L	ND	0.1	ND
pH		6.2	7.01	7.06
Total Dissolved Solids	mg/L	500	714	585
Total Organic Carbon	mg/L	4	6	2
Total Petroleum Hydorcarbons	µg/L	ND	ND	ND
Total Suspended Solids	mg/L	46	168	87

ND = not detected.

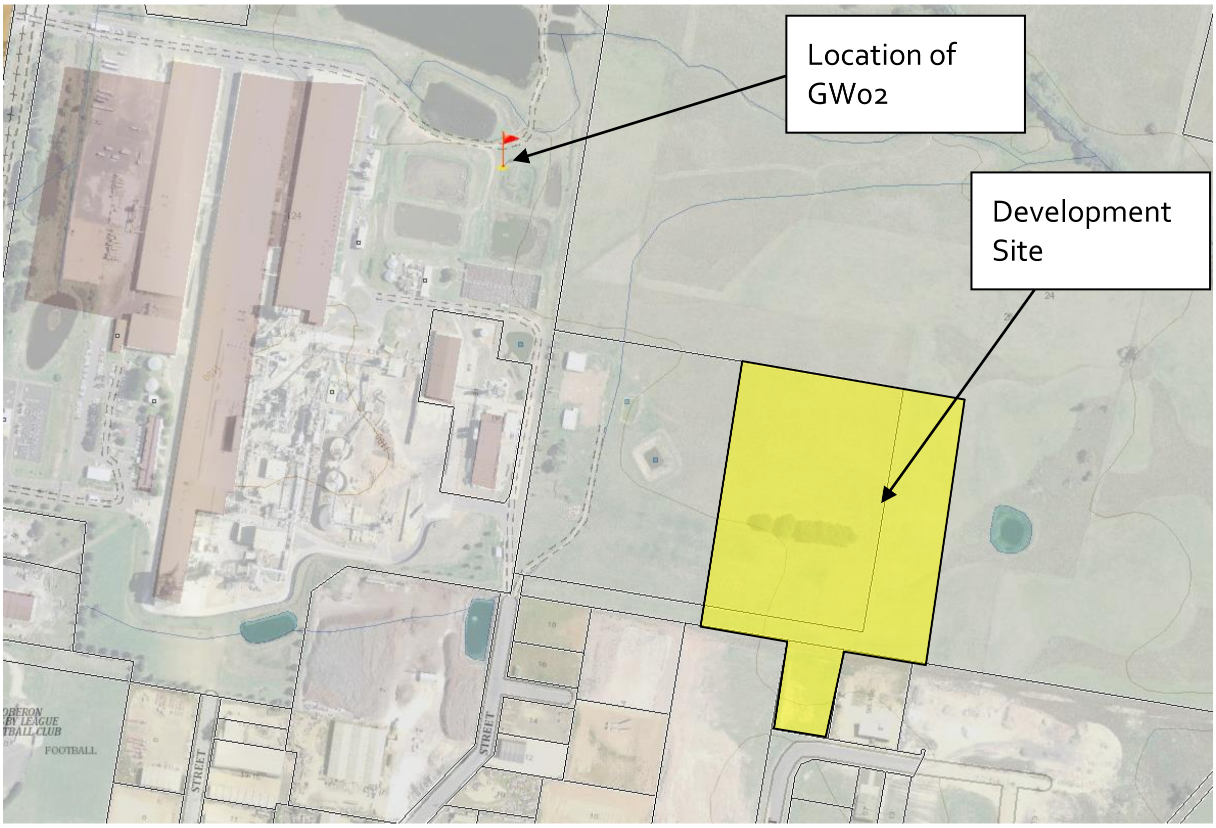


Figure 3 GW02 Bore hole location

Figure 3 shows the location of GW02 with a red flag and development site shown in yellow.

3.0 OVERVIEW OF PROPOSED DEVELOPMENT

The following information has been prepared by Jackson Environment and Planning.

It is proposed that the facility will process and recycle up to 99,000 tonnes per annum of pine bark residuals, including from Borg's MDF Manufacturing Facility, as well as waste pallets. The site may also accept timbers from other sources.

The intent of the facility is to provide a best practice, sustainable and well-designed facility to enable the beneficial recycling of pine bark, (clean, heat treated) pallets and clean untreated timbers into value-added landscape materials, with a focus on quality horticultural mulches for gardens and landscaping. No MDF, particle board or any other form of modified timber products will be accepted at the site. No mixed waste or any other type of waste will be accepted at the site.

The proposed development of the site seeks a new Development Consent with a maximum tonnage of waste processing of up to 99,000 tonnes per year. Approval is sought to construct a bark/timber processing facility, including an office, weighbridge, wheel wash, dedicated waste tipping and storage areas, including processing and product storage areas. The development will also involve construction of a hardstand, roads, drainage infrastructure, stormwater treatment infrastructure, landscaping and noise attenuation mounds / barriers. Car parking will also be established as part of the development. Site Layout and Installation.

A new site entrance and driveway will be developed, with enough width to accommodate the largest expected vehicle (23m B-Double truck) and turning path. This entrance will be a minimum of 8.1m in width to meet Australian Standard 2890.2 for articulated vehicles.

A weighbridge and site office will be installed near site entry, and all non-staff vehicles entering the site will be required to enter the facility via the weighbridge (as required under Clause 36 of the *Protection of the Environment Operations (Waste) Regulation* 2014). Parking will also be provided near the entrance to the site. A wheel wash will be installed at the entrance to the site to prevent sediment from leaving the facility.

An internal loop access roadway will be developed to enable vehicles to enter and exit the site in a forward direction. Loading and unloading areas will be separated and clearly allocated to minimise vehicle conflicts. Movable concrete bays will be used for flexible storage of material waiting to be processed and processed product. A separate waste tipping bay for pallets and timber waste only will be constructed, where incoming loads will be inspected for contamination (e.g. treated pallets). These will be removed and disposed at a lawful facility.

The site maybe sealed with an either concrete or other hardstand to reduce soil disturbance and to improve the quality of runoff water. Perimeter bunding and drains will be put in place around site boundaries to prevent the release of contaminated stormwater. Dust control mitigation systems will be installed, such as misting systems around the perimeter of the site. A gross pollutant trap will treat all runoff from the hardstand areas to remove gross pollutants, sediment, (some) nitrogen and phosphorus and oil/grease. Water then will be directed to a stormwater detention pond, which will be used for dust suppression, and sufficiently sized to contain a 1 in 100-year rainfall event.

A static water supply will be installed for fire-fighting and fire protection. An alternative site access point will also be developed for fire and other emergency services vehicles.

The Facility will be designed according to best practice and will seek to recycle 99% of all incoming bark/timber materials into the Facility.

3.1. Process description

Site feedstocks will include bark residuals and sawdust, along with pallets. Pallets and timbers will also be trucked via backloading to Oberon from Borg's other sites for recycling. Delivery vehicles will enter the facility over the weighbridge. Pallets and timbers will be tipped into a dedicated waste tipping and inspection area, where treated timbers and manufactured timbers (e.g. MDF) will be removed and disposed lawfully off-site. Any other contaminants in loads will be removed.

Incoming loads of bark from pine log processing in the MDF Manufacturing Facility will bypass the dedicated waste tipping and inspection area and be stored separately in a large concrete block storage bay, awaiting processing. Pre-inspection of this feedstock is not necessary, as it will contain clean, separated pine bark only.

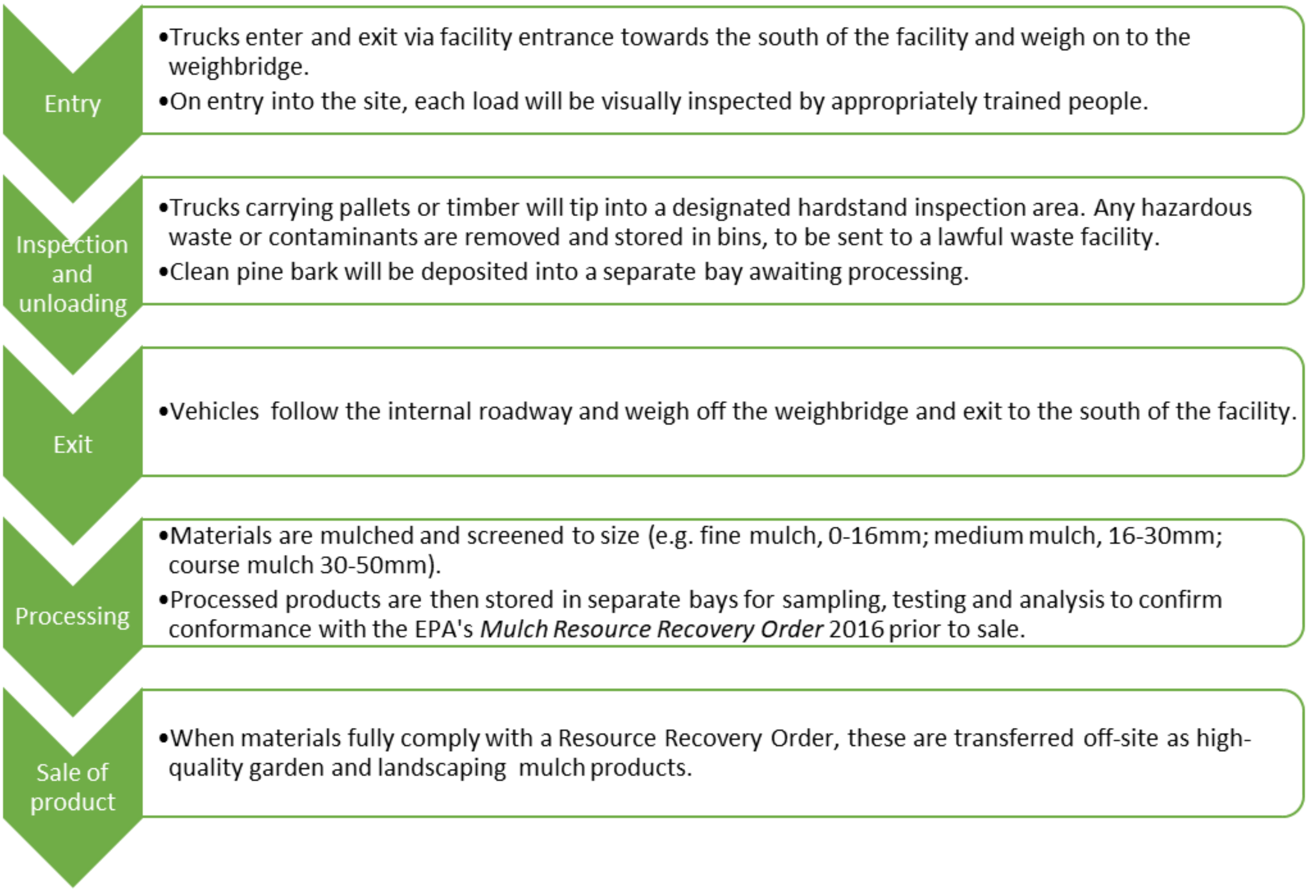
It is further noted that no other form of waste material will be accepted at the site.

Processing of feedstock is expected to include mulching via grinders and shredders, with screening by a trommel for sizing processed material. No composting will take place on site, and products will be transported from the site shortly after processing.

Processed landscaping materials will be stored in dedicated concrete block bays. To ensure the recovered products are consistently fit for purpose, and comply with *The Mulch Order* 2016, regular sampling will be undertaken in accordance with a quality assurance program and quality control measures.

The facility is proposed to be operated from 7am to 6pm, Monday to Friday, and 8am to 1pm on Saturdays. The site will be closed on Sundays and public holidays. However, it is proposed that the site be accessible 24 hours per day, 7 days per week for delivery of material. This is to allow delivery of sawdust from the nearby timber panel plant outside operational hours. Machinery on site will only operate during the nominated operational hours.

Figure 4 Process flow chart for the operation of the Bark/Timber Processing and Landscape Supplies Production Facility.



4.0 POTENTIAL IMPACTS

4.1. Water Quality

4.1.1. Long term water quality risks

The storage of bark and sawn timber (pallets) in the storage bays is likely to generate coarse timber particles and leach tannin from the bark. The coarse particles will contribute to the load of total suspended solids (TSS) and total nitrogen (TN). Leachate will contribute to the load of tannin. While tannin itself is not toxic discolouration of runoff can reduce light penetration through the water column.

Additional traffic loads will result in an increase in traffic related pollutants though these are not significant by comparison with any main road.

Additional roof and hardstand areas totalling 3.3 Ha associated with the proposed development will result in an increase in the export of TSS, TN and TP from the impervious roof areas.

Key sources of stormwater pollution will arise from:

- An increase in roof areas
- An increase in paved impervious areas
- Storage of sawn timber (pallets)
- Storage of bark
- Blending of the raw materials to create a final product
- Handling, storage and transport of blended materials
- An increase in traffic volume

The key stormwater pollutants of concern will be:

- Tannins – tannic acid.
- TSS, TP and TN

The TSS generated from the wood handling parts of the process should be relatively easy to mitigate as expected particle sizes are in the gross size range, i.e. 2mm to 3mm or larger. Equally the forms of TP and TN associated with the wood handling will be the particulate forms (provided they are kept dry) and relatively easy to remove.

The TP in the runoff is likely to be attached/bound to the TSS and therefore removal of TSS will see good removal of TP.

The TN in the hardstand runoff will be in two forms. Firstly, in a dissolved form at lower concentrations associated with atmospheric deposition. Secondly the TN will be in particulate form associated with the timber shredding and handling activities on side. Good air quality in the region is likely to see lower levels of nitrogenous pollutants emitted from the hardstand areas. Mostly, organic particulate nitrogen is at risk of emission. It is very important to keep this particulate form as dry as possible to prevent it from nitrifying and converting into a dissolved N.

The impact of the key pollutants on river health is as follows:

- TSS can smother benthic the benthos and result in siltation of creeks and an increase in turbidity of stormwater. By smothering benthos and benthic organisms TSS disrupts the natural exchange processes that occur in creeks. These processes see nutrients and sediment exchanged in different forms. Smothering of creeks with sediment reduces available habitat.
- TP and TN in the bioavailable forms (dissolved forms) contribute to the eutrophication of water bodies and waterways potentially leading to algal outbreaks and a change in the assemblage of the aquatic ecosystems from ones dominated by low nutrient levels to ones dominated by high nutrient levels. Increased nutrients can also lead to reduced dissolved oxygen levels.
- Tannic acids can discolour water and the impact is mainly aesthetic. There are many natural ecosystems (e.g. Melaleuca swamps) which have very high loads of tannic acids and which remain healthy and productive. It is also possible lower light penetration will mitigate against growth of algae.

4.1.2. Short term Water Quality Risks

Short term water quality risks associated with the development would include:

- Soil and water management during construction.
- The risk of an accidental spill of a chemical during operation of the plant. It is noted apart from storage of diesel fuel and fleet maintenance fluids (oils, hydraulic fluid etc), few other chemicals will be stored on site.

The management of soil and water during construction can have devastating impacts and is often overlooked. It is known that the impacts of poor soil and water management during construction can have the same effect as water quality discharged from an operation over its entire life.

The transport of sediment from the site is the key risk during construction. It is likely that more than 1 hectare of land will be disturbed during construction and therefore the risks of sediment transport off the site are significant. The sediment could be deposited within the rehabilitated section of Kings Stockyard Creek which was subject to rehabilitation in the past from a chemical leak many years ago under different ownership. This would impact on creek ecology at a time when it is probably reaching pre-contamination levels of diversity. None the less adherence to the Blue Book would see soil and water impacts mitigated.

4.2. Geomorphology

The proposed development will not see any new structures within 40m of the top bank of a creek. However, it is proposed to construct rock lined leaky weirs at strategic locations between the site and King Stockyard Creek.

Therefore, direct geomorphic impacts will be negligible. No riparian vegetation or aquatic habitats will be removed or affected by this proposal.

The addition of approximately 2.64 Hectares of impervious area would result in an increase in the volume of runoff leaving the site. This could potentially have some minor impact on the geomorphic condition of the creek resulting in erosion of either the bed and or banks to cater for the extra water being conveyed into the creek.

This could be mitigated through harvesting of the runoff which would reduce both the frequency of runoff and the volume of runoff and theoretically lead to an improvement in creek health (Walsh et al, 2004).

The creek has also been rehabilitated in the past by CSR and has already adjusted to the presence of large impervious areas draining into it and is now stable. Some further minor adjustment is possible though it is expected to be minor and potentially negligible if mitigated. Further, inclusion in the floodplain of leaky weirs will help maintain the same broad, shallow predevelopment flow regime. This will keep the floodplain engaged and reduce velocities and erosion at minimal cost and with minimal maintenance.

4.3. Flooding

The catchment downstream of the proposed development is a sparsely populated rural catchment where the creek flows through an incised valley eventually to form the Fish River a few kilometres downstream of the site. This is quite a common geomorphic feature of the weathered granite landform of this region which can sustain steep hills which are not prone to erosion.

Analysis of aerial photography down to the confluence of Fish River with Slippery Creek (15 km downstream of the site) reveals that there are three buildings which could potentially be affected by flooding. The first and second are located 75m from the creek and in fact not likely to be flood prone let alone affected by the 1 in 100 year flood event. Both buildings are elevated about 20m above the creek. The third building is located 40m from the creek and is elevated between 10m and 20m above the Fish River but where the sides of the river are relatively flat, and the flood conveyance area is about 80m wide. Therefore, the risk of any potential increase in peak flows impacting on downstream property is considered negligible.

The proposal, located at an elevation of 1,100m above sea level is not located within a floodplain and therefore there would be no potential impacts from floodplain filling, and this will not be considered further.

Local overland flow paths are affected by the proposal and have been defined with easements sized to convey 1 in 100 year flows, so that they can be safely directed around the proposed development without mixing any clean run-on water with site water which would be of lower quality.

4.4. Water Resources

4.4.1. Water Supply

The proposed development will see a minor increase in demand for water which could be sourced from either:

- Town water.
- Harvested stormwater runoff. The impervious areas on the site and upstream are extensive and lend themselves to a reliable stormwater harvesting scheme.

4.4.2. Wastewater

A pressure sewer will be installed on site with wastewater pumped to the Council's water treatment plant.

A treatment plant will be installed to treat stormwater prior to reuse. This will concentrate particulates. The backwash water from the plant could be discharged to the town sewer or preferably thickened on-site in a filter bag which would see filtrate water being collected for use in fertiliser products. The contents of the filter bag will then need to be dried and reapplied to blended mulches on site – adding to their nutrient quality.

4.4.3. Groundwater

There are no expected impacts to ground water caused by the proposed development. While surface runoff across pervious surfaces can infiltrate into the groundwater storages, extensive mitigation measures have been proposed to treat the surface water such that it will pose no risk to either natural receiving waters or water bodies, or groundwater.

Critical control measures include:

1) Raising the proposed development above the ground table to avoid cutting into the groundwater table. It is noted that Borgs enjoy the groundwater under an existing Water Access Licence and have a significant interest in ensuring it is not polluted or access disrupted through lowering of the water table.
2) Constructing concrete hardstand areas with sealed joints.
3) Installing a drainage layer under the hardstand areas with subsoil drainage which would discharge into the stormwater collection system.
4) Draining the said hardstand areas to a drainage system which would be lined with clay to prevent infiltration.
5) Sealing the sub-base of the pavements with clay to prevent infiltration with compaction to the requisite level specified by the EPA guidelines.
6) Ensuring the refuelling area uses a self-bunded tank and that the refuelling area is covered with an appropriately sized awning.
7) Having a stormwater pond lined with clay or geo-composite clay liner or HDPE both to retain water but also to protect groundwater.

8) Ensuring that irrigation of pervious, landscaped areas only occurs when it is not raining and by using soil moisture probes to measure the demand for irrigation.
9) Installing penstocks to ensure that fire fighting water is captured on site and does not overflow from the facility into the catchment and groundwater.

5.0 PREDICTED IMPACTS

5.1. Methodology

Because no groundwater impacts are expected predicted impacts on surface water only was assessed.

A MUSIC (Model for Urban Stormwater Improvement Conceptualisation) water quality model for the site was constructed. MUSIC was developed by the Cooperative Research Centre for Catchment Hydrology in 2001 and the program is now widely used across Australia to predict water quality impacts arising from a proposed development, and to then design appropriate stormwater mitigation strategies.

The following sections of this report describe the MUSIC models that were created to simulate both the existing site (pre-development model), the proposed development for the site (post development model), and the site as it would be if in an un-developed state (rural model).

The method used to create the climate file which contains historical rainfall data and which was used to run the MUSIC models is described below.

5.1.1. Pre-development model

The predevelopment model is a simple one node model and represents an agricultural land use.

The configuration of the pre-development model can be seen below in Figure 5.

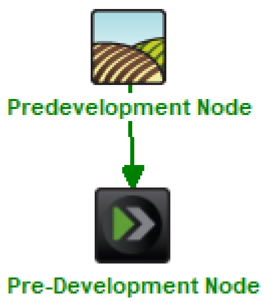


Figure 5: Predevelopment MUSIC model configuration

The event mean concentration values adopted for this land use were based on those defined in Tables 2.43, 2.44 and 2.45 in Fletcher et al (2004).

5.1.2. Post-development model

A post development model was produced to reflect the post development site conditions with 3.3 ha of impervious hardstand created, landscaped areas and drainage easements.

Key features of this models are:

- Total impervious area: The node that represents that part of the site to be developed, was modified to reflect the addition of another 3.3 hectares of impervious area.
- EMC values for the operational area were obtained from a calibrated MUSIC model which was developed as part of the State Significant Development project. That model used over 10 years of recorded Borgs site discharge water quality data to calibrate EMC values for TSS, TP and TN.
- The post development model included 4 GPTs placed strategically through the site to minimise maintenance as much as possible. The preferred GPTs for this develop application are Barramy vane traps which deflect gross pollutants and sediment out of the flow column where it is stored in a dry state and can be readily recovered and put back into the product stockpiles.

  These GPTs modelled reductions in TSS, TP and TN of 30%, 20% and 20% respectively. These are considered conservative values based on extensive long term statistically significant field measured values achieved by other GPTs including SPEL Stormsacks, Humeguard, CDS unit and Enviropods.

  Because the particulate loading of TP and TN would be so high on the proposed development site (relative to dissolved levels of nutrients) these removal rates are likely to be conservative.
- Addition of new 1.5ML treatment pond which has a minimum surface area of 1,000m^2.
- Addition of swales conveying runoff toward the pond. The swales were modelled conservatively by directing lateral inflow into the swale into the next section of swale.
- Stormwater harvesting from the pond was included in the model with annual demands of 8935 m^3/year, scaled by potential evapotranspiration minus rainfall (water deficit) drawn from the pond when water was available. This assumed irrigation of up to 1.78Ha in area which would cover areas used for blending and storage of product as well as selected landscaped areas to a depth of 400mm per year which is the deficit between annual evaporation of 1,200mm and annual average rainfall of 800mm per year. This was scaled monthly to account for the variation in evaporation with demand amplifying from spring to summer and tapering off from autumn to winter. They key point to note here is that it has been assumed that landscaped areas would also be irrigated and in fact would need to be irrigated to help draw down the pond to help reduce the volume of runoff leaving the pond.
- Pollutant assimilation between the point of discharge from the site and King's Stockyard Creek, 575m from the site was not modelled.

The proposed mitigation measures, namely GPT, swales and pond are shown in more detail in Figure 6 and the site general arrangement drawing prepared by Borgs and which is included in Appendix 1.

It should be noted that the water *quality* analysis is conducted at the site boundary after flowing out of the pond. That is, it measures pond discharge.

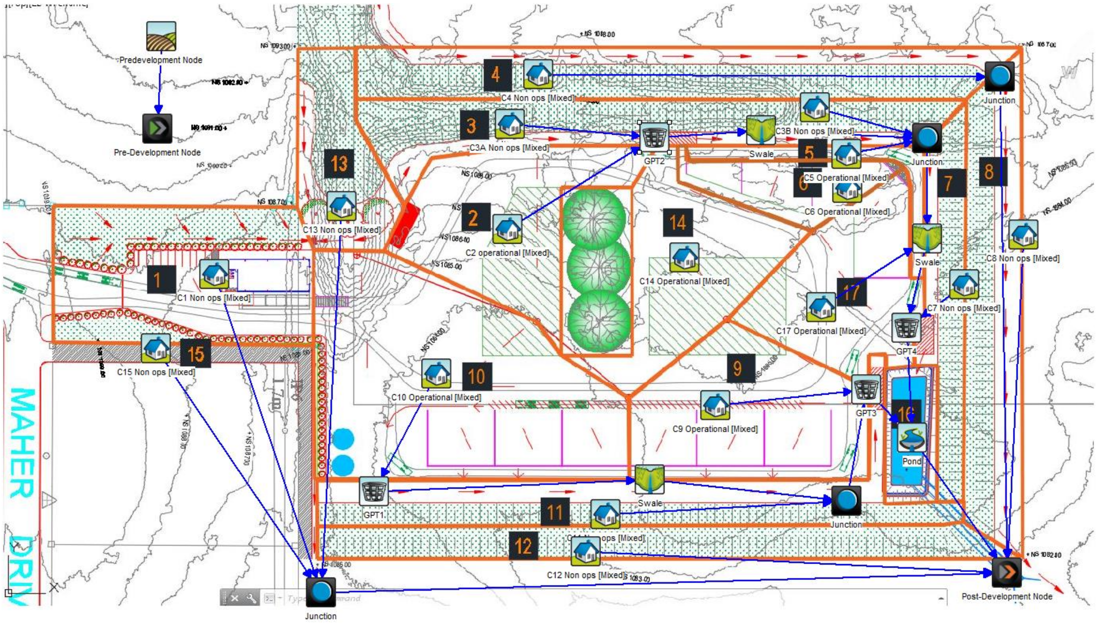


Figure 6: Post Development MUSIC model configuration

EMC values for use in the post development were based on 10 years of recorded water quality site discharge monitoring data from the Borgs main licenced discharge point at the V notch weir north of Lot 34. It is assumed that because that site has a similar timber shredding operation that it would be a good analogue site on which to model the proposed bark processing facility.

Adopted EMC values for the main operational area of the site are:

Parameter	Adopted EMC and standard deviation (mg/L)	ANZECC DGV (mg/L)
TSS	39.8 mg/L and 2	N/A
TP	0.316 and 1.333	0.02
TN	10 and 1.82	0.25

Table 4 Adopted EMC values for the post development model

The TSS EMC values are considered low relative to default values for a typical industrial site, TP is a little higher and TN is 5 times higher. The majority of the TN would start off in a particulate form and the recommended GPT would keep the TN in that form preventing wet sump decay and conversion into readily bioavailable forms of inorganic dissolved N. Worth observing also that the EMC values are orders of magnitude different to DGVs.

These are calibrated values which when included in the Borgs model produced runoff values fairly closely matching those observed through water quality monitoring.

5.1.3. Rainfall data selection

There are several pluviograph stations in close proximity to the Borgs site, which are all in the same mean annual rainfall zone, as can be seen in Figure 7, and the long term daily records at each site were analysed extensively in order to select a data set of sufficient length and quality to run in the MUSIC models. In order to accurately model the impacts of the proposed development, 6 minute (or "real time") rainfall data is required from a pluviograph station. It is preferable to use a long period of data, which reflects the long-term average rainfall (838mm/year), so that the results are more reliable and not affected by short-term cyclical weather variability. Furthermore, the data chosen should have no large continuous gaps where the station has failed and stopped recording.

Unfortunately, none of the weather stations around Oberon provide long-term high quality data, making it difficult to select a period for use. To overcome this, two smaller high quality periods (of approximately 10 years each) were selected, joined and run effectively creating a 20-year climate file used for simulation of the urban water cycle on the Borgs site.

The two periods selected were from 13/4/1966 to 15/6/1975 (with a mean annual rainfall of 1056mm), i.e. a wet period, and from 11/11/1977 until 20/05/1987 (with a mean annual rainfall of 592mm) i.e. a dry period, obtained from the Oberon Dam weather station (station number 063108). Since one period has a higher mean annual rainfall than the long term average, and the other has a lower one, the mean annual rainfall averaged across the two periods is about 800mm/year which closely reflects average rainfall over the last 20 years which has been slightly reduced from the very long term average of 838mm/year (probably as a result of climate change).

Evapotranspiration data for the site was modelled as 1174mm per annum based also on BOM data monthly distribution.

Figure 7: Location of pluviograph stations around the Borgs site. The uniform background colour indicates all stations are within the same zone of average annual rainfall around 800mm/year.

5.1.4. Stochastic Modelling Issues

Because the stochastic function in MUSIC was used to randomly generate a pollutant concentration value from a log normal distribution of pollutants (based around a specified mean and standard deviation), each model run has slightly different results.

Because it is expected that an EPL for the site specify the maximum upper limit at the 100th percentile, the maximum concentration values predicted by MUSIC become the key parameter for assessment.

There is therefore some degree of uncertainty with respect to the maximum values generated in MUSIC, i.e. the maximum values can vary considerably from run to run. We have reduced this uncertainty in two ways:

1) By having a climate file that covers 20 years of 6 minute data – this is discussed further later, i.e. a climate file that spans a very long time making it highly probable that a very high value would be generated within this very long time period, and
2) By running the model 10 times to obtain an envelope of solutions and by then adopting the largest maximum value from the set of 10 values. This provides us with statistical confidence to predict the 1 in 20 year worst single pollutant event.

5.2. Results

5.2.1. Surface water quality impacts

5.2.1.1. Load based results

The predevelopment and post development MUSIC models were run 10 times and the results obtained.

Pre and post development average annual loads and treatment performance is shown below in Table 5. Table 5 has sources columns, residual load columns and percentage reductions columns. The sources columns describe the unmitigated pollutant loads running off the land surface. The residual load is the pollutant load after mitigation. The percentage reduction columns report the percentage reduction from source to residual load, i.e. the effectiveness of the treatment systems. It needs to be appreciated that this is the predicted performance for the whole site in its entirety and not just for the additional impervious area proposed as part of this development, i.e. a wholistic approach to water management on the entire site is being undertaken as part of this assessment.

Residual Pollutant Loads			
	Pre-development	Post-development	% Reduction from pre to post development
Total Suspended Solids (kg/yr)	493	180	63% down
Total Phosphorus (kg/yr)	2.01	1.36	32% down
Total Nitrogen (kg/yr)	12.3	25.6	108% up

Table 5: Annual Pollutant Export Loads and Treatment Train Performance

Table 5 shows that despite the addition of another 2.64 hectares of impervious area, with the additional reuse of stormwater and the additional treatment measures, the proposed development is predicted to have a beneficial effect on its catchment in terms of reducing TSS and TP while a potential detrimental effect may occur from increasing TN.

Best practice stormwater treatment is often described as follows:

Removal of:

- 85% of the average annual load of TSS
- 65% of the average annual load of TP
- 45% of the average annual load of TN

Table 6 Treatment Train Effectiveness of the Borgs Treatment System

Treatment-train Effectiveness (% Reduction of Pollutants)			
	Post Development without treatment in place	Post-development (with proposed treatment system)	
Total Suspended Solids (kg/yr)	763	180	76.4
Total Phosphorus (kg/yr)	5.10	1.36	73.3
Total Nitrogen (kg/yr)	157	25.6	83.7

Table 6 shows that the proposed development would come close to achieving best practice for TSS removal, exceed best practice for TP and exceed the TN removal target by nearly double. Even though the treatment train would remove 90% of TN there is a predicted increase in TN. This analysis demonstrates that all practical steps are proposed to be undertaken to minimise the increase in the level of TN discharged from the site.

5.2.1.2. Concentration based results

A typical Environmental Protection Licence (EPL) for facility of this kind would specify pollutant discharge limits in terms of concentrations rather than annual loads. Although there is less confidence in MUSIC's ability to predict concentration based results (versus load based results), it remains the best tool available for doing so, and thus enabling a comparison with the EPL limits.

One difficulty in modelling the predicted maximum discharge concentrations values in MUSIC, is that the pollutant concentration values applied at the source nodes in the model, are derived stochastically from a log normal distribution, meaning that a pollutant concentration value for each pollutant is randomly synthesized by MUSIC based around a log normal distribution defined by its event mean concentration and standard deviation at each time step and is therefore different for each simulation (or run) of the model. While the mean predicted pollutant concentrations don't vary much between each model run, the maximum values do vary significantly.

To overcome this uncertainty with the model, the model was run 10 times to ensure a broad envelope of results was predicted. This is equivalent to running 200 years of six minute climate data. From the 10 runs the maximum value was selected and reported below in Table 7.

Table 7: Predicted maximum discharge concentrations from the MUSIC model (maximum of 10, 20 year 6 minute runs)

Parameter	Predicted Maximum concentrations (mg/L)
Total Suspended Solids	30.6
Total Phosphorus	0.203
Total Nitrogen	8.67

If an EPL limit of 50 mg/L would be imposed on the development, the modelling indicates this target would be achieved.

5.2.2. Surface water quantity impacts

In order to examine the predicted impacts of the proposed development on Kings Stockyard Creek in terms of water quantity, the post development case is compared with the predevelopment and rural site case. The purpose of modelling the predevelopment rural site, is to determine how much extra runoff is generated by the proposed development. We note the rural state is the same state of development adopted under all Water Sharing Plans formed under the Water Management Act (2000) regardless of the level of imperviousness of a site.

Table 8 below shows the results of the rural site simulation compared with the post development simulation, both with and without the reuse of the stormwater that is generated on the site. It can clearly be seen that the post development case (which includes the current infrastructure) causes a substantial increase in the volume of runoff produced on the site, more than doubling the volume of runoff that would be discharged to the creek. Such drastic increases compared with the "natural" flow regime in the creek, can have adverse effects such as erosion of the creek bed or banks.

However it can be seen in Table 8 that by harvesting and reusing some of the stormwater, rather than disposing it to the creek, the mean annual volume of runoff can be reduced closer to the rural runoff volumes, thereby lessening the chance of any adverse effects on the creek.

Table 8: Mean annual flow comparison

	Rural State (no dams)	Post development (without treatment)	Post development (with treatment and harvesting)
Mean Annual Flow (ML/year)	6.67	17.6	9.64

The SEARs indicate a need to demonstrate that all practical measures are being taken to reduce, as much as possible the volumes of polluted runoff from this site.

It would be possible to increase the volumes of irrigation and therefore reduce the volumes of runoff further however there is a risk that if the blended mulches are over irrigated, they will in fact produce leachate rich in tannin and dissolved inorganic nitrogen. This would be an undesirable outcome.

The depths of irrigation assumed in this work was identified earlier as being 400mm per annum. This is exactly enough irrigation to replace water that is lost to the atmosphere from evaporation. An irrigation controller would need to be installed on site to ensure that the right depth of irrigation occurs, and that excessive irrigation does not occur.

Because the irrigation demand is split between landscaped areas (simply to help maximise the reuse volume) during detailed design the volume at which irrigation of landscaped areas is ceased needs to be determined. This would ensure a meaningful volume of water remains with which to irrigate blended mulches to keep them moist and suppress dust.

6.0 PROPOSED MITIGATION MEASURES

The proposed mitigation measures and strategy is shown in Appendix 1.

The proposed long-term water quality treatment measures include:

- GPTs
- Swales
- Pond
- Stormwater Harvesting and Reuse
- Leaky weirs on the floodplain

These are discussed in more detail below.

6.1. Barramy GPTs

Barramy GPTs are recommended because they have been designed for environments such as the proposed development. They work to keep organic matter dry and prevent leaching of dissolved nutrients. They are easy to maintain using a back hoe or small loader.

The photos below show a recent installation in the Blue Mountains.

The proposed stormwater treatment pond will need to be designed with care. Batters can typically be 1 in 4 and planted with appropriate reeds and sedges. The pond water levels will fluctuate significantly so vegetation must be designed to be suitable for its depth zone. Ephemeral wetland plants that can tolerate both extended wetting and drying would be most suitable.

If space permits, shallower batters would allow greater density and diversity of fringing vegetation and this would improve water quality and improve safety. The pond shall be designed to enable access by machinery to remove accumulated sediment from its bed on a routine basis. This will help to improve long term quality.

Plate 2 Barramy Gross Pollutant Trap

Plate 2 shows the trap with vanes moving gross pollutants and solids to the left hand side. When flows build up water is able to flow between the vanes.

The material moved into the trap is allowed to dry as the trap slopes toward the right hand flow bypass channel. The screen at the end of the device also allows debris to be pushed to the back of the trap so that is becomes self stacking. The debris is pushed against the screen and the debris itself forms a blinding layer which stops further debris from being washed through the screen.

Plate 3 Showing a side view of the Barramy Trap.

Plate 3 shows how the trapped material can dry out against the maximesh screen.

The material caught in this trap includes very fine wood fibres less than 1mm in size, sands and silts, leaves and litter. The trap in these plates was emptied 2 weeks prior to this photo being taken and the contents were conveyed in 2 storm events from a steep catchment.

Four GPTs are proposed. 2 of the GPTs are proposed to be located upstream of the swales where they will intercept gross pollutants and silt and wood fibres before they are conveyed into the swale. This will help reduce the maintenance burden on the swale in the long term. 2 further GPTS were proposed to be located prior to the pond.

This approach must be rationalised during detailed design of the site to ensure the traps are located where they are needed and to keep the pond free of organic material.

6.2. Grassed Swales

Grassed swales have been included in the treatment train. The evidence from Borgs is that these swales perform well. Over time however, as they are designed to be a depositional tool, their depth will reduce and they will need to be maintained to reinstate their design depths.

A typical bioswale is shown below in Figure 8

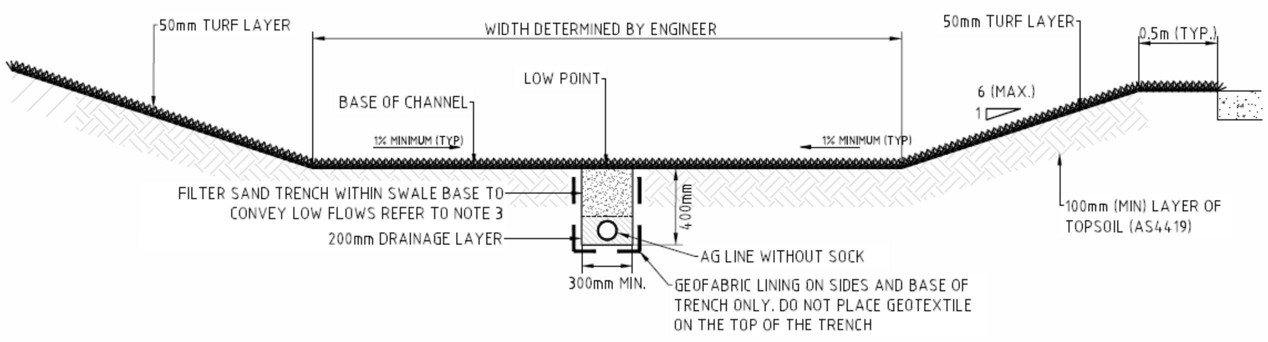


Figure 8 Typical grass swale

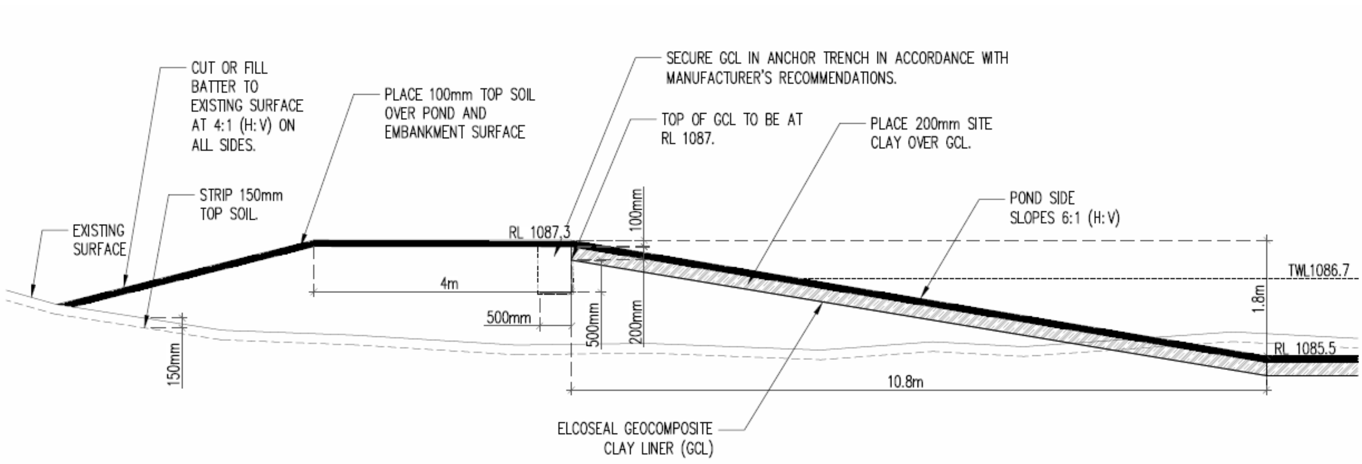
The design swale dimensions adopted in this project are:

- 1 in 4 side slopes
- 1m wide base
- 0.5m deep and 5m wide
- 0.5% longitudinal slope
- The swales would need to have subsoil drainage as shown because there will be an impermeable liner under the swales preventing groundwater impacts.

6.3. Water Quality Pond

An example of a pond cross section is shown below in Figure 9.

Figure 9 Typical water quality pond section



The typical section shows a pond with a liner required to protect groundwater and also to keep water within the pond so that it can be reused.

The design pond dimensions adopted for this project are:

- Surface area of 1,000 m².

- Maximum depth of 1.5m to ensure no stratification occurs
- Volume of 1,500 m^3
- Lined with no infiltration.
- Sufficient freeboard, (nominally 330mm) would need to exist above the overflow/spill level to allow for firefighting water to be contained on site. 330mm of freeboard would allow 330,000 litres of fire fighting water runoff to be contained on site.

  In order to contain the firefighting water on site, a water tight penstock(s) would need to be included to ensure that no flows leave the site. How this is arranged would be determined during detailed design. Possible configurations include headwall mounted penstocks with manual spindles left permanently in place. Suggested manufacturers of the penstocks would be either SPEL or AWMA.

Suitable macrophyte species for the pond would include:

PLANTING LIST

SPECIES	COMMON NAME	ZONE
Craspedia variabilis	Common Billy Buttons	Batters
Lomandra longifolia ssp. Longifolia	Spiny Headed Mat Rush	Batters
Microlaena stipoides var. stipoides	Weeping Grass	Batters
Cynadon dactylon	Couch Grass	Batters
Themeda australis	Kangaroo Grass	Batters
Poa labillardierei var. labillardierei	Tussock	Batters
Gonocarpus micranthus	Creeping Raspwort	Batters
Hypericum japonicum	Matted St Johns Wort	Batters
Utricularia dichotoma	Fairy Aprons	Ephemeral Zone
Carex gaudichaudiana	Fen Sedge	Ephemeral Zone
Scirpus polystachyus	Large Headed Club Rush	Ephemeral Zone
Carex appressa	Tall Sedge	Ephemeral Zone
Eleocharis Acuta	Common Spike Rush	Shallow Marsh
Juncus usitatus	Common Rush	Shallow Marsh
Baumea Acuta	Pale Twig Rush	Shallow Marsh
Eleocharis acuta	Common Spike Rush	Shallow Marsh
Ficinia Nidosa	Knobby Club Rush	Shallow Marsh
Baumea articulata	Jointed Twig Rush	Marsh Zone
Eleocharis sphacelata	Tall Spike Rush	Marsh Zone
Schoenoplectus validus	River Club Rush	Marsh Zone
Triglochin microtuberosum	Auqatic Herb	Marsh Zone
Triglochin procera	Water Ribbon	Marsh Zone

6.4. Fire Fighting Water Storage

As noted earlier 330,000 litres of fire fighting water shall be capable of being stored within the pond and appropriate valves and designs must be configured to ensure this outcome. The volume of storage required is based on an assessment prepared by Jackson Environment and Planning and which is repeated below.

The following estimate is based on the main fire risk on the premises being from bark and timber processing. Given the small size of the office and workshop, fire sprinklers will not be required as part of the National Construction Code (2019).

The proposed bark and timber processing and landscaping supplied facility will store both unprocessed bark and timber, and shredded bark and timber in designated concrete block bunkers in accordance with draft NSW Fire and Rescue (2018)[2] Guidelines. It is noted that bark and timber materials are potentially combustible and require continued exposure to a heat or ignition sources in order to combust.

In order to mitigate against potential fire events, the WA Department of Fire and Emergency Services[3] recommends that a volume of 2.5L of water is applied for each cubic metre of non-mulched material in a stockpile within the first 30 minutes of a fire incident. The application of water should be increased to 4L per cubic metre of mulched material in a stockpile.

The NSW Fire and Rescue (2018) draft guidelines in Appendix A (Acceptable Solutions) requires waste facilities to be designed to be supplied with firewater for a minimum of four hours duration fire event (EP1.3). Based on the firefighting water demands of a worst case scenario fire event on the site, where all bays of unprocessed timber and pine bark, and all separately stored bays of pine bark and mulch are ignited, total water requirements for a four hour event is estimated to be 330,840L (see attachment).

6.5. Stormwater Harvesting

It is proposed to draw approximately 8,935 KL/year from the pond. This water would be used to keep blending and product storage bay areas containing product at optimum moisture content. In addition to irrigating products for dust suppression, drawing water from the pond to irrigate landscaped areas would help to reduce the mean annual volume of runoff from the site considerably.

Drawing 8,935 kL/year would allow for irrigation to a depth of 400mm of:

- 1,700m^2 of product blending areas
- 2,855m^2 of product storage bays
- As well as irrigation of 1.78 hectares to a depth of 400mm of selected pervious areas including the site swales. Irrigation of swales and adjoining areas would ensure optimum grass growth and optimum water quality outcomes. Water to irrigate landscaped areas would also assist in maintaining high quality, drought resistant landscape features and reduce fire risk.
- It will be necessary to optimise the reuse of harvested water so that it can be allocated preferentially to products and dust suppression when water levels get low.

[2] NSW Fire and Rescue (2018). Fire Safety Guidelines – Fire Safety in Waste Facilities. Internet publication: https://www.fire.nsw.gov.au/gallery/files/pdf/guidelines/guidelines_fire_safety_in_waste_facilities.pdf
[3] WA Department of Fire and Emergency Services (2014). Bulk Green Waste Storage Fires. Internet publication: https://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/BushfireInfoNotesPublications/DFES-InfoNote-GreenWaste.pdf.

Sustainability Workshop has worked with MAK Water to develop an appropriate treatment process to ensure the stormwater would be fit for purpose and safe for use. It would need to be disinfected prior to irrigation. Because of the tannins likely to be present UV is not a disinfection option.

Instead media filtration is proposed together chlorination.

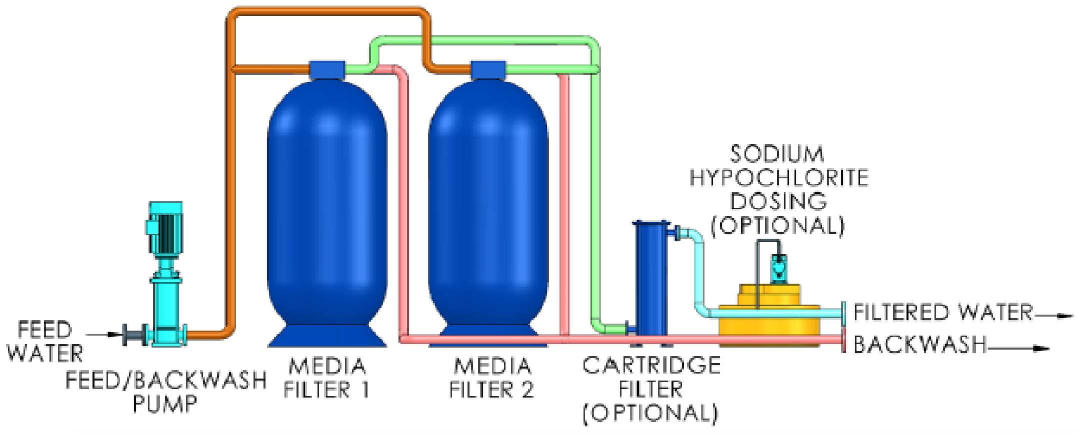


Figure 10 Schematic of Media Filtration and Treatment of stormwater

The treatment plant would come on a skid mounted 20 ft container and need to be connected to electricity. The feed pump should include a self-cleansing intake.

In addition to the treatment plant it would be necessary to store treated water in 4, 50 kL tanks on the site. This would enable a weeks irrigation demand to be stored. Because the chlorination will have a residual effect it will be safe to store the water in the tanks for shorter periods. If not used, nominally within a week, the water would need to be released back into the pond (subject to design).

Hypochlorite would need to be replenished and stored on site in a refillable, bunded container. Some WHS equipment would be required adjacent to the store – such as an emergency shower. This may require a potable water supply to the treatment plant location. The potable supply would be required anyway to make up any deficit in supply needed during very dry times when the pond was empty.

Indicative costs for the equipment would be in the order of $150,000 for the MMF plant and 4 tanks. Either a trade waste agreement with Council would need to be entered into to accept the filter backwash or the backwash could be dried out via filter bag and the sludge mixed with some of the products on-site.

During detailed design the exact plant requirements would need to be established.

An irrigation controller and moisture probes will be needed to help schedule irrigation mainly to ensure that over irrigation does not occur.

A local rainfall gauge would need to be connected to the irrigation controller to ensure that irrigation does not occur when it is raining.

6.6. Leaky Weirs in the Floodplain

It is proposed to place leaky weirs at two or three locations in the floodplain between the Lot 34 boundary and the creek to help reduce the velocity of flow and spread the flow across the floodplain. The final locations of the weirs would need to determined during detailed design. An easement which covered these weirs and a right to discharge flow from Lot 34 would be required as the flow crosses the property boundary onto the rural zoned land next door.

A typical detail showing a leaky weir is provided below.

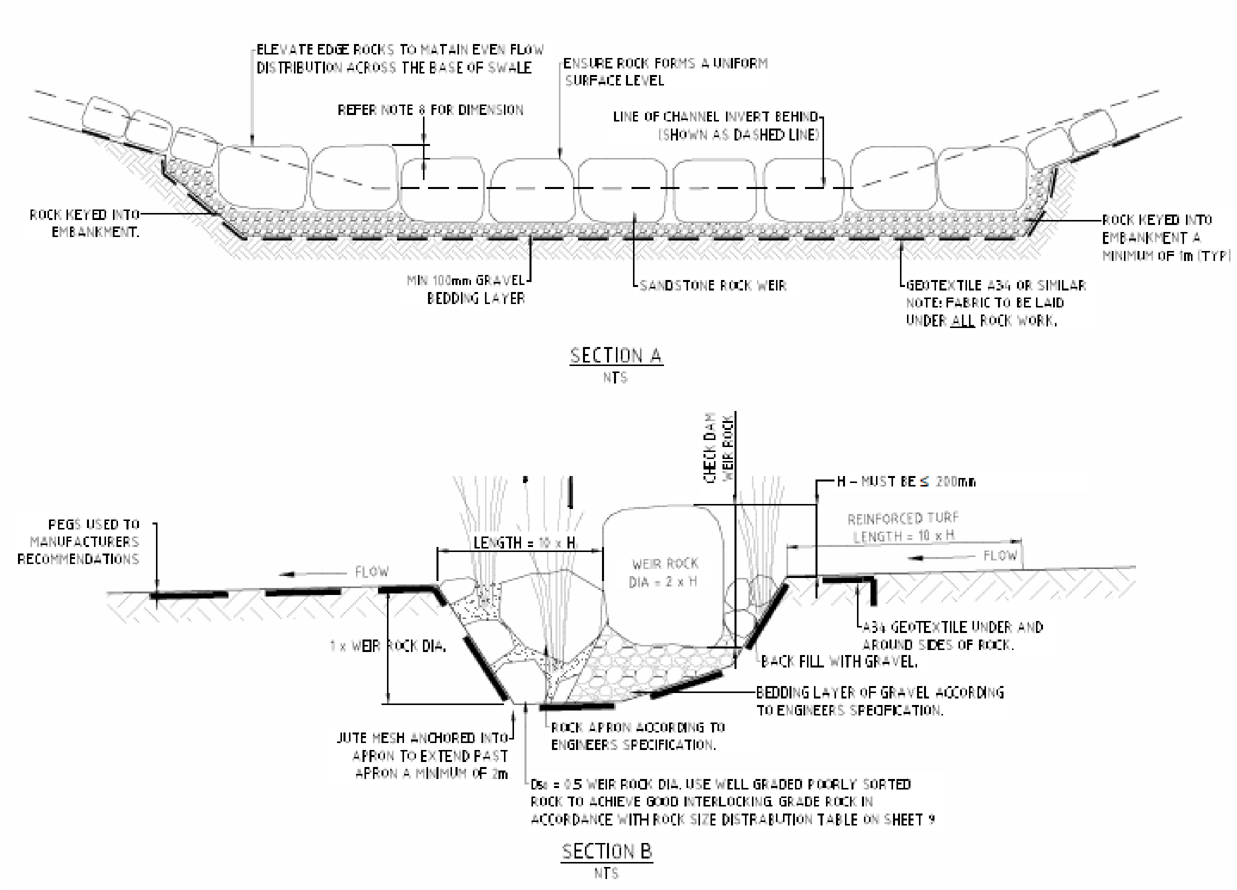


Figure 11 Leaky Weir Typical Details.

6.7. Construction Phase Water Quality Management

During construction it is critical to manage sediment rich flows from the site. Dispersibility testing on the adjacent site indicated mildly dispersible, slightly colloidal soils.

As the proposed development is larger than 1 Ha it would require a soil and water management plan and would require a sediment basin.

The sediment basin would need to be designed to contain the 75th percentile, 5 day rainfall event in order to comply with the Blue Book.

Preliminary calculations indicate the following volumes would be required:

Volume of Sediment basin = Settling Zone + Sediment storage zone		
Settling Zone Volume (TypeD/F) = $10*C_v*A*R$		
Parameter	**Value**	**Comment**
Soil Hydrologic group	C	assumed - could be D which would make Cv = 0.5
Mean annual rainfall (mm)	Between 744.8 (at Jenolan caves road) and 840.5 (at Springbank)	
$R_{(75\%, 5day)}$	22.5	(mean annual assumed at 800 and read from "all sites" chart. Mean annual closely matches Lithgow, and is much lower than Katoomba (see "all sites" list)
C_v	0.35	Read from chart in appendix F
Area (Hectares)	4.989	This is the total disturbed area draining to the basin.
Settling Zone volume	389	m^3
Storage zone volume	194	m^3
Total Volume	583	m^3

It is proposed to excavate a whole in the place where the proposed water quality pond would be located and to use this space during construction for a sediment basin.

The temporary sediment basin would be converted into the final water quality pond close to the completion of construction.

It may also be considered beneficial to construct the permanent pond off line and if that is the case the sediment basin would need to be constructed off the site and if relevant, permission from adjoining owners obtained for that to happen.

7.0 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that the development can proceed without detrimental water quality impacts provided that the recommended mitigation measures are put in place.

7.1. Predicted Water Quality Results

This report finds that the proposal will achieve a decrease in TSS and TP and increase in TN loads after mitigation is considered.

Reductions in TSS and TP would be beneficial to aquatic health.

The predicted increase in TN as a result of this development is likely to be in the form of an increase in dissolved nitrogen. Most particulate nitrogen will be captured on site. Dissolved nitrogen occurs in the forms of nitrogen oxides and ammonia. Mostly the form of nitrogen present will be oxides of nitrogen from impervious area runoff and not in the form of ammonia. Ammonia occurs in anaerobic environments which this proposal, through careful design, seeks to avoid. Dissolved nitrogen is not toxic at the concentrations predicted however it is a nuisance plant growth stimulator – i.e. a chronic pollutant where load based effects can be experienced depending on the context.

The median discharge concentration of TN from the site is predicted to be zero and therefore it strictly complies with the Macquarie Bogan Catchment Water Quality Objectives.

The 90th percentile discharge concentration of TN is predicted to be 1.56 mg/L which is well above the ambient guideline (to be measured at low flows – say less than the median) but which is highly consistent with recent water quality test results as shown in Table 2 which found a TN concentration of 1.5 mg/L at Hazel Grove Road. There is no ambient guideline for flows at the 90th percentile level and it is inappropriate to compare the guideline trigger value at low flows with the concentration at the 90th percentile flow level.

It is considered that occasional elevated levels of nitrogen which already occur in King's Stockyard Creek are unlikely to result in nuisance plant growth stimulation – especially at Oberon which at an elevation of 1100m above sea levels has considerably lower average temperatures and where temperature is a key requirement for nuisance plant growth.

5 km downstream of the site, the catchment expands to join the Fish River which has a 9,000 hectare catchment area upstream of the confluence. Certainly, the levels of dilution within Fish River would be such that there would be no discernible impact from the proposed development on water quality.

In terms of total loads of TN within the Fish River catchment, the increase in TN load is predicted to be 13 kg/annum. This equates to just 0.05% of predicted TN load in the Fish River catchment. The predicted increase in TN load will not result in any discernible change in the level of nuisance plant growth downstream of the site.

Furthermore, the ratio of TN to TP is critical in stimulating nuisance plant growth. Given that TP discharge from the site will be reduced, the ratio of TP:TN will be disrupted favourably and offset any potential impact arising from such a minor increase in the TN load.

In conclusion it is highly likely that:

1) There will be no decline or detectable change in aquatic health either locally within Kings Stockyard Creek or within the broader Fish River catchment.
2) There will be no discernible increase in any water quality parameters at almost any point in the catchment except for concentrations of TN immediately downstream of the pond and as explained above this will not result in ecological stress occurring at any point in the catchment.

The harvesting of stormwater would reduce operating costs when compared to the cost of purchasing the water from Council. Therefore, there is an economic incentive to pursue this action. It is however noted that it is not essential that harvesting is undertaken to meet any potential EPL limits. However, there would be load based water quality and geomorphological benefits from harvesting and therefore it is to be considered a core component of the mitigation measures.

What this means in practice is that if the pumps or sand/media filters were to break down and there is no harvesting for say a month then Borgs should still be able to meet anticipated EPL limits. Provided that harvesting resumes once the plant is repaired then the load based and geomorphic benefits of the proposal would be restored. Should no harvesting occur at all then the proposal is likely to have some minor additional geomorphic and load based water quality impacts but without breaching licence conditions.

It is therefore recommended that the proposed mitigation measures are adopted. The economic and environmental incentive to do so is certainly present.

It is noted there will be an increase in the TN load discharged from the proposed development but this is unlikely to result in any detectable aquatic impacts such as nuisance plant growth for the reasons explained above.

7.2. Groundwater

The proposal is unlikely to have any groundwater quality or quantity impacts.

7.3. Emergency Spill Control

It is recommended that spill control procedures be developed, staff trained, and the procedures practiced annually. Fuel storage and Chlorine storage must only be within bunded containers. Refuelling must only occur under a covered awning/canopy.

A penstock or tilting weir may be used to "seal off" the site and prevent any kind of spill including fire-fighting water from leaving the site. A total of 330 m^3 of fire fighting water shall be capable of being stored within the proposed water quality pond.

7.4. Geomorphology Impacts

The proposed harvesting and reuse scheme will see the volume of runoff from the site reduced by 40%. This will see both the frequency and volume of runoff from the site reduced. This in turn will limit geomorphic and creek health impacts arising from this project (Walsh et al, 2005 & Tippler et al 2012). None the less the health of the floodplain between Lot 34 and King's Stockyard Creek should be monitored twice a year. If it is found that erosion is occurring, then adaptive management measures to stem that should be put in place.

7.5. Water Resources and Licencing

It is recommended that dispensation be granted from the Water Management Act (2000) for the need to acquire a water access licence to harvest the excessive volumes of polluted runoff generated by the proposed impervious site.

7.6. Soil and Water Management during Construction

It is recommended that the proposed pond be constructed prior to site stripping and used as a temporary sediment basin and converted to a permanent water quality pond once the site has been effectively sealed. Small scale sediment and erosion control measures would be needed to manage local erosion issues.

7.7. Monitoring

In accordance with the recommendations in the ANZECC guidelines, a water quality monitoring programme needs to be developed for the site.

This should include recording:

1) Volumes of material removed from the GPTs (by weight)
2) Maintenance of the swales
3) Maintenance of the water quality pond including volumes of any material removed
4) Maintenance of the stormwater harvesting scheme including recording volumes of water harvested and reused on-site.
5) Measurements of water quality leaving the site including TSS, TN, TKN, ammonia, nitrate, nitrite and dissolved organic N (DON). TP and ortho phosphate. Use of a water quality probe to test in-situ pH, salinity, turbidity and Dissolved Oxygen. These would be suitable indicator species.
6) The water quality test results need to be assessed annually to determine the performance of the entire treatment system. If required installation of adaptive management measures may be needed.

7) The floodplain should also be inspected for erosion twice per year and if needed measures put in place to stem the erosion. Indicators would be loss of vegetation associated with high velocity flows (scour) and the commencement of erosional channels. These should be arrested as soon as possible to prevent them spreading. Mitigation measures would include placing jute matt over scoured areas and the placement of leaky weirs downstream of the erosion to make them depositional environments instead.

8.0 REFERENCES

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Fletcher, T., Duncan, H., Poelsma, P. and LLyod, S (2004) "Stormwater flow and quality, and the effectiveness of non-proprietary stormwater treatment measures – a review and gap analysis", Cooperative research Cetnre for Catchment Hydrology, Report 04/08, Melbourne.

Liebman, MB, Jonasson OJ, Wiese RN (2011), The Urban Stormwater Farm, Water Science and Technology, 2011; 64(1):239-46

Tippler C, Wright I. A & Hanlon A (2012) Is Catchment Imperviousness a Keystone Factor Degrading Urban Waterways? A Case Study from a Partly Urbanised Catchment (Georges River, South-Eastern Australia). Water, Air, & Soil Pollution, An International Journal of Environmental Pollution ISSN 0049-6979 Volume 223 Number 8 Water Air Soil Pollution (2012) 223:5331-5344 DOI 10.1007/s11270-012-1283-5

Walsh, C. J., Fletcher, T. D., & Ladson, A. R. (2005). Stream restoration in urban catchments through re-design stormwater systems: looking to the catchment to save the stream. Journal of the North American Benthological Society, 24, 690–750

Appendix 1

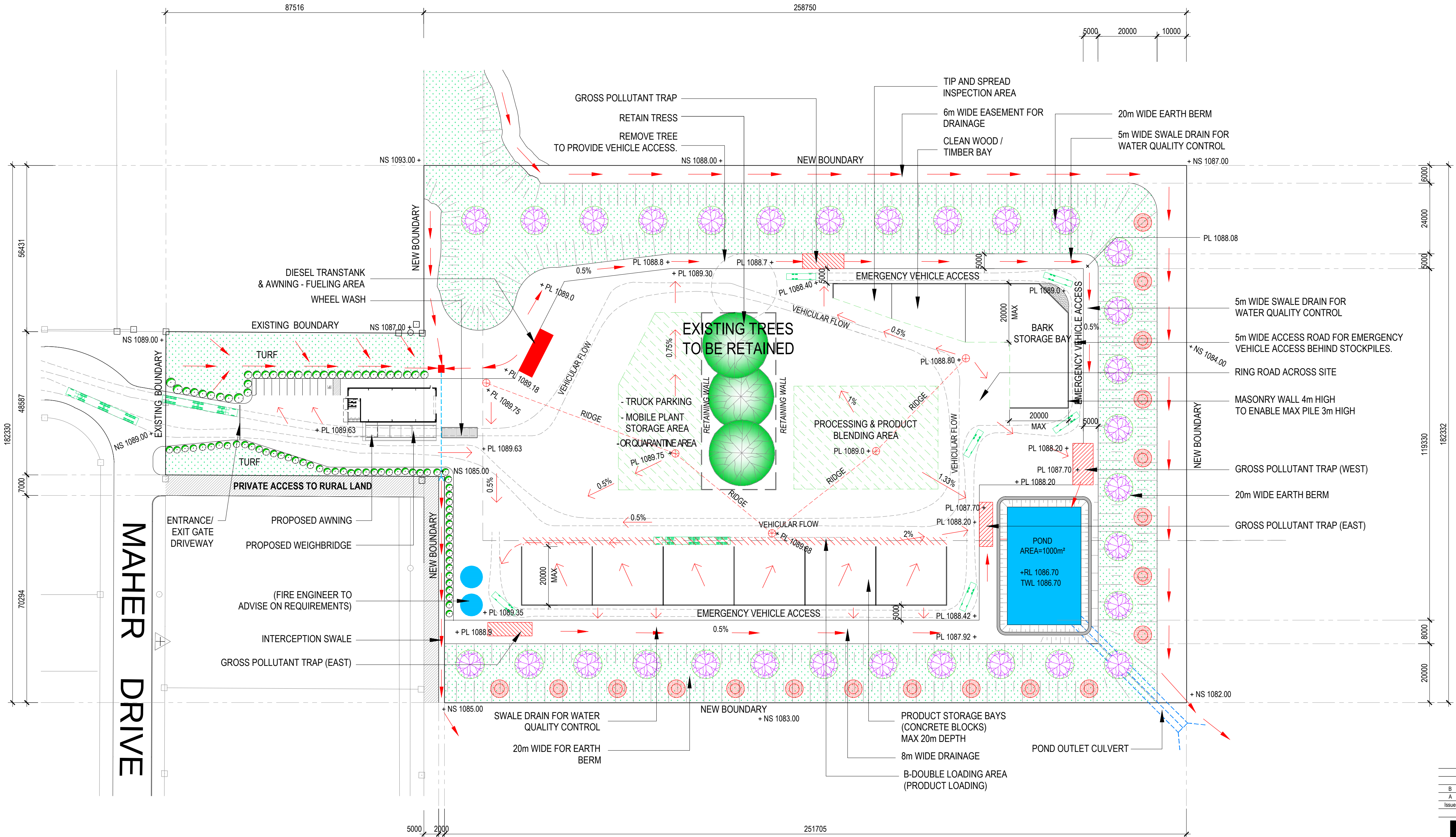
General Arrangement and Preliminary Grading Plan

SITE STATISTICS

LOT 34 DP 1228591	
TOTAL SITE AREA:	50,885m²
BUILDING FOOTPRINT AREAS	
TOTAL FOOTPRINT AREA:	347m²
SITE COVERAGE:	0.68%
BUILDING BREAK UP AREAS	
PROPOSED MAINTENANCE SHED	313.9m²
PROPOSED OFFICE	33.1m²

PARKING REQUIREMENTS

DESCRIPTION	AREA	SPACES
MAINTENANCE SHED	313.9m²	1
OFFICE:	33.1m²	1
TOTAL CAR PARKING SPACES REQUIRED		2
TOTAL CAR PARKING SPACES PROVIDED		8
TOTAL CAR PARKING FOR DISABLED		1



1 PROPOSED SITE PLAN
SCALE: 1:800

LEGEND:

PL	PROPOSED LEVEL
NS	NATURAL SURFACE
RL	REFERENCE LEVEL
TWL	TOP OF WATER LEVEL
	TRAFFIC FLOW

Issue	Description	Date	Drawn	Auth
B	Issued for Review (Amended Vehicle Movement)	31-01-2019	JIGS	MD
A	Issued for Review	24-01-2019	JIGS	MD

BORG CONSTRUCTION

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Project
CONCEPT BARK

Location
26 ENDEAVOUR STREET, OBERON
NEW SOUTH WALES

Drawing
NEW PROPOSED SITE PLAN

Scale	Drawing Number	Issue
1:800 @ A1	DA02	B