Hollinsworth Road. Western end of the road (turning circle). Area of the crossover to 140 Hollinsworth Road. Facing east from the northern side of the turning circle.

Hollinsworth Road. Western end of the road (turning circle). Area of the crossover to 140 Hollinsworth Road. Heading east from the northern side of the turning circle.
Hollinsworth Road. Western end of the road (turning circle). Area of the crossover to 140 Hollinsworth Road. Heading east from the northern side of the turning circle.
Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Hydrant Booster.

Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Area of the hydrant booster. Road and layback.
Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Area of the hydrant booster. Layback.
Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Area of the hydrant booster. Layback. Cracked paving.
Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Area of the hydrant booster. Road paving.
Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Area of the hydrant booster. Road paving.
Hollinsworth Road. Western end of the road (turning circle). Heading east from the northern side of the turning circle. Area of the hydrant booster. Road paving.

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road.

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works. Electrical kiosk 35144.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works. Area of electrical kiosk 35144.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works. Area of electrical kiosk 35144.
Job: LOGOS Building 2, Marsden Park

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Job: LOGOS Building 2, Marsden Park

14/2/2019

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.

14/2/2019

Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
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145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading east along the northern side of the road. Area opposite 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the northern side of the road. Area opposite 145 Hollinsworth Road.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road.

Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works and electrical kiosk 54082.

Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works and electrical kiosk 54082.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works and electrical kiosk 54082.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works and electrical kiosk 54082.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works and electrical kiosk 54082.

Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works. Future light pole.

Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Heading west along the southern side of the road. Area adjacent to 145 Hollinsworth Road. Area of current road works.
Hollinsworth Road. Western end of the road. Area adjacent to the site entry. Heading west along the southern side of the road.
Hollinsworth Road. Western end of the road. Area adjacent to the site entry. Facing north-west.

Hollinsworth Road. Western end of the road. Area adjacent to the site entry. Facing north-west.
Hollinsworth Road. Western end of the road. Site entry gates. Facing north-west.

Hollinsworth Road. Western end of the road. Site entry gates. Facing west.
Hollinsworth Road. Western end of the road. Site entry gates. Facing north.

Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing east.
Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing south–east.

Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing south.
Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing east.

Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing north-east.
Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing north. Concrete rubble.
Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing east.

Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Site entry gates. Facing north. Concrete rubble.
Site gates from Hollinsworth Road. East end of the line of the proposed road extension. Facing north-west.

Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Southern side of the proposed road. Heading west towards the site.
Job: LOGOS Building 2, Marsden Park

Proposed Hollinsworth Road extension. Southern side of the proposed road. Heading west towards the site.

Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.

Proposed Hollinsworth Road extension. Heading west towards the site.
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Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west towards the site.
Proposed Hollinsworth Road extension. Heading west adjacent to the site (left of photo).
Proposed Hollinsworth Road extension. Heading west adjacent to the site (left of photo).
Proposed Hollinsworth Road extension. Heading west adjacent to the site (left of photo).
Proposed Hollinsworth Road extension. Heading west adjacent to the site (left of photo).
Proposed Hollinsworth Road extension. Heading west adjacent to the site (left of photo).

Lot 23 / 262886 & Lot 24 / 262886. Historic record of the site. Heading west along the northern end of the site.
Lot 23 / 262886 & Lot 24 / 262886. Historic record of the site. Facing west to the western end of the proposed Hollinsworth Road.


Lot 23 / 262886 & Lot 24 / 262886. Northern site boundary. Western end of the proposed Hollinsworth Road.

Lot 23 / 262886 & Lot 24 / 262886. Northern site boundary. Facing north-east to the northern end of the proposed Hollinsworth Road.


Lot 23 / 262886 & Lot 24 / 262886. South-western corner of the site.
Lot 23 / 262886 & Lot 24 / 262886. South-western corner of the site.

Lot 23 / 262886 & Lot 24 / 262886. South-western corner of the site. Services pit.
Lot 23 / 262886 & Lot 24 / 262886. South-western corner of the site. Heading east.

Lot 23 / 262886 & Lot 24 / 262886. South-western corner of the site. Heading east.
Lot 23 / 262886 & Lot 24 / 262886. South-western corner of the site. Heading east.


Lot 23 / 262886 & Lot 24 / 262886. North-eastern corner of the site.
Lot 23 / 262886 & Lot 24 / 262886. North-eastern corner of the site.

Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading west along the northern side of the road.

Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.
Lot 23 / 262886 & Lot 24 / 262886. Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road.

Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
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Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
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Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.
Proposed Hollinsworth Road extension. Heading east along the northern side of the road towards the western end of the existing Hollinsworth Road. Area adjacent to the common boundary with 140 Hollinsworth Road.

Hollinsworth Road extension. Area of the site gates at the western end of the existing Hollinsworth Road. Facing north. Rubble and building debris.
Hollinsworth Road extension. Gate and signage to adjacent property: 140 Hollinsworth Road.
Job: LOGOS Building 2, Marsden Park

Hollinsworth Road extension. Gate and signage to adjacent property: 140 Hollinsworth Road.

APPENDIX J

Erosion and Sediment Control Plan
APPENDIX K

Driver Code Of Conduct
Conditions of Entry to Site for Construction Works on the LOGOS B2 & B3 Hollinsworth Road project.

(Refer to Site Overview Plan shown on Page 3)

1. The delivery and pick ups entry point is from the main entry off the access road cul-de-sac. All vehicles must enter site via the entry gate before stopping at the designated delivery area.

2. Under no circumstance are vehicles to stop, park, load/unload on Hollinsworth Road.

3. All vehicles must minimise noise (such as compression braking) on Hollinsworth Road, particularly adjacent to the site and within the vicinity of the retirement village.

4. Drivers to stop at designated delivery area and sign in on register in the site compound. Drivers are to organize to meet Subcontractor before driving on to site.

5. You must wear a Hard Hat, Hi visibility vest and steel cap boots at all times when on site.

6. Follow site 10km speed limit and watch out for any plant and pedestrian movements. Before commencing unloading/loading, check your immediate surroundings for danger. Do not put your self or others at risk with your activities.

7. Drivers must stay in the vicinity of his/her vehicle whilst unloading, if you are accompanied by others who have no need to be involved in the work activity, they are to stay in the vehicle at all times.

8. If you need to go elsewhere such as the toilet or lunch rooms etc., you must ensure that your vehicle is in a safe condition to be left unattended, i.e. the engine is shut down, park brake is on and the keys are removed from the ignition.

9. In the event of an emergency an ALARM will sound. When you hear the alarm, go directly to the evacuation assembly area. Do not attempt to remove your vehicle from site as this may interfere with the orderly evacuation of personnel. When it is safe to do so, RCC personnel will release you to remove your vehicle.

10. All vehicles leaving site must have their loads covered and must not track dirt/mud on to Hollinsworth Road.

11. Site vehicles to Enter and Exit site in a forward facing direction only via the signposted Entry and Exit gates – Turning circle in place to eliminate reversing alarm noise generated by vehicles.

12. Site vehicles to give way to existing traffic along the Hollinsworth Road when exiting site.
13. Trucks are not to be permitted to park on hardstand overnight.

14. No Truck or Vehicle Maintenance is to be undertaken or occur onsite.

**Hours of Work**

Access to and from site are limited by the following hours:

**Monday – Friday:** 0700 to 1800 (7:00am to 6:00pm);
**Saturday:** 0800 to 1300 (8:00am to 1:00pm);
**Sunday:** Site Closed.

I have read the attached site induction. I fully understand its contents and agree to comply with the on site requirements.
Access: Richmond Road → Hollinsworth Road → into site

Egress: Site → Hollinsworth Road → Richmond Road
APPENDIX L

Construction Noise Management Plan
Hollinsworth Road, Marsden Park - Building 2A and Building 2B

Construction Noise and Vibration Management Plan
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<th>Project ID</th>
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<tr>
<td>Document Title</td>
<td>Construction Noise and Vibration Management</td>
</tr>
<tr>
<td>Attention To</td>
<td>Richard Crookes Constructions Pty Ltd</td>
</tr>
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<tr>
<th>Revision</th>
<th>Date</th>
<th>Document Reference</th>
<th>Prepared By</th>
<th>Checked By</th>
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<td>VF</td>
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1 INTRODUCTION

Acoustic Logic Consultancy has been engaged to prepare a Noise and Vibration Management Plan for industrial development, Orrcon facility (Building 2A and Building 2B), located at Hollinsworth Road, Marsden Park.

This report has been prepared to satisfy Condition B31, Condition B32, Condition B33, Condition B34, Condition B40, Condition B41 and Condition B42 in ‘Development Consent’ by the NSW Government, Department of Planning and Environment, application no. SSD 8606, dated 16 August 2019. The conditions have been addressed as follow:

- Condition B31, Condition B32: ‘Hours of Work’
- Condition B33: ‘Construction Noise Limits’
- Condition B34 and Condition B35: ‘Construction Noise Management Plan’
- Condition B40, Condition B41 and Condition B42: ‘Vibration Criteria’

The report will address the following elements:

- Identification of the noise and vibration guidelines which will be applicable to this project;
- Identification of potentially impacted nearby development;
- Identify likely sources of noise and vibration generation and predicted noise levels at nearby development;
- Formulation of a strategy to comply with the standards identified and mitigation treatments in the event that compliance is not achievable.

This assessment is based on previous unattended noise monitoring data and engineering assumptions in ‘Noise assessment for the Marsden Park Warehousing and Industrial Estate SSD 8606 Modification’, provided by EMM Consulting Pty Limited, dated 24 April 2019.
2 SITE DESCRIPTION

The project site is located at the Hollinsworth Road, Marsden Park.

Noise sensitive development in the vicinity of the project site consists of the following:

- Receiver 1: Ingenia Estate (industrial development) located to the north of the site;
- Receiver 2: Existing residential receivers located to the south of the site;
- Receiver 3: Existing residential receivers located to the south-east of the site;
- Receiver 4: Existing residential receiver located to the north-east of the site
- Receiver 5: Baitul Huda Mosque (Place of Worship) to the east of the site.

A site map with measurement description is presented in below.
Figure 1 - Site Map from Google Maps

- Unattended noise monitor location
- Proposed construction site (building A and building B)
- Indicative vehicle access onto the site

- Residential receivers
- Industrial receivers
- Places of worship
3 PROPOSED CONSTRUCTION WORKS

This office has been advised as following:

- The proposed construction works will include excavation (3 months), and building construction (6 months);
- The proposed construction works do not include demolition and piling, and therefore these items do not form part of this management plan;
- Vehicle access onto the site will be existing cul-de-sac on Hollinsworth Road as indicated in figure 1 above;
- There is no specific location for the cranes and pumps (variable locations);

4 CONSTRUCTION HOURS

NOISE

Hours of Work

B31. The Applicant must comply with the hours of work detailed in Table 1, unless otherwise agreed in writing by the Planning Secretary.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Day</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Monday – Friday Saturday</td>
<td>7 am to 6 pm 8 am to 1 pm</td>
</tr>
<tr>
<td>Operation</td>
<td>Monday – Sunday</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

B32. Works outside of the hours identified in condition B31 may be undertaken in the following circumstances:

(a) works that are inaudible at the nearest sensitive receivers;
(b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or
(c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

4.1 PROPOSED CONSTRUCTION HOURS

The proposed working hours (construction) are:

- 7:00am -6:00pm, Monday to Friday
- 8:00am -1:00pm, Saturday
5 BACKGROUND NOISE LEVELS

Existing environmental noise survey (see figure 1) was based on a long-term unattended monitoring in ‘Noise assessment for the Marsden Park Warehousing and Industrial Estate SSD 8606 Modification’, provided by EMM Consulting Pty Limited, dated 24 April 2019.

Table 3.3 in Section 3.2.2 of ‘Noise assessment for the Marsden Park Warehousing and Industrial Estate SSD 8606 Modification’ outlined the rating background levels of unattended noise monitoring (see table 2 below).

5.1.1 Measured Background Noise Levels

The background noise levels established from the unattended noise monitoring are detailed in the Table below.

**Table 2 – Measured Background Noise Level (Unattended Noise Monitor)**

<table>
<thead>
<tr>
<th>Location</th>
<th>Time of Day</th>
<th>Rating Background Level $dB(A)<em>{L</em>{eq}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amelia Way, Bidwill ‘within the noise catchment representative of these residences’, (see figure 1)</td>
<td>Day</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>31</td>
</tr>
</tbody>
</table>
6 NOISE LEVEL AND VIBRATION CRITERIA

6.1 NOISE

Noise associated with excavation and construction activities on the site will be assessed in accordance with the following guidelines:

- ‘Development Consent’ by the NSW Government, Department of Planning and Environment, application no. SSD 8606, dated 16 August 2019; and
- NSW EPA Interim Construction Noise Guideline.

6.1.1 Condition B34, Condition B35

Conditions B34 and B35 of ‘Construction Noise Management Plan’ in ‘Development Consent’ by the NSW Government, Department of Planning and Environment, application no. SSD 8606, dated 16 August 2019 state:

Construction Noise Management Plan

B34. The Applicant must prepare a Construction Noise Management Plan for the development to the satisfaction of the Planning Secretary. The plan must form part of the CEMP required by condition C2 and must:

(a) be prepared by a suitably qualified and experienced noise expert;
(b) be approved by the Planning Secretary prior to the commencement of construction of each stage of the development;
(c) describe procedures for achieving the noise management levels in the EPA’s Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) (as may be updated or replaced from time to time);
(d) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;
(e) identify measures to be implemented to minimise and manage construction noise impacts including but not limited to temporary construction noise barriers and respite periods;
(f) include strategies that have been developed with the community for managing high noise generating works;
(g) describe the community consultation undertaken to develop the strategies in B34(f) above; and
(h) include a complaints management system that would be implemented for the duration of the development.

B35. The Applicant must:

(a) not commence construction of any relevant stage until the Construction Noise Management Plan required by condition B34 is approved by the Planning Secretary; and
(b) implement the most recent version of the Construction Noise Management Plan approved by the Planning Secretary for the duration of construction.

6.1.2 EPA Interim Construction Noise Guidelines

The “quantitative” assessment procedure, as outlined in the Interim Construction Noise Guideline (ICNG) will be used. The quantitative assessment method requires:

- Determination of noise and vibration management levels (based on ambient noise levels and receiver type)
- Prediction of operational noise and vibration levels at nearby development
- Recommendation of control strategies in the event that management levels are exceeded.

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:
• “Noise affected level”. (NML) Where construction noise is predicted to exceed the “noise affected” level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the “noise affected level”. For residential properties, the “noise affected” level occurs when construction noise exceeds ambient levels by more than 10dB(A) \( L_{eq(15min)} \) within Recommended standard hours (Monday to Friday, 7 am to 6 pm; Saturday 8 am to 1 pm; No work on Sundays or public holidays). The “noise affected” level occurs when construction noise exceeds ambient levels by more than 5dB(A) \( L_{eq(15min)} \) within “outside recommended standard hours”.

• “Highly noise affected level” (HNML). Where noise emissions are such that nearby properties are “highly noise affected”, noise controls such as respite periods should be considered. For residential properties, the “highly noise affected” level occurs when construction noise exceeds 75dB(A) \( L_{eq(15min)} \) at nearby residences.

In addition to the above goals for residential receivers, the ICNG nominates a Management Level of 45dB(A) \( L_{eq(15min)} \) internally for ‘Places of Worship’. Further, Section 4.1.2 ‘Other sensitive land uses’ states that:

“A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences. Some buildings may achieve greater performance, such as where windows are fixed (that is, cannot be opened).” Therefore, the Management Level of ‘Place of Worship’ shall be externally 55dB(A) \( L_{eq(15min)} \).

Moreover, section 4.1.3 Commercial and industrial premises of the ICNG states the following:

“Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels should be assessed at the most-affected occupied point of the premises: industrial premises: external \( L_{eq(15min)} \) 75 dB(A)”

The project specific management levels determined using the ICNG are summarised in the following table.

### Table 3 - Summarised Noise Management Levels

<table>
<thead>
<tr>
<th>Location</th>
<th>Day</th>
<th>Time</th>
<th>Noise Management Level dB(A) ( L_{eq, 15min} )</th>
<th>Highly Affected Management Level dB(A) ( L_{eq, 15min} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Receivers R2, R3, R4</td>
<td>Monday to Friday</td>
<td>7am-6pm</td>
<td>47</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Saturday</td>
<td>8am-1pm</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Places of Worship R5</td>
<td>When in use</td>
<td>When in use</td>
<td>45 internally 55 externally</td>
<td>N/A</td>
</tr>
<tr>
<td>Industrial Premises R1</td>
<td>When in use</td>
<td>When in use</td>
<td>75 externally</td>
<td>N/A</td>
</tr>
</tbody>
</table>
6.2 VIBRATION

Vibration caused by construction at any residence or structure outside the subject site must be limited to:

- Condition B40, Condition B41 and Condition B42: ‘Vibration Criteria’
  - For human exposure to vibration, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006); and
  - For structural damage vibration, German Standard DIN 4150-3 Structural Vibration: Effects of Vibration on Structures.

6.2.1 Condition B40, Condition B41 and Condition B42: ‘Vibration Criteria’

Vibration Criteria

B40. Vibration caused by construction at any residence or structure outside the site must be limited to:
   (a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and
   (b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).

B41. Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition B40.

B42. The limits in conditions B40 and B41 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition C2 of this consent.

6.2.2 Assessing Amenity

The NSW EPA document “Assessing Vibration: A Technical Guideline” provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings and is used in the assessment of vibration impact on amenity. Relevant vibration levels are presented below.

Table 4 – EPA Recommended Vibration Levels

<table>
<thead>
<tr>
<th>Place</th>
<th>Time</th>
<th>RMS acceleration (m/s²)</th>
<th>RMS velocity (mm/s)</th>
<th>Peak velocity (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
<td>Maximum</td>
<td>Preferred</td>
</tr>
<tr>
<td>Continuous Vibration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residences</td>
<td>Daytime</td>
<td>0.01</td>
<td>0.02</td>
<td>0.2</td>
</tr>
<tr>
<td>Offices</td>
<td>Daytime</td>
<td>0.02</td>
<td>0.04</td>
<td>0.4</td>
</tr>
<tr>
<td>Workshops</td>
<td></td>
<td>0.04</td>
<td>0.08</td>
<td>0.8</td>
</tr>
<tr>
<td>Impulsive Vibration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residences</td>
<td>Daytime</td>
<td>0.3</td>
<td>0.6</td>
<td>6.0</td>
</tr>
<tr>
<td>Offices</td>
<td>Daytime</td>
<td>0.64</td>
<td>1.28</td>
<td>13.0</td>
</tr>
<tr>
<td>Workshops</td>
<td></td>
<td>0.64</td>
<td>1.28</td>
<td>13.0</td>
</tr>
</tbody>
</table>
6.2.3 Structure Borne Vibrations (Building Damage Criteria)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 4.

It is noted that the peak velocity is the value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 5 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

<table>
<thead>
<tr>
<th>TYPE OF STRUCTURE</th>
<th>PEAK PARTICLE VELOCITY (mms⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At Foundation at a Frequency of</td>
</tr>
<tr>
<td></td>
<td>&lt; 10Hz</td>
</tr>
<tr>
<td>1 Buildings used in commercial purposes, industrial buildings and buildings of similar design</td>
<td>20</td>
</tr>
<tr>
<td>2 Dwellings and buildings of similar design and/or use</td>
<td>5</td>
</tr>
<tr>
<td>3 Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)</td>
<td>3</td>
</tr>
</tbody>
</table>

The place of worship and industrial premises would be considered a Type 1 structure, whilst residences would be considered a Type 2 structure.
7 NOISE ASSESSMENT

7.1 NOISE SOURCE DATA

The excavation/construction period has been divided into a number of work phases, along with the main noise producing equipment and activities likely to occur in each phase. Typical noise emission levels from equipment associated with the louder activities are provided in the following table.

Table 7 - Sound Power Levels of the Proposed Equipment

<table>
<thead>
<tr>
<th>CONSTRUCTION ACTIVITY</th>
<th>EQUIPMENT /PROCESS</th>
<th>SOUND POWER LEVEL - dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>Excavator (bucket attachment)</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Bobcat</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Grader</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Truck (&gt; 20 tonne)</td>
<td>110</td>
</tr>
<tr>
<td>Construction</td>
<td>Hand tool</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Concrete Pumps</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Mobile Crane (diesel)</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Boom lifts</td>
<td>105</td>
</tr>
</tbody>
</table>

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010
- Data held by this office from other similar studies.
- On-site measurements

7.2 NOISE IMPACT ASSESSMENT METHODOLOGY

The predicted noise levels during excavation and construction will depend on:

- The activity undertaken.
- The distance between the work site and the receiver. For many of the work areas, the distance between the noise source and the receiver will vary depending on which end of the site the work is undertaken. For this reason, the predicted noise levels will be presented as a range.

Predicted noise levels are presented below. Predictions take into account the following:

- Noise reduction as a result of distance.
- Depending on the management level adopted, noise emission is predicted to either external areas (property boundaries/building facades/most affected area) or internal areas. Where noise levels are predicted to internal areas, the NSW EPA Interim Construction Noise Guideline suggests that a reduction from external noise levels to internal spaces of 10 dB(A) is a conservative estimate.
7.3 PREDICTION TO RECEIVER 1: INDUSTRIAL RECEIVER TO THE NORTH

Predicted noise levels of industrial receivers to the north of the site are as follows:

Table 8 – Predicted Noise Level to R1

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Predicted Level – dB(A) $L_{eq(15min)}$ (External Areas)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>Excavator bucket attachment</td>
<td>55-69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bobcat</td>
<td>50-64</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Truck (&gt;20 tonne)</td>
<td>60-74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grader</td>
<td>60-74</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Hand tool</td>
<td>60-74 prior to construction of building shell; 40-54 after construction of building shell</td>
<td>Noise level will generally comply with NML</td>
</tr>
<tr>
<td></td>
<td>Concrete Pumps</td>
<td>55-69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobile Crane (diesel)</td>
<td>55-69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boom lifts</td>
<td>55-69</td>
<td></td>
</tr>
</tbody>
</table>

All activities will meet the NML and no mitigation is required for this receiver.
7.4 PREDICTION TO RECEIVER 2: RESIDENTIAL RECEIVER TO THE SOUTH

Predicted noise levels of residential receivers to the south of the site are as follows:

**Table 9 – Predicted Noise Level to R2**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Predicted Level – dB(A) ( L_{eq(15\text{min})} ) (External Areas)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>Excavator bucket attachment</td>
<td>45-47</td>
<td>Noise level will generally meet noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Bobcat</td>
<td>40-42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Truck (&gt;20 tonne)</td>
<td>50-52</td>
<td>Noise level can exceed noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Grader</td>
<td>50-52</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Hand tool</td>
<td>50-52 prior to construction of building shell; 30-32 after construction of building shell</td>
<td>Refer to Section 9.1 for Recommendations</td>
</tr>
<tr>
<td></td>
<td>Concrete Pumps</td>
<td>45-47</td>
<td>Noise level will generally meet noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Mobile Crane (diesel)</td>
<td>45-47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boom lifts</td>
<td>45-47</td>
<td></td>
</tr>
</tbody>
</table>

Hand tools operating externally (predominantly associated with roof and façade installation) will exceed the NML. Given these activities occur at a high level it is not possible to mitigate these noise sources with barriers. It is recommended that the southern, eastern and western facades should be erected as soon as practical so as to form “natural” barriers to the residential receivers and will reduce noise level to below the NML. Noise impacts can also be managed by avoiding this activity between 7am and 8am.

The remaining items of plant will either not exceed the NML or will only exceed by a moderate amount and for short periods when operating on the side of the site nearer the receivers. It is not reasonable to mitigate noise levels from these activities other than to manage impacts as recommended below (selecting quietest feasible plant, notification, etc).
7.5 PREDICTION TO RECEIVER 3: RESIDENTIAL RECEIVER TO THE SOUTH-EAST

Predicted noise levels of residential receivers to the south-east of the site are as follows:

Table 10 – Predicted Noise Level to R3

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Predicted Level – dB(A)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$L_{eq}(15\text{min})$</td>
<td>(External Areas)</td>
</tr>
<tr>
<td>Excavation</td>
<td>Excavator bucket attachment</td>
<td>37-41</td>
<td>Noise level will generally meet noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Bobcat</td>
<td>32-36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Truck (&gt;20 tonne)</td>
<td>42-46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grader</td>
<td>42-46</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Hand tool</td>
<td>50-54 prior to construction of building shell; 30-34 after construction of building shell</td>
<td>Noise level will exceed noise management level of 47dB(A) prior to construction of building shell. Noise level will generally meet noise management level of 47dB(A) after construction of building shell. Refer to Section 9.1 for Recommendations</td>
</tr>
<tr>
<td></td>
<td>Concrete Pumps</td>
<td>37-41</td>
<td>Noise level will generally meet noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Mobile Crane (diesel)</td>
<td>37-41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boom lifts</td>
<td>37-41</td>
<td></td>
</tr>
</tbody>
</table>

None of the activities will exceed the HNAML. The predictions indicate that only hand tools operating externally (predominantly associated with roof and façade installation) will exceed the NML. The mitigation recommended for Receiver 2 will also address impacts to this receiver.
7.6 PREDICTION TO RECEIVER 4: RESIDENTIAL RECEIVER TO THE NORTH-EAST

Predicted noise levels of residential receiver to the north-east of the site are as follows:

Table 10 – Predicted Noise Level to R4

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Predicted Level – dB(A)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( L_{eq(15min)} )</td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>Excavator bucket attachment</td>
<td>36-43</td>
<td>Noise level will generally meet noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Bobcat</td>
<td>31-38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Truck (&gt;20 tonne)</td>
<td>41-47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grader</td>
<td>41-47</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Hand tool</td>
<td>49-56 prior to construction of building shell; 29-36 after construction of building shell</td>
<td>Noise level will exceed noise management level of 47dB(A). Refer to Section 9.1 for Recommendations</td>
</tr>
<tr>
<td></td>
<td>Concrete Pumps</td>
<td>36-43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobile Crane (diesel)</td>
<td>36-43</td>
<td>Noise level will generally meet noise management level of 47dB(A)</td>
</tr>
<tr>
<td></td>
<td>Boom lifts</td>
<td>36-43</td>
<td></td>
</tr>
</tbody>
</table>

With the exception of marginal exceedance for hand tools operating externally, all other activities will meet the NML and no mitigation is required for this receiver. The mitigation recommended for Receiver 2 will also address impacts to this receiver.
7.7 PREDICTION TO RECEIVER 5: PLACE OF WORSHIP TO THE EAST

Predicted noise levels of residential receiver to the east of the site are as follows:

<table>
<thead>
<tr>
<th>Table 10 – Predicted Noise Level to R5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Excavation</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

All activities will meet the NML and no mitigation is required for this receiver.
8 ASSESSMENT OF VIBRATION

8.1 VIBRATION PRODUCING ACTIVITIES

Proposed activities that have the potential to produce significant ground vibration is Excavator working.

8.2 SAFEGUARDS TO PROTECT SENSITIVE STRUCTURES

It is impractical to predict the vibrations induced by the excavation/construction operations on site at potentially affected receivers. This is because vibration level is principally proportional to the energy impact which is unknown nature of terrain in the area (type if soil), drop weight, height etc.

8.3 VIBRATION MONITORING (IF REQUIRED)

In the event that complaints are made from neighbouring properties regarding vibration impacts from the subject site, vibration monitors will be installed at the property boundaries of the neighbouring properties nearest to the subject site to monitor vibration levels.

8.3.1 Download of Vibration Logger

Download loading of the vibration logger will be conducted on a regular basis. In the event exceedance of vibration criteria or alarms occurs, download loading of logger will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to client for review. It is proposed that reports are provided fortnightly with any exceedance in the vibration criteria reported as detailed in this report.

8.3.2 Presentation of Vibration Logger Results

A fortnightly report will be submitted to client via email summarising the vibration events. The vibration exceedance of limit is recorded the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnight reports including graphs of collected data.

8.3.3 Persons to Receive Alarms

The following personnel will receive GSM alarms:

- Acoustic consultant/advisor (1 person)
- Excavation site foreman
- Main builder foreman (where applicable)
- Client nominated two representatives
9 AMELIORATIVE MEASURES

9.1 SITE SPECIFIC RECOMMENDATIONS

Site specific recommendations as follows:

9.1.1 Excavation

- Residents at south and southeast of the site, to be notified of anticipated period of excavation.
- Vehicles to use a non-tonal reversing beacon (subject to OH&S requirements) to minimise potential disturbance of neighbours.
- Vehicle Noise:
  - Truck movements should not commence prior to 7am. Trucks are not to idle with their engines running outside the site prior to 7am.
  - Trucks must turn off their engines during idling to reduce impacts on nearby residential receivers (unless truck ignition needs to remain on during concrete pumping).
- Grader
  - Motor graders use diesel engines to level or flatten earth and gravel and remove earth. Using insulated engine compartments and cabins and placement of noisy components on the machine, the operator's sound exposure is reduced.

9.1.2 Construction

- Concrete pumps and crane.
  - Equipment is to be located as far as practical from the closest receivers around the site.
  - Notification of adjacent residential development should be provided prior to days of concrete pours.
  - Cement mixing trucks must turn off their engines when on site to reduce impacts on adjacent land use (unless truck engine needs to remain on during concrete pumping).
- Hand tools
  - The southern, eastern and western facades should be erected as soon as practical so as to form "natural" barriers to the residential receivers.
  - Noise from hand tools is typically quieter than the maximum allowable noise levels.

In the event of complaint, the procedures in Section 11 are to be adopted.
9.2 ACTIVITIES OUTSIDE PERMITTED HOURS OF CONSTRUCTION

Construction can occur outside of the permitted hours for a number of reasons including if noise is inaudible at the surrounding sensitive receivers. In this context, sensitive receivers would be the residential receivers and the place of worship.

It is not proposed to conduct general construction activities outside the approved general construction hours.

Activities that could be undertaken include maintenance of equipment using hand tools and emergency works.

Internal works such as painting and other quiet works that do not generate audible noise at residential receivers are permitted by the development consent. These other works should be specifically assessed by an acoustic specialist before being undertaken.

9.3 GENERAL RECOMMENDATIONS

Other noise management practices which may be adopted are discussed below. In addition, notification, reporting and complaints handling procedures should be adopted as recommended in section 11 of this report.

9.3.1 Acoustic Barrier (if required)

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

9.3.2 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

9.3.3 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

9.3.4 Treatment of Specific Equipment

In certain cases, it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.
9.3.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

9.3.6 Strategic Positioning of Processes On-Site

Where practicable, particular processes of activities can be located in particular positions on site to minimise noise to surrounding sensitive receivers.

For example, stationary plant may be positioned where direct line of sight shielding can be achieved using natural barriers or temporary screens, or may maximise the distance to the nearest sensitive receiver.

9.3.7 Management Training

All site managers should be made aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

9.3.8 Combination of Methods

In some cases, it may be necessary that two or more control measures be implemented to minimise noise.

9.3.9 Maintenance of Plant, Equipment and Machinery

Construction Profile will ensure all plant, equipment and machinery are regularly serviced and maintained at optimum operating conditions, to ensure excessive noise emissions are not generated from faulty, overused or unmaintained machinery.
10 ASSESSMENT METHODOLOGY AND MITIGATION METHODS

The flow chart that follows illustrates the process to be followed to minimise the impact associated with these activities.

Noise sources with the potential to exceed the management level set out in section 6 have been identified and discussed in section 7 and 9.
11 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

Should ongoing complaints of excessive noise, vibration or dust occur, immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration and dust limits, all work potentially producing vibration or dust shall cease until the exceedance is investigated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- If necessary, setup vibration monitoring at the location representing the nearest affected vibration receiver, with alarm device which can inform the project manager on site if the vibration exceedance happened;
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

11.1 COMMUNITY CONSULTATION

11.1.1 Requirement

Condition B34 (f) and Condition B34 (g) of ‘Construction Noise Management Plan’ in ‘Development Consent’ by the NSW Government, Department of Planning and Environment, application no. SSD 8606, dated 16 August 2019 states that:

(f) include strategies that have been developed with the community for managing high noise generating works;

(g) describe the community consultation undertaken to develop the strategies in B34(f) above; and

11.1.2 Community Consultation Undertaken

The community consultation undertaken and the processes to be implemented are provided in Appendix 1 attached. The outcomes of the consultation undertaken to date have been incorporated into the management plan, and the outcomes of ongoing consultation during the construction period will be incorporated as necessary in the management of impacts.
12 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
4. Selecting alternative equipment/processes where practical
5. If necessary, setup noise/vibration and dust monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise/vibration and dust generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

13 CONCLUSION

This report presents an assessment of noise and vibration impacts associated with the excavation and construction activities proposed as part of the development (building 2A and building 2B) at Hollinsworth Road, Marsden Park.

An assessment of potential noise and vibration impacts resulting from the proposed activities on site is summarised in Sections 7 and 8 of the report. The assessment was undertaken using EPA guidelines, and indicates there is generally a low to moderate risk of adverse impacts due to the nature of the works and the significant distance separation to sensitive receivers. The results of the assessment have been used to develop ameliorative treatments and a Management Plan to further reduce these impacts, which are detailed in Sections 9, 10 and 11.

Provide that the recommendations, management controls and procedures outlined in this report are implemented, noise and vibration impact from the proposed works will be minimised in accordance with the development consent.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Hugh Cao
APPENDIX 1 – COMMUNITY CONSULTATION
APPENDIX M

Stormwater Management Plan
WAREHOUSES 2 & 3
STORMWATER MANAGEMENT PLAN

MARSDEN PARK INDUSTRIAL ESTATE (SSD8606):
LOTS 23 & 24 IN DP 262886
HOLLINSWORTH ROAD
MARSDEN PARK  NSW

Prepared For:
Logos Property
Level 29 Aurora Place
88 Phillip Street
SYDNEY  NSW  2000

Prepared by:
Costin Roe Consulting
Level 1, 8 Windmill Street
WALSH BAY  NSW  2000

Rev: C
# DOCUMENT VERIFICATION

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<tr>
<td>Checked by</td>
<td>Daniel Soliman</td>
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INTRODUCTION

Costin Roe Consulting Pty Ltd has been commissioned by Logos Property to prepare this *Stormwater Management Plan* for the proposed Warehouses 2 & 3 to support a modification application to the existing SSD8606 consent.

With reference to **Figure 1.1**, construction of Stages 1 and 2 of the industrial estate have now been completed. Logos Property now proposes to construct two warehouse facilities in place of the previously proposed Building 3 (Stage 3) and will now represent Stage 4 of the development in reference to **Figure 1.1**. The proposed development property comprises an area of approximately 8.78 Ha as shown in **Figure 1.2**.

![Figure 1.1. SSD8606 Staging Plan & Current Development Footprint](image)
Figure 1.2. Estate & Proposed Development Layout

It is noted that previous applications for subdivision and infrastructure works have been granted over the land by Blacktown City Council under DA 15-275 dated 9 September 2015. The previous approval included subdivision of the land, earthworks and half road construction of the extension of Hollinsworth Road. A subsequent S96 and amending development approval application over the land relating to earthworks and road construction has been lodged by Logos Property and approved by Blacktown City Council. This SSD Application relates to the construction of two new warehouse facilities with ancillary office space, truck circulation and loading/unloading areas and associated car parking on the 8.78 Ha land parcel.

The existing site has undergone cut to fill earthworks (approved under DA 15-275 dated 9 September 2015) and comprises benched building pads to suit future construction of industrial buildings. The previous use is noted to have been rural and bushland.

This report provides a summary of the following design principles and operational requirements of the stormwater management for the proposed warehouse facilities 2 & 3 in accordance with the following requirements of Condition B22 & B23 of SSD_8606 and the stormwater management plan prepared and approved under SSD_8606:

- Management of stormwater quantity
- Management of stormwater quality;
- Flooding Considerations; and
- Erosion & Sediment Control.
The engineering objectives for the development are to provide a civil engineering solution which considers the existing benched pads, to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design and is consistent with the requirements of council’s water quality objectives and takes into consideration previously approved engineering strategies over the land.

The consent authority is the *NSW Department of Planning and Environment*. As the site is located within the Blacktown City Council local government area, the requirements of the Blacktown City Council *Engineering Guide for Development* and *Part J* of the *Development Control Plan 2015* are to be considered for the development.

The site is also located within the Marsden Park Industrial Precinct and the requirements of *Schedule 3 Marsden Park Industrial Precinct & Blacktown City Council Growth Centres Development Control Plan* documents produced by Blacktown City Council.
2 DEVELOPMENT SITE

2.1 Site Description

The proposed site is located on Lot 24 in DP262886, and is approximately 8.78 Ha in area, generally rectangular in shape and located within Blacktown City Council Local Government Area. As noted, the site is located within the Marsden Park Industrial Estate and requires consideration to the approved precinct wide policies. This SWMP has been prepared for the proposed Buildings 2A, 2B and 3 which are anticipated for construction within Stage 4 of the Marsden Park Industrial Estate.

The property is located on the southern side of the Hollinsworth Road extension in the suburb of Marsden Park as shown in Figure 2.1.

![Figure 2.1 Locality Plan (Source: Nearmap 2019)](image)

**Figure 2.1 Locality Plan (Source: Nearmap 2019)**

The site is bounded on the north by a residential caravan park/removable home development (Ingenia Property), to the east by Industrial facilities, to the south by undeveloped lands, and to the west by the proposed future development of the Orrcon Steel facility.

Access to the site is via Hollinsworth Road at the north-east corner of the site. The ground level at the termination point of Hollinsworth Road, being a partially formed cul-de-sac head, is approximately RL 54.5m AHD. The proposed site has undergone cut to fill earthworks to a certain extent (approved under DA 15-275 dated 9 September 2015).

Further discussion relating to catchments is made in the Stormwater Management section of the report following.
2.2 Proposed Development

The proposed development is for the construction of two new single level warehouses at Lots 23 & 24 Hollinsworth Road, Marsden Park. The warehouses are proposed to be built within Stage 4 of the Marsden Park Industrial Estate. The proposed developments comprise ancillary office spaces, truck circulation and loading/unloading areas and associated car parking and landscaping areas. The overall building areas cover around 4.99 Ha of the overall 8.78 Ha site as shown in Figures 2.2 & 2.3.

Figure 2.2 Proposed Developments (Warehouses 2A & 2B) Layout
Figure 2.3 Proposed Development (Warehouse 3) Layout
3 STORMWATER DRAINAGE

3.1 Site Drainage

3.1.1 Pre-Existing and Current Site Drainage

The existing site has undergone cut to fill earthworks (approved under DA 15-275 dated 9 September 2015). As part of these works a series of sediment and temporary detention basins were constructed. A sedimentation basin has been constructed at the north-west end of the proposed Warehouse developments as revealed in Figure 2.1. 

Prior to the cut to fill works described above, the pre-existing site was undeveloped with little to no formal drainage located on site.

A catchment, with an area of 12.89 Ha, drains to Hollinsworth Road on the northern side of the property and ultimately to Sydney Business Park Basin E. The second catchment, with an area of 2.35 Ha, drains from the site through private property at the north-east corner of the development site and ultimately to the proposed Sydney Business Park Basin E as well. A third catchment drains with an area of 1.45 Ha to the east of the site, to an existing basin and ultimately to an existing overland flow path, where it ultimately joins with the remaining 5.29 Ha catchment. These two catchments drain to the south-east, through an existing flow path within the future RMS road corridor, toward an existing SP2 zoned drainage corridor which ultimately drains to Sydney Business Park Basin G, via an open channel and creek within the Ahmadiyya Muslim Association Australia land.

As part of the Sydney Business Park development, a series of regional detention basins have been either designed and constructed or designed and approved for future construction. As we understand the Sydney Business Park Precinct catchment breakdown allows for the development site to drain to Basins E and G. These regional basins allow for attenuation of the site, and for water quality of Section 94 roads. At the time of writing, the construction of Basin E and Basin G are only partially completed.

3.1.2 Proposed Stage 4 Infrastructure Drainage

As per general engineering practice and the guidelines of BCC, the proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development.

The minor system is to consist of a piped drainage system which has been designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. The major system through new paved areas has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system employs the use of defined overland flow paths to safely convey excess run-off from the site to the discharge point.

The catchment configuration for the overall estate is as follows:

- The existing 5.29 Ha RMS land catchment, located along the southern boundary of lots 1 & 2, will be diverted around the site via a series of pits and pipes in a 3.5m wide easement and ultimately to Basin E. This drainage system is subject to approval under the existing subdivision and infrastructure development application approval DA 15-275.
- The proposed extension of Hollinsworth Road, which has a total catchment area of 1.48Ha, drains to the west via pits and pipes within the road, and ultimately discharges to Basin E. This drainage system is subject to approval under the existing subdivision and infrastructure development application approval DA 15-275.

- The proposed Buslink road (Daniel’s Road), which has a total catchment area of 0.52Ha, drains to either the north or the south, generally consistent with the existing site topography. No formal drainage is proposed under this approval or the separate DA approval for infrastructure works. Runoff from this area shall be captured in temporary swales as noted in the Costin Roe Amending Development Application documents in Appendix B.

- Lot 1 (being Stage 3) is currently composed of 6.1 Ha collected by on-site drainage. Flows from the proposed Building 1 within Lot 1 (occupying 3.644 Ha Land) will be attenuated with on-site detention (OSD) and discharge to Hollinsworth road per the above approval. The site is set to have approximately 0.422 Ha bypassing the formalised drainage- the flows from this bypass shall be accounted for in the OSD. The remainder of the 6.1 Ha site (being approximately 2.46 Ha) will be dedicated during Stage 4 for the proposed Warehouses 2 & 3 in Lot 2 of the Marsden Park Industrial Estate.

- Lot 3 (being Stage 1 & Stage 2) has been previously proposed to have the 6.96 Ha collected by on-site drainage. Flows from this area are attenuated by the OSD and ultimately discharge to the existing low-point in the RMS corridor. The remainder of Lot 3 (~0.34Ha) would bypass formalised drainage – the flows from this bypass shall be accounted for in the OSD.

The catchment configuration for this development (Lot 2) is as follows:

- Lot 2 (being stage 4) was originally approved with an area of approximately 6.32 Ha. The site is now proposed to be increased to have an area of 8.78 Ha. The additional area of 2.46 Ha being comprised of residual area from the former Lot 1 configurations.

- The proposed stormwater management system is to be achieved by underground combined on-site detention (OSD) and stormwater quality tanks which will attenuate and treat flows. Two combined stormwater management tanks are proposed for the whole Lot 2 configuration, with one tank situated on Warehouse 2’s site & one tank on Warehouse 3. They will be sized for these site’s catchments accordingly.

- Stormwater quality management is proposed to be managed by an Ocean Protect StormFilter filtration system.

- Stormwater quantity management measures will be performed via OSD as per BCC’s requirements. Flows from the proposed Warehouse 2 & some landscaped bypass from Warehouse 3 (occupying 4.068 Ha) will be attenuated with on-site detention (OSD) and discharge to Hollinsworth Road per the above approval. Flows from the proposed Building 3 within Lot 2 (occupying 4.502 Ha) will also be attenuated with on-site detention (OSD) and discharge alongside Building 2’s outlet. The remainder of the proposed Building 2 & 3 area (0.214 Ha) shall bypass formalised drainage or be collected by Hollinsworth Road These flows from this bypass shall be accounted for in the OSD.
3.1.3 Proposed Building/ Lot Drainage for Warehouses 2 & 3

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of BCC and accepted engineering practice and as defined in the Sydney Business Park Stormwater Management Strategy. Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage. Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (1988 Edition), Volumes 1 and 2 (AR&R).

Water quality and re-use are to be considered in the design to ensure that any increase in the detrimental effects of pollution is mitigated, BCC Water Quality Objectives are met and that the demand on potable water resources is reduced. This document confirms the requirements for future development lots based on a whole of catchment approach, allowing for treatment the proposed Hollinsworth Road extension to be completed within regional basins and treatment of buildings being performed on lot.

The provided concept stormwater management for building each lot will comprise the following elements, which are further described and quantified in following sections:

- Minor drainage system consisting of a piped drainage system designed to accommodate the 1 in 20-year ARI storm event (Q20).
- Major drainage system through new paved areas has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100);
- Stormwater Quantity Management System via two underground OSD tanks to attenuate post development stormwater runoff to pre-developed and satisfies BCC’s requirements.
- Stormwater quality system which meets the load-based pollution reduction requirements of Blacktown City Council Part J DCP2015; and
- Rainwater reuse which reduces demand on non-potable water use by 80% as per Blacktown City Council Part J DCP2015.

3.2 Hydrologic Modelling and Analysis

3.2.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Blacktown City Council and accepted engineering practice.

Specifically, the design will be based on:

- Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage;
- Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (1987 Edition), Volumes 1 and 2 (AR&R) – It is noted that a design principle is not yet in place for on-site detention systems using AR&R 2016 data;
- Blacktown City Council’s Engineering Guidelines for Development 2005;
- Storm events for the 2 to 100 Year ARI event have been assessed.
3.2.2 **Minor/ Major System Design**

The piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure.

3.2.3 **Rainfall Data**

Rainfall intensity Frequency Duration (IFD) data used as a basis for ILSAX and RAFTS modelling for the 2 to 100 Year ARI events, was taken from Blacktown City Council’s *Engineering Guidelines for Development 2005*.

3.2.4 **Runoff Models**

In accordance with the recommendations and standards of Blacktown City Council, the calculation of the runoff from storms of the design ARI will be calculated with the catchment modelling software DRAINS. The ILSAX hydrological model component will be utilised for the post-development site and the RAFTS model component for broad scale catchments. This will be in accordance with previous studies and approvals for land in the area.

The design parameters for the ILSAX model are to be based on the recommendations as defined by BCC and parameters for the area are as follows:

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*Table 3.1. DRAINS ILSAX Parameters*
3.3 **Hydraulics**

3.3.1 **General Requirements**

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems perform to or exceed the required standard.

3.3.2 **Freeboard**

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard would not be required.

Freeboard of 300mm has been achieved to building levels during the Major Storm Event.

3.3.3 **Public Safety**

For all areas subject to pedestrian traffic, the product (dV) of the depth of flow d (in metres) and the velocity of flow V (in metres per second) will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

3.3.4 **Inlet Pit Spacing**

The spacing of inlets throughout the site will be such that the depth of flow, for the Major System design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

3.3.5 **Overland Flow**

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the estate road system.

3.4 **External Catchments and Flooding**

Stage 4 is not affected by any overland flow paths or external catchments. As such no allowance for conveyance of upstream catchments is required in this SWMP.

3.5 **Stormwater Management**

The proposed stormwater management for Stage 4 will be required to be consistent with Blacktown City Councils DCP2015 Part J and generally in accordance with the approved arrangement and Council Memo’s.

Sections 4 & 5 of this report describe the arrangement for the proposed Stormwater Management and objectives as designed.
4 STORMWATER QUANTITY MANAGEMENT

4.1 Introduction

Blacktown City Council requires water quantity to be managed to limit the runoff discharged from private property into the underground piped drainage system to pre-developed flow and to assist in mitigating the increased stormwater runoff generated from the early works carried out. Water quantity management is sometimes referred to as stormwater detention, or on-site detention (OSD).

The current layout allows for the proposed Lot 2 development, consisting of a site area of 8.78 Ha discharging to the proposed Hollinsworth Road extension drainage system. The Lot 2 development (comprised of Warehouse’s 2 & 3) will discharge into the proposed downstream Hollinsworth Road Kerb Inlet Pit R01/09. The Hollinsworth Road drainage network will then discharge into downstream trunk drainage channel TC04. This channel ultimately drains to the under construction Regional Detention Basin E which is located north of the site in the Sydney Business Park.

Detention Basin E has been designed to cater for attenuation of runoff from this site and on completion of construction will fully manage runoff from this development. However, completion of Basin E construction will not occur prior to occupation and operation of the site. As a result, OSD is proposed as part of the developments within Lot 2.

The methodology employed to determine the attenuation requirements are based on assessing storms for the 1 in 2-year ARI to the 1 in 100-year ARI for the pre and post development phases. Given the pre and post development surfaces are both considered pervious, the pre-developed flows have been assessed based on a 15mm depression depth and the post development based on a fully impervious industrial lot. This is in line with Blacktown Councils requirements as set out in discussions with Tony Merrilees (Blacktown City Council’s Senior Stormwater Engineer).

4.2 Existing & Post Development Peak Flows

Intensity/Frequency/Duration (IFD) data was adopted from councils Development Guidelines used in conjunction with rational method calculations to estimate peak flows for the site and surrounding catchments. A DRAINS model was configured as per the layout in Appendix F.

The attenuation volume for the proposed OSD tanks has been assessed based on attenuating the post development flow to pre-development flow for a pre-development catchment of 8.78 Ha and storms ranging from 1 in 2-year ARI to 1 in 100-year ARI. The flow rates and attenuation volumes for the detention systems have been provided in Tables 4.1 & 4.2
The pre-development site discharge volumes for the proposed Lot 2 development is provided in Table 4.1 below.

| ARI | Design Storm Duration | Peak Flow (m³/s) | | |
|-----|------------------------|-----------------|---|---|---|
|     |                        | Undeveloped     | Site (No Attenuation) | OSD Tank |
|     |                        |                 | Site (Attenuation) | Bypass | Total Outflow |
| 2   | 1 hr                   | 1.200           | 1.460               | 0.692  | 0.030  | 0.698 |
|     | 2 hr                   | 1.140           | 1.340               | 0.684  | 0.030  | 0.688 |
|     | 3 hr                   | 0.867           | 0.993               | 0.596  | 0.012  | 0.598 |
|     | 6 Hr                   | 0.632           | 0.649               | 0.514  | 0.010  | 0.520 |
|     | 12 Hr                  | 0.587           | 0.591               | 0.486  | 0.011  | 0.495 |
| 20  | 20 min                 | 1.710           | 2.560               | 0.837  | 0.069  | 0.839 |
|     | 30 min                 | 1.980           | 2.530               | 0.872  | 0.072  | 0.882 |
|     | 1 hr                   | 2.070           | 2.490               | 1.120  | 0.069  | 1.140 |
|     | 2 hr                   | 1.960           | 2.280               | 1.110  | 0.072  | 1.120 |
|     | 3 hr                   | 1.650           | 1.860               | 0.849  | 0.038  | 0.858 |
|     | 6 Hr                   | 1.090           | 1.100               | 0.707  | 0.022  | 0.721 |
|     | 12 Hr                  | 1.030           | 1.030               | 0.680  | 0.022  | 0.691 |
| 100 | 20 min                 | 2.250           | 3.300               | 1.440  | 0.094  | 1.450 |
|     | 30 min                 | 2.550           | 3.150               | 1.770  | 0.088  | 1.790 |
|     | 1 hr                   | 2.610           | 3.090               | 2.230  | 0.087  | 2.260 |
|     | 2 hr                   | 2.430           | 2.820               | 2.270  | 0.091  | 2.300 |
|     | 3 hr                   | 2.020           | 2.260               | 1.410  | 0.048  | 1.420 |
|     | 6 Hr                   | 1.400           | 1.400               | 0.852  | 0.030  | 0.871 |

Table 4.1. Peak Flows from Lot 2
Post development site discharge volumes, as well as the provided detention volumes and depths for Warehouse 2’s OSD tank are provided in Table 4.2 below.

<table>
<thead>
<tr>
<th>ARI Duration</th>
<th>No Attenuation</th>
<th>Q2 Orifice</th>
<th>Q20 Weir</th>
<th>Q100 Emergency</th>
<th>Bypass</th>
<th>Total</th>
<th>Depth (mm)</th>
<th>Storage (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1 Hr</td>
<td>0.729</td>
<td>0.342</td>
<td>0</td>
<td>0</td>
<td>0.150</td>
<td>0.347</td>
<td>510</td>
<td>398</td>
</tr>
<tr>
<td>20 2 Hr</td>
<td>1.241</td>
<td>0.451</td>
<td>0.145</td>
<td>0</td>
<td>0.050</td>
<td>0.607</td>
<td>1120</td>
<td>875</td>
</tr>
<tr>
<td>100 2 Hr</td>
<td>1.739</td>
<td>0.469</td>
<td>0.687</td>
<td>0</td>
<td>0.068</td>
<td>1.170</td>
<td>1260</td>
<td>985</td>
</tr>
</tbody>
</table>

Table 4.2. Warehouse 2 - Detention System Flow and Volume Requirements

Post development site discharge volumes, as well as the provided detention volumes and depths for Warehouse 3’s OSD tank are provided in Table 4.3 below.

<table>
<thead>
<tr>
<th>ARI Duration</th>
<th>No Attenuation</th>
<th>Q2 Orifice</th>
<th>Q20 Weir</th>
<th>Q100 Emergency</th>
<th>Bypass</th>
<th>Total</th>
<th>Depth (mm)</th>
<th>Storage (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1 Hr</td>
<td>0.768</td>
<td>0.350</td>
<td>0</td>
<td>0</td>
<td>0.010</td>
<td>0.351</td>
<td>540</td>
<td>475</td>
</tr>
<tr>
<td>20 2 Hr</td>
<td>1.302</td>
<td>0.463</td>
<td>0.091</td>
<td>0</td>
<td>0.021</td>
<td>0.558</td>
<td>1200</td>
<td>1044</td>
</tr>
<tr>
<td>100 2 Hr</td>
<td>1.729</td>
<td>0.484</td>
<td>0.678</td>
<td>0</td>
<td>0.029</td>
<td>1.170</td>
<td>1360</td>
<td>1184</td>
</tr>
</tbody>
</table>

Table 4.3. Warehouse 3 - Detention System Flow and Volume Requirements
As shown in Table 4.2 & 4.3 above, an active detention storage of 985m$^3$ is required in Warehouse 2 OSD tank and 1,184m$^3$ is required in Warehouse 3 to attenuate the post development flows to pre-development flows for the 8.78 Ha catchment, which will discharge into the proposed council drainage infrastructure along Hollinsworth Road, Marsden Park.

It is noted that, in addition to the confirmation of detention storage through modelled stage discharge, council also require that a minimum storage of 455m$^3$/Ha in the 100-year ARI event is met, as such the provided storage will be required to increase to 4000 m$^3$ in order to meet BCC’s minimum site storage requirement (SSR) rate for the whole of Lot 2.

Based on the assessment above, a minimum active storage of 1865m$^3$ for Warehouse 2 and 2135m$^3$ for Warehouse 3 will be adopted for the development.
5  STORMWATER QUALITY CONTROLS

5.1 Stormwater Management Objectives

There is a need to provide design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by the Blacktown City Council.

Stormwater quality will comprise a treatment train which meets the percentage-based pollution reduction objectives of Blacktown Council Policy DCP2015 Part J.

The water quality objectives for the entire development are presented in terms of annual percentage pollutant reductions on a developed catchment:

- Gross Pollutants: 90%
- Total Suspended Solids: 85%
- Total Phosphorus: 65%
- Total Nitrogen: 45%
- Total Hydrocarbons: 90%

Water quality for development lots will be completed as part of individual future development applications for building development. Water quality measures will need to be provided for each lot in accordance with Blacktown City Council DCP2015 Part J reductions quoted above and proven by MUSIC modelling.

It is noted that provision for water quality treatment of the catchments associated with the Hollinsworth Road extension have been accounted for in the overall precinct Stormwater Management Strategy and S94 Contribution plan. Allowance for treatment of these catchments has been made in water quality measures provided in the Sydney Business Park Regional Basins E and G. As such no allowance for water quality treatment associated with these road corridors is required in the current SSD Approval.

5.2 Proposed Stormwater Treatment System

Roof, hardstand, car parking, roads, other paved areas and landscaping areas are required to be treated by the Stormwater Treatment Measures (STM’s). The STM’s shall be sized according to the whole catchment area of the development, except the S94 roads. The STM’s for the development shall be based on a treatment train approach to ensure that all of the objectives above are met. A concept for the treatment of each building has been presented which would need to be confirmed at detail design stage to meet the load-based objectives noted above.
Components of the treatment train for each building are expected to comprise the following elements:

- Primary treatment to parking areas, hardstand areas and majority of roof areas is to be performed via Ocean Protect OceanGuards OG200 Pit Inserts and a Gross Pollutant Trap;
- Tertiary treatment is to be made via Stormfilter Cartridges in a Stormfilter Chamber within the Proposed OSD’s for Buildings 2A, 2B and 3.
- A portion of the roof will also be treated via rainwater reuse and settlement within the proposed rainwater tanks.
- Hydrocarbon removal to be completed by treatment within the pit inserts as discussed in Section 5.4.

In order to estimate the number of Stormfilter cartridges and number of Oceanguard pit inserts required to meet the requirements of councils load based pollution reduction objectives, a MUSIC model has been prepared and generated.

5.3 Stormwater Quality Modelling

5.3.1 Introduction

The MUSIC model was chosen to model water quality. This model has been released by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km² and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC and of relevance to this report include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in Part J of BCC’s DCP2015 and nominated in Section 5.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model “12829.15-Rev3.sqz” was set up to examine the effectiveness of the water quality treatment train and to predict if BCC requirements have been achieved. The model was set up using the latest Blacktown City Council MUSICLINK parameters and the layout of the MUSIC model is presented in Appendix B.
5.3.2 Rainfall Data

Six-minute pluviographic data was provided by BCC which has been sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

<table>
<thead>
<tr>
<th>Input</th>
<th>Data Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall Station</td>
<td>67035 Liverpool (Whitlam)</td>
</tr>
<tr>
<td>Rainfall Period</td>
<td>1 January 1967 – 31 December 1976 (10 years)</td>
</tr>
<tr>
<td>Mean Annual Rainfall</td>
<td>857</td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>Sydney Monthly Areal PET</td>
</tr>
<tr>
<td>Model Timestep</td>
<td>6 minutes</td>
</tr>
</tbody>
</table>

5.3.3 Rainfall Runoff Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall Threshold</td>
<td>1.40</td>
</tr>
<tr>
<td>Soil Storage Capacity (mm)</td>
<td>170</td>
</tr>
<tr>
<td>Initial Storage (% capacity)</td>
<td>30</td>
</tr>
<tr>
<td>Field Capacity (mm)</td>
<td>70</td>
</tr>
<tr>
<td>Infiltration Capacity Coefficient a</td>
<td>210</td>
</tr>
<tr>
<td>Infiltration Capacity exponent b</td>
<td>4.7</td>
</tr>
<tr>
<td>Initial Depth (mm)</td>
<td>10</td>
</tr>
<tr>
<td>Daily Recharge Rate (%)</td>
<td>50</td>
</tr>
<tr>
<td>Daily Baseflow Rate (%)</td>
<td>4</td>
</tr>
<tr>
<td>Daily Seepage Rate (%)</td>
<td>0</td>
</tr>
</tbody>
</table>

5.3.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are based on BCC land use parameters as per the Table 5.1:

<table>
<thead>
<tr>
<th>Flow Type</th>
<th>Surface Type</th>
<th>TSS ($10^x$ values)</th>
<th>TP ($10^x$ values)</th>
<th>TN ($10^x$ values)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Std Dev.</td>
<td>Mean</td>
</tr>
<tr>
<td>Baseflow</td>
<td>Roof</td>
<td>1.20</td>
<td>0.17</td>
<td>-0.85</td>
</tr>
<tr>
<td></td>
<td>Roads</td>
<td>2.43</td>
<td>0.32</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>Landscaping</td>
<td>2.15</td>
<td>0.32</td>
<td>-0.6</td>
</tr>
<tr>
<td>Stormflow</td>
<td>Roof</td>
<td>1.30</td>
<td>0.32</td>
<td>-0.89</td>
</tr>
<tr>
<td></td>
<td>Roads</td>
<td>2.43</td>
<td>0.32</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>Landscaping</td>
<td>2.15</td>
<td>0.32</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

Table 5.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in Table 5.1 above and the catchments shown in Table 5.2.

The relevant stormwater catchment sizes are listed below in Table 5.2 and shown in Appendix B.
<table>
<thead>
<tr>
<th>Catchment</th>
<th>Area (Ha)</th>
<th>Source Node</th>
<th>% Impervious</th>
<th>Stormwater Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building 2, 2A &amp; 3 – Stage 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof (R1) to RWT</td>
<td>0.536</td>
<td>Roof</td>
<td>100%</td>
<td>Rainwater Tank/StormFilter Cartridges</td>
</tr>
<tr>
<td>Roof (R2)</td>
<td>0.536</td>
<td>Roof</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Roof (R3)</td>
<td>1.071</td>
<td>Roof</td>
<td>100%</td>
<td>Gross Pollutant Trap/StormFilter Cartridges</td>
</tr>
<tr>
<td>Roof (R4) to RWT</td>
<td>0.665</td>
<td>Roof</td>
<td>100%</td>
<td>Rainwater Tank/StormFilter Cartridges</td>
</tr>
<tr>
<td>Roof (R5)</td>
<td>0.665</td>
<td>Roof</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Roof (R6)</td>
<td>1.330</td>
<td>Roof</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Warehouse 2A Carpark (A1)</td>
<td>0.203</td>
<td>Sealedroad</td>
<td>100%</td>
<td>Gross Pollutant Trap/StormFilter Cartridges</td>
</tr>
<tr>
<td>Warehouse 2B Carpark (A2)</td>
<td>0.288</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Warehouse 3 Carpark (A3)</td>
<td>0.375</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Hardstand (H1)</td>
<td>0.880</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Hardstand (H2)</td>
<td>1.252</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Estate Driveway (H3)</td>
<td>0.251</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Estate Driveway Bypass (H3 Bypass)</td>
<td>0.033</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert</td>
</tr>
<tr>
<td>Fire Trail (H4)</td>
<td>0.204</td>
<td>Sealedroad</td>
<td>100%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Landscape (LS1)</td>
<td>0.152</td>
<td>RevegetatedLand</td>
<td>0%</td>
<td>Bypass</td>
</tr>
<tr>
<td>Landscape (LS2)</td>
<td>0.095</td>
<td>RevegetatedLand</td>
<td>0%</td>
<td>Bypass</td>
</tr>
<tr>
<td>Landscape (LS3)</td>
<td>0.121</td>
<td>RevegetatedLand</td>
<td>0%</td>
<td>OceanGuard OG 200 Pit Insert/StormFilter Cartridges</td>
</tr>
<tr>
<td>Landscape (LS4)</td>
<td>0.060</td>
<td>RevegetatedLand</td>
<td>0%</td>
<td>Bypass</td>
</tr>
<tr>
<td>Landscape (LS5)</td>
<td>0.063</td>
<td>RevegetatedLand</td>
<td>0%</td>
<td>Bypass</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8.78</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.2. Music Model Source Nodes
5.3.5 Treatment Nodes

Rainwater tank, OceanGuard OG200, Gross Pollutant Trap (GPT) and Stormfilter Chamber and Filters’ Nodes have been used in the modelling of the development.

5.3.6 Results

Table 6.3 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment over the modelled 1 Ha catchment.

<table>
<thead>
<tr>
<th>Source</th>
<th>Residual Load</th>
<th>% Reduction</th>
<th>Target Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (ML/yr)</td>
<td>61.9</td>
<td>58.7</td>
<td>5.1</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>10100</td>
<td>1230</td>
<td>88.4</td>
</tr>
<tr>
<td>(kg/yr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Phosphorus (kg/yr)</td>
<td>20.7</td>
<td>7.09</td>
<td>66.1</td>
</tr>
<tr>
<td>Total Nitrogen (kg/yr)</td>
<td>141</td>
<td>77.4</td>
<td>45</td>
</tr>
<tr>
<td>Gross Pollutants (kg/yr)</td>
<td>1600</td>
<td>13.4</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 6.3. MUSIC analysis results

The model results indicate that, through the use of the STM’s in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of Part J of BCC’s DCP 2015 over the known site configurations of Stage 4.

As can be seen, the proposed treatment train achieves reductions greater than the required pollutant reduction objectives. This will any ensure any variance in assumed arrangements in the proposed warehouse facilities drainage systems will not affect the overall outcomes of the solution.

5.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of Part J of BCC’s DCP2015 have been met.

The MUSIC modelling has shown that the proposed treatment train of SQID’s will provide stormwater treatment which will meet BCC requirements in an effective and economical manner.

Further discussion on hydrocarbon removal which is not readily modelled in MUSIC is provided in Section 5.4 as follows.
5.4 Hydrocarbon Removal

The proposed distribution/storage facilities (2A, 2B & 3) would be expected to produce low source loadings of hydrocarbons. Potential sources of hydrocarbons would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (carparking only). The potential for hydrocarbon pollution is low and published data from the CSIRO indicates that average concentrations from Industrial sites are in the order of 10mg/L and we would expect source loading from this site to be near to or below this concentration as further discussed below.

Hydrocarbon removal cannot be readily modelled with MUSIC software however there is sufficient information on the expected source loads and treatment.

5.4.1 Hydrocarbon Sources

The average storm flow concentration of hydrocarbons in an industrial facility is 9.5mg/L (3 & 30mg/L 95% confidence limits) sourced from Fletcher T, Duncan H, Poelsma P & Lloyd S, 2004: Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures - A review and Gap Analysis. Cooperative Research Centre for Catchment Hydrology, Technical Report 04/8;

5.4.2 OceanGuard Treatment

The following information relating to the performance of the OceanGuards OG200, which was previously known as EnviroPods has been provided by the product manufacturers, Ocean Protect (rebranded to Stormwater 360):

*The EnviroPod filter has been evaluated to remove all particles above 100µm when fitted with a 200µm filter mesh. Research has shown (Walker, Allison, Wong and Wootton, 1999, pg.2) that the majority of heavy metal and contaminants found in stormwater runoff are associated with fine partials (under 500 microns). This research also stated that 70% of oils and 85% of hydrocarbons were associated with solids in the stormwater and that over a period of dry weather conditions the highest oil content was found in the sediment range of 200 to 400 microns. The removal mechanism for the EnviroPod 200micron filter is direct screening, and hence removal of particles greater than the screen opening is guaranteed.*

The average O&G/Hydrocarbon reduction of the OceanGuard filter, and recommended removal rate for the treatment nodes made by Ocean Protect, is hence 77.5%. For the purpose of any simulation the lower end of this spectrum, at 70%, should be adopted.

5.4.3 Conclusion

Overall, when combining a treatment train of OceanGaurd OG200 and stormfilter cartridges, a reduction of greater than 90% of hydrocarbons is meeting the requirements of Blacktown Council Part J DCP.

It is noted that this solution has been previously assessed and agreed with Blacktown City on a similar industrial development in Eastern Creek as part of Development Consent DA14-1466 in 2014.

Given the expected low source loadings of hydrocarbons and removal efficiencies of the treatment devices we consider that the requirements of the Blacktown Council have been met.
5.5 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater where the flow is from roof areas, or stormwater where the flow is from all areas of the development.

For the purposes of this development, we refer to a rainwater harvesting system, where benefits of collected stormwater from roof areas over a stormwater harvesting system can be made as rainwater is generally less polluted than stormwater drainage.

Rainwater harvesting is proposed for this development with re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the water demand for the development by a minimum of 80% and to satisfy the requirements of Blacktown City Council DCP2015 Part J.

In general terms the rainwater harvesting system will be an in-line tank for the collection and storage of rainwater. At times when the rainwater storage tank is full rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non-potable water reticulation system.

Rainwater tanks have been designed, using MUSIC software to balance the supply and demand, based on the below base water demands and the requirement of Blacktown Council DCP2015 Part J to provide 80% reduction in non-potable water demand.

5.5.1 Internal Base Water Demand

Indoor water demand has been based on Section 7.11 of Blacktown Council DRAFT MUSIC Modelling Guideline 2013 for an industrial/commercial development. Section 7.11 requires an allowance of 0.1kL/day/toilet or urinal. No allowance is required for disable toilets. It is noted that for this assessment, the masterplan office configurations of Stage 4 Buildings 2A, 2B and 3 have been used to determine re-use rates. It should be noted that the proposed tanks will need to be appropriately sized during the detailed design phase of these developments.

The above rates result in the following internal non-potable demand:

<table>
<thead>
<tr>
<th>Building</th>
<th>Toilets</th>
<th>Water Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>20</td>
<td>2.0kL/day</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>1.8kL/day</td>
</tr>
</tbody>
</table>

As noted above, the final number of toilets & subsequent re-use for Buildings 1 shall be confirmed during detailed design.

5.5.2 External Base Water Demand

The external base water demand has also been based on Section 7.11 of Blacktown Council DRAFT MUSIC Modelling Guideline 2013 for an industrial development. Section 7.11 requires an allowance of 0.3kL/year/m² as PET-Rain for subsurface irrigation and 0.4 kL/year/m² as PET-Rain for Sprinkler Systems.

The above regime for the landscaped area for the site gives the following yearly outdoor water demand:
Warehouse 2 Irrigated Area (0.4kL/year/m²) 1000 kL/year
Warehouse 3 Irrigated Area (0.4kL/year/m²) 760 kL/year

5.5.3 Rainwater Tank Sizing

The use of rainwater reduces the mains water demand and the amount of stormwater runoff. By collecting the rainwater run-off from roof areas, rainwater tanks provide a valuable water source suitable for flushing toilets and landscape irrigation.

Rainwater tanks have been designed, using MUSIC software to balance the supply and demand, based on the calculated base water demands and proposed roof catchment areas. Allowances in the MUSIC model have been made for high flow bypass which will be managed by a dual high flow (300mm downpipe) and low flow (100mm downpipe) roofwater collection configuration along a portion of the southern elevation of the warehouse. The final configuration, including the arrangement of downpipes shall be sized and confirmed by the hydraulic engineering consultant during the detailed design of individual warehouses.

<table>
<thead>
<tr>
<th>Building</th>
<th>Roof Catchment (m²)</th>
<th>Highflow Bypass (l/s)</th>
<th>Tank Size in MUSIC (kL)</th>
<th>Predicted Demand Reduction (%)</th>
<th>Estimated Tank (kL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5360</td>
<td>100</td>
<td>160</td>
<td>80</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>6650</td>
<td>100</td>
<td>160</td>
<td>80</td>
<td>200</td>
</tr>
</tbody>
</table>

Table 6.4. Rainwater Reuse Requirements

The MUSIC model, results summarised in Table 6.4, predicts that the requirements of Blacktown Council DCP2015 Part J (80% reduction in non-potable water demand) will be met for the development.

We note that the final configuration and sizing of the rainwater tanks is subject to detail design considerations and optimum site utilisation.

5.6 Stream Erosion Index

A Stream Erosion Index (SEI) calculation has been made, in accordance with the methodology set out in Blacktown City Councils Developer Handbook for Water Sensitive Urban Design 2013, Section 19. Blacktown City Council Growth Centre DCP requires that the post development duration of stream forming flows shall be between 3.5-5.0 times the pre-development duration of stream forming flows with a stretch target of 1.

The SEI has been calculated for the site area relating on a per-hectare basis, given that the final site arrangement has not yet been approved.

The four following steps, as defined in the council document, were used in estimating the SEI:
1. Estimate the critical flow for the receiving waterway above which mobilisation of bed material or shear erosion of bank material commences.
2. Develop and run a calibrated MUSIC model of the area of interest for predevelopment conditions to estimate the mean annual runoff volume above the critical flow.
3. Develop and run a MUSIC model for the post developed scenario to estimate the mean annual runoff volume above the critical flow.
4. Use the outputs from steps 3 and 4 to calculate the SEI for the proposed scenario.

The 2-year ARI flow for the catchment is 0.629 m³/s. The critical flow for the receiving water for the 2-year ARI, being 25% of the 2-year ARI, has been estimated at 0.157 m³/s, based on a time of concentration of 18 minutes.

A pre-developed model was set up based on the site being modelled as 100% undeveloped forest. The pre-development runoff volume, above the critical flow, based on the calibrated MUSIC model was calculated at 3 ML/yr.

The post-development runoff volume, above the critical flow, based on the post-developed MUSIC model was calculated at 11 ML/yr.

The corresponding SEI was calculated at approximately 3.67. This can be seen to be below the maximum allowable range of 3.5-5.0, hence the requirements of the SEI assessment have been met.

Refer to Appendix C for MUSIC model Output relating to the SEI.
6 MAINTENANCE AND MONITORING

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, a stormwater system maintenance schedule has been prepared (refer to Section 6.3).

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the maintenance requirements below it is also recommended that inspections are made following heavy rainfall or major storm events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at the Horsley Park or Prospect Reservoir weather stations.

6.1 Types of Maintenance

Water Sensitive Urban Design (WSUD) assets require both proactive and reactive maintenance to ensure long term system health and performance.

Proactive maintenance refers to regular scheduled maintenance tasks, whereas reactive maintenance is required to address unscheduled maintenance issues. If an asset is not functioning as intended, then rectification may be required to restore the asset back to its desired function.

Our preferred approach is on proactive maintenance.

6.1.1 Proactive Maintenance

Proactive maintenance is a set of scheduled tasks to ensure that the WSUD asset is operating as designed.

Proactive maintenance involves:

- Regular inspections of the WSUD asset;
- Scheduled maintenance tasks for issues that are known to require regular attention (e.g. litter removal, weed control); and
- Responsive maintenance tasks following inspections for issues which require irregular attention (e.g. sediment removal, mulching, and scour management).

Proactive maintenance in the first two years after the establishment period (construction and planting phases) are the most intensive and important to the long-term success of the treatment asset.

Proactive maintenance is a cost-effective means of reducing the long-term costs associated with operating stormwater treatment assets.

Maintenance activities specific to each WSUD asset type are detailed in the inspection and maintenance schedules and checklists provided in the report. The frequency of scheduled maintenance depends on the asset type and the issue being managed.

As a general guide, scheduled maintenance should be completed on a three to four-month cycle. The checklists provided should be used as a minimum guide to scheduled maintenance tasks. The lists should be amended to suit site conditions and maintenance requirements.
Treatment assets should also be inspected at least once a year during or immediately after a significant rainfall event. This is important to confirm that the treatment system is functioning correctly under wet conditions.

A higher level of scheduled maintenance may be arranged for some treatment assets. This is often the case for treatment assets which are located in high profile locations (e.g. streetscapes and parklands), and where public amenity is considered to be a high priority. In these cases, a more frequent maintenance regime may be required to remove litter and weeds and to ensure vegetation health and cover is maintained to a high level.

6.1.2 Reactive Maintenance

Reactive maintenance is undertaken when a problem or fault is identified that is beyond the scope of proactive maintenance. Reactive maintenance may occur following a complaint about the WSUD asset (e.g. excessive odours or litter). Reactive maintenance often requires a swift response and may involve specialist equipment or skills.

6.1.3 Rectification

Rectification of a WSUD asset is undertaken when the system is not functioning as intended, and proactive and reactive maintenance activities are unable to return the asset to functional condition.

The lack of functional performance and therefore failure of a stormwater treatment asset may be related to many factors including inappropriate design, poor construction, and lack of regular maintenance or end of life cycle. In many cases, the design of assets has not included adequate consideration of the maintenance requirements, in terms of the system’s ability to cope with catchment pollutant loads (i.e. sediments) and the frequency of maintenance required to maintain the system at a functional level.

Maintenance planning at the design phase is therefore crucial to both the long-term operating costs and the expected life cycle of the treatment system. In general, the expected lifecycle of a stormwater treatment asset (e.g. a bio-retention system) that has been well designed and constructed and is regularly maintained should be at least 15-20 years.

However, the lifecycle for each treatment system will be different and related to:

- whether the system has been designed, constructed and maintained according to best practice;
- catchment characteristics (influences the quality of the stormwater);
- the age and general health of the system; and
- the type of plants that have been used in the system.

Regular asset condition assessments should be undertaken to monitor the system condition and to inform where an asset is in terms of its expected lifecycle. Renewal of a system refers to replacing the main elements of the system including:

- infrastructure;
- removing deposited sediment, removing and replacing the top soil (or filter media in the case of a bio-retention system) and profiling the top soil level back to the design levels;
- re-planting; and
- pavement and sub-layers (in the case of permeable pavements).
A WSUD specialist may be required to assess whether a treatment system has reached the end of its life cycle and to provide advice on the renewal works.

Asset condition assessments can also identify assets that need to be rectified. The decision to continue with an increased maintenance regime or to rectify an asset, and over what timeframe, can be a difficult one to make. This is because certain maintenance items are more important to overall system function than others. For example, extended ponding on the surface of a bio-retention system or persistent scouring of a swale should be addressed more rapidly than recurrent weed problems.

### 6.2 Routine Inspections and Maintenance Schedule for General Stormwater System

Routine inspections are to be carried out to assess the need for maintenance and are primarily concerned with checking the functionality of the stormwater drainage facilities; items such as drains, drainage pits, box culverts, detention tanks and rainwater reuse tank systems. Maintenance of these items is vitally important for the ongoing drainage and treatment of stormwater.

Should the inspection reveal that maintenance of any item is required, this is to be reported to the building management for action.

Items that are to be subject to Routine Inspections for Maintenance may comprise, but not be limited to those listed in the table below. This table is to be read in conjunction with the Stormwater design drawings.

It is vitally important that each component of the stormwater system is properly operated and maintained. In order to achieve the modelled and design treatment outcomes, a maintenance schedule has been prepared (below) to assist in the effective operation and maintenance of the various drainage and water quality components.
### 6.3 Stormwater Maintenance Schedule

<table>
<thead>
<tr>
<th>MAINTENANCE ACTION</th>
<th>FREQUENCY</th>
<th>RESPONSIBILITY</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SWALES/ LANDSCAPED AREAS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation</td>
<td>Six monthly</td>
<td>Maintenance Contractor</td>
<td>Replant and/or fertilise, weed and water in accordance with landscape consultant specifications</td>
</tr>
<tr>
<td>Inspect swale for excessive litter and sediment build up</td>
<td>Six monthly</td>
<td>Maintenance Contractor</td>
<td>Remove sediment and litter and dispose in accordance with local authorities’ requirements.</td>
</tr>
<tr>
<td>Check for any evidence of channelisation and erosion</td>
<td>Six monthly/ After Major Storm</td>
<td>Maintenance Contractor</td>
<td>Reinstate eroded areas so that original, designed swale profile is maintained</td>
</tr>
<tr>
<td>Weed Infestation</td>
<td>Three Monthly</td>
<td>Maintenance Contractor</td>
<td>Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.</td>
</tr>
<tr>
<td>Inspect swale surface for erosion</td>
<td>Six Monthly</td>
<td>Maintenance Contractor</td>
<td>Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.</td>
</tr>
<tr>
<td><strong>RAINWATER TANK</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check for any clogging and blockage of the first flush device</td>
<td>Monthly</td>
<td>Maintenance Contractor</td>
<td>First flush device to be cleaned out</td>
</tr>
<tr>
<td>Check for any clogging and blockage of the tank inlet - leaf/litter screen</td>
<td>Six monthly</td>
<td>Maintenance Contractor</td>
<td>Leaves and debris to be removed from the inlet leaf/litter screen</td>
</tr>
<tr>
<td>Check the level of sediment within the tank</td>
<td>Every two years</td>
<td>Maintenance Contractor</td>
<td>Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable</td>
</tr>
<tr>
<td>MAINTENANCE ACTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INLET &amp; JUNCTION PITS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inside Pit</td>
<td>Six Monthly</td>
<td>Maintenance Contractor</td>
<td>Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.</td>
</tr>
<tr>
<td>Outside of Pit</td>
<td>Four Monthly/ After Major Storm</td>
<td>Maintenance Contractor</td>
<td>Clean grate of collected sediment, debris, litter and vegetation.</td>
</tr>
<tr>
<td>STORMWATER SYSTEM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Inspection of complete stormwater drainage system</td>
<td>Bi-annually</td>
<td>Maintenance Contractor</td>
<td>Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.</td>
</tr>
<tr>
<td>OSD SYSTEM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect and remove any blockage from orifice</td>
<td>Six Monthly</td>
<td>Maintenance Contractor/ Owner</td>
<td>Remove grate and screen to inspect orifice.</td>
</tr>
<tr>
<td>Inspect trash screen and clean</td>
<td>Six Monthly</td>
<td>Maintenance Contractor/ Owner</td>
<td>Remove grate and screen if required to clean it.</td>
</tr>
<tr>
<td>Inspect flap valve and remove any blockage.</td>
<td>Six Monthly</td>
<td>Maintenance Contractor/ Owner</td>
<td>Remove grate. Ensure flap valve moves freely and remove any blockages or debris.</td>
</tr>
<tr>
<td>Inspect pit sump for damage or blockage.</td>
<td>Six Monthly</td>
<td>Maintenance Contractor/ Owner</td>
<td>Remove grate &amp; screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.</td>
</tr>
<tr>
<td>Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.</td>
<td>Six Monthly</td>
<td>Maintenance Contractor/ Owner</td>
<td>Remove debris and floatable materials.</td>
</tr>
<tr>
<td>Check attachment of orifice plate and screen to wall of pit</td>
<td>Annually</td>
<td>Maintenance Contractor</td>
<td>Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.</td>
</tr>
<tr>
<td>MAINTENANCE ACTION</td>
<td>FREQUENCY</td>
<td>RESPONSIBILITY</td>
<td>PROCEDURE</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Check orifice diameter is correct and retains sharp edge.</td>
<td>Five yearly</td>
<td>Maintenance Contractor</td>
<td>Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.</td>
</tr>
<tr>
<td>Check screen for corrosion</td>
<td>Annually</td>
<td>Maintenance Contractor</td>
<td>Remove grate and screen and examine for rust or corrosion, especially at corners or welds.</td>
</tr>
<tr>
<td>Inspect overflow weir and remove any blockage</td>
<td>Six monthly</td>
<td>Maintenance Contractor/ Owner</td>
<td>Ensure weir is free of blockage.</td>
</tr>
<tr>
<td>Inspect walls for cracks or spalling</td>
<td>Annually</td>
<td>Maintenance Contractor</td>
<td>Remove grate to inspect internal walls, repair as necessary.</td>
</tr>
<tr>
<td>Check step irons</td>
<td>Annually</td>
<td>Maintenance Contractor</td>
<td>Ensure fixings are secure and irons are free from corrosion.</td>
</tr>
</tbody>
</table>

**BIORETENTION BASIN/ SWALES**

<table>
<thead>
<tr>
<th>MAINTENANCE ACTION</th>
<th>FREQUENCY</th>
<th>RESPONSIBILITY</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check all items nominated for SWALES/ LANDSCAPED AREAS above</td>
<td>Refer to SWALES/ LANDSCAPED AREAS section above</td>
<td>Refer to SWALES/ LANDSCAPED AREAS section above</td>
<td>Refer to SWALES/ LANDSCAPED AREAS section above</td>
</tr>
<tr>
<td>Check for sediment accumulation at inflow points</td>
<td>Six monthly/ After Major Storm</td>
<td>Maintenance Contractor</td>
<td>Remove sediment and dispose in accordance with local authorities’ requirements.</td>
</tr>
<tr>
<td>Check for erosion at inlet or other key structures.</td>
<td>Six monthly/ After Major Storm</td>
<td>Maintenance Contractor</td>
<td>Reinstate eroded areas so that original, designed profile is maintained</td>
</tr>
<tr>
<td>Check for evidence of dumping (litter, building waste or other).</td>
<td>Six monthly</td>
<td>Maintenance Contractor</td>
<td>Remove waste and litter and dispose in accordance with local authorities’ requirements.</td>
</tr>
<tr>
<td>MAINTENANCE ACTION</td>
<td>FREQUENCY</td>
<td>RESPONSIBILITY</td>
<td>PROCEDURE</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Check condition of vegetation is satisfactory (density, weeds, watering, replating, mowing/ slashing etc)</td>
<td>Six monthly</td>
<td>Maintenance Contractor</td>
<td>Replant and/or fertilise, weed and water in accordance with landscape consultant specifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check for evidence of prolonged ponding, surface clogging or clogging of drainage structures</td>
<td>Six monthly/ After Major Storm</td>
<td>Maintenance Contractor</td>
<td>Remove sediment and dispose in accordance with local authorities’ requirements. Replace filter media &amp; planting – refer to appropriately qualified engineer or stormwater specialist</td>
</tr>
<tr>
<td></td>
<td>5-10 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check stormwater pipes and pits</td>
<td>Six monthly/ After Major Storm</td>
<td>Maintenance Contractor</td>
<td>Refer to INLET/ JUNCTION PIT section.</td>
</tr>
</tbody>
</table>

Routine Inspections for Maintenance shall be carried out over the life of the development. The inspections shall occur on a monthly frequency during the construction period, and shall continue on a regular basis as per the frequency specified above in perpetuity.

In addition to the normal inspection frequency nominated inspections should also be carried out following heavy rain events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at Prospect Dam Weather Station No. 67019. A process to establish when periods of high rainfall occur should be put in place with Estate Management.
6.4 Records

Records detailing each of the routine inspections for maintenance should be completed during the inspection, and describe in detail any required maintenance. The inspection records are to be provided to Estate or Building Management for action and then filed appropriately.

Records of any maintenance carried out as a result of the inspection should be completed immediately after the works have been finalised and filed appropriately.

6.5 Personnel

Routine inspections for maintenance are required to establish the need for basic maintenance, as described above. On this basis, such inspections do not require professional engineering knowledge and may be carried out by any responsible person, including property management staff or maintenance staff.
7  EROSION & SEDIMENT CONTROL

An erosion and sediment control plan (ESCP) is shown on Early Works CC drawings Co12829.06-EWC20 and EWC25. These are conceptual plans only providing sufficient detail to clearly show that the works can proceed without undue pollution to receiving waters. A detailed plan will be prepared once consent is given and before works start.

7.1  General Conditions

1. The ESCP will be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued in relation to development at the subject site.

2. Contractors will ensure that all soil and water management works are undertaken as instructed in this specification and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and BCC specifications.

3. All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to down slope areas.

7.2  Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in Table 7.1.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Limitation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction areas</td>
<td>Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.</td>
<td>All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.</td>
</tr>
<tr>
<td>Access areas</td>
<td>Limited to a maximum width of 5 metres</td>
<td>The site manager will determine and mark the location of these zones onsite. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.</td>
</tr>
<tr>
<td>Remaining lands</td>
<td>Entry prohibited except for essential management works</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.1 Limitations to access
7.3 Erosion Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on the plan and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.

2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils remain on the surface at the completion of works.

3. Where practicable, schedule the construction program so that the time from starting land disturbance to stabilisation has a duration of less than six months.

4. Notwithstanding this, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 20 working days.

5. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.

6. Where practical, foot and vehicular traffic will be kept away from all recently established areas.

7. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law a gradient as practical but not steeper than:
   - 2H:1V where slope length is less than 7 meters
   - 2.5H:1V where slope length is between 7 and 10 meters
   - 3H:1V where slope length is between 10 and 12 meters
   - 4H:1V where slope length is between 12 and 18 meters
   - 5H:1V where slope length is between 18 and 27 meters
   - 6H:1V where slope length is greater than 27 meters

8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event.

9. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

7.4 Pollution Control Conditions

1. Stockpiles will not be located within 5 meters of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways.

2. Sediment fences will:
   a) Be installed where shown on the drawings, and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.
b) Have a catchment area not exceeding 720 square meters, a storage depth (including both settling and settled zones) of at least 0.6 meters, and internal dimensions that provide maximum surface area for settling, and

c) Provide a return of 1 meter upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20 year t_e discharge.

3. Sediment removed from any trapping device will be disposed in locations where further erosion and consequent pollution to downslope lands and waterways will not occur.

4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.

5. Temporary soil and water management structures will be removed only after the lands they are protecting are stabilised.

7.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance service will be provided at least weekly.

7.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a Check Sheet. A site inspection using the Check Sheet will be made by the site manager:
   - At least weekly.
   - Immediately before site closure.
   - Immediately following rainfall events in excess of 5mm in any 24-hour period.

   The self-audit will include:
   - Recording the condition of every sediment control device
   - Recording maintenance requirements (if any) for each sediment control device
   - Recording the volumes of sediment removed from sediment retention systems, where applicable
   - Recording the site where sediment is disposed
   - Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information

2. In addition, a suitably qualified person will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report. The responsible person will ensure that:
   - The plan is being implemented correctly
• Repairs are undertaken as required
• Essential modifications are made to the plan if and when necessary

The report shall carry a certificate that works have been carried out in accordance with the plan.

3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.

4. Proper drainage will be maintained. To this end drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that,

• No low points exist that can overtop in a large storm event
• Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams of installing additional diversion upslope.
• Blockages are cleared (these might occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).

5. Sand/soil/spoil materials placed closer than 2 meters from hazard areas will be removed. Such hazard areas include and areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.

6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.

7. Excessive vegetation growth will be controlled through mowing or slashing.

8. All sediment detention systems will be kept in good, working condition. In particular, attention will be given to:

a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them

b) Degradable products to ensure they are replaced as required, and
c) Sediment removal, to ensure the design capacity or less remains in the settling zone.

9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.

10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e. make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.

11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site stabilised

12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.
8 CONCLUSION

This Stormwater Management Plan has been prepared in relation to the proposed Warehouses 2A, 2B and 3 within Part Stage 4 of the Marsden Park Industrial Estate SSD_8606.

A civil engineering strategy for the works has been developed which provides a best practice solution within the constraints of the existing landform and proposed subdivision layout. Within this design a stormwater quantity management strategy has been developed to reduce peak flows leaving this site to remain consistent with the existing flows as a permanent fixture.

The proposed development and civil works consider the infrastructure and site servicing designs completed and submitted as part of separate development approvals to Blacktown City Council including earthworks, the widening and upgrade of Hollinsworth Road and the extension of Hollinsworth Road.

A Sediment and Erosion Control Plan will also be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.
9 REFERENCES

- Part J, Development Control Plan (2015), Blacktown City Council
- Engineering Guide for Development (2005), Blacktown City Council
- Water Sensitive Urban Design – Technical Guidelines for Western Sydney (May 2004), URS Australia Pty Ltd
10 GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afflux</td>
<td>The rise in water level upstream of a hydraulic structure such as a bridge or culvert, caused by losses incurred from the hydraulic structure. The change in flood surface or depth as a result in a modification or change to the hydraulic flood model scenario.</td>
</tr>
<tr>
<td>Australian Height Datum (AHD)</td>
<td>National survey datum corresponding approximately to mean sea level.</td>
</tr>
<tr>
<td>Annual Exceedance Probability (AEP)</td>
<td>The chance of a flood of a given size or larger occurring in any one year, generally expressed as percentage probability. For example, a 100 year ARI flood is a 1% AEP flood. An important implication is that when a 1% AEP flood occurs, there is still a 1% probability that it could occur the following year.</td>
</tr>
<tr>
<td>Average Recurrence Interval (ARI)</td>
<td>Is statistically the long term average number of years between the occurrence of a flood as big as, or larger than the selected flood event. An ARI is the reciprocal of the AEP.</td>
</tr>
<tr>
<td>Catchment</td>
<td>The catchment at a particular point is the area of land which drains to that point.</td>
</tr>
<tr>
<td>Depth to velocity value (DV)</td>
<td>A ratio of flow depth and velocity used as a measure of safety for pedestrians and vehicles subject to flood water. Normally a maximum DV of 0.4 is recommended for pedestrian safety and 0.6 for vehicles.</td>
</tr>
<tr>
<td>Design floor level</td>
<td>The minimum (lowest) floor level specified for a building.</td>
</tr>
<tr>
<td>Design flood</td>
<td>A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood). The design flood may comprise two or more single source dominated floods.</td>
</tr>
<tr>
<td>Development</td>
<td>Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.</td>
</tr>
<tr>
<td>Discharge</td>
<td>The rate of flow of water measured in terms of volume over time. It is not the velocity of flow which is a measure of how fast the water is moving rather than how much is moving. Discharge and flow are interchangeable.</td>
</tr>
<tr>
<td>Digital Terrain Model (DTM)</td>
<td>A three-dimensional model of the ground surface that can be represented as a series of grids with each cell representing an area with a specific elevation.</td>
</tr>
</tbody>
</table>
elevation (DEM) or a series of interconnected triangles with elevations (TIN).

**Effective warning time**
The available time that a community has from receiving a flood warning to when the flood reaches their location.

**First Flush**
The initial surface runoff of a rainstorm. During this phase, water pollution in areas with high proportions of impervious surfaces is typically more concentrated compared to the remainder of the storm.

**Flood**
Above average river, creek, channel or other flows which overtop banks and inundate floodplains or urban areas.

**Flood awareness**
An appreciation of the likely threats and consequences of flooding and an understanding of any flood warning and evacuation procedures. Communities with a high degree of flood awareness respond to flood warnings promptly and efficiently, greatly reducing the potential for damage and loss of life and limb. Communities with a low degree of flood awareness may not fully appreciate the importance of flood warnings and flood preparedness and consequently suffer greater personal and economic losses.

**Flood behaviour**
The pattern / characteristics / nature of a flood.

**Flooding**
The State Emergency Service uses the following definitions in flood warnings:

*Minor flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges

*Moderate flooding:* low-lying areas inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered.

*Major flooding:* extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded.

**Flood frequency analysis**
An analysis of historical flood records to determine estimates of design flood flows.

**Flood fringe**
Land which may be affected by flooding but is not designated as a floodway or flood storage.

**Flood hazard**
The potential threat to property or persons due to flooding.
Flood level  The height or elevation of flood waters relative to a datum (typically the Australian Height Datum). Also referred to as “stage”.

Flood liable land  Land inundated up to the probable maximum flood – flood prone land.

Floodplain  Land adjacent to a river or creek which is inundated by floods up to the probable maximum flood that is designated as flood prone land.

Flood Planning Levels (FPL)  Are the combinations of flood levels and freeboards selected for planning purposes to account for uncertainty in the estimate of the flood level.

Flood proofing  Measures taken to improve or modify the design, construction and alteration of buildings to minimise or eliminate flood damages and threats to life and limb.

Floodplain Management  The coordinated management of activities which occur on flood liable land.

Floodplain Management Manual  A document by the NSW Government (2001) that provides a guideline for the management of flood liable land. This document describes the process of a floodplain risk management study.

Flood source  The source of the flood waters.

Floodplain Management  A set of conditions and policies which define the benchmark from standard which floodplain management options are compared and assessed.

Flood standard  The flood selected for planning and floodplain management activities. The flood may be an historical or design flood. It should be based on an understanding of the flood behaviour and the associated flood hazard. It should also take into account social, economic and ecological considerations.

Flood storages  Floodplain areas which are important for the temporary storage of flood waters during a flood.

Floodways  Those areas of the floodplain where a significant discharge of flow occurs during floods. They are often aligned with naturally defined channels or overland flow paths. Floodways are areas that, even if they are partially blocked, would cause significant redistribution of flood flows, or a significant increase in flood levels.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeboard</td>
<td>A factor of safety usually expressed as a height above the flood standard. Freeboard tends to compensate for the factors such as wave action, localised hydraulic effects, uncertainties in the hydrology, uncertainties in the flood modelling and uncertainties in the design flood levels.</td>
</tr>
<tr>
<td>Geographical Information System (GIS)</td>
<td>A form of computer software developed for mapping applications and data storage. Useful for generating terrain models and processing data for input into flood estimation models.</td>
</tr>
<tr>
<td>High hazard</td>
<td>Danger to life and limb; evacuation difficult; potential for structural damage, high social disruption and economic losses. High hazard areas are those areas subject to a combination of flood depth and flow velocity that are deemed to cause the above issues to persons or property.</td>
</tr>
<tr>
<td>Historical flood</td>
<td>A flood which has actually occurred – Flood of Record.</td>
</tr>
<tr>
<td>Hydraulic</td>
<td>The term given to the study of water flow.</td>
</tr>
<tr>
<td>Hydrograph</td>
<td>A graph showing how flow rate changes with time.</td>
</tr>
<tr>
<td>Hydrology</td>
<td>The term given to the study of the rain-runoff process in catchments.</td>
</tr>
<tr>
<td>Low hazard</td>
<td>Flood depths and velocities are sufficiently low that people and their possessions can be evacuated.</td>
</tr>
<tr>
<td>Map Grid of Australia (MGA)</td>
<td>A national coordinate system used for the mapping of features on a representation of the earth’s surface. Based on the geographic coordinate system ‘Geodetic Datum of Australia 1994’.</td>
</tr>
<tr>
<td>Peak flood level, flow or velocity</td>
<td>The maximum flood level, flow or velocity occurring during a flood event.</td>
</tr>
<tr>
<td>MUSIC</td>
<td>Acronym for Model for Urban Stormwater Improvement Conceptualisation. A computer model which is used to simulate rainfall runoff, associated pollutants within the runoff and expected treatment of the pollutants using different treatment measures.</td>
</tr>
<tr>
<td>Probable Maximum Flood (PMF)</td>
<td>An extreme flood deemed to be the maximum statistical flood likely to occur at a particular location.</td>
</tr>
</tbody>
</table>
Probable Maximum Precipitation (PMP)  The greatest statistical depth of rainfall for a given duration meteorologically possible over a particular location. Used to estimate the probable maximum flood.

Probability  A statistical measure of the likely frequency or occurrence of flooding.

Riparian Zone  Areas that are located adjacent to watercourses. Their definition is vague and can be characterised by landform, vegetation, legislation or their function.

Runoff  The amount of rainfall from a catchment which actually ends up as flowing water in the river of creek.

Stage  Equivalent to water level above a specific datum- see flood level.

Treatment train  A term used to describe a series of water quality measures which act in conjunction with one another to provide a combined water quality outcome.

Triangular Irregular Network (TIN)  A mass of interconnected triangles used to model three-dimensional surfaces such as the ground (see DTM) and the surface of a flood.

Velocity  The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section.
Appendix A

DRAWINGS BY COSTIN ROE CONSULTING
Appendix B

MUSIC MODEL CONFIGURATION AND MUSIC LINK

![Diagram of MUSIC model configuration and link]

![Table showing treatment train effectiveness]

<table>
<thead>
<tr>
<th>Source</th>
<th>Residual Load</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (ML/yr)</td>
<td>61.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Total Suspended Solids (kg/yr)</td>
<td>9910</td>
<td>88.4</td>
</tr>
<tr>
<td>Total Phosphorus (kg/yr)</td>
<td>20.5</td>
<td>66.1</td>
</tr>
<tr>
<td>Total Nitrogen (kg/yr)</td>
<td>140</td>
<td>45</td>
</tr>
<tr>
<td>Gross Pollutants (kg/yr)</td>
<td>1580</td>
<td>100</td>
</tr>
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</table>
Appendix C
SEI PRE AND POST DEVELOPMENT MUSIC CONFIGURATION

Pre-Development

<table>
<thead>
<tr>
<th>Flow (ML/yr)</th>
<th>TSS (kg/yr)</th>
<th>TP (kg/yr)</th>
<th>TN (kg/yr)</th>
<th>GP (kg/yr)</th>
</tr>
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<tr>
<td>18</td>
<td>1468</td>
<td>4</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>ET Loss</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Infiltration Loss</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low Flow Bypass Out</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High Flow Bypass Out</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pipe Out</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weir Out</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Transfer Function Out</td>
<td>3</td>
<td>532</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Reuse Supplied</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reuse Requested</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% Reuse Demand Met</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% Load Reduction</td>
<td>84</td>
<td>64</td>
<td>78</td>
<td>80</td>
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</tbody>
</table>

Decimal Places: 0
Post-Development

Node Water Balance - Generic Treatment Node

<table>
<thead>
<tr>
<th>Component</th>
<th>Flow (ML/yr)</th>
<th>TSS (kg/yr)</th>
<th>TP (kg/yr)</th>
<th>TH (kg/yr)</th>
<th>GP (kg/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow In</td>
<td>58.68</td>
<td>1150.60</td>
<td>7.04</td>
<td>77.00</td>
<td>0.31</td>
</tr>
<tr>
<td>ET Loss</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Infiltration Loss</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Low Flow Bypass Out</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>High Flow Bypass Out</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Pipe Out</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Weir Out</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Transfer Function Out</td>
<td>10.34</td>
<td>430.88</td>
<td>1.71</td>
<td>15.49</td>
<td>0.03</td>
</tr>
<tr>
<td>Reuse Supplied</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Reuse Requested</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>% Reuse Demand Met</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>% Load Reduction</td>
<td>82.38</td>
<td>62.55</td>
<td>75.65</td>
<td>79.88</td>
<td>89.15</td>
</tr>
</tbody>
</table>

Decimal Places: 2
Appendix E
EROSION CONTROL CHECK SHEET
EROSION AND SEDIMENT CONTROL
WEEKLY SITE INSPECTION SHEET

LOCATION .................................................................

INSPECTION OFFICER .................. DATE ..............

SIGNATURE ........................................................................

Legend: ☐ OK ☐ Not OK N/A Not applicable

<table>
<thead>
<tr>
<th>Item</th>
<th>Consideration</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Public roadways clear of sediment.</td>
<td>............</td>
</tr>
<tr>
<td>2</td>
<td>Entry/exit pads clear of excessive sediment deposition.</td>
<td>............</td>
</tr>
<tr>
<td>3</td>
<td>Entry/exit pads have adequate void spacing to trap sediment.</td>
<td>............</td>
</tr>
<tr>
<td>4</td>
<td>The construction site is clear of litter and unconfined rubbish.</td>
<td>............</td>
</tr>
<tr>
<td>5</td>
<td>Adequate stockpiles of emergency ESC materials exist on site.</td>
<td>............</td>
</tr>
<tr>
<td>6</td>
<td>Site dust is being adequately controlled.</td>
<td>............</td>
</tr>
<tr>
<td>7</td>
<td>Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.</td>
<td>............</td>
</tr>
<tr>
<td>8</td>
<td>Up-slope “clean” water is being appropriately diverted around/through the site.</td>
<td>............</td>
</tr>
<tr>
<td>9</td>
<td>Drainage lines are free of soil scour and sediment deposition.</td>
<td>............</td>
</tr>
<tr>
<td>10</td>
<td>No areas of exposed soil are in need of erosion control.</td>
<td>............</td>
</tr>
<tr>
<td>11</td>
<td>Earth batters are free of “rill” erosion.</td>
<td>............</td>
</tr>
<tr>
<td>12</td>
<td>Erosion control mulch is not being displaced by wind or water.</td>
<td>............</td>
</tr>
<tr>
<td>13</td>
<td>Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.</td>
<td>............</td>
</tr>
<tr>
<td>14</td>
<td>Sediment fences are free from damage.</td>
<td>............</td>
</tr>
<tr>
<td>15</td>
<td>Sediment-laden stormwater is not simply flowing “around” the sediment fences or other sediment traps.</td>
<td>............</td>
</tr>
<tr>
<td>16</td>
<td>Sediment controls placed up-slope/around stormwater inlets are appropriate for the type of inlet structure.</td>
<td>............</td>
</tr>
<tr>
<td>17</td>
<td>All sediment traps are free of excessive sediment deposition.</td>
<td>............</td>
</tr>
<tr>
<td>18</td>
<td>The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.</td>
<td>............</td>
</tr>
<tr>
<td>19</td>
<td>All reasonable and practicable measures are being taken to control sediment runoff from the site.</td>
<td>............</td>
</tr>
<tr>
<td>20</td>
<td>All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.</td>
<td>............</td>
</tr>
<tr>
<td>21</td>
<td>Stabilised surfaces have a minimum 70% soil coverage.</td>
<td>............</td>
</tr>
<tr>
<td>22</td>
<td>The site is adequately prepared for imminent storms.</td>
<td>............</td>
</tr>
<tr>
<td>23</td>
<td>All ESC measures are in proper working order.</td>
<td>............</td>
</tr>
</tbody>
</table>
Appendix F
DRAINS MODEL CONFIGURATION