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Dear Richard

Port Botany Industrial Estate Turning Head Flood Impact Assessment

1 Introduction

Orica Australia/DBL Property have recently undertaken development of a site located on the corner of Coal Pier Road and McPherson Street in Banksmeadow NSW. Hydraulic modelling for the site was conducted by Aurecon. Final modelling using as-constructed survey was previously undertaken to confirm acceptable flood impacts to satisfy requirements of the Project Approval.

Goodman has identified that the fire brigade has requested a turning head be installed to the NE corner of the carpark which may reduce the storage capacity of the northern basin by 23 m^3 in volume. The approximate extent of works are shown in a drawing markup by Costinroe Consulting stamped Co9349.06-SK01 (see attached).

Aurecon was commissioned to assess the feasibility of this modification to the constructed fill platform and determine whether there would be any impact to overall flood storage within the site and the effect on flood levels within and exterior to the property.

2 Background

Orica Australia has developed an industrial estate known as “Southlands” at Banksmeadow near Botany Bay. The land is located in the lower part of the water catchment of Springvale and Floodvale Drains. In 2007, Aurecon undertook a flood investigation of the proposed Orica Southlands site and surrounding areas. The investigation involved survey, hydrologic modelling using RAFTS and hydraulic modelling using a MIKE 11 one-dimensional hydraulic model. The modelling and interpretation of results was submitted in the report *ORICA/Goodman Southlands Remediation/Development Project* (Aurecon, March 2009).

The NSW Department of Planning (DoP) undertook a review of the previous modelling works using independent consultants (Webb McKeown & Associates). Comment on the development was also accepted from surrounding landholders. A meeting with DoP to discuss comments from the review suggested a number of additional tasks, primarily that two-dimensional hydraulic modelling be undertaken to address most of these comments.

In response to these comments the modelling exercise was extended utilising a two-dimensional hydraulic model, updating the model to include changes in the surrounding area and new developments that have occurred since the original model. The study also included alterations to the development plans to incorporate further flood mitigation measures to ensure no adverse flood impacts thus satisfying the planning criteria. Results of this model were presented in *ORICA*

Southlands Remediation and Development Project Hydraulic Modelling Report and Response to Exhibition Submissions/Comments (Aurecon, November 2010). Further modification of the proposed development layout and flood mitigation works were reported in an addendum letter report titled *Southlands – Detailed Design 2D Flood Re-Modelling – Addendum Advice Regarding Variation to Compensatory Flood Basin Design and Impact* (Aurecon, 22 February 2013).

Approval for the project was granted subject to a number of conditions, including Schedule 3 Condition 10, requiring a Validation Assessment of the flood modelling once an as constructed survey has been undertaken to confirm that the flood impact is no greater than indicated in Figures D9a, D10a and D11a of the addendum report. Hydraulic modelling for this validation assessment was undertaken following receipt of as-constructed survey data in May 2015 and results were reported to Orica Australia/DBL Property in a letter report *Orica Southlands – Hydraulic Modelling Flood Validation Assessment Review* (Aurecon, May 2015)

3 Hydraulic assessment

Hydraulic assessment of the Orica Southlands development was undertaken using a MIKE FLOOD linked 1D/2D hydraulic model to represent the existing, proposed development and as-constructed site conditions. Assessment of the modifications requested by Goodman been conducted by:

- Creating a 3D digital model of the proposed turning head from the markup provided by Goodman
- Creating a new hydraulic model topography file to represent the proposed changes
- Simulation of design events (50%, 10% and 1% AEP) for each scenario
- Comparison of peak water levels resulting from the modified scenarios with pre-development and as-constructed levels

4 Site configuration and general flow patterns

The development site is located between Floodvale Drain, which flows southward adjacent to Coal Pier Road to the west, and Springvale Drain, which flows adjacent to Nant Street to the east. Ground levels for the pre-development and as-constructed site conditions are shown in Figure 1.

Previous hydraulic investigations identified that the development site was relatively flood prone, and flow transfers through the site, typically from west to east, during even minor events. The site development provides a dedicated flowpath along the northern property boundary. This flowpath has been carefully sized in terms of both capacity and elevation to match existing flow capacity through the site so as not to worsen conditions in either drain.

The turning head encroaches into the northern flowpath. Although the earthworks proposed for the turning head represent a relatively small volume and minor change in level, the flow capacity and elevation of the northern flowpath are important for maintaining the correct flow balance between Floodvale and Springvale Drains. The turning head is located at the key control point for the channel, particularly during minor events, and could potentially have an adverse impact.

Several variations of the turning head were assessed. The preferred option, which has minimal impact on flooding patterns, has the turning head generally at the currently constructed ground level (~3.8 to 3.85m AHD), as proposed in Sketch Co9349.06-SK01. Changes introduced by the turning head is therefore limited to minor cut and fill through the fill platform batter slope. This condition, referred to as “Scenario 1”, represents the as-constructed fill platforms with the turning head.

5 Hydraulic assessment results

5.1 Impacts of the turning head

Hydraulic modelling was undertaken to investigate the incremental effects of including the turning head on the as-constructed works. Figure 2 to Figure 4 show the flood depths for the Scenario 1 as-constructed conditions with the turning head at current ground level ("a" series) as well as the difference in peak flood levels between Scenario 1 and as-constructed levels without the turning head ("b" series).

The b-series figures demonstrate that the turning causes negligible differences in flood level when compared to the (< ±1mm) as-constructed conditions for all modelled design events. External to the property, when compared to the as-constructed scenario some minor impacts are observed in Floodvale Drain to the south for the 50% AEP event (Figure 2b) and to the north for the 1% AEP event (Figure 4b), however these are well removed from the works area and are considered to be more likely related to minor instabilities in the model than an impact of the works.

5.2 Flow characteristics

The preferred turning head arrangement is constructed at ground level to minimise impact on currently designed flow conditions, as flood levels are dependent on the flow capacity and storage within the northern bypass channel. As discussed in Section 5.1, the turning head has negligible impact flood levels and inundation depths with the proposed turning head are virtually identical to as-constructed levels and depths. Inundation depths, velocities and depth-velocity product at the turning head are summarised in Table 1.

Because it is constructed at current ground level within the flow bypass channel, the turning head is potentially subjected to inundation during minor flood events (< 50% AEP). The inundation depth and velocities and velocities during this event are small. The turning head is considered to be trafficable by ordinary vehicles up to the 10% AEP event (D ~ 0.2m, D.V = 0.14) and is likely still trafficable by heavy vehicles up to the 1% AEP event (D < 0.4m, D.V = 0.3). Since the turning head is intended for use primarily by emergency vehicles (fire department), the coincidence of a major flood with a fire within the building is considered to be extremely low.

Warning signs and depth markers will be provided to alert potential users as to the depth and risk of flooding. If trafficability is considered unsafe, vehicles could potentially conduct a multi-point turn within the carpark, or simply wait until the flood waters recede. Duration of inundation is expected to be typically less than three hours. The car-park entry is also inundated at approximately the 10% AEP event, so the duration in which the car-park entry is trafficable and the turning head not trafficable will be even shorter.

Table 1 Turning head inundation characteristics

AEP	Water Level (m AHD)	Max Depth (m)	Max Velocity (m/s)	D.V (m^2/s)	Time of Inundation (h)
50%	3.90	0.10	0.41	0.04	<1
10%	4.01	0.21	0.66	0..14	<2
1%	4.16	0.36	0.84	0.30	<3

5.3 Comparison with Approved Design conditions

Figure 5 to Figure 7 show the differences in flood level between the original Approved Design ("a" series) and the As-Constructed with turning head ("b" series) compared to the pre-development conditions. The b-series therefore show the cumulative differences caused by both impacts of the turning head and differences between the As-Constructed and Design ground levels.

In the 50% AEP event, as-constructed flood levels are 20mm higher than the Approved Design along Springvale Drain on the eastern side of the property. This is primarily due to differences between the As-Constructed and Design levels in the detention areas on the eastern side of Nant St. These differences are generally contained within the development property boundaries. These differences reduce for larger events. For the 10% AEP event, the levels inside the property are within 3mm of the Design, although there is an area of slightly greater increase (<7mm) on the southern side of McPherson Street. As demonstrated in Figure 2, the as-constructed flood levels in this area are still over 40mm lower than for pre-development conditions. These differences are therefore not considered to represent a worsening of flood conditions. For the 1% AEP event, the as-constructed levels are generally equal to or slightly lower than the approved design with the exception of a few localised anomalies.

As identified in Section 5.1, the proposed turning head results in negligible change to the flood levels compared to as-constructed conditions. The differences between the turning head and approved design conditions are therefore virtually identical to those of the as-constructed conditions.

5.4 Alternative options

An alternative design for the turning head raised to RL 4.0m AHD (same level as the car park entrance road), providing approximately 10% AEP immunity and reduced inundation depth during larger events. This altenative was found to have a much more noticeable effect on flood levels. The turning head restricts flows through the northern channel during minor events tending to slightly lower flood levels in Springvale Drain (eastern side) while increasing flood levels in the northern channel and in Floodvale Drain (western side). Although minor, these impacts did potentially represent a slight worsening of flood levels at some locations external to the development property.

The turning head is located at a V-shape control section in the northern bypass channel. A small area of the embankment on the northern side of control section could therefore be excavated to compensate for impacts of the raised turning head. Preliminary investigations identified that such compensatory excavation was feasible, but would require a careful balance to avoid providing too little or too much conveyance.

6 Conclusions and recommendations

The proposed turning head encroaches into the northern bypass channel that conveys overflow around the development between Floodvale and Springvale Drains. The currently preferred turning head design (Scenario 1) places the turning head at the current as-constructed ground level and requires only minor changes to the fill platform batter slope, thus minimising hydraulic impact. Overall, the proposed turning head can be concluded to have negligible impact, with predicted flood levels virtually identical to the current as-constructed conditions.

The proposed turning head is acknowledge to have low immunity, however the depth of inundation and velocity are generally low and the turning head is considered to be trafficable for general vehicles under minor to moderate flood conditions and by heavy vehicles under major flood conditions, although such usage is not recommended. Warning signs and depth indicators will be provided to indicate flood conditions.

The turning head could potentially be raised to improve the flood immunity, however this would increase the hydraulic impact. The turning head works are located at a V-shape control section in the northern bypass channel, so some compensatory works on the other side of the 'V' could be undertaken to offset any impact of the turning head. These do not appear to be necessary for the proposed turning head, but could be investigated if the turning head needs to be raised to provide improved flood immunity.

Should you have any queries please do not hesitate to contact the undersigned.

Yours sincerely

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Senior Water Engineer

Enc: Sketch Co9349.06-SK01 (Costinroe Consulting, 2 June 2015)
Figure 1 Model bathymetry (pre-development and as-constructed)
Figure 2 50% AEP Turning Head Scenario 1 flood depth and level difference maps
Figure 3 10% AEP Turning Head Scenario 1 flood depth and level difference maps
Figure 4 1% AEP Turning Head Scenario 1 flood depth and level difference maps
Figure 5 50% AEP Design and Turning Head Scenario 1 differences to Existing
Figure 6 10% AEP Design and Turning Head Scenario 1 differences to Existing
Figure 7 1% AEP Design and Turning Head Scenario 1 differences to Existing