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Via email: [Gavin.Rowley@shfa.nsw.gov.au](mailto:Gavin.Rowley@shfa.nsw.gov.au)

Dear Gavin

## Cockle Bay Renewal Project - Western Promenade Crowd Flow Analysis

The scope of this analysis is to provide advice on crowd flow consequences of the wharf and surrounds. It is limited to providing advice based on crowd flow densities and what flow rates are possible before congestion starts to occur.

ACES has utilised the Fruin **Level of Service (LoS)** model which establishes a relationship between crowd density and available corridor width as depicted in Annex A to calculate potential speed and flow for pedestrians.

ACES has conducted this analysis based on available information, stakeholder consultation and research. The nature of the area however presents a dynamic area with ever changing hazard and risk profiles and event specific analysis should be a further consideration.

I look forward to further discussions at your convenience.

Best regards

Travis Semmens

Managing Director

## LEVEL OF SERVICE MODELS FOR WALKING CROWDS

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Pedestrian Level of Service Level-of-service standards provide a useful means of determining the environmental quality of a pedestrian space. Pedestrian service standards related to walking are based on the freedom to select desired walking speeds and the ability to bypass slower-moving pedestrians. Other measures related to pedestrian flow include the ability to cross a pedestrian traffic stream, to walk in the reverse direction of a major pedestrian flow, and to maneuver without conflicts and changes in walking speed.

**LEVEL OF SERVICE STANDARDS**

From a planning consideration for ambulatory crowds it is not desirable to design walkways based on capacity, but on a desired pedestrian level of service. The desirable pedestrian environment allows sufficient space for the pedestrian to:

- walk at a relaxed walking speed,
- bypass slower pedestrians,
- avoid conflicts with oncoming or crossing pedestrians, and
- interact visually with surroundings.

The level-of-service standards as depicted in Annex B are given as a relative scale based on achieving a desirable pedestrian environment that will allow for free flowing pedestrian corridors.

**NOTE:** LoS category F is not recommended due to the variable nature of the crowd flow does not allow for accurate analysis and should be considered a critical crowd density.

Further considerations such as crowd dynamic ie. family groups with prams / strollers or tourist groups with luggage will further degrade flow rates at LoS categories D and E.

The calculated flow rates for the Cockle Bay Renewal Project are provided below in Table 1 and have been extrapolated from the attachment LoS Calculator – Cockle Bay Renewal Project.xlsx.

Table 1.

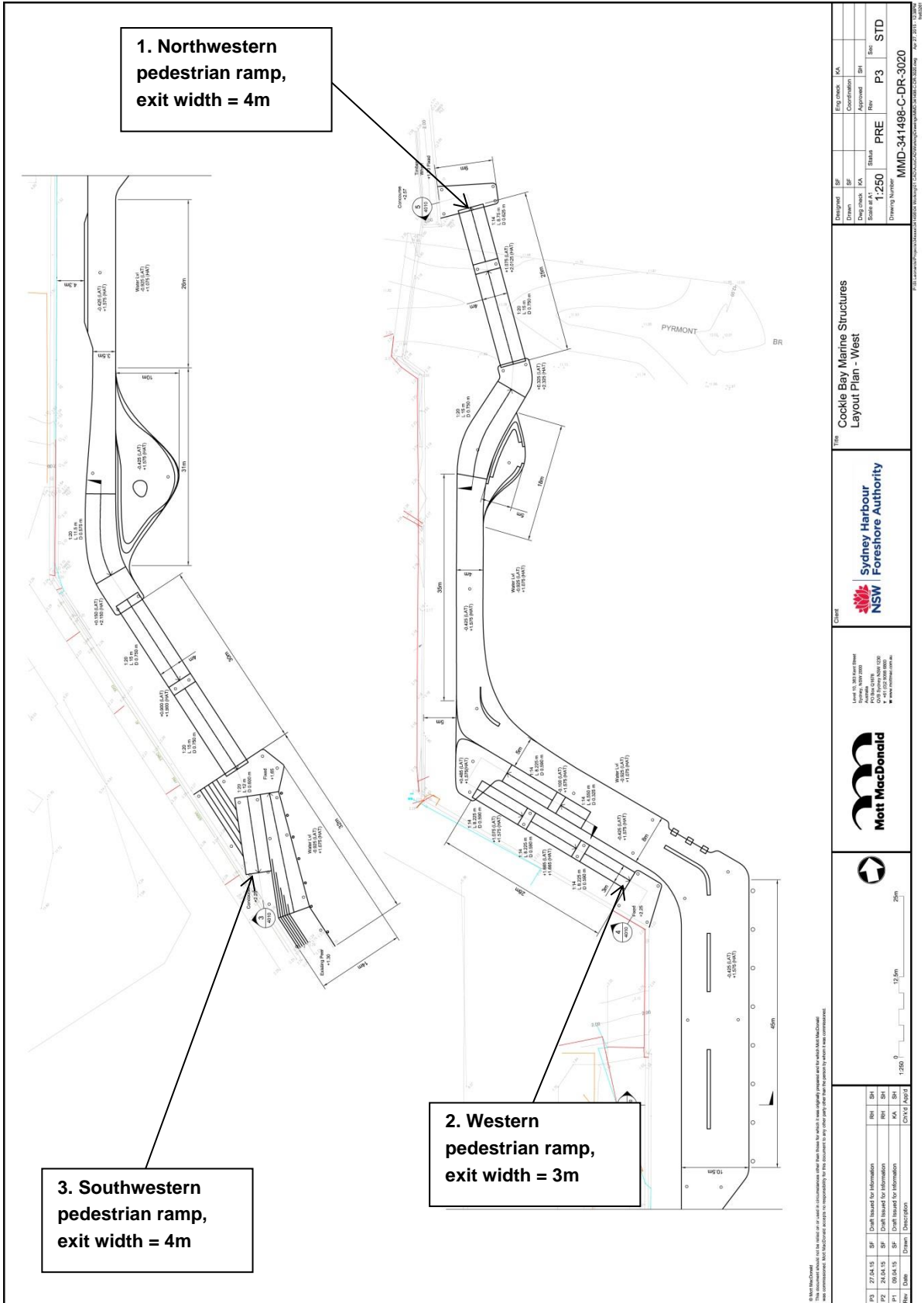
		<b>Pedestrian flow rates per minute (ppm) based on LoS level</b>				
		<b>LoS A</b>	<b>LoS B</b>	<b>LoS C</b>	<b>LoS D</b>	<b>LoS E</b>
<b>Corridor 1 =</b>	4m	24.4	85.2	122	182.8	304.8
<b>Corridor 2 =</b>	3m	18.3	63.9	91.5	137.1	228.6
<b>Corridor 3 =</b>	4m	24.4	85.2	122	182.8	304.8
<b>Total =</b>	11m	67.1	234.3	335.5	502.7	838.2

What Table 1. demonstrates is that the project area has the theoretical capacity to manage a one-way pedestrian corridor that can move upto **838** pedestrians per minute where individual freedom of movement is extremely restricted ie. cross movements and contraflow.

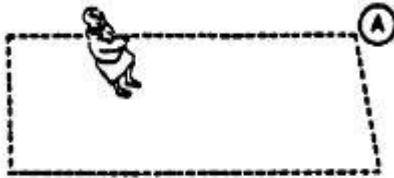
Conversly the project area still maintains manageable a crowd flow rate of **502** pedestrians per minute where individual movement is restricted but still achievable.

To maintain these flow rates for 2-way traffic significant infrastructure would need to be implemented to maintain ‘two way traffic lanes’ such as lane dividers (barricades) supplemented with pedestrian information devices to identify entry and exit lanes and directional advice (electronic arrow boards etc...).

Annex A. Cockle Bay Marine Structures Layout Plan – West



Annex B. Illustration of Walkway Levels of Service

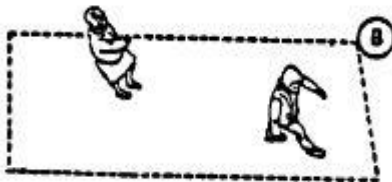


**LEVEL OF SERVICE A**

Pedestrian Space:  $\geq 12.1 \text{ m}^2/\text{ped}$

Unit Width Flow:  $\leq 6.1 \text{ ped}/\text{min}/\text{m}$

Description: Walking speeds are freely selected; conflicts with other pedestrians are unlikely.



**LEVEL OF SERVICE B**

Pedestrian Space:  $\geq 3.7 \text{ m}^2/\text{ped}$

Unit Width Flow:  $\leq 21.3 \text{ ped}/\text{min}/\text{m}$

Description: Walking speeds are freely selected; pedestrians become aware of others and respond to their presence.

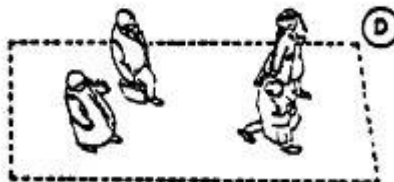


**LEVEL OF SERVICE C**

Pedestrian Space:  $\geq 2.2 \text{ m}^2/\text{ped}$

Unit Width Flow:  $\leq 30.5 \text{ ped}/\text{min}/\text{m}$

Description: Walking speeds are freely selected; passing is possible in unidirectional streams; minor conflicts will exist for reverse or crossing movements.

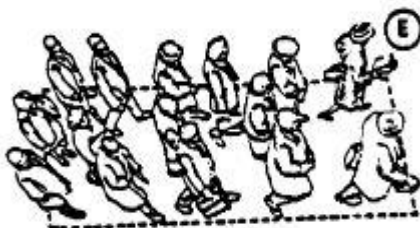


**LEVEL OF SERVICE D**

Pedestrian Space:  $\geq 1.4 \text{ m}^2/\text{ped}$

Unit Width Flow:  $\leq 45.7 \text{ ped}/\text{min}/\text{m}$

Description: Freedom to select desired walking speeds and to pass others is restricted; high probability of conflicts for reverse or crossing movements.



**LEVEL OF SERVICE E**

Pedestrian Space:  $\geq 0.6 \text{ m}^2/\text{ped}$

Unit Width Flow:  $\leq 76.2 \text{ ped}/\text{min}/\text{m}$

Description: Walking speeds and passing ability are restricted for all pedestrians; forward movement is possible only by shuffling; reverse or cross movements are possible only with extreme difficulties; traffic volumes approach limit of walking capacity.



**LEVEL OF SERVICE F**

Pedestrian Space:  $\geq 0.6 \text{ m}^2/\text{ped}$

Unit Width Flow:  $\leq \text{variable}$

Description: Walking speeds are severely restricted; frequent, unavoidable contact with others; reverse or cross movements are virtually impossible; flow is sporadic and unstable.