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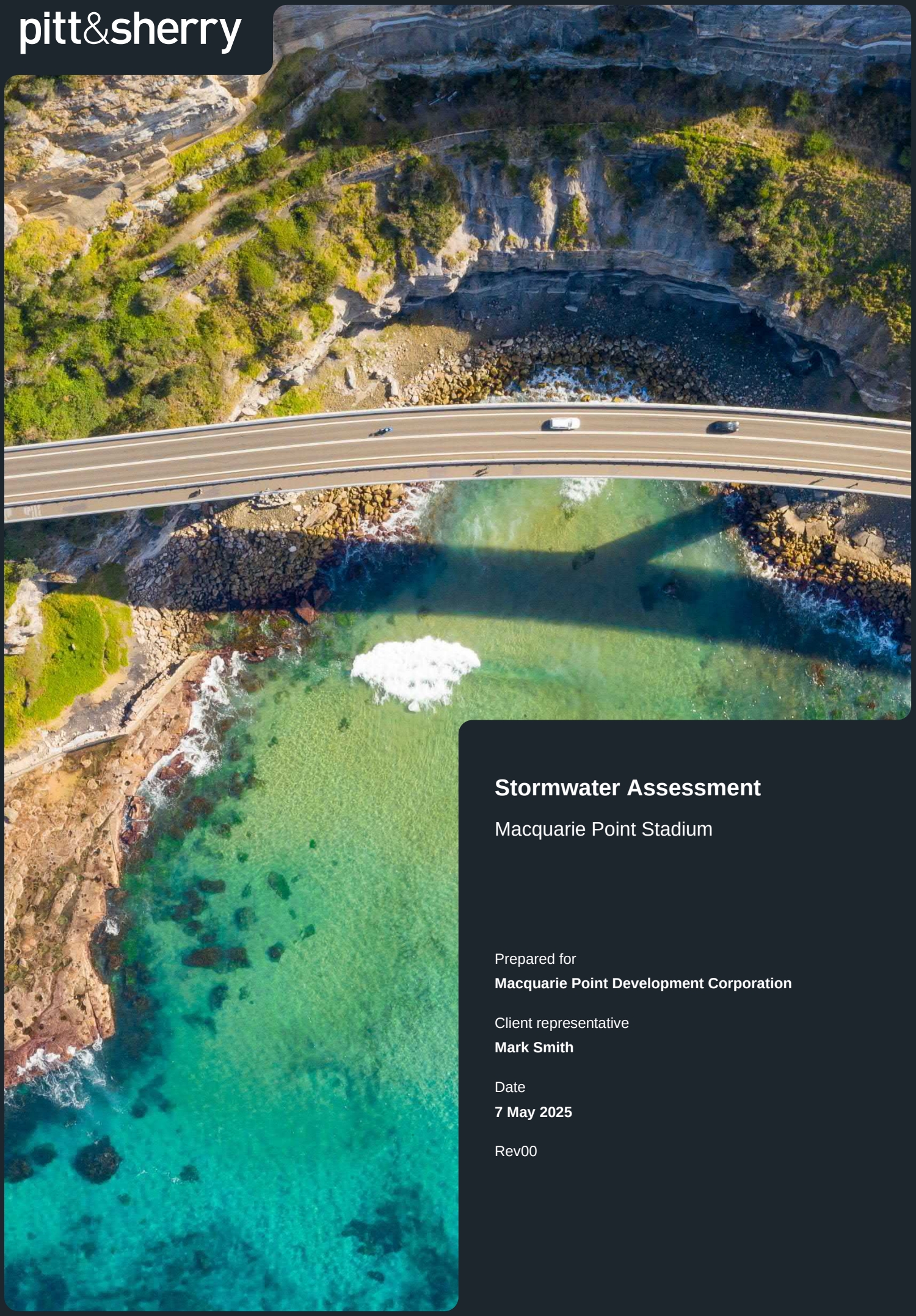

Stormwater Assessment

Macquarie Point Stadium

Prepared for

Macquarie Point Development Corporation

Client representative

Mark Smith

Date

7 May 2025

Rev00

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Appendices

Appendix A — Flood Maps

Prepared by — Josh Coates		**Date —07/05/2025**
Reviewed by — Stephen Masters		**Date — 07/05/2025**
Authorised by — Andrew Turner		**Date — 07/05/2025**

Revision History

Rev No.	Description	Prepared by	Reviewed by	Authorised by	Date

1. Introduction

1.1 Proposed development

The Macquarie Point and Regatta Point area to the north east of Hobart's CBD is proposed to be transformed into a multi-use zone. The dominant development will be a 23,000 seat multi-purpose stadium to be used for sporting events as well as other events requiring large patron capacity. Surrounding the stadium the following developments are proposed:

- Complimentary Integrated Mixed Use Zone (CIMUZ)
- Antarctic Facilities Zone (AFZ)
- Regatta Residential and Public Foreshore Zone (not part of this assessment)

The precinct requires a new road to be built from the north (Northern Road) and complimentary paved areas linking the various developments (Public Open Space, POS). Refer Figure 1 for a site master plan.

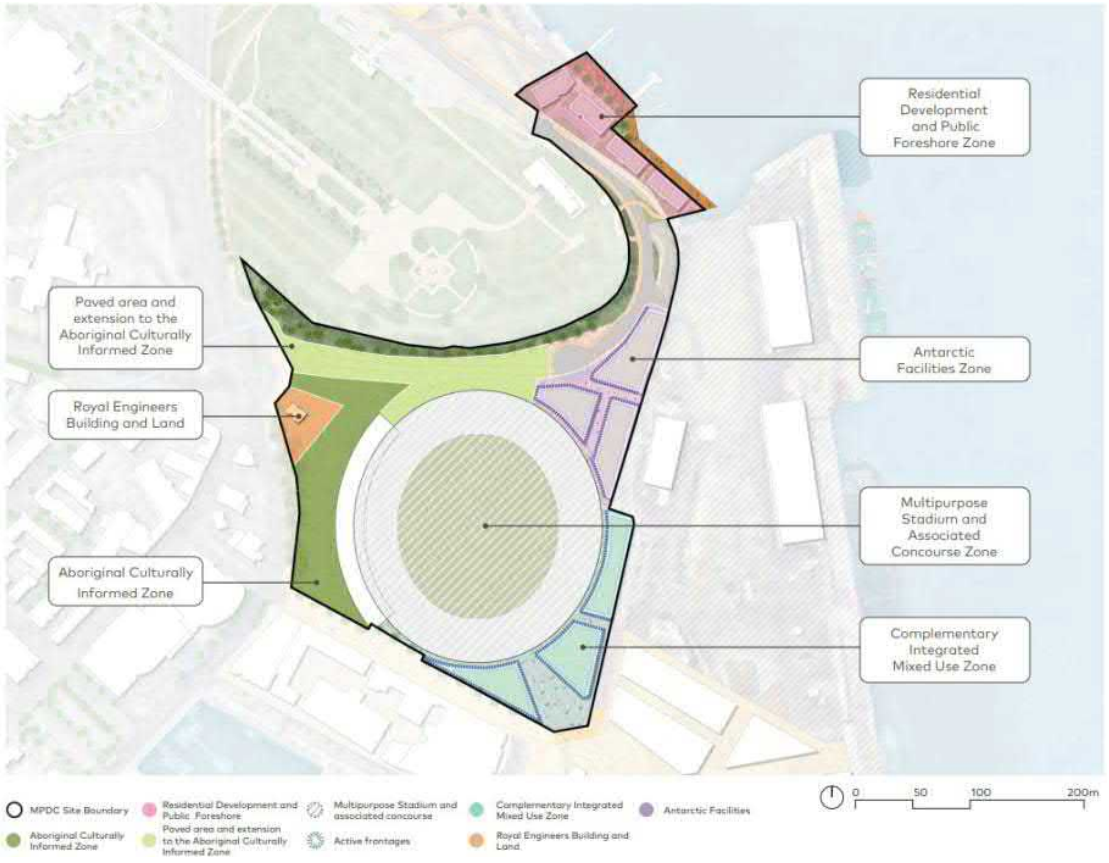

Figure 1: Proposed development plan

1.2 Purpose and format of this report

The scope of this hydrologic and hydraulic assessment is the analysis of the stormwater management system to manage runoff generated from stadium including the plaza, likely proposed buildings and the stadium roof. This report provides a high-level overview of the existing and proposed conditions with a comprehensive report to follow.

2. Drainage Assessment

2.1 Existing System Overview

A review has been undertaken of the existing drainage system servicing the Macquarie Point Precinct. Figure 2 shows the key drainage infrastructure and proposed discharge points.

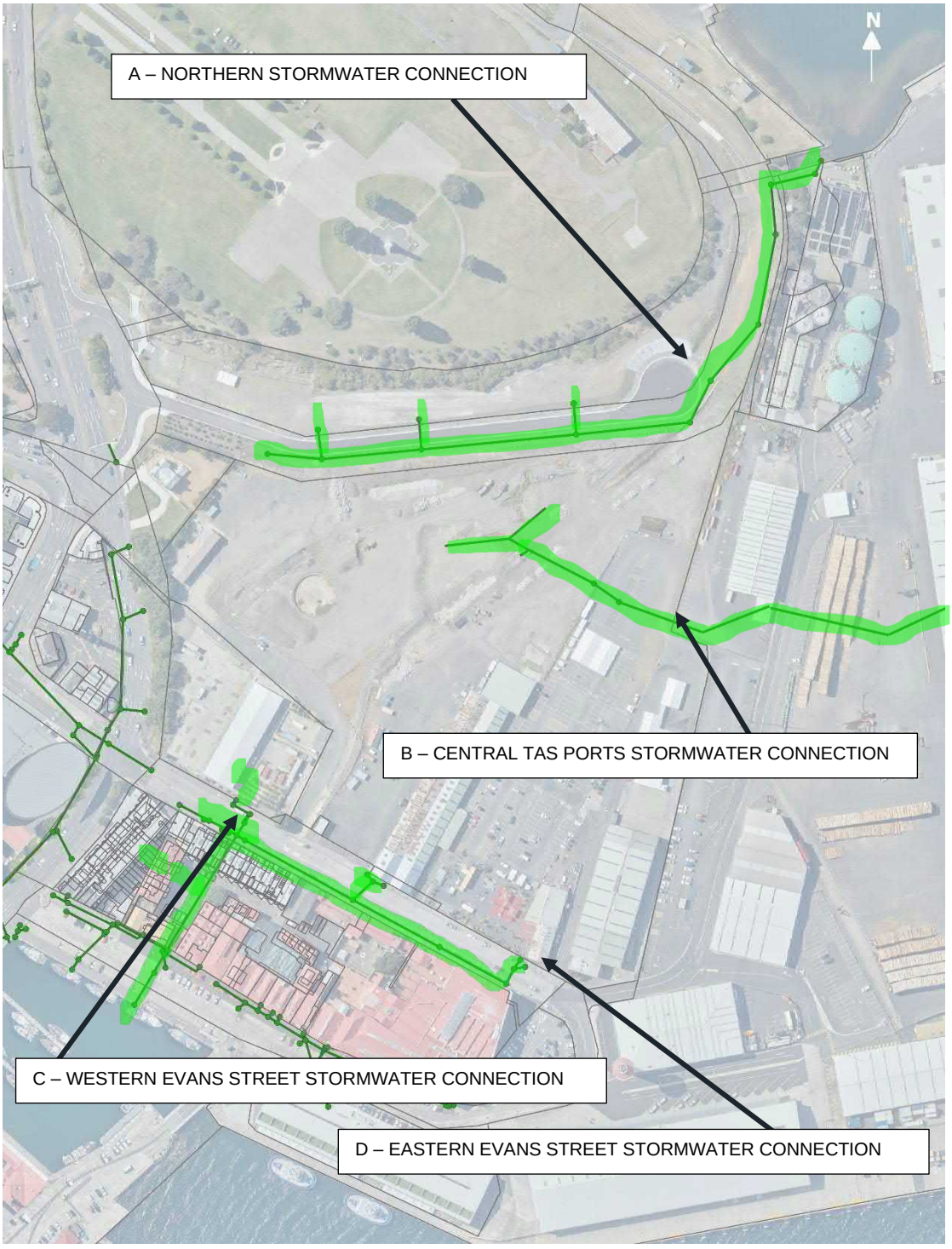

Figure 2: Existing Drainage System Servicing Macquarie Point

The site is serviced by four stormwater connections. These are:

- A – Northern Stormwater Connection – comprising a DN750 stormwater connection, inclusive of a gross pollutant trap. The stormwater connection varies from DN300 at the most upstream end (west) to DN750 at the downstream end (east). This stormwater system (installed in 2020) serviced an existing road and was designed to service a future development proposal in Macquarie Point. Much of the site south of this connection point is unable to drain to this line (elevation is lower than the invert of the stormwater pipe).
- B – Central TasPorts Connection – comprising an estimated DN450/DN525 stormwater connection.
- C – Eastern Evans Street Connection – this is an existing drainage system that services buildings on Evans / Hunter Street, road areas and the existing development within the Macquarie Point Precinct (existing goods shed etc.)
- D – Western Evans Street Connection - Includes Hobart Brewing Co and the Goods Shed. Stormwater from this location will ultimately drain to connection point C

A hydrologic / hydraulic assessment has been carried out to determine flow rates being directed to these stormwater connections points and the discharge to these points. The results of this analysis will be used to determine/inform the drainage approach for the stadium, i.e. determine how much stormwater from the stadium and associated concourse is able to be direct to stormwater connections.

A DRAINS hydrologic / hydraulic model has been developed in accordance with the principles set out in Australian Rainfall and Runoff 2019 (ARR2019). This model has been developed by sourcing information from several existing studies.

An initial loss-continuing loss (IL-CL) hydrological model was used to assess the hydrology. The hydrologic assessment included the assessment of storm durations from 5 minutes to 6 hours, with ten temporal patterns for each duration and consideration of median pre-burst rainfall depths. The following assumptions were made in the model:

- Impervious area – initial loss (mm) and continuing loss (mm/hr) area 1 and 0 respectively
- Pervious area – initial loss (mm) and continuing loss (mm/hr) are 10 and 2 respectively. These values are typical for pervious areas in urban environments.
- The total catchment has been delineated and discretised into sub-catchments areas. A breakup of the total catchment is presented below
- Time of concentration has been estimated from travel time components as recommended in the Queensland Urban Drainage Manual (QUDM), which is a document widely referred to in Australia when designing drainage networks. The document combines best practices and technical studies that are not specific to determined locations.
- The 10% AEP storm events were defined as the minor storms and 1% AEP events were defined as the major storms. The stormwater management measures were sized to major storm events to ensure the stormwater system can accommodate extreme events and based on the assumption that overland flow may be problematic to manage around underground carpark entrances and limitations of the drainage system to the south.
- Prior to the August 2024 update to ARR with respect to climate change advice, the most aggressive emissions assumption (RCP8.5) and consequent mean temperature increase, produced an 18.3**%** increase in rainfall by 2090. This equates to a design factor of 1.18. Based on recent consultation between the Project Team and the City of Hobart the following design events have been proposed for assessing the development:
    - Minor – SSP2-4.5, year 2100, 10% AEP (Climate Change design factor of 1.41 for <1hr)
    - Major – SSP3-7.0, year 2100, 1% AEP (Climate Change design factor of 1.66 for <1hr)
- A tailwater level of 1.7m AHD has been adopted for all outlets which is the HAT for the year 2100.

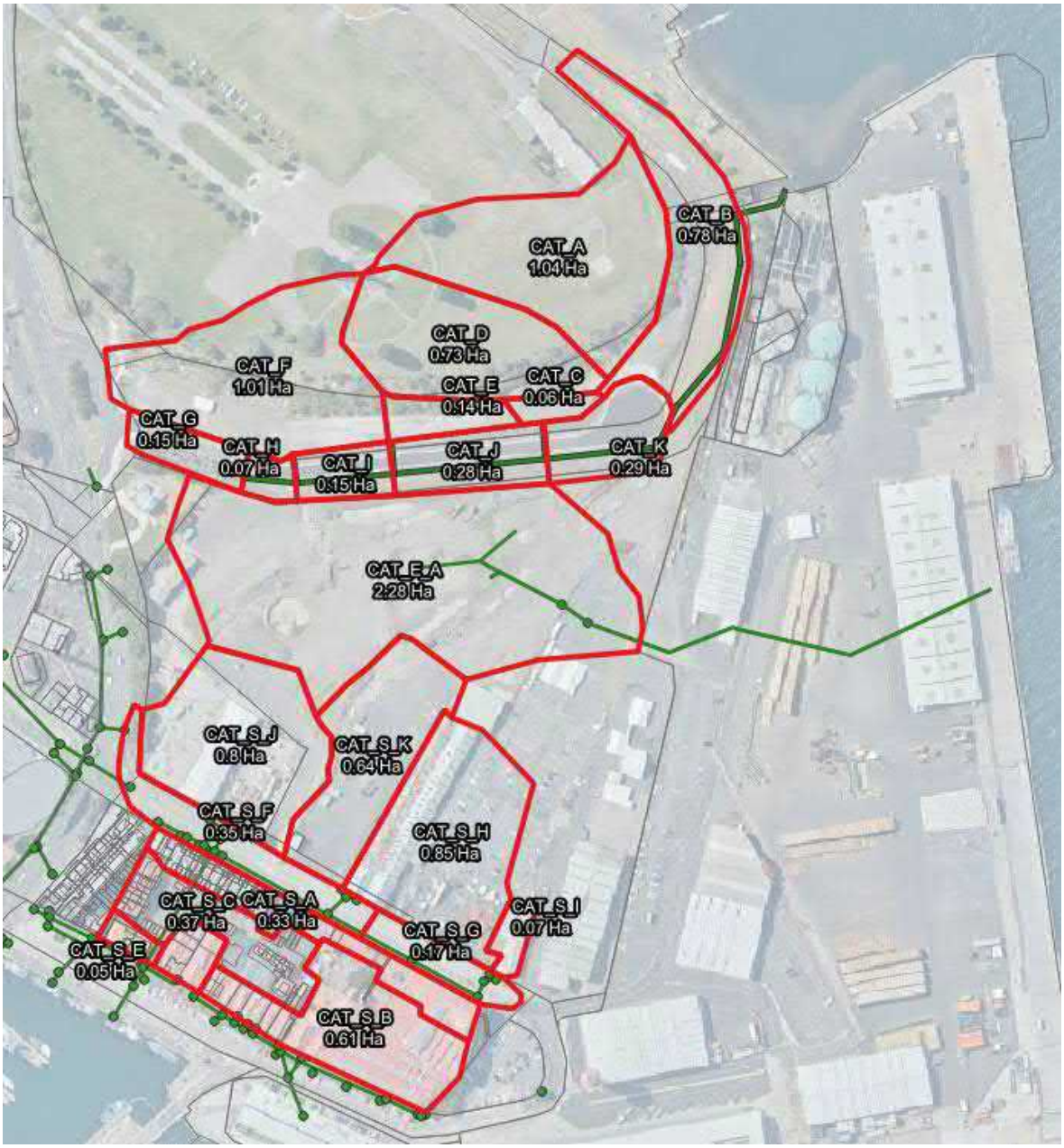

Figure 3: Existing Catchments

A summary is provided below which details the existing flows within the drainage system of the four (4) connection points. The table shows

Table 1: Existing Condition Flow rates

Connection Point	Flow Rate (m3/s) Minor Event	Flow Rate (m3/s) Major Event
A	0.60	0.94
B	0.28	0.3 (+ 0.25 Overland)
C	0.38 (+ 0.06 Overland)	0.38 (+ 0.32 Overland)
D	0.12 (+ 0.1 Overland)	0.12 (+ 0.27 Overland)

2.2 Proposed Condition

The DRAINS model was updated to reflect the proposed stormwater system. Each catchment has been labelled to provide a consistent naming convention with its discharge point. I.e., catchment ID 0_Catchment_A is directed to the connection point ID connection point A

The hatched areas in the figure below are parts of the existing system that have remained unchanged.

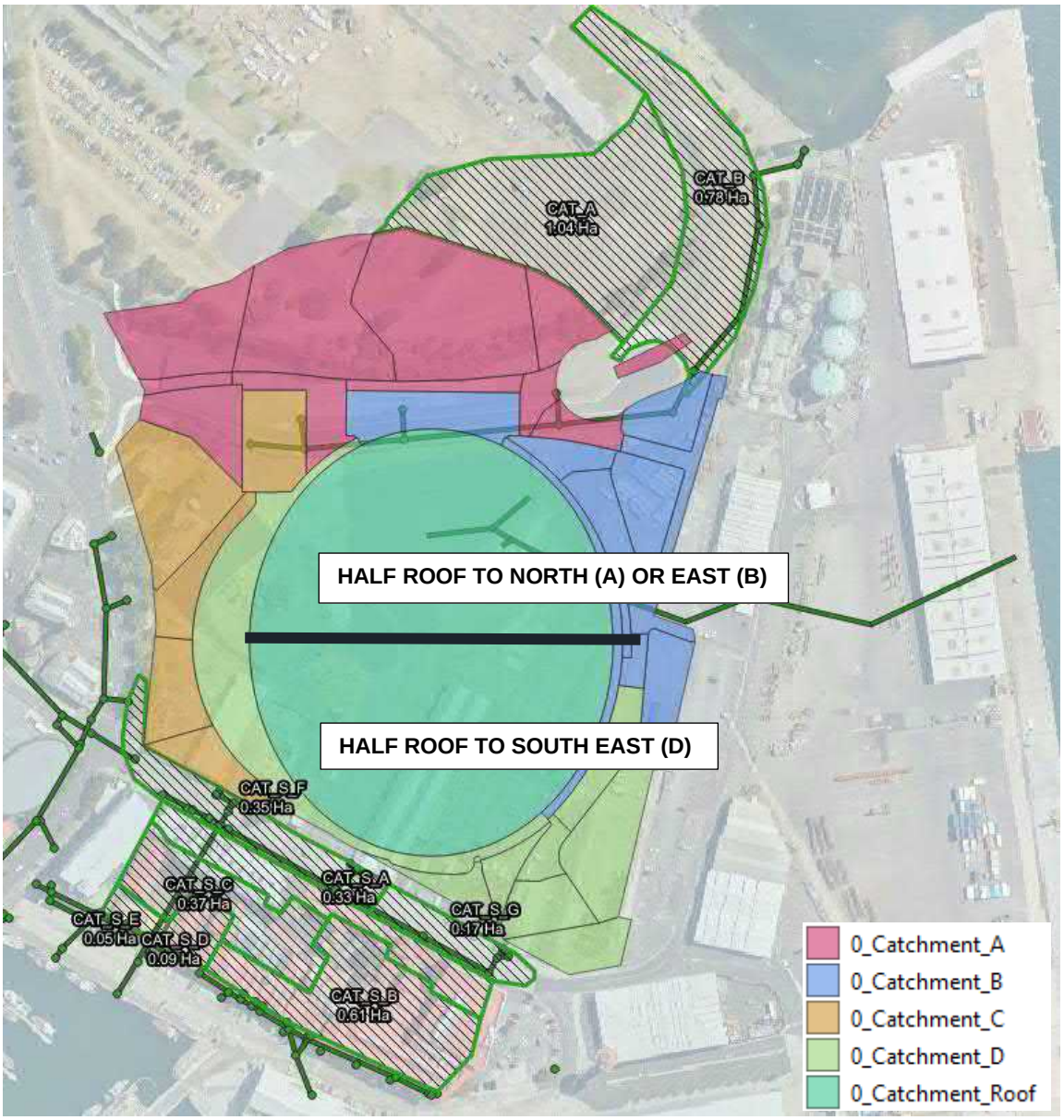

Figure 4: Proposed Catchments

The proposed drainage design has included change, however to enable a fair comparison against the existing condition, the same factor has been applied. Refer to Table 2 for flows in the proposed condition to be compared against the existing condition

Table 2: Developed Condition Flow rates (for comparison with existing case)

Connection Point	Flow Rate (m3/s) Minor Event	Flow Rate (m3/s) Major Event
A	0.61	1.09
B	0.17	0.32
C	0.08	0.10
D	0.55	0.98

The proposed solution provides a formal underground drainage system that provides substantially more pit inlet capacity within the site compared to existing. For this assessment, it has been assumed that half the roof has been directed to a piped connection to the north (A). It has also been assumed that a sufficiently sized pipe can be provided at the north (Connection A) or the east (Connection B) to cater for roof flow.

For the proposed solution, it is intended that the flow directed towards the catchment C outfall to be reduced. This connection point ultimately drains beneath heritage buildings and is not deemed to be a preferable connection to rely on. Hence greater flow is proposed to be directed toward the southeast.

The remaining half of the roof is proposed to be directed to the south. A dedicated pipe connection from the roof to an underground chamber is required to ensure roof drainage does not interact with plaza drainage. Local site constraints at the plaza have meant the piped drainage system is relatively shallow. If roof drainage is connected directly to this system, then it is likely that stormwater would surcharge in events of less severity that the 1% AEP event. For drainage at connection point D to operate effectively, a new or upgrade piped drainage system is required (likely pipe size in the order of DN750, to be confirmed following a more comprehensive assessment).

Table 3: Developed Condition Flow rates (for comparison with existing case- includes appropriate climate change factors)

Connection Point	Flow Rate (m3/s) Minor Event	Flow Rate (m3/s) Major Event
A	0.76	1.33
B	0.21	0.47
C	0.10	0.11 (0.01)
D	0.69	0.99 (0.20)

Based on the above analysis the most advantageous solution is to direct as much of the roof area (or part thereof) to the north as practical (estimated to be 4.0Ha). The reasons are detailed below:

- The previously constructed northern access road provided a stormwater network that was to service the road and future Macquarie Point development. The elevation of the outlet point is relatively high, so with minimum grade on this pipe only a portion of the Macquarie Point surface level could be drained. Such as the northern areas.
- The existing drainage system to the south and east is estimated to be at, or exceed the existing capacity.
- For half of the roof area, it is estimated for the 10% AEP that 0.55 m3/s will be generated. This will need to be directed to the discharge point B. For the balance of flow up to the 1% AEP, discharge may be directed to either the North (A) or East (B), there is flexibility in the proposed design to enable either solution to be adopted.

3. Flood Assessment

A 2D hydraulic model has been developed for the site in the flood modelling program TUFLOW. This enables flow paths to be map based on the natural terrain, which is important for this site, as the site is very flat. The purpose of the model is to assess local overland flow originating at and adjacent to the Macquarie Point site.

The extent of the of the flood model is presented in Figure 5.

Figure 5: 2D Flood Model Extent (red)

The following key assumptions have been made in developing this preliminary flood model:

- Only the 1% AEP with climate change event has been assessed for the existing condition. The 10-minute, 30-minute and 1-hour durations have been assessed (based on a review of the primary results, the 30-minute duration produces the peak depth under the existing condition).
- A climate change factor of 1.66 has been applied to rainfall corresponding to sub-hourly storms for the SSP3-7.0 year 2100 pathway.
- A direct rainfall model has been adopted.

- Surface types have been defined within the model to define both roughness and storm losses, The roughness and loss values adopted are detailed in Table 4.
- Buildings have been represented as a solid obstruction
- The underlying surface is based on 2010 LiDAR.

Table 4: Manning's 'n' and losses

Surface Type (ID)	Manning's 'n'	Initial Loss (mm)	Continuing Loss (mm/hr)
Roads / Hardstand	0.02	0	0
Grass	0.045	20	2

- At the time of undertaking this assessment, a developed case was not able to be assessed in TUFLOW as information required for the hydraulic model is still under development. However, based on the results of the DRAINS model, commentary can be provided on how the proposed stadium development will likely impact flood behaviour. For reference, flood maps have been prepared for the 1% AEP existing case and presented in Appendix A.
- Appendix A provides commentary on the flood behaviour
- No pits or pipes have been included in the flood model. It is however noted for an event of this magnitude (1% AEP + CC) the aged existing underground drainage system is unlikely to be able to perform effectively.

The figure below presents the output of the 1% AEP flood depth + climate change (1.66 factor) for the existing condition with depths below 30mm excluded for clarity.

Figure 6: 1% AEP flood depth + climate change – existing condition.

Table 5 provides a review of changes to boundary offsite flows pre and post development for the 1% flood event.

Table 5: 1% AEP Flow (Major Event) Offsite Pre and Post Development

Connection Point	TUFLOW Model of Existing (m^3/s)	Drains Model of Proposed (m^3/s)	Comment
A	Not available for overland flow relief	1.33	New / augmented open drain and pipe along the base of the escarpment will be sized to collect runoff from Plaza area, Stadium Roof and Cenotaph
B	0.68	0.47	Currently expect reduced flows heading towards TasPorts boundary. Opportunity to send more water this way to match pre-development conditions
C	0.36	0.12	Currently expect reduced flows heading towards western end of Evans Street. Opportunity to send more water this way to match pre-development conditions
D	0.58	1.19	Currently expect increased flows heading towards eastern end of Evans Street. Need to review and manage through detention arrangements, pipe augmentation and / or re-balancing catchment areas.
Other	0.5	0	Historical overflow to Davey Street not expected to occur based on proposed surface grading.
Total Flow	2.12	3.11	Approximately an increase in overland flow of 45% through the removal on depression storage within railyards and the addition of a roof that efficiently discharges stormwater

4. Discussion and Conclusion

A high-level 2D flood model has been developed for the existing case to quantify the existing flood behaviour to provide a basis for flood impact checks adjacent to the Macquarie Point stadium. Based on the minor and major system drainage design carried out as part of the proposed stadium design, commentary has been provided on how flood behaviour will be modified. The key points are:

- Four (4) key connection points have been identified that primarily relate to existing piped drainage points and have been used to compare how stormwater discharge varies from an existing situation to a proposed case.
    - A – Northern Stormwater Connection
    - B – Central TasPorts Stormwater Connection
    - C – Western Evans Street Connection, and
    - D – Eastern Evans Street Connection
- The proposed solution will require an upgraded pipe network within the site to ensure the 10% AEP event can be adequately drained to the existing connection points.
- Despite the relatively similar impervious surface portions, for the 1% AEP event it is expected that the site will see an estimated 45% increase in peak site discharge (via pipe and overland flow). This is due to the removal of depression storage that existed due to features within the rail yard and the addition of efficient large roof drainage.
- Management of the 1% and 10% events will need to consider the following to provide an optimal solution and ensure flood impacts are limited to an acceptable level:
    - Detention systems
    - Pipe upgrades, and
    - Optimising roof catchment discharge split.

    The above options are currently being assessed.

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Flood Maps

Appendix A

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Peak Depth
- <= 0.03
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

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Macquarie Point Stadium
Flood Assessment

N

SCALE @ A3: 1:3000

MAP REF: P.24.0237
AUTHOR: HP
REV: A
DATE: 02/05/2025
DATA SOURCES: State Aerial Image (TheListMap)

Legend

Flood Model boundary

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Macquarie Point Stadium
Flood Assessment

N

SCALE @ A3: 1:3000

MAP REF: P.24.0237
AUTHOR: HP
REV: A
DATE: 02/05/2025
DATA SOURCES: State Aerial Image (TheListMap)

Legend

Flood Model boundary

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Macquarie Point Stadium
Flood Assessment

N

SCALE @ A3: 1:3000

MAP REF: P.24.0237
AUTHOR: HP
REV: A
DATE: 02/05/2025
DATA SOURCES: State Aerial Image (TheListMap)

Legend

Flood Model boundary

Propose drain and pipe to capture Cenotaph flows and reduces flow arrive on down-stream properties/public

Propose drain and pipe to capture Cenotaph flows and reduces flow arrive on downstream properties/public land.

Stadium to dis-charge to connec-tion A and / or conncetion B

Indicitive alignment of upgrade to existing stormwater pipe to discharge additional site catchment under wharf.

DRAINS Total flow expected at this location ~ 0.47 m3/s. To be managed through pipe upgrades. existing overland flow path to be retained

Existing condition provides depression storage

Existing Overland Discharge 3-500l/s to Davey Street Historic Path (pre-recent earthworks)
Proposed to send entire catchment elsewhere through multiple other outlets.

Existing Discharge 1 -360l/s Across Boundary Onto Evans Street to existing sag.
Proposed Solution is to reduce the effective catchment and direct wa-ter to upgraded pipes elsewhere on the site. A remaining portion of flow will be sent to the existing 600mm pipe network.

TasPort Overland Discharge 4 680//s across entire boundary.
Most water migrates to significant depression then eventually spills to Evans and hunter street.

Existing Discharge 2 -580l/s (1% AEP + CC) Across Boundary Onto Evans Street
It is proposed to provide significant pipe upgrade through Evans / Hunter street and create reduction in downstream flooding.

DRAINS Total flow expected to be directed here is ~1.0 m3/s (1% AEP +CC) to be managed through an upgrade piped such that overland flow impact is reduced.

Peak Flood Depth 1pc CC (m)
- <= 0.03
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

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N

SCALE @ A3: 1:3000

MAP REF: P.24.0237
AUTHOR: HP
REV: A
DATE: 02/05/2025
DATA SOURCES: State Aerial Image (TheListMap)

Legend

Flood Model boundary

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Macquarie Point Stadium

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