# Memorandum

B&A Urban & Environmental

To: Russell Butchers, Auckland Council

cc/- Drury Metropolitan Centre Consolidated Stages 1 and 2 Expert Panel

From: Mary Wong / Pamela Santos – Barker & Associates Limited

Date: 5 August 2025

Re: Response to s67 further information recommended by Auckland Council Healthy Waters

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This memorandum addresses Auckland Council's second 's67 Information Gap Identification' from Healthy Waters dated 5 June 2025 ("Auckland Council memorandum") regarding the Drury Metropolitan Centre Consolidated Stages 1 and 2 listed project ("the Project"). The Auckland Council memorandum was sent to the Panel and copied to Kiwi Property No.2 Holdings Limited ("Kiwi Property").

The Panel has not issued any directions regarding the memorandum and it does not constitute a formal further information request from the Panel under section 67 of the Fast-track Approvals Act 2024 (FTAA). Despite this, and in an effort to narrow the scope of issues, Kiwi Property has prepared a response to the matters raised in the memorandum. Kiwi Property will also endeavour to work with Auckland Council and/or interested parties as the Project progresses.

Kiwi Property's responses to the individual information requests recommended by Auckland Council are contained in the table overleaf. This table consolidates responses from the project team relative to their respective disciplines. The following are also included as supporting attachments:

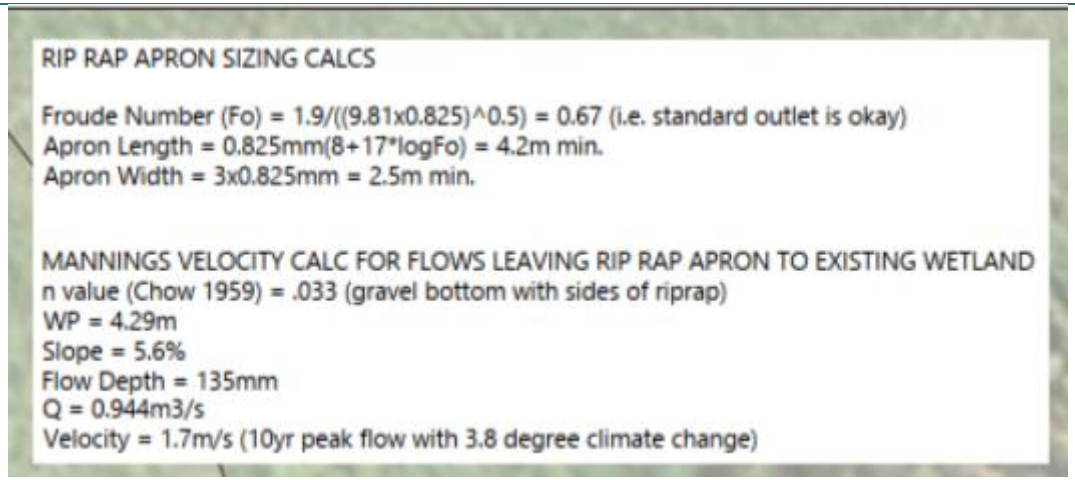
- Attachment 1: Wetland calculations

As the Auckland Council memorandum was provided to the Panel, Kiwi Property's responses have been copied to them as well.

# Memorandum

| No. | Auckland Council Information Request | Applicant Response |
|---|---|---|
| **Flood Assessment** | | |
| 1.1 | A copy of the Applicant's flood model for the Fitzgerald Stream including all of the modelled pre-development model and post-development scenarios. | This information was previously requested in Auckland Council's 's67 - Further Information' request dated 23 June 2025 for this project and Kiwi Property have already provided a response to this in its 'Response s67 further information memorandum recommended by Auckland Council' dated 24 July 2025. No further response is considered to be necessary. |
| 1.2 | Additional modelling and associated assessment of effects for the Fitzgerald Stream relative to existing land use and no climate change. These scenarios are to be included with copy of the model requested under Item 1.1. | Response as per item 1.1 above. |
| 1.3 | Additional modelling and associated assessment of effects for the Fitzgerald Stream considering 3.8-degree climate change. These scenarios are to be included with copy of the model requested under Item 1.1. | Response as per item 1.1 above. |
| 1.4 | Justification of how the effects of the proposed development can be accurately assessed with the modelled post-development scenario land use and landform assumptions/conditions that include the consented developments of | Response as per item 1.1 above. |

| | | |
|---|---|---|
| | Drury Centre Stage 1 and Fulton Hogan Stage 2 & 3, but exclude the consented development of Fulton Hogan Stage 1. | |
| 1.5 | Overland flow path assessment including catchment plans and representative cross-sections of the overland flow conveyance corridors, with supporting calculations assuming Maximum Probable Development (MPD) and 3.8-degree climate change. | Response as per item 1.1 above. |
| 1.6 | Provide the modelling and associated assessment of effects for the flow attenuation scenario. These scenarios are to be included with copy of the model requested under Item 1.1. | The attenuation scenarios have been included with copies of the model requested under Item 1.1. However, as demonstrated in the 'Drury Centre Stage 2 Stormwater Assessment', this is not an option that is being pursued as a flood management strategy for the portion of the site discharging to Fitzgerald Stream Tributary.<br><br>The effects assessment detailed in the report concludes that the peak water levels are controlled by backwater effects from Hingaia Stream and that attenuating flows from areas of Drury Centre Stage 2 results in higher peak water levels in Fitzgerald Stream due to effects of timing. |
| Erosion Assessment | | |
| 2.1 | Erosion assessment on the existing wetland and the Hingaia Stream corridor downstream of the proposed rock chute. | The design of the rock chute and the riprap within the rock chute has been designed to reduce the energy and velocity entering the wetland, and the Hingaia Stream corridor downstream of the proposed rock chute. The table below shows the velocity entering the wetland will be 1.7m/s. The final surface for this area will be grass/landscaping, and from the table, it will likely be couch, carpet or kikuyu grass. The maximum velocities associated with these grasses are 1.4-2.0m/s and 1.9-2.5m/s respectively. The maximum velocity calculated is 1.7m/s, which is in the range or less the maximum value from Table 1, and the risk of any erosion is therefore low. |

| | | |
|---|---|---|
| | |  |
| 2.2 | Erosion assessment on the stream banks (including Wetland 2-1 embankment) for the stream within the proposed development draining north to the Fitzgerald Stream. | We have calculated the velocities from the flood model as shown in question 2.4 below. The maximum velocity in stream A is 1.1m/s during a 10-year event with 3.8 degrees of climate change. An assessment was undertaken based on the 1.1m/s velocity against Table 1 of TR2013-018 Hydraulic energy management inlet and outlet design for treatment devices. Table 1 gives maximum velocities for erosion control for unlined channels for various materials. The final surface for this area will be grass/landscaping, and from the table, it will likely be couch, carpet or kikuyu grass. The maximum velocities associated with these grasses are 1.4-2.0m/s and 1.9-2.5m/s respectively. The maximum velocity from the calculated points, 1.1m/s, is therefore less than the maximum value from Table 1, and the risk of any erosion is therefore low.<br><br>Detailed design will be undertaken during EPA for the outlets discharging to the stream. |
| 2.3 | Erosion assessment on Wetland 2-2 embankments adjacent to the Hingaia Stream. | Wetland 2-2 and the fill slopes associated with the construction of the wetland are all above the 100-year Flood level for the Hingaia stream. The risk of embankment erosion is therefore low. |
| 2.4 | Please provide the design flows and flow velocities that were used to design Stream A. | Please see the table below for the design flows and velocities in Stream A at 3 locations. |

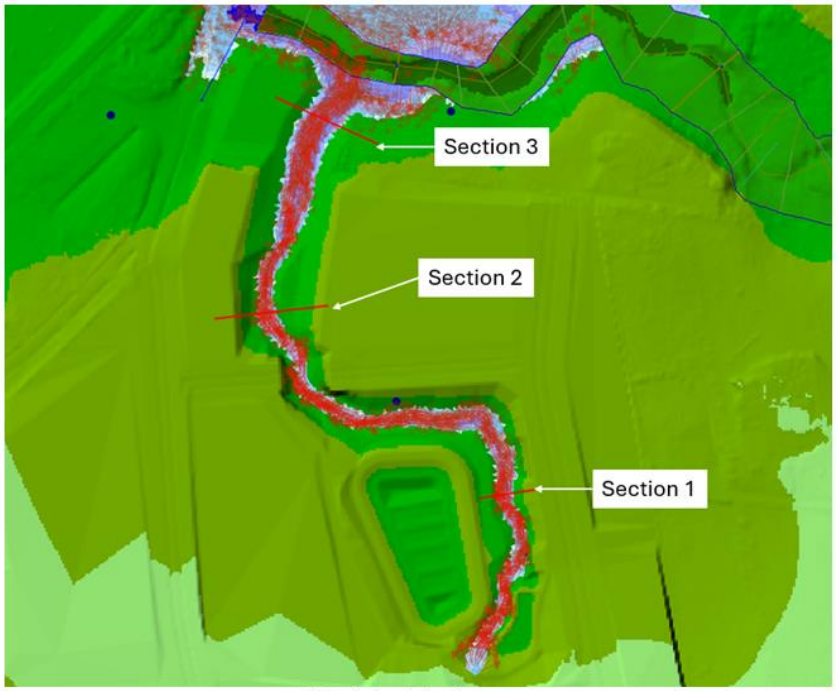



*Figure 1: Sample location*

*Table 2 : Design flows and velocity for the Dc stage 2 post dev model with FH stage 1 development*

| Rainfall Event | Drury centre stage 2 Post Dev with FH stage 1 | | | | | |
|---|---|---|---|---|---|---|
| | Stream A Design Flow (m3/s) | | | Stream A Design Velocity (m/s) | | |
| | Section 1 | Section 2 | Section 3 | Section 1 | Section 2 | Section 3 |
| **10 Yr 3.8CC** | 3.71 | 4.00 | 4.32 | 1.12 | 0.86 | 0.97 |
| **2 Yr 3.8CC** | 1.66 | 1.72 | 2.05 | 0.93 | 0.69 | 0.80 |
| **10 Yr 2.1CC** | 2.86 | 3.07 | 3.34 | 1.04 | 0.80 | 0.91 |
| **2 Yr 2.1CC** | 1.26 | 1.29 | 1.63 | 0.85 | 0.65 | 0.76 |
| **10 Yr No CC** | 2.44 | 2.60 | 2.85 | 1.00 | 0.76 | 0.87 |
| **2 Yr No CC** | 1.12 | 1.14 | 1.48 | 0.81 | 0.63 | 0.74 |

| | | |
|---|---|---|
| **Vesting of Land** | | |
| 3.1 | Supporting information that demonstrates how the proposed extent of the Local Purpose Reserve (Drainage) pertaining Lot 601, Lot 602 and Lot 603 is delivering both an essential stormwater function and additional public benefit or function (e.g. passive or active recreation, amenity, etc.) which cannot otherwise be achieved if these areas remained in private ownership. | In Kiwi Property's response to 'Response s67 further information memorandum recommended by Auckland Council' dated 24 July 2025, it was clarified that Lots 601, 602, 603 and 604 will remain in private ownership by Kiwi Property. This is consistent with the approach of the Drury Centre Stage 1 fast-track consent which only vests the esplanade reserve with Council, with all other reserves to be retained in private ownership and maintained by Kiwi Property. |
| **Stormwater Management Devices** | | |
| 4.1 | Details of the proposed legal mechanisms that will ensure that the proposed Wetland 2-1 and Wetland 2-2 will be maintained and operated in a way that achieves the required stormwater management outcomes in perpetuity. | No legal mechanisms are proposed and considered necessary for the maintenance and operation of Wetland 2-1 and Wetland 2-2. There is a legal obligation for Kiwi Property (or any subsequent owners) to comply with the conditions of consent of the Stormwater Discharge Consent. In particular, the proposed conditions of consent require the preparation of an Operation and Maintenance Plan and a Maintenance Contract for the on-going maintenance of any proprietary stormwater management devices. This is consistent with the approach of the Drury Centre Stage 1 fast-track consent where no legal mechanisms were provided for the private stormwater wetlands. Kiwi Property notes that it is in the company's best interest to proactively manage and curate the stormwater management areas, as the site is central to its development and customer experience. |
| 4.2 | Supporting information that demonstrates the proposed 'Large Format Retail' (**LFR**) roofs/buildings will be able to consistently re-use the retention volume at source. | In accordance with GD01, the retention volume stored in the tanks is intended to be reused within 72 hours for non-potable water demand within the buildings. This ensures that sufficient capacity is available for retention and detention prior to the next rainfall events. Appropriated plumbing will be installed for re-use within the buildings. Information to support this proposal will be provided during detailed design stage. |

| | | |
|---|---|---|
| | | Given that these are large format retail centres (LFR), it is envisaged that the volume will be adequately mitigated well within the 72-hour draw down period that is required. |
| 4.3 | Updated calculations for Wetland 2-2 which are consistent with the calculations provided for Wetland 2-1 or justification of why this is not applicable. | The design assumptions and allowances of the wetlands are outlined in Section 9 of 'Drury Centre Stage 2 Stormwater Assessment'. Both Wetland 2-1 and 2-2 have been sized in accordance with GD01 requirements and for the entire contributing catchment. The calculations account for volume reductions resulting from at-source hydrology mitigation and water quality treatment of roof runoff (see calculations in Attachment 1). As outlined in Section 9 of the report:<br>• Roofed areas of LFRs within Zone A, Area 1 – (discharging to Wetland 2-1) are proposed to provide retention at-source via tanks, which is considered BPO for water quality treatment.<br>• Roofed areas of LFRs within Area 2 (discharging to Wetland 2-2) are proposed to provide retention and detention at-source via tanks, which is considered BPO for water quality treatment.<br>Following Healthy Waters feedback regarding the volume calculations for Wetland 2-2, the methodology has been revised to ensure alignment with the approach used for Wetland 2-1. The difference between the methodology had been identified with how the upstream at-source mitigation was accounted for:<br>• For Wetland 2-1, the mitigation was addressed by deducting volume from the total calculated volume.<br>• For Wetland 2-2, the initial approach incorporated this mitigation by reducing contributing catchment area.<br>To ensure consistency across both wetland assessments, the calculations have been updated for Wetland 2-2 using the same methodology applied to Wetland 2-1 (i.e., applying a volume deduction approach). These calculations are included in Attachment 1. However, it is noted the outcome of this revised assessment confirms that the sizing of Wetland 2-2 does not differ from what's been provided in the report and meets the requirements of GD01. |

An overview of the treatment approach for the different zones and contributing areas is summarised in the table below with catchment areas of the two areas provided below.

| | Land use | Total area (ha) | Impervious allowance (%) | Impervious area (ha) | Hydrology Mitigation and Water Quality Treatment Provision Method |
|---|---|---|---|---|---|
| Area 1 - Zone A | LFR - Roofed areas*1 | 3.82 | 100% | 3.82 | Provided via Wetland 2-1 |
| | LFR - Hardstand areas | 3.10 | 100% | 3.10 | |
| | Private roads | 1.67 | 90% | 1.50 | |
| | Public roads | 0.64 | 90% | 0.58 | |
| Area 1 - Zone B | LFR - Roofed areas | 1.66 | 100% | 1.66 | Provided at-source via tank |
| | LFR - Hardstand areas | 2.11 | 100% | 2.11 | |
| | Private roads | 0.40 | 90% | 0.36 | Provided via private raingardens |
| | Public roads | 0.54 | 90% | 0.49 | Provided via communal Raingarden RG 2-1 |
| Area 2 | LFR - Roofed areas | 1.65 | 100% | 1.65 | Provided at-source via tank |
| | LFR - Hardstand areas | 1.48 | 100% | 1.48 | Provided via Wetland 2-2 |
| | Private roads | 0.38 | 90% | 0.34 | |
| | Public roads | 1.03 | 90% | 0.93 | |

*1 Retention and water quality treatment for roofed areas provided at-source via tanks.

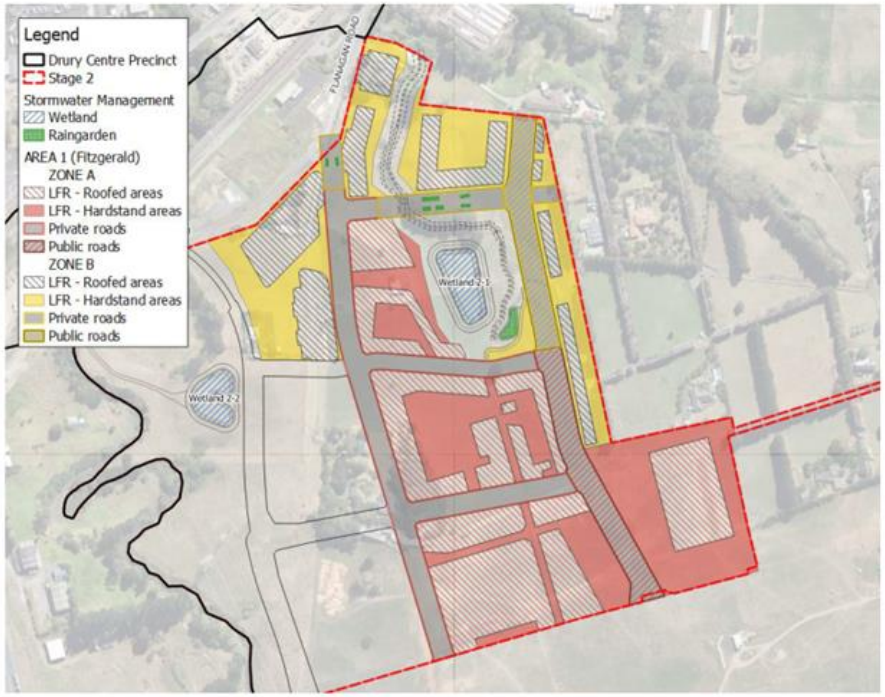
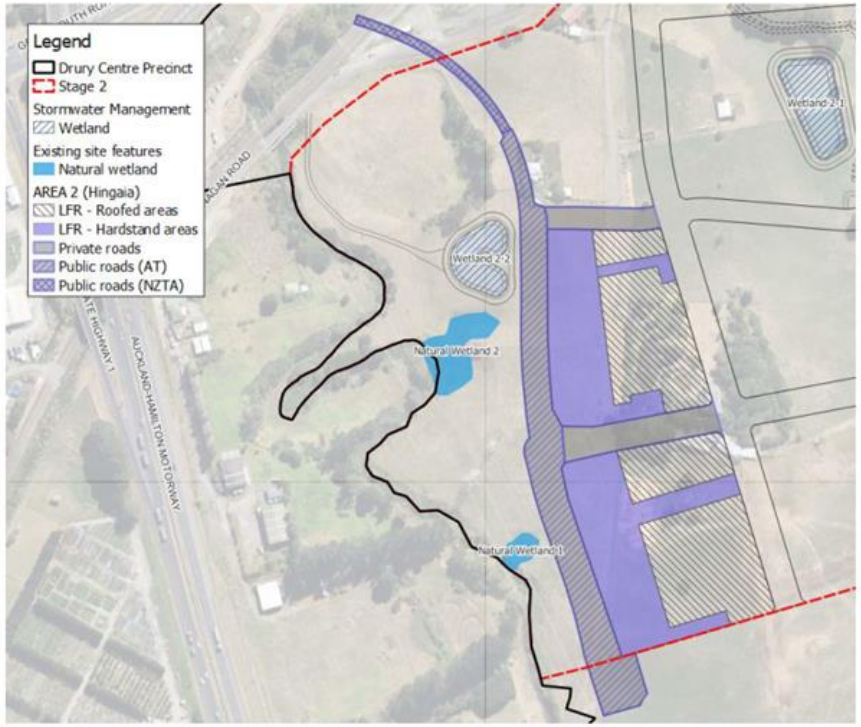



Figure 4: Area 1 - catchments

| | | |
|---|---|---|
| | |  <br>Figure 6: Area 2 - catchments |

Stage 1 Superlot Stormwater Management

| | | |
|---|---|---|
| 5.1 | Breakdown of the total JOAL impervious area per superlot (as relative to the 18% imperviousness allowance in the constructed downstream wetlands) and clarification on whether the future individual lot hardstand areas will be consequently required to | The downstream wetlands have the allowance to provide stormwater mitigation for up to 18% of each of the super lots. The table below shows the values of the JOAL impervious areas and as a percentage of the superlot areas. The table below shows that the imperious percentage for JOALs, including footpath is 14.65% and well below the 18% threshold. Any future development on the individual vacant lots will need to undertake at source stormwater management in line with previously submitted consents and reports. |

| | | |
|---|---|---|
| | deliver all necessary stormwater management outcomes at-source. | |

**Drury Centre Superlots**

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-646 | | **By** | MK | **Date** 25/07/2025 |
| **Location** | Drury Center - Stage 2 | | **Checked** | GW | **Date** 31/07/2025 |

| JOAL No. | Corresponding Lot No. | JOAL impervious area incl footpath | Corresponding Lot Area | JOAL % of Lot Area |
|---|---|---|---|---|
| | | $m^2$ | $m^2$ | |
| 500 | 10 | 587 | 3293 | 17.83% |
| 501 | 11 | 1199 | 8676 | 13.82% |
| 502 | 12 | 659 | 4333 | 15.21% |
| 503 | 13 | 798 | 5292 | 15.08% |
| 504 | 14 | 789 | 5542 | 14.24% |
| 505 | 15 | 880 | 6141 | 14.33% |
| 506 | 16 | 696 | 4990 | 13.95% |
| 507 | 17 | 685 | 4969 | 13.79% |
| 508 | 18 | 854 | 5990 | 14.26% |
| 509 | 19 | 1143 | 7356 | 15.54% |
| 510 | 20 | 514 | 2712 | 18.95% |
| 511 | 21 | 780 | 7038 | 11.08% |
| 512 | 22 | 1186 | 7174 | 16.53% |
| **Total** | | **10770** | **73506** | **14.65%** |

Attachment 1 - Wetland Calculations

**PROJECT:** DRURY CENTRE - Stage 2
**DATE:** 30/07/2025
**BY:** JM

| DEVICE | IMP AREA (HA) | PER AREA (HA) | TOTAL AREA (HA) | IMP% | WATER QUALITY VOLUME (WQV)*1 ($m^3$) | FOREBAY VOLUME ($m^3$) | WQV (ALLOWS FOR 50% REDUCTION) ($m^3$) | FINAL WATER QUALITY VOLUME PROVIDED BY WETLAND ($m^3$) | HYDROLOGY MITIGATION VOLUME - PRE DEVELOPMENT ($m^3$) | HYDROLOGY MITIGATION VOLUME - POST DEVELOPMENT ($m^3$) | CALCULATED TOTAL HYDROLOGY MITIGATION VOLUME FOR CATCHMENT (DIFFERENCE FROM PRE DEVELOPMENT) ($m^3$) | HYDROLOGY MITIGATION VOLUME FOR ROOFED AREAS*2 ($m^3$) | TOTAL HYDROLOGY MITIGATION VOLUME PROVIDED BY WETLAND ($m^3$) | TOTAL VOLUME PROVIDED BY WETLAND ($m^3$) | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WETLAND 2-1** | 9.00 | 0.23 | 9.23 | 97% | 1081 | 162 | 541 | 703 | 617 | 2582 | 1965 | 191 | 1774 | 2477 | total volume provided by wetland 2-1 allows for reduction of water quality volume and retention volume from roofed areas |
| **WETLAND 2-2** | 4.39 | 0.14 | 4.53 | 97% | 573 | 86 | 287 | 372 | 303 | 1263 | 959 | 361 | 598 | 971 | total volume provided by wetland 2-2 allows for reduction of water quality volume, retention and detention volume from roofed areas |

*1 excluding water quality volume for roofed areas (at-source treatment)
*2 Wetland 2-1 - LFR roofed areas provide retention at-source via tanks
Wetland 2-2 - LFR roofed areas provide detention and retention at-source via tanks

| | LANDUSE | TOTAL AREA (HA) | IMP% | IMP AREA (HA) | HYDROLOGY MITIGATION AND WATER QUALITY TREATMENT PROVISION METHODE |
|---|---|---|---|---|---|
| **Area 1 - Zone A** | LFR - Roofed areas*[1] | 3.82 | 100% | 3.82 | Provided via Wetland 2-1 |
| | LFR - Hardstand areas | 3.10 | 100% | 3.10 | |
| | Private roads | 1.67 | 90% | 1.50 | |
| | Public roads | 0.64 | 90% | 0.58 | |
| **Area 1 - Zone B** | LFR - Roofed areas | 1.66 | 100% | 1.66 | Provided at-source via tanks |
| | LFR - Hardstand areas | 2.11 | 100% | 2.11 | |
| | Private roads | 0.40 | 90% | 0.36 | Provided via private raingardens |
| | Public roads | 0.54 | 90% | 0.49 | Provided via communal Raingarden RG 2-1 |
| **Area 2** | LFR - Roofed areas | 1.65 | 100% | 1.65 | Provided at-source via tanks |
| | LFR - Hardstand areas | 1.48 | 100% | 1.48 | Provided via Wetland 2-2 |
| | Private roads | 0.38 | 90% | 0.34 | |
| | Public roads | 1.03 | 90% | 0.93 | |

*[1] Retention and water quality treatment for roofed areas provided at-source via tanks

# Wetland 2-1 - Pre Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 1 - Zone A - Wetland 2-1 | | | | |

## 1.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Pasture, lightly grazed | 74 | 9.23 | 683.0 |
| Group C | Sealed roads, roofs | 98 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 9.23 | 683.0 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{683.0}{9.2} = 74.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{683.0}{9.2} = 74.0$$

$$Ia_{(average)} = \frac{5\ x\ pervious\ area}{total\ area} = \frac{46.15}{9.2} = 5.00$$

## 1.2 Pre Development Volume

| | | | |
|---|---|---|---|
| Rainfall Depth | $P_{24}$ = | 33.00 | mm |
| Soil Storage | S = | 89.24 | mm |
| Runoff Depth | $Q_{24}$ = | 6.69 | mm |
| Runoff Volume | $V_{24}$ = | 617.21 | m³ |

# Wetland 2-1 - Post Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 1 - Zone A - Wetland 2-1 | | | | |

## 2.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Urban lawns | 74 | 0.23 | 16.9 |
| Group C | Sealed roads, roofs | 98 | 9.00 | 882.0 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 9.23 | 898.9 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{16.9}{0.2} = 74.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{898.9}{9.2} = 97.4$$

$$Ia_{(average)} = \frac{5 \times pervious\ area}{total\ area} = \frac{1.14}{9.2} = 0.12$$

## 2.2 Water Quality Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| 1/3 of the 24 hour Rainfall Depth in 2 Year Event (mm) [$P_{24}$] | 25.0 | |
| Component Area (ha) [$A$] | 0.2 | 9.0 |
| Curve Number [$CN$] | 74.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 89.2 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 3.7 | 20.7 |
| Runoff Volume (m³) [$V_{24} = 1000\ Q_{24}\ A$] | 8 | 1,864 |
| Combined Runoff Volume (m³) | 1,872 | |

| | |
|---|---|
| Water Quality Volume Roofed Areas (provided at source) (m³)* | 791 |

*refer to Area 1 - Zone A - Roof volume calculation sheet

| | |
|---|---|
| Final Water Quality Volume (m³) | 1,081 |

## 2.3 Extended Detention Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| Rainfall Depth (mm) [$P_{24}$] | 33.0 | |
| Component Area (ha) [$A$] | 0.2 | 9.0 |
| Curve Number [$CN$] | 74.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 89.2 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 6.7 | 28.5 |
| Runoff Volume (m³) [$V_{24} = Q_{24} A$] | 15 | 2,567 |
| Combined Runoff Volume (m³) | 2,582 | |

| | |
|---|---|
| Combined Runoff Volume (difference Pre and Post-Development) (m³) | 1,965 |

## 2.4 Hydrology Mitigation Volume Roofed Areas (provided at source) (m³)

| | | | |
|---|---|---|---|
| Rainfall Depth (mm) | = | 5 | mm |
| Roof Area ($m^2$) | = | 38189 | m2 |
| Retention Volume ($m^3$) | = | 191 | m3 |

## 2.5 Final Detention Volume

| | |
|---|---|
| Combined Runoff Volume (difference Pre and Post-Development minus Roof Volume) (m³) | 1,774 |

# Roof - Post Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 1 - Zone A - Roof | | | | |

## 2.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Urban lawns | 74 | | |
| Group C | Sealed roads, roofs | 98 | 3.82 | 374.2 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 3.82 | 374.2 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{0.0}{0.0} = 0.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{374.2}{3.8} = 98.0$$

$$Ia_{(average)} = \frac{5\ x\ pervious\ area}{total\ area} = \frac{0.00}{3.8} = 0.00$$

## 2.2 Water Quality Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| 1/3 of the 24 hour Rainfall Depth in 2 Year Event (mm) [$P_{24}$] | 25.0 | |
| Component Area (ha) [$A$] | 0.0 | 3.8 |
| Curve Number [$CN$] | 0.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 253999999999746.0 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 0.0 | 20.7 |
| Runoff Volume ($m^3$) [$V_{24} = 1000\ Q_{24}\ A$] | 0 | 791 |
| Combined Runoff Volume ($m^3$) | 791 | |

# Wetland 2-1

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |

## 3.1 Water Quality Volume

| Sub-catchment Name | Area (ha) | Storage Required ($m^3$) |
|---|---|---|
| Area 1 - Zone A - Wetland 2-1 | 5.38* | 1,081 |
| | **Total Water Quality Volume Required** | **1,081** |

Minimum Forebay Volume (15%): 162 $m^3$

An Extended Detention Overlay will be provided, reducing the Permanent Water Volume to: 541 $m^3$

* reduced area as water quality treatment for roofed areas is provided at source

# Wetland 2-1 Outlet Details

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |

| RL (m) | Outlet Element Discharge Rate (m³/s) | | | | | Total Discharge (m³/s) | Pond Volume (m³) | Storm Event | |
|---|---|---|---|---|---|---|---|---|---|
| | Outlet 1 Circular Oriffice | Outlet 2 Notch | Outlet 3 Top of Manhole | Outlet 4 Spillway | Outlet Pipe Subtotal | | | | **OUTLETS IL** |
| 10.84 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0000 | 744.42 | PW | **OUTLET 1 - CIRCULAR ORIFICE** |
| 10.90 | 0.005 | 0.000 | 0.000 | 0.000 | 0.005 | 0.0050 | 866.83 | | |
| 11.00 | 0.013 | 0.000 | 0.000 | 0.000 | 0.013 | 0.0133 | 1083.44 | | |
| 11.10 | 0.020 | 0.000 | 0.000 | 0.000 | 0.020 | 0.0203 | 1307.86 | | |
| 11.20 | 0.025 | 0.000 | 0.000 | 0.000 | 0.025 | 0.0254 | 1540.21 | | |
| 11.30 | 0.030 | 0.000 | 0.000 | 0.000 | 0.030 | 0.0297 | 1780.57 | | |
| 11.40 | 0.033 | 0.000 | 0.000 | 0.000 | 0.033 | 0.0334 | 2029.05 | | |
| 11.50 | 0.037 | 0.000 | 0.000 | 0.000 | 0.037 | 0.0368 | 2285.75 | | |
| 11.60 | 0.040 | 0.000 | 0.000 | 0.000 | 0.040 | 0.0399 | 2550.77 | ED | **OUTLET 2 - TOP OF MANHOLE** |
| 11.70 | 0.043 | 0.000 | 0.177 | 0.000 | 0.220 | 0.2200 | 2824.21 | | |
| 11.80 | 0.045 | 0.000 | 0.501 | 0.000 | 0.547 | 0.5469 | 3106.17 | | |
| 11.90 | 0.048 | 0.000 | 0.921 | 0.474 | 0.969 | 1.4434 | 3396.75 | | |
| 12.00 | 0.050 | 0.000 | 1.418 | 2.503 | 1.338 | 3.8412 | 3696.05 | | |
| 12.10 | 0.053 | 0.000 | 1.982 | 5.470 | 1.393 | 6.8630 | 4004.17 | | |
| 12.20 | 0.055 | 0.000 | 2.606 | 9.201 | 1.445 | 10.6464 | 4321.30 | | |
| 12.30 | 0.057 | 0.000 | 3.284 | 13.617 | 1.496 | 15.1133 | 4685.06 | | |
| 12.33 | 0.058 | 0.000 | 3.497 | 15.068 | 1.511 | 16.5795 | 4808.08 | Bank RL | |

## Outlet 1 Details - Circular Oriffice

| | |
|---|---|
| Bottom RL: | 10.85 |
| Diameter / Width: | 0.150 |
| Height: | 0.000 |
| Spillway Side Slope: | xxx |

Discharges to Outlet Pipe

## Outlet 2 Details - Notch

| | |
|---|---|
| Bottom RL: | xxx |
| Diameter / Width: | 0.000 |
| Height: | xxx |
| Spillway Side Slope: | xxx |

Discharges to Outlet Pipe

## Outlet 3 Details - Top of Manhole

| | |
|---|---|
| Bottom RL: | 11.60 |
| Diameter / Width: | 1.050 |
| Height: | |
| Spillway Side Slope: | |

Discharges to Outlet Pipe

## Outlet 4 Details - Spillway

| | |
|---|---|
| Bottom RL: | 11.85 |
| Diameter / Width: | 25.000 |
| Height: | 0.000 |
| Spillway Side Slope: | 5.0 |

Discharges Directly to Stream

## Outlet Pipe Details

| | |
|---|---|
| Pipe Diameter: | 0.750 |
| Inlet Invert Level: | 10.300 |
| Outlet Invert Level: | 9.85 |
| Pipe Length: | 30.00 |

# Wetland 2-2 - Pre Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 2 - Wetland 2-2 | | | | |

## 1.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Pasture, lightly grazed | 74 | 4.53 | 335.5 |
| Group C | Sealed roads, roofs | 98 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 4.53 | 335.5 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{335.5}{4.5} = 74.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{335.5}{4.5} = 74.0$$

$$Ia_{(average)} = \frac{5 \times pervious\ area}{total\ area} = \frac{22.67}{4.5} = 5.00$$

## 1.2 Pre Development Volume

| | | | |
|---|---|---|---|
| Rainfall Depth | $P_{24}$ = | 33.00 | mm |
| Soil Storage | S = | 89.24 | mm |
| Runoff Depth | $Q_{24}$ = | 6.69 | mm |
| Runoff Volume | $V_{24}$ = | 303.21 | m³ |

# Wetland 2-2 - Post Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 2 - Wetland 2-2 | | | | |

## 2.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Urban lawns | 74 | 0.14 | 10.4 |
| Group C | Sealed roads, roofs | 98 | 4.39 | 430.6 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 4.53 | 441.0 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{10.4}{0.1} = 74.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{441.0}{4.5} = 97.3$$

$$Ia_{(average)} = \frac{5 \times pervious\ area}{total\ area} = \frac{0.70}{4.5} = 0.15$$

## 2.2 Water Quality Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| 1/3 of the 24 hour Rainfall Depth in 2 Year Event (mm) [$P_{24}$] | 25.0 | |
| Component Area (ha) [$A$] | 0.1 | 4.4 |
| Curve Number [$CN$] | 74.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 89.2 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 3.7 | 20.7 |
| Runoff Volume (m³) [$V_{24} = 1000\ Q_{24}\ A$] | 5 | 910 |
| Combined Runoff Volume (m³) | 915 | |

| | |
|---|---|
| Water Quality Volume Roofed Areas (provided at source) (m³)* | 342 |

*refer to Area 2 - Roof volume calculation sheet

| | |
|---|---|
| Final Water Quality Volume (m³) | 573 |

## 2.3 Extended Detention Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| Rainfall Depth (mm) [$P_{24}$] | 33.0 | |
| Component Area (ha) [$A$] | 0.1 | 4.4 |
| Curve Number [$CN$] | 74.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 89.2 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 6.7 | 28.5 |
| Runoff Volume (m³) [$V_{24} = Q_{24} A$] | 9 | 1,253 |
| Combined Runoff Volume (m³) | 1,263 | |

| | |
|---|---|
| Combined Runoff Volume (difference Pre and Post-Development) (m³) | 959 |

## 2.4 Hydrology Mitigation Volume Roofed Areas (provided at source) (m³)*

*refer to Area 2 - Roof volume calculation sheet

| | | | |
|---|---|---|---|
| Pre-Development Volume (m³) | = | 110 | m3 |
| Post-Development Volume (m³) | = | 471 | m3 |
| Combined Runoff Volume (difference Pre and Post-Development) (m³) | = | 361 | m3 |

## 2.5 Final Detention Volume

| | |
|---|---|
| Combined Runoff Volume (difference Pre and Post-Development minus Roof Volume) (m³) | 598 |

# Roof - Pre Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 2 - Roof | | | | |

## 1.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Pasture, lightly grazed | 74 | 1.65 | 122.1 |
| Group C | Sealed roads, roofs | 98 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 1.65 | 122.1 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{122.1}{1.6} = 74.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{122.1}{1.6} = 74.0$$

$$Ia_{(average)} = \frac{5 \times pervious\ area}{total\ area} = \frac{8.25}{1.6} = 5.00$$

## 1.2 Pre Development Volume

| | | | |
|---|---|---|---|
| Rainfall Depth | $P_{24}$ = | 33.00 | mm |
| Soil Storage | S = | 89.24 | mm |
| Runoff Depth | $Q_{24}$ = | 6.69 | mm |
| Runoff Volume | $V_{24}$ = | 110.33 | m³ |

# Roof - Post Development

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |
| **Basin** | Area 2 - Roof | | | | |

## 2.1 Runnoff Curve Number (CN) and Initial Abstraction (Ia)

| Soil name and classification | Cover description (cover type, treatment, and hydrologic condition) | Curve Number [*CN*]* | Area (ha) | Product of CN x area |
|---|---|---|---|---|
| Group C | Urban lawns | 74 | | |
| Group C | Sealed roads, roofs | 98 | 1.65 | 161.7 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| * from Appendix B - TP108 | | Totals = | 1.65 | 161.7 |

**Pervious Areas:**

$$CN_{(pervious)} = \frac{pervious\ product}{pervious\ area} = \frac{0.0}{0.0} = 0.0$$

$$Ia_{(pervious)} = 5.00$$

**Impervious Areas:**

$$CN_{(impervious)} = 98.0$$

$$Ia_{(impervious)} = 0.00$$

**Overall:**

$$CN_{(average)} = \frac{total\ product}{total\ area} = \frac{161.7}{1.6} = 98.0$$

$$Ia_{(average)} = \frac{5\ x\ pervious\ area}{total\ area} = \frac{0.00}{1.6} = 0.00$$

## 2.2 Water Quality Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| 1/3 of the 24 hour Rainfall Depth in 2 Year Event (mm) [$P_{24}$] | 25.0 | |
| Component Area (ha) [$A$] | 0.0 | 1.6 |
| Curve Number [$CN$] | 0.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 253999999999746.0 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 0.0 | 20.7 |
| Runoff Volume ($m^3$) [$V_{24} = 1000\ Q_{24}\ A$] | 0 | 342 |
| Combined Runoff Volume ($m^3$) | 342 | |

## 2.3 Extended Detention Volume

| | Pervious Component | Impervious Component |
|---|---|---|
| Rainfall Depth (mm) [$P_{24}$] | 33.0 | |
| Component Area (ha) [$A$] | 0.0 | 1.6 |
| Curve Number [$CN$] | 0.0 | 98.0 |
| Initial Abstraction (mm) [$Ia$] | 5.0 | 0.0 |
| Soil Storage (mm) [$S = 25.4(1000/CN - 10)$] | 253999999999746.0 | 5.2 |
| Runoff Depth (mm) [$Q_{24} = (P_{24} - Ia)^2 / (P_{24} - Ia + S)$] | 0.0 | 28.5 |
| Runoff Volume (m³) [$V_{24} = Q_{24} A$] | 0 | 471 |
| Combined Runoff Volume (m³) | 471 | |

| | |
|---|---|
| Combined Runoff Volume (difference Pre and Post-Development) (m³) | 360 |

# Wetland 2-2

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |

## 3.1 Water Quality Volume

| Sub-catchment Name | Area (ha) | Storage Required ($m^3$) |
|---|---|---|
| Area 2 - Wetland 2-2 | 2.88* | 573 |
| | **Total Water Quality Volume Required** | **573** |

| | |
|---|---|
| Minimum Forebay Volume (15%): | 86 $m^3$ |
| An Extended Detention Overlay will be provided, reducing the Permanent Water Volume to: | 287 $m^3$ |

* reduced area as water quality treatment for roofed areas is provided at source

# Wetland 2-2 Outlet Details

| | | | | | |
|---|---|---|---|---|---|
| **Project** | P24-447 | **By** | JM | **Date** | 29/07/2025 |
| **Location** | Drury Centre - Stage 2 | **Checked** | | **Date** | |

| RL (m) | Outlet Element Discharge Rate (m³/s) | | | | | Total Discharge (m³/s) | Pond Volume (m³) | Storm Event | |
|---|---|---|---|---|---|---|---|---|---|
| | Outlet 1 Circular Oriffice | Outlet 2 Notch | Outlet 3 Top of Manhole | Outlet 4 Spillway | Outlet Pipe Subtotal | | | | **OUTLETS IL** |
| 12.34 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0000 | 383.26 | PW | **OUTLET 1 - CIRCULAR ORIFICE** |
| 12.40 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0000 | 454.76 | | |
| 12.50 | 0.007 | 0.000 | 0.000 | 0.000 | 0.007 | 0.0068 | 586.57 | | |
| 12.60 | 0.010 | 0.000 | 0.000 | 0.000 | 0.010 | 0.0096 | 734.44 | | |
| 12.70 | 0.012 | 0.000 | 0.000 | 0.000 | 0.012 | 0.0118 | 896.32 | | |
| 12.76 | 0.013 | 0.000 | 0.000 | 0.000 | 0.013 | 0.0129 | 996.00 | ED | **OUTLET 2 - TOP OF MANHOLE** |
| 12.80 | 0.014 | 0.000 | 0.000 | 0.000 | 0.014 | 0.0136 | 1064.11 | | |
| 12.90 | 0.015 | 0.000 | 0.177 | 0.000 | 0.193 | 0.1925 | 1237.61 | | |
| 13.00 | 0.017 | 0.000 | 0.501 | 0.820 | 0.517 | 1.3366 | 1416.87 | | |
| 13.10 | 0.018 | 0.000 | 0.921 | 2.379 | 0.545 | 2.9234 | 1601.95 | | |
| 13.20 | 0.019 | 0.000 | 1.418 | 4.481 | 0.571 | 5.0517 | 1792.91 | | |
| 13.30 | 0.020 | 0.000 | 1.982 | 7.069 | 0.596 | 7.6650 | 2017.78 | Bank RL | |
| 13.31 | 0.021 | 0.000 | 2.060 | 7.439 | 0.600 | 8.0388 | 2050.40 | | |

## Outlet 1 Details - Circular Oriffice

| | |
|---|---|
| Bottom RL: | 12.35 |
| Diameter / Width: | 0.100 |
| Height: | 0.000 |
| Spillway Side Slope: | xxx |
| Discharges to Outlet Pipe | |

## Outlet 2 Details - Notch

| | |
|---|---|
| Bottom RL: | xxx |
| Diameter / Width: | 0.000 |
| Height: | xxx |
| Spillway Side Slope: | xxx |
| Discharges to Outlet Pipe | |

## Outlet 3 Details - Top of Manhole

| | |
|---|---|
| Bottom RL: | 12.80 |
| Diameter / Width: | 1.050 |
| Height: | |
| Spillway Side Slope: | |
| Discharges to Outlet Pipe | |

## Outlet 4 Details - Spillway

| | |
|---|---|
| Bottom RL: | 12.90 |
| Diameter / Width: | 15.000 |
| Height: | 0.000 |
| Spillway Side Slope: | 5.0 |
| Discharges Directly to Stream | |

## Outlet Pipe Details

| | |
|---|---|
| Pipe Diameter: | 0.500 |
| Inlet Invert Level: | 11.760 |
| Outlet Invert Level: | 11.61 |
| Pipe Length: | 15.00 |