WATER CYCLE MANAGEMENT REPORT

FOR

WILTON GREENS – STAGE 2A

SUBDIVISION DEVELOPMENT APPLICATION

PROJECT TITLE: Wilton Greens – Stage 2A

PROJECT NUMBER: 8305

PREPARED FOR: Country Garden Wilton East Pty Ltd

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Base Template:	Version B June 2020

External Issue

Revision Control Register		
Version No	**Issue Date**	**Description**
1.0	18 / 10 / 2023	Issued for Development Application

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LIST OF ABBREVIATIONS

The following abbreviations are utilised in this report.

Abbreviation	Description
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Annual Recurrence Interval
ARR	Australian Rainfall & Runoff (2016)
DA	Development Application
DCP	Development Control Plan
DP	Deposited Plan
Ha	Hectare
LEP	Local Environment Plan
LGA	Local Government Area
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NP	Neighbourhood Plan
OSD	Onsite Detention
PSD	Permissible Site Discharge
SEI	Stream Erosion Index
WCMR / WCMS	Water Cycle Management Report/Strategy
WSUD	Water Sensitive Urban Design

1. INTRODUCTION

Indesco has prepared this Water Cycle Management Report (WCMR) on behalf of Country Garden Wilton East Pty Ltd, trading as Risland (the Proponent) in support of the Development Application for the proposed subdivision Stage 2A of Wilton Greens (the Site).

The Proponent proposes to develop the Site as a Torrens Title residential subdivision within a broader master-planned community.

The WCMR outlines the water cycle management plan for the proposed development and demonstrates compliance with Wollondilly Shire Council's (Council) requirements, as set out in the relevant Development Control Plan (DCP) and supporting documentation.

This report should be read in conjunction with Indesco's supporting drawing set, as enclosed in Appendix A.

2. SITE CHARACTERISTICS

2.1 SITE DETAILS

The South East Wilton Precinct (the Precinct) is located within the South West Region of the Sydney Metropolitan Area in the locality of Wilton and the Local Government Area of Wollondilly Shire Council. By road the Precinct is approximately 85km south west of the Sydney CBD, 31km north west of Wollongong, and 7km east of Picton. The approved Structure Plan for the Precinct is shown in Figure 1. Please refer to Indesco's drawing set showing the specific locality of the Site and other Site characteristics.

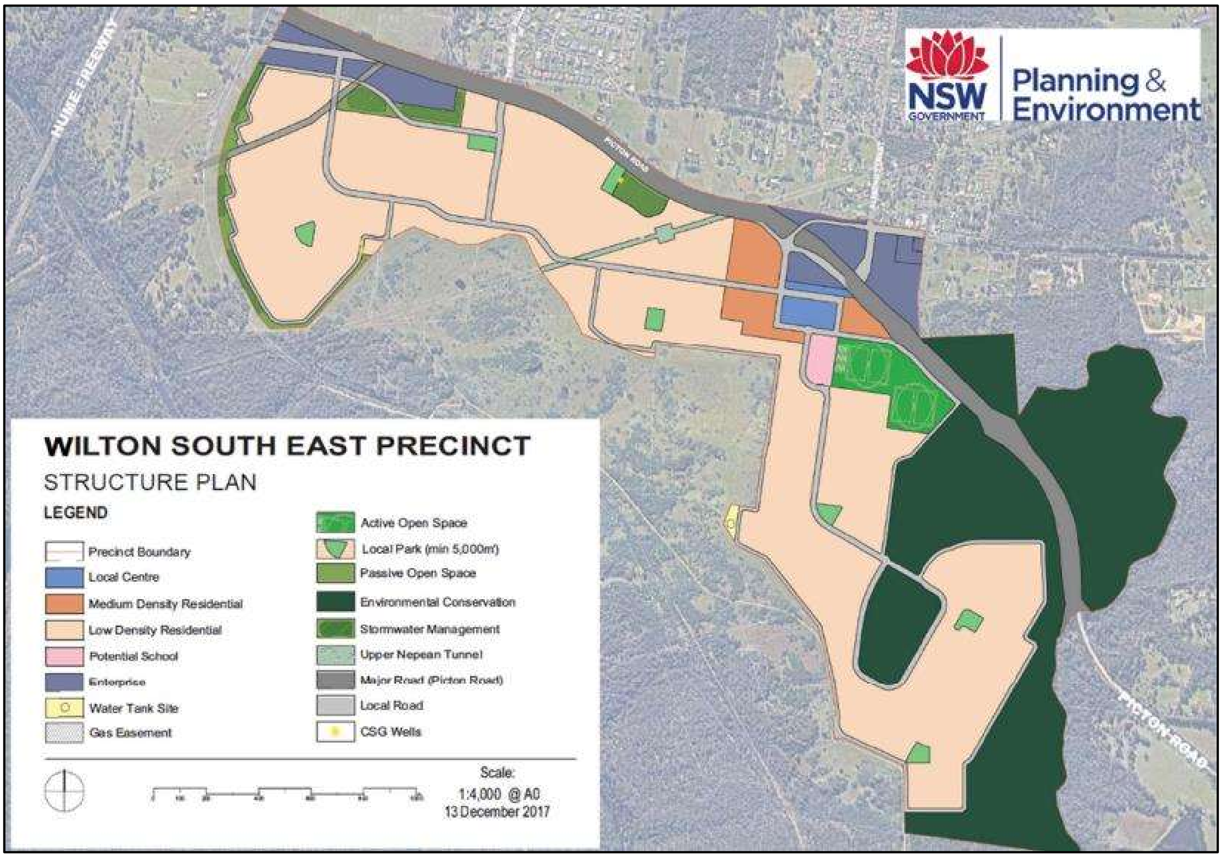


Figure 1 - Wilton South East Precinct Structure Plan

Stage 1 of the Precinct is currently under construction. The Site is comprised of Stage 2A of the Precinct and is located to the west of Stage 1 and is bounded by Conservation Land to the south, the Maldon-to-Dombarton Rail Corridor to the west, and the existing gas pipeline easement to the north.

The Site is comprised of a number of landholdings, as listed below.

Property Description*	Lot 101 on DP1232553 Lot 102 on DP1232553 *Lot details may change as a result of Stage 1 subdivision works.

2.2 SITE TOPOGRAPHY

The topography of the Site is undulating, as shown in Indesco's drawing set, though the Site generally falls to the west. It is noted that the Sites topography will change somewhat prior to Stage 2A subdivision works as the result of approved Stage 1 works and proposed Stage 2A bulk earthworks, which are the subject of separate applications. As shown on the slope analysis plans, surface gradients in Stage 2 are generally between 3 and 12% and between 3 and 22% in Stage 3.

2.3 LAND USE

The majority of the Site is cleared, and was previously used for agricultural/rural residential uses, as shown in Figure 2.

Figure 2 - Aerial Photograph (8 March 2023)

2.4 EXISTING STORMWATER CATCHMENT ANALYSIS

The stage 2A site drains generally to the south west where the existing depressions drain the site. There are catchments from stage 1 of the development that will flow through the site.

Please refer to Indesco's drawing set showing existing stormwater drainage catchments.

2.5 GEOTECHNICAL CONDITIONS

Geotechnical reporting for the Wilton Greens area shows that geotechnical conditions are typical for the region, and generally consist of topsoil atop medium-to-high plasticity clay and siltstone of varying strength.

The Council report entitled 'Regional Wollondilly Soil Assessment to Define Stormwater Infiltration Properties' dated October 2021 and prepared by WMAWater investigates infiltration rates within Council's jurisdiction. Table 69 shows that geotechnical conditions are 'Medium Heavy Clay' (consistent with geotechnical reporting for Wilton Greens), with exfiltration rates of 0.51 mm/hr to 1.14 mm/hr.

3. PROPOSED DEVELOPMENT

The proposed development will consist of 358 residential allotments and 7 Super allotments. Further to this the development also includes a public reserve/proposed park, 2 allotments for stormwater drainage infrastructure including detention/water quality basins, and 1 residue allotments. In addition to the allotments there is associated road & drainage infrastructure.

4. COUNCIL CONTROLS, GUIDELINES & REFERENCE DOCUMENTS

4.1 OVERVIEW

The Site is subject to the following planning and legislative controls:

- Environmental Planning and Assessment Act 1979;
- Wilton 2040;
- State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Including Appendix 14 South East Wilton Precinct Plan);
- NSW Department of Planning, Industry & Environment – Wilton Growth Area Development Control Plan 2021 (Including Schedule 1 – South East Precinct);
- Wilton Greens – Stage 2 & 3 – Neighbourhood Plan & associated Preliminary Water Cycle Management Plan (2021 / 2022).

The Site is also subject to the following engineering controls, guidelines and reference documents:

- 'Wilton Junction – Water Cycle Management Strategy' prepared by J. Wyndham Prince (2014);
- 'Upper Nepean River Flood Study' prepared by the Department of Land & Water Conservation (1995);
- Council's 'Design Specification – Subdivision & Engineering Standard' (2016);
- Council's 'Integrated Water Management Policy' (2020);
- Council's 'Integrated Water Management Strategy' (2020);
- Council's 'Water Sensitive Urban Design Guidelines' (2020);
- Council's 'Memo – MUSIC Template' (dated 20 March 2020);
- 'Regional Wollondilly Soil Assessment to Define Stormwater Infiltration Properties' prepared by WMAWater (2021);
- Water NSW – Using MUSIC in Sydney Drinking Water Catchment (2019);
- Australian Rainfall and Runoff Volumes 1 & 2 (2016);
- Water Sensitive Urban Design Technical Guidelines for Western Sydney; and
- Landcom's 'Managing Urban Stormwater Soils and Construction' (the Blue Book).

4.2 WILTON GROWTH AREA WATER CYCLE MANAGEMENT STRATEGY

The Site is within the study area for the Wilton Growth Area, for which a regional Water Cycle Management Strategy (WCMS) exists (as listed above). The objective of the WCMS was to:

- Identify stormwater, recycled water, and flood management issues to be considered in the future development of Wilton Junction;
- Identify flood risks;
- Evaluate and propose appropriate solutions and locations for the control of the quantity and quality of stormwater leaving the site;
- Assess all water courses which are proposed to as part of the urban development; and
- Identify the land areas required to implement the recommended management options.

The WCMS identified a combination of treatment train elements consisting of on-lot treatment, street level treatment and subdivision/development treatment measures, including the following:

- Gross Pollutant Traps (GPTs) at each stormwater discharge point;
- Bioretention raingardens;
- Gravel soakaway / level spreaders to distribute flows to the bushland perimeter; and
- A recycled water management system.

The majority of the above are shown conceptually in Figure 3.

The hydrological assessment in the Wilton Junction WCMS demonstrated that dicharges along the Nepean River have little impact as a result of the proposed development associated with the Wilton Priority Growth area and that from a regional perspective, detention storages are not required for catchments draining directly into the Nepean River. The hydrological assessment also demonstrated that a detention storage detaining discharges within the upper reaches of Allens Creek is sufficient to effectively restrict post-development peak discharges to pre-development levels within Allens Creek.

Preliminary hydraulic assessments determined that the 1% AEP Post Climate change discharges in major water courses resulted in flooding levels well below the lowest proposed development levels. In addition, proposed urban catchments within the site have a size that is generally less than 40 Ha and flows will be managed via conventional street drainage systems. Consequently, a more detailed flood assessment was not required for the development.

The WCMS included a riparian corridor assessment using NSW Office of Water Guidelines (2012) and Strahler classification, as shown in **Figure 4**. The Site includes several ‘Category 1’ water courses within the Stage 2A area.

Indesco note that a number of items have changed/evolved since the Wilton Junction WCMS was developed, most notably the following items pertaining to Neighbourhood Planning of the Site:

- The 2021 DCP includes amended Water Cycle Management requirements;
- The 2020 Water Sensitive Urban Design Guidelines and Integrated Water Cycle Management strategy provide further context;
- Land tenure and the impact on adjoining landholdings (including the rail corridor) must be considered;
- The areas between the Nepean River and the Maldon-to-Dombarton Rail Corridor (west of Stage 2A) remain zoned RU2; and
- Sydney Water have announced that a recycled water network is required to service the Wilton Growth Area.

The impact of the above on the strategy adopted in this WCMR is discussed further hereunder.

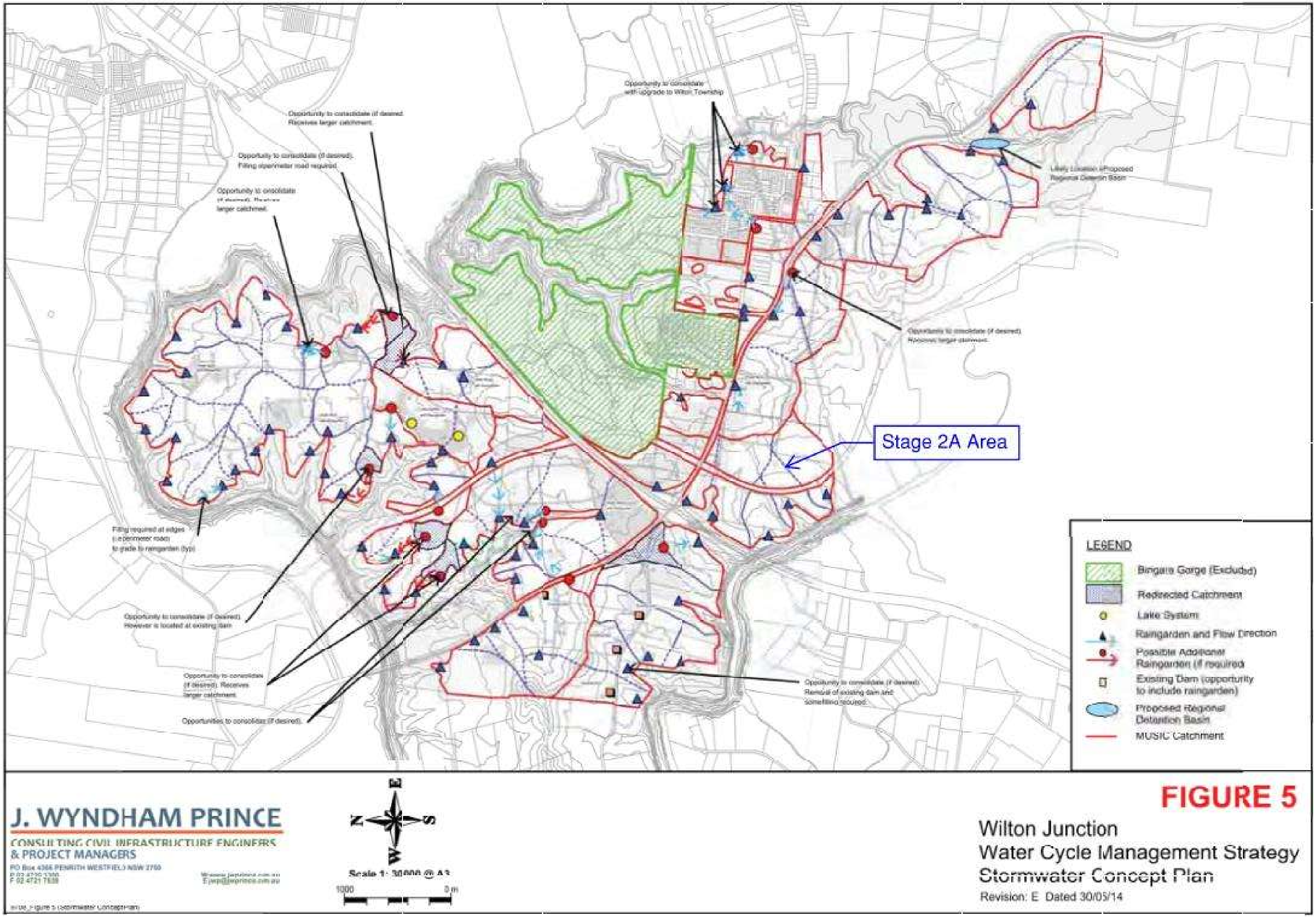


Figure 3 - Wilton Junction WCMS - Stormwater Management Concept (marked blue by Indesco)

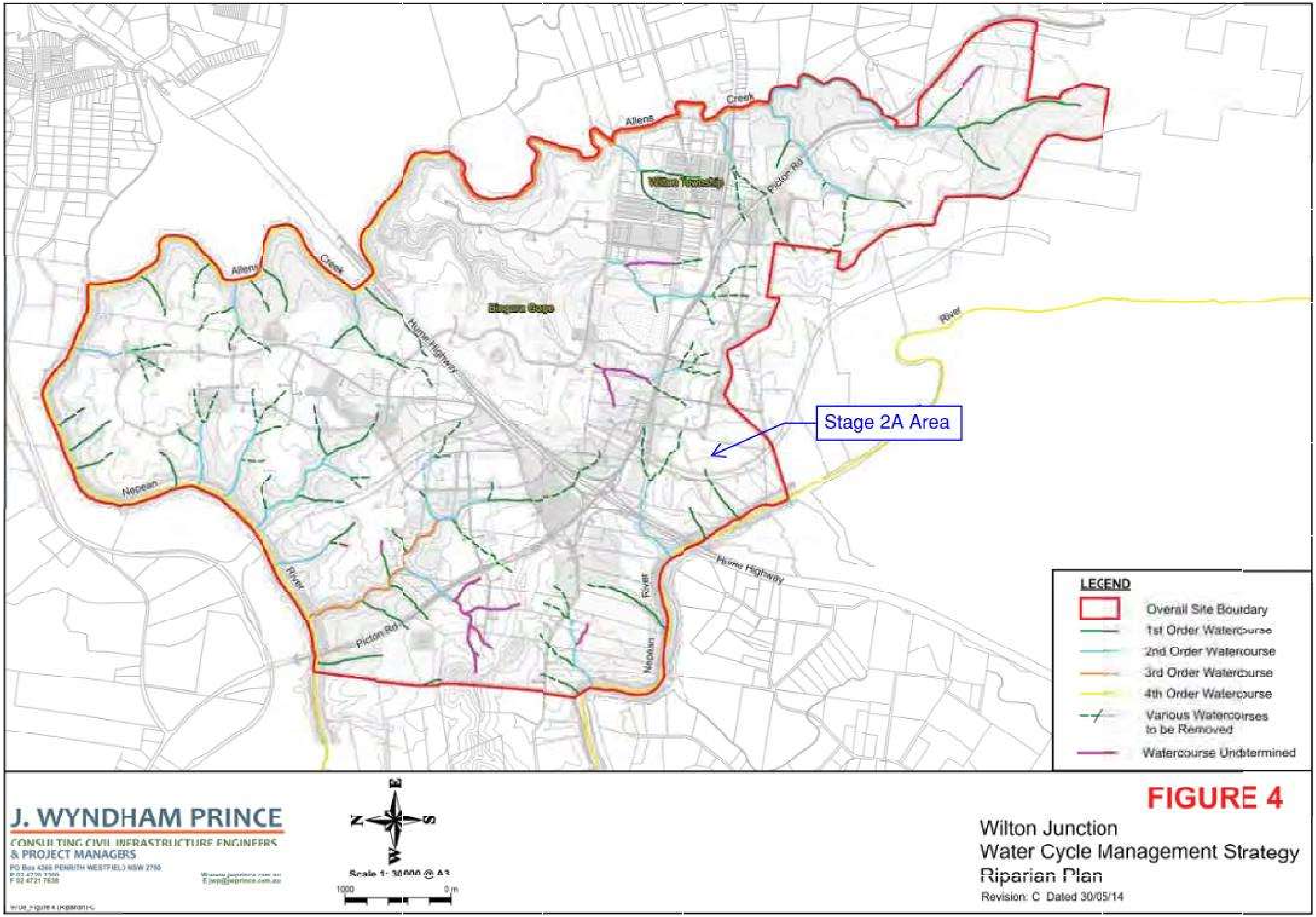


Figure 4 - Wilton Junction WCMS – Riparian Plan (marked blue by Indesco)

4.3 STORMWATER QUANTITY

Section 3.4 of the DCP outlines that Council's key objectives for stormwater quantity management are as follows:

- to limit peak stormwater flow from development such that it does not exceed pre-development rates for all storms up to and including the 1% AEP event;
- to minimise potential flooding impacts within the development;
- to ensure no adverse impacts on neighbouring properties (including rail corridors and busy roads); and
- to ensure the proposed stormwater network is coordinated with precinct planning.

4.4 STORMWATER QUALITY & WATER SENSITIVE URBAN DESIGN

4.4.1 Development Control Plan Controls

Section 3.4 of the DCP also outlines the following stormwater quality targets.

9. Development is to comply with the water quality targets in **Table 2,** below.

Table 2: Water quality targets

Element	Water quality % reduction in pollutant loads Gross Pollutants (>5mm)	Water quality % reduction in pollutant loads Total suspended solids; Total phosphorous; Total nitrogen	ENVIRONMENTAL FLOWS Stream erosion control ratio
Stormwater Management Objective	90	Neutral or Beneficial Effect on Water Quality - meaning loads of pollutants from future development must be equivalent to or less than that from the existing rural land use prior to development'	1:1

Note: Deviation from the above targets may be permissible if it can be shown through the EES Risk-based Framework that there are no adverse impacts on the high value waterways and Upper Nepean river in general.*

**Risk-based Framework for considering waterway health outcomes in strategic land use planning decisions (Dela-Cruz, Wearne and Pik, 2017).*

4.4.2 Water Sensitive Urban Design Guidelines

Council's Water Sensitive Urban Design Guidelines (2020) (the 'WSUD Guidelines') outline additional measures for consideration in development design.

Section 1 of the WSUD Guidelines identify the following key principles:

- Protect and enhance natural water systems within urban environments.
- Integrate stormwater treatment into the landscape, maximising the visual and recreational amenity of developments.
- Improve the quality of water draining from urban developments into receiving environments.
- Reduce runoff and peak flows from urban developments by increasing local detention times and minimising impervious areas.
- Minimise drainage infrastructure costs of development due to reduced runoff and peak flows.

Section 4.2.1 of the WSUD Guidelines includes the following requirements for residential development in excess of 10 lots:

- Reduce stormwater runoff to an equivalent of between 2.5 and 3 ML / year / 1 hectare of urban area
- Reduce potable water use by > 70% compared to business as usual
- Mark on plans all relevant appliances, drains, pipes and other assets that related to potable water, wastewater, rainwater and stormwater, and how each contributes to a 'zero impact' development.
- Ensure smart tank technology could in the future be integrated into residential, commercial and industrial developments.
- Prepare an Integrated Water Plan, including who owns and maintains all associated assets, and where all impervious surfaces drain to.
- Use Council MUSIC template model to demonstrate how the outcomes of this policy will be achieved.
- Design and build streetscapes in new subdivisions to achieve zero impact.
- For developments where demand is greater than 5 ML / year demonstrate how this water will be sourced through rainwater, stormwater or recycled water.
- Where the local water authority / provider advisees there is access to a recycled water network, include a recycled water meter and connection point.
- Routine monitoring of WSUD effectiveness should be undertaken on an ongoing basis.
- Monitoring of waterways to demonstrate downstream waterway of urban development is of a similar condition / quality to designated reference stream.
- Any development that is not serviced by a reticulated wastewater network available must comply with the On-site Sewage Management and Greywater Re-use policy and principles of IWM Strategy to deliver a zero impact on waterways.
- Prepare a staged erosion and sediment control plan that covers construction stages to final vegetation and establishment, developed by a Certified Professional in Erosion and Sediment Control (CPESC).

The WSUD Guidelines include a variety of additional principles, recommendations and suggestions. Discussion of relevant items is provided in the following sections of this report.

4.5 FLOODING

Sections 3.2 & 4.2 of the DCP includes the following objectives and controls relating to flooding.

3.2 Flooding

3.2.1 Objectives

1. To ensure that development is compatible with the flood behaviour, flood hazard and flood emergency management.
2. To maintain the existing flood regime and flow conveyance and avoid significant adverse impacts on flood behaviour.
3. To minimise any adverse impacts of development on the safety of the existing community in responding to floods.
4. To ensure the safety of people and development from flood risk.
5. Consider adaptability to changing flood risks due to a changing climate.
6. To utilise the best available flood information to define flood behaviour and the flood constraints within the precinct in the development of the flood impact assessment.

3.2.2 Controls

1. Development must assess impacts of climate change and increased rainfall intensities.
2. Stormwater conveyance will have a Major/Minor System configuration. Minor flows will be conveyed and contained in a system of kerb and gutter, pits and pipes/culverts. Major flows (flow in excess of Minor System capacity) will be conveyed in overland flow paths designed to cater for such flows.
3. Management of 'minor' flows using piped systems for the 1 in 10 (10%) AEP (residential land use) and the 1 in 20 (5%) AEP (commercial land use) will be in accordance Council's Design and Construction Specifications.
4. Management of 'major' flows using dedicated overland flow paths such as open space areas, roads, waterways and riparian corridors for all flows in excess of the pipe drainage system capacity and above the 10% AEP will be in accordance Council's Design and Construction Specifications.
5. Pedestrian and cycle pathways and open space may extend within the 1% AEP flood level, provided the safe access criteria contained in the NSW Floodplain Manual are met and there is no impact on the flood behaviour.
6. Development is not to result in an increase in flood levels on adjoining or surrounding land.
7. Development on flood prone land will comply with Council's Design and Construction Specifications and Flood Risk Management Policy.
8. Flood Prone Land identified in the relevant Precinct's Schedule shows indicatively the extent of the 1% AEP flood level. Where development is proposed adjacent to land identified as Flood Prone Land, in the relevant Precinct Schedule, as being affected by the 1% AEP level, Council may require a more detailed flood study to be undertaken by the applicant to confirm the extent of the flood affectation on the subject land.
9. Cut and fill is not to occur in the 1% Annual Exceedance Probability (AEP) floodway or within critical flood storage areas.

4.2 Flooding

4.2.1 Objectives

1. To ensure safety of people and development from flood risk.

4.2.2 Controls

1. Subdivision of land at or below flood planning level will be accompanied by, and comply with, a flood study prepared by a suitably experienced and qualified engineer to substantiate that the development will not increase upstream or downstream flood levels or change flood behaviour to the detriment of any other property.
2. Residential lots are not to be located at a level lower than the 1% Annual Exceedance Probability (AEP) flood level plus a freeboard of 500mm (i.e. within the 'flood planning area').
3. Subdivision design is to comply with 'Designing Safer Subdivisions – Guidance on subdivision Design in Flood Prone Areas (2007)'
4. Cut and fill is not to occur in the 1% Annual Exceedance Probability (AEP) floodway or within critical flood storage areas.

5. STORMWATER QUANTITY

5.1 STORMWATER CONVEYANCE

5.1.1 Minor Storm Event Conveyance

Minor system stormwater conveyance for the development will be a via a traditional pit and pipe system. The minor stormwater system will have the capacity to convey the peak flows from a 10% AEP storm event. For Stormwater Layout Plans refer to DA-130 to DA-139.

5.1.2 Major Storm Event Conveyance

Major system stormwater conveyance for the proposed development will be via overland flow. This will be via the road carriage way and footpath. The major stormwater system will have the capacity to convey the peak flows from a 1% AEP storm event, containing flows within the road reserve. The overland flows will flow to the stormwater management basin. The peak flows from the basin will be reduced to predeveloped peak flows and discharged to the existing drainage lines.

5.2 HYDROLOGY

Hydrological analysis for the proposed development has been undertaken using Watercom DRAINS software. DRAINS has been utilised to assess pre-development and post-development stormwater runoff to address the suitability of proposed management measures for the development.

An Initial Loss – Continuing Loss hydrological model has been utilised to assess the pre-development scenario, with model establishment parameters as shown in the table below:

Table 1 - Pre-Development Hydrological Model Data

Parameter – Initial Loss-Continuing Loss	Value
Impervious area initial loss	1 mm
Impervious area continuing loss	0 mm/hr
Pervious area initial loss	16 mm*
Pervious area continuing loss	1.29 mm/hr*
Overland Flow Calculation	Kinematic Wave Equation

*Value obtained from Australian Rainfall & Runoff (ARR) Data Hub for the Site with appropriate NSW-specific adjustments.

A Horton / ILSAX hydrological model has been utilised to assess the post-development scenario, with model establishment parameters as shown in the table below:

Table 2 - Post-Development Hydrological Model Data

Parameter – Horton/ILSAX	Value
Paved (impervious) area depression storage	1mm
Supplementary area depression storage	1mm
Paved (impervious) area depression storage	5mm
Soil Type	Normal – Type 3
Overland Flow Calculation	Kinematic Wave Equation

ARR 2016 rainfall data was obtained online from the ARR Data Hub and the Bureau of Meteorology (BOM) for the Site location and input to the model. Please refer to Appendix B for the BOM Intensity-Frequency-Duration (IFD) data utilised in modelling.

Please refer to Indesco's drawing set for an analysis of pre and post-development catchment areas.

Impervious fractions for each land use typology are shown in the table below:

Table 3 - Impervious Fractions

Development Type	Impervious Fraction
Existing	5%
Residential (Combined lot, road, open space areas)	80%*

* Value used in design is more conservative than those specified in Council's Design Specification, as residential densities are anticipated to be greater than those considered in the Design Specification.

5.3 SITE CATCHMENTS

The time of concentration for each catchment was calculated as follows using 'More Detailed Data' in DRAINS and QUDM tables for 'Additional Time':

Table 4 - Catchment Data

Catch	Status	Area (ha)	DRAINS 'More Detailed Data'			Additional Time*			
			Length	Roughn's (n*)	Slope	Length	Fall of Channel	Multiplier	Time
C	Pre		First 100m	0.13**	3.5%	Remaining 261m	13.5m	3	5.4 mins
	Post		First 100m	0.012^	5%	Remaining 861m	16.5m	1	6.5 mins
D	Pre		First 100m	0.13**	10%	Remaining 557m	30.5m	3	8.7 mins
	Post		First 100m	0.012^	5%	Remaining 824m	20.5m	1	5.8 mins

* Refer to Appendix C for QUDM tables utilised to calculate the Additional Time.

** Value has been obtained from ARR for 'Short Grass Prairie'.

^ Value has been obtained from ARR for 'Concrete or Asphalt'.

Based on the above input parameters, post-development peak flows are anticipated to exceed pre-development rates. Stormwater detention is therefore required to attenuate post-development peak flows onto neighbouring properties.

5.4 DRAINS PRELIMINARY CATCHMENT MODELLING

DRAINS modelling was undertaken to determine the predeveloped and developed peak flows for a range of AEPs from 20% to 1%, for storm durations ranging from 5 minutes to 9 hours for the proposed development to confirm detention was required.

Table 5 - Predeveloped vs Developed (without Detention) Peak Flows

Stage	Catch	Event	Pre-Development Peak Flow Rate	Post-Development Peak Flow Rate	Compliance Achieved?
	C	0.5 EY	0.646 m3/s	2.954 m3/s	No
		20% AEP	0.95 m3/s	3.86 m3/s	No
		0.2 EY	0.993 m3/s	3.933 m3/s	No
		10% AEP	1.234 m3/s	4.721 m3/s	No
		5% AEP	1.665 m3/s	5.701 m3/s	No
		2% AEP	2.355 m3/s	7.183 m3/s	No
		1% AEP	2.861 m3/s	8.33 m3/s	No
	D	0.5EY	2.072 m3/s	3.611 m3/s	No
		20% AEP	3.014 m3/s	4.718 m3/s	No
		0.2 EY	3.143 m3/s	4.807 m3/s	No
		10% AEP	3.836 m3/s	5.77 m3/s	No
		5% AEP	5.087 m3/s	6.968 m3/s	No
		2% AEP	6.977 m3/s	8.78 m3/s	No
		1% AEP	8.475 m3/s	10.182 m3/s	No

As can be seen from the above table, some detention is required to reduce the peak flows from the development to the predeveloped peak flows.

5.5 DRAINS DETENTION BASIN PARAMETERS

End-of-line stormwater basins are proposed to control peak post-development stormwater runoff to pre-development rates to satisfy Council's controls. Engineering design has been conducted for proposed stormwater detention basins with the characteristics shown in the tables below:

Table 6 - Basin C Design Data

Basin Characteristic	Details
Type	Above Ground Basin (Permanent)
Low-Flow Orifice Outlet	Outlet pipe with 700 x 600mm orifice at Basin Invert Level 213.25, AHD
Low-Flow Weir Outlet	2700mm long crest at 214.15 mAHD to DN 750mm pipe
High-Flow Weir Outlet	3600mm long crest at 214.45 mAHD to DN 750mm pipe
Emergency Overflow	9m long weir @ 215.50m AHD
Basin Crest Level	216.00m AHD
Basin Volume @ 1% AEP	5,740 m^3 and 1% AEP water level @ 214.68mAHD*
Basin Footprint @ Crest	7650m^2

Table 7 - Basin D Design Data

Basin Characteristic	Details
Type	Above Ground Basin (Permanent)
Low-Flow Orifice Outlet	Outlet pipe with 1350 x 900mm orifice at Basin Invert Level 210.75m AHD
Low-Flow Weir Outlet	2700mm long crest at 211.95 mAHD to twin DN 750mm pipe's
High-Flow Weir Outlet	4600mm long crest at 212.35 mAHD to DN 900mm pipe
Emergency Overflow	13m long weir @ 213.00m AHD
Basin Crest Level	213.50m AHD
Basin Volume @ 1% AEP	3,118 m³ and 1% AEP water level @ 212.74mAHD*
Basin Footprint @ Crest	3330m²

Please refer to Indesco's drawing set for preliminary details of the proposed stormwater detention infrastructure.

5.6 DRAINS POST DEVELOPMENT CATCHMENT MODELLING

A simple model has been established to provide conceptual detention storage volumes required to be provided within each catchment. It is envisaged that the storage volumes that will ultimately be required will be lesser than those calculated in modelling when (1) more detailed catchment analysis and stormwater design is performed, (2) streetscape stormwater infrastructure is incorporated and (3) design is optimised at Subdivision Works Certificate Stage.

The measures that have been modelled indicate that the following results are achievable:

Table 8 - Predeveloped vs Developed (with Detention) Peak Flows

Stage	Catch	Event	Pre-Development Peak Flow Rate	Post-Development Peak Flow Rate	Compliance Achieved?
	C	0.5 EY	0.646 m3/s	0.643 m3/s	Yes
		20% AEP	0.95 m3/s	0.777 m3/s	Yes
		0.2 EY	0.993 m3/s	0.802 m3/s	Yes
		10% AEP	1.234 m3/s	1.111 m3/s	Yes
		5% AEP	1.665 m3/s	1.601 m3/s	Yes
		2% AEP	2.355 m3/s	2.284 m3/s	Yes
		1% AEP	2.861 m3/s	2.94 m3/s	Yes
	D	0.5 EY	2.072 m3/s	2.063 m3/s	Yes
		20% AEP	3.014 m3/s	2.55 m3/s	Yes
		0.2 EY	3.143 m3/s	2.658 m3/s	Yes
		10% AEP	3.836 m3/s	3.434 m3/s	Yes
		5% AEP	5.087 m3/s	4.388 m3/s	Yes
		2% AEP	6.977 m3/s	5.826 m3/s	Yes
		1% AEP	8.475 m3/s	7.069 m3/s	Yes

Please refer to Indesco's DRAINS models for further information.

As can be seen from the above tables, by constructing the detention basins with the volume and outlet configuration's discussed above, the peak flows at the outlet points of the development are reduced to below the predeveloped peak flows

Due to the relatively steep topography of the Site and urban design, access, landscape, maintenance and other considerations, it is considered impractical to incorporate meaningful detention measures on-lot or in the streetscape to control peak stormwater runoff. Despite no allowance being made in modelling, it is envisaged that some storage would occur in the streetscape and on-lot (e.g. in gardens, infiltration areas and the like). The stormwater modelling performed is thus relatively conservative.

5.7 DETENTION BASIN SPILLWAYS

The Basin spillway was to be designed to cater for the entire 1% AEP storm event in the case of the staged discharge being blocked. The proposed weir design (refer design plans for details) more than caters for the 1% event and additional capacity has been provided for safety. Refer to Appendix D for the spillway calculations.

5.8 SCOUR PROTECTION

Scour protection shall be nominated on the design plans for the pipe outlets from the detention basin at detailed design. The scour protection designs shall be in accordance with Catchments & Creek guidelines on rock sizing for both single, multi-pipe outlets and spillways.

6. STORMWATER QUALITY - OPERATIONAL PHASE

6.1.1 Model Establishment

Stormwater quality has been modelled using ‘Model for Urban Stormwater Improvement Conceptualisation’ (MUSIC) software produced by eWater. MUSIC modelling has been undertaken in accordance with Wollondilly Shire Council’s Water Sensitive Urban Design Guidelines and Water NSW’s ‘Using MUSIC in Sydney Drinking Water Catchment’. Modelling has been conducted using a template MUSIC *.sqz provided by Council.

Please refer to the tables overleaf that show input parameters for the MUSIC models.

Table 9 - Source Node Rainfall-Runoff Parameters

Parameter	Adopted Value				
	Agricultural	**Commercial**	**Public Reserve**	**Lots**	**Roads**
			Impervious Area Properties		
Rainfall Threshold (mm)	1.0	1.4	1.0	1.0	1.5
			Pervious Area Properties		
Soil Capacity (mm)	94	170	94	94	94
Initial Storage (%)	25	30	25	25	25
Field Capacity (mm)	70	70	70	70	70
Infiltration Capacity Coefficient - a	135	210	135	135	135
Infiltration Capacity Coefficient - b	4.0	4.7	4.0	4.0	4.0
			Groundwater Properties		
Initial Depth (mm)	10	10	10	10	10
Daily Recharge Rate (%)	10	50	10	10	10
Daily Baseflow Rate (%)	10	4	10	10	10
Deep Deep Seepage Rate (%)	0	0	0	0	0
			General Node Parameters		
Node Type	Agricultural	Urban	Urban	Urban	Urban
Zoning/Surface Type	N/A	Mixed	Revegetated Land	Residential	Sealed Road

Table 10 - Source Node Parameters

Land-use Category		% Impervious	Log_{10} TSS (mg/L)		Log_{10} TP (mg/L)		Log_{10} TN (mg/L)	
			Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Agricultural	Mean	0%	2.15	1.30	-0.22	-1.05	0.48	0.04
	Std Dev		0.31	0.13	0.30	0.13	0.26	0.13
Commercial	Mean	90%	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev		0.32	0.17	0.25	0.19	0.19	0.12
Public Reserve	Mean	5%	1.95	1.15	-0.66	-1.22	0.30	-0.05
	Std Dev		0.32	0.17	0.25	0.19	0.19	0.12
Lots	Mean	60%	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev		0.32	0.17	0.25	0.19	0.19	0.12
Roads	Mean	85%	2.43	1.20	-0.30	-0.85	0.34	0.11
	Std Dev		0.32	0.17	0.25	0.19	0.19	0.12

6.2 MUSIC MODEL TREATMENT TRAIN

The stormwater quality treatment train consist of the following parts;

- Grassed Swales
- Bio-Swale
- Infiltration Blisters
- Tree infiltration Blisters
- Gross Pollutant Traps
- Infiltration Ponds

A brief description on each treatment measure is listed below.

6.2.1 Grassed Swales

A grassed swale is the trapezoidal open channels provided to convey and filter the stormwater runoff through vegetation to remove coarse sediments and total suspended solids. Only one third of the actual swale length are modelled in MUSIC to better simulating the actual catchment runoff scenario. On the southern east side where the road slope excess of 5%, check dam shall be provided to ensure the swale bed slope at maximum 5%. The type and species of the vegetation planted into the grassed swale shall be in accordance with council's WSUD guidelines.

Table 11 – Grassed Swales Parameters

	Treatment Node Type	Bottom Width	Top Width	Bed Slope	Swale Depth	Low-flow Bypass	Vegetation Height	Exfiltration Rate
Grassed Swale	Swale	1.2m	3m	1%~5%	300mm	0m^3/s	200mm	0.00mm/hr

6.2.2 Infiltration Blisters

An infiltration blister is an infiltration pond provided within the road reserve adjacent to the site boundary, which are linked together with grass swales. The purpose of the infiltration blisters is to reduce the site stormwater discharge volume which helps to offset the increased runoff resulting from additional impervious surface area after the site is developed. The infiltration Blisters treat the stormwater runoff by infiltrating it into the surrounding soil and groundwater. It is assumed that the site will have similar soil profile with nearby area, therefore the exfiltration rate of 0.51mm/hr is adopted. The typical detail plan for Infiltration Blister shown in DA-872.

Table 12 – Infiltration Blisters Parameters

	Treatment Node Type	Unlined Filter media Parameter	Extended Detention Depth	Low-flow Bypass	High-flow Bypass	Filter media depth	Exfiltration Rate
Infiltration Blisters (IP)	Infiltration device	Varies	0.15m	0m^3/s	100m^3/s	0.5m(C) 0.8m(D)	0.51mm/hr

6.2.3 Tree Infiltration Blisters

A tree blister is a small-size infiltration pond distributed within the road reserve where the runoff from the upstream gutter and will be diverted into. The stormwater collected by tree infiltration blister will infiltrate into the surrounding soil and groundwater. It is assumed that the site will have similar soil profile with nearby area, therefore the exfiltration rate of 5.00mm/hr is adopted. The typical detail plan for bioretention blisters is shown in DA-871.

Table 13 – Bioretention Blisters Parameters

	Treatment Node Type	Unlined Filter media Parameter	Extended Detention Depth	Low-flow Bypass	High-flow Bypass	Filter media depth	Exfiltration Rate
Tree infiltration Blisters (TB)	Infiltration device	Varies	0.15m	$0m^3/s$	$100m^3/s$	0.5m(C) 0.8m(D)	5.00mm/hr

6.2.4 Gross Pollutant Traps (End of Line)

A HumeGard GPT is proposed upstream of each bioretention basins (end of line). These products remove gross pollutants, sediment and attached nutrients. The MUSIC node for the GPT was provided by Humes. The removal efficiencies have been confirmed via independent testing. An equivalent product could be used. The flows to the GPT were limited to the 3-month peak flow (4EY) with larger flows flowing directly into the downstream bioretention basin. The design plans for the GPT locations are shown in DA-780 (catchment C) and DA-785 (Catchment D). Information on the GPT's can be found in Appendix E.

Table 14 – Gross Pollutant Traps Parameters

	Treatment Node Type	Low-flow Bypass	High-flow Bypass	GP Removal efficiency	TSS Removal efficiency	TP Removal efficiency	TN Removal efficiency
HumeGard GPT	GPT	$0m^3/s$	$1.173m^3/s$(C) $1.456m^3/s$(D)	90%	49%	40%	26%

6.2.5 Infiltration Pond (End of Line)

An infiltration pond will be the last part of the treatment train before the stormwater discharge into the detention basin. The purpose of the infiltration ponds is to reduce the site stormwater discharge volume which helps to offset the increased runoff resulting from additional impervious surface area after the site is developed. The infiltration ponds treat the stormwater runoff by infiltrating it into the surrounding soil and groundwater. It is assumed that the site will have similar soil profile with nearby area, therefore the exfiltration rate of 0.51mm/hr is adopted. The design plans for the infiltration basin locations are shown in DA-780 (catchment C) and DA-785 (Catchment D)

Table 15 –Infiltration Pond Parameters

	Treatment Node Type	Unlined Filter media Parameter	Extended Detention Depth	Low-flow Bypass	High-flow Bypass	Filter media depth	Exfiltration Rate
Infiltration Ponds	Infiltration device	Varies	1.0m	$0m^3/s$	$100m^3/s$	0.8m	0.51mm/hr

6.3 NUTRIENT STRIPPING & GROSS POLLUTANT REDUCTION

The table's below illustrates the effectiveness of the proposed treatment rain, demonstrating compliance with Council's controls.

Table 16 –Stormwater Quality Model Results NorBE – Stage 2A

Catchm't	Suspended Solids			Phosphorous			Nitrogen			Gross Pollutants		
	Pre	Post	Net	Pre	Post	Net	Pre	Post	Net	Pre	Residual	Net
C	6370	3190	-3180	26.50	8.01	-18.49	127.00	74.50	-52.50	0.00	0.00	0.00
D	8620	5960	-2660	36.80	13.50	-23.30	173.00	111.00	-62.00	0.00	0.00	0.00
Total	14990	9150	-5840	63.30	21.51	-41.79	300.00	185.50	-114.50	0.00	0.00	0.00

Table 17 –Stormwater Quality Model Results Reduction's – Stage 2A

Catchm't	Suspended Solids			Phosphorous			Nitrogen			Gross Pollutants		
	Source	Residual	% Reduct'n	Source	Residual	% Reduct'n	Source	Residual	% Reduct'n	Source	Residual	% Reduct'n
C	21000	3190	84.80	35.20	8.01	77.20	201.00	74.50	62.90	2360	0	100.00
D	25500	5960	76.70	44.30	13.50	69.60	230.00	111.00	51.60	2720	0	100.00
Total	46500	9150	80.32	79.50	21.51	72.94	431.00	185.50	56.96	5080	0	100.00

Table 18 –Stormwater Quality Model Results WSUD Checklist – Stage 2A

Catchm't	Suspended Solids		Phosphorous		Nitrogen		Gross Pollutants	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
C	85.00	84.80	65	77.20	45	62.90	90	100.00
D	85.00	76.70	65	69.60	45	51.60	90	100.00
Total	85.00	80.32	65	72.94	45	56.96	90	100.00

As can be seen from the results in Tables above, the TN, TP and gross pollutants are reduced below Wollondilly shire council's treatment objective. TSS is slightly above council check list target however is below the minimum requirement for the Wilton DCP of NorBE.

A copy of the MUSIC model has been submitted to Council.

6.4 STORMWATER RETENTION

Wollondilly Shire Council has specified the stormwater retention target for a 'zero impact' development must have an average annual stormwater runoff between 2.5 and 3 ML per hectare.

Table 19 –Stormwater Retention Model Results – Stage 2A

Catchm't	AREA	TARGET RUNOFF(ML/YR)		ACHIEVED RUNOFF				
		MIN (2.5ML/yr)	MAX (3.0ML/yr)	Source (ML/yr)	Residual (ML/yr)	% Reduct'n	Flow (ML/yr)/ha)	Reduction Flow (ML/yr)/ha)
C	13.65	34.125	40.95	88.90	47.00	-41.90	3.44	-3.07
D	17.43	43.575	52.29	105.00	71.60	-33.40	4.11	-1.92
Total	31.08	77.70	93.24	193.90	118.60	-75.30	3.82	-2.42

As can be seen from the results in Table above, the proposed development does not meet to the stormwater retention target mainly due to the following reasons:

- Non-potable (recycled) water reticulation being provided to the site thus reducing the reuse by individual allotments through rainwater tanks to 0. The requirement of the Non-potable pipe is due to Sydney waters requirements for the precinct
- Site soil conditions of medium to heavy clay with limited infiltration rate. Given this underlying soil condition there is limited options to infiltrate water in the post development situation.

6.5 ADDITIONAL TREATMENT TARGETS EXPLORED

6.5.1 Rainwater Tanks

The use of 4KL rainwater tanks with a sufficient reuse in line with WSUD technical guidelines in the proposed development would have the following impact upon rainwater runoff.

Reduction in Flow (ML/yr) – 35.60

Residual Runoff (ML/yr) – 83.00

Residual Runoff (ML/yr/ha) – 2.67

As can be seen the affected of the Sydney Water Non-Potable watermain is large and is one of the primary causes of the development not reaching runoff requirements.

6.5.2 Tree Infiltration pods

The use of Tree infiltration pods that take water from the kerb and gutter through to a buried 300mm dia pipe utilised to store water and release it to the tree, in the proposed development would have the following impact upon rainwater runoff.

Reduction in Flow (ML/yr) – 7.60

Residual Runoff (ML/yr) – 111.00

Residual Runoff (ML/yr/ha) – 3.57

As can be seen the affected of the proposed tree infiltration pods has minimal affect on the residual runoff and would cause a large maintenance issue for council as these would be transitioned to be their asset.

6.5.3 On-Lot Infiltration pods

The use of On-Lot infiltration pods consisting of a 5m^2 surface area by 0.3m deep, in the proposed development would have the following impact upon rainwater runoff.

Reduction in Flow (ML/yr) – 22.90

Residual Runoff (ML/yr) – 95.70

Residual Runoff (ML/yr/ha) – 3.08

As can be seen the affected of the on-lot infiltration pods has some affect on the residual runoff. These infiltration pods should not be considered as a long term solution due to council not being able to consistently police their use and long term maintenance post construction of the dwelling.

7. STAGING

The Proponent may seek to sub-stage the Proposed development. The proposed stormwater management measures allow flexibility for sub-staging.

In the event that sub-staging of the development is desired, then stormwater management would generally occur in accordance with the following principles:

Option A

- End-of-line basins installed to ultimate design with initial sub-stages; and
- Streetscape infrastructure installed within road reserves of each sub-stage

Or,

Option B

- Temporary basins installed to suit the relevant catch initial sub-stages; and
- Streetscape infrastructure installed within road reserves of each sub-stage

In either case, each sub-stage shall comply with the relevant Council controls.

8. CONCULSION

Council's WSUD Guidelines and Integrated Water Cycle Management Strategy call for numerous requirements for residential development that are in addition to the controls included within the DCP. Stormwater quantity and stormwater quality (operational phases) have been addressed.

Stormwater conveyance for the site will be in accordance with the minor/major system philosophy and the requirements of Wollondilly Shire Council. The minor system consisting of surface inlet pits and pipes has been designed for an AEP of 10%. The major stormwater system will consist of the road reserve and will be designed for an AEP of 1%.

Detention modelling for the site determined that the peak flows from AEPs for 20% to 1% AEP have been reduced to or below the predeveloped peak flows.

The water quality management for the development will be formed through a complex treatment train to achieve the best possible compliance to the WSUD Guidelines. A balanced and holistic approach to water cycle management should be adopted that appropriately considers Council and Sydney Water requirements as well as underlying soil conditions.

The existing soil conditions are expected to be a medium to heavy clay with a low exfiltration rate of 0.51 mm/hr to 1.14 mm/hr.

The recycled water network forms a key component of the integrated water cycle management strategy for Wilton, as it serves (1) as a discharge for treated wastewater, rather than discharging to waterways, and (2) to reduce the demand for potable water. While the presence of the recycled water network will benefit the future Wilton community, the ability of developments to comply with several of the requirements of the WSUD Guidelines and IWCMS will be affected.

As such the WSUD design documented in this report is considered as the best outcome for the development that balances the line between all stakeholder requirements.

If you have any questions regarding the information provided in this Water Cycle Management Report, please call the undersigned or Mathew Zollinger to discuss

Yours Faithfully,

Brandon Gathercole

B.E. (Civil), MIEAust, CPEng, NER, RPEQ

Principal Civil Engineer - Newcastle

APPENDIX A – INDESCO DRAWING SET

APPENDIX B – BOM IFD DATA

All Design Rainfall Depth (mm)

Issued: 06 December 2021

Location Label:

Requested coordinate: Latitude -34.238577 Longitude 150.680462

Nearest grid cell: Latitude 34.2375 (S) Longitude 150.6875 (E)

		Exceedances per Year (EY)			Annual Exceedance Probability (AEP)														
Duration	Duration in min	12EY	6EY	4EY	3EY	2EY	63.2%	50%	0.5EY	20%	0.2EY	10%	5%	2%	1%	1 in 200	1 in 500	1 in 1000	1 in 2000
5 min	5	2.79	3.28	4.11	4.71	5.55	7.01	7.94	8.82	11.1	11.3	13.4	15.9	19.4	22.3	24.0	27.0	29.2	31.3
10 min	10	4.14	4.87	6.16	7.10	8.46	10.9	12.4	13.7	17.4	17.7	21.2	25.1	30.8	35.5	38.0	42.5	45.8	49.1
15 min	15	5.07	5.96	7.55	8.72	10.4	13.5	15.3	17.0	21.6	22.0	26.2	31.2	38.2	44.1	47.2	52.8	56.9	61.0
20 min	20	5.81	6.82	8.63	9.96	11.9	15.4	17.5	19.5	24.6	25.1	30.0	35.6	43.6	50.3	53.9	60.3	65.1	69.8
25 min	25	6.42	7.52	9.51	11.0	13.1	17.0	19.3	21.5	27.1	27.7	32.9	39.1	47.8	55.1	59.2	66.3	71.6	76.8
30 min	30	6.94	8.13	10.3	11.8	14.2	18.4	20.8	23.1	29.2	29.8	35.4	41.9	51.3	59.1	63.6	71.2	76.9	82.6
45 min	45	8.21	9.60	12.1	13.9	16.6	21.6	24.4	27.1	34.0	34.7	41.2	48.6	59.3	68.2	73.5	82.5	89.2	95.9
1 hour	60	9.21	10.7	13.5	15.6	18.5	24.0	27.2	30.2	37.8	38.6	45.7	53.8	65.4	75.0	81.1	91.0	98.5	106
1.5 hour	90.0	10.8	12.5	15.7	18.1	21.6	28.0	31.7	35.2	44.0	44.8	52.9	62.1	75.2	86.0	92.9	104	113	121
2 hour	120	12.0	14.0	17.5	20.2	24.1	31.2	35.4	39.2	49.1	50.1	59.0	69.1	83.4	95.1	103	115	124	134
3 hour	180	13.8	16.2	20.4	23.5	28.0	36.5	41.5	46.0	57.8	58.9	69.4	81.1	97.6	111	119	133	144	154
4.5 hour	270.0	15.9	18.7	23.6	27.3	32.8	42.9	49.0	54.4	68.7	70.0	82.5	96.6	116	131	140	156	168	180
6 hour	360	17.6	20.6	26.2	30.4	36.6	48.2	55.3	61.3	78.0	79.5	94.0	110	132	149	158	177	190	203
9 hour	540	20.0	23.6	30.2	35.2	42.7	56.9	65.6	72.8	93.6	95.4	113	133	159	179	190	212	228	244
12 hour	720	21.8	25.8	33.3	38.9	47.5	63.8	73.9	82.0	106	109	129	153	182	205	218	243	261	279
18 hour	1080	24.4	29.1	37.9	44.6	54.8	74.6	86.7	96.3	127	129	155	184	220	248	264	295	318	340
24 hour	1440	26.3	31.5	41.2	48.7	60.1	82.6	96.3	107	142	145	175	208	250	281	302	338	365	392
30 hour	1800	27.7	33.3	43.7	51.9	64.3	88.9	104	115	154	157	190	228	273	308	336	380	412	445
36 hour	2160	28.8	34.7	45.8	54.4	67.7	94.0	110	122	163	166	202	243	292	330	363	413	450	488
48 hour	2880	30.4	36.8	48.9	58.3	72.8	102	119	132	178	181	221	267	321	363	404	462	507	552
72 hour	4320	32.2	39.4	52.8	63.3	79.5	112	131	145	195	199	244	295	356	404	454	521	574	629
96 hour	5760	33.1	40.8	55.3	66.5	83.9	118	138	153	206	210	257	311	375	425	480	551	608	668
120 hour	7200	33.6	41.7	57.1	68.9	87.1	123	143	159	213	218	266	321	387	438	494	567	625	688
144 hour	8640	33.8	42.3	58.5	70.9	89.8	127	148	164	220	224	272	328	394	445	500	575	632	697
168 hour	10080	33.8	42.7	59.6	72.5	92.2	130	152	169	225	230	278	333	399	450	501	577	634	700

APPENDIX C - QUDM TIMING GRAPHS

4.6.7 Initial estimate of kerb, pipe and channel flow time

An initial (trial) estimate of flow travel times along kerbs, pipes and channels can be determined from Figure 4.5 (Argue, 1986).

The chart may be used directly to determine approximate travel times along a range of rigid channel types and, with the application of multiplier Δ for a range of loose-boundary channel forms.

Technical notes for Figure 4.5

Flow travel time (approximate) may be obtained directly from this chart for:

- kerb-and-gutter channels
- stormwater pipes
- allotment channels of all types (surface and underground)
- drainage easement channels (surface and underground)

Multiplier Δ, should be applied to values obtained from the chart as per:

- grassed swales, well maintained and without driveway crossings, Δ = 4
- blade-cut earth table drains, well maintained and no driveway crossings, Δ = 2
- natural channels, Δ = 3

Once a trial flow rate has been determined, the travel time determined from Figure 4.5 will need to be checked using either figures 4.6 or 4.7.

Legend

= Pre-Development Catchment C

= Pre-Development Catchment D

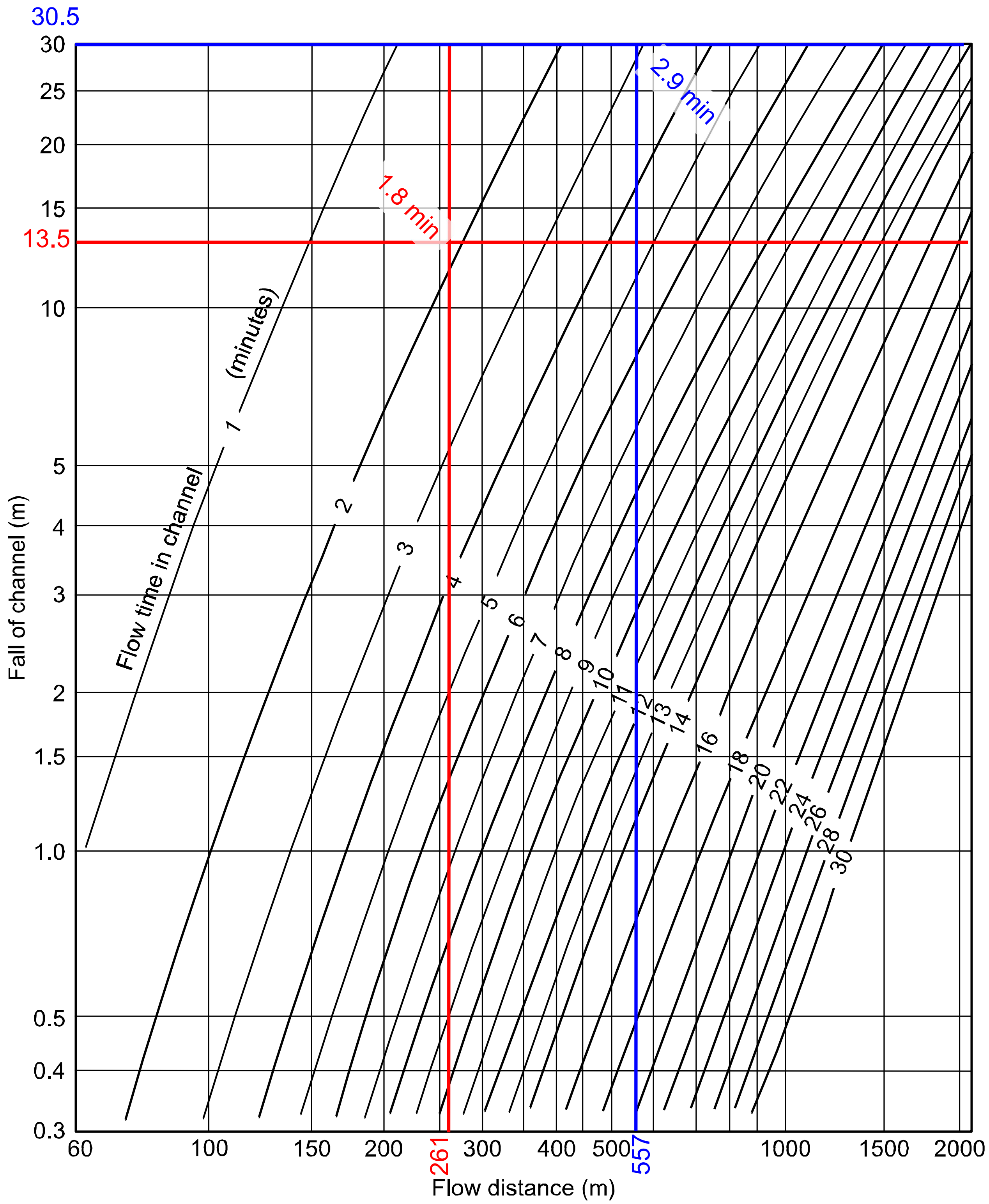


Figure 4.5 – Flow travel time in pipes and channels (Source: Argue, 1986)

4.6.8 Kerb flow travel times

Time of flow in kerb and channel should be determined by dividing the length of kerb and channel flow by the average velocity of the flow.

The average velocity of the flow may be determined in either of two ways:

- Izzard's equation—refer to Technical Note 4, Book 8, ARR (1998). Reference is also made to Section 7.4.6 (d) of this Manual for a more detailed explanation of Izzard's equation. Figure 4.7 provides a quick solution to Izzard's equation—accurate enough for travel time calculations.
- Using Figure 4.6.

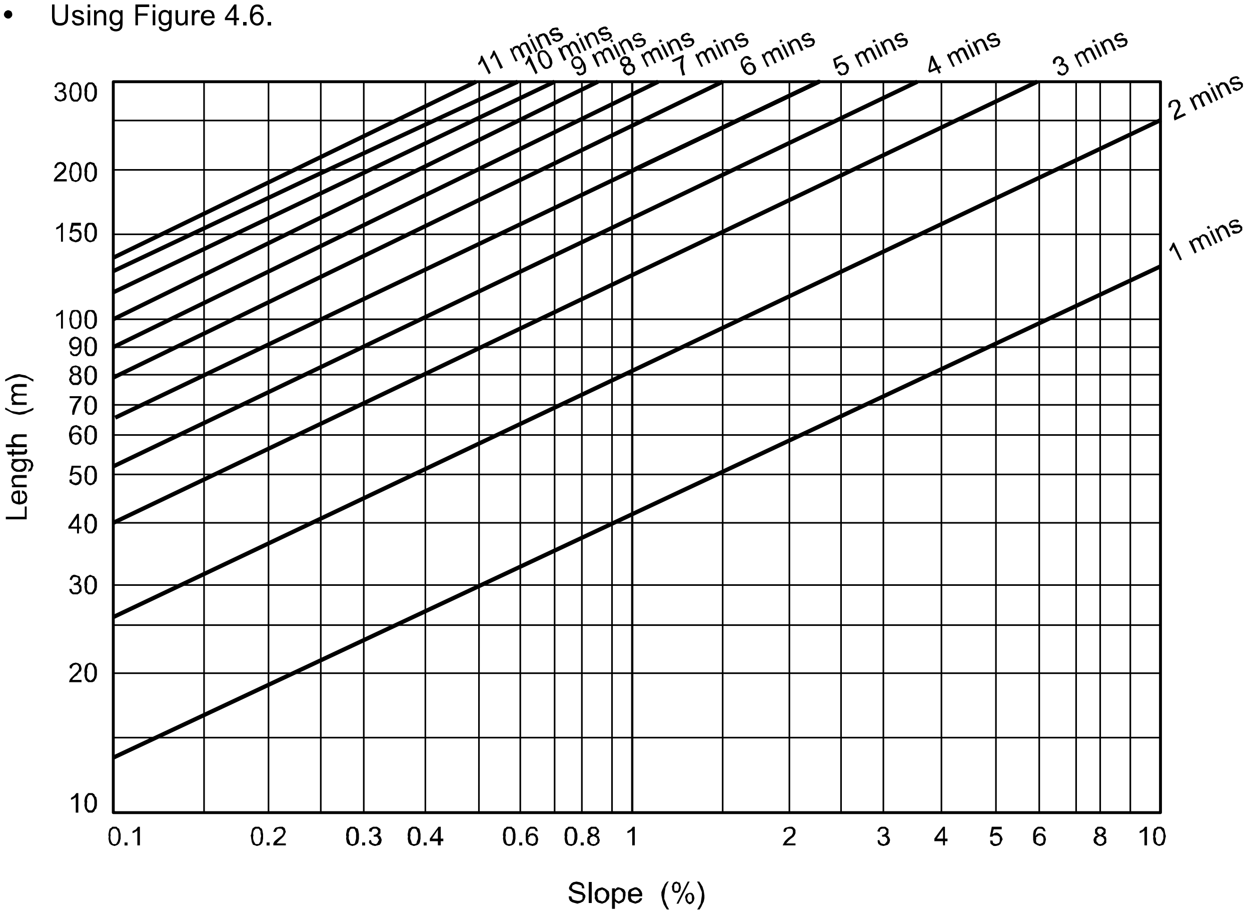


Figure 4.6 – Kerb and channel flow time using Manning's equation

Technical notes for Figure 4.6

Formula: $t = 0.025\ L / S^{0.5}$ (minutes)

where:

t = time of gutter flow in minutes

L = length of gutter flow in metres

S = slope of gutter (%)

Example Length of gutter flow = 100m

Average slope of gutter = 3%

Thus, time of travel = 1.5 minutes.

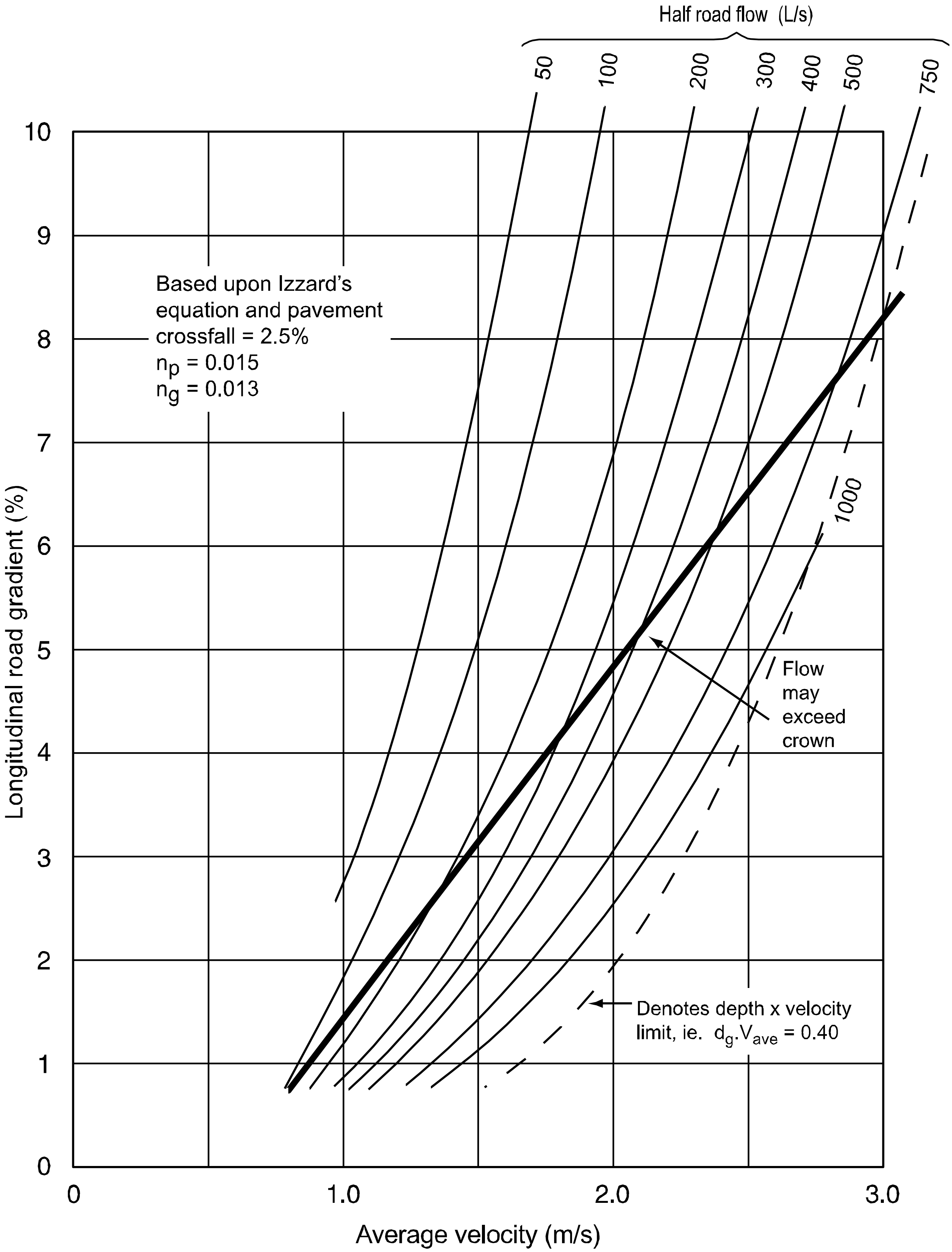


Figure 4.7 – Kerb and channel flow velocity using Izzard's equation

APPENDIX D - DETENTION BASIN SPILLWAY CALCULATIONS

PROJECT NAME:	Wilton Greens Stage 2A	**PROJECT NUMBER:**	8305	**DISCIPLINE:**	CIV
CLIENT:	Risland	**AUTHOR:**	BJG	**DATE:**	3/08/2023
DESCRIPTION:	Weir Spillway Check	**CHECKER:**	BJG	**ITEM:**	1

Spillway Check - 1% AEP Event - Staged Outlet 100% Blocked

WEIR FLOW - Basin C

Trapezoidal Weir Equation = $Qweir = CLh^{1.5} + C_sSh^{2.5}$

C = Weir Coefficent = 1.67

C_s = Weir Coefficent Side Slope = 1.67

L = Crest Length = 9

h = Height over Wier = 0.5

S = Side Slope 1 in 10

Total Weir Flow = 8.266 m^3/s

Total Weir Velocity = 0.870 m/s

TOTAL 1% AEP Event flow = 8.013

WEIR FLOW - Basin D

Trapezoidal Weir Equation = $Qweir = CLh^{1.5} + C_sSh^{2.5}$

C = Weir Coefficent = 1.67

C_s = Weir Coefficent Side Slope = 1.67

L = Crest Length = 13

h = Height over Wier = 0.5

S = Side Slope 1 in 10

Total Weir Flow = 10.628 m^3/s

Total Weir Velocity = 0.924 m/s

TOTAL 1% AEP Event flow = 10.499

APPENDIX E – HUMEGARD TECHNICAL SHEET

Humes

Strength. Performance. Passion.

HumeGard® GPT Technical manual

Issue 5

Contents

HumeGard® GPT

The HumeGard® system is a Gross Pollutant Trap (GPT) that is specifically designed to remove gross pollutants and coarse sediments ≥ 150 microns, from stormwater runoff. A wide range of models are available to provide solutions for normal and super-critical flow conditions.

The HumeGard® GPT incorporates a unique floating boom and bypass chamber to enable the continued capture of floating material, even during peak flows. The configuration also prevents re-suspension and release of trapped materials during subsequent storm events.

The HumeGard® GPT is designed for residential and commercial developments where litter and sediment are the target pollutants. It is particularly useful in retrofit applications or drainage systems on flat grades where low head loss requirements are critical, and in high backwater situations.

The value of the HumeGard® GPT has proven it to be one of the most successful treatment devices in Australia today:

- **The system provides high performance with negligible head loss**
  The HumeGard® GPT has a head loss 'k' factor of 0.2, important for retrofit and surcharging systems.
- **It captures and stores a large volume of pollutants**
  For pollutant export rates reported by Australia Runoff Quality (1 m^3/hectare/year), the HumeGard® GPT is sized for maintenance intervals up to annual durations.
- **It uses independently proven technology**
  The system was developed and tested by Swinburne University of Technology, Australia, in 1998, to demonstrate compliance with operational criteria from the Victorian EPA. The ability of the HumeGard® to capture and retain Total Suspended Solids (TSS), Total Phosphorous (TP), and Total Nitrogen (TN), was tested in 2015 by Sunshine Coast University.
- **It has low operational velocities**
  Flow velocity in the storage chamber is <0.2 m/s to ensure the comb self-cleans and improves settling of coarse sediment.
- **It retains floating material even in bypass**
  All GPTs bypass at high flows. The floating boom will capture and retain floating materials even when bypass occurs.
- **It provides cost effective treatment for litter and coarse sediments**
  The system's large capacity and long maintenance intervals reduces the overall lifecycle costs in comparison with other treatment measures.
- **It can reduce the footprint of the stormwater treatment train**
  Installation of a HumeGard® GPT prior to vegetated treatment measures can assist in reducing their overall footprint.
- **It maximises above ground land use**
  The HumeGard® GPT is a fully trafficable solution, so it can be installed under pavements and hardstands to maximise land use on constrained sites. Further, customised HumeGard® models can be designed to accommodate almost any design loads.
- **It is easy to maintain**
  Cleanout of the HumeGard® GPT can be performed safely and effectively from the surface using a vacuum truck. A full maintenance procedure is provided as a separate document.
- **It is made from quality componentry**
  All internal metal components are made from 304 stainless steel or fibreglass, and the system undergoes rigorous quality control prior to dispatch. The standard HumeGard® has a design life of 50 years.

System operation

The HumeGard® GPT utilises the processes of physical screening and floatation/sedimentation to separate the litter and coarse sediment from stormwater runoff. It incorporates an upper bypass chamber with a floating boom that diverts treatable flows into a lower treatment chamber for settling and capturing coarse pollutants from the flow.

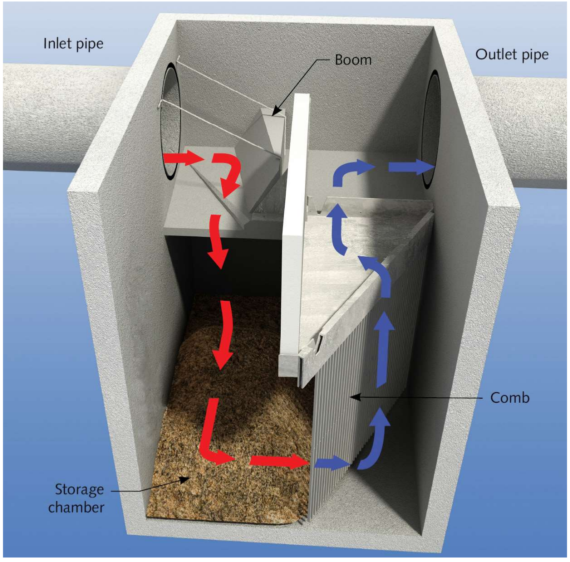
Bypass chamber

1. Stormwater flows into the inlet (boom) area of the bypass chamber (refer to Figure 1).
2. During flows up to and including the design treatment flowrate, the angled boom, acting as a weir, directs the total flow into the storage/treatment chamber.
3. The treatment flow rate will be exceeded once the depth of flow entering the HumeGard® has reached 50% of the height of the boom. Even during these higher flow conditions, the angled boom continues to direct all floating litter from the bypass chamber into the storage/treatment chamber. The inlet area of the bypass chamber floor is angled towards the treatment chamber to ensure the bed load sediment material continues to be directed into the storage chamber even when the boom is floating.
4. At peak design flows, the boom remains semi-submerged and enables excess flow to pass underneath, regulating the flow into the storage/treatment chamber. This ensures that higher flows, which could otherwise scour and re-suspend previously trapped materials, are not forced into the storage/treatment chamber. The floating boom bypass ensures previously trapped floating materials are retained. Each HumeGard® GPT is designed to achieve an operating velocity below 0.2 m/s through the storage chamber to ensure the settling of coarse sediment and keep the comb clean.

Treatment chamber

1. Once diverted into the treatment chamber, the flow continues underneath the internal baffle wall, passes through the stainless steel comb and flows over the flow controlling weir to the outlet.
2. Pollutants with a specific gravity less than water (S.G.<1) remain floating on the water surface in the storage/treatment chamber. Sediment and other materials heavier than water (S.G.>1) settle to the bottom of the chamber. The design and depth of the chamber minimises turbulent eddy currents and prevents re-suspension of settled material. The comb prevents any neutrally buoyant litter in the treatment chamber from escaping under the baffle wall.

Figure 1 – Operation during design flow conditions



Independent verification testing

Laboratory and field testing of the HumeGard® GPT for hydraulic performance and litter capture was conducted in Australia by Swinburne University of Technology, during 1996 and 1998.

Laboratory and field testing (Waste Management Council of Victoria 1998, Trinh 2007, Woods 2005, Swinburne University of Technology 2000) has proven the performance outlined in Table 1 below.

Further field testing was conducted by the University of the Sunshine Coast from 2013 to 2015, including a minimum of 15 qualifying storm events, to determine TSS, TP and TN removal efficiencies, which are also outlined in Table 1 below.

Table 1 – HumeGard® GPT performance summary

Pollutant	Removal efficiency	Details
Gross pollutants (litter, vegetation)	90%	Annually
TSS	49%	Annually (including bypass)
Hydrocarbons	90%	In an emergency spill event
TP	40%	Particulate-bound
TN	26%	Particulate-bound

Notes:

1. Nutrient removal is influenced by individual catchment characteristics and partitioning between dissolved and particulate nitrogen.
2. For further details on performance testing contact Humes.
3. Gross pollutant traps are not specifically designed to capture hydrocarbons, though may do so during emergency spill events. When this occurs, maintenance is required immediately.
4. The unique design of the HumeGard® floating boom allows it to be modified to treat higher flows and capture more gross pollutants and sediment on request.

System options

A wide range of sizes are available to suit catchment pollutant generation rates and Water Quality Objectives (WQO). Table 2 below presents the standard model dimensions and total storage chamber volume. We recommend that designers contact Humes Water Solutions for detailed sizing on each project and for advice with larger units.

Pollutant export rates detailed in Australian Runoff Quality (Engineers Australia 2006) suggests that a typical urban catchment will produce 1 m^3/hectare/year of gross pollutants and sediment. Humes Water Solutions advises that this be taken into account when selecting an appropriate model.

Table 2 – HumeGard® model range and dimensions

HumeGard® model	Treatment flow rate (L/s)	Storage chamber volume (m^3)	Pipe DN @ max. pipe grade %		
			0 - 1%	> 1 - 2.5%	> 2.5% - 5%
HG12	85	3	375	300	300
HG12A	100	3	450	375	375
HG15	130	3	525	450	450
HG15A	150	3	600	525	525
HG18	600	3	675	600	600
HG24	1,050	8	750	675	675
HG27	1,110	7	900	825	675
HG30	1,330	12	1050	900	825
HG30A	1,160	11	900	900	825
HG35	1,540	12	1050	1,050	900
HG35A	1,370	11	1050	900	900
HG40	1,910	16	1,200	1,200	900
HG40A	1,750	14	1,200	1,050	1,050
HG40B	1,580	12	1,200	1,050	900
HG45	1,960	19	1,500	1,350	1,200
HG45A	1,780	19	1,350	1,350	1,200
HG50 and above	Custom				

Notes:

1. The unique design of the HumeGard® floating boom allows it to be modified to treat a wide range of flowrates. Contact Humes for details on the model to suit your project.
2. HumeGard® can be modified to suit a box culvert, larger pipe or skewed outlet. Please contact your Humes Water Solutions Manager.
3. HumeGard® should be sized for either pipe diameter or treatment flow rate.
4. Units listed are standard configurations. Custom units can be provided to meet specific project requirements.
5. For confirmation of HumeGard® sizing or to discuss project specific requirements please contact your Humes Water Solutions Manager.
6. Refer to current Humes Terms and Conditions of Sale.
7. Australian Rainfall Quality recommend a pollutant export rate for a typical residential catchment is up to 1m^3/ha/yr of mixed waste and sediment.
8. HumeGard® can be modified to suit typical tail-water effects from downstream areas such as basins. Please contact Humes for design advice.
9. HumeGard® can be modified to suit high groundwater conditions. Please contact Humes for design advice.

Variants

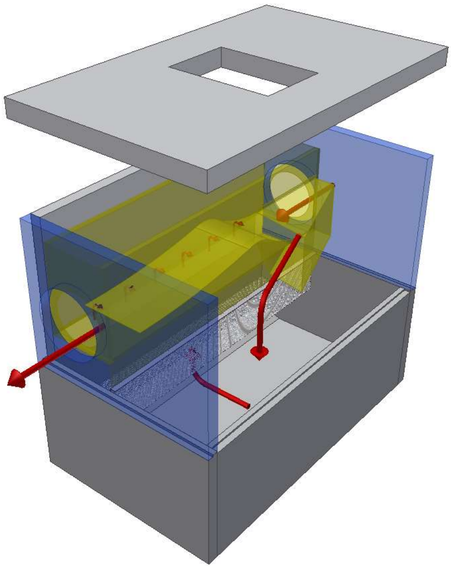
A number of additional innovations have been made to the HumeGard® GPT to facilitate their effective operation in a wider range of applications:

- Super-critical HumeGard® GPT – designed to operate under supercritical flow conditions in steep, high velocity drainage networks.
- Angled HumeGard® GPT – designed to replace a 45° or 90° junction in a drainage network.
- Dual outlet HumeGard® GPT – designed to divert the treatment flow to downstream natural Water Sensitive Urban Design (WSUD) elements such as wetlands and bio-retention whilst bypassing excess flows through a second outlet.

- **Super-critical HumeGard® GPT**
  The super-critical HumeGard® GPT (refer to Figure 2) was borne out of the original HumeGard® GPT, with modifications to deliver even greater performance under super-critical flow conditions. This model replaces the floating boom with a broad-crested weir that diverts the treatment flows into the treatment chamber under super-critical flow (Fr>1) conditions without creating hydraulic jumps and adversely impacting on performance.

  Flow into the treatment chamber passes through a stainless steel screen at a velocity <0.2 m/s and exits the device via a slot beneath the broad-crested weir (refer to the red arrows in Figure 2). The inserts in these models are manufactured from fibreglass for increased durability. The stainless steel screen can be shaped with a curved profile upon request. When the treatment flow rate is exceeded, the excess flow bypasses over the broad-crested weir to the outlet. This maintains the treatment flow into the chamber but protects against scour of captured material.

Figure 2 – Super-critical HumeGard® GPT



- **Angled HumeGard® GPT**
  The angled HumeGard® GPT (refer to Figure 3), was developed to facilitate the replacement of junction pits while still providing the treatment capabilities of the original HumeGard® device. These units simply alter the outlet location to allow for a change of pipe direction of 45° or 90°. The Angled HumeGard® GPT can be supplied in any of the standard unit sizes, however, the designer must allow for a minor head loss factor 'k' of 1.3 instead of 0.2 (which applies to the standard HumeGard® GPT design).

- **Dual Outlet HumeGard® GPT**
  The Dual Outlet HumeGard® GPT has been designed to operate as a diversion structure upstream of natural WSUD options such as constructed wetlands, ponds, lakes, and bio-retention systems.

  The units are designed such that one outlet conveys the treated flow into the natural WSUD measure and the standard outlet bypasses the excess flow around the downstream system (refer to Figure 4). Dual Outlet HumeGard® units are available in the same sizes as the standard HumeGard® units (refer Table 2 on page 4).

Figure 3 – Angled HumeGard® GPT

Figure 4 – Dual Outlet HumeGard® GPT

Inundation/tidal applications

The boom of the HumeGard® GPT enables the capture of floating pollutants even at peak flows, often when other fixed weir devices are in bypass mode. This unique feature also makes the HumeGard® GPT ideal for applications that are subject to both tidal and tail water effects.

In tidal applications the floating boom effectively traps the floating pollutants and prevents the loss of the gross pollutants from the system. In fixed weir devices, previously trapped floating litter may be backwashed out of the GPTs during the rising phase, to later bypass the GPT during the falling phase of the tide. As this happens twice daily, spring tides could quickly empty devices relying upon a fixed weir.

Marine grade 316 stainless steel is used for all internals in devices installed in tidal applications. In acidic/aggressive environments, these may also be epoxy-coated. Contact Humes Water Solutions for specific designs to suit these applications.

A plinth can also be added to the false floor under the boom to ensure sediment loads are captured and retained during inundation.

Design information

To design a system suitable for your project it is necessary to review the configuration of the stormwater system, the location and purpose of other stormwater management (WSUD) controls, the catchment area and the hydrology.

Configuration of the stormwater system

The configuration of the stormwater system is important since the HumeGard® GPT operates with an "in-line", 45° or 90° alignment. Inlet pipe grades between 0.5% and 5% are recommended for at least five pipe diameters upstream of the HumeGard® GPT. The pipe grade and flow velocity will determine whether a super-critical unit is required.

Location in the stormwater system

Depending upon the site, the GPT can be oriented to have the treatment chamber on the left or right side of the pipe to suit constraints. Humes Water Solutions can work closely with stormwater designers to select the appropriate location and orientation for their system.

Catchment area

Research presented in Australian Runoff Quality (Engineers Australia 2006) concluded that roughly 1 m^3/hectare/year of gross pollutants and sediment could be expected from a typical residential catchment. Therefore, GPTs designed for an annual maintenance interval should have a pollutant storage capacity roughly equal to the number of hectares of catchment it treats (e.g. 10 hectare catchment = 10 m^3 pollutant storage).

Sizing HumeGard® GPTs

The large storage volumes of the HumeGard® GPT enables more pollutants to be captured before maintenance is required, which greatly reduces its lifecycle costs. In accordance with accepted hydraulic principles the larger volumes in the HumeGard® GPT results in lower velocities through the device, minimising scour and re-suspension of sediment.

Humes Water Solutions has developed a design request form (see page 30) for stormwater designers to complete and return to obtain a detailed design of the appropriate device.

MUSIC/pollutant export model inputs

Many local authorities utilise MUSIC or other pollutant export models to assist in stormwater treatment train selection, and recommend generic inputs for GPTs. Considering these against the independent research results, the following conservative removal efficiencies (refer to Table 3 below) are recommended for the HumeGard® GPT on an annual basis (i.e. no bypass).

Table 3 – MUSIC inputs for HumeGard® GPTs

Pollutant	Removal efficiency
Gross pollutants (litter, vegetation)	90%
TSS	49%
TP	40%
TN	26%

System installation

Top:
Preparing the aggregate base (Step 2)

Middle:
Installing the main bypass chamber (Step 4)

Bottom:
Placing the main chamber lid (Step 7)

The installation of the HumeGard® unit should conform to the local authority's specifications for stormwater pit construction. Detailed installation instructions are dispatched with each unit.

The HumeGard® unit is installed as follows:

1. Prepare the excavation according to plans.
2. Prepare the compacted aggregate base.
3. Install the main treatment chamber section.
4. Install the main bypass chamber section/s (if required).
5. Fit the stainless steel comb (if required).
6. Connect the inlet and outlet pipes.
7. Place the main chamber lid.
8. Install the frame and access covers.
9. Backfill to specified requirements.

System maintenance

The design of the HumeGard® GPT means that maintenance is best performed by vacuum trucks which avoids entry into the unit.

Additional access covers can be designed upon request.

A typical maintenance procedure includes:

1. Remove access covers.
2. With a vacuum hose, remove the floating litter from the treatment chamber.
3. Determine the depth of water and sediment layers.
4. Insert sluice gate into the upstream manhole.
5. Decant water from the treatment chamber into the upstream manhole until the sediment layer is exposed.
6. Remove the sediment layer with the vacuum hose; jet with a high pressure hose if required.
7. Remove sluice gate from the upstream manhole and allow water to return to the HumeGard® GPT.
8. Replace access covers.

Left:
Floating litter captured in the treatment chamber

FAQs

- **Can the boom become stuck?**
  The boom can weight up to hundreds of kilograms depending on the model, with the smallest boom in the HG18 weighing in at 35 kg. Unless there is a large branch, car wheel, or other large item carried through the drainage network, the mass of the boom will ensure it returns to the floor.
- **Will the gross pollutants bypass when the boom floats?**
  All treatment measures are designed to treat a specific flow. Once this is exceeded, any entrained pollutants in the flow will bypass the treatment chamber. Often this is less than 5% of the annual load. A significant quantity of gross pollutants are buoyant when entering a GPT and, unlike fixed weir systems which bypass these floatable items, the HumeGard® boom provides continuous treatment of them, even in bypass.
- **Will the retention of water in the treatment chamber lead to the release of nutrients as pollutants break down?**
  Over time, captured organic materials will breakdown and release nutrients in all treatment measures whether natural or manufactured. As part of a treatment train, downstream vegetated measures can remove the small proportion of nutrients released during dry weather flows. A regular maintenance program will reduce the amount of breakdown occurring.
- **What is the design life of a HumeGard® GPT?**
  The entire product is designed to last a minimum of 50 years.
- **Why is the HumeGard® GPT larger than other GPTs?**
  The design of the HumeGard® GPT is to ensure a velocity through the treatment chamber <0.2 m/s to ensure the comb self-cleans and the coarse sediments settle in the sump. From engineering principles, a larger cross-sectional area is required to reduce the loading rate. As proven by Stokes Law, lower chamber velocities mean smaller sediment particles can be captured.
- **Why would I use a HumeGard® GPT upstream of a biofilter?**
  Using a HumeGard® GPT upstream of a biofilter acts as a sediment forebay and removes litter, containing it to a confined location for easy removal by a vacuum truck. This protects the biofilter, lengthens its lifespan and reduces the ongoing maintenance costs.

References

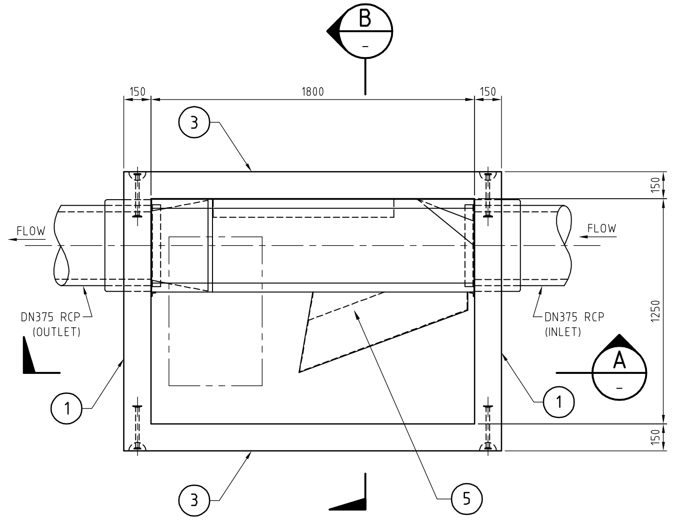
- Waste Management Council of Victoria (1998) “Inline Litter Separator: Installation and Monitoring Project”, EcoRecycle, Victoria.
- Trinh, N. An Investigation into the Trapping Efficiencies of Gross Pollutant Traps. Thesis. Brisbane, Queensland: Queensland University of Technology, 2007.
- Woods, S. Performance Evaluation of an In-Line Separator. Masters Thesis. Melbourne, Victoria: Swinburne University of Technology, 2005.
- Swinburne University of Technology (2000) “HumeGard® In-line Litter Separator Sediment Capture Testing”, School of Engineering and Science.
- Engineers Australia (2006) “Australian Runoff Quality”.
- Lucke, T. 2015, Characterisation of Water Quality Improvement Processes by GPTs at University of the Sunshine Coast (Humegard HG27 Monitoring Program), School of Science and Engineering, University of the Sunshine Coast, QLD, Australia.
- Nichols P., & Lucke T., 2016, Field Evaluation of the Nutrient Removal Performance of a Gross Pollutant Trap (GPT) in Australia, Sustainability, 8, 669; doi:10.3390/su8070669

Appendix

HumeGard® GPT technical drawings

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	—	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG12-20
2	BASE SLAB	HG12-21
3	SIDE WALL	HG12-22
4	PRECAST LID	HG12-07
5	GRP INSERT ASSEMBLY DETAILS	HG12A/L-08



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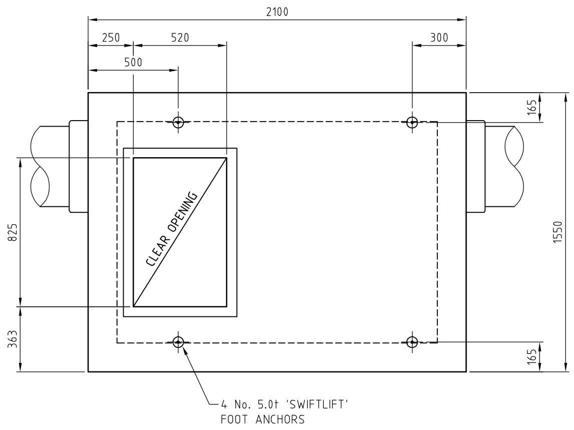
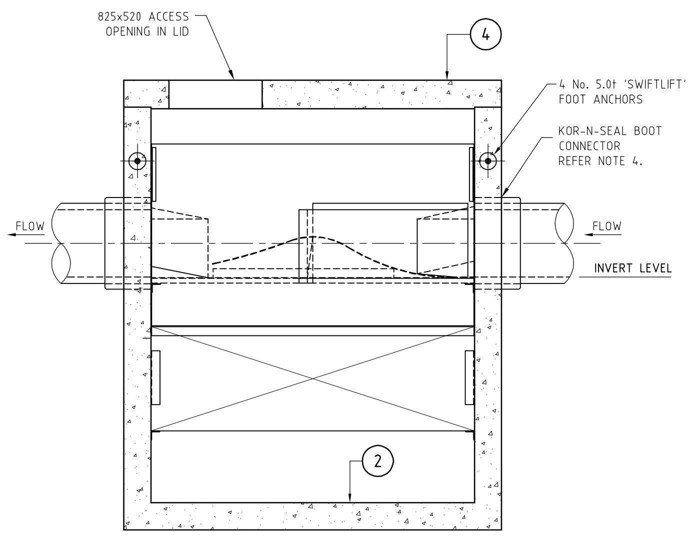
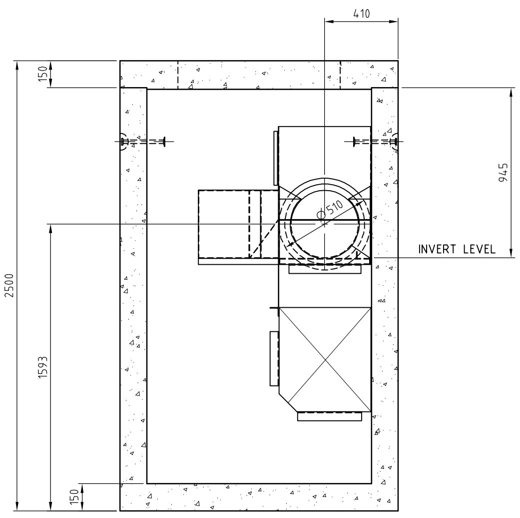


PLAN ON LID
SCALE 1:20



SECTION A
SCALE 1:20



SECTION B
SCALE 1:20

NOTES

1. GRP INSERT MANUFACTURED FROM 5mm GRP.
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.0t (WITHOUT LID)
   LID = 1.2t
4. KOR-N-SEAL BOOT CONNECTOR P/N = S106-20WP
5. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH M1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

Holcim (Australia) Pty Ltd ABN 87 099 732 297

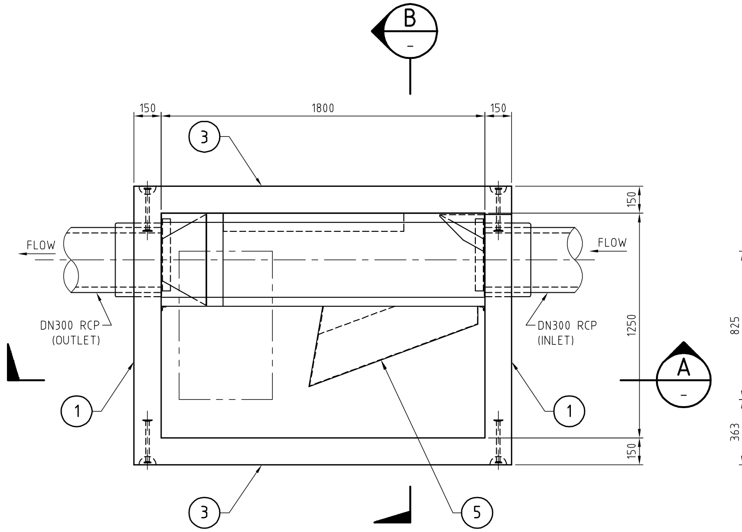
DSN.	WST	02-09-10
DWN.	MZ	02-09-10
CKD.	RM	—
APP.	WST	—

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG12A/L
DN375/DN375 RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG12A/L-01 ISSUE 1	1:1	A2	HG12A/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION	MZ	—	RM

ITEM No	DRAWING DESCRIPTIONS	DWG No
1	END WALL	HG12-20
2	BASE SLAB	HG12-21
3	SIDE WALL	HG12-22
4	PRECAST LID	HG12-07
5	GRP INSERT ASSEMBLY DETAILS	HG12/L-08



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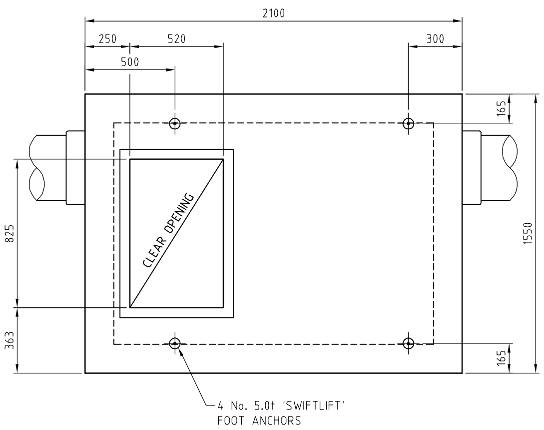
SCALE 1:20



PLAN ON LID

SCALE 1:20

NOTES

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2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.0t (WITHOUT LID)
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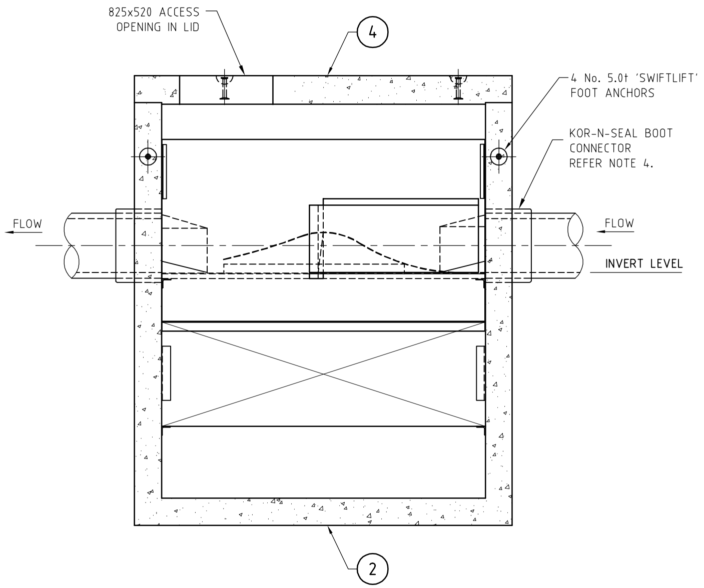
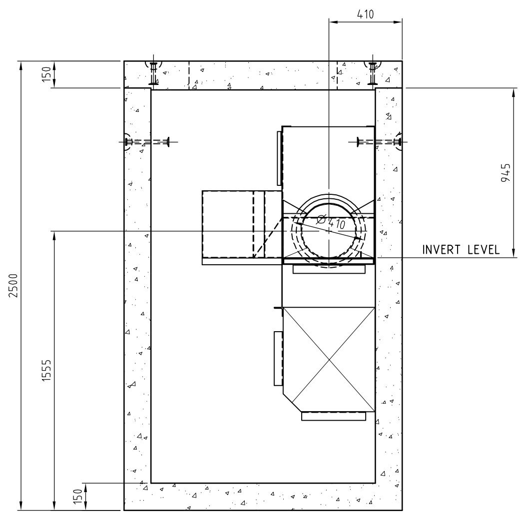
. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE



SECTION A

SCALE 1:20



SECTION B

SCALE 1:20

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH M1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

DSN.	WST	14-03-07
DWN.	MZ	14-03-07
CKD.	RM	—
APP.	WST	—

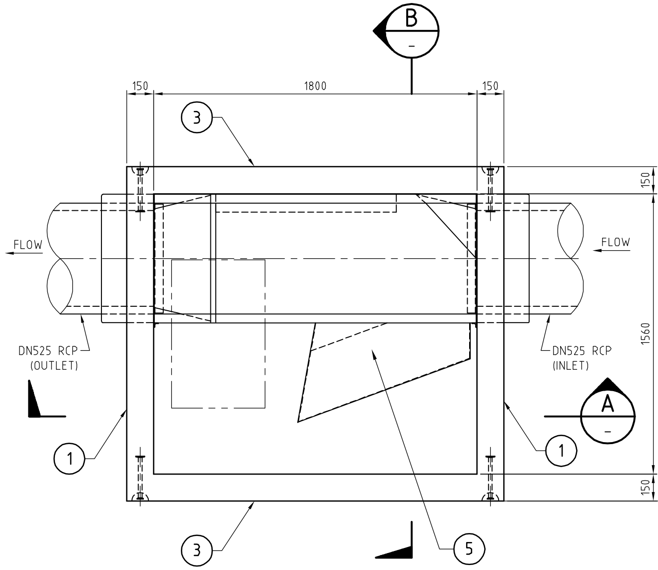
SUPERSEDES HG12/L-01 REV 1

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG12/L
DN300/DN300 RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG12/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION	MZ	—	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG15-20
2	BASE SLAB	HG15-21
3	SIDE WALL	HG15-22
4	PRECAST LID	HG15-07
5	GRP INSERT ASSEMBLY DETAILS	HG15A/L-08



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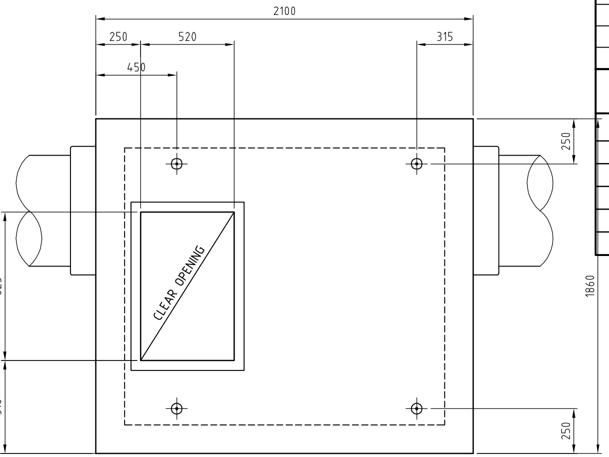
SCALE 1:20



PLAN ON LID
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NOTES

1. GRP INSERT MANUFACTURED FROM 5mm .
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.7t (WITHOUT LID) LID = 1.4t
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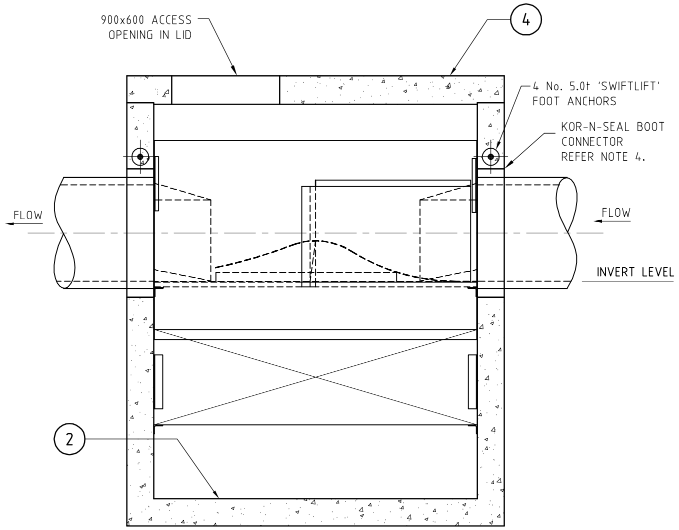

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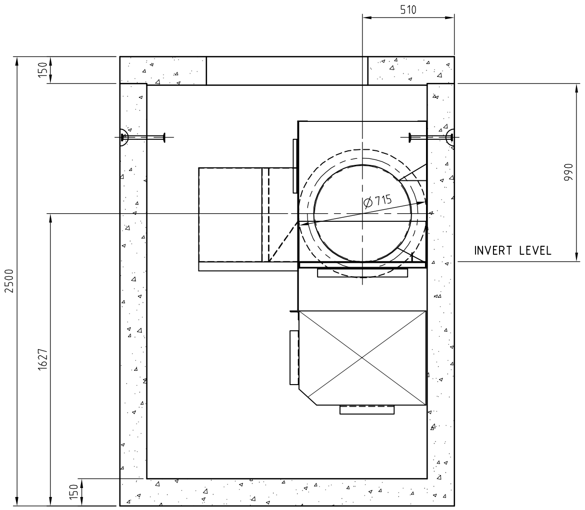

SECTION B
SCALE 1:20

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES BRISBANE, QUEENSLAND

DSN.	WST	07-09-10
DWN.	MZ	07-09-10
CKD.	RM	—
APP.	WST	—
SUPERSEDES	HG15A/L-01 ISSUE 1	

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG15A/L
DN525/DN525 RCP
GENERAL ASSEMBLY

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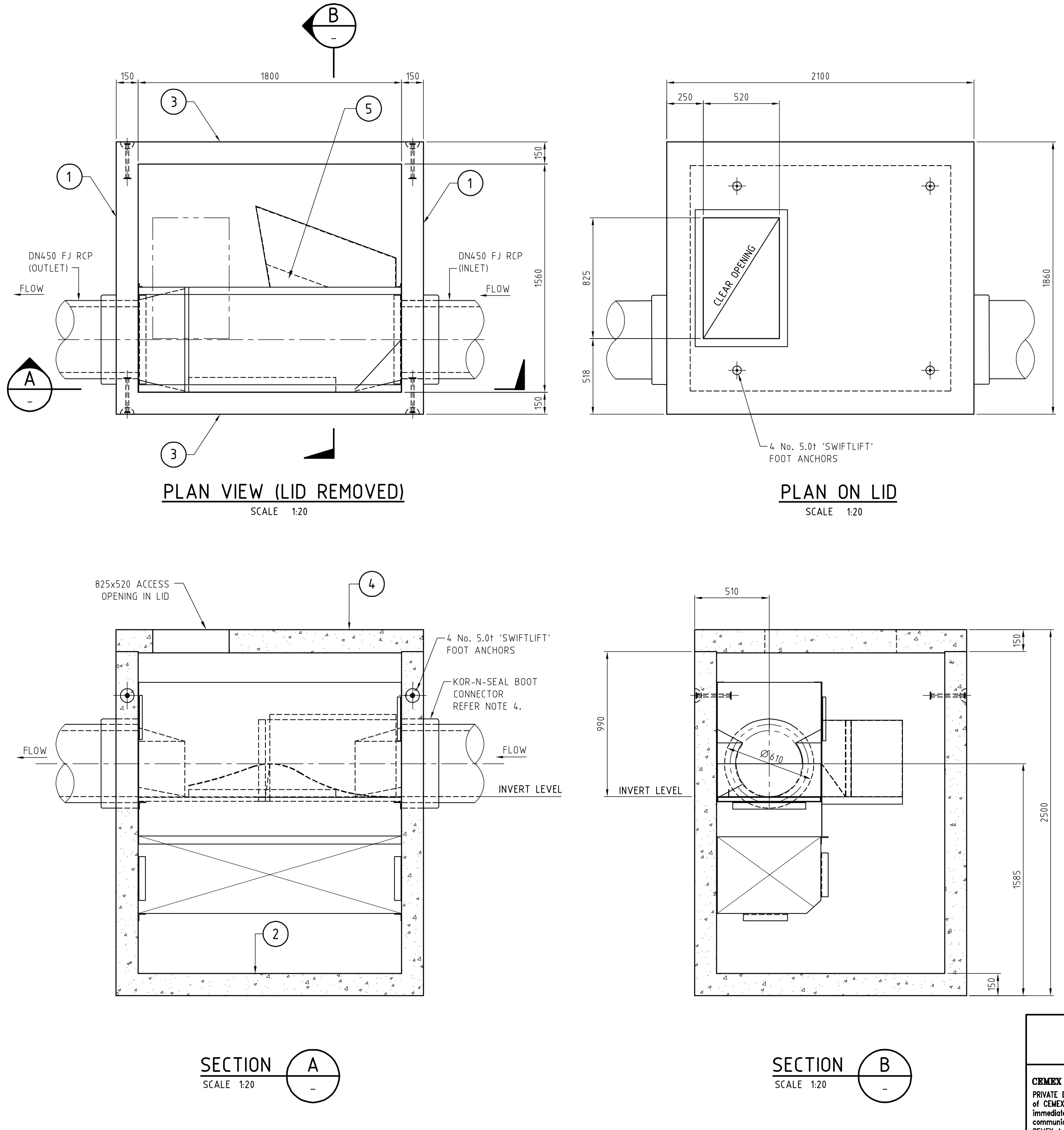

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION	MZ	——	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
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2	BASE SLAB	HG15-21
3	SIDE WALL	HG15-22
4	PRECAST LID	HG15-07
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NOTES

1. GRP INSERT MANUFACTURED FROM 5mm GRP.
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.7t (WITHOUT LID) LID = 1.5t
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5. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH M1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES BRISBANE, QUEENSLAND

DSN.	DFW	10-07-08
DWN.	MZ	10-07-08
CKD.	DFW	——
APP.	WST	——

HUMES STANDARD DRAWING
HUMEGARD HG15/R
DN450/DN450 FJ RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG15/R-01 REV 1	1:1	A2	HG15/R-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
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3, 4	SIDE WALL	HG18-04
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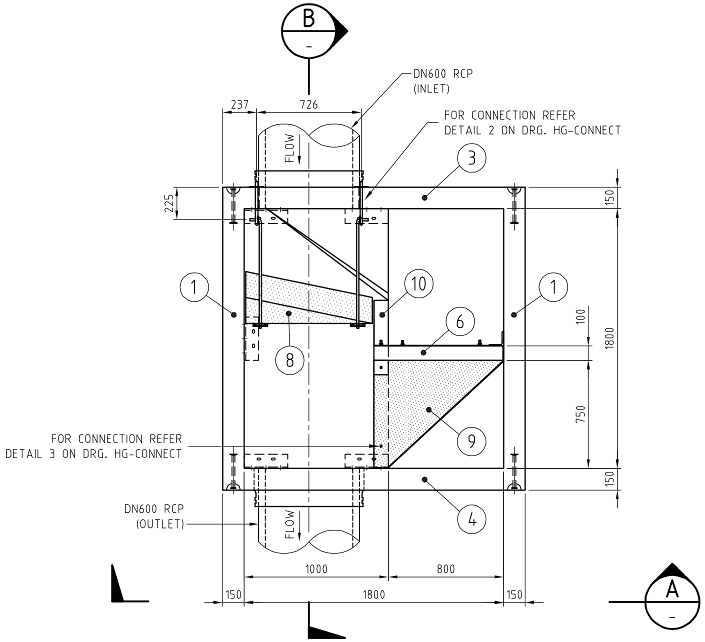
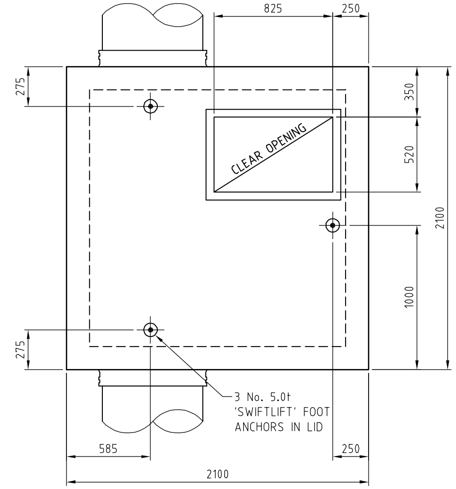
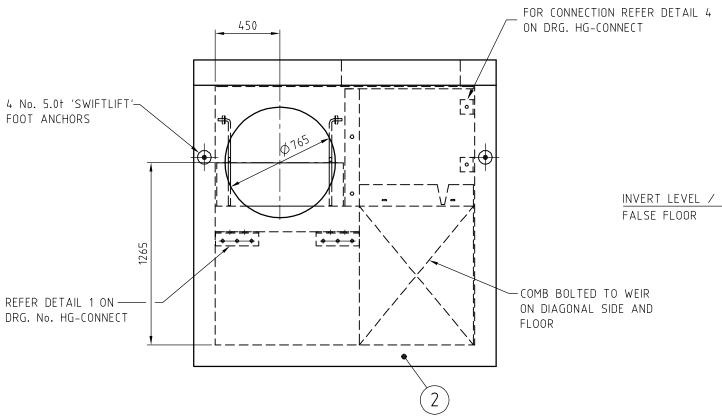
6	CONCRETE BAFFLE WALL	HG18/L-05
7	PRECAST LID	HG18/L-06
8	FLOATING BOOM	HG18/L-07
9	WEIR	HG18/L-08
10	BAFFLE SIDE WALL	HG18/L-09
11	COMB	HG18/L-10



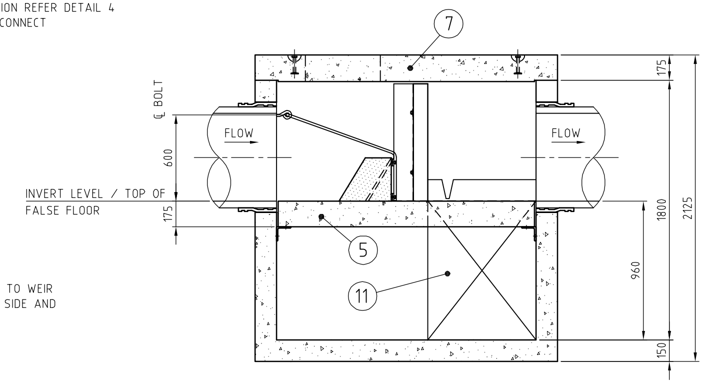
PLAN VIEW (LID REMOVED)
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 7.8 t (WITHOUT LID).
   MASS OF LID = 1.9 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-30L (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES BRISBANE, QUEENSLAND

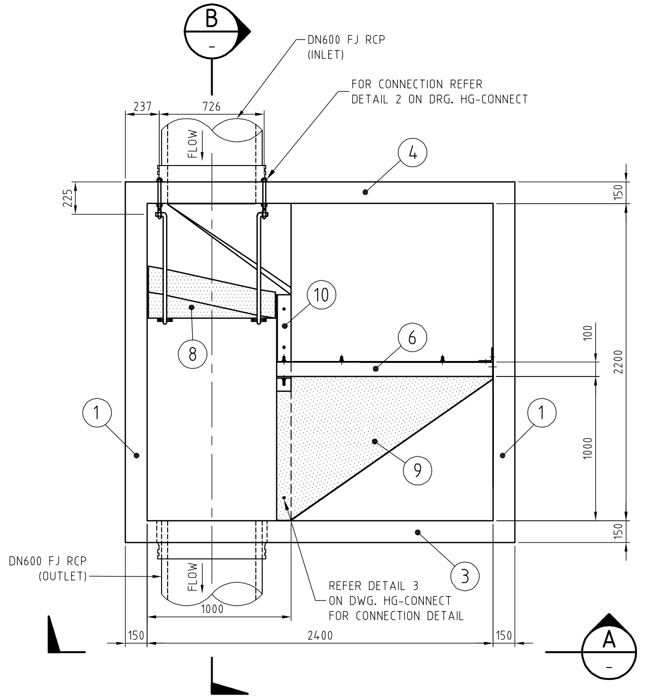
DSN.	WST	24-11-10
DWN.	MZ	24-11-10
CKD.	RM	24-11-10
APP.	WST	24-11-10

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG18/L DN600/DN600 RCP
GENERAL ASSEMBLY

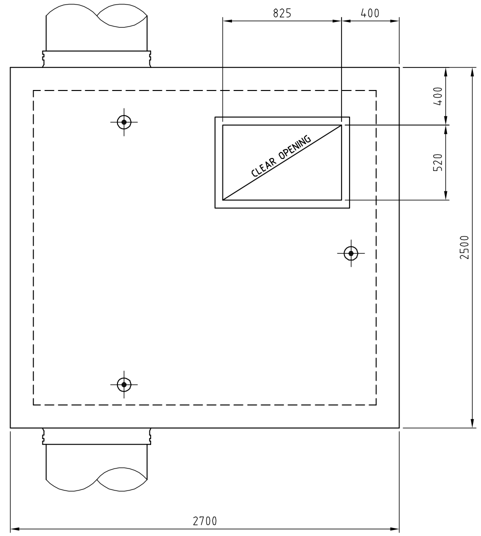
SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG18/L-01 REV. 2	1:1	A2	HG18/L-01	3

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION - ISSUED FOR MANUFACTURE	MZ	12-03-07	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG24/L-02
2	BASE SLAB	HG24/L-03
3, 4	SIDE WALL	HG24/L-04
5	FALSE FLOOR	HG24/L-05
6	CONCRETE BAFFLE WALL	HG24/L-05
7	PRECAST LID	HG24/L-06
8	FLOATING BOOM	HG24/L-07
9	WEIR	HG24/L-08
10	BAFFLE SIDE WALL	HG24/L-09
11	COMB	HG24/L-10
	SITE LAYOUT	HG24/L-11



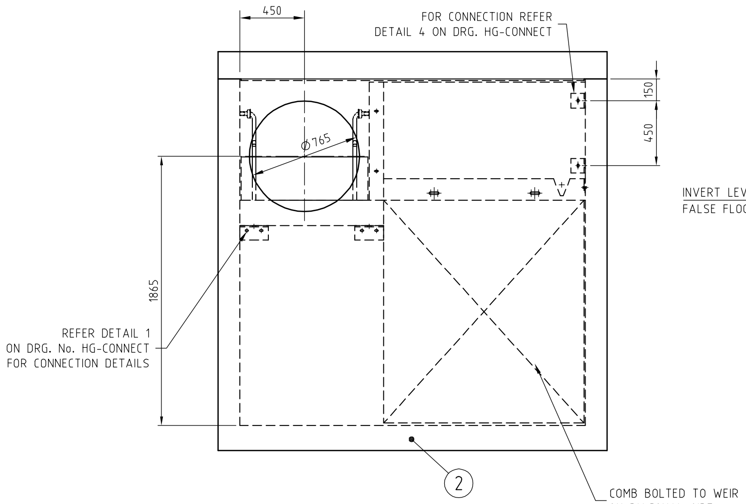
PLAN VIEW (LID REMOVED)
SCALE 1:25



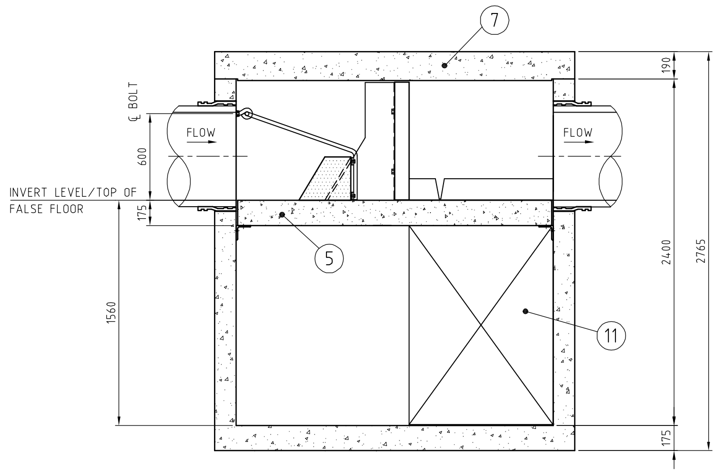
PLAN ON LID
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 13.0 t (WITHOUT LID).
   MASS OF LID = 3.2 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-30L (INLET & OUTLET)



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

DESIGN BASIS

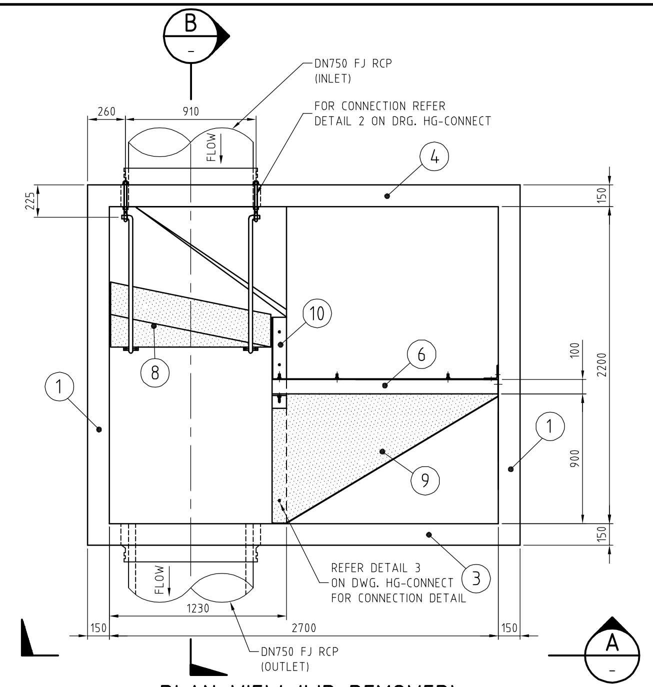
1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES BRISBANE, QUEENSLAND

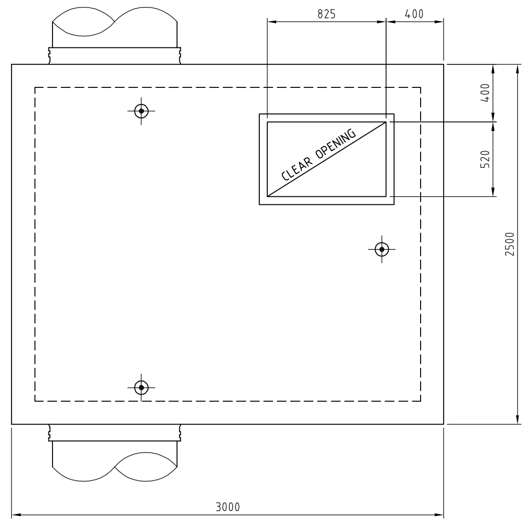
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES
STANDARD DRAWING
HUMEGARD HG24/L
DN600/DN600 FJ RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG24/L-01 REV. 0	1:1	A2	HG24/L-01	1



PLAN VIEW (LID REMOVED)
SCALE 1:25



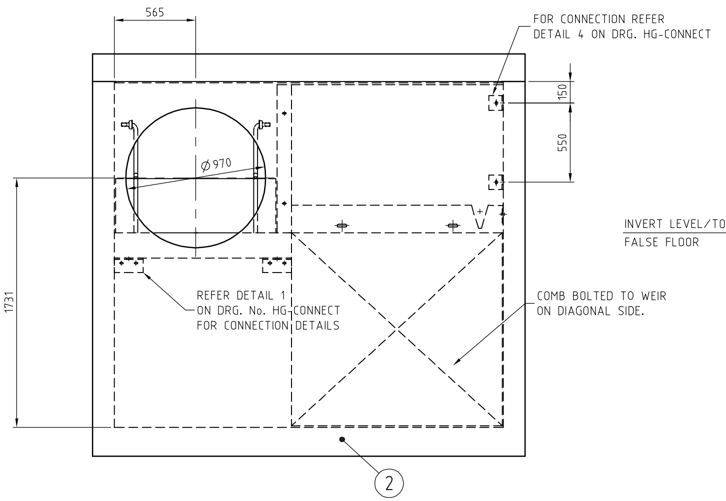
PLAN ON LID
SCALE 1:25

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION - REISSUED FOR MANUFACTURE	MZ	12-03-07	DFW

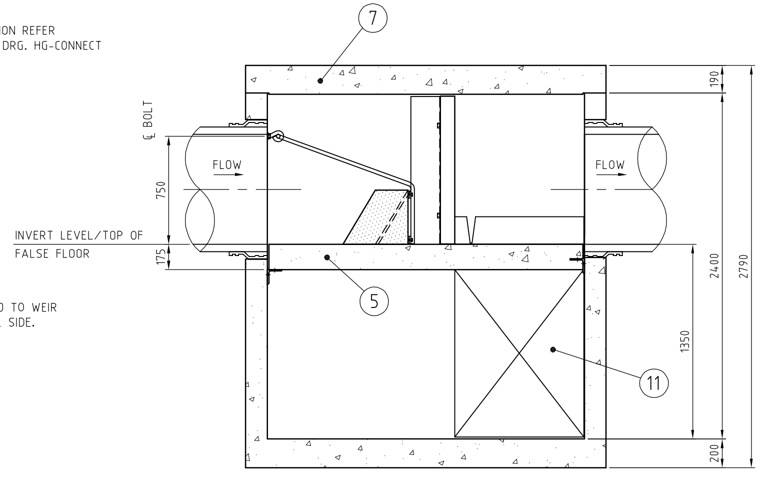
ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG27/L-02
2	BASE SLAB	HG27/L-03
3, 4	SIDE WALL	HG27/L-04
5	FALSE FLOOR	HG27/L-05
6	CONCRETE BAFFLE WALL	HG27/L-05
7	PRECAST LID	HG27/L-06
8	FLOATING BOOM	HG27/L-07
9	WEIR	HG27/L-08
10	BAFFLE SIDE WALL	HG27/L-09
11	COMB	HG27/L-10
	SITE LAYOUT	HG27/L-11

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 14.4 t (WITHOUT LID).
   MASS OF LID = 3.6 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-38 (INLET & OUTLET)



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	SG	12-03-07
SUPERSEDES	HG27/L-01 REV. 0	

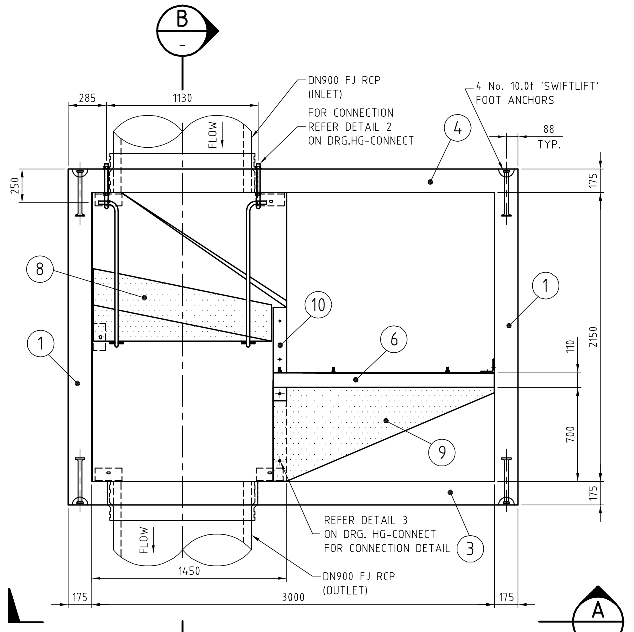
HUMES
STANDARD DRAWING
HUMEGARD HG27/L
DN750/DN750 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG27/L-01	2

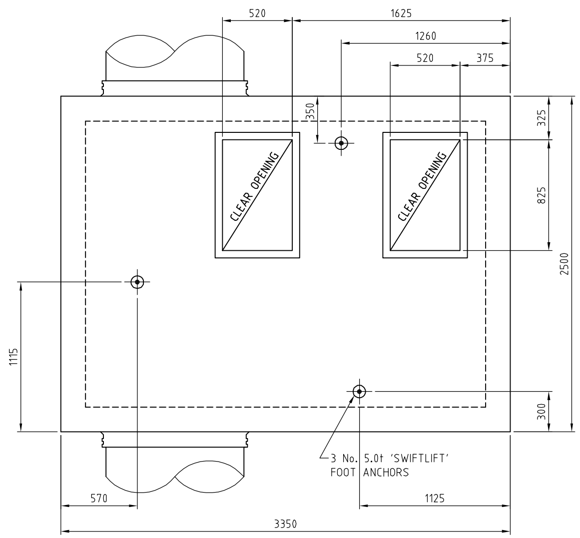
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	REFERENCE DWG No. REVISED, REISSUED FOR MANUFACTURE	MZ	—	RM

ITEM No.	DRAWING DESCRIPTION	DWG No.
1	END WALL	HG30A-02 (2)
2	BASE SLAB	HG30-04
3, 4	SIDE WALL	HG30A-05
5	FALSE FLOOR	HG30A/L-07
6	CONCRETE BAFFLE WALL	HG30A/L-07
7	PRECAST LID	HG30A/L-08
8	FLOATING BOOM	HG30A/L-09
9	WEIR	HG30A/L-10
10	BAFFLE SIDE WALL	HG30A/L-11
11	COMB	HG30A/L-12
	CONNECTION DETAILS	HG-CONNECT
	CASTING SEQUENCE	HG-CAST

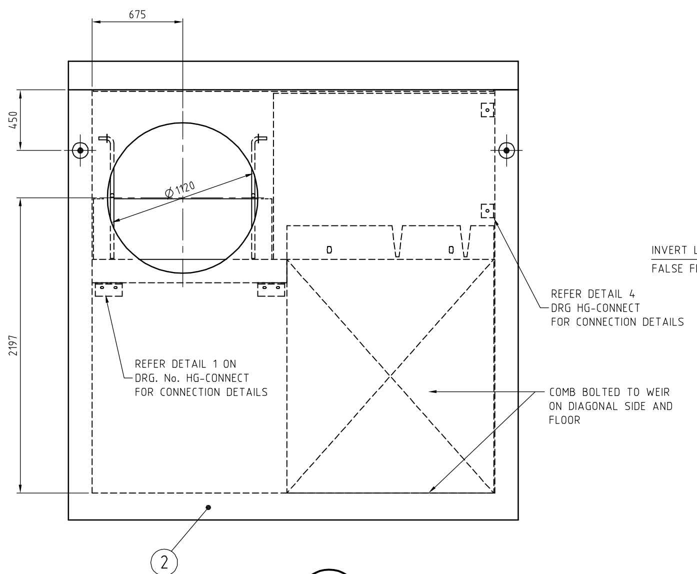
(2)



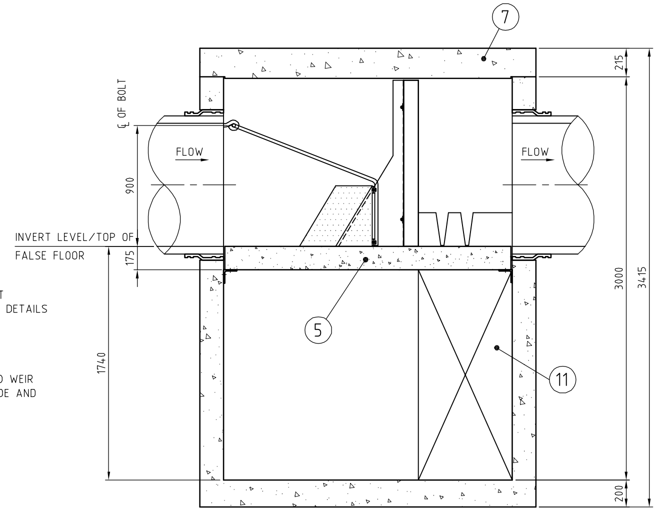
PLAN
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 20.2 t (WITHOUT LID).
   MASS OF LID = 4.3 t
   (SELF WEIGHT CONCRETE @ 2500 kg/m3)
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

SITE LIFT:
LID - 3 No. 5 t SWIFTLIFT FOOT ANCHORS
HUMEGARD UNIT - 4 No. 10 t SWIFTLIFT FOOT ANCHORS

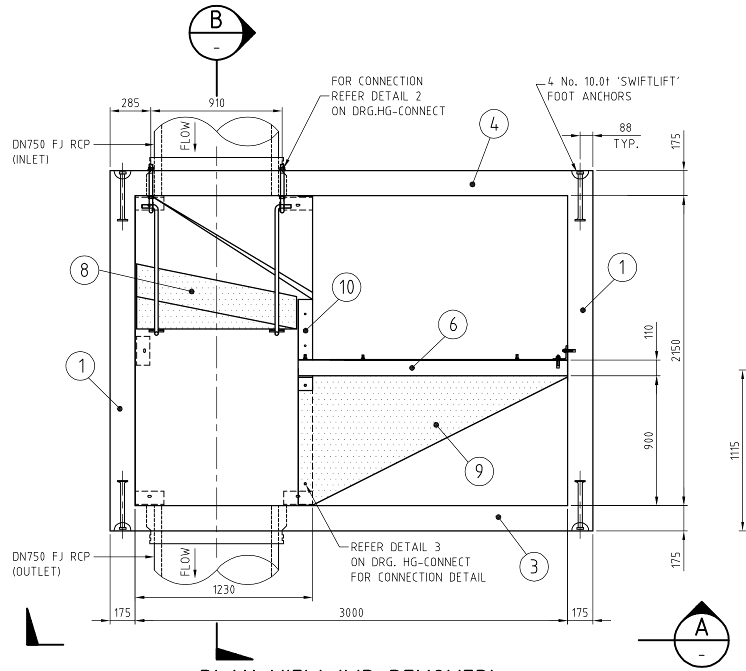
Humes TECHNICAL (DESIGN) SERVICES BRISBANE, QUEENSLAND

DSN.	DFW	06-08-08
DWN.	MZ	06-08-08
CKD.	DFW	—
APP.	WST	—
SUPERSEDES	HG30A/L-01 REV 1	

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG30A/L
DN900/DN900 FJ RCP
GENERAL ASSEMBLY

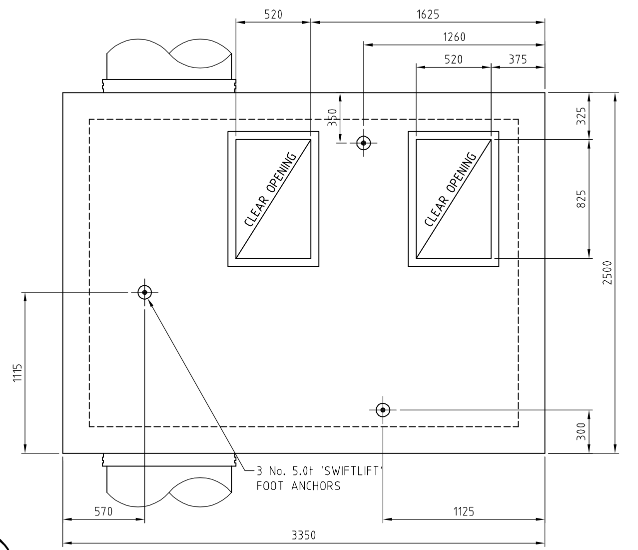
PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG30A/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	REFERENCE DWG No. REVISED, REISSUED FOR MANUFACTURE	MZ	—	RM



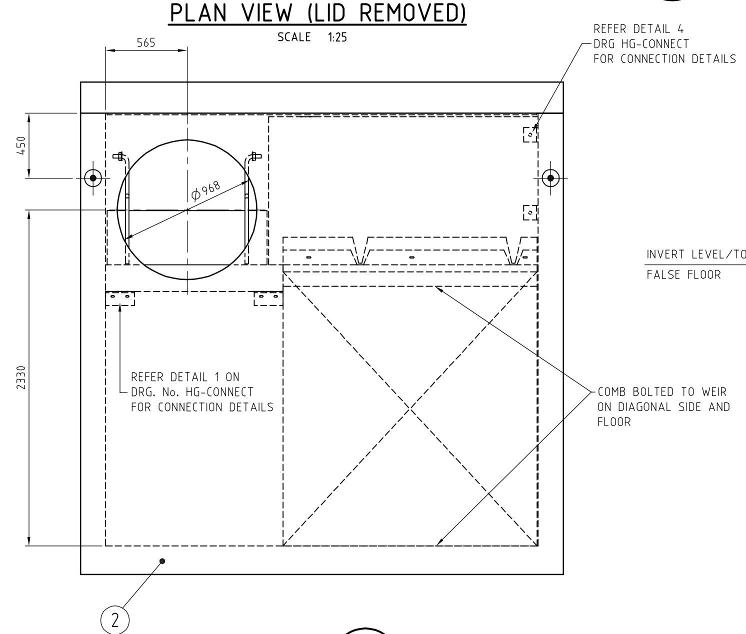
PLAN VIEW (LID REMOVED)

SCALE 1:25



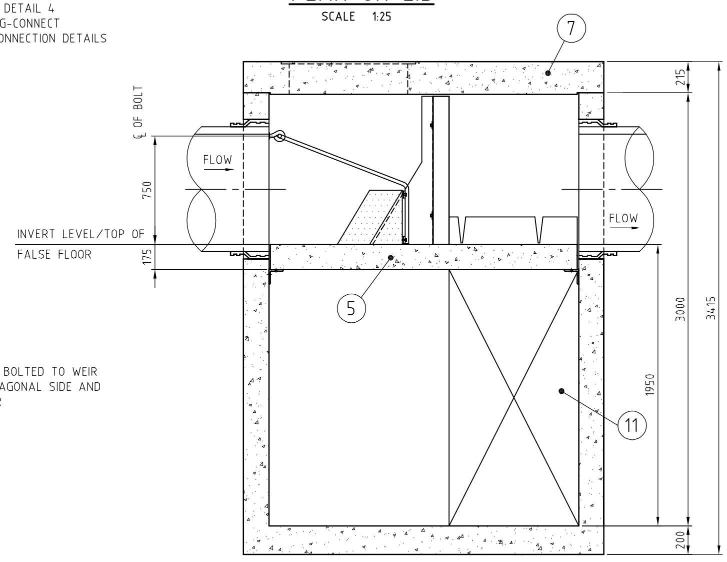
PLAN ON LID

SCALE 1:25



VIEW A

SCALE 1:25



SECTION B

SCALE 1:25

ITEM No.	DRAWING DESCRIPTION	DWG No.
1	END WALL	HG30-02
2	BASE SLAB	HG30-04
3, 4	SIDE WALL	HG30-05
5	FALSE FLOOR	HG30/L-07
6	CONCRETE BAFFLE WALL	HG30/L-07
7	PRECAST LID	HG30-08
8	FLOATING BOOM	HG30/L-09
9	WEIR	HG30/L-10
10	BAFFLE SIDE WALL	HG30/L-11
11	COMB	HG30/L-12
	CONNECTION DETAILS	HG-CONNECT
	CASTING SEQUENCE	HG-CAST

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 20.3 t (WITHOUT LID).
   MASS OF LID = 4.3 t
   (SELF WEIGHT CONCRETE @ 2500 kg/m3)
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-38 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

SITE LIFT:
LID - 3 No. 5 t SWIFTLIFT FOOT ANCHORS
HUMEGARD UNIT - 4 No. 10 t SWIFTLIFT FOOT ANCHORS

Humes TECHNICAL (DESIGN) SERVICES BRISBANE, QUEENSLAND

CEMEX Australia Pty Limited ABN 87 099 732 297

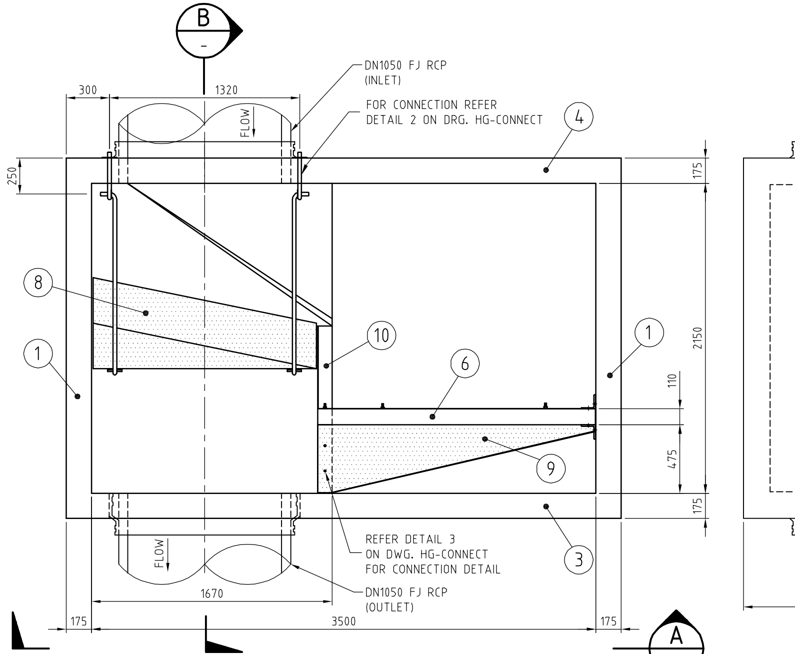
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG30/L
DN750/DN750 FJ RCP
GENERAL ASSEMBLY

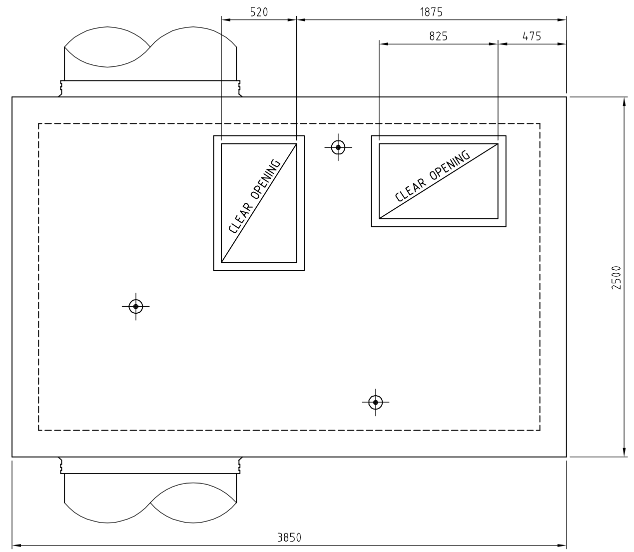
SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG30/L-01 REV 1	1:1	A2	HG30/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	12-03-07	DFW

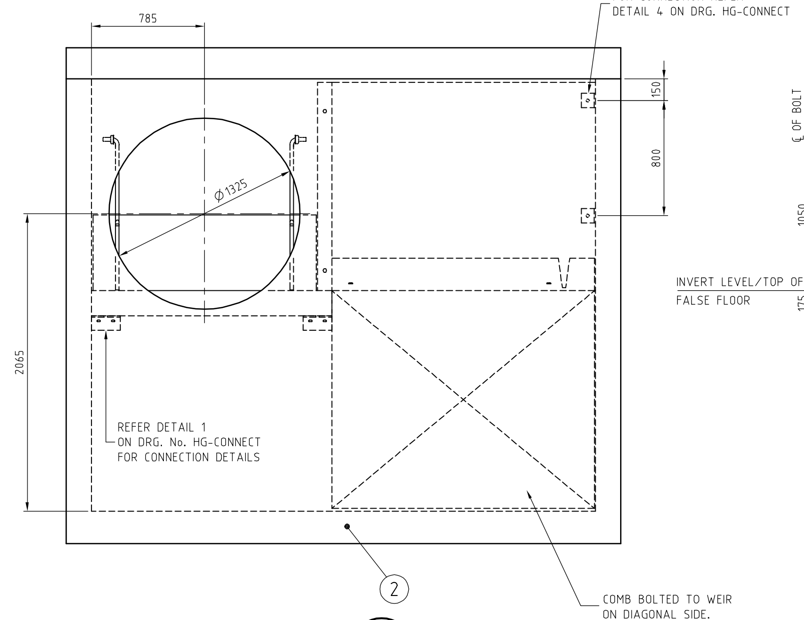
ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG35A/L-02
2	BASE SLAB	HG35A/L-04
3, 4	SIDE WALL	HG35A/L-05
5	FALSE FLOOR	HG35A/L-07
6	CONCRETE BAFFLE WALL	HG35A/L-07
7	PRECAST LID	HG35A/L-08
8	FLOATING BOOM	HG35A/L-09
9	WEIR	HG35A/L-10
10	BAFFLE SIDE WALL	HG35A/L-11
11	COMB	HG35A/L-12
	SITE LAYOUT	HG35A/L-13



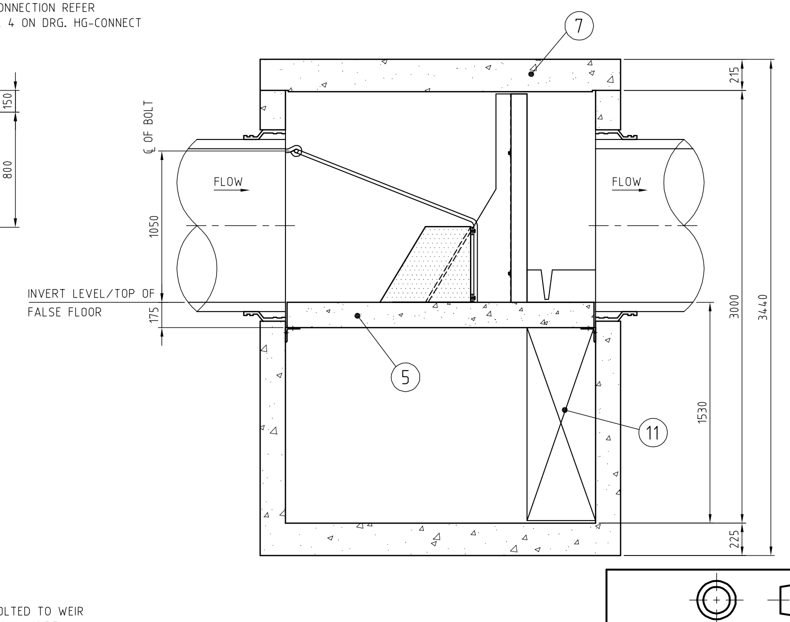
PLAN VIEW (LID REMOVED)
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 22.9 t (WITHOUT LID).
   MASS OF LID = 5.0 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-52 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

Rinker Australia Pty Limited ABN 87 099 732 297

DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

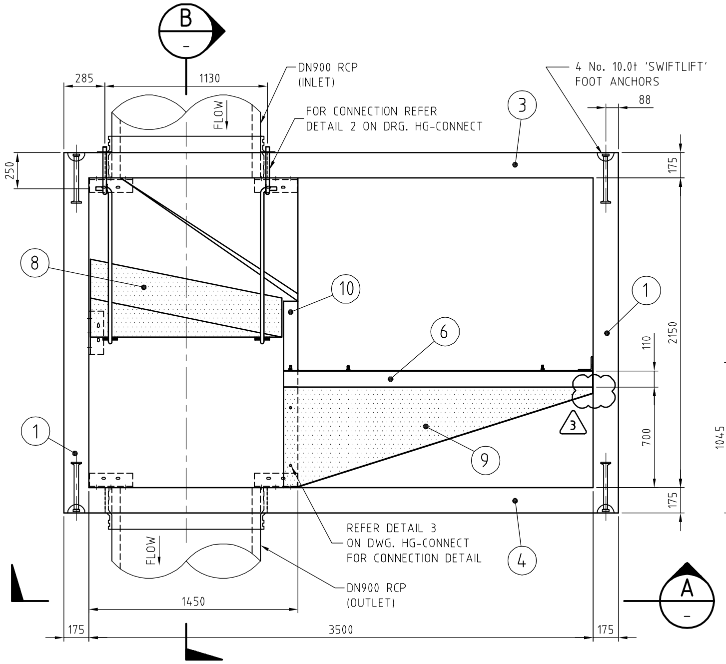
SUPERSEDES HG35A/L-01 REV 0

HUMES
STANDARD DRAWING
HUMEGARD HG35A/L
DN1050/DN1050 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG35A/L-01	1

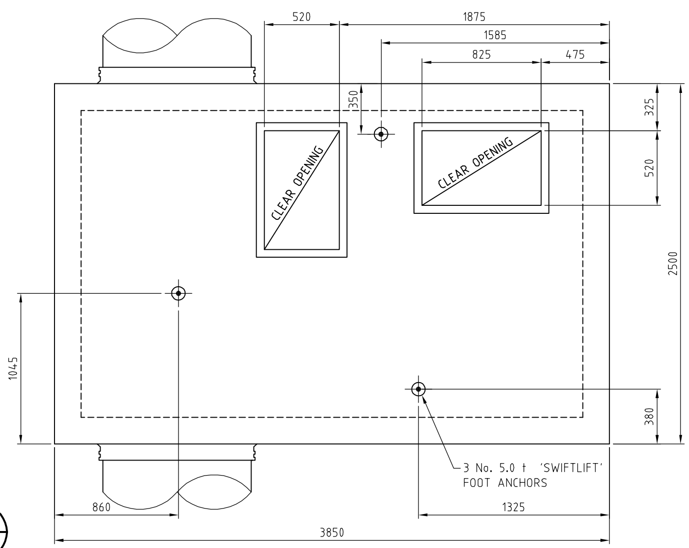
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
3	REFERENCE DWG No. REVISED, BRACKET REMOVED, REISSUED FOR MANUFACTURE	MZ	—	RM

ITEM No.	DRAWING DESCRIPTION	DWG No.
1	END WALL	HG35-02
2	BASE SLAB	HG35-04
3, 4	SIDE WALL	HG35-05
5	FALSE FLOOR	HG35/L-07
6	CONCRETE BAFFLE WALL	HG35/L-07
7	PRECAST LID	HG35-08
8	FLOATING BOOM	HG35/L-09
9	WEIR	HG35/L-10
10	BAFFLE SIDE WALL	HG35/L-11
11	COMB	HG35/L-12
	CONNECTION DETAILS	HG-CONNECT
	CASTING SEQUENCE	HG-CAST



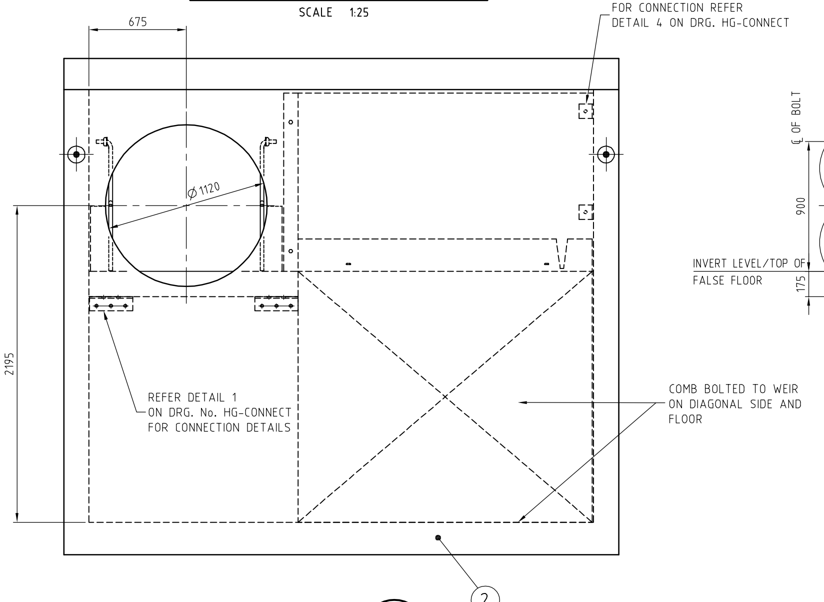
PLAN VIEW (LID REMOVED)

SCALE 1:25



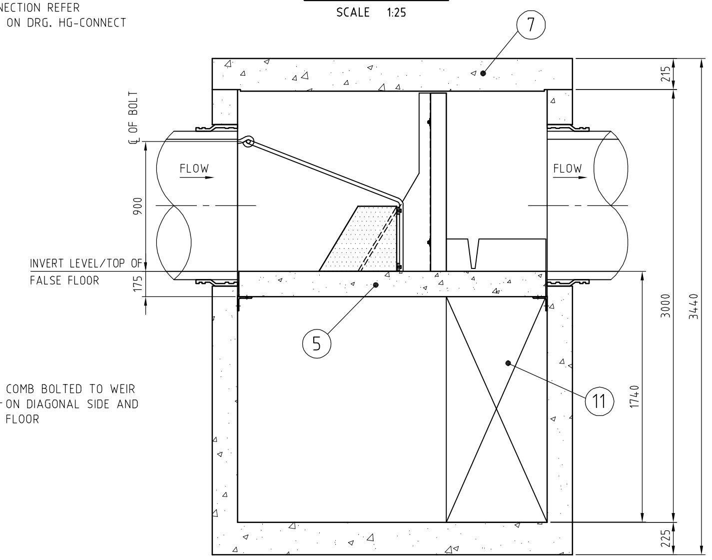
PLAN ON LID

SCALE 1:25



VIEW A

SCALE 1:25



SECTION B

SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 22.8 t (WITHOUT LID).
   MASS OF LID = 5.0 t
   (SELF WEIGHT CONCRETE @ 2500 kg/m3
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

SITE LIFT:
LID - 3 No. 5 t SWIFTLIFT FOOT ANCHORS
HUMEGARD UNIT - 4 No. 10 t SWIFTLIFT FOOT ANCHORS

Humes TECHNICAL SERVICES BRISBANE, QUEENSLAND

DSN.	WST	25-11-10
DWN.	MZ	25-11-10
CKD.	RM	—
APP.	WST	—

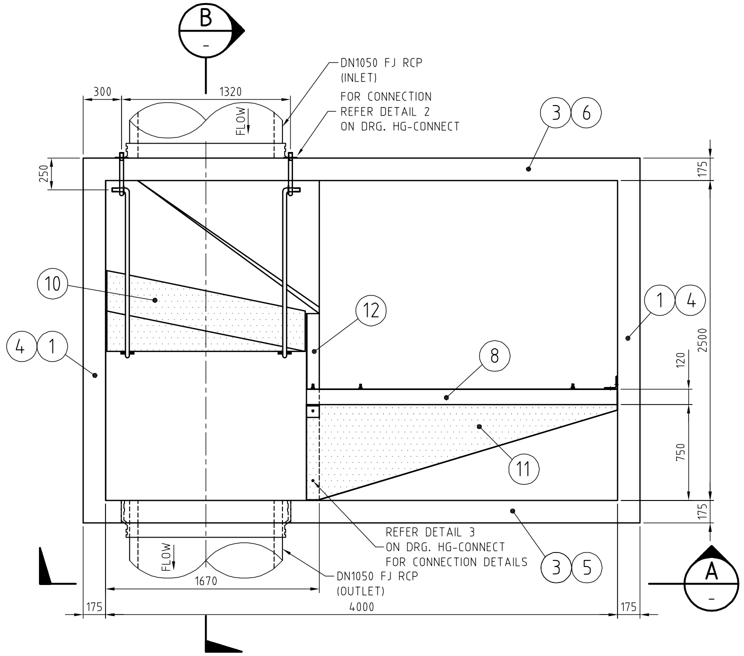
SUPERSEDES HG35/L-01 REV 2

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG35/L
DN900/DN900 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG35/L-01	3

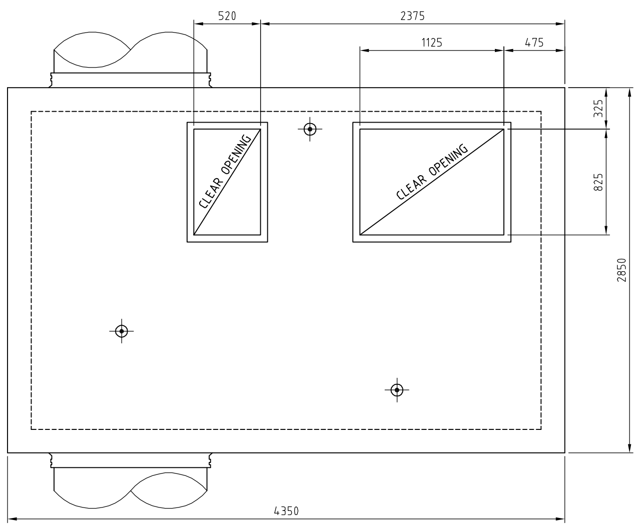
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
0	ISSUED FOR MANUFACTURE	MZ	12-03-07	DFW
1	GENERAL REVISION	MZ	—	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG40B/L-02
2	BASE SLAB	HG40B/L-04
3	SIDE WALL - BOTTOM UNIT	HG40B/L-05
4	END WALL - TOP UNIT	HG40B/L-03
5,6	SIDE WALL - TOP UNIT	HG40B/L-06
7	FALSE FLOOR	HG40B/L-07
8	CONCRETE BAFFLE WALL	HG40B/L-07
9	PRECAST LID	HG40B/L-08
10	FLOATING BOOM	HG40B/L-09
11	WEIR	HG40B/L-10
12	BAFFLE SIDE WALL	HG40B/L-11
13	COMB	HG40B/L-12



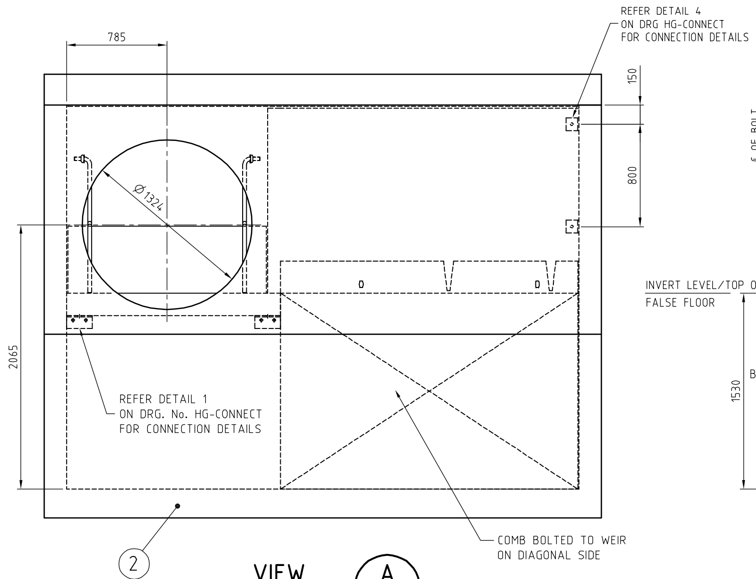
PLAN VIEW (LID REMOVED)

SCALE 1:20



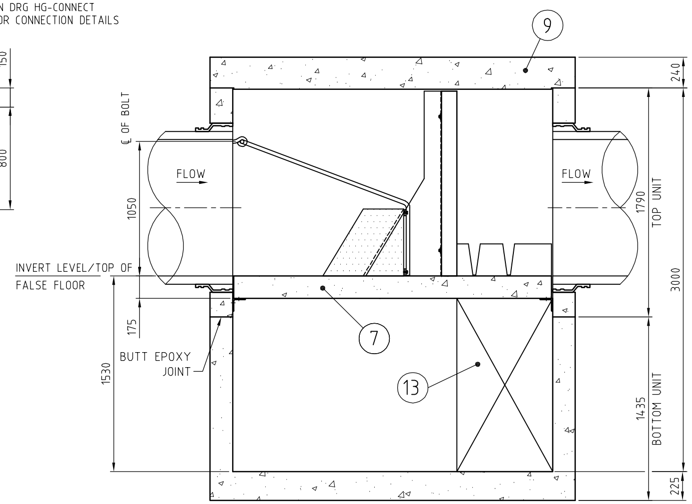
PLAN ON LID

SCALE 1:20



VIEW A

SCALE 1:20



SECTION B

SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 14.8 t
   MASS OF TOP UNIT = 12.9 t
   MASS OF LID = 7.0 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

CEMEX Australia Pty Limited ABN 87 099 732 297

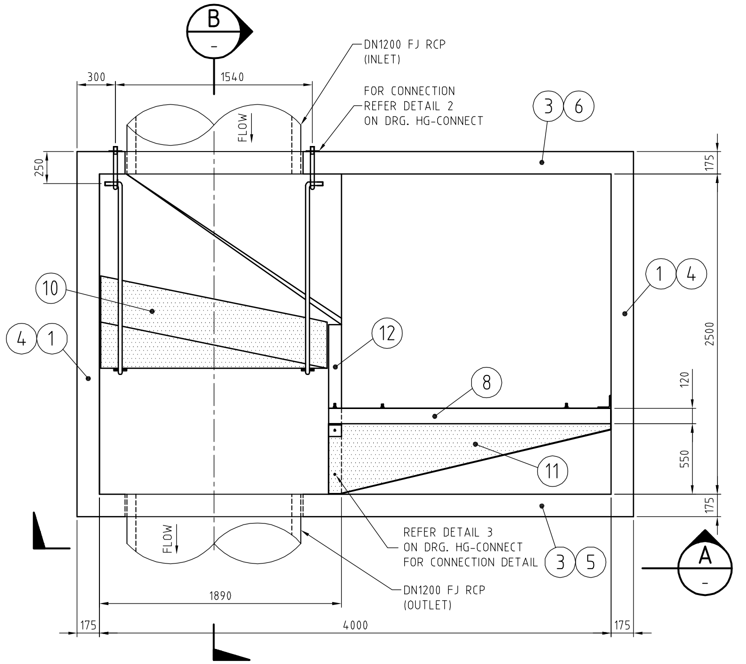
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES STANDARD DRAWING
HUMEGARD HG40A/L
DN1050/DN1050 FJ RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
	1:1	A1	HG40A/L-01	1

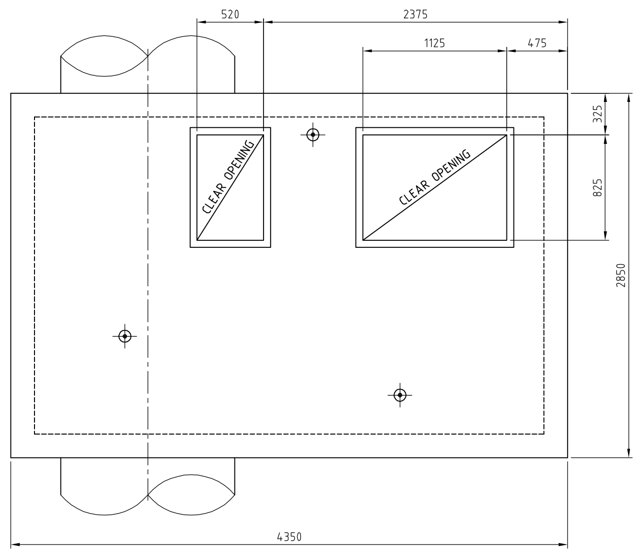
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
0	ISSUED FOR MANUFACTURE	MZ	12-03-07	DFW
1	GENERAL REVISION	MZ	—	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG40B/L-02
2	BASE SLAB	HG40B/L-04
3	SIDE WALL - BOTTOM UNIT	HG40B/L-05
4	END WALL - TOP UNIT	HG40B/L-03
5,6	SIDE WALL - TOP UNIT	HG40B/L-06
7	FALSE FLOOR	HG40B/L-07
8	CONCRETE BAFFLE WALL	HG40B/L-07
9	PRECAST LID	HG40B/L-08
10	FLOATING BOOM	HG40B/L-09
11	WEIR	HG40B/L-10
12	BAFFLE SIDE WALL	HG40B/L-11
13	COMB	HG40B/L-12



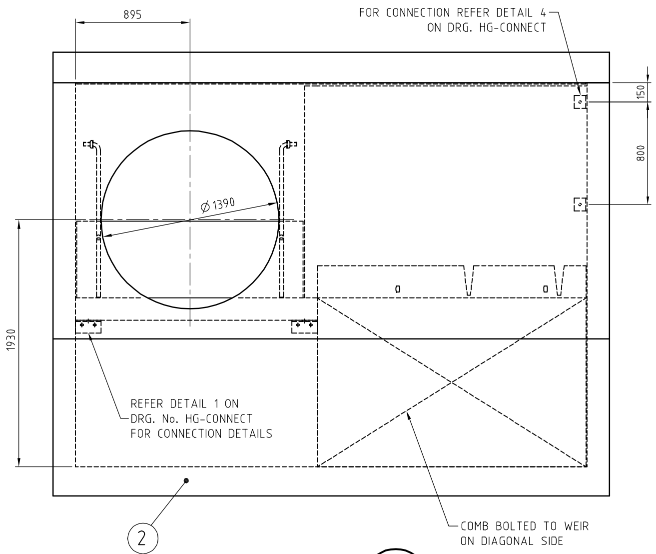
PLAN VIEW (LID REMOVED)

SCALE 1:20



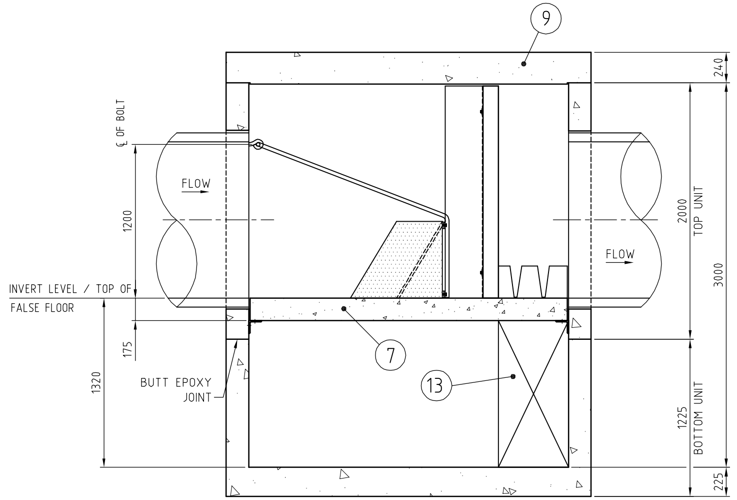
PLAN ON LID

SCALE 1:20



VIEW A

SCALE 1:20



SECTION B

SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 13.4 t
   MASS OF TOP UNIT = 14.4 t
   MASS OF LID = 7.0 t
6. PIPE HOLE SIZE ALLOWS FOR PIPE MORTAR CONNECTION.

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

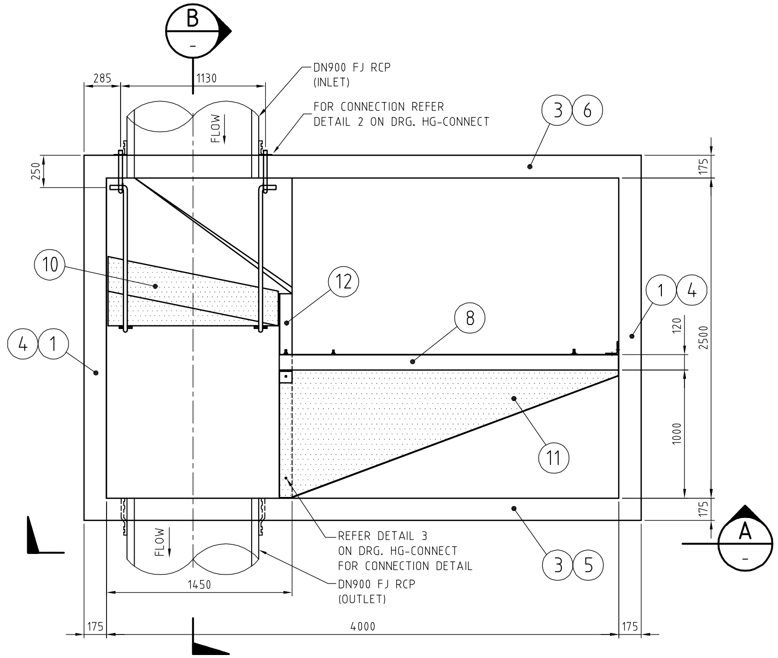
TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

DSN.	DFW	12-03-07	HUMES STANDARD DRAWING
DWN.	MZ	12-03-07	HUMEGARD HG40B/L
CKD.	DFW	12-03-07	DN1200/DN1200 FJ RCP
APP.	DFW	12-03-07	GENERAL ASSEMBLY

SUPERSEDES: HG40B/L-01 REV. C | PLOT SCALE: 1:1 | SIZE: A1 | DRG. NO.: HG40B/L-01 | ISSUE: 1

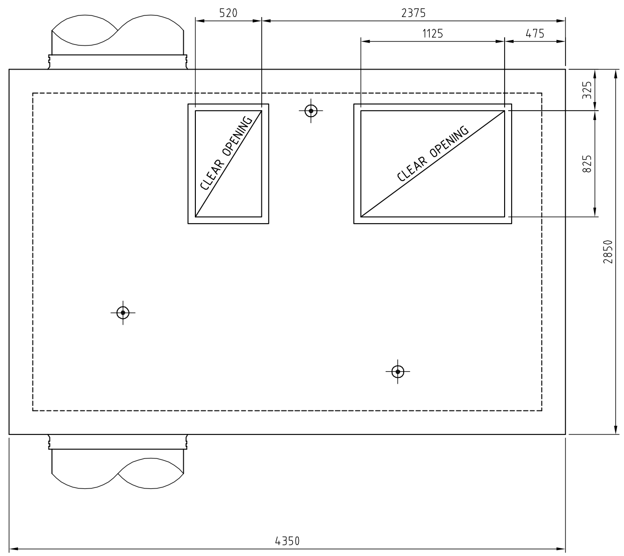
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION - REISSUED FOR MANUFACTURE	MZ	12-03-07	DFW
2	ITEM NUMBERS REVISED, REISSUED FOR MANUFACTURE	MZ	—	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG40B/L-02
2	BASE SLAB	HG40B/L-04
3	SIDE WALL - BOTTOM UNIT	HG40B/L-05
4	END WALL - TOP UNIT	HG40B/L-03
5,6	SIDE WALL - TOP UNIT	HG40B/L-06
7	FALSE FLOOR	HG40B/L-07
8	CONCRETE BAFFLE WALL	HG40B/L-07
9	PRECAST LID	HG40B/L-08
10	FLOATING BOOM	HG40B/L-09
11	WEIR	HG40B/L-10
12	BAFFLE SIDE WALL	HG40B/L-11
13	COMB	HG40B/L-12



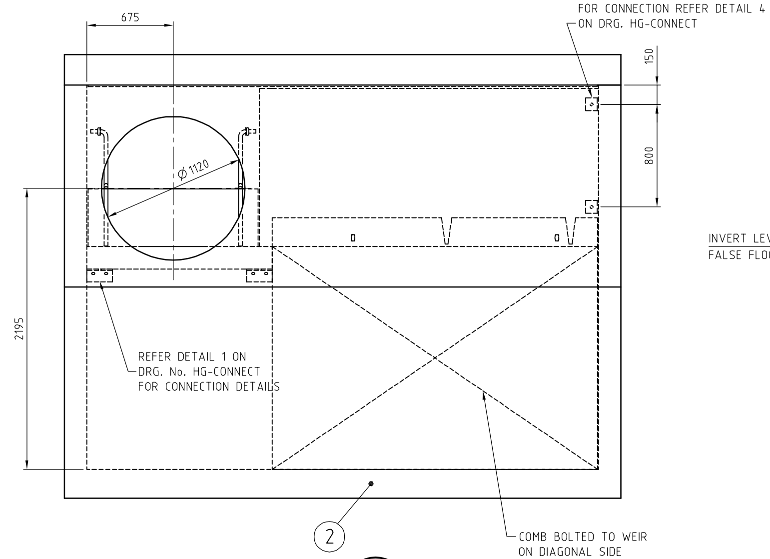
PLAN VIEW (LID REMOVED)

SCALE 1:20



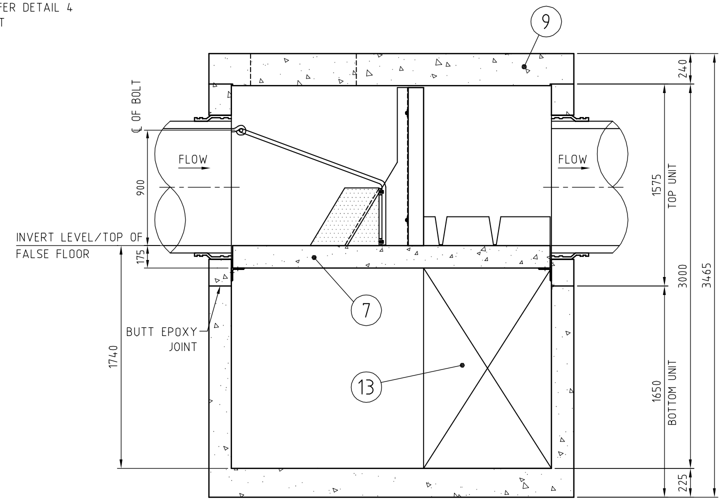
PLAN ON LID

SCALE 1:20



VIEW A

SCALE 1:20



SECTION B

SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 16.2 t
   MASS OF TOP UNIT = 11.6 t
   MASS OF LID = 7.0 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

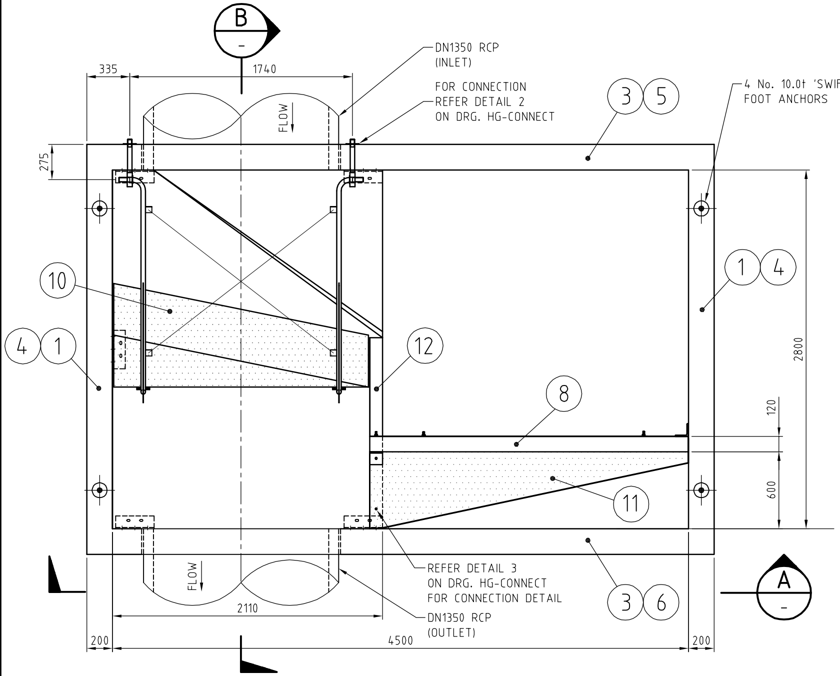
SUPERSEDES HG40/L-01 REV. 1

HUMES STANDARD DRAWING
HUMEGARD HG40/L
DN900/DN900 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE 1:1 | SIZE A1 | DRG. NO. HG40/L-01 | ISSUE 2

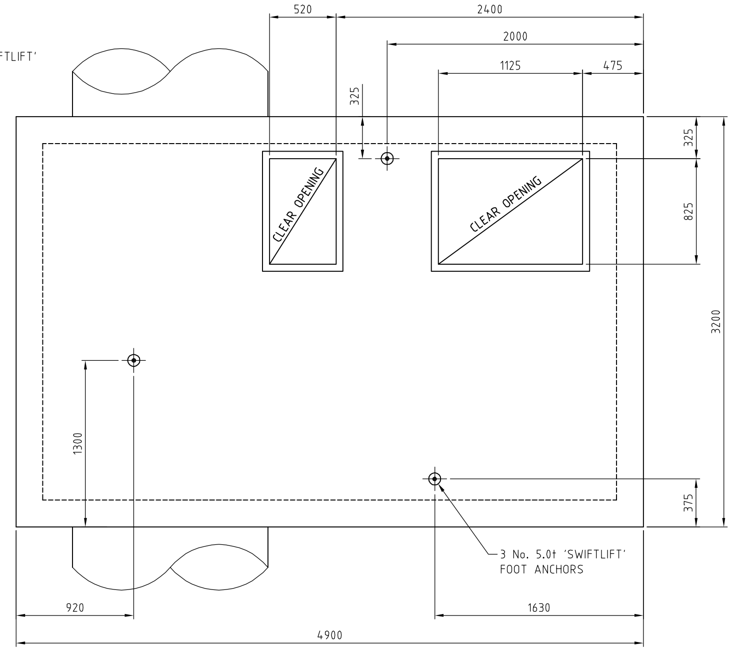
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	15-12-10	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG45A-02
2	BASE SLAB	HG45A-04
3	SIDE WALL - BOTTOM UNIT	HG45A-05
4	END WALL - TOP UNIT	HG45A-03
5,6	SIDE WALL - TOP UNIT	HG45A-06
7	FALSE FLOOR	HG45A/L-07
8	CONCRETE BAFFLE WALL	HG45A/L-07
9	PRECAST LID	HG45A/L-08
10	FLOATING BOOM	HG45A/L-09
11	WEIR	HG45A/L-10
12	BAFFLE SIDE WALL	HG45A/L-11
13	COMB	HG45A/L-12



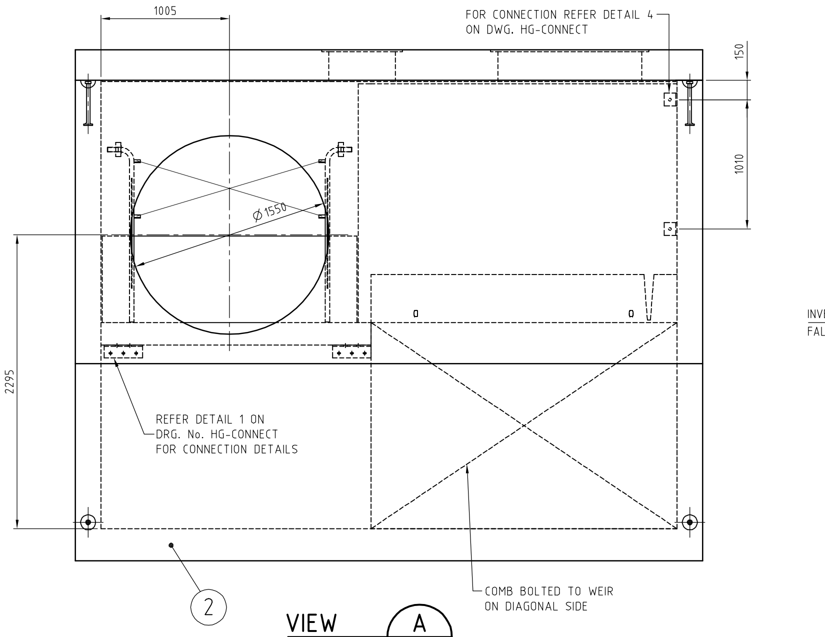
PLAN VIEW (LID REMOVED)

SCALE 1:20



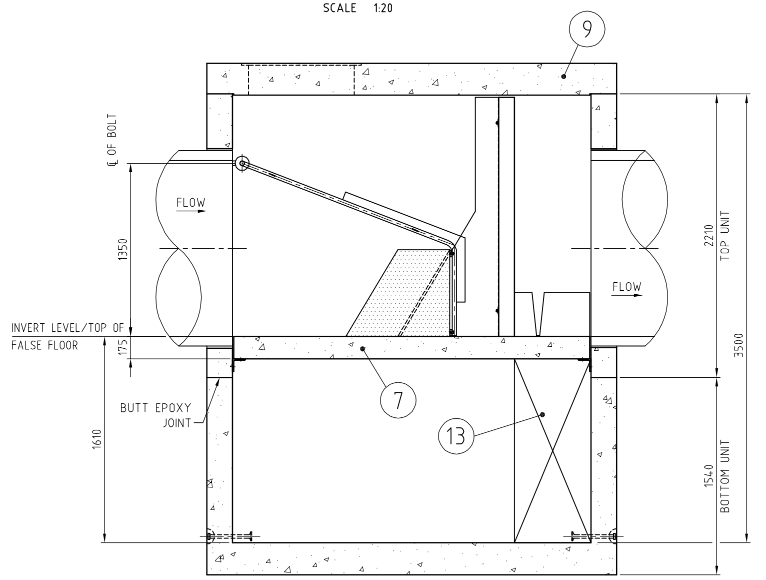
PLAN ON LID

SCALE 1:20



VIEW A

SCALE 1:20



SECTION B

SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 20.7 t
   MASS OF TOP UNIT = 19.7 t
   MASS OF LID = 9.1 t
6. PIPE HOLE SIZE ALLOWS FOR PIPE MORTAR CONNECTION.

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL SERVICES
BRISBANE, QUEENSLAND

Holcim (Australia) Pty Ltd ABN 87 099 732 297

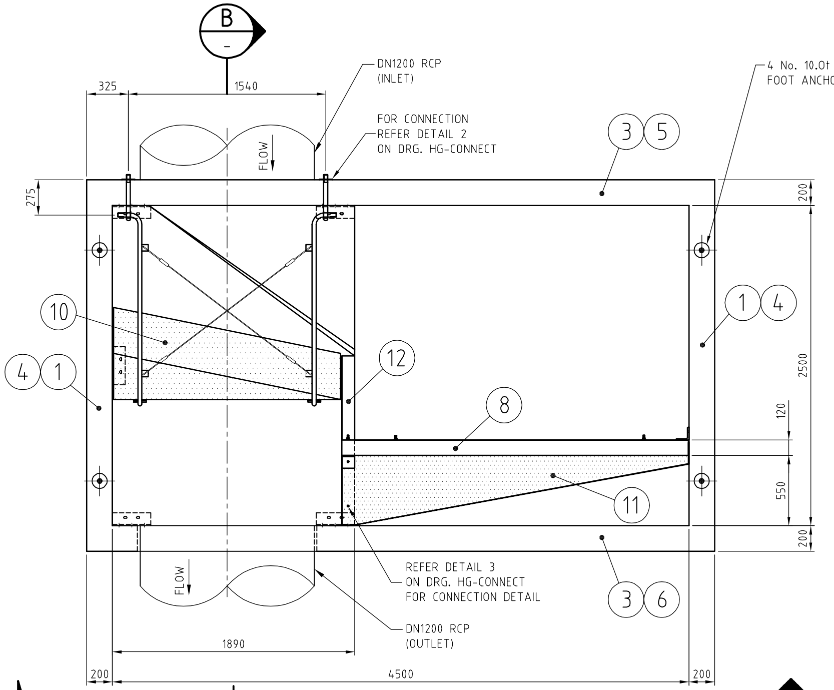
DSN.	WST	07-12-10
DWN.	MZ	07-12-10
CKD.	RM	15-12-10
APP.	WST	15-12-10

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG45A/L
DN1350/DN1350 RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG45A/L-01 REV. 0	1:1	A1	HG45A/L-01	1

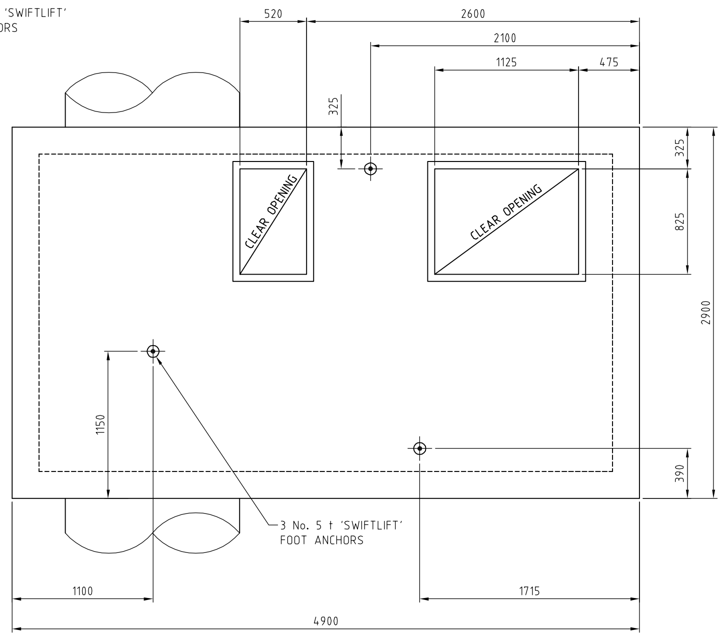
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	15-12-10	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG45-02
2	BASE SLAB	HG45-04
3	SIDE WALL - BOTTOM UNIT	HG45-05
4	END WALL - TOP UNIT	HG45-03
5,6	SIDE WALL - TOP UNIT	HG45-06
7	FALSE FLOOR	HG45/L-07
8	CONCRETE BAFFLE WALL	HG45/L-07
9	PRECAST LID	HG45/L-08
10	FLOATING BOOM	HG45/L-09
11	WEIR	HG45/L-10
12	BAFFLE SIDE WALL	HG45/L-11
13	COMB	HG45/L-12



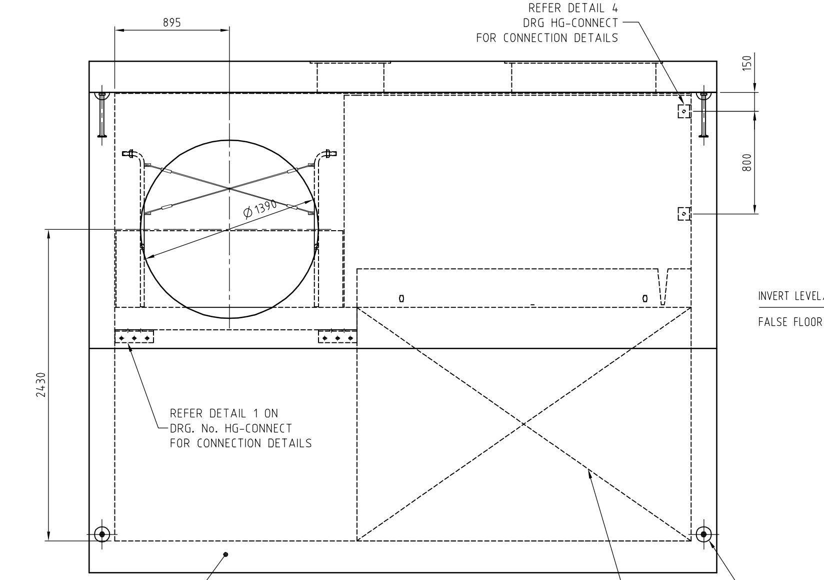
PLAN VIEW (LID REMOVED)

SCALE 1:20



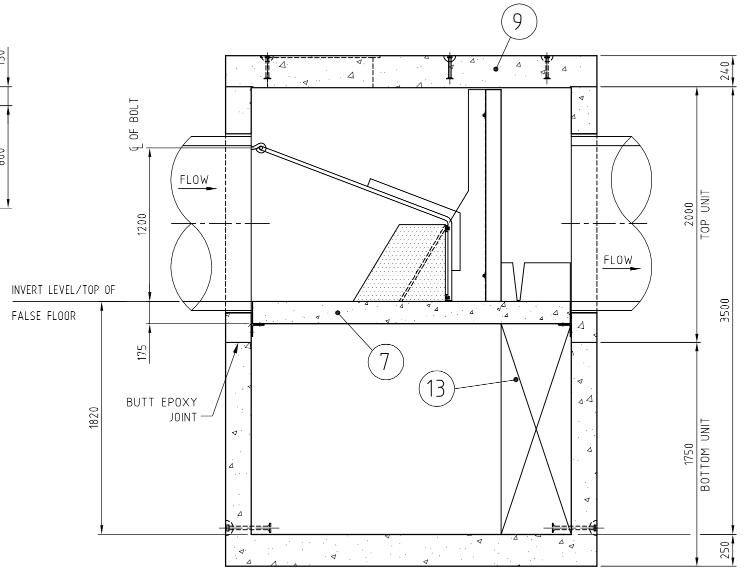
PLAN ON LID

SCALE 1:20



VIEW A

SCALE 1:20



SECTION B

SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 20.8 t
   MASS OF TOP UNIT = 17.3 t
   MASS OF LID = 8.1 t
6. PIPE HOLE SIZE ALLOWS FOR PIPE MORTAR CONNECTION.

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL SERVICES
BRISBANE, QUEENSLAND

DSN.	WST	01-12-10
DWN.	MZ	01-12-10
CKD.	RM	15-12-10
APP.	WST	15-12-10
SUPERSEDES	HG45/L-01 REV 0	

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG45/L
DN1200/DN1200 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. No.	ISSUE
1:1	A1	HG45/L-01	1

Precast solutions

Top:
StormTrap® system

Middle:
RainVault® system

Bottom:
Segmental shaft

Stormwater

Stormwater treatment

Primary treatment

HumeGard® Gross Pollutant Trap

Secondary treatment

HumeCeptor® hydrodynamic separator

Detention and infiltration

StormTrap® system

Soakwells

Harvesting and reuse

RainVault® system

ReserVault® system

RainVault® Mini system

Precast concrete cubes

Segmental shafts

Stormwater drainage

Steel reinforced concrete pipes – trench

Steel reinforced concrete pipes – salt water cover

Steel reinforced concrete pipes – jacking

Box culverts

Uniculvert® modules

Headwalls

Stormwater pits

Access chambers/Manholes

Kerb inlet systems

Floodgates

Geosynthetics

Sewage transfer and storage

Bridge and platform

Tunnel and shaft

Walling

Potable water supply

Irrigation and rural

Traffic management

Cable and power management

Rail

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