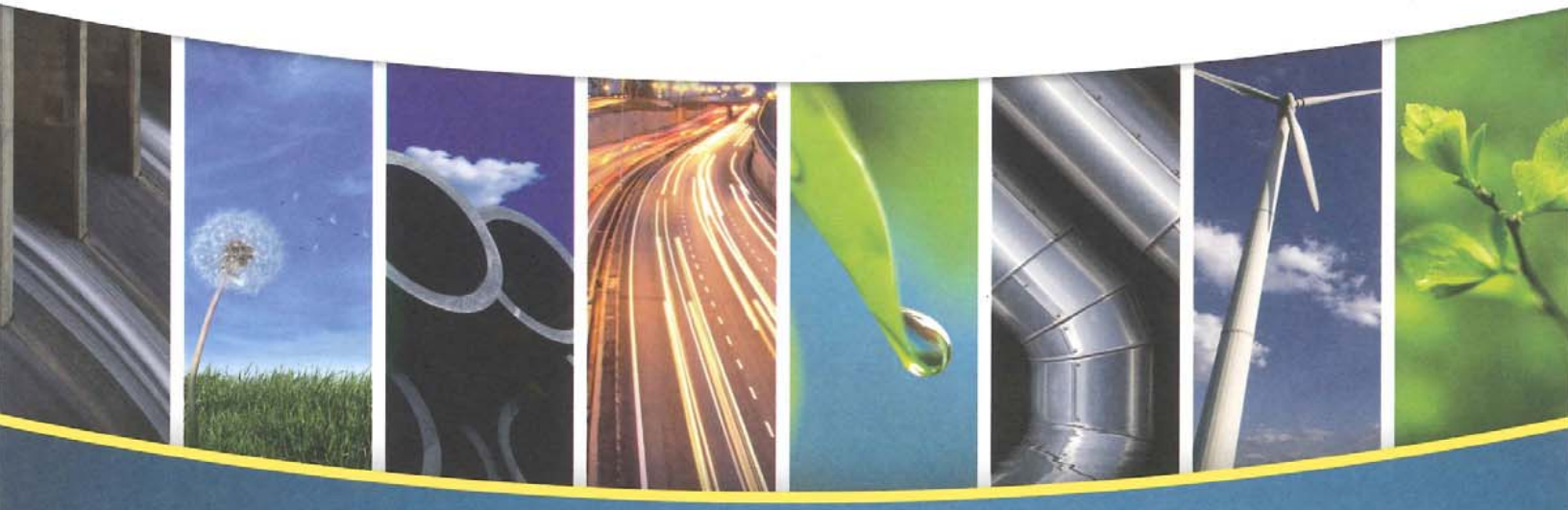
HOWARD STREET STORMWATER CAPACITY

Hastings District Council

March 2016



MWH

BUILDING A BETTER WORLD

Howard Street Stormwater Capacity Assessment

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Rev. No.	Date	Description	Prepared By	Reviewed By	Approved By
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03	31/03/2016	Final	Michael Assenmacher	Jonathan Krause	Wayne Hodson

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1 Introduction

HDC is seeking to identify the current stormwater system capacity within the Howard Street Catchment to be able to meet existing and future discharge requirements. It is understood that the area south of the school along Howard Street is proposed for development. As a first step HDC has requested MWH NZ Ltd to undertake a high level assessment of the existing piped and open channel stormwater network within Howard Street. It is intended that this will be refined in the future once information from more detailed investigations is available. Ultimately it is expected that a network hydraulic model will be created for the full Hastings area and this will be used to better define capacity constraints and upgrades that would be needed to meet acceptable level of service requirements.

The analysis herein presents a high level investigation that identifies the stormwater flow within the catchments (for a 5 and 50-year ARI flood event) and the capacity of the existing stormwater pipes and open channels around Howard Street. A 5-year event was used to consider primary flow systems while a 50-year event was used to compare against a higher intensity rainfall event.

The objective of the investigation was to determine if the stormwater system within the Howard Street area is sized adequately for a 5-year ARI flood event. Information was gathered by a site visit, desktop study and a review of Councils GIS database. The following summarises the tasks and methodology deployed for the investigation:

1. Identification of pipes discharging stormwater from the catchment areas either side of Howard Street using GIS information.
2. Calculation of stormwater runoff flow for a 5-year and a 50-year ARI event using the Rational Formula.
3. Calculation of pipe capacity using the Manning's Formula for an assumed grade of 1 in 500.
4. Comparison of the pipe capacity against the runoff flow for each sub-catchment.

2 Catchment Analysis

Eight primary catchment zones were identified within Howard Street, with Catchment 1 split into sub-catchments. A plan of these is shown in Appendix A, which also shows the discharge points from each catchment. Currently the Howard Street stormwater catchment areas flow into one of two open channel drains: the Windsor Drain or the Riverslea Drain. In most cases the extent of each catchment was based on LiDAR data which is known to be somewhat inaccurate due to the flat profile of the land. Specific notes on each catchment are described below.

Catchment 1 covers the school area and adjacent paddock on the southern side of Howard Street. The primary flow path of Catchment 1 drains into a manhole and flows across Howard Street into Catchment 2. Should this flow path become blocked or over whelmed, secondary flow paths lead toward Havelock Road or Howard Street.

Catchment 2 is the residential area located on the northern side of Howard Street and discharges to the Windsor Drain; this catchment separates at the boundary of Parkvale Estate to become Catchment 7. It has been assumed that the secondary flow path for Catchment 2 follows the ground profile toward Howard Street.

Catchment 3 is the field area on the southern side of Howard Street between the end of footpath and culvert 51142078. Property number 1239 is also included as a discharge pipe from the dwelling is visible in the swale. The catchment is assumed to cover road centreline to 15m inside the boundary line. LiDAR information indicates that flow that doesn't make its way into the southern swale flows towards Howard Street, but to be conservative we assumed that a portion flows toward Howard Street. A similar condition exists for Catchments 4, 5 and 6 with all primary and secondary flows via overland flow paths to the open channel along Howard Street.

Catchment 7 covers the northern area within the boundary of Parkvale estate. Both primary and secondary flow paths head into the swale on the northern side of Howard Street, however should this become inundated, flow will travel across the road into the southern swale.

Catchment 8 is the orchard area between the boundary of Parkvale estate and the Riverslea Drain. Both primary and secondary flow paths head into the swale on the northern side of Howard Street, however should this become inundated, flow will travel across the road into the southern swale.

Catchment 1 was further broken up into sub-catchments because of different rates of stormwater infiltration and runoff within the Catchment.

3 Stormwater Runoff Calculation

Calculations were carried out to determine the stormwater runoff from each catchment. The Rational Method was used and the runoff flow calculations were carried out based on the following:

- Time of concentration, t_c, for all sub-catchments:
  - 1a=16min
  - 1b=15min
  - 1c=12min
  - 2=17min
  - 3=15min
  - 4=12min
  - 5=12min
  - 6=15min
  - 7a=14min
  - 7b=30min
- Runoff Coefficient, C, values for the various zones were taken from the HDC Engineering Code of Practice 2011 (ECOP) For a Return period of 5-year:
  - $C_{1a} = 0.3$
  - $C_{1b} = 0.8$
  - $C_{1c} = 0.46$
  - $C_2 = 0.5$
  - $C_3 = 0.46$
  - $C_4 = 0.46$
  - $C_5 = 0.46$
  - $C_6 = 0.4$
  - $C_{7a} = 0.5$
  - $C_{7b} = 0.46$
- Rainfall intensity, i, data was taken from NIWA'a High Intensity Rainfall System (HIRDS) values with and without an allowance for climate change were considered.

Table 3-1: summarises the stormwater runoff flows from each catchment for 5-year and 50-year ARI storm events.

Table 3-1: 5 and 50-Year ARI Storm Event Flows

Sub-catchment	5yr ARI Flow (m^3/s)	5yr ARI Flow (m^3/s) with climate change 2090	50yr ARI Flow (m^3/s)	50yr ARI Flow (m^3/s) with change 2090
Catchment 1:				
a	0.03	0.03	0.08	0.10
b	0.12	0.15	0.24	0.29
c	0.02	0.03	0.06	0.07
Catchment 2	0.41	0.46	0.97	1.07
Catchment 3	0.04	0.04	0.10	0.12
Catchment 4	0.01	0.01	0.03	0.03
Catchment 5	0.01	0.01	0.02	0.03
Catchment 6	0.02	0.02	0.06	0.07
Catchment 7	0.22	0.25	0.51	0.59
Catchment 8	0.15	0.16	0.41	0.44

Table 3-2: summarises the total calculated stormwater runoff flows from each catchment for a 5-year ARI storm event.

Table 3-2: 5-Year ARI Storm Event (Without Climate Change) total Catchment Flow

Catchment	Total flow from catchment (m^3/s)
1	0.17
2	0.41
3	0.04
4	0.01
5	0.01
6	0.02
7	0.22
8	0.15

4 Stormwater Flow Assessment

The flow capacity of each stormwater pipe was determined using the Manning's Formula:

$$Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}} \sqrt{S}$$

The calculations were carried out based on the following assumptions:

- A Manning's roughness coefficient of 0.013, assuming all concrete pipes are in good condition.
- A grade of 1 in 500 for all the pipes and swales, unless information on GIS was available.
- Downstream network has adequate capacity and does not cause surcharge at the flow rates considered. This was verified by HBRC report, titled "'*HDC URBAN GROWTH STUDY – RIVERSLEA (HOWARD/ADA ST)"*, dated 11 February 2016, which recommends the installation of detention ponds to accommodate future development. This capacity is to be determined in conjunction with HBRC to understand downstream capacity.
- Velocity of flow in the swales was assumed to be 0.5m/s.
- For the purpose of the calculations, it had been assumed that discharges from the swales on the northern and southern sides of Howard Street into the Riverslea Drain are free flowing and not restricted. However, records indicate these pipes are 375mm each, and post calculations it is noted that these outlets are restricted. It has been assumed that these pipes can be replaced with larger pipes if needed. This should be considered further in the next stage of the project.

The capacity of the swale on the northern side of Howard Street was calculated to be 0.52m^3/s and the swale on the southern side has a capacity of 0.22 m^3/s. When compared to the values stated in Table 3.2, it indicates that the swales are both able to handle flows for a 5-year ARI event.

Table 4-1 summarises the calculated maximum capacity of existing stormwater pipes within the study area.

Table 4-1: Maximum Capacity of Existing Stormwater Pipes at Catchment Outlet Before Surcharging

	SUFI No.	Outlet Pipe Diameter (mm)	Pipe Capacity (m^3/s)
Catchment 1	51142088	225	0.02
Catchment 2	50003613	525	0.19
Catchment 3	51142078	300	0.04
Catchment 4	51148337	225	0.02
Catchment 5	51148338	225	0.02
Catchment 6	51148342	375	0.08
Catchment 7	51142076	525	0.19
Catchment 8	51148343	375	0.08

Table 4-2: Capacity of pipe relative to outlet flow

Catchment	**Outlet pipe capacity** (from Table 4-1) (m^3/s)	**Catchment flow: 5-year ARI event without climate change** (from Table 3-2) (m^3/s)	**Pipe capacity relative to outlet flow** (m^3/s)
1	0.02	0.17	-0.15
2	0.19	0.41	-0.22
3	0.04	0.04	0
4	0.02	0.01	0.01
5	0.02	0.01	0.01
6	0.08	0.02	0.06
7	0.19	0.22	-0.03
8	0.08	0.15	-0.07
Riverslea Drain Discharge (northern swale)	0.08	0.37	-0.29
Riverslea Drain Discharge (southern swale)	0.08	0.08	0

Capacity	Colour Band
< 50%	
50% to 90%	
90% to 120%	
120% <	

5 Summary

In Summary:

- The network within Catchments 1 and 2 are undersized and likely cannot handle flows from a 5-year ARI. Additional flows from future development should not be discharged into Catchments 1 and 2.
- For a 5-year ARI, there does appear to be capacity in existing infrastructure for existing flows from Catchments 3, 4, 5 and 6. Additional flows from these catchments will require mitigation and/or infrastructure upgrades.
- There does appear to be some storage capacity in the southern and northern swales for a 5-year ARI. However there are restrictions at the discharge into the Riverslea Drain for all storm events considered including the 5 year ARI.
- It appears that the discharge pipe from Catchment 7 does not have capacity for any additional flow without upgrading the outlet pipe, or mitigations upstream.
- It is recommended that Council acknowledge that this is a high level assessment and that this analysis should be reviewed and amended once details of any development in the study area are known. Furthermore, topographical survey will be required in selected locations to confirm flow directions and catchment boundaries.

Some recommended steps forward are for Council to:

- Confirm catchment boundaries through topographical survey.
- Validate the GIS information in Catchment 2 regarding conflicting information in the invert levels of stormwater conveyance system
- Confirm the location of the stormwater discharge from Woodfield Place.
- Data gathering of all swale outlet pipes, to confirm assumptions in this report of a free discharge through these pipes.
- Determine extent of new developments, and appropriate mitigation for future flows considering the effects of climate change.
- Investigate possibilities for diversion between catchments.

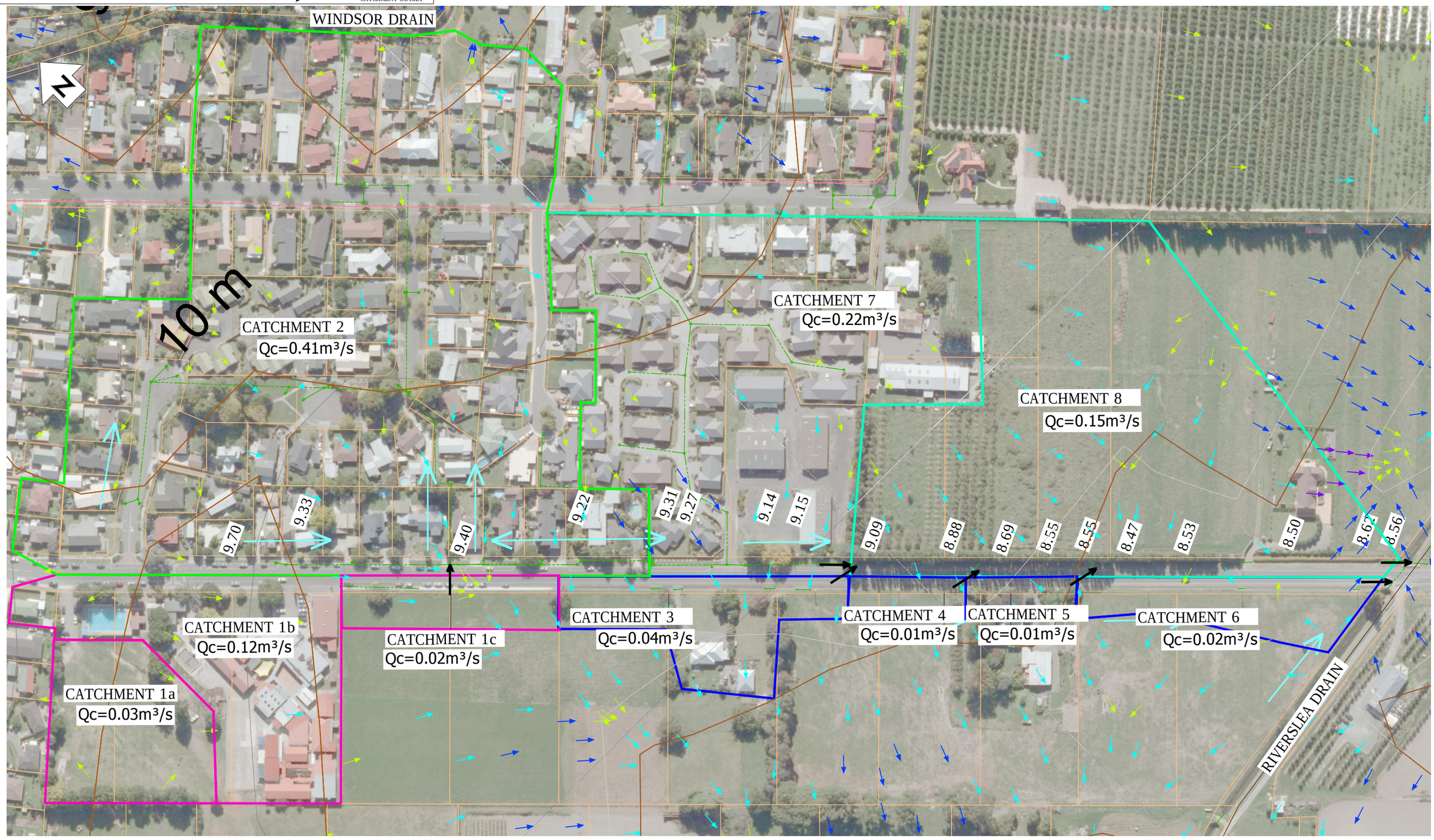
Appendix A: Catchment Map

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

LEGEND

- EXISTING STORMWATER
- CATCHMENT BOUNDARY 1
- CATCHMENT BOUNDARY 2
- CATCHMENT BOUNDARY 3
- CATCHMENT BOUNDARY 4
- CONTOUR LINES
- 0.0%-0.3%
- 0.3%-0.7%
- 0.7%-2.0%
- 2.0%-20.0%
- CATCHMENT OUTLET



NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	WORKING PLOT				

	Name	Date
SURVEYED		
DESIGNED		
DESIGN CHECK		
DRAWN	MB ASSENMACHER	02/16
DRAWING CHECK	WA HODSON	02/16
APPROVED		

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15-16 WATER SERVICES MINOR WORKS

HOWARD STREET STORMWATER
CATCHMENT ASSESSMENT

Status Stamp: **PRELIMINARY**

Date Stamp: **31/03/2016**

SCALES **(A1)** NTS

Drawing No.	Sheet No.	Rev.
80508167-0105	C150	A

XREFS : I_Model, G_Model, G_D_Model, 1m Contour Linework, Hastings Slope arrows

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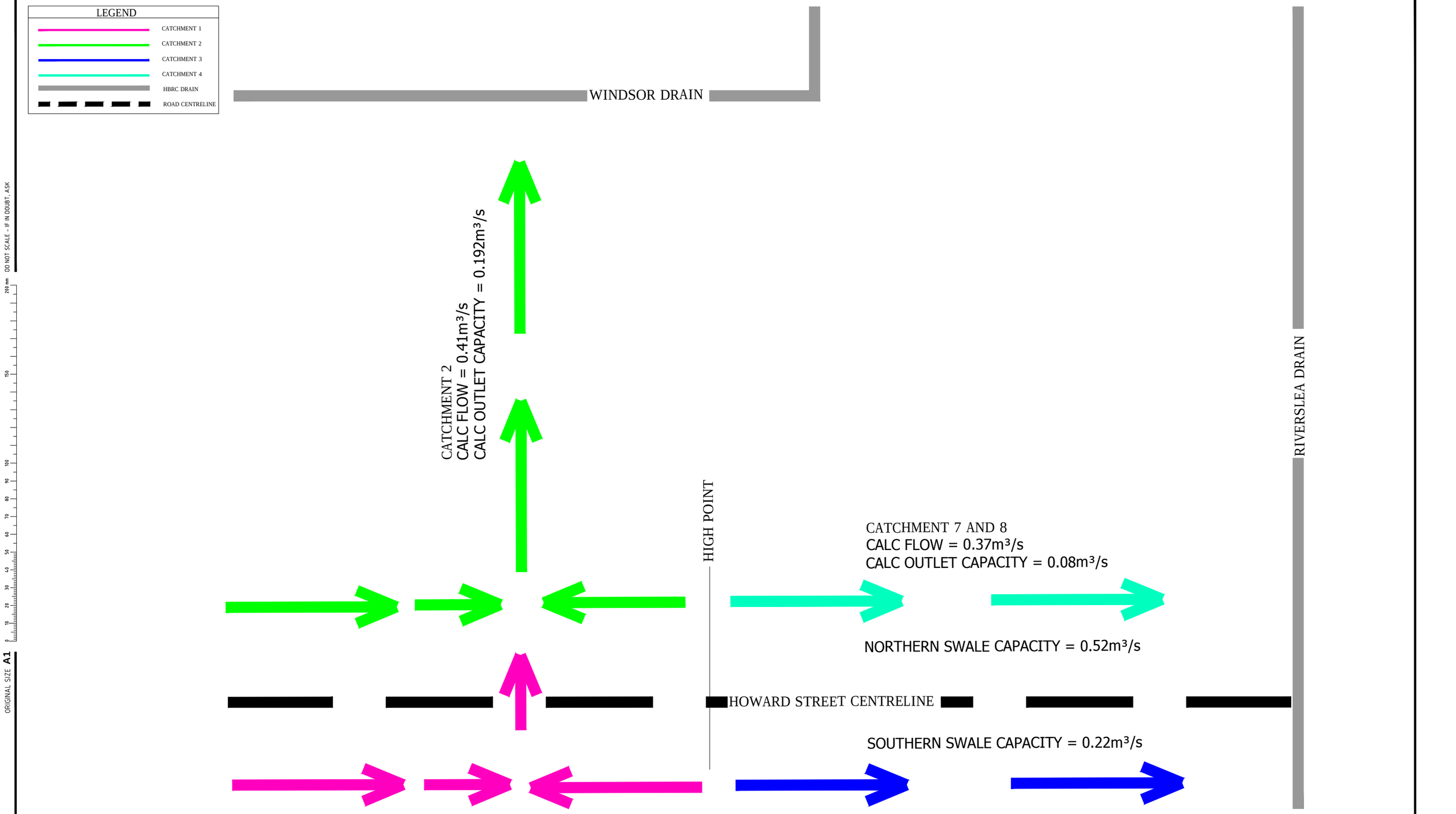
Appendix B: Vector Diagram



SCHEMATIC DETAIL OF CATCHMENT FLOWS
SCALE: NTS

Note:
Flows are based on a 5-Year ARI event without Climate Change.

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	WORKING PLOT				

	Name	Date
SURVEYED		
DESIGNED		
DESIGN CHECK		
DRAWN	MB ASSENMACHER	02/16
DRAWING CHECK	WA HODSON	02/16
APPROVED		

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HOWARD STREET STORMWATER
VECTOR DIAGRAM

Status Stamp: **PRELIMINARY**
Date Stamp: **31/03/2016**
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Sheet No.: C151
Rev.: A

XREFS : I_Model, G_Model, G_D_Model, 1m Contour Linework, Hastings Slope arrows

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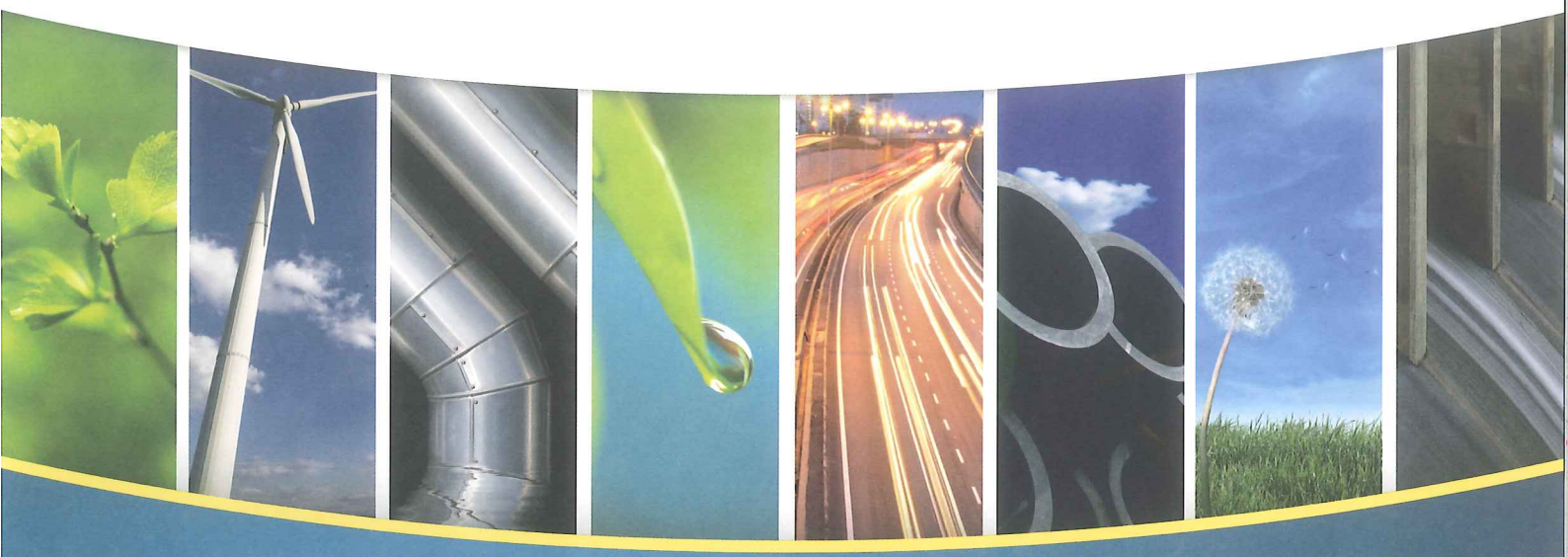

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