BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
ABN 26 134 067 842

PORT STEPHENS COUNCIL

Drainage Report

East Seaham Road Stage 5

August 2018

PLANNING
PROJECT MANAGEMENT
ENGINEERING
CERTIFICATION

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1 Introduction

This report has been prepared to detail the adequacy of the existing stormwater infrastructure and proposed drainage upgrades for the East Seaham Road upgrade Stage 5 project.

In considering the adequacy of the stormwater infrastructure at the site, this investigation will consider the following:

- The existing site conditions and stormwater infrastructure
    - A site visit was undertaken with Council's Engineers (10/08/2017);
- Advice given by Council's Drainage and Flooding Engineers;
- Flooding at the site.

The report will document the performance of the culvert crossings located within the existing East Seaham Road. Performance will be assessed for both the minor and major storm events with all criteria as set out in PSC's design specification to be adhered to.

2 Existing Drainage

The existing drainage network consists of table drains and piped culvert crossings. The existing infrastructure includes 8 culvert crossings as detailed below:

- Culvert 1 CH3,190– 2 x 750mm RCP– 1.4%
- Culvert 2 CH3,425 – 525mm RCP – 1.8%
- Culvert 3 CH3,585 – 2 x 750mm RCP – 1.2%
- Culvert 4 CH3,625 – 450mm RCP – 2.5%
- Culvert 5 CH3,630 – 450mm RCP – 2.5%
- Culvert 6 CH4,035 – 2 x 1500mm RCP – 1.4%
- Culvert 7 CH4,110 – 450mm RCP – 1.5%
- Culvert 8 CH4,260 – 450mm RCP – XXXX% - No survey has been provided on this culvert to date. As such, it has not been included in the modelling.

As per the project brief, stormwater drainage facilities are to be checked for suitability and functionality for both the minor and major storm events.

It is noted that after discussion with Council's Drainage and Flooding Engineers the following design considerations have been taken into account:

1. The road must convey via culverts only the flows generated by the 2100 2%AEP Event (Minor)
2. The road must adequately convey via culverts and overflow routes the flows generated by the 2100 1%AEP Event (Major)
3. Tail water levels are to be based off the 2% AEP Flood Level for both the 2% AEP and 1% AEP design storm events

The existing catchments have been modelled with the drainage software package DRAINS using the latest Australian Rainfall and Runoff 2016 (ARR 2016) procedures and 2016 IFD rainfall data provided by BOM. The following input parameters were used:

- Design rainfall data (2016 IFDs) provided by the Bureau of Meteorology and AR&R website
- Time of concentration for flows was calculated using the kinematic wave equation for each individual catchment
- Desktop assessment of existing catchment data. Detailed method of calculating time of concentration using values shown in Table 2 below
- 8 storm durations were considered: 5 minutes, 10 minutes, 15 minutes, 30 minutes, 1 hour, 2 hours, 6 hours and 48 hours. A total of 71 storms were analysed for each storm frequency in accordance with ARR 2016 methodologies
- A conservative headwall 'K entry' value of 1 was used to estimate head loss at headwall entry.

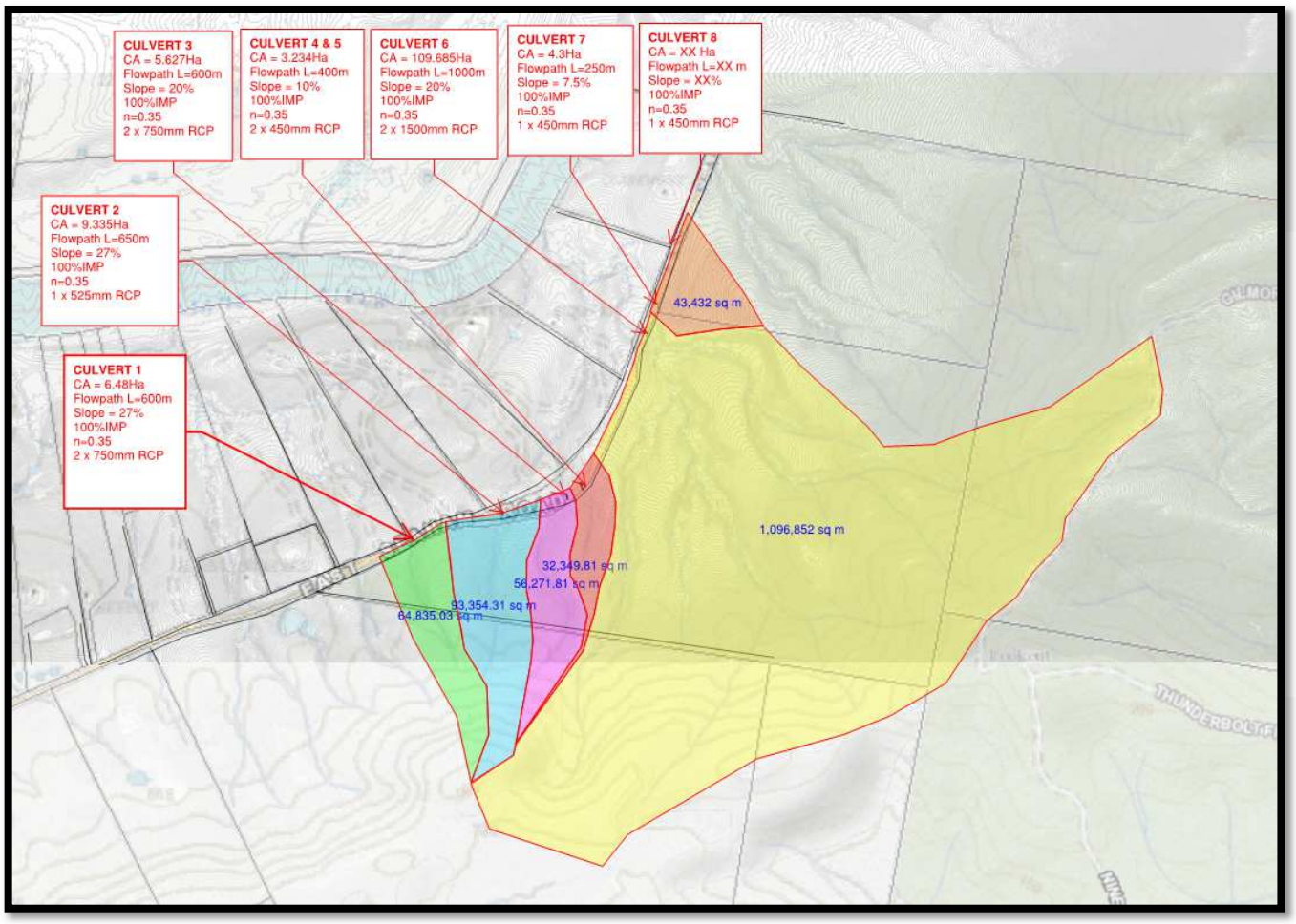
See below for a list of the soil characteristic inputs for the DRAINS model:

Parameter	Value
Soil Type	3
Antecedent Moisture Condition	3
Initial Storage (Paved)	1 mm
Initial Storage (Grassed)	5 mm
Flow Path Roughness (Natural / Rural)	0.15

Table 1 - Input parameters

2.1.1 Catchments

The catchments and their individual characteristics contributing to all culverts are shown in the figure below:



Sub-catchment	Sub-catchment Data				
	Area	%Imperv.	L	S	n
	ha	%	m	m/m	-
CULVERT 1	6.48	0%	600	0.27	0.15
CULVERT 2	9.34	0%	650	0.27	0.15
CULVERT 3	5.63	0%	600	0.20	0.15
CULVERT 4&5	3.23	0%	400	0.10	0.15
CULVERT 6	109.69	0%	1000	0.20	0.15
CULVERT 7	4.30	0%	250	0.075	0.15

Table 2 – Sub-catchment Data

The current grades of the road indicate that flows from catchments 2 to 7 will flow in an easterly direction. Current modelling assumes flows are being conveyed by the culverts directly and any overflows being bypassed as overland flows across the road in each culvert location.

2.1.2 Flooding

The site has been classified as being flood affected by Port Stephens Council (PSC). As such, the modelling of the culvert crossings must take into account the effects of the flood levels on the functionality of the culverts. The following flood levels have been provided by PSC and has been utilised in the modelling:

- **2%AEP – 7.0m AHD**
- **1%AEP – 7.5m AHD**

These flood levels have been incorporated into the model to ensure the effects of tailwater due to flood levels have been considered in the modelling for each design storm. They have been identified as having the most impact on the performance of Culverts 4, 5 and 6 given the invert levels.

2.1.3 Performance Criteria

The stormwater modelling of the existing road has been undertaken using the 2% AEP event as the storm event to be conveyed under the road and the 1% AEP event as the storm event that shall be conveyed both under the road and overflows to be routed over the road. As such, the culverts must convey flows up to and including the 2%AEP event and all overflow routes must adequately convey the 1%AEP event as per Council's requirements. In summary, the following performance criteria has been applied:

- 2% AEP Minor storm
  No road inundation, culverts are sized to fully convey storm
  Tailwater level = 7.0m AHD to allow for flooding

- 1% AEP Major storm
  Depth of inundation over road =< 200mm
  V x D =< 0.4
  Tailwater level = 7.5 AHD to allow for flooding

2.1.4 Modelling Results - Existing Infrastructure

Figures 1, 2 & 3 are screenshots of DRAINS modelling of existing infrastructure for both the 2% AEP and 1% AEP storm events.

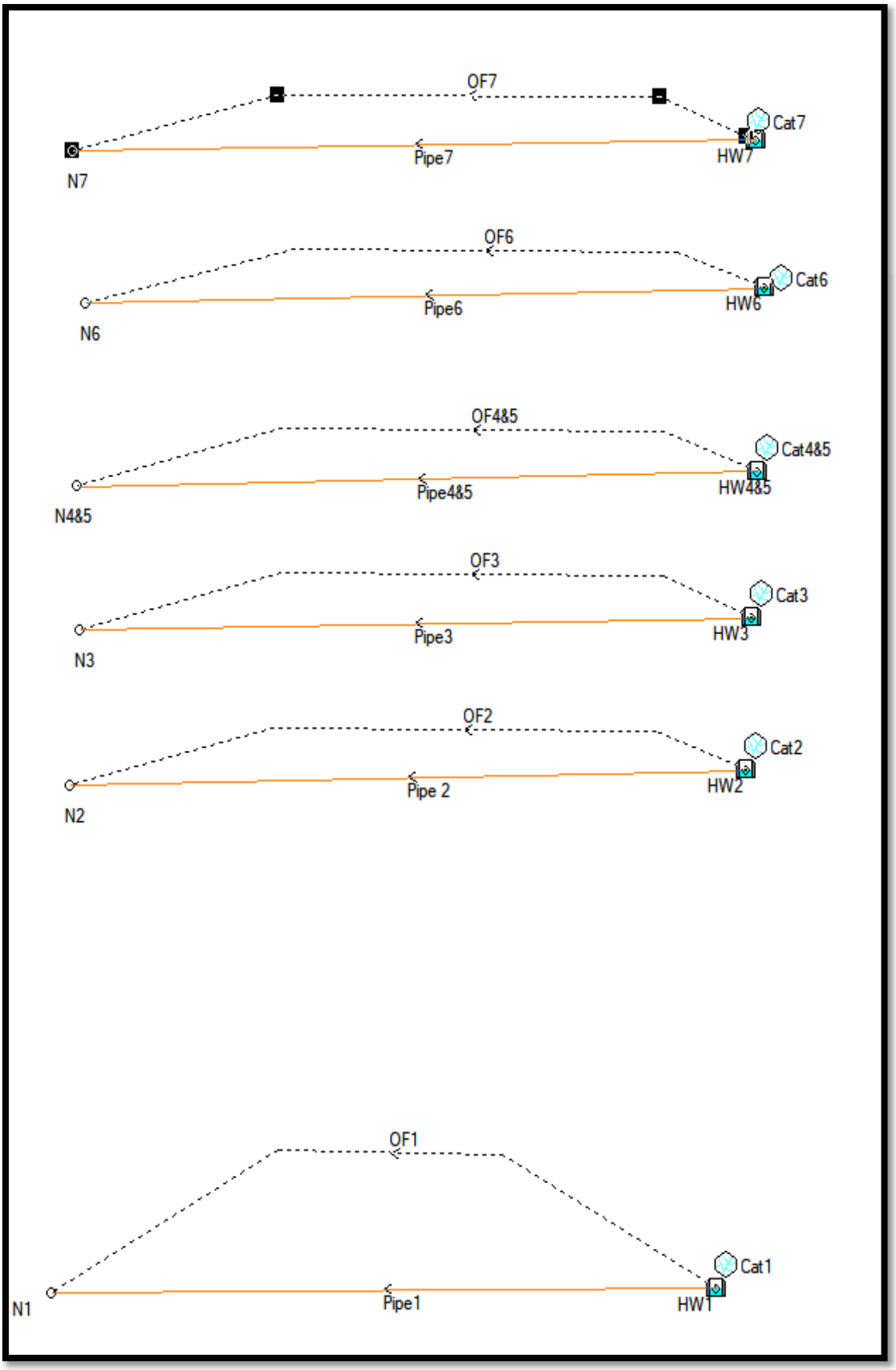


Figure 1 - DRAINS Model Layout

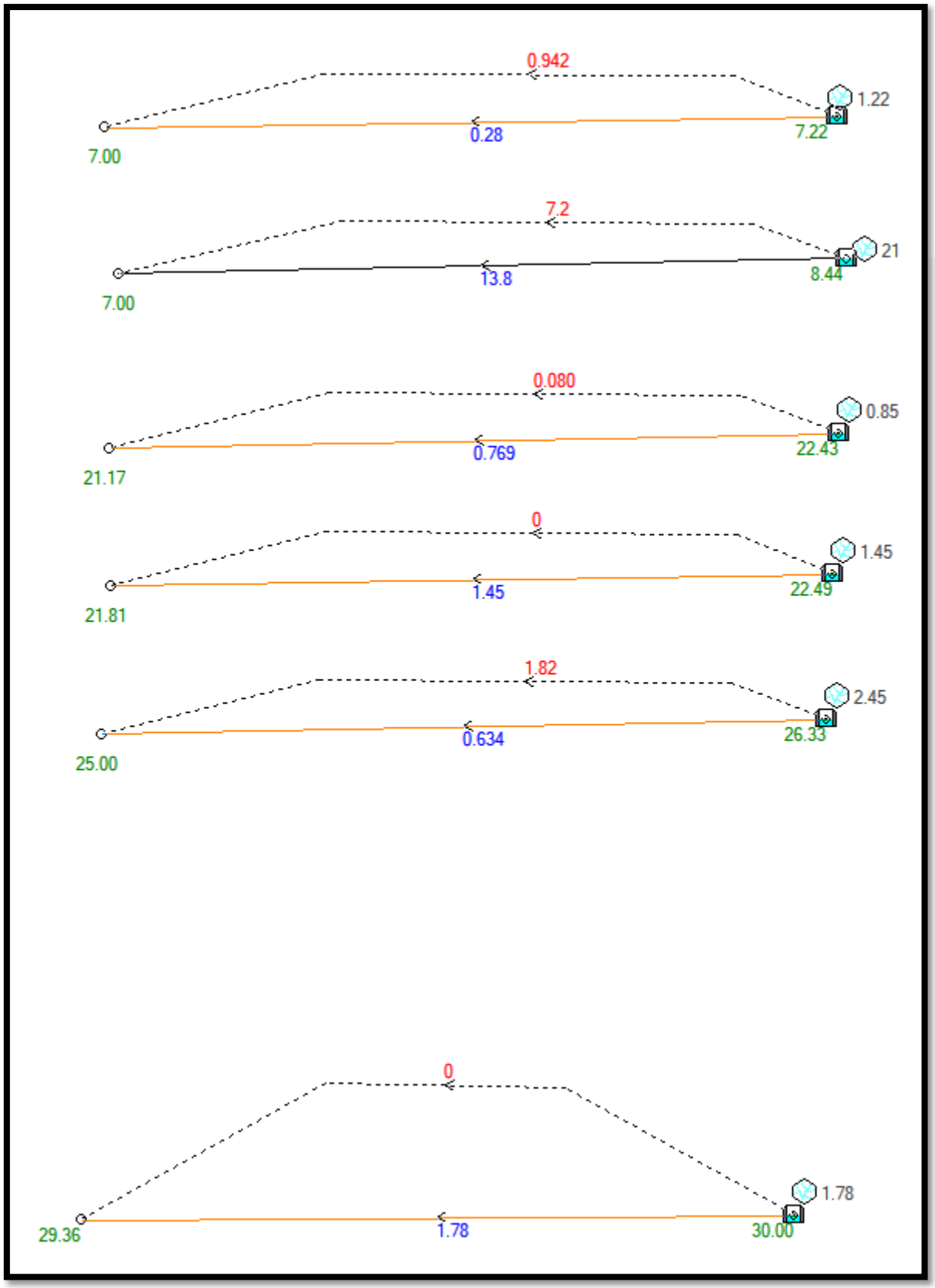


Figure 2 - DRAINS Output - 2% AEP Minor Storm

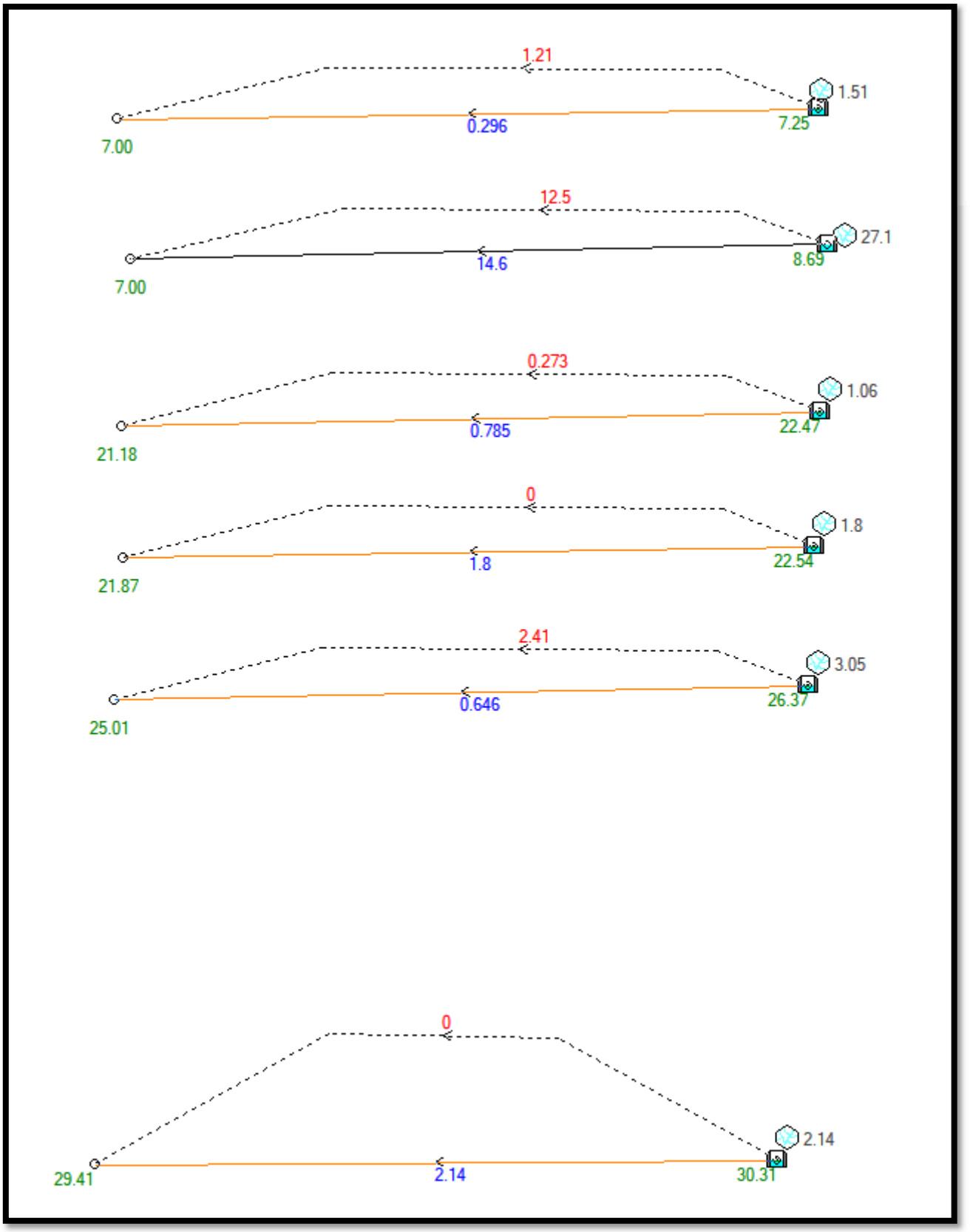


Figure 3 - DRAINS Output - 1% AEP Major Storm

ITEM	PIPE ADEQUACY	
	2% AEP	1% AEP
CULVERT 1	✓	✓
CULVERT 2	✗	✓
CULVERT 3	✓	✓
CULVERT 4&5	✗	✓
CULVERT 6	✗	✗
CULVERT 7	✗	✓

Table 3 - Pipe adequacy

As can be seen in Table 3, existing culverts 2, 4/5, 6 and 7 within stage 5 of the East Seaham Road work are not sufficiently sized to convey the design storm events.

2%AEP Minor Storm

Culverts 2, 4/5, 6 & 7 are not sufficiently sized to convey the expected flows from the 2% AEP event. As such, these culvert crossings will be required to be upgraded with any future works in order to ensure compliance to Council's requirements for all drainage infrastructure to convey the 2% AEP under the road.

1%AEP Major Storm

Culvert 6 does not contain enough capacity to ensure the 1% AEP is conveyed through the pipes and via an overland flowpath. The existing crossing exceeds both the maximum allowable depth of flows (200mm) and maximum V x D (0.4).

For further results please refer to Appendix A for the DRAINS results files.

3 Recommended Upgrades

Drainage design has been undertaken using DRAINS to determine the minimum upgrades required to achieve compliance with the Council's performance criteria as detailed in Section 2.1.3 of the report. Results from the modelling show that the following drainage upgrade works are required:

Name	Diameter (mm)	No. of Pipes	Catchment ID	Area (ha)
Culvert 1*	900	1	Cat1	6.48
Culvert 2	900	2	Cat2	9.33
Culvert 3**	750	2	Cat3	5.63
Culvert 4&5	600	2	Cat4&5	3.23
Culvert 6	1650	3	Cat6	109.68
Culvert 7	900	1	Cat7	3.10

Table 4 – Culvert Design

* The replacement of existing twin 750mm pipes with a single 900mm for Culvert 1 represents a minor reduction in capacity. However, DRAINS analysis shows that the existing Culvert 1 appears oversized for the associated catchment and the proposed 900mm pipe will fully convey both the 2% AEP and 1% AEP storms with satisfactory HGLs and no overflows onto the road.

** Proposed works for Culvert 3 are limited to extension (approx. 2.57m) of the existing twin 750mm pipes only, as detailed on Sheet 42 of the design plans.

Associated upgrades will also include the construction of new headwalls, table drains and riprap scour protection works, as necessary. All works have been designed in accordance with PSC's engineering standards together with reference to relevant Australian engineering best practice manuals.

Please refer to the design plans for full details of the proposed upgrade works. Results of the DRAINS model for the 2% AEP minor and 1% AEP major storms are provided in Figures 4 and 5 below.

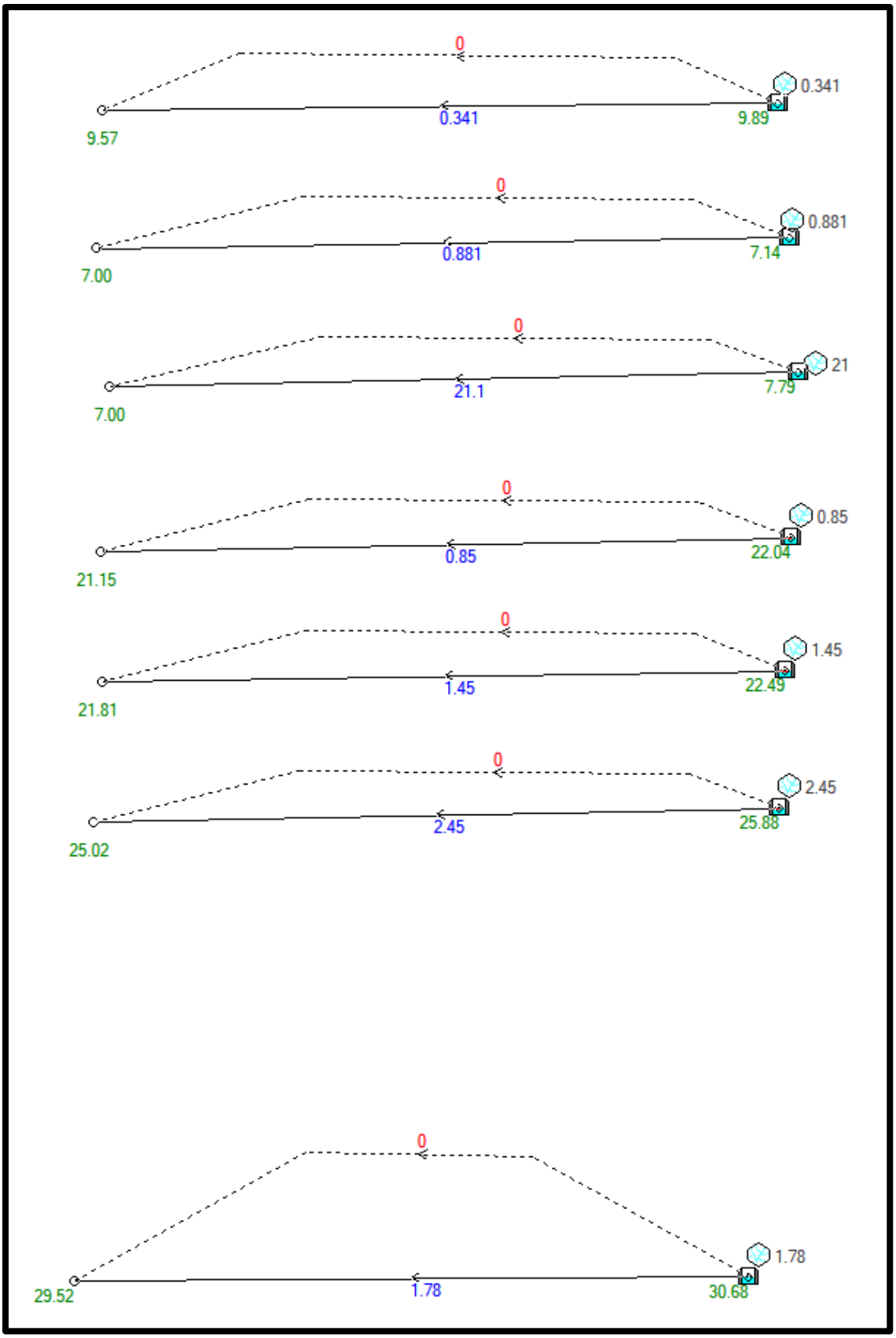


Figure 4 - DRAINS Output - 2% AEP Minor Storm

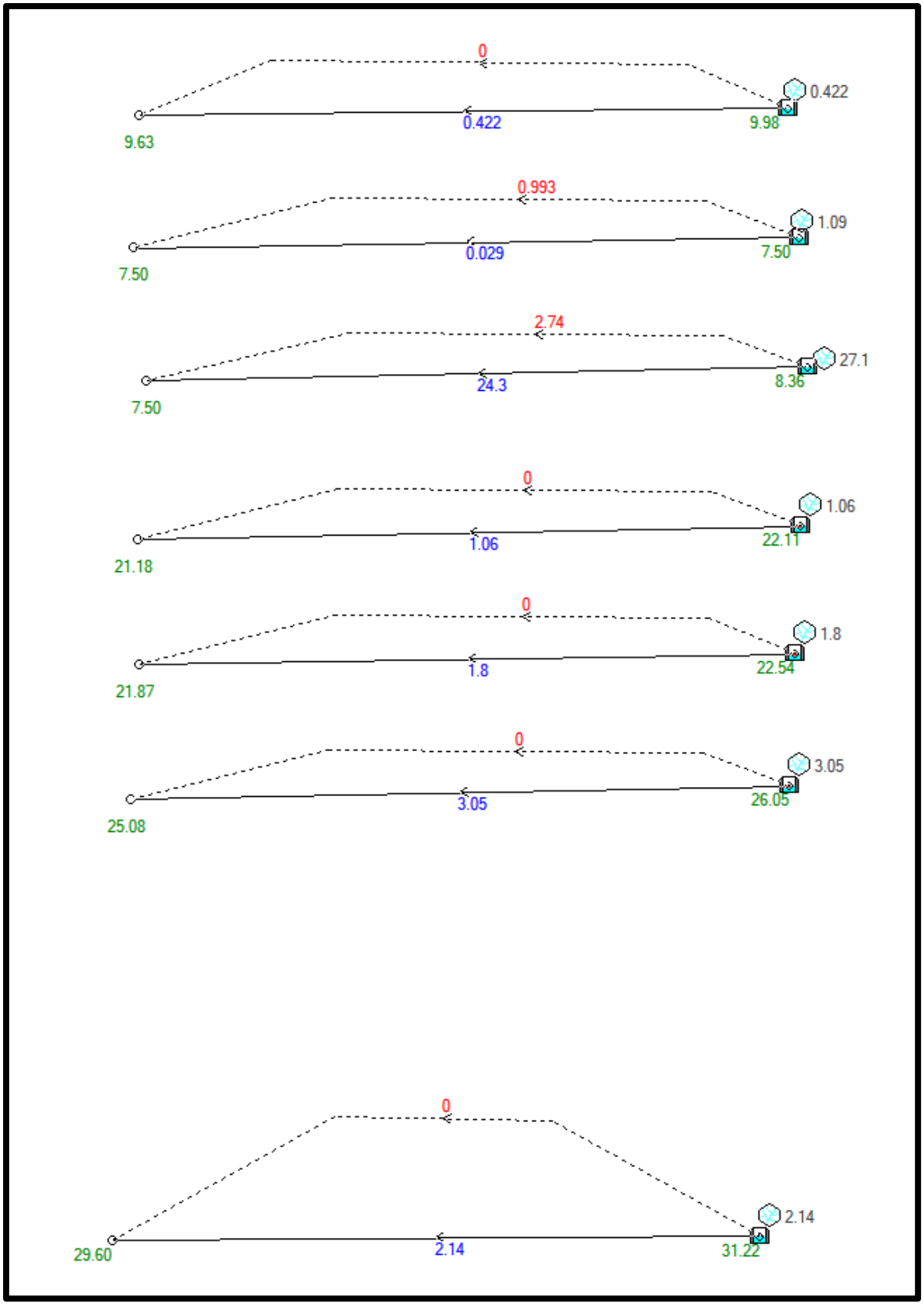


Figure 5 - DRAINS Output - 1% AEP Major Storm

Appendix A

Drains Data & Results – Existing

PIT / NODE DETAILS Version 13

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph
HW1	Headwall				1	31.574		0		375	-264		3		
N1	Node					28.954		0		301.643	-264.5		8		No
HW2	Headwall				1	26.103		0		378.269	-213		537		
N2	Node					24.613		0		303.737	-214.5		550		No
HW3	Headwall				1	23.082		0		378.976	-198.1		557		
N3	Node					21.438		0		304.769	-199.3		565		No
HW4&5	Headwall				1	22.402		0		379.546	-183.6		574		
N4&5	Node					20.897		0		304.599	-185.2		582		No
HW6	Headwall				0.5	7.877		0		380.404	-165.6		1660		
N6	Node					5.437		0		305.457	-167.2		1820		No
HW7	Headwall				1	7.077		0		379.355	-151		3203		
N7	Node					5.796		0		304.122	-152.2		3365		No

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%)	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor
Cat1	HW1	6.48	0	100	0	0	0	0	600	600	600	27	27	27	0.02	0.15	0.11	6.95165e-310
Cat2	HW2	9.335	0	100	0	0	0	0	650	650	650	27	27	27	0.02	0.15	0.11	6.95165e-310
Cat3	HW3	5.627	0	100	0	0	0	0	600	600	600	20	20	20	0.02	0.15	0.11	6.95165e-310
Cat4&5	HW4&5	3.234	0	100	0	0	0	0	400	400	400	10	10	10	0.02	0.15	0.11	6.95165e-310
Cat6	HW6	109.68	0	100	0	0	0	0	1000	1000	1000	20	20	20	0.02	0.15	0.11	6.95165e-310
Cat7	HW7	4.3	0	100	0	0	0	0	250	250	250	7.5	7.5	7.5	0.02	0.15	0.11	6.95165e-310

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg
Pipe1	HW1	N1	9.9	29.088	28.954	1.35	ete, under	750	750	0.3	Existing	2	HW1	0
Pipe 2	HW2	N2	10.5	24.802	24.613	1.8	ete, under	525	525	0.3	Existing	1	HW2	0
Pipe3	HW3	N3	15.3	21.62	21.438	1.19	ete, under	750	750	0.3	Existing	2	HW3	0
Pipe4&5	HW4&5	N4&5	17.7	21.338	20.897	2.49	ete, under	450	450	0.3	Existing	2	HW4&5	0
Pipe6	HW6	N6	10.3	5.581	5.437	1.4	ete, under	1500	1524	0.3	lewFixe	2	HW6	0
Pipe7	HW7	N7	10.1	5.949	5.796	1.51	ete, under	450	450	0.3	Existing	1	HW7	0

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth lajor Storm (m)	SafeDepth linor Storm (m)	Safe DxV sq.m/sec	Bed Slope (%)	D/S Area ontributing %	id			
OF1	HW1	N1	0.2	31.574	10	1.7	del flow acr	0.2	0	0.6	1	0	16			17.3
OF2	HW2	N2	0.2	26.103	10	1.7	del flow acr	0.2	0	0.6	1	0	544			17.6
OF3	HW3	N3	0.2	23.082	10	1.7	del flow acr	0.2	0	0.6	1	0	567			17.5
OF4&5	HW4&5	N4&5	0.2	22.402	10	1.7	del flow acr	0.2	0	0.6	1	0	580			17.7
OF6	HW6	N6	0.2	7.877	10	1.7	del flow acr	0.2	0	0.6	1	0	1768			17.7
OF7	HW7	N7	0.2	7.077	10	1.7	del flow acr	0.2	0	0.6	1	0	3312			17.8

DRAINS Input Data - Existing

DRAINS results prepared from Version 2017.10

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
HW1	30		1.889		1.58	0	None
N1	29.36		0				
HW2	26.33		2.561		-0.23	1.82	Headwall height/system capacity
N2	25		1.925				
HW3	22.49		1.529		0.6	0	None
N3	21.81		0				
HW4&5	22.43		0.887		-0.03	0.08	Headwall height/system capacity
N4&5	21.17		0.114				
HW6	8.44		22.774		-0.56	7.202	Headwall height/system capacity
N6	7		8.729				
HW7	7.22		1.442		-0.15	0.942	Headwall height/system capacity
N7	7		1.149				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Cat1	1.782	0	1.782	6.87	23	19.09	2% AEP, 30 min burst, Storm 5
Cat2	2.453	0	2.453	7.2	24.13	20.03	2% AEP, 30 min burst, Storm 9
Cat3	1.451	0	1.451	7.51	25.17	20.89	2% AEP, 30 min burst, Storm 1
Cat4&5	0.85	0	0.85	7.25	24.29	20.17	2% AEP, 30 min burst, Storm 9
Cat6	21.013	0	21.013	10.21	34.19	28.39	2% AEP, 30 min burst, Storm 6
Cat7	1.222	0	1.222	5.96	19.98	16.58	2% AEP, 30 min burst, Storm 5

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1	1.782	3.63	29.496	29.362	2% AEP, 30 min burst, Storm 5
Pipe 2	0.634	3.68	25.192	25.007	2% AEP, 30 min burst, Storm 9
Pipe3	1.451	3.29	21.995	21.813	2% AEP, 30 min burst, Storm 9
Pipe4&5	0.769	3.76	21.614	21.173	2% AEP, 30 min burst, Storm 9
Pipe6	13.828	3.82	7.066	7	2% AEP, 30 min burst, Storm 5
Pipe7	0.28	1.76	7.064	7	2% AEP, 30 min burst, Storm 5

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF1	0	0	0	0	0	0	0	
OF2	1.82	1.82	0	0.105	0.11	28.93	1.08	2% AEP, 30 min burst, Storm 9
OF3	0	0	0	0	0	0	0	
OF4&5	0.08	0.08	0	0.033	0.01	10.93	0.45	2% AEP, 30 min burst, Storm 9
OF6	7.202	7.202	0	0.184	0.29	44.74	1.56	2% AEP, 30 min burst, Storm 5
OF7	0.942	0.942	0	0.08	0.07	24.08	0.9	2% AEP, 30 min burst, Storm 5

DRAINS 2% AEP Results - Existing

DRAINS results prepared from Version 2017.10

PIT / NODE DETAILS — Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
HW1	30.31		2.397		1.27	0	None
N1	29.41		0				
HW2	26.37		3.303		-0.27	2.409	Headwall height/system capacity
N2	25.01		2.653				
HW3	22.54		1.908		0.54	0	None
N3	21.87		0				
HW4&5	22.47		1.144		-0.06	0.273	Headwall height/system capacity
N4&5	21.18		0.354				
HW6	8.69		28.627		-0.81	12.49	Headwall height/system capacity
N6	7		13.891				
HW7	7.25		1.751		-0.17	1.215	Headwall height/system capacity
N7	7		1.443				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Cat1	2.142	0	2.142	6.49	21.74	18.05	1% AEP, 30 min burst, Storm 5
Cat2	3.055	0	3.055	6.81	22.81	18.94	1% AEP, 30 min burst, Storm 5
Cat3	1.798	0	1.798	7.1	23.79	19.75	1% AEP, 30 min burst, Storm 9
Cat4&5	1.058	0	1.058	6.86	22.97	19.07	1% AEP, 30 min burst, Storm 5
Cat6	27.051	0	27.051	9.65	32.32	26.84	1% AEP, 30 min burst, Storm 3
Cat7	1.511	0	1.511	4.85	16.24	13.48	1% AEP, 15 min burst, Storm 2

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1	2.142	3.78	29.547	29.413	1% AEP, 30 min burst, Storm 5
Pipe 2	0.646	3.69	25.198	25.013	1% AEP, 30 min burst, Storm 5
Pipe3	1.798	3.46	22.047	21.865	1% AEP, 30 min burst, Storm 9
Pipe4&5	0.785	3.77	21.618	21.177	1% AEP, 30 min burst, Storm 5
Pipe6	14.565	4.01	7.072	7	1% AEP, 30 min burst, Storm 9
Pipe7	0.296	1.86	7.072	7	1% AEP, 15 min burst, Storm 8

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF1	0	0	8.878	0	0	0	0	
OF2	2.409	2.409	8.878	0.117	0.14	31.44	1.16	1% AEP, 30 min burst, Storm 5
OF3	0	0	8.878	0	0	0	0	
OF4&5	0.273	0.273	8.878	0.052	0.03	17.22	0.61	1% AEP, 30 min burst, Storm 5
OF6	12.49	12.49	8.878	0.23	0.42	54.08	1.81	1% AEP, 30 min burst, Storm 6
OF7	1.215	1.215	8.878	0.089	0.09	25.87	0.95	1% AEP, 15 min burst, Storm 1

DRAINS 1% AEP Results - Existing

Appendix B

Drains Data & Results – Upgraded

PIT / NODE DETAILS

Name	Type	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	id	Part Full Shock Loss	Inflow Hydrograph
HW1	Headwall	1	31.574		0		375	-264	3		
N1	Node		28.954		0		301.643	-264.469	8		No
HW2	Headwall	1	26.103		0		378.269	-213.045	537		
N2	Node		24.613		0		303.737	-214.534	550		No
HW3	Headwall	1	23.082		0		378.976	-198.118	557		
N3	Node		21.438		0		304.769	-199.298	565		No
HW4&5	Headwall	1	22.4		0		379.546	-183.648	574		
N4&5	Node		20.897		0		304.599	-185.174	582		No
HW6	Headwall	0.5	7.877		0		380.404	-165.627	1660		
N6	Node		5.437		0		305.61	-167.181	1820		No
HW7	Headwall	1	7.425		0		379.355	-151.038	3203		
N7	Node		5.796		0		304.122	-152.182	3365		No
HW8	Headwall	1	10.51		0		378.055	-136.36	146429		
N8	Node		9.567		0		304.657	-137.155	146450		No

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Rainfall Multiplier
Cat1	HW1	6.48	0	100	0	0	0	0	600	600	600	27	27	27	0.02	0.15	0.11	0	1
Cat2	HW2	9.335	0	100	0	0	0	0	650	650	650	27	27	27	0.02	0.15	0.11	0	1
Cat3	HW3	5.627	0	100	0	0	0	0	600	600	600	20	20	20	0.02	0.15	0.11	0	1
Cat4&5	HW4&5	3.234	0	100	0	0	0	0	400	400	400	10	10	10	0.02	0.15	0.11	0	1
Cat6	HW6	109.68	0	100	0	0	0	0	1000	1000	1000	20	20	20	0.02	0.15	0.11	0	1
Cat7	HW7	3.1	0	100	0	0	0	0	250	250	250	7.5	7.5	7.5	0.02	0.15	0.11	0	1
Cat8	HW8	1.2	0	100	0	0	0	0	250	250	250	7.5	7.5	7.5	0.02	0.15	0.11	0	1

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg
Pipe1	HW1	N1	9.9	29.088	28.954	1.35	Concrete, under roads	900	900	0.3	NewFixed	1	HW1	0
Pipe 2	HW2	N2	10.5	24.802	24.613	1.8	Concrete, under roads	900	900	0.3	NewFixed	2	HW2	0
Pipe3	HW3	N3	15.3	21.62	21.438	1.19	Concrete, under roads	750	750	0.3	NewFixed	2	HW3	0
Pipe4&5	HW4&5	N4&5	17.7	21.338	20.897	2.49	Concrete, under roads	600	600	0.3	NewFixed	2	HW4&5	0
Pipe6	HW6	N6	10.3	5.581	5.437	1.4	Concrete, under roads	1650	1676	0.3	NewFixed	3	HW6	0
Pipe7	HW7	N7	10.1	5.949	5.796	1.51	Concrete, under roads	900	900	0.3	NewFixed	1	HW7	0
Pipe 8	HW8	N8	12.3	9.283	9.221	0.5	Concrete, under roads	600	600	0.3	NewFixed	1	HW8	0

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	Safe Depth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
OF1	HW1	N1	0.2	31.574			Dummy used to model flow across road low points	0.2	0	0.6	1	0	16
OF2	HW2	N2	0.2	26.103			Dummy used to model flow across road low points	0.2	0	0.6	1	0	544
OF3	HW3	N3	0.2	23.082			Dummy used to model flow across road low points	0.2	0	0.6	1	0	567
OF4&5	HW4&5	N4&5	0.2	22.4			Dummy used to model flow across road low points	0.2	0	0.6	1	0	580
OF6	HW6	N6	0.2	7.877			Dummy used to model flow across road low points	0.2	0	0.6	1	0	1768
OF7	HW7	N7	0.2	7.425			Dummy used to model flow across road low points	0.2	0	0.6	1	0	3312
OF8	HW8	N8	0.2	10.51			Dummy used to model flow across road low points	0.2	0	0.6	1	0	146459

This model has no pipes with non-return valves

DRAINS Input Data - Upgraded

DRAINS results prepared from Version 2018.05									
PIT / NODE DETAILS				Version 8					
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint		
HW1	30.68		1.889		0.9	0	None		
N1	29.52		0						
HW2	25.88		2.561		0.22	0	None		
N2	25.02		0						
HW3	22.49		1.529		0.6	0	None		
N3	21.81		0						
HW4&5	22.04		0.887		0.36	0	None		
N4&5	21.15		0						
HW6	7.79		22.774		0.09	0	None		
N6	7		0						
HW7	7.14		1.039		0.29	0	None		
N7	7		0						
HW8	9.89		0.402		0.62	0	None		
N8	9.57		0						
SUB-CATCHMENT DETAILS									
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm		
Cat1	1.782	0	1.782	6.87	23	19.09	2% AEP, 30 min burst, Storm 5		
Cat2	2.453	0	2.453	7.2	24.13	20.03	2% AEP, 30 min burst, Storm 9		
Cat3	1.451	0	1.451	7.51	25.17	20.89	2% AEP, 30 min burst, Storm 1		
Cat4&5	0.85	0	0.85	7.25	24.29	20.17	2% AEP, 30 min burst, Storm 9		
Cat6	21.013	0	21.013	10.21	34.19	28.39	2% AEP, 30 min burst, Storm 6		
Cat7	0.881	0	0.881	5.96	19.98	16.58	2% AEP, 30 min burst, Storm 5		
Cat8	0.341	0	0.341	5.96	19.98	16.58	2% AEP, 30 min burst, Storm 5		
PIPE DETAILS									
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm				
Pipe1	1.782	4.26	29.65	29.516	2% AEP, 30 min burst, Storm 5				
Pipe 2	2.454	4.35	25.212	25.023	2% AEP, 30 min burst, Storm 9				
Pipe3	1.451	3.29	21.995	21.813	2% AEP, 30 min burst, Storm 7				
Pipe4&5	0.85	3.82	21.587	21.147	2% AEP, 30 min burst, Storm 9				
Pipe6	21.087	3.44	7.044	7	2% AEP, 30 min burst, Storm 9				
Pipe7	0.881	1.38	7.028	7	2% AEP, 30 min burst, Storm 5				
Pipe 8	0.341	1.98	9.635	9.573	2% AEP, 30 min burst, Storm 5				
OVERFLOW ROUTE DETAILS									
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm	
OF1	0	0	0	0	0	0	0		
OF2	0	0	0	0	0	0	0		
OF3	0	0	0	0	0	0	0		
OF4&5	0	0	0	0	0	0	0		
OF6	0	0	0	0	0	0	0		
OF7	0	0	0	0	0	0	0		
OF8	0	0	0	0	0	0	0		
Run Log for 20180821 run at 13:10:21 on 22/8/2018									
Flows were safe in all overflow routes.									

DRAINS 2% AEP Results - Upgraded

DRAINS results prepared from Version 2018.05											
PIT / NODE DETAILS				Version 8							
Name	Max HGL	Max Surface	Min	Overflow	Constraint						
		Flow Arriving	Freeboard	(cu.m/s)							
		(cu.m/s)	(m)								
HW1	31.22	2.397	0.36	0	None						
N1	29.6	0									
HW2	26.05	3.303	0.06	0	None						
N2	25.08	0.064									
HW3	22.54	1.908	0.54	0	None						
N3	21.87	0									
HW4&5	22.11	1.144	0.29	0	None						
N4&5	21.18	0									
HW6	8.36	28.627	-0.49	2.735	Headwall height/system capacity						
N6	7.5	4.196									
HW7	7.5	1.262	-0.08	0.993	Headwall height/system capacity						
N7	7.5	1.403									
HW8	9.98	0.489	0.53	0	None						
N8	9.63	0									
SUB-CATCHMENT DETAILS											
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm				
	Flow Q	Max Q	Max Q	Tc	Tc	Tc					
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)					
Cat1	2.142	0	2.142	6.49	21.74	18.05	1% AEP, 30 min burst, Storm 5				
Cat2	3.055	0	3.055	6.81	22.81	18.94	1% AEP, 30 min burst, Storm 5				
Cat3	1.798	0	1.798	7.1	23.79	19.75	1% AEP, 30 min burst, Storm 9				
Cat4&5	1.058	0	1.058	6.86	22.97	19.07	1% AEP, 30 min burst, Storm 5				
Cat6	27.051	0	27.051	9.65	32.32	26.84	1% AEP, 30 min burst, Storm 3				
Cat7	1.089	0	1.089	4.85	16.24	13.48	1% AEP, 15 min burst, Storm 5				
Cat8	0.422	0	0.422	4.85	16.24	13.48	1% AEP, 15 min burst, Storm 9				
PIPE DETAILS											
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm						
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)							
Pipe1	2.142	4.41	29.731	29.603	1% AEP, 30 min burst, Storm 5						
Pipe 2	3.055	4.59	25.268	25.079	1% AEP, 30 min burst, Storm 5						
Pipe3	1.798	3.46	22.047	21.865	1% AEP, 30 min burst, Storm 9						
Pipe4&5	1.058	4.05	21.62	21.179	1% AEP, 30 min burst, Storm 5						
Pipe6	24.315	3.67	7.628	7.5	1% AEP, 30 min burst, Storm 7						
Pipe7	0.029	0.05	7.5	7.5	1% AEP, 30 min burst, Storm 5						
Pipe 8	0.422	2.07	9.689	9.631	1% AEP, 15 min burst, Storm 6						
OVERFLOW ROUTE DETAILS											
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm			
OF1	0	0	8.878	0	0	0	0				
OF2	0	0	8.878	0	0	0	0				
OF3	0	0	8.878	0	0	0	0				
OF4&5	0	0	8.878	0	0	0	0				
OF6	2.735	2.735	8.878	0.124	0.15	32.7	1.2	1% AEP, 30 min burst, Storm 5			
OF7	0.993	0.993	8.878	0.082	0.07	24.44	0.91	1% AEP, 30 min burst, Storm 7			
OF8	0	0	8.878	0	0	0	0				
Run Log for 20180821 run at 13:31:38 on 22/8/2018											
Flows were safe in all overflow routes.											

DRAINS 1% AEP Results - Upgraded