Appendix B

Existing Water Quality Assessment

East West Link Alliance Memorandum

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Subject:	Stormwater quality Investigation		

1. Existing water quality assessment

1.1 Rationale for Stormwater Quality Investigation

This appendix summarises the stormwater quality field investigation results carried out as part of the assessment of the existing environment.

Given the industrial use of the area, and high number of contaminated and potentially contaminated sites, as identified in Technical Report 17 (Contaminated Land Assessment), the stormwater quality is expected to be poor, and it was considered useful to undertake a site specific assessment of stormwater quality to characterise the existing environment. The stormwater was considered likely to be impacted by run-off from contaminated sites; be subject to inadvertent industrial discharge; and be influenced by landfills and leachate potentially entering the stormwater system.

1.2 Scope

Characterisation of existing stormwater quality has focussed on the catchments that discharge to the Mangere inlet, as it was considered that project offered an opportunity to improve stormwater quality entering the Mangere inlet. Treatment of stormwater from the wider project alignment is considered to be limited to road runoff only and as such typical runoff quality can be assumed.

The following stormwater quality investigations were carried out:

- Review and compilation of existing information on stormwater quality for the Onehunga area and the wider Auckland region
- Collection of grab samples from stormwater outfalls
- Analytical testing of stormwater samples
- Rainfall monitoring with a 6 minute tipping bucket located within the catchment
- In-pipe flow monitoring at five locations
- In-pipe automated sampling at one location during storm events for water quality testing
- In-pipe continuous sampling for turbidity, pH, temperature and conductivity at five locations within the catchment.

2. Methodology

2.1 Rainfall gauge, flow monitoring and continuous monitoring

A rainfall gauge was installed for the project at a BP service station located at 267 Mt Smart Road. The gauge is a tipping bucket with a tipping bucket size of 0.2 mm.

In-pipe flow monitoring equipment was installed at 5 locations within the catchment. “In-pipe” flow monitoring equipment is set to record depth, velocity and surcharge depth at 5 minute sampling interval. Continuous turbidity, salinity and pH monitoring equipment were also installed at the same locations.

The locations of the equipment are provided in Table 1 below. Locations are shown in Figure 1

Table 1 In-pipe monitoring

Catchment	Site description	Installation date	Pipe dia.
3	Opposite 36 Galway Street	28/04/2016	600
4	Corner of Princess Street & Victoria Street (next to railway lines)	28/04/2016	1240
6	124 Captain Springs Road	13/05/2016	1000
7	9 Angle Street	28/04/2016	1240
9A	Opposite 322 Neilson Street	13/05/2016	1200

2.2 Grab samples

2.2.1 Outfalls

Stormwater sampling has focussed on the catchments that discharge to the Mangere inlet, as it was considered that project offered an opportunity improve stormwater quality entering into the Mangere inlet. Samples were collected

The stormwater sampling investigation comprised:

- Samples were taken from stormwater outfalls along the Onehunga foreshore over a variety of flow conditions using grab sampling techniques;
- Measurement of field parameters during grab sampling, including pH, electrical conductivity, turbidity, REDOX, temperature, and salinity;
- Visual indicators of contamination (e.g. hydrocarbon sheens, discolouration) and notable features were recorded;
- Stormwater samples were chilled and dispatched under chain of custody to Eurofins Laboratories for analysis;
- Analytical testing of selected samples for metals, nutrients, major ions, total petroleum hydrocarbons (TPH), semi volatile organic compounds (SVOC), volatile organic compounds (VOC), benzene, toluene, ethylbenzene, and xylenes (BTEX), monocyclic aromatic hydrocarbons (MAH), polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCP), and phenols.
- The analytical testing suite was reduced after the first two rounds found that none of the organic compounds were being detected.
- Collation of stormwater analytical results and comparisons with other Auckland data.

Analytical results tables are included in Attachment 2 this Appendix.

A summary of samples collected is provided in Table 2 below. Sampling locations are shown on Figure 1.

2.2.2 Streams

The stream assessments included the investigation of water quality from the following locations:

- Miami Stream – essentially an open stormwater drain
- Southdown Stream
- Anns Creek

The surface water assessments included:

- Collection of surface water samples over a number of sampling events
- Measurement of field parameters during grab sampling, including pH, electrical conductivity, turbidity, REDOX, temperature and salinity
- Analytical testing of stormwater samples for total and dissolved metals, petroleum hydrocarbons, semi-volatile organic compounds (selected samples only), nutrients, cations and anions (selected samples only)

2.2.3 Seeps

Samples were also collected from water found to be seeping from the rock revetment wall along the foreshore. The following locations were sampled:

- Catchment 3 Spring: Appears to be a seawater/groundwater mix seeping out of the revetment during low tide. The laboratory analysis shows the presence of heavy metals, high TSS, and faecal coliform. Due to the established channel it appears that the seep is consistently present and flowing at a reasonable rate.

- Catchment 10 Seep: Appears to be a leachate/groundwater mix seeping out of the revetment at the location of Catchment 10 Outfall. The seep is coming out from around the concrete outfall pipe and has extensive orange staining associated with it. High ammonia results suggest the seep contains landfill leachate. The seep had a very low rate of flow.

- Catchment 11 Spring: Appears to be a groundwater seep with high TSS and minor heavy metal contamination. Extensive orange staining around the seep, however analytical results do not show the presence of significant levels of ammonia as would be expected if landfill leachate was present.

A summary of the grab sampling program is provided in Table 2 below.

Table 2 - Grab sampling summary

Type	Location	Date	Analytes
Outfall pipe	Catchment 3	15/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		11/05/2016	Metals (As, Ba, Cu, Zn), TSS, major ions, E.coli, coliforms
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 4	15/03/2016	Metals, Nutrients, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/04/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH
		11/05/2016	Metals (As, Ba, Cu, Zn), TSS, major ions, E.coli, coliforms
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 5	15/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH

		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 6	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 6A	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
	Catchment 7	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		11/05/2016	Metals (As, Ba, Cu, Zn), TSS, major ions, E.coli, coliforms
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 8	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		18/05/2016	Metals, TPH/BTEX, TSS, ammonia
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 9	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		11/05/2016	Metals (As, Ba, Cu, Zn), TSS, major ions, E.coli, coliforms
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 9A	1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		11/05/2016	Metals (As, Ba, Cu, Zn), TSS, major ions, E.coli, coliforms
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 10	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 11	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 11A	13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
Seep	Catchment 3 Spring/seep	15/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		1/04/2016	Metals, Nutrients, Major Ions, Alkalinity, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Catchment 10 Seep	12/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions

	Catchment 11 Spring	12/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
Stream	Anns Creek Lower	12/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Anns Creek Upper	12/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Southdown Stream	17/03/2016	Metals, Nutrients, Major Ions, OCP, Phenols, SVOC/VOC, TPH, PAH, BTEX & MAH
		13/07/2016	Metals, TPH, BTEX, TSS, nutrients, major ions
	Miami Stream Lower	11/05/2016	TPH/BTEX
		12/07/2016	Metals, TPH/BTEX, nutrients, major ions
	Miami Stream Upper	12/07/2016	Metals, TPH/BTEX, nutrients, major ions

2.3 Manual event sampling

One round of event-based grab sampling was undertaken to complement the baseline stormwater sampling. The aim was to target the water discharging from the outfall during a rain event. The stormwater outfall event sampling investigation comprised:

- Stormwater samples were collected from the Catchment 9A outfall on the Onehunga foreshore at regular intervals (4 to 20 minutes) from the start of a rainfall event;
- Measurement of field parameters during grab sampling, including pH, electrical conductivity, turbidity, REDOX, temperature, and salinity;
- Visual indicators of contamination (e.g. hydrocarbon sheens, discolouration) and notable features were recorded;
- Stormwater samples were chilled and dispatched under a standard chain of custody to Eurofins Laboratories for analysis;
- Analytical testing of samples for metals, total suspended solids, nutrients and total petroleum hydrocarbons (TPH);

Analytical results tables are included in Attachment 2.

2.4 Automated event sampling

Catchment 9A was selected for the automated sampling as it was the largest catchment, and included various land uses that were representative of the wider catchments. The device was placed up hydraulic gradient of tidal influence within the stormwater system.

- The automated sampler comprised 12 bottles set to fill at one bottle per 10 minute interval.
- Sampling is triggered by a rainfall event, when the depth of water in the pipe reached 270 mm.
- Samples were collected manually and dispatched under a standard chain of custody to Eurofins Laboratories for analysis;
- Analytical testing of samples for total suspended solids (TSS), E.coli, faecal coliforms, total and dissolved metals;

It is noted that Auckland City stormwater proprietary product testing protocol nominates 5mm as a definition of an event. The rationale was that the trigger depth should be a sufficient increase in water depth to be representative of runoff due to storm events. However, as can be seen in Table 3 below, when compared with rainfall data, the sampling events were not necessarily representative of a storm event. This means this data may not be representative of rainfall runoff and may be more representative of baseflow conditions, as such they are referred to as “trigger events”.

A summary of samples collected is provided in Table 3 below. Sampling locations are shown on Figure 1 in Attachment 1, and analytical results are provided in Attachment 2.

Table 3 Event based sampling summary

Type	Date	Sampling time	Number of samples collected	Event Rainfall (12hr period & including sampling (mm)	Dry period	Mangere rainfall data (mm)
Catchment 9A outfall – manual grab samples	18 May 2016	13:31 – 14:35	10	2.2 (between 01:30 and 14:35)	No dry period (previous rain at 13:00).	7.37 (between 13:15 and 13:55)
Catchment 9A in-pipe automated sampler	9-10 June 2016	18:25 – 19:05 and	4	2.4 (between 06:20 and 19:05)	No dry period (previous rain at 18:15).	0.33 (between 18:25 and 19:05)
	9-10 June 2016	23:25 – 00:45	8	4.6 (between 11:25 and 00:45)	No dry period (previous rain at 23:15).	0.62 (between 23:25 and 00:45)
	12 June 2016	17:25 – 17:55	4	1.6 (between 05:35 and 17:55)	Previous rain (0.2) at 06:15 on 11/06.	0.04 (between 17:25 and 17:55)
	22 June 2016	03:15 – 07:00	10	6.2(between 15:10 and 07:00)	Previous rain (0.2) at 01:25 on 21/06.	3.4 (between 03:15 and 06:40)
	8 July 2016	15:25 – 17:20	12	1.34* (between 03:20 and 17:20)	Previous rain (1.24) between 08:25-08:45 on 08/07.	1.34
	13 July 2016	18:35 – 22:30	12	4.05* (between 06:30 and 18:30)	Previous rain (1.24) between 08:25-08:45 on 08/07.	4.05
	19 July 2016	19:10 – 21:25	12	4.17* (between 07:05 and 19:05)	Previous rain (0.39) at 05:35 on 19/07.	4.17

- * = Mangere rainfall data used as Onehunga rainfall data not available.

As data from the project rain gauge is pending for samples collected on 8, 13 & 19 July, we referred to Mangere rainfall data from NIWA.

3. Investigation Results

3.1 Results of rainfall gauge and flow monitoring

3.1.1 Rainfall

At the time of reporting, the site specific rain gauge had been installed and had been recording rainfall data for the period of 29 April to 8 July. In this period, a total of 301.6 mm of rain was recorded.

3.1.2 Flow monitoring

The flow data for the period of 29 April to 8 July is summarised in graphs with rainfall data in Attachment 3.

3.2 Results of grab samples

3.2.1 Stormwater field quality parameters

A summary of the water quality parameters measured in the field during the sampling events are summarised in the results summary table in Attachment 2.

The following observations were made with respect to field parameters recorded:

- Electrical Conductivity (EC) - EC readings ranged from 199 µS/cm at Catchment 6A outfall to 113,000 µS/cm at a seep within Catchment 3 indicating a range of fresh to saline stormwater conditions. The seep location appeared to be seawater or seawater/groundwater mix seeping out of the revetment during low tide.
- pH readings ranged from 5.7 to 9.6.

3.2.2 Stormwater analytical results

The tabulated results for all grab samples collected are presented in Attachment 2 at the end of this appendix.

A summary of the mean concentrations of the main contaminants of concern (copper, lead, zinc, TSS and ammonia) is provided in

Table 4. The mean is the average of the results collected from each sampling location, which include data from between 2 – 4 sampling rounds. Samples were collected randomly as a snapshot of the quality of stormwater discharging into the inlet (not targeting storm events). .

Table 4 Mean baseflow concentrations (mg/L)

Type	Location	Copper		Lead		Zinc		TSS		Ammonia	
		Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Outfall	Catchment 3	0.003	0.002	0.001	0	0.036	0.04	18.5	17.5	1.75	1.87
	Catchment 4	0.038	0.058	0.105	0.145	0.35	0.49	13.66	7.6	2.5	0.5
	Catchment 5	0.001	0	<0.001	0	0.026	0.003	4.5	1.08	0.10	0.03
	Catchment 6	0.004	0.002	0.004	0.0008	0.043	0.011	35	11.43	11.66	2.77
	Catchment 6A	0.007	0.003	0.007	0.005	0.046	0.032	1012	988	17.66	17.34
	Catchment 7	0.16	0.11	0.001	0.0004	0.19	0.11	16.5	12.6	1.99	1.46
	Catchment 8	0.016	0.012	0.019	0.02	0.18	0.09	563.1	542.6	14	2.16
	Catchment 9	0.01	0.003	0.001	0.0005	0.13	0.03	23.9	27.2	1.43	0.85
	Catchment 9A	0.066	0.1	0.274	0.38	0.48	0.64	105	119	1.39	0.49
	Catchment 10	0.01	0.001	0.0078	0.0022	0.18	0.018	67.5	12.5	12.15	0.15
	Catchment 11	0.005	0.0008	0.002	0.002	0.092	0.02	26.3	5.2	0.56	0.58
	Catchment 11A	<0.001	*	<0.001	*	0.007	*	2.1	*	4.9	*
Seep	Catchment 3 Spring/seep	0.06	0.055	0.05	0.06	0.25	0.244	3074	4332	0.156	0.1
	Catchment 10 Seep	0.002	*	<0.001	*	0.009	*	80	*	12	*
	Catchment 11 Spring	0.008	*	0.021	*	0.077	*	2100	*	0.64	*
Stream	Anns Creek Lower	0.002	*	<0.001	*	0.019	*	10	*	0.27	*
	Anns Creek Upper	0.003	*	<0.001	*	0.031	*	5	*	0.14	*
	Southdown Stream	0.003	0	<0.001	0	0.022	0.001	11	7	0.1	0
	Miami Stream Lower	0.37	*	0.003	*	0.16	*	11	*	3.4	*
	Miami Stream Upper	0.97	*	<0.001	*	0.19	*	4.8	*	4.2	*

NOTE: mean = average
*NA as only 1 sample collected

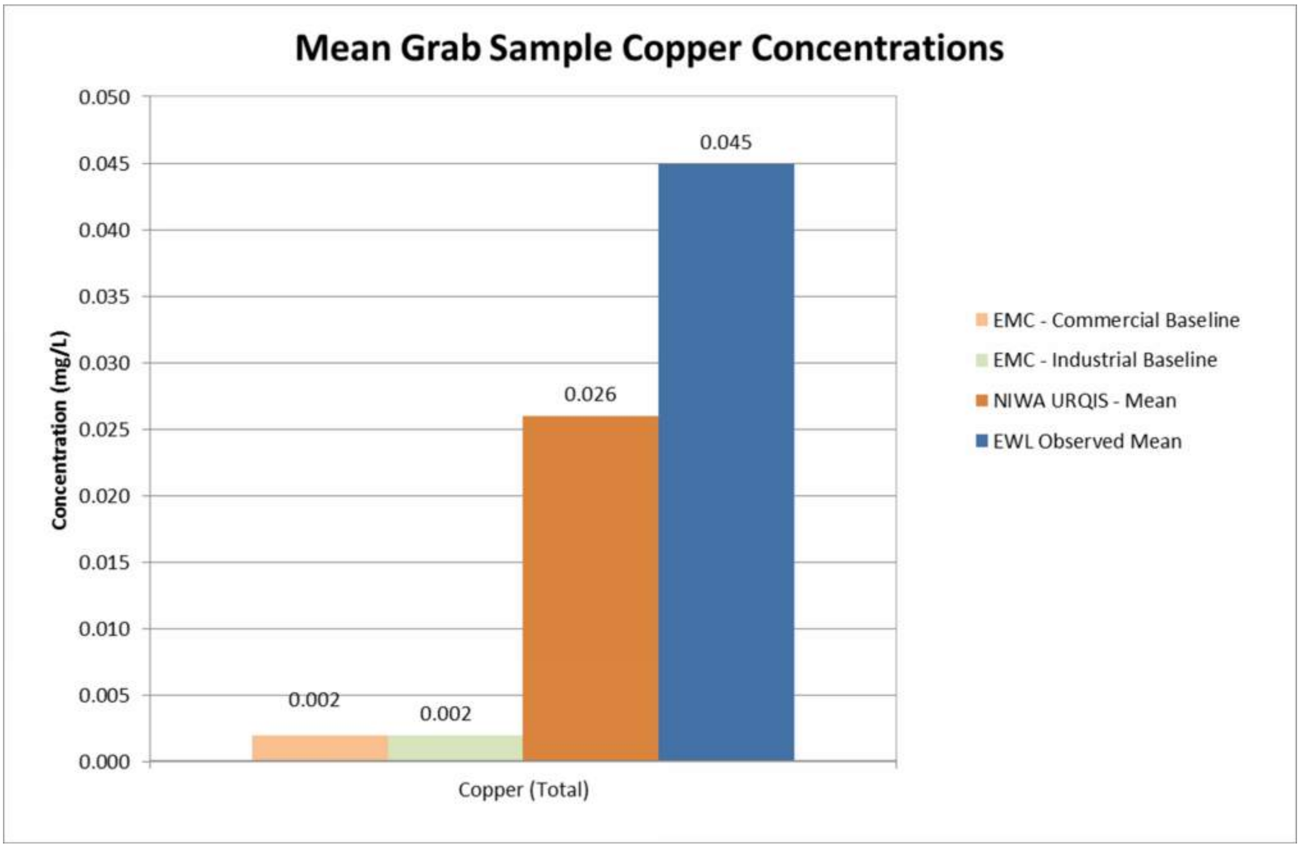
3.2.3 Comparison to other Auckland catchments:

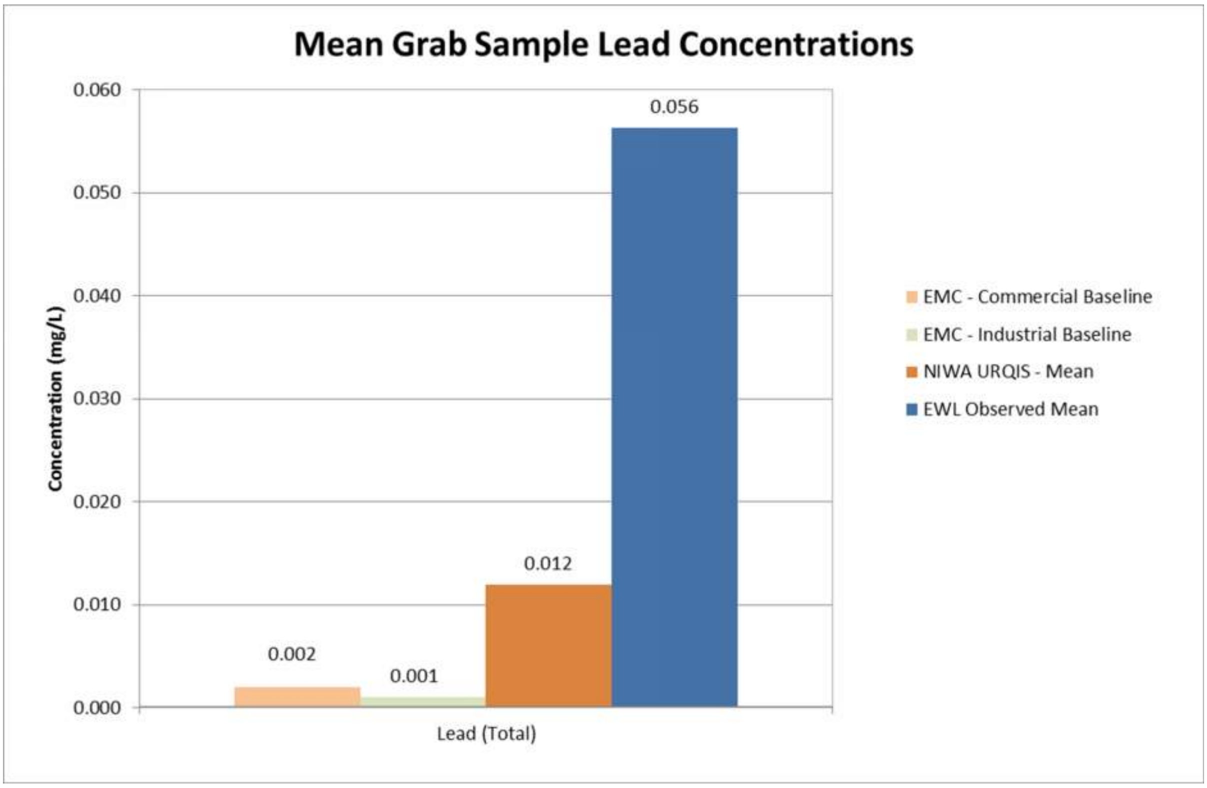
In order to assess the stormwater quality data, comparisons were made to stormwater quality data for the Auckland region. The data for comparison was sourced from:

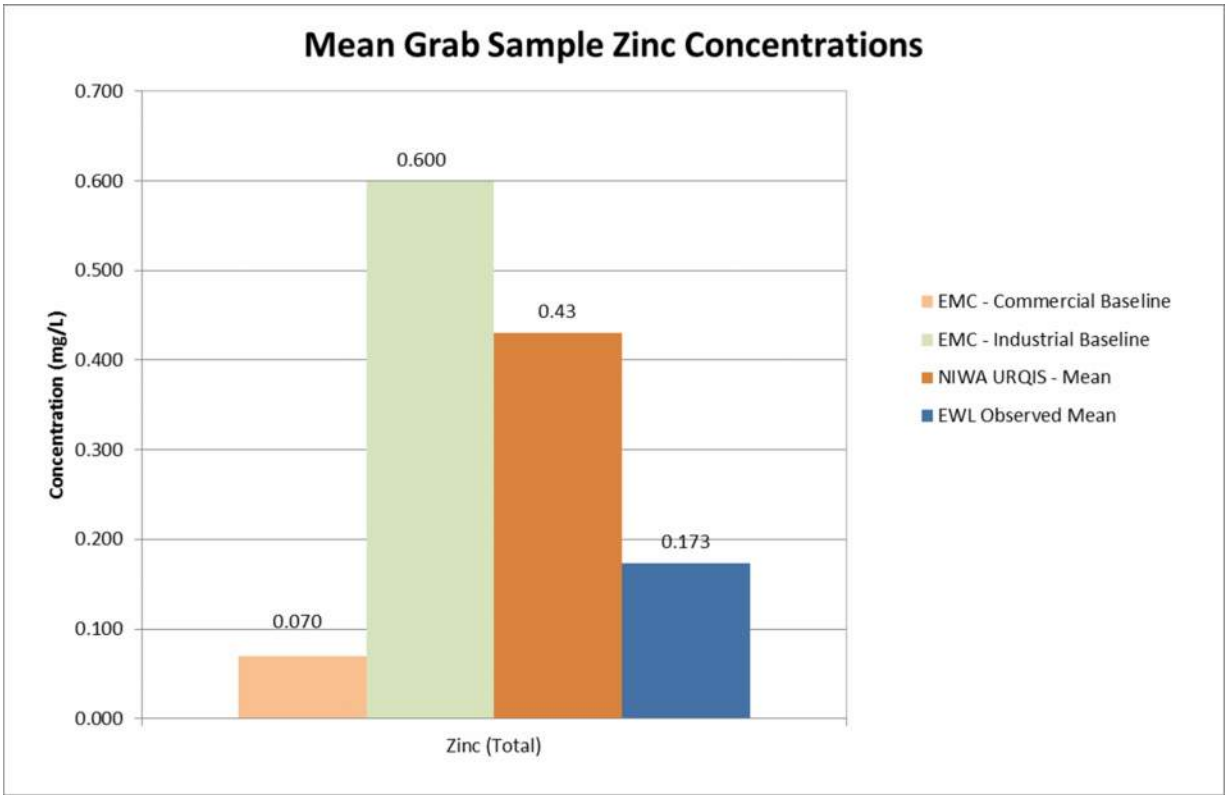
- National Institute of Water & Atmospheric Research Ltd, 2005. Auckland City Stormwater - A summary of NIWA and other relevant studies, Auckland: Report prepared for Metrowater Limited.
- National Institute of Water & Atmospheric Research Ltd, 2015. Urban Runoff Quality Information System. [Online]. Available at: http://urqis.niwa.co.nz/ (NIWA URQIS data referred to in graphs below)
- Lierop, R. v., Edmonds, H. & Cheetham, R., 2004. Medium Level Options Analysis ICS Area 4: Onehunga - Integrated Catchment Study Stage 3A-1, Auckland: Auckland City Council. (EMC Commercial and Industrial baseline data referred to in graphs below)

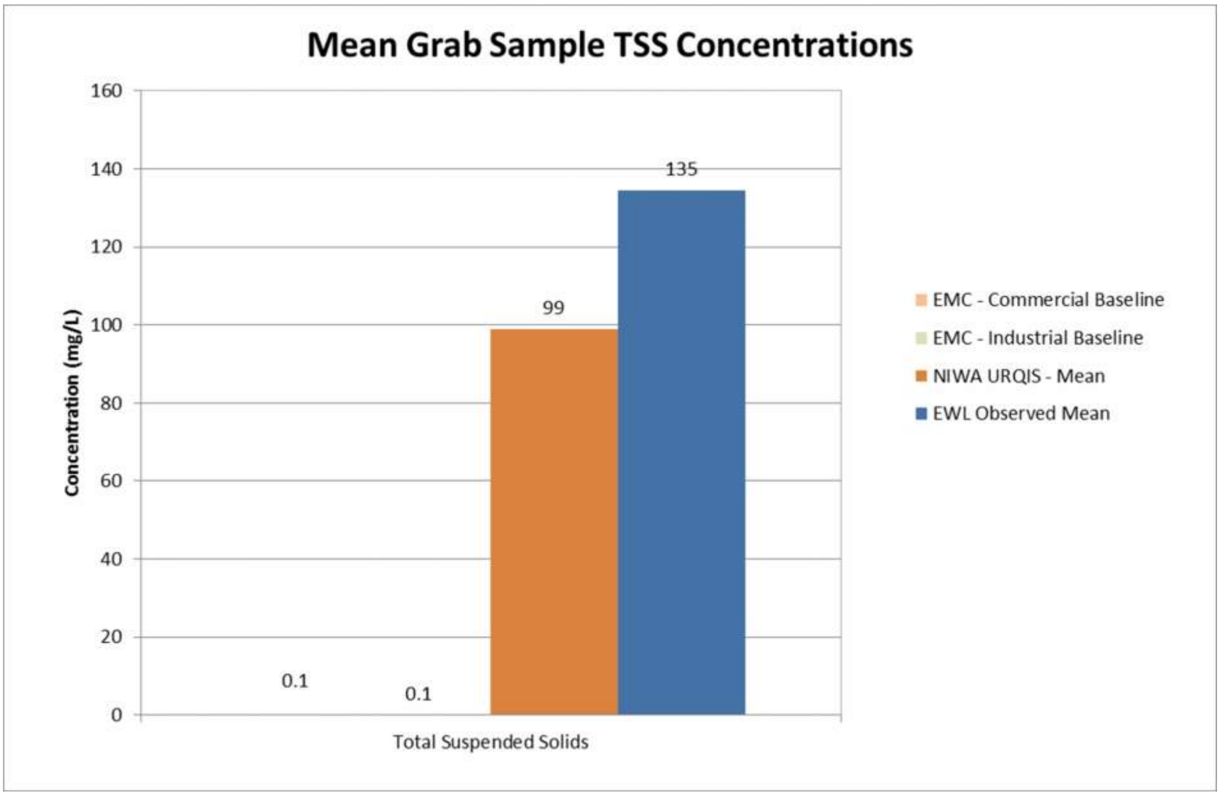
The graphs below show the mean concentrations observed during baseflow grab sampling (EWL Observed Mean) against the Auckland region data listed above. The EWL monitoring data comprised up to four rounds of samples collected from outfalls along the foreshore in baseflow conditions. Seeps have been excluded from this data.

Figures 3.1 – 3.4: Mean grab sample (stormwater base flow) concentrations of selected contaminants




Mean Grab Sample Lead Concentrations
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Concentration (mg/L)
0.056
0.012
0.002
0.001
Lead (Total)
EMC - Commercial Baseline
EMC - Industrial Baseline
NIWA URQIS - Mean
EWL Observed Mean


Mean Grab Sample Zinc Concentrations
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Concentration (mg/L)
0.600
0.43
0.173
0.070
Zinc (Total)
EMC - Commercial Baseline
EMC - Industrial Baseline
NIWA URQIS - Mean
EWL Observed Mean



The graphs above show selected parameters for stormwater base flow data collected for the EWL project, compared to mean concentrations for other stormwater data sets for the Auckland region[1,2,3.]

Copper and lead concentrations measured in stormwater were slightly higher than with the Auckland average, with zinc concentrations slightly lower. TSS is significantly higher than the Auckland averages.

3.2.4 Discussion of results

The grab sample stormwater investigations have shown stormwater quality to be variable across the Onehunga catchment outfalls, but overall water quality was generally poorer than stormwater results from the wider Auckland region.

Organics

The results of the stormwater quality testing found that concentrations of organic contaminants[4] were generally not detected above laboratory trace analytical detection limits. Total petroleum hydrocarbons (TPH) were detected in Catchment 4 and Catchment 8.

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[1] National Institute of Water & Atmospheric Research Ltd, 2005 Auckland city 50th percentile -

[2] National Institute of Water & Atmospheric Research Ltd, 2015 NIWA URQIS – Values downloaded for land uses: commercial, heavy industrial, light industrial and roads 5000->20,000 vehicles. Region: Auckland. All water types and flow conditions - National Institute of Water & Atmospheric Research Ltd, 2015

[3] Metro Water Ltd & Auckland City Council, 2004 Event Mean Concentration Values adopted for commercial and industrial land uses in baseline and wet weather -

[4] Such as organochlorine pesticides, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, and semi-volatile organic compounds.

Given that organic contaminants were not found in the first round of results, the following rounds were analysed for a reduced suite of analytes.

Nutrients

Concentrations of ammoniacal nitrogen were detected in all stormwater grab samples apart from Catchment 3 and Catchment 5, and Southdown Stream and Anns Creek.

Elevated concentrations (>10 mg/L) of up to 35 mg/L ammoniacal nitrogen were measured at Catchments 6, 6A, 8 and 10. These outfalls are located at the base of the Pikes Point landfill. Given the landfills in the catchment area, and the findings of the groundwater investigations which found elevated ammonia, (refer to Technical Report 13) the ammonia is considered to be representative of leachate interaction with stormwater. However the ammonia could also be related to the potential wastewater interaction as there were also high levels of E.coli and faecal coliforms in these locations.

Inorganics

Results of metals were considered to be typical of stormwater, with copper, zinc and lead detected in almost all outfalls and streams.

Catchment 3, 4 and 8 and Southdown stream also had concentrations of chromium detected, and cadmium (up to 0.027 mg/L) was detected at the Miami Stream, which may be related to legacy contamination from the 'Green Stream' pollution incident (refer to Technical report 17 for further information).

Total suspended solids

Some extremely high levels of TSS were observed in samples collected from water seeping in to the inlet (up to 9200 mg/L). Whilst this is not stormwater from pipes, it represents some other sources of water that are currently being drained into the inlet and would be captured by the proposed wetlands. Outfalls also recorded high TSS results of 1300 mg/L (Catchment 8 outfall) and 2000 mg/L (Catchment 6A outfall), also potentially representing discharges entering the stormwater system.

Microbiological

Faecal coliforms and E.coli were detected in most of the samples that were tested, mostly above the criteria (below) provided in the ANZECC[5] for primary and secondary contact recreation. Some outfall locations were exhibiting extremely high (>10,000,000 MPN/100 ml) faecal coliform concentrations, on occasion during base flow conditions. Results and the locations are shown on Figure 2 in Attachment 1. . The results are considered to be potentially indicative of sewage or wastewater cross connection. Whilst no guideline criteria are provided for the receiving environment for the protection of ecosystems, the ANZECC specifies the following with regards to human health risk:

Primary contact (swimming, bathing and other direct water-contact sports): The median bacterial content in fresh and marine waters taken over the bathing season should not exceed 150 faecal coliform organisms/100 mL or 35 enterococci organisms/100 mL.

Secondary contact (boating and fishing): The median value in fresh and marine waters should not exceed 1000 faecal coliform organisms/100 mL or 230 enterococci organisms/100 mL

[5] Australian and New Zealand Environmental Conservation Council (ANZECC), Australian Guidelines for Fresh and Marine Waters, 2000 guidelines (ANZECC 2000).

3.2.1 Interaction with groundwater and leachate

As part of the conceptual site model for the overall project, it is considered that there are some interactions between groundwater, leachate and surface water. Some groundwater springs have been fed into the reticulated stormwater system, and some stormwater pipes are known to be damaged and hence could be receiving groundwater and / or leachate. It was considered that water collected as ‘grab’ samples from outfalls would contain a mixture of stormwater, leachate, groundwater. This is also supported by the fact that the outfalls were observed to have a ‘baseflow’, i.e. water flowing during periods of no rain, suggesting it’s not only direct stormwater run-off from the catchment.

Piper plots were prepared using the cation/anion analytical data collected from the groundwater wells and stormwater outfalls sampled. The stormwater outfalls plot with comparatively high sodium and chloride suggesting saline influence. The chloride and sodium shows a slight decreasing trend away from the shoreline and the landfills. Piper Plots presenting data from catchments 4, 6 and 8 respectively are provided in Attachment 3.

3.3 Results of event sampling

3.3.1 Grab/manual

A manual grab sample was collected during a rain event from the outfall of Catchment 9A. Figure 3.2 below shows copper, lead, zinc and TSS concentrations in storm flow scenario compared to mean wet weather stormwater concentrations for other monitoring programmes in commercial and industrial areas in the Auckland region[6.] Copper and lead are observed to be slightly elevated above the Auckland mean, with zinc at the mean and total suspended solids an order of magnitude greater.

3.3.2 Auto-sampler

The results of the sampling are presented in the graphs in Attachment 3. The first two rounds have also been plotted with rainfall and water depth in the pipe (calculated from flow over the impervious area of the catchment). (rainfall and flow data pending for the remaining samples).

The graphs below show the mean concentrations of contaminants during the manual and automatic ‘event’ sampling against other Auckland data.

The “EWL Mean Grab Sample Wet Weather Event – Catchment 9A” represents data from one event (18th May 2016), which comprised 10 individual samples collected over a period of approximately 1 hr, from the outfall pipe.

The “EWL Mean Auto Sampler – Catchment 9A” represents all data collected from the in-pipe auto-sampler. As some of these trigger events did not correspond to storm events, the data is referred to as “trigger events” and comprises somewhat lower concentrations, and a higher number of samples make up the mean (62 individual samples analysed).

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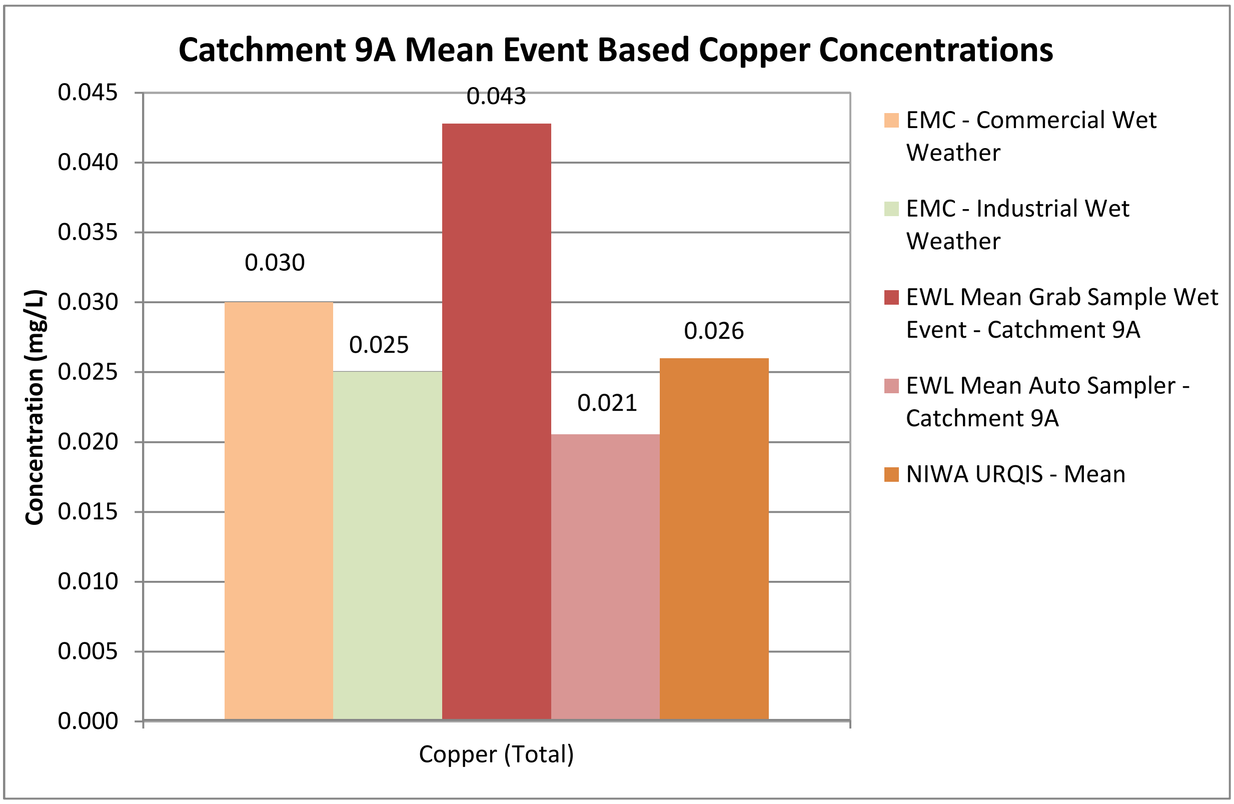
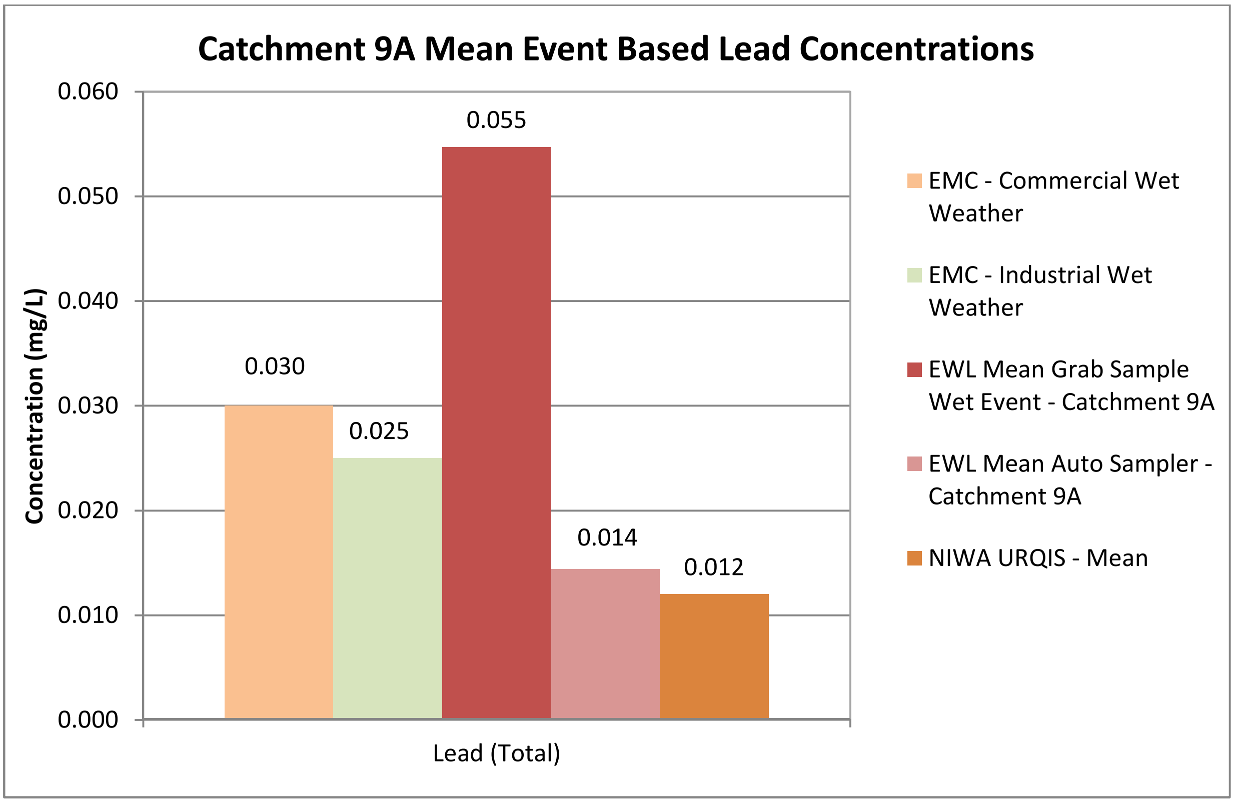
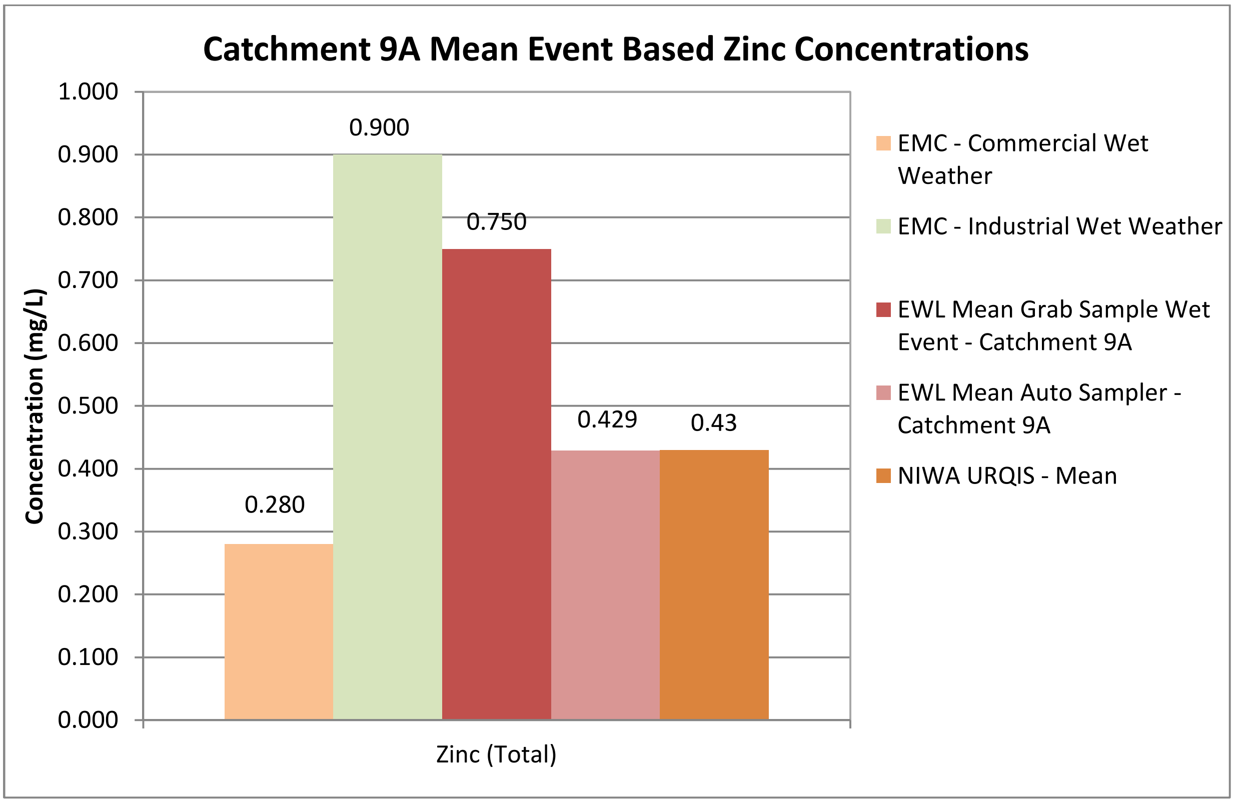
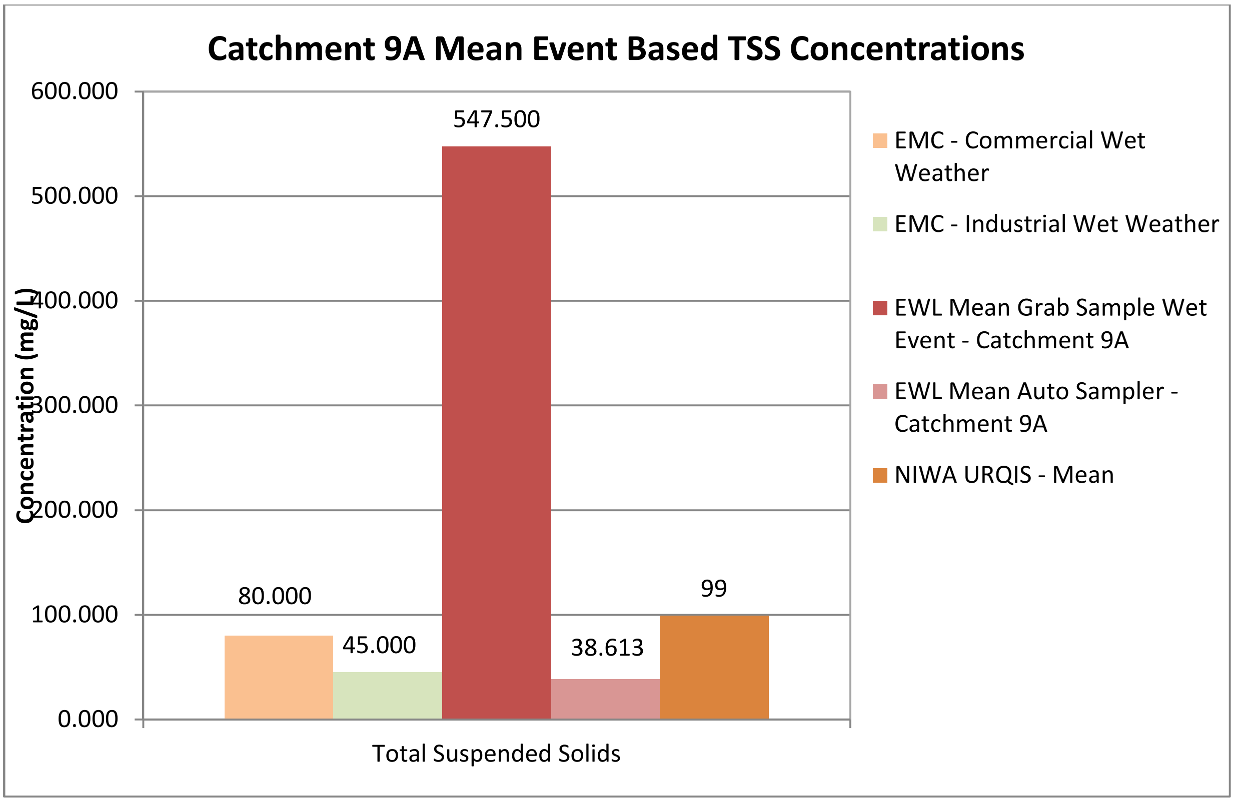
[6] Metro Water Ltd & Auckland City Council, 2004. Event Mean Concentration Values adopted for commercial and industrial land uses in baseline and wet weather -

Figure 3.2: Catchment 9A Trigger events mean concentrations






Catchment 9A Mean Event Based Zinc Concentrations
Concentration (mg/L)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.280
0.900
0.750
0.429
0.43
Zinc (Total)
EMC - Commercial Wet Weather
EMC - Industrial Wet Weather
EWL Mean Grab Sample Wet Event - Catchment 9A
EWL Mean Auto Sampler - Catchment 9A
NIWA URQIS - Mean


Catchment 9A Mean Event Based TSS Concentrations
Concentration (mg/L)
600.000
500.000
400.000
300.000
200.000
100.000
0.000
80.000
45.000
547.500
38.613
99
Total Suspended Solids
EMC - Commercial Wet Weather
EMC - Industrial Wet Weather
EWL Mean Grab Sample Wet Event - Catchment 9A
EWL Mean Auto Sampler - Catchment 9A
NIWA URQIS - Mean

3.4 Results of continuous monitoring

Conductivity, turbidity, temperature and pH were recorded at 5 minute intervals at 5 locations (in the same locations as the flow monitors). The range of recorded parameters is summarised below.

The data shows that the water quality parameters are highly variable. The fluctuations of pH and other parameters may be indicative of cross connections with wastewater and/or waste discharges into the stormwater network.

Table 5 Continuous water quality monitoring summary

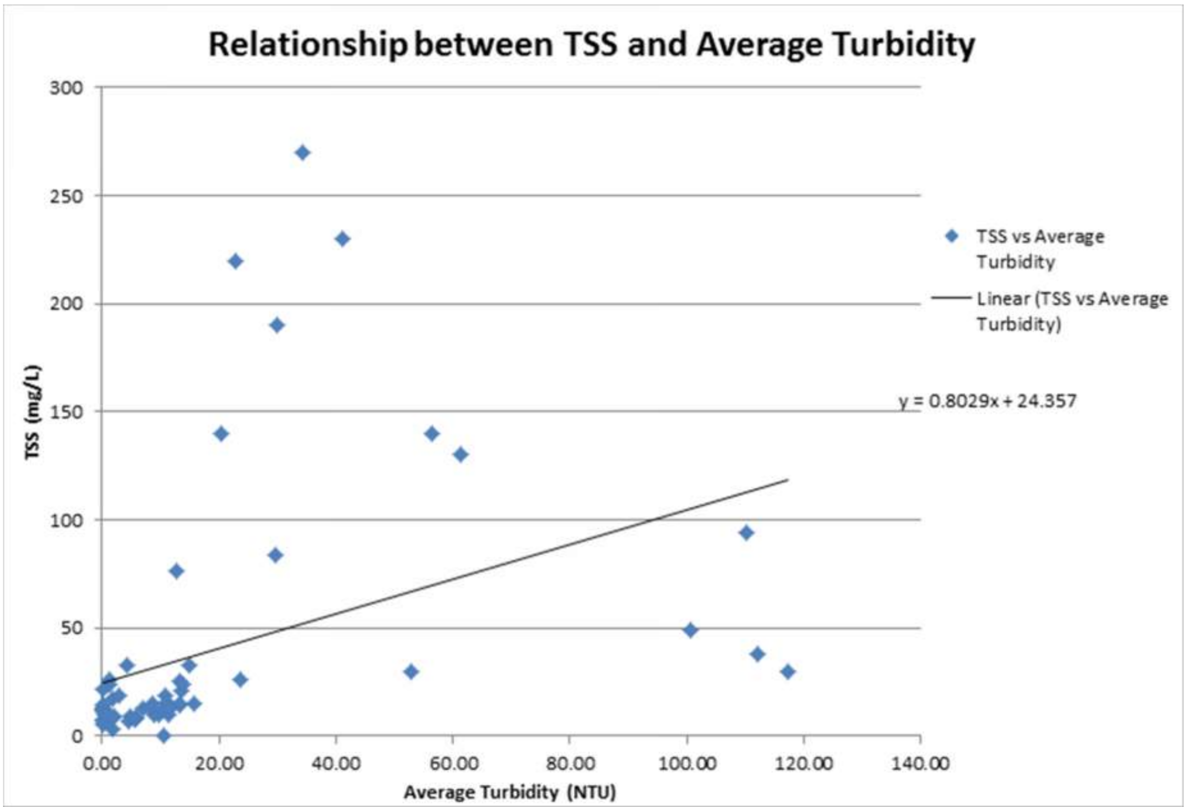
Parameter	Catchment				
	#3	#4	#6	#7	#9
pH range	5.98 – 9.74	4.45 – 9.66	5.29 – 7.01	1.56 – 11.88	5.05-9.16
pH mean	7.1	7.18	6.08	7.52	6.66
Conductivity range (μS/cm)	5.00 – 737.60	7.20 – 904.50	23.40 – 1911	27.2 - 28965	10.04-1615.34
Conductivity mean (μS/cm)	210.63	256.88	317.06	507	180
Temp range (deg C)	5.07 – 16.50	5.88 – 17.71	6.27 – 19.31	5.50 – 18.79	7.36 – 21.58
Temperature mean (deg C)	14.86	16.67	18.09	17.03	17.29
Turbidity range (NTU)	0 – 3205.18	0 – 2303.69	0 – 2976.57	0 – 4096.53	0 – 343.4
Turbidity mean (NTU)	29.45	168.07	4.25	209.34	7.3

*some outliers have been removed from the data set

3.4.1 TSS and turbidity relationship

The continual turbidity monitoring presented an opportunity to relate the turbidity results to the laboratory measured TSS, and attempt to find a relationship. It was considered a relationship may then be used to calculate the predicted TSS loads based on turbidity monitoring data over a longer period of time. The continual turbidity and laboratory TSS concentrations at Catchment 9A are plotted below, however there are not considered to be sufficient data or trends to represent a reliable relation between turbidity and TSS using these data. As the turbidity was recorded at 5 min intervals and the TSS was analysed when sampled every 10 minutes, the average of the turbidity readings during that time was used.

Figure 3 TSS and turbidity



3.5 Chemical Spill Events

Due to the industrialised nature of the catchments, it is considered that accidental discharges may also occur and any spills or illegal discharges to stormwater currently discharge into the Inlet.

Auckland Council[7] provided details of recorded spills in the Mangere and Onehunga area. However, the council's record is not a complete list of spills as it typically requires a member of the public or the spill originator to notify the Council's Pollution Response team. Recorded spills included paint and oil spills and wastewater entering stormwater drains.

During field investigations for the project, a member of the public (who wished to remain anonymous) provided photographs of release of a red chemical that they had observed entering the Mangere Inlet from a stormwater outlet located east of the Miami Stream outfall. Images of the spill are shown on Figure 3.

During stormwater sampling from the outfalls, there were visual indicators of pollution flowing from the stormwater outfalls into the Mangere inlet. Photographs are provided in Figure 3, representing potential hydrocarbon, sewerage and leachate contamination entering Mangere Inlet.

It should be noted that petroleum hydrocarbons exhibit very low water solubilities and as such, rainbow hydrocarbon sheening (as observed at catchment 7 sampling location) may be associated with

[7] P Viskovich, Auckland council 2016, pers. comm., 13 May.

relatively low water concentrations. In this case this was confirmed by analytical testing of the water sample that yielded relatively low concentrations of hydrocarbon with a diesel chromatogram profile.

It is therefore considered a potential benefit for the area that the proposed stormwater treatment system (wetlands) will capture any inadvertent spills and will provide a separation from the Mangere inlet.

3.6 Summary and conclusions on stormwater quality

The sampling undertake for the project is from a limited timeframe and provides a snapshot of expected stormwater quality.

In summary, the primary contaminants of concern that were identified in stormwater include:

- Zinc
- Copper
- Lead
- TSS
- Faecal coliforms / E. coli
- Ammoniacal N

This is consistent with other studies of stormwater within the Auckland region, for both industrialised and residential catchments8. ·The collected data suggest there are significant contaminants carried by stormwater that reach the Inlet – similar or higher concentrations to other stormwater quality noted around Auckland.

A number of outliers were detected during routine baseflow sampling – these suggest high likelihood of cross connections with sewer/ illegal dumping/ spills. This is also supported by anecdotal evidence (refer to Section 3.5).

Some extremely high levels of TSS were observed in samples collected from water seeping in to the inlet (up to 9200 mg/L). Whilst this is not stormwater from pipes, it represents some other sources of water that are currently being drained into the inlet and would be captured by the proposed wetlands. Outfalls also recorded high TSS results of 1300 mg/L (Catchment 8 outfall) and 2000 mg/L (Catchment 6A outfall), also potentially representing discharges entering the stormwater system.

In addition to the typical stormwater contaminants (copper, lead, zinc and suspended solids), elevated concentrations of ammonia and faecal coliforms were discovered in the sampling program.

The source of the faecal coliforms / E. Coli could be sewer cross connection, illegal connections, sewer leakage into stormwater system, other sources of faecal matter in the catchment (e.g. animal / bird faeces). The presence of these microbiological indicators suggests that the water discharging into the Mangere Inlet is a potential risk to human receptors through primary or secondary contact recreation.

Ammonia is also present in the stormwater indicating the potential interaction with leachate from the landfills.

The quality of the stormwater currently entering the Mangere inlet is potentially detrimental to marine ecosystems, and the microbiological indicators represent a human health risk for recreational use of the inlet.

[8] Griffiths, G. and Timperley, M., 2005. Auckland City Stormwater–a summary of NIWA and other relevant studies. NIWA, Auckland.

Laura Bell
Senior Environmental Scientist

Wijnand Udema
Contaminated Land Lead

Attachment 1 - Figures

Figure 1 - Investigation locations

GIS@beca.com

A	ISSUED FOR INFORMATION ONLY	BAP	Draft	Draft	08/08/16
No	Issued Status	Drawn	Check'd	App'd	Date

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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		
Scale: 1:10,000	Original Size: A3	Contract No PA4041	

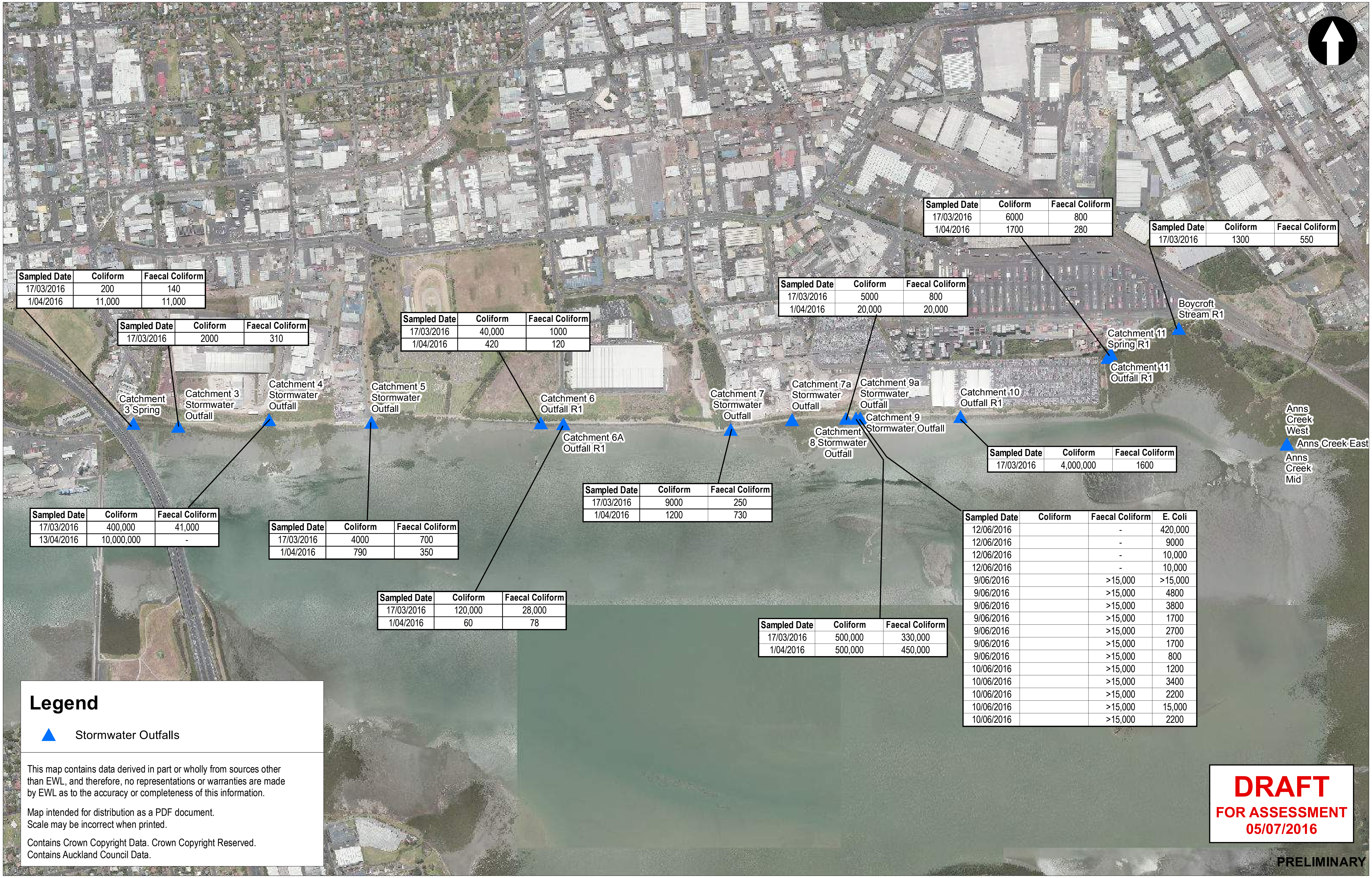
Drawing Title: WATER QUALITY
Stormwater Sampling Locations

Drawing Number: GIS-AEE-WQ-001

Rev No. A

Plot Date: 12/08/2016 Plotted by: Ben Peyton File: \\192.168.100.9\Data\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Water Quality (WQ)\DRAFTS\GIS-WQ-AEE-001_StormwaterSamplingLocations.mxd

Figure 2 – Coliform results



Sampled Date	Coliform	Faecal Coliform
17/03/2016	200	140
1/04/2016	11,000	11,000

Sampled Date	Coliform	Faecal Coliform
17/03/2016	2000	310

Sampled Date	Coliform	Faecal Coliform
17/03/2016	400,000	41,000
13/04/2016	10,000,000	-

Sampled Date	Coliform	Faecal Coliform
17/03/2016	4000	700
1/04/2016	790	350

Sampled Date	Coliform	Faecal Coliform
17/03/2016	40,000	1000
1/04/2016	420	120

Sampled Date	Coliform	Faecal Coliform
17/03/2016	120,000	28,000
1/04/2016	60	78

Sampled Date	Coliform	Faecal Coliform
17/03/2016	9000	250
1/04/2016	1200	730

Sampled Date	Coliform	Faecal Coliform
17/03/2016	5000	800
1/04/2016	20,000	20,000

Sampled Date	Coliform	Faecal Coliform
17/03/2016	500,000	330,000
1/04/2016	500,000	450,000

Sampled Date	Coliform	Faecal Coliform	E. Coli
12/06/2016		-	420,000
12/06/2016		-	9000
12/06/2016		-	10,000
12/06/2016		-	10,000
9/06/2016		>15,000	>15,000
9/06/2016		>15,000	4800
9/06/2016		>15,000	3800
9/06/2016		>15,000	1700
9/06/2016		>15,000	2700
9/06/2016		>15,000	1700
9/06/2016		>15,000	800
10/06/2016		>15,000	1200
10/06/2016		>15,000	3400
10/06/2016		>15,000	2200
10/06/2016		>15,000	15,000
10/06/2016		>15,000	2200

Sampled Date	Coliform	Faecal Coliform
17/03/2016	4,000,000	1600

Sampled Date	Coliform	Faecal Coliform
17/03/2016	6000	800
1/04/2016	1700	280

Sampled Date	Coliform	Faecal Coliform
17/03/2016	1300	550

Legend

▲ Stormwater Outfalls

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No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	Bap	Draft	Draft	07/05/16

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East West Link

Drawn | Drafting Check | Reviewed Design Manager | Approved Alliance Manager
Designed | Design Check
Scale: 1:10,000 | Original Size: A3 | Contract No PA4041

Drawing Title
ENVIRONMENT
Spills and Seepages along the Onehunga Foreshore

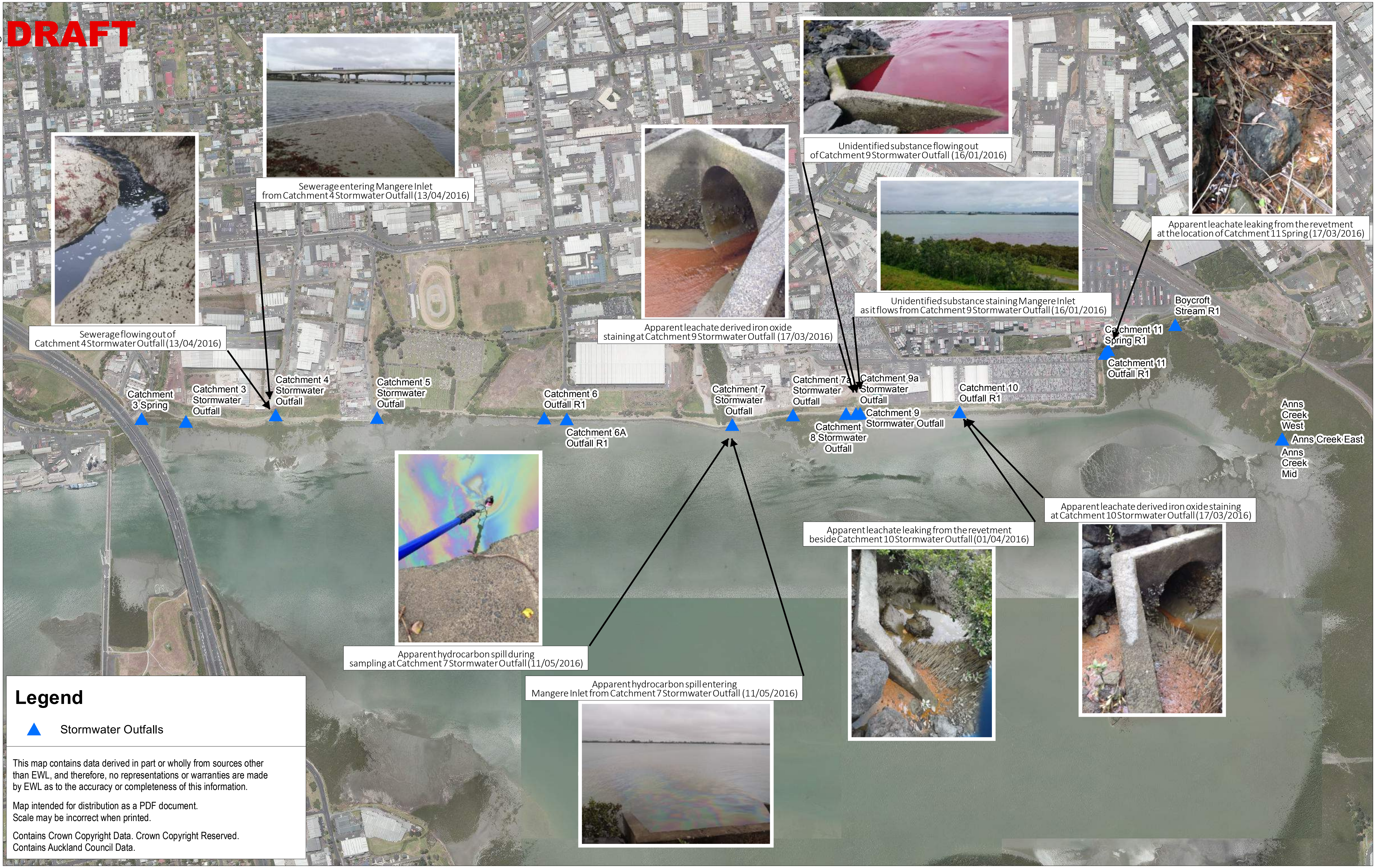
Drawing Number | Rev No. A

Plot Date: 6/07/2016 Plotted by: Ben Peyton File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Stormwater (SW-E)\DRAFTS\GIS-4216210-026_StormwaterOutfalls_Tables.mxd

Figure 3 - Stormwater Outfall Observations

GIS@beca.com

DRAFT



Legend

▲ Stormwater Outfalls

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No	Revision	Drawn	Verified	Approved	Date
A	Original Issue	Draft	Draft	Draft	24/03/15

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WAKA KOTAHI

East West Link

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Designed: | Design Check:
Scale: 1:10,000 | Original Size: A3 | Contract No PA4041

Discipline: Environment
Title: Spills and Seepage along the Onehunga Foreshore
Drawing No: | Rev: A

Plot Date: 31/05/2016 Plotted by: Rod Lockie File: D:\EWC\TGI\55_Workspaces\01_mxd\Environmental\WORKING\GIS-4216210-024_StormwaterOutfalls.mxd

Attachment 2 - Stormwater monitoring results

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_3_Outfall	Catchment_3_Outfall	Catchment_3_Outfall	Catchment_3_Spring	Catchment_3_Spring	Catchment_3_Spring	Catchment_4_Outfall	Catchment_4_Outfall	Catchment_4_Outfall
					Sampled Date	15/03/2016	11/05/2016	13/07/2016	15/03/2016	1/04/2016	13/07/2016	15/03/2016	13/04/2016	11/05/2016
Field	ORP	mV				-17.4	85.5	-	-139.4	-	-	80	-	14.4
	SP Conductivity	µS/cm				-	-	-	-	-	-	-	-	-
	SSG	Units				-	-	-	-	-	-	-	-	-
	Dissolved Oxygen (Field) %	%				41.7	-	-	12	-	-	13.9	-	-
	Dissolved Oxygen (Field) % (Filtered)	%				-	32	-	-	-	-	-	-	12
	Dissolved Oxygen (Field)	mg/L				-	-	-	-	-	-	-	-	-
	Temp (Field)	oC				18	19	-	22.1	-	-	20.6	-	19.4
	pH (Field)	pH_Units				6.71	7	-	6.63	-	-	6.32	-	6.92
	Electrical Conductivity (Field)	uS/cm				1708	27,100	-	113,000	-	-	25,400	-	3291
Metals	Aluminium	mg/L	0.05			-	-	-	-	-	-	-	4.9	-
	Aluminium (Filtered)	mg/L	0.05			0.018	-	-	<0.3	7.1	-	<0.015	-	-
	Antimony	mg/L	0.005			-	-	-	-	-	-	-	0.005	-
	Antimony (Filtered)	mg/L	0.005			<0.0002	-	-	<0.02	<0.005	-	<0.001	-	-
	Arsenic	mg/L	0.001			<0.0011	0.002	<0.001	<0.11	0.044	<0.005	<0.0053	0.018	0.003
	Arsenic (Filtered)	mg/L	0.001			<0.001	-	<0.001	<0.1	0.014	<0.005	<0.005	-	-
	Barium	mg/L	0.02			-	0.19	-	-	-	-	-	0.22	0.1
	Barium (Filtered)	mg/L	0.02			0.021	-	-	0.046	0.05	-	0.082	-	-
	Boron	mg/L	0.05			-	-	-	-	-	-	-	1.7	-
	Boron (Filtered)	mg/L	0.05			0.167	-	-	3.5	4.4	-	0.85	-	-
	Cadmium	mg/L	0.0002	0.014		<0.000053	-	<0.0002	<0.0053	0.0011	<0.001	<0.00027	0.0018	-
	Cadmium (Filtered)	mg/L	0.0002	0.014		<0.00005	-	<0.0002	<0.005	0.0011	<0.001	<0.0003	-	-
	Chromium (III+VI)	mg/L	0.001	0.02		0.00157	-	<0.001	<0.053	0.077	<0.005	<0.0027	0.024	-
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		<0.0005	-	<0.001	<0.05	0.014	<0.001	<0.003	-	-
	Cobalt	mg/L	0.001	0.014		-	-	-	-	-	-	-	0.006	-
	Cobalt (Filtered)	mg/L	0.001	0.014		<0.0002	-	-	<0.02	0.009	-	<0.001	-	-
	Copper	mg/L	0.001	0.003	0.01	0.002	0.006	0.001	<0.053	0.14	<0.005	<0.0027	0.14	0.009
	Copper (Filtered)	mg/L	0.001	0.003	0.01	0.001	-	<0.001	<0.05	0.13	<0.005	<0.003	-	-
	Iron	mg/L	0.05			-	-	-	-	-	-	-	8.4	-
	Iron (Filtered)	mg/L	0.05			0.07	-	-	<2	22	-	0.15	-	-
	Lead	mg/L	0.001	0.0066		0.00018	-	<0.001	<0.011	0.14	<0.005	0.00093	0.31	-
	Lead (Filtered)	mg/L	0.001	0.0066		<0.0001	-	<0.001	<0.01	0.13	<0.005	<0.0005	-	-
	Lithium	mg/L	0.005			-	-	-	-	-	-	-	0.04	-
	Lithium (Filtered)	mg/L	0.005			0.0019	-	-	0.15	0.14	-	0.025	-	-
	Manganese	mg/L	0.005			-	-	-	-	-	-	-	0.56	-
	Manganese (Filtered)	mg/L	0.005			0.0196	-	-	0.37	1.7	-	0.168	-	-
	Mercury	mg/L	0.0001	0.0007		<0.00008	-	<0.0001	<0.00008	-	<0.0005	<0.00008	-	-
	Mercury (Filtered)	mg/L	0.0001	0.0007		-	-	<0.0001	-	-	<0.0005	-	-	-
	Molybdenum	mg/L	0.005			-	-	-	-	-	-	-	0.007	-
	Molybdenum (Filtered)	mg/L	0.005			0.0008	-	-	<0.02	<0.005	-	0.0024	-	-
	Nickel	mg/L	0.001	0.2		0.0031	-	0.002	<0.053	0.034	<0.005	<0.0027	0.023	-
	Nickel (Filtered)	mg/L	0.001	0.2		0.0028	-	0.002	<0.05	0.014	<0.005	<0.003	-	-
	Rubidium (Filtered)	mg/L				0.0063	-	-	0.102	-	-	0.024	-	-
	Selenium	mg/L	0.001			-	-	-	-	-	-	-	0.002	-
	Selenium (Filtered)	mg/L	0.001			<0.001	-	-	<0.1	0.002	-	<0.005	-	-
	Silver	mg/L	0.005	0.0018		-	-	-	-	-	-	-	<0.005	-
	Silver (Filtered)	mg/L	0.005	0.0018		<0.0001	-	-	<0.01	<0.005	-	<0.0005	-	-
	Strontium (Filtered)	mg/L				0.156	-	-	6.5	-	-	1.23	-	-
	Thallium	mg/L	0.001			-	-	-	-	-	-	-	<0.001	-
	Thallium (Filtered)	mg/L	0.001			<0.00005	-	-	<0.005	<0.001	-	<0.0003	-	-
	Tin	mg/L	0.005			-	-	-	-	-	-	-	0.036	-
	Tin (Filtered)	mg/L	0.005			<0.0005	-	-	<0.05	<0.005	-	<0.003	-	-
	Uranium	mg/L	0.005			-	-	-	-	-	-	-	<0.005	-
	Uranium (Filtered)	mg/L	0.005			0.00002	-	-	<0.002	<0.005	-	0.00039	-	-
	Vanadium	mg/L	0.005	0.16		-	-	-	-	-	-	-	0.012	-
	Vanadium (Filtered)	mg/L	0.005	0.16		0.0031	-	-	<0.1	0.057	-	<0.005	-	-
	Zinc	mg/L	0.001	0.023	0.03	0.0075	0.094	0.008	<0.11	0.6	0.056	0.022	1.2	0.15
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.0072	-	0.006	<0.1	0.57	0.047	0.017	-	-
TPH	C7-C9	mg/L	0.1			<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	C10 - C14	mg/L	0.05			<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	0.48	-
	C15-C36	mg/L	0.4			<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	-	-
	C7-C36	mg/L	0.7			<0.7	-	<0.7	<0.7	<0.7	<0.7	<0.7	-	-
BTEX & MAH	Benzene	mg/L	0.001	0.9		<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
	BTEX (Sum of Total) - Calc	µg/L				<6	-	<6	<6	<6	<6	<6	-	-
	Ethylbenzene	mg/L	0.001			<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
	Toluene	mg/L	0.001			<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
	Xylene (o)	mg/L	0.001			<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
	Xylene (m & p)	mg/L	0.002			<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	-	-
	Xylene Total	µg/L	3			-	-	<3	-	<3	<3	-	-	-
	Xylenes (Sum of Total) - Calc	µg/L				<1	-	<1	<1	<1	<1	<1	-	-
PAH	PAHs (Sum of Total) - Calc	µg/L				<5.1	-	-	<5.1	<21	-	<5.1	<21	-
	Benzo[b+j]fluoranthene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Pyrene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Carcinogenic PAHs (as B(a)P TEQ) - Calc	µg/L				<0.726	-	-	<0.726	<2.42	-	<0.726	<2.42	-

					Location Code	Catchment_3_Outfall	Catchment_3_Outfall	Catchment_3_Outfall	Catchment_3_Spring	Catchment_3_Spring	Catchment_3_Spring	Catchment_4_Outfall	Catchment_4_Outfall	Catchment_4_Outfall
					Sampled Date	15/03/2016	11/05/2016	13/07/2016	15/03/2016	1/04/2016	13/07/2016	15/03/2016	13/04/2016	11/05/2016
Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality									
	Acenaphthene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Acenaphthylene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Anthracene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Benz(a)anthracene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Benzo(a) pyrene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Benzo(k)fluoranthene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Benzo(g,h,i)perylene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Chrysene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Dibenz(a,h)anthracene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Fluoranthene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Fluorene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Naphthalene	mg/L	0.001	0.09		<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
	Phenanthrene	mg/L	0.001			<0.0003	-	-	<0.0003	<0.001	-	<0.0003	<0.001	-
Inorganics	Cesium (Filtered)	mg/L				<0.0001	-	-	<0.01	-	-	<0.0005	-	-
	Kjeldahl Nitrogen Total	mg/L	0.2			-	-	-	-	2.5	-	-	-	-
	Lanthanum (Filtered)	mg/L				<0.0001	-	-	<0.01	-	-	<0.0005	-	-
	Total Dissolved Solids	mg/L				-	-	-	73,680	-	-	16,600	-	-
	Total Suspended Solids	mg/L	1		20	<3	36	1	6	9200	16	6	-	24
	Turbidity	NTU				-	-	-	0	-	-	0	-	-
	Salinity	ppt				-	-	-	54.9	-	-	12.8	-	-
Nutrients	Nitrogen (Organic)	µg/L	200			-	-	-	-	2200	-	-	-	-
	Ammonia as N	mg/L	0.01	1.2		-	4.4	0.25	-	0.27	0.02	-	-	3.2
	Ammonia as N (Filtered)	mg/L		1.2		0.61	-	-	0.179	-	-	2.1	-	-
	Nitrate (as N)	mg/L	0.02			3	1.2	3.3	0.26	<0.02	1.8	1.55	-	1.3
	Nitrite (as N)	mg/L	0.02			-	-	-	-	<0.02	-	-	-	-
	Nitrite (as N) (Filtered)	mg/L				0.01	-	-	<0.02	-	-	0.024	-	-
	Nitrogen (Total)	mg/L	0.2			-	-	-	-	2.7	-	-	-	-
	Phosphate total (P)	mg/L	0.05			-	-	-	-	0.38	-	-	-	-
	Reactive Phosphorus as P (Filtered)	mg/L				0.026	-	-	0.008	-	-	<0.004	-	-
	Sulphate as S	mg/L	5			-	540	20	-	740	450	-	-	150
	Nitrate-N + Nitrite-N	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Nitrate-N + Nitrite-N (Filtered)	mg/L				3	-	-	0.27	-	-	1.57	-	-
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20			-	250	-	-	-	-	-	-	210
	Alkalinity (Bicarbonate as CaCO3)	mg/L	20			-	250	61	-	150	200	-	-	210
	Carbonate Alkalinity (as CaCO3)	mg/L	10			-	<10	<10	-	<10	<10	-	-	<10
Major Ions	Calcium	mg/L	0.5			-	260	15	-	310	190	-	-	90
	Calcium (Filtered)	mg/L				15.4	-	-	350	-	-	81	-	-
	Chloride	mg/L	1			-	14,000	350	-	19,000	9200	-	-	3400
	Magnesium	mg/L	0.5			-	740	25	-	950	590	-	-	210
	Magnesium (Filtered)	mg/L				18.3	-	-	1080	-	-	174	-	-
	Potassium	mg/L	0.5			-	220	9.9	-	300	200	-	-	67
	Potassium (Filtered)	mg/L				7.8	-	-	340	-	-	61	-	-
	Sodium	mg/L	0.5			-	6500	170	-	8500	4800	-	-	1700
	Sodium (Filtered)	mg/L				111	-	-	9300	-	-	1510	-	-
OC Pesticides	Aldrin + Dieldrin - Calc	µg/L				<1	-	-	<1	<10	-	<1	<10	-
	OCPs (Sum of Total) - Calc	µg/L				<10	-	-	<10	<90	-	<10	<90	-
	4,4 DDD	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	4,4 DDE	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	4,4 DDT	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	a-BHC	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Aldrin	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	b-BHC	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	d-BHC	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	DDT + DDD + DDE - Calc	mg/L				<0.002	-	-	<0.002	<0.015	-	<0.002	<0.015	-
	Dieldrin	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Endosulfan I	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Endosulfan II	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Endosulfan sulphate	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Endrin	mg/L	0.005	0.00001		<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Endrin aldehyde	mg/L	0.005			-	-	-	-	<0.005	-	-	<0.005	-
	Endrin ketone	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	g-BHC (Lindane)	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Heptachlor	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Heptachlor epoxide	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Hexachlorobenzene	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Methoxychlor	mg/L	0.005			-	-	-	-	<0.005	-	-	<0.005	-
Phenols	2,3,4,6-tetrachlorophenol	µg/L	10			-	-	-	-	<10	-	-	<10	-
	2,4-dinitrophenol	µg/L	30			-	-	-	-	<30	-	-	<30	-
	2,6-dichlorophenol	µg/L	3			-	-	-	-	<3	-	-	<3	-
	3-methylcholanthrene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	4-nitrophenol	µg/L	30			-	-	-	-	<30	-	-	<30	-
	Acetophenone	µg/L	5			-	-	-	-	<5	-	-	<5	-

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_3_Outfall	Catchment_3_Outfall	Catchment_3_Outfall	Catchment_3_Spring	Catchment_3_Spring	Catchment_3_Spring	Catchment_4_Outfall	Catchment_4_Outfall	Catchment_4_Outfall
					Sampled Date	15/03/2016	11/05/2016	13/07/2016	15/03/2016	1/04/2016	13/07/2016	15/03/2016	13/04/2016	11/05/2016
	Phenols (Sum of Total) - Calc	µg/L				<17	-	-	<17	<168	-	<17	<168	-
	2,4,5-trichlorophenol	mg/L	0.01			<0.001	-	-	<0.001	<0.01	-	<0.001	<0.01	-
	2,4,6-trichlorophenol	mg/L	0.01			<0.001	-	-	<0.001	<0.01	-	<0.001	<0.01	-
	2,4-dichlorophenol	mg/L	0.003			<0.0005	-	-	<0.0005	<0.003	-	<0.0005	<0.003	-
	2,4-dimethylphenol	mg/L	0.003			<0.0005	-	-	<0.0005	<0.003	-	<0.0005	<0.003	-
	2-chlorophenol	mg/L	0.003			<0.0005	-	-	<0.0005	<0.003	-	<0.0005	<0.003	-
	2-methylnaphthalene	mg/L	0.005			<0.0003	-	-	<0.0003	<0.005	-	<0.0003	<0.005	-
	2-methylphenol	mg/L	0.003			<0.0005	-	-	<0.0005	<0.003	-	<0.0005	<0.003	-
	2-nitrophenol	mg/L	0.01			<0.001	-	-	<0.001	<0.01	-	<0.001	<0.01	-
	3-&4-methylphenol	mg/L	0.006			<0.001	-	-	<0.001	<0.006	-	<0.001	<0.006	-
	4-chloro-3-methylphenol	mg/L	0.01			<0.001	-	-	<0.001	<0.01	-	<0.001	<0.01	-
	Pentachlorophenol	mg/L	0.01	0.033		<0.01	-	-	<0.01	<0.01	-	<0.01	<0.01	-
	Phenol	mg/L	0.003	0.52		<0.001	-	-	<0.001	<0.003	-	<0.001	<0.003	-
VOCs	1,2,3-trichlorobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1,2,4-trichlorobenzene	mg/L	0.005	0.14		<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	1,2-dichlorobenzene	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	1,3-dichlorobenzene	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	1,4-dichlorobenzene	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Hexachlorobutadiene	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
SVOCs	1,2,3,4-tetrachlorobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1,2,3,5-Tetrachlorobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1,2,4,5-tetrachlorobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1,3,5-Trichlorobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1-Chloronaphthalene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1-naphthylamine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	2-naphthylamine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	2-nitroaniline	µg/L	5			-	-	-	-	<5	-	-	<5	-
	3,3-Dichlorobenzidine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	4-(dimethylamino) azobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	4,6-Dinitro-2-methylphenol	µg/L	30			-	-	-	-	<30	-	-	<30	-
	7,12-dimethylbenz(a)anthracene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Aniline	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Benzyl chloride	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Dibenz(a.j)acridine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Diphenylamine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Hexachlorocyclopentadiene	µg/L	5			-	-	-	-	<5	-	-	<10	-
	N-nitrosodi-n-butylamine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	N-nitrosopiperidine	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Pentachlorobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Trifluralin	µg/L	5			-	-	-	-	<5	-	-	<5	-
	1 & 2 Chloronaphthalene	mg/L				<0.0003	-	-	<0.0003	-	-	<0.0003	-	-
	4-bromophenyl phenyl ether	mg/L	0.005			<0.0003	-	-	<0.0003	<0.005	-	<0.0003	<0.005	-
	4-chlorophenyl phenyl ether	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Benzyl alcohol	mg/L				<0.005	-	-	<0.005	-	-	<0.005	-	-
	Bis(2-chloroethoxy) methane	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Bis(2-chloroethyl)ether	mg/L				<0.0005	-	-	<0.0005	-	-	<0.0005	-	-
	Bis(2-chloroisopropyl) ether	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Carbazole	mg/L				<0.0005	-	-	<0.0005	-	-	<0.0005	-	-
	Di(2-ethylhexyl)adipate	mg/L				<0.001	-	-	<0.001	-	-	<0.001	-	-
	Dibenzofuran	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Hexachloroethane	mg/L	0.005			<0.0005	-	-	<0.0005	<0.005	-	<0.0005	<0.005	-
	Isophorone	mg/L				<0.0005	-	-	<0.0005	-	-	<0.0005	-	-
	N-nitrosodi-n-propylamine	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	N-Nitrosodiphenyl & Diphenylamine	mg/L				<0.001	-	-	<0.001	-	-	<0.001	-	-
Phthalates	Bis(2-ethylhexyl) phthalate	mg/L				<0.003	-	-	<0.003	-	-	<0.003	-	-
	Butyl benzyl phthalate	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Diethylphthalate	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Dimethyl phthalate	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Di-n-butyl phthalate	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Di-n-octyl phthalate	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
Biological	Coliform	cfu/100 ml	1			2000	340,000	-	200	11,000	-	400,000	10,000,000	6,200,000
	Faecal Coliform	cfu/100 ml	1			310	-	-	140	11,000	-	41,000	-	-
	Thermotolerant Coliforms	MPN/100ml	1			-	-	-	-	-	-	-	10,000,000	-
Chlorinated Hydrocarbons	2-chloronaphthalene	µg/L	5			-	-	-	-	<5	-	-	<5	-
Explosives	2,4-Dinitrotoluene	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	2,6-dinitrotoluene	mg/L	0.005			<0.001	-	-	<0.001	<0.005	-	<0.001	<0.005	-
	Nitrobenzene	mg/L	0.05			<0.0005	-	-	<0.0005	<0.05	-	<0.0005	<0.05	-
Herbicides	Pronamide	µg/L	5			-	-	-	-	<5	-	-	<5	-
Nitroaromatics	2-Picoline	µg/L	5			-	-	-	-	<5	-	-	<5	-
	4-aminobiphenyl	µg/L	5			-	-	-	-	<5	-	-	<5	-
	Pentachloronitrobenzene	µg/L	5			-	-	-	-	<5	-	-	<5	-

					Location Code	Catchment_4_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6A_Outfall	Catchment_6A_Outfall
					Sampled Date	13/07/2016	15/03/2016	1/04/2016	13/07/2016	17/03/2016	1/04/2016	13/07/2016	17/03/2016	1/04/2016
Chem Group	**Chem Name**	**Units**	**EQL**	ANZECC 2000 MW 90%	PAUP - Stormwater Quality									
Field	ORP	mV				-	134.1	161	-	2	28.3	-	59.4	26.4
	SP Conductivity	µS/cm				-	-	-	-	-	-	-	-	-
	SSG	Units				-	-	0	-	-	4.7	-	-	27.3
	Dissolved Oxygen (Field) %	%				-	69	-	-	-	27.6	-	-	42.1
	Dissolved Oxygen (Field) % (Filtered)	%				-	-	-	-	-	-	-	-	-
	Dissolved Oxygen (Field)	mg/L				-	-	-	-	-	-	-	-	-
	Temp (Field)	oC				-	17.8	18.3	-	21.9	20.3	-	21.9	19.5
	pH (Field)	pH_Units				-	5.7	7.2	-	8.2	7.35	-	9.6	7.35
	Electrical Conductivity (Field)	uS/cm				-	803	841	-	22,850	14,660	-	199	55,060
Metals	Aluminium	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Aluminium (Filtered)	mg/L	0.05			-	0.062	<0.05	-	<0.03	0.12	-	0.1	0.61
	Antimony	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Antimony (Filtered)	mg/L	0.005			-	<0.0002	<0.005	-	<0.002	<0.005	-	<0.0002	<0.025
	Arsenic	mg/L	0.001			0.003	0.0022	0.002	0.002	<0.011	0.001	<0.005	<0.0011	0.015
	Arsenic (Filtered)	mg/L	0.001			0.001	0.002	0.002	0.001	<0.01	0.001	<0.005	<0.001	0.015
	Barium	mg/L	0.02			-	-	-	-	-	-	-	-	-
	Barium (Filtered)	mg/L	0.02			-	0.0105	<0.02	-	0.075	0.1	-	0.0021	0.18
	Boron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Boron (Filtered)	mg/L	0.05			-	0.144	0.16	-	1.41	1.2	-	0.012	4.2
	Cadmium	mg/L	0.0002	0.014		<0.0002	<0.000053	<0.0002	<0.0002	<0.00053	<0.0002	<0.001	<0.000053	<0.001
	Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.00005	<0.0002	<0.0002	<0.0005	<0.0002	<0.001	<0.00005	<0.001
	Chromium (III+VI)	mg/L	0.001	0.02		<0.001	0.00084	<0.001	<0.001	0.0083	0.002	<0.005	0.00066	0.017
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		<0.001	0.0006	<0.001	<0.001	<0.005	<0.001	<0.001	<0.0005	0.017
	Cobalt	mg/L	0.001	0.014		-	-	-	-	-	-	-	-	-
	Cobalt (Filtered)	mg/L	0.001	0.014		-	<0.0002	<0.001	-	<0.002	<0.001	-	<0.0002	<0.005
	Copper	mg/L	0.001	0.003	0.01	0.003	0.001	0.001	<0.001	0.0064	0.002	<0.005	0.004	0.01
	Copper (Filtered)	mg/L	0.001	0.003	0.01	<0.001	0.0015	0.001	<0.001	<0.005	0.001	<0.005	0.0034	0.01
	Iron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Iron (Filtered)	mg/L	0.05			-	0.08	0.24	-	<0.2	3.4	-	<0.02	15
	Lead	mg/L	0.001	0.0066		0.004	0.00025	<0.001	<0.001	0.0044	0.003	<0.005	0.00191	0.013
	Lead (Filtered)	mg/L	0.001	0.0066		<0.001	<0.0001	<0.001	<0.001	<0.001	0.003	<0.005	0.00068	0.013
	Lithium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Lithium (Filtered)	mg/L	0.005			-	0.0013	<0.005	-	0.034	0.017	-	0.0002	0.089
	Manganese	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Manganese (Filtered)	mg/L	0.005			-	0.028	0.035	-	0.25	0.21	-	0.004	2.3
	Mercury	mg/L	0.0001	0.0007		<0.0001	<0.00008	-	<0.0001	<0.00008	-	<0.0005	<0.00008	-
	Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	-	-	<0.0001	-	-	<0.0005	-	-
	Molybdenum	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Molybdenum (Filtered)	mg/L	0.005			-	0.0007	<0.005	-	0.003	<0.005	-	<0.0002	<0.025
	Nickel	mg/L	0.001	0.2		0.001	0.00098	<0.001	<0.001	<0.0053	0.002	<0.005	<0.00053	0.008
	Nickel (Filtered)	mg/L	0.001	0.2		<0.001	0.0008	<0.001	<0.001	<0.005	0.001	<0.005	<0.0005	0.008
	Rubidium (Filtered)	mg/L				-	0.0055	-	-	0.032	-	-	0.00037	-
	Selenium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Selenium (Filtered)	mg/L	0.001			-	<0.001	<0.001	-	<0.01	<0.001	-	<0.001	<0.005
	Silver	mg/L	0.005	0.0018		-	-	-	-	-	-	-	-	-
	Silver (Filtered)	mg/L	0.005	0.0018		-	<0.0001	<0.005	-	<0.001	<0.005	-	<0.0001	<0.025
	Strontium (Filtered)	mg/L				-	0.162	-	-	1.8	-	-	0.0061	-
	Thallium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Thallium (Filtered)	mg/L	0.001			-	<0.00005	<0.001	-	<0.0005	<0.001	-	<0.00005	<0.025
	Tin	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Tin (Filtered)	mg/L	0.005			-	<0.0005	<0.005	-	<0.005	<0.005	-	<0.0005	<0.025
	Uranium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Uranium (Filtered)	mg/L	0.005			-	<0.00002	<0.005	-	0.0006	<0.005	-	<0.00002	<0.025
	Vanadium	mg/L	0.005	0.16		-	-	-	-	-	-	-	-	-
	Vanadium (Filtered)	mg/L	0.005	0.16		-	<0.001	<0.005	-	<0.01	<0.005	-	<0.001	0.029
	Zinc	mg/L	0.001	0.023	0.03	0.022	0.022	0.028	0.029	0.056	0.028	0.045	0.0132	0.079
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.01	0.02	0.025	0.023	0.024	0.026	0.038	0.0126	0.079
TPH	C7-C9	mg/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	C10 - C14	mg/L	0.05			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	C15-C36	mg/L	0.4			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
	C7-C36	mg/L	0.7			<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
BTEX & MAH	Benzene	mg/L	0.001	0.9		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	BTEX (Sum of Total) - Calc	µg/L				<6	<6	<6	<6	<6	<6	<6	<6	<6
	Ethylbenzene	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Toluene	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (o)	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (m & p)	mg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Xylene Total	µg/L	3			<3	-	<3	<3	-	<3	<3	-	<3
	Xylenes (Sum of Total) - Calc	µg/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
PAH	PAHs (Sum of Total) - Calc	µg/L				-	<5.1	<21	-	<5.1	<21	-	<5.1	<21
	Benzo[b+j]fluoranthene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Pyrene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Carcinogenic PAHs (as B(a)P TEQ) - Calc	µg/L				-	<0.726	<2.42	-	<0.726	<2.42	-	<0.726	<2.42

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_4_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6A_Outfall	Catchment_6A_Outfall
					Location Code	Catchment_4_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6A_Outfall	Catchment_6A_Outfall
					Sampled Date	13/07/2016	15/03/2016	1/04/2016	13/07/2016	17/03/2016	1/04/2016	13/07/2016	17/03/2016	1/04/2016
	Acenaphthene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Acenaphthylene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Anthracene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Benz(a)anthracene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Benzo(a) pyrene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Benzo(k)fluoranthene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Benzo(g,h,i)perylene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Chrysene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Dibenz(a,h)anthracene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Fluoranthene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Fluorene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Naphthalene	mg/L	0.001	0.09		-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
	Phenanthrene	mg/L	0.001			-	<0.0003	<0.001	-	<0.0003	<0.001	-	<0.0003	<0.001
Inorganics	Cesium (Filtered)	mg/L				-	<0.0001	-	-	<0.001	-	-	<0.0001	-
	Kjeldahl Nitrogen Total	mg/L	0.2			-	-	0.6	-	-	18	-	-	38
	Lanthanum (Filtered)	mg/L				-	<0.0001	-	-	<0.001	-	-	<0.0001	-
	Total Dissolved Solids	mg/L				-	520	551	-	14,490	9516	-	130	36,410
	Total Suspended Solids	mg/L	1		20	11	4	6	3.5	51	29	25	24	2000
	Turbidity	NTU				-	-	0	-	148	0	-	-	362
	Salinity	ppt				-	0.4	0.42	-	10.5	7.31	-	0.1	27.94
Nutrients	Nitrogen (Organic)	µg/L	200			-	-	500	-	-	3000	-	-	3000
	Ammonia as N	mg/L	0.01	1.2		2.2	-	0.09	0.15	-	15	8.2	-	35
	Ammonia as N (Filtered)	mg/L		1.2		-	0.071	-	-	11.8	-	-	0.32	-
	Nitrate (as N)	mg/L	0.02			2.4	2.2	2.1	2.7	1.71	2	1.9	0.116	1.3
	Nitrite (as N)	mg/L	0.02			-	-	0.03	-	-	0.07	-	-	0.39
	Nitrite (as N) (Filtered)	mg/L				-	0.007	-	-	0.052	-	-	0.011	-
	Nitrogen (Total)	mg/L	0.2			-	-	2.7	-	-	20	-	-	40
	Phosphate total (P)	mg/L	0.05			-	-	<0.05	-	-	<0.05	-	-	0.13
	Reactive Phosphorus as P (Filtered)	mg/L				-	0.022	-	-	<0.004	-	-	0.047	-
	Sulphate as S	mg/L	5			34	-	25	140	-	84	210	-	360
	Nitrate-N + Nitrite-N	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Nitrate-N + Nitrite-N (Filtered)	mg/L				-	2.2	-	-	1.76	-	-	0.127	-
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20			-	-	-	-	-	-	-	-	-
	Alkalinity (Bicarbonate as CaCO3)	mg/L	20			180	-	64	71	-	300	240	-	790
	Carbonate Alkalinity (as CaCO3)	mg/L	10			<10	-	<10	<10	-	<10	<10	-	<10
Major Ions	Calcium	mg/L	0.5			41	-	17	50	-	63	100	-	230
	Calcium (Filtered)	mg/L				-	18.6	-	-	107	-	-	1.12	-
	Chloride	mg/L	1			620	-	54	2500	-	1800	4500	-	8600
	Magnesium	mg/L	0.5			52	-	8.9	120	-	110	250	-	500
	Magnesium (Filtered)	mg/L				-	10.4	-	-	260	-	-	0.38	-
	Potassium	mg/L	0.5			21	-	5.5	39	-	42	83	-	180
	Potassium (Filtered)	mg/L				-	6.6	-	-	99	-	-	0.32	-
	Sodium	mg/L	0.5			370	-	36	920	-	890	2100	-	4200
	Sodium (Filtered)	mg/L				-	48	-	-	2500	-	-	3.8	-
OC Pesticides	Aldrin + Dieldrin - Calc	µg/L				-	<1	<10	-	<1	<10	-	<1	<10
	OCPs (Sum of Total) - Calc	µg/L				-	<10	<90	-	<10.1	<90	-	<10	<90
	4,4 DDD	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	4,4 DDE	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	4,4 DDT	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	a-BHC	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Aldrin	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	b-BHC	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	d-BHC	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	DDT + DDD + DDE - Calc	mg/L				-	<0.002	<0.015	-	<0.002	<0.015	-	<0.002	<0.015
	Dieldrin	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Endosulfan I	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Endosulfan II	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Endosulfan sulphate	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Endrin	mg/L	0.005	0.00001		-	<0.0005	<0.005	-	<0.0006	<0.005	-	<0.0005	<0.005
	Endrin aldehyde	mg/L	0.005			-	-	<0.005	-	-	<0.005	-	-	<0.005
	Endrin ketone	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	g-BHC (Lindane)	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Heptachlor	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Heptachlor epoxide	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Hexachlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Methoxychlor	mg/L	0.005			-	-	<0.005	-	-	<0.005	-	-	<0.005
Phenols	2,3,4,6-tetrachlorophenol	µg/L	10			-	-	<10	-	-	<10	-	-	<10
	2,4-dinitrophenol	µg/L	30			-	-	<30	-	-	<30	-	-	<30
	2,6-dichlorophenol	µg/L	3			-	-	<3	-	-	<3	-	-	<3
	3-methylcholanthrene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	4-nitrophenol	µg/L	30			-	-	<30	-	-	<30	-	-	<30
	Acetophenone	µg/L	5			-	-	<5	-	-	<5	-	-	<5

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_4_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_5_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6_Outfall	Catchment_6A_Outfall	Catchment_6A_Outfall
					Sampled Date	13/07/2016	15/03/2016	1/04/2016	13/07/2016	17/03/2016	1/04/2016	13/07/2016	17/03/2016	1/04/2016
	Phenols (Sum of Total) - Calc	µg/L				-	<17	<168	-	<17	<168	-	<17	<168
	2,4,5-trichlorophenol	mg/L	0.01			-	<0.001	<0.01	-	<0.001	<0.01	-	<0.001	<0.01
	2,4,6-trichlorophenol	mg/L	0.01			-	<0.001	<0.01	-	<0.001	<0.01	-	<0.001	<0.01
	2,4-dichlorophenol	mg/L	0.003			-	<0.0005	<0.003	-	<0.0005	<0.003	-	<0.0005	<0.003
	2,4-dimethylphenol	mg/L	0.003			-	<0.0005	<0.003	-	<0.0005	<0.003	-	<0.0005	<0.003
	2-chlorophenol	mg/L	0.003			-	<0.0005	<0.003	-	<0.0005	<0.003	-	<0.0005	<0.003
	2-methylnaphthalene	mg/L	0.005			-	<0.0003	<0.005	-	<0.0003	<0.005	-	<0.0003	<0.005
	2-methylphenol	mg/L	0.003			-	<0.0005	<0.003	-	<0.0005	<0.003	-	<0.0005	<0.003
	2-nitrophenol	mg/L	0.01			-	<0.001	<0.01	-	<0.001	<0.01	-	<0.001	<0.01
	3-&4-methylphenol	mg/L	0.006			-	<0.001	<0.006	-	<0.001	<0.006	-	<0.001	<0.006
	4-chloro-3-methylphenol	mg/L	0.01			-	<0.001	<0.01	-	<0.001	<0.01	-	<0.001	<0.01
	Pentachlorophenol	mg/L	0.01	0.033		-	<0.01	<0.01	-	<0.01	<0.01	-	<0.01	<0.01
	Phenol	mg/L	0.003	0.52		-	<0.001	<0.003	-	<0.001	<0.003	-	<0.001	<0.003
VOCs	1,2,3-trichlorobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1,2,4-trichlorobenzene	mg/L	0.005	0.14		-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	1,2-dichlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	<0.0006	<0.005	-	<0.0005	<0.005
	1,3-dichlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	<0.0006	<0.005	-	<0.0005	<0.005
	1,4-dichlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	<0.0006	<0.005	-	<0.0005	<0.005
	Hexachlorobutadiene	mg/L	0.005			-	<0.0005	<0.005	-	<0.0006	<0.005	-	<0.0005	<0.005
SVOCs	1,2,3,4-tetrachlorobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1,2,3,5-Tetrachlorobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1,2,4,5-tetrachlorobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1,3,5-Trichlorobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1-Chloronaphthalene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1-naphthylamine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	2-naphthylamine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	2-nitroaniline	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	3,3-Dichlorobenzidine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	4-(dimethylamino) azobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	4,6-Dinitro-2-methylphenol	µg/L	30			-	-	<30	-	-	<30	-	-	<30
	7,12-dimethylbenz(a)anthracene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Aniline	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Benzyl chloride	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Dibenz(a.j)acridine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Diphenylamine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Hexachlorocyclopentadiene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	N-nitrosodi-n-butylamine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	N-nitrosopiperidine	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Pentachlorobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Trifluralin	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	1 & 2 Chloronaphthalene	mg/L				-	<0.0003	-	-	<0.0003	-	-	<0.0003	-
	4-bromophenyl phenyl ether	mg/L	0.005			-	<0.0003	<0.005	-	<0.0003	<0.005	-	<0.0003	<0.005
	4-chlorophenyl phenyl ether	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Benzyl alcohol	mg/L				-	<0.005	-	-	<0.005	-	-	<0.005	-
	Bis(2-chloroethoxy) methane	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Bis(2-chloroethyl)ether	mg/L				-	<0.0005	-	-	<0.0005	-	-	<0.0005	-
	Bis(2-chloroisopropyl) ether	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Carbazole	mg/L				-	<0.0005	-	-	<0.0005	-	-	<0.0005	-
	Di(2-ethylhexyl)adipate	mg/L				-	<0.001	-	-	<0.001	-	-	<0.001	-
	Dibenzofuran	mg/L	0.005			-	<0.0005	<0.005	-	<0.0005	<0.005	-	<0.0005	<0.005
	Hexachloroethane	mg/L	0.005			-	<0.0005	<0.005	-	<0.0006	<0.005	-	<0.0005	<0.005
	Isophorone	mg/L				-	<0.0005	-	-	<0.0005	-	-	<0.0005	-
	N-nitrosodi-n-propylamine	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	N-Nitrosodiphenyl & Diphenylamine	mg/L				-	<0.001	-	-	<0.001	-	-	<0.001	-
Phthalates	Bis(2-ethylhexyl) phthalate	mg/L				-	<0.003	-	-	<0.003	-	-	<0.003	-
	Butyl benzyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Diethylphthalate	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Dimethyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Di-n-butyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Di-n-octyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
Biological	Coliform	cfu/100 ml	1			-	4000	790	-	40,000	420	-	120,000	60
	Faecal Coliform	cfu/100 ml	1			-	700	350	-	1000	120	-	28,000	78
	Thermotolerant Coliforms	MPN/100ml	1			-	-	-	-	-	-	-	-	-
Chlorinated Hydrocarbons	2-chloronaphthalene	µg/L	5			-	-	<5	-	-	<5	-	-	<5
Explosives	2,4-Dinitrotoluene	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	2,6-dinitrotoluene	mg/L	0.005			-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	<0.005
	Nitrobenzene	mg/L	0.05			-	<0.0005	<0.05	-	<0.0005	<0.05	-	<0.0005	<0.05
Herbicides	Pronamide	µg/L	5			-	-	<5	-	-	<5	-	-	<5
Nitroaromatics	2-Picoline	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	4-aminobiphenyl	µg/L	5			-	-	<5	-	-	<5	-	-	<5
	Pentachloronitrobenzene	µg/L	5			-	-	<5	-	-	<5	-	-	<5

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_7_Outfall 17/03/2016	Catchment_7_Outfall 1/04/2016	Catchment_7_Outfall 11/05/2016	Catchment_7_Outfall 13/07/2016	Catchment_8_Outfall 17/03/2016	Catchment_8_Outfall 1/04/2016	Catchment_8_Outfall 18/05/2016	Catchment_8_Outfall 13/07/2016	Catchment_9_Outfall 17/03/2016
Field	ORP	mV				64.4	75.2	39.1	-	25.6	37.4	-	-	-23.3
	SP Conductivity	µS/cm				-	-	-	-	-	-	-	-	-
	SSG	Units				-	11.1	-	-	-	18.2	-	-	-
	Dissolved Oxygen (Field) %	%				-	2.1	-	-	39.4	14.2	-	-	-
	Dissolved Oxygen (Field) % (Filtered)	%				-	-	49	-	-	-	-	-	-
	Dissolved Oxygen (Field)	mg/L				-	-	-	-	-	-	-	-	-
	Temp (Field)	oC				22.8	18.8	20.3	-	22.5	20.4	-	-	20.6
	pH (Field)	pH_Units				8.25	8.32	7.6	-	7.86	8.12	-	-	8.58
	Electrical Conductivity (Field)	uS/cm				26,290	26,720	329	-	52,140	40,370	-	-	3251
Metals	Aluminium	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Aluminium (Filtered)	mg/L	0.05			<0.015	0.11	-	-	<0.06	3.2	-	-	0.064
	Antimony	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Antimony (Filtered)	mg/L	0.005			0.0036	<0.005	-	-	<0.004	<0.005	-	-	0.0003
	Arsenic	mg/L	0.001			0.018	0.01	0.006	0.035	<0.021	0.015	-	<0.005	0.0021
	Arsenic (Filtered)	mg/L	0.001			0.011	0.01	-	0.026	<0.02	0.006	0.001	<0.005	0.0016
	Barium	mg/L	0.02			-	-	0.03	-	-	-	-	-	-
	Barium (Filtered)	mg/L	0.02			0.026	0.03	-	-	0.117	0.1	-	-	0.027
	Boron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Boron (Filtered)	mg/L	0.05			1.15	1.1	-	-	2.2	2	-	-	0.39
	Cadmium	mg/L	0.0002	0.014		0.0058	0.0078	-	0.013	<0.0011	<0.0002	-	<0.001	0.000143
	Cadmium (Filtered)	mg/L	0.0002	0.014		0.0015	0.0082	-	0.012	<0.001	<0.0002	0.0005	<0.001	<0.00005
	Chromium (III+VI)	mg/L	0.001	0.02		0.0041	<0.001	-	<0.001	<0.011	0.033	-	<0.005	0.007
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		0.003	<0.001	-	<0.001	<0.01	0.006	0.001	<0.001	0.0013
	Cobalt	mg/L	0.001	0.014		-	-	-	-	-	-	-	-	-
	Cobalt (Filtered)	mg/L	0.001	0.014		0.0021	0.003	-	-	<0.004	0.004	-	-	0.0003
	Copper	mg/L	0.001	0.003	0.01	0.141	0.24	0.093	0.31	<0.011	0.034	-	<0.005	0.0094
	Copper (Filtered)	mg/L	0.001	0.003	0.01	0.036	0.24	-	0.19	<0.01	0.02	0.029	<0.005	0.0028
	Iron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Iron (Filtered)	mg/L	0.05			<0.1	0.38	-	-	<0.4	6.6	-	-	0.3
	Lead	mg/L	0.001	0.0066		0.00176	0.001	-	0.002	<0.0021	0.049	-	<0.005	0.00063
	Lead (Filtered)	mg/L	0.001	0.0066		<0.0005	0.001	-	<0.001	<0.002	0.021	0.01	<0.005	<0.0001
	Lithium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Lithium (Filtered)	mg/L	0.005			0.031	0.027	-	-	0.059	0.045	-	-	0.0047
	Manganese	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Manganese (Filtered)	mg/L	0.005			0.4	0.51	-	-	0.6	0.83	-	-	0.058
	Mercury	mg/L	0.0001	0.0007		<0.00008	-	-	<0.0001	<0.00008	-	-	<0.0005	<0.00008
	Mercury (Filtered)	mg/L	0.0001	0.0007		-	-	-	<0.0001	-	-	<0.0001	<0.0005	-
	Molybdenum	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Molybdenum (Filtered)	mg/L	0.005			0.005	<0.005	-	-	0.005	<0.005	-	-	0.0019
	Nickel	mg/L	0.001	0.2		0.0143	0.018	-	0.024	<0.011	0.015	-	<0.005	0.0031
	Nickel (Filtered)	mg/L	0.001	0.2		0.012	0.018	-	0.022	<0.01	0.007	0.008	<0.005	0.0028
	Rubidium (Filtered)	mg/L				0.033	-	-	-	0.056	-	-	-	0.0131
	Selenium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Selenium (Filtered)	mg/L	0.001			0.009	<0.001	-	-	<0.02	<0.001	-	-	<0.001
	Silver	mg/L	0.005	0.0018		-	-	-	-	-	-	-	-	-
	Silver (Filtered)	mg/L	0.005	0.0018		<0.0005	<0.005	-	-	<0.002	<0.005	-	-	<0.0001
	Strontium (Filtered)	mg/L				1.67	-	-	-	3	-	-	-	0.29
	Thallium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Thallium (Filtered)	mg/L	0.001			<0.0003	<0.001	-	-	<0.001	<0.001	-	-	<0.00005
	Tin	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Tin (Filtered)	mg/L	0.005			<0.003	<0.005	-	-	<0.01	<0.005	-	-	<0.0005
	Uranium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Uranium (Filtered)	mg/L	0.005			0.00044	<0.005	-	-	0.0009	<0.005	-	-	0.00015
	Vanadium	mg/L	0.005	0.16		-	-	-	-	-	-	-	-	-
	Vanadium (Filtered)	mg/L	0.005	0.16		<0.005	<0.005	-	-	<0.02	0.015	-	-	0.0035
	Zinc	mg/L	0.001	0.023	0.03	0.129	0.12	0.38	0.15	0.094	0.32	-	0.14	0.108
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.07	0.12	-	0.13	0.06	0.17	0.78	0.12	0.072
TPH	C7-C9	mg/L	0.1			<0.1	<0.1	-	<0.1	<0.1	0.11	-	<0.1	<0.1
	C10 - C14	mg/L	0.05			<0.2	<0.2	-	<0.2	<0.2	<0.2	-	<0.2	<0.2
	C15-C36	mg/L	0.4			<0.4	<0.4	-	<0.4	<0.4	6.9	-	<0.4	<0.4
	C7-C36	mg/L	0.7			<0.7	<0.7	-	<0.7	<0.7	7.1	-	<0.7	<0.7
BTEX & MAH	Benzene	mg/L	0.001	0.9		<0.001	<0.001	-	<0.001	<0.001	<0.001	-	<0.001	<0.001
	BTEX (Sum of Total) - Calc	µg/L				<6	<6	-	<6	<6	<6	-	<6	<6
	Ethylbenzene	mg/L	0.001			<0.001	<0.001	-	<0.001	<0.001	<0.001	-	<0.001	<0.001
	Toluene	mg/L	0.001			<0.001	<0.001	-	<0.001	<0.001	<0.001	-	<0.001	<0.001
	Xylene (o)	mg/L	0.001			<0.001	<0.001	-	<0.001	<0.001	<0.001	-	<0.001	<0.001
	Xylene (m & p)	mg/L	0.002			<0.002	<0.002	-	<0.002	<0.002	<0.002	-	<0.002	<0.002
	Xylene Total	µg/L	3			-	<3	-	<3	-	<3	-	<3	-
	Xylenes (Sum of Total) - Calc	µg/L				<1	<1	-	<1	<1	<1	-	<1	<1
PAH	PAHs (Sum of Total) - Calc	µg/L				<5.1	<21	-	-	<5.1	<21	-	-	<5.1
	Benzo[b+j]fluoranthene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Pyrene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Carcinogenic PAHs (as B(a)P TEQ) - Calc	µg/L				<0.726	<2.42	-	-	<0.726	<2.42	-	-	<0.726

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_7_Outfall 17/03/2016	Catchment_7_Outfall 1/04/2016	Catchment_7_Outfall 11/05/2016	Catchment_7_Outfall 13/07/2016	Catchment_8_Outfall 17/03/2016	Catchment_8_Outfall 1/04/2016	Catchment_8_Outfall 18/05/2016	Catchment_8_Outfall 13/07/2016	Catchment_9_Outfall 17/03/2016
	Acenaphthene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Acenaphthylene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Anthracene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Benz(a)anthracene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Benzo(a) pyrene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Benzo(k)fluoranthene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Benzo(g,h,i)perylene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Chrysene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Dibenz(a,h)anthracene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Fluoranthene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Fluorene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Naphthalene	mg/L	0.001	0.09		<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
	Phenanthrene	mg/L	0.001			<0.0003	<0.001	-	-	<0.0003	<0.001	-	-	<0.0003
Inorganics	Cesium (Filtered)	mg/L				<0.0005	-	-	-	<0.002	-	-	-	0.0002
	Kjeldahl Nitrogen Total	mg/L	0.2			-	2.4	-	-	-	20	-	-	-
	Lanthanum (Filtered)	mg/L				<0.0005	-	-	-	<0.002	-	-	-	<0.0001
	Total Dissolved Solids	mg/L				18,950	17,320	-	-	33,860	26,230	-	-	2104
	Total Suspended Solids	mg/L	1		20	13	7.8	38	7.2	380	1300	-	9.3	9
	Turbidity	NTU				-	0	-	-	-	3.1	-	-	-
	Salinity	ppt				14.89	13.29	-	-	26.03	20.17	-	-	1.61
Nutrients	Nitrogen (Organic)	µg/L	200			-	200	-	-	-	4000	-	-	-
	Ammonia as N	mg/L	0.01	1.2		-	2.2	0.17	4.2	-	16	-	11	-
	Ammonia as N (Filtered)	mg/L		1.2		1.4	-	-	-	15	-	-	-	1.5
	Nitrate (as N)	mg/L	0.02			2.6	3.2	0.54	4	0.63	1.1	-	1.1	1.48
	Nitrite (as N)	mg/L	0.02			-	0.27	-	-	-	0.39	-	-	-
	Nitrite (as N) (Filtered)	mg/L				0.185	-	-	-	0.124	-	-	-	0.18
	Nitrogen (Total)	mg/L	0.2			-	5.9	-	-	-	21	-	-	-
	Phosphate total (P)	mg/L	0.05			-	0.23	-	-	-	0.15	-	-	-
	Reactive Phosphorus as P (Filtered)	mg/L				0.197	-	-	-	0.026	-	-	-	0.004
	Sulphate as S	mg/L	5			-	150	400	160	-	210	-	300	-
	Nitrate-N + Nitrite-N	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Nitrate-N + Nitrite-N (Filtered)	mg/L				2.8	-	-	-	0.76	-	-	-	1.66
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20			-	-	130	-	-	-	-	-	-
	Alkalinity (Bicarbonate as CaCO3)	mg/L	20			-	200	130	270	-	360	-	290	-
	Carbonate Alkalinity (as CaCO3)	mg/L	10			-	<10	<10	<10	-	<10	-	<10	-
Major Ions	Calcium	mg/L	0.5			-	79	160	88	-	120	-	160	-
	Calcium (Filtered)	mg/L				101	-	-	-	163	-	-	-	23
	Chloride	mg/L	1			-	3100	9400	2700	-	4800	-	6100	-
	Magnesium	mg/L	0.5			-	180	500	190	-	270	-	410	-
	Magnesium (Filtered)	mg/L				240	-	-	-	420	-	-	-	27
	Potassium	mg/L	0.5			-	65	160	67	-	98	-	140	-
	Potassium (Filtered)	mg/L				79	-	-	-	144	-	-	-	18.6
	Sodium	mg/L	0.5			-	1400	4000	1500	-	2300	-	3500	-
	Sodium (Filtered)	mg/L				1910	-	-	-	3600	-	-	-	199
OC Pesticides	Aldrin + Dieldrin - Calc	µg/L				<1	<10	-	-	<1	<10	-	-	<1
	OCPs (Sum of Total) - Calc	µg/L				<10	<90	-	-	<10	<90	-	-	<10
	4,4 DDD	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	4,4 DDE	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	4,4 DDT	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	a-BHC	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Aldrin	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	b-BHC	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	d-BHC	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	DDT + DDD + DDE - Calc	mg/L				<0.002	<0.015	-	-	<0.002	<0.015	-	-	<0.002
	Dieldrin	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Endosulfan I	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Endosulfan II	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Endosulfan sulphate	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Endrin	mg/L	0.005	0.00001		<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Endrin aldehyde	mg/L	0.005			-	<0.005	-	-	-	<0.005	-	-	-
	Endrin ketone	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	g-BHC (Lindane)	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Heptachlor	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Heptachlor epoxide	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Hexachlorobenzene	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Methoxychlor	mg/L	0.005			-	<0.005	-	-	-	<0.005	-	-	-
Phenols	2,3,4,6-tetrachlorophenol	µg/L	10			-	<10	-	-	-	<10	-	-	-
	2,4-dinitrophenol	µg/L	30			-	<30	-	-	-	<30	-	-	-
	2,6-dichlorophenol	µg/L	3			-	<3	-	-	-	<3	-	-	-
	3-methylcholanthrene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	4-nitrophenol	µg/L	30			-	<30	-	-	-	<30	-	-	-
	Acetophenone	µg/L	5			-	<5	-	-	-	<5	-	-	-

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_7_Outfall 17/03/2016	Catchment_7_Outfall 1/04/2016	Catchment_7_Outfall 11/05/2016	Catchment_7_Outfall 13/07/2016	Catchment_8_Outfall 17/03/2016	Catchment_8_Outfall 1/04/2016	Catchment_8_Outfall 18/05/2016	Catchment_8_Outfall 13/07/2016	Catchment_9_Outfall 17/03/2016
	Phenols (Sum of Total) - Calc	µg/L				<17	<168	-	-	<17	<168	-	-	<17
	2,4,5-trichlorophenol	mg/L	0.01			<0.001	<0.01	-	-	<0.001	<0.01	-	-	<0.001
	2,4,6-trichlorophenol	mg/L	0.01			<0.001	<0.01	-	-	<0.001	<0.01	-	-	<0.001
	2,4-dichlorophenol	mg/L	0.003			<0.0005	<0.003	-	-	<0.0005	<0.003	-	-	<0.0005
	2,4-dimethylphenol	mg/L	0.003			<0.0005	<0.003	-	-	<0.0005	<0.003	-	-	<0.0005
	2-chlorophenol	mg/L	0.003			<0.0005	<0.003	-	-	<0.0005	<0.003	-	-	<0.0005
	2-methylnaphthalene	mg/L	0.005			<0.0003	<0.005	-	-	<0.0003	<0.005	-	-	<0.0003
	2-methylphenol	mg/L	0.003			<0.0005	<0.003	-	-	<0.0005	<0.003	-	-	<0.0005
	2-nitrophenol	mg/L	0.01			<0.001	<0.01	-	-	<0.001	<0.01	-	-	<0.001
	3-&4-methylphenol	mg/L	0.006			<0.001	<0.006	-	-	<0.001	<0.006	-	-	<0.001
	4-chloro-3-methylphenol	mg/L	0.01			<0.001	<0.01	-	-	<0.001	<0.01	-	-	<0.001
	Pentachlorophenol	mg/L	0.01	0.033		<0.01	<0.01	-	-	<0.01	<0.01	-	-	<0.01
	Phenol	mg/L	0.003	0.52		<0.001	<0.003	-	-	<0.001	<0.003	-	-	<0.001
VOCs	1,2,3-trichlorobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1,2,4-trichlorobenzene	mg/L	0.005	0.14		<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	1,2-dichlorobenzene	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	1,3-dichlorobenzene	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	1,4-dichlorobenzene	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Hexachlorobutadiene	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
SVOCs	1,2,3,4-tetrachlorobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1,2,3,5-Tetrachlorobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1,2,4,5-tetrachlorobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1,3,5-Trichlorobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1-Chloronaphthalene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1-naphthylamine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	2-naphthylamine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	2-nitroaniline	µg/L	5			-	<5	-	-	-	<5	-	-	-
	3,3-Dichlorobenzidine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	4-(dimethylamino) azobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	4,6-Dinitro-2-methylphenol	µg/L	30			-	<30	-	-	-	<30	-	-	-
	7,12-dimethylbenz(a)anthracene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Aniline	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Benzyl chloride	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Dibenz(a.j)acridine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Diphenylamine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Hexachlorocyclopentadiene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	N-nitrosodi-n-butylamine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	N-nitrosopiperidine	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Pentachlorobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Trifluralin	µg/L	5			-	<5	-	-	-	<5	-	-	-
	1 & 2 Chloronaphthalene	mg/L				<0.0003	-	-	-	<0.0003	-	-	-	<0.0003
	4-bromophenyl phenyl ether	mg/L	0.005			<0.0003	<0.005	-	-	<0.0003	<0.005	-	-	<0.0003
	4-chlorophenyl phenyl ether	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Benzyl alcohol	mg/L				<0.005	-	-	-	<0.005	-	-	-	<0.005
	Bis(2-chloroethoxy) methane	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Bis(2-chloroethyl)ether	mg/L				<0.0005	-	-	-	<0.0005	-	-	-	<0.0005
	Bis(2-chloroisopropyl) ether	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Carbazole	mg/L				<0.0005	-	-	-	<0.0005	-	-	-	<0.0005
	Di(2-ethylhexyl)adipate	mg/L				<0.001	-	-	-	<0.001	-	-	-	<0.001
	Dibenzofuran	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Hexachloroethane	mg/L	0.005			<0.0005	<0.005	-	-	<0.0005	<0.005	-	-	<0.0005
	Isophorone	mg/L				<0.0005	-	-	-	<0.0005	-	-	-	<0.0005
	N-nitrosodi-n-propylamine	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	N-Nitrosodiphenyl & Diphenylamine	mg/L				<0.001	-	-	-	<0.001	-	-	-	<0.001
Phthalates	Bis(2-ethylhexyl) phthalate	mg/L				<0.003	-	-	-	<0.003	-	-	-	<0.003
	Butyl benzyl phthalate	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Diethylphthalate	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Dimethyl phthalate	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Di-n-butyl phthalate	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Di-n-octyl phthalate	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
Biological	Coliform	cfu/100 ml	1			9000	1200	470,000	-	5000	20,000	-	-	500,000
	Faecal Coliform	cfu/100 ml	1			250	730	-	-	800	20,000	-	-	330,000
	Thermotolerant Coliforms	MPN/100ml	1			-	-	-	-	-	-	-	-	-
Chlorinated Hydrocarbons	2-chloronaphthalene	µg/L	5			-	<5	-	-	-	<5	-	-	-
Explosives	2,4-Dinitrotoluene	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	2,6-dinitrotoluene	mg/L	0.005			<0.001	<0.005	-	-	<0.001	<0.005	-	-	<0.001
	Nitrobenzene	mg/L	0.05			<0.0005	<0.05	-	-	<0.0005	<0.05	-	-	<0.0005
Herbicides	Pronamide	µg/L	5			-	<5	-	-	-	<5	-	-	-
Nitroaromatics	2-Picoline	µg/L	5			-	<5	-	-	-	<5	-	-	-
	4-aminobiphenyl	µg/L	5			-	<5	-	-	-	<5	-	-	-
	Pentachloronitrobenzene	µg/L	5			-	<5	-	-	-	<5	-	-	-

					Location Code	Catchment_9_Outfall	Catchment_9_Outfall	Catchment_9_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_10_Outfall	Catchment_10_Outfall
					Sampled Date	1/04/2016	11/05/2016	13/07/2016	1/04/2016	11/05/2016	18/05/2016	13/07/2016	17/03/2016	13/07/2016
Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality									
Field	ORP	mV				6.7	114	-	8	117	-	-	-39.1	-
	SP Conductivity	µS/cm				-	-	-	-	-	-	-	-	-
	SSG	Units				0	-	-	15.1	-	-	-	-	-
	Dissolved Oxygen (Field) %	%				-	-	-	-	-	-	-	42.1	-
	Dissolved Oxygen (Field) % (Filtered)	%				-	71.7	-	-	57	-	-	-	-
	Dissolved Oxygen (Field)	mg/L				-	-	-	-	-	-	-	-	-
	Temp (Field)	oC				20.6	12.7	-	20.2	12.7	-	-	20.8	-
	pH (Field)	pH_Units				8.41	7.67	-	8.34	7.54	-	-	7.58	-
	Electrical Conductivity (Field)	uS/cm				2,294,000	20,710	-	34,790	25,120	-	-	9111	-
Metals	Aluminium	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Aluminium (Filtered)	mg/L	0.05			<0.05	-	-	0.49	-	-	-	<0.006	-
	Antimony	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Antimony (Filtered)	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	0.0004	-
	Arsenic	mg/L	0.001			0.001	0.003	<0.001	0.003	0.003	0.003	0.002	0.0029	0.002
	Arsenic (Filtered)	mg/L	0.001			0.001	-	<0.001	0.003	-	-	<0.001	<0.002	<0.001
	Barium	mg/L	0.02			-	0.03	-	-	0.04	-	-	-	-
	Barium (Filtered)	mg/L	0.02			0.03	-	-	0.03	-	-	-	0.139	-
	Boron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Boron (Filtered)	mg/L	0.05			0.44	-	-	1.3	-	-	-	0.97	-
	Cadmium	mg/L	0.0002	0.014		<0.0002	-	<0.0002	<0.0002	-	0.0007	<0.0002	<0.00011	<0.0002
	Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	-	<0.0002	<0.0002	-	-	<0.0002	<0.0001	<0.0002
	Chromium (III+VI)	mg/L	0.001	0.02		0.006	-	0.005	0.004	-	0.011	0.004	0.0032	0.003
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		0.003	-	0.001	0.003	-	-	<0.001	0.0017	<0.001
	Cobalt	mg/L	0.001	0.014		-	-	-	-	-	-	-	-	-
	Cobalt (Filtered)	mg/L	0.001	0.014		<0.001	-	-	<0.001	-	-	-	0.001	-
	Copper	mg/L	0.001	0.003	0.01	0.012	0.014	0.005	0.003	0.02	0.24	0.002	0.0135	0.01
	Copper (Filtered)	mg/L	0.001	0.003	0.01	0.011	-	0.004	0.002	-	-	<0.001	0.0026	0.002
	Iron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Iron (Filtered)	mg/L	0.05			0.61	-	-	2.8	-	-	-	0.1	-
	Lead	mg/L	0.001	0.0066		<0.001	-	0.002	0.001	-	0.82	<0.001	0.0056	0.01
	Lead (Filtered)	mg/L	0.001	0.0066		<0.001	-	<0.001	0.001	-	-	<0.001	<0.0002	<0.001
	Lithium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Lithium (Filtered)	mg/L	0.005			<0.005	-	-	0.032	-	-	-	0.0174	-
	Manganese	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Manganese (Filtered)	mg/L	0.005			0.065	-	-	0.24	-	-	-	0.95	-
	Mercury	mg/L	0.0001	0.0007		-	-	<0.0001	-	-	<0.0001	<0.0001	<0.00008	<0.0001
	Mercury (Filtered)	mg/L	0.0001	0.0007		-	-	<0.0001	-	-	-	<0.0001	-	<0.0001
	Molybdenum	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Molybdenum (Filtered)	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	0.0031	-
	Nickel	mg/L	0.001	0.2		0.003	-	0.002	0.002	-	0.014	0.001	0.0026	0.004
	Nickel (Filtered)	mg/L	0.001	0.2		0.003	-	0.002	0.001	-	-	<0.001	0.0021	0.001
	Rubidium (Filtered)	mg/L				-	-	-	-	-	-	-	0.025	-
	Selenium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Selenium (Filtered)	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	0.002	-
	Silver	mg/L	0.005	0.0018		-	-	-	-	-	-	-	-	-
	Silver (Filtered)	mg/L	0.005	0.0018		<0.005	-	-	<0.005	-	-	-	<0.0002	-
	Strontium (Filtered)	mg/L				-	-	-	-	-	-	-	0.81	-
	Thallium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Thallium (Filtered)	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0001	-
	Tin	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Tin (Filtered)	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Uranium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Uranium (Filtered)	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	0.00018	-
	Vanadium	mg/L	0.005	0.16		-	-	-	-	-	-	-	-	-
	Vanadium (Filtered)	mg/L	0.005	0.16		<0.005	-	-	<0.005	-	-	-	<0.002	-
	Zinc	mg/L	0.001	0.023	0.03	0.12	0.18	0.11	0.07	0.17	1.6	0.087	0.163	0.2
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.11	-	0.1	0.069	-	-	0.061	0.055	0.042
TPH	C7-C9	mg/L	0.1			<0.1	-	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1
	C10 - C14	mg/L	0.05			<0.2	-	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.2
	C15-C36	mg/L	0.4			<0.4	-	<0.4	<0.4	-	4.6	<0.4	<0.4	<0.4
	C7-C36	mg/L	0.7			<0.7	-	<0.7	<0.7	-	4.6	<0.7	<0.7	<0.7
BTEX & MAH	Benzene	mg/L	0.001	0.9		<0.001	-	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
	BTEX (Sum of Total) - Calc	µg/L				<6	-	<6	<6	-	6.5	<6	<6	<6
	Ethylbenzene	mg/L	0.001			<0.001	-	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
	Toluene	mg/L	0.001			<0.001	-	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
	Xylene (o)	mg/L	0.001			<0.001	-	<0.001	<0.001	-	0.004	<0.001	<0.001	<0.001
	Xylene (m & p)	mg/L	0.002			<0.002	-	<0.002	<0.002	-	<0.002	<0.002	<0.002	<0.002
	Xylene Total	µg/L	3			<3	-	<3	<3	-	5	<3	-	<3
	Xylenes (Sum of Total) - Calc	µg/L				<1	-	<1	<1	-	4	<1	<1	<1
PAH	PAHs (Sum of Total) - Calc	µg/L				<21	-	-	<21	-	-	-	<5.1	-
	Benzo[b+j]fluoranthene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Pyrene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Carcinogenic PAHs (as B(a)P TEQ) - Calc	µg/L				<2.42	-	-	<2.42	-	-	-	<0.726	-

					Location Code	Catchment_9_Outfall	Catchment_9_Outfall	Catchment_9_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_10_Outfall	Catchment_10_Outfall
					Sampled Date	1/04/2016	11/05/2016	13/07/2016	1/04/2016	11/05/2016	18/05/2016	13/07/2016	17/03/2016	13/07/2016
Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality									
	Acenaphthene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Acenaphthylene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Anthracene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Benz(a)anthracene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Benzo(a) pyrene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Benzo(k)fluoranthene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Benzo(g,h,i)perylene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Chrysene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Dibenz(a,h)anthracene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Fluoranthene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Fluorene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Naphthalene	mg/L	0.001	0.09		<0.001	-	-	<0.001	-	-	-	<0.0003	-
	Phenanthrene	mg/L	0.001			<0.001	-	-	<0.001	-	-	-	<0.0003	-
Inorganics	Cesium (Filtered)	mg/L				-	-	-	-	-	-	-	0.0004	-
	Kjeldahl Nitrogen Total	mg/L	0.2			3	-	-	2.2	-	-	-	-	-
	Lanthanum (Filtered)	mg/L				-	-	-	-	-	-	-	<0.0002	-
	Total Dissolved Solids	mg/L				1,474,000	-	-	22,590	-	-	-	-	-
	Total Suspended Solids	mg/L	1		20	9.5	71	6	45	48	310	17	55	80
	Turbidity	NTU				0	-	-	128	-	-	-	-	-
	Salinity	ppt				1.13	-	-	17.13	-	-	-	-	-
Nutrients	Nitrogen (Organic)	µg/L	200			200	-	-	200	-	-	-	-	-
	Ammonia as N	mg/L	0.01	1.2		2.8	0.79	0.63	2	1.2	0.69	1.7	-	12
	Ammonia as N (Filtered)	mg/L		1.2		-	-	-	-	-	-	-	12.3	-
	Nitrate (as N)	mg/L	0.02			1.9	0.74	3	1.8	0.43	-	2.5	0.049	0.13
	Nitrite (as N)	mg/L	0.02			0.15	-	-	0.08	-	-	-	-	-
	Nitrite (as N) (Filtered)	mg/L				-	-	-	-	-	-	-	0.016	-
	Nitrogen (Total)	mg/L	0.2			5.1	-	-	4.1	-	-	-	-	-
	Phosphate total (P)	mg/L	0.05			0.49	-	-	0.06	-	-	-	-	-
	Reactive Phosphorus as P (Filtered)	mg/L				-	-	-	-	-	-	-	<0.004	-
	Sulphate as S	mg/L	5			18	460	10	210	550	-	29	-	8.9
	Nitrate-N + Nitrite-N	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Nitrate-N + Nitrite-N (Filtered)	mg/L				-	-	-	-	-	-	-	0.065	-
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20			-	150	-	-	160	-	-	-	-
	Alkalinity (Bicarbonate as CaCO3)	mg/L	20			130	150	84	160	160	-	170	-	360
	Carbonate Alkalinity (as CaCO3)	mg/L	10			<10	<10	<10	<10	<10	-	<10	-	<10
Major Ions	Calcium	mg/L	0.5			19	180	13	91	230	-	34	-	45
	Calcium (Filtered)	mg/L				-	-	-	-	-	-	-	63	-
	Chloride	mg/L	1			210	11,000	46	4100	13,000	-	450	-	360
	Magnesium	mg/L	0.5			17	590	7.8	230	740	-	39	-	32
	Magnesium (Filtered)	mg/L				-	-	-	-	-	-	-	76	-
	Potassium	mg/L	0.5			18	180	8	79	230	-	22	-	20
	Potassium (Filtered)	mg/L				-	-	-	-	-	-	-	35	-
	Sodium	mg/L	0.5			110	4600	33	1900	6300	-	280	-	210
	Sodium (Filtered)	mg/L				-	-	-	-	-	-	-	610	-
OC Pesticides	Aldrin + Dieldrin - Calc	µg/L				<10	-	-	<10	-	-	-	<1	-
	OCPs (Sum of Total) - Calc	µg/L				<90	-	-	<90	-	-	-	<10	-
	4,4 DDD	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	4,4 DDE	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	4,4 DDT	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	a-BHC	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Aldrin	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	b-BHC	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	d-BHC	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	DDT + DDD + DDE - Calc	mg/L				<0.015	-	-	<0.015	-	-	-	<0.002	-
	Dieldrin	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Endosulfan I	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Endosulfan II	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Endosulfan sulphate	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Endrin	mg/L	0.005	0.00001		<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Endrin aldehyde	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	-	-
	Endrin ketone	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	g-BHC (Lindane)	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Heptachlor	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Heptachlor epoxide	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Hexachlorobenzene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Methoxychlor	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	-	-
Phenols	2,3,4,6-tetrachlorophenol	µg/L	10			<10	-	-	<10	-	-	-	-	-
	2,4-dinitrophenol	µg/L	30			<30	-	-	<30	-	-	-	-	-
	2,6-dichlorophenol	µg/L	3			<3	-	-	<3	-	-	-	-	-
	3-methylcholanthrene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	4-nitrophenol	µg/L	30			<30	-	-	<30	-	-	-	-	-
	Acetophenone	µg/L	5			<5	-	-	<5	-	-	-	-	-

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_9_Outfall	Catchment_9_Outfall	Catchment_9_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_9A_Outfall	Catchment_10_Outfall	Catchment_10_Outfall
					Sampled Date	1/04/2016	11/05/2016	13/07/2016	1/04/2016	11/05/2016	18/05/2016	13/07/2016	17/03/2016	13/07/2016
	Phenols (Sum of Total) - Calc	µg/L				<168	-	-	<168	-	-	-	<17	-
	2,4,5-trichlorophenol	mg/L	0.01			<0.01	-	-	<0.01	-	-	-	<0.001	-
	2,4,6-trichlorophenol	mg/L	0.01			<0.01	-	-	<0.01	-	-	-	<0.001	-
	2,4-dichlorophenol	mg/L	0.003			<0.003	-	-	<0.003	-	-	-	<0.0005	-
	2,4-dimethylphenol	mg/L	0.003			<0.003	-	-	<0.003	-	-	-	<0.0005	-
	2-chlorophenol	mg/L	0.003			<0.003	-	-	<0.003	-	-	-	<0.0005	-
	2-methylnaphthalene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0003	-
	2-methylphenol	mg/L	0.003			<0.003	-	-	<0.003	-	-	-	<0.0005	-
	2-nitrophenol	mg/L	0.01			<0.01	-	-	<0.01	-	-	-	<0.001	-
	3-&4-methylphenol	mg/L	0.006			<0.006	-	-	<0.006	-	-	-	<0.001	-
	4-chloro-3-methylphenol	mg/L	0.01			<0.01	-	-	<0.01	-	-	-	<0.001	-
	Pentachlorophenol	mg/L	0.01	0.033		<0.01	-	-	<0.01	-	-	-	<0.01	-
	Phenol	mg/L	0.003	0.52		<0.003	-	-	<0.003	-	-	-	<0.001	-
VOCs	1,2,3-trichlorobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1,2,4-trichlorobenzene	mg/L	0.005	0.14		<0.005	-	-	<0.005	-	-	-	<0.0005	-
	1,2-dichlorobenzene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	1,3-dichlorobenzene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	1,4-dichlorobenzene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Hexachlorobutadiene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
SVOCs	1,2,3,4-tetrachlorobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1,2,3,5-Tetrachlorobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1,2,4,5-tetrachlorobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1,3,5-Trichlorobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1-Chloronaphthalene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1-naphthylamine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	2-naphthylamine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	2-nitroaniline	µg/L	5			<5	-	-	<5	-	-	-	-	-
	3,3-Dichlorobenzidine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	4-(dimethylamino) azobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	4,6-Dinitro-2-methylphenol	µg/L	30			<30	-	-	<30	-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Aniline	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Benzyl chloride	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Dibenz(a.j)acridine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Diphenylamine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Hexachlorocyclopentadiene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	N-nitrosodi-n-butylamine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	N-nitrosopiperidine	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Pentachlorobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Trifluralin	µg/L	5			<5	-	-	<5	-	-	-	-	-
	1 & 2 Chloronaphthalene	mg/L				-	-	-	-	-	-	-	<0.0003	-
	4-bromophenyl phenyl ether	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0003	-
	4-chlorophenyl phenyl ether	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Benzyl alcohol	mg/L				-	-	-	-	-	-	-	<0.005	-
	Bis(2-chloroethoxy) methane	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Bis(2-chloroethyl)ether	mg/L				-	-	-	-	-	-	-	<0.0005	-
	Bis(2-chloroisopropyl) ether	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Carbazole	mg/L				-	-	-	-	-	-	-	<0.0005	-
	Di(2-ethylhexyl)adipate	mg/L				-	-	-	-	-	-	-	<0.001	-
	Dibenzofuran	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Hexachloroethane	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.0005	-
	Isophorone	mg/L				-	-	-	-	-	-	-	<0.0005	-
	N-nitrosodi-n-propylamine	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	N-Nitrosodiphenyl & Diphenylamine	mg/L				-	-	-	-	-	-	-	<0.001	-
Phthalates	Bis(2-ethylhexyl) phthalate	mg/L				-	-	-	-	-	-	-	<0.003	-
	Butyl benzyl phthalate	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Diethylphthalate	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Dimethyl phthalate	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Di-n-butyl phthalate	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Di-n-octyl phthalate	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
Biological	Coliform	cfu/100 ml	1			500,000	36,000,000	-	-	8,700,000	-	-	4,000,000	-
	Faecal Coliform	cfu/100 ml	1			450,000	-	-	-	-	-	-	1600	-
	Thermotolerant Coliforms	MPN/100ml	1			-	-	-	-	-	-	-	-	-
Chlorinated Hydrocarbons	2-chloronaphthalene	µg/L	5			<5	-	-	<5	-	-	-	-	-
Explosives	2,4-Dinitrotoluene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	2,6-dinitrotoluene	mg/L	0.005			<0.005	-	-	<0.005	-	-	-	<0.001	-
	Nitrobenzene	mg/L	0.05			<0.05	-	-	<0.05	-	-	-	<0.0005	-
Herbicides	Pronamide	µg/L	5			<5	-	-	<5	-	-	-	-	-
Nitroaromatics	2-Picoline	µg/L	5			<5	-	-	<5	-	-	-	-	-
	4-aminobiphenyl	µg/L	5			<5	-	-	<5	-	-	-	-	-
	Pentachloronitrobenzene	µg/L	5			<5	-	-	<5	-	-	-	-	-

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_10_Seep	Catchment_11_Outfall	Catchment_11_Outfall	Catchment_11_Outfall	Catchment_11_Spring	Catchment_11A_Outfal	ANNS_CREEK_LOWER	ANNS_CREEK_UPPER	Anns_Creek
					Sampled Date	12/07/2016	17/03/2016	1/04/2016	13/07/2016	12/07/2016	13/07/2016	12/07/2016	12/07/2016	18/03/2016
Field	ORP	mV				-	219.4	106.8	-	-	-	-74.8	117.3	159.5
	SP Conductivity	µS/cm				-	-	-	-	-	-	447.6	4962	-
	SSG	Units				-	-	0	-	-	-	-	-	17.7
	Dissolved Oxygen (Field) %	%				-	33.7	57.4	-	-	-	61.1	74.5	62.9
	Dissolved Oxygen (Field) % (Filtered)	%				-	-	-	-	-	-	-	-	-
	Dissolved Oxygen (Field)	mg/L				-	-	-	-	-	-	6.23	7.46	-
	Temp (Field)	oC				-	19.4	19.3	-	-	-	14.6	12	22.5
	pH (Field)	pH_Units				-	6.87	8.63	-	-	-	7.78	7.39	7.2
	Electrical Conductivity (Field)	uS/cm				-	1424	2032	-	-	-	358.9	3605	40,550
Metals	Aluminium	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Aluminium (Filtered)	mg/L	0.05			-	0.005	0.25	-	-	-	-	-	-
	Antimony	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Antimony (Filtered)	mg/L	0.005			-	0.0005	<0.005	-	-	-	-	-	-
	Arsenic	mg/L	0.001			0.002	<0.0011	0.001	0.002	0.017	<0.001	<0.001	<0.001	-
	Arsenic (Filtered)	mg/L	0.001			-	<0.001	<0.001	<0.001	-	<0.001	-	-	-
	Barium	mg/L	0.02			-	-	-	-	-	-	-	-	-
	Barium (Filtered)	mg/L	0.02			-	0.04	0.05	-	-	-	-	-	-
	Boron	mg/L	0.05			-	-	-	-	-	-	-	-	-
	Boron (Filtered)	mg/L	0.05			-	1.15	1.4	-	-	-	-	-	-
	Cadmium	mg/L	0.0002	0.014		<0.0002	<0.000053	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
	Cadmium (Filtered)	mg/L	0.0002	0.014		-	<0.00005	<0.0002	<0.0002	-	<0.0002	-	-	-
	Chromium (III+VI)	mg/L	0.001	0.02		<0.001	0.00083	0.001	0.003	0.002	<0.001	<0.001	<0.001	-
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		-	<0.0005	<0.001	<0.001	-	<0.001	-	-	-
	Cobalt	mg/L	0.001	0.014		-	-	-	-	-	-	-	-	-
	Cobalt (Filtered)	mg/L	0.001	0.014		-	<0.0002	<0.001	-	-	-	-	-	-
	Copper	mg/L	0.001	0.003	0.01	0.002	0.005	0.004	0.006	0.008	<0.001	0.002	0.003	-
	Copper (Filtered)	mg/L	0.001	0.003	0.01	-	0.0032	0.003	0.002	-	<0.001	-	-	-
	Iron	mg/L	0.05			<0.05	-	-	-	120	-	-	-	-
	Iron (Filtered)	mg/L	0.05			-	<0.02	2.7	-	-	-	-	-	-
	Lead	mg/L	0.001	0.0066		<0.001	0.00093	0.002	0.005	0.021	<0.001	<0.001	<0.001	-
	Lead (Filtered)	mg/L	0.001	0.0066		-	<0.0001	0.001	<0.001	-	<0.001	-	-	-
	Lithium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Lithium (Filtered)	mg/L	0.005			-	0.0092	0.006	-	-	-	-	-	-
	Manganese	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Manganese (Filtered)	mg/L	0.005			-	0.147	0.2	-	-	-	-	-	-
	Mercury	mg/L	0.0001	0.0007		<0.0001	<0.00008	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
	Mercury (Filtered)	mg/L	0.0001	0.0007		-	-	-	<0.0001	-	<0.0001	-	-	-
	Molybdenum	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Molybdenum (Filtered)	mg/L	0.005			-	0.0051	<0.005	-	-	-	-	-	-
	Nickel	mg/L	0.001	0.2		0.002	0.00094	0.002	0.003	0.011	<0.001	0.001	0.002	-
	Nickel (Filtered)	mg/L	0.001	0.2		-	0.0007	0.001	0.001	-	<0.001	-	-	-
	Rubidium (Filtered)	mg/L				-	0.0177	-	-	-	-	-	-	-
	Selenium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Selenium (Filtered)	mg/L	0.001			-	<0.001	<0.001	-	-	-	-	-	-
	Silver	mg/L	0.005	0.0018		-	-	-	-	-	-	-	-	-
	Silver (Filtered)	mg/L	0.005	0.0018		-	<0.0001	<0.005	-	-	-	-	-	-
	Strontium (Filtered)	mg/L				-	0.57	-	-	-	-	-	-	-
	Thallium	mg/L	0.001			-	-	-	-	-	-	-	-	-
	Thallium (Filtered)	mg/L	0.001			-	<0.00005	<0.001	-	-	-	-	-	-
	Tin	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Tin (Filtered)	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Uranium	mg/L	0.005			-	-	-	-	-	-	-	-	-
	Uranium (Filtered)	mg/L	0.005			-	0.00012	<0.005	-	-	-	-	-	-
	Vanadium	mg/L	0.005	0.16		-	-	-	-	-	-	-	-	-
	Vanadium (Filtered)	mg/L	0.005	0.16		-	<0.001	<0.005	-	-	-	-	-	-
	Zinc	mg/L	0.001	0.023	0.03	0.009	0.072	0.074	0.13	0.077	0.007	0.019	0.031	-
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	-	0.03	0.065	0.019	-	0.002	-	-	-
TPH	C7-C9	mg/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
	C10 - C14	mg/L	0.05			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-
	C15-C36	mg/L	0.4			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	-
	C7-C36	mg/L	0.7			<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	-
BTEX & MAH	Benzene	mg/L	0.001	0.9		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
	BTEX (Sum of Total) - Calc	µg/L				<6	<6	<6	<6	<6	<6	<6	<6	-
	Ethylbenzene	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
	Toluene	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
	Xylene (o)	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
	Xylene (m & p)	mg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
	Xylene Total	µg/L	3			<3	-	<3	<3	<3	<3	<3	<3	-
	Xylenes (Sum of Total) - Calc	µg/L				<1	<1	<1	<1	<1	<1	<1	<1	-
PAH	PAHs (Sum of Total) - Calc	µg/L				-	<5.1	<21	-	-	-	-	-	-
	Benzo[b+j]fluoranthene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Pyrene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Carcinogenic PAHs (as B(a)P TEQ) - Calc	µg/L				-	<0.726	<2.42	-	-	-	-	-	-

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_10_Seep	Catchment_11_Outfall	Catchment_11_Outfall	Catchment_11_Outfall	Catchment_11_Spring	Catchment_11A_Outfal	ANNS_CREEK_LOWER	ANNS_CREEK_UPPER	Anns_Creek
					Sampled Date	12/07/2016	17/03/2016	1/04/2016	13/07/2016	12/07/2016	13/07/2016	12/07/2016	12/07/2016	18/03/2016
	Acenaphthene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Acenaphthylene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Anthracene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Benz(a)anthracene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Benzo(a) pyrene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Benzo(k)fluoranthene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Benzo(g,h,i)perylene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Chrysene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Dibenz(a,h)anthracene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Fluoranthene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Fluorene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
	Naphthalene	mg/L	0.001	0.09		-	<0.0003	<0.001	-	-	-	-	-	-
	Phenanthrene	mg/L	0.001			-	<0.0003	<0.001	-	-	-	-	-	-
Inorganics	Cesium (Filtered)	mg/L				-	0.00021	-	-	-	-	-	-	-
	Kjeldahl Nitrogen Total	mg/L	0.2			160	-	0.5	-	1.1	-	0.5	0.5	-
	Lanthanum (Filtered)	mg/L				-	<0.0001	-	-	-	-	-	-	-
	Total Dissolved Solids	mg/L				-	-	-	-	-	-	-	-	26,310
	Total Suspended Solids	mg/L	1		20	80	19	31	29	2100	2.1	10	5	-
	Turbidity	NTU				-	-	-	-	-	-	-	-	0
	Salinity	ppt				-	-	-	-	-	-	-	-	20.22
Nutrients	Nitrogen (Organic)	µg/L	200			150,000	-	400	-	500	-	200	400	-
	Ammonia as N	mg/L	0.01	1.2		12	-	0.15	1.4	0.64	4.9	0.27	0.14	-
	Ammonia as N (Filtered)	mg/L		1.2		-	0.152	-	-	-	-	-	-	-
	Nitrate (as N)	mg/L	0.02			0.33	0.65	2.7	1.8	0.33	0.32	1.5	1.4	-
	Nitrite (as N)	mg/L	0.02			0.02	-	0.08	-	0.06	-	<0.02	0.02	-
	Nitrite (as N) (Filtered)	mg/L				-	0.24	-	-	-	-	-	-	-
	Nitrogen (Total)	mg/L	0.2			160	-	3.3	-	1.5	-	2	2	-
	Phosphate total (P)	mg/L	0.05			-	-	<0.05	-	-	-	-	-	-
	Reactive Phosphorus as P (Filtered)	mg/L				-	<0.004	-	-	-	-	-	-	-
	Sulphate as S	mg/L	5			16	-	22	21	58	5	84	15	-
	Nitrate-N + Nitrite-N	mg/L	0.05			0.36	-	-	-	0.39	-	1.5	1.5	-
	Nitrate-N + Nitrite-N (Filtered)	mg/L				-	0.89	-	-	-	-	-	-	-
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20			-	-	-	-	-	-	-	-	-
	Alkalinity (Bicarbonate as CaCO3)	mg/L	20			490	-	410	400	960	110	170	130	-
	Carbonate Alkalinity (as CaCO3)	mg/L	10			<10	-	<10	<10	<10	<10	<10	<10	-
Major Ions	Calcium	mg/L	0.5			62	-	84	84	220	19	53	24	-
	Calcium (Filtered)	mg/L				-	74	-	-	-	-	-	-	-
	Chloride	mg/L	1			440	-	32	31	59	55	1300	42	-
	Magnesium	mg/L	0.5			48	-	20	21	31	7.5	100	13	-
	Magnesium (Filtered)	mg/L				-	13.7	-	-	-	-	-	-	-
	Potassium	mg/L	0.5			22	-	18	17	26	4.7	33	5.8	-
	Potassium (Filtered)	mg/L				-	14.4	-	-	-	-	-	-	-
	Sodium	mg/L	0.5			270	-	61	59	93	42	790	45	-
	Sodium (Filtered)	mg/L				-	42	-	-	-	-	-	-	-
OC Pesticides	Aldrin + Dieldrin - Calc	µg/L				-	<1	<10	-	-	-	-	-	-
	OCPs (Sum of Total) - Calc	µg/L				-	<10	<90	-	-	-	-	-	-
	4,4 DDD	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	4,4 DDE	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	4,4 DDT	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	a-BHC	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Aldrin	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	b-BHC	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	d-BHC	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	DDT + DDD + DDE - Calc	mg/L				-	<0.002	<0.015	-	-	-	-	-	-
	Dieldrin	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Endosulfan I	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Endosulfan II	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Endosulfan sulphate	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Endrin	mg/L	0.005	0.00001		-	<0.0005	<0.005	-	-	-	-	-	-
	Endrin aldehyde	mg/L	0.005			-	-	<0.005	-	-	-	-	-	-
	Endrin ketone	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	g-BHC (Lindane)	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Heptachlor	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Heptachlor epoxide	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Hexachlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Methoxychlor	mg/L	0.005			-	-	<0.005	-	-	-	-	-	-
Phenols	2,3,4,6-tetrachlorophenol	µg/L	10			-	-	<10	-	-	-	-	-	-
	2,4-dinitrophenol	µg/L	30			-	-	<30	-	-	-	-	-	-
	2,6-dichlorophenol	µg/L	3			-	-	<3	-	-	-	-	-	-
	3-methylcholanthrene	µg/L	5			-	-	<5	-	-	-	-	-	-
	4-nitrophenol	µg/L	30			-	-	<30	-	-	-	-	-	-
	Acetophenone	µg/L	5			-	-	<5	-	-	-	-	-	-

Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality	Catchment_10_Seep	Catchment_11_Outfall	Catchment_11_Outfall	Catchment_11_Outfall	Catchment_11_Spring	Catchment_11A_Outfal	ANNS_CREEK_LOWER	ANNS_CREEK_UPPER	Anns_Creek
					Sampled Date	12/07/2016	17/03/2016	1/04/2016	13/07/2016	12/07/2016	13/07/2016	12/07/2016	12/07/2016	18/03/2016
	Phenols (Sum of Total) - Calc	µg/L				-	<17	<168	-	-	-	-	-	-
	2,4,5-trichlorophenol	mg/L	0.01			-	<0.001	<0.01	-	-	-	-	-	-
	2,4,6-trichlorophenol	mg/L	0.01			-	<0.001	<0.01	-	-	-	-	-	-
	2,4-dichlorophenol	mg/L	0.003			-	<0.0005	<0.003	-	-	-	-	-	-
	2,4-dimethylphenol	mg/L	0.003			-	<0.0005	<0.003	-	-	-	-	-	-
	2-chlorophenol	mg/L	0.003			-	<0.0005	<0.003	-	-	-	-	-	-
	2-methylnaphthalene	mg/L	0.005			-	<0.0003	<0.005	-	-	-	-	-	-
	2-methylphenol	mg/L	0.003			-	<0.0005	<0.003	-	-	-	-	-	-
	2-nitrophenol	mg/L	0.01			-	<0.001	<0.01	-	-	-	-	-	-
	3-&4-methylphenol	mg/L	0.006			-	<0.001	<0.006	-	-	-	-	-	-
	4-chloro-3-methylphenol	mg/L	0.01			-	<0.001	<0.01	-	-	-	-	-	-
	Pentachlorophenol	mg/L	0.01	0.033		-	<0.01	<0.01	-	-	-	-	-	-
	Phenol	mg/L	0.003	0.52		-	<0.001	<0.003	-	-	-	-	-	-
VOCs	1,2,3-trichlorobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	1,2,4-trichlorobenzene	mg/L	0.005	0.14		-	<0.0005	<0.005	-	-	-	-	-	-
	1,2-dichlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	1,3-dichlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	1,4-dichlorobenzene	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Hexachlorobutadiene	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
SVOCs	1,2,3,4-tetrachlorobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	1,2,3,5-Tetrachlorobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	1,2,4,5-tetrachlorobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	1,3,5-Trichlorobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	1-Chloronaphthalene	µg/L	5			-	-	<5	-	-	-	-	-	-
	1-naphthylamine	µg/L	5			-	-	<5	-	-	-	-	-	-
	2-naphthylamine	µg/L	5			-	-	<5	-	-	-	-	-	-
	2-nitroaniline	µg/L	5			-	-	<5	-	-	-	-	-	-
	3,3-Dichlorobenzidine	µg/L	5			-	-	<5	-	-	-	-	-	-
	4-(dimethylamino) azobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	4,6-Dinitro-2-methylphenol	µg/L	30			-	-	<30	-	-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	µg/L	5			-	-	<5	-	-	-	-	-	-
	Aniline	µg/L	5			-	-	<5	-	-	-	-	-	-
	Benzyl chloride	µg/L	5			-	-	<5	-	-	-	-	-	-
	Dibenz(a.j)acridine	µg/L	5			-	-	<5	-	-	-	-	-	-
	Diphenylamine	µg/L	5			-	-	<5	-	-	-	-	-	-
	Hexachlorocyclopentadiene	µg/L	5			-	-	<5	-	-	-	-	-	-
	N-nitrosodi-n-butylamine	µg/L	5			-	-	<5	-	-	-	-	-	-
	N-nitrosopiperidine	µg/L	5			-	-	<5	-	-	-	-	-	-
	Pentachlorobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-
	Trifluralin	µg/L	5			-	-	<5	-	-	-	-	-	-
	1 & 2 Chloronaphthalene	mg/L				-	<0.0003	-	-	-	-	-	-	-
	4-bromophenyl phenyl ether	mg/L	0.005			-	<0.0003	<0.005	-	-	-	-	-	-
	4-chlorophenyl phenyl ether	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Benzyl alcohol	mg/L				-	<0.005	-	-	-	-	-	-	-
	Bis(2-chloroethoxy) methane	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Bis(2-chloroethyl)ether	mg/L				-	<0.0005	-	-	-	-	-	-	-
	Bis(2-chloroisopropyl) ether	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Carbazole	mg/L				-	<0.0005	-	-	-	-	-	-	-
	Di(2-ethylhexyl)adipate	mg/L				-	<0.001	-	-	-	-	-	-	-
	Dibenzofuran	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Hexachloroethane	mg/L	0.005			-	<0.0005	<0.005	-	-	-	-	-	-
	Isophorone	mg/L				-	<0.0005	-	-	-	-	-	-	-
	N-nitrosodi-n-propylamine	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	N-Nitrosodiphenyl & Diphenylamine	mg/L				-	<0.001	-	-	-	-	-	-	-
Phthalates	Bis(2-ethylhexyl) phthalate	mg/L				-	<0.003	-	-	-	-	-	-	-
	Butyl benzyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Diethylphthalate	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Dimethyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Di-n-butyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Di-n-octyl phthalate	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
Biological	Coliform	cfu/100 ml	1			-	6000	1700	-	-	-	-	-	-
	Faecal Coliform	cfu/100 ml	1			-	800	280	-	-	-	-	-	-
	Thermotolerant Coliforms	MPN/100ml	1			-	-	-	-	-	-	-	-	-
Chlorinated Hydrocarbons	2-chloronaphthalene	µg/L	5			-	-	<5	-	-	-	-	-	-
Explosives	2,4-Dinitrotoluene	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	2,6-dinitrotoluene	mg/L	0.005			-	<0.001	<0.005	-	-	-	-	-	-
	Nitrobenzene	mg/L	0.05			-	<0.0005	<0.05	-	-	-	-	-	-
Herbicides	Pronamide	µg/L	5			-	-	<5	-	-	-	-	-	-
Nitroaromatics	2-Picoline	µg/L	5			-	-	<5	-	-	-	-	-	-
	4-aminobiphenyl	µg/L	5			-	-	<5	-	-	-	-	-	-
	Pentachloronitrobenzene	µg/L	5			-	-	<5	-	-	-	-	-	-

Appendix X
Table X
Table Title

					Location Code	Boycroft_Stream	Boycroft_Stream	MIAMI_STREAM_LOWER	MIAMI_STREAM_LOWER	MIAMI_STREAM_UPPER
					Sampled Date	17/03/2016	13/07/2016	11/05/2016	12/07/2016	12/07/2016
Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality					
Field	ORP	mV				42.9	-	-	215.8	-
	SP Conductivity	µS/cm				-	-	-	15,510	-
	SSG	Units				-	-	-	-	-
	Dissolved Oxygen (Field) %	%				56.6	-	-	12.3	-
	Dissolved Oxygen (Field) % (Filtered)	%				-	-	-	-	-
	Dissolved Oxygen (Field)	mg/L				-	-	-	1.35	-
	Temp (Field)	oC				19.2	-	-	15.1	-
	pH (Field)	pH_Units				8.35	-	-	7.03	-
	Electrical Conductivity (Field)	uS/cm				3250	-	-	11,250	-
Metals	Aluminium	mg/L	0.05			-	-	-	-	-
	Aluminium (Filtered)	mg/L	0.05			0.04	-	-	-	-
	Antimony	mg/L	0.005			-	-	-	-	-
	Antimony (Filtered)	mg/L	0.005			0.0011	-	-	-	-
	Arsenic	mg/L	0.001			<0.0011	<0.001	-	0.035	<0.001
	Arsenic (Filtered)	mg/L	0.001			<0.001	<0.001	-	-	-
	Barium	mg/L	0.02			-	-	-	-	-
	Barium (Filtered)	mg/L	0.02			0.0121	-	-	-	-
	Boron	mg/L	0.05			-	-	-	-	-
	Boron (Filtered)	mg/L	0.05			0.32	-	-	-	-
	Cadmium	mg/L	0.0002	0.014		<0.000053	<0.0002	-	0.015	0.027
	Cadmium (Filtered)	mg/L	0.0002	0.014		<0.00005	<0.0002	-	-	-
	Chromium (III+VI)	mg/L	0.001	0.02		0.0138	0.028	-	0.001	<0.001
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		0.0078	0.006	-	-	-
	Cobalt	mg/L	0.001	0.014		-	-	-	-	-
	Cobalt (Filtered)	mg/L	0.001	0.014		<0.0002	-	-	-	-
	Copper	mg/L	0.001	0.003	0.01	0.0029	0.003	-	0.37	0.97
	Copper (Filtered)	mg/L	0.001	0.003	0.01	0.0021	0.002	-	-	-
	Iron	mg/L	0.05			-	-	-	-	-
	Iron (Filtered)	mg/L	0.05			0.17	-	-	-	-
	Lead	mg/L	0.001	0.0066		0.00052	<0.001	-	0.003	<0.001
	Lead (Filtered)	mg/L	0.001	0.0066		<0.0001	<0.001	-	-	-
	Lithium	mg/L	0.005			-	-	-	-	-
	Lithium (Filtered)	mg/L	0.005			0.0043	-	-	-	-
	Manganese	mg/L	0.005			-	-	-	-	-
	Manganese (Filtered)	mg/L	0.005			0.04	-	-	-	-
	Mercury	mg/L	0.0001	0.0007		<0.00008	<0.0001	-	<0.0001	<0.0001
	Mercury (Filtered)	mg/L	0.0001	0.0007		-	<0.0001	-	-	-
	Molybdenum	mg/L	0.005			-	-	-	-	-
	Molybdenum (Filtered)	mg/L	0.005			0.0018	-	-	-	-
	Nickel	mg/L	0.001	0.2		0.00062	<0.001	-	0.028	0.039
	Nickel (Filtered)	mg/L	0.001	0.2		<0.0005	<0.001	-	-	-
	Rubidium (Filtered)	mg/L				0.0112	-	-	-	-
	Selenium	mg/L	0.001			-	-	-	-	-
	Selenium (Filtered)	mg/L	0.001			<0.001	-	-	-	-
	Silver	mg/L	0.005	0.0018		-	-	-	-	-
	Silver (Filtered)	mg/L	0.005	0.0018		<0.0001	-	-	-	-
	Strontium (Filtered)	mg/L				0.27	-	-	-	-
	Thallium	mg/L	0.001			-	-	-	-	-
	Thallium (Filtered)	mg/L	0.001			<0.00005	-	-	-	-
	Tin	mg/L	0.005			-	-	-	-	-
	Tin (Filtered)	mg/L	0.005			<0.0005	-	-	-	-
	Uranium	mg/L	0.005			-	-	-	-	-
	Uranium (Filtered)	mg/L	0.005			0.00008	-	-	-	-
	Vanadium	mg/L	0.005	0.16		-	-	-	-	-
	Vanadium (Filtered)	mg/L	0.005	0.16		0.0023	-	-	-	-
	Zinc	mg/L	0.001	0.023	0.03	0.021	0.023	-	0.16	0.19
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.0149	0.015	-	-	-
TPH	C7-C9	mg/L	0.1			<0.1	<0.1	2.8	<0.1	<0.1
	C10 - C14	mg/L	0.05			<0.2	<0.2	<0.2	<0.2	<0.2
	C15-C36	mg/L	0.4			<0.4	<0.4	2.7	<0.4	<0.4
	C7-C36	mg/L	0.7			<0.7	<0.7	5.5	<0.7	<0.7
BTEX & MAH	Benzene	mg/L	0.001	0.9		<0.001	<0.001	<0.001	<0.001	<0.001
	BTEX (Sum of Total) - Calc	µg/L				<6	<6	<6	<6	<6
	Ethylbenzene	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
	Toluene	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (o)	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (m & p)	mg/L	0.002			<0.002	<0.002	<0.002	<0.002	<0.002
	Xylene Total	µg/L	3			-	<3	<3	<3	<3
	Xylenes (Sum of Total) - Calc	µg/L				<1	<1	<1	<1	<1
PAH	PAHs (Sum of Total) - Calc	µg/L				<5.1	-	-	-	-
	Benzo[b+j]fluoranthene	mg/L	0.001			<0.0003	-	-	-	-
	Pyrene	mg/L	0.001			<0.0003	-	-	-	-
	Carcinogenic PAHs (as B(a)P TEQ) - Calc	µg/L				<0.726	-	-	-	-

					Location Code	Boycroft_Stream	Boycroft_Stream	MIAMI_STREAM_LOWER	MIAMI_STREAM_LOWER	MIAMI_STREAM_UPPER
					Sampled Date	17/03/2016	13/07/2016	11/05/2016	12/07/2016	12/07/2016
Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality					
	Acenaphthene	mg/L	0.001			<0.0003	-	-	-	-
	Acenaphthylene	mg/L	0.001			<0.0003	-	-	-	-
	Anthracene	mg/L	0.001			<0.0003	-	-	-	-
	Benz(a)anthracene	mg/L	0.001			<0.0003	-	-	-	-
	Benzo(a) pyrene	mg/L	0.001			<0.0003	-	-	-	-
	Benzo(k)fluoranthene	mg/L	0.001			<0.0003	-	-	-	-
	Benzo(g,h,i)perylene	mg/L	0.001			<0.0003	-	-	-	-
	Chrysene	mg/L	0.001			<0.0003	-	-	-	-
	Dibenz(a,h)anthracene	mg/L	0.001			<0.0003	-	-	-	-
	Fluoranthene	mg/L	0.001			<0.0003	-	-	-	-
	Fluorene	mg/L	0.001			<0.0003	-	-	-	-
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			<0.0003	-	-	-	-
	Naphthalene	mg/L	0.001	0.09		<0.0003	-	-	-	-
	Phenanthrene	mg/L	0.001			<0.0003	-	-	-	-
Inorganics	Cesium (Filtered)	mg/L				0.00012	-	-	-	-
	Kjeldahl Nitrogen Total	mg/L	0.2			-	-	-	190	4.8
	Lanthanum (Filtered)	mg/L				<0.0001	-	-	-	-
	Total Dissolved Solids	mg/L				-	-	-	-	-
	Total Suspended Solids	mg/L	1		20	18	4.1	-	11	4.8
	Turbidity	NTU				-	-	-	-	-
	Salinity	ppt				-	-	-	-	-
Nutrients	Nitrogen (Organic)	µg/L	200			-	-	-	190,000	600
	Ammonia as N	mg/L	0.01	1.2		-	0.09	-	3.4	4.2
	Ammonia as N (Filtered)	mg/L		1.2		0.1	-	-	-	-
	Nitrate (as N)	mg/L	0.02			2.1	2.8	-	4	3.6
	Nitrite (as N)	mg/L	0.02			-	-	-	0.12	0.05
	Nitrite (as N) (Filtered)	mg/L				0.014	-	-	-	-
	Nitrogen (Total)	mg/L	0.2			-	-	-	190	8.5
	Phosphate total (P)	mg/L	0.05			-	-	-	-	-
	Reactive Phosphorus as P (Filtered)	mg/L				0.029	-	-	-	-
	Sulphate as S	mg/L	5			-	12	-	160	150
	Nitrate-N + Nitrite-N	mg/L	0.05			-	-	-	4.1	3.7
	Nitrate-N + Nitrite-N (Filtered)	mg/L				2.1	-	-	-	-
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20			-	-	-	-	-
	Alkalinity (Bicarbonate as CaCO3)	mg/L	20			-	110	-	280	230
	Carbonate Alkalinity (as CaCO3)	mg/L	10			-	<10	-	<10	<10
Major Ions	Calcium	mg/L	0.5			-	20	-	92	63
	Calcium (Filtered)	mg/L				23	-	-	-	-
	Chloride	mg/L	1			-	100	-	2700	2200
	Magnesium	mg/L	0.5			-	13	-	200	100
	Magnesium (Filtered)	mg/L				29	-	-	-	-
	Potassium	mg/L	0.5			-	10	-	70	35
	Potassium (Filtered)	mg/L				16.8	-	-	-	-
	Sodium	mg/L	0.5			-	71	-	1600	640
	Sodium (Filtered)	mg/L				230	-	-	-	-
OC Pesticides	Aldrin + Dieldrin - Calc	µg/L				<1	-	-	-	-
	OCPs (Sum of Total) - Calc	µg/L				<10	-	-	-	-
	4,4 DDD	mg/L	0.005			<0.0005	-	-	-	-
	4,4 DDE	mg/L	0.005			<0.0005	-	-	-	-
	4,4 DDT	mg/L	0.005			<0.001	-	-	-	-
	a-BHC	mg/L	0.005			<0.0005	-	-	-	-
	Aldrin	mg/L	0.005			<0.0005	-	-	-	-
	b-BHC	mg/L	0.005			<0.0005	-	-	-	-
	d-BHC	mg/L	0.005			<0.0005	-	-	-	-
	DDT + DDD + DDE - Calc	mg/L				<0.002	-	-	-	-
	Dieldrin	mg/L	0.005			<0.0005	-	-	-	-
	Endosulfan I	mg/L	0.005			<0.001	-	-	-	-
	Endosulfan II	mg/L	0.005			<0.001	-	-	-	-
	Endosulfan sulphate	mg/L	0.005			<0.001	-	-	-	-
	Endrin	mg/L	0.005	0.00001		<0.0005	-	-	-	-
	Endrin aldehyde	mg/L	0.005			-	-	-	-	-
	Endrin ketone	mg/L	0.005			<0.001	-	-	-	-
	g-BHC (Lindane)	mg/L	0.005			<0.0005	-	-	-	-
	Heptachlor	mg/L	0.005			<0.0005	-	-	-	-
	Heptachlor epoxide	mg/L	0.005			<0.0005	-	-	-	-
	Hexachlorobenzene	mg/L	0.005			<0.0005	-	-	-	-
	Methoxychlor	mg/L	0.005			-	-	-	-	-
Phenols	2,3,4,6-tetrachlorophenol	µg/L	10			-	-	-	-	-
	2,4-dinitrophenol	µg/L	30			-	-	-	-	-
	2,6-dichlorophenol	µg/L	3			-	-	-	-	-
	3-methylcholanthrene	µg/L	5			-	-	-	-	-
	4-nitrophenol	µg/L	30			-	-	-	-	-
	Acetophenone	µg/L	5			-	-	-	-	-

					Location Code	Boycroft_Stream	Boycroft_Stream	MIAMI_STREAM_LOWER	MIAMI_STREAM_LOWER	MIAMI_STREAM_UPPER
					Sampled Date	17/03/2016	13/07/2016	11/05/2016	12/07/2016	12/07/2016
Chem Group	Chem Name	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality					
	Phenols (Sum of Total) - Calc	µg/L				<17	-	-	-	-
	2,4,5-trichlorophenol	mg/L	0.01			<0.001	-	-	-	-
	2,4,6-trichlorophenol	mg/L	0.01			<0.001	-	-	-	-
	2,4-dichlorophenol	mg/L	0.003			<0.0005	-	-	-	-
	2,4-dimethylphenol	mg/L	0.003			<0.0005	-	-	-	-
	2-chlorophenol	mg/L	0.003			<0.0005	-	-	-	-
	2-methylnaphthalene	mg/L	0.005			<0.0003	-	-	-	-
	2-methylphenol	mg/L	0.003			<0.0005	-	-	-	-
	2-nitrophenol	mg/L	0.01			<0.001	-	-	-	-
	3-&4-methylphenol	mg/L	0.006			<0.001	-	-	-	-
	4-chloro-3-methylphenol	mg/L	0.01			<0.001	-	-	-	-
	Pentachlorophenol	mg/L	0.01	0.033		<0.01	-	-	-	-
	Phenol	mg/L	0.003	0.52		<0.001	-	-	-	-
VOCs	1,2,3-trichlorobenzene	µg/L	5			-	-	-	-	-
	1,2,4-trichlorobenzene	mg/L	0.005	0.14		<0.0005	-	-	-	-
	1,2-dichlorobenzene	mg/L	0.005			<0.0005	-	-	-	-
	1,3-dichlorobenzene	mg/L	0.005			<0.0005	-	-	-	-
	1,4-dichlorobenzene	mg/L	0.005			<0.0005	-	-	-	-
	Hexachlorobutadiene	mg/L	0.005			<0.0005	-	-	-	-
SVOCs	1,2,3,4-tetrachlorobenzene	µg/L	5			-	-	-	-	-
	1,2,3,5-Tetrachlorobenzene	µg/L	5			-	-	-	-	-
	1,2,4,5-tetrachlorobenzene	µg/L	5			-	-	-	-	-
	1,3,5-Trichlorobenzene	µg/L	5			-	-	-	-	-
	1-Chloronaphthalene	µg/L	5			-	-	-	-	-
	1-naphthylamine	µg/L	5			-	-	-	-	-
	2-naphthylamine	µg/L	5			-	-	-	-	-
	2-nitroaniline	µg/L	5			-	-	-	-	-
	3,3-Dichlorobenzidine	µg/L	5			-	-	-	-	-
	4-(dimethylamino) azobenzene	µg/L	5			-	-	-	-	-
	4,6-Dinitro-2-methylphenol	µg/L	30			-	-	-	-	-
	7,12-dimethylbenz(a)anthracene	µg/L	5			-	-	-	-	-
	Aniline	µg/L	5			-	-	-	-	-
	Benzyl chloride	µg/L	5			-	-	-	-	-
	Dibenz(a.j)acridine	µg/L	5			-	-	-	-	-
	Diphenylamine	µg/L	5			-	-	-	-	-
	Hexachlorocyclopentadiene	µg/L	5			-	-	-	-	-
	N-nitrosodi-n-butylamine	µg/L	5			-	-	-	-	-
	N-nitrosopiperidine	µg/L	5			-	-	-	-	-
	Pentachlorobenzene	µg/L	5			-	-	-	-	-
	Trifluralin	µg/L	5			-	-	-	-	-
	1 & 2 Chloronaphthalene	mg/L				<0.0003	-	-	-	-
	4-bromophenyl phenyl ether	mg/L	0.005			<0.0003	-	-	-	-
	4-chlorophenyl phenyl ether	mg/L	0.005			<0.0005	-	-	-	-
	Benzyl alcohol	mg/L				<0.005	-	-	-	-
	Bis(2-chloroethoxy) methane	mg/L	0.005			<0.0005	-	-	-	-
	Bis(2-chloroethyl)ether	mg/L				<0.0005	-	-	-	-
	Bis(2-chloroisopropyl) ether	mg/L	0.005			<0.0005	-	-	-	-
	Carbazole	mg/L				<0.0005	-	-	-	-
	Di(2-ethylhexyl)adipate	mg/L				<0.001	-	-	-	-
	Dibenzofuran	mg/L	0.005			<0.0005	-	-	-	-
	Hexachloroethane	mg/L	0.005			<0.0005	-	-	-	-
	Isophorone	mg/L				<0.0005	-	-	-	-
	N-nitrosodi-n-propylamine	mg/L	0.005			<0.001	-	-	-	-
	N-Nitrosodiphenyl & Diphenylamine	mg/L				<0.001	-	-	-	-
Phthalates	Bis(2-ethylhexyl) phthalate	mg/L				<0.003	-	-	-	-
	Butyl benzyl phthalate	mg/L	0.005			<0.001	-	-	-	-
	Diethylphthalate	mg/L	0.005			<0.001	-	-	-	-
	Dimethyl phthalate	mg/L	0.005			<0.001	-	-	-	-
	Di-n-butyl phthalate	mg/L	0.005			<0.001	-	-	-	-
	Di-n-octyl phthalate	mg/L	0.005			<0.001	-	-	-	-
Biological	Coliform	cfu/100 ml	1			1300	-	-	-	-
	Faecal Coliform	cfu/100 ml	1			550	-	-	-	-
	Thermotolerant Coliforms	MPN/100ml	1			-	-	-	-	-
Chlorinated Hydrocarbons	2-chloronaphthalene	µg/L	5			-	-	-	-	-
Explosives	2,4-Dinitrotoluene	mg/L	0.005			<0.001	-	-	-	-
	2,6-dinitrotoluene	mg/L	0.005			<0.001	-	-	-	-
	Nitrobenzene	mg/L	0.05			<0.0005	-	-	-	-
Herbicides	Pronamide	µg/L	5			-	-	-	-	-
Nitroaromatics	2-Picoline	µg/L	5			-	-	-	-	-
	4-aminobiphenyl	µg/L	5			-	-	-	-	-
	Pentachloronitrobenzene	µg/L	5			-	-	-	-	-

Appendix X
Table X
Table Title

					Location Code	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1	Catchment_9A_FF1
					Sampled Date	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
					Field ID	EWL_9A_1331	EWL_9A_1336	EWL_9A_1341	EWL_9A_1346	EWL_9A_1350	EWL_9A_1354	EWL_9A_1357	EWL_9A_1405	EWL_9A_1417	EWL_9A_1435
					Sample Code	M16-Jn00665	M16-Jn00666	M16-My19411	M16-My19412	M16-My19413	M16-My19414	M16-My19415	M16-My19416	M16-My19417	M16-My19418
					Lab Report Number	502718	502718	501165	501165	501165	501165	501165	501165	501165	501165
				ANZECC 2000 MW 90%	PAUP - Stormwater Quality										
Chem Group	**Chem Name**	**Units**	**EQL**												
Field	ORP	mV				35.7	32.1	32.5	30.1	42.8	100.7	119.1	111.3	118.7	149
	SP Conductivity	µS/cm				1191	1222	1245	801	571.1	350.3	321.3	26.7	473.7	631
	Dissolved Oxygen (Field) % (Filtered)	%				77.8	75.3	74.3	69.9	86.3	93.9	94.2	84.4	91.4	87.7
	Dissolved Oxygen (Field) (Filtered)	mg/L				7.47	7.23	7.12	6.66	8.26	9.2	9.22	9.26	8.9	8.48
	Temp (Field)	oC				17.1	17.2	17.2	17.6	17.1	16.3	16.4	16.3	16.6	16.9
	pH (Field)	pH_Units				7.05	7.09	7.09	7.13	7.27	7.34	7.27	7.46	8.09	7.87
	Electrical Conductivity (Field)	uS/cm				1012	1039	1060	688	488.4	292.3	268.4	22.2	397.8	533
Metals	Arsenic	mg/L	0.001			-	-	0.005	0.006	0.006	0.004	0.003	0.002	0.004	0.004
	Arsenic (Filtered)	mg/L	0.001			0.003	0.004	-	-	-	-	-	-	-	-
	Cadmium	mg/L	0.0002	0.014		-	-	<0.0002	0.0003	0.0004	0.0002	<0.0002	<0.0002	0.0005	0.0004
	Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.0002	-	-	-	-	-	-	-	-
	Chromium (III+VI)	mg/L	0.001	0.02		-	-	0.01	0.016	0.028	0.018	0.011	0.005	0.011	0.013
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		0.016	0.017	-	-	-	-	-	-	-	-
	Copper	mg/L	0.001	0.003	0.01	-	-	0.02	0.045	0.089	0.053	0.035	0.024	0.057	0.067
	Copper (Filtered)	mg/L	0.001	0.003	0.01	0.018	0.02	-	-	-	-	-	-	-	-
	Lead	mg/L	0.001	0.0066		-	-	0.018	0.062	0.14	0.09	0.047	0.024	0.063	0.072
	Lead (Filtered)	mg/L	0.001	0.0066		0.015	0.016	-	-	-	-	-	-	-	-
	Mercury	mg/L	0.0001	0.0007		-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	<0.0001	-	-	-	-	-	-	-	-
	Nickel	mg/L	0.001	0.2		-	-	0.004	0.008	0.016	0.009	0.006	0.004	0.02	0.023
	Nickel (Filtered)	mg/L	0.001	0.2		0.006	0.01	-	-	-	-	-	-	-	-
	Zinc	mg/L	0.001	0.023	0.03	-	-	0.3	0.59	1.7	1.3	0.81	0.49	0.79	0.88
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.31	0.33	-	-	-	-	-	-	-	-
TPH	C7-C9	mg/L	0.1			-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	C10 - C14	mg/L	0.2			-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	C15-C36	mg/L	0.4			-	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5
	C7-C36	mg/L	0.7			-	-	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Inorganics	Total Suspended Solids	mg/L	1		20	-	-	120	310	1200	1000	330	170	630	620
Nutrients	Ammonia as N	mg/L	0.01	1.2		-	-	0.9	0.98	0.58	0.07	0.05	0.09	<0.01	0.1
Hydrogen sulfide	Hydrogen sulfide	µg/L				-	-	20,000	-	-	-	-	-	-	-

Location Code
Sampled Date
Field ID
Sample Code
Lab Report Number

				ANZECC 2000 MW 90%	PAUP - Stormwater Quality	**Statistical Summary**										
Chem Group	**Chem Name**	**Units**	**EQL**			Number of	Number of	Minimum	Minimum	Maximum	Maximum	Average	Median	Standard	Number of	Number of
Field	ORP	mV				10	10	30.1	30.1	149	149	77	71.75	47	0	0
	SP Conductivity	µS/cm				10	10	26.7	26.7	1245	1245	683	601.05	423	0	0
	Dissolved Oxygen (Field) % (Filtered)	%				10	10	69.9	69.9	94.2	94.2	84	85.35	8.7	0	0
	Dissolved Oxygen (Field) (Filtered)	mg/L				10	10	6.66	6.66	9.26	9.26	8.2	8.37	0.99	0	0
	Temp (Field)	oC				10	10	16.3	16.3	17.6	17.6	17	17	0.45	0	0
	pH (Field)	pH_Units				10	10	7.05	7.05	8.09	8.09	7.4	7.27	0.35	0	0
	Electrical Conductivity (Field)	uS/cm				10	10	22.2	22.2	1060	1060	580	510.7	361	0	0
Metals	Arsenic	mg/L	0.001			8	8	0.002	0.002	0.006	0.006	0.0043	0.004	0.0014	0	0
	Arsenic (Filtered)	mg/L	0.001			2	2	0.003	0.003	0.004	0.004		0.0035		0	0
	Cadmium	mg/L	0.0002	0.014		8	5	<0.0002	0.0002	0.0005	0.0005	0.00026	0.00025	0.00016	0	0
	Cadmium (Filtered)	mg/L	0.0002	0.014		2	0	<0.0002	ND	<0.0002	ND		0.0001		0	0
	Chromium (III+VI)	mg/L	0.001	0.02		8	8	0.005	0.005	0.028	0.028	0.014	0.012	0.0069	1	1
	Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		2	2	0.016	0.016	0.017	0.017		0.0165		0	0
	Copper	mg/L	0.001	0.003	0.01	8	8	0.02	0.02	0.089	0.089	0.049	0.049	0.023	8	8
	Copper (Filtered)	mg/L	0.001	0.003	0.01	2	2	0.018	0.018	0.02	0.02		0.019		2	2
	Lead	mg/L	0.001	0.0066		8	8	0.018	0.018	0.14	0.14	0.065	0.0625	0.039	8	8
	Lead (Filtered)	mg/L	0.001	0.0066		2	2	0.015	0.015	0.016	0.016		0.0155		2	2
	Mercury	mg/L	0.0001	0.0007		8	0	<0.0001	ND	<0.0001	ND	0.00005	0.00005	0	0	0
	Mercury (Filtered)	mg/L	0.0001	0.0007		2	0	<0.0001	ND	<0.0001	ND		0.00005		0	0
	Nickel	mg/L	0.001	0.2		8	8	0.004	0.004	0.023	0.023	0.011	0.0085	0.0074	0	0
	Nickel (Filtered)	mg/L	0.001	0.2		2	2	0.006	0.006	0.01	0.01		0.008		0	0
	Zinc	mg/L	0.001	0.023	0.03	8	8	0.3	0.3	1.7	1.7	0.86	0.8	0.45	8	8
	Zinc (Filtered)	mg/L	0.001	0.023	0.03	2	2	0.31	0.31	0.33	0.33		0.32		2	2
TPH	C7-C9	mg/L	0.1			8	0	<0.1	ND	<0.1	ND	0.05	0.05	0	0	0
	C10 - C14	mg/L	0.2			8	0	<0.2	ND	<0.2	ND	0.1	0.1	0	0	0
	C15-C36	mg/L	0.4			8	1	<0.4	0.5	0.5	0.5	0.24	0.2	0.11	0	0
	C7-C36	mg/L	0.7			8	0	<0.7	ND	<0.7	ND	0.35	0.35	0	0	0
Inorganics	Total Suspended Solids	mg/L	1		20	8	8	120	120	1200	1200	548	475	391	8	8
Nutrients	Ammonia as N	mg/L	0.01	1.2		8	7	<0.01	0.05	0.98	0.98	0.35	0.095	0.41	0	0
Hydrogen sulfide	Hydrogen sulfide	µg/L				1	1	20000	20000	20000	20000		20000		0	0

				LocCode	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2
				Sampled_Date-Time	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016	10/06/2016	10/06/2016	10/06/2016	10/06/2016	10/06/2016
				Field_ID	SW1 18:25-18:35	SW2 18:35-18:45	SW3 18:45-18:55	SW4 18:55-10.05	SW5 23:25-23:35	SW6 23:35-23:45	SW7 23:45-23:55	SW10 00:15-00:25	SW11 00:25-00:35	SW12 00:35-00:45	SW8 23:55-00:05	SW9 00:05-00:15
				SampleCode	M16-Jn11130	M16-Jn11131	M16-Jn11132	M16-Jn11133	M16-Jn11134	M16-Jn11135	M16-Jn11136	M16-Jn11139	M16-Jn11140	M16-Jn11141	M16-Jn11137	M16-Jn11138
				Lab_Report_Number	504197	504197	504197	504197	504197	504197	504197	504197	504197	504197	504197	504197
ChemName	**Units**	**EQL**	ANZECC 2000 MW 90%	PAUP - Stormwater Quality												
Arsenic	mg/L	0.001			0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Arsenic (Filtered)	mg/L	0.001			0.001	0.001	0.001	0.001	0.001	<0.001	<0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	mg/L	0.0002	0.014		0.0003	0.0003	0.0003	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002
Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium (III+VI)	mg/L	0.001	0.02		0.01	0.009	0.01	0.008	0.006	0.006	0.006	0.006	0.008	0.007	0.006	0.008
Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	<0.001
Copper	mg/L	0.001	0.003	0.01	0.046	0.041	0.039	0.029	0.02	0.017	0.017	0.018	0.027	0.021	0.016	0.024
Copper (Filtered)	mg/L	0.001	0.003	0.01	0.004	0.005	0.007	0.009	0.008	0.007	0.008	0.009	0.006	0.007	0.009	0.007
Lead	mg/L	0.001	0.0066		0.032	0.026	0.026	0.02	0.009	0.008	0.007	0.009	0.015	0.018	0.01	0.015
Lead (Filtered)	mg/L	0.001	0.0066		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.001	0.2		0.006	0.006	0.006	0.005	0.003	0.003	0.003	0.002	0.005	0.004	0.003	0.004
Nickel (Filtered)	mg/L	0.001	0.2		0.003	0.002	0.002	0.002	0.001	0.001	0.001	<0.001	<0.001	0.001	0.001	0.001
Zinc	mg/L	0.005	0.023	0.03	0.86	0.91	0.85	0.75	0.47	0.46	0.47	0.41	0.67	0.48	0.41	0.49
Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.79	0.57	0.61	0.5	0.41	0.34	0.39	0.34	0.29	0.3	0.34	0.35
C7-C9	mg/L	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
C10 - C14	mg/L	0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
C15-C36	mg/L	0.4			<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
C7-C36	mg/L	0.7			<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Total Suspended Solids	mg/L	1		20	230	190	140	33	15	<1	9.7	25	21	15	14	15
E. Coli	cfu/100 ml	1			>15,000	4800	3800	1700	2700	1700	800	2200	15,000	2200	1200	3400
Faecal Coliform	cfu/100 ml	1			>15,000	>15,000	>15,000	>15,000	>15,000	>15,000	>15,000	>15,000	>15,000	>15,000	>15,000	>15,000

				LocCode	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2
				Sampled_Date-Time	12/06/2016	12/06/2016	12/06/2016	12/06/2016	22/06/2016	22/06/2016	22/06/2016	22/06/2016	22/06/2016	22/06/2016	22/06/2016	22/06/2016
				Field_ID	SW1 17:40-17:50	SW2 17:50-18:00	SW3 18:00-18:10	SW4 18:10-18:20	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
				SampleCode	M16-Jn11154	M16-Jn11155	M16-Jn11156	M16-Jn11157	Z16-Jn20868	Z16-Jn20869	Z16-Jn20870	Z16-Jn20871	Z16-Jn20872	Z16-Jn20873	Z16-Jn20874	Z16-Jn20875
				Lab_Report_Number	504199	504199	504199	504199	505389	505389	505389	505389	505389	505389	505389	505389
			ANZECC 2000 MW 90%	PAUP - Stormwater Quality												
ChemName	**Units**	**EQL**														
Arsenic	mg/L	0.001			0.003	0.004	<0.001	0.001	0.003	0.002	0.002	0.002	0.001	0.002	0.002	0.003
Arsenic (Filtered)	mg/L	0.001			0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Cadmium	mg/L	0.0002	0.014		0.0004	0.0003	<0.0002	<0.0002	0.0004	0.0004	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002
Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium (III+VI)	mg/L	0.001	0.02		0.011	0.016	0.003	0.003	0.011	0.01	0.004	0.005	0.002	0.006	0.005	0.006
Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.003	0.01	0.069	0.071	0.012	0.014	0.076	0.049	0.022	0.02	0.011	0.041	0.022	0.025
Copper (Filtered)	mg/L	0.001	0.003	0.01	0.003	0.003	0.007	0.006	0.005	0.005	0.009	0.008	0.009	0.008	0.007	0.008
Lead	mg/L	0.001	0.0066		0.044	0.055	0.006	0.009	0.044	0.035	0.009	0.009	0.002	0.022	0.015	0.016
Lead (Filtered)	mg/L	0.001	0.0066		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.001	0.2		0.007	0.01	0.002	0.002	0.007	0.006	0.003	0.003	0.001	0.004	0.003	0.004
Nickel (Filtered)	mg/L	0.001	0.2		0.003	<0.001	0.001	<0.001	0.002	0.002	0.001	0.001	0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	0.023	0.03	0.76	1.2	0.29	0.38	0.93	0.83	0.55	0.5	0.35	0.62	0.41	0.43
Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.46	0.2	0.26	0.26	0.39	0.2	0.43	0.42	0.35	0.41	0.28	0.27
C7-C9	mg/L	0.1			<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	-	-
C10 - C14	mg/L	0.2			<0.2	<0.2	0.5	<0.2	-	-	-	-	-	-	-	-
C15-C36	mg/L	0.4			<0.4	<0.4	2.3	<0.4	-	-	-	-	-	-	-	-
C7-C36	mg/L	0.7			<0.7	<0.7	2.8	<0.7	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/L	1		20	220	76	19	10	270	130	30	26	13	94	49	38
E. Coli	cfu/100 ml	1			420,000	9000	10,000	10,000	-	-	-	-	-	-	-	-
Faecal Coliform	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-

ChemName	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality												
				LocCode	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2
				Sampled_Date-Time	22/06/2016	22/06/2016	22/06/2016	22/06/2016	8/07/2016	8/07/2016	8/07/2016	8/07/2016	8/07/2016	8/07/2016	8/07/2016	8/07/2016
				Field_ID	SW9	SW10	SW11	SW12	SW10	SW11	SW12	SW1	SW2	SW3	SW4	SW5
				SampleCode	Z16-Jn20876	Z16-Jn20877	Z16-Jn20878	Z16-Jn20879	Z16-Jl06417	Z16-Jl06418	Z16-Jl06419	Z16-Jl06408	Z16-Jl06409	Z16-Jl06410	Z16-Jl06411	Z16-Jl06412
				Lab_Report_Number	505389	505389	505389	505389	507296	507296	507296	507296	507296	507296	507296	507296
Arsenic	mg/L	0.001			0.002	0.001	0.004	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic (Filtered)	mg/L	0.001			<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	0.014		<0.0002	<0.0002	0.0003	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium (III+VI)	mg/L	0.001	0.02		0.004	0.002	0.012	0.017	0.006	0.005	0.006	0.006	0.005	0.005	0.005	0.005
Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		<0.001	<0.001	<0.001	<0.001	0.004	0.003	0.004	0.003	0.003	0.003	0.004	0.003
Copper	mg/L	0.001	0.003	0.01	0.018	0.01	0.049	0.06	0.012	0.009	0.01	0.013	0.012	0.013	0.012	0.011
Copper (Filtered)	mg/L	0.001	0.003	0.01	0.007	0.007	0.01	0.005	0.011	0.008	0.009	0.008	0.012	0.011	0.012	0.011
Lead	mg/L	0.001	0.0066		0.013	0.005	0.083	0.1	0.004	0.004	0.006	0.009	0.005	0.006	0.005	0.005
Lead (Filtered)	mg/L	0.001	0.0066		<0.001	<0.001	0.001	<0.001	0.004	0.003	0.005	0.007	0.005	0.005	0.005	0.004
Mercury	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.001	0.2		0.002	0.001	0.009	0.013	0.002	0.002	0.003	0.003	0.003	0.002	0.002	0.002
Nickel (Filtered)	mg/L	0.001	0.2		<0.001	<0.001	0.001	<0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Zinc	mg/L	0.005	0.023	0.03	0.34	0.25	0.58	0.84	0.24	0.19	0.22	0.15	0.23	0.26	0.23	0.23
Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.24	0.24	0.27	0.22	0.23	0.18	0.2	0.12	0.23	0.24	0.21	0.22
C7-C9	mg/L	0.1			-	-	-	-	-	-	-	-	-	-	-	-
C10 - C14	mg/L	0.2			-	-	-	-	-	-	-	-	-	-	-	-
C15-C36	mg/L	0.4			-	-	-	-	-	-	-	-	-	-	-	-
C7-C36	mg/L	0.7			-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/L	1		20	30	24	84	140	7.1	7.6	5.6	22	13	11	12	13
E. Coli	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-
Faecal Coliform	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-

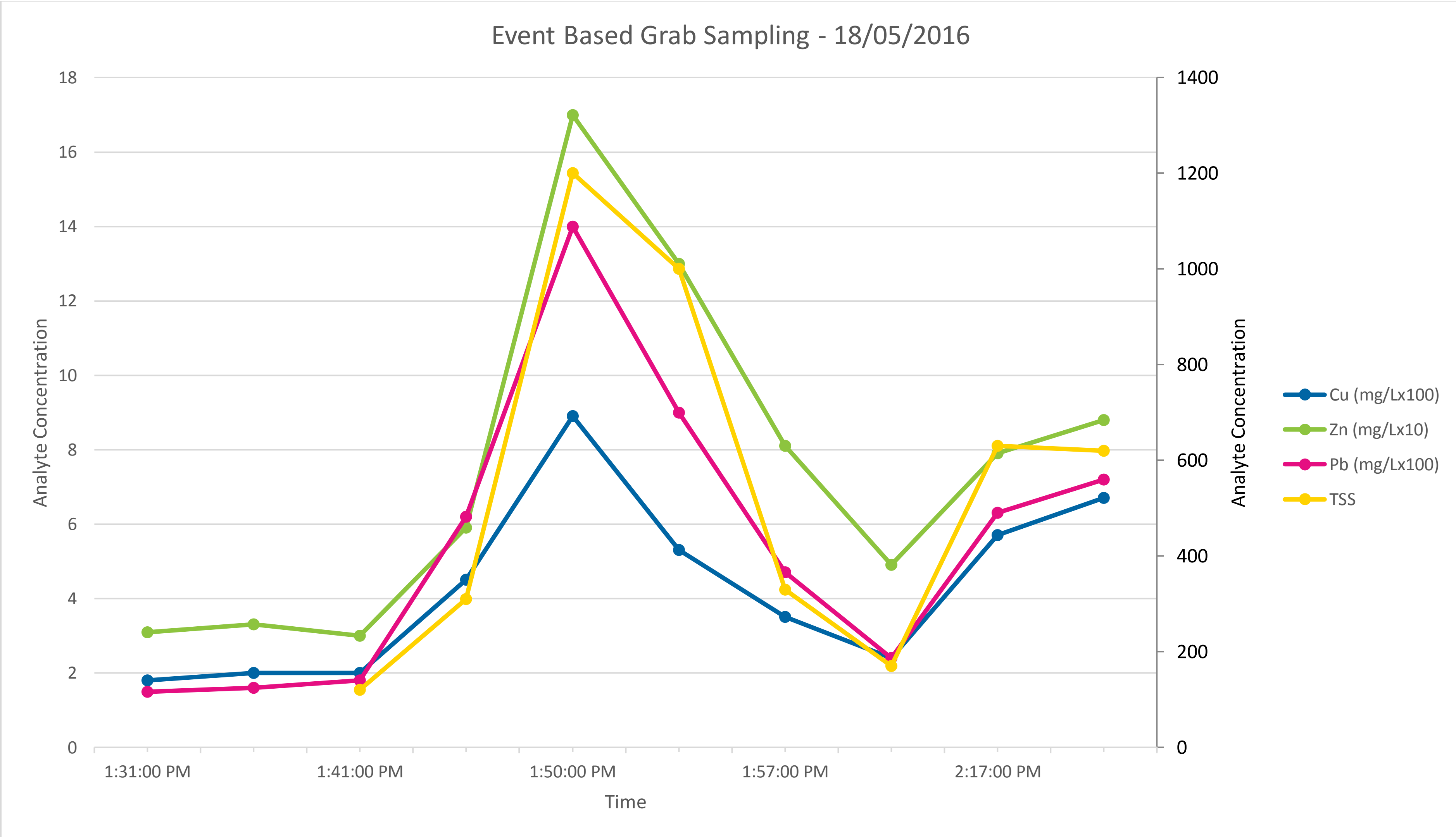
ChemName	Units	EQL	ANZECC 2000 MW 90%	PAUP - Stormwater Quality												
				LocCode	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2
				Sampled_Date-Time	8/07/2016	8/07/2016	8/07/2016	8/07/2016	13/07/2016	13/07/2016	13/07/2016	13/07/2016	13/07/2016	13/07/2016	13/07/2016	13/07/2016
				Field_ID	SW6	SW7	SW8	SW9	SW10	SW11	SW12	SW3	SW4	SW5	SW6	SW7
				SampleCode	Z16-JI06413	Z16-JI06414	Z16-JI06415	Z16-JI06416	Z16-JI10934	Z16-JI10935	Z16-JI10936	Z16-JI10927	Z16-JI10928	Z16-JI10929	Z16-JI10930	Z16-JI10931
				Lab_Report_Number	507296	507296	507296	507296	507954	507954	507954	507954	507954	507954	507954	507954
Arsenic	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic (Filtered)	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium (III+VI)	mg/L	0.001	0.02		0.005	0.006	0.006	0.005	0.003	0.003	0.003	0.004	0.005	0.004	0.005	0.005
Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		0.003	0.004	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.004
Copper	mg/L	0.001	0.003	0.01	0.013	0.014	0.013	0.013	0.01	0.009	0.01	0.015	0.014	0.011	0.011	0.009
Copper (Filtered)	mg/L	0.001	0.003	0.01	0.011	0.013	0.011	0.011	0.009	0.009	0.01	0.014	0.012	0.01	0.009	0.009
Lead	mg/L	0.001	0.0066		0.006	0.007	0.006	0.005	0.002	0.002	0.003	0.005	0.004	0.003	0.003	0.002
Lead (Filtered)	mg/L	0.001	0.0066		0.005	0.006	0.006	0.005	0.002	0.002	0.003	0.005	0.004	0.003	0.003	0.002
Mercury	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.001	0.2		0.003	0.003	0.003	0.003	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002
Nickel (Filtered)	mg/L	0.001	0.2		0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
Zinc	mg/L	0.005	0.023	0.03	0.27	0.28	0.28	0.25	0.28	0.29	0.28	0.35	0.4	0.31	0.28	0.21
Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.26	0.28	0.25	0.23	0.28	0.28	0.28	0.35	0.37	0.29	0.25	0.21
C7-C9	mg/L	0.1			-	-	-	-	-	-	-	-	-	-	-	-
C10 - C14	mg/L	0.2			-	-	-	-	-	-	-	-	-	-	-	-
C15-C36	mg/L	0.4			-	-	-	-	-	-	-	-	-	-	-	-
C7-C36	mg/L	0.7			-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/L	1		20	13	12	14	14	13	12	12	16	15	10	8.1	6.6
E. Coli	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-
Faecal Coliform	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-

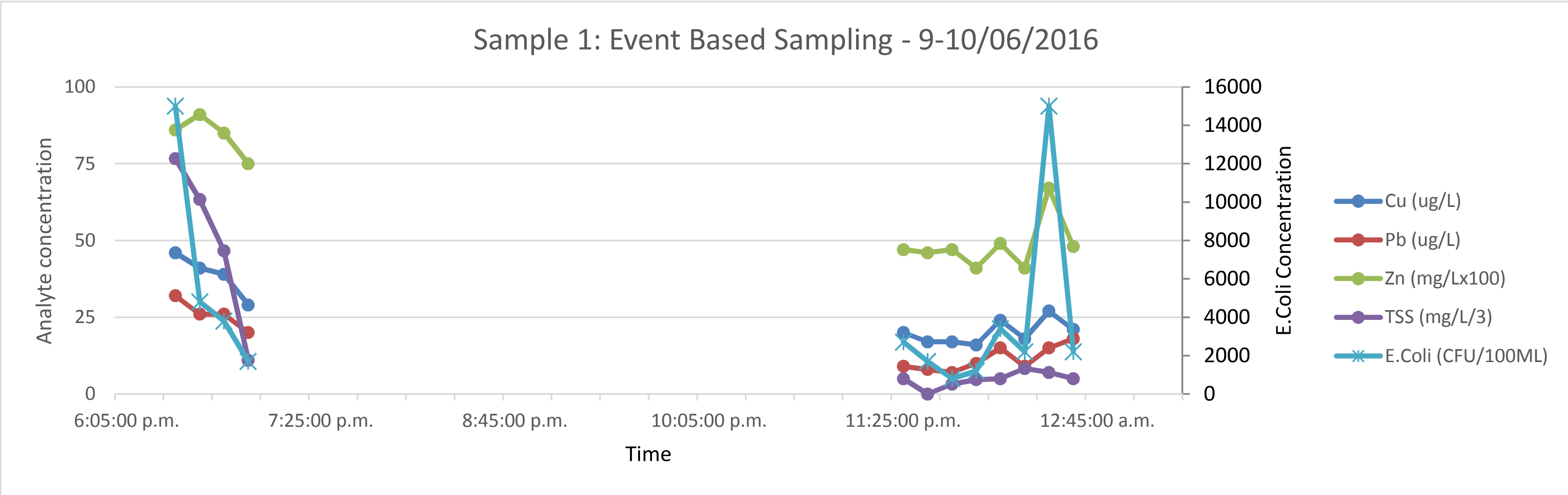
				LocCode	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2	Catchment_9A_FF2
				Sampled_Date-Time	13/07/2016	13/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016	19/07/2016
				Field_ID	SW8	SW9	SW10	SW11	SW12	SW1	SW2	SW3	SW4	SW5	SW6	SW7
				SampleCode	Z16-JI10932	Z16-JI10933	Z16-JI16851	Z16-JI16852	Z16-JI16853	Z16-JI16842	Z16-JI16843	Z16-JI16844	Z16-JI16845	Z16-JI16846	Z16-JI16847	Z16-JI16848
				Lab_Report_Number	507954	507954	508724	508724	508724	508724	508724	508724	508724	508724	508724	508724
			ANZECC 2000 MW 90%	PAUP - Stormwater Quality												
ChemName	**Units**	**EQL**														
Arsenic	mg/L	0.001			<0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic (Filtered)	mg/L	0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cadmium (Filtered)	mg/L	0.0002	0.014		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium (III+VI)	mg/L	0.001	0.02		0.005	0.004	0.002	0.002	0.002	0.007	0.006	0.005	0.003	0.004	0.004	0.004
Chromium (III+VI) (Filtered)	mg/L	0.001	0.02		0.003	0.003	<0.001	<0.001	<0.001	0.003	0.001	0.001	0.002	0.002	0.002	<0.001
Copper	mg/L	0.001	0.003	0.01	0.01	0.011	0.011	0.007	0.006	0.009	0.017	0.013	0.009	0.007	0.008	0.014
Copper (Filtered)	mg/L	0.001	0.003	0.01	0.009	0.011	0.002	0.003	0.002	0.003	0.003	0.003	0.004	0.003	0.003	0.003
Lead	mg/L	0.001	0.0066		0.002	0.003	0.011	0.006	0.005	0.011	0.014	0.011	0.006	0.005	0.01	0.015
Lead (Filtered)	mg/L	0.001	0.0066		0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury (Filtered)	mg/L	0.0001	0.0007		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.001	0.2		0.002	0.002	0.001	<0.001	<0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.002
Nickel (Filtered)	mg/L	0.001	0.2		0.002	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.005	0.023	0.03	0.25	0.27	0.18	0.13	0.094	0.36	0.74	0.51	0.47	0.35	0.29	0.44
Zinc (Filtered)	mg/L	0.001	0.023	0.03	0.22	0.27	0.12	0.1	0.076	0.28	0.55	0.37	0.42	0.29	0.24	0.31
C7-C9	mg/L	0.1			-	-	-	-	-	-	-	-	-	-	-	-
C10 - C14	mg/L	0.2			-	-	-	-	-	-	-	-	-	-	-	-
C15-C36	mg/L	0.4			-	-	-	-	-	-	-	-	-	-	-	-
C7-C36	mg/L	0.7			-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/L	1		20	7.4	13	24	8.8	8.8	8.6	33	17	2.9	8.9	10	26
E. Coli	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-
Faecal Coliform	cfu/100 ml	1			-	-	-	-	-	-	-	-	-	-	-	-

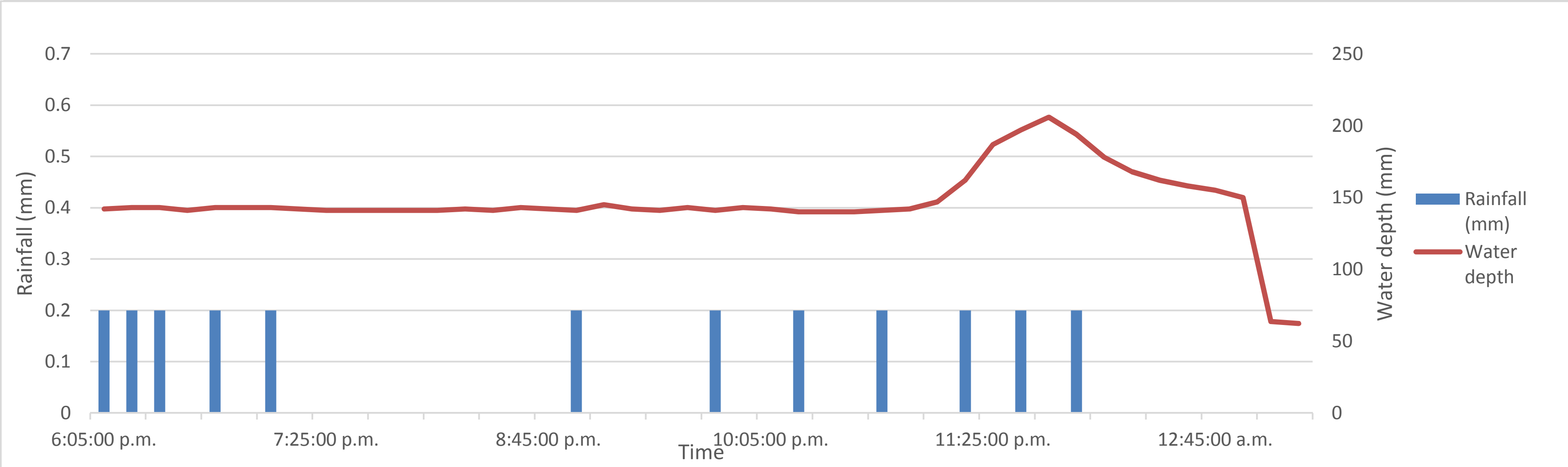
					LocCode	Catchment_9A_FF2	Catchment_9A_FF2											
					Sampled_Date-Time	19/07/2016	19/07/2016											
					Field_ID	SW8	SW9											
					SampleCode	Z16-JI16849	Z16-JI16850											
					Lab_Report_Number	508724	508724											
			ANZECC 2000 MW 90%	PAUP - Stormwater Quality				Statistical Summary										
ChemName	Units	EQL						Number of	Number of	Minimum	Minimum	Maximum	Maximum	Average	Median	Standard	Number of	Number of
Arsenic	mg/L	0.001				0.001	<0.001	62	31	<0.001	0.001	0.005	0.005	0.0013	0.00075	0.0011	0	0
Arsenic (Filtered)	mg/L	0.001				<0.001	<0.001	62	13	<0.001	0.001	0.001	0.001	0.0006	0.0005	0.00021	0	0
Cadmium	mg/L	0.0002	0.014			<0.0002	<0.0002	62	12	<0.0002	0.0002	0.0004	0.0004	0.00014	0.0001	0.000088	0	0
Cadmium (Filtered)	mg/L	0.0002	0.014			<0.0002	<0.0002	62	0	<0.0002	ND	<0.0002	ND	0.0001	0.0001	0	0	0
Chromium (III+VI)	mg/L	0.001	0.02			0.005	0.002	62	62	0.002	0.002	0.017	0.017	0.0058	0.005	0.0031	0	0
Chromium (III+VI) (Filtered)	mg/L	0.001	0.02			<0.001	<0.001	62	35	<0.001	0.001	0.004	0.004	0.0016	0.001	0.0012	0	0
Copper	mg/L	0.001	0.003	0.01		0.021	0.013	62	62	0.006	0.006	0.076	0.076	0.021	0.0135	0.016	62	62
Copper (Filtered)	mg/L	0.001	0.003	0.01		0.003	0.002	62	62	0.002	0.002	0.014	0.014	0.0074	0.008	0.0032	59	59
Lead	mg/L	0.001	0.0066			0.029	0.013	62	62	0.002	0.002	0.1	0.1	0.014	0.009	0.018	35	35
Lead (Filtered)	mg/L	0.001	0.0066			<0.001	<0.001	62	23	<0.001	0.001	0.007	0.007	0.0018	0.0005	0.0019	1	1
Mercury	mg/L	0.0001	0.0007			<0.0001	<0.0001	62	0	<0.0001	ND	<0.0001	ND	0.00005	0.00005	0	0	0
Mercury (Filtered)	mg/L	0.0001	0.0007			<0.0001	<0.0001	62	0	<0.0001	ND	<0.0001	ND	0.00005	0.00005	0	0	0
Nickel	mg/L	0.001	0.2			0.003	0.001	62	60	<0.001	0.001	0.013	0.013	0.0031	0.002	0.0023	0	0
Nickel (Filtered)	mg/L	0.001	0.2			<0.001	<0.001	62	41	<0.001	0.001	0.003	0.003	0.0013	0.001	0.00072	0	0
Zinc	mg/L	0.005	0.023	0.03		0.53	0.25	62	62	0.094	0.094	1.2	1.2	0.43	0.355	0.23	62	62
Zinc (Filtered)	mg/L	0.001	0.023	0.03		0.31	0.15	62	62	0.076	0.076	0.79	0.79	0.3	0.28	0.12	62	62
C7-C9	mg/L	0.1				-	-	16	0	<0.1	ND	<0.1	ND	0.05	0.05	0	0	0
C10 - C14	mg/L	0.2				-	-	16	1	<0.2	0.5	0.5	0.5	0.13	0.1	0.1	0	0
C15-C36	mg/L	0.4				-	-	16	1	<0.4	2.3	2.3	2.3	0.33	0.2	0.53	0	0
C7-C36	mg/L	0.7				-	-	16	1	<0.7	2.8	2.8	2.8	0.5	0.35	0.61	0	0
Total Suspended Solids	mg/L	1		20		19	8.4	62	61	<1	2.9	270	270	39	14.5	59	23	23
E. Coli	cfu/100 ml	1				-	-	16	16	800	800	420000	420000	31469	3600	103718	0	0
Faecal Coliform	cfu/100 ml	1				-	-	12	12	15000	15000	15000	15000	15000	15000	0	0	0

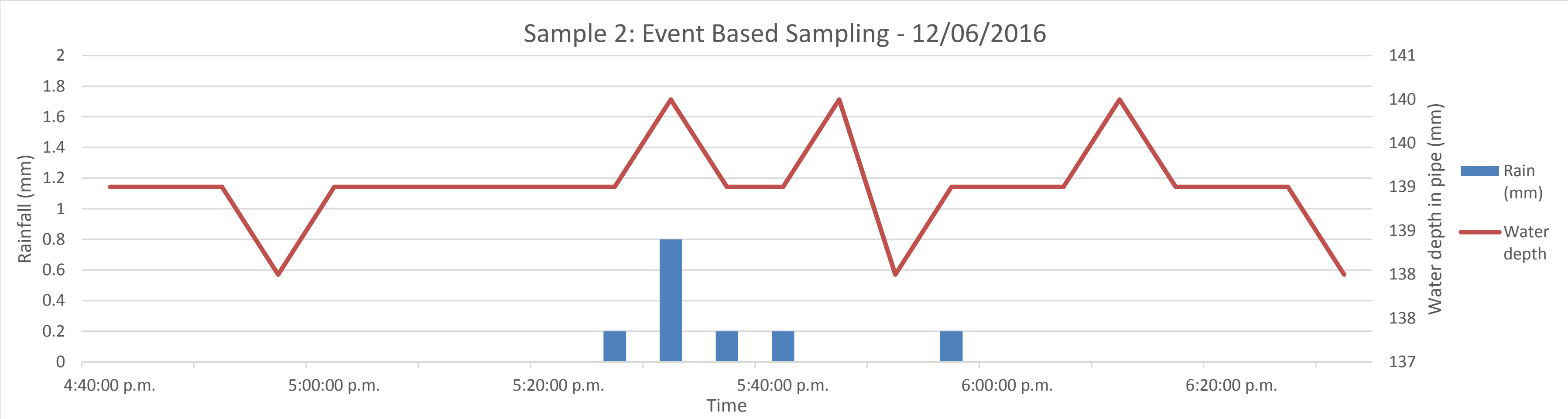
Attachment 3 – Graphs and piper plots

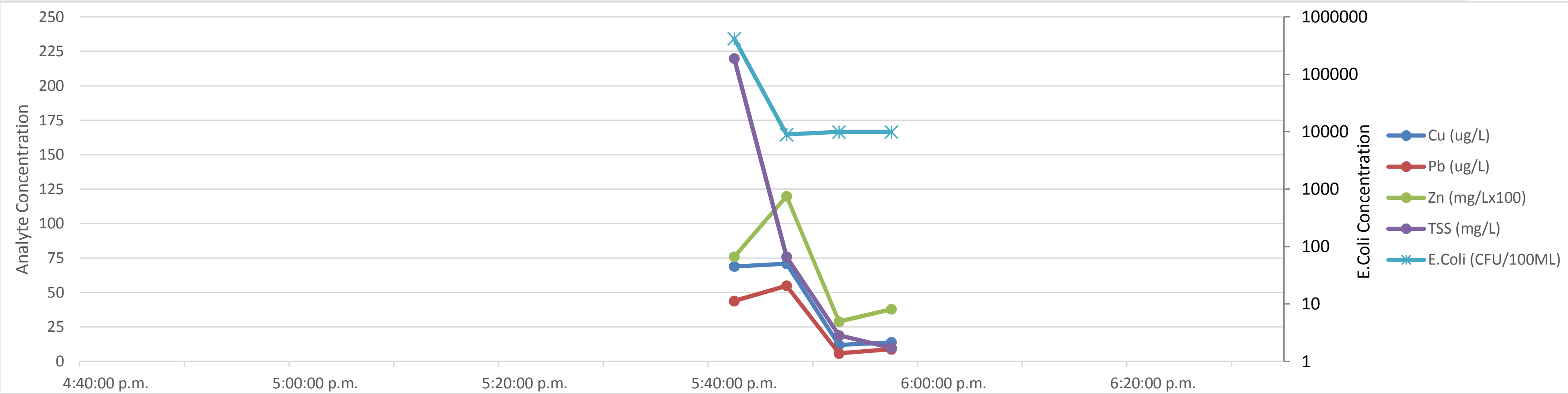
Event based samples – concentrations and rainfall

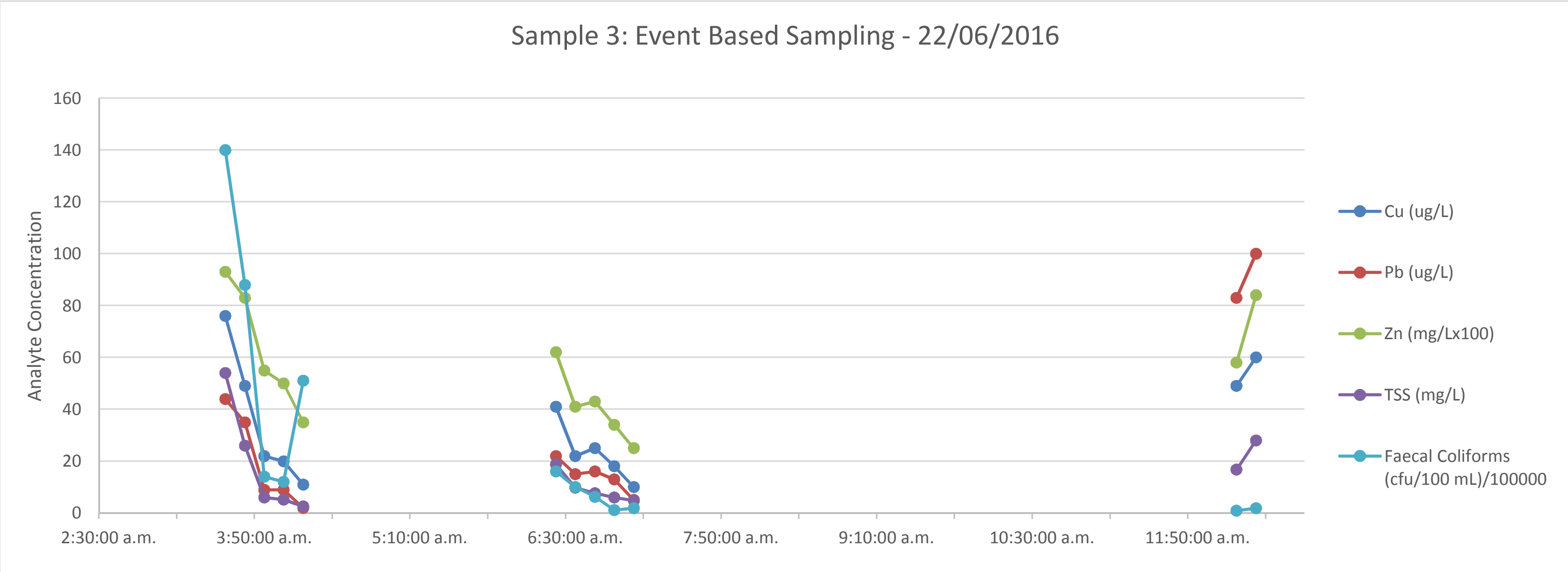

Event Based Grab Sampling - 18/05/2016
Analyte Concentration
18
16
14
12
10
8
6
4
2
0
1400
1200
1000
800
600
400
200
0
Analyte Concentration
1:31:00 PM
1:41:00 PM
1:50:00 PM
1:57:00 PM
2:17:00 PM
Time
Cu (mg/Lx100)
Zn (mg/Lx10)
Pb (mg/Lx100)
TSS

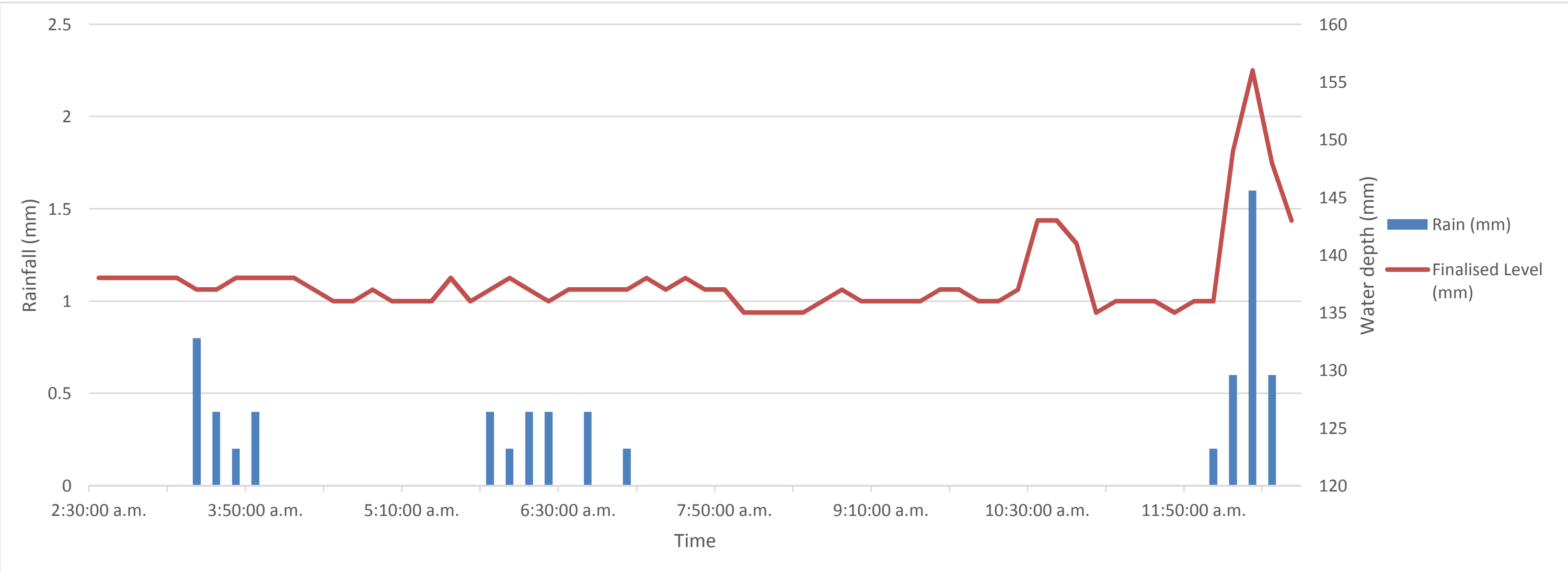

Sample 1: Event Based Sampling - 9-10/06/2016
Analyte concentration
100
75
50
25
0
E.Coli Concentration
16000
14000
12000
10000
8000
6000
4000
2000
0
6:05:00 p.m.
7:25:00 p.m.
8:45:00 p.m.
10:05:00 p.m.
11:25:00 p.m.
12:45:00 a.m.
Time
Cu (ug/L)
Pb (ug/L)
Zn (mg/Lx100)
TSS (mg/L/3)
E.Coli (CFU/100ML)

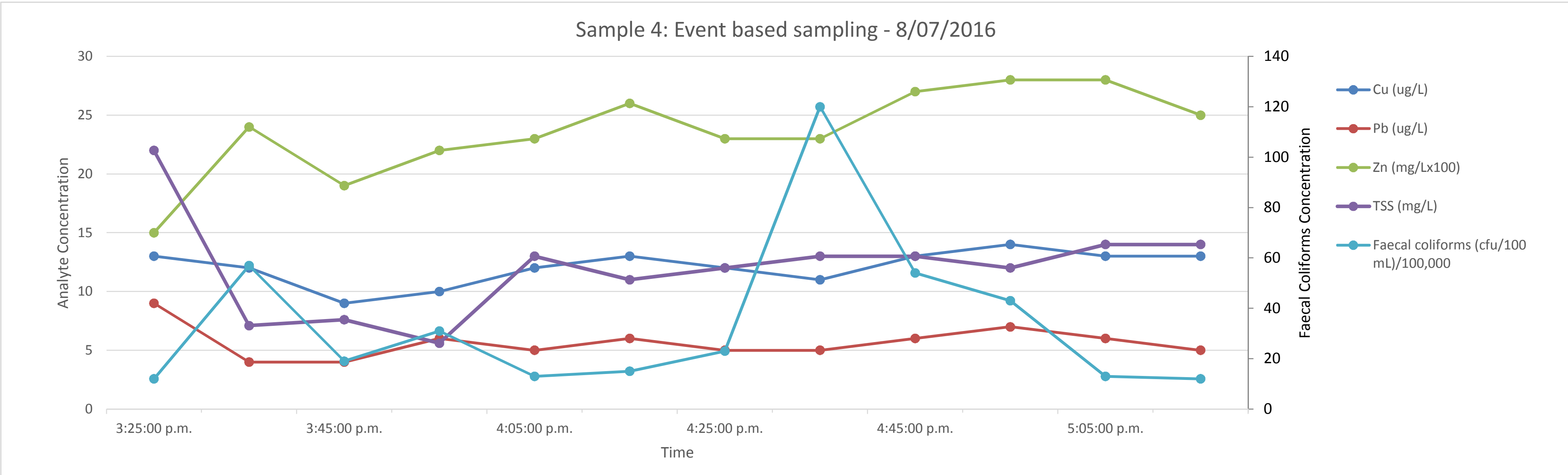

Rainfall (mm)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Water depth (mm)
250
200
150
100
50
0
6:05:00 p.m.
7:25:00 p.m.
8:45:00 p.m.
10:05:00 p.m.
11:25:00 p.m.
12:45:00 a.m.
Time
Rainfall (mm)
Water depth


Sample 2: Event Based Sampling - 12/06/2016
Rainfall (mm)
Water depth in pipe (mm)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
141
140
140
139
139
138
138
137
4:40:00 p.m.
5:00:00 p.m.
5:20:00 p.m.
5:40:00 p.m.
6:00:00 p.m.
6:20:00 p.m.
Time
Rain (mm)
Water depth

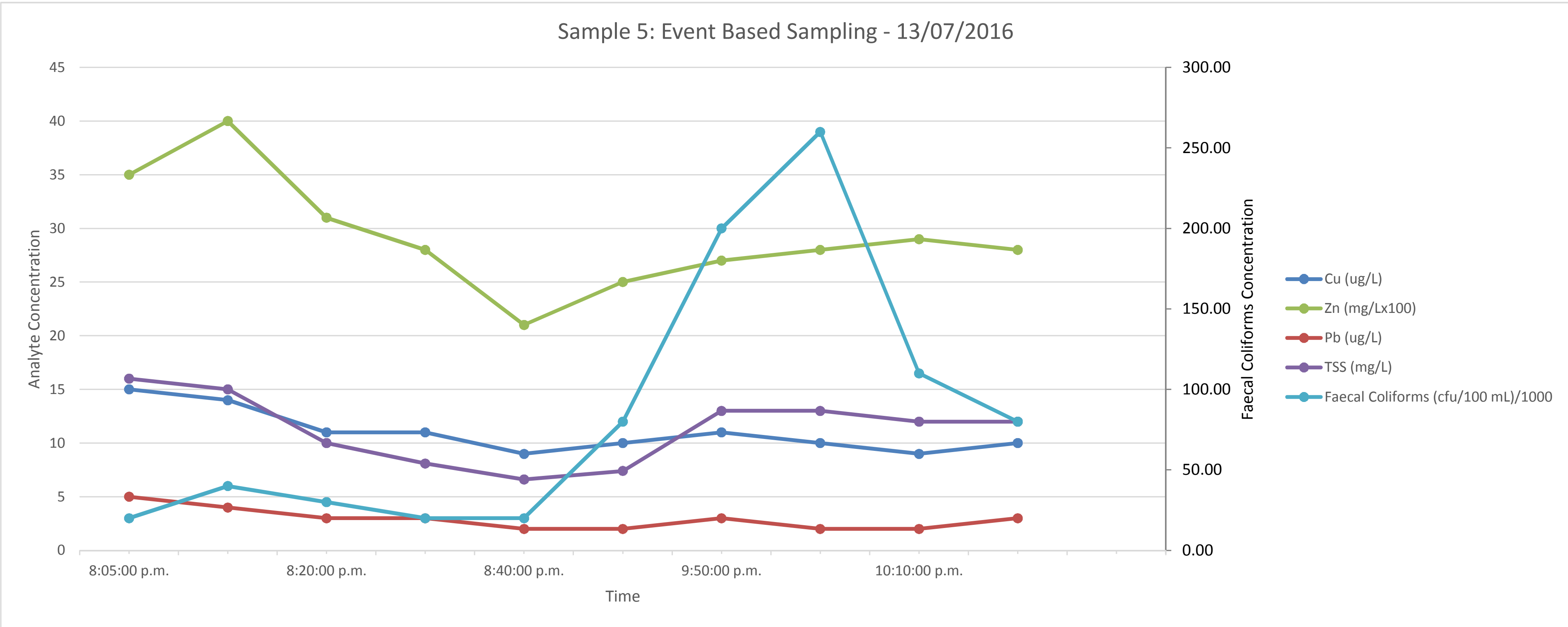

Analyte Concentration
E.Coli Concentration
250
225
200
175
150
125
100
75
50
25
0
1000000
100000
10000
1000
100
10
1
4:40:00 p.m.
5:00:00 p.m.
5:20:00 p.m.
5:40:00 p.m.
6:00:00 p.m.
6:20:00 p.m.
Cu (ug/L)
Pb (ug/L)
Zn (mg/Lx100)
TSS (mg/L)
E.Coli (CFU/100ML)


Sample 3: Event Based Sampling - 22/06/2016
Analyte Concentration
160
140
120
100
80
60
40
20
0
2:30:00 a.m.
3:50:00 a.m.
5:10:00 a.m.
6:30:00 a.m.
7:50:00 a.m.
9:10:00 a.m.
10:30:00 a.m.
11:50:00 a.m.
Cu (ug/L)
Pb (ug/L)
Zn (mg/Lx100)
TSS (mg/L)
Faecal Coliforms (cfu/100 mL)/100000


Rainfall (mm)
2.5
2
1.5
1
0.5
0
Water depth (mm)
160
155
150
145
140
135
130
125
120
2:30:00 a.m.
3:50:00 a.m.
5:10:00 a.m.
6:30:00 a.m.
7:50:00 a.m.
9:10:00 a.m.
10:30:00 a.m.
11:50:00 a.m.
Time
Rain (mm)
Finalised Level (mm)

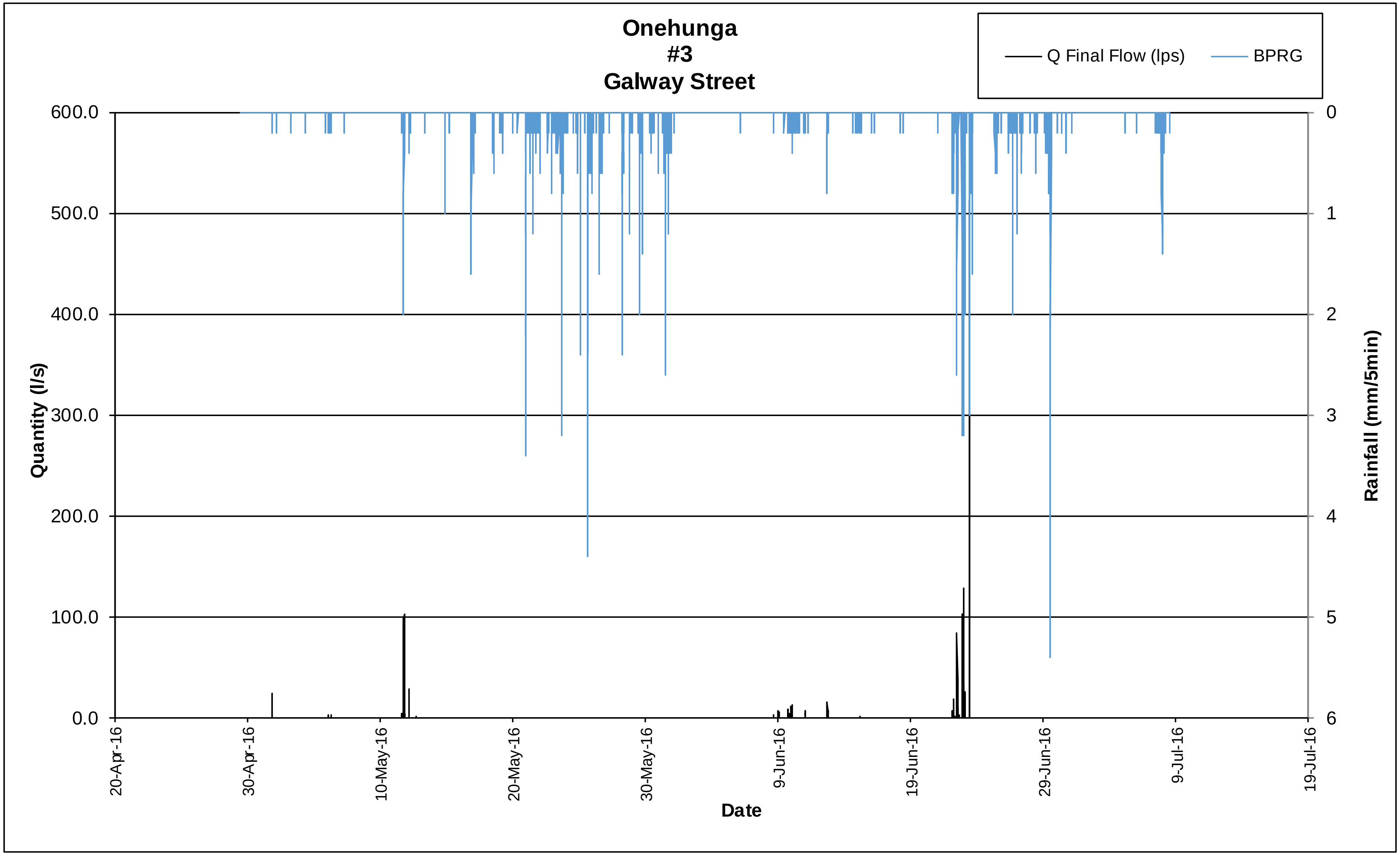


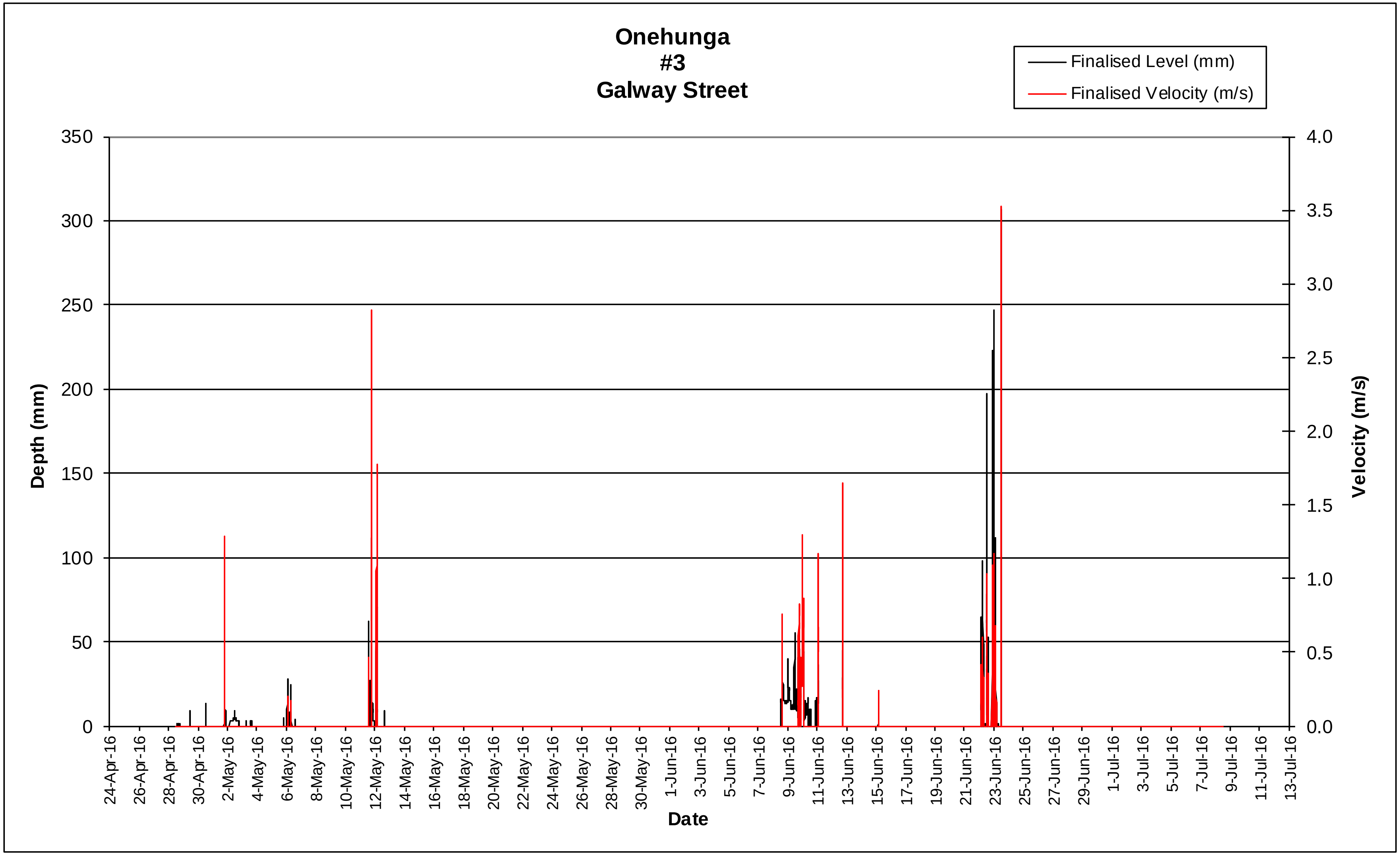
Sample 4: Event based sampling - 8/07/2016
Analyte Concentration
Faecal Coliforms Concentration
Time
0
5
10
15
20
25
30
0
20
40
60
80
100
120
140
3:25:00 p.m.
3:45:00 p.m.
4:05:00 p.m.
4:25:00 p.m.
4:45:00 p.m.
5:05:00 p.m.
Cu (ug/L)
Pb (ug/L)
Zn (mg/Lx100)
TSS (mg/L)
Faecal coliforms (cfu/100 mL)/100,000



Sample 5: Event Based Sampling - 13/07/2016
Analyte Concentration
45
40
35
30
25
20
15
10
5
0
Faecal Coliforms Concentration
300.00
250.00
200.00
150.00
100.00
50.00
0.00
8:05:00 p.m.
8:20:00 p.m.
8:40:00 p.m.
9:50:00 p.m.
10:10:00 p.m.
Time
Cu (ug/L)
Zn (mg/Lx100)
Pb (ug/L)
TSS (mg/L)
Faecal Coliforms (cfu/100 mL)/1000

Rainfall and flow graphs


Onehunga
#3
Galway Street
Q Final Flow (lps)
BPRG
Quantity (l/s)
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Rainfall (mm/5min)
0
1
2
3
4
5
6
20-Apr-16
30-Apr-16
10-May-16
20-May-16
30-May-16
9-Jun-16
19-Jun-16
29-Jun-16
9-Jul-16
19-Jul-16
Date


Onehunga
#3
Galway Street
Finalised Level (mm)
Finalised Velocity (m/s)
Depth (mm)
Velocity (m/s)
Date
0
50
100
150
200
250
300
350
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
24-Apr-16
26-Apr-16
28-Apr-16
30-Apr-16
2-May-16
4-May-16
6-May-16
8-May-16
10-May-16
12-May-16
14-May-16
16-May-16
18-May-16
20-May-16
22-May-16
24-May-16
26-May-16
28-May-16
30-May-16
1-Jun-16
3-Jun-16
5-Jun-16
7-Jun-16
9-Jun-16
11-Jun-16
13-Jun-16
15-Jun-16
17-Jun-16
19-Jun-16
21-Jun-16
23-Jun-16
25-Jun-16
27-Jun-16
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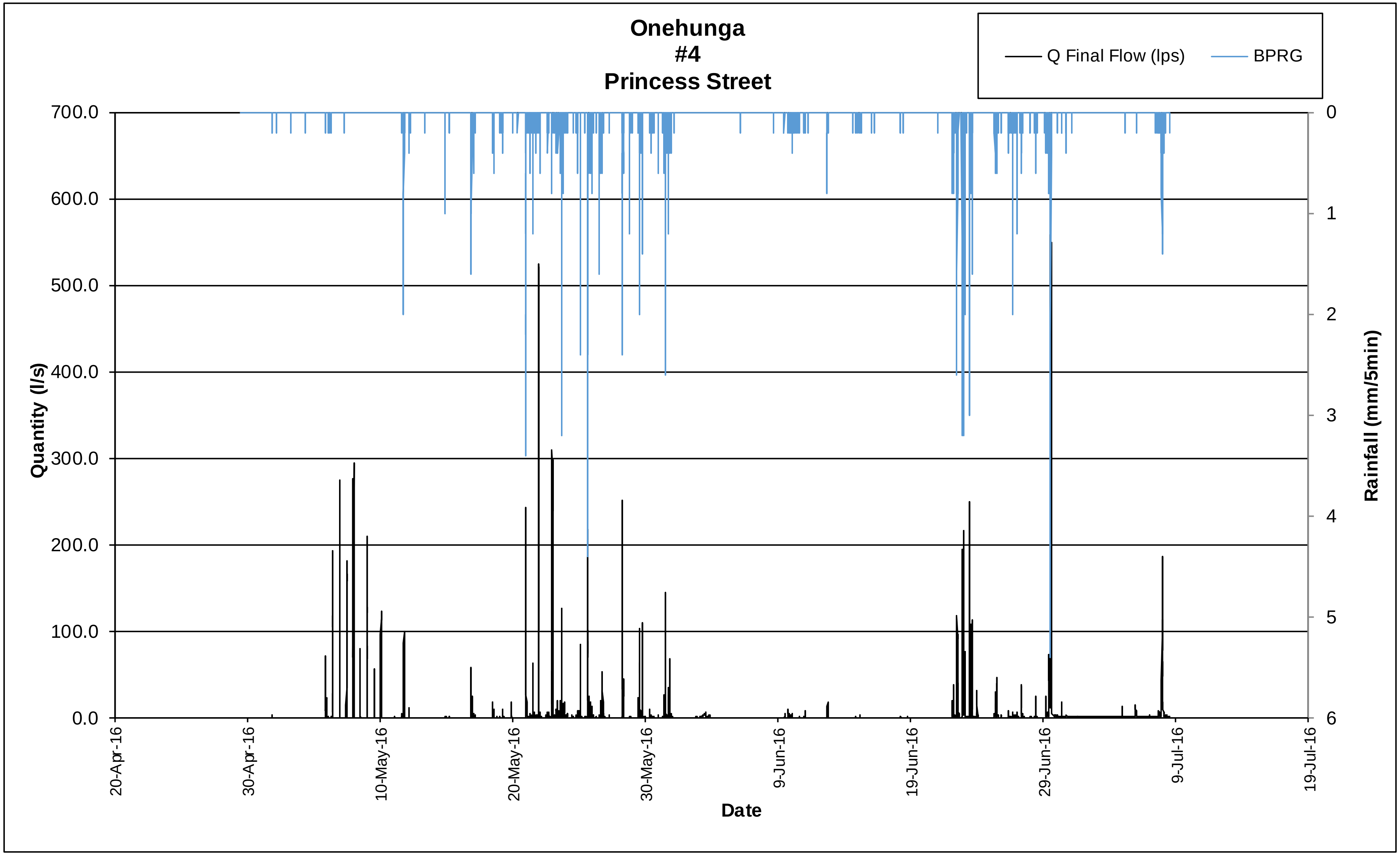
9-Jul-16
11-Jul-16
13-Jul-16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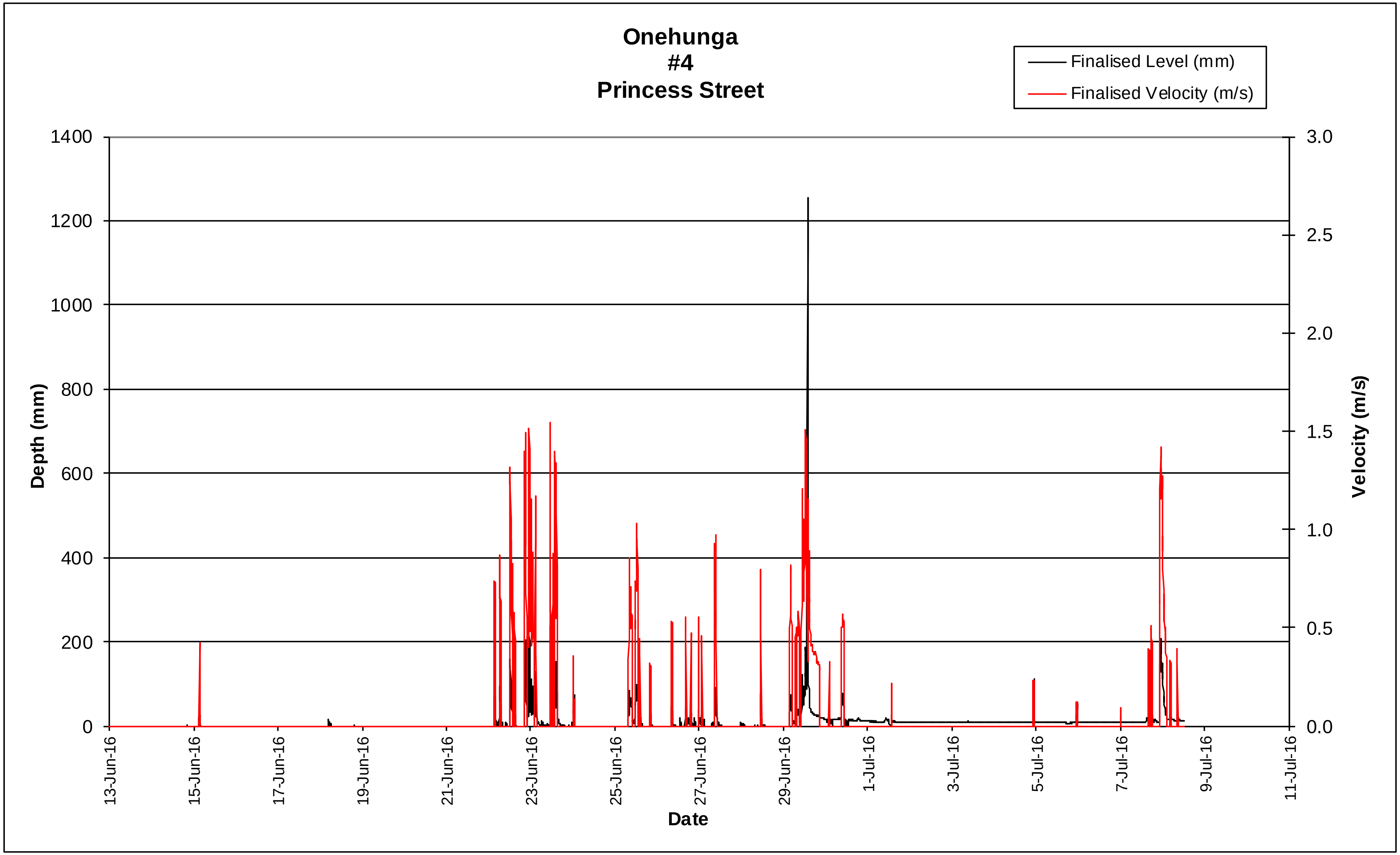
#4
Princess Street
Q Final Flow (lps)
BPRG
Quantity (l/s)
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Rainfall (mm/5min)
0
1
2
3
4
5
6
20-Apr-16
30-Apr-16
10-May-16
20-May-16
30-May-16
9-Jun-16
19-Jun-16
29-Jun-16
9-Jul-16
19-Jul-16
Date


Onehunga
#4
Princess Street
Finalised Level (mm)
Finalised Velocity (m/s)
Depth (mm)
Velocity (m/s)
Date
0
200
400
600
800
1000
1200
1400
0.0
0.5
1.0
1.5
2.0
2.5
3.0
13-Jun-16
15-Jun-16
17-Jun-16
19-Jun-16
21-Jun-16
23-Jun-16
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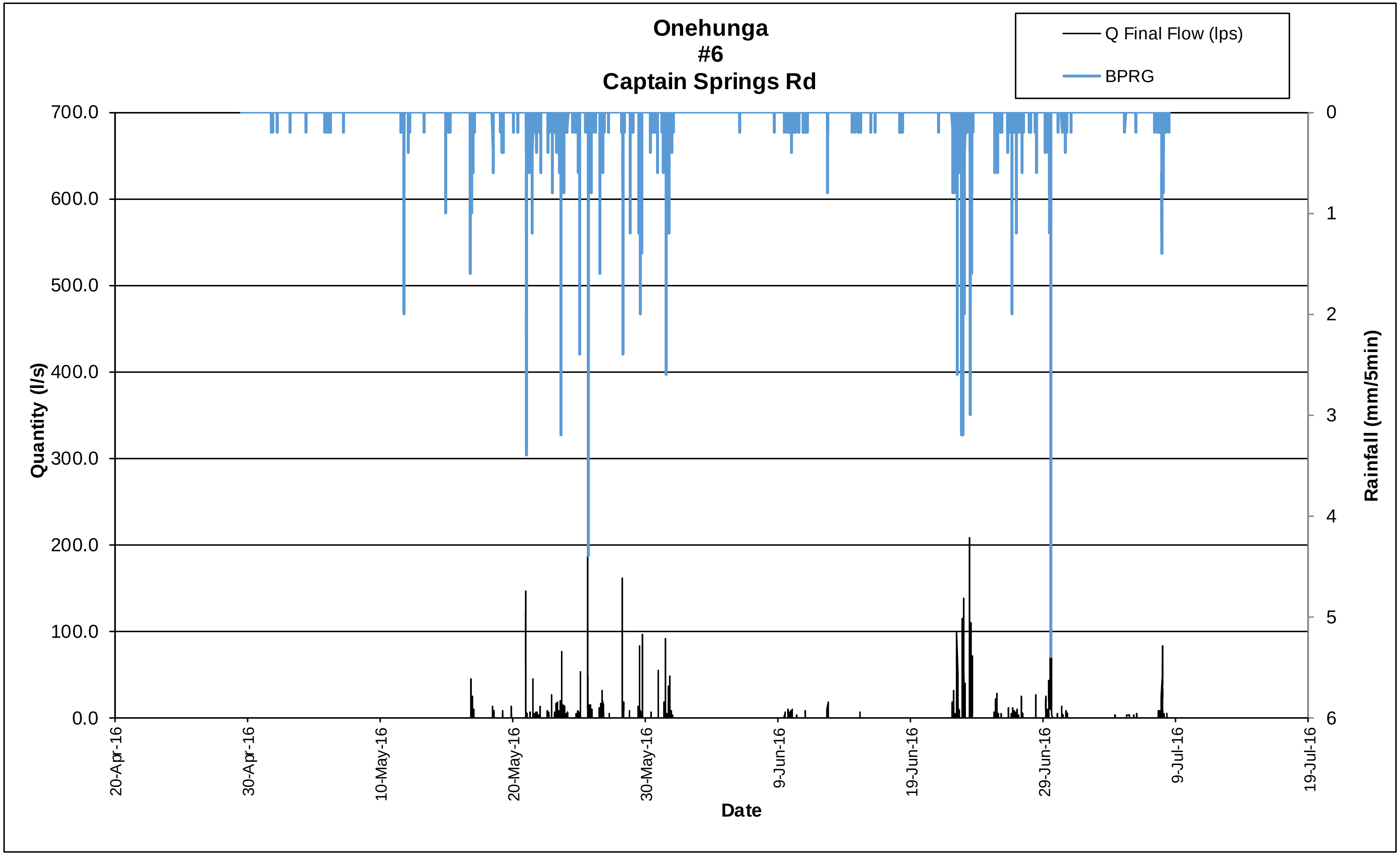
9-Jul-16
11-Jul-16


Onehunga
#6
Captain Springs Rd
Q Final Flow (lps)
BPRG
Quantity (l/s)
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Rainfall (mm/5min)
0
1
2
3
4
5
6
20-Apr-16
30-Apr-16
10-May-16
20-May-16
30-May-16
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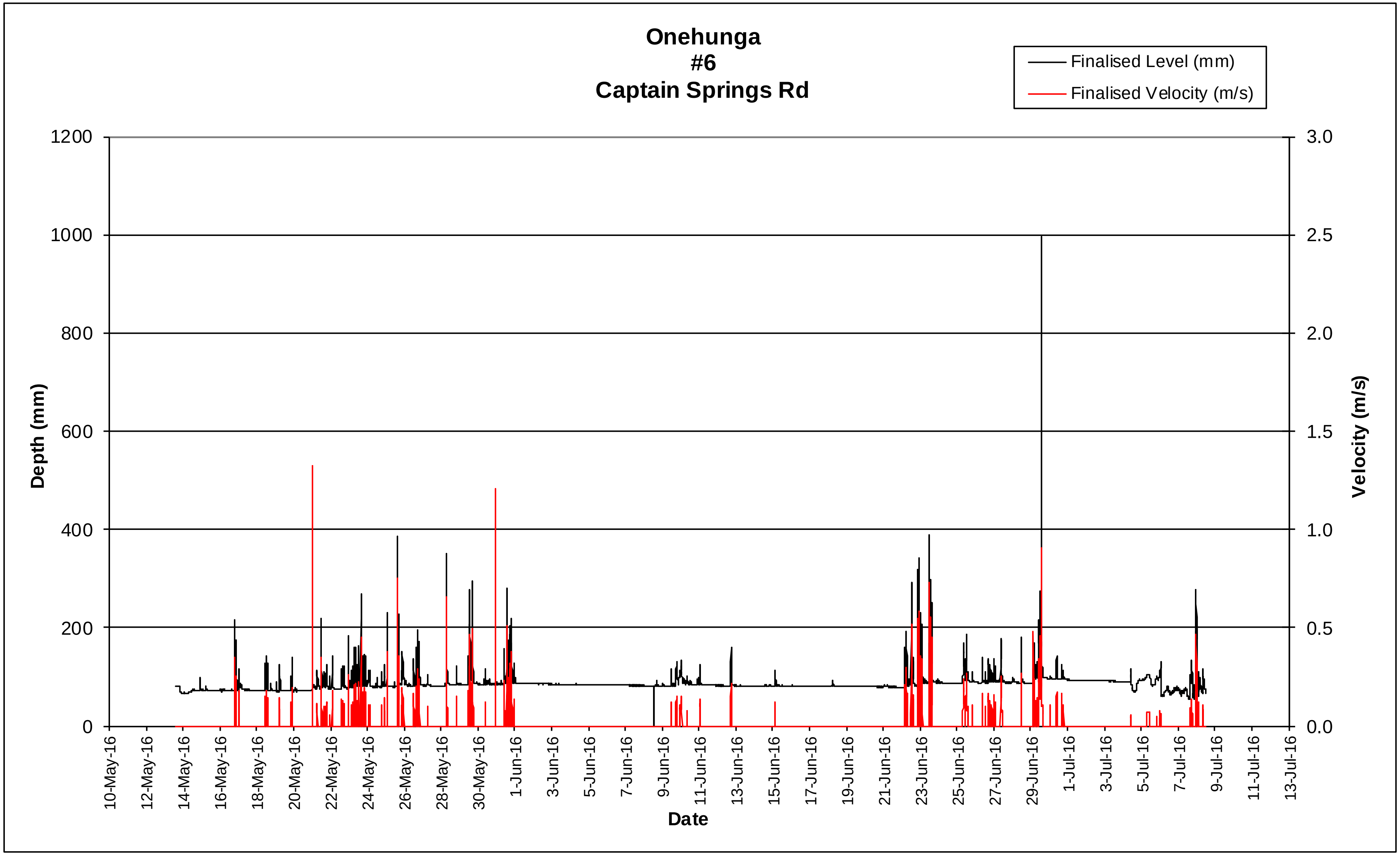
9-Jul-16
19-Jul-16
Date


Onehunga
#6
Captain Springs Rd
Finalised Level (mm)
Finalised Velocity (m/s)
Depth (mm)
Velocity (m/s)
1200
1000
800
600
400
200
0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
10-May-16
12-May-16
14-May-16
16-May-16
18-May-16
20-May-16
22-May-16
24-May-16
26-May-16
28-May-16
30-May-16
1-Jun-16
3-Jun-16
5-Jun-16
7-Jun-16
9-Jun-16
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21-Jun-16
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27-Jun-16
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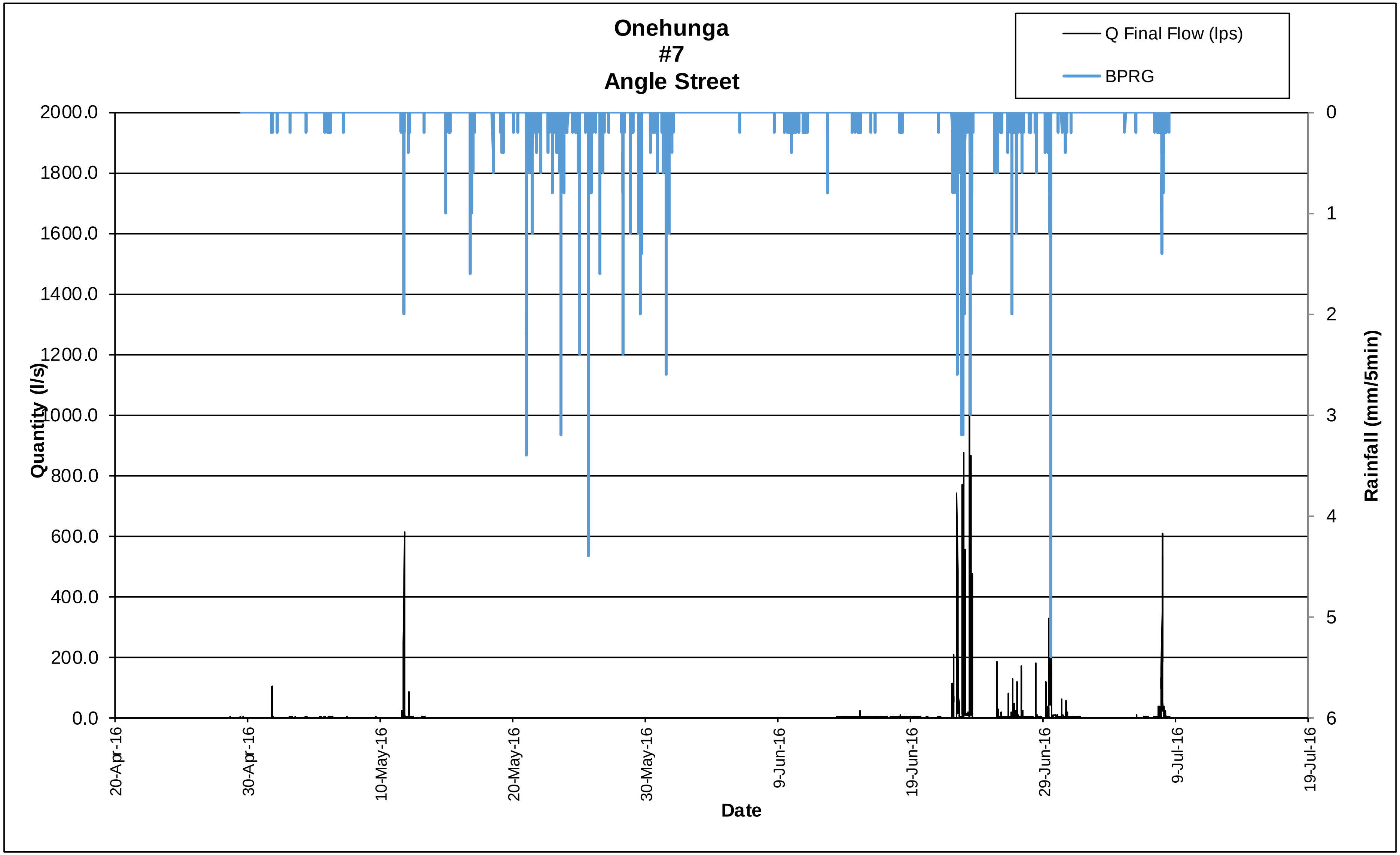
11-Jul-16
13-Jul-16
Date


Onehunga
#7
Angle Street
Q Final Flow (lps)
BPRG
Quantity (l/s)
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Rainfall (mm/5min)
0
1
2
3
4
5
6
20-Apr-16
30-Apr-16
10-May-16
20-May-16
30-May-16
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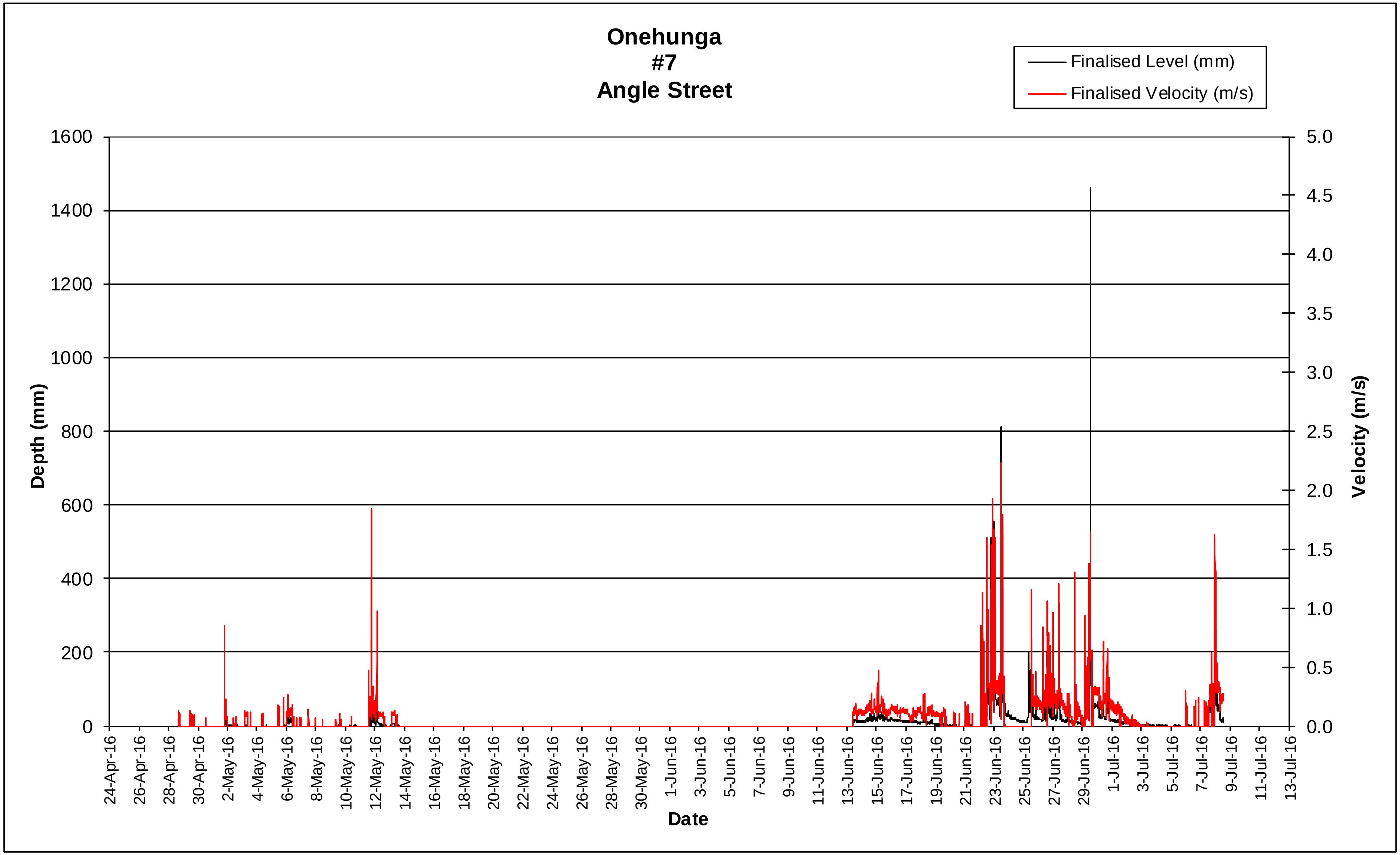
19-Jun-16
29-Jun-16
9-Jul-16
19-Jul-16
Date


Onehunga
#7
Angle Street
Finalised Level (mm)
Finalised Velocity (m/s)
Depth (mm)
Velocity (m/s)
Date
1600
1400
1200
1000
800
600
400
200
0
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
24-Apr-16
26-Apr-16
28-Apr-16
30-Apr-16
2-May-16
4-May-16
6-May-16
8-May-16
10-May-16
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3-Jun-16
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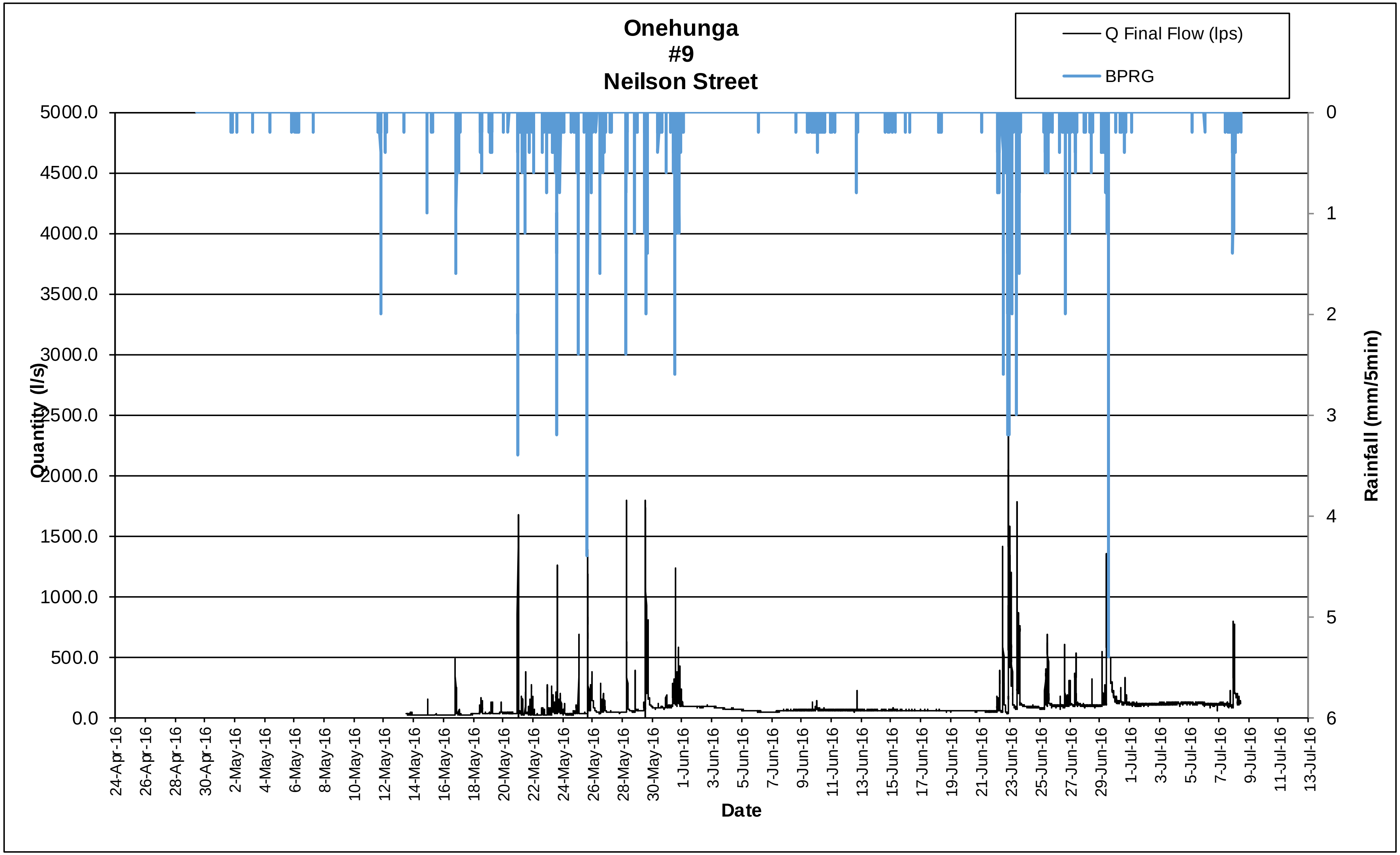
11-Jul-16
13-Jul-16


Onehunga
#9
Neilson Street
Q Final Flow (lps)
BPRG
Quantity (l/s)
Rainfall (mm/5min)
Date
5000.0
4500.0
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0
1
2
3
4
5
6
24-Apr-16
26-Apr-16
28-Apr-16
30-Apr-16
2-May-16
4-May-16
6-May-16
8-May-16
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9-Jun-16
11-Jun-16
13-Jun-16
15-Jun-16
17-Jun-16
19-Jun-16
21-Jun-16
23-Jun-16
25-Jun-16
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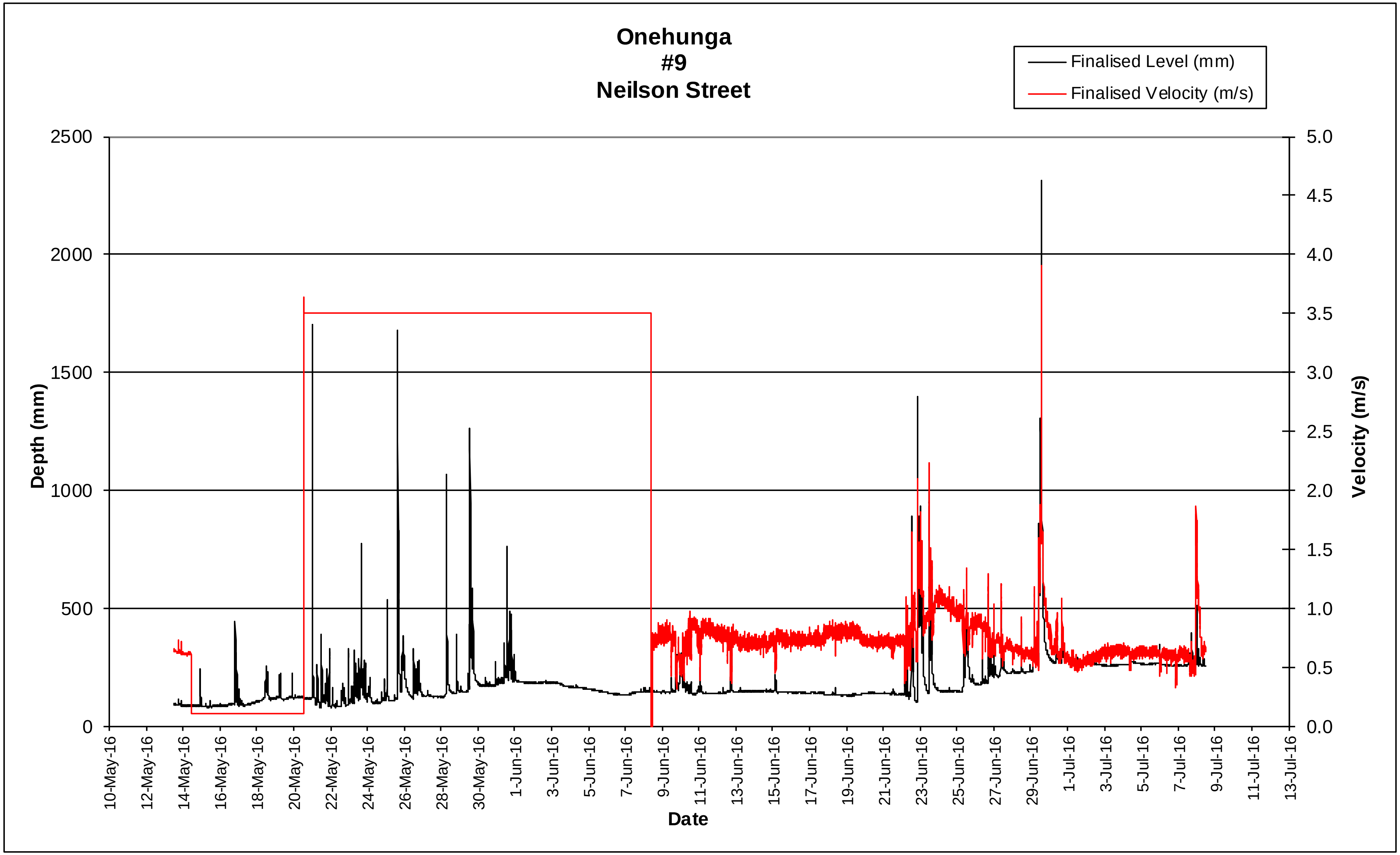
11-Jul-16
13-Jul-16


Onehunga
#9
Neilson Street
Finalised Level (mm)
Finalised Velocity (m/s)
Depth (mm)
Velocity (m/s)
Date
2500
2000
1500
1000
500
0
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
10-May-16
12-May-16
14-May-16
16-May-16
18-May-16
20-May-16
22-May-16
24-May-16
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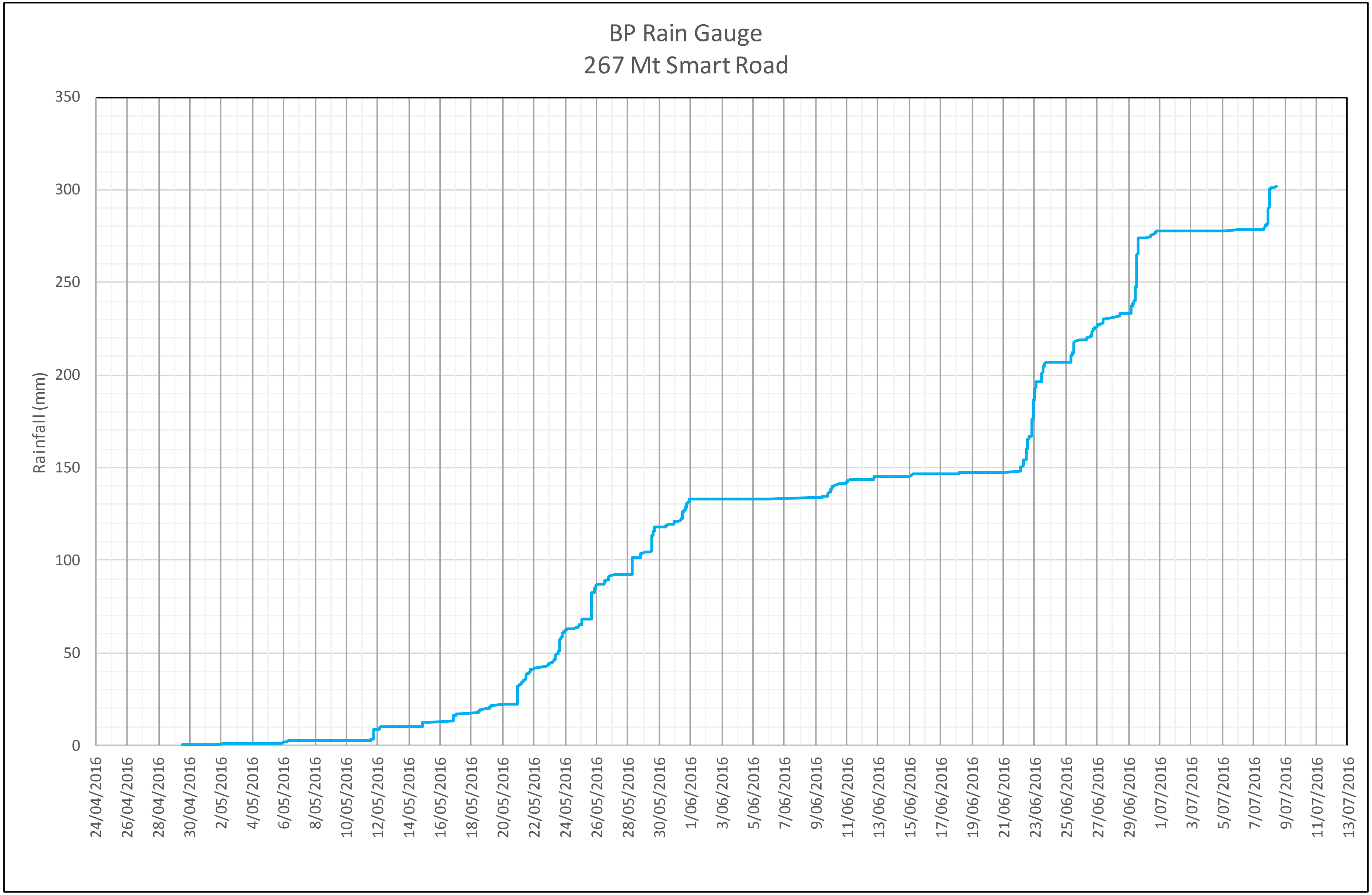
11-Jul-16
13-Jul-16


BP Rain Gauge
267 Mt Smart Road
Rainfall (mm)
0
50
100
150
200
250
300
350
24/04/2016
26/04/2016
28/04/2016
30/04/2016
2/05/2016
4/05/2016
6/05/2016
8/05/2016
10/05/2016
12/05/2016
14/05/2016
16/05/2016
18/05/2016
20/05/2016
22/05/2016
24/05/2016
26/05/2016
28/05/2016
30/05/2016
1/06/2016
3/06/2016
5/06/2016
7/06/2016
9/06/2016
11/06/2016
13/06/2016
15/06/2016
17/06/2016
19/06/2016
21/06/2016
23/06/2016
25/06/2016
27/06/2016
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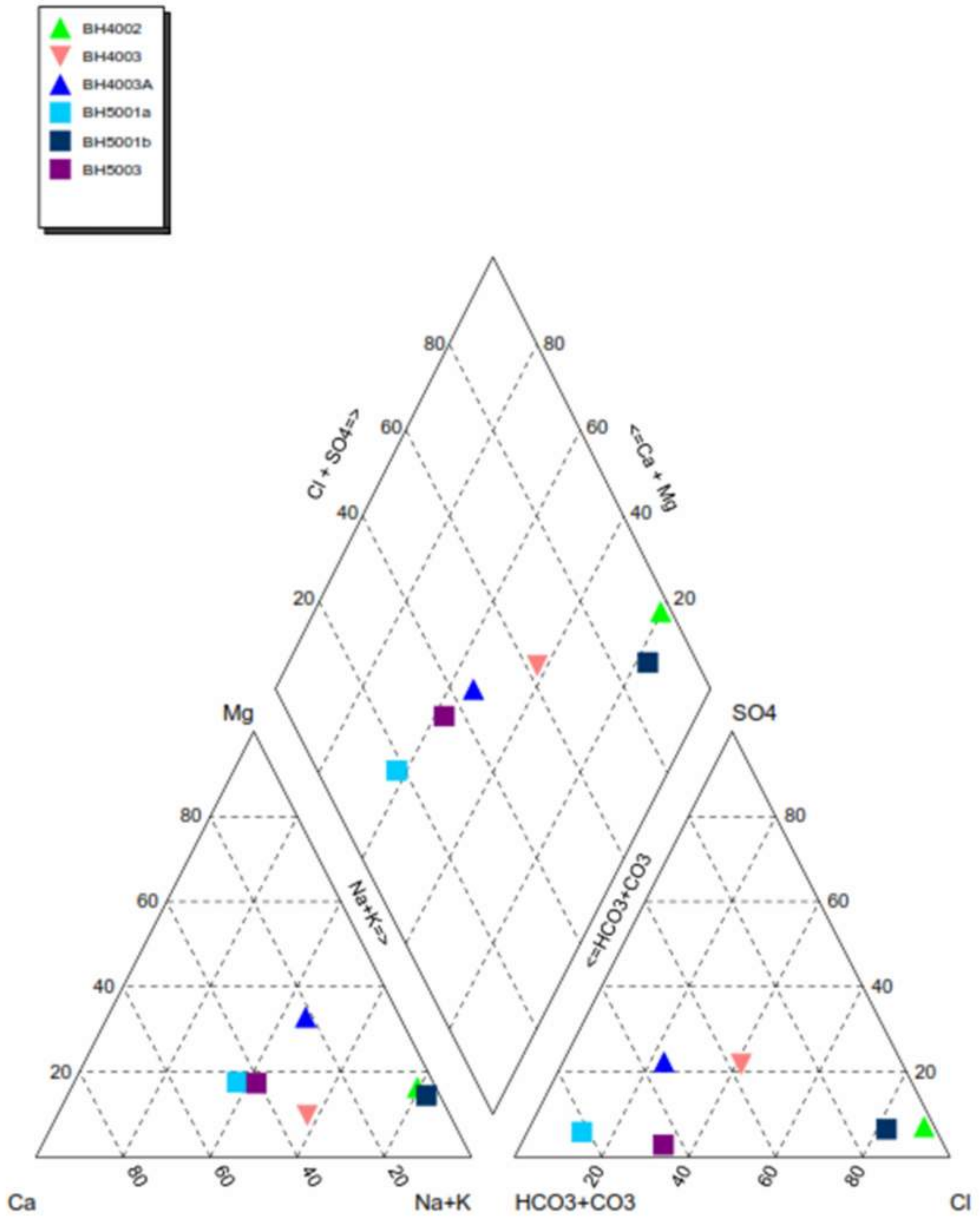
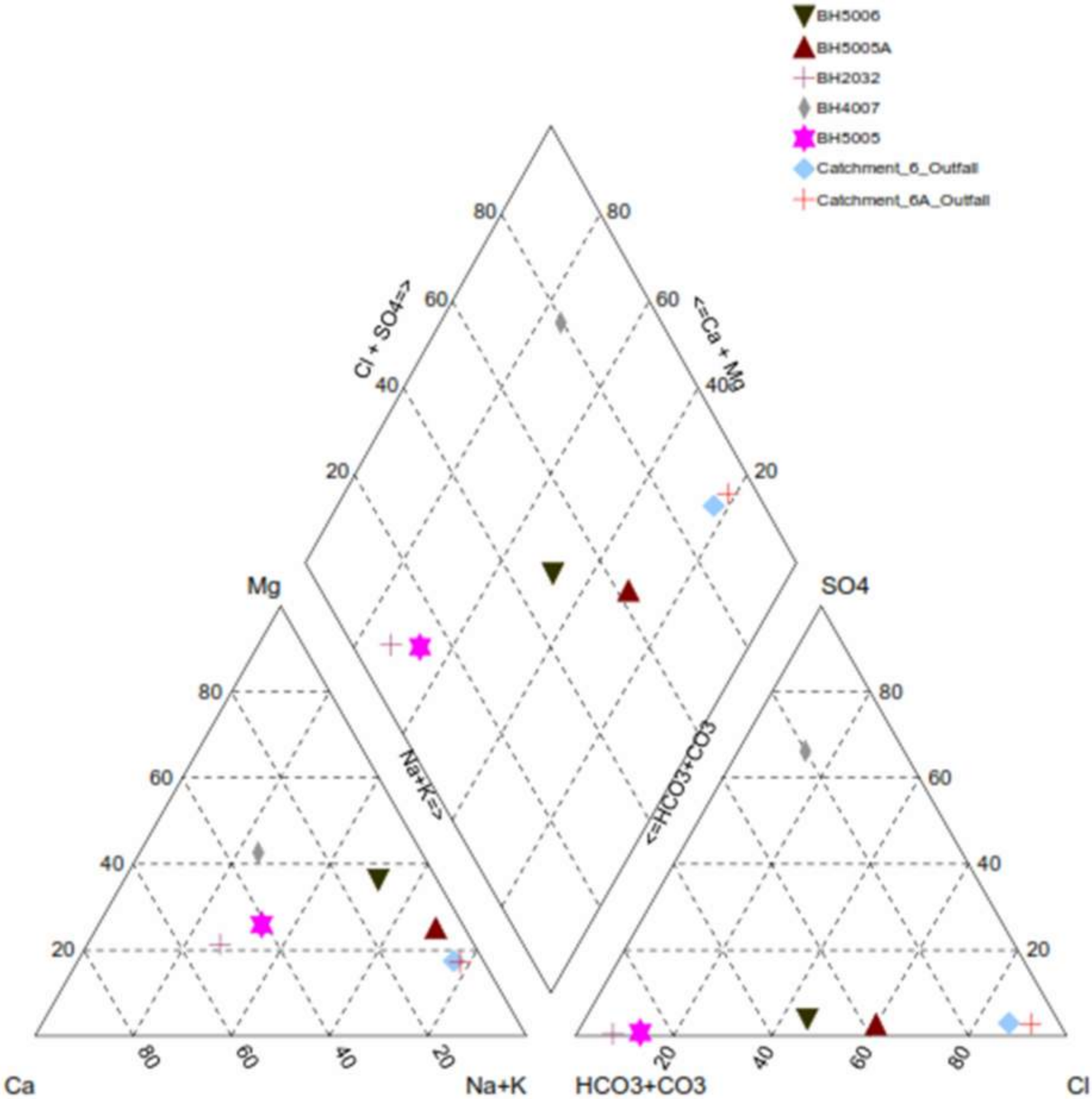
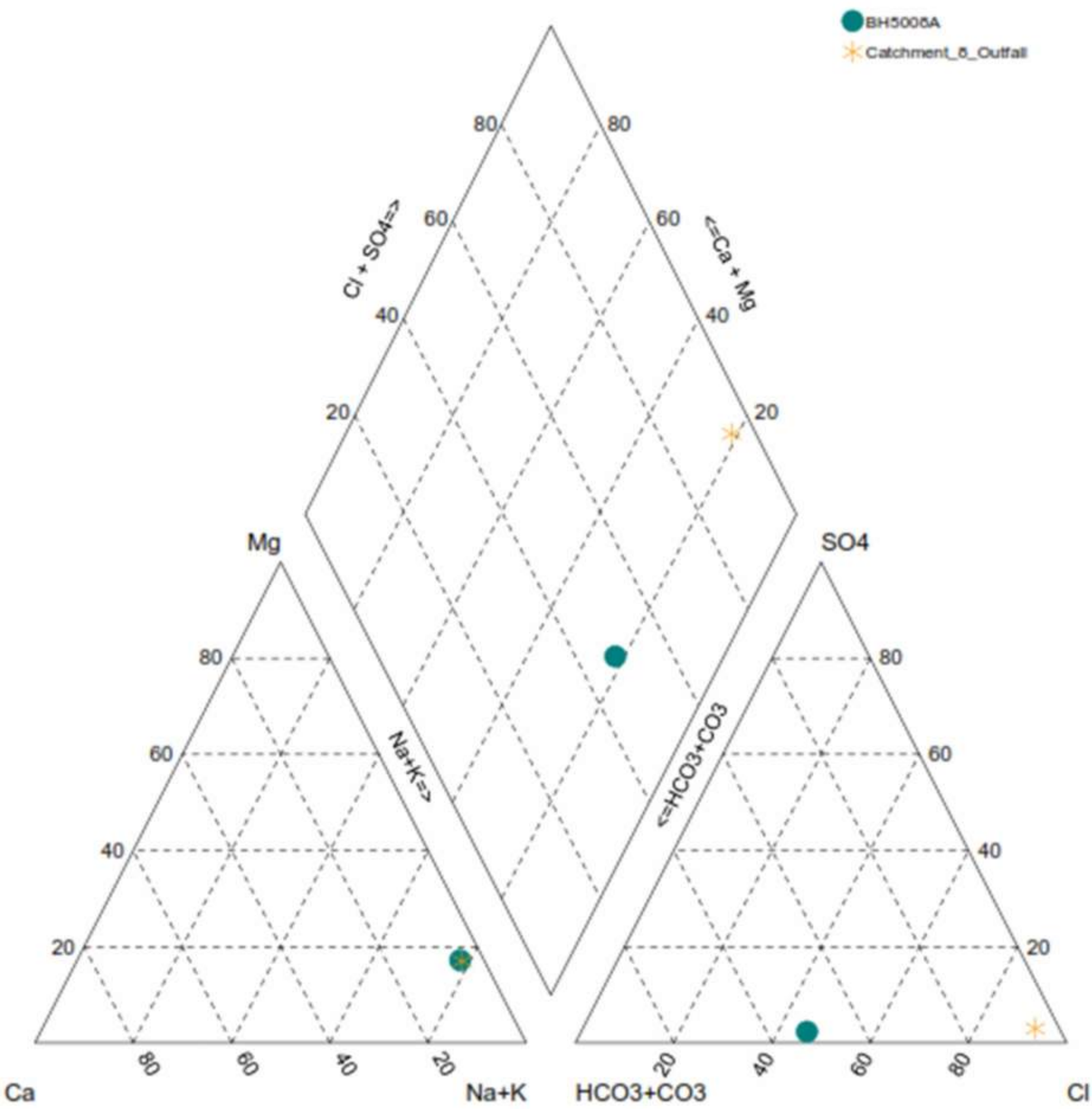
13/07/2016

Piper plots



BH4002
BH4003
BH4003A
BH5001a
BH5001b
BH5003
Cl + SO4=>
<=Ca + Mg
Na+K=>
<=HCO3+CO3
Mg
SO4
Ca
Na+K
HCO3+CO3
Cl
80
60
40
20


BH5006
BH5005A
BH2032
BH4007
BH5005
Catchment_6_Outfall
Catchment_6A_Outfall
Cl + SO4=>
<=Ca + Mg
Na+K=>
<=HCO3+CO3
Mg
SO4
Ca
Na+K
HCO3+CO3
Cl
80
60
40
20


BH5006A
Catchment_8_Outfall
Cl + SO4=>
<=Ca + Mg
Mg
SO4
Na+K=>
<=HCO3+CO3
Ca
Na+K
HCO3+CO3
Cl
80
60
40
20

Appendix C

Water Quality Treatment Assessment

APPENDIX C: WATER QUALITY ASSESSMENT

Table of Contents

1 Introduction

1.1 Purpose and Scope of this Appendix

The purpose of this note is to describe the modelling approach used to assess stormwater treatment associated with the East West Link project.

2 Water quality treatment assessment

One of the main objectives for a proposed stormwater treatment system along the Mangere Inlet is to minimise the required footprint to provide treatment. Reducing the required footprint for treatment means less land (reclamation) is required.

A treatment design objective has been adopted that represents best practice design in the Auckland region. The design target is 75% reduction in annual loads of total suspended solids (TSS- which are representative of a wider range of stormwater contaminants).

An innovative combination of wetlands and bioretention is proposed to achieve these targets while reducing the required footprint compared to standard methods.

Wetlands are proposed as the first component of treatment to treat coarse sediment (in forebays) and baseflows (that bioretention can't deal with) and the first part of storm events. During a storm event the wetlands will overtop into adjacent bioretention systems (that use a smaller footprint for treatment than wetlands).

Assessment of the water quality performance of this combined treatment system is beyond the methods in standard design guides in Auckland (e.g. TP10) that focus on single treatment systems. Therefore, a model was adopted that can model contaminant generation and treatment processes (including multiple treatments). It was then possible to model the combined system of wetlands overflowing into bioretention and assessing their combined performance (i.e. the treatment train).

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was adopted. A widely used stormwater treatment assessment tool used in Australia and elsewhere. The parameters used in MUSIC include a rainfall:runoff model as well as runoff quality parameters. The stormwater quality inputs to MUSIC were derived from a review of more than 700 scientific papers from around the world reporting runoff quality for various land uses. These data include some New Zealand papers.

An exercise was firstly performed to compare the sizes of systems using TP10 and MUSIC acting as stand-alone systems. This was done for both bioretention and wetlands to ensure MUSIC was predicting a similar sized stand-alone treatment to TP10 before combinations were modelled.

MUSIC (described further below) allows the user to vary the components of a treatment (including the sizes) and predicts the likely contaminant reduction.

To compare the sizes of required treatment using TP10 and MUSIC, the sizes for a particular configuration were determined using TP10 and then the same attributes of the treatment system (e.g. active storage depth etc.) were applied in MUSIC (Table 1). Each component of the configurations used represented standard design approaches (e.g. detention times, active storage depths etc.). Auckland rainfall data were used in the modelling.

The size of the treatment was then varied in MUSIC until the 75% TSS reduction was reached. The sizes required to meet the 75% TSS reduction can then be compared between TP10 methods and MUSIC.

A catchment with 70% impervious surfaces was adopted and the sizes calculated as a percentage of the catchment area.

Table 1 Common attributes for comparative treatments

WETLANDS	
Active storage (extended detention depth))	500 mm
Detention time	72 hours
Permanent pool average depth (dead storage)	400 mm
BIORETENTION	
Saturated hydraulic conductivity of filter media	75 mm/hr
Filter media depth	0.5m
Maximum ponding depth	220 mm

Figure 1 shows a plot of the required sizes to meet 75% TSS reduction using both stand-alone wetlands and bioretention using the two methods.

The plot shows that for bioretention, TP10 predicts a required size of 0.48% of the catchment. MUSIC predicts a required size of 0.43% of the catchment area.

For wetlands both methods predict a required size of approximately 2% of the catchment area.

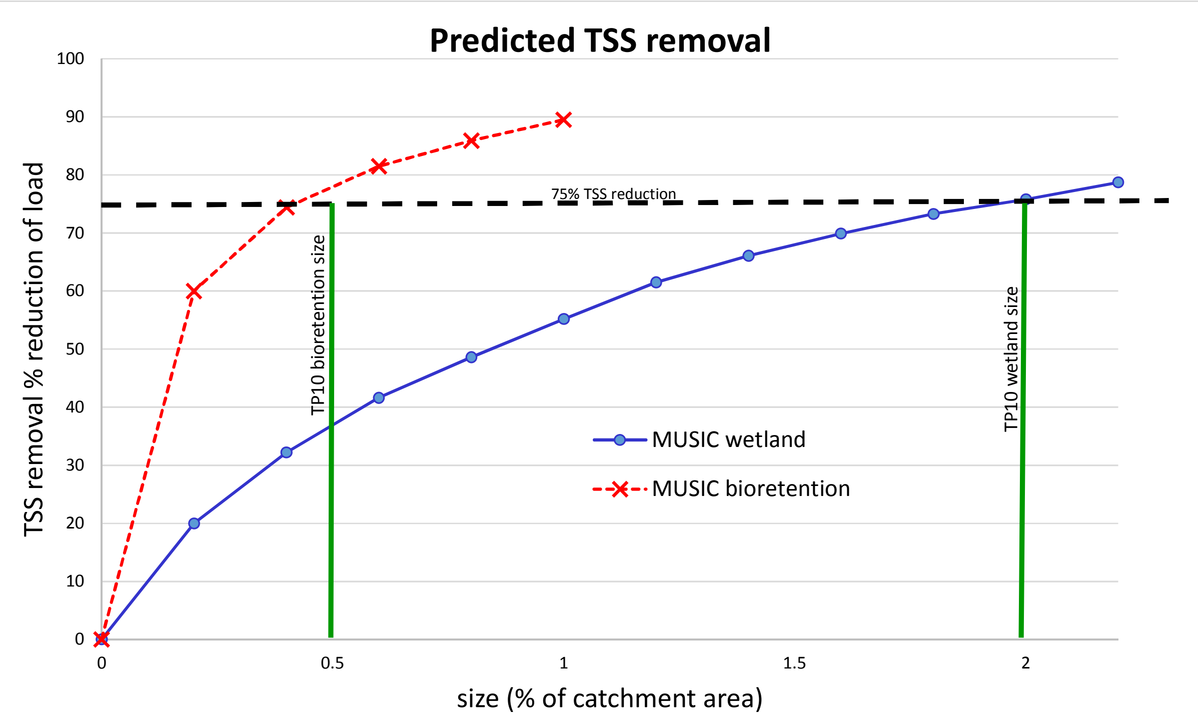


Figure 1 Required sizes to meet 75% TSS reduction for wetlands and bioretention

On the basis of the MUSIC program and TP10 providing similar results for a stand-alone standard configuration, MUSIC was then applied to assess more complex configuration for treatment. All with the intent of minimising the footprint while providing best practice treatment.

The proposed treatment systems used the following operating sequence, all of which can be replicated in the MUSIC model and the performance predicted.

The operating sequence for treatment which is replicated in MUSIC is:

1. stormwater enters an inlet pond (sediment forebay) where coarse sediment collect – after a possible GPT located further upstream
2. flow transfers directly into a vegetated wetland
3. water levels in the wetland rise during storm events by up to 400mm during a storm event
4. once the wetland reaches 250mm depth it overflows into a bioretention system located adjacent to the wetland
5. as flows continue to increase the ponded water over the wetland increase up to 400mm and up to 300mm over the bioretention
6. treated water from the wetland and bioretention system combine and become treated water outflows
7. an overflow pipe collects higher flows (once the wetland and bioretention are at full ponding depths) and discharge to the coast.

A more thorough description of the MUSIC modelling is provided below.

2.1 MUSIC Modelling approach

To assess the performance of the proposed stormwater treatment systems, a continuous modelling approach was adopted. The treatment systems were sized to meet the desired treatment objectives of 75% annual reduction in total suspended solids (as representative of a wider range of stormwater contaminants).

A continuous modelling approach was adopted to simulate the effect of antecedent rainfall patterns, interactions between the different treatment systems (e.g. when the wetland overtops to the bioretention) and to simulate the processes of treatment that occur with frequent rainfall events. It is the frequent rainfall events that carry the majority of annual contaminant loads.

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC – version 6.1) was used for the simulation using 6-minute rainfall data over an eight year period. The MUSIC model is specifically designed to simulate contaminant generation and removal process in urban catchments. It allows particular treatment measures (e.g. wetland or raingardens) to be configured based on catchment characteristics and site constraints.

The model simulates the interaction between treatment devices and contaminant generation and removal at each time step (6-minute) to provide a thorough assessment of the contaminant removal process. MUSIC has been developed over more than a decade as is based on thorough research results from the last 18 years on the contaminant removal performance of different treatment systems and is the subject of numerous publications (see www.toolkit.net.au).

MUSIC has become the standard modelling approach for stormwater systems in Australia. Assessing stormwater treatment strategies using MUSIC is a requirement by many local authorities in the eastern seaboard. MUSIC was also used as the basis for the design of the stormwater treatment systems in Waterfront Auckland (e.g. Jellicoe, Madden and Halsey Streets) and at Wellington's Waitangi Park.

Six minute rainfall data were gathered from Auckland Airport (C74082) from 1986 and 1994. These data were the longest 6-minute data set identified close to the site and have an average rainfall depth of 1114 mm per year. The results were also compared using a longer data set (15 years) from Albany Wastewater Treatment Plant and were found to have similar results.

Input	Data used in modelling
Rainfall station	C74082 Auckland airport
Time step	6 minute
Modelling period	1986 – 1994
Mean annual rainfall	1,114 mm (for the period used)
Mean annual evapotranspiration	1,059 mm

Appendix D

Stormwater Treatment Devices and Project Discharge locations

Table 1-9-1: Stormwater Treatment Devices

Sector	Device Ref	DWG Ref	Catchment area (ha)			Type of treatment device	Device Area (m2)	Level of Treatment
			Total	Project	Out-of-project			
1	S1A	AEE-SW-101	0.3	0.3	0.0	Stormfilter (7 Cartridges)	NA	75% TSS
	S1B	AEE-SW-101	0.6	0.6	0.0	Wetland	1,700	75% TSS
	S1D	AEE-SW-101	0.3	0.3	0.0	Stormfilter (8 Cartridges)	NA	75% TSS
	S1E	AEE-SW-101	0.4	0.4	0.0	Stormfilter (10 Cartridges)	NA	75% TSS
	S1G	AEE-SW-102	5.2	5.2	0.0	Wetland	2,500	75% TSS
	S1H	AEE-SW-102	1.0	1.0	0.0	Stormfilter (22 Cartridges)	NA	75% TSS
	S1I	AEE-SW-102	0.3	0.3	0.0	Stormfilter (7 Cartridges)	NA	75% TSS
	S1J	AEE-SW-102	0.9	0.9	0.0	Stormfilter (23 Cartridges)	NA	75% TSS
	S1K	AEE-SW-103	0.7	0.0	0.7	Stormfilter (15 Cartridges)	NA	75% TSS
	S1L	AEE-SW-103	1.5	0.0	1.5	Stormfilter (37 Cartridges)	NA	75% TSS
	S1M	AEE-SW-103	1.6	0.4	1.2	Stormfilter (34 Cartridges)	NA	75% TSS
2	Galway Street Treatment Area	AEE-SW-103	64.5	Approx. 1% out-of-project	64.5	Sediment forebay and biofiltration system	2000	75% TSS
	Landform 1 Treatment Area	AEE-SW-104	81.55	Approx. 2% out-of-project	80.2	Sediment forebays and combined wetland / biofiltration system	6150	
	Landform 2 Treatment Area	AEE-SW-104	81.4	Approx. 4% out-of-project	81.4	Sediment forebays and combined wetland / biofiltration system	7525	
	Landform 3 Treatment Area	AEE-SW-106	326.5	Approx. 1% out-of-project	326.5	Sediment forebays and combined wetland / biofiltration system	31690	
	Miami Stream Treatment Area	AEE-SW-105	43.8	Approx. 2-4% out-of-project	43.8	Sediment forebays and combined wetland / biofiltration system	4550	
3	S3A	AEE-SW-107	2.3	1.7	0.6	Wetland	6,000	75% TSS
	S3B	AEE-SW-107	0.2	0.2	0.0	Stormfilter (6 Cartridges)	NA	75% TSS

Sector	Device Ref	DWG Ref	Catchment area (ha)			Type of treatment device	Device Area (m2)	Level of Treatment
			Total	Project	Out-of-project			
	S3C	AEE-SW-107	0.0	0.0	0.0	Stormfilter (1 Cartridges)	NA	75% TSS
	S3D	AEE-SW-107	0.0	0.0	0.0	Stormfilter (1 Cartridges)	NA	75% TSS
	S3E	AEE-SW-108	2.9	2.9	0.0	Stormfilter (69 Cartridges)	NA	75% TSS
	S3G	AEE-SW-108	0.4	0.4	0.0	Stormfilter (10 Cartridges)	NA	75% TSS
4	S4A	AEE-SW-108	1.5	1.5	0.0	Stormfilter (36 Cartridges)	NA	75% TSS
	S4B	AEE-SW-108	2.0	0.0	2.0	Stormfilter (44 Cartridges)	NA	75% TSS
	S4C	AEE-SW-109	1.0	1.0	0.0	Stormfilter (25 Cartridges)	NA	75% TSS
	S4D	AEE-SW-109	8.1	0.0	8.1	Stormfilter (147 Cartridges)	NA	75% TSS
	S4E	AEE-SW-109	0.9	0.9	0.0	Stormfilter (22 Cartridges)	NA	75% TSS
	S4F	AEE-SW-110	0.3	0.3	0.0	Stormfilter (8 Cartridges)	NA	75% TSS
	S4G	AEE-SW-110	3.3	3.3	0.0	Stormfilter (76 Cartridges)	NA	75% TSS
5	S5A	AEE-SW-110	2.0	1.9	0.1	Stormfilter (45 Cartridges)	NA	75% TSS
	S5B	AEE-SW-111	4.0	1.4	2.6	Stormfilter (78 Cartridges)	NA	75% TSS
	S5C	AEE-SW-111	0.2	0.2	0.0	Stormfilter (4 Cartridges)	NA	75% TSS
	S5D	AEE-SW-112	6.7	2.2	4.5	Stormfilter (133 Cartridges)	NA	75% TSS
	S5E	AEE-SW-112	4.7	2.7	2.0	Stormfilter (103 Cartridges)	NA	75% TSS
	S5F	AEE-SW-113	0.2	0.2	0.0	Stormfilter (4 Cartridges)	NA	75% TSS
	S5G	AEE-SW-113	5.5	3.4	2.1	Wetland	1,200	75% TSS
	S4I	AEE-SW-113	0.1	0.1	0.0	Stormfilter (4 Cartridges)	NA	75% TSS
	S4J	AEE-SW-113	0.1	0.1	0.0	Stormfilter (4 Cartridges)	NA	75% TSS

Table 1-9-2: Project Discharge Locations

Sector	Outfall Reference	Chainage	Drawing Reference	Catchment Area (Ha)			Flood Flows (m3/s)		Pipe Diameter (mm)	Existing or New Outfall
				Total	Project	Out-of-project	Q_{10}	Q_{100}		
1	S1A	N/A	AEE-SW-101	0.3	0.3	0.0	0.1	0.2	TBC	New
	S1B	N/A	AEE-SW-101	0.6	0.6	0.0	0.1	0.2	TBC	New - connection to existing open drain
	S1C	MC00 50	AEE-SW-101	101.8	0.0	101.8	11.5	0.2	TBC	Existing - connection to existing open drain
	S1D	N/A	AEE-SW-101	0.3	0.3	0.0	0.1	0.2	TBC	New Connection to new open drain
	S1E	N/A	AEE-SW-101	0.4	0.4	0.0	0.1	0.2	375 (TBC)	New
	S1F	N/A	AEE-SW-102	102.7	1.0	101.8	11.7	0.3	1350 & 900	Existing with new outfall structures
	S1G	MC00 400	AEE-SW-102	5.2	5.2	0.0	0.9	1.7	1050 (TBC)	Existing with new outfall structure
	S1H	MC00 450	AEE-SW-102	1.0	1.0	0.0	0.3	0.5	525 (TBC)	New
	S1I	MC00 525	AEE-SW-102	0.3	0.3	0.0	0.1	0.1	300 (TBC)	New
	S1J	MC00 850	AEE-SW-102	0.9	0.9	0.0	0.3	0.5	525 (TBC)	New
	S1K	MC00 800	AEE-SW-103	0.7	0.0	0.7	0.2	0.4	TBC	Existing connection to existing pipe
	S1L	MC00 950	AEE-SW-103	1.5	0.0	1.5	0.6	0.9	600 (TBC)	New
	S1M	MC00 980	AEE-SW-103	1.6	0.4	1.2	0.5	0.8	600 (TBC)	New
	S1N	MC00 960	AEE-SW-103	64.50	Approx. 1% out-of-project area	64.50	6.44	10.3 *	APPROX 900 (TBC)	New
	S1O	MC00 1120	AEE-SW-103						APPROX 2100 (TBC)	New

Sector	Outfall Reference	Chainage	Drawing Reference	Catchment Area (Ha)			Flood Flows (m3/s)		Pipe Diameter (mm)	Existing or New Outfall
				Total	Project	Out-of-project	Q_{10}	Q_{100}		
2	S2 A (C4)	MC00 1350	AEE-SW-103	35.3	Approx. 2% out-of project area	35.3 (excl. reclamation)	4.50	8.3 *	APPROX 1800 (TBC)	New
	S2 LF1B	N/A	AEE-SW-104	46.3		46.3 (excl. reclamation)	3.7	5.7 *	APPROX 1800 (TBC)	New
	S2 LF1A	N/A	AEE-SW-103				N/A - low flow		APPROX 450 (TBC)	New
	S2 LF2A	N/A	AEE-SW-104	81.4	Approx. 4% out-of-project area	81.4 (excl. reclamation)	N/A - low flow		APPROX 450 (TBC)	New
	S2 LF2B	N/A	AEE-SW-104				5.41	13.3 *	APPROX 1800 (TBC)	New
	S2G (C7)	MC 2710	AEE-SW-105	43.8	Approx. 2-4 % out-of-project area	43.8	5.2	16.9 *	APPROX 1200 (TBC)	New
	S2 LF3A	N/A	AEE-SW-105	286.3	Approx. 1% out-of-project area	286.3 (excl. reclamation)	22.7	36.1 *	APPROX 2100 (TBC)	New
	S2 LF3B	N/A	AEE-SW-105						APPROX 2100 (TBC)	New
	S2 LF3C	N/A	AEE-SW-106	40.2		40.2 (excl. reclamation)	N/A - low flow		APPROX 525 (TBC)	New
	S2 LF3E	N/A	AEE-SW-106				N/A - low flow		APPROX 525 (TBC)	New
	S2 LF3D	N/A	AEE-SW-106				6.8	10.2 *	APPROX 1500 (TBC)	New
	S2 LF3F	N/A	AEE-SW-106						APPROX 2100	New

Sector	Outfall Reference	Chainage	Drawing Reference	Catchment Area (Ha)			Flood Flows (m3/s)		Pipe Diameter (mm)	Existing or New Outfall
				Total	Project	Out-of-project	Q_{10}	Q_{100}		
									(TBC)	
3	S3A	MC00 4200	AEE-SW-107	2.3	1.7	0.6	0.7	1.0	TBC	New connection to existing open drain
	S3B	MC00 4350	AEE-SW-107	0.2	0.2	0.0	0.1	0.1	TBC	New connection to new open drain
	S3C	MC00 4450	AEE-SW-107	0.0	0.0	0.0	0.0	0.0	TBC	New connection to existing open drain
	S3D	MC00 4500	AEE-SW-107	0.0	0.0	0.0	0.0	0.0	TBC	New connection to existing network
	S3E	MC00 4970	AEE-SW-108	2.9	2.9	0.0	1.1	1.7	900 (TBC)	New
	S3F	MC00 5060	AEE-SW-108	131.3	3.6	127.7	15.8	17.8	2 x 2500 (TBC)	Existing to be extended
	S3G	MC00 5080	AEE-SW-108	0.4	0.4	0.0	0.2	0.2	TBC	New connection to existing network
4	S4A	MC00 5200	AEE-SW-108	1.5	1.5	0.0	0.6	0.8	TBC	New connection to existing network
	S4B	MC00 5350	AEE-SW-108	2.0	0.0	2.0	0.7	1.0	TBC	New connection to existing network
	S4C	MC00 5550	AEE-SW-109	1.0	1.0	0.0	0.4	0.6	TBC	New connection to existing network
	S4D	MC00 5650	AEE-SW-109	8.1	0.0	8.1	2.3	3.5	TBC	New connection to existing network
	S4E	MC00 5710	AEE-SW-109	0.9	0.9	0.0	0.3	0.5	TBC	New connection to existing network
	S4F	MC00 6270	AEE-SW-110	0.3	0.3	0.0	0.1	0.2	TBC	New connection to existing modified open drain
	S4G	MC00 6550	AEE-SW-110	3.3	3.3	0.0	1.2	1.8	TBC	New connection to proposed box culvert
	S4H	MC00 6300	AEE-SW-110	42.5	6.6	35.9	4.6	9.2	5.3 x 1 (TBC)	Existing connection to existing modified open drain

Sector	Outfall Reference	Chainage	Drawing Reference	Catchment Area (Ha)			Flood Flows (m3/s)		Pipe Diameter (mm)	Existing or New Outfall
				Total	Project	Out-of-project	Q_{10}	Q_{100}		
	S4I	MC00 6275	AEE-SW-110	12.3	0.0	12.3	2.2	3.2	1200	Existing connection to existing modified open drain
	S4J	MC00 6150	AEE-SW-110	58.7	6.9	51.8	8.7	11.7	2 x 1650 (TBC)	Existing
5	S5A	MC00 6750	AEE-SW-110	2.0	1.9	0.1	1.4	5.1	1350 & 2 x 300 (TBC)	New to modified existing open drain
	S5B	MC00 7200	AEE-SW-111	4.0	1.4	2.6	0.7	1.6	1350 (TBC)	New connection to proposed network
	S5C	MC00 7150	AEE-SW-111	0.2	0.2	0.0	0.1	0.1	TBC	New connection to existing network
	S5D	MC00 7900	AEE-SW-112	6.7	2.2	4.5	1.3	2.1	525 & 300 (TBC)	New
	S5E	MC00 8050	AEE-SW-112	4.7	2.7	2.0	1.0	2.9	675 & 300 (TBC)	New
	S5F	MC00 8340	AEE-SW-113	0.2	0.2	0.0	0.1	0.1	TBC	Connection to existing pipe
	S5G	MC00 8360	AEE-SW-113	5.5	3.4	2.1	1.0	0.9	900 TBC	Connection to existing open drain
	S5H	MC00 8450	AEE-SW-113	5.5	3.4	2.1	1.0	0.9	TBC	Connection to proposed wetland
	S5I	MC00 8590	AEE-SW-113	0.1	0.1	0.0	0.0	0.1	TBC	Connection to existing pipe
	S5J	MC00 8750	AEE-SW-113	0.1	0.1	0.0	0.1	0.1	TBC	Connection to existing pipe

Appendix E

USLE Calculations

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 -Construction Works Outfalling to Clemow Stream		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With ESC Controls, Stabilisation and Flocculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2+10{,}000} + \frac{4.56 \times s}{\sqrt{s^2+10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
0.9	2.6	SH1 Outfall to DEB S4_1	0.27	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
0.9	2.6	SH1 Outfall to DEB S4_2	0.3	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
0.9	2.6	SH1 Outfall to DEB S4_3	0.3	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
2.8	5.5	SH1 Outfall to DEB S4_4	0.164	7.6	10007.6	100.0	200.0	61.0	0.3	0.5
2.6	3.9	SH1 Outfall to DEB S4_5	0.23	6.9	10006.9	100.0	150.0	45.7	0.3	0.4
0.4	0.7	SH1 Outfall to DEB S4_6	0.12	0.1	10000.1	100.0	200.0	61.0	0.2	0.1
1.3	3.2	SH1 Outfall to DEB S4_7	0.25	1.6	10001.6	100.0	250.0	76.2	0.3	0.3

*Earthworks Area = Area of Construction to Sediment Retention Devices to Clemow Stream

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$ | R = 70.66 J/ha | *Based on HIRDS data | p = 48.1 mm | *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	37	42	22	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.37	0	0	0.37	0.49

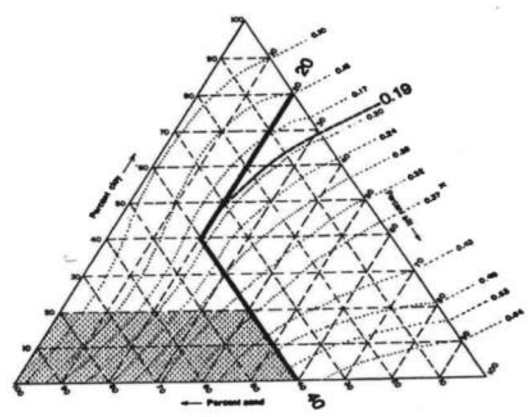
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			

DEB S4_1	SH1 Outfall to DEB S4_1	0.270	71	0.49	300.0	0.86	0.18	1	0.90	0.50	**0.77**		0.70	0.80	**0.11**
DEB S4_2	SH1 Outfall to DEB S4_2	0.300	71	0.49	300.0	0.86	0.18	1	0.90	0.50	**0.86**		0.70	0.80	**0.12**
DEB S4_3	SH1 Outfall to DEB S4_3	0.300	71	0.49	300.0	0.86	0.18	1	0.90	0.50	**0.86**		0.70	0.80	**0.12**
DEB S4_4	SH1 Outfall to DEB S4_4	0.164	71	0.49	200.0	2.76	0.47	1	0.90	0.50	**1.18**		0.70	0.80	**0.17**
DEB S4_5	SH1 Outfall to DEB S4_5	0.230	71	0.49	150.0	2.62	0.41	1	0.90	0.50	**1.45**		0.70	0.80	**0.20**
DEB S4_6	SH1 Outfall to DEB S4_6	0.120	71	0.49	200.0	0.36	0.13	1	0.90	0.50	**0.24**		0.70	0.80	**0.03**
DEB S4_7	SH1 Outfall to DEB S4_7	0.250	71	0.49	250.0	1.26	0.28	1	0.90	0.50	**1.07**		0.70	0.80	**0.15**
	Total Area	**1.6340**					**Total Estimate Gross Sediment Yield (tonnes)**				**6.43**	**Total Mitigated Sediment Loss (tonnes)**			**0.90**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil - compacted and smooth - track walked on contour - rough irregular surface - disked to 250 mm depth	 1.0 1.0 1.0 1.0	 1.32 1.2 0.9 0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 -Construction Works Outfalling to Clemow Stream		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With ESC Controls in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
0.9	2.6	SH1 Outfall to DEB S4_1	0.27	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
0.9	2.6	SH1 Outfall to DEB S4_2	0.3	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
0.9	2.6	SH1 Outfall to DEB S4_3	0.3	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
2.8	5.5	SH1 Outfall to DEB S4_4	0.164	7.6	10007.6	100.0	200.0	61.0	0.3	0.5
2.6	3.9	SH1 Outfall to DEB S4_5	0.23	6.9	10006.9	100.0	150.0	45.7	0.3	0.4
0.4	0.7	SH1 Outfall to DEB S4_6	0.12	0.1	10000.1	100.0	200.0	61.0	0.2	0.1
1.3	3.2	SH1 Outfall to DEB S4_7	0.25	1.6	10001.6	100.0	250.0	76.2	0.3	0.3

*Earthworks Area = Area of Construction to Sediment Retention Devices to Clemow Stream

Calculate R (Erosion Index)

$R = 0.00828p^{2.2} * 1.7$

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

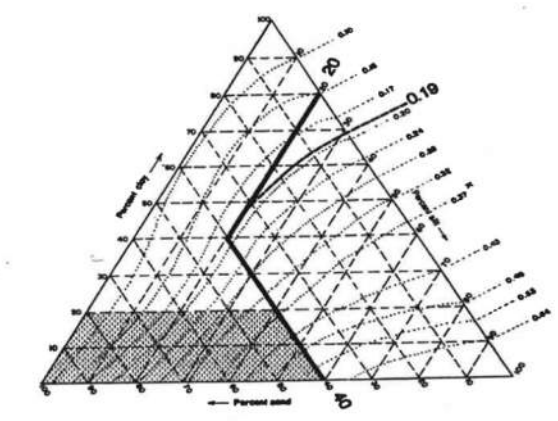
	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	37	42	22	0	0

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.37	0	0	0.37	0.49

*Refer to Table 1 and Figure 1

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters $A = R*K*LS*C*P$								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			

DEB S4_1	SH1 Outfall to DEB S4_1	0.270	71	0.49	300.0	0.86	0.18	1	0.90	0.50	**0.77**		0.70	0.60	**0.22**
DEB S4_2	SH1 Outfall to DEB S4_2	0.300	71	0.49	300.0	0.86	0.18	1	0.90	0.50	**0.86**		0.70	0.60	**0.24**
DEB S4_3	SH1 Outfall to DEB S4_3	0.300	71	0.49	300.0	0.86	0.18	1	0.90	0.50	**0.86**		0.70	0.60	**0.24**
DEB S4_4	SH1 Outfall to DEB S4_4	0.164	71	0.49	200.0	2.76	0.47	1	0.90	0.50	**1.18**		0.70	0.60	**0.33**
DEB S4_5	SH1 Outfall to DEB S4_5	0.230	71	0.49	150.0	2.62	0.41	1	0.90	0.50	**1.45**		0.70	0.60	**0.41**
DEB S4_6	SH1 Outfall to DEB S4_6	0.120	71	0.49	200.0	0.36	0.13	1	0.90	0.50	**0.24**		0.70	0.60	**0.07**
DEB S4_7	SH1 Outfall to DEB S4_7	0.250	71	0.49	250.0	1.26	0.28	1	0.90	0.50	**1.07**		0.70	0.60	**0.30**
Total Area		**1.6340**	**Total Estimate Gross Sediment Yield (tonnes)**								**6.43**	**Total Mitigated Sediment Loss (tonnes)**			**1.80**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Checked By:		**Date:**	
Element:	SH1 -Construction Works Outfalling to Clemow Stream		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - No Controls in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
0.9	2.6	SH1 Outfall to DEB S4_1	0.27	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
0.9	2.6	SH1 Outfall to DEB S4_2	0.3	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
0.9	2.6	SH1 Outfall to DEB S4_3	0.3	0.7	10000.7	100.0	300.0	91.4	0.2	0.2
2.8	5.5	SH1 Outfall to DEB S4_4	0.164	7.6	10007.6	100.0	200.0	61.0	0.3	0.5
2.6	3.9	SH1 Outfall to DEB S4_5	0.23	6.9	10006.9	100.0	150.0	45.7	0.3	0.4
0.4	0.7	SH1 Outfall to DEB S4_6	0.12	0.1	10000.1	100.0	200.0	61.0	0.2	0.1
1.3	3.2	SH1 Outfall to DEB S4_7	0.25	1.6	10001.6	100.0	250.0	76.2	0.3	0.3

*Earthworks Area = Area of Construction to Sediment Retention Devices to Clemow Stream

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R =	70.66	J/ha	*Based on HIRDS data	p =	48.1	mm

*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	37	42	22	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.37	0	0	0.37	0.49

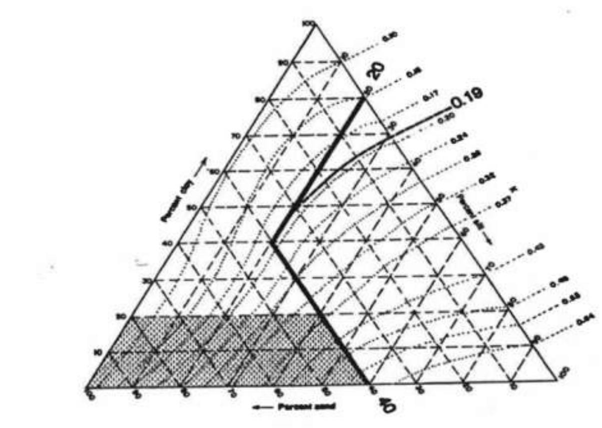
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period		

DEB S4_1	SH1 Outfall to DEB S4_1	0.270	71	0.49	300.0	0.86	0.18	1	1.32	0.50	**1.13**		0.70		**0.79**
DEB S4_2	SH1 Outfall to DEB S4_2	0.300	71	0.49	300.0	0.86	0.18	1	1.32	0.50	**1.26**		0.70		**0.88**
DEB S4_3	SH1 Outfall to DEB S4_3	0.300	71	0.49	300.0	0.86	0.18	1	1.32	0.50	**1.26**		0.70		**0.88**
DEB S4_4	SH1 Outfall to DEB S4_4	0.164	71	0.49	200.0	2.76	0.47	1	1.32	0.50	**1.74**		0.70		**1.22**
DEB S4_5	SH1 Outfall to DEB S4_5	0.230	71	0.49	150.0	2.62	0.41	1	1.32	0.50	**2.13**		0.70		**1.49**
DEB S4_6	SH1 Outfall to DEB S4_6	0.120	71	0.49	200.0	0.36	0.13	1	1.32	0.50	**0.35**		0.70		**0.24**
DEB S4_7	SH1 Outfall to DEB S4_7	0.250	71	0.49	250.0	1.26	0.28	1	1.32	0.50	**1.57**		0.70		**1.10**
Total Area		**1.6340**	**Total Estimate Gross Sediment Yield (tonnes)**								**9.44**	**Total Mitigated Sediment Loss (tonnes)**			**6.61**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	17/08/2016
Element:	Anns Creek Construction Yard		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - Stbilised, SRP in place with Flocculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}\ 22.1}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
35.0	3.5	Anns Creek Construction Yard to SRP 3_2	0.82	1225.0	11225.0	105.9	10.0	3.0	0.5	5.9

Calculate R (Erosion Index)

R = 0.00828p$^{2.2}$*1.7

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.18	2	0	0.18	0.24

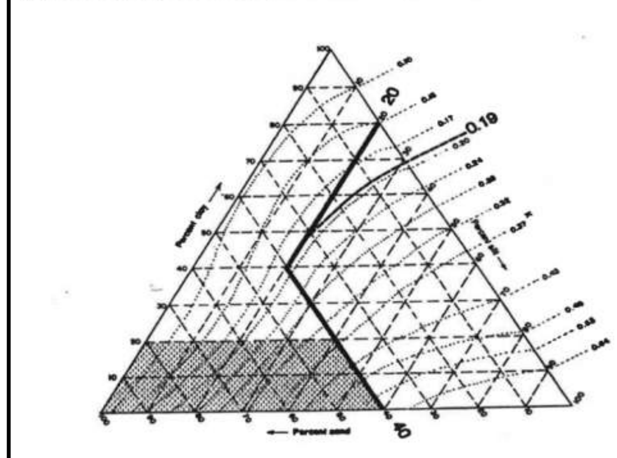
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP 3_2	Anns Creek Construction Yard to SRP 3_2	0.820	71	0.24	10.0	35.00	5.86	1	0.90	1.00	72.60		0.70	0.90	5.08
	Total Area	0.8200	Total Estimate Gross Sediment Yield (tonnes)								72.60	Total Mitigated Sediment Loss (tonnes)			5.08

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	17/08/2016
Checked By:		**Date:**	
Element:	Anns Creek Construction Yard		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - Stbilised, SRP in place with Flocculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
35.0	3.5	Anns Creek Construction Yard to SRP 3_2	0.82	1225.0	11225.0	105.9	10.0	3.0	0.5	5.9

Calculate R (Erosion Index)

R = 0.00828p$^{2.2}$*1.7	R =	70.66 J/ha	*Based on HIRDS data	p =	48.1 mm	*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.18	2	0	0.18	0.24

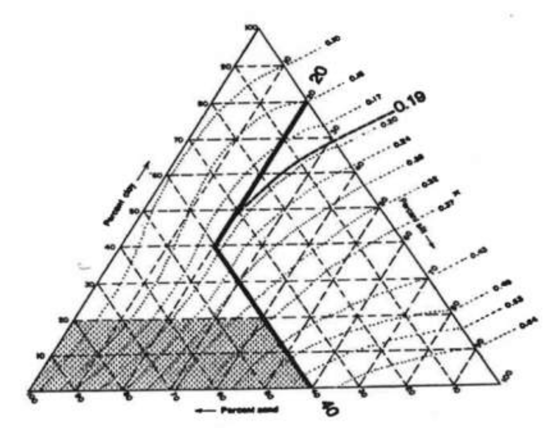
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters $A = R*K*LS*C*P$								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP 3_2	Anns Creek Construction Yard to SRP 3_2	0.820	71	0.24	10.0	35.00	5.86	1	0.90	0.17	**12.10**		0.70	0.90	**0.85**
	Total Area	**0.8200**								**Total Estimate Gross Sediment Yield (tonnes)**	**12.10**	**Total Mitigated Sediment Loss (tonnes)**			**0.85**

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	17/08/2016
Element:	Anns Creek Construction Yard		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - Stbilised, SRP in place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41\times s^2}{s^2+10{,}000} + \frac{4.56\times s}{\sqrt{s^2+10{,}000}} + 0.065\right)\times\left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
35.0	3.5	Anns Creek Construction Yard to SRP 3_2	0.82	1225.0	11225.0	105.9	10.0	3.0	0.5	5.9

Calculate R (Erosion Index)

R = 0.00828p$^{2.2}$*1.7

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.18	2	0	0.18	0.24

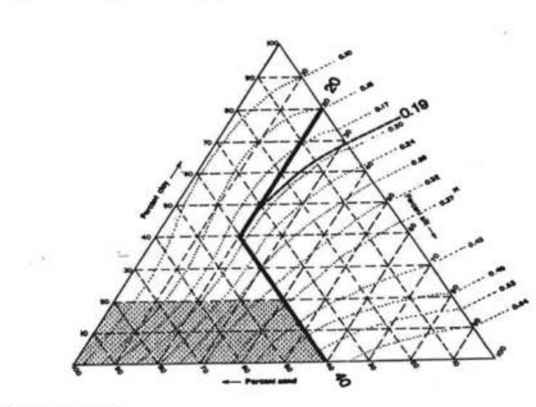
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period		
SRP 3_2	Anns Creek Construction Yard to SRP 3_2	0.820	71	0.24	10.0	35.00	5.86	1	0.90	0.17	12.10		0.70	0.75	2.12
	Total Area	0.8200								Total Estimate Gross Sediment Yield (tonnes)	12.10	Total Mitigated Sediment Loss (tonnes)		2.12

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	**East West Link**		
Calculations By:	Tony Cain	**Date:**	17/08/2016
Checked By:		**Date:**	
Element:	Anns Creek Construction Yard		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - Unstabilised, SuperSilt Fencing

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
35.0	3.5	Anns Creek Construction Yard to SRP 3_2	0.82	1225.0	11225.0	105.9	10.0	3.0	0.5	5.9

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$	R =	70.66 J/ha	*Based on HIRDS data	p =	48.1 mm	*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

Table 1

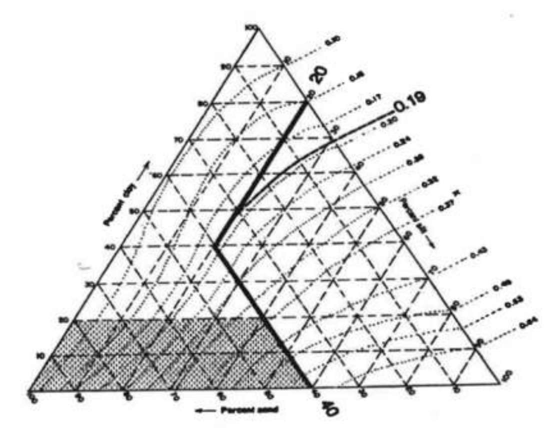
	Correction factor when percent organic matter is				
K Value	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.18	2	0	0.18	0.24

*Refer to Table 1 and Figure 1

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP 3_2	Anns Creek Construction Yard to SRP 3_2	0.820	71	0.24	10.0	35.00	5.86	1	1.32	0.17	17.75		0.70	0.50	6.21
	Total Area	0.8200	Total Estimate Gross Sediment Yield (tonnes)								17.75	Total Mitigated Sediment Loss (tonnes)			6.21

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	**East West Link**		
Calculations By:	Tony Cain	**Date:**	17/08/2016
Element:	Anns Creek Construction Yard		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - Unstabilised, No ESC Controls

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS=\left(\frac{65.41\times s^2}{s^2+10{,}000}+\frac{4.56\times s}{\sqrt{s^2+10{,}000}}+0.065\right)\times\left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
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m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
35.0	3.5	Anns Creek Construction Yard to SRP 3_2	0.82	1225.0	11225.0	105.9	10.0	3.0	0.5	5.9

Calculate R (Erosion Index)

R = $0.00828p^{2.2}$*1.7

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.18	2	0	0.18	0.24

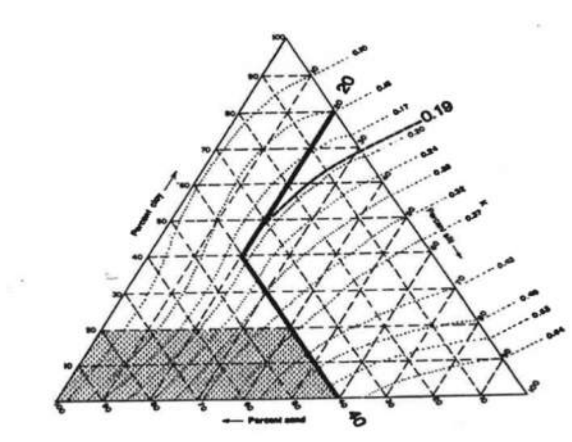
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

USLE Parameters: **A = R*K*LS*C*P**

Device	Description / Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	Time (Years)	Estimated Gross Sediment Yield (tonnes) Construction Period	Re-estab Period	Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
SRP 3_2	Anns Creek Construction Yard to SRP 3_2	0.820	71	0.24	10.0	35.00	5.86	1	1.32	0.17	17.76		0.70	0.00	12.43
	Total Area	0.8200	Total Estimate Gross Sediment Yield (tonnes)								17.76	Total Mitigated Sediment Loss (tonnes)			12.43

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 -Construction Works At Hugo Johnson Drive		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - ESC Controls in Place + Floc

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
1.8	5.0	SH1 Outfall to SRP S3_1	2	3.2	10003.2	100.0	278.0	84.7	0.3	0.4
9.1	5.0	SH1 Outfall to DEB S3_2	0.3	82.6	10082.6	100.4	55.0	16.8	0.5	1.6
6.0	5.0	SH1 Outfall to DEB S3_3	0.21	36.3	10036.3	100.2	83.0	25.3	0.5	1.1

Calculate R (Erosion Index)

R = $0.00828p^{2.2}$*1.7

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type (%age)				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	25	53	23	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.41	0	0	0.41	0.54

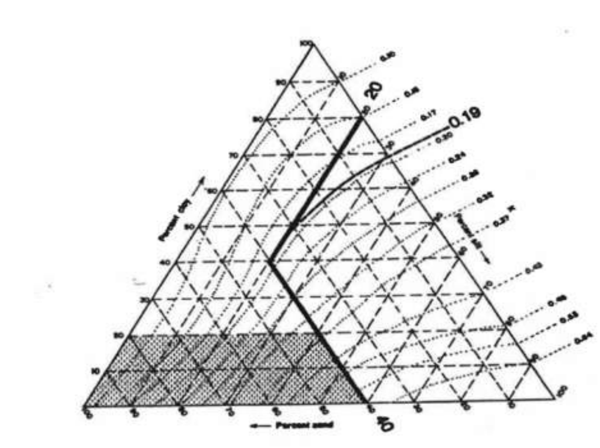
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

USLE Parameters: **A = R*K*LS*C*P**

Device	Description: Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	Time (Years)	Estimated Gross Sediment Yield (tonnes): Construction Period	Estimated Gross Sediment Yield (tonnes): Re-estab Period	Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
DEB S4_1	SH1 Outfall to SRP S3_1	2.000	71	0.54	278.0	1.80	0.36	1	0.90	0.50	**12.37**		0.70	0.90	**0.87**
DEB S4_2	SH1 Outfall to DEB S3_2	0.300	71	0.54	55.0	9.09	1.60	1	0.90	0.50	**8.26**		0.70	0.80	**1.16**
DEB S4_3	SH1 Outfall to DEB S3_3	0.210	71	0.54	83.0	6.02	1.12	1	0.90	0.50	**4.03**		0.70	0.80	**0.56**

Total Area	2.5100	Total Estimate Gross Sediment Yield (tonnes)	24.66	Total Mitigated Sediment Loss (tonnes)	2.59

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	**East West Link**		
Calculations By:	**Tony Cain**	**Date:**	**24/08/2016**
Element:	**SH1 -Construction Works At Hugo Johnson Drive**		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - ESC Controls in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{72.5}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
1.8	5.0	SH1 Outfall to SRP S3_1	2	3.2	10003.2	100.0	278.0	84.7	0.3	0.4
9.1	5.0	SH1 Outfall to DEB S3_2	0.3	82.6	10082.6	100.4	55.0	16.8	0.5	1.6
6.0	5.0	SH1 Outfall to DEB S3_3	0.21	36.3	10036.3	100.2	83.0	25.3	0.5	1.1

Calculate R (Erosion Index)

$R = 0.00828p^{2.2} * 1.7$

R = 70.66 **J/ha** ***Based on HIRDS data**

p = 48.1 **mm** ***6 hour duration 2 year storm**

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type (%age)				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	25	53	23	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.41	0	0	0.41	0.54

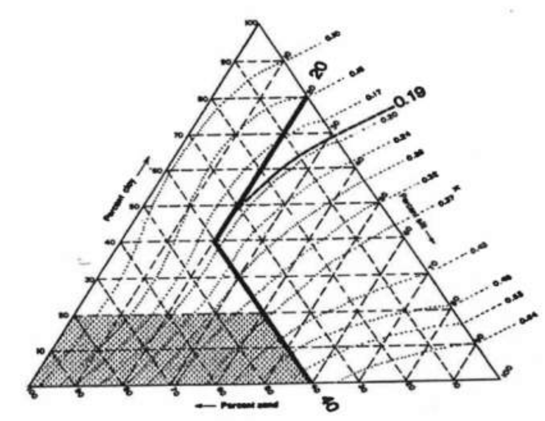
***Refer to Table 1 and Figure 1**

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period		
DEB S4_1	SH1 Outfall to SRP S3_1	2.000	71	0.54	278.0	1.80	0.36	1	0.90	0.50	**12.37**		0.70	0.75	**2.16**
DEB S4_2	SH1 Outfall to DEB S3_2	0.300	71	0.54	55.0	9.09	1.60	1	0.90	0.50	**8.26**		0.70	0.60	**2.31**
DEB S4_3	SH1 Outfall to DEB S3_3	0.210	71	0.54	83.0	6.02	1.12	1	0.90	0.50	**4.03**		0.70	0.60	**1.13**

Total Area	2.5100	Total Estimate Gross Sediment Yield (tonnes)	24.66	Total Mitigated Sediment Loss (tonnes)	5.61

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link			
Calculations By:	Tony Cain	**Date:**	24/08/2016	
Element:	SH1 -Construction Works At Hugo Johnson Drive			

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - No ESC Controls in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness 0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
1.8	5.0	SH1 Outfall to SRP S3_1	2	3.2	10003.2	100.0	278.0	84.7	0.3	0.4
9.1	5.0	SH1 Outfall to DEB S3_2	0.3	82.6	10082.6	100.4	55.0	16.8	0.5	1.6
6.0	5.0	SH1 Outfall to DEB S3_3	0.21	36.3	10036.3	100.2	83.0	25.3	0.5	1.1

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha ***Based on HIRDS data**

p = 48.1 mm ***6 hour duration 2 year storm**

Calculate K (Soil Erodability Factor)

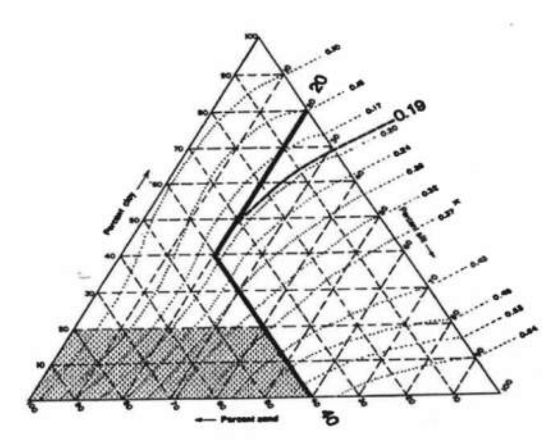
	Constituents of Basic Soil Type (%age)				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	25	53	23	0	0

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.41	0	0	0.41	0.54

*Refer to Table 1 and Figure 1

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
DEB S4_1	SH1 Outfall to SRP S3_1	2.000	71	0.54	278.0	1.80	0.36	1	1.32	0.50	**18.14**		0.70		**12.70**
DEB S4_2	SH1 Outfall to DEB S3_2	0.300	71	0.54	55.0	9.09	1.60	1	1.32	0.50	**12.11**		0.70		**8.48**
DEB S4_3	SH1 Outfall to DEB S3_3	0.210	71	0.54	83.0	6.02	1.12	1	1.32	0.50	**5.91**		0.70		**4.14**

Total Area	2.5100	Total Estimate Gross Sediment Yield (tonnes)	36.17	Total Mitigated Sediment Loss (tonnes)	25.32

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	**East West Link**		
Calculations By:	Tony Cain	**Date:**	16/08/2016
Element:	Construction Works for Foreshore Road Embankment		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With ESC Controls in Place Plus Flocculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}\ 22.1}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness 0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
5.7	2.0	Embankment Outfall to SRP 2_1	0.89	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_2	2.5	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_3	1.47	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_4	1.8	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_5	2	32.7	10032.7	100.2	35.0	10.7	0.5	0.7

Calculate R (Erosion Index)

R = 0.00828p$^{2.2}$*1.7

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.15	0	0	0.15	0.20

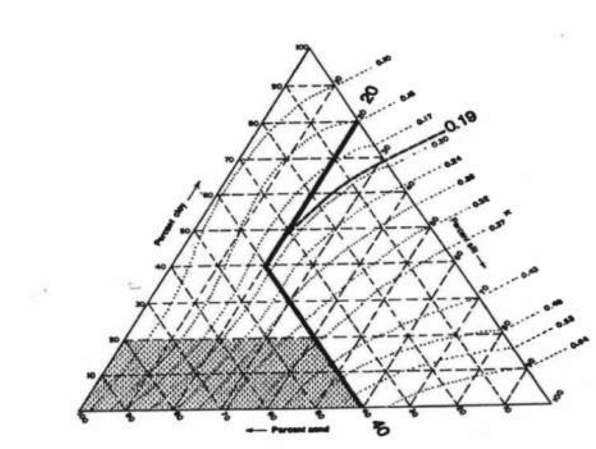
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP S2_1	Embankment Outfall to SRP 2_1	0.890	71	0.20	35.0	5.71	0.68	1	0.90	1.00	7.59		0.70	0.90	0.53

SRP S2_2	Embankment Outfall to SRP 2_2	2.500	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**21.32**		0.70	0.90	**1.49**
SRP S2_3	Embankment Outfall to SRP 2_3	1.470	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**12.53**		0.70	0.90	**0.88**
SRP S2_4	Embankment Outfall to SRP 2_4	1.800	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**15.35**		0.70	0.90	**1.07**
SRP S2_5	Embankment Outfall to SRP 2_5	2.000	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**17.05**		0.70	0.90	**1.19**
Total Area		**8.6600**	**Total Estimate Gross Sediment Yield (tonnes)**								**73.84**	**Total Mitigated Sediment Loss (tonnes)**			**5.17**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	**East West Link**		
Calculations By:	Tony Cain	**Date:**	16/08/2016
Element:	Construction Works for Foreshore Road Embankment		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With ESC Controls in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
5.7	2.0	Embankment Outfall to SRP 2_1	0.89	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_2	2.5	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_3	1.47	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_4	1.8	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_5	2	32.7	10032.7	100.2	35.0	10.7	0.5	0.7

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.15	0	0	0.15	0.20

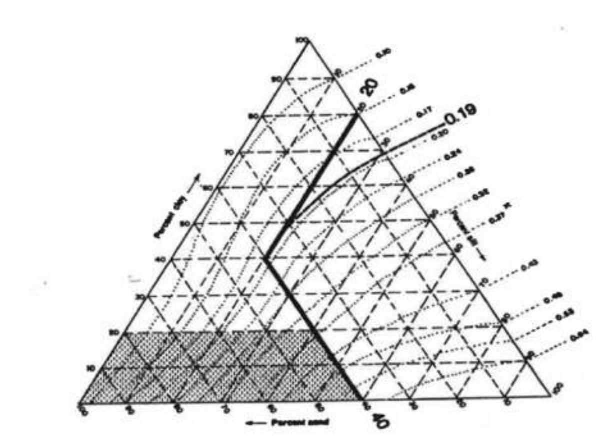
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP S2_1	Embankment Outfall to SRP 2_1	0.890	71	0.20	35.0	5.71	0.68	1	0.90	1.00	7.59		0.70	0.75	1.33

SRP S2_2	Embankment Outfall to SRP 2_2	2.500	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**21.32**		0.70	0.75	**3.73**
SRP S2_3	Embankment Outfall to SRP 2_3	1.470	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**12.53**		0.70	0.75	**2.19**
SRP S2_4	Embankment Outfall to SRP 2_4	1.800	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**15.35**		0.70	0.75	**2.69**
SRP S2_5	Embankment Outfall to SRP 2_5	2.000	71	0.20	35.0	5.71	0.68	1	0.90	1.00	**17.05**		0.70	0.75	**2.98**
Total Area		**8.6600**	**Total Estimate Gross Sediment Yield (tonnes)**								**73.84**	**Total Mitigated Sediment Loss (tonnes)**			**12.92**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	16/08/2016
Element:	Construction Works for Foreshore Road Embankment		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - No ESC Controls in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness 0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
5.7	2.0	Embankment Outfall to SRP 2_1	0.89	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_2	2.5	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_3	1.47	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_4	1.8	32.7	10032.7	100.2	35.0	10.7	0.5	0.7
5.7	2.0	Embankment Outfall to SRP 2_5	2	32.7	10032.7	100.2	35.0	10.7	0.5	0.7

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.15	0	0	0.15	0.20

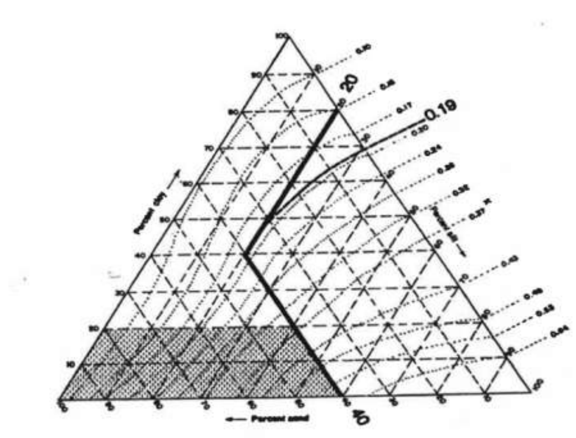
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description / Sub Catchment	USLE Parameters $A = R*K*LS*C*P$ — Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	Time (Years)	Estimated Gross Sediment Yield (tonnes) — Construction Period	Re-estab Period	Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
SRP S2_1	Embankment Outfall to SRP 2_1	0.890	71	0.20	35.0	5.71	0.68	1	1.32	1.00	11.13		0.70		7.79

SRP S2_2	Embankment Outfall to SRP 2_2	2.500	71	0.20	35.0	5.71	0.68	1	1.32	1.00	**31.26**		0.70		**21.88**
SRP S2_3	Embankment Outfall to SRP 2_3	1.470	71	0.20	35.0	5.71	0.68	1	1.32	1.00	**18.38**		0.70		**12.87**
SRP S2_4	Embankment Outfall to SRP 2_4	1.800	71	0.20	35.0	5.71	0.68	1	1.32	1.00	**22.51**		0.70		**15.76**
SRP S2_5	Embankment Outfall to SRP 2_5	2.000	71	0.20	35.0	5.71	0.68	1	1.32	1.00	**25.01**		0.70		**17.51**
Total Area		**8.6600**	**Total Estimate Gross Sediment Yield (tonnes)**								**108.29**	**Total Mitigated Sediment Loss (tonnes)**			**75.81**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	25/08/2016
Element:	East West Link - Neilsen Street Interchange		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With ESC Controls, Floc and Stabilisation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065 \right) \times \left(\frac{l}{\cancel{72.5}} \right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
0.2	0.3	Area to DEB1_1	0.26	0.0	10000.0	100.0	156.0	47.5	0.2	0.1
1.5	1.3	Area to DEB1_2	0.13	2.4	10002.4	100.0	81.0	24.7	0.3	0.2
0.7	0.5	Area to DEB1_3	0.33	0.6	10000.6	100.0	67.0	20.4	0.2	0.1
0.5	0.8	Area to DEB1_4	0.66	0.3	10000.3	100.0	140.0	42.7	0.2	0.1
2.5	2.0	Area to DEB1_5	0.31	6.3	10006.3	100.0	80.0	24.4	0.3	0.3
0.2	0.3	Area to DEB1_6	0.29	0.1	10000.1	100.0	103.0	31.4	0.2	0.1
0.1	0.2	Area to DEB1_7	0.29	0.0	10000.0	100.0	193.0	58.8	0.2	0.1
0.0	0.1	Area to DEB1_8	0.3	0.0	10000.0	100.0	209.0	63.7	0.2	0.1
0.8	1.0	Area to DEB1_9	0.29	0.6	10000.6	100.0	133.0	40.5	0.2	0.1
0.1	0.3	Area to DEB1_10	0.19	0.0	10000.0	100.0	172.0	52.4	0.2	0.1
1.1	1.3	Area to DEB1_11	0.28	1.3	10001.3	100.0	110.5	33.7	0.3	0.2
3.2	4.0	Area to DEB1_12	0.12	10.1	10010.1	100.1	126.0	38.4	0.4	0.6
0.2	0.3	Area to DEB1_13	0.27	0.0	10000.0	100.0	130.0	39.6	0.2	0.1
2.2	5.0	Area to DEB1_14	0.31	4.7	10004.7	100.0	231.6	70.6	0.3	0.4
3.2	4.3	Area to DEB1_15	0.27	10.5	10010.5	100.1	131.0	39.9	0.4	0.6
0.2	0.5	Area to SRP 1_1	1.88	0.0	10000.0	100.0	324.0	98.8	0.2	0.1

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha

*Based on HIRDS data

p = 48.1 mm

*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	26	24	51		0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.22	0	0	0.22	0.29

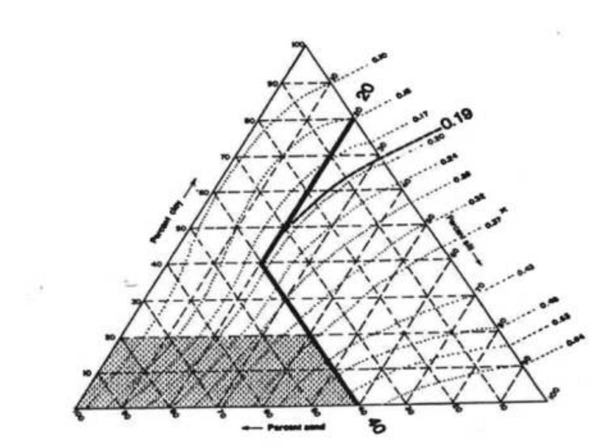
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP S2_1	Area to DEB1_1	0.260	71	0.29	156.0	0.16	0.11	1	1.32	1.00	**0.75**		0.70	0.80	**0.11**
SRP S2_2	Area to DEB1_2	0.130	71	0.29	81.0	1.54	0.22	1	1.32	1.00	**0.78**		0.70	0.80	**0.11**
SRP S2_3	Area to DEB1_3	0.330	71	0.29	67.0	0.75	0.13	1	1.32	1.00	**1.15**		0.70	0.80	**0.16**
SRP S2_4	Area to DEB1_4	0.660	71	0.29	140.0	0.54	0.13	1	1.32	1.00	**2.36**		0.70	0.80	**0.33**
SRP S2_5	Area to DEB1_5	0.310	71	0.29	80.0	2.50	0.32	1	1.32	1.00	**2.72**		0.70	0.80	**0.38**
SRP S2_6	Area to DEB1_6	0.290	71	0.29	103.0	0.24	0.10	1	1.32	1.00	**0.82**		0.70	0.80	**0.11**
SRP S2_7	Area to DEB1_7	0.290	71	0.29	193.0	0.08	0.11	1	1.32	1.00	**0.83**		0.70	0.80	**0.12**
SRP S2_8	Area to DEB1_8	0.300	71	0.29	209.0	0.05	0.11	1	1.32	1.00	**0.86**		0.70	0.80	**0.12**
SRP S2_9	Area to DEB1_9	0.290	71	0.29	133.0	0.75	0.15	1	1.32	1.00	**1.16**		0.70	0.80	**0.16**
SRP S2_10	Area to DEB1_10	0.190	71	0.29	172.0	0.15	0.11	1	1.32	1.00	**0.56**		0.70	0.80	**0.08**
SRP S2_11	Area to DEB1_11	0.280	71	0.29	110.5	1.13	0.20	1	1.32	1.00	**1.54**		0.70	0.80	**0.22**
SRP S2_12	Area to DEB1_12	0.120	71	0.29	126.0	3.17	0.55	1	1.32	1.00	**1.80**		0.70	0.80	**0.25**
SRP S2_13	Area to DEB1_13	0.270	71	0.29	130.0	0.19	0.11	1	1.32	1.00	**0.77**		0.70	0.80	**0.11**
SRP S2_14	Area to DEB1_14	0.310	71	0.29	231.6	2.16	0.39	1	1.32	1.00	**3.29**		0.70	0.80	**0.46**
SRP S2_15	Area to DEB1_15	0.270	71	0.29	131.0	3.24	0.57	1	1.32	1.00	**4.20**		0.70	0.80	**0.59**
SRP S2_16	Area to SRP 1_1	1.880	71	0.29	324.0	0.15	0.12	1	1.32	1.00	**6.29**		0.70	0.90	**0.44**
	Total Area	**6.1800**							**Total Estimate Gross Sediment Yield (tonnes)**		**29.87**	**Total Sediment Loss (tonnes)**			**3.74**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	25/08/2016
Element:	East West Link - Neilsen Street Interchange		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With ESC Controls and Stabilisation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41\times s^2}{s^2+10{,}000}+\frac{4.56\times s}{\sqrt{s^2+10{,}000}}+0.065\right)\times\left(\frac{l}{\underset{22.1}{\cancel{72.5}}}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
0.2	0.3	Area to DEB1_1	0.26	0.0	10000.0	100.0	156.0	47.5	0.2	0.1
1.5	1.3	Area to DEB1_2	0.13	2.4	10002.4	100.0	81.0	24.7	0.3	0.2
0.7	0.5	Area to DEB1_3	0.33	0.6	10000.6	100.0	67.0	20.4	0.2	0.1
0.5	0.8	Area to DEB1_4	0.66	0.3	10000.3	100.0	140.0	42.7	0.2	0.1
2.5	2.0	Area to DEB1_5	0.31	6.3	10006.3	100.0	80.0	24.4	0.3	0.3
0.2	0.3	Area to DEB1_6	0.29	0.1	10000.1	100.0	103.0	31.4	0.2	0.1
0.1	0.2	Area to DEB1_7	0.29	0.0	10000.0	100.0	193.0	58.8	0.2	0.1
0.0	0.1	Area to DEB1_8	0.3	0.0	10000.0	100.0	209.0	63.7	0.2	0.1
0.8	1.0	Area to DEB1_9	0.29	0.6	10000.6	100.0	133.0	40.5	0.2	0.1
0.1	0.3	Area to DEB1_10	0.19	0.0	10000.0	100.0	172.0	52.4	0.2	0.1
1.1	1.3	Area to DEB1_11	0.28	1.3	10001.3	100.0	110.5	33.7	0.3	0.2
3.2	4.0	Area to DEB1_12	0.12	10.1	10010.1	100.1	126.0	38.4	0.4	0.6
0.2	0.3	Area to DEB1_13	0.27	0.0	10000.0	100.0	130.0	39.6	0.2	0.1
2.2	5.0	Area to DEB1_14	0.31	4.7	10004.7	100.0	231.6	70.6	0.3	0.4
3.2	4.3	Area to DEB1_15	0.27	10.5	10010.5	100.1	131.0	39.9	0.4	0.6
0.2	0.5	Area to SRP 1_1	1.88	0.0	10000.0	100.0	324.0	98.8	0.2	0.1

Calculate R (Erosion Index)

R = 0.00828$p^{2.2}$*1.7	R =	70.66	J/ha	*Based on HIRDS data	p =	48.1	mm	*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	26	24	51		0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.22	0	0	0.22	0.29

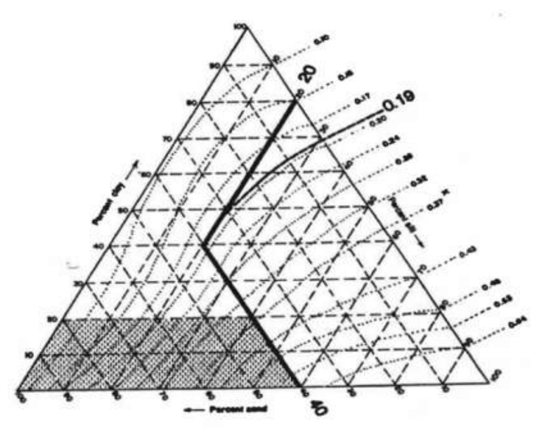
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters $A = R*K*LS*C*P$								Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
SRP S2_1	Area to DEB1_1	0.260	71	0.29	156.0	0.16	0.11	1	1.32	1.00	**0.75**		0.70	0.60	**0.21**
SRP S2_2	Area to DEB1_2	0.130	71	0.29	81.0	1.54	0.22	1	1.32	1.00	**0.78**		0.70	0.60	**0.22**
SRP S2_3	Area to DEB1_3	0.330	71	0.29	67.0	0.75	0.13	1	1.32	1.00	**1.15**		0.70	0.60	**0.32**
SRP S2_4	Area to DEB1_4	0.660	71	0.29	140.0	0.54	0.13	1	1.32	1.00	**2.36**		0.70	0.60	**0.66**
SRP S2_5	Area to DEB1_5	0.310	71	0.29	80.0	2.50	0.32	1	1.32	1.00	**2.72**		0.70	0.60	**0.76**
SRP S2_6	Area to DEB1_6	0.290	71	0.29	103.0	0.24	0.10	1	1.32	1.00	**0.82**		0.70	0.60	**0.23**
SRP S2_7	Area to DEB1_7	0.290	71	0.29	193.0	0.08	0.11	1	1.32	1.00	**0.83**		0.70	0.60	**0.23**
SRP S2_8	Area to DEB1_8	0.300	71	0.29	209.0	0.05	0.11	1	1.32	1.00	**0.86**		0.70	0.60	**0.24**
SRP S2_9	Area to DEB1_9	0.290	71	0.29	133.0	0.75	0.15	1	1.32	1.00	**1.16**		0.70	0.60	**0.32**
SRP S2_10	Area to DEB1_10	0.190	71	0.29	172.0	0.15	0.11	1	1.32	1.00	**0.56**		0.70	0.60	**0.16**
SRP S2_11	Area to DEB1_11	0.280	71	0.29	110.5	1.13	0.20	1	1.32	1.00	**1.54**		0.70	0.60	**0.43**
SRP S2_12	Area to DEB1_12	0.120	71	0.29	126.0	3.17	0.55	1	1.32	1.00	**1.80**		0.70	0.60	**0.50**
SRP S2_13	Area to DEB1_13	0.270	71	0.29	130.0	0.19	0.11	1	1.32	1.00	**0.77**		0.70	0.60	**0.22**
SRP S2_14	Area to DEB1_14	0.310	71	0.29	231.6	2.16	0.39	1	1.32	1.00	**3.29**		0.70	0.60	**0.92**
SRP S2_15	Area to DEB1_15	0.270	71	0.29	131.0	3.24	0.57	1	1.32	1.00	**4.20**		0.70	0.60	**1.18**
SRP S2_16	Area to SRP 1_1	1.880	71	0.29	324.0	0.15	0.12	1	1.32	1.00	**6.29**		0.70	0.75	**1.10**
	Total Area	**6.1800**	**Total Estimate Gross Sediment Yield (tonnes)**								**29.87**	**Total Sediment Loss (tonnes)**			**7.70**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	17/08/2016
Element:	Anns Creek Construction Yard		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - Stbilised, SRP in place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065 \right) \times \left(\frac{l}{\cancel{72.5}\ 22.1} \right)^m$$

LS = topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
35.0	3.5	Anns Creek Construction Yard to SRP 3_2	0.82	1225.0	11225.0	105.9	10.0	3.0	0.5	5.9

Calculate R (Erosion Index)

$R = 0.00828p^{2.2} * 1.7$

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	60	20	10	10	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.18	2	0	0.18	0.24

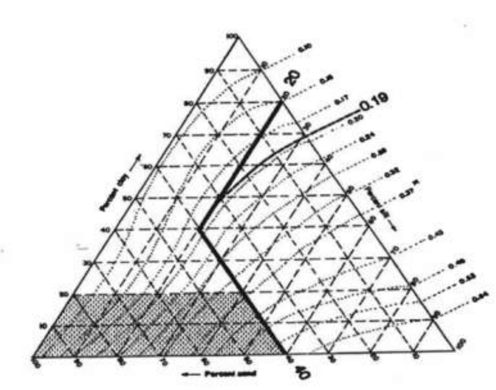
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period		
SRP 3_2	Anns Creek Construction Yard to SRP 3_2	0.820	71	0.24	10.0	35.00	5.86	1	0.90	0.17	12.10		0.70	0.75	2.12
	Total Area	0.8200						Total Estimate Gross Sediment Yield (tonnes)			12.10	Total Mitigated Sediment Loss (tonnes)		2.12

*Refer to Table 3 for C factor and P factor

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

Project:	East West Link				
Calculations By:	Tony Cain			Date:	26/08/2016
Element:	USLE Summary Table				

USLE (Universal Soil Loss Equation)Calculations: Summary Table

Outfall Location	Estimated Construction Based Annual Sediment Yields (tonnes)					
	Construction Zone Area (ha)	No ESC Measures	With ESC Measures	With ESC Measures and Floc	Percentage Reduction with ESC	Percentage Reduction with ESC & Floc
Manukau Harbour Catchment						
Neilson Street Interchange	6.18	20.91	7.7	3.74	63%	82%
Foreshore Embankment	8.66	75.81	12.92	5.17	83%	93%
Southdown Reserve	2.51	25.32	5.61	2.59	78%	90%
Anns Creek	0.82	74.53	24.99	21.18	66%	72%
Total	18.17	196.57	51.22	32.68	74%	83%
Tamaki Estuary Catchment						
Clemow Stream	1.63	6.61	1.80	0.90	73%	86%
Otahuhu Creek	1.54	8.43	2.30	1.15	73%	86%
Frank Grey Place	2.13	0.94	0.26	0.13	72%	86%
Total	5.31	15.98	4.36	2.18	73%	86%

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 - Widening Works Outfalling to Frank Grey Place		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - ESC Measures in Place and Stabilisation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}\ 22.1}\right)^m$$

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness 0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
1.4	2.8	SH1 to Outfall S5E	0.232	2.0	10002.0	100.0	200.0	61.0	0.3	0.3
1.4	2.8	SH1 to Outfall S5E	0.232	2.0	10002.0	100.0	201.0	61.3	0.3	0.3
0.8	1.5	SH1 to Outfall S5E	0.315	0.6	10000.6	100.0	200.0	61.0	0.2	0.2
0.7	1.0	SH1 to Outfall S5E	0.31	0.4	10000.4	100.0	150.0	45.7	0.2	0.1
0.3	0.5	SH1 to Outfall S5E	0.247	0.1	10000.1	100.0	150.0	45.7	0.2	0.1
0.7	1.0	SH1 to Outfall S5E	0.3	0.4	10000.4	100.0	150.0	45.7	0.2	0.1
0.6	1.0	SH1 to Outfall S5E	0.285	0.4	10000.4	100.0	165.0	50.3	0.2	0.1
0.5	0.5	SH1 to Outfall S5E	0.21	0.3	10000.3	100.0	100.0	30.5	0.2	0.1

*Earthworks Area = Area of Construction to Sediment Sretention Devices - Prior to dischargefull catchment area of CSRDs as per Plan P6 Revision A

Calculate R (Erosion Index)

R = 0.00828p$^{2.2}$*1.7

R = 70.66 J/ha

*Based on HIRDS data

p = 48.1 mm

*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

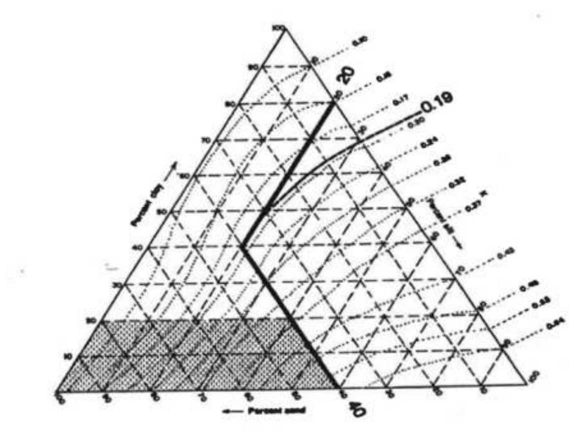
	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	72	23	6	0	0

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.17	0	0	0.17	0.22

*Refer to Table 1 and Figure 1

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			

DEB S5E_1	SH1 to Outfall S5E	0.232	71	0.22	200.0	1.42	0.28	1	0.90	1.00	**0.92**		0.70	0.60	**0.26**
DEB S5E_2	SH1 to Outfall S5E	0.232	71	0.22	201.0	1.41	0.28	1	0.90	1.00	**0.92**		0.70	0.60	**0.26**
DEB S5E_3	SH1 to Outfall S5E	0.315	71	0.22	200.0	0.75	0.16	1	0.90	1.00	**0.72**		0.70	0.60	**0.20**
DEB S5E_4	SH1 to Outfall S5E	0.310	71	0.22	150.0	0.67	0.14	1	0.90	1.00	**0.64**		0.70	0.60	**0.18**
DEB S5E_5	SH1 to Outfall S5E	0.247	71	0.22	150.0	0.33	0.12	1	0.90	1.00	**0.42**		0.70	0.60	**0.12**
DEB S5E_6	SH1 to Outfall S5E	0.300	71	0.22	150.0	0.67	0.14	1	0.90	1.00	**0.62**		0.70	0.60	**0.17**
DEB S5E_7	SH1 to Outfall S5E	0.285	71	0.22	165.0	0.61	0.14	1	0.90	1.00	**0.58**		0.70	0.60	**0.16**
DEB S5E_8	SH1 to Outfall S5E	0.210	71	0.22	100.0	0.50	0.12	1	0.90	1.00	**0.36**		0.70	0.60	**0.10**
	Total Area	**2.1310**								**Total Estimate Gross Sediment Yield (tonnes)**	**0.92**	**Total Mitigated Sediment Loss (tonnes)**			**0.26**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 - Widening Works Outfalling to Frank Grey Place		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - ESC Measures in Place and Stabilisation and Flocculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS = topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
1.4	2.8	SH1 to Outfall S5E	0.232	2.0	10002.0	100.0	200.0	61.0	0.3	0.3
1.4	2.8	SH1 to Outfall S5E	0.232	2.0	10002.0	100.0	201.0	61.3	0.3	0.3
0.8	1.5	SH1 to Outfall S5E	0.315	0.6	10000.6	100.0	200.0	61.0	0.2	0.2
0.7	1.0	SH1 to Outfall S5E	0.31	0.4	10000.4	100.0	150.0	45.7	0.2	0.1
0.3	0.5	SH1 to Outfall S5E	0.247	0.1	10000.1	100.0	150.0	45.7	0.2	0.1
0.7	1.0	SH1 to Outfall S5E	0.3	0.4	10000.4	100.0	150.0	45.7	0.2	0.1
0.6	1.0	SH1 to Outfall S5E	0.285	0.4	10000.4	100.0	165.0	50.3	0.2	0.1
0.5	0.5	SH1 to Outfall S5E	0.21	0.3	10000.3	100.0	100.0	30.5	0.2	0.1

*Earthworks Area = Area of Construction to Sediment Sretention Devices - Prior to dischargefull catchment area of CSRDs as per Plan P6 Revision A

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha

*Based on HIRDS data

p = 48.1 mm

*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	72	23	6	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.17	0	0	0.17	0.22

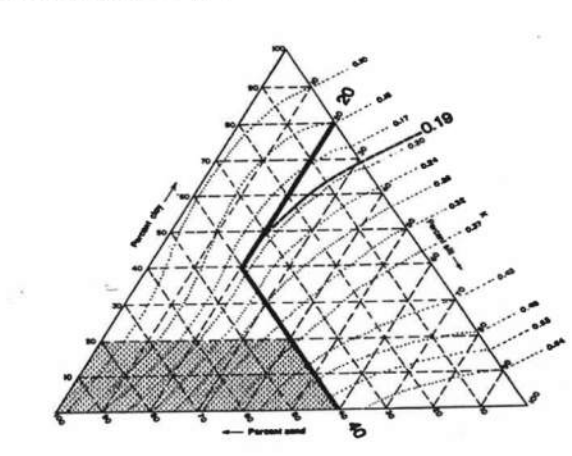
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters $A = R*K*LS*C*P$							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period		

DEB S5E_1	SH1 to Outfall S5E	0.232	71	0.22	200.0	1.42	0.28	1	0.90	1.00	**0.92**		0.70	0.80	**0.13**
DEB S5E_2	SH1 to Outfall S5E	0.232	71	0.22	201.0	1.41	0.28	1	0.90	1.00	**0.92**		0.70	0.80	**0.13**
DEB S5E_3	SH1 to Outfall S5E	0.315	71	0.22	200.0	0.75	0.16	1	0.90	1.00	**0.72**		0.70	0.80	**0.10**
DEB S5E_4	SH1 to Outfall S5E	0.310	71	0.22	150.0	0.67	0.14	1	0.90	1.00	**0.64**		0.70	0.80	**0.09**
DEB S5E_5	SH1 to Outfall S5E	0.247	71	0.22	150.0	0.33	0.12	1	0.90	1.00	**0.42**		0.70	0.80	**0.06**
DEB S5E_6	SH1 to Outfall S5E	0.300	71	0.22	150.0	0.67	0.14	1	0.90	1.00	**0.62**		0.70	0.80	**0.09**
DEB S5E_7	SH1 to Outfall S5E	0.285	71	0.22	165.0	0.61	0.14	1	0.90	1.00	**0.58**		0.70	0.80	**0.08**
DEB S5E_8	SH1 to Outfall S5E	0.210	71	0.22	100.0	0.50	0.12	1	0.90	1.00	**0.36**		0.70	0.80	**0.05**
Total Area		**2.1310**	**Total Estimate Gross Sediment Yield (tonnes)**								**0.92**	**Total Mitigated Sediment Loss (tonnes)**			**0.13**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	**East West Link**
Calculations By:	Tony Cain
Date:	24/08/2016
Element:	SH1 - Widening Works Outfalling to Frank Grey Place

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - No ESC Measures in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS=\left(\frac{65.41\times s^2}{s^2+10{,}000}+\frac{4.56\times s}{\sqrt{s^2+10{,}000}}+0.065\right)\times\left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
1.4	2.8	SH1 to Outfall S5E	0.232	2.0	10002.0	100.0	200.0	61.0	0.3	0.3
1.4	2.8	SH1 to Outfall S5E	0.232	2.0	10002.0	100.0	201.0	61.3	0.3	0.3
0.8	1.5	SH1 to Outfall S5E	0.315	0.6	10000.6	100.0	200.0	61.0	0.2	0.2
0.7	1.0	SH1 to Outfall S5E	0.31	0.4	10000.4	100.0	150.0	45.7	0.2	0.1
0.3	0.5	SH1 to Outfall S5E	0.247	0.1	10000.1	100.0	150.0	45.7	0.2	0.1
0.7	1.0	SH1 to Outfall S5E	0.3	0.4	10000.4	100.0	150.0	45.7	0.2	0.1
0.6	1.0	SH1 to Outfall S5E	0.285	0.4	10000.4	100.0	165.0	50.3	0.2	0.1
0.5	0.5	SH1 to Outfall S5E	0.21	0.3	10000.3	100.0	100.0	30.5	0.2	0.1

*Earthworks Area = Area of Construction to Sediment Sretention Devices - Prior to dischargefull catchment area of CSRDs as per Plan P6 Revision A

Calculate R (Erosion Index)

R = $0.00828p^{2.2}$*1.7

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	72	23	6	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.17	0	0	0.17	0.22

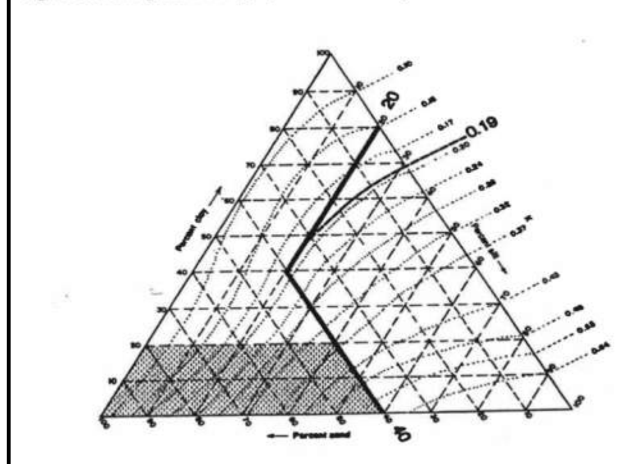
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			

DEB S5E_1	SH1 to Outfall S5E	0.232	71	0.22	200.0	1.42	0.28	1	1.32	1.00	**1.34**		0.70	0.00	**0.94**
DEB S5E_2	SH1 to Outfall S5E	0.232	71	0.22	201.0	1.41	0.28	1	1.32	1.00	**1.34**		0.70	0.00	**0.94**
DEB S5E_3	SH1 to Outfall S5E	0.315	71	0.22	200.0	0.75	0.16	1	1.32	1.00	**1.05**		0.70	0.00	**0.74**
DEB S5E_4	SH1 to Outfall S5E	0.310	71	0.22	150.0	0.67	0.14	1	1.32	1.00	**0.94**		0.70	0.00	**0.65**
DEB S5E_5	SH1 to Outfall S5E	0.247	71	0.22	150.0	0.33	0.12	1	1.32	1.00	**0.61**		0.70	0.00	**0.43**
DEB S5E_6	SH1 to Outfall S5E	0.300	71	0.22	150.0	0.67	0.14	1	1.32	1.00	**0.91**		0.70	0.00	**0.63**
DEB S5E_7	SH1 to Outfall S5E	0.285	71	0.22	165.0	0.61	0.14	1	1.32	1.00	**0.85**		0.70	0.00	**0.59**
DEB S5E_8	SH1 to Outfall S5E	0.210	71	0.22	100.0	0.50	0.12	1	1.32	1.00	**0.53**		0.70	0.00	**0.37**
	Total Area	**2.1310**						**Total Estimate Gross Sediment Yield (tonnes)**			**1.34**	**Total Mitigated Sediment Loss (tonnes)**			**0.94**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Checked By:		**Date:**	
Element:	SH1 - Widening Works Outfalling to Otahuhu Creek		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With DEBs, Stabilisation and Flocculation

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41 \times s^2}{s^2 + 10{,}000} + \frac{4.56 \times s}{\sqrt{s^2 + 10{,}000}} + 0.065\right) \times \left(\frac{l}{\cancel{72.5}\ 22.1}\right)^m$$

LS = topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness 0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
2.7	14.3	SH1 Outfall to S5A	0.29	7.4	10007.4	100.0	525.0	160.0	0.3	0.6
2.7	14.3	SH1 to Outfall S5B	0.51	7.4	10007.4	100.0	525.0	160.0	0.3	0.6
0.7	3.8	SH1 to Outfall S5C	0.365	0.5	10000.5	100.0	550.0	167.6	0.2	0.2
0.7	3.8	SH1 to Outfall S5D	0.377	0.5	10000.5	100.0	550.0	167.6	0.2	0.2

*Earthworks Area = Area of Construction to Sediment Sretention Devices - Prior to dischargefull catchment area of CSRDs as per Plan P6 Revision A

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha *Based on HIRDS data

p = 48.1 mm *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

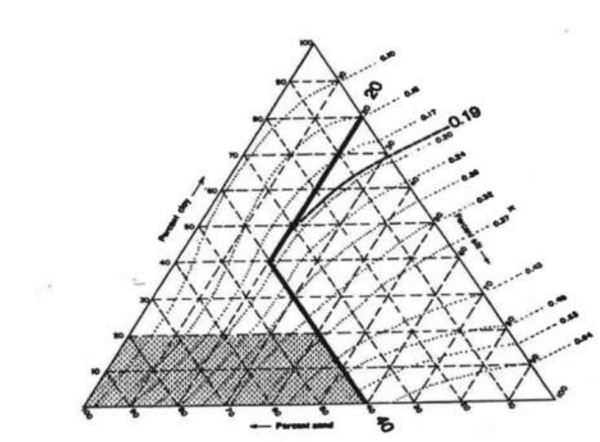
	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	14	31	53	0	0

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Conversion K Value
Sample 1	0.31	0	0	0.31	0.41

*Refer to Table 1 and Figure 1

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters A = R*K*LS*C*P							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
Outfall S5A	SH1 Outfall to S5A	0.290	71	0.41	525.0	2.72	0.61	1	0.90	0.50	2.32		0.70	0.80	0.32

Outfall S5B	SH1 to Outfall S5B	0.510	71	0.41	525	2.72	0.61	1	0.90	0.50	**4.08**		0.70	0.80	**0.57**
Outfall S5C	SH1 to Outfall S5C	0.365	71	0.41	550	0.68	0.19	1	0.90	0.50	**0.90**		0.70	0.80	**0.13**
Outfall S5D	SH1 to Outfall S5D	0.377	71	0.41	550	0.68	0.19	1	0.90	0.50	**0.93**		0.70	0.80	**0.13**
Total Area		**1.5420**	**Total Estimate Gross Sediment Yield (tonnes)**								**8.22**	**Total Mitigated Sediment Loss (tonnes)**			**1.15**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 - Widening Works Outfalling to Otahuhu Creek		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - With DEBs in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS = \left(\frac{65.41\times s^2}{s^2+10{,}000}+\frac{4.56\times s}{\sqrt{s^2+10{,}000}}+0.065\right)\times\left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	
	0.2 for slopes < 1%
	0.3 for slopes 1 to 3%
	0.4 for slopes 3.5 to 4.5%
	0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
2.7	14.3	SH1 Outfall to S5A	0.29	7.4	10007.4	100.0	525.0	160.0	0.3	0.6
2.7	14.3	SH1 to Outfall S5B	0.51	7.4	10007.4	100.0	525.0	160.0	0.3	0.6
0.7	3.8	SH1 to Outfall S5C	0.365	0.5	10000.5	100.0	550.0	167.6	0.2	0.2
0.7	3.8	SH1 to Outfall S5D	0.377	0.5	10000.5	100.0	550.0	167.6	0.2	0.2

*Earthworks Area = Area of Construction to Sediment Sretention Devices - Prior to dischargefull catchment area of CSRDs as per Plan P6 Revision A

Calculate R (Erosion Index)

R = 0.00828$p^{2.2}$*1.7

R = 70.66 J/ha

*Based on HIRDS data

p = 48.1 mm

*6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	14	31	53	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.31	0	0	0.31	0.41

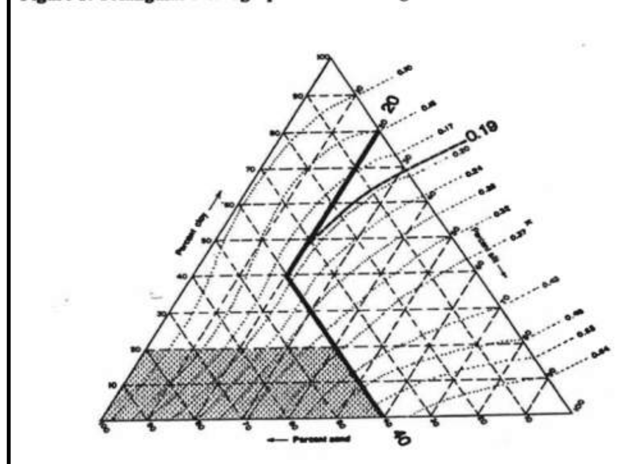
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

Device	Description	USLE Parameters $A = R*K*LS*C*P$							Time	Estimated Gross Sediment Yield (tonnes)		Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
	Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	(Years)	Construction Period	Re-estab Period			
Outfall S5A	SH1 Outfall to S5A	0.290	71	0.41	525.0	2.72	0.61	1	0.90	0.50	**2.32**		0.70	0.60	**0.65**
Outfall S5B	SH1 to Outfall S5B	0.510	71	0.41	525	2.72	0.61	1	0.90	0.50	**4.08**		0.70	0.60	**1.14**

Outfall S5C	SH1 to Outfall S5C	0.365	71	0.41	550	0.68	0.19	1	0.90	0.50	**0.90**		0.70	0.60	**0.25**
Outfall S5D	SH1 to Outfall S5D	0.377	71	0.41	550	0.68	0.19	1	0.90	0.50	**0.93**		0.70	0.60	**0.26**
	Total Area	**1.5420**						**Total Estimate Gross Sediment Yield (tonnes)**			**8.22**	**Total Mitigated Sediment Loss (tonnes)**			**2.30**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

USLE (Universal Soil Loss Equation) Calculations

v1 9/11/15

Project:	East West Link		
Calculations By:	Tony Cain	**Date:**	24/08/2016
Element:	SH1 - Widening Works Outfalling to Otahuhu Creek		

USLE (Universal Soil Loss Equation)Calculations: Fully Open Area of Construction - No ESC Measures in Place

Calculate LS (Slope length and Steepness Factor)

Calculated From:

$$LS=\left(\frac{65.41\times s^2}{s^2+10{,}000}+\frac{4.56\times s}{\sqrt{s^2+10{,}000}}+0.065\right)\times\left(\frac{l}{\cancel{72.5}}\right)^m$$

22.1

LS= topographic factor
l = Slope length, m
s = Slope steepness
m = Exponent dependent on slope steepness
0.2 for slopes<1%, 0.3 for slopes 1-3%. 0.4 for slopes 3.5-4.5%, and 0.5 for slopes > 5%)

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

L = slope length
s= slope steepness
m=exponent dependent on steepness
LS = Slope length and steepness factor

Slope (S, based on max slope) %	Height Diff (m)	Section	Area (ha)	S^2	S^2+10000	SQR(S^2+10000)	Slope Length (m)	Weight L	*m*	LS
2.7	14.3	SH1 Outfall to S5A	0.29	7.4	10007.4	100.0	525.0	160.0	0.3	0.6
2.7	14.3	SH1 to Outfall S5B	0.51	7.4	10007.4	100.0	525.0	160.0	0.3	0.6
0.7	3.8	SH1 to Outfall S5C	0.365	0.5	10000.5	100.0	550.0	167.6	0.2	0.2
0.7	3.8	SH1 to Outfall S5D	0.377	0.5	10000.5	100.0	550.0	167.6	0.2	0.2

Calculate R (Erosion Index)

$R = 0.00828p^{2.2}*1.7$

R = 70.66 J/ha   *Based on HIRDS data

p = 48.1 mm   *6 hour duration 2 year storm

Calculate K (Soil Erodability Factor)

	Constituents of Basic Soil Type				
	Clay	Silt	Fine Sand	Course sand	Gravel
Percentage (%)	14	31	53	0	0

	Nomograph K Value	Percentage of Organic Matter %	Correction Factor for Organic Matter	Corrected K Value	Metric Convertion K Value
Sample 1	0.31	0	0	0.31	0.41

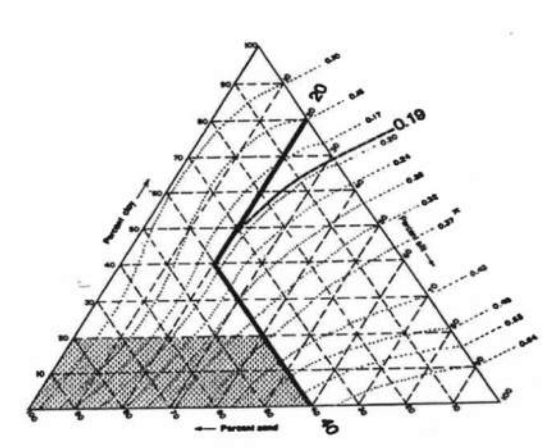
*Refer to Table 1 and Figure 1

Table 1

K Value	Correction factor when percent organic matter is 0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Figure 1: Triangular Nomograph for Estimating K Values



Goldman et al. 1986

Calculate Net Sediment Loss (tonnes)

USLE Parameters: **A = R*K*LS*C*P**

Device	Description / Sub Catchment	Area (ha)	R	K	Slope Length (ave m)	Slope Steepness (ave %)	LS	C	P	Time (Years)	Estimated Gross Sediment Yield (tonnes) Construction Period	Re-estab Period	Sediment Delivery Ratio	Sediment Control Efficiency (%)	Net Sediment Loss (tonnes)
Outfall S5A	SH1 Outfall to S5A	0.290	71	0.41	525.0	2.72	0.61	1	1.32	0.50	**3.40**		0.70	0.00	**2.38**
Outfall S5B	SH1 to Outfall S5B	0.510	71	0.41	525	2.72	0.61	1	1.32	0.50	**5.98**		0.70	0.00	**4.18**

Outfall S5C	SH1 to Outfall S5C	0.365	71	0.41	550	0.68	0.19	1	1.32	0.50	**1.32**		0.70	0.00	**0.92**
Outfall S5D	SH1 to Outfall S5D	0.377	71	0.41	550	0.68	0.19	1	1.32	0.50	**1.36**		0.70	0.00	**0.95**
Total Area		**1.5420**	**Total Estimate Gross Sediment Yield (tonnes)**								**12.05**	**Total Mitigated Sediment Loss (tonnes)**			**8.43**

***Refer to Table 3 for C factor and P factor**

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

Borehole / Trail Pit Reference	Depth of Sample	Percentage						
		Clay	Silt	Sand	Organics	Total	k Value	k value from graph
Discharge to Clemow Stream								
BH2011	15-15.5	24%	55%	21%		100%	0.69	
BH2012	21	26%	36%	38%		100%	0.32	
BH2013	15-15.5	35%	38%	27%		100%	0.31	
BH2014	13.5	31%	27%	42%		100%	0.25	
BH2018	19	48%	34%	18%		100%	0.27	
TP2011	3	25%	50%	25%		100%	0.39	
		37%	**42%**	**22%**			**0.37**	0.32
Discharge to Otahuhu Creek (Northside)								
TP2015	1	18%	28%	54%		100%	0.28	
TP2015	4	9%	34%	52%		95%	0.34	
		14%	**31%**	**53%**			**0.31**	0.32
Discharge to Otahuhu Creek (Southside)								
TP2017	3	12%	53%	35%		100%	0.49	
TP2019	1	65%	26%	9%		100%	0.18	
TP2019	4	78%	20%	2%		100%	0.16	
		72%	**23%**	**6%**			**0.28**	0.17
Discharge to Southdown								
BH2001	8	26%	62%	12%		100%	0.44	
BH2001	3	24%	43%	33%		100%	0.37	
		25%	53%	23%			0.41	0.41
Neilson Street Interchange								
BH2028a		11	16	73		100%	0.18	
BH2030		40	32	28		100%	0.28	
		26	**24**	**51**			**0.23**	0.22