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Report for Menangle Park

Review of Drainage Options

November 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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1. Introduction

1.1 Background

GHD was appointed to assist with the surface water management for the Menangle Park Release Area and in the formulation of a Water Sensitive Urban Design strategy.

This drainage review forms an update to aspects of the drainage strategy, previously documented in the Menangle Park Local Environmental Study (LES), and aims to investigate the effectiveness and feasibility of an alternative strategy without provision of some of the basins.

This study builds on prior work carried out towards development of the detention strategy and should be read in conjunction with the May 2010 report by GHD: "*Local Flooding and Stormwater Quality Management (Detention)"* which was included as a chapter of the Menangle Park LES.

1.2 Objectives

The objectives of the drainage review were to:

- Review efficacy of various proposed detention basins;
- Assess potential for works to upgrade or stabilise existing open channels as an alternative to provision of a number of basins;
- Investigate routes for release of flow to the Nepean over land belonging to Harness Racing; and
- Provide preliminary cost estimates for stream stabilisation works.

1.3 Information Used in the Study

Information used in carrying out the drainage review includes:

- *Local Flooding and Stormwater Quality Management (Detention) Report*, GHD (May 2010);
- RAFTS models for developed catchment case, both with and without basins, GHD;
- Ground data and survey information previously provided for Menangle Park;
- Information gathered during a site visit (September 2011), and
- *Campbelltown (Sustainable City) Development Control Plan 2009, Volume 2, Engineering Design for Development*, June 2009 (hereafter referred to as the Campbelltown DCP).

1.4 Assumptions and Limitations

The following assumptions were made in carrying out this study:

- Survey data was assumed to be current, except where visual inspection identified otherwise;
- Existing hydrology models were assumed to be correct, except where specific review and checking of the models formed part of the brief; and
- It is noted that the study is limited by the existing survey data, which does not include detailed channel survey or bathymetry. Such information could have an impact on the findings of the study.
- Costing is based on preliminary estimates. No concept or detailed design has been carried out.

2. Basin Review

2.1 Overview

Basins 2, 4, 4a, 5, 6, 9, 11 and 12 were selected for review, with the aim of removing these basins and then compensating the loss of the basins with stream stabilisation works. In the case of Basin 8, the option of relocating the basin to a lot south of the current proposed location was reviewed. The proposed location and configuration of these basins is shown in GHD's Stormwater Quantity Management Strategy Drawing (June 2010), updated in this report and included as Appendix A.

A review of channel capacities of proposed overland flowpaths was carried out for the drainage from Basins 7 and 8 discharging to the Harness Racing Land.

The delineation of the hydrologic catchments have been included in previous reports but are also reproduced here in Appendix A.

2.2 Howes Creek

2.2.1 Basins 5 and 6

West of the Hume Highway, two streams converge to form Howes Creek. The proposed Basins 5 and 6 are located such that they discharge to each of these streams.

It was therefore necessary to consider both the outflows from Basins 5 and 6 into the individual creeks, as well as the combined flows into Howes Creek further downstream.

RAFTS models were run to assess the combined downstream flows for proposed Basins 5 and 6, discharging to Howes Creek with both basins removed.

Outflows at each of the proposed basin locations were also determined for the 1-year Annual Recurrance Interval (ARI) and 5-year ARI events and checked for the 2-year ARI events.

The individual peak basin outflows from Basin 5 and from Basin 6 in the 100- year ARI and 2-year ARI event as reported in Table 9 of the Flooding and Stormwater Quality Management Report (hereafter referred to as the Detention Report) were found to be consistent.

2.2.2 Basins 2, 4, 4a and 12

The proposed basins 2, 4, 4a and 12 are located downstream of Basins 5 and 6 but upstream of the railway.

No existing channels between the basins and Howes Creek currently exist.

Flows along this reach were assessed at two locations:

- Immediately downstream of the discharge from Basins 4a and 12, and;

- Downstream of the discharge from all Basins, including Basins 4 and 2 (immediately upstream of the railway).

2.2.3 Modelled Flow Results, Howes Creek

Flows predicted from the RAFTS modelling for various ARI's are included in **Error! Reference source not found.** to Table 2.

The location of the outflow is given with respect to a node from RAFTS (refer to drawings in Appendix A) and are described as follows:

- Node T9 is downstream of Basins 5 and 6, but upstream of proposed Basins 4a and 12;
- Node T12 is downstream of Basins 5, 6, 4a and 12; and,
- Node T16 is downstream of Basins 5, 6, 4a, 12, 4 and 2.

The flows quoted for the individual basins are at locations immediately downstream of each basin. It is noted that all flows quoted are either with all upstream basins in place or with no upstream basins in place. No permutations were modelled considering some basins in place and some not in place.

Table 1 Howes Creek Flows, 2-year ARI

Location	Existing Flow (where previously reported)	Developed Flow (without mitigation)	Developed Flow (with mitigation)
Outflow from Basins, 5 and 6 - Howes Creek Upstream Reach			
Basin 5 outflow	2	3.3	1.9
Basin 6 outflow	3.3	5	3.2
Upstream Catchments Outflow (node T9)	-	34.7	33.4
Outflow from Basins 2, 4, 4a and 12 - Howes Creek Downstream Reach			
Basin 2 outflow	2.7	6.7	2.1
Basin 4 outflow	3.7	6.7	3.1
Basin 4a outflow	1.9	3.7	1.8
Basin 12 outflow	6	11.7	5.7
Downstream catchments outflow (node T12)	-	39.3	43.1
Outflow from Basins 2, 4, 4a, 5, 6 - Upstream of Railway			

Location	Existing Flow (where previously reported)	Developed Flow (without mitigation)	Developed Flow (with mitigation)
Node T16	46	44	46

Table 2 Howes Creek Flows, 100-year ARI

Location	Existing Flow (where previously reported)	Developed Flow (without mitigation)	Developed Flow (with mitigation)
Outflow from Basins, 5 and 6 - Howes Creek Upstream Reach			
Basin 5 outflow	6.6	8.5	6
Basin 6 outflow	10.2	11.9	9.9
Upstream Catchments Outflow (node T9)	-	111	106
Outflow from Basins 2, 4, 4a and 12 - Howes Creek Downstream Reach			
Basin 2 outflow	10.5	14.3	8.5
Basin 4 outflow	11.2	14.9	10.4
Basin 4a outflow	6.2	8.3	6
Basin 12 outflow	19	25.7	18.2
Downstream catchments outflow (node T12)	-	129.4	131.8
Outflow from Basins 2, 4, 4a, 5, 6 - Upstream of Railway			
Node T16	142*	136	139

The results demonstrate that flows in the lower reaches of Howes Creek are slightly lower when no basins are in place. In the upstream catchments however (node T9), flows are slightly higher when basins are removed; approximately 5% higher in a 100-year ARI event and between 1% and 3% higher in the smaller ARI's.

Although the basins mitigate the developed flows, the results do not preclude assessment of an alternative drainage strategy, given that the difference in flows is relatively small. These flow results were used to assess existing channel capacities and required size of low flow channels (refer to section 3)

2.3 Basins 7 and 8

2.3.1 Review of Catchment Areas and Design Flows

The outflows from Basin 8 as tabulated in the Detention Report were reviewed.

Shortly before the Detention Report was finalised, it was proposed to relocate Basin 7 to the current proposed location.

A review of the catchments specified in the report identified that these were correct for the old configuration of Basins 7 and 8 and as included in the RAFTS model reviewed by council. The fall of the existing ground levels tended towards the catchments identified with the original location of Basin 7.

However, with the relocation of Basin 7, the preferred catchment strategy is as indicated on the map identified in Appendix A. It is noted that the catchments will be subject to final development levels and should be taken into account as the site grading is progressed.

On the basis of the preferred strategy therefore, the catchments have been reassessed.

Table 3 updates the catchment list provided in Table 10 of the detention report to reflect the new strategy.

Table 3 Catchments Contributing to Basins 7 and 8

Basin	Contributing Catchments	Offset Catchments	Area, ha
7	V11, V12, V13, $V14_a$, V17, V18, V19, V20, V21	None	41.5
8	V1, V7, V8, V9, V10, $V14_b$	V2, V3	31.5 (41.9)

(includes offset catchments)

The RAFTS model was adjusted to account for the revised catchment configuration. The volume of Basin 7 was reassessed to accommodate the additional flows.

Preliminary sizing for Basin 7 was carried out to allow for over-throttling of the flows to discharge to the 3 x 600 and 3 x 900 culverts beneath the railway.

The revised estimated catchment flows used for design are included in Table 4.

Table 4 Revised 100-year ARI Flows (m^3/s), Basin 7 and 8

Basin	Area	Existing Flows	Developed Flows (no mitigation)	Developed Flows (with mitigation)	Developed No Mitigation Flows, Specific Flow Rate
7	41.5	14.3	18.2	4.8	0.44
8	41.9	15.1	19.5*	13.8*	0.47*

**Includes offset catchments*

Table 4 indicates the need for the basins to mitigate the developed flows.

2.3.2 Relocation of Basin 8 to south lot

Council expressed a desire to review the location of Basin 8 and assess the possibility of moving it to the lot south of its existing location.

A visual assessment of the lot was carried out during a site visit. Photographs of the lot show the gently sloping ground including stockpiled fill falling away steeply to the south.

Figure 1 South lot, taken from the south-west corner

Figure 2 South Lot, taken from the west

Relocating Basin 8 to the south lot would require an increased embankment height to batter to existing levels on Racecourse Avenue.

Maintaining basin capacity and appropriate levels, a basin embankment of up to 5m high would be required, as compared to that of up to approximately 2.6m in the current proposed location.

The new invert of the basin would be at approximately 74.5 mAHD with top level at 76.5m AHD and total volume of approximately 12,000 m^3 as per the previously proposed basin.

It is noted that the south lot is shown to be within the 100-year ARI event floodplain. The Nepean flood level downstream of the railway is 76.07 mAHD. Flow through the railway culverts relies on head from the basins for flow through the culverts.

If the downstream is flooded to a higher level, then flow through the culvert will not occur.

Ground levels at the existing basin location range from 75.9 mAHD to 76.8 mAHD. At the south lot they fall steeply from 79 mAHD in the north east corner to 70.5, with the majority of the lot being located below 74.5 mAHD.

At its current location, some flow would be expected (amount depending on the water level in the pond) to occur from Basin 8 even during backwater flooding.

If moved to the south lot, the Basin cannot be raised substantially without impacting on the potential for catchment V8 to drain into the basin.

However, in the event that flow through the culverts did not occur due to tailwater levels, there is no predicted increase in flood levels over existing and hence this may be considered acceptable.

The presence of the Basin in the floodplain would displace an estimated 7,200 m^3 in volume from the floodplain, with a subsequent increase in expected flood levels in the roads. On the above basis, it is considered that the preferred location is as originally proposed. However, the alternative location of Basin 8 is also shown on the plan in Appendix A. Costing of this option is also included in Appendix B.

2.4 Basin 9

The proposed Basin 9 discharges into a Category 3 riparian corridor. The potential for retaining the existing flow characteristics rather than introducing a basin was assessed.

2.4.1 Modelled Flow Results, Basin 9

Table 5 summarises the modelled outflows for Basin 9. Two locations are assessed, that immediately downstream of the proposed basin, as well as at the downstream outflow into the Nepean (node T20 in the RAFTS model).

Table 5 Downstream Flow (m^3/s), with and without Basin 9

ARI	Location	Existing Flow (where previously reported)	Developed Flow (without mitigation)	Developed Flow (with mitigation)
100y	At outflow to Nepean (node T20)	-	54.1	49.6
1y	At outflow to Nepean (node T20)	-	10.7	9.8
2y	At outflow to Nepean (node T20)	-	18.6	16.2
5y	At outflow to Nepean (node T20)	-	27.9	25.5
100y	Basin Outflow	15.0*	16.3*	15*
1y	At Basin Outflow	-	4.9	3.8
2y	At Basin Outflow	5.1*	5.6*	4.9*
5y	At Basin Outflow	-	9.6	7.4

**Previously reported in Table 9 of the Detention Report*

As in the case of Basins 5 and 6, the differences in flows suggest that an alternative strategy to basin implementation can be considered. The flow results were used in determining the adequacy of the existing channel and for sizing of a low flow channel.

2.5 Basin 11

The proposed Basin 11 also discharges into a Category 3 riparian corridor. As with Basin 9, the potential for retaining the existing flow characteristics rather than introducing a basin was assessed.

2.5.1 Modelled Flow Results, Basin 11

Table 6 summarises the modelled outflows for Basin 11. Two locations are assessed, that immediately downstream of the proposed basin, as well as at the downstream outflow into the Nepean (node O8 in the RAFTS model).

Table 6 Downstream Flow (m^3/s), with and without Basin 11

ARI	Location	Existing Flow (where previously reported)	Developed Flow (without mitigation)	Developed Flow (with mitigation)
100y	At outflow to Nepean (node O8)	-	21.9	20.3
1y	At outflow to Nepean (node O8)	-	3.4	3.0
2y	At outflow to Nepean (node O8)	-	6.7	5.9
5y	At outflow to Nepean (node O8)	-	11.8	9.6
100y	At Basin Outflow	7.9*	9.6*	7.9*
1y	At Basin Outflow	-	2.1	1.7
2y	At Basin Outflow	2.6*	3.6*	2.4*
5y	At Basin Outflow	-	5.7	3.8

***** *Previously reported in Table 9 of the Detention Report*

As in the case of Basins 5, 6 and 9, the flow results from Table 6 were used to estimate the adequacy of the existing channel and also for sizing of a low-flow channel.

3. Channels

3.1 Overview

It was desired to review existing conditions of the watercourses on site to determine their condition. The creeks are referred to with the nomenclature used in the Detention Report, that is:

- Basin 9 discharges to Creek S1
- Basin 11 discharges to Creek S2
- Basins 5, 6, 2, 4, 4a and 12 discharge to Creek M (Howes Creek)

Creek M is further divided into various reaches for the purposes of this study.

The channels providing drainage for low flows from Basin 7 over Harness Racing Land is referred to as HR-1. HR-2 downstream is proposed to take flows from Basin 8 as well as the low flows from Basin 7. It is proposed that a third flow path (HR-3) will be provided to take high flows from Basin 7 over a route yet to be agreed.

Channels are shown on the plan in Appendix A. Existing channel estimates are based on available DEM data and limited site visit information and are therefore preliminary.

It is further noted that the existing survey does not include detailed channel survey. Cross-sections are approximate and may not pick up inverts, bank levels or any existing low flow channels.

Velocity limits for estimation of low flow channels and costing of stabilisation works assumed a limiting velocity of 2m/s.

The limiting velocities for erosion resistance of grass vegetation is generally dependent on the flow duration as well as the quality of the cover. For normal cover and flow durations of between 6 to 12 hours, limiting velocities of between 2.1 to 2.5 m/s may be expected (Table 7).

Table 7 Limiting Velocities for Erosion Resistance of Grasses

Flow Duration (hours)	Velocities for Quality of cover (m/s)		
	Good	Normal	Poor
2	5.0	3.9	2.8
4	3.7	2.9	2.1
6	3.3	2.5	1.8
9	3.0	2.3	1.6
12	2.8	2.1	1.5
18	2.7	2.0	1.3

Flow Duration (hours)	Velocities for Quality of cover (m/s)		
24	2.6	1.9	1.2
48	2.5	1.7	1.0
72	2.4	1.6	0.9

Source: AR&R (1987)

For Menangle Park, this may vary depending on the types of native vegetation selected as part of the creek stabilisation works. It is recommended that this be reviewed during detailed design.

3.2 Existing Channels

Typical cross-sections of the existing channels were determined from survey, as well as existing longitudinal profiles. From this information, approximate 100-year, 5-year, 2-year and 1-year ARI levels within each creek were approximated using Mannings equation.

The channels identified by the survey typically have wide overbanks with shallow side slopes, resulting in relatively shallow flow depths in the 100-year ARI event (excluding backwater effects from the Nepean).

Approximate existing in-channel and overbank dimensions are included in Table 8.

The in-channel top width refers to the dimensions of the “low flow” channel, as estimated from aerial photography. The overbank channel refers to the wider floodplain cross-section as estimated from the survey.

For longer channels, where possible, existing cross sections were examined both downstream of the proposed Basin and also at the outflow to the Nepean. Where survey and access did not permit, this is in some cases limited to a single location.

Several separate existing reaches of Howes Creek (Creek M1) were assessed. The locations can be seen on the drawing in Appendix A and were as follows:

- The tributary channel immediately downstream of Basin 5 (M1_5);
- The tributary channel immediately downstream of Basin 6 (M1_6);
- The existing main channel immediately downstream of both basins 5 and 6 (M1_U);
- The channel downstream stream of Basins 4a and 12 (M1_D1); and,
- The channel downstream of all basins including basins 2 and 4 (M1_D2)

No existing channels immediately downstream of proposed basins 4, 4a, 2 and 12 have been identified.

Creek S1 (Basin 9) was assessed both at the location of the proposed basin outflow, as well as at the downstream outflow to the Nepean.

Creek S2 (Basin 11) was assessed at a location towards the downstream outflow into the Nepean.

The flow channels over Harness Racing Land were assessed at location HR-1 (Basin 7 low flows) and HR-2 (Basins 7 low flows and Basin 8).

Table 8 Existing Channel Geometry*

Chnl	Location	Basin	Top Width, In-channel (m)	Overbank Flow Width (m)	Base Width (m)	In-channel depth (m)	Longitu-dinal Slope (%)
M1_5	Stream immediately DS of 5	5	7.5	43	0.3	1.2	1.2
M1_6	Stream immediately DS of 6	6	5	45	0.3	0.5	1.2
M1_U	Howes Creek DS of Basin 5 & 6	5 & 6	14	260	5	0.9	1.2
M1_D1	Howes Creek DS of Basins 12 & 4a,	4a, 12	17.5	270	12	0.4	1
M1_D2	Howes Creek DS of all Basins	5, 6, 4q, 12, 2, 4	17.5	310	12	0.4	1
S1	Downstream near Nepean Outflow	9	22	143	2	0.7	1.2**
S1	Downstream of Basin 9	9	8.5	143	0.5	0.4	1
S2	Downstream near Nepean outflow	11	8.5	52	0.5	0.5	1.2**
HR1	Near entrance to Harness Racing	7	4.5	12	0.3	0.6	1.2
HR2	Downstream of existing pond	7 & 8	4.6	107	1	0.4	1.2

***** *Approximate, from aerial and representative survey cross-sections*

***Average over several hundred metres upstream of outlet*

The predicted 100-year ARI event velocities and depths of flow are included for scenarios with and without basins at comparative locations in Table 9. These consider the larger surveyed cross-section. As Basins 7 and 8 are not considered for removal, these channels are considered for the “with basins” case only.

Council noted that Creeks S1 and S2 are steep and deeply incised towards the Nepean Outlet. At the Nepean outlet, the area is heavily vegetated and the survey does not identify the channel.

The slopes of Table 8 are an average for the area downstream of the development outflows (i.e. downstream of the locations of Basins 9 and 11).

The estimated slope of Basin 9 is approximately 0.5% for approximately 200m, after which the channel bed appears to drop sharply and steepen to a slope of 1.4%. This has been considered further when identifying potential stabilisation options.

Creek S2 is poorly reflected in the survey, making it difficult to refine slope estimates along its length. On the basis that it does steepen towards the downstream area, provisional allowances are made for stabilisation works.

Table 9 Existing Channel Flow Depths and Velocities, 100-year ARI

Drainage System	Location	Basin	Depth (m)		Velocity (m/s)	
			With Basin	Without Basin	With Basin	Without Basin
M1_5	Stream immediately DS of 5	5	1.5	1.7	1.5	1.4
M1_6	Stream immediately DS of 6	6	1.4	1.4	1.8	1.8
M1_U	Howes Creek DS of Basin 5 & 6	5 & 6	1.2	1.2	2	2
M1_D1	Howes Creek DS of Basins 12 & 4a,	4a, 12	0.95	0.95	1.8	1.8
M1_D2	Howes Creek DS of all Basins	5, 6, 4a, 12, 2, 4	0.96	0.96	1.8	1.8
S1	Downstream near Nepean Outflow	9	1	1	1.7	1.7
S1	Downstream of Basin 9	9	1.2	1.2	1.8	1.8
S2	Downstream near Nepean outflow	11	0.7	0.7	1.7	1.7
HR1	Near entrance to Harness Racing	7	0.5	N/A	1.1	N/A
HR2	Downstream of existing pond	7 & 8	0.56	N/A	1.43	N/A

Table 9 indicates that the overbank channels have capacity to pass the 100-year ARI events for the developed case, both with and without basins, at velocities not predicted to exceed 2 m/s.

Table 10 shows the predicted channel flow for the 2-year ARI. Where flow is anticipated to pass beyond the existing channel banks into the overbank floodplain, results are underlined for information. However, wide corridors are available for the conveyance of overbank flows.

Table 10 Existing Channel Flow Depths and Velocities, 2-year ARI

Drainage System	Location	Basin	Depth (m)		Velocity (m/s)	
			With Basin	Without Basin	With Basin	Without Basin
M1_5	Stream immediately DS of 5	5	0.7	0.9	1.8	2.0
M1_6	Stream immediately DS of 6	*6*	*0.9*	*1.5*	*0.9*	*1.5*
M1_U	Howes Creek DS of Basin 5 & 6	5 & 6	0.8	0.8	1.6	1.6
M1_D1	Howes Creek DS of Basins 12 & 4a,	4a, 12	*0.6*	*0.6*	*1.2*	*1.2*
M1_D2	Howes Creek DS of all Basins	5, 6, 4a, 12, 2, 4	*0.7*	*0.7*	*1.3*	*1.3*
S1	Downstream near Nepean Outflow	*9*	*0.8*	*0.9*	*1.3*	*1.5*
S1	Downstream of Basin 9	*9*	0.7	1.2	0.7	1.2
S2	Downstream near Nepean outflow	11	0.5	0.5	1.3	1.3
HR1	Near entrance to Harness Racing	*7*	0.42	N/A	1.0	N/A
HR2	Downstream of existing pond	7 & 8	0.41	N/A	1.1	N/A

**Underlined italics indicates flow passes into overbank corridor*

3.2.1 Flood Modelling Assessment, 100-year ARI

The Howes Creek TUFLOW model was run for the 100-year developed flow (without Basins 2, 4, 4a, 12, 5 and 6) case. A flood map is included in the Appendix.

The flood line indicates limited changes from that issued in the Flooding and Detention Report. The flood line considers flooding from rivers only and the drainage will need to be designed to manage flood risk from development flows.

As compared to the approximate hydraulic estimates of Table 9, the TUFLOW results generally indicated velocities of up to 1.1 m/s in the floodplain, and 1.8 m/s in channel.

Modelled velocity-depth products were below 1 in the floodplain and up to 1.5 in the channel. However, as the high hazard areas are mostly confined within the main channel and are buffered with low hazard areas within the overall floodplain which is typical of most natural creeks, it is not considered to be an issue.

3.3 Low Flow Channels

For those channels found to exceed the capacity of the existing low flow channel in the 2-year ARI event, or where existing velocities were estimated at greater than 2m/s, approximate required dimensions of low flow channels at the locations previously identified were assessed for the 2-year ARI event.

On the basis that the catchments concerned are downstream of the development areas with a substantial riparian zone available for overland flow of larger ARI events, the 2-year ARI event was not considered unreasonable, although overbank velocities and flood impacts have not been assessed through hydraulic modelling.

The difference in the with-basin and without-basin scenarios was minor in many cases. The level of detail in the preliminary estimates therefore did not in all cases identify differences in required channel geometry.

Although sizing of these channels has been investigated, it is suggested that the flows may be better managed through allowing overbank flow to occur and carrying out stabilisation works.

3.3.1 Creek M, upstream catchments

Howes Creek drains a substantial catchment, with the 2-year ARI combined flows downstream of Basins 5 and 6 being in excess of 30 m^3/s.

Table 11 Howes Creek Channels Required Channel Geometry for 2-year ARI, Upstream Reaches

Event	Q* (m^3/s)	Top Width (m)	Base Width (m)	Longitudinal Slope (%)	Side Slope, 1 in x	Average Velocity (m/s)	Depth (m)
M1_5							
Existing channel sufficient for all development conditions							

Event	Q* (m^3/s)	Top Width (m)	Base Width (m)	Longitudinal Slope (%)	Side Slope, 1 in x	Average Velocity (m/s)	Depth (m)
M1_6							
With Basins	3.2	7.4*	0.5	1.2	6	1.4	0.58
Without Basins	5	8.9*	1.3	1.2	6	1.6	0.63
Howes Creek_U							
Existing channel sufficient for all development conditions							

***** *Indicates top width required for flow. Channel geometry could be extended to provide minimum width of 15m as per Council's DCP requirement.*

3.3.2 Creek M, downstream catchments

The required flows for the channel reaches downstream of proposed basins 4a and 2, as well as downstream of basins 12 and 4a are included in Table 12.

Table 12 Howes Creek Channels Required Low-Flow Channel Geometry for 2-year ARI, Downstream Reaches

M1_D1 (Downstream of Basins 4a and 12)							
With Basins	43	27.4	10	1.2	8	2.1	1.1
Without Basins	39	26.7	10	1.2	8	2.1	1.0
M1_D2 (Downstream of all Howes Creek Basins, upstream of railway)							
With Basins	46	28.1	10	1.2	8	2.2	1.13
Without Basins	44	27.6	10	1.2	8	2.1	1.10

A substantial channel would be required in these lower reaches of Howes Creek for a 2-year ARI event. Predicted velocities and velocity products are high and stabilisation works or channel flattening would be required in order to reduce the velocities to acceptable levels (2m/s).

The required size of channel for the 2-year ARI would indicate that provision of a low flow channel may not be practical. Management of flows by improvement to the existing channel was examined as an alternative. For Howes Creek, the assessment of the existing flow regime indicates velocities are more favourable.

3.3.3 Creek S1, Basin 9

Table 13 Creek S1, Required Channel Geometry for 2-year-ARI

Event	Q* (m^3/s)	Top Width (m)	Base Width (m)	Longitudinal Slope (%)	Side Slope, 1 in x	Average Velocity (m/s)	Depth (m)
S1, Downstream of Basin 9							
Existing channel sufficient for all development conditions, stabilisation considered							
S1, at outflow to Nepean							
With Basins	16.2	22.1	12	1	9	1.73	0.56
Without Basins	18.6	24.1	14	1	9	1.76	0.56

It is noted that the existing channel slopes at this downstream location are estimated to be steeper than indicated on the survey. Stabilisation works to the existing channel have been considered.

3.3.4 Creek S2, Basin 11

Creek S2, into which Basin 11 is proposed to drain, was found to have sufficient existing in-capacity for the 2-year ARI event for both development scenarios.

3.3.5 Harness Racing Land

A heavily vegetated existing drainage ditch (referred to as HR1 in this report) flows in a southerly direction on the harness racing land to the west of the railway embankment Appendix A.

At the entrance to the racecourse, the ditch appears to pass under the roadway, although it was not possible to view the culvert.

From there, it is assumed that the ditch passes beneath the flood embankment into the existing culvert which joins HR-2 downstream before discharging into the Nepean.

Figure 3 Drainage Ditch, looking towards the south-east, railway embankment in the background

Channel requirements are assessed in Table 14.

Table 14 Harness Racing, Channel HR-1, Required Channel Geometry for 2-year ARI

Event	Q* (m^3/s)	Top Width (m)	Base Width (m)	Longitudinal Slope (%)	Side Slope, 1 in x	Average Velocity (m/s)	Depth (m)
With Basins	0.86	4.5	1	1.2	6	1.14	0.29

***** *Peak Low Flow from Basin 7*

The channel referred to as HR-2 is an existing Creek as identified on the plan in Appendix A.

Table 15 Harness Racing, Channel HR-2, Required Channel Geometry for 2-year ARI

Event	Q* (m^3/s)	Top Width (m)	Base Width (m)	Longitudinal Slope (%)	Side Slope, 1 in x	Average Velocity (m/s)	Depth (m)
With Basins	6.7	10.3	3.5	1.2	6	1.73	0.57

***** *Simplified estimate – sum of peak low flow for Basin 7 and peak total flow for Basin 8*

3.4 Harness Racing Easement

For the existing channel HR-1, the flow width in the 100-year ARI event is estimated at 4.5m. Allowing for 0.5m freeboard and an additional 1m (council DCP Volume 2, Table 14.8), the easement width required would be 8.5m. If council's minimum floodway width of 15m is required then the freeboard allowance would already be included and the minimum easement required would be 16m.

Channel HR-1 flows between the railway embankment and a cut-off wall (Figure 3). The total width between the railway embankment and cut-off wall is approximately 20m.

Because of the proximity of HR-1 to the existing railway embankment (distance estimated from visual inspection to be approximately 3m from top of channel), the easement width would be primarily on the western side of the channel with a limited width between the channel and railway.

If necessary, realignment of the channel to meet with the easement width requirements could take place.

Figure 4 HR-1 looking north: railway embankment at right of picture and cut-off wall to the left

For the existing channel HR-2, the flow width in the 100-year ARI event is estimated at 38 m. This takes account of the peak flow from Basin 8, peak low flow from Basin 7 and excludes backwater effects from the Nepean.

Council has noted that this land is flood affected in the 100-year ARI event and a width of easement allowing for the full extent may not be beneficial.

If the 2-year ARI is considered instead, the width required when 0.5m freeboard allowance is taken into consideration is still greater than the predicted 100-year ARI flow width.

The following alternatives are considered:

1. Construct new channel to take 100-year flows with steeper side slopes than existing and narrower easement requirements;
2. Adopt a nominal easement width of the minimum floodway width plus an additional 1m i.e. 16m.

Given that the channel capacity and existing velocity-depth products are estimated to be acceptable and that the channel lies within the Nepean flood extent, the benefits of option 1 above are considered minimal.

It is suggested that a nominal easement width be adopted as suggested in 2.

3.5 Stabilisation

There are a number of options available for stabilisation and erosion prevention of existing channels.

3.5.1 Stabilisation Matting

Bank stabilisation could be considered through introduction of channel lining in problem areas. Because of the shallow side slopes identified from survey (1 in 3 or flatter), it was assumed that general purpose polyethylene matting would be suitable for stabilisation.

Although the matting deteriorates with time and would not be expected to have a design life of the required 100 years, it allows for establishment of a well vegetated and more stable channel which should endure beyond the life of the matting.

Indicative costs for stabilisation works have been provided assuming introduction over an assumed width.

3.5.2 Grade Control Structures

The predicted channel velocities have generally been estimated to be 2m/s or below; however, the channel slopes are relatively high for natural creeks at 1 to 1.2%.

Drop structures can be used to control velocities and manage sudden changes in slope (as identified at a location along Channel S2).

A variety of options are available, including straight drop concrete drops, rock-lined chutes or a series of smaller drops using logs.

Straight concrete drop structures tend to have a lower chance of failure and longer design life, but may not be preferred for flora and fauna habitat.

As an alternative to implementing lining mats, costs for construction have been provided for implementing drop structures to reduce effective longitudinal stream

slopes to 0.5%. Various options have been considered in the cost estimates (Appendix B).

3.5.3 Preferred Stabilisation Options

It is expected that channel stabilisation works for each creek may necessitate a combination of options. In order to assess and design these in detail, it is recommended that:

- Detailed cross-sectional survey of channels is carried out;
- Complete longitudinal profile of channel is surveyed;
- Monitoring of channel flows and velocities;
- Mapping of key channel features based on survey and further site work

4. Costing

4.1 General

For costing of channel works at this initial stage, estimates were made for construction of low flow channels in those cases where the 2-year flow was found to flow into the overbank. Estimates both with and without basins were only made where appreciable differences in channel geometry were identified (please see section 3.3). Otherwise, a single cost estimate was provided.

Where low flow channels have been sized, these are intended to provide suitable flow velocities within channel and thus stabilisation works required would be limited.

Separate cost estimates have been provided for stabilisation works only (no low-flow channel).

Cost estimates are included in Appendix B. The following limitations and assumptions are noted in regard to these estimates:

- No allowance has been made for temporary works or design (construction costs only);
- Costing assumes cut and fill of low flow channels will be balanced;
- Road inlet drainage has not been costed in detail;
- Existing channel side slopes have been assumed to be 1 in 3 or shallower (based on survey);
- The channel width over which stabilisation works have been costed is that determined for the existing low flow cross-section where channel side slopes are steepest, plus a nominal additional 30% width;
- The scenario considered for stabilisation works is “with-basins” for HR-1 and HR-2 and “without basins” for the other channels;
- No allowance has been made for requirements of the water quality strategy as it is understood that allowances have been made in a separate study; and

Cost estimates are provided in Appendix B for the following:

- Construction of low-flow channels for the estimated formed channel;
- Construction of stabilisation works for two options; and,
- Updated Basin 7 and 8 costs and costs for relocated Basin 8.

4.2 Findings

4.2.1 Howes Creek Basins

Cost estimates for low-flow channels and stabilisation works have been provided for two reaches of Howes Creek, M1_U (catchments of Basins 5 and 6) and M1_D (downstream reach including flows from all basins).

The preliminary hydraulic estimates showed little difference in flow between the with-basins and without-basins approach for Basins 5 and 6. For this reason, there was no difference in costing for the upper reaches of Howes Creek between the two scenarios.

For the lower reach, minor differences were noted downstream near the railway and separate cost estimates were provided for the with basins and without basins scenarios.

The existing channel from Basin 5 (upstream of the confluence of the channels which combine to form Howes Creek) was sufficient for passing the 2-year ARI flow and no low-flow channel works were included. Costs for estimated stabilisation of the existing channel were estimated.

A comparison of costs estimated for Basin Construction (July 2011) against channel stabilisation are included in Table 16.

Table 16 Comparison of Estimated Basin Construction Costs against Channel Stabilisation Works

Basins	Basin Construction Cost Estimate	Stabilisation Works Estimate
5 & 6	$1.85 million	$975,000
2, 4, 4a & 12	$5.4 million	$1.6 million
TOTAL	$7.25 million	$2.575 million

Note that the channel stabilisation includes works to the existing channel only over a limited width and excludes all works associated with water quality aspects and costs of constructing a low flow channel.

4.2.2 Basin 9

Estimated costs for construction of Basin 9 were $1.2 million (July 2010). Stabilisation works are estimated at a cost of $1.07 million. Basin 9 may therefore be identified for removal depending on the outcome of detailed assessment.

4.2.3 Basin 11

Construction of Basin 11 was estimated at a cost of approximately $1 million (July 2010).

In this study, the estimated costs of stabilisation works were found to be approximately $400,000.

4.2.4 Harness Racing Land (Basins 7 and 8)

Estimated costs of stabilisation works for these channels (HR-1 and HR-2) are estimated at approximately $400,000 each.

4.2.5 Basin 8

It is estimated that the cost of constructing Basin 8 in its current location is approximately $1.975 million. The value is higher than estimated in July 2011 due to a more conservative value assumed for reinforced turf (used in construction of the high flow spillway).

A comparative cost for a Basin south of the current proposed location is estimated to cost approximately $2.6 million with a reduction to $2.2 million if a retaining wall is constructed instead of an earth embankment.

The primary difference in cost is due to expected additional fill import requirements associated with building the basin with a larger embankment over steeper ground on the south lot.

4.2.6 Basin 7

Basin 7 construction estimates have been updated based on allowance for additional capacity to take the flows of the southern catchments, originally proposed to drain to Basin 8.

Costs are now estimated at $1,500,000.

5. Conclusions and Recommendations

From the preliminary cost estimates, it appears that there may be some merit in considering channel upgrade works rather than implementing basins on Howes Creek (Basins 2, 4, 4a, 5, 6, and 12) and in Creek S1 (Basin 9) and Creek S2 (Basin 11). The estimated cost of stabilisation works for these basins is approximately $3 million whilst the costs of constructing the basins were estimated in July 2011 at approximately $8.2 million.

This report has not considered water quality requirements as it is understood these are considered in a separate study.

Approximate easement widths on the Harness Racing Land have been identified.

The existing channels were found sufficient to manage the flows up to the 100-year ARI event if overbank flow portions are permitted and it may therefore not be necessary to engineer low flow channels for the purposes of keeping the low ARI events within channel.

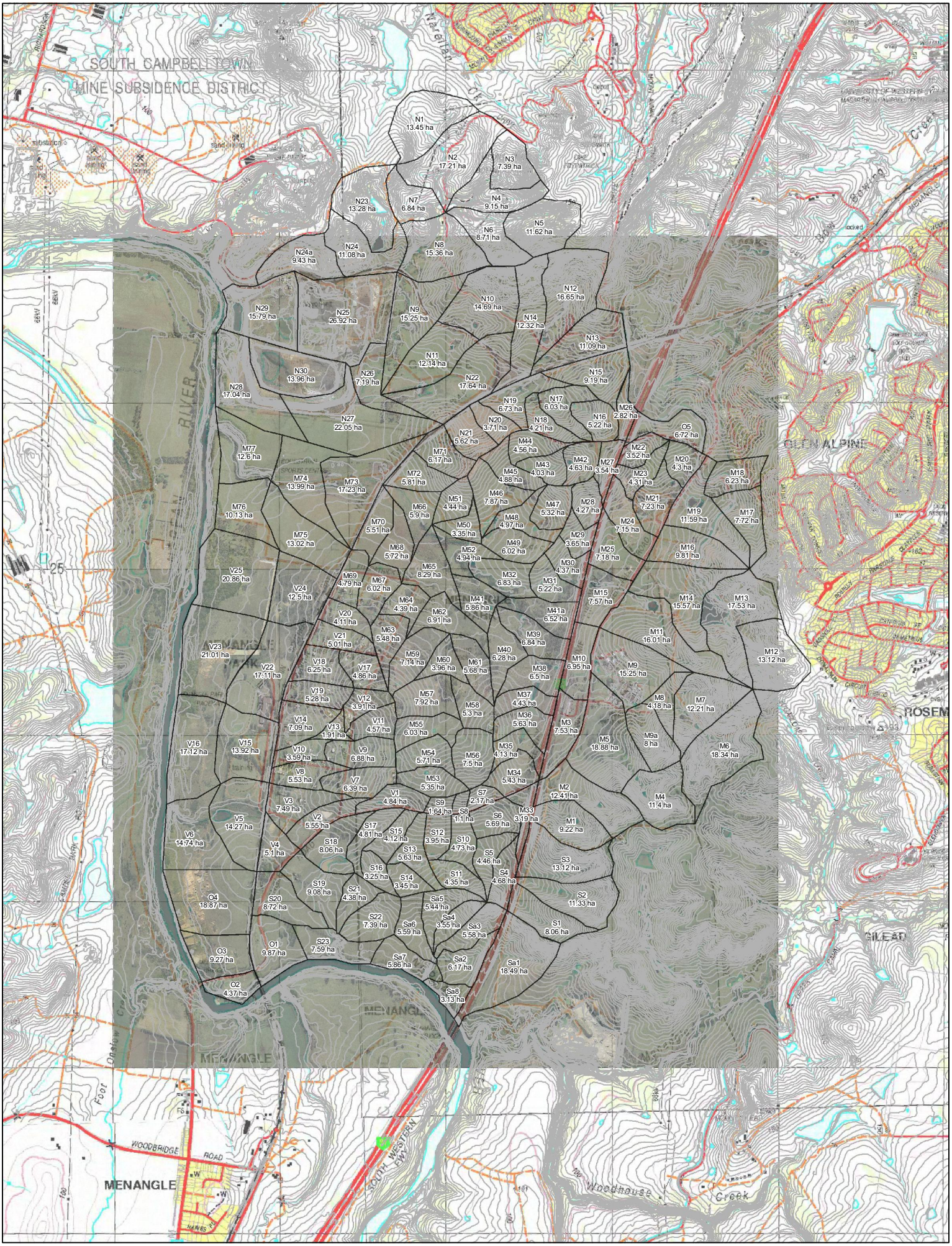
It is concluded that there may be merit in removing some of the basins from the scheme and reconsidering the need for low flow channels up to the 2 year event; however these findings would need to be confirmed through detailed site investigation, survey and possibly hydraulic modelling of overland flow paths (where not already undertaken).

Before carrying out any stabilisation works, it is recommended that monitoring of the creek condition should be carried out

The findings indicate a revised drainage strategy is possible where basins Basins 2, 4, 4a, 5, 6, 9 and 11 are removed for water quantity management while retaining water quantity management in accordance with the Menangle Park WSUD report. It is proposed that Basins 7 and 8 be retained for water quantity management

Appendix A

Drawings



1:20,000 at A3

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N
W E
S

Campbelltown City Council/Landcom
Menangle Park Local Flooding and Detention

RAFTS Catchments

Job Number	21-15581
Revision	A
Date	20th Jan 2010

Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7000 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: C Pappin

Basin 13
Basin 4
M1_D2
Basin 4a
Basin 2
M1_D1
Basin 5
M1_5
Basin 12
M1_U
M1_6
Basin 6
HR-3
Preferred drainage path
to be agreed with Harness
Racing Land
Basin 7
Basin 8
HR-1
HR-2
Basin 8 - relocated
Basin 9
S1
Basin 11
S2

Legend

- Relocated Basin 8
- Fill Locations
- Proposed Basin Catchments
- Offset Catchments

1:12,000 at A3

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W
E
S

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

Campbelltown City Council/Landcom
Menangle Park Local Flooding and Detention

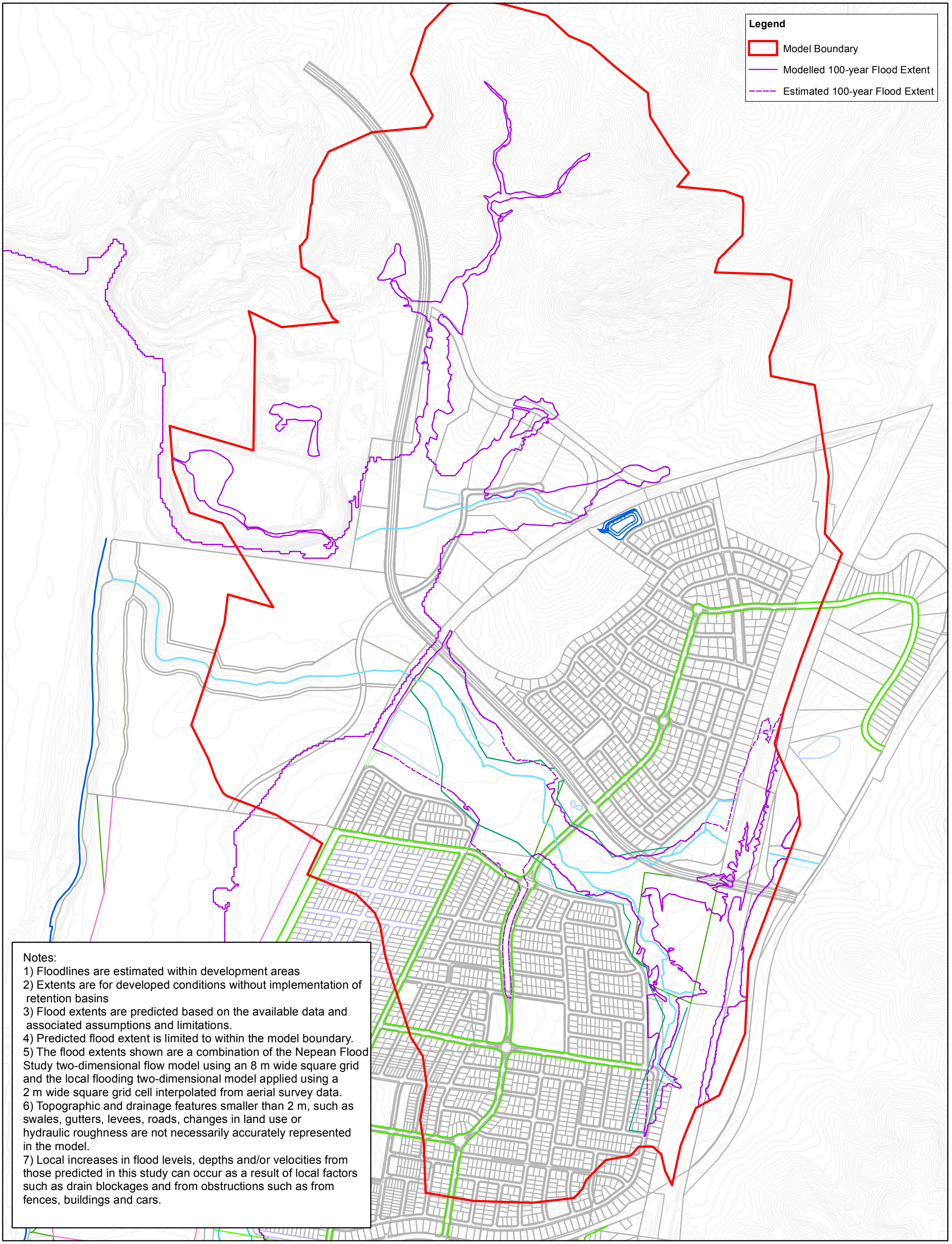
Job Number	21-20952
Revision	A
Date	November 2011

Drainage Review

G:\21\15581\CADD\GIS\ArcGIS\Maps

Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia **T** 61 2 9239 7000 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: C Pappin



0 62.5 125 250 375 500 Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N
W E
S

Flood extents in this map show the 100-yr developed scenario and 20-yr in the Nepean.

THIS MAP SHOWS ONLY FLOOD EXTENTS GREATER THAN 50mm

Campbelltown City Council/Landcom
Menangle Park Local Flooding and Detention

Howes Creek 100-year Flood Extent

Job Number	21-21024
Revision	A
Date	November 2011

PRELIMINARY

G:\21\15581\CADD\GIS\ArcGIS\Maps

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Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: C Pappin

Appendix B

Cost Estimates

Appendix B1 – Basin 7 and 8 cost estimates

Appendix B2 – Low Flow Channel Cost Estimates

Appendix B3 – Stabilisation Works Cost Estimates, 1

Appendix B 4 – Stabilisation Works Cost Estimates, 2

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Landcom/Campbelltown City Council
APPENDIX B1, PRELIMINARY COST ESTIMATE SUMMARY

ITEM	DESCRIPTION		AMOUNT
1	**Basin 8**		
1.1	Preliminaries	$	20,000
1.2	Earthworks	$	179,839
1.3	High Flow Spillway	$	82,413
1.4	High Flow Box Culvert	$	617,400
1.5	Low Flow Outlet Pipe	$	72,690
1.6	Inlet from Road Drainage (to be advised)	$	112,980
1.7	Landscaping and Planting	$	113,715
1.8	Bioretention Area Not Costed	$	-
1.9	Supervision, Project Management & Contractor On-Costs	$	359,711
2.0	Contingencies	$	359,711
		$	**1,918,000**
2	**Basin 8 Relocated - Earth Embankment**		
2.1	Preliminaries	$	20,000
2.2	Earthworks	$	579,849
2.3	High Flow Spillway	$	66,776
2.4	High Flow Box Culvert	$	617,400
2.5	Low Flow Outlet Pipe	$	72,690
2.6	Inlet from Road Drainage (to be advised)	$	112,980
2.7	Landscaping and Planting	$	151,039
2.8	Bioretention Area Not Costed	$	-
2.9	Supervision, Project Management & Contractor On-Costs	$	486,220
3.0	Contingencies	$	486,220
		$	**2,593,000**
3	**Basin 8 Relocated - Retaining Wall**		
3.1	Preliminaries	$	20,000
3.2	Earthworks	$	380,649
3.3	High Flow Spillway	$	1,538
3.4	High Flow Box Culvert	$	617,400
3.5	Low Flow Outlet Pipe	$	72,690
3.6	Inlet from Road Drainage (to be advised)	$	112,980
3.7	Landscaping and Planting	$	151,039
3.8	Bioretention Area Not Costed	$	-
3.9	Supervision, Project Management & Contractor On-Costs	$	406,889
4.0	Contingencies	$	406,889
		$	**2,170,000**
3	**Basin 7 Updated**		
3.1	Preliminaries	$	20,000
3.2	Earthworks	$	255,862
3.3	High Flow Spillway	$	71,174
3.4	High Flow Box Culvert	$	161,100
3.5	Low Flow Outlet Pipe	$	24,930
3.6	Inlet from Road Drainage (to be advised)	$	112,980
3.7	Landscaping and Planting	$	298,479
3.8	Bioretention Area Not Costed	$	-
3.9	Supervision, Project Management & Contractor On-Costs	$	283,358
4.0	Contingencies	$	283,358
		$	**1,511,000**

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Menangle Park
Detention Basin 8
SCHEDULE OF ESTIMATED QUANTITIES

Revision: 03

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	1.3	ha	2900	$ 3,713	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	50.0	m2	50	$ 2,500	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	-	m2	63	$ -	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	-	m2	13	$ -	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	1,921	m3	5	$ 9,412	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	5,104	m3	9	$ 45,936	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	2,765	m3	12	$ 33,177	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	232	m3	10	$ 2,319	
2.9	Access Road: place and compact imported fill	232	m3	12	$ 2,782	
2.10	Allowance: Over excavation to restore soil profile				$ 10,000	
2.11	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
2.12	Allowance: Separate and place select clay in embankment core				$ 20,000	
	SUBTOTAL				**$ 179,839**	
3	**High Flow Spillway**					
3.1	Form spillway crest in embankment	38	m3	21	$ 788	-
3.2	Geotextile Fabric - non woven polypropylene/ polyethylene 2.8mm thick (310g/sqm)	150	m2	5	$ 750	-
3.3	Reinforced Turf - supply, deliver, lay turf, roll and water	578	m2	140	$ 80,875	0
	SUBTOTAL				**$ 82,413**	
4	**High Flow Outlet Box Culvert**					
	Box Culvert - Supply and deliver 4.2m (span) x 0.9m (height) box culvert	120	m	4500	$ 540,000	
	Headwall - Supply, deliver, lay and join precast unit; including toe excavation to suit 4.2m (span) x 0.9m (height) box culvert: 1 cell	4	each	5700	$ 22,800	
	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	2	m3	300	$ 600	
	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	120	m	380	$ 45,600	
	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	60	m2	140	$ 8,400	
	SUBTOTAL				**$ 617,400**	
5	**Low Flow Outlet Pipe**					
4.1	Pit - Supply, deliver, lay and join 900mm square pit with grated inlet	3	item	3700	$ 11,100	-
4.2	Pipe - Supply, deliver, lay and join 600mm RCP (Class 2)	30	m	270	$ 8,100	Rubber ring joint; excavation excluded
	Pipe - Supply, deliver, lay and join 525mm RCP (Class 2)	60	m	230	$ 13,800	
4.3	Headwall - Supply, deliver, lay and join precast unit; including toe excavation - to suit 600mm pipe	3	each	590	$ 1,770	-
4.4	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	4	m3	300	$ 1,200	Approximate only
4.5	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	90	m	380	$ 34,200	Assuming clay soil
4.6	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	18	m2	140	$ 2,520	0
	SUBTOTAL				**$ 72,690**	
6	**Inlet from Road Drainage**					
5.1	Pipe - Supply, deliver, lay and join 375mm RCP (Class 2)	90	m	130	$ 11,700	Rubber ring joint; excavation excluded
5.2	Excavate 1200mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	90	m	140	$ 12,600	Assuming clay soil
5.3	GPT - Supply, deliver and install CDS 2018	1	each	87000	$ 87,000	Subject to final design
5.4	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	12	m2	140	$ 1,680	0
	SUBTOTAL				**$ 112,980**	
7	**Landscaping and Planting**					
6.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	1,921	m3	6	$ 11,524	
6.2	Lawn turf - spread and grade 50mm topsoil, lay turf, roll and water	8,586	m2	10	$ 85,862	-
6.3	Landscaping - supply, deliver and plant approved plants	419	m2	39	$ 16,329	-
	SUBTOTAL				**$ 113,715**	
8	**Bioretention Area**					
7.1	Construct bioretention system, complete with geofabric liner, drainage pipe, drainage layer, filter media, top-soil and vegetation		m2		$ -	NOT COSTED
7.2	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia		m2		$ -	NOT COSTED
7.3	Allowance: Placement and removal of sacrificial layer for staged development. 150mm thick layer, woven textile and temporary turf.					NOT COSTED
	SUBTOTAL				**$ -**	
	SUBTOTAL ITEMS 1-7				**$ 1,199,037**	
9	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 359,711.14	-
	SUBTOTAL				**$ 359,711**	
10	**Contingencies**					
9.1	Contingencies - General	30	%	-	$ 359,711	-
	SUBTOTAL				**$ 359,711**	
	TOTAL				**$ 1,918,000**	

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Menangle Park
Detention Basin 8, Relocated - Earth Embankment
SCHEDULE OF ESTIMATED QUANTITIES

Revision: 03

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				$ 20,000	
2	**Earthworks**					
2.1	Clearing and grubbing	1.6	ha	2900	$ 4,758	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	50.0	m2	50	$ 2,500	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	-	m2	63	$ -	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	-	m2	13	$ -	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	2,461	m3	5	$ 12,059	Assuming light soil (not clay)
2.6	Fill - place and compact imported fill	7,192	m3	60	$ 431,520	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	3,615	m3	12	$ 43,380	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	285	m3	10	$ 2,850	
2.9	Access Road: place and compact imported fill	232	m3	12	$ 2,782	
2.10	Allowance: Over excavation to restore soil profile				$ 10,000	
2.11	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
2.12	Allowance: Separate and place select clay in embankment core				$ 20,000	
	SUBTOTAL				$ 579,849	
3	**High Flow Spillway**					
3.1	Form spillway crest in embankment	38	m3	21	$ 788	-
3.2	Geotextile Fabric - non woven polypropylene/ polyethylene 2.8mm thick (310g/sqm)	150	m2	5	$ 750	-
3.3	Reinforced Turf - supply, deliver, lay turf, roll and water	466	m2	140	$ 65,239	0
	SUBTOTAL				$ 66,776	
4	**High Flow Outlet Box Culvert**					
	Box Culvert - Supply and deliver 4.2m (span) x 0.9m (height) box culvert	120	m	4500	$ 540,000	
	Headwall - Supply, deliver, lay and join precast unit; including toe excavation to suit 4.2m (span) x 0.9m (height) box culvert: 1 cell	4	each	5700	$ 22,800	
	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	2	m3	300	$ 600	
	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	120	m	380	$ 45,600	
	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	60	m2	140	$ 8,400	
	SUBTOTAL				$ 617,400	
5	**Low Flow Outlet Pipe**					
4.1	Pit - Supply, deliver, lay and join 900mm square pit with grated inlet	3	item	3700	$ 11,100	-
4.2	Pipe - Supply, deliver, lay and join 600mm RCP (Class 2)	30	m	270	$ 8,100	Rubber ring joint; excavation excluded
	Pipe - Supply, deliver, lay and join 525mm RCP (Class 2)	60	m	230	$ 13,800	
4.3	Headwall - Supply, deliver, lay and join precast unit; including toe excavation - to suit 600mm pipe	3	each	590	$ 1,770	-
4.4	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	4	m3	300	$ 1,200	Approximate only
4.5	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	90	m	380	$ 34,200	Assuming clay soil
4.6	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	18	m2	140	$ 2,520	0
	SUBTOTAL				$ 72,690	
6	**Inlet from Road Drainage**					
5.1	Pipe - Supply, deliver, lay and join 375mm RCP (Class 2)	90	m	130	$ 11,700	Rubber ring joint; excavation excluded
5.2	Excavate 1200mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	90	m	140	$ 12,600	Assuming clay soil
5.3	GPT - Supply, deliver and install CDS 2018	1	each	87000	$ 87,000	Subject to final design
5.4	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	12	m2	140	$ 1,680	0
	SUBTOTAL				$ 112,980	
7	**Landscaping and Planting**					
6.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,461	m3	6	$ 14,766	
6.2	Lawn turf - spread and grade 50mm topsoil, lay turf, roll and water	12,255	m2	10	$ 122,545	-
6.3	Landscaping - supply, deliver and plant approved plants	352	m2	39	$ 13,728	-
	SUBTOTAL				$ 151,039	
8	**Bioretention Area**					
7.1	Construct bioretention system, complete with geofabric liner, drainage pipe, drainage layer, filter media, top-soil and vegetation		m2		$ -	NOT COSTED
7.2	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia		m2		$ -	NOT COSTED
7.3	Allowance: Placement and removal of sacrificial layer for staged development. 150mm thick layer, woven textile and temporary turf.					NOT COSTED
	SUBTOTAL				$ -	
	SUBTOTAL ITEMS 1-7				$ 1,620,734	
9	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 486,220.25	-
	SUBTOTAL				$ 486,220	
10	**Contingencies**					
9.1	Contingencies - General	30	%	-	$ 486,220	-
	SUBTOTAL				$ 486,220	
	TOTAL				$ 2,593,000	

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Menangle Park
Detention Basin 8, Relocated - Retaining Wall
SCHEDULE OF ESTIMATED QUANTITIES

Revision: 03

SCHEDULE OF ESTIMATED QUANTITIES

PAY ITEM	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT	NOTES
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				$ 20,000	
2	**Earthworks**					
2.1	Clearing and grubbing	1.6	ha	2900	$ 4,758	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	50.0	m2	50	$ 2,500	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	-	m2	63	$ -	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	-	m2	13	$ -	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	2,461	m3	5	$ 12,059	Assuming light soil (not clay)
2.6	Fill - place and compact imported fill	1,312	m3	60	$ 78,720	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	3,615	m3	12	$ 43,380	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	285	m3	10	$ 2,850	
2.9	Access Road: place and compact imported fill	232	m3	12	$ 2,782	
2.10	Allowance: Over excavation to restore soil profile				$ 10,000	
2.11	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
2.12	Allowance: Separate and place select clay in embankment core				$ 20,000	
2.13	Retaining wall - Keystone system blockwork including levelling base, joint pins, and 3.0m crushed rock backfill - 3.0 - 5.0m high	320	m2	480	$ 153,600	
	SUBTOTAL				$ 380,649	
3	**High Flow Spillway**					
3.1	Form spillway crest in embankment	38	m3	21	$ 788	-
3.2	Geotextile Fabric - non woven polypropylene/ polyethylene 2.8mm thick (310g/sqm)	150	m2	5	$ 750	-
3.3	Reinforced Turf - supply, deliver, lay turf, roll and water	-	m2	140	$ -	0
	SUBTOTAL				$ 1,538	
4	**High Flow Outlet Box Culvert**					
	Box Culvert - Supply and deliver 4.2m (span) x 0.9m (height) box culvert	120	m	4500	$ 540,000	
	Headwall - Supply, deliver, lay and join precast unit; including toe excavation to suit 4.2m (span) x 0.9m (height) box culvert: 1 cell	4	each	5700	$ 22,800	
	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	2	m3	300	$ 600	
	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	120	m	380	$ 45,600	
	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	60	m2	140	$ 8,400	
	SUBTOTAL				$ 617,400	
5	**Low Flow Outlet Pipe**					
4.1	Pit - Supply, deliver, lay and join 900mm square pit with grated inlet	3	item	3700	$ 11,100	-
4.2	Pipe - Supply, deliver, lay and join 600mm RCP (Class 2)	30	m	270	$ 8,100	Rubber ring joint; excavation excluded
	Pipe - Supply, deliver, lay and join 525mm RCP (Class 2)	60	m	230	$ 13,800	
4.3	Headwall - Supply, deliver, lay and join precast unit; including toe excavation - to suit 600mm pipe	3	each	590	$ 1,770	-
4.4	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	4	m3	300	$ 1,200	Approximate only
4.5	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	90	m	380	$ 34,200	Assuming clay soil
4.6	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	18	m2	140	$ 2,520	0
	SUBTOTAL				$ 72,690	
6	**Inlet from Road Drainage**					
5.1	Pipe - Supply, deliver, lay and join 375mm RCP (Class 2)	90	m	130	$ 11,700	Rubber ring joint; excavation excluded
5.2	Excavate 1200mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	90	m	140	$ 12,600	Assuming clay soil
5.3	GPT - Supply, deliver and install CDS 2018	1	each	87000	$ 87,000	Subject to final design
5.4	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	12	m2	140	$ 1,680	0
	SUBTOTAL				$ 112,980	
7	**Landscaping and Planting**					
6.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,461	m3	6	$ 14,766	
6.2	Lawn turf - spread and grade 50mm topsoil, lay turf, roll and water	12,255	m2	10	$ 122,545	-
6.3	Landscaping - supply, deliver and plant approved plants	352	m2	39	$ 13,728	-
	SUBTOTAL				$ 151,039	
8	**Bioretention Area**					
7.1	Construct bioretention system, complete with geofabric liner, drainage pipe, drainage layer, filter media, top-soil and vegetation		m2		$ -	NOT COSTED
7.2	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia		m2		$ -	NOT COSTED
7.3	Allowance: Placement and removal of sacrificial layer for staged development. 150mm thick layer, woven textile and temporary turf.					NOT COSTED
	SUBTOTAL				$ -	
	SUBTOTAL ITEMS 1-7				$ 1,356,295	
9	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 406,888.62	-
	SUBTOTAL				$ 406,889	
10	**Contingencies**					
9.1	Contingencies - General	30	%	-	$ 406,889	-
	SUBTOTAL				$ 406,889	
	TOTAL				$ 2,170,000	

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Menangle Park
Detention Basin 7
SCHEDULE OF ESTIMATED QUANTITIES

Revision: 03

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	1.7	ha	2900	$ 4,974	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	50.0	m2	50	$ 2,500	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	-	m2	63	$ -	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	-	m2	13	$ -	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	2,573	m3	5	$ 12,607	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	6,307	m3	9	$ 56,763	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	7,762	m3	12	$ 93,144	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	267	m3	10	$ 2,670	
2.9	Access Road: place and compact imported fill	267	m3	12	$ 3,204	
2.10	Allowance: Over excavation to restore soil profile				$ 10,000	
2.11	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
2.12	Allowance: Separate and place select clay in embankment core				$ 20,000	
	SUBTOTAL				**$ 255,862**	
3	**High Flow Spillway**					
3.1	Form spillway crest in embankment	38	m3	21	$ 788	-
3.2	Geotextile Fabric - non woven polypropylene/ polyethylene 2.8mm thick (310g/sqm)	150	m2	5	$ 750	-
3.3	Reinforced Turf - supply, deliver, lay turf, roll and water	497	m2	140	$ 69,637	0
	SUBTOTAL				**$ 71,174**	
4	**High Flow Outlet Box Culvert**					
	Box Culvert - Supply and deliver 4.2m (span) x 0.9m (height) box culvert	30	m	4500	$ 135,000	
	Headwall - Supply, deliver, lay and join precast unit; including toe excavation to suit 4.2m (span) x 0.9m (height) box culvert: 1 cell	1	each	5700	$ 5,700	
	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	2	m3	300	$ 600	
	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	30	m	380	$ 11,400	
	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	60	m2	140	$ 8,400	
	SUBTOTAL				**$ 161,100**	
5	**Low Flow Outlet Pipe**					
4.1	Pit - Supply, deliver, lay and join 900mm square pit with grated inlet	1	item	3700	$ 3,700	-
4.2	Pipe - Supply, deliver, lay and join 600mm RCP (Class 2)	30	m	270	$ 8,100	Rubber ring joint; excavation excluded
	Pipe - Supply, deliver, lay and join 525mm RCP (Class 2)	-	m	230	$ -	
4.3	Headwall - Supply, deliver, lay and join precast unit; including toe excavation - to suit 600mm pipe	1	each	590	$ 590	-
4.4	Concrete - reinforced, cast in-situ 25MPa to form cut-off wall	1	m3	300	$ 300	Approximate only
4.5	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	30	m	380	$ 11,400	Assuming clay soil
4.6	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	6	m2	140	$ 840	0
	SUBTOTAL				**$ 24,930**	
6	**Inlet from Road Drainage**					
5.1	Pipe - Supply, deliver, lay and join 375mm RCP (Class 2)	90	m	130	$ 11,700	Rubber ring joint; excavation excluded
5.2	Excavate 1200mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	90	m	140	$ 12,600	Assuming clay soil
5.3	GPT - Supply, deliver and install CDS 2018	1	each	87000	$ 87,000	Subject to final design
5.4	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia	12	m2	140	$ 1,680	0
	SUBTOTAL				**$ 112,980**	
7	**Landscaping and Planting**					
6.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,573	m3	6	$ 15,437	
6.2	Lawn turf - spread and grade 50mm topsoil, lay turf, roll and water	8,513	m2	10	$ 85,133	-
6.3	Landscaping - supply, deliver and plant approved plants	5,075	m2	39	$ 197,909	-
	SUBTOTAL				**$ 298,479**	
8	**Bioretention Area**					
7.1	Construct bioretention system, complete with geofabric liner, drainage pipe, drainage layer, filter media, top-soil and vegetation		m2		$ -	NOT COSTED
7.2	Rip Rap - supply, deliver and place rip rap scour protection, 250mm dia		m2		$ -	NOT COSTED
7.3	Allowance: Placement and removal of sacrificial layer for staged development. 150mm thick layer, woven textile and temporary turf.					NOT COSTED
	SUBTOTAL				**$ -**	
	SUBTOTAL ITEMS 1-7				**$ 944,525**	
9	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 283,357.61	-
	SUBTOTAL				**$ 283,358**	
10	**Contingencies**					
9.1	Contingencies - General	30	%	-	$ 283,358	-
	SUBTOTAL				**$ 283,358**	
	TOTAL				**$ 1,511,000**	

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Title : Menangle Park
Job No : 21-20952

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Menangle Park
Landcom/Campbelltown City Council
APPENDIX B2, PRELIM COST ESTIMATE - LOW FLOW CHANNELS SUMMARY

ITEM	DESCRIPTION	AMOUNT
1	**Channel S1 With Basins**	
1.1	Preliminaries	$ 20,000
1.2	Earthworks	$ 220,172
1.3	Inlet from Road Drainage	$ 32,000
1.4	Landscaping and Planting	$ 590,799
1.5	Supervision, Project Management & Contractor On-Costs	$ 258,891
1.6	Contingencies	$ 258,891
		$ 1,381,000
2	**Channel S1 Without Basins**	
2.1	Preliminaries	$ 20,000
2.2	Earthworks	$ 227,757
2.3	Inlet from Road Drainage	$ 32,000
2.4	Landscaping and Planting	$ 644,265
2.5	Supervision, Project Management & Contractor On-Costs	$ 277,207
2.6	Contingencies	$ 277,207
		$ 1,478,000
3	**Channel HR1 With Basins**	
3.1	Preliminaries	$ 20,000
3.2	Earthworks	$ 87,951
3.3	Inlet from Road Drainage	$ 32,000
3.4	Landscaping and Planting	$ 123,890
3.5	Supervision, Project Management & Contractor On-Costs	$ 79,152
3.6	Contingencies	$ 79,152
		$ 422,000
5	**Channel HR2 With Basins**	
5.1	Preliminaries	$ 20,000
5.2	Earthworks	$ 118,701
5.3	Inlet from Road Drainage	$ 32,000
5.4	Landscaping and Planting	$ 269,596
5.5	Supervision, Project Management & Contractor On-Costs	$ 132,089
5.6	Contingencies	$ 132,089
		$ 704,000
6	**Channel HR3 With Basins**	
6.1	Preliminaries	$ 20,000
6.2	Earthworks	$ 88,050
6.3	Inlet from Road Drainage	$ 32,000
6.4	Landscaping and Planting	$ 125,637
6.5	Supervision, Project Management & Contractor On-Costs	$ 79,706
6.6	Contingencies	$ 79,706
		$ 425,000
7	**Howes Creek Upstream, With/Without Basins**	
7.1	Preliminaries	$ 20,000
7.2	Earthworks	$ 134,333
7.3	Inlet from Road Drainage	$ 32,000
7.4	Landscaping and Planting	$ 426,374
7.5	Supervision, Project Management & Contractor On-Costs	$ 183,812
7.6	Contingencies	$ 183,812
		$ 980,000
8	**Howes Creek Downstream, With Basins**	
8.1	Preliminaries	$ 20,000
8.2	Earthworks	$ 297,586
8.3	Inlet from Road Drainage	$ 128,000
8.4	Landscaping and Planting	$ 885,505
8.5	Supervision, Project Management & Contractor On-Costs	$ 399,327
8.6	Contingencies	$ 399,327
		$ 2,130,000
9	**Howes Creek Downstream, Without Basins**	
9.1	Preliminaries	$ 20,000
9.2	Earthworks	$ 296,107
9.3	Inlet from Road Drainage	$ 128,000
9.4	Landscaping and Planting	$ 878,502
9.5	Supervision, Project Management & Contractor On-Costs	$ 396,783
9.6	Contingencies	$ 396,783
		$ 2,116,000
	TOTAL LOW FLOW, WITH BASIN OPTION (Exl-GST)	**$ 6,042,000**
	TOTAL LOW FLOW, WITHOUT BASIN OPTION (Exl-GST)	**$ 6,125,000**

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Menangle Park
Low Flow Channel Channel S1 With Basins
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	1.5	ha	2900	$ 4,294	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	740	m2	63	$ 46,642	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	740	m2	13	$ 9,625	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	2,221	m3	5	$ 10,883	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	6,097	m3	12	$ 73,164	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	402	m3	10	$ 4,020	-
2.9	Access Road: place and compact imported fill	402	m3	12	$ 4,824	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	48	m2	140	$ 6,720	0
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 220,172**	
3	**Inlet From Road Drainage**					
3.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
4	**Landscaping and Planting**					
4.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,221	m3	6	$ 13,326	
4.2	Landscaping - supply, deliver and plant approved plants	14,807	m2	39	$ 577,473	-
	SUBTOTAL				**$ 590,799**	
	SUBTOTAL ITEMS 1-7				**$ 862,971**	
5	**Supervision, Project Management & Contractor On-Costs**					
5.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 258,891	-
	SUBTOTAL				**$ 258,891**	
6	**Contingencies**					
6.1	Contingencies - General	30	%	-	$ 258,891	-
	SUBTOTAL				**$ 258,891**	
	TOTAL				**$ 1,381,000**	

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Menangle Park
Low Flow Channel S1 Without Basin
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	1.6	ha	2900	$ 4,683	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	807	m2	63	$ 50,863	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	807	m2	13	$ 10,496	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	2,422	m3	5	$ 11,868	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	6,097	m3	12	$ 73,164	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	402	m3	10	$ 4,020	-
2.9	Access Road: place and compact imported fill	402	m3	12	$ 4,824	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	56	m2	140	$ 7,840	
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 227,757**	
3	**Inlet From Road Drainage**					
3.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
4	**Landscaping and Planting**					
4.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,422	m3	6	$ 14,532	
4.2	Landscaping - supply, deliver and plant approved plants	16,147	m2	39	$ 629,733	-
	SUBTOTAL				**$ 644,265**	
	SUBTOTAL ITEMS 1-7				**$ 924,023**	
5	**Supervision, Project Management & Contractor On-Costs**					
5.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 277,207	-
	SUBTOTAL				**$ 277,207**	
6	**Contingencies**					
6.1	Contingencies - General	30	%	-	$ 277,207	-
	SUBTOTAL				**$ 277,207**	
	TOTAL				**$ 1,478,000**	

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Menangle Park
Low Flow Channel Channel HR1 With Basin
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	0.3	ha	2900	$ 900	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	155	m2	63	$ 9,781	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	155	m2	13	$ 2,018	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	466	m3	5	$ 2,282	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	275	m3	12	$ 3,302	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	414	m3	10	$ 4,140	-
2.9	Access Road: place and compact imported fill	414	m3	12	$ 4,968	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	4	m2	140	$ 560	0
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 87,951**	
3	**Inlet From Road Drainage**					
3.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
4	**Landscaping and Planting**					
4.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	466	m3	6	$ 2,795	
4.2	Landscaping - supply, deliver and plant approved plants	3,105	m2	39	$ 121,095	-
	SUBTOTAL				**$ 123,890**	
	SUBTOTAL ITEMS 1-7				**$ 263,841**	
5	**Supervision, Project Management & Contractor On-Costs**					
5.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 79,152	-
	SUBTOTAL				**$ 79,152**	
6	**Contingencies**					
6.1	Contingencies - General	30	%	-	$ 79,152	-
	SUBTOTAL				**$ 79,152**	
	TOTAL				**$ 422,000**	

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Menangle Park
Low Flow Channel HR2 With Basin
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	0.7	ha	2900	$ 1,959	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	338	m2	63	$ 21,284	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	338	m2	13	$ 4,392	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	1,014	m3	5	$ 4,966	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	1,290	m3	12	$ 15,480	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	394	m3	10	$ 3,936	-
2.9	Access Road: place and compact imported fill	394	m3	12	$ 4,723	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	14	m2	140	$ 1,960	0
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 118,701**	
3	**Inlet From Road Drainage**					
3.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
4	**Landscaping and Planting**					
4.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	1,014	m3	6	$ 6,081	
4.2	Landscaping - supply, deliver and plant approved plants	6,757	m2	39	$ 263,515	-
	SUBTOTAL				**$ 269,596**	
	SUBTOTAL ITEMS 1-7				**$ 440,297**	
5	**Supervision, Project Management & Contractor On-Costs**					
5.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 132,089	-
	SUBTOTAL				**$ 132,089**	
6	**Contingencies**					
6.1	Contingencies - General	30	%	-	$ 132,089	-
	SUBTOTAL				**$ 132,089**	
	TOTAL				**$ 704,000**	

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Menangle Park
Low Flow Channel HR3 With Basins
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	0.3	ha	2900	$ 913	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	157	m2	63	$ 9,919	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	157	m2	13	$ 2,047	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	472	m3	5	$ 2,314	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	256	m3	12	$ 3,078	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	394	m3	10	$ 3,936	-
2.9	Access Road: place and compact imported fill	394	m3	12	$ 4,723	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	8	m2	140	$ 1,120	0
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 88,050**	
3	**Inlet From Road Drainage**					
3.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
4	**Landscaping and Planting**					
4.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	472	m3	6	$ 2,834	
4.2	Landscaping - supply, deliver and plant approved plants	3,149	m2	39	$ 122,803	-
	SUBTOTAL				**$ 125,637**	
	SUBTOTAL ITEMS 1-7				**$ 265,687**	
5	**Supervision, Project Management & Contractor On-Costs**					
5.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 79,706	-
	SUBTOTAL				**$ 79,706**	
6	**Contingencies**					
6.1	Contingencies - General	30	%	-	$ 79,706	-
	SUBTOTAL				**$ 79,706**	
	TOTAL				**$ 425,000**	

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Menangle Park
Low Flow Channel Howes Creek Upstream
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	0.8	ha	2900	$ 2,259	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	390	m2	63	$ 24,540	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	390	m2	13	$ 5,064	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	1,169	m3	5	$ 5,726	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	2,028	m3	12	$ 24,342	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	431	m3	10	$ 4,314	-
2.9	Access Road: place and compact imported fill	431	m3	12	$ 5,177	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	21	m2	140	$ 2,912	0
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 134,333**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	1,169	m3	6	$ 7,011	
5.2	Landscaping - supply, deliver and plant approved plants	10,753	m2	39	$ 419,363	-
	SUBTOTAL				**$ 426,374**	
	SUBTOTAL ITEMS 1-7				**$ 612,708**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 183,812	-
	SUBTOTAL				**$ 183,812**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 183,812	-
	SUBTOTAL				**$ 183,812**	
	TOTAL				**$ 980,000**	

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Menangle Park
Low Flow Channel Howes Creek Downstream, With Basins
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Earthworks**					
2.1	Clearing and grubbing	2.2	ha	2900	$ 6,436	Assuming medium density bushland
2.2	Demolition - break up and remove existing works on site	-	m2	50	$ -	Disposal extra
2.3	Dewatering - system to reduce water level by 1.0m	1,110	m2	63	$ 69,908	Approximate only
2.4	Desilting - strip soil to 0.5m deep and dispose of excavated material to tip within 10km	1,110	m2	13	$ 14,426	Approximate only
2.5	Topsoil - excavate to average 150mm deep and deposit in spoil heaps within 500m for later use: light soil	3,329	m3	5	$ 16,312	Assuming light soil (not clay)
2.6	Excavate to reduce levels and deposit surplus cut in spoil heaps within 10km, in Light Soil	-	m3	9	$ -	-
2.7	Excavate to reduce levels and deposit, spread, level and compact to 90% within 1km, in Light Soil	9,061	m3	12	$ 108,731	-
2.8	Access Road: excavate to reduce levels and deposit in spoil heaps within 10km, in Light Soil	481	m3	10	$ 4,806	-
2.9	Access Road: place and compact imported fill	481	m3	12	$ 5,767	-
2.10	Rip Rap - supply, deliver and place rip rap scour protection at channel inlet, 250mm dia	80	m2	140	$ 11,200	0
2.11	Allowance: Over excavation to restore soil profile				$ 10,000	
2.12	Allowance: Treatment of dispersive soils with gypsum (or similar)				$ 50,000	
	SUBTOTAL				**$ 297,586**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	4	item	32000	$ 128,000	
	SUBTOTAL				**$ 128,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	3,329	m3	6	$ 19,974	
5.2	Landscaping - supply, deliver and plant approved plants	22,193	m2	39	$ 865,531	-
	SUBTOTAL				**$ 885,505**	
	SUBTOTAL ITEMS 1-7				**$ 1,331,091**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 399,327	-
	SUBTOTAL				**$ 399,327**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 399,327	-
	SUBTOTAL				**$ 399,327**	
	TOTAL				**$ 2,130,000**	

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Menangle Park
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APPENDIX B3, PRELIM COST ESTIMATE - STABILISATION 1 SUMMARY

ITEM	DESCRIPTION		AMOUNT
1	**Channel S1**		
1.1	Preliminaries	$	20,000
1.2	Stabilisation	$	126,630
1.3	Inlet from Road Drainage	$	32,000
1.4	Landscaping and Planting	$	489,214
1.5	Supervision, Project Management & Contractor On-Costs	$	200,353
1.6	Contingencies	$	200,353
		$	**1,069,000**
2	**Channel S2**		
2.1	Preliminaries	$	20,000
2.2	Earthworks	$	36,720
2.3	Inlet from Road Drainage	$	32,000
2.4	Landscaping and Planting	$	138,373
2.5	Supervision, Project Management & Contractor On-Costs	$	68,128
2.6	Contingencies	$	68,128
		$	**363,000**
3	**Channel HR1**		
3.1	Preliminaries	$	20,000
3.2	Earthworks	$	41,400
3.3	Inlet from Road Drainage	$	32,000
3.4	Landscaping and Planting	$	148,667
3.5	Supervision, Project Management & Contractor On-Costs	$	72,620
3.6	Contingencies	$	72,620
		$	**387,000**
4	**Channel HR2**		
4.1	Preliminaries	$	20,000
4.2	Earthworks	$	40,147
4.3	Inlet from Road Drainage	$	32,000
4.4	Landscaping and Planting	$	144,483
4.5	Supervision, Project Management & Contractor On-Costs	$	70,989
4.6	Contingencies	$	70,989
		$	**379,000**
5	**Howes Creek Upstream**		
5.1	Preliminaries	$	20,000
5.2	Earthworks	$	110,538
5.3	Inlet from Road Drainage	$	64,000
5.4	Landscaping and Planting	$	414,377
5.5	Supervision, Project Management & Contractor On-Costs	$	182,675
5.6	Contingencies	$	182,675
		$	**974,000**
6	**Howes Creek Downstream**		
6.1	Preliminaries	$	20,000
6.2	Earthworks	$	173,016
6.3	Inlet from Road Drainage	$	128,000
6.4	Landscaping and Planting	$	671,158
6.5	Supervision, Project Management & Contractor On-Costs	$	297,652
6.6	Contingencies	$	297,652
		$	**1,587,000**
	TOTAL, WITHOUT BASIN OPTION (Exl-GST)	**$**	**4,759,000**

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Menangle Park
Stabilisation Channel S1
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Nominal**					
3.1	General purpose mat, high density polethylene, laid on embankment, mesh size 40 x 60mm	12,261	m2	10	$ 122,610	
3.2	Anchor trench 300m wide x 250mm deep, including excavation, backfilling and pinning edge of matting	804	m	5	$ 4,020	
	S2				**$ 126,630**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	1,839	m3	6	$ 11,035	
5.2	Landscaping - supply, deliver and plant approved plants	12,261	m2	39	$ 478,179	-
	SUBTOTAL				**$ 489,214**	
	SUBTOTAL ITEMS 1-7				**$ 667,844**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 200,353	-
	SUBTOTAL				**$ 200,353**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 200,353	-
	SUBTOTAL				**$ 200,353**	
	TOTAL				**$ 1,069,000**	

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Menangle Park
Stabilisation Channel S2
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Nominal Allowance for works to existing Channel S2**					
3.1	General purpose mat, high density polethylene, laid on embankment, mesh size 40 x 60mm	3,468	m2	10	$ 34,680	
3.2	Anchor trench 300m wide x 250mm deep, including excavation, backfilling and pinning edge of matting	408	m	5	$ 2,040	
	SUBTOTAL				**$ 36,720**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	520	m3	6	$ 3,121	
5.2	Landscaping - supply, deliver and plant approved plants	3,468	m2	39	$ 135,252	-
	SUBTOTAL				**$ 138,373**	
	SUBTOTAL ITEMS 1-7				**$ 227,093**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 68,128	-
	SUBTOTAL				**$ 68,128**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 68,128	-
	SUBTOTAL				**$ 68,128**	
	TOTAL				**$ 363,000**	

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Menangle Park
Stabilisation Channel HR1
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Nominal Allowance for works to existing Channel S2**					
3.1	General purpose mat, high density polethylene, laid on embankment, mesh size 40 x 60mm	3,726	m2	10	$ 37,260	
3.2	Anchor trench 300m wide x 250mm deep, including excavation, backfilling and pinning edge of matting	828	m	5	$ 4,140	
	SUBTOTAL				**$ 41,400**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	559	m3	6	$ 3,353	
5.2	Landscaping - supply, deliver and plant approved plants	3,726	m2	39	$ 145,314	-
	SUBTOTAL				**$ 148,667**	
	SUBTOTAL ITEMS 1-7				**$ 242,067**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 72,620	-
	SUBTOTAL				**$ 72,620**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 72,620	-
	SUBTOTAL				**$ 72,620**	
	TOTAL				**$ 387,000**	

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Menangle Park
Stabilisation Channel HR2
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Nominal Allowance for works to existing Channel S2**					
3.1	General purpose mat, high density polethylene, laid on embankment, mesh size 40 x 60mm	3,621	m2	10	$ 36,211	
3.2	Anchor trench 300m wide x 250mm deep, including excavation, backfilling and pinning edge of matting	787	m	5	$ 3,936	
	SUBTOTAL				**$ 40,147**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	543	m3	6	$ 3,259	
5.2	Landscaping - supply, deliver and plant approved plants	3,621	m2	39	$ 141,224	-
	SUBTOTAL				**$ 144,483**	
	SUBTOTAL ITEMS 1-7				**$ 236,630**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 70,989	-
	SUBTOTAL				**$ 70,989**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 70,989	-
	SUBTOTAL				**$ 70,989**	
	TOTAL				**$ 379,000**	

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Menangle Park
Stabilisation Channel M1, Upstream
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Nominal Allowance for works to existing Channel S2**					
3.1	General purpose mat, high density polethylene, laid on embankment, mesh size 40 x 60mm	10,385	m2	10	$ 103,854	
3.2	Anchor trench 300m wide x 250mm deep, including excavation, backfilling and pinning edge of matting	1,337	m	5	$ 6,684	
	SUBTOTAL				**$ 110,538**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	2	item	32000	$ 64,000	
	SUBTOTAL				**$ 64,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	1,558	m3	6	$ 9,347	
5.2	Landscaping - supply, deliver and plant approved plants	10,385	m2	39	$ 405,031	-
	SUBTOTAL				**$ 414,377**	
	SUBTOTAL ITEMS 1-7				**$ 608,915**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 182,675	-
	SUBTOTAL				**$ 182,675**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 182,675	-
	SUBTOTAL				**$ 182,675**	
	TOTAL				**$ 974,000**	

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Menangle Park
Stabilisation Channel M1, Downstream
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Nominal Allowance for works to existing Channel S2**					
3.1	General purpose mat, high density polethylene, laid on embankment, mesh size 40 x 60mm	16,821	m2	10	$ 168,210	
3.2	Anchor trench 300m wide x 250mm deep, including excavation, backfilling and pinning edge of matting	961	m	5	$ 4,806	
	SUBTOTAL				**$ 173,016**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	4	item	32000	$ 128,000	
	SUBTOTAL				**$ 128,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,523	m3	6	$ 15,139	
5.2	Landscaping - supply, deliver and plant approved plants	16,821	m2	39	$ 656,019	-
	SUBTOTAL				**$ 671,158**	
	SUBTOTAL ITEMS 1-7				**$ 992,174**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 297,652	-
	SUBTOTAL				**$ 297,652**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 297,652	-
	SUBTOTAL				**$ 297,652**	
	TOTAL				**$ 1,587,000**	

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APPENDIX B4, PRELIM COST ESTIMATE - STABILISATION 2 SUMMARY

ITEM	DESCRIPTION		AMOUNT
1	**Channel S1**		
1.1	Preliminaries	$	20,000
1.2	Stabilisation - Drop Structure	$	81,000
1.3	Inlet from Road Drainage	$	32,000
1.4	Landscaping and Planting	$	489,214
1.5	Supervision, Project Management & Contractor On-Costs	$	186,664
1.6	Contingencies	$	186,664
		$	**996,000**
2	**Channel S2**		
2.1	Preliminaries	$	20,000
2.2	Stabilisation - Drop Structure	$	27,000
2.3	Inlet from Road Drainage	$	32,000
2.4	Landscaping and Planting	$	138,373
2.5	Supervision, Project Management & Contractor On-Costs	$	65,212
2.6	Contingencies	$	65,212
		$	**348,000**
3	**Channel HR1**		
3.1	Preliminaries	$	20,000
3.2	Stabilisation - Drop Structure	$	54,000
3.3	Inlet from Road Drainage	$	32,000
3.4	Landscaping and Planting	$	148,667
3.5	Supervision, Project Management & Contractor On-Costs	$	76,400
3.6	Contingencies	$	76,400
		$	**407,000**
4	**Channel HR2**		
4.1	Preliminaries	$	20,000
4.2	Stabilisation - Drop Structure	$	54,000
4.3	Inlet from Road Drainage	$	32,000
4.4	Landscaping and Planting	$	144,483
4.5	Supervision, Project Management & Contractor On-Costs	$	75,145
4.6	Contingencies	$	75,145
		$	**401,000**
5	**Howes Creek Upstream**		
5.1	Preliminaries	$	20,000
5.2	Stabilisation - Drop Structure	$	54,000
5.3	Inlet from Road Drainage	$	64,000
5.4	Landscaping and Planting	$	141,845
5.5	Supervision, Project Management & Contractor On-Costs	$	83,953
5.6	Contingencies	$	83,953
		$	**448,000**
6	**Howes Creek Downstream**		
6.1	Preliminaries	$	20,000
6.2	Stabilisation - Drop Structure	$	81,000
6.3	Inlet from Road Drainage	$	128,000
6.4	Landscaping and Planting	$	671,158
6.5	Supervision, Project Management & Contractor On-Costs	$	270,047
6.6	Contingencies	$	270,047
		$	**1,440,000**
	TOTAL, (Exl-GST)	**$**	**4,040,000**

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Menangle Park
Stabilisation Channel S1
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
2	**Stabilisation - Drop Structure***					
	Concrete Drop Structure - Construction Estimate	3	each	27000	$ 81,000	
	SUBTOTAL				**$ 81,000**	
3	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
4	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	1,839	m3	6	$ 11,035	
5	Landscaping - supply, deliver and plant approved plants	12,261	m2	39	$ 478,179	-
	SUBTOTAL				**$ 489,214**	
	SUBTOTAL ITEMS 1-7				**$ 622,214**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 186,664	-
	SUBTOTAL				**$ 186,664**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 186,664	-
	SUBTOTAL				**$ 186,664**	
	TOTAL				**$ 996,000**	

	***Alternative Stabilisation - Rock Chute**					
	Rock Chute - Construction Estimate	5	item	7100	$ 35,500	
	Alternate TOTAL 1				**$ 922,742**	
	***Alternative Stabilisation - Pool-Riffle**					
	Pool - Riffle Construction Estimate	9	item	3700	$ 33,300	
	Alternate TOTAL 2				**$ 919,222**	

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Menangle Park
Stabilisation Channel S2
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Drop Structure***					
3.1	Concrete Drop Structure - Construction Estimate	1	each	27000	$ 27,000	
	SUBTOTAL				**$ 27,000**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	520	m3	6	$ 3,121	
5.2	Landscaping - supply, deliver and plant approved plants	3,468	m2	39	$ 135,252	-
	SUBTOTAL				**$ 138,373**	
	SUBTOTAL ITEMS 1-7				**$ 217,373**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 65,212	-
	SUBTOTAL				**$ 65,212**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 65,212	-
	SUBTOTAL				**$ 65,212**	
	TOTAL				**$ 348,000**	

	***Alternative Stabilisation - Rock Chute**					
	Rock Chute - Construction Estimate	2	item	7100	$ 14,200	
	Alternate TOTAL 1				**$ 327,317**	
	***Alternative Stabilisation - Pool-Riffle**					
	Pool - Riffle Construction Estimate	3	item	3700	$ 11,100	
	Alternate TOTAL 2				**$ 322,357**	

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Menangle Park
Stabilisation Channel HR1
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Drop Structure***					
3.1	Concrete Drop Structure - Construction Estimate	2	each	27000	$ 54,000	
	SUBTOTAL				**$ 54,000**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	559	m3	6	$ 3,353	
5.2	Landscaping - supply, deliver and plant approved plants	3,726	m2	39	$ 145,314	-
	SUBTOTAL				**$ 148,667**	
	SUBTOTAL ITEMS 1-7				**$ 254,667**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 76,400	-
	SUBTOTAL				**$ 76,400**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 76,400	-
	SUBTOTAL				**$ 76,400**	
	TOTAL				**$ 407,000**	

	***Alternative Stabilisation - Rock Chute**					
	Rock Chute - Construction Estimate	4	item	7100	$ 28,400	
	Alternate TOTAL 1				**$ 350,508**	
	***Alternative Stabilisation - Pool-Riffle**					
	Pool - Riffle Construction Estimate	8	item	3700	$ 29,600	
	Alternate TOTAL 2				**$ 352,428**	

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Menangle Park
Stabilisation Channel HR2
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Drop Structure***					
3.1	Concrete Drop Structure - Construction Estimate	2	each	27000	$ 54,000	
	SUBTOTAL				**$ 54,000**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	1	item	32000	$ 32,000	
	SUBTOTAL				**$ 32,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	543	m3	6	$ 3,259	
5.2	Landscaping - supply, deliver and plant approved plants	3,621	m2	39	$ 141,224	-
	SUBTOTAL				**$ 144,483**	
	SUBTOTAL ITEMS 1-7				**$ 250,483**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 75,145	-
	SUBTOTAL				**$ 75,145**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 75,145	-
	SUBTOTAL				**$ 75,145**	
	TOTAL				**$ 401,000**	

	***Alternative Stabilisation - Rock Chute**					
	Rock Chute - Construction Estimate	4	item	7100	$ 28,400	
	Alternate TOTAL 1				**$ 359,812**	
	***Alternative Stabilisation - Pool-Riffle**					
	Pool - Riffle Construction Estimate	8	item	3700	$ 29,600	
	Alternate TOTAL 2				**$ 361,732**	

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Menangle Park
Stabilisation Channel M1, Upstream Tributaries 5 and 6
SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Drop Structure***					
3.1	Concrete Drop Structure - Construction Estimate	2	each	27000	$ 54,000	
	SUBTOTAL				**$ 54,000**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	2	item	32000	$ 64,000	
	SUBTOTAL				**$ 64,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	533	m3	6	$ 3,200	
5.2	Landscaping - supply, deliver and plant approved plants	3,555	m2	39	$ 138,645	-
	SUBTOTAL				**$ 141,845**	
	SUBTOTAL ITEMS 1-7				**$ 279,845**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 83,953	-
	SUBTOTAL				**$ 83,953**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 83,953	-
	SUBTOTAL				**$ 83,953**	
	TOTAL				**$ 448,000**	

	***Alternative Stabilisation - Rock Chute**					
	Rock Chute - Construction Estimate	2	item	7100	$ 14,200	
	Alternate TOTAL 1				**$ 384,071**	
	***Alternative Stabilisation - Pool-Riffle**					
	Pool - Riffle Construction Estimate	4	item	3700	$ 14,800	
	Alternate TOTAL 2				**$ 385,031**	

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SCHEDULE OF ESTIMATED QUANTITIES

Revision: Draft

SCHEDULE OF ESTIMATED QUANTITIES						
PAY ITEM	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**	**NOTES**
1	**Preliminaries**					
1.1	Establishment	1	item	10000	$ 10,000	Allowance only
1.2	Erosion and sediment control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 20,000**	
3	**Stabilisation - Drop Structure***					
3.1	Concrete Drop Structure - Construction Estimate	3	each	27000	$ 81,000	
	SUBTOTAL				**$ 81,000**	
4	**Inlet From Road Drainage**					
4.1	GPT - Supply, deliver and install CDS 1009	4	item	32000	$ 128,000	
	SUBTOTAL				**$ 128,000**	
5	**Landscaping and Planting**					
5.1	Topsoil - excavate from spoil heap, cart not exceeding 500m and spread and level average 150mm thick: light soil - battered areas	2,523	m3	6	$ 15,139	
5.2	Landscaping - supply, deliver and plant approved plants	16,821	m2	39	$ 656,019	-
	SUBTOTAL				**$ 671,158**	
	SUBTOTAL ITEMS 1-7				**$ 900,158**	
6	**Supervision, Project Management & Contractor On-Costs**					
6.1	Supervision, Project Management & Contractor On-Costs	30	%	-	$ 270,047	-
	SUBTOTAL				**$ 270,047**	
7	**Contingencies**					
7.1	Contingencies - General	30	%	-	$ 270,047	-
	SUBTOTAL				**$ 270,047**	
	TOTAL				**$ 1,440,000**	

	***Alternative Stabilisation - Rock Chute**					
	Rock Chute - Construction Estimate	6	item	7100	$ 42,600	
	Alternate TOTAL 1				**$ 1,378,813**	
	***Alternative Stabilisation - Pool-Riffle**					
	Pool - Riffle Construction Estimate	11	item	3700	$ 40,700	
	Alternate TOTAL 2				**$ 1,375,773**	

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
01	N Bailey	R. Kwan		R. Kwan		2011-09-29
02	N Bailey	R Kwan		R. Kwan		2011-10-17
03	N Bailey	R Kwan		R. Kwan		2011-11-18
04	N Bailey	R Kwan		R. Kwan		2011-11-25