1 Introduction

Northrop Consulting Engineers were engaged by EJE Architecture to undertake a Concept Stormwater Management Assessment for the proposed development of Kendel Park Environmental Village in Burton Road, Mount Hutton. It is intended that the Stormwater Management Assessment form part of the documentation to support a Development Application for the proposed works.

1.1 Aim

The objective of the Concept Stormwater Management Assessment was to determine existing site constraints in regards to stormwater and drainage, as well as the effect the proposed development will have on water quality and quantity, both within and downstream of the site. This assessment further aims to identify appropriate processes for the control of both sediment and pollutants generated onsite, and to present an appropriate solution for onsite stormwater detention.

The Concept Stormwater Management Plan presented in this report has been designed with Lake Macquarie City Council's (LMCC) DCP No.1 in mind, and has endeavoured to comply with all the requirements of this document.

This report is intended to discuss Stormwater Management issues at a level appropriate for a Development Application. It does not attempt to provide detailed design solutions to all issues; rather it investigates the feasibility of achieving solutions based on information that we have gathered to date from a number of sources.

1.2 Site Characteristics

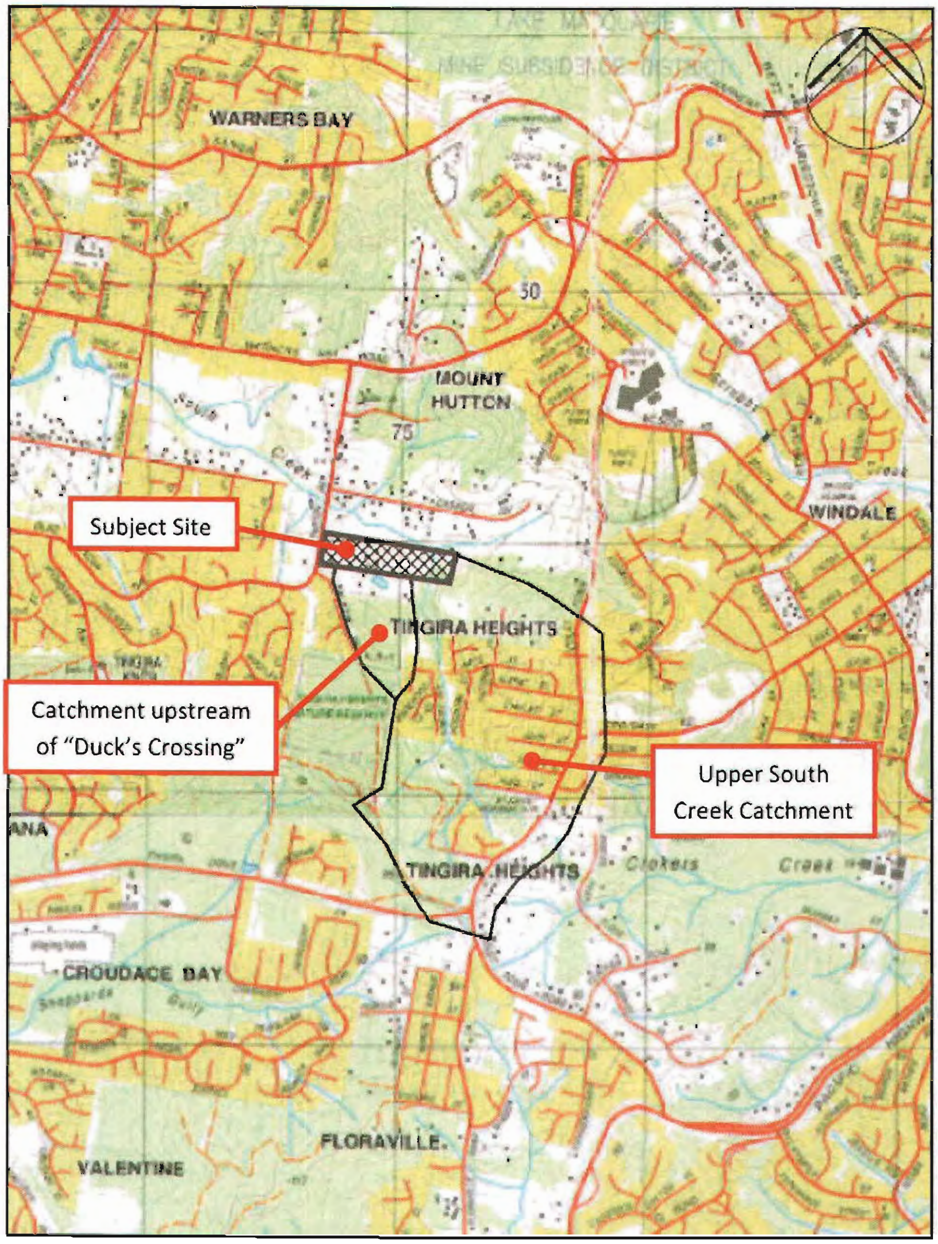
The 4.95ha site of the proposed development, consisting of Lots 11 and 12 in DP 830292, is hereafter referred to within this report as "the subject site".

The subject site is bounded by Burton Road to the west, and private residential land to the north, east, and south. The site is situated in the upper area of the South Creek catchment, and a portion of South Creek traverses the rear of the site. The rear area of the site (approx 0.8ha) grades towards South Creek, whilst the majority of the site slopes generally to the north-west away from South Creek. The front area of the site grades more generally to the north. Existing site grades are gentle, typically averaging 3%.

The subject site currently accommodates two residences, and associated buildings including stables and garages. The majority of the site is cleared rural land, with some established disperse vegetation.

An existing stock dam is situated near the southern boundary of the subject site. Existing dams situated on the property to the south of the site, 'Duck's Crossing', appear to currently drain through the subject site near the site's dam, (without an easement), toward a vegetated drainage path located on the property to the north of the subject site. This drainage path appears to discharge into an existing table drain situated along Burton Road.

Figure 1 overleaf depicts the site location and upstream catchments.



Note: Maps extracted from the Wallsend and Swansea 1:25 000 Topographic Maps.

Figure 1 - Site locality and upstream catchments

2 Stormwater Management

2.1 Overview

The proposed development consists of 51 of residential units, a community centre, and associated roadways, which will increase the impervious area of the subject site. This increase in impervious area will increase both peak flows and the concentration of pollutants within stormwater runoff from the site. Stormwater management devices will be adopted within the proposed development to mitigate peak flows from the site and treat stormwater pollutants to acceptable levels.

In broad terms, it is proposed that surface runoff from the subject site be directed towards a formal road drainage system comprising a series of pits and pipes, before being discharged into an aboveground stormwater detention system. The detention system will be designed to detain flows directed to it, such that peak developed flow from the entire subject site is limited to the peak pre-developed site flow, for storm events up to and including the 1 in 100yr ARI event. Controlled flow from the detention system will be directed to Burton Road[1]. It is proposed the detention system be constructed as a bio-detention system to serve a dual purpose, and filter stormwater pollutants prior to stormwater exiting the site.

Additional stormwater treatment and peak flow detention will be provided on site via rainwater tanks which are proposed to be connected to each unit to harvest roofwater for reuse.

It is proposed an overland stormwater drainage path be maintained through the subject site to safely convey flow derived offsite to a downstream outlet point.

2.2 Upstream Flows

As indicated in Figure 1, an upstream catchment estimated to be 13ha drains towards the subject site through the "Ducks Crossing" property located to the south. The "Duck's Crossing" property currently has a dam situated adjacent to the subject site's southern boundary, which appears to mitigate upstream flows. This dam appears to currently overflow into the subject site, through the subject site's dam, and into a drainage path located on the property north of the subject site. The proposed development layout has been designed to maintain an overland flow path through the subject site to safely convey this upstream flow to the existing drainage path downstream of the subject site.

A section of South Creek passes through the rear of the subject site, as indicated in Figure 1. Detailed survey of the subject site indicates the proposed development will drain away from, rather than toward South Creek, and will therefore not alter the existing flow or flood regime through the rear of the site. Flow and flooding characteristics for this section of South Creek are discussed in Section 2.3 of this report.

[1] The geometry of the existing table drain in Burton Road downstream of the site has adequate capacity to convey the peak 100 year ARI flow from the proposed detention basin. It is required to convey the 10 year flow in accordance with Council's Engineering Guidelines Part 1. Refer to Appendix C for further detail.

2.3 Flooding

As previously noted, the subject site is situated within the upper reach of the South Creek catchment, and a portion of South Creek passes through the rear of the site. The Lake Macquarie City Council South Creek Flood Study (Draft April 2010, prepared by Cardno) suggests that areas of the subject site could be inundated in the 1% AEP and PMF rainfall events.

To assess the potential for flooding within the subject site, and the impact of the proposed development on local flood regimes upstream and downstream of the subject site, flood modelling based on detail survey has been undertaken in collaboration with Cardno.

Based on the flood modelling completed by Cardno we have reproduced on C09DA (refer Appendix B) the 1% AEP and PMF flood extents for the developed site. In accordance with the 'Flood Management Manual (Jan 2001)' we provide the following advice regarding the design of the development with relation to flood levels:

- Developable areas on site are proposed to be raised above the 1% AEP flood extents.
- Finished Floor Levels for dwellings across the site are proposed to be set a minimum of 500mm above the 1% AEP flood levels adjacent to developable land.
- The PMF extent covers the majority of the site. The exception to this is an area on the eastern development pad adjacent to Burton Road; Units 23-30; Units 49-51; and Units 37-41. In these areas the FFL have been set at or just above the PMF level. Furthermore it is noted that the PMF depth across the development area of the site is minor ranging from 0-400mm. As such, the results of the PMF modelling show that there are sufficient areas on site which can act as safe refuge in the event of a PMF.

Further detailed discussion on the Flood Modelling results are presented in the Flooding Report completed by Cardno.

2.4 On-site Detention

2.4.1 Methodology

Lake Macquarie City Council's DCP No. 1 & 2 requires the Concept Stormwater Management Plan to show how peak developed flow from the site can be appropriately limited to that expected from the pre-developed site, for all events up to and including the 1% AEP event. It is proposed that this will be best achieved on site via an aboveground detention system, in combination with underground rainwater tanks.

It is proposed the detention basin be located in the north-western corner of the developed site, and discharge flows to Burton Road. The detention basin will be wide and shallow (0.5m depth) to enable integration with existing site levels and vegetation, and the proposed fire-trail.

Based on existing surface grades, which will generally be maintained post development, the subject site was divided into 2 sub-catchments for the purpose of detention modelling, as depicted in Figure 2 below. Runoff from each sub-catchment will be directed into the proposed detention basin via a pit and pipe network.

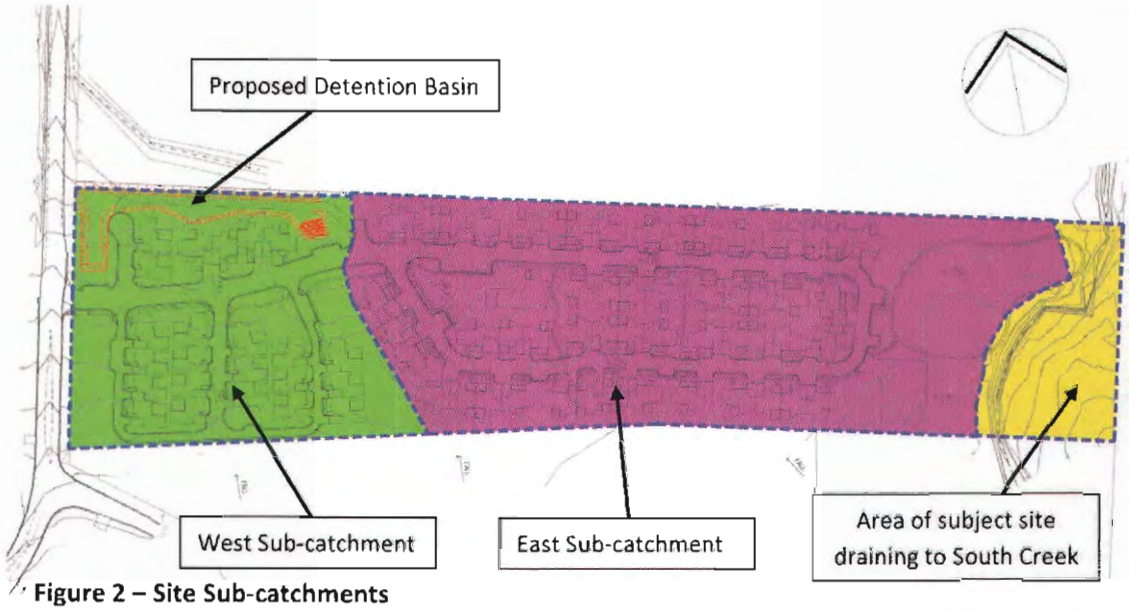


Figure 2 – Site Sub-catchments

The runoff routing software XP_RAFTS was used to model peak flow from the sub-catchments. Model parameters include:

- Initial Loss and Continuing Loss parameters for pervious areas have been assumed to be 10mm and 2.5 mm/hr respectively.
- Initial Loss and Continuing Loss parameters for impervious areas have been assumed to be 1.5 mm and 0 mm/hr respectively.
- Pre-developed sub-catchments were assumed to be 100% pervious.

Table 1 outlines sub-catchment areas and the impervious fractions modelled for the developed state.

Table 1 – Sub-Catchment Parameters used in the XP_RAFTS Modelling

Sub-catchment	Total Area (ha)	% Impervious (developed case) (roof areas and pavements)
East	2.9	32%
West	1.6	40%

The "Duck's Crossing" catchment was not included in the XP_RAFTS model, as flow from this catchment will be directed past the detention basin toward the existing drainage path to the north of the site, as noted in previous sections of this report.

2.4.2 Detention Facility

A detention basin for the development was designed using the XP_RAFTS model, to detain flows such that peak flow from the developed site does not exceed peak flow pre-development across rainfall events up to and including the 1% AEP event.

The detention system was modelled as an above ground basin with a top water level of 10.80m AHD, an invert level of 10.30m AHD and the stage / storage relationship shown in Table 2. The detention basin was designed with 2 x 450mm diameter orifice low flow outlets having an inlet invert at 9.55m AHD and downstream outlet invert at 9.45m AHD, and a high level overflow weir (5m long) having an invert of 10.6m AHD.

Table 2 – Basin Elevation versus Storage Relationship

Stage (m AHD)	Storage (m^3/s)
10.3	0
10.55	177
10.8	405

2.4.3 Hydraulic Modelling Results

To determine peak flow from the subject site, a range of storm durations were run in XP_RAFTS for a range of AEP's. A summary of the peak results are shown in Table 3 overleaf, while results for all durations and AEP's are shown in Appendix A.

Table 3 – Peak Flow Results from the XP_RAFTS Modelling

AEP	20% AEP m^3/s	10% AEP m^3/s	5% AEP m^3/s	2% AEP m^3/s	1% AEP m^3/s
Pre-developed	1.0	1.1	1.4	1.5	1.7
Developed (with detention.)	0.8	0.8	1.1	1.4	1.6

As shown in Table 3, peak post-developed flow is limited by the proposed detention basin to below pre-developed flow for all storm events modelled. The modelling found the peak storage required to detain the 1% AEP storm event to be 395m^3, which occurred at a stage of 10.79m AHD.

This is a conservative estimate for the proposed detention basin size and performance, as it assumes the proposed rainwater tanks for each dwelling do not contribute to stormwater detention during peak rainfall events. In reality, it is likely that there will be some storage capacity available within the rainwater reuse / storage tanks, and the tanks will be designed to perform this dual purpose.

2.4.4 Basin Safety

The proposed basin will be a dry basin, with no permanent water. Maximum temporary water levels within the basin will be 0.5m deep (proposed basin top water level 10.8m AHD, minimum proposed base level 10.3m AHD).

The proposed southern side of the basin consists largely of existing gently graded site levels, with grades max 1V:8H in line with the rear of the proposed residences. Appropriate vehicular access for maintenance can be readily achieved from a proposed cul-de-sac turning head to be constructed as part of the proposed Stage 2 works. The proposed mound forming the northern side of the basin will be situated adjacent to the northern boundary of the site, and planted and fenced in accordance with the proposed landscaping plan.

Planting / landscaping is proposed around the proposed basin inlets, where basin side batter slopes are maximum 1V:4H. This treatment is in accordance with Council's 'Batter Slope Treatments and Fencing Guidelines for Constructed Wetlands and Detention Basins' (2009) for basins with maximum 1V:4H side slopes and water depths less than 1.2m.

Review of Table 1 in Council's 'Batter Slope Treatments and Fencing Guidelines for Constructed Wetlands and Detention Basins' (2009) with regard to risk factors yields the following:

1. Batter slopes above permanent water level	Risk Factor = 1 – 2
2. Vertical drop at water edge – below permanent water level	Risk Factor = 0
3. Max water depth between water edge and 4m from the water edge – below permanent water level	Risk Factor = 4
4. Site context	Risk Factor = 4
	Total Risk Factor Score <10

The required batter treatment and fencing requirement in accordance with Table 1 for the basin is therefore mown grass and/or planting for aesthetic and shade purposes.

2.5 Water Quality

2.5.1 Treatment

The development of the subject site and its change of use will likely increase pollutant loads within stormwater runoff from the site. In order to mitigate the increase in pollutants and protect downstream receiving waters, the proposed stormwater management concept includes a number of treatment measures. Stormwater Quality Improvement Devices (SQIDS) have been specifically chosen to form a treatment train through the subject site, such that all forms of pollutants will ultimately be mitigated.

The design of SQUIDS for the subject site has been completed in accordance with Lake Macquarie City Council's 'Stormwater Treatment Framework & Stormwater Quality Improvement Device Guidelines' (SQID Guidelines). In accordance with Table 2.1 of this document, residential developments greater than 2ha are required to treat stormwater runoff to the following target pollutant removal levels:

- Gross pollutants: 50-100% reduction
- Course Sediments: 50-100% reduction
- Medium Sediments: 30-80% reduction

- Fine Sediments: 30-50% reduction
- Nutrients: 30-50% reduction
- Heavy Metals /Oils and Greases: 30-50% reduction

The SQUIDS treatment train proposed for the development was modelled using the continuous simulation software MUSIC, to assess the likely pollutant reduction. The MUSIC model used observed rainfall data taken from Williamtown Airport over a period of 7 years from 2000-2007. Figure 3 overleaf presents a screen shot of the MUSIC model compiled for the subject site.

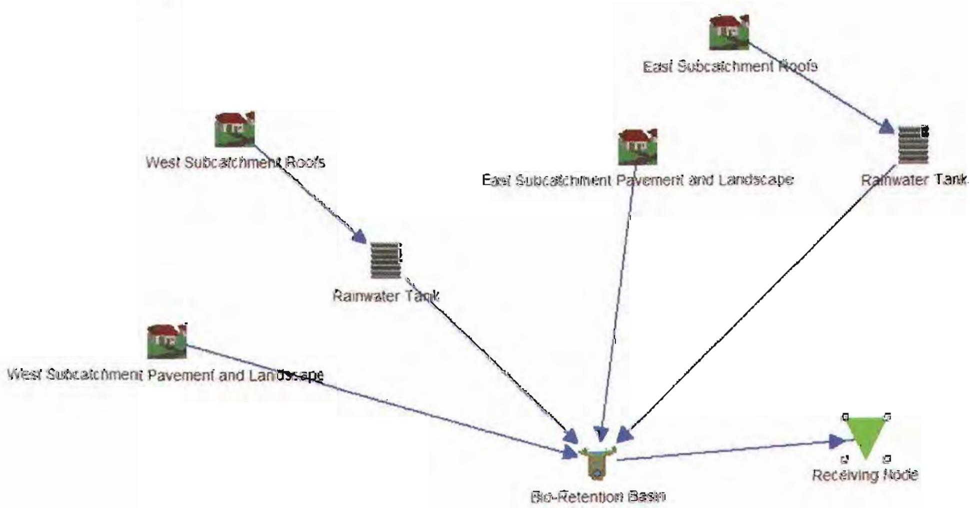


Figure 3 – MUSIC model Schematic

As illustrated in Figure 3, the MUSIC model was based around the two site sub-catchments described in Section 2.4. A summary of the SQIDS proposed for the development, how they were modelled in MUSIC, and how they will are proposed to be incorporated within the subject site is as follows:

- First Flush Diverters - Runoff from the roofs of all proposed Units (likely containing small amounts of phosphorus and dust particles) will be treated by first flush devices attached to all downpipes. By capturing the first portion of runoff from roofs, the first flush devices will effectively remove dead insects, bird and animal droppings, and concentrated tannic acids from the stormwater system. Runoff captured by first flush devices will, in accordance with common practice, be emptied from the devices into landscaped areas at a rate of approximately 1 L/hr. It is proposed that leaves and gross pollutants be filtered from runoff via mesh filters fitted to downpipes. It should be noted that first flush devices were not modelled in MUSIC, making the modelled pollutant removal results somewhat conservative.

- Roof Water Tanks - Runoff from roof areas of all proposed Units will be collected in downpipes and directed to minimum 3kL underground rainwater tanks, proposed to be

located below the rear courtyard of each unit. Roofwater tanks will effectively act as sediment traps, collecting fine sediment and nutrients attached to sediment particles. Reused water from the tanks will limit the volume of runoff leaving the site, as well as removing pollutants contained in the water. MUSIC modelling assumed that each unit would reuse approximately 80L/day for toilet flushing, clothes washing and external irrigation. Based on an average daily water use of 400L/day for each unit this equates to roughly 20% of total usage. This volume of reuse is considered conservative when compared to relevant literature which suggests toilet flushing and irrigation make up ~30% of total water use.

- Bio-retention Basin – The proposed detention basin will function as a bio-retention system, as it is intended to have highly permeable upper soil layers planted with water tolerant plants in keeping with local vegetation. The vegetation and permeable soil mediums will treat stormwater to remove fine sediments and nutrients. A rock-lined and vegetated stilling basin will be incorporated into the basin design to slow and disperse flows within the basin, and provide initial water quality treatment. The fire trail area within the basin has been assumed to be impermeable for the purposes of MUSIC modelling.

2.5.2 MUSIC Modelling Results

While MUSIC does not model all pollutants noted in LMCC's SQUID guidelines, it is noted that 'Total Suspended Solids' in MUSIC include fine and medium sized particles, and the removal process for Nitrogen and Heavy Metal are very similar, in regards to the form of treatment being provided. Table 4 below outlines the results of the MUSIC modelling.

Table 4 – MUSIC Modelling Results

	Source	Residual	% Reduction	% Reduction Required
Total Suspended Solids (kg/yr)	3.49E+03	1.04E+03	70.2	50-100%
Total Phosphorous (kg/yr)	7.62	3.68	51.8	30-50%
Total Nitrogen(kg/yr)	57	38.1	33.3	30-50%
Gross Pollutants(kg/yr)	571	0	100	50-100%

From the output of the MUSIC modelling it can be seen that the treatment train proposed for the subject site will meet Lake Macquarie City Council's water quality guidelines.

2.6 Site Discharge Index (SDI)

SDI is defined by Lake Macquarie City Council (LMCC) as 'the ratio of the impermeable area that drains directly to a drainage system to the total site area' (LMCC Handbook of Drainage Design Criteria, 2004). LMCC require at least 90% of stormwater runoff from impervious areas of a site to be

managed through suitably designed stormwater controls, to achieve a desired SDI of no more than 0.1.

Proposed stormwater controls to treat runoff from the subject site include:

- Rainwater reuse tanks on all units, to treat and manage roof water runoff.
- Bio-retention basin to treat and manage runoff from paved surfaces.

All site flows from impervious areas can be directed toward the bio-retention basin, effectively rendering the SDI for the proposed development to be zero. Therefore, LMCC requirements for the proposed development can be readily met in regards to SDI.

3 Staging

The proposed development consists of 51 units and a community centre, with associated roadways, driveways and footpaths. It is understood that the development is likely to be undertaken in 5 stages, with construction commencing nearest to Burton Road and progressing toward the rear of the site.

The stormwater management concept for the development discussed in this report could readily accommodate staged construction. The proposed basin should be constructed during the first stage of the development, and stormwater infrastructure extended as the development progresses upstream.

4 Conclusion

The proposed development will require the incorporation of a number of stormwater initiatives and devices to mitigate and manage stormwater runoff from the site and from upstream sources. The stormwater concept outlined in this report will suitably mitigate and manage stormwater impacts within and downstream of the subject site. Upstream flows can be effectively managed and safely conveyed through the site without impacting on the proposed development. Stormwater management for the proposed development can be appropriately designed to suit construction staging.

It is reiterated that this Stormwater Management Assessment has been undertaken to discuss stormwater management issues at a conceptual level appropriate for a Development Application. It does not attempt to provide detailed design solutions to all issues; rather, it identifies that stormwater quantity and quality can be appropriately managed within the proposed development.

Appendix A – Detention Modelling Results

XP_RAFTS Modelling Results:

Table B1 - Flow rates from the Pre-developed subject site

Duration	20% AEP m^3/s	10% AEP m^3/s	5% AEP m^3/s	2% AEP m^3/s	1% AEP m^3/s
10	0.2222	0.3138	0.4194	0.5985	0.7709
25	0.5407	0.69	0.8739	1.162	1.384
30	0.6512	0.7992	0.982	1.189	1.378
45	0.7244	0.8542	1.011	1.238	1.394
60	0.8452	0.9916	1.218	1.45	1.679
90	0.8982	1.061	1.325	1.548	1.741
120	0.9524	1.133	1.356	1.527	1.747
180	0.682	0.8346	0.9967	1.144	1.293
360	0.5711	0.6547	0.7681	0.8438	0.9491
540	0.4934	0.5678	0.6685	0.7403	0.8272

Table B2 - Flow rates from the Developed subject site, with the basin

Duration	20% AEP m^3/s	10% AEP m^3/s	5% AEP m^3/s	2% AEP m^3/s	1% AEP m^3/s
10	0.493	0.5722	0.6815	0.7189	0.7607
25	0.6839	0.7231	0.7731	1.003	1.199
30	0.6634	0.7077	0.7742	0.9854	1.186
45	0.6304	0.711	0.8234	1.026	1.225
60	0.7157	0.7623	0.9834	1.232	1.416
90	0.7313	0.7794	0.9721	1.277	1.57
120	0.7548	0.842	1.128	1.373	1.56
180	0.6824	0.7168	0.7793	0.9552	1.123
360	0.5332	0.6047	0.6858	0.7173	0.7694
540	0.4663	0.5286	0.6161	0.6785	0.7119

Appendix B – Concept Drawings

KENDEL PARK
ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton. N.S.W.

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Bringing people, ideas & engineering together

EJE ARCHITECTURE

DRAWING INDEX

DRAWN: S.FORBES. DESIGNED: S.WILSON. JOB MANAGER: S.WILSON VERIFIER: A.BROWN.

APPROVAL

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
A	ISSUED FOR DA APPROVAL			02.06.10
B	DETAIL SHEET C07 DA ADDED			07.10.10
C	REISSUED FOR DA			17.12.10
D	REISSUED FOR DA			20.12.10

CLIENT: Ken Delforce

ARCHITECT: EJE ARCHITECTURE
412-414 King Street
Newcastle West
NSW 2300
PH (02) 4929 2353
FAX (02) 4926 3069

ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE MAKING ANY SHOP DRAWINGS OR COMMENCING ANY WORK.

NORTHROP
Bringing people, ideas & engineering together
Newcastle
323 Charlestown Road, Charlestown, NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
P.O. Box 180 Charlestown, NSW 2290
Email newcastle@northrop.com.au ABN 81 094 433 100

PROJECT: KENDEL PARK ENVIRONMENTAL VILLAGE Burton Road, Mount Hutton.

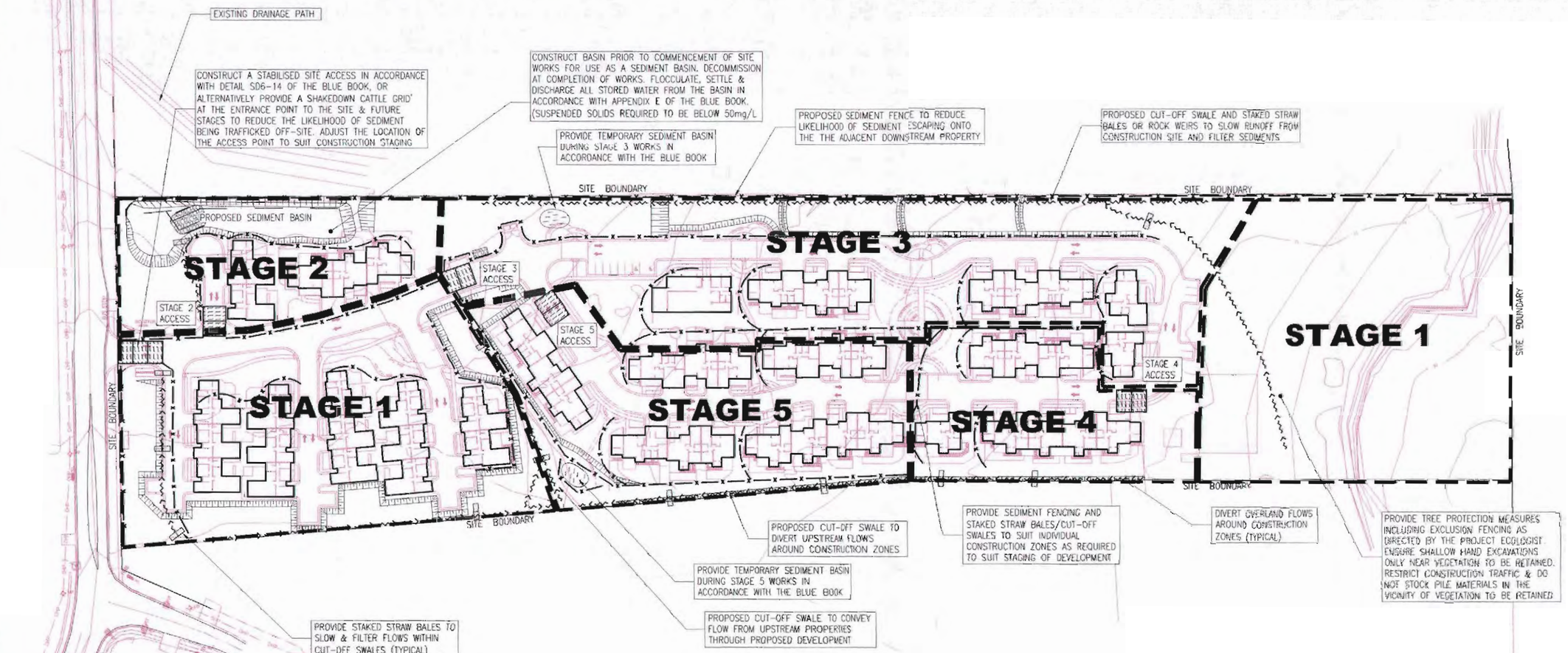
DRAWING TITLE: COVER SHEET & DRAWING INDEX

JOB NUMBER: NL100073

DRAWING NUMBER: C00 DA

ISSUE: D

DRAWING SHEET SIZE = A1



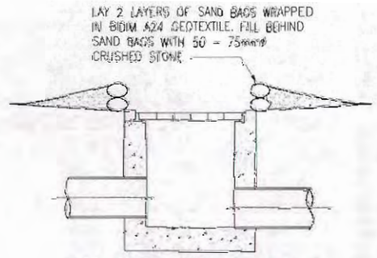
LEGEND

- DENOTES CUT-OFF SWALE
- DENOTES SEDIMENT CONTROL FENCE
- DENOTES TEMPORARY ROCK WEIRS WITHIN SWALES
- DENOTES STABILISED SITE ACCESS
- FALL → DENOTES DIRECTION OF FALL IN NATURAL SURFACE

NOTE: A DETAILED SEDIMENT & EROSION CONTROL PLAN SHALL BE PREPARED FOR EACH STAGE OF THE DEVELOPMENT AT CC STAGE.

SEDIMENT & EROSION CONTROL NOTES

1. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH RELEVANT ORDINANCES AND REGULATIONS; NOTE IN PARTICULAR THE REQUIREMENTS OF LANDCOMS 'MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION' (THE 'BLUE BOOK').
2. INSTALL SEDIMENT PROTECTION FILTERS ON ALL NEW AND EXISTING STORMWATER INLET PITS IN ACCORDANCE WITH EITHER THE MESH AND GRAVEL INLET FILTER DETAIL SD6-13 OR THE GEOTEXTILE INLET FILTER DETAIL SD6-12 OF THE 'BLUE BOOK'. ALTERNATIVELY, PROVIDE PIT PROTECTION AS SHOWN IN THE DETAIL.
3. ESTABLISH ALL REQUIRED SEDIMENT FENCES & STAKED STRAW BALES IN ACCORDANCE WITH DETAILS SD6-7 & SD6-8 OF THE 'BLUE BOOK'.
4. INSTALL SEDIMENT FENCING AROUND INDIVIDUAL BUILDING ZONES/AREAS AS REQUIRED AND AS DIRECTED BY THE SUPERINTENDENT.
5. ALL TRENCHES INCLUDING ALL SERVICE TRENCHES AND SWALE EXCAVATION SHALL BE SIDE-CAST TO THE HIGH SIDE AND CLOSED AT THE END OF EACH DAYS WORK.
6. ENSURE THAT ALL VEGETATION (TREE, SHRUB & GROUND COVER) WHICH IS TO BE RETAINED SHALL BE PROTECTED DURING THE DURATION OF CONSTRUCTION.
7. CONSTRUCT AND MAINTAIN ALL MATERIAL STOCKPILES IN ACCORDANCE WITH DETAIL SD4-1 OF THE 'BLUE BOOK' (INCLUDING CUT-OFF SWALES TO THE HIGH SIDE AND SEDIMENT FENCES TO THE LOW SIDE).
8. ENSURE STOCKPILES DO NOT EXCEED 2.0m HIGH. PROVIDE WIND AND RAIN EROSION PROTECTION AS REQUIRED IN ACCORDANCE WITH THE 'BLUE BOOK'.
9. PROVIDE WATER TRUCKS OR SPRINKLER DEVICES DURING CONSTRUCTION AS REQUIRED TO SUPPRESS DUST.
10. ONCE CUT/FILL OPERATIONS HAVE BEEN FINALISED ALL DISTURBED AREAS THAT ARE NOT BEING WORKED ON SHALL BE RE-VEGETATED AS SOON AS IS PRACTICAL.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR KEEPING A DETAILED WRITTEN RECORD OF ALL EROSION & SEDIMENT CONTROLS ON-SITE DURING THE CONSTRUCTION PERIOD. THIS RECORD SHALL BE UPDATED ON A DAILY BASIS & SHALL CONTAIN DETAILS ON THE CONDITION OF CONTROLS AND ANY/ ALL MAINTENANCE, CLEANING & BREACHES. THIS RECORD SHALL BE KEPT ON-SITE AT ALL TIMES AND SHALL BE MADE AVAILABLE FOR INSPECTION BY THE PRINCIPAL CERTIFYING AUTHORITY AND THE SUPERINTENDENT DURING NORMAL WORKING HOURS.
12. PROVIDE SEDIMENT BASINS AND MAINTAIN DURING CONSTRUCTION IN ACCORDANCE WITH THE 'BLUE BOOK' FOR EACH STAGE OF WORKS.
13. FLOCCULATE, SETTLE AND DISCHARGE STORED WATER FROM THE TEMPORARY SEDIMENT BASIN, DISCHARGING WHEN SUSPENDED SOLIDS (SS) CONCENTRATION DROPS TO 50mg/L. TESTING OF SS CONCENTRATION SHALL BE UNDERTAKEN PRIOR TO DISCHARGE. DISCHARGE SHALL BE DIRECTED TO THE EXISTING DRAINAGE LINE BELOW THE BASIN IN A DISPERSED AND CONTROLLED MANNER, CONDUCTED IN ACCORDANCE WITH APPENDIX E OF THE 'BLUE BOOK'.



PIT PROTECTION DETAIL
(ALTERNATIVE DETAIL SD6-11 OR SD6-12 OF THE BLUE BOOK AS APPROPRIATE)

INSTALL PIT PROTECTION TO ALL NEW & EXISTING STORMWATER PITS.

APPROVAL

DRAWN: S.FORBES DESIGNED: S.WILSON JOB MANAGER: S.WILSON VERIFIER: A.BROWN

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
1	PRELIMINARY ISSUE			28.05.10
A	ISSUED FOR DA APPROVAL			02.06.10
B	LAYOUT AMENDED			07.10.10
C	REISSUED FOR DA			17.12.10
D	REISSUED FOR DA			20.12.10

CLIENT: Ken Delforce

DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED

ARCHITECT: EJE ARCHITECTURE
412-414 King Street Newcastle West NSW 2300 PH (02) 4929 2353 FAX (02) 4926 3069

PLANS 1:750 0 7.5 15 22.5 30 37.5m

ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE MAKING ANY SHOP DRAWINGS OR COMMENCING ANY WORK.

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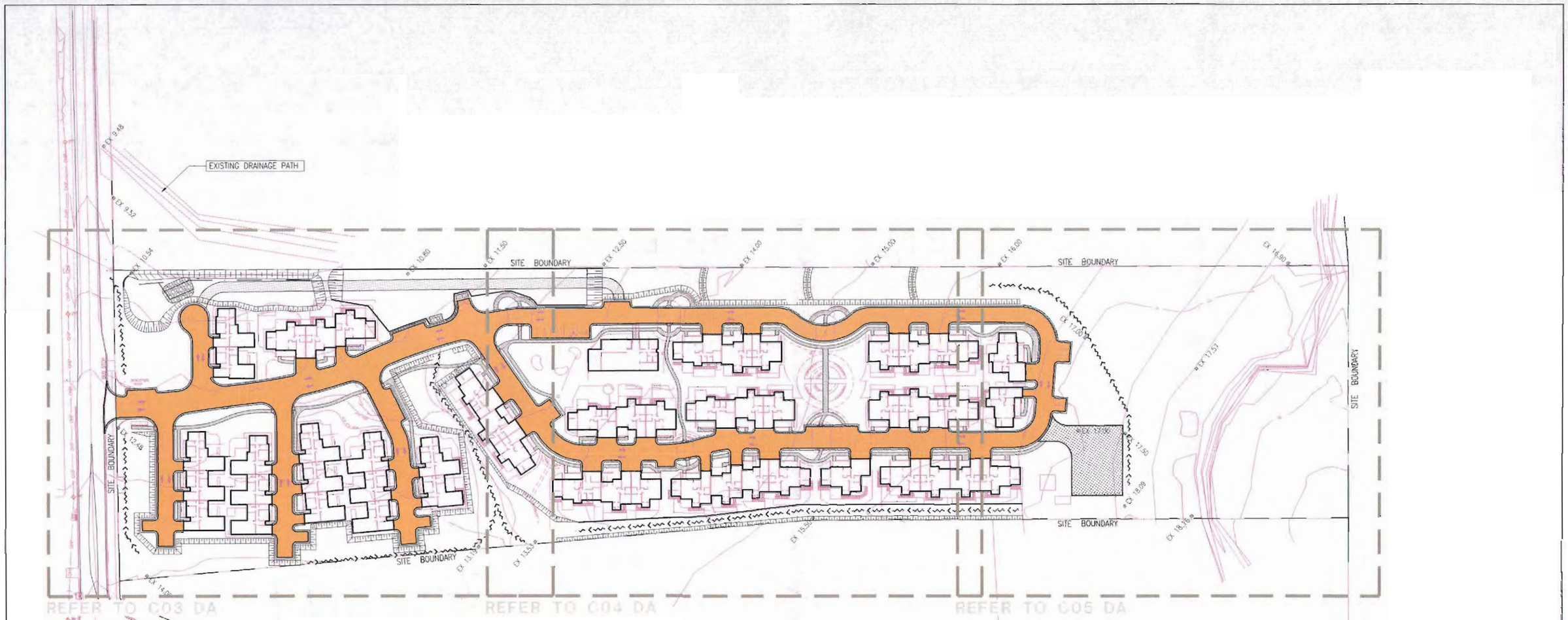
P.O. Box 180 Charlestown NSW 2290
Email: newcastle@northrop.com.au ABN 81 094 433 100

PROJECT: KENDEL PARK ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE: SEDIMENT & EROSION CONTROL PLAN

JOB NUMBER: NL100073
DRAWING NUMBER: C01 DA
ISSUE: D
DRAWING SHEET SIZE: A1



LEGEND

- DENOTES EXTENT OF PROPOSED NEW ROAD/DRIVEWAY PAVEMENT.
- DENOTES EXTENT OF PROPOSED NEW FOOTPATH PAVEMENT.
- DENOTES EXTENT OF PROPOSED NEW FIRE TRAIL PAVEMENT.
- DENOTES EXTENT OF PROPOSED NEW PERMEABLE PAVEMENT.
- DENOTES PROPOSED LANDSCAPED SWALE.
- RW — DENOTES PROPOSED RETAINING WALL
- FFL 17.80 — DENOTES PROPOSED FINISHED FLOOR LEVEL.
- FALL — DENOTES PROPOSED DIRECTION OF FALL IN FINISHED SURFACE.
- PIT / OL — DENOTES PROPOSED STORMWATER INLET PIT & COVER LEVEL.
- DENOTES PROPOSED STORMWATER DRAINAGE PIPE.
- DENOTES PROPOSED SUBSOIL DRAINAGE LINE.
- PL 15.00 — DENOTES PROPOSED FINISHED SURFACE LEVEL.
- EX 14.00 — DENOTES APPROXIMATE EXISTING SURFACE LEVEL.
- (T) — DENOTES UNDERGROUND RAINWATER TANK (5kL).

STORMWATER CONCEPT SUMMARY

ROOF WATER RUNOFF FROM PROPOSED UNITS SHALL BE DIRECTED TO UNDERGROUND RAINWATER STORAGE TANKS FOR REUSE IN TOILET FLUSHING, LAUNDRY AND IRRIGATION. FIRST FLUSH DEVICES SHALL BE FITTED TO DOWNPIPES TO FILTER ROOF WATER PRIOR TO IT ENTERING STORAGE TANKS. STORAGE TANKS WILL PROVIDE STORMWATER DETENTION FOR THE PROPOSED UNITS IN ADDITION TO REUSE. DISPERSED OVERFLOW FROM TANKS SHALL BE DIRECTED TO LANDSCAPED SWALES AND THE SITE STORMWATER NETWORK.

SURFACE RUNOFF FROM PROPOSED ROADWAYS AND DRIVEWAYS SHALL BE COLLECTED IN A PIT AND PIPE NETWORK AND DIRECTED TO A LANDSCAPED STILLING BASIN TO SLOW AND DISPERSE FLOWS. FLOWS WILL BE CONVEYED THROUGH AN OVERSIZED LANDSCAPED SWALE FOR WATER QUALITY TREATMENT. THE SWALE SHALL ADDITIONALLY SERVE AS A BASIN TO PROVIDE STORMWATER DETENTION STORAGE FOR THE PAVED AREAS. STORMWATER WILL BE DISCHARGED TO BURTON ROAD IN A DISPERSED MANNER MIMICKING THE EXISTING SITE FLOW REGIME.

UPSTREAM FLOWS SHALL BE CONVEYED THROUGH THE SITE TO THE EXISTING DRAINAGE PATH TO THE NORTH, IN ACCORDANCE WITH ICARDING FLOOD MODELLING.

THE PROPOSED STILLING BASIN AND DETENTION SWALE SHALL BE CONSTRUCTED AS PART OF THE FIRST STAGE OF DEVELOPMENT. THE STORMWATER NETWORK SHALL BE CONNECTED STAGE BY STAGE AS THE DEVELOPMENT PROGRESSES UPSTREAM OF THE BASIN/SWALE.

REFER TO REPORT NL100073 EGT FOR DETAILS.

APPROVAL

DRAWN: S.FARRES, DESIGNED: S.WILSON, JOB MANAGER: S.WILSON, VERIFIED: A.BROWN

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
1	PRELIMINARY ISSUE			28.05.10
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C	REISSUED FOR DA			17.12.10
D	REISSUED FOR DA			20.12.10

CLIENT: Ken Delforce

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PLANS 1:750 0 7.5 15 22.5 30 37.5m

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PROJECT: KENDEL PARK ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE: CONCEPT STORMWATER & LEVELS SITE PLAN

JOB NUMBER: NL100073
DRAWING NUMBER: C02 DA
ISSUE: D
DRAWING SHEET SIZE - A1

LOW LEVEL OUTLET TO TABLE DRAIN (TABLE DRAIN INVERT 9.45)

PROPOSED LANDSCAPED MOUNDED BERM ALONG BOUNDARY. TOP LEVEL 10.80 AHD.

SUBSOIL DRAINAGE LINE TO REDUCE PONDING

ABOVE GROUND DETENTION STORAGE 405m³ (TWL 10.80 1% AEP)

STABILISED GRAVEL/STONE FIRE TRAIL TO MEANDER THROUGH TREES

LOW FLOWS FROM UPSTREAM TO BE CONVEYED BELOW ROADWAY IN CULVERT SYSTEM IN ACCORDANCE WITH CARDNO FLOOD MODELLING.

MINIMISE DISTURBANCE OF EXISTING TREES IN THIS AREA WHILE STILL ACCOMMODATING STORMWATER DRAINAGE

PROVIDE 5m LONG BERM/WEIR AT RL. 10.60 TO ALLOW DISPERSED DISCHARGE OF DETAINED FLOWS FROM SITE

BATTER 1 IN 6 WHERE FIRE TRAIL TRAVERSES BATTERS (TYPICAL)

FLOW FROM RETENTION BASIN TO BE CONTROLLED BY BLOCKOUTS IN WALL IN ACCORDANCE WITH FLOOD MODELLING COMPLETED BY CARDNO

LANDSCAPE WALL TO PROVIDE STORAGE & RETAIN FLOWS FROM UPSTREAM OF SITE, IN ACCORDANCE WITH FLOOD MODELLING BY CARDNO

EXCAVATE BEHIND WALL TO PROVIDE STORAGE VOLUME BEHIND WALL AS REQUIRED. INVERT OF EXCAVATION RL10.80m AHD

ROCKLINED AND LANDSCAPED STILLING BASIN TO SLOW AND DISPERSE FLOW AND MINIMISE EROSION.

OVERFLOW FROM UNDERGROUND TANKS TO DRAIN VIA GRAVITY TO STORMWATER SYSTEM. REFER TO DETAIL FOR CRITICAL LOCATION & TYPICAL ARRANGEMENT

ROAD STORMWATER SYSTEM TO BE LAID OVER CULVERT USING MULTIPLE SMALLER PIPES TO MAINTAIN COVER

PROPOSED VEHICULAR CROSSING TO LAKE MACQUARIE CITY COUNCIL STANDARDS

PROPOSED PIT AND PIPE ROAD DRAINAGE SYSTEM DISCHARGING TO DETENTION SYSTEM

PROPOSED OVERLAND FLOW PATH TO CONVEY FLOW FROM UPSTREAM PROPERTIES THROUGH PROPOSED DEVELOPMENT

REFER TO DRAWING C02 DA FOR LEGEND

FOR CONTINUATION REFER TO DRAWING C04 DA

SITE BOUNDARY

BUS STOP

BOOSTER

PP

TEL

PIT

TRENCH

RW

T

U-01 FFL 13.20

U-02 FFL 13.65

U-03 FFL 13.80

U-04 FFL 13.80

U-05 FFL 13.65

U-06 FFL 13.20

U-07 FFL 13.40

U-08 FFL 13.75

U-09 FFL 13.90

U-10 FFL 13.90

U-11 FFL 13.75

U-12 FFL 13.60

U-13 FFL 13.90

U-14 FFL 13.90

U-15 FFL 12.50

U-16 FFL 12.50

U-17 FFL 12.50

U-18 FFL 12.50

U-19 FFL 12.50

U-49 FFL 13.90

U-50 FFL 13.90

U-51 FFL 13.65

APPROVAL

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CLIENT: Ken Delforce

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PLANS 1:250 0 2.5 5 7.5 10 12.5m

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PROJECT: KENDEL PARK ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE: CONCEPT STORMWATER & LEVELS PART PLAN SHEET 1 OF 3

JOB NUMBER: NL100073
DRAWING NUMBER: C03 DA
ISSUE: D
DRAWING SHEET SIZE = A1

DRAWN: S.FARRES DESIGNED: S.WILSON JOB MANAGER: S.WILSON VERIFIER: A.BROWN

SITE BOUNDARY

EARTH LEVEL SPREADERS (TYPICAL)

SITE BOUNDARY

PROPOSED PIT AND PIPE ROAD DRAINAGE SYSTEM DISCHARGING TO DETENTION SYSTEM

OVERFLOW FROM TANK DISCHARGES TO STORMWATER SYSTEM

PIT

COMMUNITY CENTRE
FFL 15.00

U-20
FFL 15.80

U-21
FFL 16.05

U-22
FFL 16.05

U-23
FFL 16.80

U-24
FFL 16.80

U-25
FFL 17.30

U-50
FFL 13.90

U-49
FFL 13.90

U-36
FFL 15.00

U-35
FFL 15.50

U-34
FFL 15.50

U-33
FFL 15.80

U-32
FFL 16.05

U-31
FFL 16.05

U-30
FFL 17.30

U-29
FFL 17.30

U-28
FFL 17.30

INTERNAL STORMWATER PIPE TO BE PLACED OVER CULVERT

OVERFLOW FROM TANK DISCHARGES TO STORMWATER SYSTEM

U-48
FFL 15.00

U-47
FFL 15.50

U-46
FFL 15.50

U-45
FFL 16.00

U-44
FFL 16.30

U-43
FFL 16.30

U-42
FFL 16.30

U-41
FFL 16.60

U-40
FFL 17.30

U-39
FFL 17.30

U-38
FFL 17.80

RW

SITE BOUNDARY

VEGETATED SWALE, APPROX 800mm DEEP IN ACCORDANCE WITH DARDNG FLOOD MODELLING

1.5m WIDE CULVERT TO COLLECT FLOW FROM UPSTREAM & DIRECT TO NORTHERN SIDE OF SWALE

LANDSCAPED ROCK RETAINING WALL MAX 800mm HIGH. REFER TO LANDSCAPE DRAWINGS FOR SECTION DETAILS & VEGETATION FOR SWALE

FOR CONTINUATION REFER TO DRAWING C03 DA

FOR CONTINUATION REFER TO DRAWING C05 DA

REFER TO DRAWING C02 DA FOR LEGEND

APPROVAL

DRAWN: S.FORBES DESIGNED: S.WILSON JOB MANAGER: S.WILSON VERIFIER: A.BROWN

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PLANS 1:250 0 2.5 5 7.5 10 12.5m

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PROJECT: KENDEL PARK
ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE: CONCEPT STORMWATER & LEVELS PART PLAN
SHEET 2 OF 3

JOB NUMBER: NL100073

DRAWING NUMBER: C04 DA

ISSUE: D

DRAWING SHEET SIZE: A1

SITE BOUNDARY

PROPOSED CUT-OFF SWALE TO CONVEY FLOW FROM UPSTREAM THROUGH PROPERTY

PIT

PIT

T

U-26
FFL 17.80

U-27
FFL 17.80

PIT

PIT

T

U-38
FFL 17.80

U-37
FFL 17.80

RW

SITE BOUNDARY

PROPOSED CUT-OFF SWALE TO CONVEY FLOW FROM UPSTREAM PROPERTIES THROUGH PROPOSED DEVELOPMENT

BOAT/CARAVAN STORAGE AREA TO BE CONSTRUCTED AS PERMEABLE PAVEMENT TO PROVIDE WATER QUALITY TREATMENT AND MANAGE STORMWATER RUNOFF

17

17

18

SITE BOUNDARY

SITE BOUNDARY

FOR CONTINUATION REFER TO DRAWING C04 DA

REFER TO DRAWING C02 DA FOR LEGEND

APPROVAL

DRAWN: S.FIBBES DESIGNED: S.WILSON JOB MANAGER: S.WILSON VERIFIER: A.BROWN

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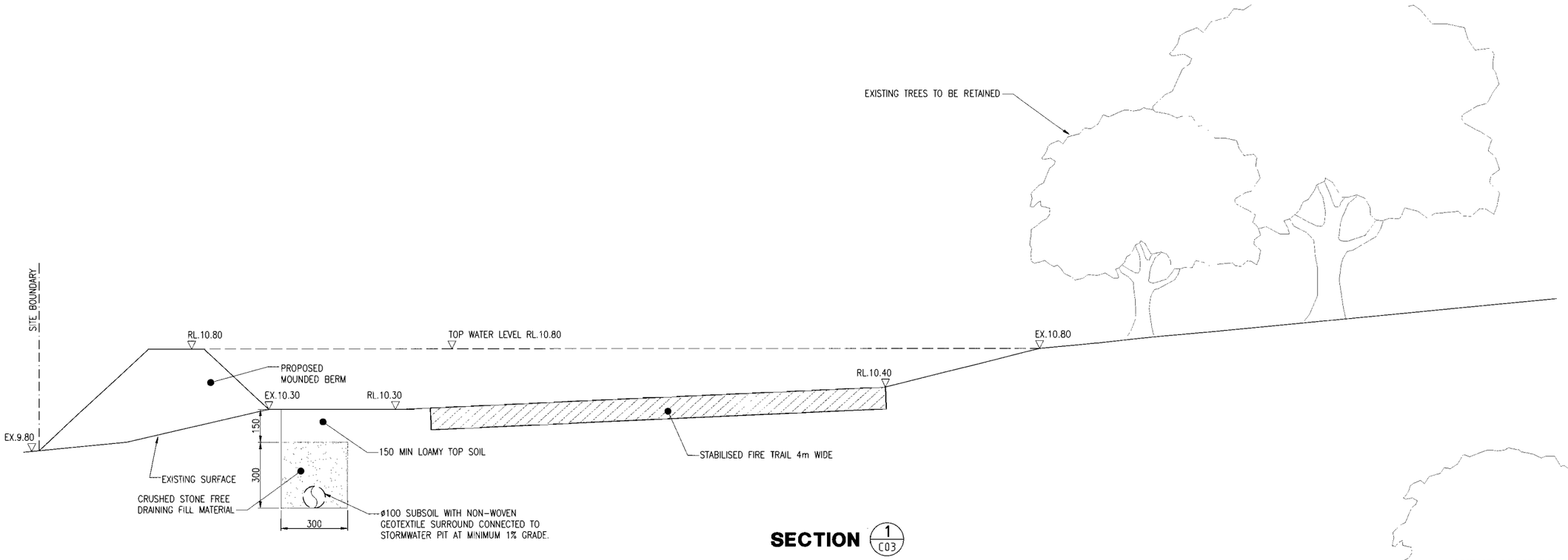
PROJECT
KENDEL PARK ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE
CONCEPT STORMWATER & LEVELS PART PLAN SHEET 3 OF 3

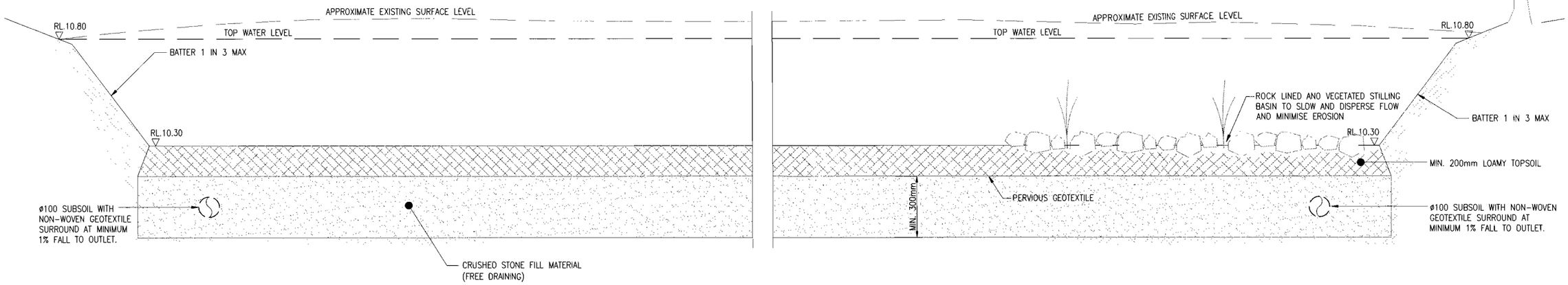
JOB NUMBER **NL100073**

DRAWING NUMBER **C05 DA** ISSUE **D**

DRAWING SHEET SIZE = A1



SECTION 1/C03



SECTION 2/C03

DRAWN: S.FORRES. DESIGNED: S.WILSON. JOB MANAGER: S.WILSON VERIFIER: A.BROWN.

APPROVAL

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
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B	LAYOUT AMENDED			07.10.10
C	REISSUED FOR DA			17.12.10
D	REISSUED FOR DA			20.12.10

CLIENT
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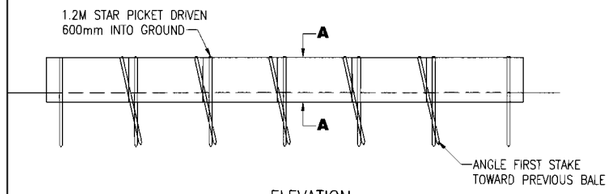
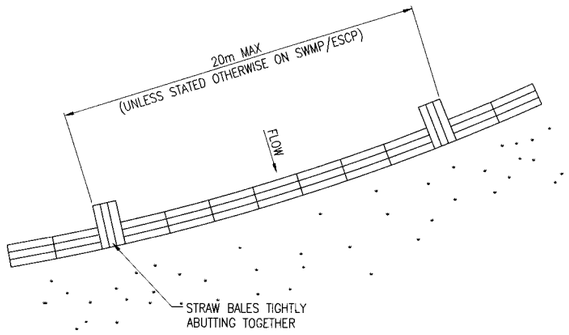
PROJECT
KENDEL PARK
ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE
CIVIL DETAILS SHEET 1

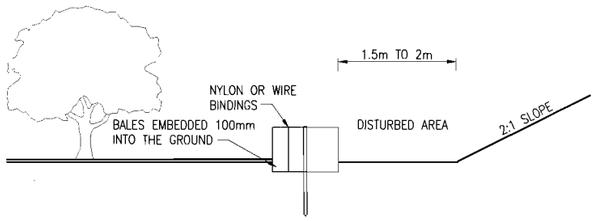
JOB NUMBER **NL100073**
DRAWING NUMBER **C06 DA** ISSUE **D**
DRAWING SHEET SIZE = A1



ELEVATION



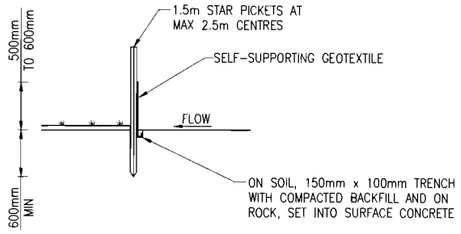
PLAN



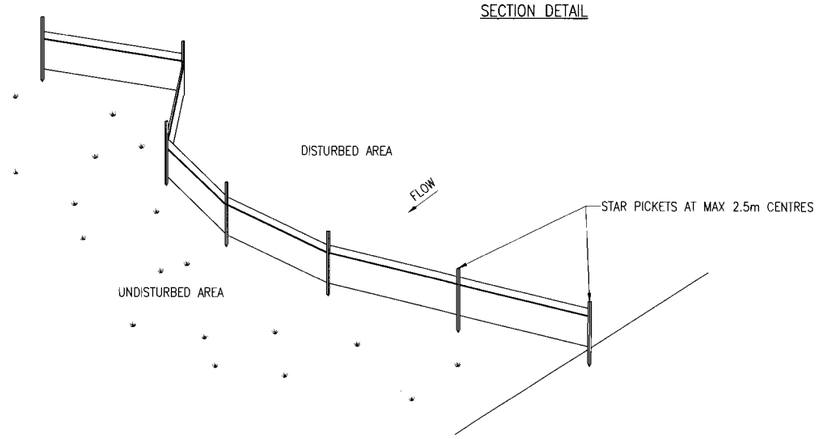
SECTION AA

STRAW BALE FILTER SD 6-7

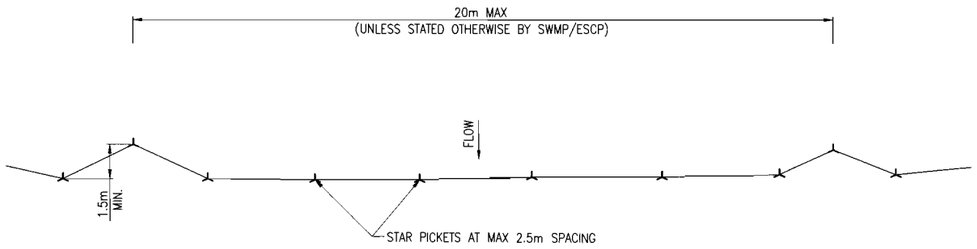
NOTES
1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN BALES. STRAWS ARE TO BE PLACED PARALLEL TO THE GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH TWO 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm INTO THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE A STRAW BALE FILTER IS CONSTRUCTED DOWN SLOPE FROM A DISTURBED BATTER, ENSURE THE BALES ARE PLACED 1 TO 2m DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAM THAT ENSURES THE INTEGRITY OF THE BALES IS RETAINED – THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.



SECTION DETAIL



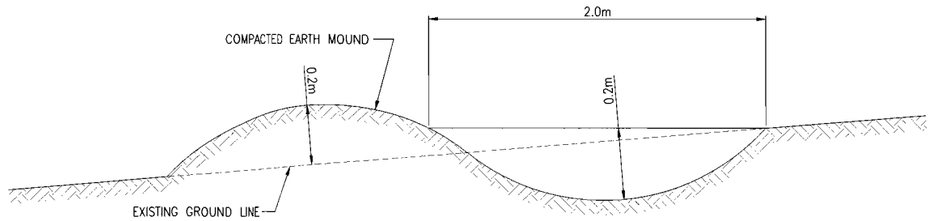
ISOMETRIC VIEW



PLAN

SEDIMENT FENCE SD 6-8

NOTES
1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50L/SEC IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5m LONG STAR PICKETS INTO THE GROUND AT 2.5m INTERVALS (MAX) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH THE WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.



TYPICAL CUT OFF SWALE DETAIL

APPROVAL

DRAWN. S.FORBES. DESIGNED. S.WILSON. JOB MANAGER. S.WILSON VERIFIER. A.BROWN.

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
A	DETAILS ADDED			07.10.10
B	REISSUED FOR DA			17.12.10
C	REISSUED FOR DA			20.12.10

CLIENT **Ken Delforce**

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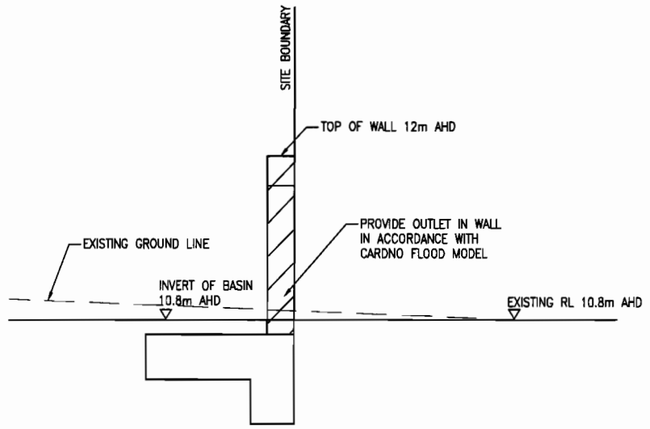
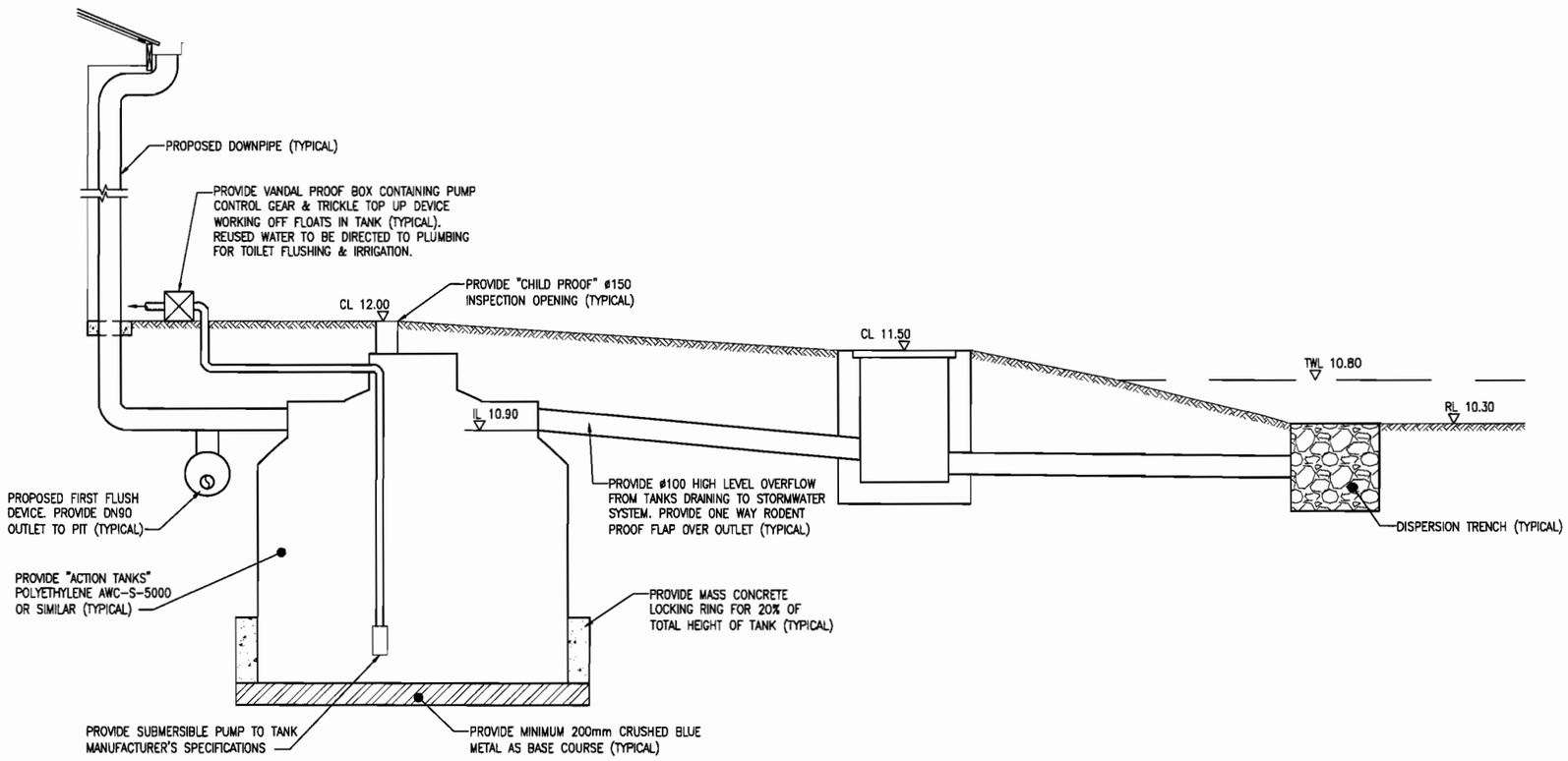
PROJECT
KENDEL PARK ENVIRONMENTAL VILLAGE
Burton Road, Mount Hutton.

DRAWING TITLE
CIVIL DETAILS SHEET 2

JOB NUMBER **NL100073**
DRAWING NUMBER **C07 DA** ISSUE **C**
DRAWING SHEET SIZE = A1



TYPICAL OUTLET FROM FLOODING RETENTION POND



TYPICAL UNDERGROUND REUSE TANK DETAIL (CRITICAL LOCATION)

DRAWN: S.FORBES. DESIGNED: S.WILSON. JOB MANAGER: S.WILSON VERIFIER: A.BROWN.

APPROVAL

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
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B	REISSUED FOR DA			20.12.10

CLIENT: **Ken Delforce**

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PROJECT: **KENDEL PARK ENVIRONMENTAL VILLAGE**
Burton Road, Mount Hutton.

DRAWING TITLE: **CIVIL DETAILS SHEET 3**

JOB NUMBER: **NL100073**
DRAWING NUMBER: **C08 DA** ISSUE: **B**
DRAWING SHEET SIZE = A1

LEGEND

DENOTES 100 YEAR FLOOD EXTENT WITH 0.05m DEPTH

DENOTES PMF FLOOD LEVEL

FFL 18.80 — DENOTES PROPOSED FINISHED FLOOR LEVEL. FINISHED FLOOR LEVEL SET A MINIMUM 500mm ABOVE 1% AEP FLOOD EVENT

DRAWN: S.FORBES; DESIGNED: S.WILSON; JOB MANAGER: S.WILSON VERIFIER: A.BROWN.

APPROVAL

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
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B	REISSUED FOR DA			20.12.10

CLIENT: **Ken Delforce**

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PLANS 1:500 0 5 10 15 20 25m

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PROJECT: **KENDEL PARK ENVIRONMENTAL VILLAGE**
Burton Road, Mount Hutton.

DRAWING TITLE: **FLOODING EXTENTS PLAN**

JOB NUMBER: **NL100073**
DRAWING NUMBER: **C09 DA** ISSUE: **B**
DRAWING SHEET SIZE = A1

Appendix C – Table Drain Calculations, Burton Road

Peak flows from basin, modelled in XP-RAFTS:

10 year ARI = 0.8m^3/sec 100 year ARI = 1.6m^3/sec

The surveyed table drain (survey data provided by de Witt Consulting) was modelled in HEC-RAS to assess flow capacity.

HEC-RAS Modelling Results:

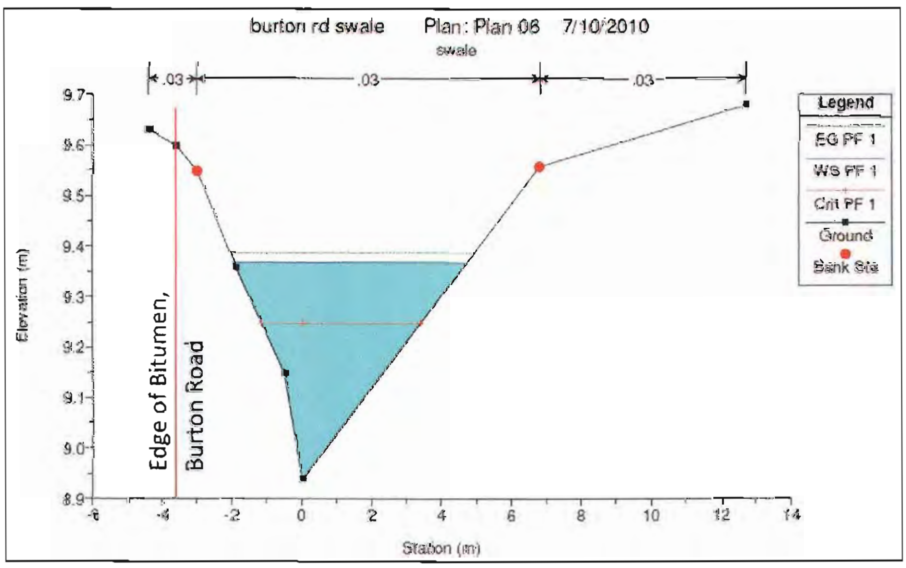

Figure D1 – 10 year ARI peak flow from basin within existing swale adjacent to Burton Rd

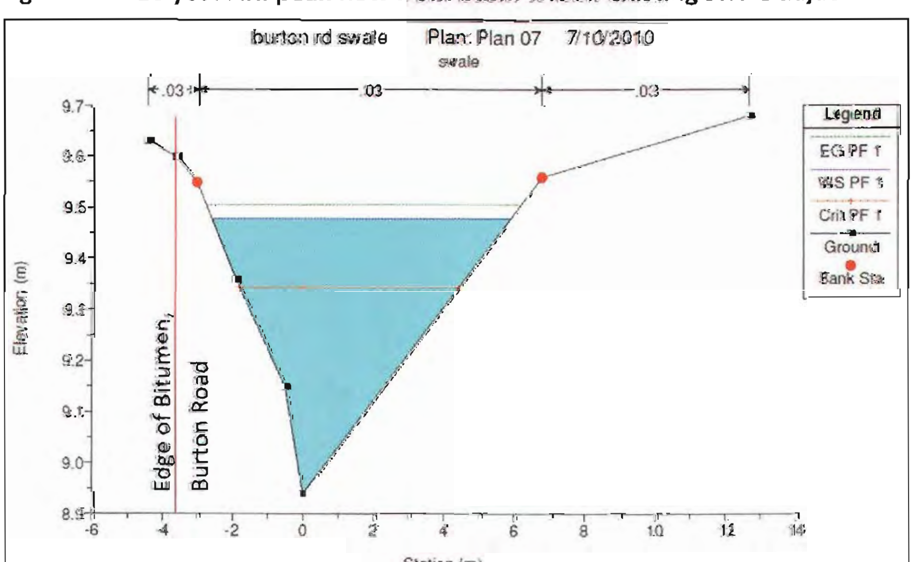

Figure D2 – 100 year ARI peak flow from basin within existing swale adjacent to Burton Rd