CONCEPT STORMWATER MANAGEMENT PLAN

PROPOSED RESIDENTIAL SUBDIVISION
AT
SECTOR 5 WARRIEWOOD VALLEY

Prepared For

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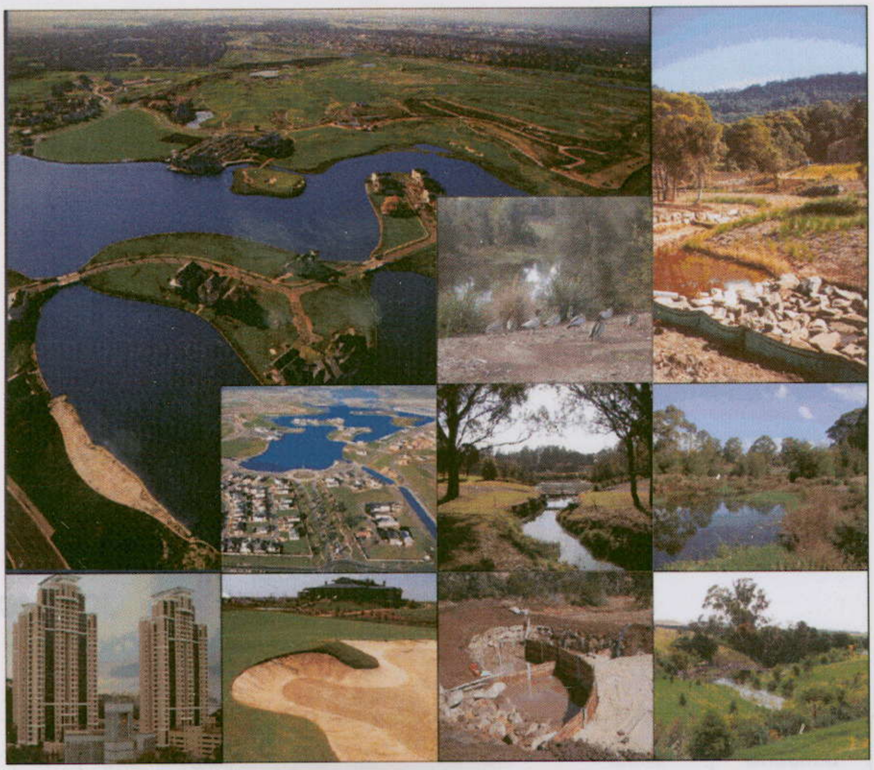

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APPENDICIES

CONCEPT STORMWATER MANAGEMENT PLAN

SECTOR 5 – WARRIEWOOD VALLEY

1.0 INTRODUCTION

Brown Consulting (NSW) Pty Ltd has been commissioned to provide a stormwater management plan for a development application at Sector 5 Warriewood Valley in the Pittwater local government area. This report and its associated drawings provide concept detail as to the stormwater management for the proposed residential development.

The following drawings should be read in conjunction with this stormwater management plan:

- D01 Existing Survey and Flood Extents
- D02 Stormwater Drainage Concept Plan
- D03 OSD Tanks and Sand Filter Details
- D04 Bio-retention Basin & Design Creek Details
- D10 Narrabeen Creek Design Plan & HEC-RAS Cross Sections
- D11 Narrabeen Creek Existing & Design Long Section
- D12 Narrabeen Creek Design Cross Sections – Sheet 1
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- D20 Overland Flowpath – Sector 5
- D21 Overland Flowpath Long Section – Sector 5
- D22 Overland Flowpath Cross Sections – Sheet 1
- D23 Overland Flowpath Cross Sections – Sheet 2

1.1 Site Location & Description

The site is located in the upper reaches of Narrabeen Creek, with the proposed development located to the south of Narrabeen Creek, which flows in an easterly direction. The site currently contains glasshouses and is predominantly cleared. Most riparian vegetation on Sector 5 is predominantly weed species and significant incision (up to 2 m depth) of the creek channel has occurred in places as a result of channel instability. In its existing condition, this section of Narrabeen Creek is considered a Class 3 fish habitat "Minimal Fish Habitat', although with riparian restoration would be considered a Class 2 habitat "Moderate Fish Habitat".

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A steep bushland catchment of 4.12 ha drains through the site in a northerly direction through a low point that is ill-defined as it extends through the proposed development area on Sector 5. Drainage from this catchment is currently conveyed through the site by a series of small earth drains and pipe culverts, and in places the drainage line would only exist as sheet overland flow. This drainage discharges into Narrabeen Creek near the creek crossing with Jubilee Avenue.

The ephemeral drainage line passing through Sector 5 is considered a Class 4 fish habitat "Unlikely Fish Habitat" by the NSW Department of Primary Industry (Fisheries) due to the ephemeral nature of this drainage line, lack of vegetation, significant modification of the drainage line and the absence of any upstream or downstream significant aquatic habitat.

1.2 Warriewood Valley Stormwater Management Specification

This study has been developed in accordance with Pittwater Councils (2001) Stormwater Management Specification for the Warriewood Valley Urban Release Area. The key issues outlined by this specification include:

Stormwater Quantity Management

- Developed hydrograph must be within ±10% of the pre-developed hydrograph at any location on the rising or falling limb,
- Peak flow from the sector to be within ±5% of the peak flow given in Appendix A of the specification.
- Developed peak flow to be no greater than pre-developed conditions,
- All OSD aboveground structures to be located above the 100 year ARI flood level,
- Stormwater reuse to be utilised for the development

Flooding

- Estimation of flood levels for pre and post development,
- Floor levels to be +500 mm above the 1% AEP flood,
- The 50% AEP flood to be conveyed within the creek banks,
- Walkways & cycleways to be above 20% AEP flood level,
- Water quality control devices to be above the 20% AEP flood level,
- Flood hazard and evacuation associated with the PMF to be considered if it flows through residential areas.

Stormwater Quality

- Load based modelling of pre and post development using a daily load model for 90^{th} 50^{th} and 10^{th} percentile rainfall years,
- Ensure post developed pollutant loads do not exceed existing loads,
- Concept design of stormwater treatment facilities,

Water Balance

- Water balance modelling for pre and post development,

Watercourse & Creekline Preservation

- Establish baseline conditions by survey every 25 m,
- 1% AEP flood to be conveyed in creekline for post-development conditions,
- Use of natural channels in the design sections of the creek,
- 50% AEP flood to be conveyed below bank-full levels,
- Stormwater discharges to be adequately stabilised,

1.3 The Development Proposal

The DA is for the construction of 75 residential dwellings in Sector 5 Warriewood Valley, as shown in **Drawing D02**. A total of 55 dwellings are proposed adjacent to Narrabeen Creek, denoted Site A in this study. A further 20 dwellings are proposed in the south-east corner of Sector 5, denoted Site B.

The development of Sector 5 will utilise stormwater quality and quantity controls in accordance with industry 'best practice management', and more specifically to meet the objectives of Pittwater Council's *"Water Management Specification"*. This will include stormwater reuse for each dwelling in accordance with the NSW government's BASIX, in addition to utilising stormwater treatments such as bio-retention, sand filters and gross pollutant traps. The development will also provide on-site detention to maintain existing flow regimes, provide rehabilitation of Narrabeen Creek through Sectors 5 & 6 and provide a landscaped overland flow path for overland flows passing across Sector 5.

2.0 EXISTING CONDITIONS

The hydrology of the proposed development area has been previously modelled by Lawson & Treloar Pty Ltd for Pittwater Council using the *XP-RAFTS* hydrological model. This model was a broad scale model covering most of the catchment of Narrabeen Creek, including Sector 5.

2.1 Hydrology

2.1.1 Narrabeen Creek

The existing peak flow at the upstream and downstream end of Sector 5 & 6 for various design floods as estimated by Lawson & Treloar Pty Ltd is shown in **Table 2.1**.

Table 2.1 Peak Flows Upstream & Downstream of Sectors 5 & 6

Sector 5	PMF	1% AEP	2% AEP	5% AEP	20% AEP	50% AEP
Upstream	62.8	14.1	11.5	8.6	4.2	1.3
Downstream	75.0	17.0	13.6	10.1	5.0	1.5

These flows relate to the runoff contributed from both Sectors 5 and 6.

2.1.2 Drainage Line through Bisecting Sector 5

A small ephemeral drainage line passes through the proposed subdivision. This drainage line has a catchment area of 4.12 ha upstream of the proposed subdivision. The catchment landuse is bushland and the average slope in this area is 15%.

The peak 100 year ARI flow from this catchment has been estimated using the RAFTS component of DRAINS as being 1.54 m^3/s. This flow was estimated suing a Manning's value of 0.06 representing the bushland conditions and the same initial and continuing losses as adopted in the RAFTS model developed for Narrabeen Creek by Lawson & Treloar Pty Ltd.

2.2 Existing Flood Conditions in Narrabeen Creek

Flood levels for existing conditions were established by Lawson & Treloar for Pittwater Council from four cross sections through the site. The estimated 100 year ARI flood level varied from 20.77 to 19.79 m AHD through Sector 5. These flood levels were revised as part of this study using a more detailed survey through the site, which was taken at 25 m spacings along the creek and extended further onto the floodplain.

The HEC-RAS boundary condition adopted was the known surface water level as derived from the modelling undertaken by Lawson & Treloar Pty Ltd for each design flood (eg 17.92 m AHD for the 100 y ARI flood). The model was run in sub-critical mode.

Drawing D01 shows the PMF, 20 and 100 year ARI flood extents through Sector 5. **Table 2.2** shows that the revised 100 year ARI flood level varies from approximately 20.86 to 18.91 m AHD through the site. All floods except the PMF are completely contained within the existing channel of Narrabeen Creek.

Table 2.2 Existing 100 year ARI Flood Levels

Section	Q Total (m3/s)	Flood Level (m, AHD)	Channel Velocity (m/s)	Froude	Mannings LOB	Mannings Channel	Mannings ROB
11	14.1	20.86	1.89	0.65	0.1	0.045	0.1
10	14.1	20.4	2.55	0.91	0.1	0.045	0.1
9	14.1	20.29	1.55	0.49	0.1	0.045	0.1
8	14.1	20.14	1.61	0.5	0.1	0.045	0.1
7	14.1	19.98	1.75	0.51	0.05	0.045	0.1
6	14.1	19.65	2.32	0.8	0.05	0.045	0.1
5	14.1	19.66	1.35	0.39	0.05	0.045	0.1
4	14.1	19.6	1.18	0.33	0.05	0.045	0.1
3	14.1	19.55	1.13	0.35	0.05	0.045	0.1
2	14.1	18.99	2.85	1.01	0.05	0.045	0.1
1	17	18.91	1.59	0.49	0.05	0.045	0.1
0	Bridge						

2.3 Narrabeen Creek Corridor through Sector 5

Narrabeen Creek is considerably degraded adjacent to Sector 5, showing signs of scour and containing many weed species in the riparian area. Proposed creek works will aid in stabilising the creek and provide a revegetated riparian corridor.

Drawing D10 and **Drawing D11** show the existing creek survey information in section and plan.

3.0 WATER BALANCE FOR SECTOR 5

A daily water balance model was developed for pre and post development of the site using a spreadsheet model. This type of approach is recommended by the EPA (1997) for estimating flows and pollutant loads at the development application stage.

3.1 Model Assumptions

This model used daily rainfall data from the Bureau of meteorology Station at Mona Vale to estimate daily runoff volumes. The period of record covered 31 years from January 1972 to the end of 2002. Evaporation data used were daily averages for each month.

Volumetric runoff coefficients and initial rainfall loss used in the model for each landuse included:

Existing Site	15%	4 mm
Roof Areas	100%	0 mm
Roads	85%	1 mm
Lots	18%	4 mm

For developed conditions, the stormwater reuse was assumed to occur only if no greater than 1 mm of rainfall had occurred that day, as although the water will be available for domestic use it is assumed most of the water will be used for irrigation. Daily rainwater demand was assumed to be 450 L/d/dwelling if available (for irrigation, washing machines and toilet flushing), which is conservative given that if >1 mm of rainfall occurred it is assumed there is no water demand from the rainwater tanks. Total rainwater storage for each dwelling is 8,000 L of storage.

Evaporation losses from the bio-retention basin were also considered in the modelling using average daily evaporation for each month in Sydney. Such losses were only applied while water was held in the bio-retention basin.

3.2 Water Balance Summary

The water balance modelling estimated the following total rainfall depths for statistically representative rainfall years:

- 10th Percentile Rainfall Year — 744 mm
- Average rainfall year — 1,090 mm
- 90th Percentile rainfall year — 1,537 mm

The water balance model results are shown in **Table 3.1**.

Table 3.1 **Water Balance Modelling Results**

Site	Pre-development Runoff (ML/y)		Post-Development Runoff with Stormwater Re-use (ML/y)	
	A	B	A	B
10th Percentile Rainfall Year	5.88	0.84	2.66	0.52
Average rainfall year	8.60	1.23	4.69	0.75
90th Percentile rainfall year	14.26	2.03	9.86	1.21

The model shows that development of Sector 5 would not increase runoff volumes from that of existing conditions. This has been achieved by incorporating a substantial stormwater reuse component for each dwelling. However, environmental flows to Narrabeen Creek will not be reduced as the rainwater reuse is only from roof areas of the site and all roads and lot areas will continue to flow to Narrabeen Creek through the water quality treatment devices and on-site detention.

Figure 2.1 shows the storage in the rainwater tanks associated with the stormwater demand for an average rainfall year on Site A. It can be seen that for approximately 30% of the year stormwater would be unavailable for reuse on Site A.

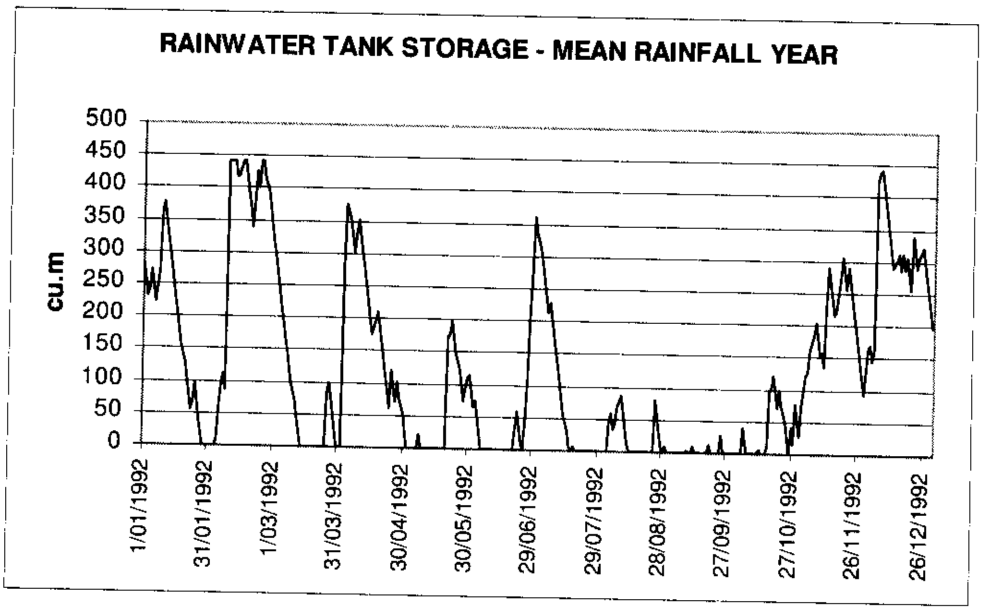


Figure 2.1 **Rainwater Tank Storage – Site A**

4.0 STORMWATER DRAINAGE CONCEPT PLAN (SDCP)

A requirement of Pittwater Council is to provide a Stormwater Drainage Concept Plan (SDCP). This plan is shown in **Drawing D02**, which identifies:

- Location & size of SQIDS
- Location of diversion drains,
- Location and size of the OSD systems,
- 1% AEP and PMF extents - post development
- Creekline corridors - post development
- Piped drainage system
- Onsite retention facilities
- Surface overland flowpaths

5.0 STORMWATER QUALITY MANAGEMENT

5.1 Modelling Methodology

Stormwater quality was analysed using the daily water balance model developed for this study, coupled with a water quality model component, as recommended by Pittwater Council's (2001) *Warriewood Valley Water Management Specification*. It was necessary to combine the two models as the reduction in runoff volumes through water reuse would also reduce pollutant loads from the catchment. Such a relationship is not yet adequately modelled by water quality models such as MUSIC, which can only accommodate simplistic reuse from ponds.

The event mean concentrations (EMC) used for establishing the existing conditions for the site were taken from the average results of water quality sampling data for the 'Wet Conditions' classification at the McPherson Street Bridge, being:

- TN 1.85 mg/L
- TP 0.74 mg/L
- TSS 131 mg/L

For developed conditions, the catchment was subdivided into roof, landscaped and road areas. The EMC values used for these landuses were taken from Australian Runoff Quality-DRAFT (2003) which were adopted from Duncan (1999) and are shown in **Table 5.1**.

Table 5.1 Pollutant EMC Values & Runoff Coefficients

Landuse	TSS (mg/L)	TP (mg/L)	TN (mg/L)
Roof Areas	35	0.13	0.60
Landscaped Areas	150	0.40	1.85
Roads	250	0.25	1.12

Note: TN for landscaped areas was assigned as 1.85 mg/L which is greater than Duncan (1999)

5.2 Existing Pollutant Loads from Sector 5

The existing pollutant loads off Site A and B as estimated by the model are shown in **Table 5.2**.

Table 5.2 Existing pollutant Loads

Percentile Year	TSS kg/y	TN kg/y	TP kg/y
	Site A		
10th	771	10.89	1.18
mean	1127	15.91	1.72
90th	1869	26.37	2.85
	Site B		
10th	109	1.55	0.62
mean	160	2.27	0.90
90th	266	3.76	1.50

5.3 Proposed Stormwater Treatment Strategy – Site A

The water quality treatment for Site A will consist of:

- Stormwater re-use of dwelling roof runoff by utilising 8,000 L rainwater tanks,
- Gross pollutant traps to pre-treat road and lot drainage, and
- Two bio-retention basins which will receive flows from the gross pollutant trap.

The pollutant removal rates adopted for stormwater treatment devices are shown in **Table 5.3**. Data from Melbourne Water in Appendix B indicates that bio-retention basins may achieve higher pollutant removal rates than adopted in this study. The performance of sand filters was adopted from the *Water Sensitive Planning Guide for the Sydney Region*.

Table 5.3 Pollutant Load Reductions for Stormwater Treatments

	TSS	TP	TN
Bio-retention Basins	85%	77%	70%
GPT's	50-75%	20%	0%
Sand Filter	65%	58%	50%

5.3.1 Post Development Pollutant Loads – Site A

The estimates of pollutant loads from Site A with stormwater treatment are shown in **Table 5.4**.

Table 5.4 Site A - Pollutant Loads with Treatment

Percentile Year	TSS kg/y	TN kg/y	TP kg/y
10th	96	3.62	0.60
mean	160	5.81	0.98
90th	337	12.31	2.07
Mean Reduction	*86%*	*64%*	*43%*

5.3.2 Bio-retention Basin Concept Design

The design of the bio-retention basins was in accordance with Melbourne Waters WSUD Manual and other similar procedures. The design assumptions include:

Bio-retention Basin Sizing

Filter Media depth	750 mm
Filter Media Surface Area	317 m^2 (Total)
Extended Detention Depth	300 mm
Total Basin Volume	95 m^3 (Total)
Adopted Saturated Hydraulic Conductivity	36 mm/h (adopted long term k)
Maximum Time to Drain Basin	24 hours

Filter Media Specification

Filter Media Type	Sandy Loam (0.45 mm)
Maximum Hydraulic Conductivity	180 mm/h
Sub-surface Drain Type	Perforated PVC (min 0.5% grade)

Surface Treatment on Filter Media

Plants selected for use in bio-retention systems need to be able to tolerate periods of inundation, as these systems can be expected to have a proportion of the soil profile saturated for several days. The selection of a sandy loam soil with a hydraulic conductivity in the range of 40-180mm/h will normally ensure soils are not waterlogged, which has been accommodated in the concept design.

Plants with extensive fibrous root systems are generally preferred as they prevent the filter media from clogging. Plants with a spreading, rhizomatous or suckering habit are also preferred. The filter must be planted to ensure it does not clog, and a stone layer at the surface could be used if required, although no mulch should be placed on the filter.

Sub-surface Drainage

100 mm PVC perforated pipes will be placed in a 150-200 mm thick fine gravel layer below a 100 mm thick sand transition layer located immediately below the filter media. The grading of the transition layer should be:

- 1.4 mm 100% passing
- 1.0 mm 80%
- 0.7 mm 44%
- 0.5 mm 8.4% passing

The maximum spacing of the perforated PVC pipes is to be maximum 2 m spacings centre to centre.

5.4 Proposed Stormwater Treatment Strategy – Site B

The water quality treatment for Site B will consist of:

- Stormwater re-use from dwelling roof runoff using 8,000L rainwater tanks,
- Gross pollutant traps to treat road and lot drainage, and
- Sand filters which will receive runoff from the gross pollutant trap and treat to remove nutrients, grease and hydrocarbons. These will discharge runoff to the OSD tanks.

5.4.1 Post Development Pollutant Loads – Site B

The model estimates of pollutant loads from Site B on Sector 5 are shown in **Table 5.5**.

Table 5.5 Site B - Pollutant Loads with Treatment

Percentile Year	TSS kg	TN kg	TP kg
10th	14.5	0.32	0.05
mean	28.3	0.55	0.09
90th	39.0	0.80	0.12
Mean Reduction	*82%*	*76%*	*90%*

5.4.2 Concept Water Quality Treatment Device Sizing – Site B

The GPT's will be sized to treat the 3 month ARI peak flow from the catchment. The sand filter will receive flows directed to it via the GPT's, effectively making them off-line, and has been sized based on the following assumptions:

Combined Runoff Volume (first 15 mm)	36.5 m^3
Combined Filter SA	57 m^2
Filter depth	600 mm
Filter Media	Clean, washed aggregate

6.0 ONSITE DETENTION - SECTOR 5

The Warriewood Valley Water Management Specification provides site storage requirements (SSR) and permissible site discharge (PSD) for Sector 5. These were estimated from the *RAFTS* modelling undertaken by Lawson & Treloar for Pittwater Council. These factors were determined as being:

SSR for 1% AEP 1 hr Storm	368 m^3/ha = 740 m^3 for Site A
PSD for 1% AEP 1 hr Storm	0.331 m^3/s
PSD for 1% AEP 2 hr Storm	0.390 m^3/s

The PSD and SSR were verified using the *RAFTS* hydrological component of the *DRAINS* model for both catchments A and B in Sector 5. This software has a more advanced detention basin modelling component than RAFTS that allows multiple orifices to be modelled and hydrographs examined. Initial and continuing losses adopted were those used in the flood study by Lawson & Treloar Pty Ltd for Pittwater Council.

6.1 Onsite Detention Calculations for Site A

The hydrological parameters adopted for the existing catchment conditions were the same as for the RAFTS modelling undertaken by Lawson & Treloar, being:

Existing Mannings 'n'	0.05
Developed Mannings 'n'	0.025
Slope	5%
Contributing catchment area	2.01 ha
Impervious percentage	50%

Exceptions from the parameters used in the existing *RAFTS* model were the catchment area modelled, where it is proposed to develop only 2.01 ha of Site A and hydrologically isolate the remaining upslope catchment area from the rest of the site.

The proposed OSD system for Site A is shown in **Drawing D03**. The OSD system will utilise 560 m^3 of storage located in storage provided under the access road. An additional 220 m^3 of storage will be provided within the rainwater tanks for each dwelling, equating to 4 m^3 of OSD storage per dwelling. It should be noted that BASIX states that 50% of the rainwater tank capacity can be counted towards OSD storage if the rainwater tank is connected into the household water supply, which is proposed. Therefore, the downpipes for each dwelling and inter-allotment drainage will be required to convey the roof runoff from the 100 year ARI storm.

The *DRAINS* modelling has estimated that the development of Site A would not increase the peak flow from that of existing conditions when using OSD, as shown in **Table 6.1**.

Table 6.1 **Summary of Peak Flows - Site A**

ARI Storm	Critical Storm (min)	Existing Conditions	PSD	Developed With OSD
5	120	0.346	0.346	0.322
20	120	0.499	0.499	0.488
100	120	0.673	0.784	0.687

Note: The PSD of 0.784 for the 100y ARI storm is from the Warriewood Valley Water Management Specification

The concept outlet arrangement from the OSD tank is:

- Low level orifice 458 mm at centre RL 20.17 m
- High level Orifice 310 mm at centre RL 20.89 m
- Overflow weir at RL 21.35 m (Q100 level 21.37 m)
- Outlet using a 900 mm RCP at IL 19.04 m

The OSD system has been designed to ensure that there is no pronounced 'tail' on the falling limb of the hydrograph and that the times of peak and hydrograph shapes are similar (**Figure 6.1**). Furthermore, the system has been designed to account for the hydraulic grade line in the outlet pipe due to flooding in Narrabeen Creek.

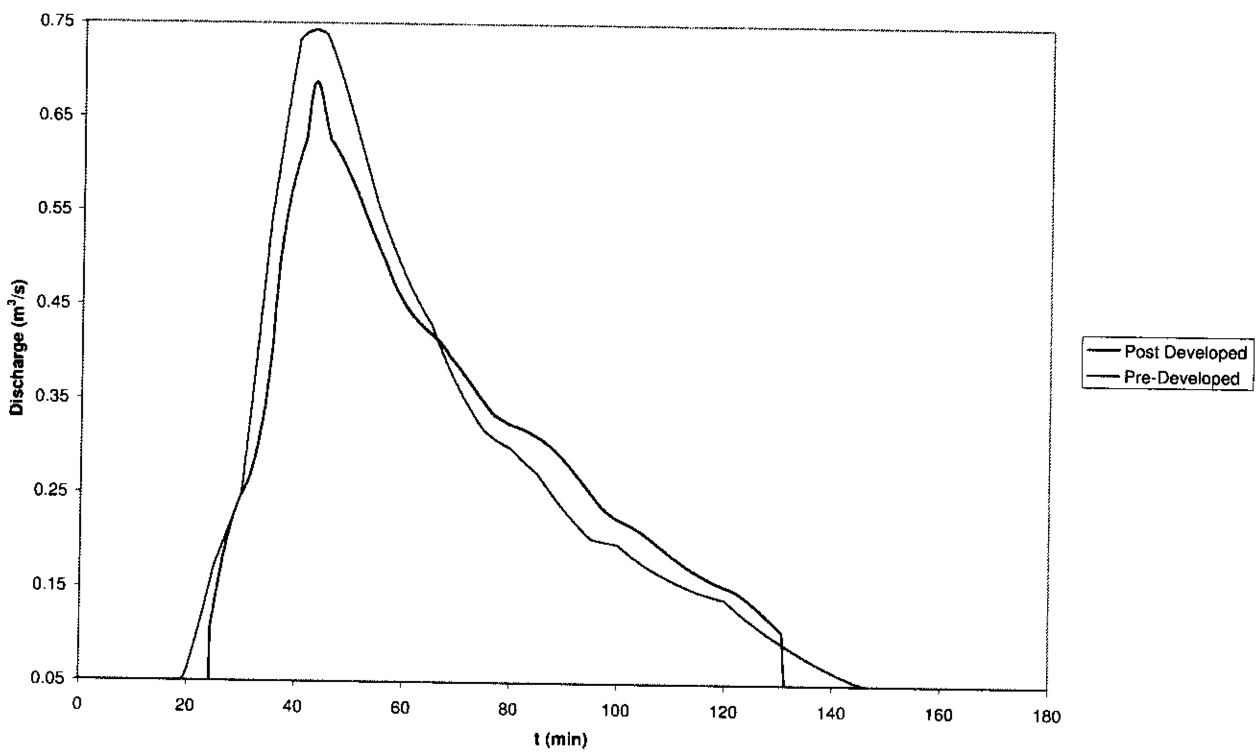


Figure 6.1
2 hour 100 year ARI Storm Hydrograph - Site A

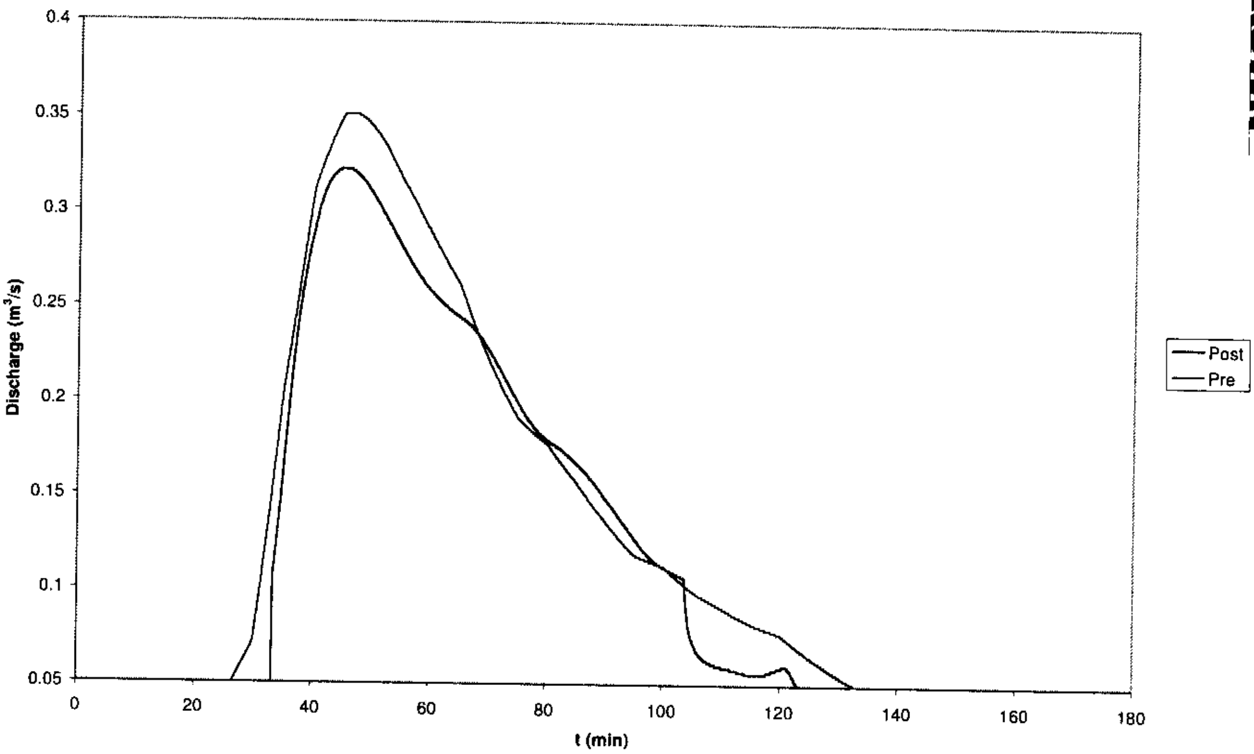


Figure 6.2
2 hour 5 year ARI Storm Hydrograph - Site A

6.2 Onsite Detention Calculations for Site B

This catchment was modelled in *DRAINS* using the *ILSAX* hydrological component, as a smaller sub-catchment in the RAFTS component will alter the peak flows from the catchment.

The upslope bushland catchment was excluded from the model as flows from this catchment will be diverted around the site and into the drainage line that is proposed to flow through Site A.

The existing peak flows for each design storm were adopted as the PSD for the site, except for the 100 year ARI storm where the PSD given in the Warriewood Water Management Specification was used. The PSD and results are shown in **Table 6.2**.

Table 6.2 **Summary of Peak Flows - Site B**

ARI Storm	Critical Duration (min)	Existing Conditions (m^3/s)	Developed Site With OSD (m^3/s)
5	90	0.182	0.176
20	120	0.254	0.224
100	120	0.338 (PSD = 0.275)*	0.273

*PSD adopted from the Warriewood Valley Urban Release Area Water Management Specification (2001)

The proposed OSD system utilises two underground tanks to provide a combined storage of 232 m^3 including 80 m^3 of OSD storage in rainwater tanks in the dwellings draining to the OSD system. It is proposed that the tanks will be located underneath the roads in this area as shown in **Drawing D03**.

Concept design details for the OSD on Site B are provided below:

Tank 1 - Catchment area 0.377 ha

- Total OSD Storage (incl Rainwater tanks) 107 m^3
- Low level outlet - 220 mm orifice with Centre at RL 25.5m
- High level outlet - weir at RL 27 m

Tank 2 - Catchment area 0.453 ha

- Total OSD Storage (incl rainwater tanks) 125 m^3
- Low level outlet - 265 mm orifice with centre at RL 21.5m
- High level outlet - weir at RL 23 m

Unlike most conventional OSD systems, there is no sustained base-flow resulting from the attenuation of peak flows for all storms up to the 100 year ARI.

WATERCOURSE RESTORATION & FLOOD PROTECTION

6.3 Narrabeen Creek

Narrabeen Creek will be rehabilitated by providing revegetation of the riparian zone along with earthworks to stabilise the existing creek and manage flooding. The existing creek channel will be stabilised by creating benching in accordance with natural channel design principles. Small natural sandstone retaining walls of 300 mm height will extend above the bank full flow section of the channel throughout some sections of the creek. The creek bank above these retaining wall sections is proposed to be battered at a 1 in 6 grade to other 300 mm high benches until the design or natural surface level is reached. Concept creek design sections are shown in **Drawings D10, D11, D12, D13, D14** and **D04**.

We have been advised that the section of Narrabeen Creek on Sector 6 will have straight 1 in 3 batters, which has been adopted for the hydraulic modelling. Therefore, flood levels through this section of Narrabeen Creek will need to be re-viewed in the context of proposed works on the other side of the creek that fronts Sector 6 for the detailed design. In either case, changes to the flood levels estimated in this study are expected to be minimal for the detailed design.

6.3.1 Estimate of Design Flood Levels – Narrabeen Creek

Flood levels in Narrabeen Creek adjacent to Sector 5 were estimated using HEC-RAS, the cross sectional geometry from the proposed creek design and the estimate of flows derived by Lawson & Treloar for Sectors 5 & 6. The hydraulic modelling results are given in **Table 7.1**.

Table 7.1 Hydraulic Modelling Results & the Flood Planning Level

Section	PMF (m, AHD)	100 y ARI (m, AHD)	100 y ARI Velocity (m/s)	20 y ARI (m, AHD)	2 y ARI (m, AHD)	Flood Planning Level * (m, AHD)
11	21.85	20.35	3.07	20.04	19.41	20.85
10	21.56	20.08	2.03	19.8	19.19	20.58
9	21.56	20.0	1.60	19.7	19.03	20.50
8	21.32	19.81	1.98	19.52	18.88	20.31
7	21.21	19.65	2.05	19.36	18.73	20.15
6	21.15	19.51	1.98	19.22	18.57	20.01
5	21.12	19.43	1.79	19.13	18.45	19.93
4	20.97	19.22	2.13	18.91	18.28	19.72
3	20.98	19.09	1.97	18.77	18.12	19.59
2	20.96	18.96	1.91	18.62	17.91	19.46
1	20.9	18.83	2.11	18.54	17.77	19.33
0	Bridge					

*Flood Planning Level = (Q100+500 mm for minimum floor level for adjacent buildings)

Mannings values adopted for the flood study included:

- 0.08 for overbanks (representing dense planting within the riparian zone), and
- 0.045 for the channel (representing scattered vegetation with rushes and macrophytes).

Hydraulic controls included the road bridge immediately downstream of Sector 5.

Drawing D11 shows the design 100 year ARI flood levels along this section of creek. It can be seen that the design of the creek reduces flood levels from that of existing conditions as a consequence of increasing the conveyance capacity of Narrabeen Creek.

6.4 Overland Flow Path through Site A

A minor overland flow path is proposed to pass through the site in Site A. An ephemeral landscaped corridor has been provided to pass overland flows from the upstream 4.12 ha catchment, in addition to conveying the flows from the 0.81 ha catchment upslope of Site B.

6.4.1 Estimated Flows

The 100 year ARI flow from the total 4.93 ha upstream catchment is estimated as being 1.91 m^3/s, of which 0.389 m^3/s is diverted from the upslope catchment of Site B. A box culvert under the access road is proposed to convey these flows into the designated overland flow path through Site A. Two box culverts of 1800 mm width and 600 mm height will convey this flow without overtopping of the access road when 50% blocked. Their combined capacity without blockage is estimated at 2.84 m^3/s at a headwater depth of 0.6 m. With blockage the culvert capacity is estimated at 2.0 m^3/s at the same headwater depth, which exceeds the estimated 100 year ARI flow at this location.

The total peak flow arriving at the downstream end of the overland flow path is estimated at 2.01 m^3/s for the 100 year ARI storm. Flows from this overland flow path will be piped in a 1,050 mm diameter RCP, where they will combine with flows from the OSD system for Site A, continue through a 1200 mm RCP and discharge into a stabilised energy dissipater at Narrabeen Creek. The access road will form an overland flow path for floods above the 100 year ARI.

This corridor consists of an overland flow path that leads to a series of self draining rock weirs. It should be noted that this structure is not designed to retain water, although in large storms ponding of water will occur behind the weirs and at the inlet to the pipe culvert.

A 300 mm high rock retaining wall will form a hard edge to the overland flow path. This will aid in reducing mosquito larvae development and preventing scour in extreme floods. All batters below and above the edge wall will be a maximum of 1(V) in 6(H).

6.4.2 Estimate of Design Flood Levels – Sector 5 overland Flow Path

The HEC-RAS hydraulic model was used to estimate flood levels in the proposed overland flow path through Sector 5. The model used a downstream boundary condition of a known surface water level, as the permeable rock weirs located across the overland flow path act as a hydraulic control for the water level in each section of the overland flow path. Therefore the results shown in **Table 7.2** do not extend beyond Section OF10.

Drawings D20, D21, D22 and **D23** show long sections and cross sections of this overland flow path along with the 100 year ARI flood level, which in the lower sections of the overland flow path is controlled by the inlet capacity of the pipe that conveys runoff to Narrabeen Creek. It can be seen that all adjacent dwellings are located a minimum of 500 mm above the 100 year ARI flood level. Furthermore, all dwellings fronting the access road have sufficient freeboard.

For storms greater than the 100 year ARI, or if significant blockage of the culvert occurred, the adjacent road would act as an overland flow path for those overflows allowing runoff to reach Narrabeen Creek. Dwellings adjacent to the road have sufficient freeboard provided.

Table 7.2 100 Year ARI flood Levels in the Overland Flow Path

Section	Chainage	100 Y ARI Flood Level (m, AHD)	Energy Grade Elevation (m, AHD)	100 Y ARI Channel Velocity (m/s)
1	90	28.49	28.72	2.14
2	85	28.08	28.28	1.97
3	80	27.90	28.17	2.32
4	75	27.64	27.76	1.57
5	70	27.07	27.36	2.39
6	65	26.74	26.89	1.72
7	60	26.36	26.55	1.93
8	55	25.85	26.09	2.17
9	50	25.58	25.70	1.54
10	40	25.01	25.16	1.67

6.5 Stormwater Outlet Concept Design

A single stormwater outlet to Narrabeen Creek is proposed. This outlet will contain a 1200 mm RCP discharging through a headwall situated in the riparian zone. The DRAINS model has estimated the flow velocity in the pipe to be a maximum of 2.75 m/s.

The outlet will incorporate a natural rip rap energy dissipater in accordance with a *Type A - Roads & Traffic Authority* dissipater to force a hydraulic jump and allow flow to return to subcritical. A total dissipater length of 10 m has been provided to prevent scour at the confluence of this outlet and Narrabeen Creek. The proposed creek design will require that this stormwater outlet be surrounded by a sandstone boulder retaining wall that will mesh with the proposed benched creek design.

7.0 RECOMMENDATIONS

The stormwater management plan for Sector 5 Warriewood Valley has been prepared in accordance with Pittwater Councils Water Management Specification. The stormwater components used in the development will meet five principle objectives being:

- Ensuring that peak flows are maintained at a rate not exceeding that of existing conditions, while maintaining a similar deign storm hydrograph,
- Improving water quality in discharge from the site so that it is no worse than that of existing conditions,
- Ensuring that the average annual flows from the site are no greater than that of existing conditions,
- Promoting WSUD in the design,
- Rehabilitating the creek corridor along Narrabeen Creek ensuring long term channel stability and promoting revegetated benched riparian zones.

8.0 REFERENCES

Duncan H.P. (1999). *"Urban Stormwater Quality: A Statistical Overview"*. CRC for Catchment Hydrology.

Institution of Engineers Australia (2004) Australian Runoff Quality - DRAFT.

Melbourne Water (2004). WSUD Engineering Procedures: Stormwater DRAFT.

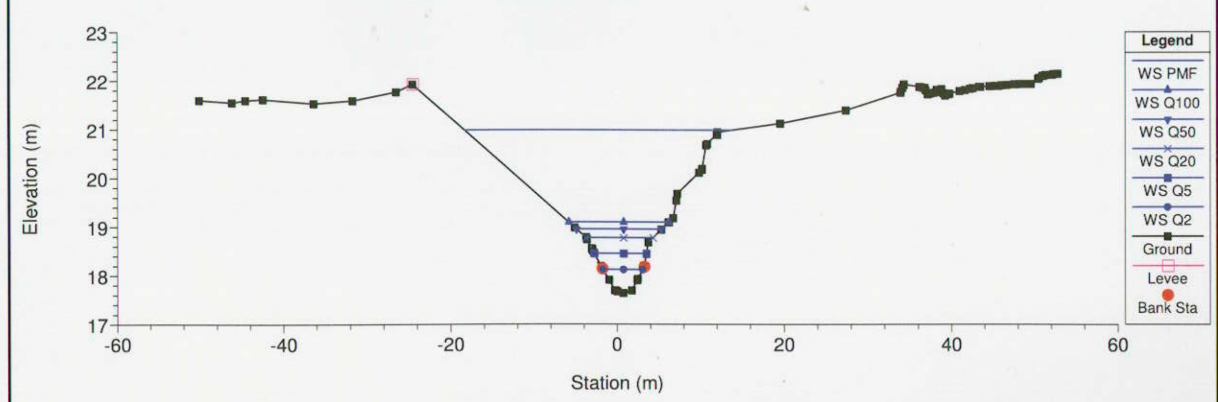
NSW EPA (1997a). Managing Urban Stormwater: Council Handbook.

NSW EPA (1997b). Managing Urban Stormwater: Treatment Techniques.

Pittwater Council (2001). Warriewood Valley Urban Land Release Water Management Specification. Prepared by Lawson & Treloar Pty Ltd.

APPENDIX A HEC-RAS RESULTS

Sector5 Warriewood Plan: DESIGN
River = Sector5 Reach = 01 RS = 107



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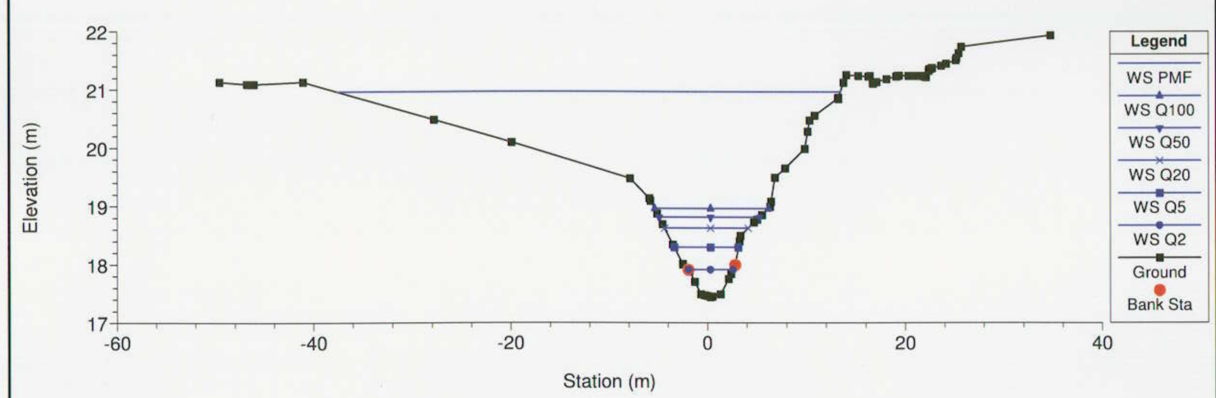

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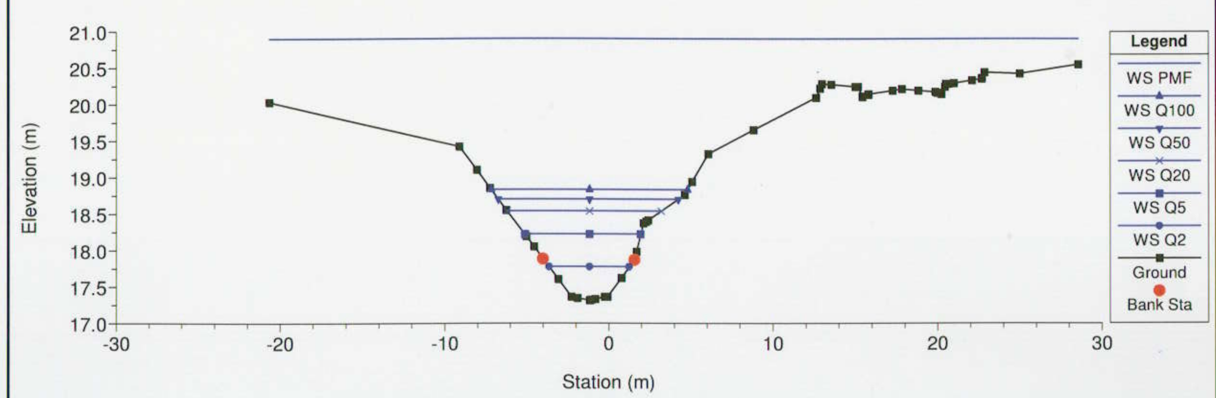

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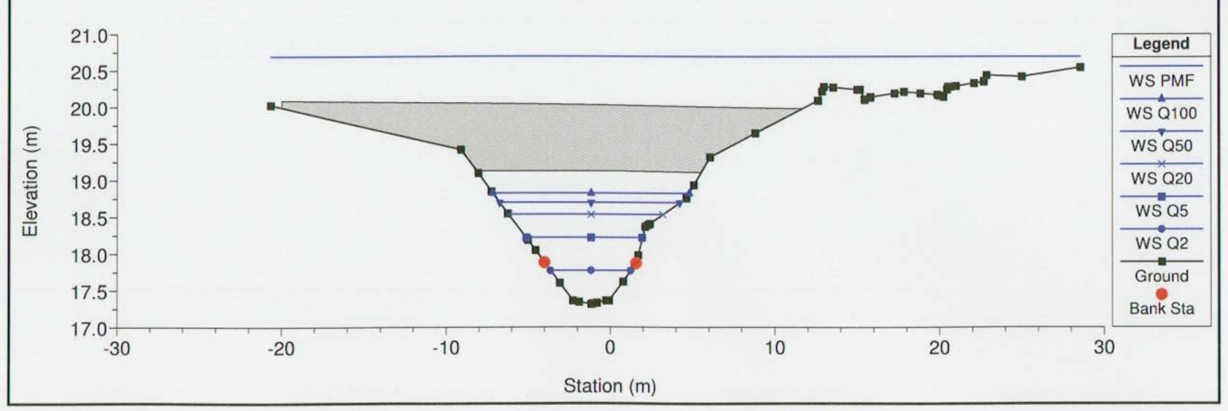

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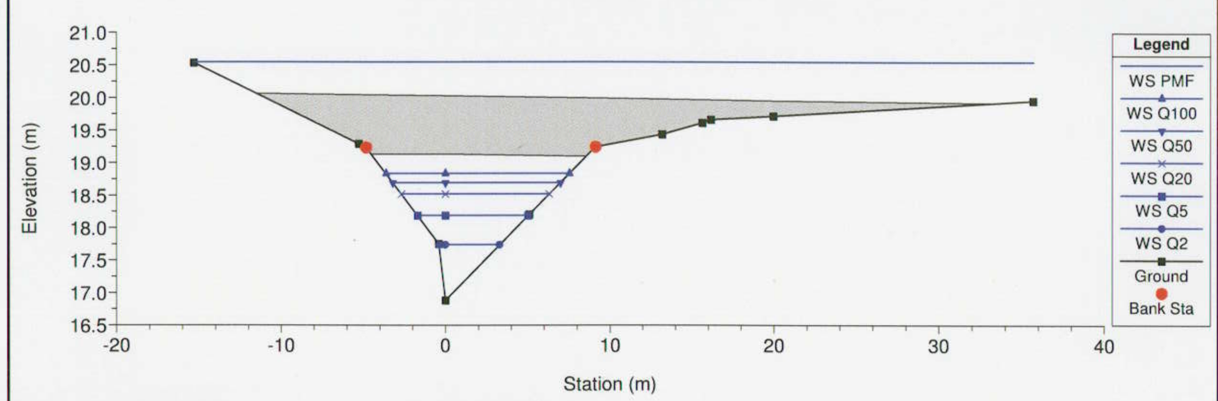

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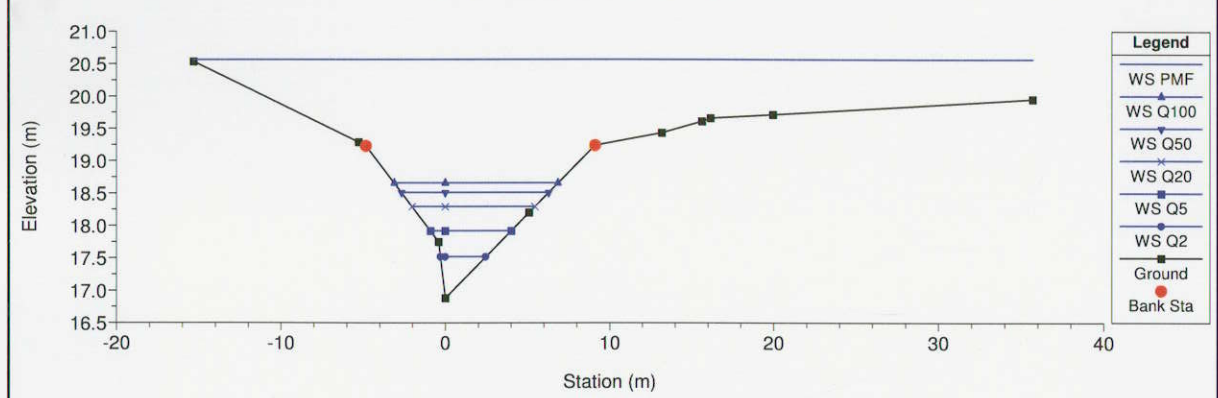

Sector5 Warriewood Plan: DESIGN
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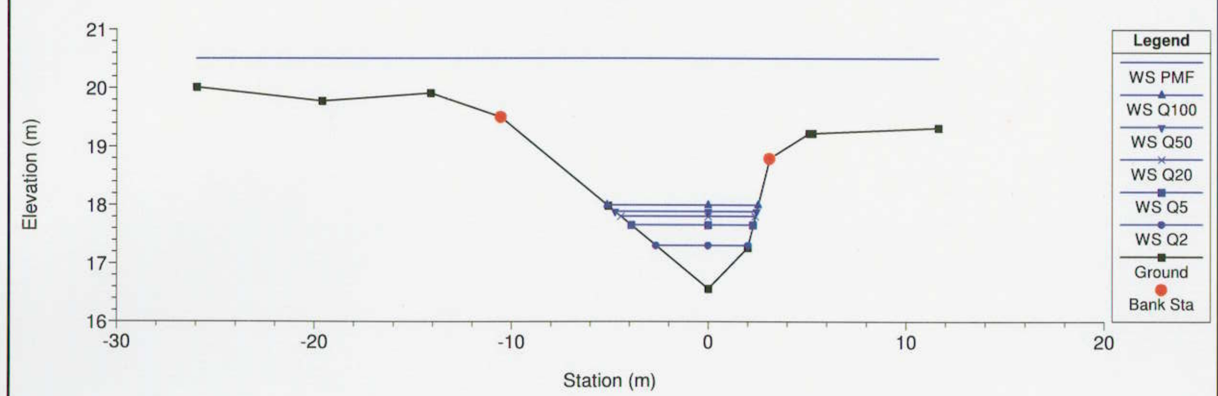

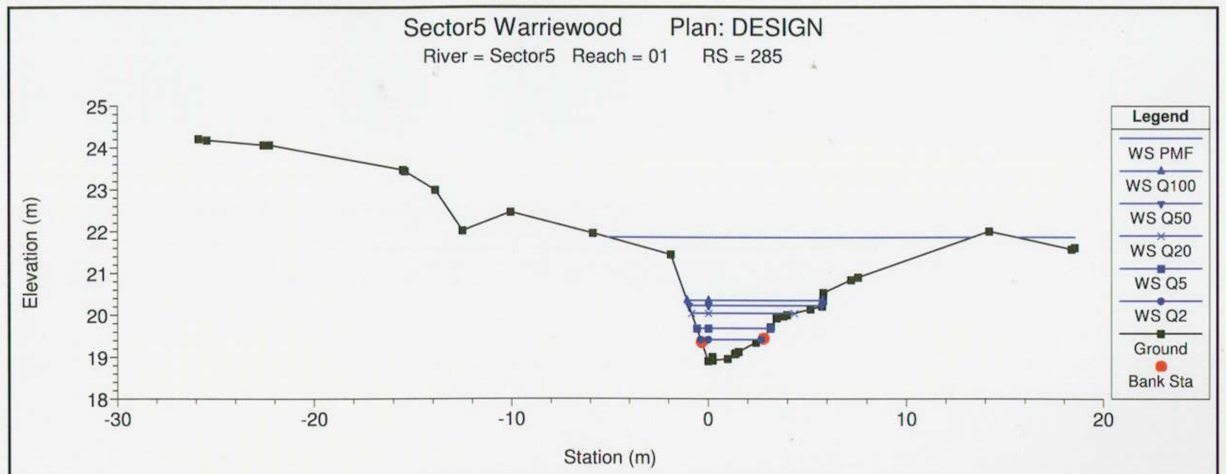
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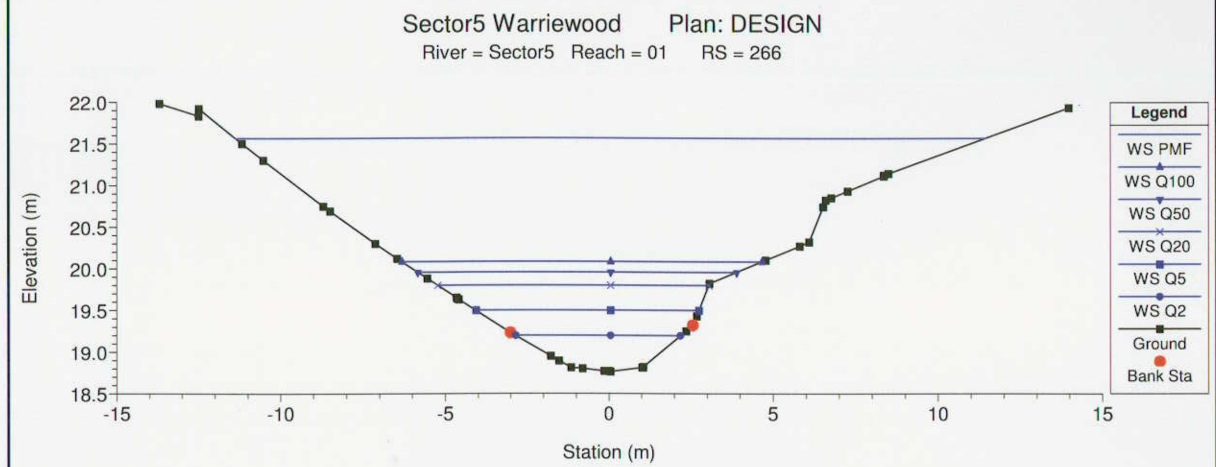
River = Sector5 Reach = 01 RS = 285
Elevation (m)
Station (m)
Legend
WS PMF
WS Q100
WS Q50
WS Q20
WS Q5
WS Q2
Ground
Bank Sta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River = Sector5 Reach = 01 RS = 266
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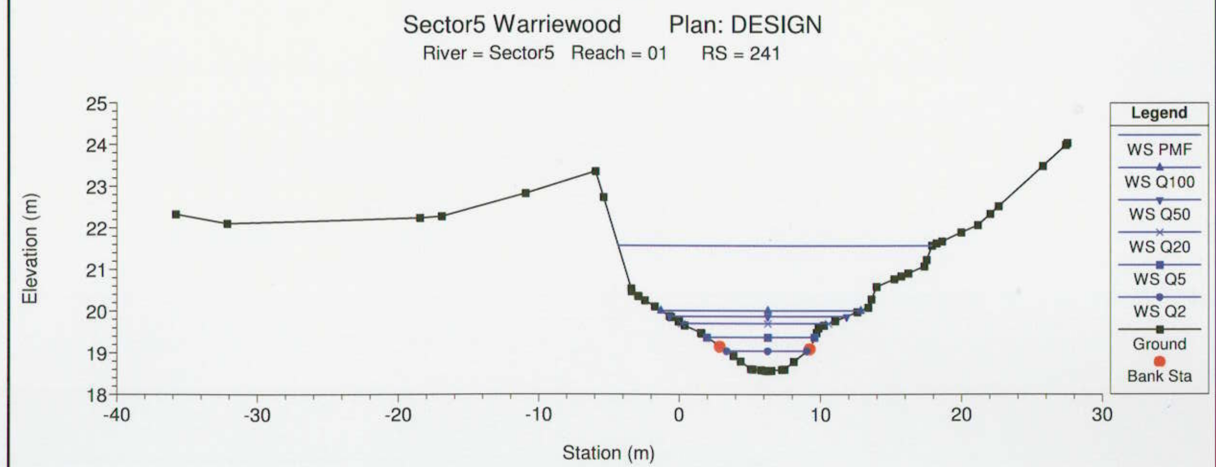
WS Q2
Ground
Bank Sta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Station (m)
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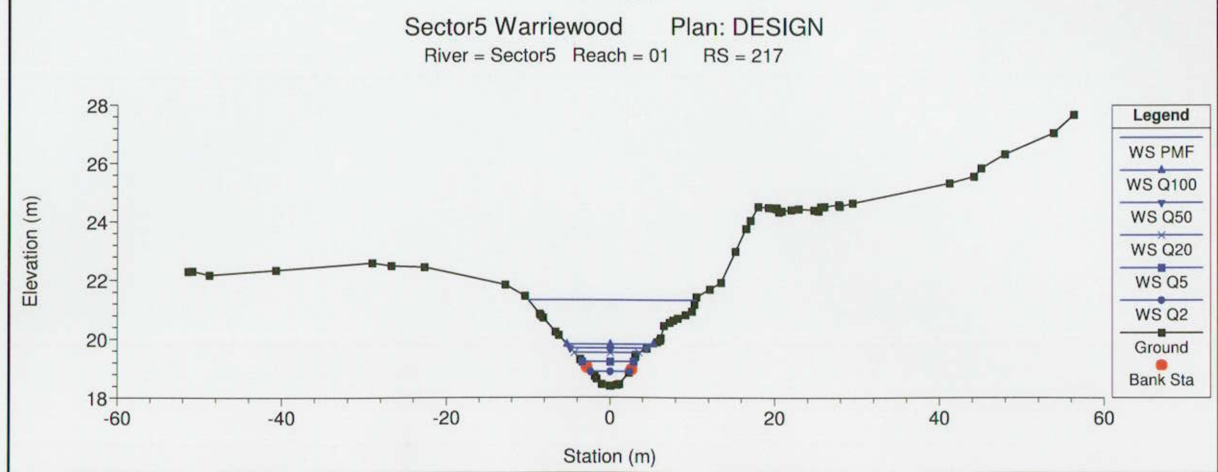
WS Q2
Ground
Bank Sta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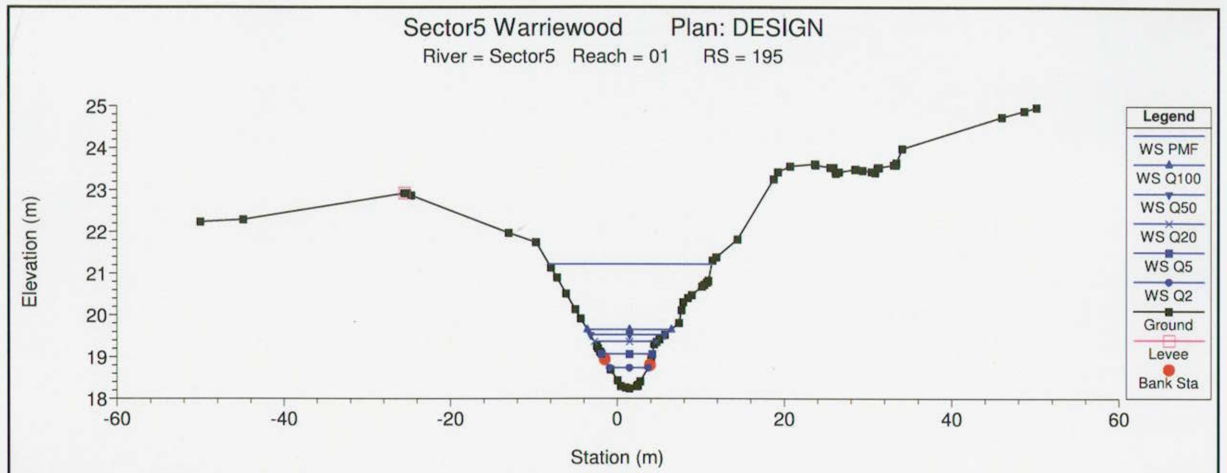
WS Q20
WS Q5
WS Q2
Ground
Bank Sta


Sector5 Warriewood Plan: DESIGN
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Station (m)
Legend
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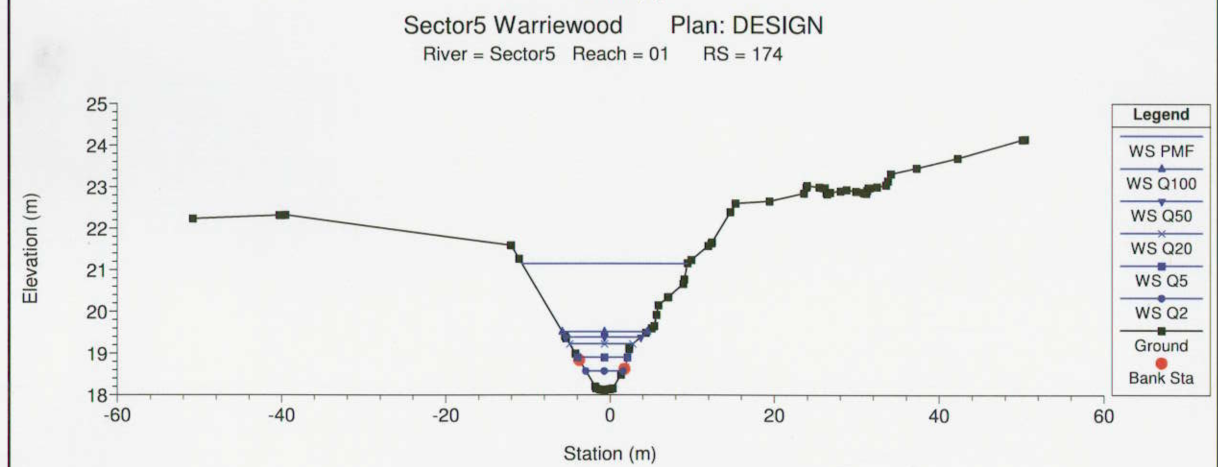
WS Q50
WS Q20
WS Q5
WS Q2
Ground
Levee
Bank Sta


Sector5 Warriewood Plan: DESIGN
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Station (m)
Legend
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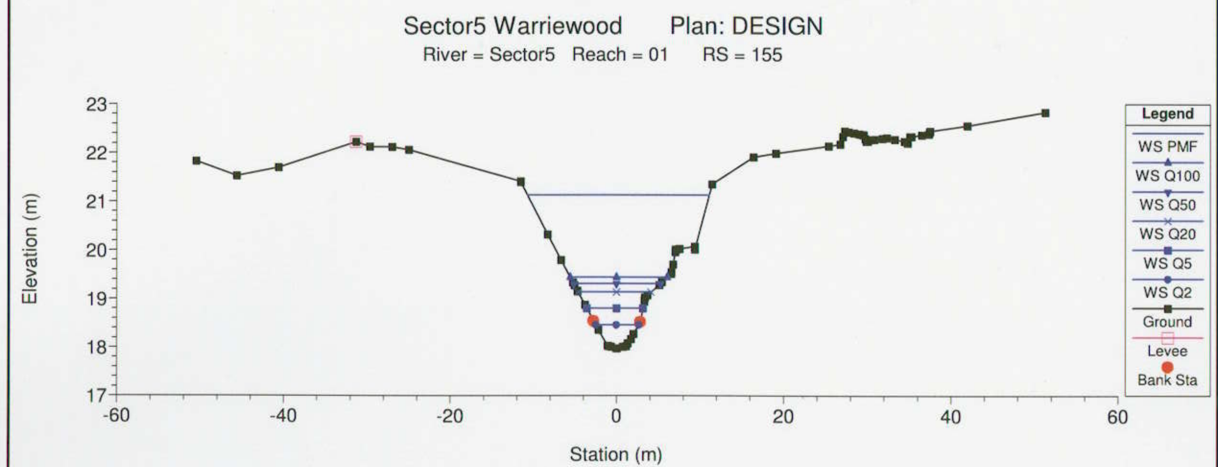
WS Q100
WS Q50
WS Q20
WS Q5
WS Q2
Ground
Bank Sta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Elevation (m)
Station (m)
Legend
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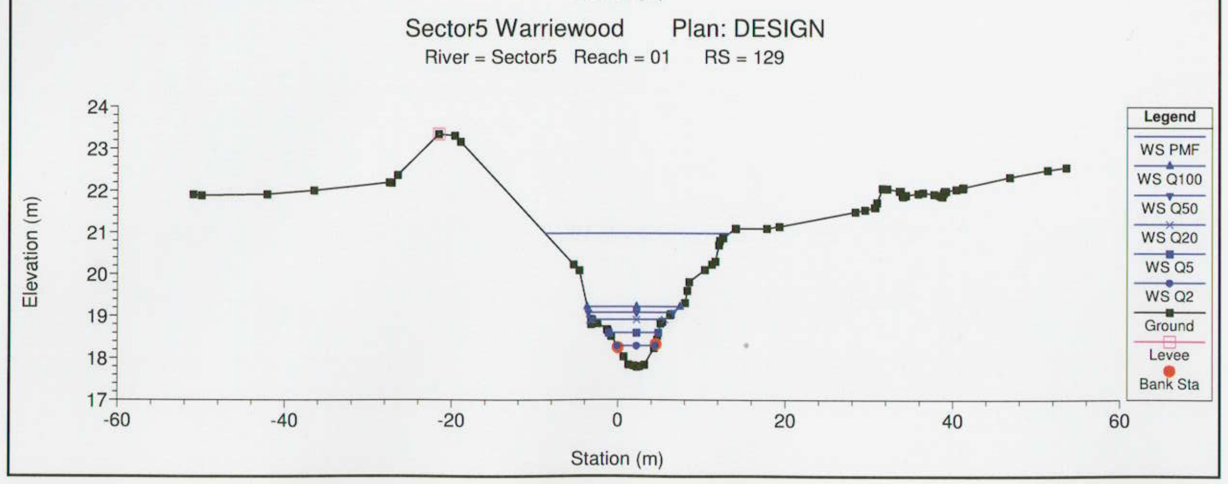
WS Q50
WS Q20
WS Q5
WS Q2
Ground
Levee
Bank Sta


Sector5 Warriewood Plan: DESIGN
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Elevation (m)
Station (m)
Legend
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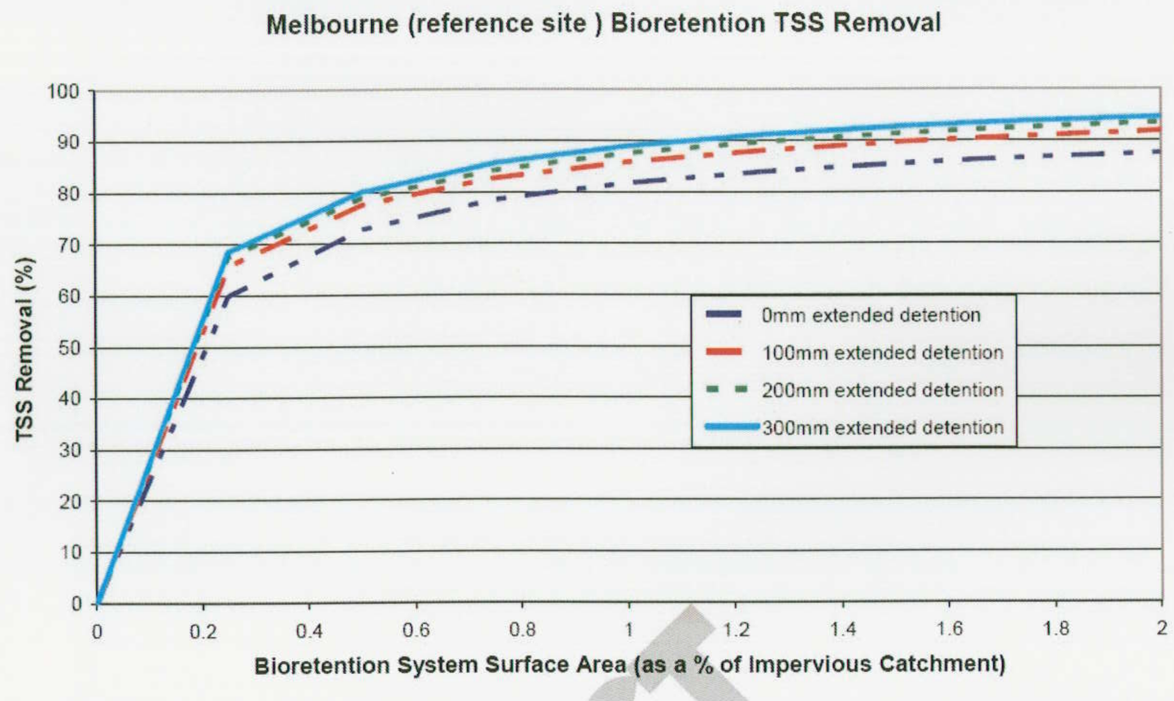
WS Q2
Ground
Levee
Bank Sta

APPENDIX B WATER QUALITY



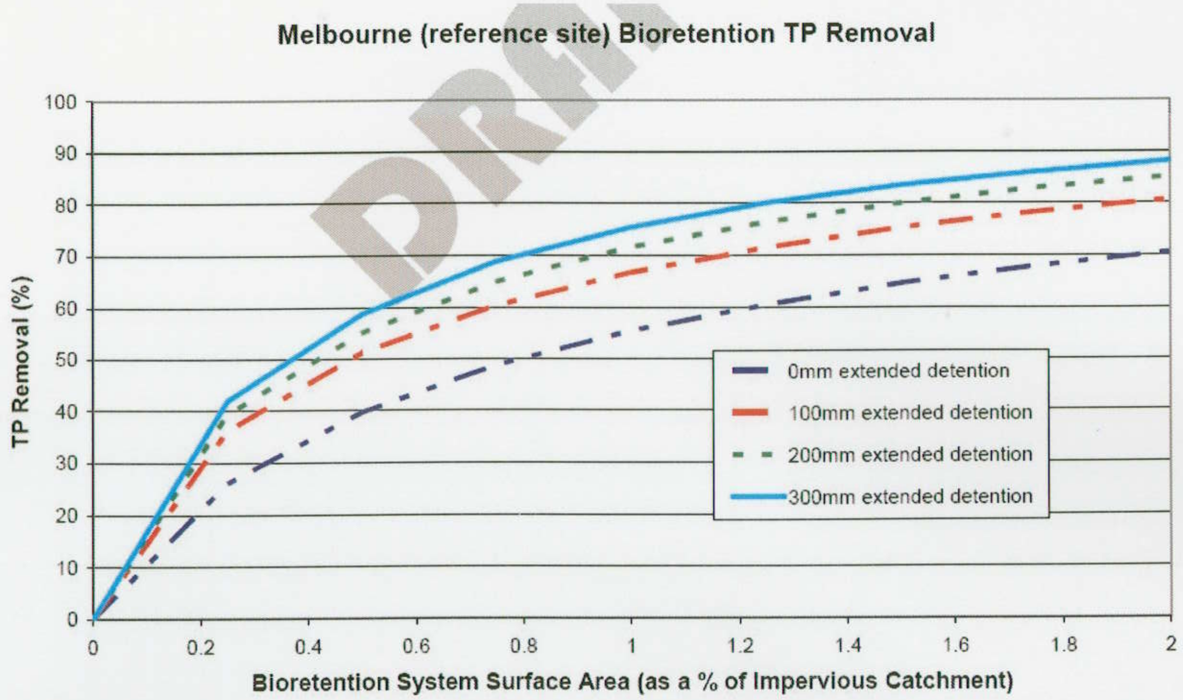


Figure 6.3 Bioretention system TP removal performance in Melbourne

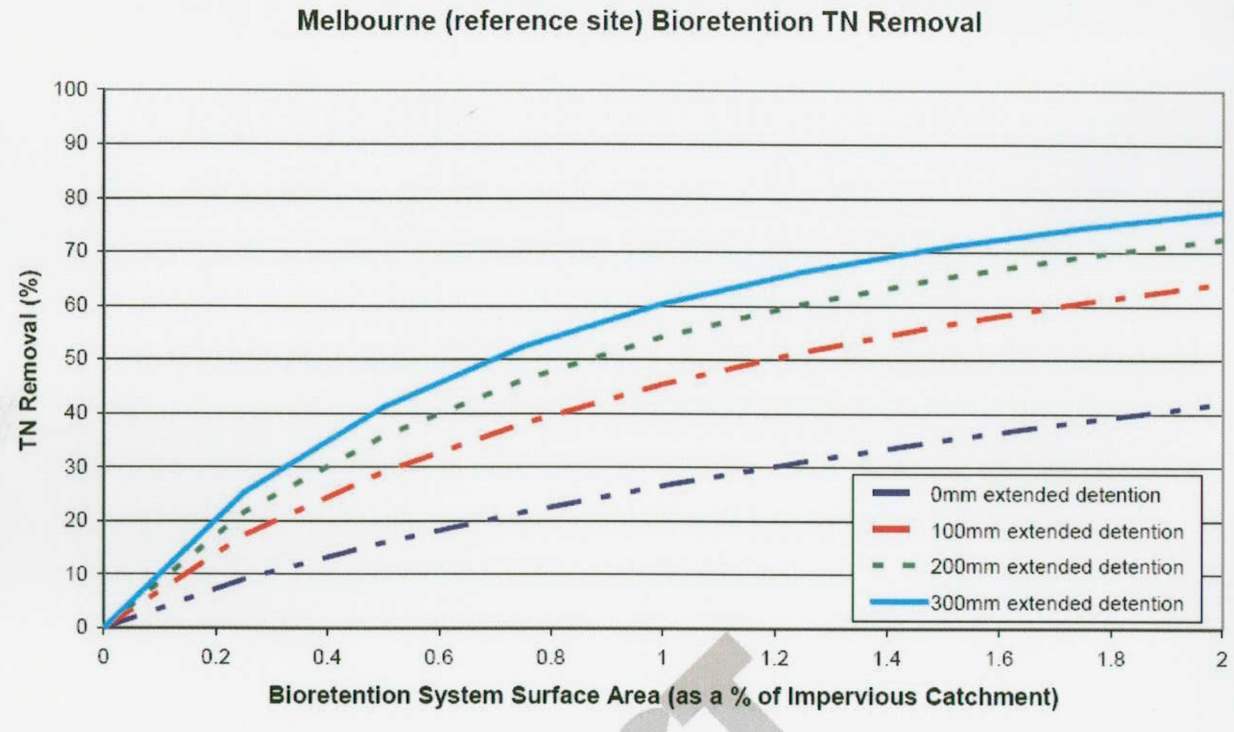


Figure 6.4 Bioretention system TN removal performance in Melbourne

CATCHMENT DETAILS

RES	0.869	ha
LOSS	4	mm
ROAD	0.475	ha
LOSS	1	mm
ROOF	0.711	ha
LOSS	0	mm
TOT AREA	2.055	ha

WATER REUSE

NO:	55	DWELLINGS
RE-USE	0.45	m3/d
	24.75	m3/d
RAINWATER STORAGE	8	m3/dwelling
	440	m3 site

PAN FACTOR	0.8	
BIORETENTION VOL	160	m3
BIORETENTION SA	320	m2
SEEPAGE	864	mm/d
	0.036	m/h

EVAP

	mm/d
Apr	2.83
Aug	1.87
Dec	5.26
Feb	4.82
Jan	5.81
Jul	1.39
Jun	1.43
Mar	4.13
May	1.87
Nov	5.07
Oct	4.1
Sep	2.93

SUBCATCHMENT	AREA	% IMP	Cv * Area	RATIO Cv*Area	TSS (mg/L)	TN (mg/L)	TP (mg/L)
Lots	0.869	16	0.28	0.22	150.0	1.85	0.40
Roads	0.475	85	0.38	0.29	250.0	1.12	0.25
Roofs	0.711	100	0.64	0.49	35.0	0.60	0.13
Total	2.055		1.30	1.00	122.5	1.02	0.22

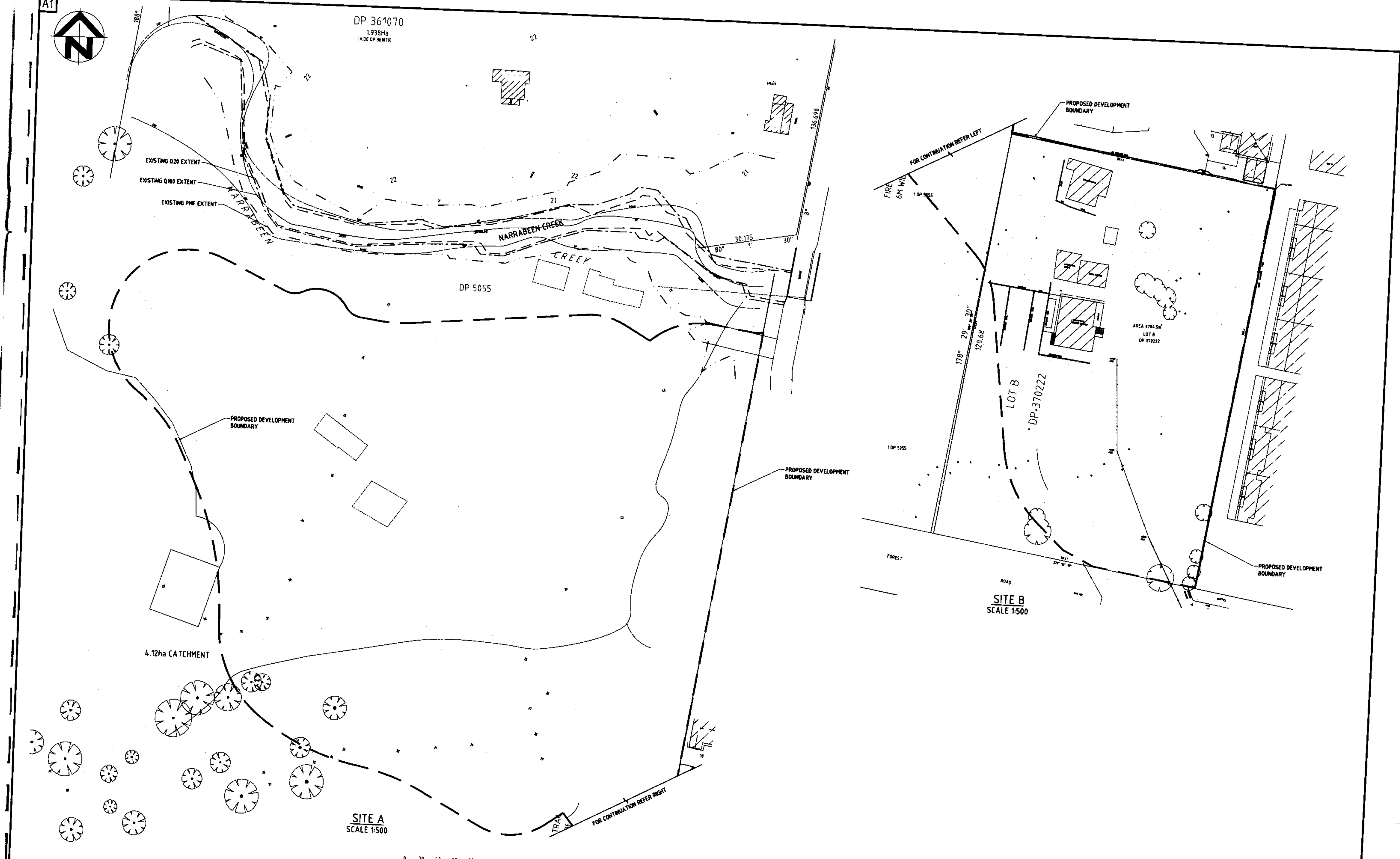
VOLUMETRIC RUNOFF COEFFICIENTS

Pervious Cv	0.2
Impervious Cv	0.9

	% Removal		
BIRETENTION PERFORMANCE	85.0	70.0	77.0
GPT PERFORMANCE	75.0	0.0	20.0

	DATE	RAINFALL mm	RES RUNOFF	ROAD RUNOFF	ROOF RUNOFF	RAINWATER STORAGE	ROOF OVERFLOW	RAINWATER DEMAND	RAINWATER REUSE	RAINWATER STORAGE BALANCE	TOT RUNOFF	BIORETENTION VOL Initial	OVERFLOW	SA
										120				
Jan	1/01/1972	0.0	0.0	0.0	0.0	120.0	0.0	24.8	24.8	95.3	0.0	0.0	0.0	0.0
Jan	2/01/1972	0.0	0.0	0.0	0.0	95.3	0.0	24.8	24.8	70.5	0.0	0.0	0.0	0.0
Jan	3/01/1972	0.0	0.0	0.0	0.0	70.5	0.0	24.8	24.8	45.8	0.0	0.0	0.0	0.0
Jan	4/01/1972	0.0	0.0	0.0	0.0	45.8	0.0	24.8	24.8	21.0	0.0	0.0	0.0	0.0
Jan	5/01/1972	0.0	0.0	0.0	0.0	21.0	0.0	24.8	21.0	0.0	0.0	0.0	0.0	0.0
Jan	6/01/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Jan	7/01/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Jan	8/01/1972	0.5	0.0	0.0	2.3	2.3	0.0	24.8	2.3	0.0	0.0	0.0	0.0	0.0
Jan	9/01/1972	10.2	15.3	16.5	46.4	46.4	0.0	0.0	0.0	46.4	31.8	31.8	0.0	320.0
Jan	10/01/1972	0.0	0.0	0.0	0.0	46.4	0.0	24.8	24.8	21.7	0.0	0.0	0.0	0.0
Jan	11/01/1972	0.0	0.0	0.0	0.0	21.7	0.0	24.8	21.7	0.0	0.0	0.0	0.0	0.0
Jan	12/01/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Jan	13/01/1972	22.9	46.5	39.3	104.2	104.2	0.0	0.0	0.0	104.2	85.8	85.8	0.0	320.0
Jan	14/01/1972	42.9	95.8	75.2	195.2	299.4	0.0	0.0	0.0	299.4	170.9	160.0	10.9	320.0
Jan	15/01/1972	66.8	154.6	118.0	303.9	440.0	163.3	0.0	0.0	440.0	435.9	160.0	275.9	320.0
Jan	16/01/1972	43.4	97.0	76.1	197.5	440.0	197.5	0.0	0.0	440.0	370.5	160.0	210.5	320.0
Jan	17/01/1972	4.8	2.0	6.8	21.8	440.0	21.8	0.0	0.0	440.0	30.6	30.6	0.0	320.0
Jan	18/01/1972	44.2	99.0	77.5	201.1	440.0	201.1	0.0	0.0	440.0	377.6	160.0	217.6	320.0
Jan	19/01/1972	14.7	26.3	24.6	66.9	440.0	66.9	0.0	0.0	440.0	117.8	117.8	0.0	320.0
Jan	20/01/1972	0.0	0.0	0.0	0.0	440.0	0.0	24.8	24.8	415.3	0.0	0.0	0.0	0.0
Jan	21/01/1972	0.0	0.0	0.0	0.0	415.3	0.0	24.8	24.8	390.5	0.0	0.0	0.0	0.0
Jan	22/01/1972	0.0	0.0	0.0	0.0	390.5	0.0	24.8	24.8	365.8	0.0	0.0	0.0	0.0
Jan	23/01/1972	5.8	4.4	8.6	26.4	392.1	0.0	0.0	0.0	392.1	13.0	13.0	0.0	320.0
Jan	24/01/1972	9.4	13.3	15.1	42.8	434.9	0.0	0.0	0.0	434.9	28.4	28.4	0.0	320.0
Jan	25/01/1972	16.5	30.8	27.8	75.1	440.0	70.0	0.0	0.0	440.0	128.6	128.6	0.0	320.0
Jan	26/01/1972	57.4	131.5	101.2	261.2	440.0	261.2	0.0	0.0	440.0	493.8	160.0	333.8	320.0
Jan	27/01/1972	5.3	3.2	7.7	24.1	440.0	24.1	0.0	0.0	440.0	35.0	35.0	0.0	320.0
Jan	28/01/1972	0.5	0.0	0.0	2.3	440.0	2.3	24.8	24.8	415.3	2.3	2.3	0.0	320.0
Jan	29/01/1972	0.0	0.0	0.0	0.0	415.3	0.0	24.8	24.8	390.5	0.0	0.0	0.0	0.0
Jan	30/01/1972	0.0	0.0	0.0	0.0	390.5	0.0	24.8	24.8	365.8	0.0	0.0	0.0	0.0
Jan	31/01/1972	0.0	0.0	0.0	0.0	365.8	0.0	24.8	24.8	341.0	0.0	0.0	0.0	0.0
Feb	1/02/1972	0.0	0.0	0.0	0.0	341.0	0.0	24.8	24.8	316.3	0.0	0.0	0.0	0.0
Feb	2/02/1972	0.0	0.0	0.0	0.0	316.3	0.0	24.8	24.8	291.5	0.0	0.0	0.0	0.0
Feb	3/02/1972	0.8	0.0	0.0	3.6	295.1	0.0	24.8	24.8	270.4	0.0	0.0	0.0	0.0
Feb	4/02/1972	0.0	0.0	0.0	0.0	270.4	0.0	24.8	24.8	245.6	0.0	0.0	0.0	0.0
Feb	5/02/1972	21.3	42.6	36.4	96.9	342.5	0.0	0.0	0.0	342.5	79.0	79.0	0.0	320.0
Feb	6/02/1972	8.1	10.1	12.7	36.9	379.4	0.0	0.0	0.0	379.4	22.8	22.8	0.0	320.0
Feb	7/02/1972	6.9	7.1	10.6	31.4	410.8	0.0	0.0	0.0	410.8	17.7	17.7	0.0	320.0
Feb	8/02/1972	18.3	35.2	31.0	83.3	440.0	54.1	0.0	0.0	440.0	120.3	120.3	0.0	320.0
Feb	9/02/1972	3.0	0.0	3.6	13.6	440.0	13.6	0.0	0.0	440.0	17.2	17.2	0.0	320.0
Feb	10/02/1972	0.0	0.0	0.0	0.0	440.0	0.0	0.0	0.0	440.0	0.0	0.0	0.0	0.0
Feb	11/02/1972	6.9	7.1	10.6	31.4	440.0	31.4	0.0	0.0	440.0	49.1	49.1	0.0	320.0
Feb	12/02/1972	3.0	0.0	3.6	13.6	440.0	13.6	0.0	0.0	440.0	17.2	17.2	0.0	320.0
Feb	13/02/1972	0.0	0.0	0.0	0.0	440.0	0.0	24.8	24.8	415.3	0.0	0.0	0.0	0.0
Feb	14/02/1972	0.0	0.0	0.0	0.0	415.3	0.0	24.8	24.8	390.5	0.0	0.0	0.0	0.0
Feb	15/02/1972	0.0	0.0	0.0	0.0	390.5	0.0	24.8	24.8	365.8	0.0	0.0	0.0	0.0
Feb	16/02/1972	0.0	0.0	0.0	0.0	365.8	0.0	24.8	24.8	341.0	0.0	0.0	0.0	0.0
Feb	17/02/1972	1.8	0.0	1.4	8.2	349.2	0.0	0.0	0.0	349.2	1.4	1.4	0.0	320.0
Feb	18/02/1972	16.5	30.8	27.8	75.1	424.3	0.0	0.0	0.0	424.3	58.6	58.6	0.0	320.0
Feb	19/02/1972	0.0	0.0	0.0	0.0	424.3	0.0	24.8	24.8	399.5	0.0	0.0	0.0	0.0
Feb	20/02/1972	0.0	0.0	0.0	0.0	399.5	0.0	24.8	24.8	374.7	0.0	0.0	0.0	0.0
Feb	21/02/1972	5.6	3.9	8.3	25.5	400.2	0.0	24.8	24.8	375.5	12.2	12.2	0.0	320.0
Feb	22/02/1972	0.0	0.0	0.0	0.0	375.5	0.0	24.8	24.8	350.7	0.0	0.0	0.0	0.0
Feb	23/02/1972	0.0	0.0	0.0	0.0	350.7	0.0	24.8	24.8	326.0	0.0	0.0	0.0	0.0
Feb	24/02/1972	0.0	0.0	0.0	0.0	326.0	0.0	24.8	24.8	301.2	0.0	0.0	0.0	0.0
Feb	25/02/1972	0.0	0.0	0.0	0.0	301.2	0.0	0.0	0.0	301.2	0.0	0.0	0.0	0.0
Feb	26/02/1972	2.5	0.0	2.7	11.4	312.6	0.0	0.0	0.0	312.6	2.7	2.7	0.0	320.0
Feb	27/02/1972	2.0	0.0	1.8	9.1	321.7	0.0	0.0	0.0	321.7	1.8	1.8	0.0	320.0
Feb	28/02/1972	0.0	0.0	0.0	0.0	321.7	0.0	24.8	24.8	296.9	0.0	0.0	0.0	0.0
Feb	29/02/1972	14.0	24.6	23.3	63.7	360.7	0.0	0.0	0.0	360.7	47.9	47.9	0.0	320.0
Mar	1/03/1972	0.0	0.0	0.0	0.0	360.7	0.0	24.8	24.8	335.9	0.0	0.0	0.0	0.0
Mar	2/03/1972	18.0	34.5	30.5	81.9	417.8	0.0	0.0	0.0	417.8	67.5	67.5	0.0	320.0
Mar	3/03/1972	4.1	0.2	5.6	18.7	436.5	0.0	0.0	0.0	436.5	5.8	5.8	0.0	320.0
Mar	4/03/1972	0.0	0.0	0.0	0.0	436.5	0.0	24.8	24.8	411.7	0.0	0.0	0.0	0.0
Mar	5/03/1972	3.8	0.0	5.0	17.3	429.0	0.0	0.0	0.0	429.0	18.8	18.8	0.0	320.0
Mar	6/03/1972	42.9	95.8	75.2	195.2	440.0	184.2	0.0	0.0	440.0	355.1	160.0	195.1	320.0
Mar	7/03/1972	101.1	239.0	179.6	460.0	440.0	460.0	0.0	0.0	440.0	878.6	160.0	718.6	320.0
Mar	8/03/1972	6.4	5.9	9.7	29.1	440.0	29.1	0.0	0.0	440.0	44.7	44.7	0.0	320.0
Mar	9/03/1972	1.3	0.0	0.5	5.9	440.0	5.9	0.0	0.0	440.0	6.5	6.5	0.0	320.0
Mar	10/03/1972	0.0	0.0	0.0	0.0	440.0	0.0	24.8	24.8	415.3	0.0	0.0	0.0	0.0
Mar	11/03/1972	1.0	0.0	0.0	4.5	419.8	0.0	0.0	0.0	419.8	4.5	4.5	0.0	320.0
Mar	12/03/1972	0.0	0.0	0.0	0.0	419.8	0.0	24.8	24.8	395.0	0.0	0.0	0.0	0.0
Mar	13/03/1972	0.0	0.0	0.0	0.0	395.0	0.0	24.8	24.8	370.3	0.0	0.0	0.0	0.0
Mar	14/03/1972	0.0	0.0	0.0	0.0	370.3	0.0	24.8	24.8	345.5	0.0	0.0	0.0	0.0
Mar	15/03/1972	0.0	0.0	0.0	0.0	345.5	0.0	24.8	24.8	320.8	0.0	0.0	0.0	0.0
Mar	16/03/1972	0.0	0.0	0.0	0.0	320.8	0.0	24.8	24.8	296.0	0.0	0.0	0.0	0.0
Mar	17/03/1972	0.0	0.0	0.0	0.0	296.0	0.0	24.8	24.8	271.3	0.0	0.0	0.0	0.0
Mar	18/03/1972	0.0	0.0	0.0	0.0	271.3	0.0	24.8	24.8	246.5	0.0	0.0	0.0	0.0
Mar	19/03/1972	0.0	0.0	0.0	0.0	246.5	0.0	24.8	24.8	221.8	0.0	0.0	0.0	0.0
Mar	20/03/1972	0.0	0.0	0.0	0.0	221.8	0.0	24.8	24.8	197.0	0.0	0.0	0.0	0.0
Mar	21/03/1972	0.0	0.0	0.0	0.0	197.0	0.0	24.8	24.8	172.3	0.0	0.0	0.0	0.0
Mar	22/03/1972	0.0	0.0	0.0	0.0	172.3	0.0	24.8	24.8	147.5	0.0	0.0	0.0	0.0
Mar	23/03/1972	3.0	0.0	3.6	13.6	161.2	0.0	0.0	0.0	161.2	3.6	3.6	0.0	320.0
Mar	24/03/1972	16.5	30.8	27.8	75.1	236.3	0.0	0.0	0.0	236.3	58.6	58.6	0.0	320.0
Mar	25/03/1972	0.0	0.0	0.0	0.0	236.3	0.0	24.8	24.8	211.5	0.0	0.0	0.0	0.0
Mar	26/03/1972	0.0	0.0	0.0	0.0	211.5	0.0	24.8	24.8	186.8	0.0	0.0	0.0	0.0
Mar	27/03/1972	0.0	0.0	0.0	0.0	186.8	0.0	24.8	24.8	162.0	0.0	0.0	0.0	0.0
Mar	28/03/1972	0.0	0.0	0.0	0.0	162.0	0.0	24.8	24.8	137.3	0.0	0.0	0.0	0.0
Mar	29/03/1972	0.0	0.0	0.0	0.0	137.3	0.0	24.8	24.8	112.5	0.0	0.0	0.0	0.0
Mar	30/03/1972	0.0	0.0	0.0	0.0	112.5	0.0	24.8	24.8	87.8	0.0	0.0	0.0	0.0
Mar	31/03/1972	0.0	0.0	0.0	0.0	87.8	0.0	24.8	24.8	63.0	0.0	0.0	0.0	0.0
Apr	1/04/1972	0.0	0.0	0.0	0.0	63.0	0.0	24.8	24.8	38.3	0.0	0.0	0.0	0.0
Apr	2/04/1972	0.0	0.0	0.0	0.0	38.3	0.0	24.8	24.8	13.5	0.0	0.0	0.0	0.0
Apr	3/04/1972	8.4	10.8	13.3	38.2	51.7	0.0	0.0	0.0	51.7	24.1	24.1	0.0	320.0
Apr	4/04/1972	44.2	99.0	77.5	201.1	252.8	0.0	0.0	0.0	252.8	176.5	160.0	16.5	320.0
Apr	5/04/1972	0.0	0.0	0.0	0.0	252.8	0.0	24.8	24.8	228.1	0.0	0.0	0.0	0.0
Apr	6/04/1972	3.3	0.0	4.1	15.0	243.1	0.0	0.0	0.0	243.1	4.1	4.1	0.0	320.0
Apr	7/04/1972	0.0	0.0	0.0	0.0	243.1	0.0	24.8	24.8	218.3	0.0	0.0	0.0	0.0
Apr	8/04/1972	0.0	0.0	0.0	0.0	218.3	0.0	24.8	24.8	193.6	0.0	0.0	0.0	0.0
Apr	9/04/1972	0.0	0.0	0.0	0.0	193.6	0.0	24.8	24.8	168.8	0.0	0.0	0.0	0.0
Apr	10/04/1972	0.0	0.0	0.0	0.0	168.8	0.0	24.8	24.8	144.1	0.0	0.0	0.0	0.0
Apr	11/04/1972	0.0	0.0	0.0	0.0	144.1	0.0	24.8	24.8	119.3	0.0	0.0	0.0	0.0
Apr	12/04/1972	0.0	0.0	0.0	0.0	119.3	0.0	24.8	24.8	94.6	0.0	0.0	0.0	0.0
Apr	13/04/1972	0.0	0.0	0.0	0.0	94.6	0.0	24.8	24.8	69.8	0.0	0.0	0.0	0.0
Apr	14/04/1972	0.0	0.0	0.0	0.0	69.8	0.0	24.8	24.8	45.1	0.0	0.0	0.0	0.0
Apr	15/04/1972	3.8	0.0	5.0	17.3	62.4	0.0	24.8	24.8	37.6	5.0	5.0	0.0	320.0
Apr	16/04/1972	0.0	0.0	0.0	0.0	37.6	0.0	24.8	24.8	12.9	0.0	0.0	0.0	0.0
Apr	17/04/1972	0.0	0.0	0.0	0.0	12.9	0.0	24.8	12.9	0.0	0.0	0.0	0.0	0.0
Apr	18/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	19/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	20/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	21/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	22/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	23/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	24/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	25/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	26/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	27/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	28/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0
Apr	29/04/1972	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0	0.0

DATE	EVAP mm	EVAP m3	SEEPAGE m3	BIORETENTION OUTFLOW Final	WATER QUALITY - SITE LOADS TSS kg	TN kg	TP kg	LOADS CAPTURED - RAINWATER REUSE TSS kg	TN kg	TP kg	GPT OVERFLOW LOADS OUT - GPT TSS kg	TN kg	TP kg	BIORETENTION+GPT LOADS OUT - SEEPAGE TSS kg	TN kg	TP kg	WATER QUALITY - OUT TSS kg	TN kg	TP kg
1/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.02	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9/01/1972	5.81	1.9	31.8	29.9	3.9	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
10/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.02	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13/01/1972	5.81	1.9	85.8	84.0	10.5	0.1	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0
14/01/1972	5.81	1.9	160.0	169.1	20.9	0.2	0.0	0.0	0.00	0.00	0.3	0.0	0.0	0.7	0.0	0.0	1.1	0.1	0.0
15/01/1972	5.81	1.9	160.0	434.1	53.4	0.4	0.1	0.0	0.00	0.00	8.4	0.3	0.1	0.7	0.0	0.0	9.2	0.3	0.1
16/01/1972	5.81	1.9	160.0	368.6	45.4	0.4	0.1	0.0	0.00	0.00	6.4	0.4	0.1	0.7	0.0	0.0	7.2	0.4	0.1
17/01/1972	5.81	1.9	30.6	28.8	3.8	0.0	0.0	0.0	0.00	0.00	0.9	0.0	0.0	0.1	0.0	0.0	1.1	0.0	0.0
18/01/1972	5.81	1.9	160.0	375.7	46.2	0.4	0.1	0.0	0.00	0.00	11.6	0.4	0.1	0.7	0.0	0.0	12.3	0.4	0.1
19/01/1972	5.81	1.9	117.8	115.9	14.4	0.1	0.0	0.0	0.00	0.00	3.6	0.1	0.0	0.5	0.0	0.0	4.1	0.2	0.0
20/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23/01/1972	5.81	1.9	13.0	11.2	1.6	0.0	0.0	0.0	0.00	0.00	0.4	0.0	0.0	0.1	0.0	0.0	0.5	0.0	0.0
24/01/1972	5.81	1.9	28.4	26.5	3.5	0.0	0.0	0.0	0.00	0.00	0.9	0.0	0.0	0.1	0.0	0.0	1.0	0.0	0.0
25/01/1972	5.81	1.9	128.6	126.7	15.7	0.1	0.0	0.0	0.00	0.00	3.9	0.1	0.0	0.6	0.0	0.0	4.5	0.2	0.0
26/01/1972	5.81	1.9	160.0	491.9	60.5	0.5	0.1	0.0	0.00	0.00	15.1	0.5	0.1	0.7	0.0	0.0	15.9	0.6	0.1
27/01/1972	5.81	1.9	35.0	33.2	4.3	0.0	0.0	0.0	0.00	0.00	1.1	0.0	0.0	0.2	0.0	0.0	1.2	0.0	0.0
28/01/1972	5.81	1.9	2.3	0.4	0.3	0.0	0.0	3.0	0.03	0.01	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
29/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31/01/1972	5.81	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5/02/1972	4.82	1.5	79.0	77.5	9.7	0.1	0.0	0.0	0.00	0.00	2.4	0.1	0.0	0.4	0.0	0.0	2.8	0.1	0.0
6/02/1972	4.82	1.5	22.8	21.3	2.8	0.0	0.0	0.0	0.00	0.00	0.7	0.0	0.0	0.1	0.0	0.0	0.8	0.0	0.0
7/02/1972	4.82	1.5	17.7	16.2	2.2	0.0	0.0	0.0	0.00	0.00	0.5	0.0	0.0	0.1	0.0	0.0	0.6	0.0	0.0
8/02/1972	4.82	1.5	120.3	118.7	14.7	0.1	0.0	0.0	0.00	0.00	3.7	0.1	0.0	0.6	0.0	0.0	4.2	0.2	0.0
9/02/1972	4.82	1.5	17.2	15.7	2.1	0.0	0.0	0.0	0.00	0.00	0.5	0.0	0.0	0.1	0.0	0.0	0.6	0.0	0.0
10/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/02/1972	4.82	1.5	49.1	47.6	6.0	0.1	0.0	0.0	0.00	0.00	1.5	0.1	0.0	0.2	0.0	0.0	1.7	0.1	0.0
12/02/1972	4.82	1.5	17.2	15.7	2.1	0.0	0.0	0.0	0.00	0.00	0.5	0.0	0.0	0.1	0.0	0.0	0.6	0.0	0.0
13/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17/02/1972	4.82	1.5	1.4	0.0	0.2	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18/02/1972	4.82	1.5	58.6	57.0	7.2	0.1	0.0	0.0	0.00	0.00	1.8	0.1	0.0	0.3	0.0	0.0	2.1	0.1	0.0
19/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21/02/1972	4.82	1.5	12.2	10.6	1.5	0.0	0.0	3.0	0.03	0.01	0.4	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0
22/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/02/1972	4.82	1.5	2.7	1.1	0.3	0.0	0.0	0.0	0.00	0.00	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
27/02/1972	4.82	1.5	1.8	0.3	0.2	0.0	0.0	0.0	0.00	0.00	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
28/02/1972	4.82	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/02/1972	4.82	1.5	47.9	46.4	5.9	0.0	0.0	0.0	0.00	0.00	1.5	0.0	0.0	0.2	0.0	0.0	1.7	0.1	0.0
1/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2/03/1972	4.13	1.3	67.5	66.2	8.3	0.1	0.0	0.0	0.00	0.00	2.1	0.1	0.0	0.3	0.0	0.0	2.4	0.1	0.0
3/03/1972	4.13	1.3	5.8	4.5	0.7	0.0	0.0	0.0	0.00	0.00	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
4/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5/03/1972	4.13	1.3	18.8	17.4	2.3	0.0	0.0	0.0	0.00	0.00	0.6	0.0	0.0	0.1	0.0	0.0	0.7	0.0	0.0
6/03/1972	4.13	1.3	160.0	353.8	43.5	0.4	0.1	0.0	0.00	0.00	10.9	0.4	0.1	0.7	0.0	0.0	11.6	0.4	0.1
7/03/1972	4.13	1.3	160.0	877.2	107.6	0.9	0.2	0.0	0.00	0.00	26.9	0.9	0.2	0.7	0.0	0.0	27.6	0.9	0.2
8/03/1972	4.13	1.3	44.7	43.4	5.5	0.0	0.0	0.0	0.00	0.00	1.4	0.0	0.0	0.2	0.0	0.0	1.6	0.1	0.0
9/03/1972	4.13	1.3	6.5	5.1	0.8	0.0	0.0	0.0	0.00	0.00	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
10/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/03/1972	4.13	1.3	4.5	3.2	0.6	0.0	0.0	0.0	0.00	0.00	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
12/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23/03/1972	4.13	1.3	3.6	2.3	0.4	0.0	0.0	0.0	0.00	0.00	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
24/03/1972	4.13	1.3	58.6	57.3	7.2	0.1	0.0	0.0	0.00	0.00	1.8	0.1	0.0	0.3	0.0	0.0	2.1	0.1	0.0
25/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31/03/1972	4.13	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3/04/1972	2.83	0.9	24.1	23.2	3.0	0.0	0.0	0.0	0.00	0.00	0.7	0.0	0.0	0.1	0.0	0.0	0.8	0.0	0.0
4/04/1972	2.83	0.9	160.0	175.5	21.6	0.2	0.0	0.0	0.00	0.00	5.4	0.2	0.0	0.7	0.0	0.0	6.1	0.2	0.0
5/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/04/1972	2.83	0.9	4.1	3.2	0.5	0.0	0.0	0.0	0.00	0.00	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
7/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15/04/1972	2.83	0.9	5.0	4.1	0.6	0.0	0.0	3.0	0.03	0.01	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
16/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.03	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/04/1972	2.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



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SCALE 1:2000 (A1) SCALE 1:4000 (A3)

REV	DATE	DESCRIPTION	BY	VER	APP
01	22/09/04	ISSUED FOR DA APPROVAL	AK	JL	RAP

AMENDMENTS

Disclaimer and Copyright:
ALL DIMENSIONS TO BE CHECKED ON SITE BY SUPERINTENDANT PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY. DO NOT SCALE.

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Singapore

VERIFICATION	INITIALS	SIGNATURE	DATE
DRAFTING	AK		16/19/04
DESIGN	JL		16/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects:
DENIS LEECH & ASSOCIATES PTY LTD

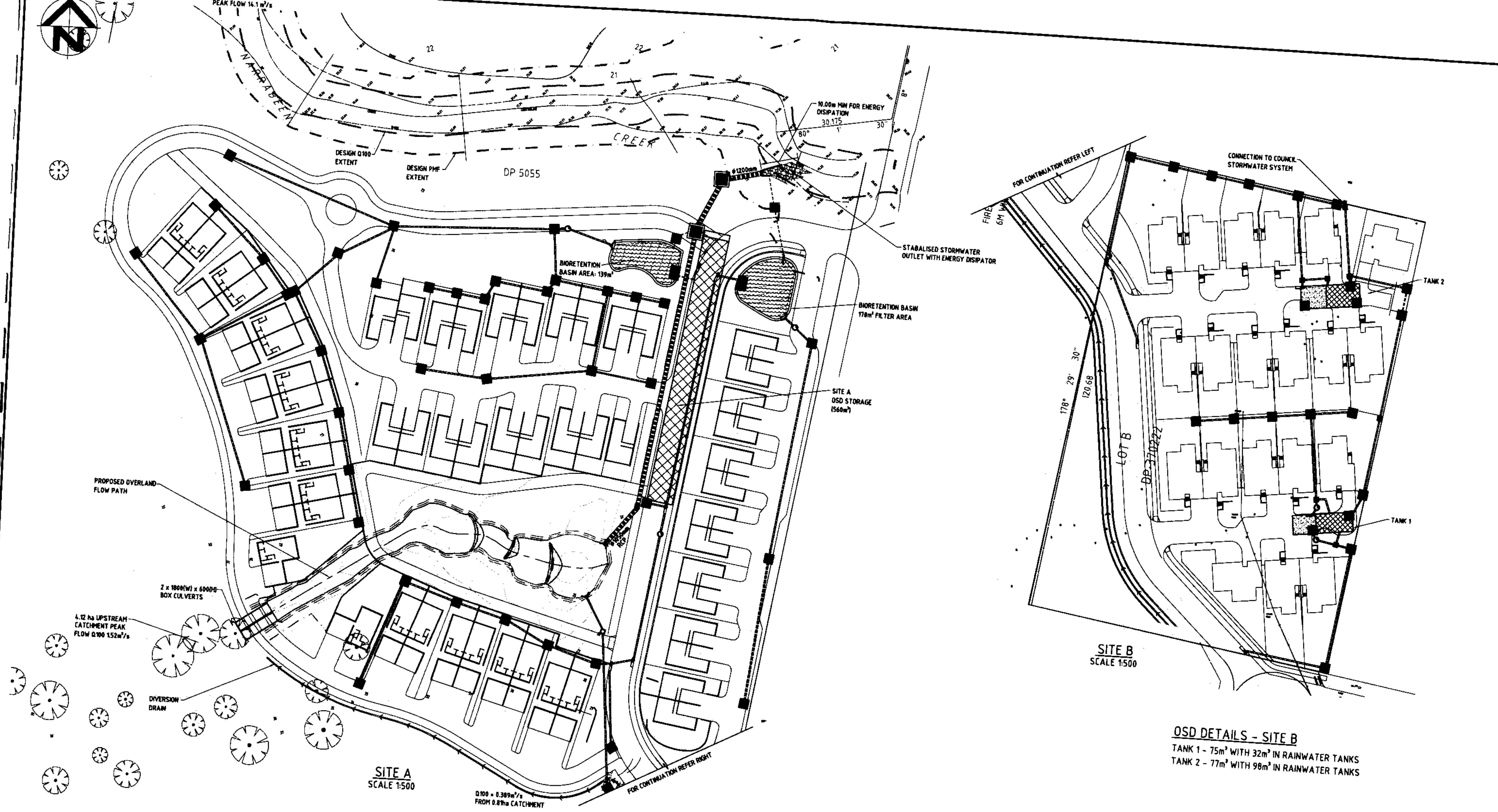
Project:
SECTOR 5
WARRIEWOOD VALLEY

Drawing:
EXISITING FLOOD EXTENTS
AND SURVEY
- SECTOR 5

PRELIMINARY

Drawn by: AK	Sheet: 1 of 12
Design by: JL	Scale: 1:500
Project No: X04023	
Drawing No: D01	Rev: 01

A1



OSD DETAILS - SITE B

TANK 1 - 75m³ WITH 32m³ IN RAINWATER TANKS
TANK 2 - 77m³ WITH 98m³ IN RAINWATER TANKS

LEGEND

- BIORETENTION BASIN
- OSD STORAGE (UNDERGROUND)
- SAND FILTER
- DIVERSION DRAIN
- EXISTING TREES
- GPT (NTS)
- PIT(NTS)
- DROP PIT (NTS)
- HEADWALL (NTS)

NOTE:

1) ALL DWELLINGS TO UTILISE 8000L RAINWATER TANKS (50% OSD CONTRIBUTION)
2) DIVERSION DRAINS SIZED TO CONVEY 100YR ARI PEAK FLOW
3) RIPARIAN ZONE TO BE RE-VEGETATED IN ACCORDANCE WITH LANDSCAPE ARCHITECT & DIPNR REQUIRMENTS

0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1)
SCALE 1:4000 (A3)

REV	DATE	DESCRIPTION	BY	VER	APP
01	22/09/04	ISSUED FOR DA APPROVAL	AK	JL	RAP

AMENDMENTS

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BROWN

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VERIFICATION	INITIALS	SIGNATURE	DATE
DRAFTING	AK		16/19/04
DESIGN	JL		16/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects: DENIS LEECH & ASSOCIATES PTY LTD

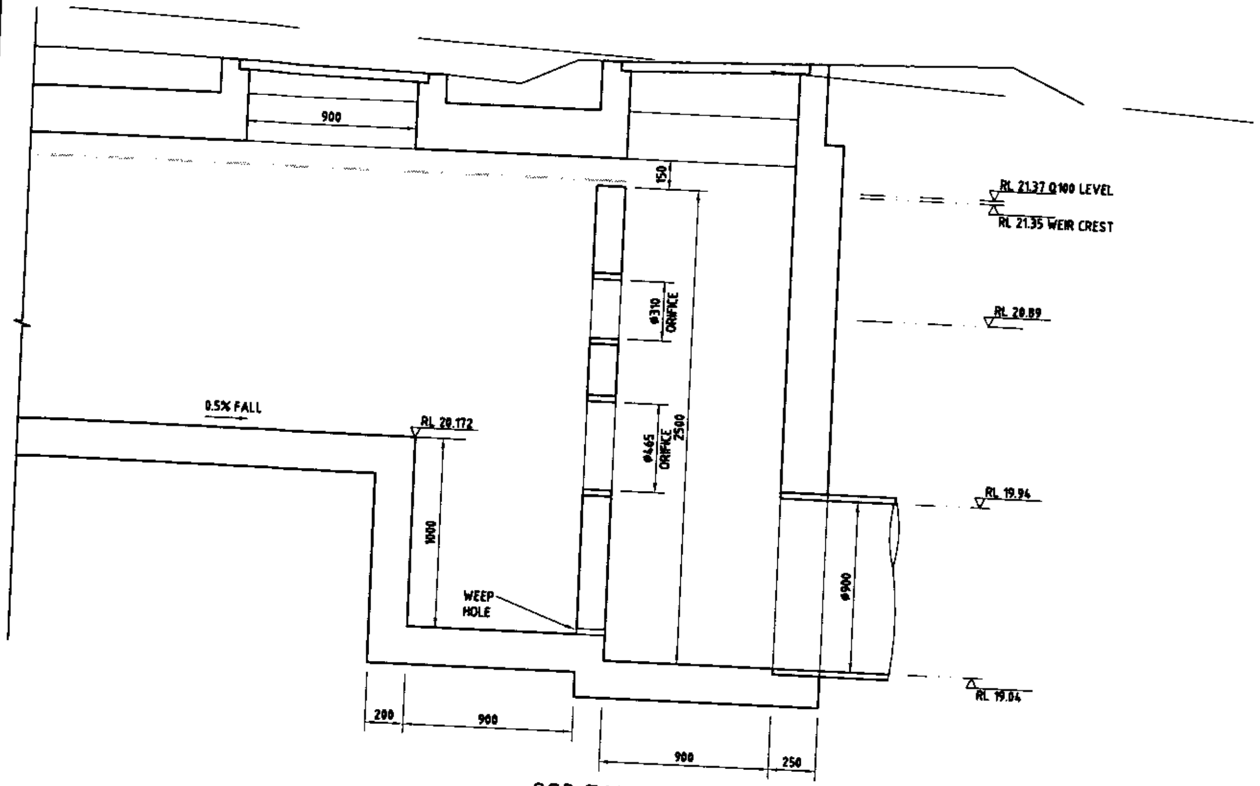
Project: SECTOR 5 WARRIEWOOD VALLEY

Drawing: STORMWATER DRAINAGE CONCEPT PLAN

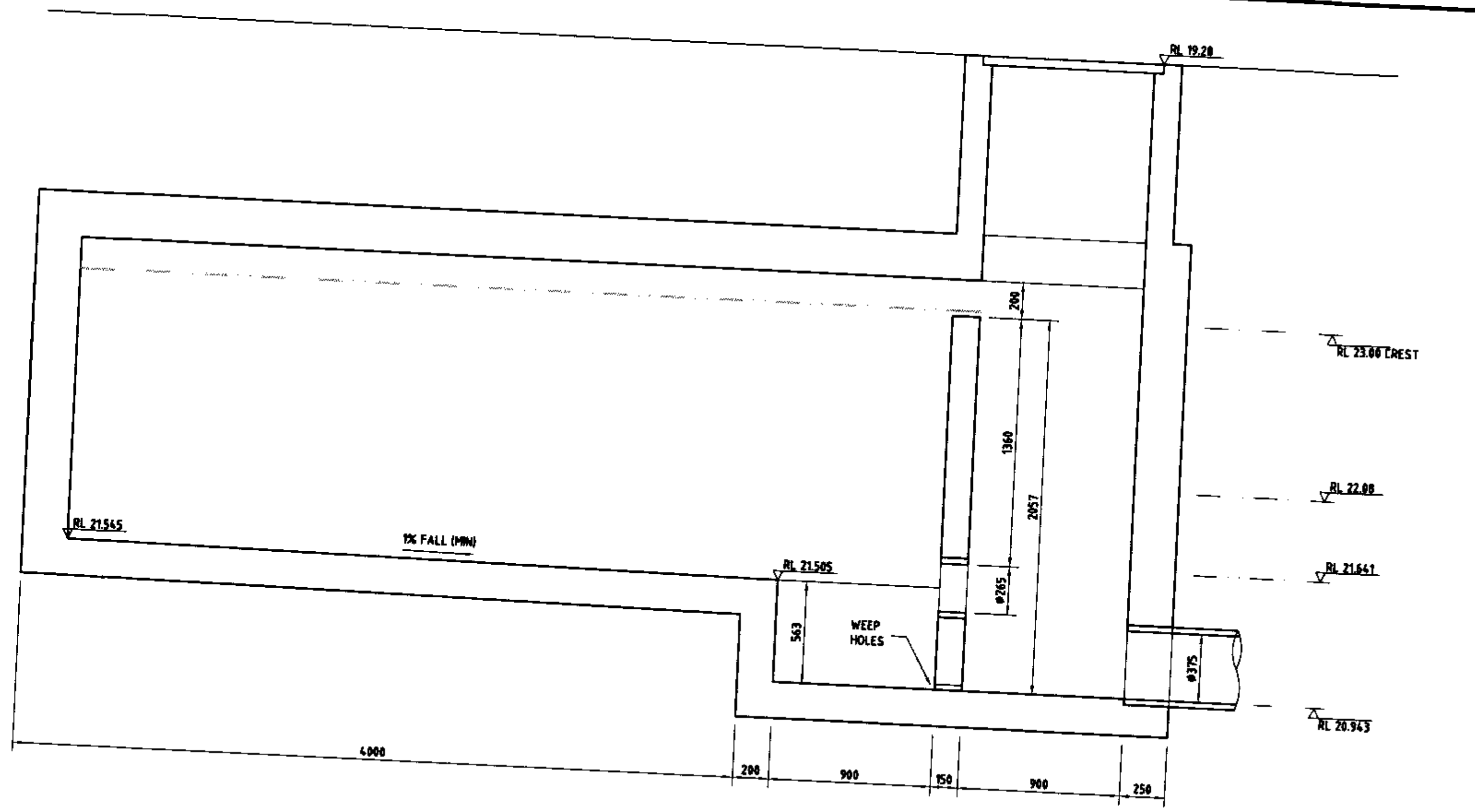
PRELIMINARY

Drawn by: AK	Sheet: 2 of 12
Design by: JL	Scale: 1:500
Project No: X04023	
Drawing No: D02	Rev: 01

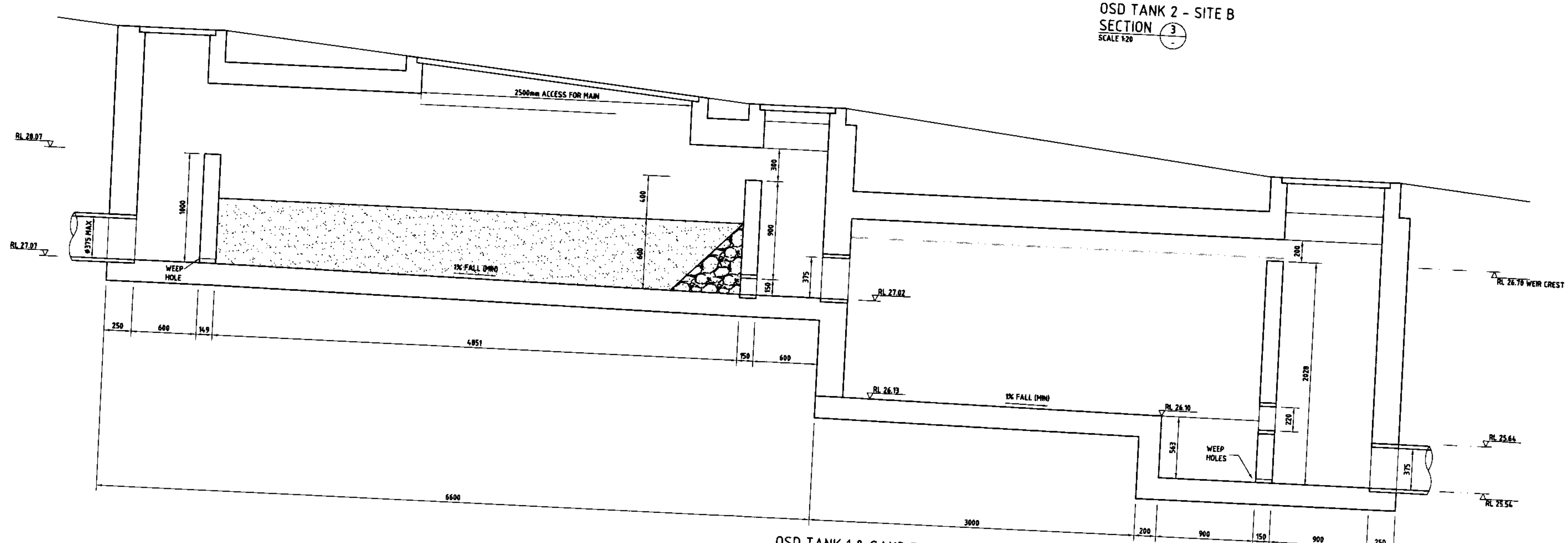
A1



OSD TANK 1 - SITE A
SECTION 1
SCALE 1:20



OSD TANK 2 - SITE B
SECTION 3
SCALE 1:20



OSD TANK 1 & SAND FILTER - SITE B
SECTION 2
SCALE 1:20

0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
SCALE 1:20 (A1) SCALE 1:40 (A3)

REV	DATE	DESCRIPTION	BY	VER	APP
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VERIFICATION	INITIALS	SIGNATURE	DATE
DRAFTING	AK		16/19/04
DESIGN	JL		16/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects:
DENIS LEECH & ASSOCIATES PTY LTD

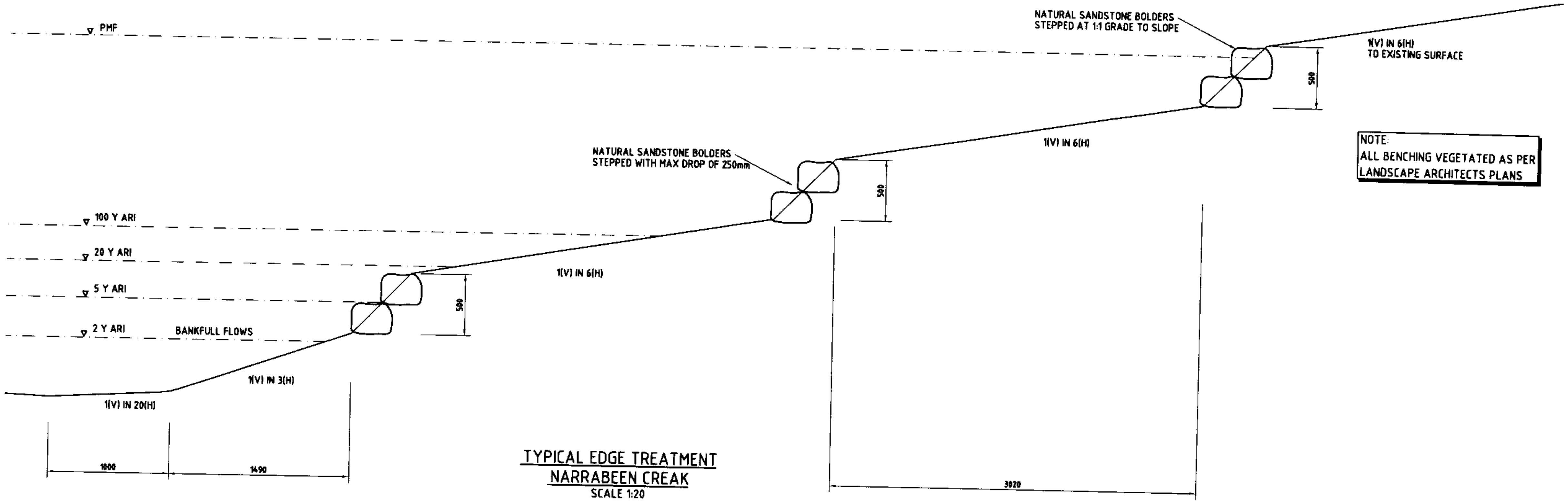
Project:
SECTOR 5
WARRIEWOOD VALLEY

Drawing:
OSD TANKS AND SAND FILTER
CONCEPT DETAILS

PRELIMINARY

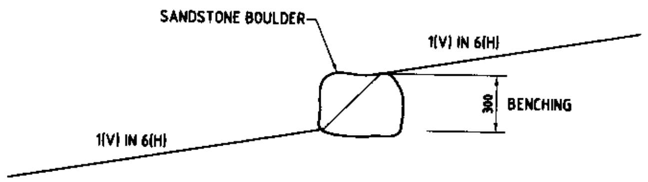
Drawn by: AK	Sheet: 3 of 12		
Design by: JL	Scale: 1:20		
Project No: X04023			
Drawing No: D03	Rev: 01		

A1

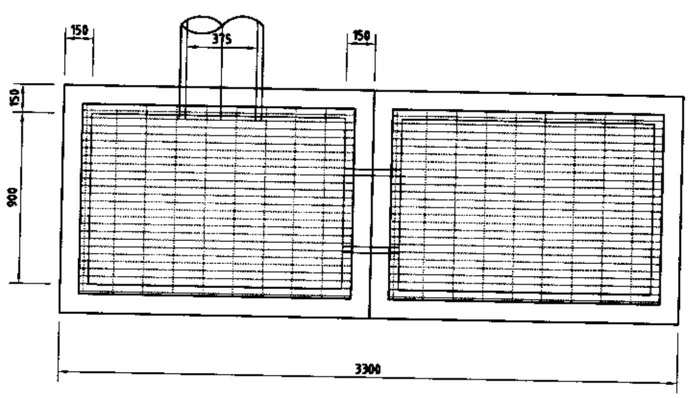


NOTE:
ALL BENCHING VEGETATED AS PER LANDSCAPE ARCHITECTS PLANS

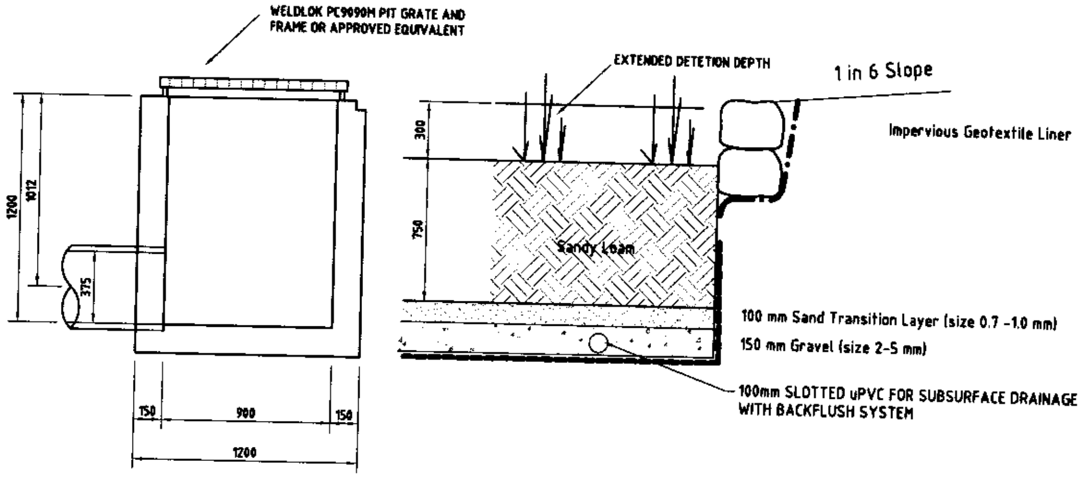
TYPICAL EDGE TREATMENT
NARRABEEN CREAK
SCALE 1:20



TYPICAL EDGE TREATMENT
OVERLAND FLOW PATH
SCALE 1:20



PLAN
BIORETENTION BASIN OUTLET STRUCTURE - SITE A
SCALE 1:20



SECTION
BIORETENTION BASIN FILTER AND OUTLET STRUCTURE - SITE A
SCALE 1:20

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DRAFTING	AK		16/19/04
DESIGN	JL		16/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

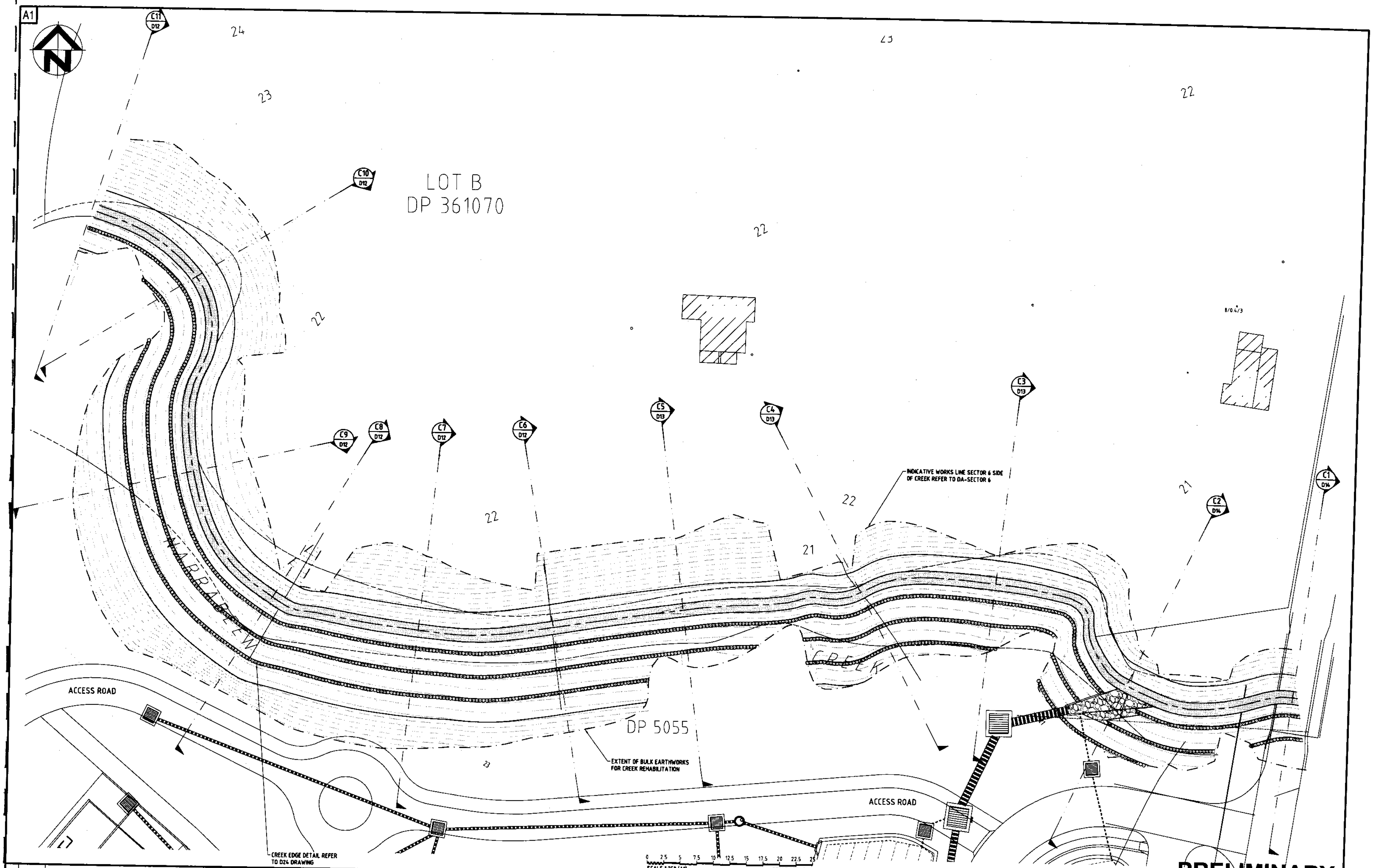
Architects: DENIS LEECH & ASSOCIATES PTY LTD

Project: SECTOR 5
WARRIEWOOD VALLEY

Drawing: BIORETENTION BASIN AND DESIGN CREEK DETAILS

PRELIMINARY

Drawn by: AK
Sheet: 12 OF 12
Design by: JL
Scale: 1:20
Project No: X04023
Drawing No: D04
Rev: 01



PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
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VERIFICATION	INITIALS	SIGNATURE	DATE
DRAFTING	AK		16/19/04
DESIGN	JL		16/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		15/19/04

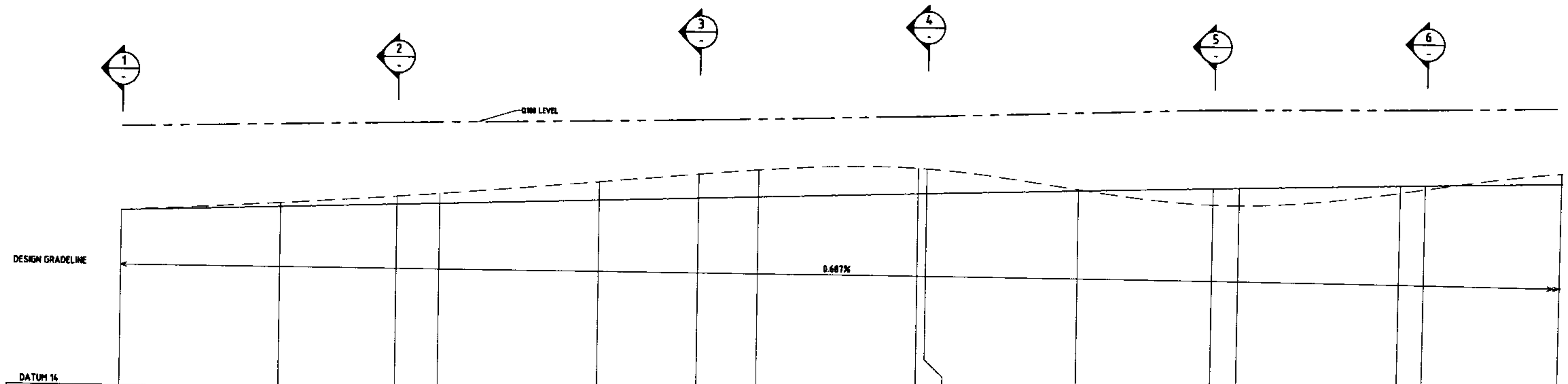
Architects: DENIS LEECH & ASSOCIATES PTY LTD

Project: SECTOR 5 WARRIEWOOD VALLEY

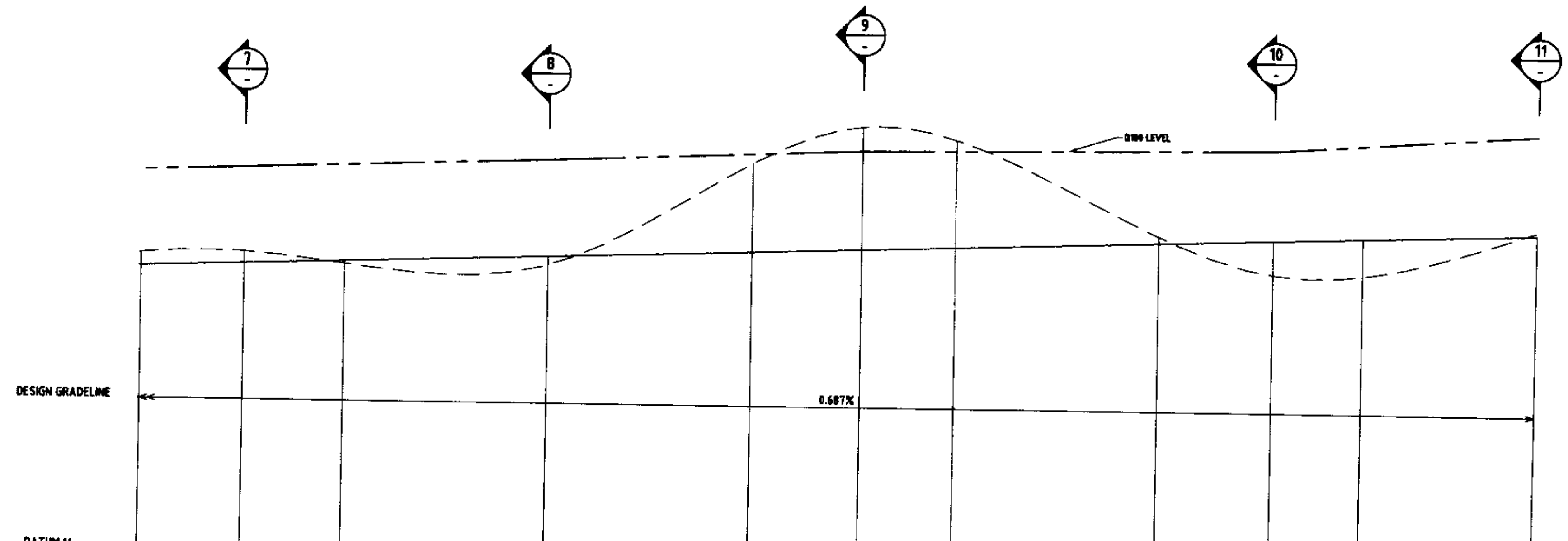
Drawing: NARRABEEN CREEK DESIGN PLAN AND HEC RAS SECTIONS

Drawn by: AK	Sheet: 4 OF 12
Design by: JL	Scale: 1:250
Project No: X04023	
Drawing No: D10	Rev: 01

A1



Q100 LEVEL	18.830		18.960			19.090			19.220		19.430			19.510	
DESIGN	17.264	17.367	17.442	17.47	17.573	17.637	17.676	17.779	17.784	17.882	17.968	17.985	18.088	18.104	18.191
EXISTING	17.263	17.440	17.592	17.654	17.915	18.084	18.179	18.256	18.246	17.907	17.666	17.664	17.958	18.031	18.383
CHAINAGE	0	15	25.984	30	45	54.360	60	75	75.802	90	102.559	105	120	122.330	135



Q100 LEVEL		19.650		19.810		20.000			20.080		20.350
DESIGN	18.191	18.243	18.294	18.397	18.5	18.555	18.603	18.706	18.764	18.809	18.897
EXISTING	18.383	18.413	18.255	18.277	19.800	20.350	20.179	18.808	18.259	18.270	18.944
CHAINAGE	135	142.587	150	165	180	188.079	195	210	218.484	225	237.83

NOTE:
POOLS AND RIFFLES AREAS WILL BE INCORPORATED INTO THE CREEK DESIGN BASED ON OBTAINING AN APPROXIMATE GRADE OF 0.6%

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
SCALE 1:50 (A1) SCALE 1:100 (A3)
0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25
SCALE 1:250 (A1) SCALE 1:500 (A3)

PRELIMINARY

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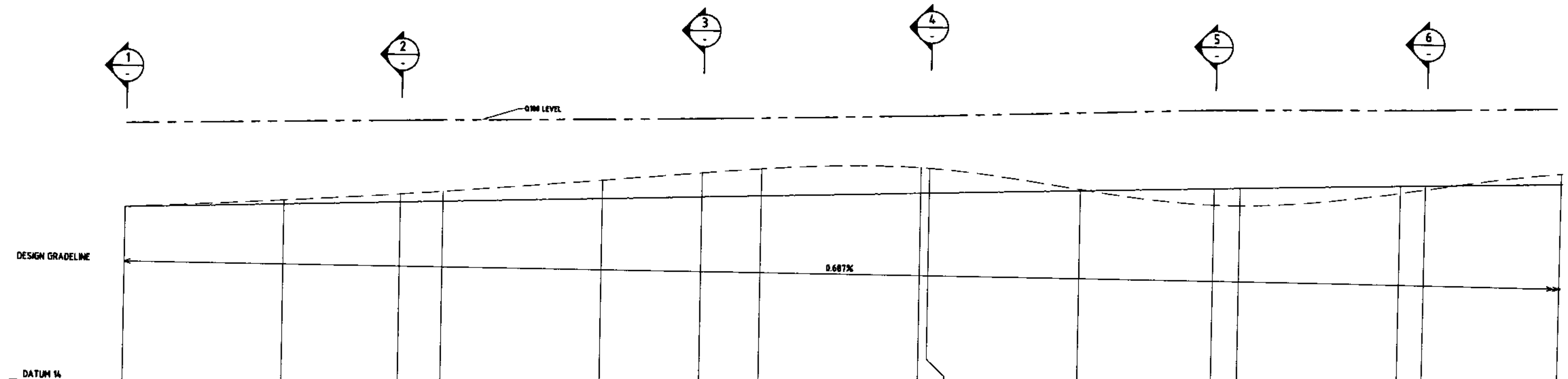
DESIGN	JL		16/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects: DENIS LEECH & ASSOCIATES PTY LTD

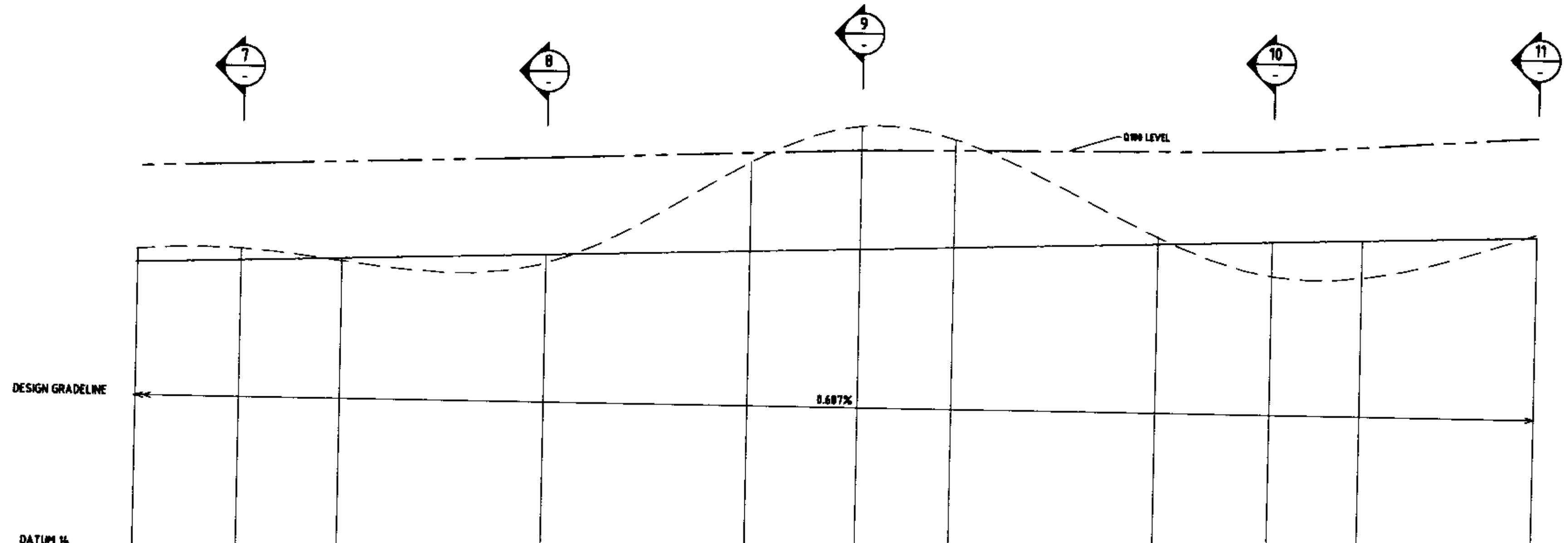
Project: SECTOR 5
WARRIEWOOD VALLEY

Drawing: NARRABEEN CREEK
DESIGN LONGSECTION

Drawn by: AK
Sheet: 5 OF 12
Design by: JL
Scale: 1:250 (H) 1:50 (V)
Project No: X04023
Drawing No: D11
Rev: 01



Q100 LEVEL	18.830		18.960			19.090			19.220		19.430			19.510	
DESIGN	17.264	17.367	17.442	17.47	17.573	17.637	17.676	17.779	17.784	17.882	17.968	17.985	18.088	18.104	18.191
EXISTING	17.263	17.440	17.592	17.654	17.915	18.084	18.179	18.256	18.246	17.907	17.666	17.664	17.958	18.031	18.383
CHAINAGE	0	15	25.984	30	45	54.360	60	75	75.802	90	102.559	105	120	122.330	135



Q100 LEVEL		19.650		19.810		20.000			20.080		20.350
DESIGN	18.191	18.243	18.294	18.397	18.5	18.555	18.603	18.706	18.764	18.809	18.897
EXISTING	18.383	18.413	18.255	18.277	19.800	20.350	20.179	18.808	18.259	18.270	18.944
CHAINAGE	135	142.587	150	165	180	188.079	195	210	218.404	225	237.83

NOTE:
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0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
SCALE 1:50 (A1) SCALE 1:100 (A3)
0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25
SCALE 1:250 (A1) SCALE 1:500 (A3)

REV	DATE	DESCRIPTION	BY	VER	APP
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DRAFTING	AK		16/19/04
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VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects:
DENIS LEECH & ASSOCIATES PTY LTD

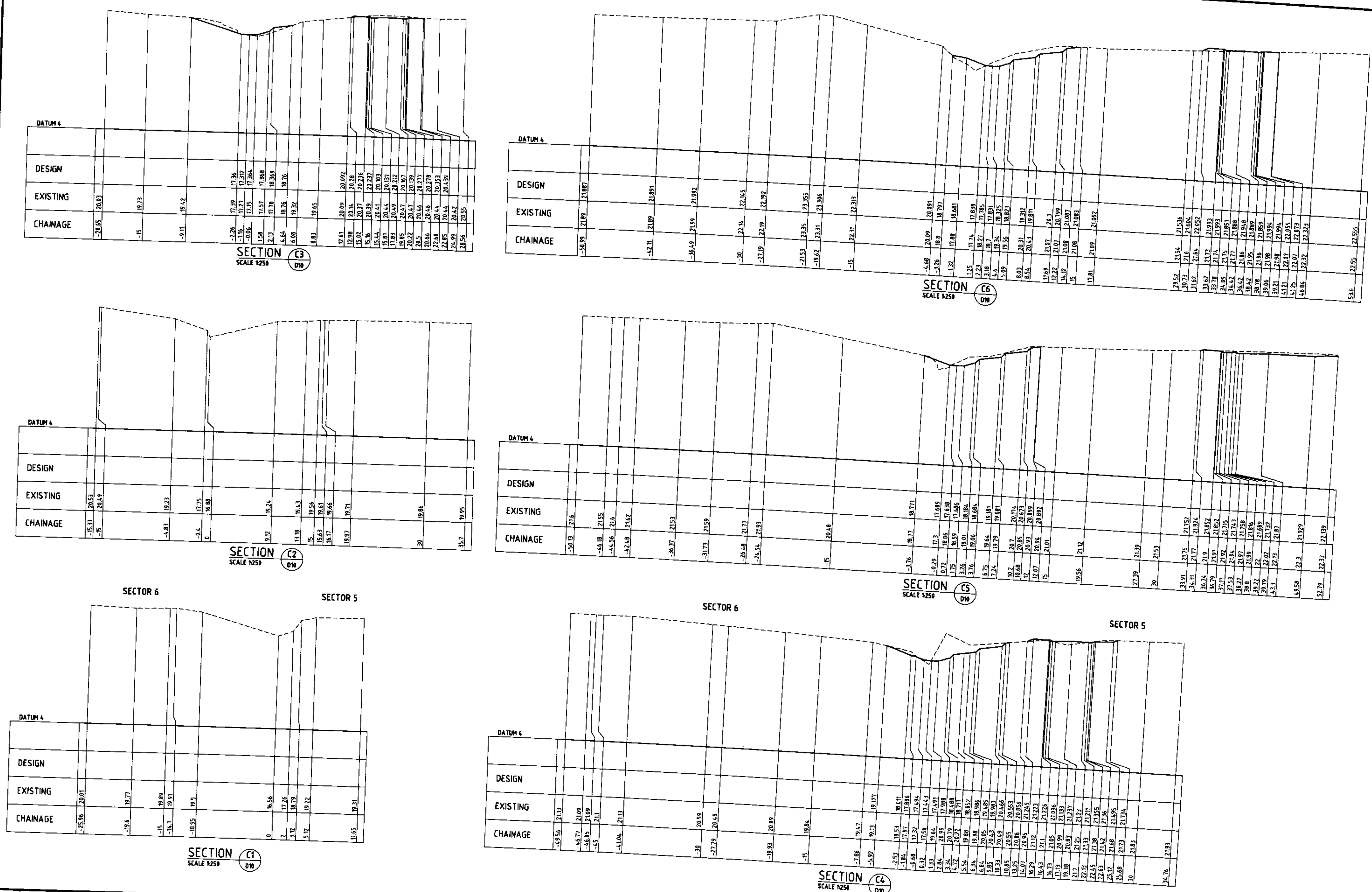
Project:
SECTOR 5
WARRIEWOOD VALLEY

Drawing:
NARRABEEN CREEK
DESIGN LONGSECTION

PRELIMINARY

Drawn by: AK	Sheet: 5 OF 12
Design by: JL	Scale: 1:250 (H) 1:50 (V)
Project No: X04023	
Drawing No: D11	Rev: 01

A1



SCALE 1:250 (A1) 0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25 SCALE 1:500 (A3)

REV	DATE	DESCRIPTION	BY	VER	APP
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VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects:
DENIS LEECH & ASSOCIATES PTY LTD

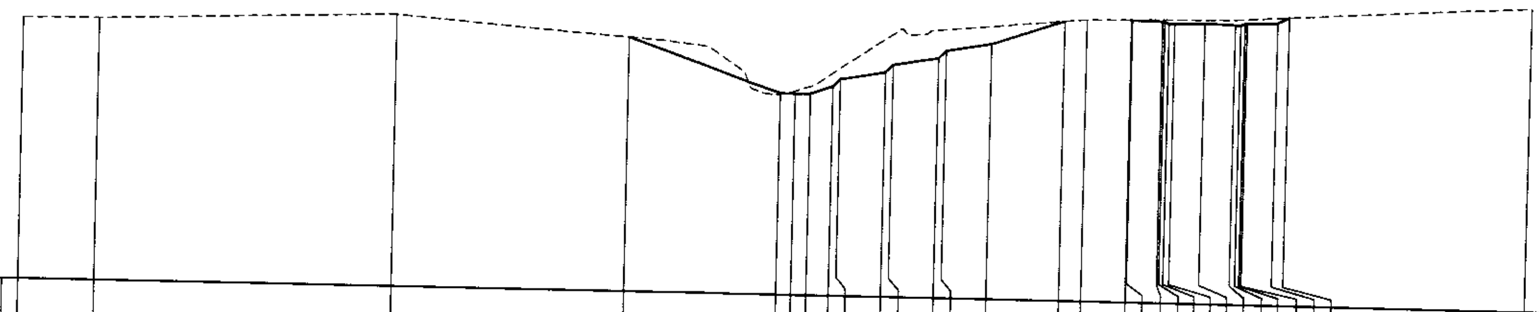
Project:
SECTOR 5
WARRIEWOOD VALLEY

Drawing:
NARRABEEN CREEK
DESIGN CROSS SECTIONS
SHEET 1

PRELIMINARY

Drawn by: AK	Sheet: 6 OF 12
Design by: JL	Scale: 1:250
Project No: X04023	
Drawing No: D12	Rev: 01

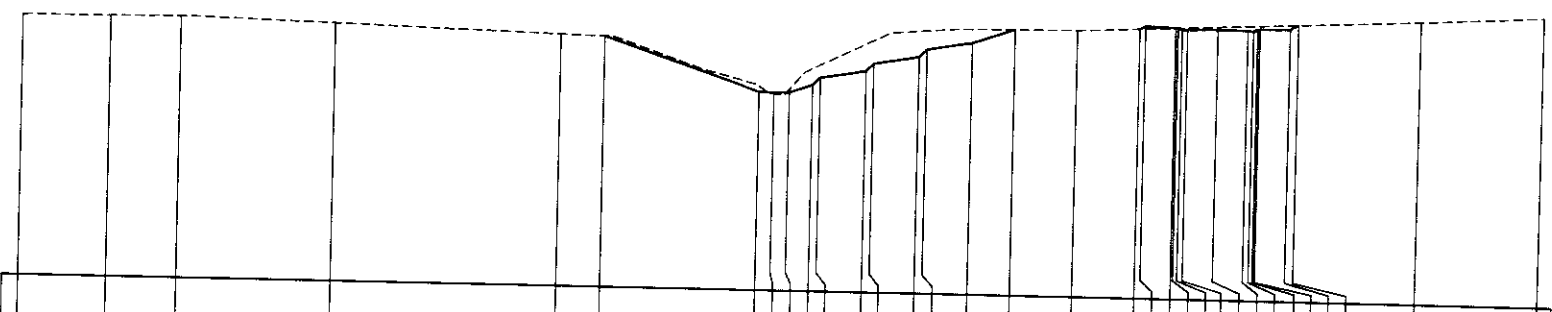
A1



DATUM 5

	DESIGN	EXISTING	CHAINAGE
	22.233	22.23	-50.07
	22.278	22.28	-45
	22.906	22.91	-25.19
	21.742	21.74	-9.75
	18.293	18.22	0.41
	18.243	18.43	1.42
	18.295	18.76	2.42
	18.797	19.66	3.91
	19.297	20.01	4.4
	19.799	21.98	7.38
	20.299	22.31	7.88
	20.802	22.65	10.9
	21.303	22.69	11.4
	21.805	22.97	14.4
	23.421	23.42	19.25
	23.557	23.56	20.72
	23.615	23.61	23.67
	23.587	23.62	23.73
	23.528	23.66	25.73
	23.528	23.66	25.88
	23.393	23.66	26.16
	23.424	23.67	26.52
	23.485	23.71	28.52
	23.427	23.75	30.52
	23.396	23.78	30.89
	23.532	23.79	31.17
	23.532	23.8	31.31
	23.594	23.93	33.32
	23.979	23.98	34.09
	24.959	24.96	50.13

SECTION C9 / D10
SCALE 1:250



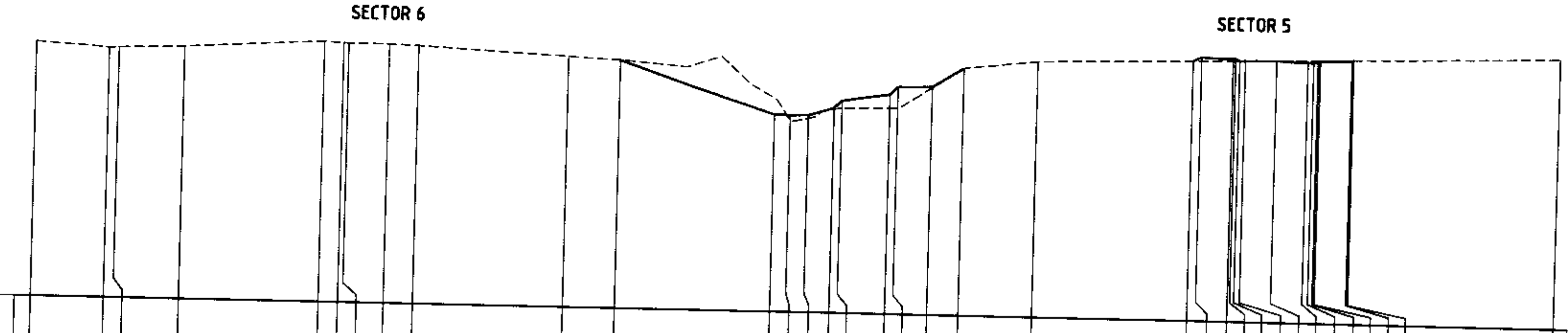
DATUM 5

	DESIGN	EXISTING	CHAINAGE
	22.23	22.23	-50.85
	22.273	22.27	-45
	22.307	22.31	-40.3
	22.068	22.07	-30
	21.668	21.67	-15
	21.59	21.59	-12.08
	18.155	18.53	-1.7
	18.104	18.03	-0.69
	18.153	18.32	0.32
	18.651	19.75	1.86
	19.151	19.99	2.37
	19.654	21.43	5.39
	20.154	21.67	5.9
	20.656	22.35	8.92
	21.156	22.39	9.43
	21.658	22.57	12.44
	22.6	22.6	15.28
	22.646	22.65	19.43
	22.837	22.84	23.59
	23.028	22.85	23.97
	22.97	22.95	25.97
	22.97	22.95	26.12
	22.835	22.97	26.4
	22.865	22.98	26.76
	22.927	23.07	28.77
	22.869	23.16	30.77
	22.839	23.18	31.13
	22.974	23.19	31.41
	22.974	23.2	31.56
	23.036	23.29	33.56
	23.314	23.31	34.12
	23.692	23.69	42.24
	24.142	24.14	50.42

SECTION C8 / D10
SCALE 1:250

SECTOR 6

SECTOR 5



DATUM 5

	DESIGN	EXISTING	CHAINAGE
	21.823	21.82	-50.51
	21.518	21.52	-45.66
	21.541	21.54	-45
	21.688	21.69	-40.62
	22.218	22.22	-31.28
	22.138	22.14	-30
	22.117	22.12	-29.66
	22.114	22.11	-26.94
	22.049	22.05	-24.98
	21.566	21.57	-15
	21.399	21.4	-11.54
	18.017	19.1	-1.11
	17.969	17.67	-0.07
	18.014	17.8	1.15
	18.509	18.44	2.85
	19.007	18.52	3.39
	19.5	18.6	6.56
	19.999	18.61	7.09
	20.064	20	9.37
	21.34	21.34	11.47
	21.897	21.9	16.41
	22.166	22.17	26.75
	22.439	22.18	27.32
	22.366	22.23	29.42
	22.365	22.24	29.58
	22.228	22.25	29.87
	22.256	22.26	30.25
	22.303	22.31	32.35
	22.23	22.36	34.44
	22.198	22.37	34.82
	22.33	22.38	35.11
	22.33	22.38	35.27
	22.377	22.44	37.37
	22.441	22.44	37.5
	22.827	22.83	51.3

SECTION C7 / D10
SCALE 1:250

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25
SCALE 1:250 (A1) SCALE 1:500 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
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DESIGN	JL		15/19/04
VERIFY	RAP		16/19/04
APPROVED	RAP		16/19/04

Architects: DENIS LEECH & ASSOCIATES PTY LTD

Project: SECTOR 5
WARRIEWOOD VALLEY

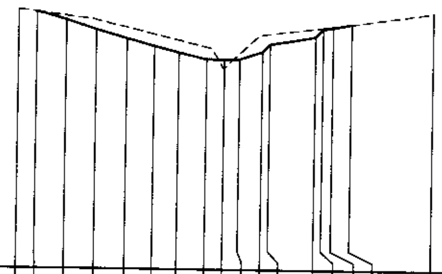
Drawing: NARRABEEN CREEK
DESIGN CROSS SECTIONS
SHEET 2

Drawn by: AK	Sheet: 8 OF 12
Design by: JL	Scale: 1:250
Project No: X04023	
Drawing No: D13	Rev: 01

A1

A1

DATUM 5



CHAINAGE	EXISTING	DESIGN
-13.7	21.98	
-12.5	21.83	21.832
-10.52	21.59	21.302
-8.5	21.33	20.691
-6.46	20.85	20.122
-4.64	20.42	19.641
-3.01	20.03	19.232
-1.15	19.6	18.809
0.05	18.24	18.764
1.05	19.17	18.815
2.57	20.42	19.316
3.07	20.48	19.816
6.09	20.85	20.32
6.6	20.91	20.821
7.26	20.99	20.931
8.5	21.14	21.142
13.98	21.93	

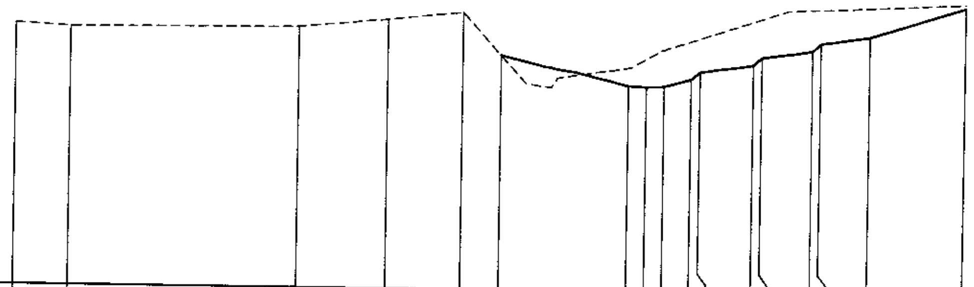
SECTION C12 / D10
SCALE 1:250

DATUM 6

CHAINAGE	EXISTING	DESIGN
-25.87	24.22	
-22.27	24.07	
-15.51	23.47	
-13.88	23	
-12.51	22.02	
-10.06	22.47	
-1.89	21.45	
-0	18.9	18.897
0.99	19.37	18.946
2.82	19.89	19.438
3.47	20.03	19.935
5.75	20.52	20.214
7.22	20.84	20.843
14.19	22	
18.54	21.61	

SECTION C13 / D10
SCALE 1:250

DATUM 5



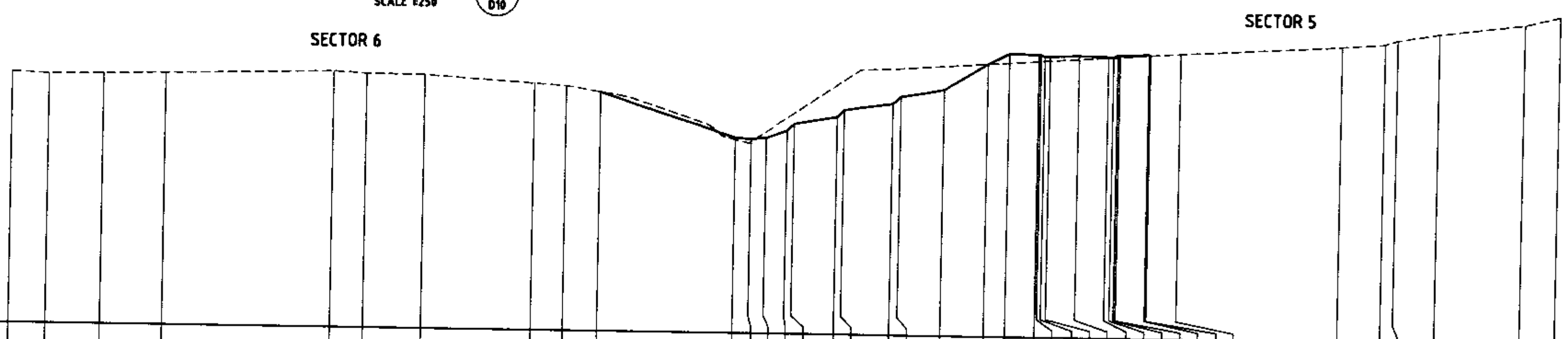
CHAINAGE	EXISTING	DESIGN
-35.8	22.32	22.317
-32.15	22.1	22.1
-16.92	22.27	22.267
-10.95	22.81	22.811
-5.95	23.34	23.341
-3.39	20.53	20.529
5.1	19.78	18.611
6.3	20.39	18.556
7.47	21.01	18.601
9.27	21.6	19.095
9.87	21.79	19.592
13.4	22.93	20.081
13.98	23.12	20.579
17.36	23.77	21.071
17.91	23.8	21.569
21.17	23.96	22.063
27.53	24.28	24.029

SECTION C11 / D10
SCALE 1:250

SECTOR 6

SECTOR 5

DATUM 5



CHAINAGE	EXISTING	DESIGN
-51.35	22.3	
-48.77	22.18	
-45	22.26	
-40.68	22.35	
-28.98	22.61	
-26.67	22.51	
-22.63	22.46	
-15	21.99	
-12.78	21.85	
-10.38	21.46	21.462
-0.99	18.33	18.451
0.11	18.16	18.397
1.16	18.87	18.448
2.65	19.85	18.947
3.14	20.18	19.447
6.12	22.16	19.945
6.62	22.49	20.445
10	23.33	20.936
10.55	23.36	21.435
13.54	23.57	21.935
16.58	23.77	23.768
18.07	23.87	24.512
20.12	24	24.465
20.25	24.01	24.466
20.53	24.03	24.332
20.9	24.06	24.365
22.93	24.19	24.438
24.96	24.33	24.391
25.32	24.35	24.364
25.61	24.37	24.5
25.76	24.38	24.501
27.79	24.52	24.575
27.9	24.52	24.523
30	24.66	
41.21	25.33	
44.19	25.56	
45.07	25.84	
47.96	26.32	
53.89	27.05	
56.34	27.67	

SECTION C10 / D10
SCALE 1:250

0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25
SCALE 1:250 (A1) SCALE 1:500 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
01	22/09/04	ISSUED FOR DA APPROVAL	AK	JL	RAP

AMENDMENTS

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VERIFICATION	INITIALS	SIGNATURE	DATE
DRAFTING	AK		16/09/04
DESIGN	JL		16/09/04
VERIFY	RAP		15/09/04
APPROVED	RAP		16/09/04

Architects: DENIS LEECH & ASSOCIATES PTY LTD

Project: SECTOR 5
WARRIEWOOD VALLEY

Drawing: NARRABEEN CREEK
DESIGN CROSS SECTIONS
SHEEET 3

Drawn by: AK	Sheet: 7 OF 12
Design by: JL	Scale: 1:250
Project No: X04023	
Drawing No: D14	Rev: 01

PRELIMINARY

01	22/09/04	ISSUED FOR DA APPROVAL	AK	JL	RAP
REV	DATE	DESCRIPTION	BY	VER	APP
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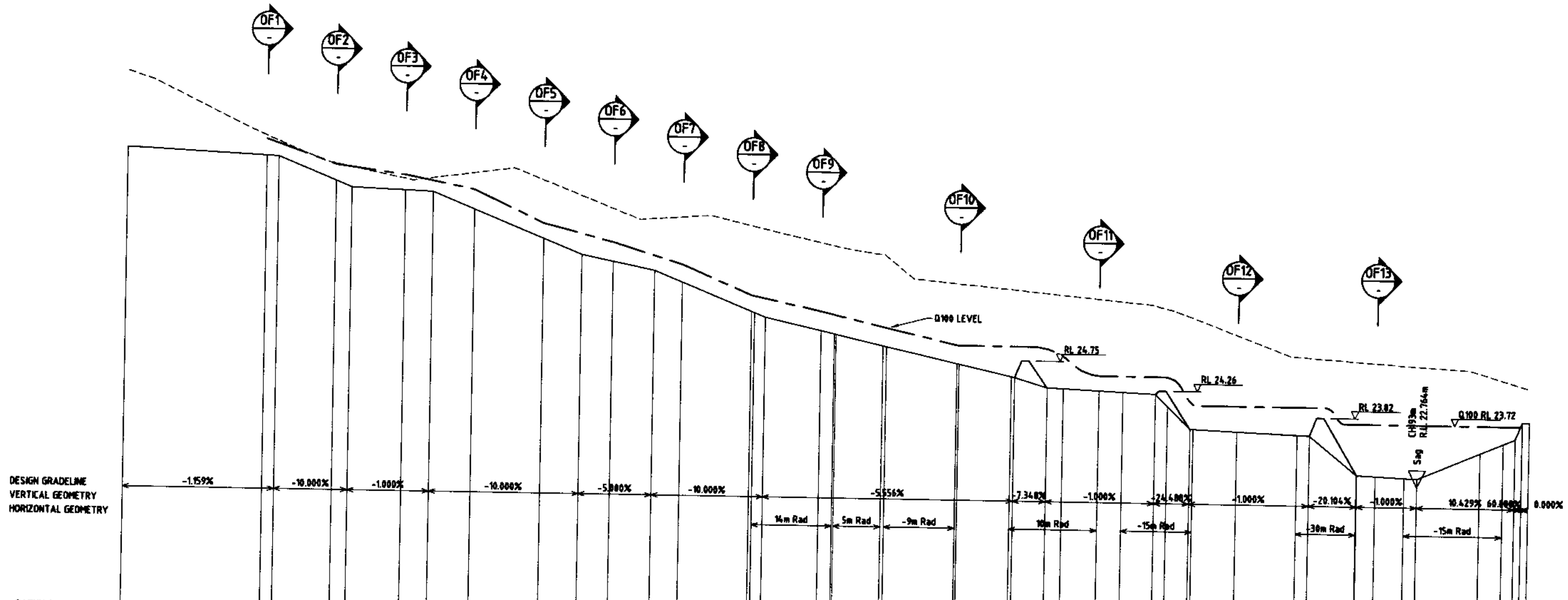
APPROVED	RAP		16/19/04

Architects: DENIS LEECH & ASSOCIATES PTY LTD

Project: SECTOR 5 WARRIEWOOD VALLEY

Drawing: OVERLAND FLOWPATH PLAN SECTOR 5

Drawn by: AK	Sheet: 8 OF 12		
Design by: JL	Scale: 1:200		
Project No: X04023			
Drawing No: D20	Rev: 01		



DATUM 20

CHAINAGE	Q100	DESIGN	EXISTING
0		28.30	29.66
10	28.49	28.18	
10.86		28.174	28.45
15	28.08	27.76	28.07
16.14		27.654	28.01
20	27.90	27.61	
22		27.588	27.83
25	27.64	27.29	
30	27.07	26.798	27.82
32.76		26.512	27.56
35	26.74	26.4	
38		26.25	27.17
40	26.36	26.05	
45	25.85	25.55	27.07
45.22		25.532	27.06
46		25.45	27.01
50	25.58	25.23	
50.97		25.174	26.74
51.11		25.176	26.73
54.51		24.987	26.6
54.77		24.963	26.56
59.84		24.681	26.1
60	25.00	24.672	26.1
63.75	25.00	24.464	26.01
64	25.00	24.45	26.01
66.34	25.00	24.278	25.95
67.5		24.266	25.93
70.06	24.50	24.241	25.87
71.8	24.50	24.223	25.83
74.12	24.50	24.20	25.77
75		23.986	25.7
76.63		23.586	25.57
76.85		23.584	25.55
80	24.00	23.55	
84.32	24.00	23.510	24.9
85.22	24.00	23.50	24.88
88.63	23.72	22.814	24.83
88.66	23.72	22.810	24.83
90	23.72	22.794	24.8
92.08	23.72	22.773	24.77
93	23.72	22.764	24.76
97.5	23.72	23.233	24.65
99.15	23.72	23.410	24.53
100	23.72	23.494	24.46
100.5		23.794	24.43
101		23.794	24.39

SCALE 1:50 (A1) / SCALE 1:100 (A3)
SCALE 1:200 (A1) / SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
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APPROVED	RAP		16/19/04

Architects: DENIS LEECH & ASSOCIATES PTY LTD

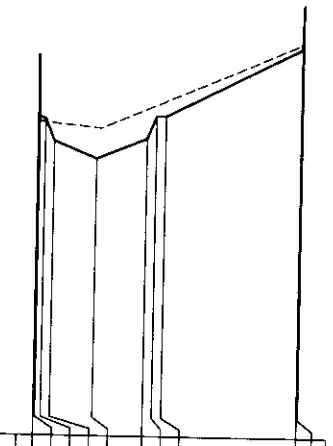
Project: SECTOR 5
WARRIEWOOD VALLEY

Drawing: OVERLAND FLOWPATH
LONGSECTION
SECTOR 5

Drawn by: AK | Sheet: 9 OF 12
Design by: JL | Scale: 1:200 (H) 1:50 (V)
Project No: X04023
Drawing No: D21 | Rev: 01

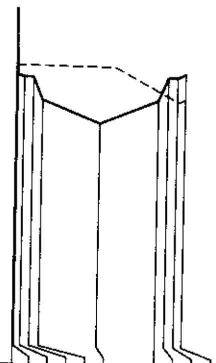
A1

A1



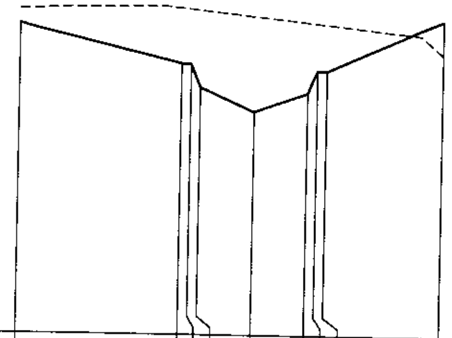
DATUM 24										
DESIGN	29.021	28.204	28.196	27.896	27.66	27.93	28.23	28.23	29.133	29.68
EXISTING	28.15	28.14	28.14	28.12	28.07	28.32	28.37	28.42	29.19	29.2
CHAINAGE	-3.15	-3.06	-2.76	-2.26	-0	2.7	3.2	3.7	10.92	11

SECTION OF2 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



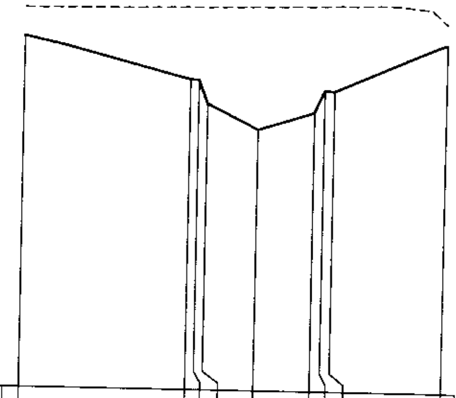
DATUM 24										
DESIGN	28.692	27.843	27.794	27.794	27.494	27.188	27.598	27.808	27.808	27.85
EXISTING	27.95	27.95	27.95	27.95	27.95	27.94	27.62	27.56	27.49	27.52
CHAINAGE	-4.47	-4.4	-4.07	-3.57	-3.07	0	3.11	3.61	4.11	4.52

SECTION OF4 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



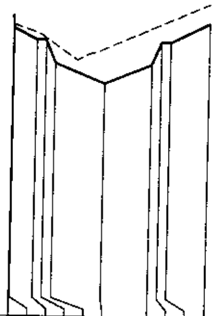
DATUM 23									
DESIGN	27.091	26.579	26.574	26.268	25.95	26.203	26.598	26.492	27.173
EXISTING	27.28	27.31	27.29	27.28	27.21	27.13	27.12	27.11	26.72
CHAINAGE	-12.5	-3.89	-3.38	-2.88	0	2.84	3.35	3.86	10.05

SECTION OF6 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



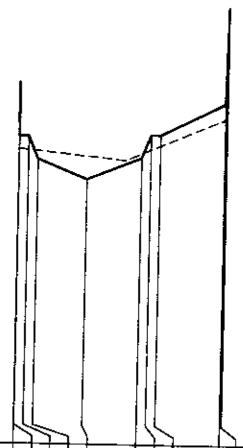
DATUM 22									
DESIGN	26.643	26.101	26.094	25.796	25.45	25.688	25.989	25.97	26.6105
EXISTING	27.02	27.05	27.05	27.05	27.07	27.08	27.09	27.09	26.87
CHAINAGE	-12.5	-3.65	-3.18	-2.71	0	3	3.52	4.05	10.05

SECTION OF8 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



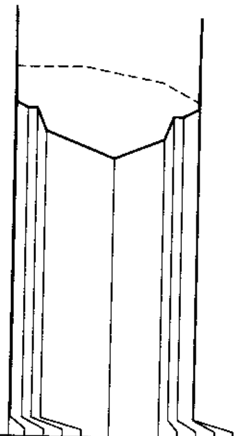
DATUM 25										
DESIGN	28.976	28.80	28.654	28.654	28.354	28.084	28.343	28.643	28.643	28.892
EXISTING	28.86	28.86	28.75	28.68	28.59	28.54	28.82	28.87	28.92	29.15
CHAINAGE	-4.9	-4.86	-3.64	-3.14	-2.64	-0	2.51	3.01	3.51	5.56

SECTION OF1 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



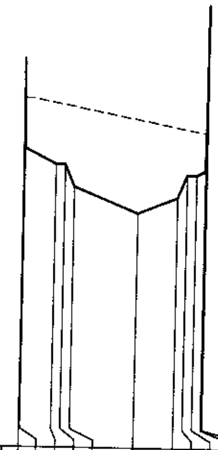
DATUM 24										
DESIGN	28.799	28.072	28.072	27.772	27.510	27.809	28.109	28.109	28.532	29.802
EXISTING	27.91	27.9	27.89	27.88	27.81	27.85	27.9	27.96	28.32	28.33
CHAINAGE	-3.65	-3.64	-3.14	-2.64	-0	2.9	3.4	3.9	7.34	7.43

SECTION OF3 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



DATUM 23											
DESIGN	28.692	27.432	27.354	27.354	27.054	26.688	26.952	27.252	27.252	27.356	28.564
EXISTING	27.89	27.89	27.89	27.9	27.9	27.82	27.69	27.62	27.55	27.44	27.44
CHAINAGE	-5.3	-5.23	-4.61	-4.11	-3.61	0	2.64	3.14	3.64	4.48	4.52

SECTION OF5 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



DATUM 23											
DESIGN	28.331	27.154	26.942	26.942	26.642	26.30	26.512	26.812	26.812	26.872	29.078
EXISTING	27.61	27.61	27.55	27.52	27.5	27.34	27.24	27.21	27.19	27.17	27.16
CHAINAGE	-6.13	-6.07	-4.42	-3.92	-3.42	0	2.12	2.62	3.12	3.6	3.67

SECTION OF7 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
SCALE 1:50 (A1) SCALE 1:100 (A3)
0 2 4 6 8 10 12 14 16 18 20
SCALE 1:200 (A1) SCALE 1:400 (A3)

REV	DATE	DESCRIPTION	BY	VER	APP
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DESIGN	JL		16/19/04
VERIFY	RAP		16/18/04
APPROVED	RAP		16/19/04

Architects:
DENIS LEECH & ASSOCIATES PTY LTD

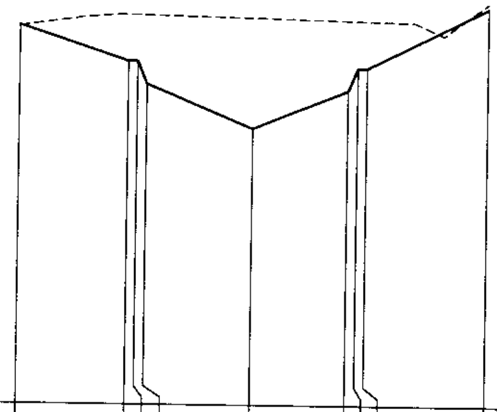
Project:
SECTOR 5
WARRIEWOOD VALLEY

Drawing:
OVERLAND FLOWPATH CROSS SECTIONS
SHEET 1

PRELIMINARY

Drawn by: AK	Sheet: 10 OF 12
Design by: JL	Scale: 1:200 (H) 1:50 (V)
Project No: X04023	
Drawing No: D22	Rev: 01

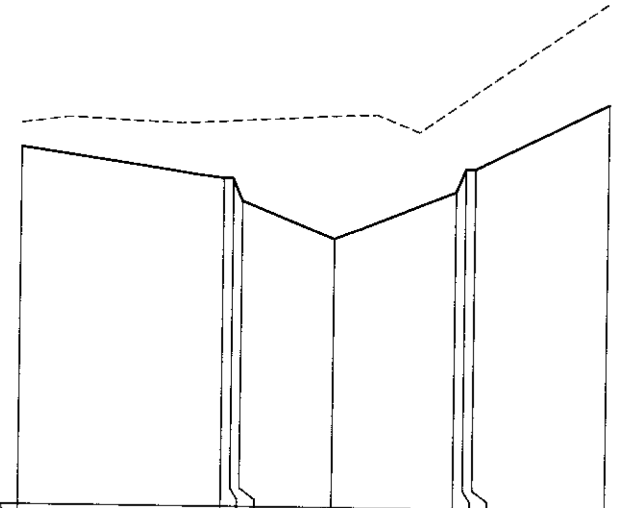
A1



DATUM 21

DESIGN	25.996	25.524	25.523	25.223	24.65	25.15	25.454	25.454	26.254
EXISTING	25.97	26.14	26.13	26.13	26.1	26.07	26.07	26.07	26.31
CHAINAGE	-12.5	-6.68	-6.18	-5.68	0	5.06	5.56	6.06	12.5

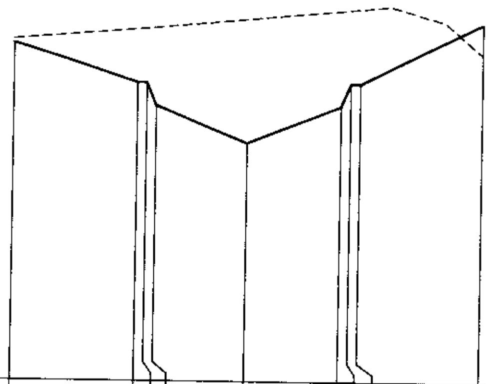
SECTION OF10 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



DATUM 20

DESIGN	24.713	24.331	24.331	24.031	23.541	24.179	24.478	24.478	25.354
EXISTING	25.03	25.07	25.08	25.09	25.15	25.3	25.38	25.47	26.68
CHAINAGE	0	10.78	11.28	11.78	16.68	23.19	23.7	24.21	31.28

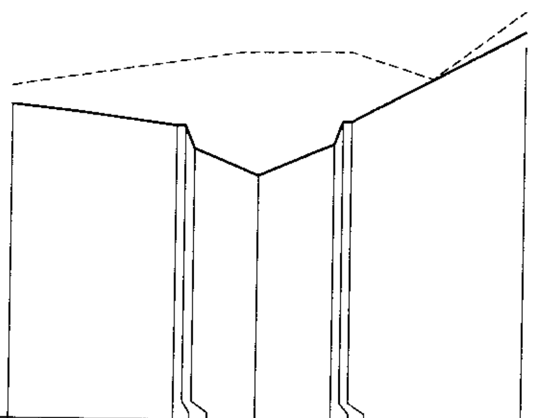
SECTION OF12 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



DATUM 22

DESIGN	26.457	25.943	25.943	25.643	25.15	25.654	25.954	25.954	26.754
EXISTING	26.51	26.65	26.66	26.67	26.79	26.91	26.92	26.93	26.34
CHAINAGE	-12.5	-5.89	-5.39	-4.89	-0	4.99	5.5	6.01	12.5

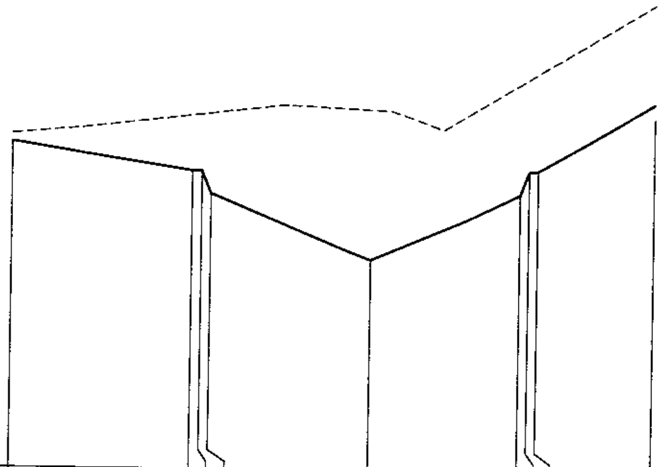
SECTION OF9 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



DATUM 21

DESIGN	25.159	24.995	24.996	24.696	24.254	24.67	24.977	24.975	26.187
EXISTING	25.41	25.74	25.76	25.78	25.88	25.89	25.9	25.89	26.46
CHAINAGE	0	8.75	9.23	9.71	13.12	17.14	17.59	18.05	27.31

SECTION OF11 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)



DATUM 20

DESIGN	24.310	23.954	23.943	23.642	22.787	23.652	23.969	23.976	24.873
EXISTING	24.42	24.68	24.69	24.71	24.76	25.12	25.19	25.26	26.19
CHAINAGE	0	9.58	10.09	10.59	19.15	27.08	27.56	28.04	34.25

SECTION OF13 / D20
SCALE 1:200 (H)
SCALE 1:50 (V)

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
SCALE 1:50 (A1) SCALE 1:100 (A3)
0 2 4 6 8 10 12 14 16 18 20
SCALE 1:200 (A1) SCALE 1:400 (A3)

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APPROVED	RAP		15/19/04

Architects:
DENIS LEECH & ASSOCIATES PTY LTD

Project:
SECTOR 5
WARRIEWOOD VALLEY

Drawing:
OVERLAND FLOWPATH CROSS SECTIONS
SHEET 2

Drawn by: AK
Sheet: 11 OF 12
Design by: JL
Scale: 1:200 (H) 1:50 (V)
Project No: X04023
Drawing No: D23
Rev: 01