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Epping Park - Early Works Package Project Application

Stormwater Management Strategy, Servicing Strategy & Civil Works Report

301015-01035 – CI-REP01

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PROJECT 301015-01035 - EPPING PARK - EARLY WORKS PACKAGE PROJECT APPLICATION

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	DRAFT	SCP	CJM	MJS	13-03-2009	N/A	
B	INCORPORATING INTERNAL REVIEW	SCP	CJM	MJS	18-03-2009		
C	FINAL	SCP	CJM	MJS	26-04-2009		

CONTENTS

1. EXECUTIVE SUMMARY

1.1 Assessment Requirements

This report addresses the assessment requirements relating to; flooding, stormwater management, servicing, and civil works for the Epping Park development as set out in the following documents, viz:

- Concept Plan Approval;
- Preferred Project Report; and
- Director General's Requirements.

The assessment requirements of each document, and the responses (*where one is required*) documented within this report are summarised under headings below.

1.1.1 Concept Plan Approval

The Concept Plan Approval lists a series of requirements for the proposed stormwater management strategy in terms of modelling work, design requirements, and construction protocols. Conditions (*referred to as "Modifications"*) B13, and B14 have been included as **Appendix 1 -** .

Responses to the Modifications are summarised below in **Table 1—1**.

Table 1—1 Responses to Conditions of Consent

Modification	Sub-number	Response
B13	n/a	Hydrological, hydraulic, and stormwater quality modelling has been undertaken and is documented within this report.
B14	1	The existing open drainage channel has been preserved and will be rehabilitated to ensure it can continue to convey its existing flow capacity.
	2	The catchment upstream of the site can be conveyed safely through the existing drainage corridor within the site. This has been shown through hydrologic and hydraulic modelling work.

Modification	Sub-number	Response
	3	The proposed detention storage strategy has been demonstrated to result in no increase in peak flow rates downstream of the site. The proposed detention strategy reduces peak flow rates downstream of the development site for the 2 year, 5 year, 20 year, and 100 year Average Recurrence Interval (ARI) storm events.
B14	4	The proposed detention strategy will result in reduced peak flow rates being discharged downstream of the site. This reduction in peak flow rates could ease the frequency of inundation, particularly for more frequent storm events.
	5	Detailed hydraulic design will be completed at a later stage. Provision has been made for drainage infrastructure capable of conveying the 20 year ARI peak flows in pipes and any additional flows up to and including the 100 year ARI within designated overland flow paths.
	6	Stormwater pipes and associated pits will be placed along the northern side of Mobbs Lane as part of the external works package. These stormwater pipes will be designed to convey the 20 year ARI peak flow rates and discharge into an existing stormwater channel or Terrys Creek directly (*for more detail refer **Section 4***).
	7	Stormwater quality will be managed on site through the implementation of at source and end-of-line treatment measures. Bio-retention swales, rain gardens, Gross Pollutant Traps, and a constructed wetland will reduce the export of stormwater pollutants from the development site (*for more detail refer **Section 5***).
	8(i) & (ii)	The preliminary stormwater management strategy for the site has been developed with input from Parramatta City Council. This consultation will continue through the detailed design phase.

1.1.2 Preferred Project Report

The Preferred Project Report contained a Statement of Commitments that included a series of commitments for the proposed stormwater management strategy. Responses to the commitments raised in the Preferred Project Report are included below in **Table 1—2**. The relevant Preferred Project Report sections are included as **Appendix 2 -** .

Table 1—2 Responses to Preferred Project Report

PPR Statement of Commitment Item Number	Sub-Number	Response
9	1	The stormwater management strategy complies with current objectives set out by the relevant New South Wales Government Departments. Where the stormwater management strategy varies from Parramatta City Council's general requirements appropriate discussion/explanation is provided.
	2	A volume of storage has been provided for stormwater runoff within the proposed development. The derivation of this volume has been the subject of detailed hydraulic and hydrologic modelling. The detention basin and outflow control devices will result in decreased peak flow rates being discharged from the site (*i.e. compared with existing conditions*) in the 2 year, 5 year, 20 year and 100 year Average Recurrence Interval storm event.
	3 (bullet point 1)	Sufficient stormwater detention volume has been provided within the development to reduce peak discharge flow rates downstream of the site. This has the potential to reduce localised flooding in the vicinity of the site.
	3 (bullet point 2)	The stormwater detention strategy accounts for the constructed wetland. The calculated detention storage volume will be included as part of the constructed wetland.
	3 (bullet point 3)	Upon approval being granted for a wet detention basin, appropriate documentation will be submitted during detailed design. Documentation would address; eutrophication prevention, odour minimisation, mosquito breeding, and any other related concerns.
	3 (bullet point 4)	As part of the detailed design of the proposed wet basin, appropriate documentation would be submitted outlining the necessary flushing extent and frequency of the proposed wet basin as part of the detailed design.
	3 (bullet point 5)	A suite of Water Sensitive Urban Design measures will be incorporated into the development to minimise stormwater runoff and to improve the quality of stormwater discharged from the

PPR Statement of Commitment Item Number	Sub-Number	Response
		site.

1.1.3 Director General's Requirements

The Director General's Requirements have been included as **Appendix 3 -** .

The Director General's Requirements stipulate that drainage and flooding issues should consider the impacts of climate change, sea level rise, and an increase in rainfall intensity.

The New South Wales Department of Environment and Climate Change (*DECC*) have published a guideline titled, '*Practical Consideration of the Impacts of Climate Change*', 2007. This document provides a high range estimate of 30% increases in storm intensities as a result of climate change. Thus, for proposed scenario modelling, rainfall intensities have been increased by 30%.

The development site is located at the top of the Terrys Creek catchment and is situated on relative high ground (*in relation to Terrys Creek*). The existing 100 year Average Recurrence Interval flood level is significantly below the proposed surface levels within the development.

Given the distance of the site from the 100 year ARI flood extent, and the coast, sea level rise was not considered in terms of flood inundation on the site or in the development of the stormwater management strategy.

1.2 Flooding

The proposed development lies outside the existing flood extents of Terrys Creek. Given the relative height of the site in the context of Terrys Creek it is unlikely that the site will experience inundation from Terrys Creek.

Flows entering and passing through the development site from external sources will be safely conveyed in a rehabilitated drainage channel.

Roadways and overland flow paths will convey internal 100 year Average Recurrence Interval (*ARI*) surface flows safely through the site.

The stormwater quantity management strategy will ensure that flood behaviour downstream of the proposed development is not adversely impacted.

1.3 Stormwater Quantity Management Strategy

The stormwater quantity management strategy is driven by four key locations at regions downstream of the site, viz:

- An existing open channel located off Mobbs Lane to the west of Valley Road;

- Terrys Creek at the Mobbs Lane/Terrys Creek crossing;
- Mobbs Lane Reserve; and
- The Terrys Creek/Valley Road Drainage Channel Junction (*i.e. total of three above locations*)[1].

Through the provision of 850m^3 of detention storage with engineered discharges, the proposed peak flow rates at the four key locations have been shown to closely replicate, and in most cases result in reducing the existing peak flow rates for each location. Therefore, the proposed stormwater quantity management strategy can be considered as having no adverse impacts on flood levels or stormwater infrastructure downstream of the site. In fact, the proposed stormwater management strategy has the potential to reduce flood impacts downstream of the site.

1.4 Stormwater Quality Management Strategy

The stormwater quality management strategy has been developed to comply with the DECC guidelines on stormwater pollutant reduction targets for urban development.

The DECC stormwater pollutant reduction targets are achieved through the implementation of at source and end-of-line Water Sensitive Urban Design (*WSUD*) measures. At source treatment measures include bio-retention swales, rain gardens, and filtration units[2]. End-of-line stormwater treatment is provided with the inclusion of Gross Pollutant Traps (*GPTs*) and a constructed wetland.

The bio-retention swales and rain gardens have been designed in preliminary nature to represent current industry best practices.

Gross Pollutant Traps would be designed in direct consultation with manufacturers and would take into pollutant load percentage reduction targets and catchment area requiring treatment.

The proposed constructed wetland will be designed in accordance with the NSW Department of Land and Water Conservation publication, '*The Constructed Wetlands Manual*'.

A preliminary water quality model has been developed for the Epping Park development masterplan using the industry recognised MUSIC software. MUSIC modelling outputs indicate that the DECC stormwater pollutant reduction targets will be exceeded for total suspended solids, total Phosphorus, total Nitrogen, and gross pollutants.

[1] Only flows generated from within the site and those affecting the proposed stormwater management strategy have been considered at this location.

[2] Filtration units are a smaller version of a Gross Pollutant Trap

1.5 Servicing Strategy

A preliminary servicing strategy has been undertaken for the proposed development to ensure that all buildings, community facilities, and public open spaces can be adequately serviced for potable water, sewer, electricity, gas, and telecommunications.

Initial discussions with local service providers indicate that the demands of the development can be met with amplification of existing networks. The exact nature and extent of amplification works will be negotiated with appropriate service providers during detailed design.

1.6 Civil Works

The civil works design process has been undertaken through the consideration of relevant Australian Standards and in direct consultation with regulatory authorities. The civil works scope is defined by the following items, viz:

- Internal road design;
- Internal earthworks;
- Internal and external stormwater drainage design; and
- External road design.

The proposed internal earthworks have been subject to earthworks volume calculations. The calculations were based on current conceptual building characteristics, proposed road levels, and open space concept design. The current internal earthworks calculations estimate an excess cut volume in the range of 10,000m^3 to 17,500m^3. However within the detailed design phase of future stages of the development all best endeavours will be undertaken to balance cut and fill volumes through the alteration of basement footprints, basement depths, and batter slopes within the Epping Park masterplan. For this reason it is anticipated that no cut or fill will be removed or imported to or off the site during construction.

The full extent of the proposed civil works is included in the WorleyParsons '*Epping Park - Project Application - Early Works Drawing Package*', April 2009.

2. INTRODUCTION

Epping Park is a proposed residential development comprising of 650 residential dwellings in a number of buildings, a series of internal roads, resident and community facilities, and substantial areas of open space. A concept plan (MP_05_0086) for the proposed development was approved by the Minister for Planning in August 2006.

The Epping Park development will be located at 61 Mobbs Lane, Epping and is within the Parramatta City Council Local Government Area. The site is currently occupied by Seven Network. Early in 2010, Seven Network will vacate the site which will then be redeveloped into the Epping Park development through a series of construction phases.

The Early Works Package will be the first construction phase associated with the Epping Park masterplan. The Early Works Package includes the construction of the following, viz:

- All internal roads;
- All stormwater management infrastructure;
- All servicing infrastructure;
- All resident facilities;
- The Child Care Centre; and
- Road re-alignment works in Mobbs Lane.

WorleyParsons has been engaged by Sydney Broadcast Property to prepare and document the following items associated with the Early Works Package Project Application for the Epping Park development, viz:

- The stormwater management strategy (*i.e. flooding, stormwater quantity and stormwater quality*);
- The servicing strategy;
- Internal civil works; and
- External civil works.

3. FLOODING

As part of the Early Works Package, flooding issues have been considered on the catchment wide and local scales.

The catchment wide scale identifies the flood levels in nearby Terrys Creek to establish if the site is at risk of inundation. The local scale considers overland flow paths that drain external catchments and internal catchments running through the site under existing and proposed conditions.

3.1 Terrys Creek

The western boundary of 61 Mobbs Lane, Epping is located in close proximity to Terrys Creek.

In 2005 Cardno Willing completed the '*Terrys Creek Subcatchment Management Plan*' report. This report established peak flood levels within Terrys Creek for various Average Recurrence Interval (*ARI*) events. Parramatta City Council has provided the flood extents and flood levels for the 20 year ARI and 100 year ARI floods. The maximum 100 year ARI flood level adjacent to the site is 85.37m AHD[3].

The flood extents and associated levels have been included as **Appendix 4 -** .

Review of the flood extent and the associated levels indicates that the site is located well outside the flood conveyance and flood storage areas of Terrys Creek. The minimum surface level of the site is approximately 85.50m AHD. Immediately adjacent to the minimum surface level of the site, the 100 year ARI flood level is approximately 83.49m AHD. Hence, the site is not impacted by existing flooding from Terrys Creek.

3.2 External Overland Flows

External flows entering the site via the TAFE School of Horticulture are currently conveyed through 61 Mobbs Lane via an existing open drainage channel. It is proposed to retain and rehabilitate the open drainage channel to ensure that flows can continue and be fully contained within this channel.

The channel will meander gently through the site from the western extent of the TAFE School of Horticulture through the western boundary of the site and into Terrys Creek.

A 6m wide trapezoidal channel with a 4.5m wide base and 1 in 4 side batters has been subject to Manning's "n" Calculations to establish the velocity depth profile within the drainage channel for the 100 year ARI peak flow rate. The velocity depth product was calculated as 0.33 which represents a low flood hazard for the 100 year ARI.

[3] This flood level has been taken at the upstream extent of the model. The level within the site adjacent to this location is approximately 89.00m AHD.

The Manning's "n" Calculation has been included as **Appendix 5 -** .

3.3 Internal Overland Flows

It is proposed to convey internal flows in events greater than the 20 year ARI via the road network and a series of internal constructed overland flow paths (*i.e. channels or swales*).

The proposed road network will be integrated into the stormwater management strategy and measures will be incorporated to ensure that vehicles and pedestrians can safely access/egress the site for events up to the 100 year ARI storm. Additionally, raised board walks are proposed to ensure that residents and the public can safely traverse designed overland flow paths (*channels*) for events up to the 100 year ARI storm.

4. STORMWATER QUANTITY MANAGEMENT STRATEGY

The Early Works Package includes the construction of all stormwater management infrastructure. To that effect, the stormwater quantity management strategy has been developed through the consideration of the ultimate development scenario within the site (*i.e. based on the Epping Park masterplan*). As such, the stormwater quantity management strategy for the site has been developed to ensure that the proposed Epping Park development has no adverse impacts on stormwater infrastructure or flood levels downstream of the site.

To ensure that the proposed development has no adverse impact on downstream stormwater infrastructure or flooding, the stormwater quantity management strategy focuses on proposed peak flow rates at four locations within and around the development site. The locations are illustrated on **Drawing 7587-PA-14** and are listed below, viz:

- An existing culvert located within Mobbs Lane that discharges stormwater into an open channel[4];
- The Mobbs Lane/Terrys Creek crossing;
- Mobbs Reserve; and
- The Terrys Creek/Valley Road Drainage Channel junction (*i.e. the total of the above three locations*)[5].

The stormwater quantity management strategy has been developed through the analyses of existing and proposed catchments using XP-RAFTS.

4.1 XP-RAFTS Modelling

XP-RAFTS is a non-linear rainfall/runoff program developed by WP Software and can be used to estimate peak flows for catchments using actual storm events, or design rainfall data derived from *Australian Rainfall and Runoff (AR&R) Volume 1,* Institute of Engineers, 1987. In addition to being capable of generating peak flows from catchments, XP-RAFTS is also capable of routing stormwater flows through stormwater detention devices such as basins.

To model a catchment within XP-RAFTS, the catchment is divided into sub-catchments based on watershed boundaries. Data required for each sub-catchment includes; catchment area, catchment slope, proportion of impervious area, rainfall loses, and surface roughness factors.

[4] For the purpose of this report the open drainage channel will be identified as the “Valley Road drainage channel”

[5] Only flows generated from within the site and those affecting stormwater management have been considered at this location.

The stormwater quantity management strategy has been developed through the modelling work conducted in XP-RAFTS based on the 2 year, 5 year, 20 year and 100 year ARI storm events for existing and proposed scenarios.

4.1.1 XP-RAFTS Model Parameters

Intensity-frequency-duration (*IFD*) data was derived for the site based on Latitude and Longitude. The Latitude and Longitude of the site is 33.78°S and 151.07ºE respectively.

The Bureau of Meteorology (*BoM*) website enables IFD data from the Latitudinal and Longitudinal coordinates of a location within Australia to be calculated. Based on the aforementioned latitudinal and longitudinal coordinates, the IFD data presented below in **Table 4—1** was derived using http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml.

Table 4—1 Intensity-Frequency-Duration Data

Intensity-Frequency-Duration Data		
	Rainfall Intensities (mm/hr)	
Duration	2 year ARI	50 year ARI
1 hour	35.1	69.0
12 hour	8.01	17.0
72 hour	2.52	5.63
Frequency Factors		
F2	4.30	
F50	15.84	
Location Skew		
G	0.00	

The IFD data listed in **Table 4—1** was used to calculate design storm intensities for the existing model scenario. Under proposed conditions, the impacts of Climate Change must be considered. The DECC publication, '*Practical Considerations of Climate Change*', 2007, nominates a 30% increase in storm intensities as an upper limit. Thus, direct intensities were calculated (*based on the IFD data*) for various durations for the 2 year, 5 year, 20 year, and 100 year ARI storm events and nominally increased by 30%. The increased direct storm intensities have been included as **Appendix 6 -** .

XP-RAFTS has the capacity to account for ground infiltration via initial and continuing loss parameters. Runoff is not generated from a rainfall event until the value of the initial loss has been exceeded, once the initial loss is exceeded, the continuing loss is applied to all rainfall throughout the

storm duration. The initial and continuing loses adopted for all XP-RAFTS model scenarios are included in **Table 4—2**.

Table 4—2 Rainfall Loss Parameters

	Pervious Surfaces	Impervious Surfaces
Initial Loss	20mm	2.5mm
Continuing Loss	5mm	0mm

XP-RAFTS is capable of lagging hydrographs generated from an upstream catchment across a downstream catchment. In estimating lag times a runoff velocity of 2m/s has been assumed in all instances.

Surface roughness factors (*i.e. Manning's "n" values*) for impervious and pervious areas were based upon WorleyParsons' assessment. All XP-RAFTS model scenarios (*i.e. existing and proposed*) adopted Manning's "n" values of 0.015 and 0.03 for impervious and pervious surfaces respectively.

4.1.2 Model Verification

In order to verify the IFD data the XP-RAFTS input parameters and the flows generated within the XP-RAFTS model were compared against flow estimates derived by the Rational Method, '*Australian Rainfall and Runoff, Volume 1*', Institute of Engineers, 1987. The Rational Method is often applied across natural catchments (*i.e. 100% pervious*) as a method of estimating peak flow rates.

The Rational Method for estimating peak flow rates is driven by three attributes; catchment area, frequency factor, and rainfall intensity (*based on a Time of Concentration calculation*) for a given ARI storm event. The parameters used in the Rational Method peak flow estimation are summarised in **Table 4—3**.

Table 4—3 Rational Method Parameters

Parameter	**Value**
Catchment Area (ha)	8.9
C10	0.9
F100	1.2
Frequency Factor (C10 x F100)	1.08
Time of Concentration (mins)	18
Intensity (mm/hr)	172

The XP-RAFTS and rational method flow estimations for the 100 year ARI are shown below in **Table 4—4**.

Table 4—4 XP-RAFTS Verification Against The Rational Method

Peak Flow Estimation Method	100 Year Peak Flow Estimation (m^3/s)
XP-RAFTS	4.6
The Rational Method	4.4

Table 4—4 indicates that the XP-RAFTS peak flow approximation is comparable to the peak flow estimate derived from the Rational Method calculation. The XP-RAFTS estimate must be considered more accurate the Rational Method. XP-RAFTS considers catchment specific conditions and the verification against the Rational Method in this instance has been completed to verify the magnitude of peak flow estimates out of XP-RAFTS derived from location specific IFD data and adopted input parameters.

4.2 Existing Catchment Characteristics

The characteristics of existing catchments within and around the site must be investigated and modelled to quantify existing peak flow rates at key locations. The establishment of existing peak flow rates is the key driver in the development of a stormwater quantity management strategy.

4.2.1 Internal Catchments

Under existing conditions the site can be considered to comprise of four discrete internal catchments (*refer **Drawing 7587-PA-13***). A brief description of the four existing catchments is provided below and the existing internal catchment properties are summarised in **Table 4—5**.

Existing Catchment 1 is located in the north-eastern corner of the site and is predominately impervious. Existing Catchment 1 contains extensive roof and hardstand areas. Stormwater runoff generated in this catchment is drained via a pit and pipe network. The existing drainage network discharges flow into an existing pit located in Mobbs Lane. Flows from this pit are directed into a culvert under Mobbs Lane and then discharge into the Valley Road drainage channel. Flows from Existing Catchment 1 exceeding the capacity of the existing drainage network have been assumed to travel overland into Existing Catchment 2.

Existing Catchment 2 is bound by Existing Catchment 1 to the north and east, Mobbs Lane to the south and Existing Catchment 3 to the west. Existing Catchment 2 is essentially a grassed embankment containing no drainage infrastructure. Under existing conditions, Existing Catchment 2 generally drains in a south-westerly direction into the Mobbs Lane road reserve and is drained into the culvert located under Mobbs Lane and into the open channel. Flows exceeding that capacity of

the existing culvert[6] are conveyed within Mobbs Lane and discharged directly into Terrys Creek at the Mobbs Lane/Terrys Creek crossing.

Existing Catchment 3 is bound by Existing Catchment 4 to the north, Existing Catchment 1 and 2 to the east, Mobbs Lane to the south, and Mobbs Lane Reserve to the west. Existing Catchment 3 comprises predominately of grassed surfaces and intermittent regions of road, car park, and satellite dish footings. Existing Catchment 3 drains overland in a south-westerly direction through the western boundary of the site and into Mobbs Lane Reserve.

Existing Catchment 4 is bound by residential developments along Grimes Lane to the north, the TAFE School of Horticulture to the east, Existing Catchment 3 to the south, and Mobbs Reserve to the west. Existing Catchment 4 is approximately 95% pervious and flows into a drainage channel located within the site. This drainage channel manoeuvres runoff through the western boundary of the site being discharging into the upper extent of Terrys Creek.

Table 4—5 Existing Internal Catchment Characteristics

Catchment Name	Catchment Area (ha)	Impervious Percentage	Vectored Average Catchment Slope	Location of Discharge
Existing Catchment 1	4.05	82%	4.5%	Channel to the south of Mobbs Lane and west of Valley Road
Existing Catchment 2	0.93	4%	8%	Channel to the south of Mobbs Lane and west of Valley Road
Existing Catchment 3	2.53	18%	9%	Mobbs Lane Reserve
Existing Catchment 4	1.40	5%	7%	Upper extents of Terrys Creek

4.2.2 External Catchments

Whilst the site is located at the upper extents of the Terrys Creek catchment, there are two external catchments that require consideration; the TAFE School of Horticulture, and Mobbs Lane. The external catchment properties are summarised in **Table 4—6**. The external catchments are shown on **Drawing 7587-PA-13**.

[6] Based on information supplied by Parramatta City Council and site inspection, the culvert under Mobbs Lane consists of three 450mm diameter pipes. The pipes under Mobbs Lane have been calculated to run at 2.5% grade. A flow capacity analysis of the culvert determined that the peak conveyance of this culvert is 1.03m^3/s.

The TAFE School of Horticulture has been considered as two catchments. The first sub-catchment (*Ext1*) is relatively steep and largely pervious. It contains substantial vegetation and an irrigation pond. The second sub-catchment (*Ext2*) is relatively flat and predominately impervious, despite containing garden areas.

The TAFE School of Horticulture generally drains from the east to the west and into an irrigation pond. Conservatively, this pond has not been considered in modelling flows down the existing drainage line located in Existing Catchment 4.

The Mobbs Lane External Catchment (*MLext*) contains regions of Mobbs Lane, Valley Road and some residential lots bound by Mobbs Lane and Valley Road. This catchment is of interest to quantify existing peak flow rates arriving at the culvert under Mobbs Lane that ultimately discharges into the open channel located to the west of Valley Road for various ARI events.

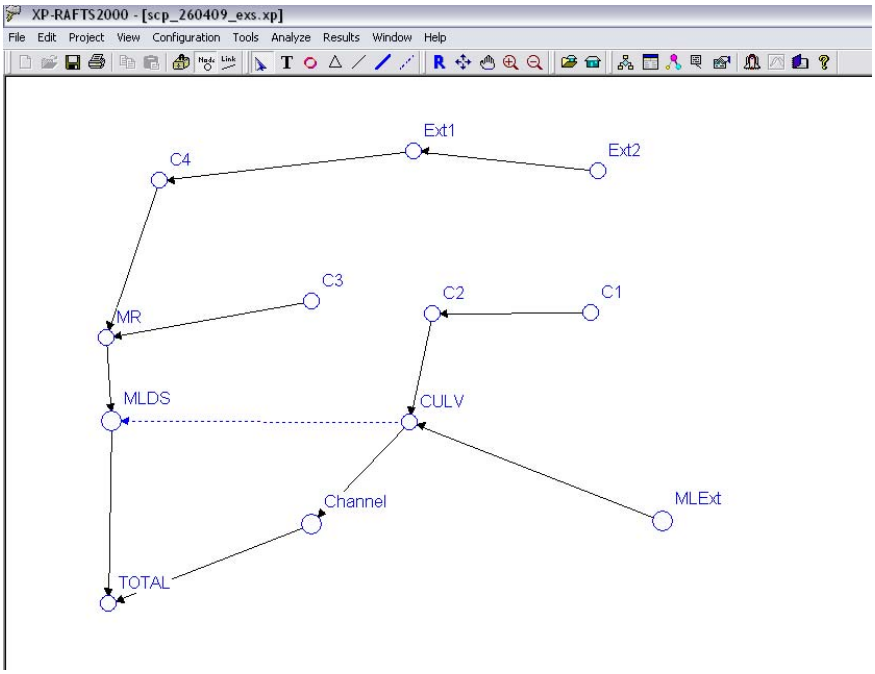
Table 4—6 External Catchment Characteristics

Catchment Name	Catchment Area (ha)	Impervious Percentage	Vectored Average Catchment Slope	Location of Discharge
External Catchment 1	1.07	5%	10%	Existing Catchment 4
External Catchment 2	1.00	60%	2%	External Catchment 1
Mobbs Lane External	2.20	64%	4%	Open Channel

4.3 Existing Peak Flow Rates

The existing scenario model layout is represented below as **Diagram 4-1**.

Diagram 4-1 Existing Scenario Model Layout[7]



Peak flows rates for the 2 year, 5 year, 20 year and 100 year ARI storm events are provided below in **Table 4—7**.

Table 4—7 Existing Peak Flow Rates

		Peak Flow Rates (m^3/s)			
Catchment Name/Location	Model Identification	2 Year ARI	5 Year ARI	20 Year ARI	100 Year ARI
Existing Catchment 1	C1	1.1	1.4	1.7	2.4
Existing Catchment 2	C2	1.1	1.6	2.2	2.8
Existing Catchment 3	C3	0.3	0.6	0.9	1.2
Existing	C4	0.4	0.8	1.3	1.7

[7] The diversion link from CULV to MLDS is activated when flows arriving at CULV exceed the flow capacity of the culvert. For more detail refer **Sections 4.2** and **4.4.1**.

		Peak Flow Rates (m^3/s)			
Catchment Name/Location	Model Identification	2 Year ARI	5 Year ARI	20 Year ARI	100 Year ARI
Catchment 4					
External Catchment 1	Ext1	0.3	0.5	0.8	1.0
External Catchment 2	Ext2	0.2	0.3	0.4	0.5
Mobbs Lane External	MLExt	0.5	0.7	0.9	1.2
Mobbs Reserve	MR	0.7	1.3	2.0	2.8
Culvert at Mobbs Lane	CULV	1.5	2.2	3.1	3.9
Valley Road Drainage Channel	Channel	1.0	1.0	1.0	1.0
Terrys Creek/Mobbs Lane crossing	MLDS	1.0	2.3	4.1	5.7
Total	**TOTAL**	**2.0**	**3.3**	**5.1**	**6.7**

4.4 Proposed Conditions

The proposed Epping Park development results in a minor increase in the impervious area on the site (*from approximately 45% to 50%*). This increase in impervious area results in minor increases in stormwater runoff. The proposed internal catchments are shown in **Drawing 7587-PA-14**.

The proposed conditions model maintains the existing characteristics of the external catchments.

The purpose of modelling proposed conditions is to determine the required detention storage to ensure no impact on downstream stormwater infrastructure and in turn flooding. To that effect, modelling focused on proposed conditions and the peak flow rates arriving at four locations, viz;

- The Valley Road drainage channel;
- Mobbs Lane/Terrys Creek crossing;
- Mobbs Lane Reserve; and

- The Terrys Creek/Valley Road Drainage Channel junction (*i.e. total of above three locations*)[8].

The criteria for limiting the proposed peak flow rates at the four locations are described in the sections below.

4.4.1 Culvert Under Mobbs Lane

The existing culvert that runs under Mobbs Lane and discharges stormwater runoff into the Valley Road drainage channel an open channel is known to comprise of three 450mm diameter parallel pipes (*refer* ***Appendix 7 -***) with a grade of approximately 2.5%. Hydraulic modelling was undertaken to determine the peak capacity of this culvert which was determined to be approximately 1.03m^3/s.

XP-RAFTS modelling of the existing scenario estimated the peak flow arriving at this existing culvert would be 1.5m^3/s for the 2 year ARI event. This implies that for minor rainfall events the existing culvert does not provide adequate capacity to direct stormwater runoff into the existing channel. Thus, when the peak flow rate arriving at this culvert exceeds 1.03m^3/s stormwater runoff would bypass the culvert (*and subsequently the Valley Road drainage channel*) resulting in stormwater runoff discharging directly into Terrys Creek at the Mobbs Lane/Terrys Creek crossing.

As part of the proposed development works will be undertaken to upgrade the Mobbs Lane road reserve. The upgrade works will include drainage infrastructure in the form of kerb and gutter, stormwater pits, and stormwater pipes. The design capacity for the upgraded drainage infrastructure will be the 20 year ARI storm event.

Under proposed conditions, the site will not discharge (*excluding proposed catchments 2 and 18*) into the existing culvert running under Mobbs Lane. Rather, the development will drain directly into Terrys Creek at the Mobbs Lane/Terrys Creek crossing via appropriate drainage infrastructure designed and constructed as part of the Mobbs Lane external works.

With the proposed development bypassing the existing culvert and open channel, the 20 year ARI peak flow from the Mobbs Lane External Catchment will be directed via the proposed pipe network into the open channel. This will also result in a reduced flow rate being discharged into the open channel (*which anecdotally experiences flooding issues*) for events up to and including the 20 year ARI event.

4.4.2 Mobbs Lane at Terrys Creek

The proposed stormwater detention basin will discharge stormwater directly into Terrys Creek at the Mobbs Lane/ Terrys Creek crossing via a pipe network and overland flow path in Mobbs Lane. Additionally, flows from the Mobbs Lane External catchment in excess of the 20 year ARI peak flow

[8] Only flows generated from within the site and those affecting stormwater management have been considered at this location.

rate will bypass the Valley Road drainage channel and be conveyed within Mobbs Lane before discharging directly into Terrys Creek at the Mobbs Lane/Terrys Creek crossing.

Under proposed conditions the peak flow rate arriving at the Mobbs Lane/Terrys Creek crossing will not exceed the existing peak flow rate for the 2 year, 5 year, 20 year and 100 year ARI events.

Table 4—8 below has been included to summarise the existing and proposed scenarios for stormwater flows discharging into the open channel, and directly into Terrys Creek via Mobbs Lane.

Table 4—8 Summary of Existing and Proposed Conditions at the Open Channel and at the Terrys Creek/Mobbs Lane Crossing

Discharge Location	Existing Scenario	Proposed Scenario
Valley Road Drainage Channel	Combined flows from Existing Catchment 1, Existing Catchment 2, and Mobbs Lane External up to a quantity of 1.03m^3/s.	All flows from the Mobbs Lane External Catchment for events up to and including the 20 year ARI event.
Terrys Creek at the Mobbs Lane/Terrys Creek crossing	Direct flows from Existing Catchment 3 and combined flows from Existing Catchment 1, Existing Catchment 2, and Mobbs Lane External that exceed 1.03m^3/s.	All flows from the Epping Park development (*except proposed catchments 2 and 18*) and flow exceeding 1.03m^3/s from the Mobbs Lane External Catchment. Flows generated from within the site that discharge into Terrys Creek directly from Mobbs Lane will be detained to match existing peak flow rates arriving at this location for the 2 year, 5 year, 20 year and 100 year ARI events.

4.4.3 Mobbs Lane Reserve

Peak flow rates generated from the proposed development discharging into Mobbs Lane Reserve will not exceed the existing flow rates for the 2 year, 5 year, 20 year and 100 year ARI storm events.

4.4.4 Terrys Creek/Valley Road Drainage Channel (*i.e. total of three above locations*)[9]

The combined total peak flow rates generated by the proposed development site will not exceed the existing combined total peak flow rates being discharged off the site for the 2 year, 5 year, 20 year, and 100 year ARI storm events.

4.5 Proposed Catchment Characteristics

The catchment characteristics modelled for the proposed scenario are presented below as **Table 4—9**.

Table 4—9 Proposed Catchment Characteristics

Catchment Name	Catchment Area (ha)	Impervious Percentage	Vectored Average Catchment Slope
Proposed Catchment 1	1.29	65%	1%
Proposed Catchment 2	0.18	17%	2%
Proposed Catchment 3	0.52	74%	2%
Proposed Catchment 4	0.25	81%	1%
Proposed Catchment 5	1.37	65%	4%
Proposed Catchment 6	0.35	70%	2%
Proposed Catchment 7	0.16	65%	1%
Proposed Catchment 8	0.35	72%	1%
Proposed Catchment 9	0.43	75%	1%
Proposed Catchment 10	0.65	60%	2%
Proposed Catchment 11	0.35	83%	1%
Proposed Catchment 12	0.96	12%	7%
Proposed Catchment 13	0.58	14%	8%
Proposed Catchment 14	0.22	30%	1%
Proposed Catchment 15	0.24	68%	3%

[9] Only flows generated from within the site and t0.64hose aff25ecting stormwater management have been considered at this location.

Catchment Name	Catchment Area (ha)	Impervious Percentage	Vectored Average Catchment Slope
Proposed Catchment 16	0.11	30%	5%
Proposed Catchment 17	0.64	25%	3%
Proposed Catchment 18	0.23	10%	15%
External Catchment 1	1.07	5%	10%
External Catchment 2	1.00	60%	2%
Mobbs Lane External	2.20	65%	4%
Total	**13.18**	**51%**	**n/a**

4.6 Proposed Detention Basin

Under proposed conditions, the majority of stormwater runoff within the proposed development site will be directed towards a constructed wetland/detention basin. It is proposed to allocate a volume of storage above the constructed wetland to facilitate peak flow attenuation.

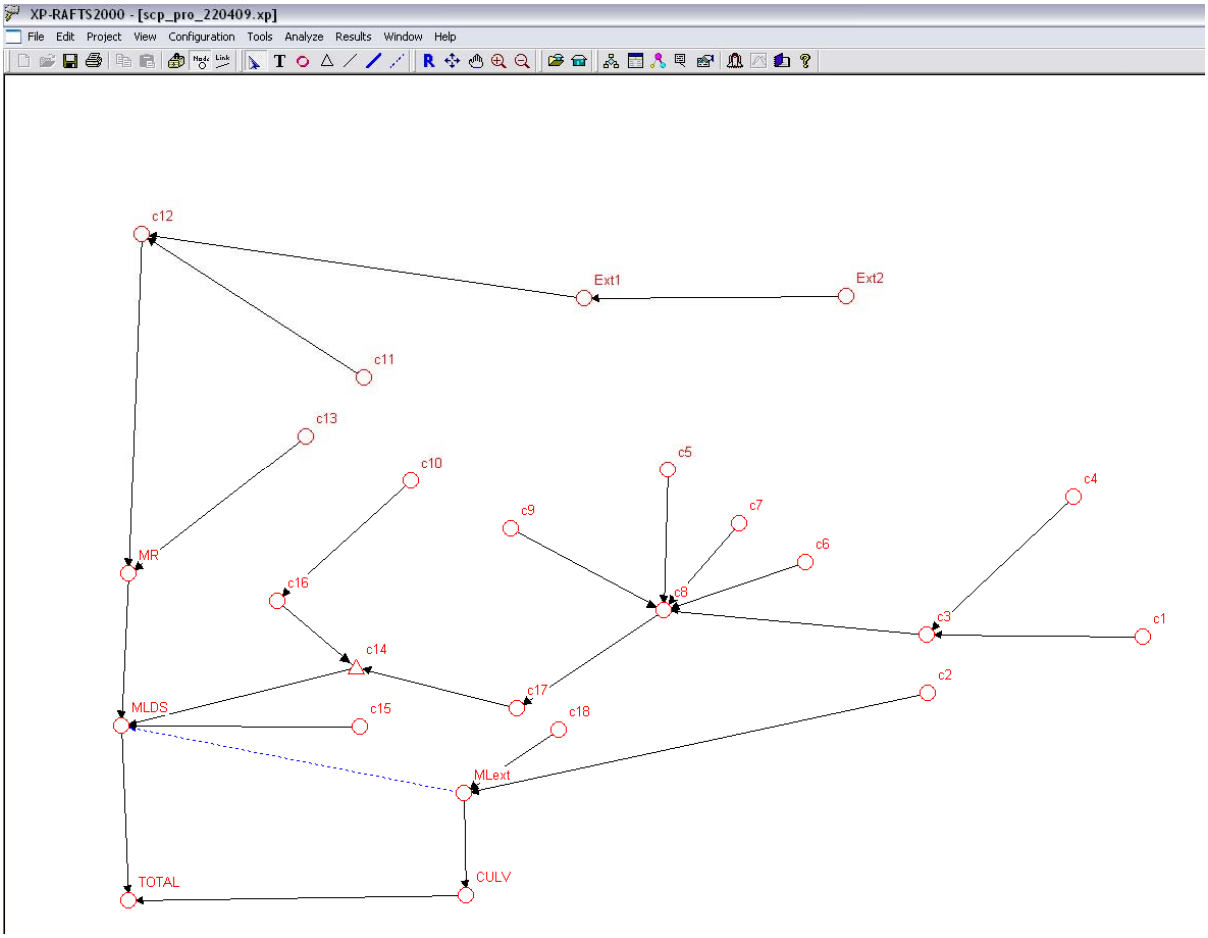
The proposed detention basin will pipe flows directly into Terrys Creek via Mobbs Lane for events up to and including the 20 year ARI storm event. Beyond the 20 year ARI storm, outflows from the proposed basin will be discharged via an overflow weir and spillway. Up to the 100 year ARI storm, peak flows out of the basin will be attenuated back to the existing peak flow rates.

XP-RAFTS was used to develop stage/storage and stage/discharge relationships to ensure that under proposed conditions, peak flow rates were attenuated back to existing levels for the 2 year, 5 year, 20 year, and 100 year ARI event. The completion of the relationship modelling concluded that approximately 850m^3 of detention storage would be required within the development to ensure no adverse downstream impacts on flooding or existing infrastructure. This results in a detention volume of 94m^3/ha.

4.7 Proposed Scenario Peak Flow Rates

The proposed model layout is shown below as **Diagram 4-2**.

Diagram 4-2 Proposed Scenario Model Layout[10]



The peak flow rates within and downstream of the development site are presented in **Table 4—10** below. These results include the modelling of the 850m^3 detention volume that is operated via a series of hydraulic control structures.

[10] The diversion link connecting MLext and MLDS is activated when flow rate arriving at MLext exceed 1.03m^3/s. This flow rate corresponds with the 20 year ARI peak flow rate from the Mobbs Lane External Catchment.

Table 4—10 Proposed Scenario Peak Flow Rates

		Peak Flow Rates (m^3/s)			
Catchment Name/Location	Model Identification	2 Year ARI	5 Year ARI	20 Year ARI	100 Year ARI
Proposed Catchment 1	C1	0.26	0.34	0.46	0.61
Proposed Catchment 2	C2	0.02	0.03	0.06	0.08
Proposed Catchment 3	C3	0.44	0.59	0.81	1.04
Proposed Catchment 4	C4	0.07	0.08	0.12	0.14
Proposed Catchment 5	C5	0.28	0.39	0.58	0.73
Proposed Catchment 6	C6	0.08	0.11	0.15	0.19
Proposed Catchment 7	C7	0.03	0.04	0.07	0.08
Proposed Catchment 8	C8	1.01	1.37	1.93	2.45
Proposed Catchment 9	C9	0.11	0.13	0.18	0.22
Proposed Catchment 10	C10	0.13	0.18	0.25	0.34
Proposed Catchment 11	C11	0.10	0.12	0.16	0.20
Proposed Catchment 12	C12	0.41	0.81	1.27	1.66
Proposed Catchment 13	C13	0.07	0.15	0.24	0.30
Proposed Catchment 14	C14	0.55	1.10	1.70	2.20

		Peak Flow Rates (m^3/s)			
Catchment Name/Location	Model Identification	2 Year ARI	5 Year ARI	20 Year ARI	100 Year ARI
Proposed Catchment 15	C15	0.05	0.08	0.11	0.14
Proposed Catchment 16	C16	0.14	0.76	0.29	0.39
Proposed Catchment 17	C17	1.05	0.52	2.12	2.70
Proposed Catchment 18	C18	0.04	0.26	0.11	0.14
External Catchment 1	Ext1	0.28	0.52	0.79	1.04
External Catchment 2	Ext2	0.19	0.26	0.38	0.51
Mobbs Lane Reserve	MR	0.48	0.94	1.46	1.90
Mobbs Lane External	MLext	0.49	0.76	1.09	1.38
Valley Road Drainage Channel	CULV	0.49	0.76	1.03	1.03
Mobbs Lane/Terrys Creek Crossing	MLDS	1.06	2.07	3.25	4.52
Terrys Creek/Valley Road Drainage Channel Junction	Total	1.50	2.78	4.28	5.55

4.8 Comparison of Existing and Proposed Peak Flow Rates

Table 4—11 below compares the peak flow rates for the existing and proposed scenarios at the four key locations within and around the proposed development.

Table 4—11 Comparison of Existing and Proposed Peak Flow Rates

			Peak Flow Rates (m^3/s)			
Location	Model Identification	Scenario	2 Year ARI	5 Year ARI	20 Year ARI	100 Year ARI
Valley Road Drainage Channel	Channel	Existing	1.0	1.0	1.0	1.0
		Proposed	0.5	0.8	1.0	1.0
Terrys Creek/Mobbs Lane Crossing	MLDS	Existing	1.0	2.3	4.1	5.7
		Proposed	1.1	2.1	3.3	4.5
Mobbs Lane Reserve	MR	Existing	0.7	1.3	2.0	2.8
		Proposed	0.5	0.9	1.5	1.9
Terrys Creek/Valley Road Drainage Channel Junction	TOTAL	Existing	2.0	3.3	5.1	6.7
		Proposed	1.5	2.8	4.3	5.6

The results outlined in **Table 4—11** demonstrate that the proposed stormwater quantity management strategy achieves the objective of no increase in peak flow rates off the proposed development site at strategic locations. Additionally, the proposed stormwater quantity management strategy will result in significantly lower peak flow rates within the Valley Road drainage channel and at Terrys Creek/Valley Road drainage channel junction during frequent storm events.

The reductions indicated in **Table 4—11** indicate that the proposed stormwater quantity management strategy has the potential to reduce the frequency and severity of flooding downstream of the development site.

5. STORMWATER QUALITY MANAGEMENT STRATEGY

The Early Works Package includes the construction of all stormwater infrastructure. Thus, the development of the stormwater quality management strategy has taken into account the ultimate development scenario at the proposed site (*i.e. the Epping Park masterplan*).

5.1 Stormwater Quality Management Strategy (Construction Phase)

Construction can result in large amounts of sediment and other pollutants migrating downstream during storm events.

It is proposed to treat surface runoff (*occurring during the construction phase*) in accordance with the NSW Department of Housing publication, '*Managing Urban Stormwater – Soils and Construction*', 2004 (*commonly referred to as the "Blue Book").* Runoff during construction phases will be managed through the implementation of a sediment and erosion control plan, refer **Drawing 7587-PA-26** and **Drawing 7587-PA-26**.

The proposed sediment and erosion control plan would comprise of the following measures:

- Temporary settling basin;
- Silt fencing;
- Straw bales;
- Pit inlet protection;
- Flow diversion channels; and
- Management of construction entry and exit locations.

5.2 Stormwater Quality Management Strategy (Post Construction Phase)

The NSW Department of Environment and Climate Change (*DECC*) has published a document entitled, '*Managing Urban Stormwater: Urban Design*', October 2007, as a consultation draft. This document outlines water quality objectives for development within New South Wales. The DECC pollutant reduction targets are summarised below in **Table 5—1**.

Table 5—1 DECC Stormwater Pollutant Reduction Targets

Pollutant	Ideal Pollutant Reduction Percentage	Pollutant Reduction Percentage Objective
Gross Pollutants	100	90
Total Suspended Solids	95	85
Total Phosphorus	95	65
Total Nitrogen	85	45

The pollutant reduction percentage objectives are required for stormwater runoff generated from within the development site boundary (*i.e. there is no consideration of externally generated pollutant loads in the achievement of the above objectives*). The Epping Park development plans to incorporate a suite of Water Sensitive Urban Design (*WSUD*) measures to fulfil the DECC pollutant reduction percentage objectives.

The nature and location of the WSUD measures is shown on **Drawing 7587-PA-14**.

5.2.1 MUSIC Stormwater Quality Modelling

The software package developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH*) termed "*MUSIC*" (*Model for Urban Stormwater Improvement Conceptualisation*) was used to assess the effectiveness of the proposed WSUD mechanisms located throughout the proposed development.

MUSIC is a continual-run conceptual water quality assessment model that can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected mean annual pollutant loads. MUSIC is also able to conceptually simulate the performance of a group of WSUD measures to assess whether a proposed water quality management strategy is able to meet specified water quality objectives.

MUSIC has been used to ensure compliance with DECC's stormwater pollutant reduction objectives because it has the following attributes:

- It can account for temporal variation in storm rainfall throughout a year;
- Modelling steps can be as low as 6 minutes to allow accurate modelling of treatment devices;
- It can model a range of treatment devices;
- It can be used to estimate pollutant loads at any location within the catchment; and
- It is based on logical and accepted algorithms.

5.2.2 Climate Data

RAINFALL

MUSIC can model actual rainfall events on a 6 minute basis. To harness this capacity it is preferable to use 6 minute pluviograph data. Pluviograph data recorded at the Bureau of Meteorology station at Parramatta North (*Masons Drive – station number 66124*) between years 1988 and 1995 inclusive has been used.

The long term average annual rainfall at the Parramatta North rainfall station is 959mm per year (*based on data collected from 1984 to 2006*). The 8 years of rainfall data used for the MUSIC modelling had a mean annual rainfall of 958mm per year. Despite the close correlation between the long term average and the average across the 8 years of data used, an appropriate range of wet and dry years are present within the data set.

EVAPOTRANSPIRATION

Monthly aerial potential evapotranspiration values were obtained for the site from the '*Climate Atlas of Australia, Evapotranspiration*', Bureau of Meteorology, 2001. The adopted values are shown below in **Table 5—2**.

Table 5—2 Monthly Aerial Potential Evapotranspiration

Month	Aerial Potential Evapotranspiration (*mm*)
January	180
February	140
March	128
April	85
May	58
June	43
July	43
August	58
September	88
October	127
November	152
December	180

5.2.3 Soil Data and Model Calibration

SOIL DATA

In the absence of the appropriate site specific geotechnical data required to calibrate soil parameters within MUSIC, the DECC's recommended soil parameters for MUSIC modelling in western Sydney have been adopted. The DECC's recommended soil parameters are included as **Table 5—3**.

Table 5—3 DECC's Recommended Soil Parameters

	Units	Urban	Non-Urban
Impervious area parameters			
Rainfall threshold	mm/day	1.4	1.4
Pervious area parameters			
Soil storage capacity	mm	170	210
Initial storage	% of capacity	30	30
Field capacity	mm	70	80
Infiltration capacity coefficient – a	n/a	210	175
Infiltration capacity coefficient – b	n/a	4.7	3.1
Groundwater properties			
Initial depth	mm	10	10
Daily recharge rate	%	50	35
Daily base flow rate	%	4	20
Daily deep seepage rate	%	0	0

MODEL CALIBRATION

The recommended soil parameters were evaluated for appropriateness through the consideration of the volumetric runoff coefficient. In order to establish the legitimacy of a set of soil parameters, the volumetric runoff coefficient has been evaluated for a 100% pervious non-urban scenario and a 60% impervious urban scenario. The adopted soil parameters were applied to 1.0ha urban and non-urban catchments. The rainfall volume, runoff volume, and runoff coefficient values for the urban and non-urban scenario are summarised below in **Table 5—4**.

Table 5—4 Volumetric Runoff Coefficients

	1.0ha 100% Pervious Non-Urban Catchment	1.0ha 60% Pervious Urban Catchment
Rainfall Volume	9,590m^3	9,590m^3
Runoff Volume	3,120m^3	6,230m^3
Runoff Coefficient (C_v)	0.3	0.6

Based on the former NSW Government Department for Environment and Conservation publication, '*Managing Urban Stormwater: Strategy Framework*', 1997, the runoff coefficients calculated in **Table 5—4** lie within an acceptable range. Thus, the DECC's recommended soil parameters can be considered as appropriate and relevant for use on the site.

5.2.4 Event Mean Concentrations

DECC has recommended that the Event Mean Concentration (*EMC*) values presented in **Table 5—5** be adopted for MUSIC models for catchments throughout New South Wales. The recommended EMC values were determined by the CRCCH following an extensive literature review, '*Urban Stormwater Quality: A Statistical Overview*', H Duncan et al (CRCCH), 1999, which drew on data collected throughout Australia, but focussed more specifically on studies within New South Wales.

Table 5—5 DECC Recommended Event Mean Concentration Values

Land use	Base Flow						Storm Flow					
	Total Suspended Solids		Total Phosphorus		Total Nitrogen		Total Suspended Solids		Total Phosphorus		Total Nitrogen	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	(all values expressed as log_{10} mg/l)											
General urban Residential Industrial Commercial	1.20	0.17	-0.85	0.19	0.11	0.12	2.15	0.32	-0.60	0.25	0.30	0.19
Rural	1.15	-	-1.22	-	-0.05	-	1.95	-	-0.66	-	0.30	-
Roads	-	-	-	-	-	-	2.43	0.32	-0.30	0.25	0.34	0.19
Roofs	-	-	-	-	-	-	1.30	0.32	-0.89	0.25	0.30	0.19
Forest/Natural	0.78	0.17	-1.52	0.19	0.52	0.12	1.60	0.32	-1.10	0.25	-0.05	0.19

5.3 Existing Site Conditions

Under existing conditions, the proposed development site contains three land use types, viz:

- Roof area;
- Road area; and
- General area.

Table 5—6 below shows the approximate area break down for the existing land uses.

Table 5—6 Existing Catchment Areas and Land Uses

Land Use	Total Area (ha)	Percentage Impervious	Soil Parameters
Roof	1.18	100%	Urban
Road	3.00	85%[11]	Urban
General[12]	4.73	5%	Urban
Total	**8.91**	**45%**	

The areas nominated above in **Table 5—6** were modelled in MUSIC to provide an approximation of existing stormwater annual pollutant loads generated within the proposed development site.

5.3.1 Existing Stormwater Pollutant Concentrations

The MUSIC outputs for the existing catchment conditions are included below in **Table 5—7**.

Table 5—7 Existing Stormwater Pollutant Loads

Stormwater Pollutant	Mean Annual Load (*kg/yr*)
Total Suspended Solids	6,480
Total Phosphorus	14
Total Nitrogen	99
Gross Pollutants	896

5.4 Proposed Catchment Characteristics

The proposed development masterplan has been separated into eighteen sub-catchments (*refer **Drawing 7587_PA-14***). The catchment splitting process was primarily driven by watershed boundaries and regions draining to WSUD measures. The proposed catchment characteristics that are integral in the preparation of the water quality modelling are included in **Table 5—8** below.

[11] For the purpose of the MUSIC model, the existing road area has been assumed to be 85% impervious. This accounts for the areas of planting within the road footprint and the road pavements lack of condition (*i.e. wear, potholes, cracks, etc*).

[12] Under existing conditions, the General Urban Area has been modelled with the forest/natural Event Mean Concentration Values.

Table 5—8 Proposed Catchment Characteristics

Catchment Name	Total Area (ha)	Roof Area (ha)	Road Area (ha)	General Urban Area (ha)	General Urban % Impervious
Proposed Catchment 1	1.3	0.39	0.15	0.75	40%
Proposed Catchment 2	0.2	0.00	0.01	0.17	10%
Proposed Catchment 3	0.5	0.22	0.08	0.23	40%
Proposed Catchment 4	0.3	0.18	0.00	0.08	40%
Proposed Catchment 5	1.4	0.34	0.22	0.82	40%
Proposed Catchment 6	0.35	0.03	0.00	0.32	67%
Proposed Catchment 7	0.2	0.07	0.00	0.10	40%
Proposed Catchment 8	0.4	0.11	0.08	0.16	40%
Proposed Catchment 9	0.4	0.18	0.07	0.19	40%
Proposed Catchment 10	0.7	0.17	0.05	0.43	40%
Proposed Catchment 11	0.4	0.19	0.06	0.10	40%
Proposed Catchment 12[13]	1.0	0.02	0.00	0.94	10%
Proposed Catchment 13[13]	0.6	0.02	0.00	0.56	10%
Proposed Catchment 14	0.2	0.00	0.00	0.22	30%
Proposed Catchment 15	0.2	0.06	0.6	0.13	40%
Proposed Catchment 16	0.1	0.00	0.00	0.11	30%
Proposed Catchment 17	0.6	0.07	0.00	0.57	15%
Proposed Catchment 18[13]	0.2	0.00	0.00	0.23	10%
Total	**8.9**	**2.04**	**0.77**	**6.10**	**n/a**

The MUSIC model representing the proposed development applied the EMC values presented in **Table 5—5** to the roof, road and general urban catchment areas listed in **Table 5—8**. Roof and road areas were modelled as 100% impervious catchments whereas general urban areas were modelled

[13] The General Urban Area for the nominated catchment is predominately open space and containing minimal improvement. Thus, the General Urban Area has adopted the forest/natural Event Mean Concentration values.

with varying percentages of imperviousness based on the proposed composition of the open space regions.

5.5 Proposed Water Sensitive Urban Design Measures

In order to meet the recommended stormwater pollution reduction targets, the proposed development integrates a series of Water Sensitive Urban Design (*WSUD*) measures. These measures include:

- Bio-retention swales;
- Rain gardens;
- Gross Pollutant Traps;
- A constructed wetland/basin; and
- A reed bed[14].

An area breakdown of the proposed treatment measures is included below as **Table 5—9**.

Table 5—9 Proposed Treatment Measures Area Breakdown[14]

Water Sensitive Urban Design Measure	Total Area (m^2)
Bio-retention swales	2,097
Rain gardens	453
Gross Pollutant Traps	7 items
Constructed Wetland/basin	1,800
Total	4,350

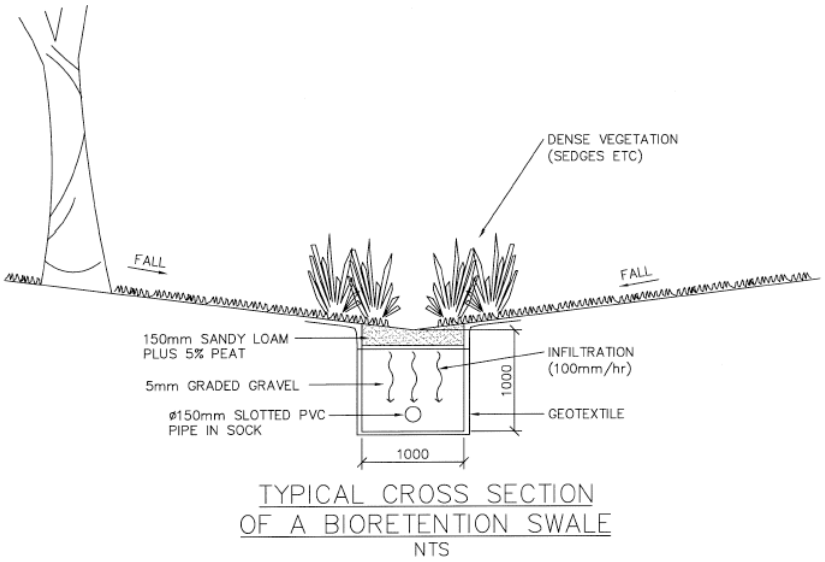
The proposed WSUD measures account for approximately 5% of the proposed development footprint.

5.5.1 Bio-retention Swales/Rain gardens

Bio-retention swales/rain gardens consist of a planted region containing native grasses, shrubs and trees underlain by an infiltration area. The swale/rain garden are proposed to be gravel filled and approximately 700mm deep with 200mm of sandy loam topsoil and a perforated pipe at the base. A typical bio-retention swale/rain garden cross-section, with indicative dimensions, is included below as **Diagram 5-1**.

[14] The reed bed has not been included as it has not been modelled as part of the stormwater quality strategy for the proposed development as it will only treat flows generated outside of the development site.

Diagram 5-1 Typical Bio-retention Swale/Rain garden Cross Section



Bio-retention swales/rain gardens remove stormwater pollutants via detention and an extended filtration process. Further treatment would be achieved by filtering through the gravel trench and biological action due to growth on the gravel.

Bio-retention swales/rain gardens are typically designed to allow stormwater runoff to pond upon their surface (*the maximum depth of ponding for swales located within the proposed development is 0.3m*). Over time, the ponded water filters through vegetation and a layer of gravel. Flows maintained on the surface enable sunlight exposure and introduce small degrees of turbulence as flows travel along the vegetated base. Turbulence is beneficial to improving stormwater quality by enabling oxygen to enter flow volumes.

5.5.2 Gross Pollutant Traps

It is proposed to incorporate two styles of Gross Pollutant Traps into the stormwater quality management strategy; large scale end-of-line treatment GPTs, and at source GPT units.

GPTs capture litter, debris, coarse sediment, oils, and greases. While the pollutant capture efficiency of GPTs may vary from manufacturer to manufacturer, the paper '*Removal of Suspended Solids and Associated Pollutants by a Gross Pollutant Trap*', CRCCH, 1999 suggests the following efficiencies for GPTs:

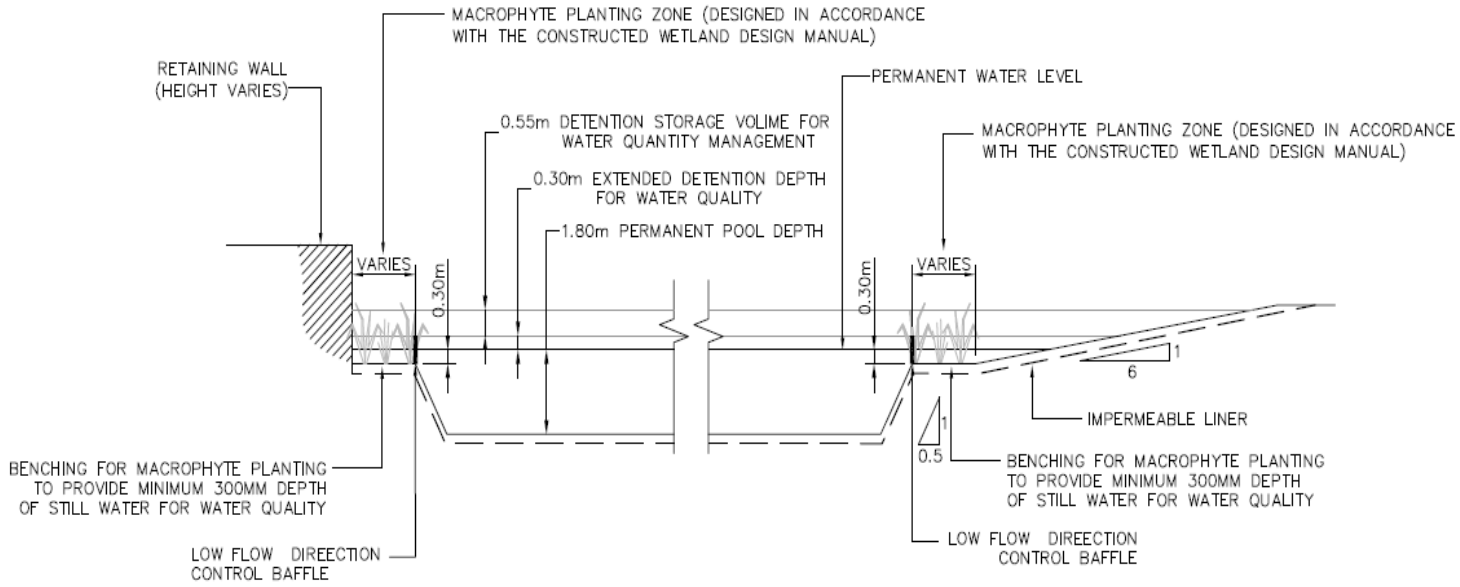
- Gross pollutants majority;
- Total suspended solids up to 70%;
- Total phosphorus up to 30%; and

- Total nitrogen up to 13%.

5.5.3 Constructed Wetlands

The proposed constructed wetland will be designed for a dual purpose encompassing stormwater quality improvement, and stormwater detention. A typical cross-section through the constructed wetland is included below as **Diagram 5-2**.

Diagram 5-2 Typical Constructed Wetland Cross Section



TYPICAL BASIN CROSS-SECTION
NTS

Constructed wetlands are typically installed as end-of-line stormwater quality improvement devices. Through a combination of sedimentation, filtration and other pollutant uptake processes, constructed wetlands reduce stormwater pollutant loadings. The constructed wetland is proposed to consist of a 1.8m permanent pool depth an additional 0.3m of extended detention depth[15]. A macrophyte zone will be established around the perimeter of the basin and will be sized in accordance with '*The Constructed Wetlands Manual*', NSW Department of Land and Water Conservation, 1998.

[15] The 0.3m extended detention depth extends 1.5m inwards from the basin perimeter. This depth of water is generally recommended as adequate for water related safety concerns.

In addition to the water quality improvement capability, the constructed wetland will also contain an allocated volume of detention storage to attenuate peak flow rates off the site in accordance with the stormwater quantity management strategy (*refer **Section 4***). The allocated volume of storage will be provided directly above the water quality depths.

5.5.4 Reed Bed

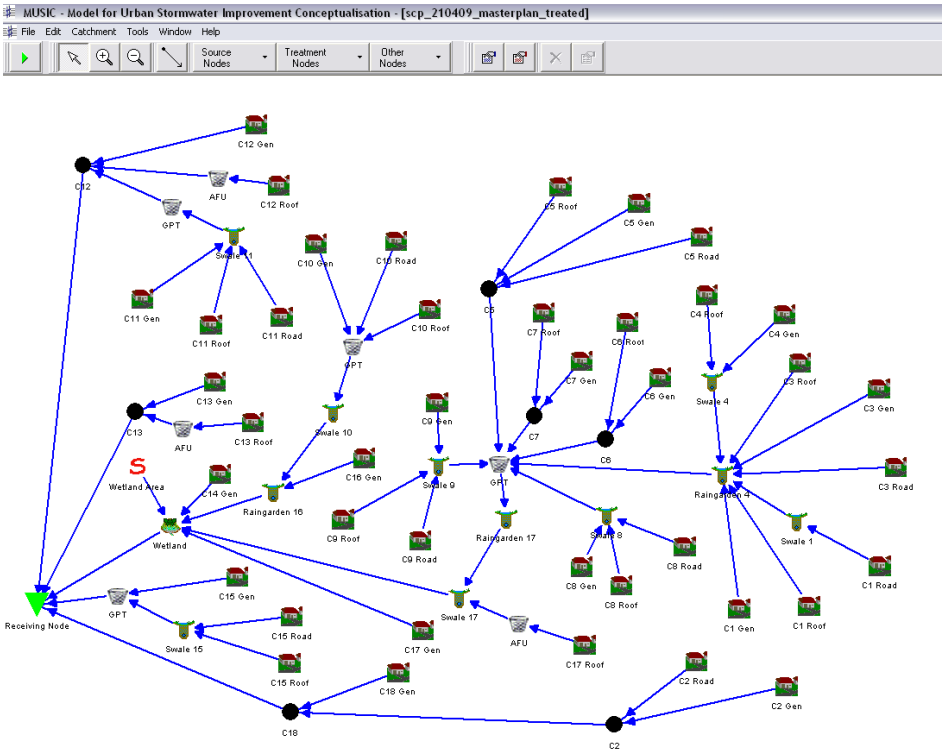
Reed beds, or subsurface flow wetlands, are well known for their efficacy in removing a wide variety of organic compounds, nutrients and bacteria through the processes of sorption, oxidation and breakdown of compounds into less complex entities.

It is proposed to place a reed bed within Proposed Catchment 12. The reed bed will treat stormwater runoff entering the proposed development site from the TAFE School of Horticulture. As the reed bed will not treat stormwater runoff generated from within the proposed development site, it has not been included in MUSIC modelling.

5.6 MUSIC Model Layout

A schematic of the MUSIC model is included below as **Diagram 5-3**.

Diagram 5-3 Proposed Development MUSIC Model Layout



5.7 MUSIC Modelling Results

The MUSIC modelling results can be considered in two parts, viz:

- Responding to the DECC stormwater pollutant reduction objectives; and
- The levels of stormwater pollutants being exported off the development site after construction relative to the existing scenario.

5.7.1 Stormwater Pollutant Reduction Targets

The objectives set out by the DECC for stormwater quality are driven by percentage reductions targets for four pollutants; total suspended solids, total phosphorus, total nitrogen, and gross pollutants. Thus, an existing scenario model is required to estimate two things, viz:

- The total stormwater pollutant loads generated by sources (*i.e. road areas, roof areas and general areas*); and
- The effectiveness of the proposed WSUD measures in reducing the migration of stormwater pollutants downstream of the site.

The effectiveness of the proposed WSUD measures in removing stormwater pollutants from the development site is summarised below in **Table 5—10**.

Table 5—10 MUSIC Modelling Results

	Mean Annual Loads			
	Sources	**Residual Load**	**Percentage Reduction**	**DECC Target**
Flow (ML/year)	52	50	4%	n/a
Total Suspended Solids (kg/year)	4,710	542	89%	85%
Total Phosphorus (kg/year)	12.0	3.5	70%	65%
Total Nitrogen (kg/year)	102	50	51%	45%
Gross Pollutants (kg/year)	1,181	80	93%	90%

The results presented in **Table 5—10** demonstrate that the proposed stormwater quality management strategy achieves the objectives set out by the DECC).

Furthermore, the proposed stormwater quality strategy results in a significant improvement in annual pollutants discharged off-site in comparison with existing conditions (*refer **Table 5—11***)

Table 5—11 Comparison Between Existing and Proposed Annual Pollutant Loads

	Mean Annual Loads (kg/yr)	
	Existing	**Proposed**
Total Suspended Solids	6,480	542
Total Phosphorus	14	3.5
Total Nitrogen	99	50
Gross Pollutants	896	80

5.8 Volumetric Runoff Coefficients

The volumetric runoff coefficient represents the proportion of rainfall across a catchment that does not infiltrate into the ground or is not lost by other means. Typically, volumetric runoff coefficients are dependent upon soil characteristics and the impervious percentage of the catchment. The soil properties and the percentage impervious are discussed in **Section 5.2.3** and **Section 5.3** respectively.

The affect of Water Sensitive Urban Design measures on the volumetric run off coefficient within the proposed development are summarised in **Table 5—12**.

Table 5—12 Volumetric Runoff Coefficient Summary

Modelled Scenario	Volumetric Runoff Coefficient
Existing	0.56
Proposed without WSUD measures	0.61
Proposed with WSUD measures	0.57

Based on WorleyParsons' experience a volumetric runoff coefficient of 0.57 represents a typical outcome for an urban catchment containing WSUD measures.

5.9 Maintenance of Water Sensitive Urban Design Measures

The proposed maintenance program for the water sensitive urban design measures outlined below has been based upon '*Managing Urban Stormwater: Treatment Techniques*', New South Wales Environment Protection Agency, 1997, and would consist of the following:

- Inspection of bio-retention swales, rain gardens, and reed beds should be undertaken quarterly and following large storm events. The following items should be inspected and, if required remedial action taken;
    - Channelisation and erosion;
    - Vigour and density of vegetation;
    - Weed inundation;
    - Access and wear;
    - Sediment build up behind check dams and in subsoil drainage; and
    - Litter/debris.

- The constructed wetland should be inspected quarterly and following large storm events. The following should be inspected and, if required remedial action taken;
    - Performance of outlet structures;
    - Integrity of embankments/retaining walls;
    - Weed infestation;
    - Mosquito breeding;
    - Litter and sediment levels; and
    - Health and diversity of macrophytes.
- Gross Pollutant Traps should be inspected and maintained in accordance with the manufacturer's specifications. Specifications would likely involve inspection and maintenance quarterly and after major rainfall events.

6. SERVICING STRATEGY

A preliminary servicing strategy has been undertaken for the proposed Epping Park masterplan. The primary function of the preliminary servicing strategy was to confirm that the proposed development can adequately service all buildings and public open spaces for, viz:

- Potable water;
- Sewer;
- Electricity;
- Gas; and
- Telecommunications.

As part of the Early Works Package it is proposed to place all required servicing infrastructure. As such, discussions with local service providers have been undertaken to ensure that the proposed Epping Park load demands can be met for the above listed services. However, as part of the Early Works Package, only a small fraction of the total masterplan demands will be required.

The above listed services are discussed under the headings below and a preliminary servicing concept plan for the proposed development has been included as, viz:

- **Drawing 7587-PA-28**;
- **Drawing 7587-PA-29**;
- **Drawing ESK01**; and
- **Drawing ESK02**.

6.1 Potable Water

A Sydney Water Servicing Coordinator (*Qalchek*) has been engaged to complete a preliminary design of a potable water network for the proposed development including, viz:

- Internal network design;
- Establishment of connection points; and
- Any external works (*if required*).

The potable water network within the proposed development has been prepared to ensure that all buildings, community facilities, and public open spaces associated with the Epping Park masterplan be adequately serviced with potable water. The proposed network will largely follow proposed road network and where possible is designed to run in a looped fashion.

The proposed network will connect into existing water infrastructure located in Mobbs Lane at two locations, viz:

- The intersection of proposed Road 1 and Mobbs Lane; and
- The intersection of proposed Road 2 and Mobbs Lane.

No amplification of the existing water network is required to ensure demands can be met for the proposed masterplan.

The pre-feasibility study completed by Sydney Water has been included as **Appendix 8 -** .

6.2 Sewer

A Sydney Water Service Coordinator (*Qalchek*) has been engaged to complete a preliminary design of a sewer network associated with the proposed development and includes, viz:

- Internal network design;
- Establishment of connection points; and
- Any required external works.

The proposed sewer network has been developed to ensure all proposed buildings, community facilities, and public open spaces associated with the Epping Park masterplan can have appropriate sewer access. The proposed network will largely follow the proposed road network and will drain via gravity to the sites major sewer line proposed to be located on the western extents of proposed Buildings 13, 14, 15, 16, and 17 (*all of which are not part of the Early Works Package*).

The major sewer line located within the proposed development will pass through the southern boundary of the site opposite Valley Road. The proposed Child Care Centre will have a separate sewer connection point (*it can not drain to the Valley Road outlet under gravity*). The proposed Child Care Centre will connect into existing nearby sewer infrastructure located adjacent to Terrys Creek.

Initial discussions with Sydney Water Corporation indicate that the existing sewer network can not accommodate the proposed 650 dwellings nominated in the masterplan. Thus, external upgrades of the sewer network are required. Sydney Water Corporation has nominated a connection point for the proposed development in Holway Street, Epping. A proposed alignment to this nominated connection point has been prepared, however it will require input and approval from Council prior to construction.

No indication from Sydney Water Corporation has been received nominating the phasing of the external sewer upgrades.

The pre-feasibility study completed by Sydney Water has been included as **Appendix 8 -** .

6.3 Electricity

A proposed electricity network within the proposed development has been prepared by Lincolne Scott.

The proposed electricity network has been developed to ensure all proposed buildings, community facilities, and public open spaces associated with the Epping Park masterplan can have appropriate access to electricity. The proposed network will largely follow the proposed road networks, pathways, and will extend into public open space areas as required.

6.4 Gas

A proposed gas network within the proposed development has been prepared by Lincolne Scott.

The proposed gas network has been developed to ensure all proposed buildings, community facilities, and public open spaces associated with the Epping Park masterplan can have appropriate access to gas. The proposed network will largely follow the proposed road networks, and extend into public open spaces if required.

Initial discussions with local gas infrastructure owner, Jemena Gas Networks, has established that existing infrastructure located within the Midson Road road reserve could be extended along Mobbs Lane and has sufficient capacity to service standard gas services (*hot water, cooking, heating and cooling*) within the proposed masterplan.

Correspondence from Jemena stating that the site can be adequately serviced for standard residential usages has been included as **Appendix 9 -** .

6.5 Telecommunications

A proposed telecommunications network within the proposed development has been prepared by Lincolne Scott.

The proposed telecommunications network has been developed to ensure that all proposed buildings, community facilities, associated with the Epping Park masterplan can have appropriate access to telecommunication services. The proposed network will largely follow the proposed road network.

Discussions are currently ongoing with telecommunication providers to supply services and manage network infrastructure within the proposed development. While the discussions are ongoing with providers, initial discussions with Telstra has indicated that the local exchange has adequate capacity to service the requirements of the proposed Epping Park masterplan.

7. CIVIL WORKS

The civil works package for the Early Works Package includes the following:

- Internal road design;
- Stormwater drainage;
- External works within the Mobbs Lane road reserve and intersections with Midson Road and Marsden Road; and
- Earthworks within the development site.

Each of these elements will be discussed independently over the following sections. For more detail on the nature and extent of the civil works package the WorleyParsons drawing set entitled '*Epping Park Early Works PA*' should be referenced.

7.1 Stormwater Drainage

Within the Early Works Package PA submission, allowances have been made for a 20 year ARI capacity drainage network and provision for overland flow paths for events greater than the 20 year ARI.

A concept stormwater drainage layout has been prepared for the Early Works Package. This concept drainage layout will evolve through the advent of detailed design further down the development approval process.

For storm events exceeding the 20 year ARI, the stormwater network will be running at capacity. Thus, overland flow paths will be required to safely convey stormwater runoff for events up to and including the 100 year ARI storm event. It is proposed to use roadways and constructed swales as major overland flow paths.

Flow behaviour within major overland flow paths will be managed to ensure that the velocity depth product does not exceed $0.4m^2/s$[16]. In addition, residents and the public will be separated from dedicated overland flow paths/spillways by raised boardwalks.

7.2 Internal Road Design

The proposed masterplan includes five individual road lengths. Roads generally consist of a 6m wide carriageway and are either one-way or two-way cross fall (*depending on the location of drainage infrastructure*). All roads within the development have been designed in accordance with the AUS-

[16] The '*NSW Floodplain Development Manual*', Department of Infrastructure Planning and Natural Resources, 2005 categorizes flood hazard. $0.4m^2/s$ is recommended as the safe upper limit for velocity depth products for pedestrians.

SPEC Joint Venture publication, '*Aus-Spec #1*', 2002, and will be maintained as private roads throughout the life cycle of the development.

7.3 External Works

As part of the proposed development, works external to the development site are required. The extend of the external works includes;

- Local widening of Mobbs Lane;
- Provision of drainage infrastructure (*i.e. kerb and gutter, pits and pipes*);
- Upgrading existing road pavements and verges (*i.e. footpaths*);
- Provision for a bus stopping bay;
- Intersection works at Marsden Road and Midson Road (*including service re-alignments where required*);
- Upgrading of traffic management signals; and
- Relocation of existing servicing infrastructure.

Design documentation for the external works has already been submitted and subsequently approved (*refer attached RTA correspondence included as* ***Appendix 10 -*** *)*. The construction of the required external works will be undertaken as required during the phased construction of the proposed development.

7.4 Earthworks

Under existing conditions the site contains considerable changes in elevation. While the proposed surface generally maintains the existing topography of the land, significant changes in elevation between buildings, roads, and open space areas is unavoidable. Thus, it is proposed that a series of earth batters, future building basements and structural retaining walls be incorporated into the proposed development to provide suitable transitions across changes in elevation.

The conceptual regrading of the site has been designed to minimise any requirement to export excess cut off site or import a short fall of fill. A preliminary earthworks volume calculation based on the proposed early works and conceptual designs for the future buildings and basements has been undertaken. The preliminary calculation estimates that excess cut for the concept would be in the range of 10,000m^3 to 17,500m^3.

During detailed design of the roads, revised buildings and basements; considerations will be made to further reduce any excess cut. Thus, the Early Works Package will aim to result in no excess cut being removed from the site. For the Early Works Package any excess cut will be stockpiled within the development site for use during later construction phases.

8. CONCLUSION

This report has outlined how the proposed Epping Park development will respond to; flooding, stormwater quality, stormwater quantity, servicing, and civil works issues. The specific conclusions that can be drawn regarding these five areas are outlined below.

8.1 Flooding

The proposed development is situated outside the existing flood extent of Terrys Creek. Given the relative location of the development site within the catchment (*i.e. at the upstream extent*) it is unlikely that flood levels within Terrys Creek could increase enough to have an impact on the proposed development.

The implementation of stormwater detention measures not only mitigates any local impact of the proposed development but has the potential to minimise flows downstream of the site and thus, potentially reduce the severity of local flooding issues.

8.2 Stormwater Quantity

The stormwater quantity strategy ensures that peak flow rates at four strategic locations under proposed conditions closely replicate the existing peak flow rates. These locations include;

- An existing open channel located to the west of Valley Road;
- Mobbs Reserve;
- Terrys Creek at the Mobbs Lane/Terrys Creek crossing; and
- The Terrys Creek/Valley Road Drainage Channel crossing (*i.e. the combination of the three above locations*)[17].

Through the provision of 850m^3 of detention storage, the proposed development closely replicates or improves upon (*i.e. reduces*) existing peak flow rates at the four listed locations.

The reductions in peak flows resulting from the proposed stormwater quantity management strategy will assist in alleviating anecdotal flooding issues associated with the Valley Road drainage channel.

8.3 Stormwater Quality

The stormwater quality strategy has been developed to ensure that current guidelines set out by the Department of Environment and Climate Change (*DECC*) are satisfied.

[17] Only flows generated from within the site and those affecting stormwater management have been considered at this location.

Through the implementation of a suite of WSUD measures, the proposed development achieves reductions that exceed the targets set out by the DECC (*refer* ***Table 1—1***)

Table 8—1 Volumetric Runoff Coefficient Summary

	Stormwater Runoff Pollutant Reductions	
	Percentage Reduction	**DECC Target**
Total Suspended Solids (kg/year)	89%	85%
Total Phosphorus (kg/year)	70%	65%
Total Nitrogen (kg/year)	51%	45%
Gross Pollutants (kg/year)	93%	90%

A proposed reed bed downstream of the TAFE School of Horticulture will assist in improving the suspected heavily polluted runoff generated from the TAFE site.

8.4 Servicing

Preliminary discussions held with relevant service providers indicate that with the amplification of some existing networks, the site can be serviced adequately for potable water, sewer, electricity, gas, and telecommunications.

8.5 Civil Works

The civil works incorporates internal road design, internal earthworks, internal and external stormwater drainage design, and external road design. The civil design has been conducted in accordance with relevant Australian standards and for more detail the WorleyParsons '*Epping Park Project Application Early Works*' drawing package should be referenced.

9. REFERENCES

'*Practical Consideration of the Impacts of Climate Change*', Department of Environment and Climate Change, 2007;

'*The Constructed Wetlands Manual*', Department of Land and Water Conservation, 1998;

'*Epping Park – Early Works - Project Application (Drawing Package)'*, WorleyParsons, 2009;

'*Terrys Creek Subcatchment Management Plan*', Cardno Willing, 2005;

'*Australian Rainfall and Runoff, Volume 1*', Institute of Engineers, 1987;

'*Managing Urban Stormwater – Soils and Construction*', New South Wales Department of Housing, 2004;

'*Managing Urban Stormwater: Urban Design*', Department of Environment and Climate Change, 2007;

'*Climate Atlas of Australia, Evapotranspiration*', Bureau of Meteorology, 2001;

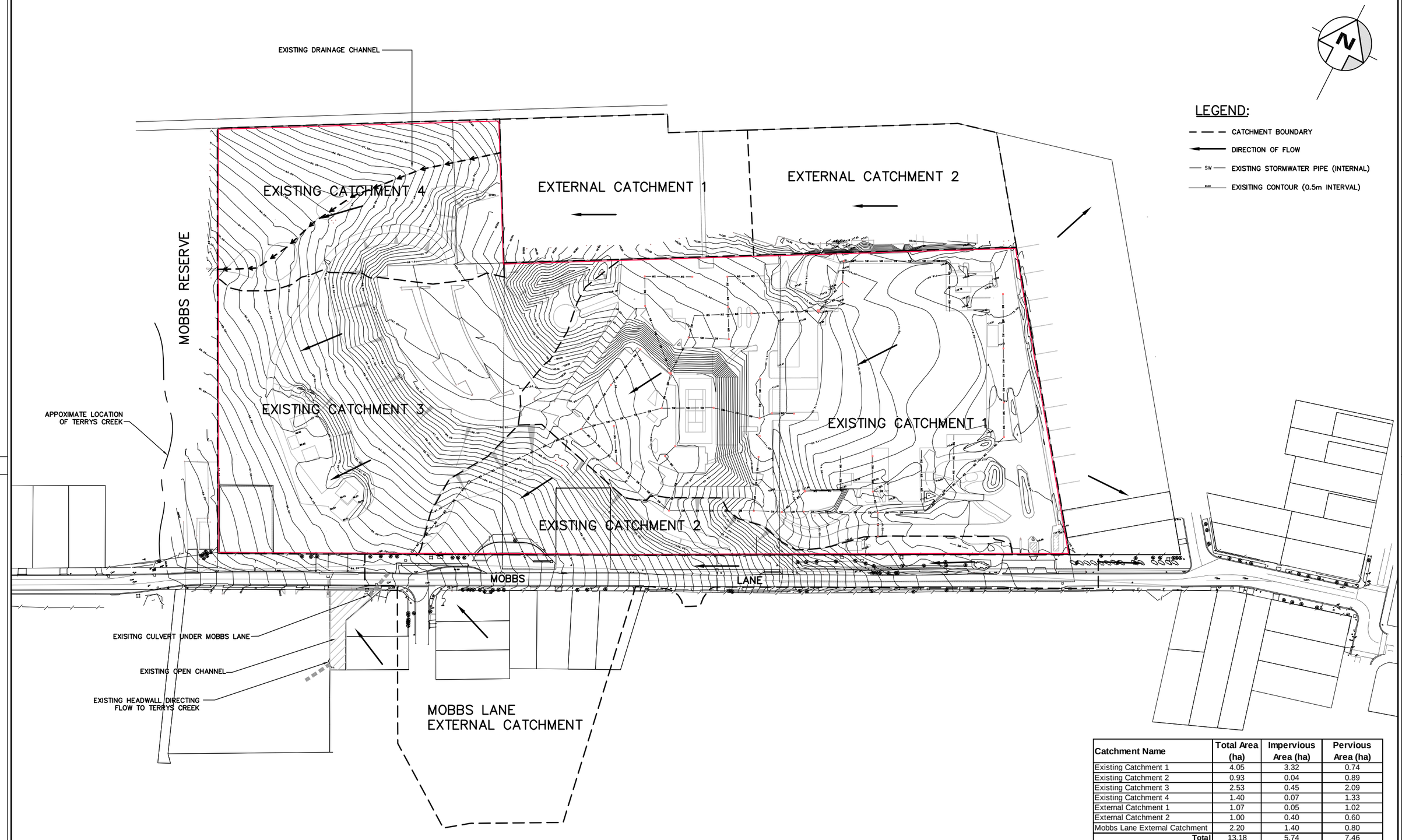
'*Managing Urban Stormwater: Strategy Framework*', Department of Environment and Conservation, 1997;

'*Urban Stormwater Quality: A Statistical Overview*', H Duncan et al (Combined Research Centre for Catchment Hydrology), 1999;

'*Removal of Suspended Solids and Associated Pollutants by a Gross Pollutant Trap*', Combined Research Centre for Catchment Hydrology, 1999;

'*Managing Urban Stormwater: Treatment Techniques*', New South Wales Environmental Protection Agency, 1997.

Drawings



Catchment Name	Total Area (ha)	Impervious Area (ha)	Pervious Area (ha)
Existing Catchment 1	4.05	3.32	0.74
Existing Catchment 2	0.93	0.04	0.89
Existing Catchment 3	2.53	0.45	2.09
Existing Catchment 4	1.40	0.07	1.33
External Catchment 1	1.07	0.05	1.02
External Catchment 2	1.00	0.40	0.60
Mobbs Lane External Catchment	2.20	1.40	0.80
Total	13.18	5.74	7.46

0 20 40 60 80 100m
1:1000 (A1) 1:2000 (A3)

DRG STATUS : NOT FOR CONSTRUCTION

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
D	ISSUED FOR APPROVAL	PBC	PMT	CM	M.SHAW	27.04.09
C1	ISSUED FOR CLIENT REVEIW	PBC	GI	CM		18.03.09
C	ISSUED FOR CLINT & INTERNAL REVIEW	PBC	PBC	CM		12.03.06
B	ISSUED FOR CLIENT REVIEW	PBC	PBC	CM		

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Client: SYDNEY BROADCAST PROPERTY PTY LTD

Project: EPPING PARK, EARLY WORKS PA

Title: EXISTING CATCHMENT PLAN

Drawing No. 7587-PA-13

Issue D

Cad File No. 7587-PA-13

Xref.(s)

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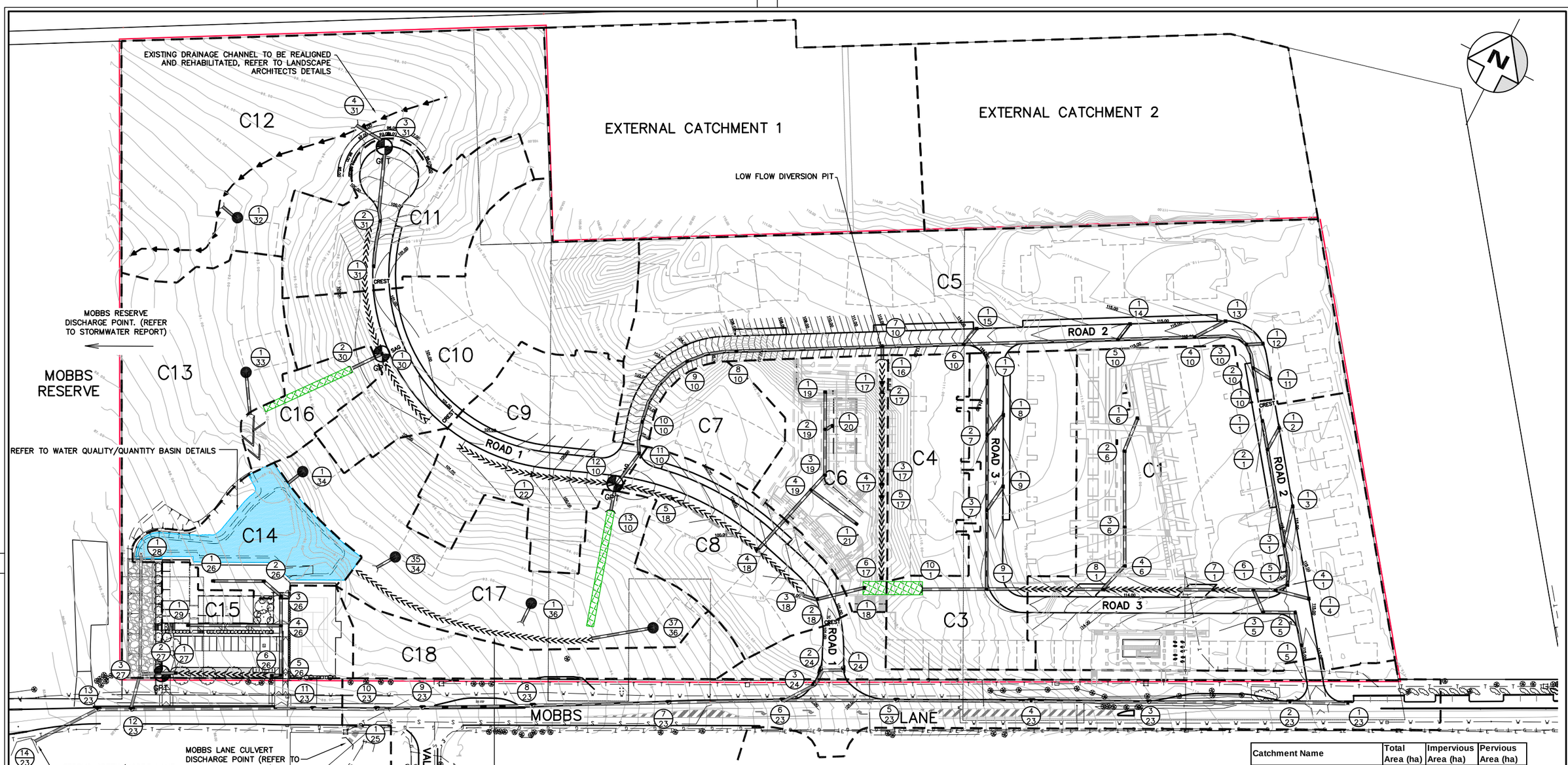

LEGEND

- C2 — CATCHMENT NUMBER
- CATCHMENT BOUNDARIES
- BIO–RETENTION SWALES AND DIRECTION OF FLOWS REFER DRAINAGE DETAILS
- HEADWALL
- PROPOSED STORMWATER DRAINAGE LINE
- PROPOSED DRAINAGE PIT AND NUMBER
- DROP STRUCTURE/RAINGARDEN. REFER DRAINAGE DETAILS
- DETENTION BASIN. REFER BASIN DETAILS
- EMERGENCY SPILLWAY
- GPT — GROSS POLLUTANT TRAP (CDS OR EQUIVALENT)
- T — EXISTING TELSTRA LINE (EXTERNAL)
- W — EXISTING WATER LINE (EXTERNAL)
- G — EXISTING GAS LINE (EXTERNAL)
- 100.00 — EXISTING CONTOUR (0.5m INTERVAL)
- 100.00 — PROPOSED MAJOR CONTOUR (1m INTERVAL)
- PROPOSED MINOR CONTOUR (0.25m INTERVAL)
- ATLANTIS PURIFICATION UNIT OR APPROVED EQUIVALENT (ALL RESIDUAL BUILDING/ROOF DRAINAGE DIRECTED TO UNIT)

0 15 30 45 60 75m
1:750 (A1) 1:1500 (A3)

Catchment Name	Total Area (ha)	Impervious Area (ha)	Pervious Area (ha)
Catchment 1	1.29	0.84	0.45
Catchment 2	0.18	0.03	0.15
Catchment 3	0.52	0.39	0.14
Catchment 4	0.25	0.21	0.05
Catchmetn 5	1.37	0.89	0.48
Catchment 6	0.35	0.25	0.11
Catchment 7	0.16	0.10	0.06
Catchment 8	0.35	0.26	0.10
Catchment 9	0.43	0.32	0.11
Catchment 10	0.65	0.39	0.26
Catchment 11	0.35	0.29	0.06
Catchment 12	0.96	0.11	0.85
Catchment 13	0.58	0.08	0.50
Catchment 14	0.22	0.07	0.16
Catchment 15	0.24	0.17	0.08
Catchment 16	0.11	0.03	0.08
Catchment 17	0.64	0.16	0.48
Catchment 18	0.23	0.02	0.21
External Catchment 1	1.07	0.05	1.02
External Catchment 2	1.00	0.60	0.40
Mobbs Lane External Catchment	2.20	1.40	0.82
Total	**13.18**	**6.65**	**6.55**

DRG STATUS : NOT FOR CONSTRUCTION

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
D	ISSUED FOR APPROVAL	PBC	PMT	CM	M.SHAW	20.03.09
C1	ISSUED FOR CLIENT REVEIW	PBC	GI	CM		18.03.09
C	ISSUED FOR CLIENT & INTERNAL REVIEW	PBC	PBC	CM		12.03.09
B	ISSUED FOR CLIENT REVIEW	PBC	PBC	CM		

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Client: SYDNEY BROADCAST PROPERTY PTY LTD

Project: EPPING PARK, EARLY WORKS PA

Title: OVERALL STORMWATER DRAINAGE PLAN

Drawing No. 7587-PA-14
Issue D
Cad File No. 7587-PA-14
Xref.(s)

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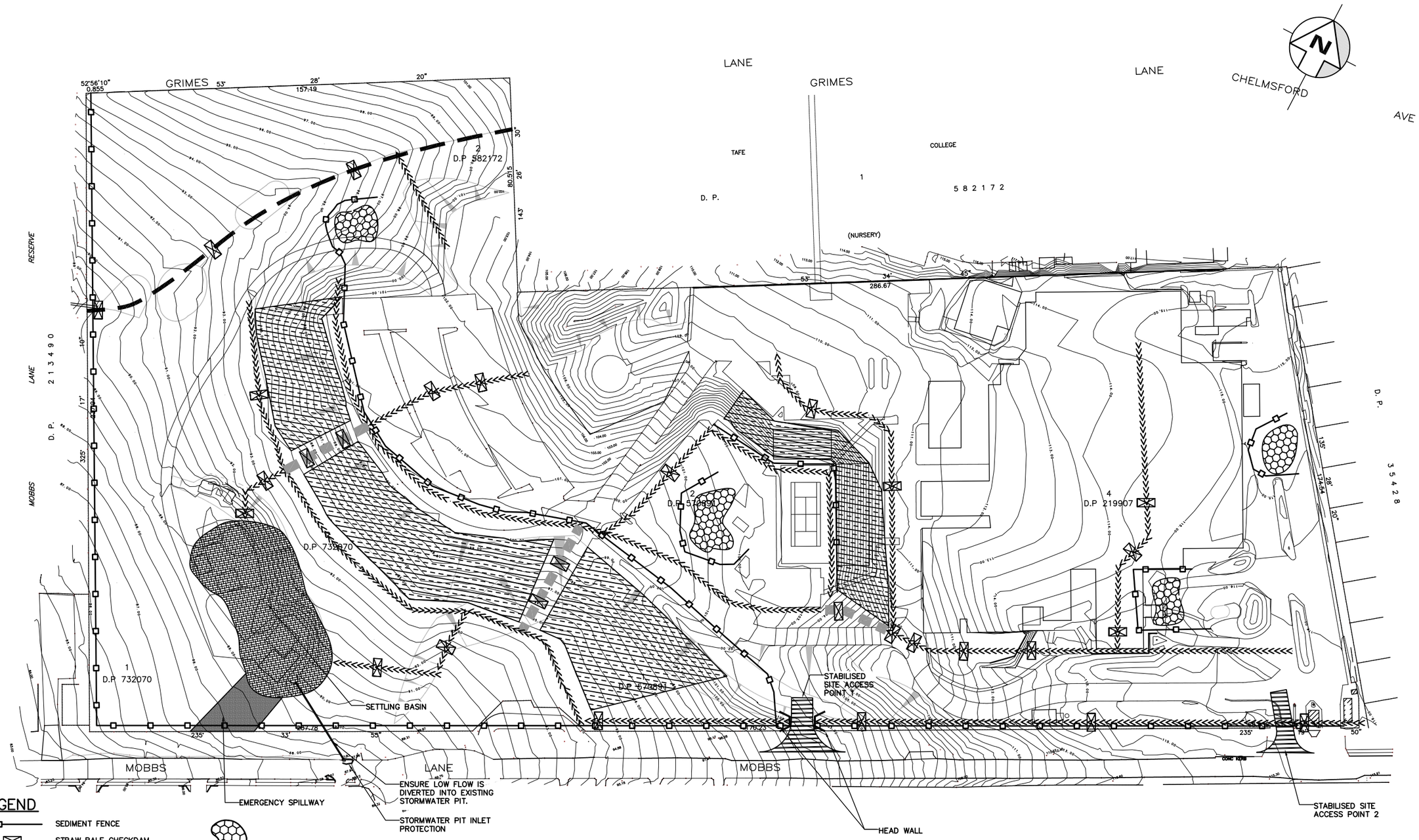

LEGEND

- SEDIMENT FENCE
- STRAW BALE CHECKDAM
- DIRTY WATER DIVERSION
- TEMPORARY SEDIMENT BASIN
- BANK STABILISATION
- STOCKPILE LOCATIONS
- SLOPE DRAINAGE ON EMBANKMENTS
- EXISTING DRAINAGE CHANNEL
- CONSTRUCTION ENTRY/EXIT
- EXISITNG INLET PROTECTION

0 15 30 45 60 75m

1:750 (A1) 1:1500 (A3)

DRG STATUS : NOT FOR CONSTRUCTION

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
D	ISSUED FOR APPROVAL	PBC	OMT	CM	M.SHAW	27.04.09
C1	ISSUED FOR CLIENT REVEIW	PBC	GI	CM		18.03.09
C	ISSUED FOR CLIENT & INTERNAL REVIEW	PBC	PBC	CM		12.03.09
B	ISSUED FOR CLIENT REVIEW	PBC	PBC	CM		

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Client: SYDNEY BROADCAST PROPERTY PTY LTD

Project: EPPING PARK, EARLY WORKS PA

Title: **SEDIMENT & EROSION CONTROL PLAN**

Drawing No. 7587-PA-26

Issue D

Cad File No. 7587-PA-26

Xref.(s)

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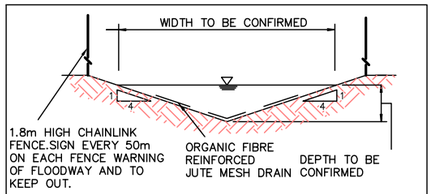
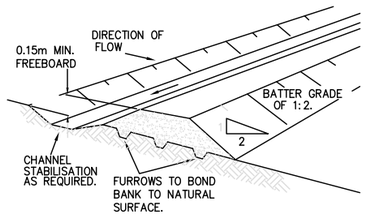
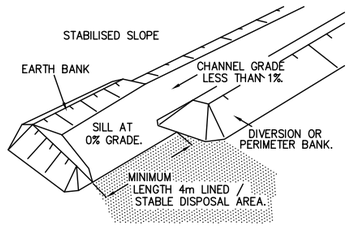




DIVERSION BANK AND SWALE 1



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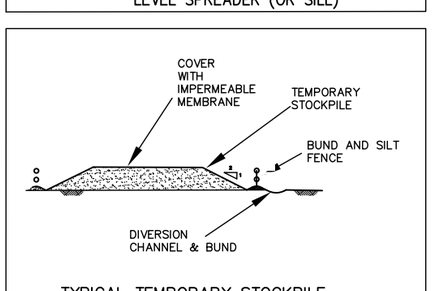

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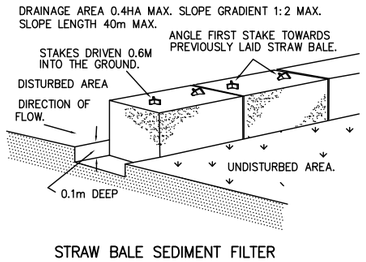

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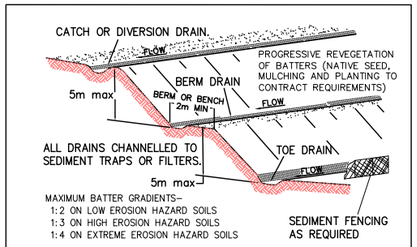
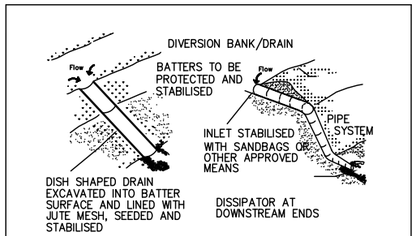
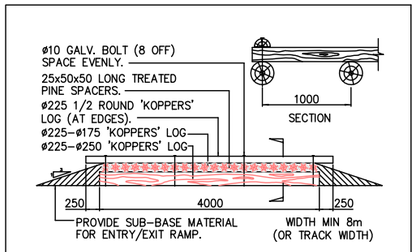


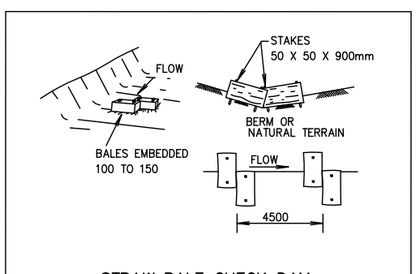
BATTER STABILISATION



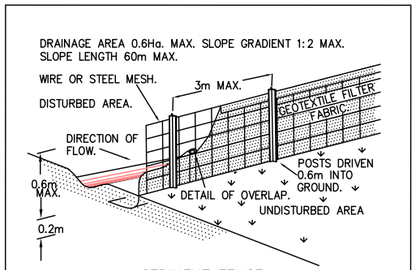
SLOPE DRAINAGE
ON EMBANKMENTS / BATTERS



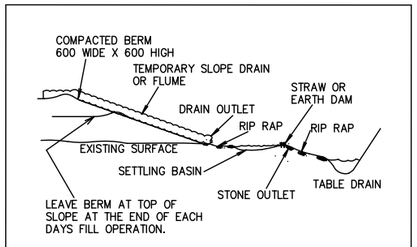
LONG TERM CONSTRUCTION SITE ENTRY/EXIT



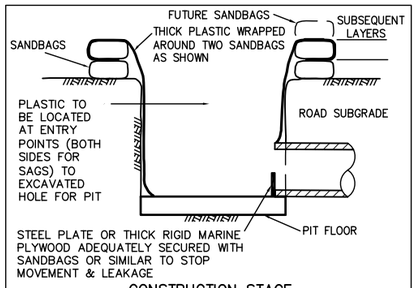
STRAW BALE CHECK DAM



SEDIMENT FENCE



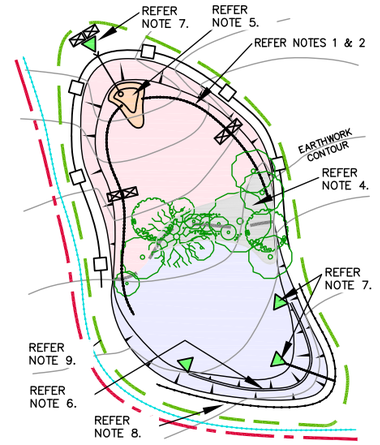
EMBANKMENT CONSTRUCTION



CONSTRUCTION STAGE
PIT SEDIMENT CONTROL

NOTES:

1. DIVERSION DRAIN (OR LIP ON THE TOP OF FILL BATTERS) DIRECTING FLOW INTO SEDIMENT BASIN. STRAW BALES TO BE PLACED AT 50m INTERVALS AS A MINIMUM TRANSVERSE PROTECTIVE DEVICE
2. FOR DIVERSION DRAINS OF 0–2.5% PROVIDE TRANSVERSE STRAW BALE PROTECTION, FOR GRADES OF 2.5–20% PROVIDE GRADE STABILISING STRUCTURES AND FOR GRADE 20%+ PROVIDE ROCK CHECK DAMS.
3. A 'CLEAN' WATER DRAIN SHALL BE PROVIDED ON THE HIGH SIDE OF THE WORKS. ALL FLOWS SHALL BE DIRECTED AROUND THE CONSTRUCTION SITE WITHOUT COMING IN CONTACT WITH DISTURBED GROUND.
4. VEGETATION SHALL BE RETAINED IN UNDISTURBED AREAS AND LOCATIONS OF CUT TO FILL TRANSITIONS.
5. SEDIMENT BASINS SHALL BE CONSTRUCTED IN A MANNER TO UTILISE THE PROPOSED FILL EMBANKMENT. BASIN DEPTH IS ASSUMED AT 1m TYPICALLY FOR ALL BASINS INDICATED ON THIS PLAN.
6. PROVIDE BENCHING ON BATTER SLPOES AS DETAILED.
7. LEVEL SPREADERS OR DISSIPATORS SHALL BE EMPLOYED IN ALL AREAS WHER A DIVERSION, EMBANKEMENT OR BATTER DRAIN DOES NOT OUTLET INTO ANOTHER CONTROL DEVICE.
8. PROVIDE BARRIER FENCING (PARAWEB AS A MINIMUM) IN AREAS WHERE A CUT BATTER EXCEEDS 2m IN VERTICAL HEIGHT.
9. INTERNAL CATCHMENT BOUNDARY



TYPICAL EROSION AND SEDIMENT CONTROLS
WITHIN INDIVIDUAL CATCHMENT AREAS

NOTES:

ALL EROSION AND SEDIMENT CONTROL MEASURES TO BE INSTALLED IN ACCORDANCE WITH THE DEPARTMENT OF HOUSINGS "BLUE BOOK".

GEOFABRIC LINED SEDIMENT FENCE

1. FOR SEDIMENT FENCE, JOIN SECTIONS OF FABRIC AT A STAR PICKET WITH 150mm OVERLAP.
2. DRIVE 1.5m LONG STAR PICKETS INTO GROUND, 3m APART.
3. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
4. BACKFILL TRENCH OVER BASE OF FABRIC
5. FIX SELF–SIPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANFACTURER.

TEMPORARY DIVERSION BANKS

1. DRAINS TO BE OF PARABOLIC OR TRAPEZOIDAL CROSS SECTION NOT V–SHAPED.
2. EARTH BANKS TO BE ADEQUATELY COMPACTED IN ORDER TO PREVENT FAILURE.
3. CONSTRUCTION IS OF A TEMPORARY NATURE AND SHALL BE REMOVED AT COMPLETION OF WORKS.
4. DIRECT DISCHARGE TO LEVEL SPREADER.
5. COMPACT WITH A SUITABLE IMPLEMENT IN SITUATIONS WHERE THEY ARE REQUIRED TO FUNCTION FOR MORE THAN FIVE DAYS.
6. EARTH BANKS TO BE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT WILL IMPEDE NORMAL FLOW.
7. ALL OPEN DRAINS TO BE TURFED AS A MINIMUM. PROVIDE JUTE MESH LINING ON ANY DRAIN WITH A LONGITUDINAL GRADE EXCEEDING 5%.

TURF BUFFER STRIP

1. PROVIDE 300mm TURF STRIP BEHIND KERB AND GUTTER AND SURROUNDING ALL INLET PITS NOT SURROUNDED BY PAVEMENT.

STABILISED SITE ACCESS

1. STRIP TOPSOIL AND LEVEL SITE.
2. COMPACT SUBGRADE
3. COVER AREA WITH NEEDLE–PUNCHED GEOTEXTILE
4. CONSTRUCT 200mm THICK PAD OVER GEOTEXTILE USING 40mm AGGREGATE . MINIMUM LENGTH 15 METRES OR TO BUILDING ALIGNMENT. MINIMUM WIDTH 3 METRES.
5. CONSTRUCT HUMP IMMEDIATELY WITHIN BOUNDARY TO DIVERT WATER TO A SEDIMENT FENCE OR OTHER SEDIMENT TRAP.

DRG STATUS : NOT FOR CONSTRUCTION

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
D	ISSUED FOR APPROVAL	PBC	PMT	CM	M.SHAW	27.04.09
C1	ISSUED FOR CLIENT REVEIW	PBC	GI	CM		18.03.09
C	ISSUED FOR CLIENT & INTERNAL REVIEW	PBC	PBC	CM		12.03.09
A1	ISSUED FOR REVIEW	PBC	LVD	CM		

INITIALS SHOWN IN THE ADJACENT ISSUE RECORDS INDICATE THE STAGES UNDERTAKEN IN THE DRAWING APPROVAL PROCESS. DRAWINGS ARE ONLY TO BE USED WHEN APPROVED BY WORLEYPARSONS AND THEN ONLY AS NOTED FOR DRG STATUS. THE ORIGINAL SIGNATURES CAN BE FOUND ON THE REVERSE SIDE OF THE ORIGINAL OF THE DRG REGISTER/TRANSMITTAL FORM No.5.2.2. HELD BY WORLEYPARSONS

WorleyParsons
resources & energy
Infrastructure & Environment
Level 11
141 Walker Street
North Sydney 2060
telephone (02) 8456 7200
facsimile (02) 8923 6877
www.worleyparsons.com
A.B.N. 61 001 279 812

Client: SYDNEY BROADCAST PROPERTY PTY LTD

Project: EPPING PARK, EARLY WORKS PA

Title: SEDIMENT & EROSION CONTROL DETAILS

Drawing No. 7587-PA-27
Issue D
Cad File No. 7587–PA–26
Xref.(s)

A1

N:\7587 Channel 7 Development\Drawings\EARLY WORKS PA DRAWINGS\7587-PA-26.dwg, 7587-PA-27, 28/04/2009 5:35:27 PM

NOTES:

1. SEWER & WATER RETICULATION PROVIDED BY QALCHECK (10.03.09)
2. ALL SERVICE LOCATIONS ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN

TAFE

MOBBS LANE RESERVE

13 12 8 9 11 14 10 15 16 17

ROAD 1 ROAD 2

DRAWING AJOINS 7587-PA-29

LEGEND

- PROPOSED POTABLE WATER RETICULATION
- PROPOSED SEWER RETICULATION
- S — PROPOSED SEWER LEAD IN
- T T — EXISTING TELSTRA LINE
- W W — EXISTING WATER LINE
- G G — EXISTING GAS LINE

WATER CONNECTION TO EXISTING WATER MAIN IN MOBBS LANE

PROPOSED SEWER CONNECTION POINT TO EXISTING

(GRASS) TP S

PROPOSED SEWER LEAD IN WORKS TO HOLWAY ROAD, REFER TO QALCHECK DRAWING SHEET 5 OF 5

MOBBS LANE

WATER CONNECTION TO EXISTING WATER MAIN IN MOBBS LANE

0 10 20 30 40 50m
1:500 (A1) 1:1000 (A3)

DRG STATUS : NOT FOR CONSTRUCTION

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
B	ISSUED FOR APPROVAL	PBC	PBC	CM	M.SHAW	27.04.09
A	ISSUED FOR REVIEW	PBC	PBC	CM		24.04.09

INITIALS SHOWN IN THE ADJACENT ISSUE RECORDS INDICATE THE STAGES UNDERTAKEN IN THE DRAWING APPROVAL PROCESS. DRAWINGS ARE ONLY TO BE USED WHEN APPROVED BY WORLEYPARSONS AND THEN ONLY AS NOTED FOR DRG STATUS. THE ORIGINAL SIGNATURES CAN BE FOUND ON THE REVERSE SIDE OF THE ORIGINAL OF THE DRG REGISTER/TRANSMITTAL FORM No.5.2.2. HELD BY WORLEYPARSONS

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Client: SYDNEY BROADCAST PROPERTY PTY LTD

Project: EPPING PARK, EARLY WORKS PA

Title: SERVICING PLAN SHEET 1 OF 2

Drawing No. 7587-PA-28

Issue B

Cad File No. 7587-PA-28

Xref.(s)

A1

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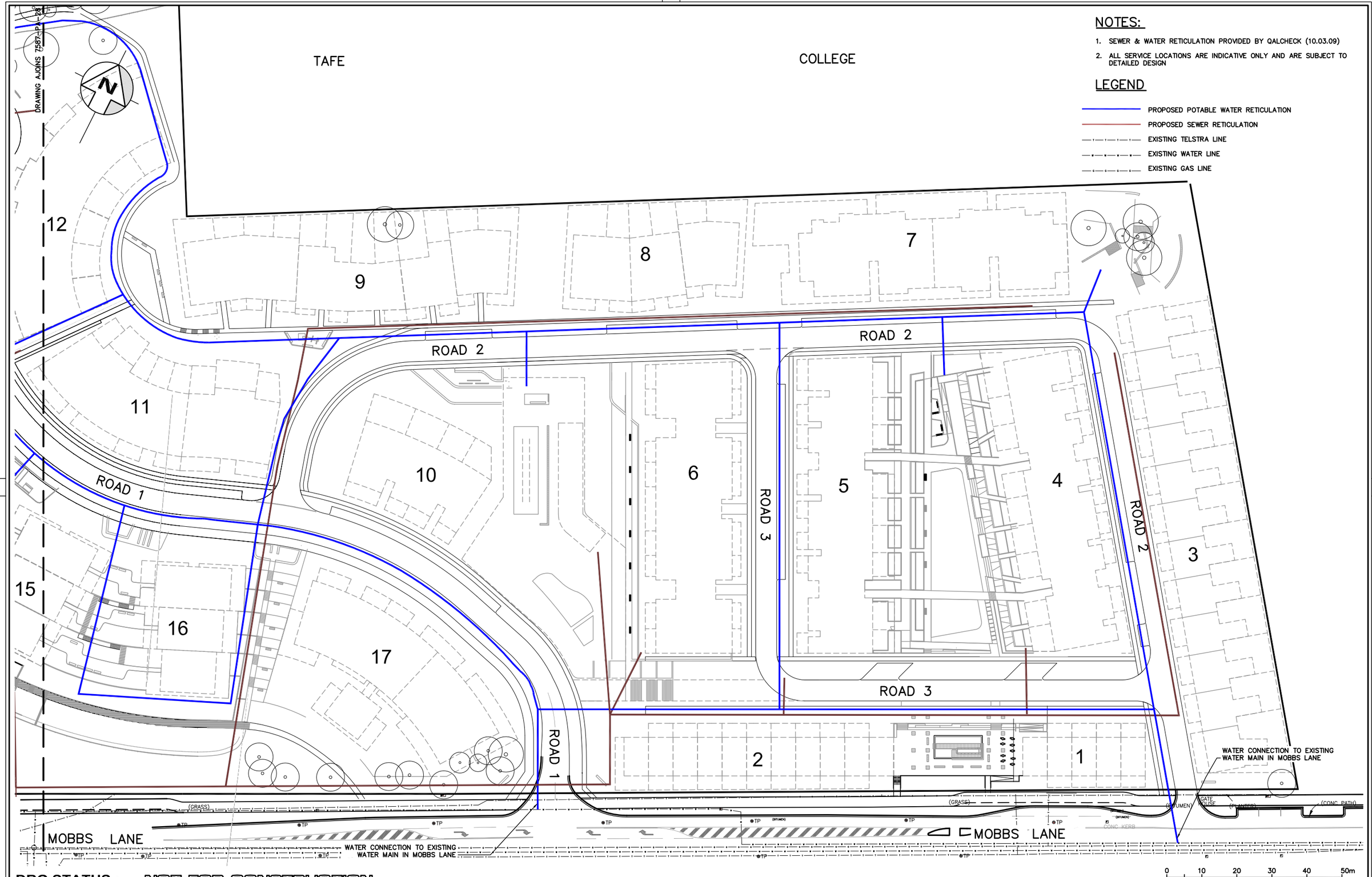
NOTES:

1. SEWER & WATER RETICULATION PROVIDED BY QALCHECK (10.03.09)
2. ALL SERVICE LOCATIONS ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN

LEGEND

- PROPOSED POTABLE WATER RETICULATION
- PROPOSED SEWER RETICULATION
- EXISTING TELSTRA LINE
- EXISTING WATER LINE
- EXISTING GAS LINE



DRG STATUS : NOT FOR CONSTRUCTION

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
B	ISSUED FOR APPROVAL	PBC	PBC	CM	M.SHAW	27.04.09
A	ISSUED FOR REVIEW	PBC	PBC	CM		

INITIALS SHOWN IN THE ADJACENT ISSUE RECORDS INDICATE THE STAGES UNDERTAKEN IN THE DRAWING APPROVAL PROCESS. DRAWINGS ARE ONLY TO BE USED WHEN APPROVED BY WORLEYPARSONS AND THEN ONLY AS NOTED FOR DRG STATUS. THE ORIGINAL SIGNATURES CAN BE FOUND ON THE REVERSE SIDE OF THE ORIGINAL OF THE DRG REGISTER/TRANSMITTAL FORM No.5.2.2. HELD BY WORLEYPARSONS

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facsimile (02) 8923 6877
www.worleyparsons.com
A.B.N. 61 001 279 812

Client: SYDNEY BROADCAST PROPERTY PTY LTD

Project: EPPING PARK, EARLY WORKS PA

Title: SERVICING PLAN SHEET 2 OF 2

Drawing No. 7587-PA-29

Issue B

Cad File No. 7587-PA-28

Xref.(s)

A1

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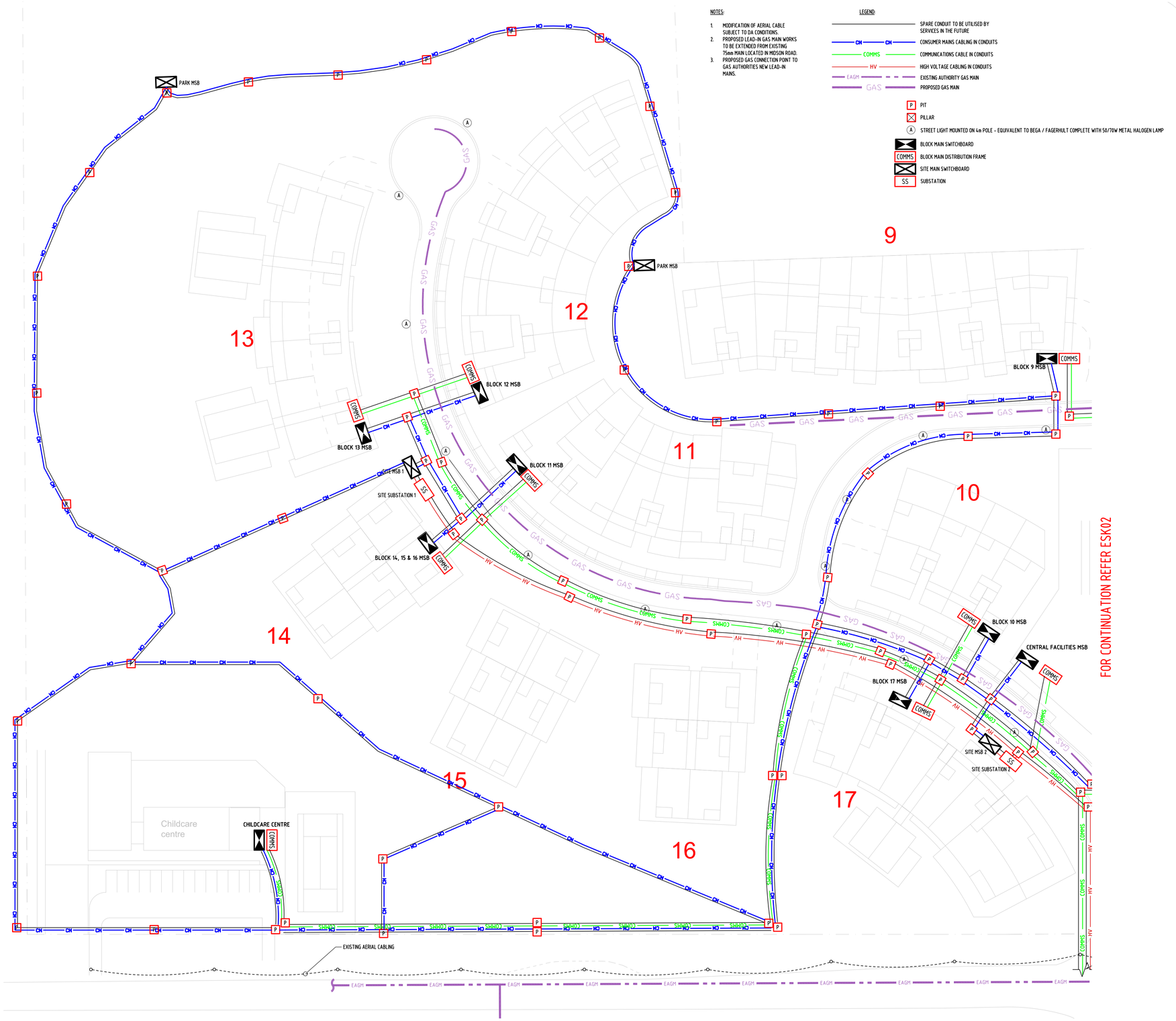
DATE	REV	AMENDMENT	BY	CHKD
27.04.09	01	PRELIMINARY ISSUE	TDG	SXS
28.04.09	02	FOR INFORMATION	SMD	SXS

NOTES:

1. MODIFICATION OF AERIAL CABLE SUBJECT TO DA CONDITIONS.
2. PROPOSED LEAD-IN GAS MAIN WORKS TO BE EXTENDED FROM EXISTING 75mm MAIN LOCATED IN MOSON ROAD.
3. PROPOSED GAS CONNECTION POINT TO GAS AUTHORITIES NEW LEAD-IN MAINS.

LEGEND:

- SPARE CONDUIT TO BE UTILISED BY SERVICES IN THE FUTURE
- CM — CONSUMER MAINS CABLING IN CONDUITS
- COMMS — COMMUNICATIONS CABLE IN CONDUITS
- HV — HIGH VOLTAGE CABLING IN CONDUITS
- EAGM — EXISTING AUTHORITY GAS MAIN
- GAS — PROPOSED GAS MAIN
- P — PIT
- PILLAR
- A — STREET LIGHT MOUNTED ON 4m POLE - EQUIVALENT TO BEGA / FAGERHULT COMPLETE WITH 50/70W METAL HALOGEN LAMP
- BLOCK MAIN SWITCHBOARD
- COMMS — BLOCK MAIN DISTRIBUTION FRAME
- SITE MAIN SWITCHBOARD
- SS — SUBSTATION



FOR CONTINUATION REFER ESK02

NOT FOR CONSTRUCTION

0mm 10 20 30 40 50 60 70mm

REFERENCE COORDINATION DRAWINGS

DESCRIPTION	DRAWING NO.	REV	CHKD

Lincolne Scott

Consulting Engineers
Adelaide Auckland Bangkok
Brisbane Cairns Canberra
Honolulu Melbourne Perth
San Diego Singapore Sydney

Level 1 41 McLaren Street
PO Box 6245 North Sydney
New South Wales 2060 Australia
Telephone 61 2 8907 0900
Facsimile 61 2 9957 4127
sydney@lincolnescott.com

PROJECT
EPPING PARK

CLIENT
SYDNEY BROADCAST PROPERTY PTY LTD

DATE	27.04.09	DRAWN	TDG
SCALE	1:500	CHECKED	SXS
SHEET SIZE	A1	APPROVED	SXS

CAD FILE J:\Projects\MIS LS Projects SYD09xxx\SYD0901100 EPPING PARK

TITLE
ELECTRICAL, COMMUNICATION & GAS SITE INFRASTRUCTURE

PROJECT NO.	DRAWING NO.	REVISION
SYD SYD0901100	ESK01	02

DATE	REV	AMENDMENT	BY	CHKD
27.04.09	01	PRELIMINARY ISSUE	TDG	SXS
28.04.09	02	FOR INFORMATION	SMD	SXS

NOTES:

1. MODIFICATION OF AERIAL CABLE SUBJECT TO DA CONDITIONS.
2. PROPOSED LEAD-IN GAS MAIN WORKS TO BE EXTENDED FROM EXISTING 75mm MAIN LOCATED IN MIDSON ROAD.
3. PROPOSED GAS CONNECTION POINT TO GAS AUTHORITIES NEW LEAD-IN MAINS.

LEGEND:

- SPARE CONDUIT TO BE UTILISED BY SERVICES IN THE FUTURE
- CH — CONSUMER MAINS CABLING IN CONDUITS
- COMMS — COMMUNICATIONS CABLE IN CONDUITS
- HV — HIGH VOLTAGE CABLING IN CONDUITS
- EAGM — EXISTING AUTHORITY GAS MAIN
- GAS — PROPOSED GAS MAIN
- P — PIT
- PILLAR
- A — STREET LIGHT MOUNTED ON 4m POLE - EQUIVALENT TO BEGA / FAGERHULT COMPLETE WITH 50/70W METAL HALOGEN LAMP
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- COMMS — BLOCK MAIN DISTRIBUTION FRAME
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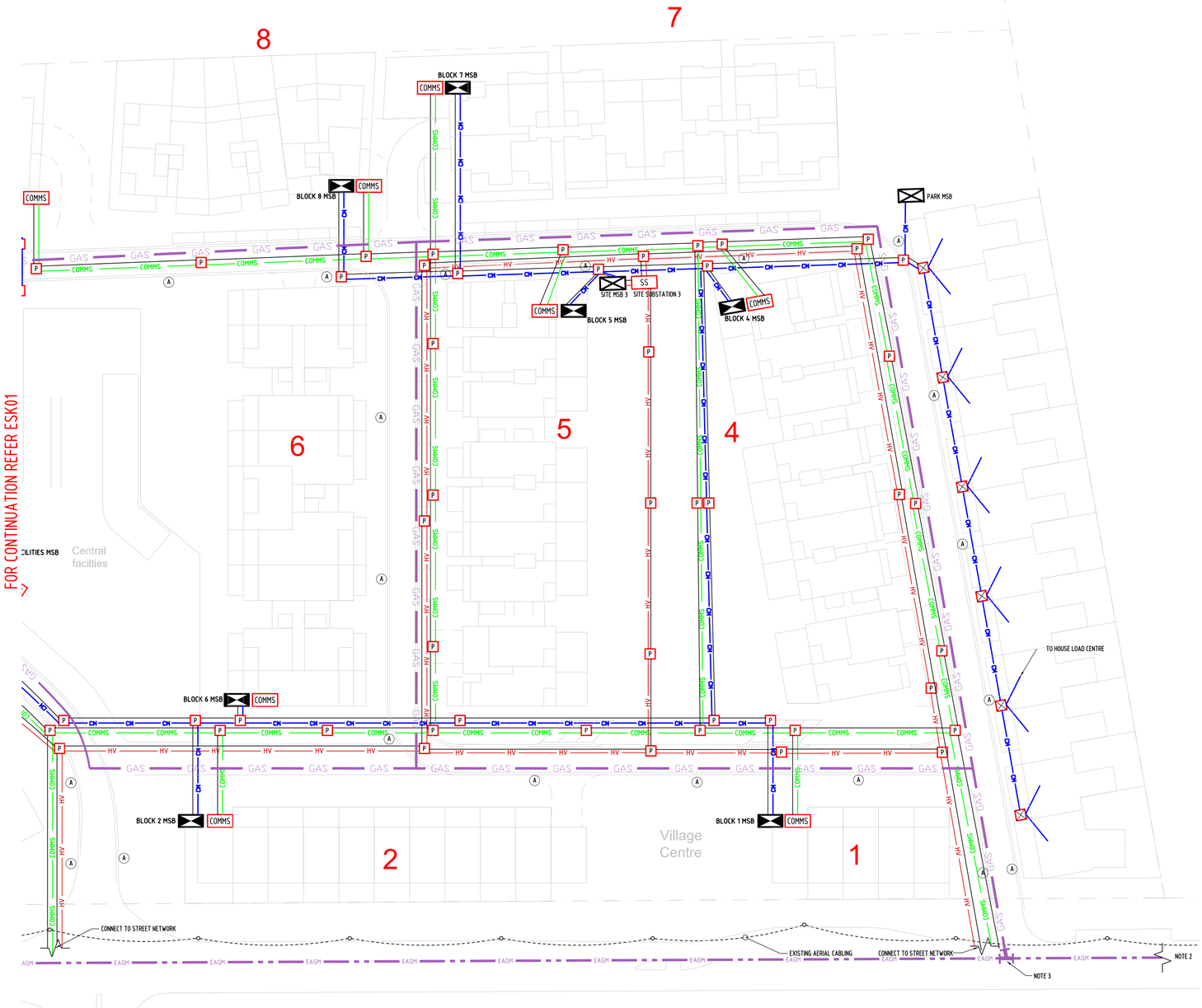

NOT FOR CONSTRUCTION

0mm 10 20 30 40 50 60 70mm

REFERENCE COORDINATION DRAWINGS

DESCRIPTION	DRAWING NO.	REV	CHKD

Lincolne Scott

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Adelaide Auckland Bangkok
Brisbane Cairns Canberra
Honolulu Melbourne Perth
San Diego Singapore Sydney

Level 1 41 McLaren Street
PO Box 6245 North Sydney
New South Wales 2060 Australia
Telephone 61 2 8907 0900
Facsimile 61 2 9957 4127
sydney@lincolnescott.com

PROJECT
EPPING PARK

CLIENT
SYDNEY BROADCAST PROPERTY PTY LTD

DATE	27.04.09	DRAWN	TDG
SCALE	1:500	CHECKED	SXS
SHEET SIZE	A1	APPROVED	SXS

CAD FILE J:\Projects\MIS LS Projects SYD09xxx\SYD0901100 EPPING PARK

TITLE
ELECTRICAL, COMMUNICATION & GAS SITE INFRASTRUCTURE

PROJECT NO.	DRAWING NO.	REVISION
SYD SYD0901100	ESK02	02

Appendix 1 - Concept Plan Approval – Relevant Items to The Stormwater Management Strategy

1) A safe pedestrian environment that seeks to minimise contacts and conflicts with the road network, by providing green linkages/corridors to/from the main open space areas.

2) Open space that is perceived unequivocally by members of the public, by its proper site planning and design, to be welcoming, accessible and inclusive.

3) Well designed engineering functions that do not dominate or alienate the use and enjoyment of open space.

4) Facilities that will attract users to the park, including facilities that normally associates with successful design of open space.

5) Retention of significant vegetation that will enhance the amenity of the development, helping to place the development within its local context.

Condition B10 is DELETED and replaced with the following:
(modified by Section 75W modification MOD 1 approved on 23 December 2008)

B10. Aboriginal Archaeological and Archaeological Investigation

Future applications for development **(other than the erection of a temporary marketing suite as detailed in Project No. 208.044.11, dated December 2008, MSA000, MSA100 - 101, MSA110, MSA200 - 203,MSA400, MSA306 -MSA309)** on the subject site will be accompanied by an Aboriginal heritage and archaeological investigation to be formalised by the proponent and agreed by the Department, in consultation with Council where appropriate and implemented by the proponent to the satisfaction of the Department, in consultation with Council, and other agencies where appropriate. The Aboriginal archaeological and archaeological investigation will be prepared and undertaken by a suitably qualified person(s).

Condition B11 is DELETED and replaced with the following:
(modified by Section 75W modification MOD 1 approved on 23 December 2008)

B11. Geotechnical Investigation

Future applications for development **(other than the erection of a temporary marketing suite as detailed in Project No. 208.044.11, dated December 2008, MSA000, MSA100 - 101, MSA110, MSA200 - 203,MSA400, MSA306 -MSA309)** on the subject site will be accompanied by a geotechnical investigation to be formalised by the proponent and agreed by the Department, in consultation with Council where appropriate and implemented by the proponent to the satisfaction of the Department, in consultation with Council, and other agencies where appropriate. The geotechnical investigation will be prepared and undertaken by a suitably qualified person(s).

B12. Sub Consultant Reports

The proponent will implement all the recommendations set out within "*The Parklands, 61 Mobbs Lane, Epping – Preferred Project Report – Appendices*" produced by Architectus (May 2006) in any future applications for development on the subject site to the satisfaction of the Department, in consultation with Council, and other agencies where appropriate. Each report may require updating as determined by the Department or Council.

(Note: Under Modification A3, in the event of any inconsistency between the recommendations of any sub-consultant report, and the requirement of these modifications, then the modifications shall prevail).

B13. Stormwater Modelling

Prior to the issuance of certificates of occupancy for any building on the site, the proponent will provide detailed hydrological, hydraulic, water balance and water quality modelling in accordance with the NSW

Department of Conservation Guidelines – "*Managing Urban Streams and Urban Stormwater: Treatment Techniques*" to the satisfaction of the Department, in consultation with Council, and other agencies where appropriate.

B14. Stormwater Management

Prior to the issuance of certificates of construction, the proponent shall prepare and submit plans and relevant documentation to the Department for approval demonstrating compliance with, or evidence of the following matters:

(1) The open drainage channel through the site (north-western side) from Grimes Lane is required to be preserved in order to maintain stormwater drainage discharge from upstream catchments (e.g: First Avenue, Second Avenue, etc);

(2) The upstream catchment run off can be safely managed and conveyed through the site from the north and north-eastern side of the Channel Seven site;

(3) Any proposed detention storage strategy will demonstrate zero increase in flooding or stormwater flows;

(4) Any proposed detention storage strategy will result in significantly reduced frequencies of inundation;

(5) All piped drainage infrastructure located on the site is designed to convey 20 year ARI flows generated on the site;

(6) Provision of stormwater pipes under mobs lane to discharge site run off (off the site) to nearby Terry's Creek;

(7) Installation of Pollution Control Devices (PCD's) along various drainage outlets discharging runoff from the developed site; and

(8) Rehabilitation of existing drainage outlets and the open drainage channel.

In undertaking the above the proponent shall take into consideration the following:

(1) Any relocation or adjustment of existing stormwater infrastructure is to be undertaken at the proponent's expense and subject to the requirements of Council.

(2) The proponent is to enter into a suitable Deed of Agreement with the Council relating to stormwater infrastructure which provides Council with rights of access and protects Council's interests.

B15. State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004

Future applications for development on the subject site shall be in accordance with State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004 to be formalised by the proponent and agreed by the Department, in consultation with Council where appropriate and implemented by the proponent to the satisfaction of the Department, in consultation with Council.

Appendix 2 - Preferred Project Report – Relevant Items to The Stormwater Management Strategy

- Design of the internal road network in accordance with the road hierarchy, to provide a sense of place in different locations and to improve safety for pedestrians and cyclists.
- Provision of parking and storage in accordance with Parramatta City Council's codes and/or RTA guidelines.
- Provision of pathways accessible for people with disabilities within the site and linking to Mobbs Lane Reserve and a footpath along the Mobbs Lane frontage to the site.
- Public access for the community to the common open space and roads on the site.

The Proponent commits to working with Parramatta City Council and the RTA in implementing the two recommendations set out in the Sydney Regional Advisory Committee's letter to the Department of Planning, dated 24 January 2006 and resolve the issues set out in Councils submission.

9. Stormwater Management

The Proponent commits to working with Parramatta City Council to develop the design for the stormwater management system, which will operate effectively to the standards for infrastructure, safety and public health set down Parramatta City Council, and to the satisfaction of the Department of Planning.

Layout and design of the detention basin is yet to be finalised, and will be subject to a detailed hydrologic and hydraulic analysis. The developer will work with Parramatta City Council to achieve a design that resolves the issues noted in Parramatta City Council's submission.

The Proponent commits to:

- Providing sufficient stormwater storage on-site, for Council's flood Mitigation Strategy, including increased provision in storage to detain run-off generated by development on-site.
- In the event that Parramatta City Council approves irrigation storage, wetland or water features on-site, increasing the stormwater detention volume to accommodate this retention.
- In the event that approval is given for a wet detention basin with a lake and/or other water features, providing consultancy confirmation, including hydrogeological analysis or equivalent that the proposed lake system and wetland will survive and operate effectively in the manner proposed and the mitigation measure to prevent potential for eutrophication, odours, mosquito breeding and related concerns.
- Providing consultancy confirmation on the required level of flushing of the system
- Installing suitable stormwater quality improvement devices and measures such as GPT's screen/baskets, swales and wetlands to form part of the overall stormwater management scheme.

Appendix 3 - Director General's Requirements – Relevant Items to The Stormwater Management Strategy

Appendix 4 - Flood Levels in Terrys Creek – Provided By Parramatta City Council

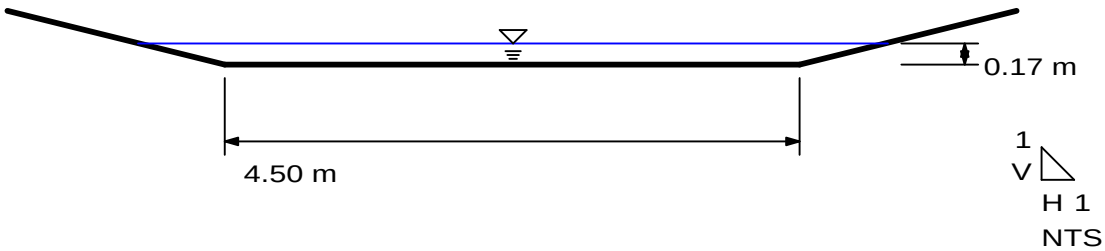

ST
AVE
AVE
SECOND
AVE
ST
ST
PL
LN
MOBBS
1:100
1:20
85.37
85.28
83.59
83.44
83.49
83.33
81.87
81.63
80.70
80.46

Appendix 5 - Manning's "n" Calculation to Determine Flood Hazard in Rehabilitated Drainage Channel

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Project File	I:\~0007 - ui programs\haestad\academic\fmw\parkland.fm2
Worksheet	Drainage Channel Through Catchment 12
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.040000	m/m
Depth	0.17	m
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	4.50	m
Discharge	1.70	m³/s



Appendix 6 - Proposed Conditions Direct Rainfall Intensities (*Considering Climate Change*)

Calculation of Intenstities based on IFD coefficients and applying a 30% increase for Climate Change

---

Location:-61 Mobbs Lane Epping-----
Latitude:-33º 46' 56"------
Longtiude:-151º 04' 12"------

IFD Coefficients-------

ARI in years	Coefficient A	Coefficient B	Coefficient C	Coefficient D	Coefficient E	Coefficient F	Coefficient G
2	3.56E+00	-5.71E-01	-2.44E-02	7.99E-03	-1.84E-04	-2.63E-04	1.13E-05
5	3.81E+00	-5.61E-01	-2.23E-02	7.43E-03	-2.77E-04	-2.05E-04	5.00E-06
20	4.07E+00	-5.52E-01	-2.05E-02	7.37E-03	-4.11E-04	-2.02E-04	8.84E-06
100	4.34E+00	-5.44E-01	-1.87E-02	7.30E-03	-5.51E-04	-1.99E-04	1.33E-05

2 Year Storm Intensities

Duration (min)	Duration (hr)	Log(e) Intensity	Intensity (mm/hr)	Intensity (post climate change) (mm/hr)
10	0.17	4.46	86.47	112.41
15	0.25	4.28	72.38	94.09
30	0.5	3.94	51.38	66.79
60	1	3.56	35.08	45.61
90	1.5	3.32	27.74	36.06
120	2	3.15	23.40	30.42
180	3	2.91	18.37	23.88
270	4.5	2.67	14.41	18.73
360	6	2.50	12.13	15.77
540	9	2.25	9.52	12.38

5 Year Storm Intensities

Duration (min)	Duration (hr)	Log(e) Intensity	Intensity (mm/hr)	Intensity (post climate change) (mm/hr)
10	0.17	4.70	110.23	143.30
15	0.25	4.53	92.38	120.09
30	0.5	4.19	65.80	85.54
60	1	3.81	45.20	58.76
90	1.5	3.58	35.89	46.66
120	2	3.41	30.39	39.51
180	3	3.18	23.98	31.17
270	4.5	2.94	18.91	24.58
360	6	2.77	15.97	20.76
540	9	2.53	12.60	16.38

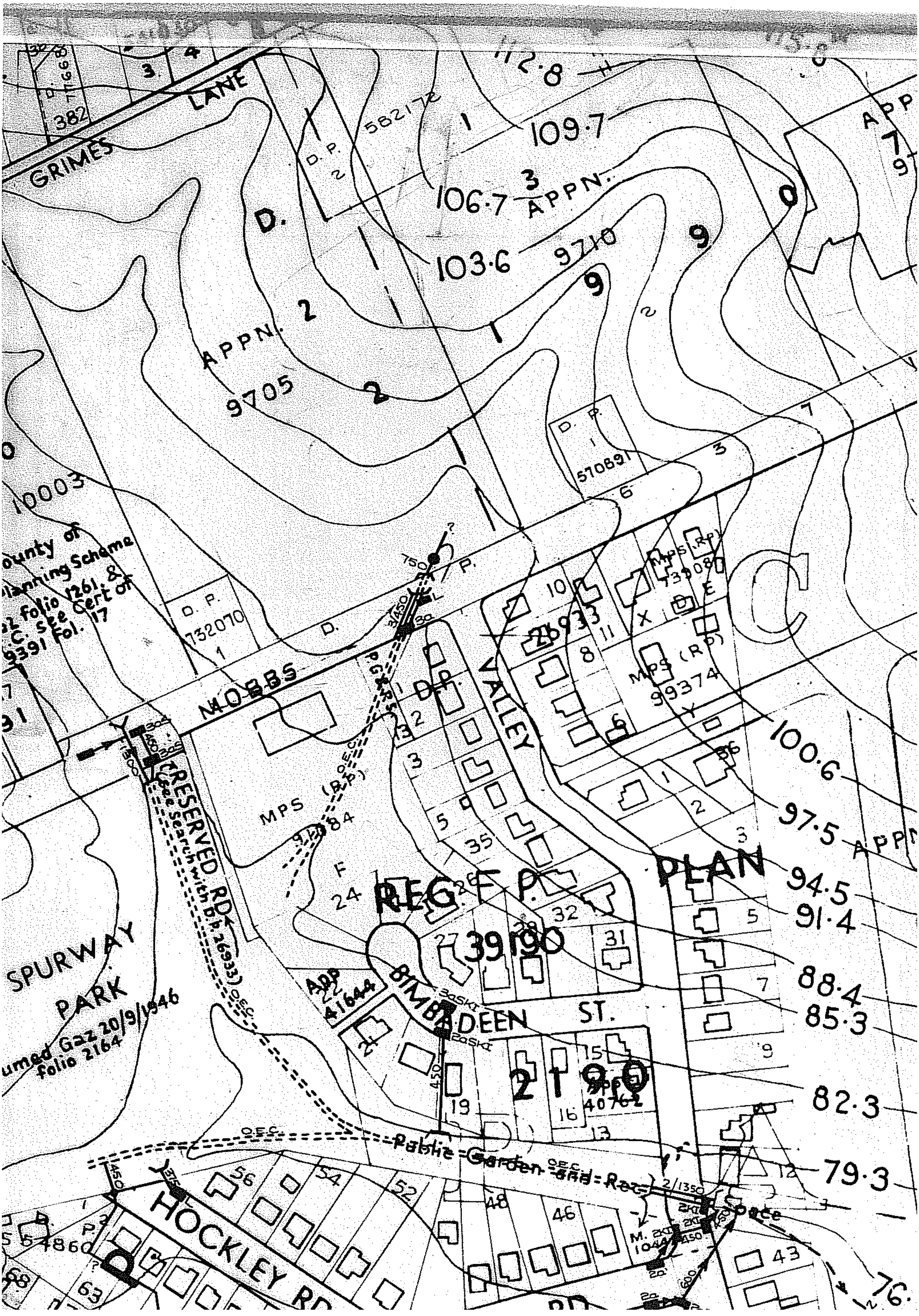
20 Year Storm Intensities

Duration (min)	Duration (hr)	Log(e) Intensity	Intensity (mm/hr)	Intensity (post climate change) (mm/hr)
10	0.17	4.96	141.89	184.45
15	0.25	4.78	119.13	154.87
30	0.5	4.44	85.18	110.73
60	1	4.07	58.82	76.47
90	1.5	3.85	46.89	60.96
120	2	3.68	39.83	51.77
180	3	3.45	31.58	41.05
270	4.5	3.22	25.02	32.53
360	6	3.05	21.22	27.58
540	9	2.82	16.82	21.86

100 Year Storm Intensities

Duration (min)	Duration (hr)	Log(e) Intensity	Intensity (mm/hr)	Intensity (post climate change) (mm/hr)
10	0.17	5.21	183.20	238.15
15	0.25	5.04	154.04	200.26
30	0.5	4.70	110.49	143.63
60	1	4.34	76.65	99.64
90	1.5	4.12	61.31	79.70
120	2	3.96	52.21	67.87
180	3	3.73	41.57	54.04
270	4.5	3.50	33.08	43.01
360	6	3.34	28.14	36.58
540	9	3.11	22.40	29.12

Appendix 7 - Drainage Infrastructure Nearby 61 Mobbs Lane Epping – Provided by Parramatta City Council



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VALLEY
RESERVED RD.
(See Search with D.P. 26933)
MPS (R.P.) 99384
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REG. P. PLAN
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SPURWAY PARK
Gaz 20/9/1946
Folio 2164
APP 41644
BIMBADEEN ST.
2190
40762
Public Garden and Rec. Space
HOCKLEY RD
D.P. 54860
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Appendix 8 - Sydney Water Pre-Feasibility Study

10 September 2007

Case Number: 108814
V 1

Patterson Britton & Partners Pty Ltd
c/- Qalcheck Pty Ltd

Dear Applicant

FEASIBILITY LETTER

Developer: **Patterson Britton & Partners Pty Ltd**
Development: **Redevelopment of Channel 7 Studios, Mobbs Lane Epping.**

Your attention is drawn to the requirements in this letter that may apply should you proceed to obtain development consent and then are required to apply to Sydney Water for a Section 73 Subdivider/ Developer Compliance Certificate (the Certificate) for your proposed development.

Because of the tentative nature of this application, after you receive that consent, you would need to make **a fresh application to Sydney Water for that Certificate by engaging your current or another authorised Water Servicing Coordinator (the Coordinator).**

The advice provided in this letter is valid for today's date only.

Since you have not yet obtained development consent, this letter contains Sydney Water's anticipated requirements. It is not an approval to execute any work.

You must engage your current or another authorised Coordinator to manage the design and construction of the sewer works that you must provide, at your cost, to service your development.

For a list of authorised Coordinators, see **www.sydneywater.com.au** and refer to *e-Developer* under *Your Business*, or call **13 20 92**. Coordinators may provide you with **a quote or advice regarding costs for their and other supplier's services/ works as well as** other Sydney Water costs.

The Coordinator generally will be the single point of contact between you and Sydney Water and can answer any questions in the first instance you may have on Sydney Water's developer process and developer charges.

SUMMARY OF REQUIREMENTS TO OBTAIN A CERTIFICATE:

You must:

1. **Engage a Coordinator prior to signing an Agreement.**

2. **Sign both copies of the Agreement and lodge with the Coordinator.**

3. **Consequent to signing the Agreement, build Sewer works at your cost, pay associated charges and note advice on existing service availability.**

4. **Pay a total of $11,307 in charges identified in Section 4.**

DETAILED REQUIREMENTS

1. Water Servicing Coordinator.

You must engage an authorised Coordinator to manage the design and construction of works that you must provide, at your cost, to service your development.

2. Major Works Agreement.

After you engage a Coordinator, you will need to sign and lodge **both copies** of the enclosed Major Works Agreement with your nominated Coordinator. The agreement identifies the responsibilities of Sydney Water, the Coordinator and you (the Developer) for your development's water/sewer construction. After execution by Sydney Water, one copy will be returned to your authorised Coordinator.

***Note:** The authorisation of the Coordinator must be current at all times throughout the project.*

3. Water and Sewer works.

Further investigation into specific requirements may occur if Parramatta Council approves rezoning of the site.

Water:

The proposed development of 650 dwellings would be adequately served by the 375mm CICL watermain in Mobbs Lane.

Assessment of any firefighting capability of Sydney Water main is not part of the Section 73 Certificate system capability assessment which is for predicted normal domestic supply only. Firefighting capability assessment is the responsibility of the applicant. Sydney Water can assist only by indicating modelled pressures at flows nominated by the applicant (provided that such flows do not exceed water supply capability) on a standard pressure enquiry form submitted with the scheduled fee.

It is expected that demand management initiatives would be undertaken that are in line with Planning NSW BASIX directives.

Sewer:

The development is located within the West Lane Cove catchment. **Analysis of the catchment sewers indicates that there would still be insufficient capacity for the planned 650 lot development.** (When compared with the previous application for 900 dwellings. – CN 62912) The original design of the sewers would have allocated a small nominal demand for the 11 ha site.

The effect of the development if connected to the nearest sewer would result in Sydney Water Corporation breaching its Operating Licence.

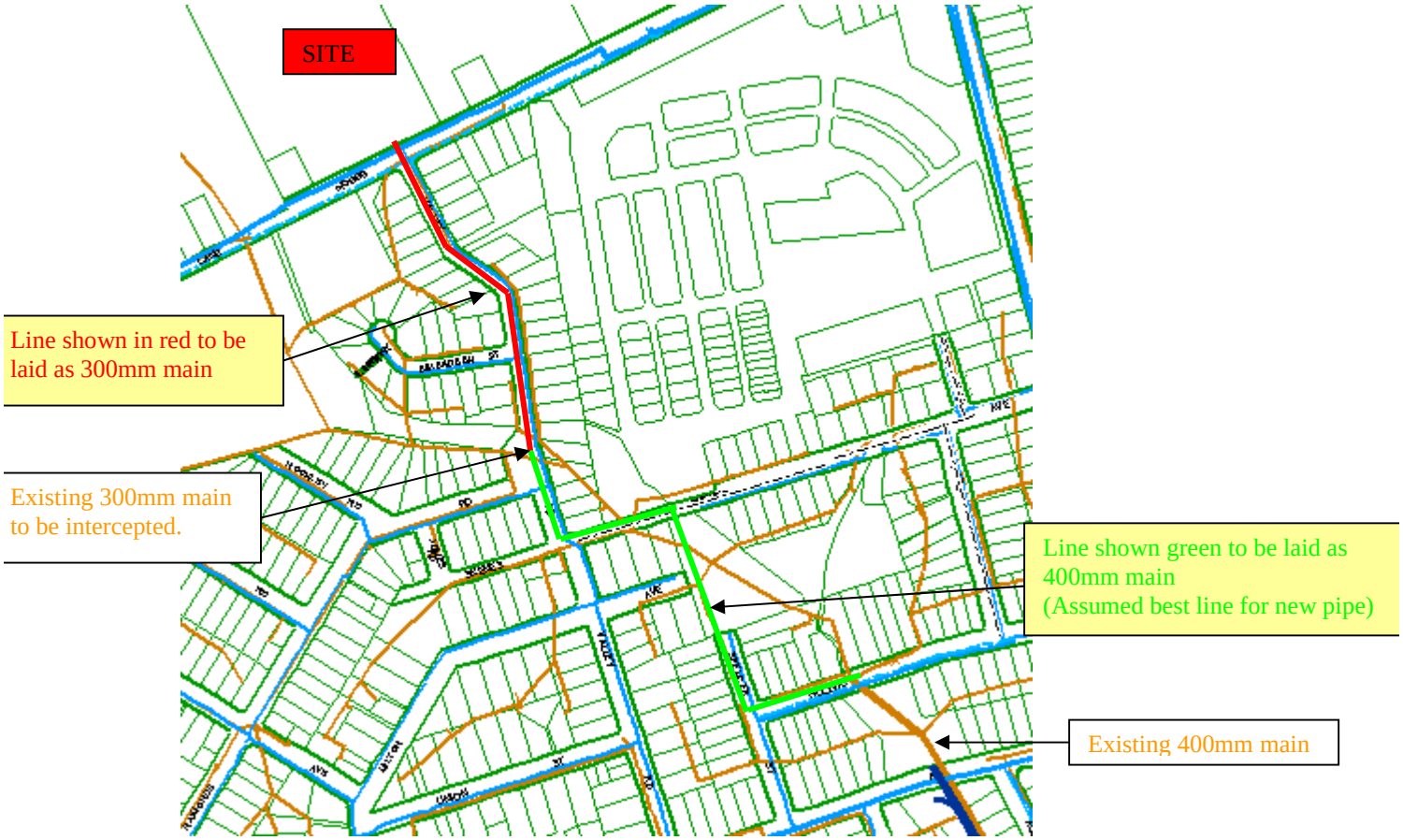
Accordingly, the requirements would be:

- **The proposed 650 dwelling development will be required to connect to a new 400mm/300mm sewer main amplification as per the attached figure.**

- The downstream end of the new 400mm main will intersect the existing 400mm sewer in Holway Street. The upstream end of the new 400mm main will intersect the existing 300mm sewer in Valley Road. Flow in the existing 300mm sewer west of Valley Road will be diverted into the new 400mm main.

- A new 300mm sewer will be required from the new access chamber in Valley Road, up Valley Road to the proposed development in Mobbs Lane.

- Where possible, dwellings in the new subdivision must connect to this 300mm amplification.



At the Developer's own risk the Works may be carried out prior to the granting of Development Consent. In such cases you will be responsible for any adjustments to Sydney Water assets and the associated costs thereof necessitated by variation to the Consent.

Note: *If construction must take place on neighbouring properties, written consent on Sydney Water's* ***Permission to Enter*** *form must be obtained from the relevant property owners. Your Coordinator has copies of the form (also available on the Internet at the address as above) and can negotiate on your behalf.*

In providing these works to Sydney Water you will need to pay project management, survey, design and construction costs **directly to your suppliers**. These costs may include Sydney Water charges for:

- Water main shutdown and disinfection
- Connection of new mains to Sydney Water system(s)
- Design and construction audit fees
- **Contract administration on project finalisation**
- Creation or modification of Sydney Water interests in land (eg. easements)
- Further application fees for staged developments.

Your Coordinator can advise you about these costs and how these costs may be quoted.

4. Developer charges.

Development Servicing Plan (DSP)	Basis of Calculation	Charge ($) for Applicable period (10/09/07-10/09/07)	Charge ($) for Applicable Period - (*CPI adjusted)
Mobbs Hill Water DSP Area	**Residential** Development Density 66-81 dwellings per ha band; 650 dwellings @ $25 = **$16,250** **Less Credit of $4,943** for previous payment/ use	**$**11,307	
Lane Cove Sewer DSP Area	**Residential** **No charges apply to this zone at present.**	$Nil	
Reticulation Recovery	Nil	$Nil	
DEVELOPER CHARGES TOTAL: *[OFFICE USE- Invoice Charges total - Developer $11,307]*		**$11,307**	

Notes:

- If you do not pay the charges identified in column 3 of the above table by 30 June, the total will be adjusted for inflation (based on the weighted average of the capital cities CPI for the 12 months to the end of the previous March) from 1 July for the balance of the 12-month period. The charge from 1 July is shown in column 4 when the inflation figure is known.

- **DSP charges** are a contribution towards the cost of systems (eg treatment plants), which serve your development. They have been calculated using base developer charges that cannot be changed or waived by Sydney Water having been established in Plan(s), available on request, and registered with the Independent Pricing and Regulatory Tribunal (IPART) under its relevant Determination. For further details, and a copy of the IPART Act 1992 including section 31 that refers to arbitration rights, see the IPART web site **www.IPART.nsw.gov.au**. Costs of arbitration, if appropriate, are borne equally by you and Sydney Water irrespective of outcome.

- These charges are directly payable to Sydney Water. CASH or BANK CHEQUE payments ONLY at any Sydney Water Customer Service Centre.

- **You must pay any DSP charge before you will be given permission to connect your development to Sydney Water's water/sewer systems.**

- **Reticulation Recovery Charges** recover part of the cost of works that have been provided by Sydney Water or other developers that benefit your development. This charge has been calculated before your detailed designs are completed. If later design investigation shows your development will be connected to other main/s, the Reticulation Recovery charge may be varied and/or you may need to construct other works.

Stamping and approval of your engineering and building plans.

You are reminded that all building plans must be stamped and approved at:

- a Quick Check agency (for an agency list see **www.sydneywater.com.au**, refer to *Your Business* then see *Building & Renovating* under the heading *Building & Developing* or call 13 20 92); or
- a Sydney Water Customer Service Centre.

Approval is required as construction/building works (eg earthworks, roadworks, drainage, landscaping, excavation, foundation works) may impact on existing Sydney Water assets (eg water and sewer mains). Approval of the plans may take up to 21 days and the results may affect these activities.

Note: If any work on our assets is carried out without that approval, then Sydney Water will take action to have work on the site cease and apply the provisions of Section 44 of the Sydney Water Act 1994.

POSSIBLE FUTURE COSTS

Requirements in this Notice relate to your Certificate application and may not cover all aspects of Sydney Water's involvement with your development. During design and construction of your development other Sydney Water fees/requirements may be necessary, including:

- construction/building plan stamping fees including fees to ensure the protection of Sydney Water assets
- plumbing and drainage inspection costs for private service lines (including property service connection and inspection fees)
- install backflow prevention devices for certain commercial/industrial connections
- trade waste requirements when constructing a building
- council fire fighting requirements (if not catered for by your current Sydney Water main). You should investigate fire fighting facility requirements for your development as soon as possible, including a standard pressure inquiry to Sydney Water if needed.

END OF NOTICE

Appendix 9 - Jemena Gas Network Correspondence

Natural Gas. The Natural Choice.

17 February 2009

Worley Parsons P/L
L 12, 141 Walker St
NTH SYDNEY NSW 2060
Att. S. Porter

PROPOSED SUB-DIVISION OF
61 MOBBS LANE, EPPING(EX-ATN 7 STUDIOS)

Dear Sean,

Natural Gas is available adjacent to the above subdivision and could be extended to supply any proposed development at this site depending upon it's commercial viability.

Currently there is a 75mm nylon medium pressure gas main (210kPa) along Midson Rd. This can be utilised to supply standard residential housing development on the proposed site, however capacity is not reserved for any individual project. The standard inclusions are natural gas hot water, cooking and heating in each dwelling.

Jemena encourages the use of shared trenching within the proposed site. Supply of infrastructure to any other appliance types will be assessed upon known load profiles and may require external power generating organisations to engage an Energy Retailer. Costs associated with supply of infrastructure could be formalised once detailed information is supplied to Jemena.

We appreciate the opportunity to be involved in the forward planning of this development and would like to pursue the potential for the connection to the natural gas network. Thank you for your inquiry. If further information or assistance is required, please do not hesitate to contact me on (02) 9270 4695

Yours faithfully,

Neale Hilton
Network Development Manager

Jemena Gas Networks (NSW) Ltd
ABN 87 003 004 322 Locked Box 2/159 Ridgecrop Drive Castle Hill 2154 Telephone 0402 060 151 Facsimile (02) 9899 3571 www.thenaturalchoice.com.au

Appendix 10 - RTA Approval Letter

88142107

RDC 2005-1851c

Andrew Popoff

McLachlan Lister Pty Limited
Level 1
1 Hickson Road
The Rocks NSW 2000

Attention: Alistair Mein

THE PARKLANDS (CHANNEL SEVEN) CONCEPT PLAN (MPA NO. 05_0086) – FINAL CONCEPT DESIGNS FOR MARSDEN ROAD / MOBBS LANE AND MIDSON ROAD / MOBBS LANE INTERSECTIONS.

Dear Alistair,

I refer to your letter dated 26 March 2008 which included revised concept designs (Ref: 5316-05-01; Figure 1, 2, 3, 4 and 5; Dated: 26/03/2008) that were submitted to the Roads and Traffic Authority (RTA) for "in principle" approval in order to address several outstanding design issues.

Reference is also made to your earlier correspondence dated 10 October 2007 which related to the timing for the installation of the proposed traffic signals at Marsden Road / Mobbs Lane.

The RTA has reviewed the submitted concept designs and provides "in principle" approval subject to the following:

1. The design of the proposed traffic control signals and associated civil works at the intersection of Marsden Road / Mobbs Lane shall be in accordance with the RTA's Road Design Guide and other Australian Codes of Practice. The certified copies of the design plans shall be submitted to the RTA for consideration and approval prior to the release of the construction certificate (*for the first stage of development*) by the Certifying Authority and commencement of road / signal works.

   Revised Traffic Signal design plans for the intersection of Midson Road / Eastwood Avenue / Mobbs Lane must also be submitted to the RTA for formal acceptance prior to the commencement of road / signal works.

   The RTA fees for administration, plan checking, civil / signal works inspections and project management shall be paid by the developer prior to the commencement of works.

   The developer may be required to enter into a Works Authorisation Deed (WAD) for the abovementioned works. If required, please note that the Works Authorisation Deed (WAD) will need to be executed prior to the RTA's assessment of the detailed civil design plans.

2. The developer shall be responsible for all public utility adjustment/relocation works, necessitated by the above work and as required by the various public utility authorities and/or their agents.

3. As part of the detailed design that the interface between new pavement and existing pavement is not to be in the wheel tracks of vehicles (ie: this may mean that extra pavement has to be removed so the interface is in the middle of a lane).

4. That the pedestrian crossing across the northern Marsden Road (leg) is not installed up front. However, the ducting, wiring, etc is done to facilitate future installation when required.

5. The proposed right turn bay from Marsden Road into Mobbs Lane should have the chevron linemarked area deleted in order to maximise the storage of this right turn bay.

6. As the narrowing of the footway along the western side of Marsden Road may somewhat restrict sight distances for vehicles leaving these properties, it is recommended that a "Driveways Ahead" sign be installed along Marsden Road for northbound traffic prior to the Illarangi Street intersection.

7. If the property at No 278 Marsden Road is still a vacant lot when the traffic signal / civil works occur at the Marsden Road / Mobbs Lane intersection, then the existing driveway crossing for this property should be relocated to the northern side of this lot when the SA kerb is reconstructed.

In addition, the following comments are provided with regard to the timing of the installation of the traffic signals at Marsden Road / Mobbs Lane:

8. The early provision of traffic signals at this intersection will improve the safety of a number of (Right-Through – from right) accidents that have occurred in the past. In addition, the early provision of traffic signals at this intersection would also facilitate the safe movement of construction related vehicles at this intersection.

   Therefore, the certified copies of the civil / traffic signal design plans at the Marsden Road / Mobbs Lane intersection shall be submitted to the RTA for consideration and approval prior to the release of the construction certificate (*for the first stage of development*) by the Certifying Authority and commencement of road / signal works.

9. As stated previously, the Occupation Certificate (*for the first stage*) of the proposed development shall not be released until the traffic control signals at the intersection of Marsden Road / Mobbs Lane is fully constructed and operational.

10. As the traffic signals will be required to be operational prior to the nominated trigger points as stated in your correspondence:

    - The occupation of the childcare centre plus 150 dwellings, or
    - The occupation of 225 dwellings with no childcare centre.

    The RTA would be willing to "halve" the total 10 year traffic signal operational / maintenance costs that you would be required to pay (which equates to $35,860).

88142107

(Note: The total 10 year operational / maintenance cost is $71,720 – per new signal site).

Note: The turn movements for buses (ie: left-in and left-out of the site) as depicted on Figure 3 show them encroaching over the right turn bays within Mobbs Lane. This issue will need to be addressed to the satisfaction of Council.

Any inquiries in relation to this matter can be directed to the RTA's Land Use & Transport Planner, Andrew Popoff on telephone 8849 2180 or facsimile 8849 2918.

Yours sincerely,

Ken Moon
Land Use Planning & Assessment Manager
Transport Planning, Sydney Region

16 April 2008