SOIL AND WATER MANAGEMENT NOTES

GENERAL INSTRUCTIONS:

1. ALL REFERENCES OF DETAILS, TESTING AND PROCEDURES ARE TO BE FOLLOWED AS SPECIFIED IN THE DEPARTMENT OF HOUSING "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" MANUAL (MARCH 04)

2. THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING PLANS, AND ANY OTHER PLANS OR WRITTEN INSTRUCTIONS THAT MAY BE ISSUED AND RELATING TO DEVELOPMENT AT THE SUBJECT SITE.

3. THE CONTRACTOR WILL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE LOCATED AS SHOWN IN THIS SPECIFICATION.

4. ALL CONTRACTORS SHALL BE AWARE OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE LANDS AND WATERWAYS.

5. THESE PLANS PRESENT CONCEPTS ONLY, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ESTABLISHMENT & MANAGEMENT OF A DETAILED SCHEME MEETING COUNCIL'S APPROVAL.

CONSTRUCTION SEQUENCE:

6. THE SOIL EROSION POTENTIAL ON THIS SITE SHALL BE MINIMISED. HENCE INITIAL WORKS SHALL BE UNDERTAKEN IN THE FOLLOWING SEQUENCE PRIOR TO COMMENCING CONSTRUCTION :-
(a) INSTALL ALL TEMPORARY SEDIMENT FENCES AND BARRIER FENCES.WHERE FENCES ARE ADJACENT TO EACH OTHER THE SEDIMENT FENCE CAN BE INCORPORATED INTO THE BARRIER FENCE.
(b) CONSTRUCT TEMPORARY STABILISED SITE ACCESS.
(c) INSTALL SEDIMENT TRAPS AND SEDIMENT BASINS.

7. UNDERTAKE SITE DEVELOPMENT WORKS SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF MINIMUM WORKABLE SIZE.

EROSION CONTROL:

8. AT ALL TIMES AND IN PARTICULAR DURING WINDY AND DRY WEATHER, LARGE, UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.

SEDIMENT CONTROL:

9. ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) WILL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.

10. WATER WILL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS IT IS RELATIVELY SEDIMENT FREE, I.E. THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED/STABILISED AND/OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.

11. TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE STABILISED/REHABILITATED.

OTHER MATTERS:

12. ACCEPTABLE RECEPTORS WILL BE CONSTRUCTED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.

13. ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES BY:
(a) PROTECTING THEM WITH BARRIER FENCING OR SIMILAR MATERIALS INSTALLED OUTSIDE THE DRIP LINE:
(b) ENSURING THAT NOTHING IS NAILED TO THEM:
(c) PROHIBITING PAVING, GRADING, SEDIMENT WASH OR PLACING OF STOCKPILES WITHIN THE DRIP LINE EXCEPT UNDER THE FOLLOWING CONDITIONS.
(i) ENCROACHMENT ONLY OCCURS ON ONE SIDE AND NO CLOSER TO THE TRUNK THAN EITHER 1.5 METRES OR HALF THE DISTANCE BETWEEN THE OUTER EDGE OF THE DRIP LINE AND THE TRUNK, WHICH EVER IS THE GREATER
(ii) A DRAINAGE SYSTEM THAT ALLOWS AIR AND WATER TO CIRCULATE THROUGH THE ROOT ZONE (E.G. A GRAVEL BED) IS PLACED UNDER ALL FILL LAYERS OF MORE THAN 300 MILLIMETRES DEPTH
(iii) CARE IS TAKEN

SITE INSPECTION AND MAINTENANCE:

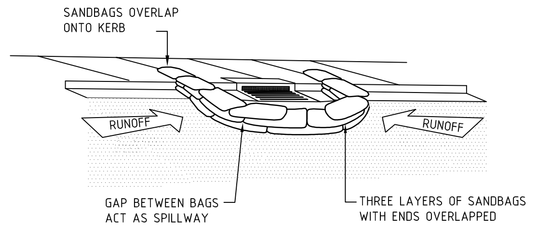
14. ALLOW FOR GRASS STABILISATION OF UNSTABLE AREAS, OPEN CHANNELS AND ROCK BATTERS AS AND WHERE DIRECTED.

15. ALLOW FOR ESTABLISHMENT OF OTHER EROSION PROTECTION MEASURES AS DIRECTED.

16. RECEPTORS FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER ARE TO BE EMPTIED AS NECESSARY. DISPOSAL OF WASTE SHALL BE IN A MANNER APPROVED BY THE SITE SUPERINTENDENT.

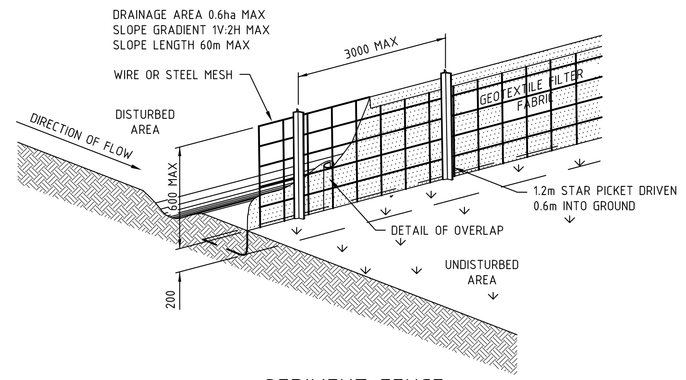
17. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED TO ENSURE THAT THEY OPERATE EFFECTIVELY. REPAIRS AND OR MAINTENANCE SHALL BE UNDERTAKEN REGULARLY AND AS REQUIRED, PARTICULARLY FOLLOWING STORM EVENTS.

18. THE CONTRACTOR SHALL PROVIDE ALL MONITORING CONTROLS & TESTING



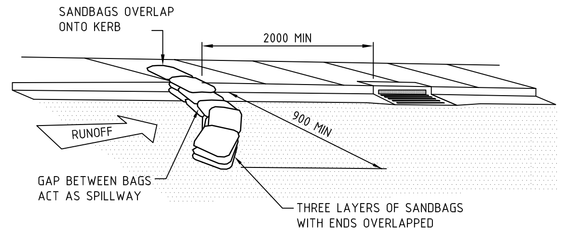
SEDIMENT TRAP FOR KERB INLET
(AT LOW POINT - SANDBAG)

NOT TO SCALE



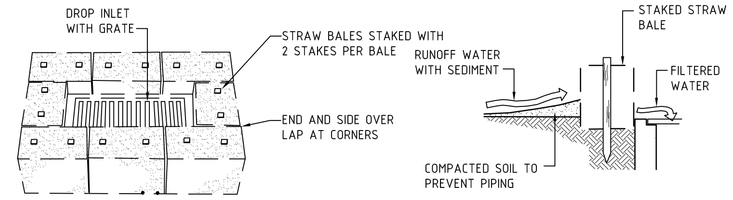
SEDIMENT FENCE
(GEOTEXTILE FILTER FABRIC)

NOT TO SCALE



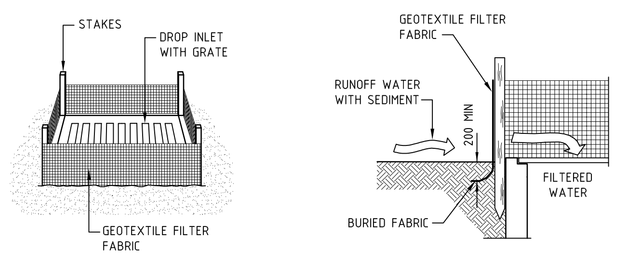
SEDIMENT TRAP FOR KERB INLET
(ON GRADE - SANDBAG)

NOT TO SCALE



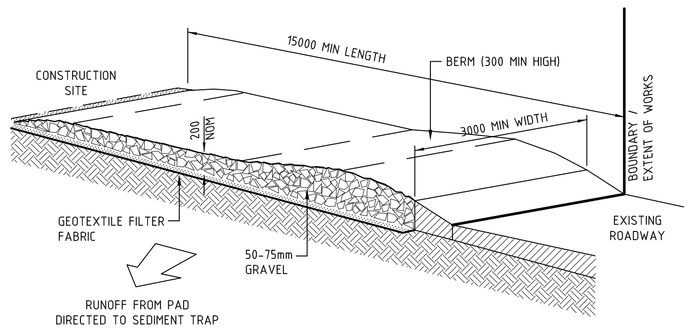
SEDIMENT TRAP FOR DROP INLET
(STRAW BALE)

NOT TO SCALE



SEDIMENT TRAP FOR DROP INLET
(GEOTEXTILE FILTER FABRIC)

NOT TO SCALE



TEMPORARY SITE ENTRANCE

NOT TO SCALE

MAINTENANCE

- THE TEMPORARY ACCESS SHALL BE MAINTAINED IN A CONDITION THAT PREVENTS TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS OF WAY,
- THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL GRAVEL AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT,
- ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS OF WAY MUST BE REMOVED IMMEDIATELY.

PRELIMINARY - NOT FOR CONSTRUCTION

Rev	Amendment / Reason For Issue	Date	Drawing Completed by	Designed & Checked by	Verified by X = Not verified	Issue Authorised (✱)
P3	ISSUED FOR PA APPROVAL	11.04.12	JAB	CB	X	RPH

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Architect/Project Manager:
Drawing Title: SEDIMENT & EROSION CONTROL NOTES
Drawing No.: MMD-300830-S-DR-CD-0004
Sheet: 04 of 04
Rev: P3

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Date 11.4.12 Time 10:16am Plotted By brad1835 Filename P:\ST Leonards\Projects\30xxxx\300830\CAD\Working Files\Civil\Autocad\Drawings\MMD-300830-S-DR-CD-0004.dwg

Appendix B. Stormwater Management Report

Note: The table below replaces Table 6.1 in the following report.

Table 6.1 – Road Cross Sections

Street	Typical Cross Section	Pavement Material
Irving Street	*Two way cross fall*	*Asphaltic Concrete*
Tooth Avenue	*One way cross fall to the southern side of the road*	*Asphaltic Concrete*
Carlton Street	*One way cross fall to the eastern side of the road, with a change of slope to the west at the intersection with Irving Street*	*Asphaltic Concrete*
Balfour Street	*Two way cross fall*	*Asphaltic Concrete*
Chippen Lane	*One way cross fall to the western side of the road*	*Cobblestone*
Kent Road	*Two way cross fall with parking bays along the western side*	*Asphaltic Concrete*
Kensington Street	*Two way cross fall*	*Asphaltic Concrete*
O'Connor Street	*Two way cross fall with parking bays along the southern side*	*Asphaltic Concrete*

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FRASERS PROPERTY

STORMWATER QUANTITY MANAGEMENT STUDY

Frasers Broadway

NOVEMBER 2008

VERSION 1.1

PREPARED BY:	Q.A. CHECK:	CO-ORDINATED:	APPROVED FOR ISSUE:	DATE:
S. REILLY G. SULLIVAN	S. GRIBBLE	R. HIGGINS	FINAL	21ST SEPTEMBER 2008

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COMMERCIAL IN CONFIDENCE

1.0 EXECUTIVE SUMMARY

It is proposed to develop the former Carlton and United Brewery site at Chippendale now known as the Frasers Broadway site. The site is 6 hectares and is bounded by Broadway, Abercrombie Street, O'Connor Street, Wellington Street and Kensington Street. This study is intended to provide an estimate of critical flood levels for the site, identify flood risk issues and assist to provide recommended floor levels for the proposed development.

This study does not address stormwater quality management or water storage/water harvesting issues. Hughes Trueman (2007) prepared a preliminary report covering water quality management. Subsequently Frasers Properties has appointed Lincolne Scott to prepare a water cycle management strategy for the site. It is important to integrate the findings from the water quantity and water quality reports to provide a coordinated robust outcome.

The site is located within the catchment of the Blackwattle Bay (SWC 17) trunk stormwater system. Drawing No. 08S018C-02 Regional Catchment Plan shows the upper part of the Blackwattle Bay Catchment. The trunk stormwater system was constructed in the late 1800s and early 1900s and falls short of current standards.

Two Branches of the Blackwattle Bay Stormwater System pass through the site as follows:

- The Prince Alfred Park Branch has a catchment area of 25 hectares upstream of the site. It originates to the east of the main railway line near Cleveland Street Redfern. It runs along Queen Street, Balfour Street then Irving Street before joining the Wattle Street Branch (Branch 17D) that runs along Abercrombie Street. Its capacity is reported to be less than the 2 year ARI.
- The Tooths Brewery Branch (Branch 17H) has a catchment area of about 9 hectares. It originates on the Railway land and flows under Regent and Kensington Streets then runs partly through the site and joins the Prince Alfred Park Branch near the intersection of Balfour and Irving Streets.

Downstream of the site, the Prince Alfred Park Branch joins the Wattle Street Branch that runs along Abercrombie Street. The capacity of the Wattle Street Branch is also reported to be less than the 2 year ARI.

Generally the site grades down to the North West corner at the intersection of Broadway and Abercrombie Street. There is a trapped sag point upstream of the site in Kensington Street. There are also sag points in Regent Street and Wellington Street, which need to be considered but are not likely to have direct impact on the site.

The DRAINS model of the Blackwattle Bay Catchment previously set up by Hughes Trueman (2004) for the area was modified to provide more detail in the vicinity of the site using additional ground survey data to assess the existing conditions on the site. The revised model was then used to evaluate 100 year ARI flows in the vicinity of the site. This analysis found that:

- Overland flow velocities and depths in Irving, Balfour, Abercrombie and Wellington Streets are not safe.

- Ponding occurs in the Kensington Street sag and the sag in Wellington Street near Balfour Street. The ponding depths are approximately 1m and 0.3m respectively. The Kensington Street sag acts as a defacto detention basin. When the wall along Kensington Street is removed, this will potentially increase flows through the site to Abercrombie Street. Thus compensatory detention storage is needed to be provided elsewhere in the site to mitigate this.

The DRAINS model was modified to evaluate the impact of the proposed development on surrounding areas. The following additions and changes were made to the DRAINS model:

- New internal stormwater reticulation to reflect the proposed road layout. The majority of the site catchment is designed to drain to the proposed detention tank.
- New overland flow paths and road cross sections to reflect the proposed road layout and grading.
- An onsite detention tank was added to the model with a calculated required storage volume of 2500 m^3. The tank has been designed to accommodate the site catchment running to the tank, the removed Kensington Street sag and the overland flow from offsite in Balfour Street, with the aim of reducing the outflow from the site and to not increase flows downstream of the site.

The velocity x depth relationship was calculated for each overland flow path throughout the site. From this the flood hazard was determined in accordance with the NSW Government Floodplain Development Manual. The flood levels calculated were all classified as low hazard within the site. Flood levels determined to be unsafe were calculated in public roads adjacent to the site in both Abercrombie Street and Balfour Street. These locations were also calculated as unsafe for the existing conditions.

Freeboard requirements were also calculated throughout the site in accordance with the *Green Square Town Centre Development Control Plan 1997 Amendment Part H (Green Square DCP)*. All areas of the site, in accordance with the above document and the Floodplain Development Manual (NSW Government, 2005), can be classified as being subject to local flooding.

The total flows downstream of the site for the sum of the piped and overland flows, were also determined to be reduced from the existing conditions in Irving Street, Abercrombie Street and Broadway.

2.0 INTRODUCTION

2.1 STUDY OBJECTIVES

It is proposed to develop the former Carlton and United Brewery site at Chippendale. The site is located within the vicinity of the Tooths Brewery and Prince Alfred Park trunk stormwater mains.

The objectives of the Stormwater Quantity Management Study are to:

- Identify relevant physical stormwater management issues for site planning;
- Identify authority requirements for site planning;
- Review and validate existing critical site flows – regional and local flows - 100 year ARI flood levels and discharges for the site;
- Review and identify potential detention needs for the site;
- Identify potential overland flow path requirements;
- Identify potential piped flow paths;
- Identify potential site grading considerations to provide an integrated site grading outcome;
- Identify appropriate flood planning levels and flood risks for the development; and
- Identify potential stormwater management issues that may adverse impact on adjacent properties that need to be considered in the detail design.

The aim of the report is to quantify flow behaviour for the existing site and identify issues and principles that need to be included in the masterplanning process. Then we aim to quantify flow behaviour for the proposed development and evaluate the proposed water quantity management measures.

2.2 METHODS ADOPTED

The DRAINS model of the Blackwattle Bay Catchment previously set up by Hughes Trueman (2004) for the area was used to estimate design flows in the vicinity of the site. The DRAINS model was modified to provide more detail in the vicinity of the site using additional ground survey data. The model was used to calculate flood depths and overland flows in the roads within and adjoining the site.

2.3 FLOOD FREQUENCY TERMINOLOGY

The frequency of floods is generally referred to in terms of their Annual Exceedance Probability (AEP) or Average Recurrence Interval (ARI). For example, for a flood magnitude having a 1% AEP, there is a 1% probability that there will be floods of greater magnitude each year. As another example, for a flood having 100 year ARI there will be floods of equal or greater magnitude once in 100 years on average. A flood of 1% AEP corresponds to a 1 in 100 year ARI flood.

Australian Rainfall & Runoff (Institution of Engineers, 1999) (ARR99) recommends that ARI is the correct terminology for procedures based on rainfall intensity-frequency data, as is the case for this report. Values in this report have been expressed in terms of ARI to be consistent with ARR99.

3.0 PHYSICAL SETTING

The site is bounded by Broadway, Abercrombie Street, O'Connor Street, Wellington Street and Kensington Street at Chippendale, as shown on Drawing No. 08S018C-01 Cover Sheet. The site is situated within the Blackwattle Bay (SWC 17) catchment. Most of the stormwater infrastructure in the catchment was constructed in the late 1800s and early 1900s to lower design standards than currently adopted for new infrastructure. Inadequacies in the piped drainage system lead to excess runoff being conveyed as overland flow or ponding at low points in the road system.

Drawing No.s 08S018C-05 & C-06 Existing Stormwater Infrastructure Plans show the existing trunk stormwater layout in the area and summarises some of the system constraints. There are two major trunk stormwater mains, branch 17J and branch 17H that pass through the site and connect to branch 17D, that runs along Abercrombie Street.

The existing piped regional system is described as follows:

- The Prince Alfred Park Branch (Branch 17J) has a catchment area of 25 hectares upstream of the site as shown on Drawing No. 08S018C-02 Regional Catchment Plan. It originates to the east of the main railway line near Cleveland Street, Redfern. It runs along Queen Street, Balfour Street then Irving Street before joining the Wattle Street Branch (Branch 17D) that runs along Abercrombie Street. The section between Regent Street and Irving Street consists of a 1050mm dia. concrete pipe. From Balfour Street to Abercrombie Street the conduit consists of a 900x1350 Brick Oviform.

  The capacity of the Prince Alfred Park Branch is reportedly less than the 2 year Average Recurrence Interval (ARI) flow and apparently there is regular flooding along the line due to the capacity limitations.

- The Tooths Brewery Branch (Branch 17H) has a catchment area of about 9 hectares as shown on Drawing No. 08S018C-02 Regional Catchment Plan. It originates on the railway corridor and flows under Regent and Kensington Streets then runs partly through the site and joins Branch 17J near the intersection of Balfour and Irving Streets. The conduit size changes several times along this reach, ranging from 1050x1300 Stone Arch and 1320x1920 Brick Oviform to 1050mm dia. Concrete Pipe.

  According to the Sydney Water Capacity Assessment, this Branch has a capacity of more than the 20 year ARI flows. The Sout*h Sydney Stormwater Quantity and Quality Study – Blackwattle Bay and Johnstone's Creek Catchments* (Hughes Trueman 2004) suggested that the capacity of some reaches is considerably less.

- The Wattle Street Branch (Branch 17D) runs down Abercrombie Street and consists of a 1350x900 Brick Oviform south of Irving Street and a 1800x1225 Brick Oviform north of Irving Street. The capacity of the 17D Branch that runs along Abercrombie Street is also less than the 2 year ARI flow.

4.0 DATA

4.1 TOPOGRAPHIC DATA

4.1.1 Ground Survey

A surface and underground services survey of the site and road reserves surrounding the site was undertaken by surveyors Degotardi, Smith and Partners as part of the project investigation. This survey includes details of the trunk lines and local street drainage.

The following surveys have been referenced or used to form the base survey:

- Blackwattle Bay SWC 17 Asset Survey by AWT – 1997
- Detail and Levels Survey of the Carlton & United Brewery Site by Degotardi, Smith & Partners – 6th July 2006
- Underground Services Survey of the Frasers Broadway Site by Degotardi, Smith & Partners – 12th February 2008
- Detail and Levels Survey of the Catchment Area South of Frasers Broadway Site by Degotardi, Smith & Partners – 25th February 2008

4.1.2 Digital Terrain Model

The DTM from the *South Sydney Stormwater Quality and Quantity Study* (SQQS) was used for topographic information for areas of the catchment not covered by the above ground survey. This DTM was derived from photogrammetry and includes spot levels at a 15 m grid spacing. The vertical accuracy of the DTM is +/- 0.2m (1 standard deviation).

4.2 PREVIOUS STUDIES

4.2.1 Sydney Water Corporation Studies

A Capacity Assessment study was undertaken on the Blackwattle Bay Catchment by Sydney Water in 1997. This study was the source of most of the information for the DRAINS model for those parts of the catchment upstream of the site.

Sydney Water, Central Region also undertook a flood study in 1994. The flood study utilised an ILSAX model and a MIKE11-UD model to investigate the behaviour of the trunk drainage network. The study identified the Kensington Street sag as one of the most severe locations where flooding occurs.

4.2.2 South Sydney Stormwater Quality and Quantity Study — Blackwattle Bay and Johnstons Creek Catchments

The *South Sydney Stormwater Quality and Quantity Study (SSQQS)* was undertaken by Hughes Trueman and Perrens Consultants (2004). This investigation was intended to form a structure from which South Sydney Council could move towards a set of development control policies and guidelines that would assist developers to understand the complex catchment characteristics and the need for site specific stormwater studies when considering any development proposal in the region. A broad-scale *DRAINS* model and GIS of the catchments were produced. The study identified areas of main regional stormwater ponding, and overland flow magnitudes. Stormwater management options were proposed.

The findings of this report were not intended to be directly applied to any particular development application. Due to the local complexities of the system, site specific investigations are required to confirm flows and optimise solutions for each specific development in the catchment.

4.3 HISTORICAL FLOODING

The *SSQQS* (Hughes Trueman, 2004) included a table of reported flooding within the Blackwattle Creek catchment. However the table does not include any records of flooding in the vicinity of the site, as it was not within the former South Sydney Local Government Area.

Sydney Water Corporation (1994) also provides records of historical flooding. However there were no records of flooding given in the vicinity of the site.

5.0 EXISTING FLOOD BEHAVIOUR AND STORMWATER CAPACITY

Modelling was undertaken using the DRAINS software package. DRAINS is a simulation program that:

- Converts rainfall patterns to stormwater runoff and routes flows through networks of pipes and channels;
- Develops hydrographs and calculates hydraulic grade lines throughout drainage systems;
- Analyses the magnitudes of overland flow; and
- Simulates detention storages. Road sags with significance storage volumes can be modelled as discrete detention storages.

The modelling was based on the DRAINS model that was developed as part of the *SSQQS* (Hughes Trueman, 2004). However the original DRAINS model was modified for the following reasons:

- The SSQQS DRAINS model was a broad scale model and did not account for localised conditions; and
- In the time since the *SSQQS* was completed, Watercom has released an unsteady flow module for DRAINS (April 2006). Among other improvements, the unsteady flow module provides a more realistic assessment of ponding depths at sag pits.

The modifications to the base DRAINS model are described below.

5.1 MODIFICATIONS TO DRAINS MODEL

5.1.1 Network

The nodes in the original DRAINS model represented the nodes of the trunk drainage system. Additional nodes and reaches in the vicinity of the site were included in the revised DRAINS model to represent local flood behaviour. Drawing No.s 08S018C-05 and 08S018C-06 Existing Stormwater Infrastructure Plans show the revised DRAINS network in the vicinity of the site.

During the development of the model, the following changes were made based on a visual assessment of the site and surrounding areas:

- Abercrombie Street was split into 2 separate catchments with the overland flow from the western side of the street flowing west, away from the site;
- Meagher Street was spilt up into 2 separate catchments with the northern portion of the street running north down either Chippen, Balfour or Abercrombie Streets and the southern portion of the street sheeting across Abercrombie Street into Myrtle Street;
- A sag was located in Kensington Street with an overtopping level of approx 17.6 m with the overland flow flowing into Broadway;
- A sag was located in Regent Street with an overtopping level of approx 18.0 m with the overland flow flowing into Outram Street;

- A sag was located in Wellington Street with an overtopping level of approx 16.3 m with the overland flow flowing into Balfour Street;
- Regent Street was split into 2 separate catchments with the eastern portion flowing to the Regent Street sag and the catchment north of Wellington Street all flowing down into Wellington Street;
- Overland flow from Broadway east of Balfour Street will flow down Balfour Street; and
- All overland flow from Balfour Street, from both directions, flows into Irving Street.

5.1.2 Catchment Areas

Catchment areas were determined for locations in the vicinity of the site. Each of these areas was given an impervious area of 98%. Drawing No.s 08S018C-03 and 08S018C-04 Existing Site Catchment Plans show the catchments in the vicinity of the site with their DRAINS reference and area. Drawing No. 08S018C-02 Regional Catchment Plan shows the regional catchment contributing to the trunk mains in the vicinity of the site. The tables in Appendix B also outline the catchment area data.

5.1.3 Pit Inlet Capacity and Sag Volumes

As described in Section 3.0, the sag points adjacent to the site contain multiple inlet pits. A composite pit inlet relationship was derived for each sag based on the surveyed pit dimensions and using Equations 1.6 and 1.7 from Book 8 of ARR99. A blockage factor of 0.5 was applied in accordance with ARR99.

Other pits in the DRAINS model were converted from the old pit database format to the current database format used by DRAINS. However new pit capacity relationships were derived to preserve the assumptions adopted in SSQQS (2004).

The unsteady flow module allows an elevation-surface area table to be developed at sag-pits thus allowing more accurate estimation of ponding depths. The analysis incorporates this approach at the Regent, Kensington and Wellington Street sags only. The elevation-surface area data was derived from a triangulation of the ground survey.

Preliminary values of pit head loss coefficients were derived from A.R.R.B. SR 34 (Argue, 1986). These values are “on the ‘high’ side of average”. Where more rigorous derivation of head loss coefficients was warranted, the Hare Equations were used.

5.1.4 Pipes

All pipe lengths, diameter and invert levels for pipes that were updated from the original DRAINS Model were either taken from the survey by Degotardi Smith and Partners or the Sydney Water Blackwattle Bay survey. Reference was also made to the Prince Alfred hospital submain and Blackwattle Bay stormwater channel, Dilapidation Report (SAS TTI JV, January 2008).

5.1.5 Overland Flow Paths

The unsteady flow module of DRAINS requires that upstream and downstream invert levels, flow path lengths and cross-section shapes be inserted for all overland flow paths. In the vicinity of the site, this data was derived from the ground survey, with relevant cross section shapes derived.

For all other overland flowpaths in the model for which there was no ground survey data the following assumptions were made:

- Pit surface levels (plus ponding depth at the upstream pit where applicable) were used as the flow paths invert levels;
- Approximate flow paths lengths were either calculated from the node coordinates or set to the same length as corresponding pipe reach; and
- A 20m wide rectangular cross-section was used for the cross-section shape. This assumes that no flow loss occurs from the cross section. This does not actually occur and this approach is conservative.

5.2 RESULTS

Drawing No. 08S018C-07 Existing Flood Behaviour shows flood behaviour in the 100 year ARI flood event. **Table 5.1** provides a summary of results for overland flows in the vicinity of the site for the 100 year ARI event.

From tables L1 and L2 in the NSW Government Floodplain Development Manual the flood hazard was determined for each of the overland flow paths in **Table 5.1**. The 3 categories for the flood hazard are as follows:

- VP – Safe for vehicles and pedestrians
- P – Safe for pedestrians only
- Unsafe

Table 5.1 – Summary of Results for Existing Site

Location	DRAINS Reference	Overland Flow (m^3/s)	Overland Depth (m)	Overland Velocity (m/s)	Hazard
Broadway West	OSA1	0.14	0.08	1.8	VP
Broadway East	OSA3	0.60	0.20	1.7	P
Abercrombie Street North	OSB3	5.45	0.27	2.3	**Unsafe**
Abercrombie Street South	OSB5/J1	1.03	0.21	2.2	**Unsafe**
Irving Street	OSC2	3.84	0.28	2.5	**Unsafe**
Balfour Street North	OSA2	0.64	0.24	1.7	P
Balfour Street South	OSE2	1.08	0.24	2.5	**Unsafe**
Wellington Street	OSG5	0.50	0.65	1.4	**Unsafe**
Queen Street	OSF5	0.10	0.15	1.1	VP

The results also show that:

- Ponding occurs to approx RL 17.8m in the Kensington Street sag (SC18A);
- The peak overflow from the Kensington Street sag into Broadway (OSC18) is approx 0.27 m^3/s;
- Ponding occurs to approx RL 18.1m in the Regent Street sag (SC21A);
- The peak overflow from the Regent Street sag into Outram Street (OSC21) is approx 0.15 m^3/s;
- Ponding occurs to approx RL 16.6m in the Wellington Street sag (SG4); and
- The peak overflow from the Wellington Street sag into Balfour Street (OSG4) is approx 0.86 m^3/s.

Results and inputs for the whole site can be seen in Appendix B.

5.3 COMPARISON WITH OTHER FLOOD STUDIES

Results from this study were compared with results from the *Blackwattle Bay SWC 17 Flood Study – Final Report* (1994) undertaken by Sydney Water and the *South Sydney Stormwater Quality and Quantity Study (SSQQS)* undertaken by Hughes Trueman and Perrens Consultants (2004). Due to their being only limited information available in the Sydney Water study limited comparisons can be made for the flows and flow depths between the 3 studies. **Table 5.2** provides comparisons between the flows and flow depths from the 3 reports.

Table 5.2 – Comparisons between Reports

Location	HT Report	HT (SQQS 2004)	Sydney Water Report
Total flows at the intersection of Abercrombie Street and Broadway	16.8 m^3/s	16.4 m^3/s	13.8 m^3/s
Depth of flow in Abercrombie Street between Irving Street and Broadway	0.27 m	0.29 m	0.33 m
Depth of flow in Balfour Street near the intersection with Wellington Street	0.14 m	NA	0.15 m

From these comparisons it can be seen that the results at the above locations are comparable to those calculated in the Sydney Water and Hughes Trueman (2004) Reports.

6.0 PROPOSED DEVELOPMENT

6.1 PROPOSED FLOODING AND STORMWATER MANAGEMENT MEASURES

The proposed stormwater management measures for the site are shown on Drawing No. 08S018C-09 Proposed Stormwater Infrastructure. The various measures are described below.

6.1.1 Site Grading

Filling and grading of the site has been carefully considered and optimised respecting the following constraints:

- Proposed buildings and carpark entrances are above the 100 year ARI flood level including freeboard (where applicable);
- Flood depths on internal roads are safe for vehicles;
- Internal stormwater and kerb and gutter has sufficient grade to achieve self cleansing velocities; and
- Overland flow can be conveyed through the site without trapped low points.

6.1.2 Road Cross Sections

Details on the cross sections for each of the roads throughout the site are shown in **Table 6.1**.

Table 6.1 – Road Cross Sections

Street	Cross Section	Pavement Material
Irving Street	Two way cross fall with a parking lane on the southern side of the road	Asphaltic Concrete
Tooth Avenue	One way cross fall to the southern side of the road	Cobblestone
Carlton Street	One way cross fall to the eastern side of the road, with a change of slope to the west at the intersection with Irving Street	Cobblestone
Balfour Street	Two way cross fall	Cobblestone
Chippen Lane	One way cross fall to the western side of the road	Brick Paving
Kent Road	Two way cross fall with a parking lane on the western side	Asphaltic Concrete
Kensington Street	Fall to the centre of the road	Brick Paving

6.1.3 Site Stormwater Reticulation

There are no formal requirements for the design of stormwater reticulation from the City of Sydney Council. In the Robert Bird Group (2006), *Infrastructure Report for Kent Brewery Redevelopment*, it is proposed that "all new drain lines within the site will be designed to capture and convey the runoff from the peak 20 year ARI storm." This is the normal standard that is applied to medium high density developments. Therefore the stormwater reticulation system for the site has been designed for the 20 year ARI storm event.

6.1.4 Flood Storage

Due to the realignment and regrading of the site including the southern end of Kensington Street the existing sag located in Kensington Street has been removed. Storage in this sag was calculated to be approximately 1,000m^3. This loss of flood storage will be compensated for in the proposed detention storage, with a piped and overland flow route to direct the water from the existing sag point location into the proposed detention storage.

6.1.5 Detention

In the letter from Sydney Water dated 23 June 2008, included in Appendix D of this report, it states that a minimum on-site detention capacity of 1,730 m^3 for storage of the excess flow from a 100 year ARI design storm be required, as calculated for the site area of 60,000 m^2.

However the Sydney Water detention guidelines do not govern the design of the detention tank. As existing external overland flows cross the site, the governing issue for stormwater detention is to limit outflows from the site to pre-development flows and to ensure that proposed overland flows are safe for pedestrians and vehicles.

6.1.6 Overland Flow

The site has been graded to ensure that unobstructed overland flow paths are provided throughout the site. It is also aimed to divert as much of the site's overland flow through the site to the proposed on-site detention tank.

6.1.7 Changes to Existing Stormwater

Changes are to be made to the existing stormwater system to reflect the changes made to the site from the proposed development. These changes are outlined in section 6.2.1.

6.1.8 Freeboard

Freeboard is the difference between the building floor level (or flood planning level) and the design flood level. It is a safety factor that is applied to account for uncertainty in the flood level estimation and provide a protection buffer.

The Floodplain Development Manual (NSW Government, 2005), and as referenced in the Green Square DCP, stipulates two types of flooding; mainstream flooding and local overland flooding. The manual defines mainstream flooding as "inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam." The manual defines local overland flooding as "inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam."

Local overland flooding encompasses major drainage, involving (as per the above manual)

- "the floodplains of original watercourses (which may now be piped, channelised or diverted), or sloping areas where overland flows develop along alternative paths once system capacity is exceeded; and/or
- water depths generally in excess of 0.3m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or
- major overland flowpaths through developed areas outside of defined drainage reserves; and/or
- the potential to affect a number of buildings along the major flow path."

and local drainage referring to smaller scale problems in urban areas falling outside the above definition of major drainage.

From the above documents, it is evident that flooding on the site falls within the local overland flooding category.

From correspondence with the City of Sydney Council, included in Appendix D of this report, it was indicated that the guidelines set in the *Green Square Town Centre Development Control Plan 1997 Amendment Part H*, would be acceptable for this site. Refer to the extract from this document included as Appendix D of this report. The relevant freeboard requirements from the above document are presented in **Table 6.2**:

Table 6.2 – Green Square DCP Flood Planning Levels

Item	Flood Planning Level
Residential Properties- *Habitable Room Floor Level* • Inundated by local drainage flooding	1% AEP + 0.5m or if the depth of flow in the 1% AEP is <0.25m than 2 x the depth of flow with a minimum of 0.3m above the surrounding surface.
Underground Garage or Car Park- *For this purpose an underground garage or car park is where the floor of the car park is more than 1m below the surrounding natural ground.* • Inundated by mainstream or local overland flooding	1% AEP + 0.5m (as a minimum) or a level that is determined based on a review of the PMF, whichever is the higher.
Industrial/Commercial Properties • Floor level of a small business	1% AEP

Regarding the issue of no freeboard required for commercial properties (floor level of a small business), please note the following comment in the DCP; "it is assumed that all properties will be advised of the flood risk, either from existing studies or investigations by the proponent."

Frasers Property must consider the implications of providing no freeboard above the 100 year flood level to commercial sites in forming a judgement as to the freeboard levels adopted in planning.

Where the requirement of freeboard above the 100 year ARI flood levels at basement carpark entries would impose substantial constraints on the development, the freeboard requirements will be addressed by the installation of automatic flood barriers at these entries.

Regarding the issue of Probable Maximum Flood (PMF) levels, we note the advice of the Department of Planning to all NSW Councils (ref. Guideline on Development Controls on Low Flood Risk Areas—Floodplain Development Manual) to the effect that PMF levels should not be used for planning purposes for residential sites unless in exceptional circumstances. Therefore, we have not included consideration of PMF levels in this report.

6.1.9 Water Quality

This study does not address stormwater quality management or water storage/water harvesting issues. Hughes Trueman (2007) prepared a preliminary report covering water quality management. Subsequently Frasers Properties has appointed Lincolne Scott to prepare a water cycle management strategy for the site. It is important to integrate the findings from the water quantity and water quality reports to provide a coordinated robust outcome.

6.1.10 Rainwater Reuse

Rainwater collection/retention tanks are to be provided in each building throughout the development. For this study the rainwater reuse tanks were not considered, so as to simulate the worst case scenario with maximum runoff when all the tanks are at capacity. This flow however does not govern the design of the on-site detention tank. At a meeting with City of Sydney Council on the 8th May 2008, council advised that it did not have a policy for offsetting rainwater reuse storage for detention storage and did not favour it.

6.1.11 Clashes with Other Services

Clashes with existing services occur in the following locations:

- Balfour Street at the intersections of Tooth Lane and O'Connor Street;
- Irving Street at the crossing of the oviform; and
- The heritage drain in O'Connor Street.

For the purpose of this study a minimum clearance of 500 mm was taken either above or below the existing pipes/oviform. The assumed clearance will need to be confirmed with the appropriate service authority. Before detailed design, potholing will need to take place to determine the exact locations of these services as well as any other existing services throughout the site which may clash with the proposed stormwater system.

6.2 MODELLING OF PROPOSED DEVELOPMENT

The DRAINS model was modified to evaluate the impact of the proposed development on surrounding areas. Further additions were made to the DRAINS model to include internal stormwater reticulation and overland flowpaths, with assumptions made as discussed in the previous section.

6.2.1 Changes to Model

The following modifications were made to the model:

- Removal of existing stormwater within the site to be replaced with new internal stormwater drainage. The majority of the site area is to be directed to the proposed detention storage under the park area. There are to be 4 inlet pipes into the detention tank, 2 each from O'Connor Street and Carlton Street.
- The existing stormwater main in Kensington Street to become redundant up to the intersection with Outram Street. The pit and connection from Outram Street is to remain connected into the existing line.
- Extension of existing line in Broadway to connect into proposed new stormwater lines in Kent Road and Kensington Street.
- Installation of new pipe for outlet from detention storage with 4 surcharge pits located in Abercrombie Street. The outlet pipe is graded to have a minimum clearance of 500 mm above the

Prince Alfred Park Branch trunk main, and then connect into the existing manhole on the Wattle Street branch trunk main in Abercrombie Street before the intersection with Broadway (SB2). The diameter of the outlet pipe is to be 1500 mm with the diameter reduced to 1050 mm at the surcharge pit locations to surcharge more of the flows out of the pipe system. The surcharge level at the upstream pit will be approximately RL 10.36 which ensures that no surcharge flows will occur within the proposed development site.

- Outlet pipe from detention tank set at invert level of 9.60 to be above the hydraulic grade line resulting from the existing pipe system in Abercrombie Street.
- Top Water Level in detention tank set at RL11.14 to provide sufficient clearance above TWL for the tank support structure and an appropriate soil depth for planting.
- Overland flow from Broadway which under existing conditions travels down Balfour Street now to travel straight down Broadway as a result of proposed road grading.
- Relocation of Pit in Balfour Street (SE2A) as a result of the proposed new park. Pit now located to the south of the proposed park.
- Removal of sag in Kensington Street. Road to be graded to keep continuous flow through this part of the site.
- Surcharge pits are to be located on the trunk main at 2 locations within the site where existing surcharge pits are located along the Tooths Brewery and Prince Alfred Park branch trunk mains. These are located in Kent Road (SC18) and at the intersection of Irving Street and Carlton Street (SC2).
- Pits in Dwyer Street (SD5) to be replaced (A10 and A11) to connect into proposed stormwater system in Kensington Street.
- Existing pits and lines in O'Connor Street (PSJ1) to be replaced with new stormwater system.
- Pipe in O'Connor Street to be graded at 0.42% to be located above the 1050 mm dia pipe in Balfour Street. If the pipe were to be graded to be located under the 1050 mm dia pipe then the invert level of the inlet pipe to the detention storage would be below the invert level of the detention tank outlet pipe.
- Inlet pit to detention tank on O'Connor Street (A1) sized in accordance with Australian Rainfall and Runoff. Pit sized at 4 no 0.6m x 0.9m inlet pits. Details of the proposed detention tank inlet will be further developed during detailed design.
- Pits have been put in the park area (G1 and G2) to cater for the park area to cater for all the park area flows. More detailed design of this stormwater line and pits will need to be undertaken during detailed design.

6.2.2 Results

The results for the proposed development are shown in **Table 6.3**. Results are also shown on Drawing No. 08S018C-10 Proposed Flood Behaviour along with appropriate flood freeboard levels.

From tables L1 and L2 in the NSW Government Floodplain Development Manual the flood hazard was determined for each of the overland flow paths in **Table 6.3**. The 3 categories for the flood hazard are as follows:

- VP – Safe for vehicles and pedestrians
- P – Safe for pedestrians only
- Unsafe

Table 6.3 – Summary of Results for Proposed Development

Location	DRAINS Reference	Overland Flow (m^3/s)	Overland Depth (m)	Overland Velocity (m/s)	Hazard
Abercrombie Street	OB5/OC1/ OC2	0.74	0.14	2.1	U
Abercrombie Street	OSB3	0.94	0.18	1.3	VP
Abercrombie Street	O Det 7	2.13	0.19	1.9	P
Broadway	OSE1	0.08	0.09	0.9	VP
Broadway	OSA3	0.08	0.08	1.1	VP
Broadway	OSA2	0.10	0.07	1.5	VP
Broadway	OSA1	0.14	0.07	1.8	VP
Irving Street	O Irving 1	0.14	0.15	1.1	VP
Carlton Street	OD4	0.002	0.12	1.1	VP
Carlton Street	OD3	0.14	0.12	0.8	VP
Tooth Lane	O7A/O8	0.01	0.09	0.5	VP
Tooth Lane	OD6	0.03	0.09	0.8	VP
Tooth Lane	OD5	0.01	0.06	0.6	VP
Balfour Street	OSE2	1.0	0.24	1.9	U
O Connor Street	OA4/OA4 A	0.06	0.08	0.7	VP
Outram Street	OSI1	0.22	0.10	1.2	VP
Kent Road	OSC18	0.17	0.12	0.7	VP

Comparisons in the outflow from the site comparing proposed flows to existing flows are shown in **Table 6.4**.

Table 6.4 – Comparison of Site Outflow, Existing and Proposed

Location	Existing Overland Flow (m^3/s)	Existing Pipe Flow (m^3/s)	Existing Total Flow (m^3/s)	Proposed Overland Flow (m^3/s)	Proposed Pipe Flow (m^3/s)	Proposed Total Flow (m^3/s)
Irving Street at the intersection with Abercrombie Street	3.84	7.14	10.98	0.14	6.99	7.13
Abercrombie Street at the intersection with Broadway	5.45	11.10	16.55	2.13	11.82	13.95
Broadway at the intersection with Abercrombie Street	0.14	0.22	0.36	0.14	0.19	0.33

As seen above in **Table 6.4** the proposed developments outflows have been reduced from flows under existing conditions. The outflows from the site are similar in Broadway as there are only minor changes to the stormwater system leading to this point. However the outflows in Abercrombie Street and Irving Street have been decreased significantly from the existing conditions. This is as a result of the majority of the catchment to these locations passing through the proposed on-site detention tank. In Abercrombie Street the flow in the pipe for the proposed development is slightly increased from the existing conditions. However as the total flow (piped and overland) is much lower than the existing conditions and there is no significant increase in the hydraulic grade line in the Wattle Street Branch trunk main in Abercrombie Street upstream of the site, it is considered to be acceptable.

A below ground detention tank is to be located beneath the central park area. It was determined a tank with a volume 2500 m^3 would be required. The tank will have a footprint area of 50m x 45m (2250 m^2) with an invert at the outlet pipe of RL 9.60 and a top water level in the tank of RL 11.14. The base of the detention tank is to be graded at 1% to the low point at the invert of the outlet pipe. The diameter of the outlet pipe from the tank is a 1500 mm dia pipe, with the diameter reduced to a 1050 mm dia pipe at the surcharge pits in Abercrombie Street. The detention tank has a minimum outlet invert level of RL 9.60 as a result of the downstream stormwater system being under capacity. If the invert was any lower than this level it would be below the hydraulic grade line of the Sydney Water trunk main in Abercrombie Street, which would cause backwater affects and result in wasted detention storage area.

6.3 FLOOD HAZARD

As can be seen above in **Table 6.3** the flood hazard has been determined for each area where overland flow is present on the site for the 100 year ARI. As shown in **Table 6.3**, all overland flows within the site are safe for pedestrians and vehicles. Some overland flows in public roads adjacent to the site (i.e. Abercrombie Street and Balfour Street) have an unsafe flood hazard. Existing flood hazards in these areas are currently unsafe (Refer to **Table 5.1**).

6.4 STAGING

A staging plan has not been determined for the proposed development. The staging of the development has not been considered in the study and will need to be considered once the proposed staging of the development has been determined.

7.0 CONCLUSION

The DRAINS model of the Blackwattle Bay Catchment previously set up by Hughes Trueman (2004) for the area was modified to provide more detail in the vicinity of the site using additional ground survey data to assess the existing conditions on the site. From the results of this model it was found that:

- The stormwater system downstream of the site is under capacity.
- Overland flow velocities and depths in Irving, Balfour, Abercrombie and Wellington Streets are not safe.
- Ponding occurs in the Kensington Street sag and the sag in Wellington Street near Balfour Street. The ponding depths are approximately 1m and 0.3m respectively.

The DRAINS model was then modified to evaluate the impact of the proposed development on surrounding areas with comparison to the impact from the existing conditions. From the results of this model it was found that:

- As the stormwater system downstream of site is under capacity, there is an impact on how the site stormwater can be handled and the stormwater detention is provided. This leads to the detention having an outlet invert level of RL 9.60
- The proposed stormwater design is based on not exacerbating the flows downstream of the site. Sydney Water has provided a minimum detention storage requirement of 1,730 m^3 that has been exceeded based on the design requirements.
- The removal of the Kensington Street sag leads to the need for the removed flood storage volume from the sag being collected in the site stormwater system and included in the required detention storage volume. The regional overland flow that enters the site from Balfour Street will also be collected in the site stormwater system and has been included in the required detention storage volume.
- As a result of the site stormwater measures the outflows from the site in Irving Street and Abercrombie Street have been reduced compared to the existing conditions. Therefore there is no adverse impact on the existing pipe system and overland flows, through and external to the site.

8.0 REFERENCES

City of Sydney Council (1997). *South Sydney Development Control Plan 1997 Amendment Part H: Green Square Town Centre*, City of Sydney Council.

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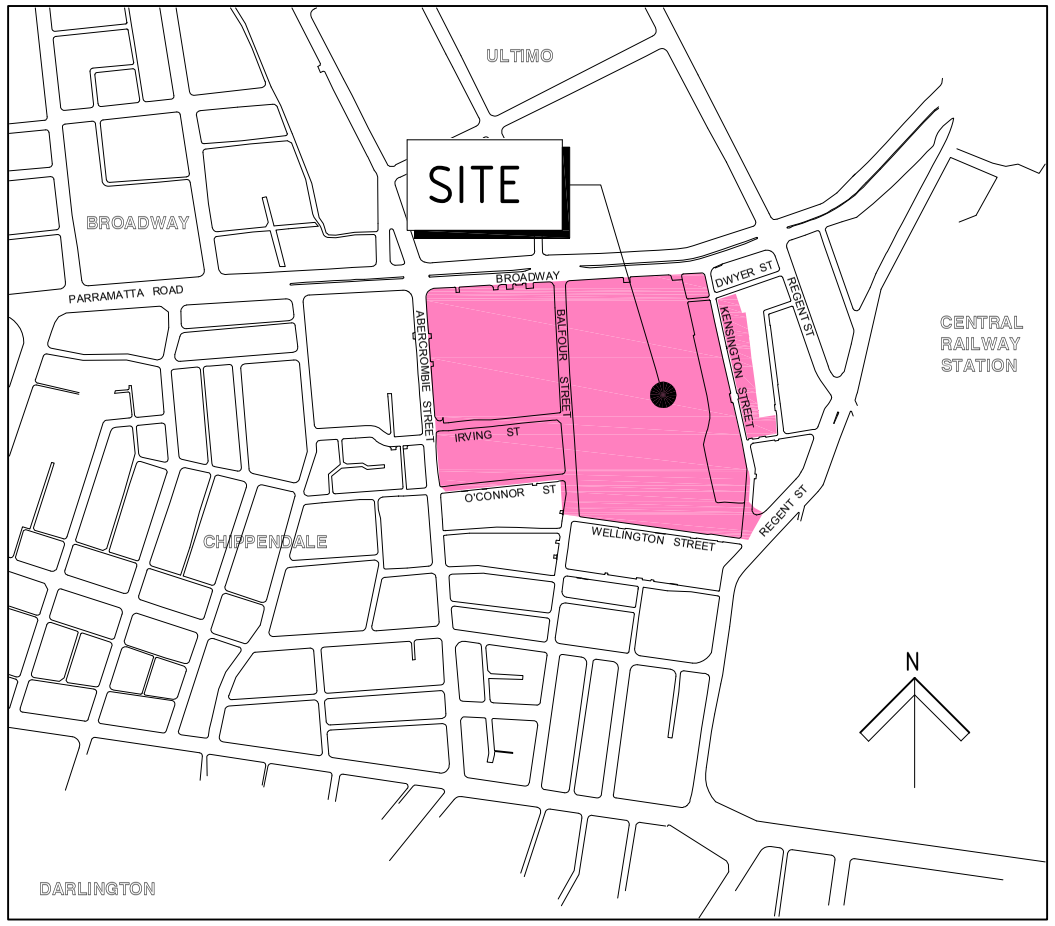
APPENDIX A – DRAWINGS



CHIPPENDALE
LOCALITY SKETCH
Not to Scale

FRASERS BROADWAY

STORMWATER QUANTITY MANAGEMENT STUDY

.

Civil Drawing List	
Sheet Number	Sheet Title
01	Cover Sheet
02	Regional Catchment Plan
03	Existing Site Catchment Plan - 1 of 2
04	Existing Site Catchment Plan - 2 of 2
05	Existing Stormwater Infrastructure Plan - 1 of 2
06	Existing Stormwater Infrastructure Plan - 2 of 2
07	Existing Flood Behaviour
08	Proposed Site Catchment Plan
09	Proposed Stormwater Infrastructure Plan
10	Proposed Flood Behaviour

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HT Project No: 08S018
Dwg No: C-01
Revision: C
Date: 20.11.08
Reason for Issue: FINAL ISSUE

Preliminary - NOT FOR CONSTRUCTION

17H – TOOTHS BREWERY BRANCH
GENERALLY 900mm x 1350mm OVIFORM
WITH MINOR STRUCTURE CROSS
SECTION CHANGES THROUGHOUT

17J – PRINCE ALFRED PARK BRANCH
Ø1050mm CONCRETE PIPE

17D – WATTLE STREET BRANCH
1350mm x 900mm OVIFORM

EXTENT OF WORKS LEGEND

Extent of Siteworks

CATCHMENT LEGEND

- Catchment Boundary
- Blackwattle Bay SWC17 Catchment Boundary
- 17J Prince Alfred Park Catchment
- 17H Tooths Brewery Branch Catchment
- 17D Wattle Street Branch Catchment

DRAINAGE LEGEND

- ESW — Existing Primary (Trunk) Stormwater Drainage Line

PRELIMINARY - NOT FOR CONSTRUCTION

Rev	Amendment / Reason For Issue	Date	Drawing Completed by	Designed & Checked by	Verified by (X = Not verified)	Issue Authorised (✓)
C	ROAD LAYOUT AMENDED	20.11.08	CB	CB		
B	FINAL ISSUE	05.08.08	BY	GS / SR		
A	ISSUED FOR REVIEW	31.03.08	AS	GS / SR		

Plan Scale 1:2000 @ A0

North

* Drawing Status Warning: Unless there is an authorised Hughes Trueman signature at *, this drawing is not authorised for issue.

This Drawing may have been prepared using COLOUR, and may be incomplete if copied to BLACK & WHITE.

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Drawing Title: REGIONAL CATCHMENT PLAN
Project: FRASERS BROADWAY
STORMWATER QUANTITY
Client: FRASERS PROPERTY
Architect/Project Manager: INCOLL MANAGEMENT
Drawing No: 08S018C-C02
Sheet 02 of 10
Rev C

A0 SHEET
Filename: P:\SI_Leonards\08S018\dwg\Civil\Regional Catchment Plan.dwg
Plotted By: cbullock
Date: 21/11/08 Time: 9:15am

NOTES: N##

N01. REGENT STREET IS SPLIT INTO TWO SEPERATE CATCHMENTS WITH THE OVERLAND FLOW FROM THE EASTERN PORTION FLOWING TO THE REGENT STREET SAG AND THE WESTERN PORTION NORTH OF WELLINGTON STREET ALL FLOWING DOWN WELLINGTON STREET.

N02. FLOODING ASSOCIATED WITH THE SAG LOCATED IN WELLINGTON STREET WITH AN OVERTOPPING LEVEL OF APPROXIMATELY 16.3m FLOWING INTO BALFOUR STREET.

N03. MEAGHER STREET WAS SPLIT INTO TWO SEPERATE CATCHMENTS WITH THE NORTHERN PORTION OF THE STREET RUNNING NORTH DOWN EITHER CHIPPEN, BALFOUR AND ABERCROMBIE STREETS. THE SOUTHERN PORTION SHOOTS ACROSS ABERCROMBIE STREET INTO MYRTLE STREET.

N04. SAG IN KENSINGTON STREET WITH AN OVERTOPPING LEVEL OF APPROXIMATELY 17.6m FLOWING INTO BROADWAY.

N05. FLOODING ASSUMED WITH THE SAG IN REGENT STREET, WITH AN OVERTOPPING LEVEL OF APPROX 18.0m FLOWING INTO OUTRAM STREET.

N06. ABERCROMBIE STREET IS SPLIT INTO TWO SEPERATE CATCHMENTS WITH THE OVERLAND FLOW FROM THE WESTERN SIDE OF THE STREET FLOWING WEST AWAY FROM THE SITE.

N07. ALL OVERLAND FLOW FROM BALFOUR STREET FLOWS DOWN IRVING STREET.

N08. OVERLAND FLOW FROM BROADWAY EAST OF BALFOUR STREET ALL FLOWS DOWN BALFOUR STREET.

GENERAL:
CATCHMENT AREAS SHOWN ARE ASSUMED TO BE 98% IMPERVIOUS.

N08
N07
N04
N05
N02
N06

CS A1 0.21ha
CS A2 0.28ha
CS 0.20ha
CS D5 0.06ha
CS A3 0.90ha
CS B2A 0.48ha
CS B2B 0.27ha
CS B3 1.01ha
CS C3 2.64ha
CS D2 0.16ha
CS I1 0.15ha
CS D1 0.19ha
CS C2 0.26ha
CS C14 0.13ha
CS C1 0.11ha
CS J1 0.47ha
CS C18 0.46ha
CS G4 0.55ha
CS C21 0.16ha
CS B4 0.30ha
CS B5 0.09ha
CS G1 0.36ha
CS C23 0.49ha
CS G5 0.06ha
CS G3 0.06ha

BROADWAY
BROADWAY
O'CONNOR STREET
KENSINGTON STREET
ABERCROMBIE STREET
BALFOUR STREET
IRVING STREET
O'CONNOR STREET
REGENT STREET
DICK STREET
WELLINGTON STREET
O'CONNOR STREET

JOIN LINE - REFER DRAWING C04 FOR CONTINUATION

DRAINAGE LEGEND
- Existing Primary (Trunk) Stormwater Drainage Line
- Existing Secondary Stormwater Drainage Line

CATCHMENT LEGEND
- CS D5 0.06ha — Catchment Boundary, Name & Area
- 17J Prince Alfred Park Catchment
- 17H Toohys Brewery Branch Catchment
- 17D Wattle Street Branch Catchment
- Direction of Flow to Collection Point

PRELIMINARY - NOT FOR CONSTRUCTION

Rev	Amendment / Reason For Issue	Date	Drawing Completed by	Designed & Checked by	Verified by (X = Not verified)	Issue Authorised (✓)
C	ROAD LAYOUT AMENDED	201108	CB	CB		
B	FINAL ISSUE	050808	BY	GS / SR		
A	ISSUED FOR REVIEW	310308	AS	GS / SR		

Plan Scale 1:500 @ A0

North

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STORMWATER QUANTITY
Client: FRASERS PROPERTY
Architect/Project Manager: INCOLL MANAGEMENT

Drawing Title: EXISTING SITE CATCHMENT PLAN SHEET 1 OF 2
Drawing No: 08S018C-C03
Sheet 03 of 10
Rev C

A0 SHEET