11 December 2020

CIVIL ENGINEERING SERVICES

Liverpool Civic Place, 52 Scott Street, Liverpool

Phase B/C Main Works

Development Application Report

DOCUMENT CONTROL

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APPROVALS

Rev #	Author	Approver
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CIVIL ENGINEERING SERVICES

1. INTRODUCTION

Warren Smith & Partners (WS+P) have been engaged by Built Development Group to assist the design team with the planning and design of Liverpool Civic Place Phase B/C, relating to the following civil services:

- Proposed site levels and grading;
- Private stormwater drainage system;
- Proposed connection to existing Council stormwater infrastructure;
- Stormwater quality treatment, and;
- Sediment and Erosion Controls.

1.1 BACKGROUND

This Civil and Stormwater Report is submitted to Liverpool City Council (Council) on behalf of Built Development Group in support of a Stage 2 Development Application (DA) for Phase B and Phase C of the Liverpool Civic Place development located at 40-42 Scott Street, Liverpool. It follows the approval of a Concept Proposal / Stage 1 DA (DA-585/2019) for the broader Liverpool Civic Place master plan that has determined land uses, building envelopes, public domain and a multi-level common basement across the site. The full Liverpool Civic Place site, subject to the Concept Proposal / Stage 1 DA approval is illustrated at Figure 1.1, however the scope of this Stage 2 DA is limited to Phase B and C, (refer to Figure 1.2) with the exception of embellishments to the Terminus Street pocket park.

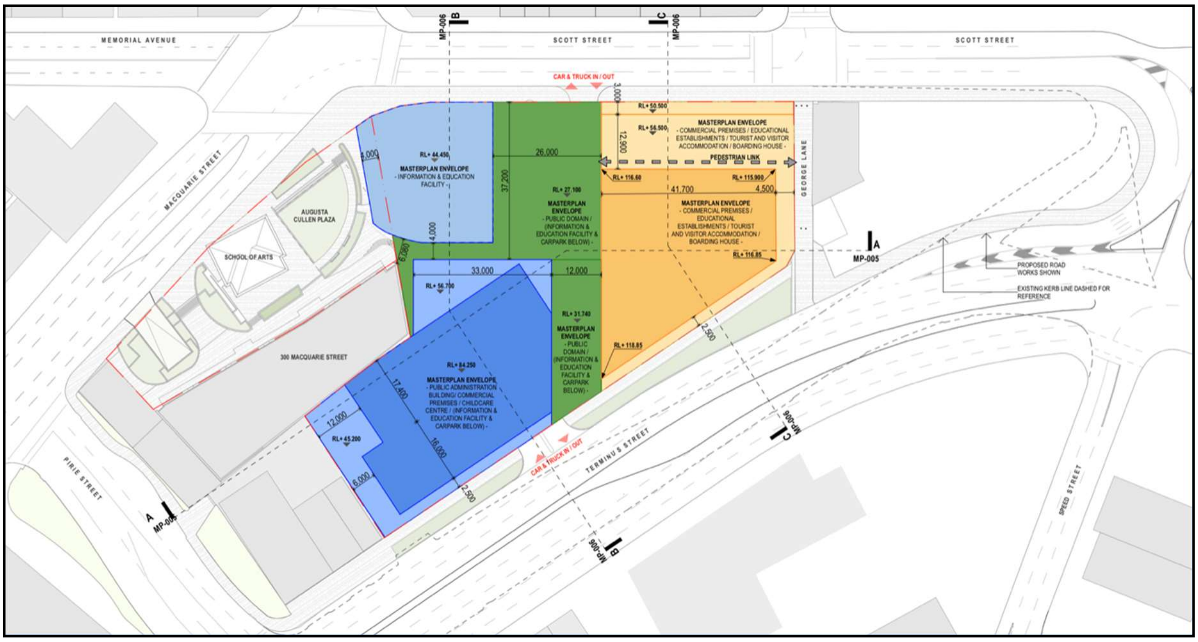


Figure 1.1: Liverpool Civic Place Master Plan site (Source: FJMT)

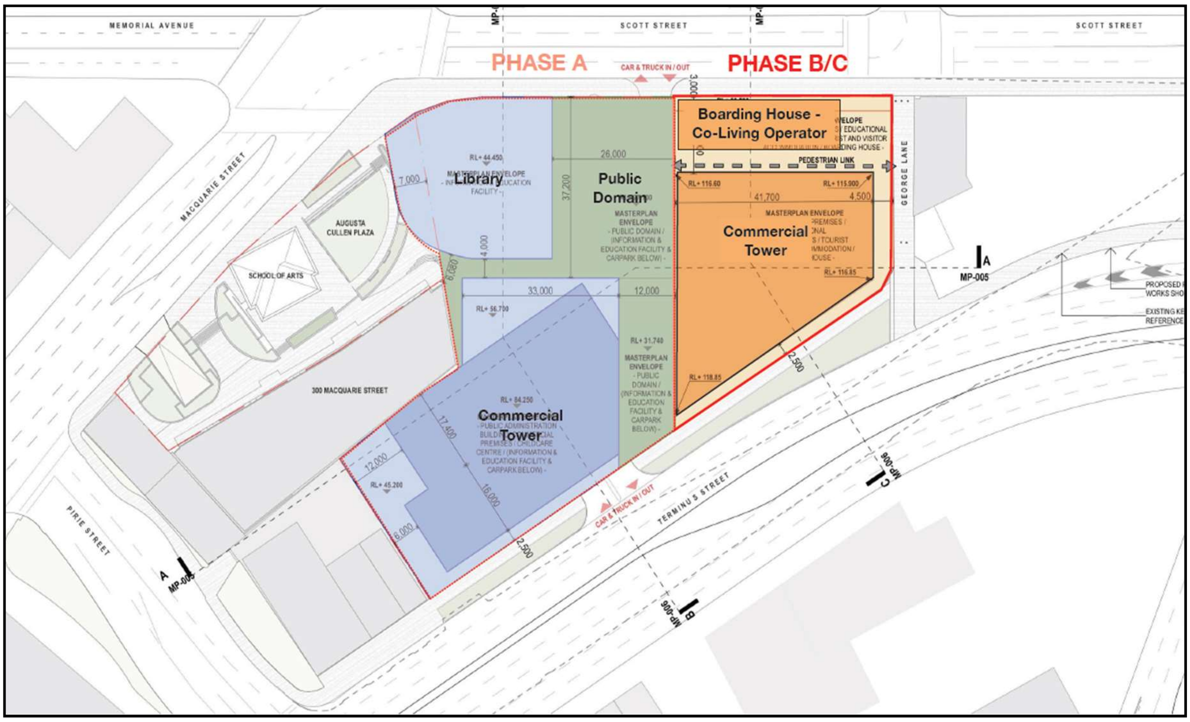


Figure 1.2: Liverpool Civic Place Phase B/C Site (subject site) (Source: FJMT)

This Stage 2 DA seeks approval for:

- Construction and use of a nine (9) storey boarding house to be operated as a co-living facility, comprising;
  - ground floor lobby and retail tenancies;
  - eighty-four (84) rooms;
  - communal facilities including living, kitchen and dining areas, a gym, rooftop terrace and a laundry.
- Construction and use of a twenty-two (22) storey commercial office building, comprising:
  - ground floor lobby and retail tenancies;
  - nineteen (19) commercial office levels; and
  - mid level and rooftop plant.
- Construction and use of four basement levels;
- Landscaping and public domain works including:
  - provision of a pocket park fronting Scott Street and George Lane;
  - embellishment of the elevated pocket park fronting Terminus Street; and
  - provision of a through-site link, connecting George Lane to the central public plaza.
- Extension and augmentation of services and infrastructure as required.

This DA reflects the staged planning approval pathway for the Liverpool Civic Place redevelopment which has included two previously approved DAs and a third DA currently under assessment, as outlined below:

Concept DA DA-585/2019:

The planning approval pathway for the Liverpool Civic Place development commenced in in 2019, with the submission of a Concept Proposal / Stage 1 DA for the Liverpool Civic Place master plan. On 31 August 2020, the Concept Proposal / Stage 1 DA (DA-585/2019) was approved by the Sydney Western City Planning Panel. The Concept Proposal / Stage 1 DA consent sets out the future development concept of the site, including the approved land uses, building envelopes, an expanse of public domain and a common basement. The Concept Proposal / Stage 1 DA did not approve any physical works.

Early Works DA DA-906/2019:

DA-906/2019 was approved by the Sydney Western City Planning Panel on 29 June 2020. The development consent relates to demolition of all structures, select tree removal and bulk earthworks including shoring through the use of piles. Early works commenced on site in September 2020 and are scheduled for completion in August 2021.

Phase A Stage 2 DA DA-836/2020:

DA-836/2020 was submitted to Council on 8 October 2020 and is currently under assessment (at the time of writing). The proposed development relates to Phase A of the Liverpool Civic Place redevelopment for the construction and use of a public library, as well as a mixed use building containing commercial office floor space, and public administration floor space to be occupied by Council. The proposal also comprises significant public domain works, including a public plaza and part of the site's five level common basement.

1.2 SITE ANALYSIS

1.2.1. SITE LOCATION AND CONTEXT

The site is located at 40-42 Scott Street, Liverpool within the Liverpool City Council Local Government Area (LGA) as illustrated at Figure 1.3. The site is located at the southern fringe of the Liverpool CBD. The site is approximately 300m south west of the Liverpool Railway Station and is also in the vicinity of a number of regionally significant land uses and features including Liverpool Hospital, Westfield Liverpool, Western Sydney University Liverpool Campus, the Georges River and Biggie Park public open space as illustrated at Figure 1.3.

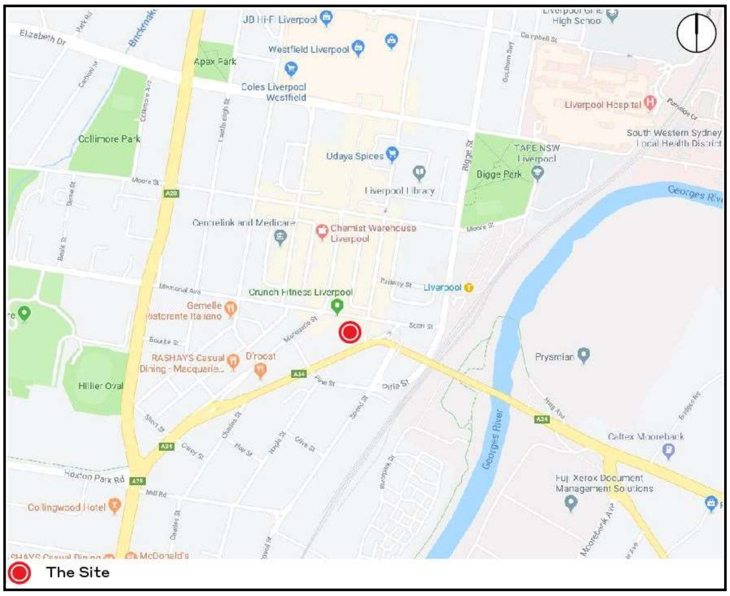


Figure 1.3: Site Location (Source: Google Maps & Ethos Urban.

Figure 1.4: Aerial View of the Development Boundary (Source: Near Maps)

2. ABBREVIATIONS AND DEFINITIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
DN	Diameter (mm)
EY	Exceedances per Year
IFD	Intensity-Frequency-Duration
L/s	Litres per second
m/s	Metres per second
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	On-Site Detention
PSD	Permissible Site Discharge
RCP	Reinforced Concrete Pipe
RWT	Rainwater Reuse Tank
SID	Safety In Design
SSR	Site Storage Requirement
WSC	Water Services Coordinator
WSUD	Water Sensitive Urban Design

The Use of Must, Shall & Should:

In accordance with the international Organisation for Standardisation (ISO) Directives, the word “shall” is used to state that a requirement is strictly to be followed in order to conform to a Performance Requirement. Consequently, there can be no deviation from that requirement, other than a specific tolerance.

It is noted that in legislation and specifications it is common to use the word “must” to express a requirement. The word “shall” in this document should be considered as equivalent to “must” in the legislation.

The word “should” introduces a suggestion or recommendation that is not a requirement. It is not necessary that such recommendations or suggestions be followed in order to comply with the Performance Requirement.

3. EXISTING DRAINAGE INFRASTRUCTURE

3.1 EXISTING DRAINAGE INFRASTRUCTURE & SITE GRADING

A desktop review of the existing site and a site inspection were undertaken to determine the existing site conditions and drainage infrastructure within the proposed development site. The investigations revealed the following:

- The development site is generally an urban area with a commercial building covering a large portion of the site;
- The site grades from south to north at a grade of approximately 4%;
- There are two (2) existing stormwater grated pits located at the south of the proposed development and one (1) existing DN225 stormwater pipe reticulating from south to north and connecting to stormwater kerb inlet pit in Scott Street and;
- There is one (1) existing stormwater kerb inlet pit located in Scott Street at north of the proposed development.

Refer to Figure 3.1 below for an illustration of the existing site grading.

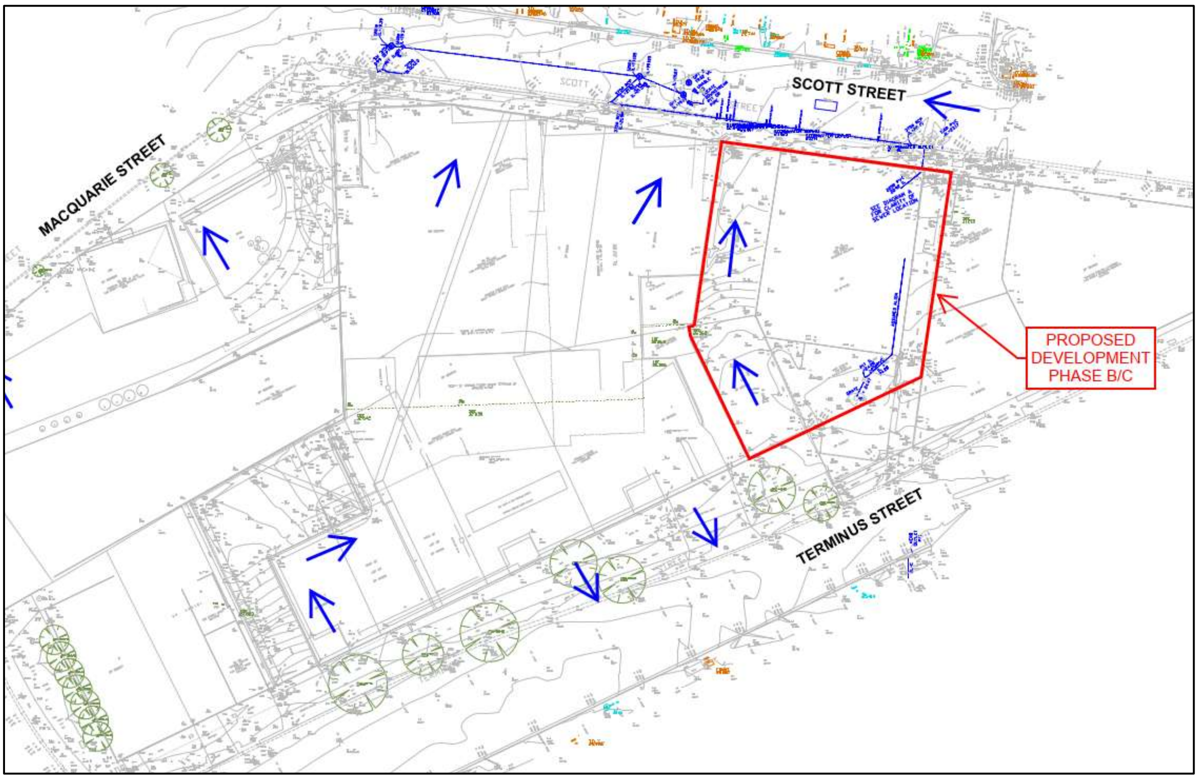


Figure 3.1: Existing Site Grading

4. AUTHORITY AND REGULATORY REQUIREMENTS

4.1 DESIGN CRITERIA

Table 4.1: Design Criteria

Item	Design Criteria
Stormwater Drainage Works	AS/NZS 3500.3 – 2015 – Stormwater Drainage Liverpool Council Development Design Specification for Stormwater Design (DCP) 2003
Water Quality Requirements and Proposed Treatment System	Draft NSW MUSIC Modelling Guidelines 2010 Liverpool Council Water Management Policy (2016)
Sediment and Erosion Control	Landcom 'Blue Book' – Managing Urban Stormwater Soils and Construction Guideline Edition 4

The proposed development application design has considered the concept DA conditions set out in Table 4.2.

Table 4.2: Concept Development Application Conditions

Condition	Description
14. Stormwater Management	A concept stormwater drainage system must be designed to ensure that stormwater runoff from upstream properties is conveyed through the site without adverse impact on the development or adjoining properties.
15. Stormwater Management	Engineering plans and supporting calculations for the stormwater drainage system are to be prepared by a suitably qualified engineer.
17. Stormwater Management	A stormwater pre-treatment system shall be incorporated on the proposed stormwater plans and that the design meets pollutant retention criteria in accordance with Council's Development Control Plan.
18. Stormwater Management	On site water quality treatment facilities shall be provided to ensure that stormwater runoffs leaving the site comply with Council's water quality standards. The treatment facilities shall capture all gross pollutants and liquid contaminants from the stormwater before discharging it to downstream. Water quality treatment works shall be designed using MUSIC modelling software and the water quality treatment system performance shall be verified using Council's MUSIC link.
19. Stormwater Management	The below pollutant reduction targets are to be satisfied: 45% reduction in the baseline annual pollutant load of total nitrogen (TN); 65% reduction in the baseline annual pollutant load of total phosphorous (TP); 85% reduction in the baseline annual pollutant load of total suspended solids TSS); and 90% reduction in the baseline annual pollutant load of litter and vegetation larger than 5mm (gross pollutants).
25. Traffic and Access	Detailed design drawings of the driveways and ramps, demonstrating that the design has been carried out in accordance with Australian Standards is to be submitted to Council with the detailed development applications.

The proposed development application design has considered the items relating to civil and stormwater outlined in the pre-DA meeting minutes, refer to Table 4.3.

Table 4.3: Pre-Development Application Meeting Minutes – Items Relating to Civil & Stormwater

Condition	Description
i) Flooding	Water Sensitive Urban Design / on site water quality treatment trains shall be incorporated in the stormwater design. Water quality treatment works shall be designed using MUSIC modelling software and the water quality treatment system performance shall be verified using Council's MUSIC
j) Development engineering Stormwater	• Stormwater drainage for the site must be in accordance with Council's Development Control Plan. • A detailed stormwater concept plan shall be submitted with the application. • The stormwater concept plan shall be accompanied by a supporting report and calculations including relevant DRAINS digital model. (Note: Onsite Detention is not expected to be required give the existing site coverage). • The proposed basement car park shall ensure that the stormwater drainage system has been designed in accordance with the requirements for pumped systems in AS3500.3:2003 and Council's Stormwater Drainage Design Specifications for pump out systems for basement carparks. • A water quality treatment device shall be provided in accordance with Council's Development Control Plan. A MUSIC model shall be submitted with the development application.
17. Stormwater Management	A stormwater pre-treatment system shall be incorporated on the proposed stormwater plans and that the design meets pollutant retention criteria in accordance with Council's Development Control Plan.

4.2 STORMWATER DRAINAGE AND ON SITE DETENTION (OSD) REQUIREMENTS

With reference to the following documents, the Council requirements are presented in the sub-sections below:

- Liverpool City Council Development Control Plan (DCP), dated 2008;
- Liverpool City Council Development Design Specification, Section D5 Stormwater Drainage Design, dated January 2003, and;
- Liverpool City Council Development Design Specification, Section D2 Pavement Design, dated October 2003.

4.3 STORMWATER DRAINAGE REQUIREMENTS

- The piped system must be capable of conveying stormwater up to, and including, the 20% AEP storm event, and overland flow paths must be capable of conveying stormwater up to, and including, the 1% AEP storm event;
- As per the correspondence with Liverpool Council, an OSD is not required for the proposed development. Refer to Schedule 2 for the Council Correspondence, and;
- Post-development flows shall not exceed pre-development flows.

Liverpool City Council stormwater drainage design specification (2003) outlines standards for design of minor and major systems. Since the proposed development is located within the Liverpool CBD, the design specifications require minor systems to be designed for 20-year ARI. Design of minor systems require the following:

- Pipe gradient to be a minimum 1% and maximum 10%.
- Velocity within pipelines to be minimum 0.6m/s and maximum 6m/s.
- Water surface level within drainage pits to be 0.15m below gutter invert.
- Angle between inlet and outlet at pit junction to be greater than 90 degrees.
- Maximum pit bypass flow rate to be 10l/s.
- Allowance for blockage for grated pits at both sag and continuous grades are 50%. For side entry pits, blockage allowance at both sag and continuous grades is 80%. For Combination pits, blockage allowance at continuous grade is 90%, and only the grate is assumed to be fully blocked at sag.

Design of major systems require provision of safe, well defined overland flow paths for extreme storm events.

4.4 FLOODING & FREEBOARD REQUIREMENTS

The proposed development in Liverpool Civic is outside of the flooding zone, therefore no freeboard requirements are required for the proposed development.

Refer to the Figure 4.1 for the location of the proposed development on the flooding map and to Schedule 3 for Liverpool CBD Floodplain Management Study.

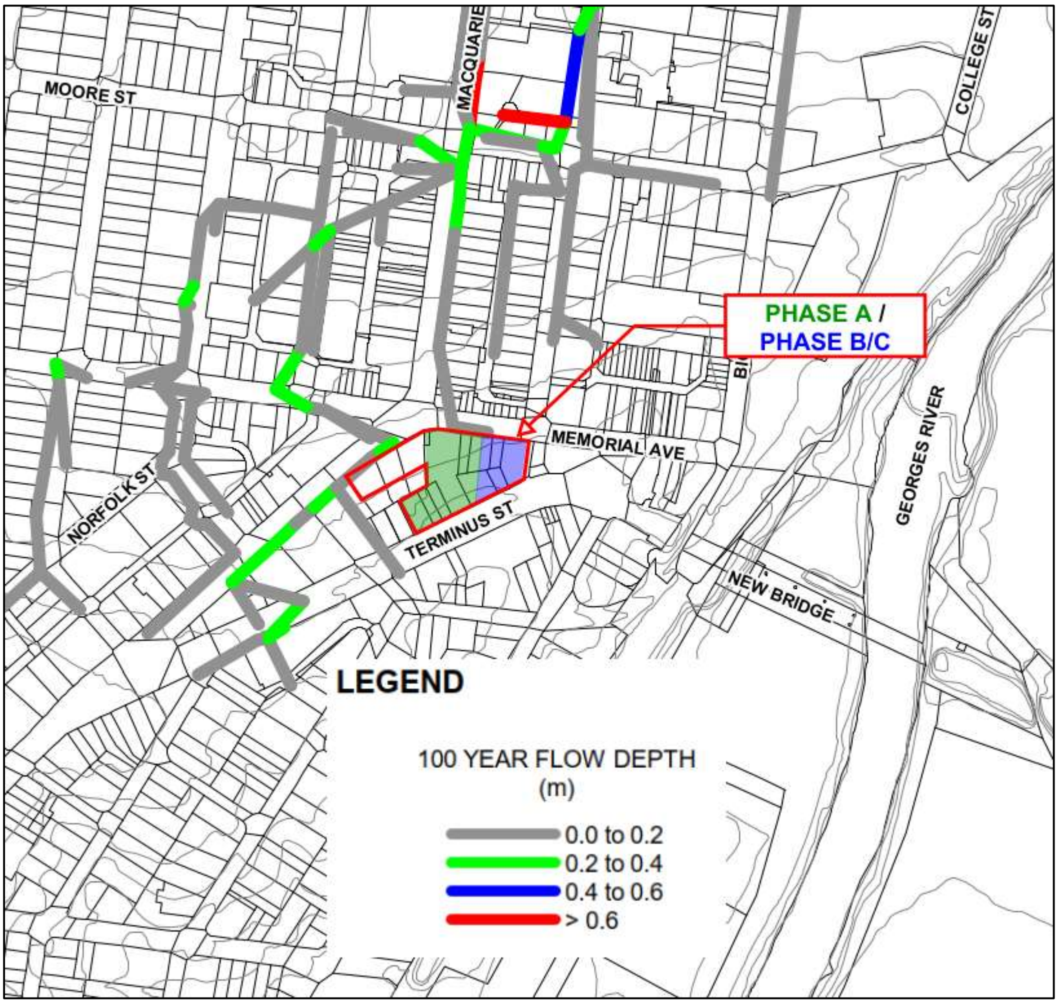


Figure 4.1: Location of the proposed development on the flooding map *(Source: Liverpool CBD Floodplain Management Study)*

4.5 WATER SENSITIVE URBAN DESIGN (WSUD) REQUIREMENTS

Table 4.4: WSUD Stormwater Quality Reduction Targets as per Liverpool Council DCP

Pollutant Type	Reduction Target (%)
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	85%
Total Phosphorus (TP)	65%
Total Nitrogen (TN)	45%

Additional requirements from *Liverpool Civic Place Sustainability Services Design Brief, dated 3 June 2020* are presented in

Table 4.5: WSUD Stormwater Quality Reduction Targets as per ESD Framework (Table 26.2 of the LCP Phase A Sustainability Services report, Column B)

Pollutant Type	Reduction Target (%)
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	60%
Total Nitrogen (TN)	45%
Free Oils	90%
TPH	90%

5. PROPOSED STORMWATER SYSTEM

The total site development area is 0.3010 Ha. A breakdown of the proposed development area is presented in Table 5.1.

Table 5.1: Breakdown of Proposed Development Site Catchment

Catchment	Impervious (Ha)	Pervious (Ha)	Total Area (Ha)
George Lane, Main Ground & Hardstands	0.0917	-	**0.0917**
Roof North Building	0.0473	-	**0.0473**
Roof Office	0.1418	-	**0.1418**
Bypass	0.0178	0.0024	**0.0202**
Total Area	**0.2986**	**0.0024**	**0.3010**

It is proposed that there will be one (1) combination treatment tank installed for the proposed development located in the Phase B Office building. The tank will be 2.5 m long by 1.3 m wide by 1.35 m high. The roof catchment from the building will be discharging into the proposed tank. Refer to Figure 5.1 for an illustration of the combination tank location.

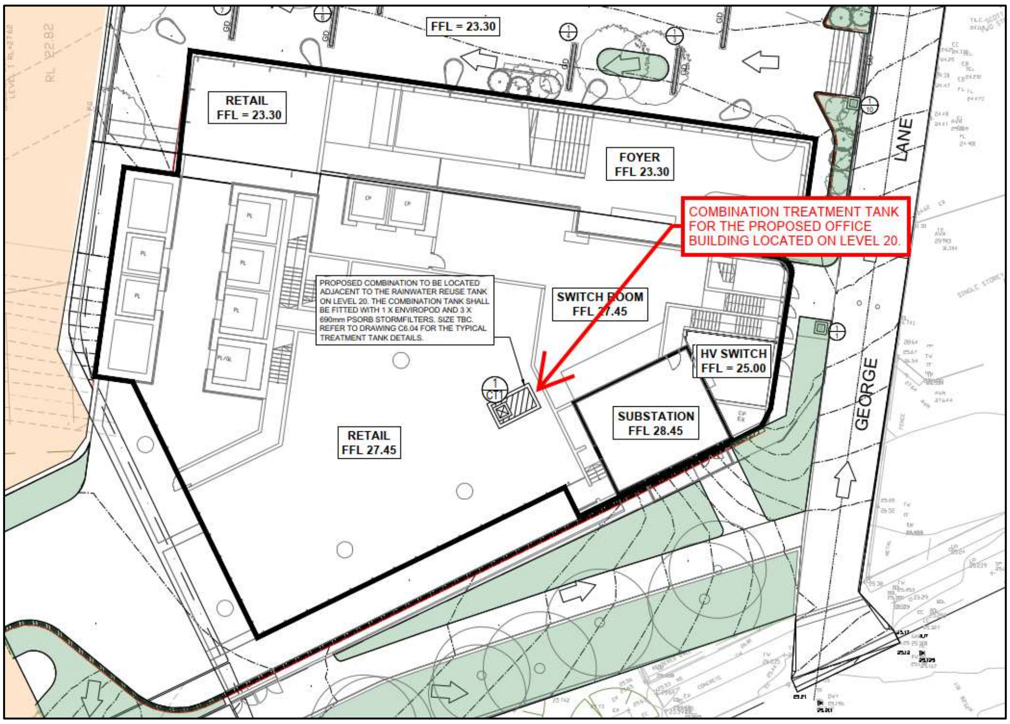


Figure 5.1: Location of the proposed combination treatment tank.

George Lane drains north towards Scott Street and stormwater runoff will be captured along the driveway by three (3) stormwater grate pits located on the western side of the George Lane in the proposed landscaped areas. The pits are to be connected via internal hydraulic drainage to the discharge treatment pit in the north east corner of the proposed development and than to be discharged to the existing kerb intel pit in Scott Street.

Stormwater runoff from all hardstand areas between Phase B Office building and Phase C Retail building to be captured by 8 (eight) x trench drains integrated in the pavement finishes. The grated drains will reticulate to a treatment pit located to the north west of the proposed development. Roof drainage for Phase B Office building and Phase C Retail building will be also connected to this pit. The treatment pit will discharge to the new V-grate pit located in Scott Street at IL 21.84. The new pit will intercept the existing DN375 stormwater pipe.

Refer to Figure 5.2 for the proposed stormwater layout.

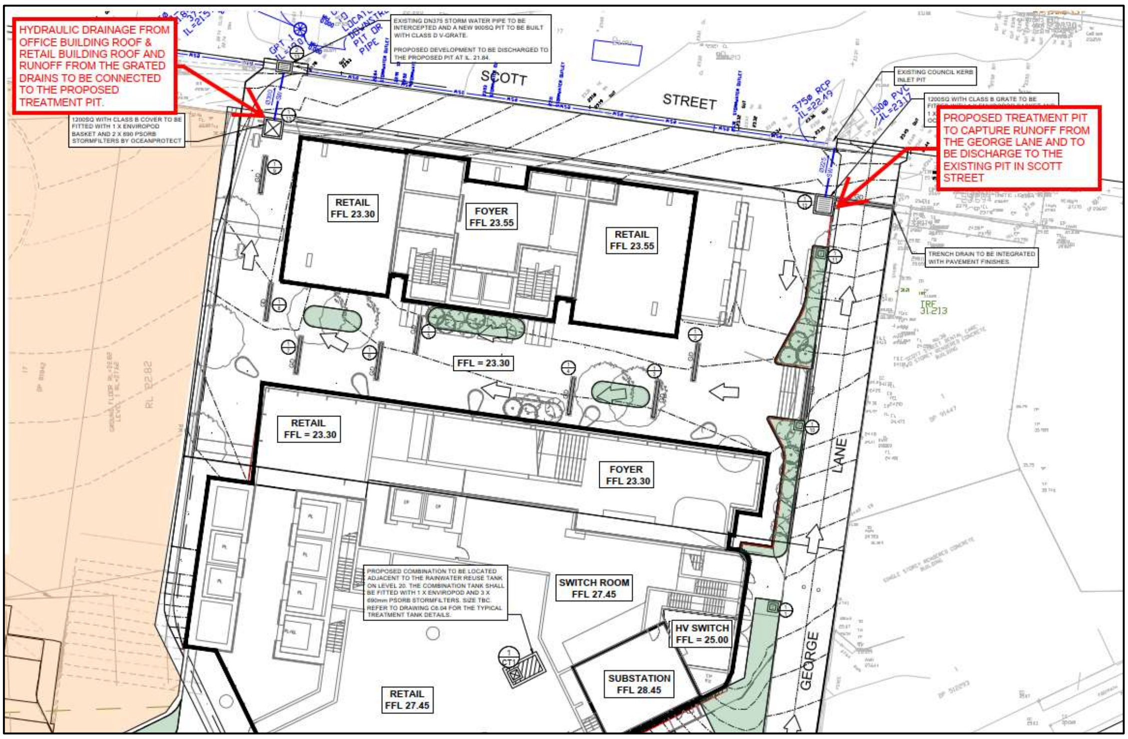


Figure 5.2: Stormwater Layout.

5.1 STORMWATER SYSTEM DESIGN

5.1.1 DRAINS INPUT PARAMETERS

The drainage system has been modelled utilising DRAINS to ensure the system is designed to meet Council and the ESD framework stormwater requirements. DRAINS is a stormwater drainage design and analysis program which performs hydraulic grade line analysis and generates the flows which would occur for a particular Annual Exceedance Probability (AEP) storm event.

The catchment characteristic factor values which have been used in the DRAINS model are summarised below:

- Paved (impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Soil Type - Normal 3.0
- Antecedent Moisture Condition (AMC) 3.0
- Minimum Pit Freeboard 300mm
- Blockage Factor for On-Grade Pits 20%
- Blockage Factor for Sag Pits 50%

5.2 RESULTS

The proposed development has been designed to ensure that the post development stormwater runoff from the total development area does not exceed the pre-development runoff. Refer to Table 5.2 for the development area's site discharge results.

Table 5.2: Development Area's Site Discharge Results

Scenario	50% AEP Storm Event (L/s)	20% AEP Storm Event (L/s)	10% AEP Storm Event (L/s)	5% AEP Storm Event (L/s)	2% AEP Storm Event (L/s)	1% AEP Storm Event (L/s)
Pre-Development	66	91	106	121	146	162
Post Development	64	88	106	119	146	161

6. WATER QUALITY REQUIREMENTS AND PROPOSED TREATMENT SYSTEM

In order to comply with Liverpool Council's requirements for the adequate treatment of stormwater runoff, treatment solutions have been provided to remove suspended solids, hydrocarbons, and nutrients prior to being discharged from site.

The pollutants that could potentially be generated as a result of the development are as follows:-

- Litter;
- Sediment;
- Nutrients (Phosphorus and Nitrogen), and;
- Hydrocarbons.

The development has been modelled to demonstrate the performance of the stormwater treatment system utilising a program called MUSIC. MUSIC models the proposed stormwater treatment devices and estimates their respective performance against the performance targets of the project. The pollutants modelled in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP), Total Nitrogen (TN), and Total Petroleum Hydrocarbons (TPH).

6.1 RAINFALL

A continuous simulation of ten (10) years was run with a six (6) minute time step. The time period for which the model was run is 1st January 1967 to 31st December 1976. The rainfall station utilised was 067035 Liverpool (Whitlam Centre).

The average potential evapotranspiration (PET) data used in the MUSIC model was based on the average Sydney PET and is presented in Table 6.1 below.

Table 6.1: Evapotranspiration Data for MUSIC Modelling

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm)	180	135	128	85	58	43	43	58	88	127	152	163

6.2 RAINFALL RUNOFF PROPERTIES

In accordance with the Draft NSW MUSIC Modelling Guidelines, dated August 2010, the following Table 6.2 and Table 6.3 presents the rainfall runoff properties which have been used in the MUSIC model.

Table 6.2: MUSIC Rainfall Runoff Properties

Parameter	Unit	Value
Impervious Area Parameters		
Rainfall Threshold	mm	1.0 (for roads/paths etc.) 1.5 (for roadways) 0.3 (for roofs)
Pervious Area Parameters		
Soil Storage Capacity	mm	120
Initial Storage Capacity	%	30
Field Capacity	mm	80
Infiltration Capacity co-efficient a		200
Infiltration Capacity co-efficient b		1.0
Groundwater Properties		
Initial depth	mm	10
Daily recharge rate	%	25
Daily base seepage rate	%	5
Daily seepage rate (%)	%	0

Table 6.3: Pollutant Concentration Parameters for MUSIC Source Nodes

Land Use Category		Concentration (mg/L-log_{10})					
		Total Suspended Solids		Total Phosphorus		Total Nitrogen	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
General Urban (incl public open space)	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Standard Deviation	0.32	0.17	0.25	0.19	0.19	0.12
Roofs	Mean	1.30	*	-0.89	*	0.30	*
	Standard Deviation	0.32	*	0.25	*	0.19	*

*Base flows are only generated from pervious areas; therefore these parameters are not relevant to impervious areas.

6.3 MUSIC MODEL CATCHMENT AREAS AND STORMWATER TREATMENT PLAN

The MUSIC model's total catchment area to be treated is 0.3010 Ha. Refer to Table 6.4 for a breakdown of the MUSIC model catchment areas.

Table 6.4: Breakdown of MUSIC Model Catchment

Catchment	Impervious (Ha)	Pervious (Ha)	Total Area (Ha)
George Lane, Main Ground & Hardstands	0.0917	-	**0.0917**
Roof North Building	0.0473	-	**0.0473**
Roof Office	0.1418	-	**0.1418**
Bypass	0.0178	0.0024	**0.0202**
Total Area	**0.2986**	**0.0024**	**0.3010**

The proposed site treatment will utilise two (2) different products by Ocean Protect: OceanGuard and 690mm PSORB Stormfilter.

The first level of treatment will include three (3) OceanGuards, which intercept surface water runoff at the pit grates and filter the runoff prior to entering the piped stormwater system. It is proposed that an Ocean Guard filter basket will be fitted in each of the two (2) 1.2m square treatment pits located north of the proposed development. An additional OceanGuard filter basket will be fitted in the combination treatment tank, located on Level 20 in Phase B Office building. The OceanGuard is fitted with a monofilament 200 micron pore size filter bag that removes gross pollutants such as sediment, trash and debris, as well as suspended solids. Please refer to Figure 6.1 below for an illustration of a typical Ocean Guard.

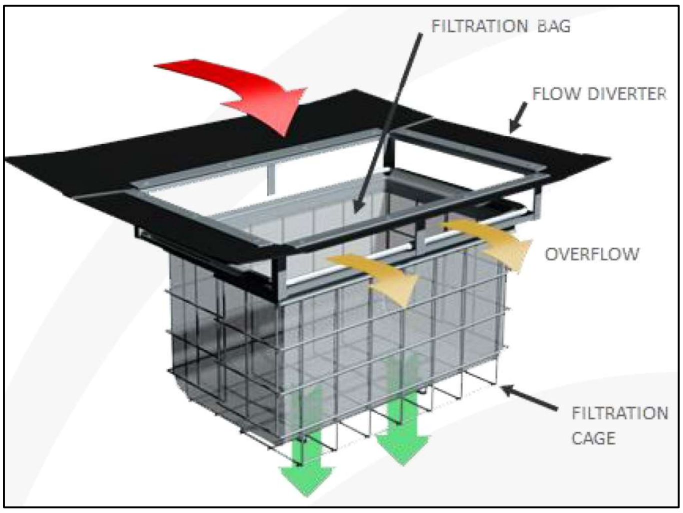


Figure 6.1: Typical OceanGuard Filter

The second treatment device to be utilised are the total number of six (6) 690mm PSORB StormFilters. There will be four (3) Psorb 690mm fitted in the combination tank (2.5 m long, 1.3 m wide and 1.35 m high), which will capture the roof water from the proposed Phase B Office building. There will be two (2) Psorb 690mm fitted in the 1.2m square treatment pit located in the north west corner of the Phase C building. There will be another one (1) Psorb 690mm fitted in 1.2m square treatment pit, located at the downstream end of George Lane.

A Psorb StormFilter cartridge system is provided to remove any remaining suspended sediments, hydrocarbons and nutrients which have entered the stormwater system. Please refer to Figure 6.2 below for an illustration of a typical Psorb StormFilter.

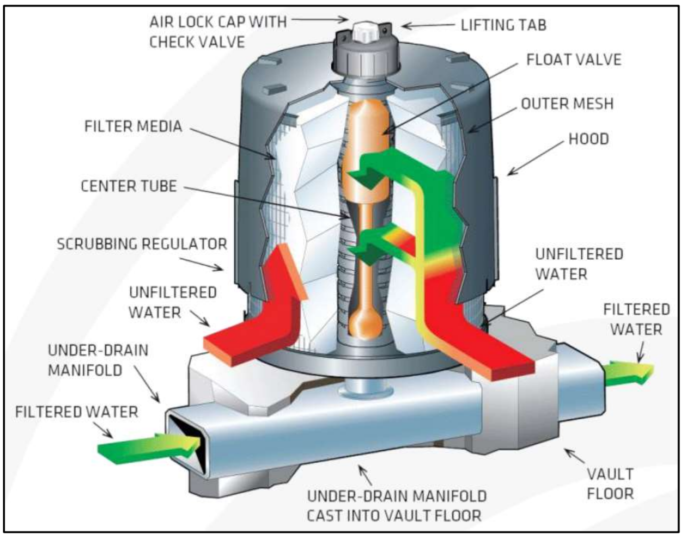


Figure 6.2: Typical PSorb StormFilter

6.4 MUSIC MODEL TREATMENT RESULTS

The stormwater quality treatment system has been modelled using the MUSIC software. Refer to Figure 6.3 for the treatment plan and Table 6.5 for the treatment results.

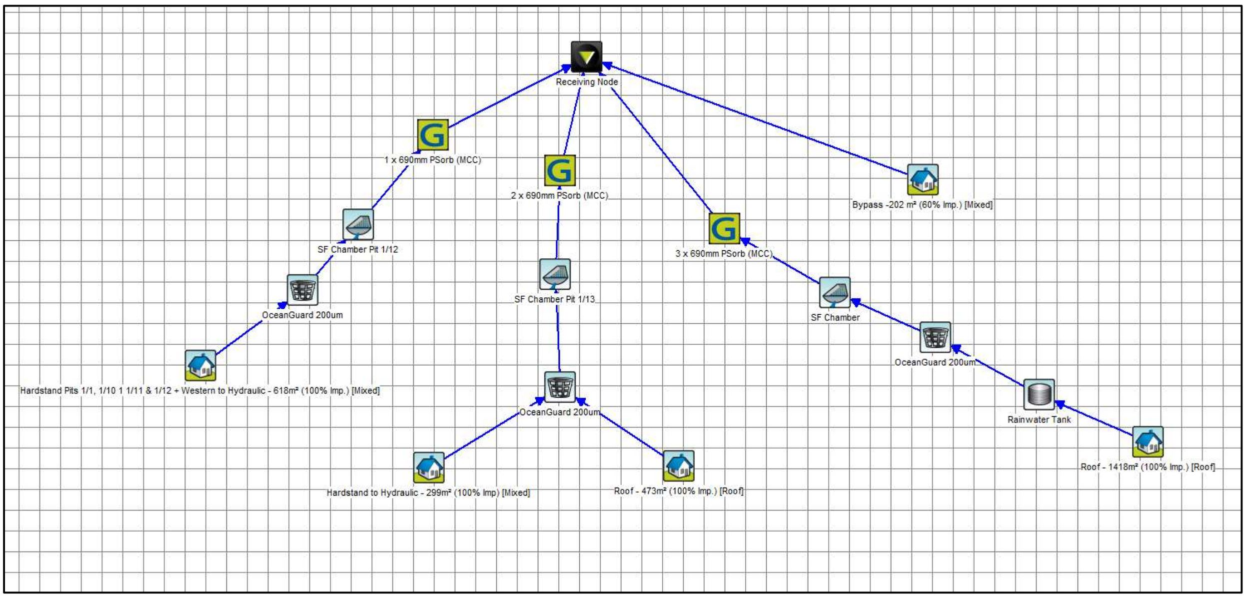


Figure 6.3: MUSIC Model Treatment Plan

Table 6.5: Percentage Based Load Reduction in Pollutant Results

Pollutant Type	Source (kg/yr)	Residual Load (kg/yr)	Reduction % Achieved	Target Reduction %
Gross Pollutants (GP)	64	3.09	**95.2**	**90**
Total Suspended Solids (TSS)	185	26.8	**85.5**	**85**
Total Phosphorus (TP)	0.469	0.0996	**78.7**	**65**
Total Nitrogen (TN)	5.18	1.62	**68.8**	**45**
TPH (kg/yr)	40	2.56	**93.6**	**90**
Free Oil (kg/yr)	39.9	2.44	**93.9**	**90**

As is demonstrated by the results, the development is achieving Liverpool Council's targets for pollutant load reduction. Refer to Schedule 5 for the MUSIC modelling results.

7. SEDIMENT AND EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the general requirements outlined below.

7.1 SITE PROTECTION MEASURES

It is proposed to provide the following in order to inhibit the movement of sediment off the site during the demolition and construction phases.

7.1.1 SITE ACCESS

Construction vehicles leaving the site shall be required to pass over a Temporary Construction Vehicle Entry consisting of a 1.5m long by 3m wide 'cattle rack'.

7.1.2 SEDIMENT CONTROL

All exposed earth areas where it may be possible for runoff to transport silt down slope shall be protected with a sediment and erosion control silt fence generally installed along the boundaries of the site.

The fence will be constructed in accordance with details provided by the Department of Conservation and Land Management incorporating geotextile fabric which will not allow suspended particles greater than 50mg/L non-filterable solids to pass through, and as such comply with the appropriate provisions of the Clean Waters Act 1970.

The construction of the silt fence will include the following:-

- Geotextile fabric buried to a maximum of 100mm below the surface;
- Overlapping any joins in the fabric, and;
- Turning up on the ends for a length of 1 metre in order to prevent volumes of suspended solids escaping in a storm event.

Please refer to Figure 7.1 for details.

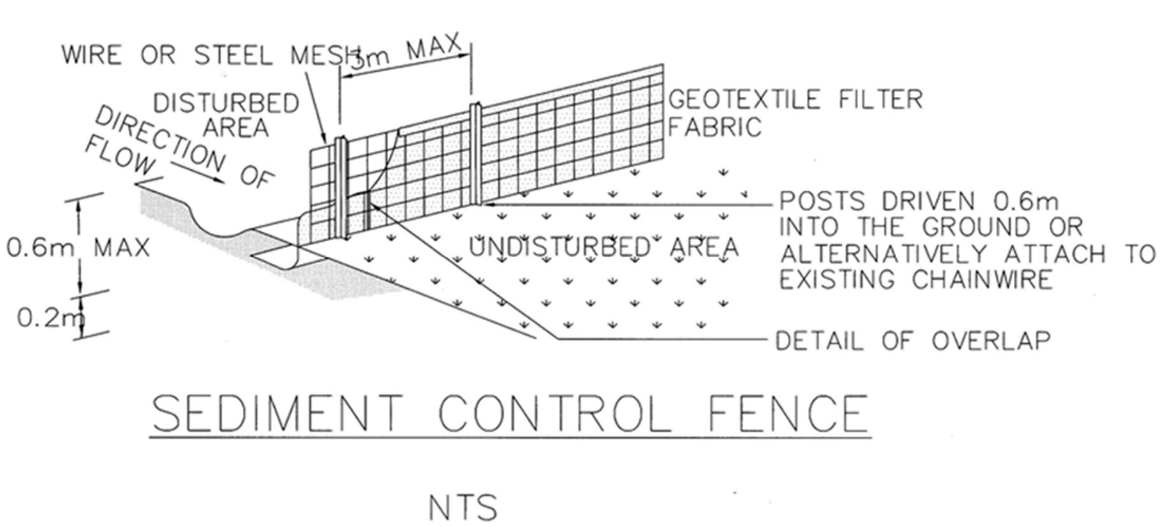


Figure 7.1: Sediment Control Fence Illustration

Existing stormwater infrastructure is also to be protected from incoming sediment using the following methods:

- Any Council owned road kerb entry and/or gully pits will be protected by Filter Bales and EcoSocks. Additional protection will be provided by inserting Water Clean Filter Cartridges into the gully opening, and;
- Internal site drainage pits shall be protected by Sediment Traps consisting of hay bales.

Please refer to Figure 7.2, Figure 7.3 and Figure 7.4 for details.

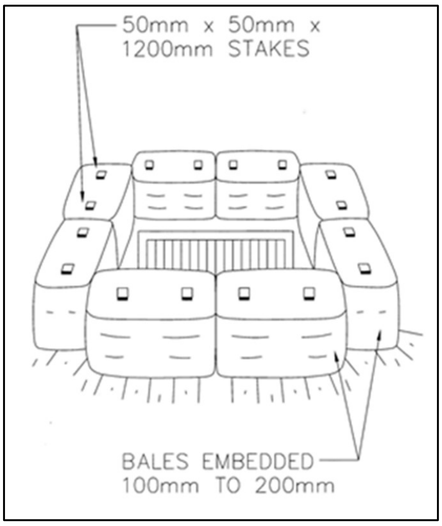


Figure 7.2: Stormwater Pit Sediment Trap (NTS)

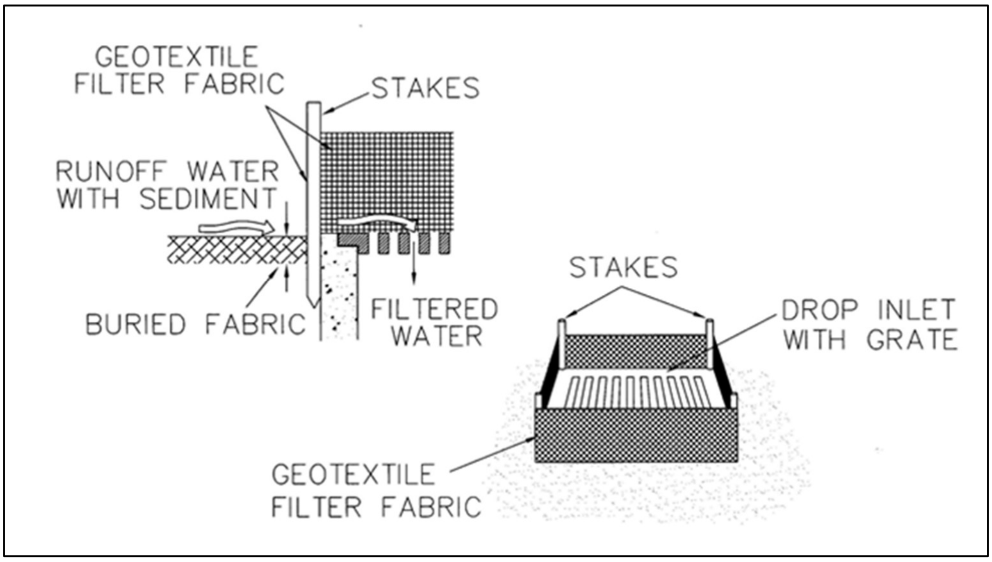


Figure 7.3: Geotextile Filter Fabric Drop Inlet Sediment Trap (NTS)

What are FilterBales?

Water Clean FilterBales are a unique new patented 7 stage sediment filter device developed to substantially reduce the migration of sediment and contaminants into drainage systems while allowing filtered water to easily pass through. FilterBales reduce customers' time and money by providing solutions to comply witht environmental and regulatory requirements.

Durable, Dependable, Reusable. Replacing hay bales and other inadequate attempts to stop sediment run-off, FilterBales are durable and re-useable, effectively stopping your money from "pouring down the drain". They are also lightweight and easy to handle. Replaceable Water Clean Filter Cartridges guarantee peak performance is maintained.

Ask your local FilterBales stockist about replacement frequencies in your area. Cartridges and filter covers should be changed when the infiltration rate decreases. Water Clean FilterBales are suitable for a wide range of sediment and water management situations and can be easily secured in place for long term use. The unique multi-directional filter system allows you to position Water Clean FilterBales in any direction without reducing performance.

Water Clean FilterBales can be fixed to concrete or bitumen surfaces using an epoxy mortar-binder or fixed to earth surfaces using 6-10 mm pegs or stakes. When positioning, the side with the red reflective marker should be facing traffic.

1. **FilterBales frames** are a perforated plastic structure made from recycled wheelie bins, battery cases, milk bottles etc.

2. **Filter medium** (bio engineered soil media) used in the filter cartridges is made from a special blend of recycled organic (RO) materials from kerbside and vegetation drop off centres. The RO hosts enhanced naturally occurring micro-organisms. The blend also contains natural minerals to capture nutrients. The filter medium is as safe as normal soil.

3. **FilterBales** have a seven (7) stage filtration system:

1. In through the filter bag
2. Through the perforated plastic structure wall
3. In through the filter cartridge bag
4. Through the bio engineered filter medium
5. Out through the filter cartridge bag
6. Out through the perforated plastic structure wall
7. Out through the filter bag

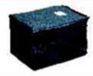
4. **The filter bag** is made from 300-micron (one third of a millimetre) pore size geotextile. This is the first stage that filters much of the sediment and other suspended solids from the run-off water. The geotextile is designed to stop sediment and reduce clogging but allow water to pass through easily. The filter cartridge bags are made from a similar geotextile.

5. **FilterBales** work effectively up to "a one-in-one-year 48 hours, 100 mm "storm events". This is the largest storm event experienced since the commercialisation of FilterBales. Having handled this easily, Filter Bales are considered capable of handling much greater "storm events". During these storm events FilterBales were used inside gully pits in one application and on the ground surrounding the gully pit in another application.

6. **EcoSocks** are made from a similar geotextile to the filter cartridge bags and contain the same bio engineered soil media as the FilterBales. They appear able to stand up to as much wear and tear as a sandbag.

7. **FilterBales** are much lighter (at around 15 kgs dry weight) than hay bales. This reduces exposure to Occupational Health and Safety problems

Product Range

Item No.	Description	
HFB001	**High FilterBale,** suitable for high flow situations and higher retention time applications. Contains two standard size WaterClean Filter Cartridges in upright formation to treat contaminated waters. (605mm x 485mm x 460mm)	
LFB002	**Low FilterBale,** suitable for low flow situations and kerb & gutter applications. Multi-directional module containing two standard size WaterClean Filter Cartridges. (605mm x 485mm x 220mm)	
ESF004	**Directional EcoSock,** can be used in conjunction with FilterBales to direct water. Will also provide some sediment filtration from seepage through bio-remediating media contained within the EcoSock (1135mm x 160mm x 30mm)	

Accessories

Item No.	Description	
FCR004	**WaterClean Filter Cartridges** contain a unique blend of fixating and bio-remediating products that treat common pollutants. To achieve maximum performance, each FilterBale uses two WaterClean Filter Cartridges. (440mm x 400mm x 100mm)	
HBC005 (High bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	
HBC006 (Low bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	

Figure 7.4: Erosion Control Filter Products

7.2 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained into a central holding well within the excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non Filterable Residues (NFR) is required to be achieved prior to discharge.

7.2.1 DUST CONTROL

The following dust control procedures will be adhered to:

- Loose loads entering or leaving the site will be securely covered by a tarpaulin or like material in accordance with RMS and local Council Guidelines.
- Soil transport vehicles will use the single main access to the site.
- There will be no burning of any materials on site.
- Water sprays will be used across the site to suppress dust. The water will be applied either by water sprinklers or water carts across ground surfaces whenever the surface has dried out and has the potential to generate visible levels of dust either by the operation of equipment over the surface or by wind. The watercraft will be equipped with a pump and sprays.
- Spraying water at the rate of not less than three (3) L/s and not less than 700kPa pressure. The area covered will be small enough that surfaces are maintained in a damp condition and large enough that runoff is not generated. The water spray equipment will be kept on site during the construction of the works.
- During excavation all trucks/machinery leaving the site will have their wheels washed and/or agitated prior to travelling on Council Roads.
- Fences will have shade cloth or similar fabric fixed to the inside of the fence.

7.2.2 MAINTENANCE

Generally, the following maintenance measures shall be adhered to during construction:-

- It will be the responsibility of the contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily and the appropriate maintenance undertaken as necessary.
- Prior to the closing of the site each day, the road shall be swept and materials deposited back onto the site.
- Gutters and roadways will be kept clean regularly to maintain them free of sediment.
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail;
- If fugitive emissions have the potential to cause the ambient as quality to foul the ambient air quality;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site; and,
- Materials processing equipment suitably comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks.

It is considered that by complying with the above, appropriate levels of protection are afforded to the site, the adjacent public roads, footpaths, and environment.

SCHEDULE 1 CONCEPT DA CONDITIONS & PRE-DEVELOPMENT APPLICATION MEETING MINUTES

ATTACHMENT A

CONDITIONS OF CONSENT TO CONCEPT DEVELOPMENT APPLICATION

A. GENERAL CONDITIONS

Approved Plans / Documents

1. Development the subject of this determination notice must be carried out strictly in accordance with the following approved plans / reports marked as follows, except where modified by the undermentioned conditions.

Plan Name	Plan Number	Date	Prepared By
Basement Envelope Plan	MP-002	2/05/2020	FJMT
Envelope Plan	MP-001	2/05/2020	FJMT
Envelope Section A	MP-005	2/05/2020	FJMT
Envelope Section B & C	MP-006	2/05/2020	FJMT
Envelope Perspective North	MP-003	2/05/2020	FJMT
Envelope Perspective South	MP-004	2/05/2020	FJMT
Envelope Perspective East	MP-007	2/05/2020	FJMT

Environmental Planning and Assessment Act 1979

2. In accordance with section 4.22(4) of the EP&A Act all development under the Concept Proposal must be subject of future application(s). This consent does not permit the carrying out of any works.

Land uses

3. This consent does not approve any residential land uses on the subject site.

Public Domain and Landscaping – Design Excellence

4. <u>A *Public Domain Design Panel* is to be convened and a Public Domain Plan prepared:</u>

   a) Prior to the determination of any Detailed DA subject to this Concept Approval, a detailed Public Domain and Landscape Plan must be prepared by a suitably qualified AILA Registered Landscape Architect or Urban Designer, in accordance with the requirements of this condition.

   b) A design review process is to be undertaken for the Public Domain and Landscape Plan with the purpose of achieving design excellence of the public domain in accordance with Clause 7.5 of Liverpool Local Environmental Plan 2008.

c) As part of the design review process, a *Public Domain Design Panel* is to be convened, that is to be chaired by the nominated chair of Council's Design Excellence Panel or his or her nominee, and whose other members are to include (at least):

- A representative of -or person nominated by Government Architect NSW;
- A suitably qualified landscape architect and urban designer;
- A representative of Liverpool City Council's City Design and Public Domain team.

d) At least two public domain design workshops are to be convened for attendance by members of the Public Domain Design Panel, the Applicant, and other relevant technical officers of Liverpool City Council which may include officers responsible for Heritage, Traffic, Public Art, Community Planning, Indigenous Culture and Heritage, and Community Development.

e) At the conclusion of the public domain design workshops, the *Public Domain Design Panel* is to record its recommendations.

f) The recommendations of the *Public Domain Design Panel* are to be incorporated into a Public Domain and Landscape Plan to be prepared by the Applicant.

g) The Public Domain and Landscape Plan is to be endorsed by the Chair of the Public Domain Design Panel as satisfactorily responding to the outcome of the public domain workshops, prior to the determination of any future Detailed DA under this Concept Approval.

5. The Public Domain and Landscape Plan is to:

a) Identify any landscape constraints, including (but not limited to) setbacks, existing street trees, landscape features, screening / buffer requirements

b) Include public domain design guidelines that are to be implemented across the subject site

c) Identify the location of public domain areas within the site, providing detail on their role, character and extent

d) Set aspirations and principles for each public domain area in order to achieve Design Excellence in accordance with Clause 7.5 of Liverpool Local Environmental Plan 2008

e) Identify the location of trees, planters, water sensitive urban design treatments, deep soil and direct sunlight to public domain areas

f) Detail design principles for roof terraces, including (but not limited to) how planting, deep soil, access and shade would be implemented

g) Identify any intended design elements such as green roofs and walls, water sensitive landscape design treatments and sustainability targets

h) Demonstrate consistency with the relevant landscape provisions of the Liverpool Development Control Plan 2008 and Liverpool City Centre Public Domain Master Plan

i) Demonstrate how the public domain areas will relate to proposed future built form within site, including consideration of pedestrian movements to and between buildings within the site

6. All future detailed Development Applications subject to this Concept approval will need to demonstrate to the consent authority consistency with the endorsed Public Domain and

Landscape Plan.

Traffic and Access

7. Prior to the determination of a Detailed DA, a Local Area Traffic Management Plan is to be submitted to Council's Traffic and Transport Section and to the Liverpool Pedestrian Active Transport and Traffic Committee for endorsement. The Local Area Traffic Management Plan is to identify traffic infrastructure improvements including changes to the adjoining traffic signals, signs, line markings and timed parking restrictions.

Transport for NSW Conditions

8. Future Detailed DAs subject to this Concept Approval shall comply with all conditions provided by Transport for NSW dated 12 August 2020. A copy of the conditions is attached to this decision notice (Attachment 1). Note: the conditions do not constitute a Section 138 concurrence under the Roads Act 1993.

B. CONDITIONS TO BE SATISFIED PRIOR TO THE SUBMISSION OF FUTURE DEVELOPMENT APPLICATIONS

Pre-Development Application Meeting

9. Prior to the submission of a development application which seeks approval for any detailed design of a building under this Concept Approval, a Pre-Development Application meeting is to be convened with representatives of Liverpool City Council. Advice of the subject Pre-Development application meeting is to accompany the development application when lodged.

Amended Plans

10. Prior to the lodgement of any Detailed DA subject to this Concept Approval, the plans outlined in Condition 1 must be amended to reflect the following:

    a. The extent of the building envelope titled ‘Masterplan Envelope – Information & Education Facility’ must be reduced to a maximum of 4 metres from the eastern edge of Lot 201 in DP 1224084, also known as 306-310 Macquarie Street (excluding any decorative architectural features above ground level). Evidence is to be provided to Liverpool City Council’s Manager Development Assessment that satisfactorily demonstrates the plans have been amended to reflect this condition.

C. CONDITIONS TO BE SATISFIED IN FUTURE DEVELOPMENT APPLICATIONS

Building Envelopes

11. Built form proposed in any future Detailed DA subject to this Concept Approval is not permitted to extend beyond the building envelopes approved under DA-585/2019.

12. Any built form proposed within the building envelope titled ‘Masterplan Envelope – Information & Education Facility’ must incorporate the following requirements:
    a. Floors facing the north western façade of the existing mixed-use building at 300 Macquarie Street, Liverpool, are to incorporate design features that limits overlooking into existing residential areas.

Public Domain and Landscaping – Design Excellence

13. All future detailed Development Applications subject to this Concept Approval are to demonstrate consistency with an endorsed Public Domain Plan, detailed in Conditions 4 and 5.

Stormwater Management

14. A concept stormwater drainage system must be designed to ensure that stormwater runoff from upstream properties is conveyed through the site without adverse impact on the development or adjoining properties.

15. Engineering plans and supporting calculations for the stormwater drainage system are to be prepared by a suitably qualified engineer and shall accompany the application for a Construction Certificate.

16. The stormwater drainage system for the basement car park is to be designed in accordance with the requirements for pumped systems in AS3500.3:2003 and Council’s Stormwater Drainage Design Specifications for pump out systems in basement carparks.

17. A stormwater pre-treatment system shall be incorporated on the proposed stormwater plans and that the design meets pollutant retention criteria in accordance with Council’s Development Control Plan.

18. On site water quality treatment facilities shall be provided to ensure that stormwater runoffs leaving the site comply with Council’s water quality standards. The treatment facilities shall capture all gross pollutants and liquid contaminants from the stormwater before discharging it to downstream. Water quality treatment works shall be designed using MUSIC modelling software and the water quality treatment system performance shall be verified using Council’s MUSIC link.

19. The below pollutant reduction targets are to be satisfied:

    45% reduction in the baseline annual pollutant load of total nitrogen (TN);
    65% reduction in the baseline annual pollutant load of total phosphorous (TP);
    85% reduction in the baseline annual pollutant load of total suspended solids TSS); and
    90% reduction in the baseline annual pollutant load of litter and vegetation larger than 5mm (gross pollutants).

Planting Schedule

20. A full planting schedule details and specifications are to be provided including planting details and specifications, maintenance, planting pits, pots and structural elements to be certified by an appropriately qualified person where appropriate.

Social Impact Assessment

21. A comprehensive social impact assessment (CSIA) is to be submitted in accordance with Liverpool City Council's *Development Control Plan 2008* and Social Impact Assessment Policy.

Heritage Considerations

22. The Lachlan Macquarie Statue on the corner of Scott Street and Macquarie Street is to be retained at its existing location.

Traffic and Access

23. Revised Traffic Impact Assessment (TIA) reports are to accompany future Detailed DAs for the site. The revised TIAs are to include the following:

    - Updated SIDRA analysis using traffic generation rates in the TfNSW Guide (1.6 and 1.2 vehicular trips per hour per 100m2 GFA during the morning and afternoon peak period, respectively) for the 'Developer Buildings' component, at the minimum, to understand the traffic impact of the development under an alternative scenario.

    - Endorsed vehicular access arrangements – The revised reports are to outline and provide details of the endorsed left in/left out access arrangement off Terminus Street addressing all the requirements contained in the letter from TfNSW to Council in Attachment 1 of this consent.

    - Allocation of car parking spaces - information regarding the allocation of car parking spaces to the various land uses, including adequate provisions for bicycle and motorcycle parking in the revised TIA.

24. Car parking provision – future Detailed DAs are to provide car parking provisions in accordance with the car parking rates set out in the Liverpool LEP 2008 and Liverpool DCP 2008 as well as provide for the replacement of the existing public car parking spaces at the site as outlined in the TIA, as prepared by PTC, dated 22 April 2020.

25. Detailed design drawings of the driveways, ramps, aisles, loading bays and parking spaces, as well as for swept path analysis, footpath paving, street lighting, sign and line marking scheme, demonstrating that the design has been carried out in accordance with RMS Guidelines, DCP and AS: 2890 is to be submitted to Council with the detailed development applications.

26. The drawings must be certified by a qualified traffic engineer and are to comply with the requirements of the DCP and Australian Standards in relation to the Terminus Street access.

27. A Travel Plan that contains specific measures to promote the use of more sustainable modes of travel including walking, cycling, public transport and car sharing are to be submitted as part of any future Detailed DA.

Urban Design Considerations

28. Provide a footpath design that ensures pedestrian priority along Scott Street. The pavement design at driveway locations must include:
    a. The design of the driveway must be delivered with Granite pavement in 100x100mm sets (refer to Figure 6.254, page 268, Liverpool City Centre Master Plan)
    b. The driveway is to be designed flush with the pedestrian pavement along Scott Street and only demarcated by the change in pavement
    c. The pedestrians have priority over vehicle movements. And the space must be demarcated as such

29. Weather protection is required to be provided along Scott Street (east of the driveway access) to allow pedestrian movements along the street in all-weather situations. Street trees must be provided and designed into the street awning.

30. Include sun-shading and façade treatments are functional in reducing heat-gain from sun exposure.

Wind Study

31. Any future development application is to be accompanied by a wind report prepared by a suitably qualified consultant. Wind tunnel testing and mitigation measures are to be provided as part of the wind study, with consideration of wind impacts on public areas and roof gardens.

Acoustic Report

32. Any future development application is to be accompanied by an acoustic report prepared by a suitably qualified acoustic consultant that demonstrates compliance with the relevant provisions of the State Environmental Planning Policy (Infrastructure) 2007, as well as consideration of impacts on surrounding sensitive receivers.

Contamination

33. The Preliminary Site Investigation prepared by Douglas Partners, dated April 2019, submitted with the application has identified asbestos contamination on the site. Any future Detailed DA subject to this Concept Approval that proposes excavation requires a Stage 2 – Detailed Site Investigation to fully delineate the contamination issues prior to the preparation of a Remediation Action Plan. The relevant assessments are to be undertaken by a suitably qualified and experienced contaminated land consultant with regard to the potential effects of any contaminants on public health, the environment and building structures and shall meet the sampling density outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995).

Sydney Water

34. Future Detailed DAs subject to this Concept Approval shall comply with the advice provided by Sydney Water dated 26 June 2020. A copy of the advice is attached to this decision notice (Attachment 2).

ATTACHMENT 1 – Transport for NSW conditions

12 August 2020

TfNSW Reference: SYD19/00516/09
Council Reference: DA-585/2019

The General Manager
Liverpool City Council
Locked Bag 7064
LIVERPOOL NSW 1871

Attention: Boris Santana

Dear Sir/Madam

CONCEPT FOR PROPOSED MIXED-USE DEVELOPMENT KNOWN AS LIVERPOOL CIVIC PLACE – 52 SCOTT STREET, LIVERPOOL

Reference is made to Council's correspondence dated 10 August 2020, regarding the abovementioned application which was referred to Transport for NSW (TfNSW) for comment.

TfNSW has reviewed the submitted application and in principle raises no objection to the abovementioned concept plan. It should be noted this is not a Section138 concurrence under the *Roads Act 1993*. Concurrence would be provided following review and approval of detailed design plans received in subsequent applications. Any concurrence provided would be subject to the following conditions:

1. Access from Terminus Street will be limited to a maximum of 202 spaces and segregated from the total underground parking.

2. Access from Terminus Street is to be a left in / left out movement. A median is to be installed along Terminus Street to physically restrict right turn movements into and out of the driveway. The median is to cover the full length of the driveway.

3. The proposed road works (median and lane widths) along Terminus Street shall be designed and constructed to meet TfNSW requirements, and endorsed by a suitably qualified practitioner. The design requirements will be in accordance with AUSTROADS and other Australian Codes of Practice. The certified copies of the civil design plans shall be submitted to TfNSW for consideration and approval prior to the release of the Construction Certificate by the Principal Certifying Authority and commencement of road works.

4. Redundant driveways along Terminus Street shall be removed and replaced with kerb and gutter to match existing. The design and construction of the kerb and gutter shall be in accordance with TfNSW requirements.

5. The developer will be required to enter into a Works Authorisation Deed for the abovementioned works.

6. The largest vehicle to use this site shall be no bigger than 9.9m.

7. Detailed design plans and hydraulic calculations of any changes to the stormwater drainage system arte to be submitted to TfNSW for approval, prior to the commencement of any works. Documents should be submitted to Development.Sydney@rms.nsw.gov.au.

8. TfNSW has previously vested a strip of land as road along the Terminus Street frontage of the subject property, as shown by grey colour on the attached Aerial - "X"

   The subject property is affected by a Road Widening Order under Section 25 of the Roads Act, 1993 as published in Government Gazette No. 22 of 5 February 1960; Folio 353, as shown by pink colour on the attached Aerial- "X" and DP 446163.

   The subject property is also affected by an additional road proposal as shown by pink colour on the attached Aerial - 'Y"

Any new buildings or structures, together with any improvements integral to the future use of the site, are erected clear of Terminus Street boundary, land reserved for road widening and land required for road (unlimited in height or depth).

In addition, the subject property is also within a broader investigation area to look at options to upgrade Macquarie and Terminus Streets at this location. The investigations have not yet advanced to the stage where options have been defined and accordingly it is not possible at this date to identify if any part of the subject property would be required to accommodate this proposal however it is likely that the frontage· of the site may be impacted.

If you have any further questions, Sandra Grimes, Development Assessment Officer, would be pleased to take your call on (02) 9563 8651 or please email development.sydney@rms.nsw.gov.au. I hope this has been of assistance.

Yours sincerely

Pahee Rathan
Senior Land Use Assessment Coordinator


"X"
11
DP20730
1
DP214769
MEMORIAL AVE
MACQUARIE ST
SCOTT ST
201
DP1224084
2
DP229979
3
DP229979
100
DP877435
UNDER INVESTIGATION REFER ALL ENQUIRIES TO
NETWORK SYDNEY (MARIA SWALLOW) (03/04/2018)
200
DP1224084
1
DP507070
1
DP512293
1
DP229979
TERMINUS ST
100
DP1079650
11
DP1161981
1
DP75990
14
DP13536
13
DP13536
101
DP1079650
NAGLE ST
PIRIE ST
SPEED ST
SP8626


"Y"
SP67703
11
DP20730
4
DP214769
1
DP214769
MEMORIAL AVE
MACQUARIE ST
SCOTT ST
201
DP1224084
2
DP229979
17
DP81842
3
DP229979
UNDER INVESTIGA
NETWORK SYDNEY
200
DP1224084
1
DP507070
22
DP441010
23
DP441010
1
DP229979

ATTACHMENT 2 – Sydney Water advice

Sydney WATER

26 June 2020 Our Ref: 181695

Ian Stendara
Exec Strategic Officer
Liverpool City Council
stendarai@liverpool.nsw.gov.au

RE: Liverpool Civic Place – 40-46 Scott Street, Liverpool – DA-585/2019.

Dear Mr Stendara,

Thank you for providing Sydney Water additional information for Concept DA 585/2019, a new mixed-use precinct known as Liverpool Civic Place.

Sydney Water wrote to Liverpool Council in December 2019 to advise Council that water servicing is **available**, however the developer will be required to amplify the existing reticulation system to meet the Sydney Water guideline based on development type and building height.

Sydney Water also advised in December 2019 that the development is within the catchment of a potential **future sewer lead in main** (to be situated along Macquarie Street) and we advised that there would be a significant timeframe (around 18months) involved to finalise the design and construction of this main once approved.

We also noted the potential risk to existing Sydney Water assets within the area and requirements to protect these. A copy of this letter is attached for reference.

We have now reviewed the additional staging and flow information from Liverpool Council and provide the following further advice:

- Flows from the proposed development exceed the capacity of the existing wastewater main, therefore the current wastewater network is unable to service the proposed development. The second main is required to service the development and enable connections.
- The Design for the second main is complete however, funding approval is required to progress the project. Funding approval is based on the **confirmed need** for new infrastructure and also the **anticipated timescale** for delivery.
- SWC will only progress with the second main when Council provide **confidence** that the proposed project will occur. Continued discussion will be required to ensure that as the Council's planning progresses, Sydney Water are given as much notice as possible with regards to project status updates, any changes to yields OR anticipated timescales, to ensure as much synergy as possible with our internal approval and construction timescales.
- **Therefore, in support of the above, we advocate that a Feasibility application is lodged with Sydney Water to ensure we fully assess the development requirements and understand Council's timescales for when water and wastewater will be required. This will also start the process for the protections of SW assets in the vicinity.**

Sydney WATER

This advice is not a formal approval of our servicing requirements. The developer will need to engage a Water Servicing Coordinator (WSC) to lodge a Feasibility application.

Sydney Water are keen to collaborate with Council to ensure the best servicing outcomes are identified as early as possible and to align delivery to meet development timescales. If you require any further information, please contact the Growth Planning Team on **urbangrowth@sydneywater.com.au** or your account manager, Sean Pracey via email: **Sean.Pracey@sydneywater.com.au**

Yours sincerely,

Kristine Leitch
Growth Intelligence Manager

CC: Boris Santana email: santanab@liverpool.nsw.gov.au

architectus™

10 September 2020

Built Group
C/o Ethos Urban
7/343 George Street
Sydney NSW 2000

Architecture
Urban Design
Planning
Interior Architecture

To: Luke Feltis

Liverpool Civic Place (52 Scott Street, Liverpool)

Pre-Lodgement Review – Stage 1 Detailed DA

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Dear Luke,

Architectus has been engaged by Liverpool City Council ('Council') to undertake the independent assessment of the proposed mixed-use development at Liverpool Civic Place.

This letter provides an overview of comments and key issues identified by Architectus and Council technical officers following a review of the Liverpool Civic Place (Stage 1 Detailed DA) Pre-Lodgement package presented by Built Group (the applicant) and the project team on 19 August 2020. The Pre-Lodgement package was reviewed by the following Council departments:

- Environmental Health
- Urban Design
- Economic Development
- Community Planning
- Heritage
- Traffic
- Development Engineering
- Flooding

The issues and comments presented in this letter should be further considered or resolved prior to lodgement of the DA to Council.

1. Background

The development subject to the Pre-Lodgement review is for the proposed Stage 1 Detailed DA for Liverpool Civic Place, which encompasses the western half of the subject site, and includes:

- Public Domain including a new civic square (approximately 1,000 sqm in area)
- Liverpool City Library (approximately 5,000 sqm GFA)
- Commercial Tower (approximately 17,500 sqm GFA), including:
  - Childcare facility (90 places)
  - Council customer service centre
  - Council chambers
  - Council offices
  - Office lease

Architectus Group Pty Ltd
ABN 90 131 245 684

Nominated Architect
Managing Director
Ray Brown
NSWARB 6359

It is noted that the proposed Stage 1 Detailed DA is subject to the Concept DA for the site (DA-585/2019), which was considered for determination by the Sydney Western City Planning Panel

(SWCPP) on 31 August 2020, and is currently pending finalisation by the SWCPP. The Concept DA proposed land uses, maximum building envelopes and vehicular site access points for the site. The Stage 1 Detailed DA will be subject to a Concept DA approval for the site and conditions of consent.

A Pre-Lodgement meeting with the applicant and Liverpool City Council's Design Excellence Panel (DEP) was held separately on 20 August 2020. The DEP has noted the proposal is supported and that all recommendations of the DEP are addressed and incorporated in the DA. Refer to Design Excellence Panel Minutes appended at **Attachment A**.

2. Comments and key issues

a) Terminus Street vehicular access

The proposed Terminus Street vehicular / basement access point has been shifted west, away from the pocket park named 'Upper Civic Plaza'. This is generally supported as this limits the interface between key public domain on the site (the pocket park and through site link) and the Terminus Street basement entrance, enabling further opportunities to improve pedestrian amenity along this frontage and potentially reducing conflicts between pedestrians and vehicles entering the basement.

It is noted, however, the following issues for further consideration and / or action by the applicant:

- The proposed Terminus Street basement access is now located at a closer distance to the Terminus / Pirie Street intersection. Agreement from Transport for NSW would be required for the proposed location of the basement access from Terminus Street.
- It is noted that any variances from an approved Concept DA would require a S4.55 modification of that approval. This applies to the proposed location of the Terminus Street access, if it is not proposed in the same location indicated on the stamped plans of the Concept DA.

b) Public car park

The public car park accessible from Terminus Street needs to ensure that it has appropriate access separation from the private car park(s) servicing the remaining uses on the site. This is to ensure alignment with Transport for NSW's agreement of supporting the vehicular access point from Terminus Street as part of the assessment of DA-585/2019. Detailed basement plans and supporting documentation are to be provided with DA lodgement, demonstrating how vehicular access will be separated and managed between the public and private car parks.

The proposed number of public car parking spaces should be consistent with the number of existing public car parking spaces on site.

c) Wind impacts

To enable a rigorous assessment of wind impacts, the DA is to provide a detailed assessment of potential wind impacts on the public domain, building entrances and roof top gardens. Wind tunnel testing and mitigation measures are to be provided as part of the wind study, with particular consideration of wind impacts on the proposed civic plaza, the Terminus Street pocket park and Augusta Cullen Plaza.

d) Lot consolidation

It is noted that the area subject to the proposed Stage 1 Detailed DA should be appropriately consolidated into a single lot.

e) Terminus Street ground floor interface

Based on the Upper Ground floor plan presented in the Pre-Lodgement package, it appears that the building frontage to Terminus Street primarily consists of plant, services and basement entrance. While it is acknowledged that there are limitations to the interface along this frontage, the DA should demonstrate how a high level of pedestrian amenity can be achieved along Terminus Street. Detail of the public domain approach to Terminus Street should be provided with further consideration of public domain treatments, landscaping, green infrastructure and public art.

f) Urban design

The following urban design matters are to be considered:

- Review the Library entrance to increase the civic nature of the building entry.
- Investigate options for including brick as the contrasting pedestrian pavement within the plaza area. Further consider brick elements as part of the furniture suite within the plaza.
- Confirm that *Lagerstroemia* (Crepe Myrtle) as proposed within the plaza off Scott Street (near the driveway entry) is of a scale appropriate to the building and achieves the desired design outcome.
- Ensure adequate soil and drainage is provided to the sunken courtyard.
- Ensure use of Aboriginal elements (e.g. plant and tree species that have special uses) in the plaza and building design are designed and agreed through collaboration with the local Aboriginal elders to ensure approval and meaningful integration is achieved.
- Review the layout of the Terminus Street pocket park and ensure it is a comfortable space for pedestrians to move through.
- Ensure wind movements do not negatively impact pedestrians within the plaza. Consider tree planting or building design elements to minimise impacts if required.
- Confirm solar access and views are appropriate with the extent of glass in the building façade.
- Strongly support the further development of the art / interpretation elements.

g) Traffic

The applicant is requested to submit a Traffic Impact Assessment (TIA) report addressing the traffic and parking issues associated with Stage 1 development, including:

- Allocation of parking spaces to the various land uses and access arrangements.
- Proposed traffic management plan to assist access to the site. It is to be noted access off Scott Street and Terminus Street are to be restricted to left in / left out only.
- Swept path analysis incorporating the comments made by PTC on the draft presentation (for the pre-DA) and certification by independent qualified professional that the access, ramp and parking areas are designed in compliance with the requirements of Council's DCP and Australian Standards.
- Public transport and other sustainable modes of travel.
- Proposed Travel Plan for the site to support sustainable modes of travel to the site and reduce dependence on single occupant vehicle travel.
- The application must demonstrate that access, car parking and manoeuvring details comply with AS2890 Parts 1, 2 & 6 and Council's Development Control Plan.
- The application shall be supported by turning paths in accordance with AS2890 clearly demonstrating satisfactory manoeuvring on-site and forward entry and exit to and from the public road.

h) Heritage

The applicant is to include a Statement of Heritage Impact addressing materiality, and the relationship between the new development and the School of Arts heritage building.

i) Flooding

Water Sensitive Urban Design / on site water quality treatment trains shall be incorporated in the stormwater design. Water quality treatment works shall be designed using MUSIC modelling software and the water quality treatment system performance shall be verified using Council's MUSIC link.

j) Development engineering

Stormwater

- Stormwater drainage for the site must be in accordance with Council's Development Control Plan.
- A detailed stormwater concept plan shall be submitted with the application.
- The stormwater concept plan shall be accompanied by a supporting report and calculations including relevant DRAINS digital model. (Note: Onsite Detention is not expected to be required give the existing site coverage).
- The proposed basement car park shall ensure that the stormwater drainage system has been designed in accordance with the requirements for pumped systems in AS3500.3:2003 and Council's Stormwater Drainage Design Specifications for pump out systems for basement carparks.
- A water quality treatment device shall be provided in accordance with Council's Development Control Plan. A MUSIC model shall be submitted with the development application.

Earthworks

- No retaining walls or filling is permitted for this development which will impede, divert or concentrate stormwater runoff passing through the site.
- Earthworks and retaining walls must comply with Council's Development Control Plan.

Roadworks and Road Reserve Works

- The development will require the following external road works:
  - Footpath treatment works in accordance with Council current specifications and requirements.
  - Stormwater Drainage connections and upgrades with Council's road reserve.

k) Economic development

The DA is to address Council's City Activation Strategy, with commentary on how the development will contribute towards the achievement of an 18-hour economy in the CBD.

The CBD Retail study provides guidance on various precincts throughout the CBD. The applicant is advised to address the recommendations found in this study.

Council's Destination Management Plan (DMP) also has a vision for Liverpool to be 'A place locals are proud to call home; celebrating and sharing our diversity, heritage and nature', containing five key strategic directions which are: promote, support, celebrate, attract and leverage. The applicant is encouraged to therefore consider and respond to the DMP's underlying ethos of 'loving local', by exploring how the development, in particular any retail opportunities, can support local businesses and offerings that are reflective of Liverpool's cultural diversity and dynamic demographic make-up.

Liverpool has a range of specific cultural characteristics that set it apart from other LGAs in Greater Sydney. There is already a significant "visiting friends and relatives" market in Liverpool and a growing medical and business visitors market. Such unique characteristics should be leveraged, expanded, and celebrated, in any new development in the city centre.

Liverpool Civic Place will be a key location for city activations and will "secure" the southern end of the CBD. The proponent provides opportunity for passive and programmed activation of the space. This includes providing flexible furniture that can be moved when programming events in the different spaces on offer, which is supported. The City Economy Unit though suggests a considered and proactive approach to addressing Council's ambitions for an activated and vibrant 18-hour city centre. The applicant is encouraged to explore ways that the development can be activated through the following additional specific means:

- Consider innovative design that actively invites the public into semi-private/public spaces. i.e. integrating enhanced greenery (i.e. less pavers, more grass and ground cover), more plantar boxes with edible gardens or public art.
- Programs of events and activities that will attract local workers and students and make use of the area.
- Provide for a mix of retail offerings (reflecting the recommendations in the Retail Study) that have extended trading hours and are planned to activate the night-time economy, whilst being sensitive to residential receivers in proximity of the Civic Place.
- A view to collaborating with neighbouring developments and retailers to activate the entire precinct and improve linkages throughout the city centre.
- Reconsider design of the Pocket Park to allow for it be fully activated and utilised. The current design/location of Pocket Park could potentially lead it to becoming just a thoroughfare or used for unwanted activities. The proponent could consider how the space could be activated perhaps with two to three shipping containers or kiosks, which could be occupied by social enterprises, not for profits or creative businesses. The space would then provide a unique visitor experience and offering. The space and offerings could also complement the activations at the main Civic Plaza and Augusta Cullen Plaza and add to the ambience and potential for local pop up market type activity.
- Multiple strategic power locations and accessibility to power should be identified, to allow for activations and larger temporary events to occur on the site.
- Any planned permanent movie screen is discouraged but opportunity for temporary projections is supported. i.e. There is already an existing screen in Macquarie Mall which costs Council money to maintain. If a screen is to be included, maintenance and programming budget for the screen must be accounted for.
- A "Maker's Space" could be considered in the library area, to attract creative businesses, entrepreneurs and artists to engage and contribute to the creativity, business development potential and vibrancy of the precinct.
- No smoking is suggested for in the whole precinct, to ensure it is a place which is welcoming to all workers, families and community members.
- Increase grassed areas in the Scott Street Square to allow for more passive activation and be a more inviting location for recreational activity.
- Storage areas for moveable furniture and other event infrastructure needs, should be considered in the design of the library and/or the civic building.

l) Environmental health

<u>Acoustic Assessment</u>

The proposed development may be a source of offensive noise and potentially impact upon human health and amenity. An acoustic report shall be prepared by a suitably qualified acoustic consultant in accordance with the NSW Environment Protection Authority's (EPA) 'Noise Policy for Industry' (2017), with consideration for the Noise Guide for Local Government (2013) (including Noise Guide for Local Government Update: Changes arising from the noise control Regulation 2017 (2018)) published by the NSW EPA. The cumulative effect of noise must be considered when assessing the impact upon receivers.

As part of the proposed development and ongoing use of the site, several activities that are likely to create offensive noise will be occurring. The suitably qualified acoustic consultant must consider, however not limit the assessment to, the following activities;

- Use of the amphitheatre for events/ markets, as well as media screenings/ weekend events (with consideration for the Liverpool City Council City Activation Strategy 2019-2024)
- Increased traffic generation
- Construction noise
- Outdoor dining (if applicable)

When assessing noise levels at commercial or industrial premises, the noise level shall be determined at the most affected point on or within the property boundary. Alternatively, when gauging noise levels at residences, the noise level shall be assessed at the most affected point on or within the residential property boundary. Where necessary, sound levels shall be adjusted in accordance with NSW Environment Protection Authority's guidelines for tonality, frequency weighting, impulsive characteristics, fluctuations and temporal content.

Construction Noise Assessment

A site-specific Construction Noise, Vibration Assessment and Management Plan prepared by a suitably qualified acoustic consultant is required to be submitted. The Construction Noise, Vibration Assessment and Management Plan must include an assessment of expected noise impacts and detail feasible work practices to be adopted to avoid, remedy or mitigate construction noise and vibration impacts.

The Construction Noise, Vibration Assessment and Management Plan shall be consistent with the 'Interim Construction Noise Guideline' published by the Department of Environment and Climate Change NSW (DECC 2009/265) dated July 2009 and include, but not necessarily be limited to the following information:

- Identification of nearby residences and other noise sensitive land uses;
- Assessment of expected noise impacts;
- Detailed examination of feasible and reasonable work practices that will be implemented to minimise noise impacts;
- Strategies to promptly deal with and address noise complaints;
- Details of performance evaluating procedures (for example, noise monitoring or checking work practices and equipment);
- Methods for receiving and responding to complaints about construction noise;
- Procedures for notifying nearby residents of forthcoming works that are likely to produce noise impacts; and
- Reference to relevant licence and consent conditions.

Road Traffic Noise

Road traffic noise impacts are to be assessed in accordance with the NSW Environment Protection Authority's 'Noise Policy for Industry' (2017) and 'NSW Road Noise Policy' prepared by the Department of Environment, Climate Change and Water NSW (DECCW NSW) dated March 2011. The project noise trigger levels for the proposed development shall be selected according to the most stringent intrusive or amenity criteria. If required, recommendations and noise control measures shall be specified to achieve compliance with the assessment criteria.

Where applicable, consideration must be given to Sections 87 and 102 of State Environmental Planning Policy (Infrastructure) 2007 and Department of Planning's 'Development Near Rail Corridors and Busy Roads– Interim Guideline' dated December 2008. The proposed development may generate additional traffic and affect existing residential or other noise-sensitive land uses. Therefore, road traffic noise impacts may need to be assessed in accordance with the 'NSW Road Noise Policy' prepared by the Department of Environment, Climate Change and Water NSW (DECCW NSW) dated March 2011.

Centre-Based Child Care Facility

The proposed childcare facility may be a source of offensive noise within the commercial building and potentially impact upon amenity. Consequently, the suitably qualified acoustic consultant to assess the facility in accordance with the 'Association of Australasian Acoustical Consultants Guideline for Child Care Centre Acoustic Assessment' (AAAC) (Version 2.0) dated October 2013 and NSW Environment Protection Authority's 'Noise Policy for Industry' (2017) where applicable. The consultant is to consider that the nearest sensitive receivers are within the same building.

If the predicted level of noise exceeds the criteria or it is concluded that the noise from the facility may be offensive, recommendations and noise control measures shall be specified to achieve compliance. Management measures that may be incorporated in a Noise Management Plan as outlined in the AAAC Guideline.

Internal sound absorption elements to be provided for the amenity of children within the internal spaces.

Sleeping/ cot rooms should be located where they are unlikely to be impacted by road traffic noise.

Noise Management Plan

The Application shall be supported by a Noise Management Plan prepared under the supervision of a suitably qualified acoustic consultant. The Noise Management Plan must identify and implement strategies to minimise noise from the proposed development and incorporate: approaches for promoting noise awareness by patrons and staff; training procedures; a complaint lodgement procedure to ensure that members of the public and local residents are able to report noise issues; an ongoing review process and a plan for responding to noise complaints. The Noise Management Plan shall clearly specify the responsibilities of site personnel in managing noise and include a detailed list of steps taken to manage potential noise impacts.

Note: 'Suitably qualified acoustic consultant' means a consultant who possesses Australian Acoustical Society membership or are employed by an Association of Australasian Acoustical Consultants (AAAC) member firm.

The report's cover or title page must confirm membership details or include a watermark for the relevant certification body.

Council is unable to recommend specific consultants or auditors.

Air Handling and Water Systems

The design and construction of the cooling tower is to be in accordance with AS3666.1:2011 Air Handling and Water Systems of Buildings – Microbial Control – Design, Installation and Commissioning.

Food Premises Construction Details (if applicable)

Detailed floor and section plans for the food premises are to be submitted to Council for review.

The plans are to demonstrate compliance with the following:

- AS4674-2004 – Design, construction and fit-out of food premises
- Food Standards Code (Australia)
- Building Code of Australia

In this regard, the submitted plans shall make provisions for the following:

I. Construction details/finishes for the floors (including coving), walls, ceiling, fixtures and fittings in the food preparation area of the premises;
II. Location and construction details of all light fittings and any floor wastes within the food preparation area;
III. A designated hand washing facility, accessible and no further than 5 metres, except for toilet hand basins, from any place where food handlers are handling open food, fitted with a single spout capable of delivering a supply of warm running water;

IV. A double-bowl wash sink suitable for cleaning and sanitising food contact surfaces and equipment;
V. Details of proposed cooking appliances and mechanical ventilation system;
VI. Please note: In addition to the requirements of AS/NZS 1668.1 and AS 1668.2, an extraction system shall be provided where there is any dishwasher and other washing and sanitising equipment that vents steam into the area to the extent that there is, or is likely to be, condensation collecting on walls and ceilings;
VII. A cleaner's sink for disposal of liquid waste (which is not to be located in areas where open food is handled); and
VIII. Details of storage facilities for cleaning equipment and staff personal belongings.

The following documentation is to be submitted as part of the development application;

- Detailed Acoustic Assessment (including construction noise, vibration assessment and management plan)
- Food construction details (if applicable)

m) Community Planning

- **Childcare outdoor play area: Regulation 108 of NSW Childcare Planning Guidelines** 2017 states that, *'Outdoor play areas are important for growth and development. An education and care service premises must provide for every child being educated and cared for within the facility to have a minimum of 7.0m2 of unencumbered outdoor space. Proponents should aim to provide the requisite amount of unencumbered outdoor space in all development applications. A service approval will only be granted in exceptional circumstances when outdoor space requirements are not met. For an exemption to be granted, the preferred alternate solution is that indoor space be designed as a simulated outdoor environment. Simulated outdoor space must be provided in addition to indoor space and cannot be counted twice when calculating areas'*[i].
  The proposed 90 place childcare centre is located on level 6 in an enclosed premise. We recommend ensuring adequate and safe outdoor space for the children.
- **Aboriginal stakeholder involvement**: The public domain art works and places should be designed and delivered ensuring adequate consultation and involvement with Aboriginal stakeholders.

  As expressed by Nomra Burrows, '*Nice one, fingers cross acknowledgement of Aboriginal culture features thought-out the civic place. I'll have to get my creative mind working, maybe a open it up to a local artist competition to cater for a number of opportunity across the LGA, I will look into funding opportunity and have them up my sleeve. "love your work*[ii]"

  We recommend involving Norma in the Aboriginal stakeholder consultation process, Her contact details are given below.

  > **Norma Burrows,** Community Development Worker ATSI, Liverpool City Council, Tel: 0287117477, Email: BurrowsN@liverpool.nsw.gov.au,,
  > Customer Service: 1300 36 2170, 52 Scott Street, Liverpool, NSW 2170

- **Accessibility:** The new public domain and library arenas are expected to create scope of great collaborations across Council and the overlay it has for the community. It is good to see the concept of Civic Place also including Access and Inclusion as part of the development with respect to accessible parking, a lift and change facility, mobility access and bus drop offs for our Seniors and women with prams.

- **Existing Stock of Arts & Crafts:** Councils' existing stock of arts and crafts in library and CPAC can be reviewed to check whether any part of these can be utilized in the proposed premises rather than sourcing all new. We recommend involving the Casula Powerhouse Arts Centre (CPAC) in the process if they are not already involved. The existing stock of CPAC collection can be reviewed online[iii]

3. Conclusion

We trust the feedback provided in this letter and during the Pre-Lodgement meeting held on 19 August 2020 assists Built Group in preparing a comprehensive and responsive Stage 1 Detailed DA for Liverpool Civic Place.

If you wish to discuss any of the above matters further, feel free to contact Geoff Kwok, Urban Planner at geoff.kwok@architectus.com.au or 8252 8400.

Yours sincerely,

Jane Fielding
Senior Associate, Planning
Architectus Group Pty Ltd

Attachment A – Design Excellence Panel Pre-Lodgement Minutes

LIVERPOOL CITY COUNCIL

Minutes

MINUTES OF DESIGN EXCELLENCE PANEL MEETING
Thursday 20th August 2020

DEP PANEL MEMBERS PRESENT:

Rory Toomey	Chairperson	Government Architect NSW
Geoff Baker	Panel Member	GBDC
Kim Crestani	Panel Member	Order Architects

APPLICANT REPRESENTITIVES:

Andrew Morse	PT Consultants
Andrew Duggan	Ethos Urban
Annie Hensley	FJMT Studio
Barry Teeling	Built Development Group
Chris Bridge	FJMT Studio
Grace Goh	FJMT Studio
Luis Betancor	FJMT Studio
Luke Feltis	Ethos Urban
Mona Zhang	FJMT Studio
Richard Francis-Jones	FJMT Studio
Richard Tripolone	FJMT Studio
Sarah Gruedl	FJMT Studio

OBSERVERS:

Boris Santana	Principal Planner	Liverpool City Council
Scott Sidhom	Coordinator Urban Design	Liverpool City Council
David Petrie	Manager City Design and Public Domain	Liverpool City Council
John F. Morgan	Director Property and Commercial Development	Liverpool City Council
Neeraj Kumar	Senior Project Manager Property and Commercial Development	Liverpool City Council
Danielle Hijazi	Panel Support Officer	Liverpool City Council
Geoff Kwok	Urban Planner	Architectus
Jane Fielding	Senior Associate, Urban Planning	Architectus

ITEM DETAILS:

- Application Reference Number: PL-60/2020;
- Property Address: 52 Scott Street, Liverpool, NSW, 2170;
- Council's Planning Officer: Architectus (Overseen by Boris Santana);
- Applicant: BUILT; and
- Proposal: Construction of a 13-level commercial Tower, public domain, 4 story basement & Public Library.

1.0 WELCOME, ATTENDANCE, APOLOGIES AND OPENING

The Chairperson introduced the Panel and Council staff to the Applicant Representatives.
Attendees signed the Attendance Registration Sheet.
The Liverpool Design Excellence Panel's (the Panel), comments are to assist Liverpool City Council in its consideration of the Development Application.

The absence of a comment under any of the principles does not necessarily imply that the Panel considers the particular matter has been satisfactorily addressed, as it may be that changes suggested under other principles will generate a desirable change.

All nine design principles must be considered and discussed. Recommendations are to be made for each of the nine principles, unless they do not apply to the project. If repetition of recommendations occurs, these may be grouped together but must be acknowledged.

2.0 DECLARATIONS OF INTEREST

NIL.

3.0 PRESENTATION

The applicant presented their proposal for PL-60/2020, 52 Scott Street Liverpool NSW 2170.

4.0 DEP PANEL RECOMMENDATIONS

The nine design principles were considered by the panel in discussion of the Development Application. These are 1] **Context,** 2] **Built Form + Scale,** 3] **Density,** 4] **Sustainability,** 5] **Landscape,** 6] **Amenity,** 7] **Safety,** 8] **Housing Diversity + Social Interaction,** 9] **Aesthetics.**

The Design Excellence Panel makes the following recommendations in relation to the project:

4.1. Context

- The panel fully supports the much-improved entrance to the civic building (as previously discussed). The proposed library is also a significant civic building, and the current scale and design of its entrance could be further improved to reflect that significance – it seems understated and subservient as currently designed;

- The panel is concerned that the scale of the library entrance, might not comfortably accommodate movement of people at peak times. It would be prudent to carry out some further pedestrian modelling at peak times, to interrogate whether the ramp width and aperture is appropriate. Consider, for example, a situation where multiple school groups and library users are using the library entrance simultaneously;
- The ramp to the library entrance needs to be better contextualised in the public space. Explore alternative landscape hierarchies such as increased integration (i.e. both formally and materially), of the library entrance and verandah plaza spaces;
- The panel is concerned about stages two and three of the development, and notes that it is important that these stages of the development relate to the public spaces within and around the site;
- The panel supports the high aspirations, in terms of the buildings serving the public space and notes that the design of stage one of the development needs to facilitate and support following through on these aspirations, in the subsequent stages of the development;
- The panel takes comfort in learning that FJMT will be the lead architects for the subsequent stages of the development;
- The panel supports and commends the response and proposal to Indigenous and European heritage for the site;
- The incorporation of a digital screen in the civic plaza space is supported;
- The panel notes that a highly functional and robust treatment is proposed for the Terminus Street boundary condition, at street level. However, the proposal should consider and improve upon, the current condition at this part of the site, including with the proposed large graphic print artwork. This will help make this part of the development a landmark and help to culturally activate a part of the site that cannot be physically activated. Consider the experience of motorists as well as pedestrians;
- The panel notes that the application of the scale of the buildings around the civic plaza is working well, and the parapet heights of the buildings will frame the space effectively.
- The panel notes that the relationship between the existing School of Arts building and proposed library building is working well.

4.2. Built Form + Scale

- The panel notes that the approved building envelope controls are successfully translating into the more detailed scheme;
- The articulation of the Council Administration Building entrance, twisting of the upper built form, and the high-quality materiality that is proposed in the scheme are supported;
- As noted in 4.1 Context, the public space between the Council Administration Building and Library Building needs further development, in terms of the dialogue between the two building entrances.
- The approved building envelopes allow for awnings or other forms of articulation to distinguish the building uses. Explore how to use the surplus within the building envelopes, to define and distinguish the built form around the entrances.

4.3. Density

- The proposed density for the site is supported, noting that it was resolved at earlier stages of the design process.

4.4. Sustainability

- The panel supports the rigorous and highly ambitious approach to sustainability that is proposed for the site, and looks forward to seeing how these strategies are integrated into the design.
- Concerns exist regarding the performance of the glazing and reliance on mechanised blinds for the library building. Explore the opportunity to incorporate external sun shading of the façade of the building;
- It is recommended that a peer review of the façade treatments is undertaken by a suitably qualified sustainability expert;
- Incorporation of the proposed large photovoltaic array system is supported;
- The panel supports and commends the landscape approach, particularly the incorporation of indigenous and Cumberland Plain vegetation species and microclimatic design, which is low maintenance and low cost to maintain.
- The panel recommends incorporating Water Sensitive Urban Design measures into the public spaces, in the detailed design stage. Liverpool has a hot and dry climate, and the panel recommends maximising opportunities to harvest rainwater, to water the trees and other vegetation on site.
- The panel is supportive of a “timber” look materiality in the public domain, subject to suitable selection of low maintenance options.

4.5. Landscape

- The panel supports the landscape approach for the site, and commends the rigorous approach that has been taken.
- Whilst indigenous plantings are encouraged, there may also be a role for deciduous trees, which provide summer shade and winter sun control at no cost.

4.6. Amenity

- The panel notes that there is a diverse offering of public space experiences proposed within the project, and woven into the experience of the site; and
- The proposed elevated pocket park located on Terminus Street, does not have the same level of development and function/role as the other areas of public domain in the proposal. This could be a well-used and intimate space on a hot day. Explore options for a small retail pop-up café with seating. This will make the space more interesting and mediate the level differences within this space.

4.7. Safety

- The panel has concerns about sightlines and the 24-hour day experience for a pedestrian moving through the site. In particular, the family of entrances and the pinch point between the entrances to the Council Administration Building and Library entrances.

- The panel supports the proposed safe and equitable lift access. Please confirm hours of operation for lifts.

4.8. Housing Diversity + Social Interaction

- N/A.

4.9. Aesthetics

- The panel supports the proposed material palette, and differentiation in materials for the different buildings and uses.

5.0 OUTCOME

The panel have determined the outcome of the DEP review and have provided final direction to the applicant as follows:

The project is supported. Respond to recommendations made by the panel, then the proposal must return to the DEP, with all feedback incorporated or addressed.

ENDNOTES

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[i] Delivering quality childcare for NSW, August 2017, NSW Government, pg 32-34, https://www.google.com/search?q=Delivering+quality+childcare+for+NSW%2C+August+2017%2C&oq=Delivering+quality+childcare+for+NSW%2C+August+2017%2C+&aqs=chrome..69i57j33.1577j0j15&sourceid=chrome&ie=UTF-8, accessed on 27/08/20

[iii] Explore the Collection, Casula Powerhouse Arts Centre, https://collection.casulapowerhouse.com/explore

SCHEDULE 2 CORRESPONDENCE WITH LIVERPOOL COUNCIL REGARDING OSD

Laura Shaughnessy

From:	Michael Cahalane
Sent:	Tuesday, 7 April 2020 10:41 AM
To:	kumarj2@liverpool.nsw.gov.au
Cc:	Barry Teeling; Aston Weber; Laura Shaughnessy; MorganJf@liverpool.nsw.gov.au; Neeraj Kumar
Subject:	6734000 | Liverpool Civic Place | Stormwater Drainage
Attachments:	6734000_WS+P-CS-SC-0001-LCP-Civil Services-Planning [02].pdf
Categories:	Liverpook Civic Place

Hi Jason,

Many thanks for the chat about Liverpool Civic Place. As discussed, the site is currently fully impervious and therefore no on-site detention will be required as we will be compliant with council policy in relation to pre v post development flow rates.

Attached is a drawing illustrating the proposed development and existing drainage. Please note that this is a prelim draft and the extent of works are to be confirmed. We have shown an extension of the council system on Terminus Street but this may be reduced, or deleted, depending on how we reticulate the stormwater through the development.

It would be appreciated if you could provide any information on the existing drainage network, including two CDS GPT units located in Scott Street, from your asset team.

Please give me a call if you wish to discuss further.

Regards,

Michael Cahalane
Director - Civil & Water Engineering

Mobile +61 433 522 569
Address: Level 9, 233 Castlereagh St, Sydney NSW 2000

SCHEDULE 3 FLOOD STUDY

Liverpool City Council

Liverpool CBD

Floodplain Management Study

Report

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F Submissions

GLOSSARY

100-year flood - A flood that occurs on average once every 100 years. Also known as a 1% flood. See annual exceedance probability (AEP) and average recurrence interval (ARI).

50-year flood - A flood that occurs on average once every 50 years. Also known as a 2% flood. See annual exceedance probability (AEP) and average recurrence interval (ARI).

20-year flood - A flood that occurs on average once every 20 years. Also known as a 5% flood. See annual exceedance probability (AEP) and average recurrence interval (ARI).

Afflux - The increase in flood level upstream of a constriction of flood flows. A road culvert, a pipe or a narrowing of the stream channel could cause the constriction.

Annual exceedance probability (AEP) - AEP (measured as a percentage) is a term used to describe flood size. AEP is the long-term probability between floods of a certain magnitude. For example, a 1% AEP flood is a flood that occurs on average once every 100 years. It is also referred to as the '100 year flood' or 1 in 100 year flood'. The terms 100-year flood, 50-year flood, 20-year flood etc, have been used in this study. See also average recurrence interval (ARI).

Australian Height Datum (AHD) - A common national plane of level approximately equivalent to the height above sea level. All flood levels; floor levels and ground levels in this study have been provided in meters AHD.

Average annual damage (AAD) - Average annual damage is the average flood damage per year that would occur in a nominated development situation over a long period of time.

Average recurrence interval (ARI) - ARI (measured in years) is a term used to describe flood size. It is a means of describing how likely a flood is to occur in a given year. For example, a 100-year ARI flood is a flood that occurs or is exceeded on average once every 100 years. The terms 100-year flood, 50-year flood, 20-year flood etc, have been used in this study. See also annual exceedance probability (AEP).

Catchment - The land draining through the main stream, as well as tributary streams.

Development Control Plan (DCP) - A DCP is a plan prepared in accordance with Section 72 of the *Environmental Planning and Assessment Act, 1979* that provides detailed guidelines for the assessment of development applications.

Design flood level - A flood with a nominated probability or average recurrence interval, for example the 100-year flood.

DIPNR Department of Infrastructure, Planning and Natural Resources - Now incorporates the floodplain management responsibilities of the former Department of Land and Water Conservation (DLWC).

Discharge - The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving.

DLWC Department of Land and Water Conservation - Since May 1995, this was the name for the Department of

Flood Study - A study that investigates flood behaviour, including identification of flood extents, flood levels and flood velocities for a range of flood sizes.

Floodplain - The area of land that is subject to inundation by floods up to and including the Probable Maximum Flood event, that is, flood prone land or flood liable land.

Floodplain Risk Management Study – Studies carried out in accordance with the Floodplain Management Manual and assess options for minimising the danger to life and property during floods.

Floodplain Risk Management Plan - The outcome of a Floodplain Management Risk Study.

Floodway - Those areas of the floodplain where a significant discharge of water occurs during floods. Floodways are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.

Freeboard - A factor of safety expressed as the height above the design flood level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as "greenhouse" and climate change.

High Flood Hazard - For a particular size flood, there would be a possible danger to personal safety, able-bodied adults would have difficulty wading to safety, evacuation by trucks would be difficult and there would be a potential for significant structural damage to buildings.

Hydraulics Term - given to the study of water flow in waterways, in particular, the evaluation of flow parameters such as water level and velocity.

Hydrology Term - given to the study of the rainfall and runoff process; in particular, the evaluation of peak discharges, flow volumes and the derivation of hydrographs (graphs that show how the discharge or stage/flood level at any particular location varies with time during a flood).

LGA - Local Government Area, or Council boundary.

Local catchments - Local catchments are river sub-catchments that feed river tributaries, creeks, and watercourses and channelised or piped drainage systems.

Local Environmental Plan (LEP) – A Local Environmental Plan is a plan prepared in accordance with the *Environmental Planning and Assessment Act*, 1979, that defines zones, permissible uses within those zones and specifies development standards and other special matters for consideration with regard to the use or development of land.

Local overland flooding - Local overland flooding is inundation by local runoff within the local catchment.

Local runoff - local runoff from the local catchment is categorised as either major drainage or local drainage in the NSW Floodplain Management Manual, 2001.

Low flood hazard - For a particular size flood, able-bodied adults would generally have little difficulty wading and trucks could be used to evacuate people and their possessions should it be necessary.

Water Resources (DWR), the Department of Conservation and Land Management (CALM) and flood sections of the Public Works Department (PWD). The former DLWC is now incorporated in DIPNR.

DUAP The former Department of Urban Affairs and Planning (NSW) - Previously the Department of Planning (NSW). Now called Planning NSW.

DWR The former Department of Water Resources - This department became a major component of the Department of Land and Water Conservation (DLWC) in May 1995.

Ecologically sustainable development (ESD) - Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the *Local Government Act 1993*.

Effective warning time - The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.

Emergency management - A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.

EP&A Act- Act *Environmental Planning and Assessment Act, 1979*

Extreme flood - An estimate of the probable maximum flood (PMF), which is the largest flood likely to occur.

Flood - A relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.

Flood awareness - An appreciation of the likely effects of flooding and knowledge of the relevant flood warning, response and evacuation procedures.

Flood hazard - The potential for damage to property or risk to persons during a flood. Flood hazard is a key tool used to determine flood severity and is used for assessing the suitability of future types of land use.

Flood level - The height of the flood described either as a depth of water above a particular location (eg. 1m above a floor, yard or road) or as a depth of water related to a standard level such as Australian Height Datum (eg the flood level was 7.8m AHD). Terms also used include flood stage and water level.

Flood liable land - Land susceptible to flooding up to the Probable Maximum Flood (PMF). Also called flood prone land. Note that the term flood liable land now covers the whole of the floodplain, not just that part below the flood planning level, as indicated in the superseded Floodplain Development Manual (NSW Government, 1986).

Flood Planning Levels (FPLs) - The combination of flood levels and freeboards selected for planning purposes, as determined in floodplain management studies and incorporated in floodplain management plans. The concept of flood planning levels supersedes the designated flood or

Flows or discharges - It is the rate of flow of water measured in terms of volume per unit time.

Merit approach- The principles of the merit approach are embodied in the *Floodplain Management Manual* (NSW Government, 2001) and weigh up social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the State's rivers and floodplains.

Overland flow path - The path that floodwaters can follow if they leave the confines of the main flow channel. Overland flow paths can occur through private property or along roads. Floodwaters travelling along overland flow paths, often referred to as 'overland flows', may or may not re-enter the main channel from which they left — they may be diverted to another watercourse.

Peak discharge - The maximum flow or discharge during a flood.

Planning NSW - Formerly the Department of Urban Affairs and Planning (NSW) and the Department of Planning (NSW), at present DIPNR (since March 2003).

Present value - In relation to flood damage, is the sum of all future flood damages that can be expected over a fixed period (usually 20 years) expressed as a cost in today's value.

Probable Maximum Flood (PMF) - The largest flood likely to ever occur. The PMF defines the extent of flood prone land or flood liable land, that is, the floodplain.

PWD - Public Works Department - Formerly the State Government Department responsible for floodplain management matters in tidal waterways.

Reliable access - During a flood, reliable access means the ability for people to safely evacuate an area subject to imminent flooding within effective warning time, having regard to the depth and velocity of floodwaters, the suitability of the evacuation route, and other relevant factors.

REP - Regional Environmental Plan. A plan prepared in accordance with the EPA Act that provides objectives and controls for a region, or part of a region. For example, the Georges River REP.

Risk - Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.

RORB/RAFTS - The software programs used to develop a computer model that analyses the hydrology (rainfall–runoff processes) of the catchment and calculates hydrographs and peak discharges. Known as a hydrological models.

Runoff - the amount of rainfall that ends up as flow in a stream, also known as rainfall excess.

SES - State Emergency Service of New South Wales

Stage–damage curve - A relationship between different water depths and the predicted flood damage at that depth.

Velocity - the term used to describe the speed of floodwaters, usually in m/s (metres per second). 10km/h = 2.7m/s.

Water surface profile - A graph showing the height of the flood (flood stage, water level or flood level) at any given location along a watercourse at a particular time.

the flood standard used in earlier studies.

Flood Prone Land - Land susceptible to flooding up to the Probable Maximum Flood (PMF). Also called flood liable land.

Flood Proofing - A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate damages during a flood.

Flood stage see flood level.

Executive Summary

GHD Pty Ltd was engaged by Liverpool City Council to prepare a Floodplain Management Study for the Liverpool Central Business District (CBD) in accordance with the NSW Floodplain Management Manual. The Liverpool Central Business District (CBD) is at risk of extensive overland flooding, potentially affecting commerce and public safety. During larger events, stormwater runoff from within the CBD catchment exceeds the capacity of the existing local stormwater network. This eventuates in flooding of buildings and business premises, which in turn could lead to expensive clean-up costs, loss of stock, and loss of revenue.

Flood behaviour and flood categorisation was undertaken based on DRAINS model simulations, and a number of floodways and flood storage areas have been categorised throughout the Liverpool CBD. The most severely affected areas include Macquarie, George and Moore Streets. Overland flow in these areas has been simulated at depths in excess of 0.5 m in places and these have been designated as High Hazard areas.

A key objective was to consult with the community and relevant stakeholders to determine the community's attitude to past flooding, to document anecdotal history about flooding, and to assist in developing recommendations that are suitable and acceptable for the community. Businesses were surveyed and a public meeting was held in the Liverpool City Council Chambers on the 28^{th} June 2005. Of the sample of 30 surveyed businesses, all of which were identified in flood affected areas, only six 6 indicated that they had experienced flood impacts. The majority had little awareness of the potential flood impacts to their property. Whilst the low level of flood awareness may be indicative of a turnover of business management, ownership or tenancy, overall this indicates that the CBD business community may not be suitably prepared for flood impacts. The degree of social impact is likely to be greater in a community that is not aware or prepared for the flood event.

A number of flood management options have been investigated, namely property modification, response modification and flood modification. In addition a number of structural drainage solutions have been considered in this and other reports. Works, which divert flow from the South-East catchment away from the main system in Northumberland Street and diverting flow from the Central-North catchment. A new outlet is provided to the Georges River at Moore Street.

Appropriate flood management options and issues were evaluated using a benefit/cost analysis. The results showed that the two structural drainage solutions (Section A works and both Section A and B works) have highest benefit/cost ratio. These are followed by a public flood awareness scheme.

Flood planning levels (FPLs) are an important tool in the management of flood risk .It is recommended that FPLs and controls be adopted for the Liverpool CBD in particular to manage re-development. These should recognise that flooding in the Liverpool CBD is

on account of local overland flow and key planning parameters would need to account for the predominantly commercial land use in the CBD.

The total cost of implementing the structural works associated with this study is approximately $7.39M (Section A works only) and $9.89M (Section A and B works) A variety of potential funding sources include the Department of Infrastructure, Planning and Natural Resources through the subsidised Flood Mitigation Program, Council funds, Section 94 contributions from future development, contributions from residents or businesses.

1. Introduction

1.1 Background

The Liverpool Central Business District (CBD) is at risk of extensive overland flooding, potentially affecting commerce and public safety. Historically flooding has been above the footpath level and businesses have been inundated during significant rainfall events. The CBD drainage system consists of standard pit and pipe networks, mostly under capacity as will be shown in this study. Roof runoff either enters the systems via pits, or discharges to kerb and gutter. The drainage network is routed to the Georges River via two outlets. During larger events, stormwater runoff from within the CBD catchment exceeds the capacity of the existing local stormwater network. This eventuates in flooding of buildings and business premises, which in turn could lead to expensive clean-up costs, loss of merchandise/stock and loss of revenue. In response to the potential impact of flooding within the CBD area, Liverpool City Council has recognised the need to undertake floodplain risk management to manage the existing and future flood hazards effectively.

GHD Pty Ltd was engaged by Liverpool City Council to prepare a Floodplain Management Study for the Liverpool Central Business District (CBD) in accordance with the NSW Floodplain Management Manual[1].

Key objectives of the study were to:

- Review and supplement existing flood data;
- Calculate flood levels;
- Categorise floodplain risk;
- Examine social and economic effects;
- Assess the impact of existing upgrade design proposals;
- Examine planning or policy mitigation measures;
- Develop other management options;
- Provide cost estimates;
- Analyse potential works and measures; and
- Undertake a community consultation process.

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[1] Flood Management Manual: The Management of Flood Liable Land, NSW Government, January 2001

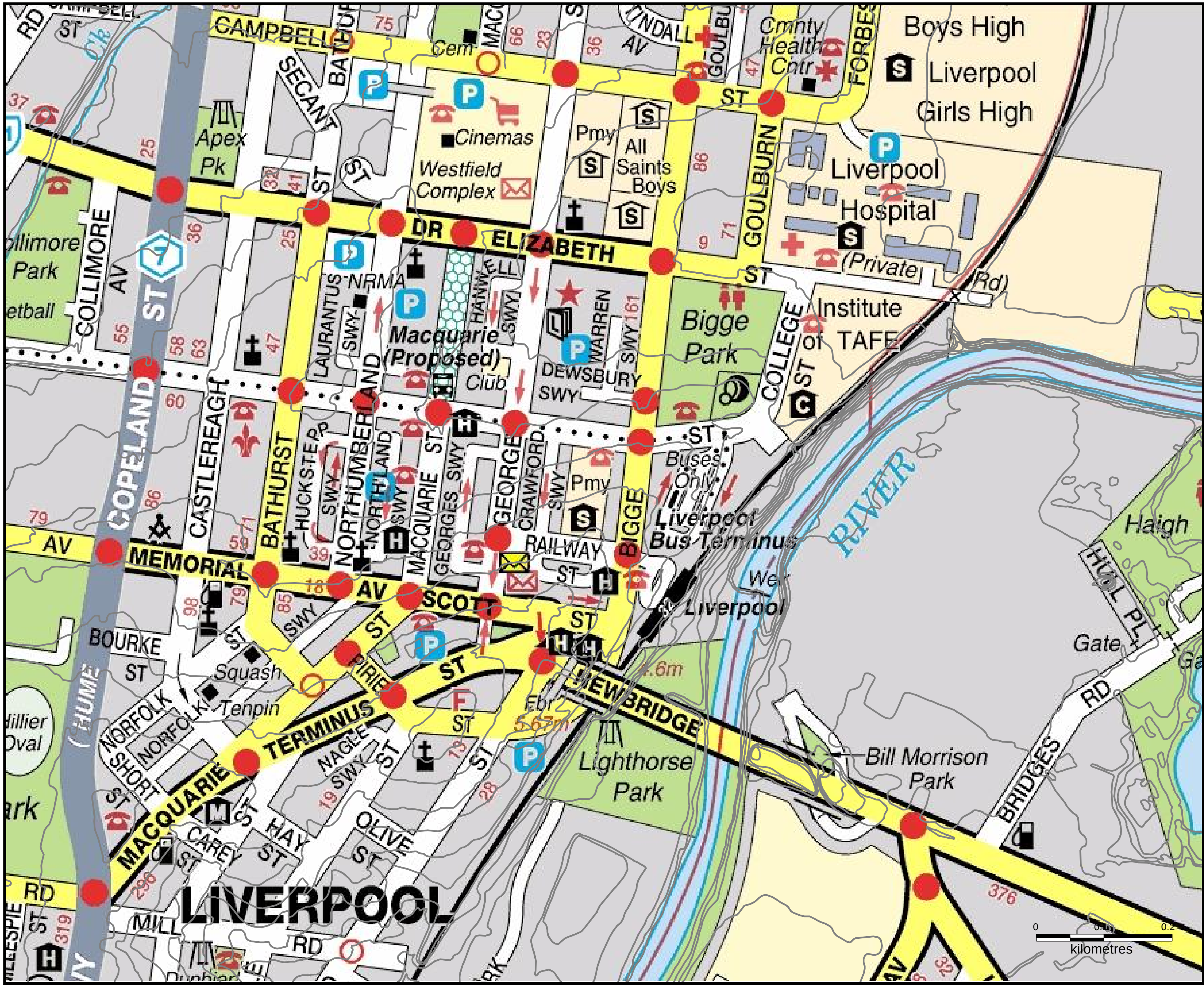


FIGURE 1

LOCATION

North

0 0.1 0.2
kilometres

CLIENT	LIVERPOOL CITY COUNCIL
PROJECT	LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY
TITLE	STUDY AREA

GHD MANAGEMENT ENGINEERING ENVIRONMENT	DRAWN HTR	REVISION A
	CHECKED	SCALE SEE SCALE BAR
DWG REF 21/13153/MI-01	DATE 27/04/2005	SIZE A4

1.2 Study Area

Referring to Figure 1, the CBD area of Liverpool approximately covers the area from Terminus Street in the south to Campbell Street in the north, and is bounded by the Great Southern Railway to the east and by Bathurst Street to the west. It incorporates commercial development, some residential areas to the west, Liverpool TAFE College, Liverpool District Hospital, parks, schools, and churches.

1.3 NSW Government's Floodplain Management Process

The prime responsibility for planning and management of flood prone lands in NSW rests with local government. The NSW Government provides assistance with statewide policy issues and technical support. Financial assistance is also provided to undertake flood behaviour and floodplain management studies, such as the current study, and for the implementation of works identified in these studies.

A Flood Prone Land Policy and a *Floodplain Management Manual* (NSW Government, 2001) forms the basis of floodplain management in NSW. The objectives of the Policy include:

- Reducing the impact of flooding and flood liability on existing developed areas by flood mitigation works and measures, including ongoing emergency management measures, voluntary purchase and house raising programs, flood mitigation works, and development controls; and
- Reducing the potential for flood losses in new development areas by the application of ecologically sensitive planning and development controls.

The policy provides some legal protection for Councils and other public authorities and their staff against claims for damages resulting from their issuing advice or granting approvals on floodplains, providing they have acted substantially in accordance with the principles contained in the *Floodplain Management Manual*.

The implementation of the Flood Prone Lands Policy generally culminates in the preparation and implementation of a Floodplain Management Plan.

1.4 Specific Project Characteristics

In discussion with Liverpool City Council[2] the following project specific characteristics were required by the Brief:

- The study was to rely, as much as possible, on existing information and models. Council provided contour information for the flood study at 0.5m intervals;
- The existing modelling regime was based on ILSAX and DRAINS. Council was in favour of maintaining these modelling regimes;

[2] Mr Steven Martin, Liverpool City Council

- The flood study was to provide best estimates of overland flood level data. This approach provides indicative results not of an appropriate accuracy to be used for deriving Flood Planning Levels, however recommendations of adopting Flood Planning Level controls in response to flooding hazards were to be a task in the study; and
- While there are modelling regimes that may provide a higher level of accuracy to calculated overland flow path flood levels, these would require more detailed survey and more complex hydraulic model configuration at increased costs. As a result, Council nominated to build on their existing data to reduce costs.

1.5 Report Structure

This report is structured so that:

- Section 2: provides background information;
- Section 3: describes modelling of the flood behaviour;
- Section 4: describes the flood behaviour;
- Section 5: describes the community consultation process;
- Section 6: examines social and economic effects;
- Section 7: examines floodplain management measures;
- Section 8: reviews and assesses floodplain management measures; and
- Section 9: examines implementation and planning/policy issues.

2. Background Information

2.1 Previous Studies

There have been a number of previous studies undertaken by other consultants that have been referred to in this report. The key documents are:

- Liverpool City Council, 1992, Investigation and Design of Liverpool CBD Trunk Drainage, November 1992;
- Liverpool City Council, 1995, CBD Catchment – Drainage Strategy Study – Summary Report, Webb McKeown and Associates, April 1995;
- Liverpool City Council, 2003, Liverpool CBD Trunk Drainage – Concept Design Report", Cardno Willing, October 2003; and
- Liverpool City Council, 2004, Liverpool CBD Trunk Drainage – Detailed Design Report Cardno Willing, June 2004.

2.2 History of Flooding

A number of documented historic flood events in the Liverpool local government area are described in the Georges River Floodplain Risk Management Study and Plan[3]. Many of the floods will have been associated with the Georges River adjacent to the Liverpool CBD. Some key historic events include:

- The largest observed flooding is thought to have occurred in February 1873;
- The February 1956 flood, which was estimated to be less than a 1% AEP event. The Sydney Morning Herald referred to this flood as the "biggest Sydney storm in living memory". It also refers to properties worth millions of pounds being destroyed, with 8,000 people left homeless;
- The August 1986 and April 1988 floods. These are the largest floods to have occurred over the last 30 years, and are estimated to be about a 20 year flood[5]. The 1988 flood was estimated to have inundated over 1,000 residential properties along the Georges River, Prospect Creek and Cabramatta Creek, with an estimated damage of over $18M (1988 values);

It is highly likely that associated flooding within the CBD would have occurred during these times, on account of local runoff or backwater from the Georges River. During the community consultation process the following photographs were obtained from a business owner on George Street. The photographs show local flooding at and above kerb level in George Street near Hanwell Street.

[3] Liverpool City Council, 2004, Georges River Floodplain Risk Management Study and Plan, May 2004

Figure 2 - Photographs of local CBD Flooding in 2000 and 2001 (George Street)

3. Modelling of the Flood Behaviour

3.1 Existing Stormwater System

Referring to Figure 3, the existing stormwater network servicing the Liverpool CBD, whilst mostly under capacity:

- Collects stormwater from Terminus and Macquarie Streets and conveys this to Bathurst and Northumberland Streets;
- Collects additional local runoff from Bathurst and Northumberland Streets and conveys stormwater via Bathurst and Northumberland Streets to the corner of Moore Street and Macquarie and George Streets;
- Collects additional local runoff from Moore, Macquarie and George Streets and conveys stormwater via George and Macquarie Streets to Elizabeth Street; and
- Collects additional local runoff from Bigge and Goulburn Streets and conveys stormwater via Elizabeth Streets to the Georges River.

In addition,

- Stormwater is collected from Campbell Street and side roads and discharged to the Georges River via the Liverpool Hospital grounds.

For the purpose of this study, the existing CBD was divided into five sub-catchments similar to those derived for previous studies undertaken[4]. These catchments are as follows:

- South East – East of Macquarie Street and south of Scott Street;
- South West – South of Memorial Avenues and west of Bathurst Street inclusive of Bathurst Street. This catchment discharges to existing stormwater pipes on Castlereagh Street (the receiving catchment is beyond the scope of this report);
- Central South – Between Moore Street and Memorial Avenue, bounded by Bigge and Bathurst Streets. This catchment receives flows from the South East catchment;
- Central North – Between Moore and Campbell Streets. This catchment discharges to the Georges River, and receives flows from the Central South catchment; and
- North – Within and north of Campbell Street and includes the Liverpool Hospital. This catchment discharges to the Georges River.

3.2 History of Stormwater Models

It is understood that Webb McKeown first configured a basic stormwater model for the Liverpool CBD using ILSAX. Cardno Willing upgraded this model (also using ILSAX) in 1993, incorporating inlet capacities for each catchment and allowing for localised

[4] Liverpool City Council, 2003, Liverpool CBD Trunk Drainage Concept Design Report, Cardno Willing, October 2003

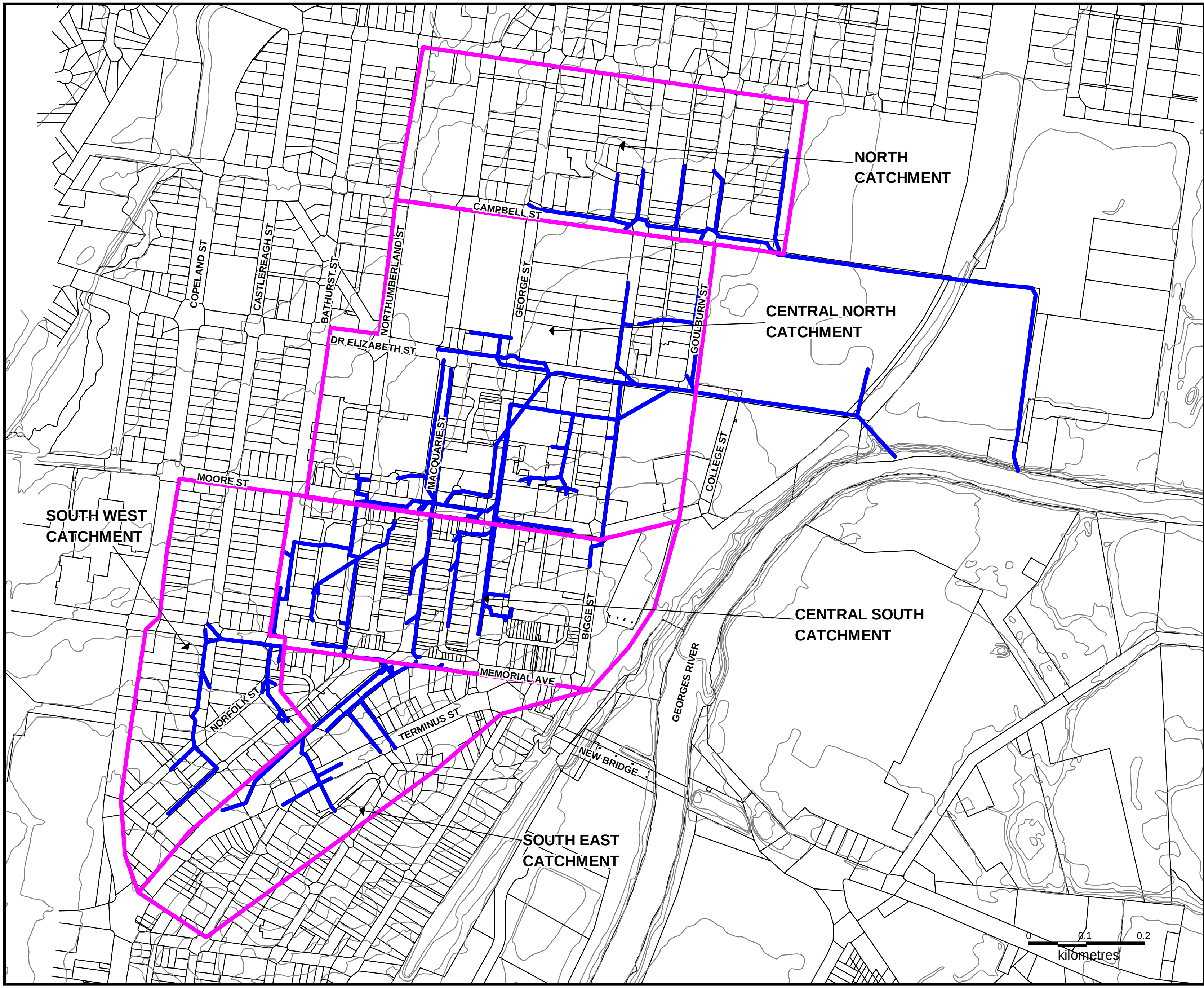
ponding and overland flow. The ILSAX model is a predecessor of the DRAINS stormwater model, and while it requires a number of key data items, it does not rely on invert and ground level data for simulations. However, the ILSAX model provides valuable information such as:

- Catchments - sizes, impervious/pervious percentages, lag times;
- Pipe - diameters, slopes, lengths;
- Stormwater overflow - routes, travel times; and
- Basin/low point – volume, depth, area, discharge at various heights.

3.3 Site Visit

A number of site visits were undertaken during the course of the study. Site visits were an essential component to the study in order to understand the topography, identify drainage routes, constraints, and provide the required background data to establish representative hydrological and hydraulic models. Of particular interest were known hydraulic controls. Site visits allowed the identification of overflow path, flow controls, upstream, downstream and sections where critical flow conditions might occur.

FIGURE 3



LEGEND

- CADASTRE
- CONTOURS
- EXISTING STORMWATER NETWORK
- DRAINAGE SUB-CATCHMENT

North

CLIENT	LIVERPOOL CITY COUNCIL
PROJECT	LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY
TITLE	DRAINAGE SUB-CATCHMENTS & EXISTING STORMWATER NETWORK

GHD MANAGEMENT ENGINEERING ENVIRONMENT	DRAWN HTR	REVISION A
	CHECKED RB	SCALE SEE SCALE BAR
DWG REF 21/13153/MI-03	DATE 27/04/2005	SIZE A4

3.4 Model Development

3.4.1 Model Compilation

For the modelling of flood behaviour and to undertake the flood categorisation, it was deemed necessary to convert the ILSAX model to a DRAINS model. This would provide the required depth and velocity data on overland flow paths. For the conversion further data was required, in particular, reduced levels of the pits and invert levels of the pipes. The DRAINS model compilation was undertaken as follows:

- Liverpool Council provided GHD with a number of CAD drawings that included detailed survey for selected areas within the CBD. These survey files were imported and merged within the 12D Digital Terrain Model (DTM) software, to provide a ground surface model. Given the fragmented nature of the survey, a number of gaps existed where no detailed survey data was available. To infill theses areas, the available Land and Property Information 2m contours of the Liverpool CBD area were also merged. The result was not always successful given the coarser accuracy of the 2m contours, however this was accepted in the absence of other information;
- Pit locations were shown on a drawing in the Cardno Willing reports. In some cases the locations were an aggregation of a number of inlet pits to simplify the ILSAX modelling. The pits were located in 12D along with the connecting pipe links. Using the ground surface model, the pits were allotted ground levels based on their location and exported to DRAINS via a 12D interface. Where the pit type was unknown, it was assumed that the pit inlet capacity was unrestricted, due to the difficulty of identifying the percentage of flows enter the pit below ground level (typically roofed flows) and the percentage of flows that enter the pit above ground (typically road runoff);
- Pipe invert levels were determined, using selected pit locations (where the invert level was known), pipe lengths and slopes obtained from the ILSAX model. Calculations were undertaken upstream and downstream from the known pit to populate the pipe invert databases. These levels were checked with the ground level created in the 12d model to avoid ‘day lighting’ of pipes above the ground surface; and
- Overland flow paths were identified, utilising the flow paths determined in the ILSAX model, the survey data and observation from the site visits.

3.4.2 Model Parameters

Adopted modelling parameters are listed in Table 1.

Table 1 Modelling Parameters

Feature	Value
Soil Type	3 (slow infiltration rates)
Impervious area depression storage	1 mm
Pervious area depression storage	5 mm
Rainfall Data	Data recommended by Liverpool City Council (see Appendix A)
Travel time in overland flow paths	Based on 1m/s velocity
Pipe roughness	0.3 mm
Pit inlet capacity	Unrestricted

As noted in Table 1 above, design storms were derived from rainfall Intensity Frequency Duration (IFD) charts recommended for Liverpool City Council (see Appendix A). Design storms were compiled for the 20%, 5% and 1% AEP events. The design storm temporal distributions recommended in the Australian Rainfall and Runoff (ARR) were adopted.

3.4.3 Model Calibration

In the absence of corresponding rainfall (hyetograph) and runoff data, calibration of the DRAINS model was not possible. Furthermore no historic flood markers were available for calibrating of overland flood depths. Calibration of the models was thus limited to checking the “reasonableness” of the overland flow routes and depths, and qualitatively comparing the findings to known CBD flooding occurrences.

3.5 Simulation Results

The existing CBD stormwater system was simulated for the 20%, 5% and 1% AEP design storm events. The results confirmed that many of the pipes are undersized for the 20% AEP event. Findings on a catchment-by-catchment basis were:

- South-East Catchment - Ponding occurs at two low points in Terminus Street and overflows through commercial property westward to Macquarie Street. These overflows continue northward along Macquarie Street, westward along Memorial Avenue, and northward along Northumberland Street;
- South-West Catchment - Overflows from Norfolk Street travel north along Castlereagh Street and through the intersection with Memorial Avenue (this is the boundary of the catchment network modelled). Overflows from the southern end of Bathurst Street travel north along Bathurst Street to a low point in Bathurst Street

north of Memorial Avenue. Ponding greater than 0.15m within the roadway would overtop the kerb and gutter system and potentially flood road-front properties. The original ILSAX model simulated the low point as a 1m deep basin. However it is considered, from a site inspection, that this is an overestimation of the ponding;

- Central-South Catchment - Overflows from the Southeast catchment enter the Central-South Catchment from Northumberland Street. Overflows from Huckstepp Serviceway also flow into Northumberland Street. A significant low-point exists on Northumberland Street, which is bisected by a raised pedestrian crossing. Overflows from this low point spill through a small serviceway mall to Northumberland Serviceway.

  Large overflows arrive at the intersection of Macquarie and Moore Streets, where the pipe capacity is severely undersized. This area is the junction for pipes coming from Northumberland Street, Macquarie Street and Moore Street and the cumulative effects from overflows from these catchments are significant. Whilst overflows will travel eastward along Moore Street (into the Central North Catchment), large flood events could overtop the kerb and enter into the Macquarie Street Mall, leading to flooding of commercial premises;

- Central-North Catchment - Overflows from the Central-South Catchment, the southern end of George Street, and the eastern end of Moore Street discharge along Moore Street. There is a low point within George Street adjacent to the Hanwell Serviceway where ponding occurs. Overflows from this low point will flood neighbouring premises and flow eastward along Elizabeth Drive and through the Liverpool Hospital grounds before discharging into the Georges River. Additional overflows discharge from the undersized stormwater systems to the north of Elizabeth Street from Bigge and Goulburn Streets; and

- North-Catchment - Significant overflows occur from the undersized piped network in the North Catchment. Overflows travel eastward along Elizabeth and Campbell Streets before discharging to the Georges River, via the Liverpool Hospital grounds.

Detailed results of the DRAINS simulations are provided in Appendix B.

4. Flood Behaviour Categorisation

4.1 Hydraulic Flood Categorisation

The NSW Floodplain Management Manual provides three categories in the determination of hydraulic flood risks. These are outlined below:

- Floodways – Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas;
- Flood Storage – Areas that are important in the temporary storage of floodwaters during the passage of a flood. If the area is substantially removed by levees or filled it will result in elevated water levels and/or elevated discharges. Flood storage areas, if completely blocked, would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%; and
- Flood Fringe – Remaining areas of flood prone land, after floodway and flood storage areas have been defined. Blockage or filling of this area will not have any significant affect on the flood pattern or flood levels.

While these categories generally apply to floodplains, where the major flooding is caused by extreme water levels in a river system, they can be adapted to some extent to a catchment with a piped system and overland flows. Floodways would be roads, pathways, drainage depressions, easements and other routes conveying overland flows. Flood storage areas could be low points and blocked sag pits where temporary or permanent ponding occurs. Figure 4 shows the locations of floodways and flood storage areas identified in the Liverpool CBD.

4.1.1 Identified Floodways

The following roads have been categorised as floodways based on the simulation results. In designating floodways, the minimum criteria adopted was for the road to convey overland flows in excess of 0.5 m^3/s (for example, a 15 m wide road discharging at a velocity of 0.2m/s would flow at a depth of 0.17m). Table 2 summarises floodways within the Liverpool CBD.

Table 2 Floodways within Liverpool CBD

	AEP			
	20%	**5%**	**2%**	**1%**
Memorial Ave (Northumberland → Macquarie	*	*	*	*
Macquarie St (Bathurst → Pirie)	*	*	*	*
Macquarie St (Scott → Moore)	*	*	*	*
Moore St (Macquarie → George)	*	*	*	*
George St (Moore → Elizabeth)	*	*	*	*

Elizabeth St (George → Georges River)	*	*	*	*
Campbell St (Bigge → Georges River)	*	*	*	*
Bigge St (100m north of Elizabeth→ Elizabeth)	*	*	*	*
Goulburn St (100m north of Elizabeth→ Elizabeth)	*	*	*	*
Castlereagh St (Norfolk → Memorial)		*	*	*
Northumberland St (Memorial → 200m north of Memorial)		*	*	*
Bigge St (100m south of Elizabeth → Elizabeth)				*
Northumberland St (Memorial → 200m north of Memorial)				*

4.1.2 Identified Flood Storage Areas

Flood storage areas are listed in Table 3 below. These were determined through site visits and from information obtained in previous studies. The storage and depth data listed in the table are based on the 1% AEP peak design storm.

Table 3 Flood Storage Areas within Liverpool CBD

DRAINS ID	Location	Storage (m^3)	Depth (m)
A2	Terminus Street	50	0.28
AC1	Terminus Street	130	0.45
G2	Bathurst Street	230	1.05
A14	Northumberland Street	40	0.28
AF1	Northumberland Serviceway	12	0.24
A19	George Street	245	0.31
W1	Bigge Street	100	0.27
NJ4	Campbell Street	450	0.49
X2.2	Bathurst Street (south)	150	0.33

4.2 Hazard Flood Categorisation

The NSW Floodplain Management Manual provides two categories in the determination of flood hazard categories:

- High Hazard: Possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings.
- Low Hazard: Should it be necessary, trucks could evacuate people and their possession; able-bodied adults would have little difficulty in wading to safety.

The following factors were considered when determining the flood hazard within the Liverpool CBD area:

- AEP of flood – in this the 20%, 5%, and 1% flood events;
- Depth and velocity of floodwaters;
- Warning time –Floods through the Liverpool CBD are generated by short duration storms, and runoff peaks arrive after 15-25 minutes, depending on location;
- Flood readiness;
- Duration of flooding;
- Evacuation problems – special evacuation needs, level of occupant awareness, potential for damage and danger to personal safety;
- Effective flood access; and
- Type of development – number of people, distance to flood free ground, lack of suitable evacuation equipment.

Other factors that need special consideration in the CBD context are:

- Proximity to pedestrian crossings;
- Shop levels;
- Traffic islands;
- Footpaths; and
- Outdoor malls.

Flood hazards in the Liverpool CBD can be separated into two different sections – hazard to property and hazard to personal safety.

A high hazard for properties has been identified to be any depth of flow that exceeds 0.15 m (i.e. the height of a kerb) adjacent to a road (i.e. a floodway). Low hazard for properties will be any depth that exceeds 0.1 m (i.e. possibility of exceeding kerb, cars moving through the water can also create surges of water). Hazards for personal safety are determined by velocity and depth, with exemptions and additions made for particular locations. The matrix below describes the general hazard categorisation for personal safety adopted in this study.

Table 4 Flood Hazard Matrix

Depth (m)	**Velocity (m/s)**			
	0 - 0.25	**0.25 - 0.5**	**0.5 – 1.0**	**>1.0**
>0.6	High	High	High	High
0.4-0.6	Low	High	High	High
0.2-0.4	Low	Low	High	High
0-0.2	Low	Low	Low	Low

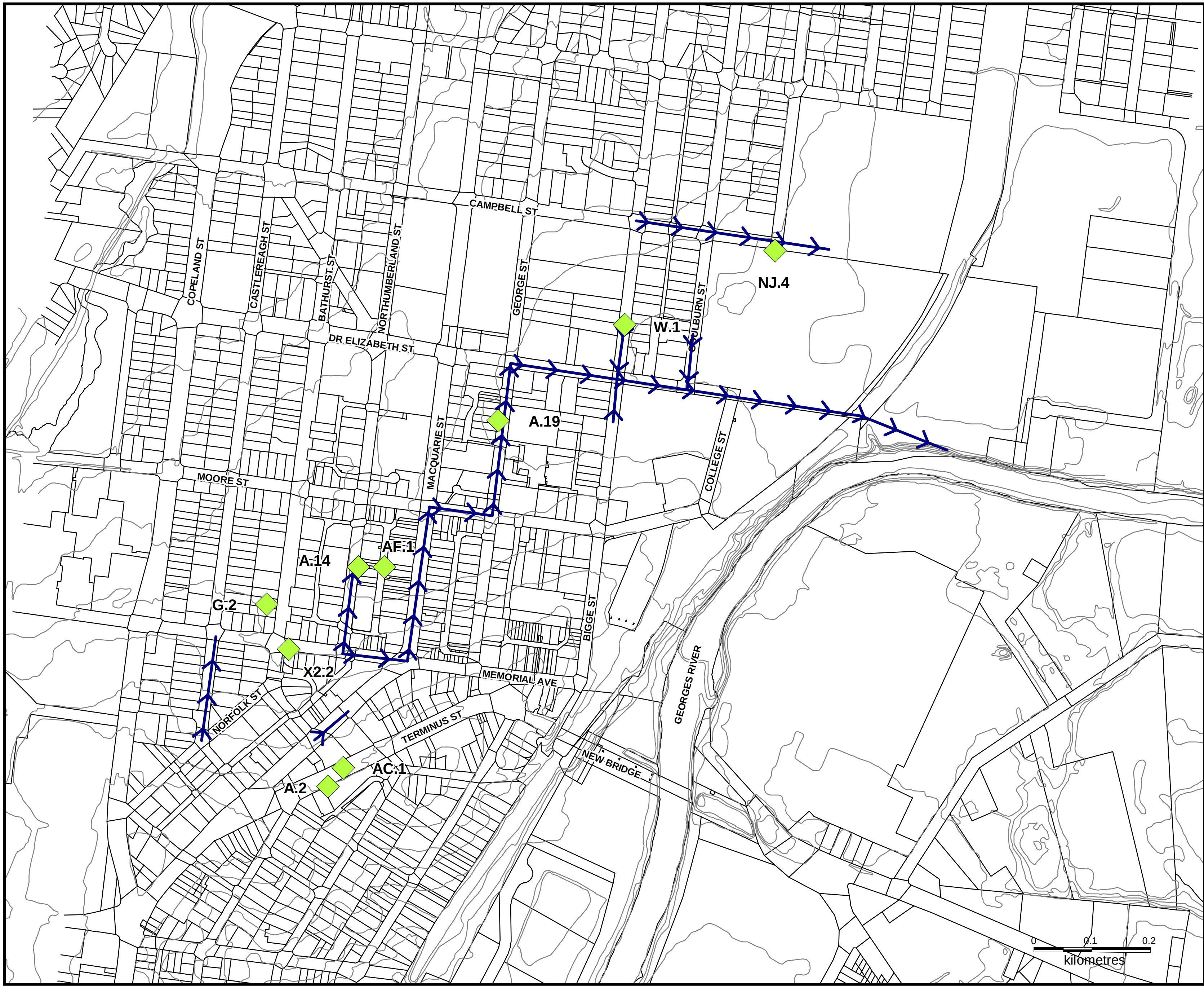


FIGURE 4

LEGEND

FLOOD STORAGE AREA

FLOODWAYS

North

CLIENT
LIVERPOOL CITY COUNCIL

PROJECT
LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY

TITLE
FLOODWAYS AND FLOOD STORAGE AREAS

GHD MANAGEMENT ENGINEERING ENVIRONMENT

DRAWN HTR	REVISION A	
CHECKED RB	SCALE SEE SCALE BAR	
DWG REF 21/13153/MI-04	DATE 27/04/2005	SIZE A4

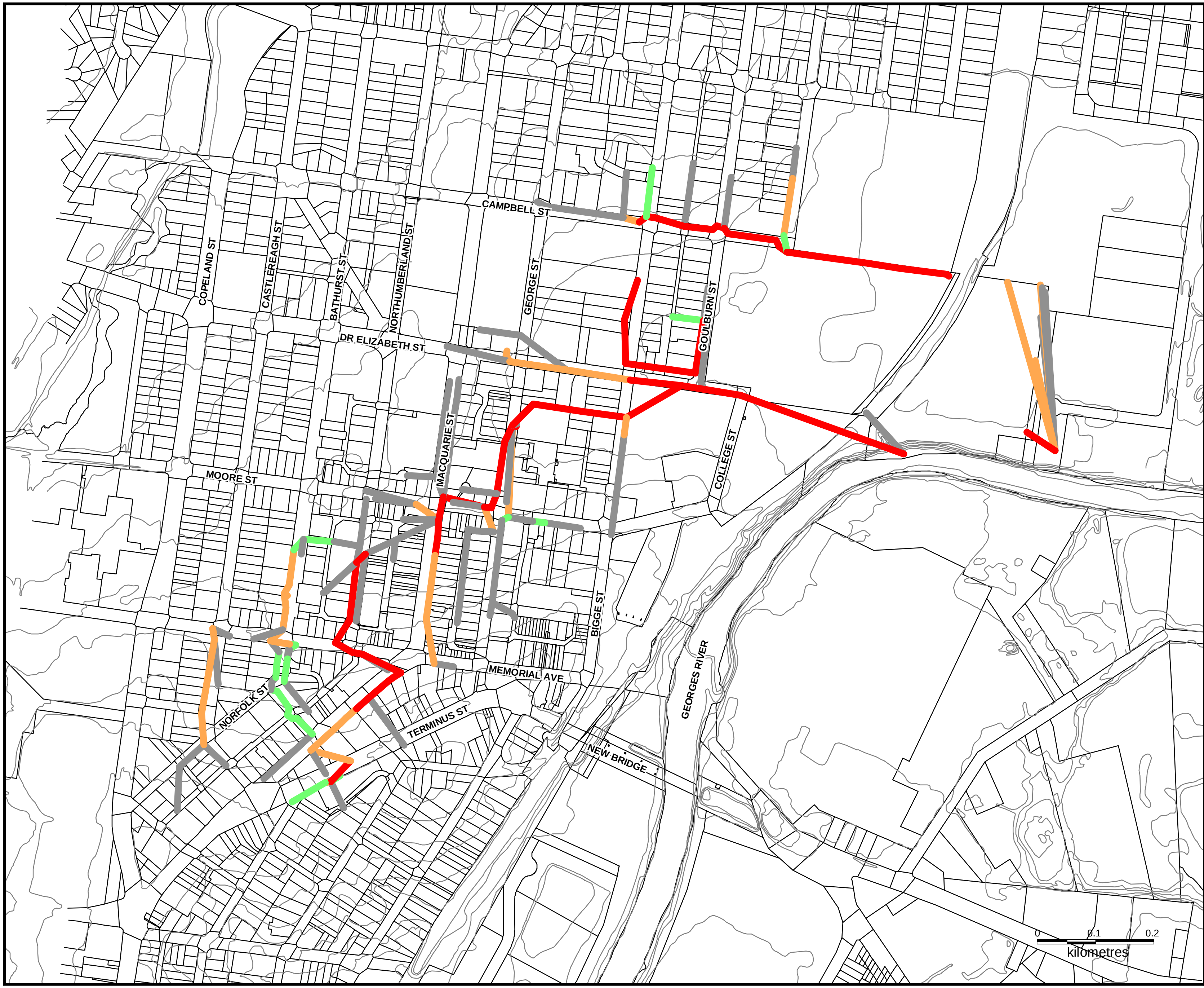


FIGURE 5A

LEGEND

100 YEAR VELOCITY
(m/s)

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 1.00
- >1.0

North

CLIENT
LIVERPOOL CITY COUNCIL

PROJECT
LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY

TITLE
FLOOD HAZARD CATEGORIZATION - 100 YEAR VELOCITY

GHD MANAGEMENT ENGINEERING ENVIRONMENT	DRAWN HTR	REVISION A
	CHECKED RB	SCALE SEE SCALE BAR
DWG REF 21/13153/MI-05	DATE 27/04/2005	SIZE A4

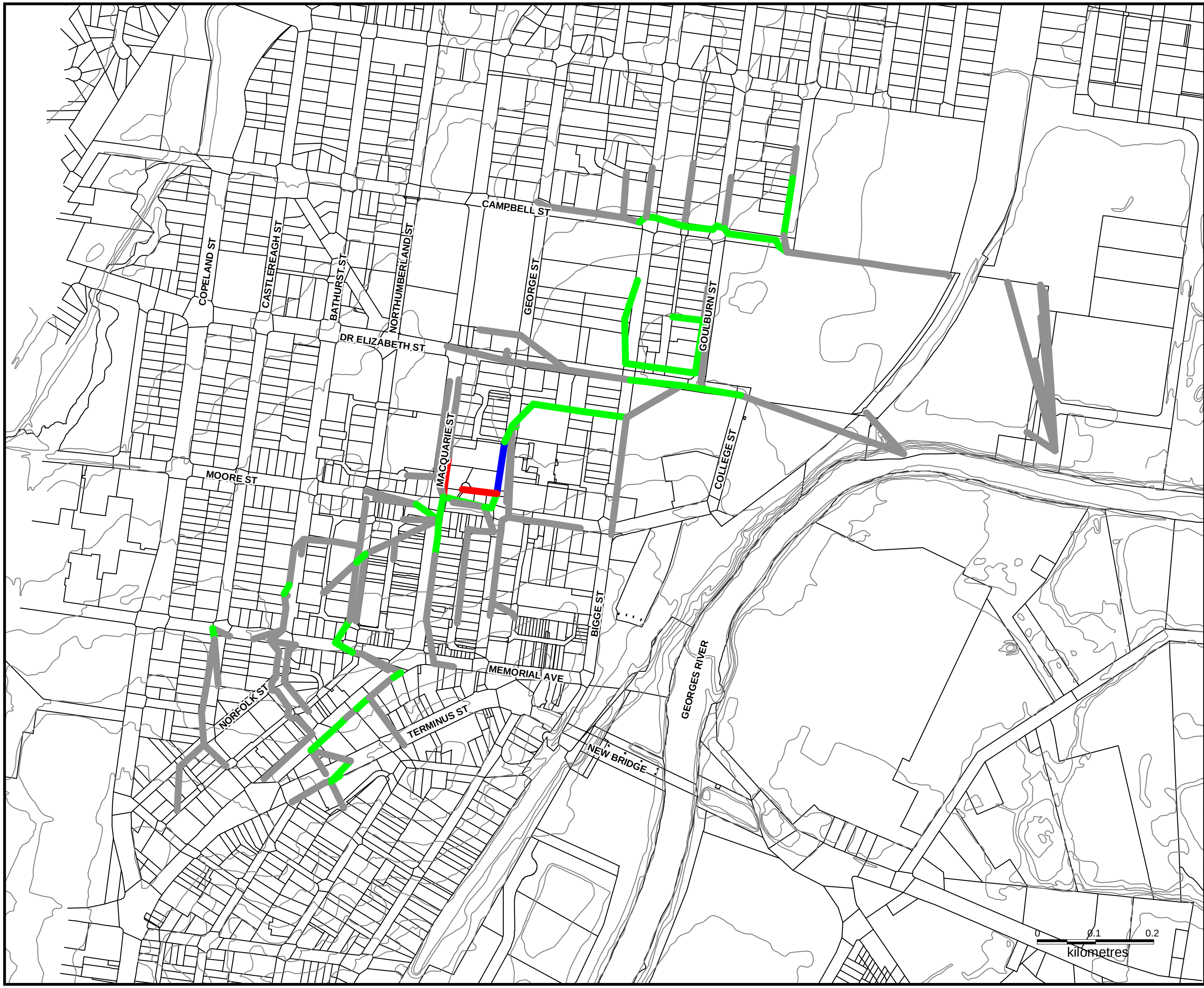


FIGURE 5B

LEGEND

100 YEAR FLOW DEPTH (m)

- 0.0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- > 0.6

North

CLIENT	LIVERPOOL CITY COUNCIL
PROJECT	LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY
TITLE	FLOOD HAZARD CATEGORIZATION - 100 YEAR FLOW DEPTH

GHD MANAGEMENT ENGINEERING ENVIRONMENT	DRAWN HTR	REVISION A
	CHECKED RB	SCALE SEE SCALE BAR
DWG REF 21/13153/MI-05	DATE 27/04/2005	SIZE A4

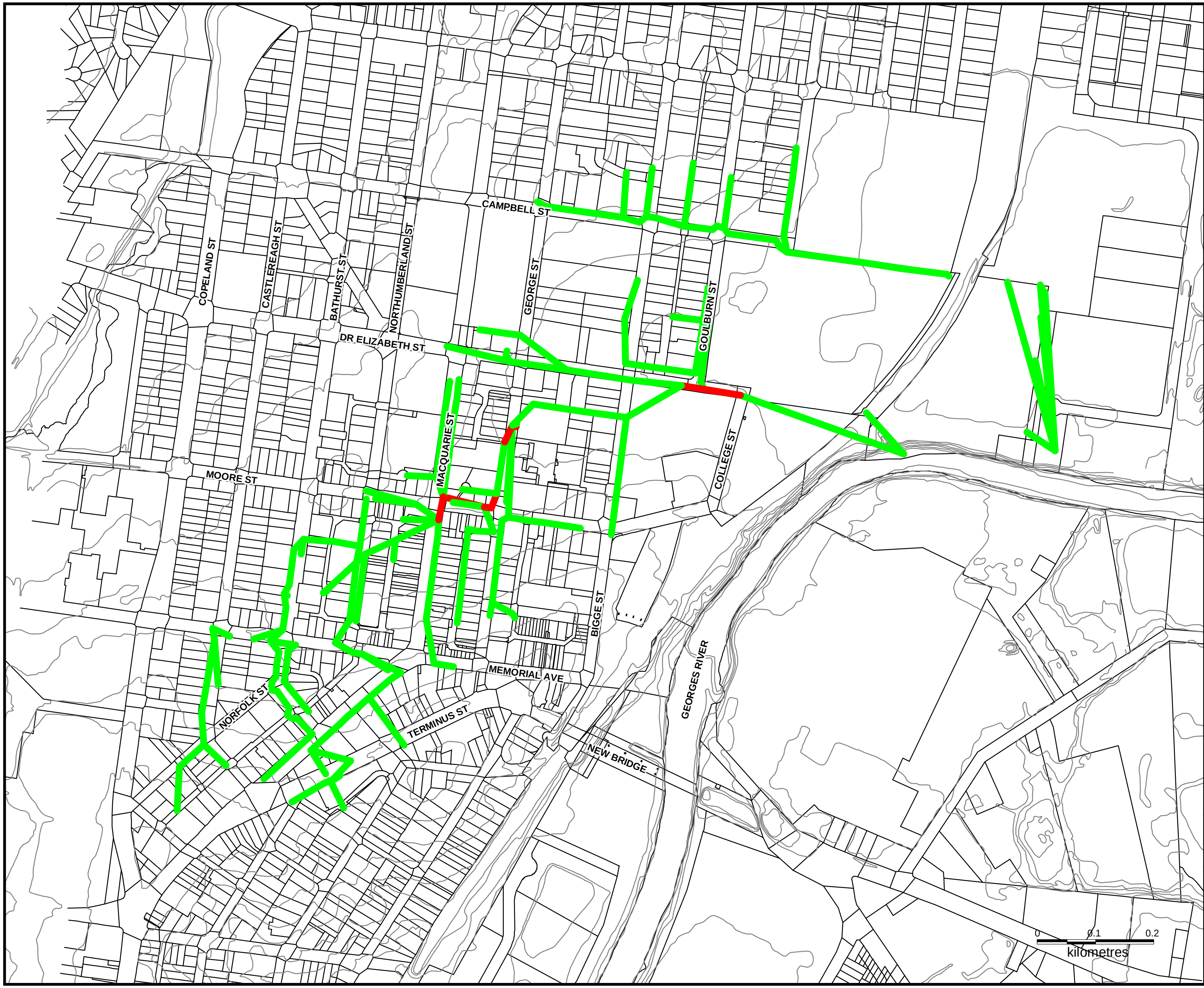


FIGURE 5C

LEGEND

100 YEAR DEPTH X VELOCITY
(m2/s)

< 0.4
> 0.4

North

CLIENT
LIVERPOOL CITY COUNCIL

PROJECT
LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY

TITLE
FLOOD HAZARD CATEGORIZATION - 100 YEAR FLOW DEPTH X VELOCITY

GHD MANAGEMENT ENGINEERING ENVIRONMENT

DRAWN HTR	REVISION A
CHECKED RB	SCALE SEE SCALE BAR
DWG REF 21/13153/MI-05	DATE 27/04/2005	SIZE A4

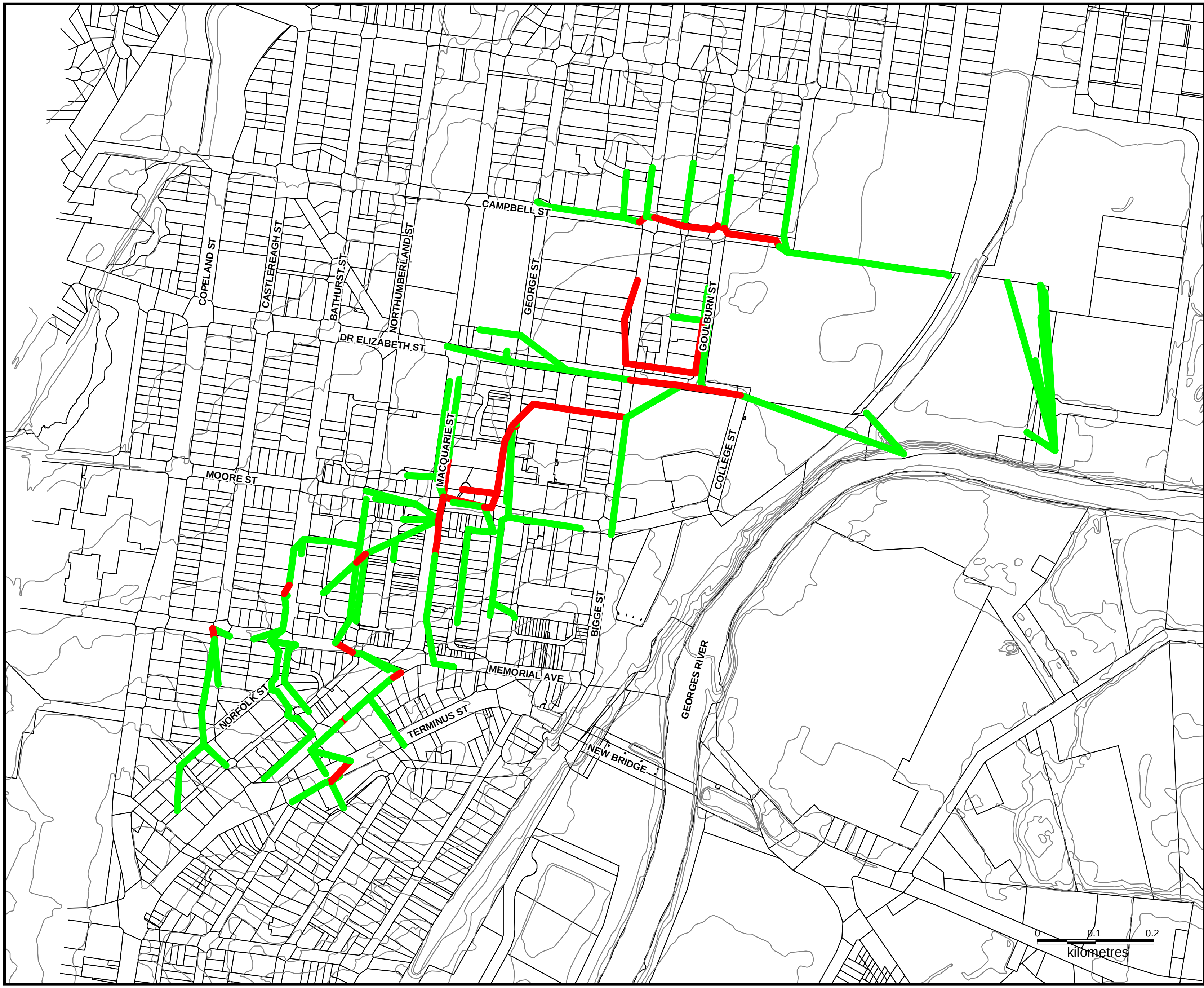


FIGURE 5D

LEGEND

FLOOD HAZARD CATEGORISATION

- LOW
- HIGH

North

CLIENT: LIVERPOOL CITY COUNCIL

PROJECT: LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY

TITLE: FLOOD HAZARD CATEGORIZATION

GHD MANAGEMENT ENGINEERING ENVIRONMENT

DRAWN HTR	REVISION A	
CHECKED RB	SCALE SEE SCALE BAR	
DWG REF 21/13153/MI-05	DATE 28/04/2005	SIZE A4

4.2.1 Summary of 1% AEP High Hazard Areas

The areas listed in Table 5 have been identified as high hazard areas during the 1% AEP event, based on the flood hazard matrix, results of the simulations and identified through the study.

Table 5 1% AEP High Hazard Areas

Location	Comments
Campbell Street	From Goulburn Street through the hospital grounds to the Georges River outlet.
Elizabeth Street	From Bigge Street through the hospital grounds to the Georges River outlet.
George Street	From Moore Street to Elizabeth Street.
Moore Street	From Macquarie Street to George Street
Northumberland Street, Northumberland Serviceway, Bathurst Street, Terminus Street, Norfolk Street, Bigge Street	Low points
Macquarie Street Mall	Shop premises with low frontages. Overflows travelling through Macquarie Street / Moore Street intersection would be likely to spill over the kerb and into the mall. This area has heavy pedestrian numbers. However, with rain, the number of pedestrians is likely to be reduced.
Mall between Northumberland Street and Northumberland Avenue	The mall/serviceway is an enclosed drainage path for overland flows from ponding at a low point in Northumberland Street to spill through to Northumberland Avenue. Shops within this mall have low frontages and are highly susceptible to flooding by even minor flows through the mall.

5. Community Consultation

5.1 Approach to Consulting the Community

A key objective of the Liverpool CBD Floodplain Management Study is to consult with the community and relevant stakeholders to determine the community's attitude to past flooding, to document anecdotal history about flooding, and to assist in developing recommendations that are suitable and acceptable for the community. This process included discussing the experiences of affected business operators, consulting with stakeholders to identify issues of concern, and discussing possible measures to address flood impacts.

Key elements of the consultation process were:

- Stakeholder Notification and Consultation;
- Business Community survey;
- Public Meeting; and
- Public Exhibition and Submissions Review.

The issues identified throughout the community consultation process are summarised in Section 5.2, Community Issues and Concern.

5.1.1 Liverpool CBD Floodplain Management Committee

The Liverpool CBD Floodplain Management Committee is a representative committee co-ordinated to oversee the development of the Liverpool CBD Floodplain Management Study. The committee is responsible for reviewing the study documents and recommending the outcomes to be considered by Council. Members of the Liverpool Floodplain Management Committee include representatives from:

- Liverpool Council;
- Department of Infrastructure, Planning and Natural Resources (DIPNR);
- State Emergency Services (SES); and
- Community members.

5.1.2 Stakeholder Notification

Stakeholders are individuals or groups who have specific interest in the study or its outcomes. As part of the study, conducting a community scan identified the key stakeholders.

The community of the study area comprises business owners and operators, residents and visitors to the area. Key stakeholders identified during the community scan and community consultation activities were:

Table 6 Key Stakeholders identified

Key Stakeholders	
Liverpool City Council	Liverpool Boys High School
Department of Infrastructure, Planning and Natural Resources	Liverpool Girls High School
State Emergency Services (SES)	Liverpool Chamber of Commerce
Liverpool Hospital	Liverpool TAFE
Liverpool bus companies (including Transit First, Westbus and Busabout services)	Liverpool Bowling Club

The above stakeholders were formally notified of the study in writing and invited to participate in the public meeting.

5.1.3 Business Community Survey

A preliminary assessment of community level of concern, knowledge and understanding of flood issues was undertaken by conducting a survey of businesses within the Liverpool CBD. The survey aim was to determine flood awareness and readiness, impacts of previous floods and to invite any suggestions for preventing or managing floods in the area.

Seventy-eight (78) properties were identified as being potentially flood-affected through flood simulations as part of this study. Of these, a sample of thirty (30) businesses located at the property addresses were surveyed for the study. These premises were located on flood prone land on Bathurst Street; Bigge Street; Elizabeth Street; George Street; Macquarie Street; Moore Street; and Northumberland Street. The surveys were conducted on 22 March 2005.

5.1.4 Public Meeting

As part of the brief for this study, Council required a public meeting to advise the community and stakeholders of the study, identify key community issues and concern, and to discuss possible measures and implications for flood management in the Liverpool CBD. Key stakeholders and community members including owners and tenants of affected properties within the CBD were invited by letter to attend the Public Meeting. The public meeting was held on 28 June 2005 in the Liverpool City Council Chambers and a transcript of the presentation is provided in Appendix E.

5.1.5 Public Exhibition and Review of Submissions

The final stage of community consultation for this study was a public exhibition of the Draft Liverpool CBD Floodplain Management Study. The exhibition period extended 60 days and ended 19 September 2005. This provided an opportunity for the community to comment on the draft study and proposed management measures. Two submissions were received and are documented in Appendix F.

5.2 Key Community and Stakeholder Issues

A Business Community Survey and the Public Meeting were undertaken to identify key stakeholder and community issues and concern. These consultation procedures are outlined in Section 5. The key issues are summarised as follows.

5.2.1 Previous Flood Experiences

Of the sample of thirty (30) businesses selected to be surveyed for this study, only six (6) indicated that they had experienced flood impacts. Although the surveyed businesses included a sample selected from Council's flood complaints database, the low number of surveyed businesses having experienced flood impacts could be indicative of a change of ownership, tenancy or management.

Of the six businesses that indicated they had experienced the impacts of flooding, 3 were located on George Street (towards the corner of Moore Street) and 3 were located on Bathurst Street (towards the corner of Memorial Avenue). Although it was unclear how frequently flooding impacted these premises, it appears that flooding has occurred at least once over the last 3 years in these locations. It was also indicated that flood depths were approximately 0.3-0.5m and lasted for a period of 30 minutes to a few hours.

More specifically, one business owner indicated that their business had been flooded 6 times over 27 years of ownership. The most recent flood occurred in 2004 and accrued $5,000 worth of damages and an estimated clean-up cost of $2,000-5,000.

Overall, respondents that had experienced flooding to their premises mentioned they had experienced the following impacts:

- Internal damages to walls, carpets, furniture, equipment and furnishings;
- External damages to paving and doors;
- Damages to retail stock;
- Restricted access to their premises during flooding period;
- Loss of business during clean-up time;
- Health and contamination concerns; and
- Continued anxiety about repeated flooding.

5.2.2 Flood Awareness and Flood Readiness

Flood awareness and flood readiness is critically important to enabling a community to reduce the impact of floods. In general, a flood aware community is more likely to be prepared for the impact of flooding and is more able to avoid and minimise potential flood damage.

Whilst a small number of businesses surveyed for this study were aware of, and had experienced flood impacts, overall the majority of surveyed businesses had little awareness of the potential flood impacts to their property. This may be due to a turnover of staff or business ownership suggested by the high mobility rates of the local community discussed above. The diversity of languages spoken by a high proportion of the Liverpool CBD community may have impacted on the understanding of potential flood impacts in the area. As a consequence of low flood awareness, there appears to be a low level of 'flood readiness' and little attention given to flood prevention procedures within the CBD business community.

However the operators that had experienced flood impacts were more likely to be flood ready and prepared to reduce the potential of flood damage. For example during one particular flood, one such operator was able to minimise potential flood damage by endeavouring to block all water access points and elevating all valuable electrical equipment off the ground.

5.2.3 Community concern regarding Flooding and Mitigation

Previously flood affected business operators surveyed as part of this study were of the opinion that flooding in the area was due to poor drainage systems, over-development of land (particularly nearby residential development), and lack of permeable land in the vicinity of their premises.

Concerns were raised at the public meeting regarding the impact of construction works on the patronage and accessibility of local businesses, particularly the Liverpool Bowling Club. It was suggested that Liverpool Council liaise with business owners to minimise potential impacts during the construction phase.

During the public meeting a representative of the State Emergency Services (SES) also indicated that the SES are considering an early warning systems for the Liverpool area. It was acknowledged that the information provided in this study would be a useful source of information when considering a flood warning systems for Liverpool area.

Queries were also raised regarding the potential use of stormwater, which could be held in detention tanks, for use by the local fire brigade and Liverpool Council. However, this was not considered an option due to the limited capacity of the Liverpool CBD to accommodate detention systems and that these tanks would need to be of considerable size, designed for the dual purposes of detaining runoff and to providing storage supply.

6. Socio-Economic Effects

6.1 Social Setting and Characteristics

The Liverpool CBD acts as a business hub for the local community, accommodating business activity such as retail, commercial, and community service industries. The study area also comprises a number of community facilities including a hospital, schools, TAFE, church, and parklands. Macquarie Street Mall leading up to the Westfield Shopping Mall acts as a focal point to the CBD where a number of community activities and performances are held. Surrounding the study area is predominantly residential development to the north, west and south whilst to the east is the Georges River and Liverpool Railway Line.

6.1.1 Population Profile

Analysis of the study area population was drawn from the Australian Bureau of Statistics, 2001 Population and Housing Census. Five collector districts (1290911; 1290909; 1290706; 1290903; 1290705) covering the Liverpool Floodplain CBD were used for comparative analysis against the Liverpool Statistical Local Area (SLA). It should be noted that the boundaries of these collector districts extend slightly beyond the floodplain to the north, south and west and do not include properties to the east of the railway line.

In 2001, the study area population comprised 2,444 people. A notably higher proportion of this population was aged 25-29 years (10%) compared to the Liverpool SLA (8.1%). There were also a comparatively lower proportion (5.8-7.8%) of children and adolescents (0-19 years) in the study area.

In 2001, a substantially lower proportion of the population spoke English only (18.1%), compared to the Liverpool SLA (50.5%). Other than English, the key languages spoken within the study area included: Serbian (16.5%), Arabic (including Lebanese) (7.1%), Hindi (4.4%), and Spanish (4.0%). This also reflects the proportion of the population who were born in Australia and those born overseas.

In 2001, the Labourforce Participation Rate (LFPR) of the study area was 80.0%, which is considerably lower than Liverpool SLA of 91.7%. Of the 790 people who were employed in the study area in 2001, the majority were involved in the following listed industries:

- Manufacturing (184 people or 23.3% of those employed);
- Retail trade (103 people or 13.0%);
- Property and business services (103 people or 13.0%);and
- Construction (82 people or 10.4%).

This is comparable to Liverpool SLA, however the study area has a slightly higher proportion of population in property and business services, and construction.

In each of the five collector districts, the unemployment rate in 2001 ranged between 12.5-25.0%. This was higher than the Liverpool SLA of 8.3%. In general, the majority of people who were unemployed were aged between 25-44 years for both the study area and Liverpool SLA.

6.1.2 Land Use

The study area predominantly comprises land for business activity. Under the Liverpool Council Local Environment Plan, 1997 most of the study area is zoned 3(a) Business. Exceptions to this are special use zones such as the Liverpool Hospital, Liverpool TAFE, and Bigge Park. Also existing within the study area is the Liverpool Girls and Boys High School, zoned 2(c) Residential-Flat Buildings and some residential land. The predominant land use surrounding the study area is residential.

In 2001, there were a total of 999 dwellings identified in the five collector districts covering the study area. The main dwelling type were flats, units or apartment buildings (88.1% of all dwellings), housing 94.2% of the study area population. This is notably higher than Liverpool SLA (12.5% of total dwellings).

In general, residents in the study area are more mobile than those in Liverpool SLA. 58.5% of the study area population recorded the same address between 1996 and 2001 compared to 76.1% at Liverpool SLA. Similarly, only 24.8% of the study area population recorded the same address between 1996 and 2001 compared to 41.9% of Liverpool SLA.

6.1.3 Business and Community Facility Profile

The Liverpool CBD accommodates a range of businesses and community services. The flood affected properties identified in this study offer a variety of retail, commercial and community service facilities to the local community. Such retail outlets include for example newsagencies, clothes shops, cafes, book shops, scuba diving shop, florist, fabric store, motor cycle outlet, window covering shop, bottle shop, supermarket and computer stores. The CBD also accommodates commercial businesses such as solicitors, real estates, accountants, funeral services, construction businesses and travel agents. Community services in the area include healthcare facilities, police, RSL Club, careers centre, and rehabilitation centre.

In addition, key community facilities that have been identified as flood affected are:

- Macquarie Street Mall consisting of a range of retail, commercial and community service facilities;
- Liverpool Hospital;
- Liverpool Bowling Club;
- Liverpool TAFE; and
- Liverpool Boys High School and Liverpool Girls High School.

6.2 Socio-Economic Impact of Flooding

Flood damages are either social or financial and can be categorised as:

- 'Direct' costs- Direct damages can be quantified in monetary terms. These include damages such as structural damage, contents damage and clean-up costs;
- 'Indirect' costs - Indirect damages can also be translated into monetary values but are secondary impacts such as the loss of business revenue and changes to employment patterns; and
- 'Intangible' costs - Intangible damages are difficult to quantify in meaningful dollar terms and include impacts such as individual health impacts and the loss of sentimental items.

6.2.1 Land Use Impacts

Whilst a number of businesses and residential areas within the Liverpool CBD have been, and may potentially be impacted by flooding, there is limited indication that the land use within the CBD has been altered as a result.

In considering the future development of land within the study area, potential flooding may have an impact on property values and decisions to maximise the development potential of the flood-prone allotments within the CBD. This may have implications for promoting the CBD as a business and commercial centre and possibly increasing residential densities if flood management and mitigation measures are not implemented.

6.2.2 Social Impacts

Major flooding typically causes a great deal of distress to people's lives. Social costs are often intangible damages and relate to changes to social networks, lifestyles, community activities and individual state of well-being. The degree of disruption to people's lives depends on the severity of flooding and the ability of the community and individuals to recover from the flood event.

Impaired accessibility and availability of community services such as schools, healthcare services and the hospital within the Liverpool CBD has the potential to cause substantial social impacts for the broader community. This may include changes to the employee working patterns, schooling routines, and access to medical assistance. This has the potential to cause further disruption as resources from other areas may be sought.

Damages to businesses within the Liverpool CBD also have the potential to cause disruption to business activities such as trading capacity and employment routines. Residential damages may also have the potential to cause lifestyle changes as members of the community adjust personal activities to address flood damages.

Flooding may also cause stress and depression for individual community members related to the loss of sentimental and personally valuable items. These social costs are particularly difficult to quantify as the personal and emotional value of loss often exceeds that of material value. Anxiety, panic and insecurity may also increase amongst the community as a response to the possibility of future flood events.

It is generally acknowledged that the degree of social impact caused by flooding is likely to reduce if the community is prepared for a flood event and has adequate access to support services. Given the low level of flood 'awareness' and flood 'readiness' within the study area community, it can be estimated that the social impacts in the Liverpool CBD would be greater than that of a flood aware community.

6.2.3 Economic Impacts

Whilst consideration of direct economic impacts is important, it is not unusual to proceed with urban flood mitigation schemes on largely social grounds such as intangible costs and social disruption. Economic costs would depend on the level of physical flood damage, the nature of the premises impacted, level of community flood 'readiness', and the level of readily available assistance.

In addition to damages to individual properties, there may also be disruptions to infrastructure such as roads, sewage systems, gas, electricity telephones and water supply. Identified damages from previous floods are mentioned in Section 5.2.1. A summary of the potential impact on the socio-economic workings of the community is summarized in Table 7.

Table 7 Potential Socio-economic Impacts

Direct	Indirect	Intangible
	Residential Areas:	
Structural Damages	Relocation costs	Stress and Anxiety
Contents Damages	Loss of ability to work	Loss of sentimental items
Outside damages	Changes to work routines	Lifestyle changes
Clean-up costs	Disruption to social capital	Loss of amenity
Replacement and repairs	Restricted access	
	Commercial Businesses and Community Facilities:	
Structural Damages	Loss of revenue/profit	Stress and Anxiety
Contents Damages	Loss of productivity	Loss of sentimental items
Outside Damages	Disruption to employment	Lifestyle changes
Clean-up costs	Loss of patronage	Loss of amenity
Infrastructure damages	Drop in property values	
Restricted Access	Disruption to community services and social capital	

6.2.4 Damage Cost Estimates

In order to provide a cost-benefit assessment of floodplain management option, it is necessary to estimate the costs of flood damages. Flood damages are typically determined by first making an assessment of which properties are flood affected, then estimating a direct damage cost for a range of flooding events. The resulting stage-damage curves are used as a basis for estimating other direct and indirect costs from flooding, such as those listed above in Table 7.

Flood affected properties were estimated from the results of overland flow simulations reported in Section 3.5. Given the lack of detailed survey (in particular detailed floor levels) for many of the flood affected areas, the number of flood affected properties were estimated by referring to Figure 5, available survey and the calculated overland flow depth in the adjacent street. Furthermore, a kerb height of 150-mm and the premise that floor levels of buildings is usually set higher than the top of kerb were adopted assumptions. It is noted that some retail premises have on grade entrances, such as those in Macquarie Street Mall. Such properties have been identified as flood prone in minor storms. Table 8 summarises the findings.

Table 8 Method for Determining Flood Affected Properties

Flow Depth in Street (m)	Flood Depth over Floor Level (m)	Flood Affected Properties
< 0.2	< 0.2	None of the properties adjacent to the flow path, unless there is a known flooding problem
0.2 to 0.4	< 0.2	50% of properties adjacent to the flow path
0.4 to 0.6	0.2 to 0.4	80% of properties adjacent to the flow path
> 0.6	0.4 to 0.6	100% of properties adjacent to the flow path

Gissing (2002) investigated commercial flood damage in the Kempsy floods of 2001. Based on damage surveys a correlation between flood depth and direct internal damage (that is, damage to merchandise/stock, equipment, and furniture) was found. Gissing found that structural damage to buildings contributed 13% of the total direct damage costs. Table 9 shows the Gissings' relationship between flooding depth and direct flood damages. This direct cost estimate was used for the Liverpool CBD, as most of the properties determined to be potentially flood affected are commercial premises.

Table 9 Approximate Relationships between Depth of Flooding and Damage (Based on Gissing 2002)

Depth of Flooding over Floor Level	Damage per m^2 (converted to 2005 dollars)
< 0.2m	$43
0.2 – 0.4m	$72
> 0.4m	$110

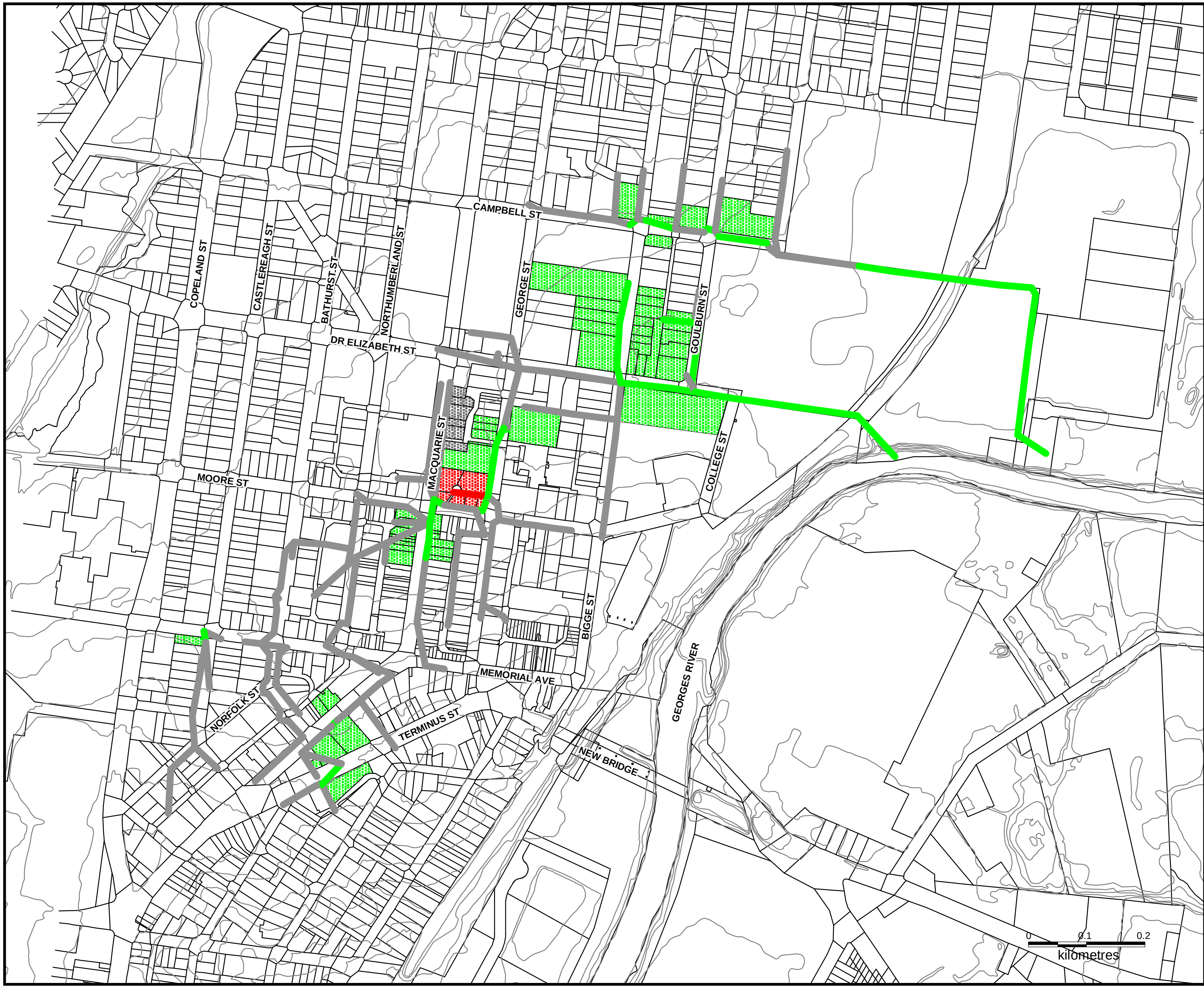


FIGURE 6A

LEGEND

5 YEAR FLOW DEPTH (m)

- 0.0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- >0.6

5 YEAR FLOOD AFFECTED LOT (m)

- 0.0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- >0.6

North

CLIENT
LIVERPOOL CITY COUNCIL

PROJECT
LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY

TITLE
FLOOD AFFECTED LOTS - 5 YEAR FLOW DEPTH

GHD MANAGEMENT ENGINEERING ENVIRONMENT

DRAWN HTR	REVISION A	
CHECKED ND	SCALE SEE SCALE BAR	
DWG REF 21/13153/MI-06	DATE 13/05/2005	SIZE A4

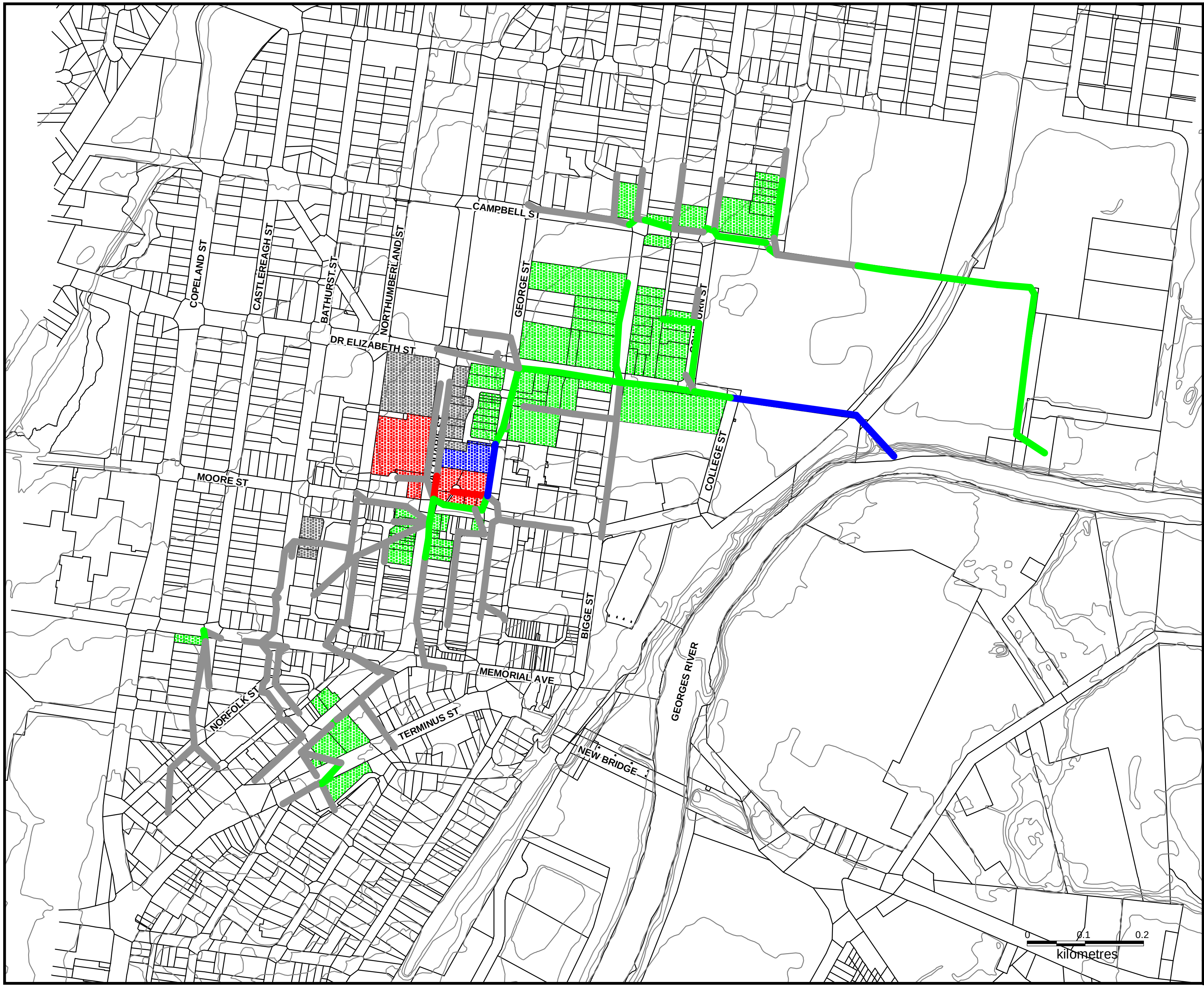


FIGURE 6B

LEGEND

20 YEAR FLOW DEPTH
(m)

- 0.0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- >0.6

20 YEAR FLOOD
AFFECTED LOTS (m)

- 0.0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- >0.6

North

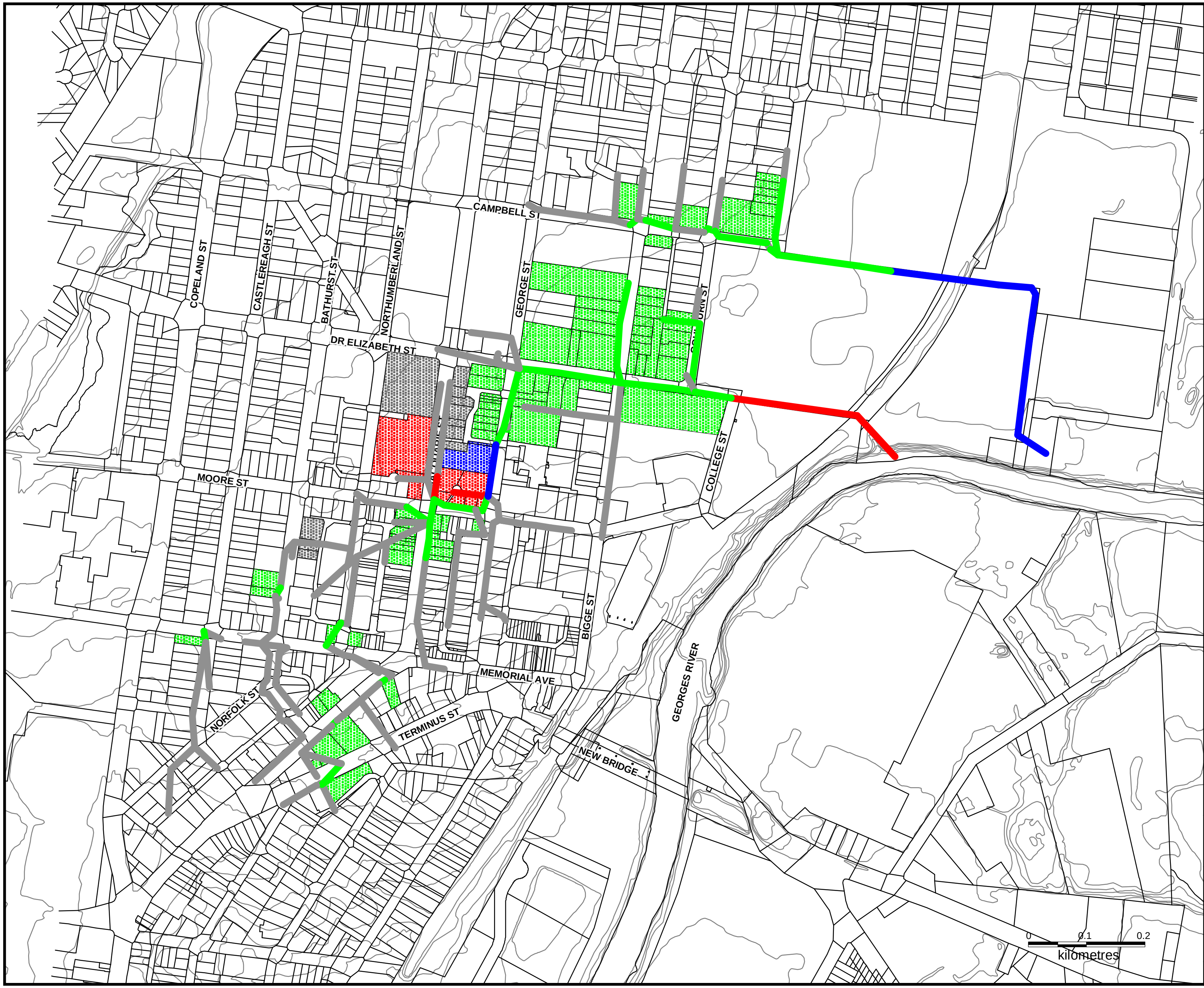
CLIENT
LIVERPOOL CITY COUNCIL

PROJECT
LIVERPOOL CBD FLOODPLAIN
MANAGEMENT STUDY

TITLE
FLOOD AFFECTED LOTS -
20 YEAR FLOW DEPTH

GHD MANAGEMENT ENGINEERING ENVIRONMENT	DRAWN HTR	REVISION A
	CHECKED ND	SCALE SEE SCALE BAR
DWG REF 21/13153/MI-06	DATE 13/05/2005	SIZE A4

FIGURE 6C



LEGEND

100 YEAR FLOW DEPTH
(m)

- 0.0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- >0.6

100 YEAR FLOOD
AFFECTED LOTS (m)

- 0 to 0.2
- 0.2 to 0.4
- 0.4 to 0.6
- 0.6 to 1

North

CLIENT	LIVERPOOL CITY COUNCIL
PROJECT	LIVERPOOL CBD FLOODPLAIN MANAGEMENT STUDY
TITLE	FLOOD AFFECTED LOTS - 100 YEAR FLOW DEPTH

GHD MANAGEMENT ENGINEERING ENVIRONMENT

DRAWN HTR	REVISION A	
CHECKED ND	SCALE SEE SCALE BAR	
DWG REF 21/13153/MI-06	DATE 13/05/2005	SIZE A4

The Georges River Floodplain and Risk Management Plan was used as a guide to the apportionment of flood damage components, as listed in Table 10.

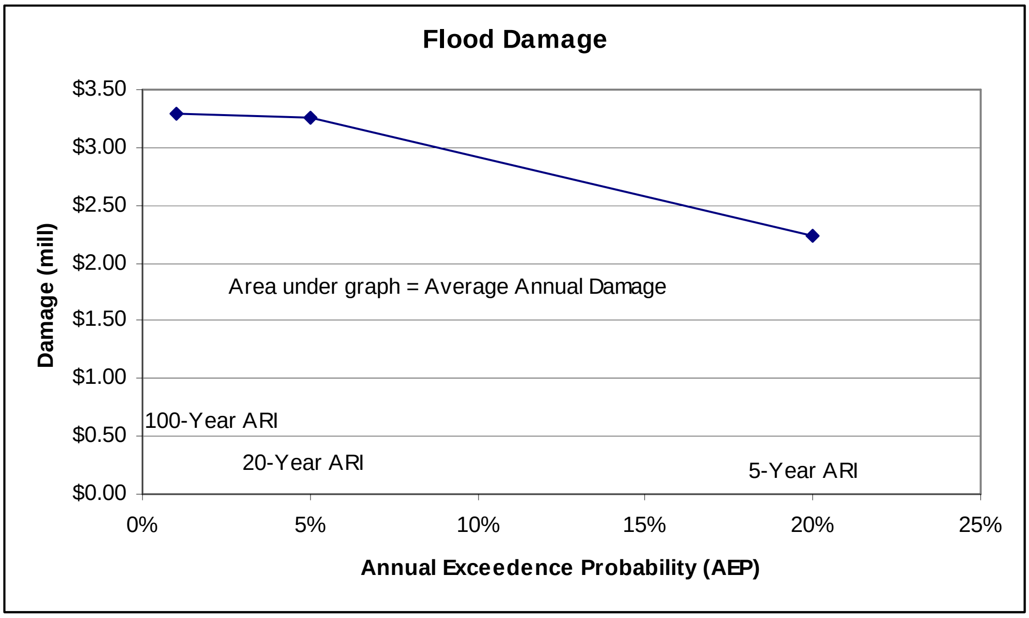
Table 10 Percentage Breakdown of Flood Damage (Georges River Floodplain and Risk Management Plan)

Component	Percentage of Total Damage
Direct Property Damage (including structural damage, damage to stock, equipment and furniture)	60 %
Indirect Damage	15 %
Infrastructure and Public Sector Damage	20 %
Social Damage	5 %
Total	100 %

Using the above information, the following methodology was used to estimate the Average Annual Damage (AAD) and present value of the AAD over a 20-year period:

- The count and area of the lots adjacent to flooded overland flow paths in the 20%, 5%, and 1% AEP storms was estimated from the DRAINS simulations and GIS model;
- Assuming 80% of each lot is occupied by a building structure, the number and area of the buildings, together with the flooding depth was estimated for each design storm;
- The cost of damage for the flooding was estimated for each design storm and depth range by multiplying the building area by the damage per square meter;
- A direct damage bill for each storm was calculated;
- A total damage bill was apportioned based on Table 10;
- Flood AEP was plotted against storm damage and integrated to find the area under the graph, which provides the AAD; and
- A present value for the AAD was estimated based on a 6% discount rate over a 20-year period.

Figure 7 – Flood Damage Results



Referring to Figure 7, the area under the line is equal to the potential Average Annual Damage (AAD). For the Liverpool CBD, the AAD is estimated as $542,000. Over a 20-year period, this has a present value of $6.22 million.

7. Floodplain Management Measures

7.1 Floodplain Management Options

In accordance with the NSW Government Floodplain Management Manual (2001), this report considers various floodplain risk management measures. Risk management measures can be broadly categorised into three categories as shown in Table 11.

Table 11 Floodplain Risk Management Options

Category	Potential Floodplain Management Measures
Property Modification	Land Use Planning House raising or flood proofing of buildings Voluntary purchase of high hazard properties
Response Modification	Flood warning systems and evacuation plans Flood insurance and recovery Public flood awareness schemes
Flood Modification	Retro fitting On-Site Detention tanks and detention basins Structural drainage solutions

Each of the above floodplain management options is examined in the following sections. An additional "do nothing" option is also considered.

7.2 Property Modification

7.2.1 Land use planning

Land use planning limits and controls are an essential element in managing flood risk and the most effective way of ensuring future flood risk is managed appropriately. A detailed discussion on appropriateness of development controls and Flood Planning Levels (FPLs) for the Liverpool CBD is provided in Section 9.3.

7.2.2 House Raising or Flood Proofing of Buildings

House raising is a structural solution to lift buildings above the flood planning level to avert damage to buildings, improve personal safety and reduce stress and post-flood trauma. Since house raising is not suitable for commercial properties and blocks of units, this option is not considered appropriate for the Liverpool CBD.

Flood proofing of buildings involves designing and constructing buildings with appropriate water resistant building materials to reduce flood damage. This solution reduces damage to the building structure but in most cases does not protect building contents. In this situation, flood proofing will need to be retro fitted to existing buildings or included as a development control. Flood affected properties tend to be commercial premises so the contents are likely to be costly to replace if flood damaged.

Flood proofing has been considered as an option.

7.2.3 Voluntary Purchase of High Hazard Properties

To avoid the economic and social expenses of flooding in high hazard areas, it may be viable for Council to purchase flood affected properties at an equitable price where voluntarily offered. The property should then be rezoned to a flood compatible use, such as open space. This will have little impact on reducing flood hazards but will reduce annual flood damage to the affected properties.

While this option may be expensive and limiting on account of the high densities and zoning, voluntary purchase has been considered as an option.

7.3 Response Modification

7.3.1 Flood Warning Systems and Evacuation Plans

Flood warning systems and evacuation plans are used to prepare a community for an impending flood. Depending on warning time and resources available, flood warning systems and evacuation plans can be used to protect buildings, evacuate people, provide relief to evacuees and recover the flood affected areas.

The critical storm event for this catchment is the 25-minute storm. A storm of this duration in a catchment of this size is not considered conducive to flood warning systems and evacuation plans.

Flood warning has not considered been considered as an option.

7.3.2 Flood Insurance and Recovery

Insuring properties against flooding is a method of transferring the flood financial risk to the insurer. There is limited benefit in this flood risk management option because insurance does not mitigate flooding. Therefore, issues of community disruption, property values, flood hazards and safety remain.

Flood insurance has been considered as an option.

7.3.3 Public Flood Awareness Scheme

A public awareness scheme will assist in raising flood awareness and readiness, and increase the appreciation of the flood problem and prevention activities. Implementation of a flood awareness scheme will also assist in minimizing the social and economic impacts of flooding in the Liverpool CBD. Measures to increase flood awareness could be for example:

- The dissemination of a Flood Information Pack that could be sent to all business owners, operators and residents of potential flood impacted properties (this information should be provided in a range of different languages);

- The dissemination of flood certificates on a regular basis which would inform each property owner of the flood situation at their particular property, flood data and advice (this information should be provided in a range of different languages); and
- Signage in flood prone areas giving notification of potential flood levels.

A flood awareness scheme has been considered as an option.

7.4 Flood Modification

7.4.1 Retro Fitting On-Site Detention Tanks and Detention Basins

On-Site Detention tanks and detention basins attenuate the peak discharge in a storm by temporarily storing the stormwater and discharging it a slower rate. This will reduce the demand on existing drainage infrastructure and potentially mitigate flooding. The Liverpool CBD catchment is predominantly medium and high-density residential and commercial premises. This type of development provides limited opportunity for retro fitting on-site detention tanks and detention basins.

Retro fitting on-site detention tanks and detention basins has not been considered as an option.

7.4.2 Structural Drainage Solutions

The purpose of structural drainage solutions is to mitigate flooding and associated economic and social consequences of flooding. For the Liverpool CBD, there are opportunities to improve the drainage system to reduce the impact of flooding on the community. Structural solutions will also provide an opportunity to provide and improve the water quality of Georges River through the use of structural water quality devices such as Gross Pollutant Traps. As identified by the simulations, the underlying problems within the CBD is an under-capacity drainage system and a trend amongst commercial premises to have their floor levels set at ground level.

Structural drainage solutions are further discussed in Sections 7.5 and 7.6, and have been considered as options.

7.5 Previously Proposed Management Measures

The Liverpool CBD Trunk Drainage Report: Concept Design Report[5] considered 10 options for upgrade of the existing stormwater system within the catchments comprising the Liverpool CBD. Options investigated aimed at ensuring flood protection to properties up to the 5% AEP event. Table 12 summarises the options considered.

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[5] Liverpool City Council, 2003, Liverpool CBD Trunk Drainage Concept Design Report, Cardno Willing, October 2003

Table 12 Upgrade Options considered in Previous Studies

Option	Description
South-East, Central-South and Central-North Catchment	
A	Diversion of South-East and Central-South catchments along Moore Street, diversion of North Catchment to Elizabeth Street and connection of Central-North catchment to a new outfall at the end of Moore Street.
A1	This is essentially the same as Option A however box culverts are used instead of multiple pipes
A2	This is essentially the same as Option A however with additional upgrades through Bigge Park
A3	This is essentially the same as Option A however with additional upgrades in Bathurst and Terminus Street
B	Diversion of south-east and Central-South catchments along Moore Street. Diversion from George Street to Elizabeth Street. Diversion of North-Catchment to Elizabeth Street and connection of Central-North catchment to a new outfall at the end of Moore Street.
C	Diversion of south-east and Central-South catchments along Moore Street to a new outfall at the end of Moore Street. Diversion of North Catchment to Elizabeth Street and upgrade of existing system through Liverpool District Hospital.
South-West Catchment	
D	Upgrade of South-West Catchment without Macquarie Street/Scott Street works
DA	Upgrade of South-West Catchment after Macquarie Street/Scott Street works
North-Catchment	
E	Upgrade of North-Catchment by pipe replacement
EA	Upgrade of North-Catchment by pipe duplication

For the subsequent Liverpool CBD Trunk Drainage Report: Detailed Design Report[6], Liverpool City Council decided to opt for Option B incorporating some system upgrade associated with Option A3. The design sought to alleviate flooding within the commercial district for the 5% AEP storm event. This design upgrade was divided into two stages, namely Section A and Section B with works summarised in Table 13.

The design is based on diverting flow from the South-East catchment away from the main system in Northumberland Street and diverting flow from the Central-North catchment. This is essentially achieved by creating two new branches (on Scott Street and Moore Street) of pipes, discharging to a new outlet in the Georges River. Further upgrades to the system in Elizabeth Street were also proposed.

[6] Liverpool City Council, 2004, Georges River Floodplain Risk Management Study and Plan, May 2004

Table 13 Works proposed in Liverpool CBD Trunk Drainage Report: Detailed Design Report

Section A Works	Section B Works
Moore Street from Macquarie Street to College Street;	Upgrade from Bathurst Street to Northumberland Street through easements and Huckstepp Serviceway;
Scott Street from 50m east of Macquarie Street to George Street;	George Street from adjacent to the Police Station to Elizabeth Street
George Street from Scott Street to Moore Street;	Upgrade works from Terminus Street through easements to Macquarie Street and west (typo, should be east) along Macquarie Street to Scott Street;
Elizabeth Street from 55m east of George Street to College Street;	Macquarie Street between Memorial Avenue and Moore Street;
College Street from Elizabeth Street to Moore Street; and	Elizabeth Street between Northumberland Street and George Street;
Outlet pipeline from College Street to Georges River.	Campbell Street from 35m west of Bigge Street to Goulburn Street;
	Goulburn Street from Campbell Street to Elizabeth Street; and
	Bigge Street between Campbell and Elizabeth Street (- continued south along Goulburn Street to Elizabeth Street).

7.5.1 Comments on Previously Proposed Management Measures

To test the options proposed, Cardno Willing developed a DRAINS model. A review of this DRAINS model showed that only new pipe upgrades and existing pipes in the vicinity of the proposed upgrade options, were configured in the model and simulated. Hydrographs from the ILSAX models were configured as inflows and were allowed to discharge to upstream nodes in the model.

However, from the review, it appears that the inflows did not include overland flows from the upstream catchments. These overland flows form part of the total flow that needs to be conveyed, and should not be omitted. To further investigate this anomaly, the proposed Section A works were configured into the new DRAINS model developed for the present study. This showed that there were numerous locations within the study area that did not conform to the adopted design standard, namely prevent flooding in the 5% AEP event.

If these areas, proposed to be mitigated as part of the Section B works, are upgraded then the downstream system would be unable to cope with the additional inflows. Should the works detailed in the Liverpool CBD Trunk Drainage Report: Detailed Design Report be adopted, then Table 14 summarises floodways that would be classified as “high hazard” using the categorisation developed in Section 4.2.

Table 14 High Hazard areas should previous proposed works be adopted

Location	AEP			
	20%	5%	2%	1%
Moore St (Macquarie → George)	*	*	*	*
George St (Moore → Elizabeth)		*	*	*
Elizabeth St (George → Georges River)		*	*	*
Campbell St (Bigge → Georges River)	*	*	*	*
Bigge St (100m north of → Elizabeth)	*	*	*	*
Goulburn St (100m north of → Elizabeth)	*	*	*	*
Castlereagh St (Norfolk → Memorial)		*	*	*
Bigge St (100m south of → Elizabeth)				*
Northumberland St (Memorial → 200m north of)				*

7.6 Additional Structural Management Measures

The following management measures have been identified over and above the design improvements recommended in the Liverpool CBD Trunk Drainage Report: Detailed Design Report.

7.6.1 Section A Works

Central-South Catchment

The proposed upgrades in Section B works allow for an upgrade of the under-capacity pipes within Macquarie Street to 900 mm diameter pipes. Whilst this alleviates the immediate problem in Macquarie Street, the upgrades downstream proposed as Section A works would then be under-capacity. The proposed Section A works pipes on Moore Street will need to be upgraded to approximately two 1350 mm pipes up to and including the intersection with George Street.

Central-North Catchment

The drainage systems in Bigge and Goulburn Streets to the north of Elizabeth are under-capacity. The Section B works have allowed for these proposed systems to be upgraded. Upgrade to Elizabeth stormwater infrastructure has been identified as part of Section A works, however when the upgrades in Section B are constructed then the proposed Elizabeth Street system will be undersized. The Section A works proposal is to supplement an existing 1500 mm diameter pipe with a 1050 mm diameter pipe. To convey the increased piped flows from Bigge and Goulburn Streets duplication of the 1500 mm diameter pipe would be required.

7.6.2 Section B Works

North-Catchment

The piped system on Elizabeth Street between Bigge Street and the Georges River has a capacity of about half of what is required to alleviate flooding in the 5% AEP event. Capacity upgrade would be required by replacement or duplicating the existing pipes. Further detailed simulation would be required to determine the exact pipe dimensions.

South-East catchment

The piped system from Terminus Street and continuing on to Macquarie Street until the intersection of Scott Street needs to be upgraded to alleviate flooding in the 5% AEP event. It is estimated that the upgrade needs to approximately triple the capacity of the existing system.

South-West catchment

The stormwater line along Norfolk Street and Castlereagh Street needs to be approximately doubled in capacity. While stormwater lines beyond the Castlereagh Street/Memorial Avenue intersection are beyond the scope of this investigation, it is likely that these pipe system will need similar upgrade to alleviate flooding in a 5% AEP event. In addition a small section of pipe around the Memorial Avenue/Norfolk Street intersection will also need to be upgraded.

Central-South catchment

The stormwater pipe between Bathurst Street and Huckstepp Serviceway needs to be upgraded with additional inlet pits required to alleviate large amounts of ponding.

8. Review and Assessment of Floodplain Management Measures

8.1 Cost of Floodplain Management Options

From the discussion in Section 7, the following were identified as options:

- Flood proofing of buildings;
- Voluntary purchase of high hazard properties;
- Flood insurance and recovery;
- Public flood awareness scheme; and
- Structural drainage solutions.

8.1.1 Flood Proofing of Buildings

Cost estimates for the flood proofing of buildings should consider a range of the variables, such as the physical characteristics of the building (existing building materials, age, size and dimensions), the costs associated with downtime while buildings are being flood proofed, and the costs of maintaining flood proofed buildings. Given the complexity of these variables, the flood proofing was estimated at 3% of the property value, based on consideration of typical works.

Flood damage costs after buildings have been flood proofed would then exclude direct structural damage costs. Based on the breakdown of direct, indirect and other flooding costs in Table 10, the direct structural damage costs equal 50% of the total flood damages. Therefore, potential savings in flood damage is equal to the 50% of the total flood damages.

8.1.2 Voluntary Purchase of High Hazard Properties

Including negotiation fees, legal fees, survey and demolition, the cost of commercial properties in the Liverpool CBD is estimated in the order of \$7500 per m^2. Based on Table 5, a number of properties in Macquarie Street Mall, Northumberland Street, and between George and Bigge Streets are identified as high hazard areas and could suffer from regular flooding. This option would involve the rezoning and purchase of these properties.

8.1.3 Flood Insurance and Recovery

Flood insurance premiums cost approximately \$1000 per annum per \$100,000 property value. It is assumed that property values are in the order of \$6000 per square metre. The average annual insurance cost can be estimated by calculating the product of the integral of the Flood Affected Properties Area versus AEP graph with the insurance cost per annum per \$100,000 property value and the property value. For the Liverpool CBD, this equates to \$379,000 per annum or a present value of \$4.34 million over 20 years.

Flood damages that are not insured include damage to goods, equipment, furniture, infrastructure, indirect damage and social damages. Recovery costs include cleaning, repairing or replacing uninsured structures and goods, as well as the unquantifiable costs of miscellaneous flood relief efforts. Based on Table 10, these uninsured damages make up about 50% of total damages. Therefore, insurance will give savings of 50% of total flood damages.

8.1.4 Public Flood Awareness Scheme

A public flood awareness scheme as described in Section 7.3.3 could be implemented in a cost effective manner. For the purpose of this study it is estimated that the scheme would cost approximately $25 000 to implement and $4000 per annum to maintain (based on costs documented in the Georges River Floodplain Risk Management Study and Plan).

A public flood awareness scheme will assist the public prepare for flooding and reduce the potential flood damages. Damage will primarily be borne in the direct costs of damage to equipment, stock and furniture, with some savings potentially made to building structures. The short critical storm duration for the catchment will counter much of these potential gains. For the Liverpool CBD, the anticipated savings in flood damage were estimated to be 1%.

8.1.5 Structural Drainage Solutions

The construction cost of the Section A works is approximately $7.11 million, as documented by Liverpool City Council. The major component is the thrust boring of pipes and the amount of traffic control required on busy commercial streets. The costs of GHD’s recommended improvements to Section A, as described in Section 7.6.1, are estimated as:

- Central South Catchment – Additional $141,000; and
- Central North Catchment – Additional $140,000.

These costs were estimated assuming that the work will be carried out in the same construction staging as the other Section A works. This brings the total for Section A of the structural design solution to $7.39 million.

The Section B design is still to be finalised. A preliminary cost estimate for the works as identified thus far is in the order of $2.5 million.

The total (Section A and B works) for the structural design solution is thus estimated to be $9.89 million. Savings in flood damage for Section A works only are considered proportional to the capital costs.

8.2 Assessment of Options

A number of social, economic and environmental issues were considered while assessing the floodplain risk management options. These are listed in Table 15.

Table 15 Social, Economic and Environmental issues for assessing Options

Category	Issues
Social	◗ The capacity of the option to reduce flood hazards and personal safety risks to the community, ◗ How the option will influence property values; ◗ The capacity of the option to promote community growth; and ◗ The level of disruption to the community, either through implementing the option or through the resulting floodplain behaviour.
Economic and Financial	◗ The capital costs associated with implementing the option; ◗ The ongoing or maintenance costs of the option; and ◗ The costs or savings of flood damage after the option is implemented.
Environmental	◗ Change to ecology, habitats, riparian vegetation, and the “natural state” of the river; ◗ Pollution; ◗ Energy and resources required to implement the option ◗ Energy and resources required for maintaining and decommissioning the option.

The above options and issues were rated and weighted as a score of 1 to 5 (where 5 is the best). Details of the assessment matrix and costing are provided in Appendix D. The result of the assessment matrix is listed in Table 16.

Table 16 Floodplain Risk Management Option Assessment Matrix

Option	Benefit/Cost Ratio Factored with Intangible Score
Do Nothing	0
Flood Proofing of Buildings	0.32
Voluntary Purchase of High Hazard Properties	0.07
Flood Insurance and Recovery	0.42
Public Flood Awareness Scheme	0.46
Structural drainage solution – Section A	0.58
Structural drainage solution – Section A+B	0.63

Referring to Table 16, the structural drainage solution with Section A and Section B works result in the highest benefit/cost ratio. Albeit that the cost benefit ratio is less than 1, these options have the highest intangible score.

9. Funding, Implementation and Planning/Development Controls

9.1 Funding

The total cost of implementing the structural works associated with this study is approximately $7.39M (Section A works only) and $9.89M (Section A and B works). There are a variety of sources of funding that could be considered for implementation. These include:

- State funding for flood risk management measures through the Department of Infrastructure, Planning and Natural Resources through the subsidised Flood Mitigation Program;
- Council funds;
- Section 94 contributions from future development where a link can be established between that development and flooding; and
- Contributions from residents or businesses to fund measures from which they will benefit.

Council can expect to receive the majority of financial assistance through the Department of Infrastructure, Planning and Natural Resources. These funds are available to implement measures that contribute to reducing existing flood problems. Funding assistance is usually provided on a 2:1 basis (State:Council). Although much of the proposal may be eligible for Government assistance, funding cannot be guaranteed. Government funds are allocated on an annual basis to competing projects throughout the State. Funding of investigation and design activities as well as any works and on-going programs such as voluntary purchase schemes is normally available.

9.2 Implementation

The next steps in progressing the floodplain management process from this point are:

- The Floodplain Management Committee reviews the comments and submissions received on the draft study;
- Any amendments considered necessary are made, and a final report prepared and submitted to Council for adoption;
- Council determines a program of works, based on overall priority, available Council funds and any other constraints;
- Council submits an application for funding assistance to the Department of Infrastructure, Planning and Natural Resources and negotiates other sources of funding; and
- Implementation of the Plan proceeds, as funds become available and in accordance with established priorities.

9.3 Planning and Development Controls

Flood planning levels (FPLs) are an important tool in the management of flood risk, and are derived from a combination of a flood event of certain AEP and a freeboard. FPLs do not, however, ensure that development is located in areas where it will not have significant adverse impacts on flooding nor do they address personal danger issues.

The decision on appropriate FPLs for commercial and industrial developments would relate more to economic benefits versus costs. Therefore, there is greater potential for FPLs for these developments to be based on event more common that the 1% AEP flood. The greater flexibility of business in managing risk and recovering financially from flooding, means that FPLs for industrial and commercial development may be based upon a more frequent flood events. However, danger to personal safety for personnel and clients still requires careful consideration, particularly where more frequent events are used as the basis for FPLs.

New development and relatively undeveloped areas provide more flexibility in decision making than developed areas. Greenfield sites provide an excellent opportunity to set appropriate FPLs. However, as land is developed, the options for changing its use and management are greatly reduced. This is due to the significant investment, both public and private, in existing development and associated infrastructure, such as buildings, roads, drainage, water supply, sewerage and electricity. The scale of existing investment is frequently such that the development cannot reasonably be abandoned, even if it is does have a high potential for flood damage.

In the context of the Liverpool CBD, key considerations affecting the suitability of planning controls and policies include:

- The significant existing development in the Liverpool CBD;
- The nature of flooding, which is short-duration overland flow due to surcharged pipe systems; and
- The fact that imposing of FPLs would likely not lead to reduction in flood damage costs.

Nevertheless, FPLs and controls could influence future development (and redevelopment) and therefore some benefits will accrue gradually over time. For example, redevelopment of buildings within the CBD, building extensions, or sub-division and redevelopment. In such cases FPLs and controls would determine:

- Floor level requirements;
- Requirements on appropriate freeboard;
- Entry levels to underground car parks and driveways;
- Requirements on flood proofing building;
- Requirements on structural soundness;
- Requirements on flood effects and impacts, in terms of flood storage and changes in flood levels and velocities;

- Appropriate development types, for example critical use facilities not being appropriate; and
- Evacuation requirements.

Based on the above discussion, it is recommended that FPLs and controls be adopted for the Liverpool CBD in particular to manage re-development. These should be along the lines of the Proposed Planning Matrix (other floodplains), provided in Figure 9.3 of the Georges River Floodplain Risk Management Study & Plan[7]. The matrix however should be adjusted to recognise that:

- The flooding in the Liverpool CBD is on account of local overland flow, and not mainstream Georges River flooding; and
- That adjustment of key planning parameters would likely be required to take account of the predominantly commercial land use, for example the frequency of flooding adopted to set FPLs and setting of appropriate freeboard requirements.

[7] Liverpool City Council, 2004b, Georges River Floodplain Risk Management study and Plan, Volume 1 Main Report, May 2004

10. Summary and Conclusions

- GHD Pty Ltd was engaged by Liverpool City Council to prepare a Floodplain Management Study for the Liverpool Central Business District (CBD) in accordance with the NSW Floodplain Management Manual. Key objectives were to review and supplement existing flood data, calculate flood levels, categorise floodplain risk, examine social and economic effects, assess the impact of existing upgrade design proposals, examine planning or policy mitigation measures, develop other management options, provide cost estimates, analyse potential works and measures and undertake a community consultation process;
- The Liverpool Central Business District (CBD) is at risk of extensive overland flooding, potentially affecting commerce and public safety. During larger events, stormwater runoff from within the CBD catchment exceeds the capacity of the existing local stormwater network. This eventuates in flooding of buildings and business premises, which in turn potentially leads to expensive clean-up costs, loss of stock, and loss of revenue;
- Webb McKeown first configured a basic ILSAX stormwater model for the Liverpool CBD. Cardno Willing updated this model in 1993. For this study, to model flood behaviour and to undertake the flood categorisation, these ILSAX models were upgraded and converted to a DRAINS software;
- A number of floodways and flood storage areas have been categorised throughout the Liverpool CBD. The most severely affected areas include Macquarie, George and Moore Streets. Overland flow in these areas has been simulated at depths in excess of 0.5 m in places and these have been designated as High Hazard areas;
- A key objective of the Liverpool CBD Floodplain Management Study was to consult with the community and relevant stakeholders to determine the community's attitude to past flooding, to document anecdotal history about flooding, and to assist in developing recommendations that are suitable and acceptable for the community. Key elements of the consultation process included engaging the stakeholders, undertaking a business community survey, a public meeting and public exhibition and reviewing submissions. A public meeting was held in the Liverpool Council Chambers on the 28th June 2005. Key findings were:
  - Of the sample of 30 businesses surveyed only 6 indicated that they had experienced flood impacts. The low number could be indicative of a change of ownership, tenancy or management; and
  - A small number of businesses were aware of, and had experienced flood impacts. However the majority of surveyed businesses had little awareness of the potential flood impacts to their property;
- Social and economic effects were examined. Key findings were:
  - Whilst a number of businesses and residential areas within the Liverpool CBD have been, and may potentially be impacted by flooding, there is limited indication that the land use within the CBD has been altered as a result; and

  - The degree of social impact caused by flooding is likely to reduce if the community is prepared for a flood event. Given the low level of flood ‘awareness’ and flood ‘readiness’ within the study area, it can be estimated that the social impacts in the Liverpool CBD would be greater than that of a flood aware community.
- A number of flood management options have been investigated:
  - Property Modification: land use planning, house raising or flood proofing of buildings, voluntary purchase of high hazard properties
  - Response Modification: flood warning systems and evacuation plans, flood insurance and recovery, public flood awareness scheme
  - Flood Modification: retro fitting on-site detention tanks and detention basins, structural drainage solutions
- A number of structural drainage solutions have been considered, in this, and other reports. Numerous options and sub options have been investigated, arriving at works which divert flow from the South-East catchment away from the main system in Northumberland Street and diverting flow from the Central-North catchment. A new outlet is provided to the Georges River at Moore Street. The works have been divided into two phases, namely Section A works being trunk conveyance infrastructure, and Section B works being local infrastructure;
- A benefit/cost analysis has been undertaken for appropriate flood management options and issues were rated and weighted. The results show that the two structural drainage solutions (Section A works and both Section A and B works) have highest benefit/cost ratio. These are followed by the public flood awareness scheme;
- Flood planning levels (FPLs) are important tools in the management of flood risk. It is recommended that FPLs and controls be adopted for the Liverpool CBD in particular to manage re-development. These should recognise that flooding in the Liverpool CBD is on account of local overland flow and key planning parameters would need to account for the predominantly commercial land use in the CBD.
- The total cost of implementing the structural works associated with this study is approximately $7.39M (Section A works only) and $9.89M (Section A and B works) A variety of potential funding sources include the Department of Infrastructure, Planning and Natural Resources through the subsidised Flood Mitigation Program, Council funds, Section 94 contributions from future development, contributions from residents or businesses to fund measures from which they will benefit..

11. References

- Liverpool City Council, 1992, Investigation and Design of Liverpool CBD Trunk Drainage, November 1992;
- Liverpool City Council, 1995, CBD Catchment – Drainage Strategy Study – Summary Report, Webb McKeown and Associates, April 1995;
- Liverpool City Council, 2003, Liverpool CBD Trunk Drainage – Concept Design Report", Cardno Willing, October 2003; and
- Liverpool City Council, 2004, Liverpool CBD Trunk Drainage – Detailed Design Report Cardno Willing, June 2004.
- Liverpool City Council, 2004b, Georges River Floodplain Risk Management study and Plan, Volume 1 Main Report, May 2004.
- NSW Gov, 2001, Floodplain Management Manual, Management of Flood Liable Land, January 2001,
- AR&R, Australian Rainfall and Runoff, 2001

Appendix A

Liverpool City Council IFD Rainfall Charts

Liverpool city council
creating our future together

Fax

Organisation:	**GHD**	**Department:**	
Attention:	**Rainer Berg**	**Sender:**	**Steve Martin**
Subject:	**Rainfall Intensity Charts**	**Date:**	**21/10/04**
Fax:	**9239 7197**	**Phone:**	**9821 9254**
Phone:	**9239 7247**	**Pages:**	**3 (including cover)** If all pages are not received, please contact the sender immediately.

Message:

Rainer,

I have enclosed the most up to date charts we have for the subject area.

Regards

Steve Martin

DESIGN RAINFALL INTENSITY DIAGRAM

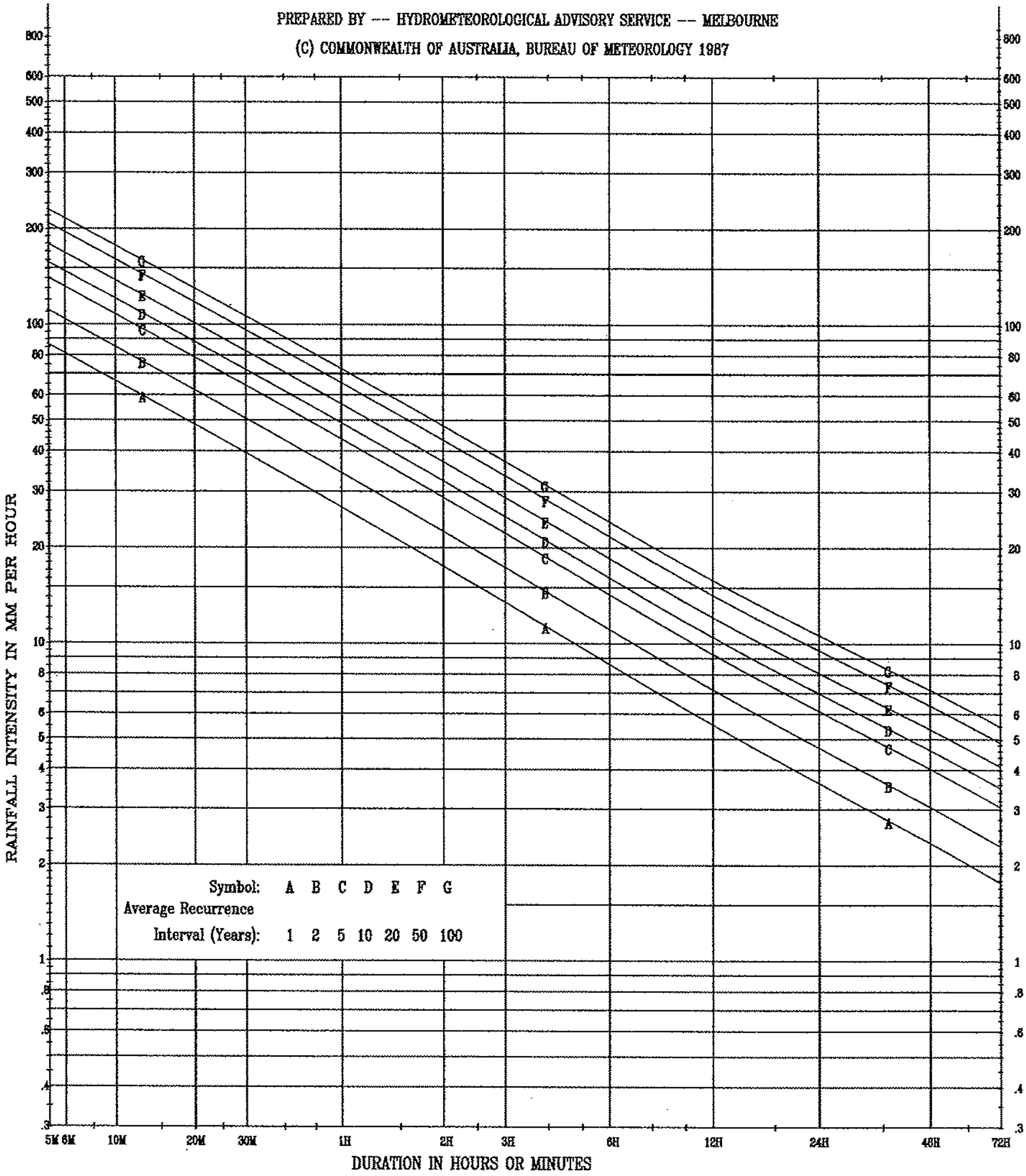
LOCATION 33.925 S 150.975 E * NEAR.. Eastern Georges River

* ENSURE THE COORDINATES ARE THOSE REQUIUIRED,
SINCE DATA IS BASED ON THESE AND NOT THE LOCATION NAME.

ISSUED 18TH DECEMBER 2000 REF.--FN5469

(RAW DATA: 34.46, 7.13, 2.29, 65.75, 14.12, 4.87, .000, 11G)

PREPARED BY --- HYDROMETEOROLOGICAL ADVISORY SERVICE -- MELBOURNE



LOCATION 33.925 S 150.975 E * NEAR.. Eastern Georges River ISSUED 18TH DECEMBER 2000 REF.~FN5469

PREPARED BY -- HYDROMETEOROLOGICAL ADVISORY SERVICE -- MELBOURNE

* ENSURE THE COORDINATES ARE THOSE REQUIURED, SINCE DATA IS BASED ON THESE AND NOT THE LOCATION NAME.

LIST OF COEFFICIENTS TO EQUATIONS OF THE FORM

LN(I) = A + B*(LN(T)) + C*(LN(T))**2 + D*(LN(T))**3 + E*(LN(T))**4 + F*(LN(T)) **5 + G*(LN(T))**6

T = TIME IN HOURS I = INTENSITY IN MILLIMETRES PER HOUR

RETURN PERIOD (YEARS)	A	B	C	D	E	F	G
1	3.2860	-.5919	-.0394	.00708	.001498	-.0001236	-.0000567
2	3.5354	-.5901	-.0395	.00695	.001584	-.0001092	-.0000617
5	3.7771	-.5852	-.0388	.00681	.001599	-.0000906	-.0000632
10	3.8936	-.5821	-.0390	.00621	.001778	-.0000123	-.0000820
20	4.0296	-.5805	-.0388	.00639	.001775	-.0000305	-.0000782
50	4.1830	-.5779	-.0386	.00606	.001848	.0000115	-.0000868
100	4.2850	-.5762	-.0384	.00598	.001863	.0000222	-.0000885

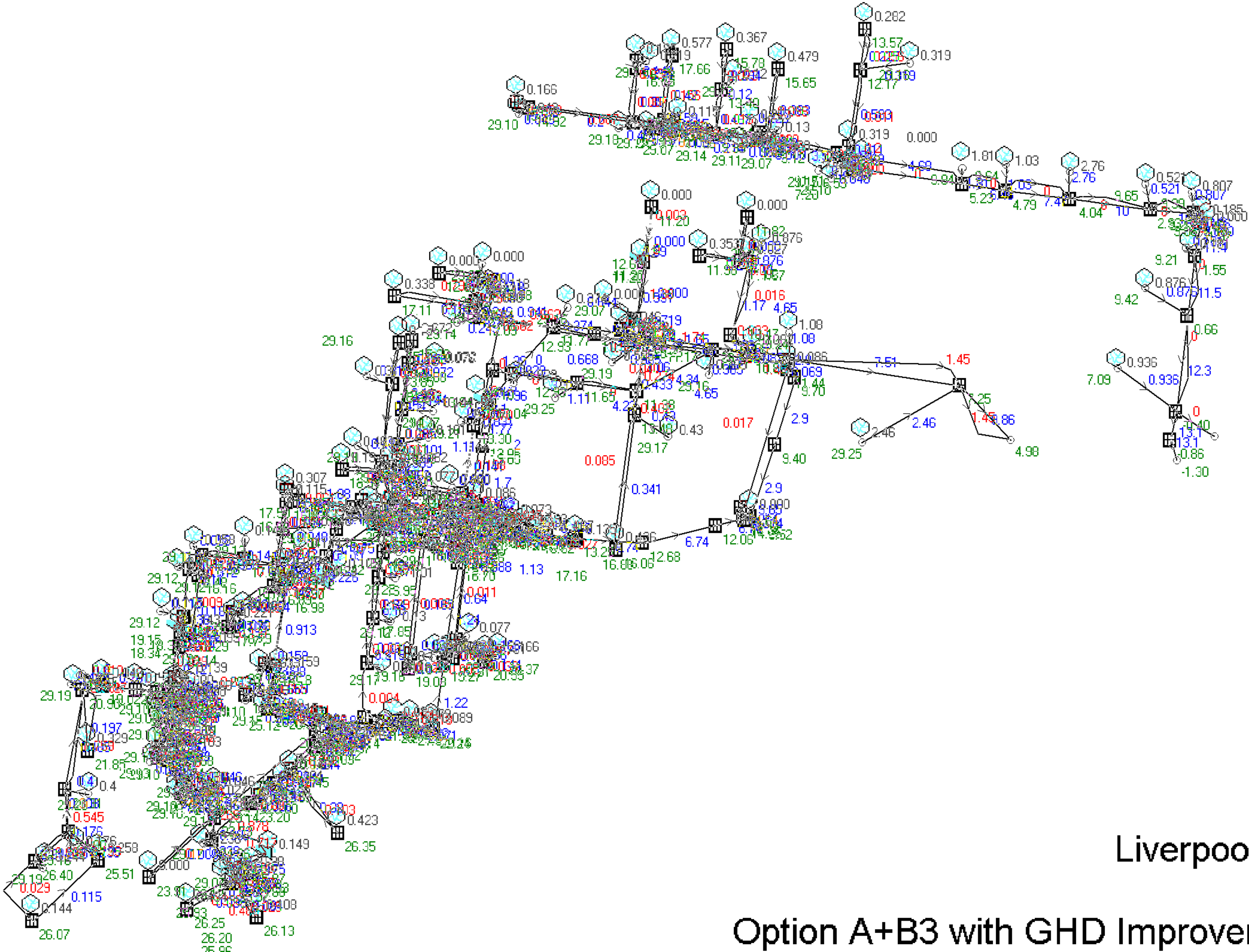
RAINFALL INTENSITY IN MM/HR FOR VARIOUS DURATIONS AND RETURN PERIODS

DURATION (HOURS)	RETURN PERIOD 1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
.083	86.5	111.	140.	157.	179.	208.	230.
.100	81.1	104.	131.	147.	168.	195.	216.
.167	66.4	84.9	108.	120.	138.	160.	177.
.333	48.5	62.1	78.6	88.3	101.	117.	130.
.500	39.5	50.6	64.2	72.0	82.4	95.9	106.
1.000	26.7	34.3	43.7	49.1	56.2	65.6	72.6
2.000	17.5	22.4	28.7	32.3	37.0	43.2	47.9
3.000	13.5	17.3	22.2	25.0	28.7	33.5	37.2
6.000	8.59	11.1	14.2	16.1	18.5	21.6	24.1
12.000	5.54	7.15	9.25	10.5	12.1	14.2	15.8
24.000	3.63	4.69	6.12	6.97	8.07	9.52	10.6
48.000	2.35	3.05	4.02	4.61	5.37	6.37	7.14
72.000	1.76	2.29	3.05	3.50	4.09	4.87	5.47

(RAW DATA: 34.46, 7.13, 2.29, 65.75, 14.12, 4.27, .000, [illegible])

Appendix B

Detailed DRAINS Simulation Results



Liverpool CBD

Option A+B3 with GHD Improvements

DRAINS DATA - OPTION A+B3 WITH GHD IMPROVEMENTS

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
L.2z	OnGrade	Hornsby C	3.6 m lintel (all grades		0.5	16.113		0	0.2	308044.6	6244502	Yes	26	1 x Ku
M.6	OnGrade	Hornsby C	3.6 m lintel (all grades		2	15.798		0	0.2	308079.5	6244497	Yes	27	1 x Ku
A.17	OnGrade	Hornsby C	3.6 m lintel (all grades		0	15.628		0	0.2	308098.2	6244494	No	8002	1 x Ku
A.18	OnGrade	Hornsby C	3.6 m lintel (all grades		3.5	15.302		0	0.2	308151.9	6244487	No	28	1 x Ku
A.18z	OnGrade	Hornsby C	3.6 m lintel (all grades		0.6	15.331		0	0.2	308163.7	6244485	Yes	29	1 x Ku
A.19B	OnGrade	Hornsby C	3.6 m lintel (all grades		3	15.147		0	0.2	308187.3	6244496	Yes	31	1 x Ku
A.19A	OnGrade	Hornsby C	3.6 m lintel (all grades		0	14.13		0	0.2	308198.2	6244570	Yes	4000	1 x Ku
A.L1	OnGrade	Hornsby C	3.6 m lintel (all grades		0.5	14.081		0	0.2	308199.3	6244578	Yes	1784	1 x Ku
AJ.1	OnGrade	Hornsby C	2.4 m lintel (all grades		0.1	13.78		0	0.2	308206.1	6244624	No	624863	1 x Ku
A.19	OnGrade	Hornsby C	3.6 m lintel (all grades		2.5	13.783		0	0.2	308207	6244629	No	32	1 x Ku
A.19z	OnGrade	Hornsby C	3.6 m lintel (all grades		2.5	13.623		0	0.2	308211.6	6244667	Yes	33	1 x Ku
A.20	OnGrade	Hornsby C	3.6 m lintel (all grades		3.5	13.469		0	0.2	308235.5	6244663	No	1785	1 x Ku
A.22	OnGrade	Hornsby C	3.6 m lintel (all grades		0.3	13.369		0	0.2	308319.4	6244650	No	34	1 x Ku
A.23	OnGrade	Hornsby C	3.6 m lintel (all grades		0.1	13.032		0	0.2	308394.6	6244640	No	35	1 x Ku
AP7	Sag	Hornsby C	3.0 m lintel	20	0.6	11.892	0.15	0	0.5	308489.8	6244693	No	10007	1 x Ku
AP8	OnGrade	Hornsby C	3.0 m lintel (all grades		0.6	11.986		0	0	308537.5	6244686	No	10008	1 x Ku
AP9	OnGrade	Junction Pi	Junction - Solid Cover		3.7	12.183		0	0	308588.4	6244680	No	10009	1 x Ku
AP10	OnGrade	Junction Pi	Junction - Solid Cover		0.5	12.495		0	0	308595.1	6244658	No	10010	1 x Ku
AP11	OnGrade	Junction Pi	Junction - Solid Cover		0	13.989		0	0	308570.2	6244572	No	10011	1 x Ku
MS12	OnGrade	Junction Pi	Junction - Solid Cover		0.5	15.344		0	0	308538.4	6244480	No	10012	1 x Ku
MS13	Node					9.5		0		308555.1	6244472		10013	
XE.1	OnGrade	Dummy	Unlimited capacity		4	28.668		0	0.2	307625.3	6243967	No	1781	1 x Ku
XE.2	OnGrade	Dummy	Unlimited capacity		3.3	25.514		0	0.2	307709.2	6244044	No	1782	1 x Ku
XE.4	OnGrade	Hornsby C	3.6 m lintel (all grades		3	24.904		0	0.2	307670.8	6244080	No	2	1 x Ku
XE.5	OnGrade	Hornsby C	3.6 m lintel (all grades		2.3	23.314		0	0.2	307666.9	6244133	No	5	1 x Ku
XE.6	OnGrade	Hornsby C	3.6 m lintel (all grades		3.2	21.067		0	0.2	307689.5	6244260	No	8	1 x Ku
XF.6	OnGrade	Dummy	Unlimited capacity		2.2	20.513		0	0.2	307715.5	6244265	No	9	1 x Ku
XE.O	Node					20.955		0		307689	6244281		2040	
XJ.1	OnGrade	Dummy	Unlimited capacity		4	21.855		0	0.2	307695.6	6244183	No	1783	1 x Ku
X3.1	OnGrade	Hornsby C	3.6 m lintel (all grades		4	19.725		0	0.2	307828.5	6244251	No	1788	1 x Ku
X2.3	OnGrade	Hornsby C	3.6 m lintel (all grades		2	19.682		0	0.2	307817.9	6244252	No	1789	1 x Ku
X1.8	OnGrade	Hornsby C	3.6 m lintel (all grades		3.2	19.751		0	0.2	307802.1	6244255	No	12	1 x Ku
X1.9	OnGrade	Hornsby C	3.6 m lintel (all grades		3.8	19.711		0	0.2	307784.6	6244257	No	11	1 x Ku
XF.5	OnGrade	Dummy	Unlimited capacity		0.9	20.041		0	0.2	307756.7	6244260	No	10	1 x Ku
L.1	OnGrade	Dummy	Unlimited capacity		4	19.156		0	0.2	307948.1	6244514	No	1806	1 x Ku
L.2A	OnGrade	Hornsby C	3.6 m lintel (all grades		2.1	18.516		0	0.2	307965.3	6244501	No	24	1 x Ku
MS1	OnGrade	Junction Pi	Junction - Solid Cover		0.6	16.296		0	0	308033.7	6244492	No	10050	1 x Ku
MS2	OnGrade	Hornsby C	3.0 m lintel (all grades		0.8	15.77		0	0.2	308054.4	6244487	No	10051	1 x Ku
MS3	OnGrade	Junction Pi	Junction - Solid Cover		1.6	15.773		0	0	308059.8	6244486	No	10035	1 x Ku
MS4	OnGrade	Junction Pi	Junction - Solid Cover		0.7	15.698		0	0	308076	6244485	Yes	10016	1 x Ku
MS - GPT	OnGrade	Junction Pi	Junction - Solid Cover		0.5	15.53		0	0	308086.6	6244483	No	10017	1 x Ku
MS5	OnGrade	Hornsby C	3.0 m lintel (all grades		0.5	15.32		0	0	308141.3	6244476	No	10018	1 x Ku
MS6	Sag	Hornsby C	2.4 m lintel	11	0	15.236	0.18	0	0.5	308155.4	6244475	No	10019	1 x Ku
MS7	OnGrade	Junction Pi	Junction - Solid Cover		1.7	15.758		0	0	308188	6244471	No	10020	1 x Ku
MS8	OnGrade	Dummy	Unlimited capacity		1.7	16.488		0	0	308254.5	6244462	No	10021	1 x Ku
MS9	OnGrade	Junction Pi	Junction - Solid Cover		0.5	17.218		0	0	308317.1	6244453	No	10022	1 x Ku
MS10	OnGrade	Junction Pi	Junction - Solid Cover		0.5	17.588		0	0	308402.1	6244447	No	10023	1 x Ku
MS11	OnGrade	Junction Pi	Junction - Solid Cover		0.5	16		0	0	308494.1	6244470	No	10024	1 x Ku
N.1	OnGrade	Dummy	Unlimited capacity		4	16.533		0	0.2	308108.5	6244704	No	1813	1 x Ku
N.2	OnGrade	Hornsby C	3.6 m lintel (all grades		1.3	16.424		0	0.2	308104.6	6244675	No	1814	1 x Ku
N.3	OnGrade	Hornsby C	3.6 m lintel (all grades		2	16.308		0	0.2	308095.6	6244617	No	1815	1 x Ku
N.4	OnGrade	Hornsby C	3.6 m lintel (all grades		1.1	16		0	0.2	308090.5	6244573	No	1816	1 x Ku
N.5	OnGrade	Hornsby C	3.6 m lintel (all grades		0.7	16		0	0.2	308086.1	6244543	No	1817	1 x Ku
M.5	OnGrade	Hornsby C	3.6 m lintel (all grades		0	15.864		0	0.2	308081	6244504	No	1827	1 x Ku
M.1	OnGrade	Dummy	Unlimited capacity		4	16.766		0	0.2	308092.5	6244702	No	1819	1 x Ku
M.2	OnGrade	Hornsby C	3.6 m lintel (all grades		2.9	16.642		0	0.2	308083.7	6244649	No	1820	1 x Ku
M.3	OnGrade	Hornsby C	3.6 m lintel (all grades		2.1	16		0	0.2	308070.8	6244551	No	1821	1 x Ku
M.4	OnGrade	Hornsby C	3.6 m lintel (all grades		2.4	15.913		0	0.2	308069.1	6244538	No	1825	1 x Ku
LR.3	OnGrade	Dummy	Unlimited capacity		4	17.099		0	0.2	308019.5	6244540	No	1822	1 x Ku
P.4	OnGrade	Dummy	Unlimited capacity		4	15.475		0	0.2	308189.7	6244495	No	1836	1 x Ku
P.1	OnGrade	Dummy	Unlimited capacity		4	20.721		0	0.2	308160.8	6244301	No	1838	1 x Ku
P.2	OnGrade	Hornsby C	3.6 m lintel (all grades		2.5	19.629		0	0.2	308164.6	6244323	No	1845	1 x Ku
SS7	OnGrade	Junction Pi	Junction - Solid Cover		0	16.156		0	0	308178.3	6244447	No	10038	1 x Ku
SS - GPT	OnGrade	Junction Pi	Junction - Solid Cover		0.5	15.944		0	0	308179.3	6244455	No	10039	1 x Ku
SS8	OnGrade	Junction Pi	Junction - Solid Cover		1.5	15.868		0	0	308180.1	6244462	No	10032	1 x Ku
Q.1	OnGrade	Dummy	Unlimited capacity		4	21.066		0	0.2	308203.3	6244297	No	1839	1 x Ku
Q.2	OnGrade	Hornsby C	3.6 m lintel (all grades		2.8	21.109		0	0.2	308199.4	6244304	No	1842	1 x Ku
R.1D	OnGrade	Dummy	Unlimited capacity		4	20.857		0	0.2	308104.8	6244288	No	1848	1 x Ku
R.1C	OnGrade	Hornsby C	3.6 m lintel (all grades		2.9	20.351		0	0.2	308107.7	6244306	No	1849	1 x Ku
R.1B	OnGrade	Hornsby C	3.6 m lintel (all grades		2	16.476		0	0.2	308123.7	6244448	No	1855	1 x Ku
R.1A	OnGrade	Hornsby C	3.6 m lintel (all grades		0.8	16.241		0	0.2	308138.2	6244445	No	1856	1 x Ku
EX R2A	Sag	Hornsby C	3.0 m lintel	10	1.3	15.91	0.15	0	0.5	308164.3	6244439	No	10063	1 x Ku
SS6	OnGrade	Junction Pi	Junction - Solid Cover		1.2	16.242		0	0	308169.2	6244439	No	10037	1 x Ku
A.5z	OnGrade	Dummy	Unlimited capacity		0.5	25.645		0	0.2	307773.9	6244022	No	1876	1 x Ku
A.5	OnGrade	Hornsby C	3.6 m lintel (all grades		2.6	23.535		0	0.2	307856.6	6244098	No	1887	1 x Ku
A.6	OnGrade	Dummy	Unlimited capacity		0.6	21.938		0	0.2	307986.1	6244208	No	1888	1 x Ku
A.6z	OnGrade	Hornsby C	3.6 m lintel (all grades		3.5	21.03		0	0.2	307992	6244230	Yes	1910	1 x Ku
A.11	OnGrade	Hornsby C	3.6 m lintel (all grades		2	20.324		0	0.2	307942.7	6244235	No	1911	1 x Ku
A.12	OnGrade	Hornsby C	3.6 m lintel (all grades		3.7	20.12		0	0.2	307925.9	6244237	No	1912	1 x Ku

A.12z	OnGrade	Hornsby C	3.6 m lintel (all grades	1.2	19.62	0	0.2	307927.5	6244251	No	1915	1 x Ku
A.13	OnGrade	Hornsby C	3.6 m lintel (all grades	2.3	18.535	0	0.2	307932.2	6244291	No	1916	1 x Ku
A.14	OnGrade	Hornsby C	2.4 m lintel (all grades	3.1	17.3	0	0.2	307948.3	6244401	No	624839	1 x Ku
A.15	OnGrade	Hornsby C	3.6 m lintel (all grades	2	17.061	0	0.2	307999.2	6244430	No	1931	1 x Ku
EX A15A	OnGrade	Junction Pi	Junction - Solid Cover	0.5	15.913	0	0	308059.4	6244472	Yes	10014	1 x Ku
EX A15B	OnGrade	Junction Pi	Junction - Solid Cover	0.5	15.754	0	0	308072.8	6244483	Yes	10015	1 x Ku
A.A1	OnGrade	Dummy	Unlimited capacity	4	26.125	0	0.2	307910.5	6243972	No	1877	1 x Ku
A.2	OnGrade	Hornsby C	2.4 m lintel (all grades	2.4	25.926	0	0.2	307885.8	6244018	No	624766	1 x Ku
A.3	OnGrade	Hornsby C	3.6 m lintel (all grades	3.5	25.576	0	0.2	307880	6244030	No	1884	1 x Ku
A.4	OnGrade	Hornsby C	3.6 m lintel (all grades	3.4	24.061	0	0.2	307854.1	6244070	No	1886	1 x Ku
AB.1	OnGrade	Hornsby C	3.6 m lintel (all grades	4	25.934	0	0.2	307904.1	6244027	No	1879	1 x Ku
A.1	OnGrade	Dummy	Unlimited capacity	4	26.25	0	0.2	307822.3	6243982	No	1880	1 x Ku
A.2A	OnGrade	Hornsby C	3.6 m lintel (all grades	2.6	25.966	0	0.2	307879.3	6244015	No	1881	1 x Ku
c.1	OnGrade	Dummy	Unlimited capacity	4	26.347	0	0.2	308014	6244079	No	1890	1 x Ku
B.4A	OnGrade	Hornsby C	3.6 m lintel (all grades	2.6	22.452	0	0.2	307954.1	6244160	No	1896	1 x Ku
B.4	OnGrade	Hornsby C	3.6 m lintel (all grades	2.6	22.031	0	0.2	307986.9	6244189	No	1898	1 x Ku
B.5A	OnGrade	Hornsby C	3.6 m lintel (all grades	2.4	22.084	0	0.2	307995.9	6244195	No	1899	1 x Ku
B.5	OnGrade	Hornsby C	3.6 m lintel (all grades	3.7	21.972	0	0.2	308008.5	6244203	No	1908	1 x Ku
B.5z	OnGrade	Dummy	Unlimited capacity	0.5	21.884	0	0.2	308000.6	6244216	No	1909	1 x Ku
J.1	OnGrade	Hornsby C	3.6 m lintel (all grades	4	18.706	0	0.2	307875.5	6244340	No	1919	1 x Ku
J.1z	OnGrade	Hornsby C	3.6 m lintel (all grades	2.9	18.572	0	0.2	307880.5	6244358	No	1922	1 x Ku
J.2	OnGrade	Hornsby C	3.6 m lintel (all grades	2.4	17.668	0	0.2	307932.7	6244392	No	1923	1 x Ku
K.1	OnGrade	Dummy	Unlimited capacity	4	18.595	0	0.2	307882.6	6244344	No	1921	1 x Ku
AG.1	OnGrade	Dummy	Unlimited capacity	4	16.995	0	0.2	308012.5	6244466	No	1928	1 x Ku
AH.1z	OnGrade	Dummy	Unlimited capacity	4	16	0	0.2	308113.6	6244516	No	1947	1 x Ku
AH.1	OnGrade	Hornsby C	3.6 m lintel (all grades	3.5	15.213	0	0.2	308173	6244510	No	1949	1 x Ku
AH.2	OnGrade	Hornsby C	3.6 m lintel (all grades	3.4	13.971	0	0.2	308186.4	6244598	No	1951	1 x Ku
T.1	OnGrade	Dummy	Unlimited capacity	4	17.115	0	0.2	308087.2	6244762	No	1952	1 x Ku
T.2z	OnGrade	Hornsby C	3.6 m lintel (all grades	3.9	14.423	0	0.2	308188.5	6244746	No	1954	1 x Ku
T.2	OnGrade	Hornsby C	3.6 m lintel (all grades	2.7	13.982	0	0.2	308195	6244736	No	1955	1 x Ku
AP2	OnGrade	Junction Pi	Junction - Solid Cover	1.6	12.814	0	0	308288.1	6244721	No	10001	1 x Ku
AP - GPT	OnGrade	Junction Pi	Junction - Solid Cover	0.5	12.544	0	0	308340.6	6244714	No	10002	1 x Ku
AP3	OnGrade	Junction Pi	Junction - Solid Cover	1.9	12.318	0	0	308384.9	6244708	No	10003	1 x Ku
AP5	OnGrade	Junction Pi	Junction - Solid Cover	1.4	12.267	0	0	308404.8	6244707	No	10005	1 x Ku
AP6	OnGrade	Junction Pi	Junction - Solid Cover	0.5	12.105	0	0	308423.7	6244702	No	10006	1 x Ku
U.1y	OnGrade	Dummy	Unlimited capacity	0.5	16.298	0	0.2	308143.6	6244790	No	1956	1 x Ku
U.1z	OnGrade	Hornsby C	3.6 m lintel (all grades	3.5	15.223	0	0.2	308194.9	6244783	No	1958	1 x Ku
U.1	OnGrade	Hornsby C	3.6 m lintel (all grades	2	14.672	0	0.2	308190.3	6244754	No	1959	1 x Ku
Z.1	OnGrade	Dummy	Unlimited capacity	4	17.821	0	0.2	308368.8	6244439	No	1972	1 x Ku
V.1	OnGrade	Hornsby C	3.6 m lintel (all grades	2.8	13.479	0	0.2	308391.4	6244610	No	1974	1 x Ku
W.1z	OnGrade	Dummy	Unlimited capacity	0.5	13.249	0	0.2	308413.7	6244874	No	1976	1 x Ku
W.1	OnGrade	Hornsby C	2.4 m lintel (all grades	2.5	12.353	0	0.2	308404.1	6244805	No	624885	1 x Ku
W.1y	OnGrade	Hornsby C	3.6 m lintel (all grades	2.9	12.114	0	0.2	308393.6	6244732	No	1979	1 x Ku
W.3z	OnGrade	Dummy	Unlimited capacity	0.5	12.54	0	0.2	308534.9	6244862	No	1981	1 x Ku
W.3	OnGrade	Hornsby C	3.6 m lintel (all grades	1.6	11.989	0	0.2	308526.5	6244806	No	1984	1 x Ku
W.3y	OnGrade	Dummy	Unlimited capacity	2.5	11.942	0	0.2	308536.1	6244805	No	1985	1 x Ku
EX ESF1	OnGrade	Hornsby C	2.4 m lintel (all grades	2	11.614	0	0.2	308514	6244711	No	10062	1 x Ku
W.2	OnGrade	Dummy	Unlimited capacity	4	11.98	0	0.2	308474.1	6244812	No	1983	1 x Ku
NA.1	OnGrade	Dummy	Unlimited capacity	4	17.813	0	0.2	308242.8	6245009	No	1989	1 x Ku
NA.2	OnGrade	Hornsby C	3.6 m lintel (all grades	1.4	17.441	0	0.2	308256.5	6245001	No	1990	1 x Ku
NA.3	OnGrade	Hornsby C	3.6 m lintel (all grades	1.9	15.63	0	0.2	308389.6	6244982	No	1994	1 x Ku
NA.4	OnGrade	Hornsby C	3.6 m lintel (all grades	2.8	15.474	0	0.2	308416.9	6244974	No	1996	1 x Ku
NA.5	OnGrade	Hornsby C	3.6 m lintel (all grades	3.2	15.767	0	0.2	308429.1	6244984	No	1998	1 x Ku
NA.6	OnGrade	Hornsby C	3.6 m lintel (all grades	2.7	15.778	0	0.2	308443.2	6244982	No	1999	1 x Ku
NA.6z	OnGrade	Hornsby C	3.6 m lintel (all grades	2.5	15.825	0	0.2	308446.5	6244973	No	2000	1 x Ku
NA.7	OnGrade	Hornsby C	3.6 m lintel (all grades	1.9	15.307	0	0.2	308494	6244967	No	2003	1 x Ku
NA.9	OnGrade	Hornsby C	3.6 m lintel (all grades	2.6	14.605	0	0.2	308542.9	6244961	No	2005	1 x Ku
NA.10	OnGrade	Hornsby C	3.6 m lintel (all grades	2.6	14.669	0	0.2	308549.5	6244968	No	2006	1 x Ku
NA.11	OnGrade	Hornsby C	3.6 m lintel (all grades	0.8	14.263	0	0.2	308562.2	6244964	No	2009	1 x Ku
NA.11z	OnGrade	Hornsby C	3.6 m lintel (all grades	2.1	13.963	0	0.2	308568.5	6244955	No	2010	1 x Ku
NA.12	OnGrade	Hornsby C	3.6 m lintel (all grades	2.6	11.944	0	0.2	308650.7	6244943	No	2011	1 x Ku
NA.13	OnGrade	Hornsby C	3.6 m lintel (all grades	0.7	11.657	0	0.2	308656.9	6244932	No	2012	1 x Ku
Pit22	OnGrade	Dummy	Unlimited capacity	0.8	11.586	0	0.2	308670.5	6244922	No	624755	1 x Ku
NA.15	OnGrade	Hornsby C	3.6 m lintel (all grades	0.8	10	0	0.2	308808.4	6244904	No	2018	1 x Ku
NA.17	OnGrade	Hornsby C	3.6 m lintel (all grades	1.1	10	0	0.2	308863	6244895	No	2019	1 x Ku
NA.18	OnGrade	Hornsby C	3.6 m lintel (all grades	0.9	10	0	0.2	308944.4	6244885	No	2020	1 x Ku
NA.20	OnGrade	Hornsby C	3.6 m lintel (all grades	0.7	8.463	0	0.2	309047.9	6244871	Yes	2021	1 x Ku
NA.19	OnGrade	Hornsby C	3.6 m lintel (all grades	1.7	8.66	0	0.2	309103.8	6244867	Yes	2022	1 x Ku
NA.21	OnGrade	Hornsby C	3.6 m lintel (all grades	0.6	8.7	0	0.2	309107.3	6244862	Yes	2023	1 x Ku
NA.21z	OnGrade	Hornsby C	3.6 m lintel (all grades	0.5	8.759	0	0.2	309111.5	6244854	Yes	2024	1 x Ku
NA.22	OnGrade	Hornsby C	3.6 m lintel (all grades	0.6	9.041	0	0.2	309104.6	6244812	Yes	2025	1 x Ku
NA.23	OnGrade	Hornsby C	3.6 m lintel (all grades	0.2	9.448	0	0.2	309095.2	6244737	Yes	2026	1 x Ku
NA.24	OnGrade	Hornsby C	3.6 m lintel (all grades	0.7	10	0	0.2	309080.7	6244615	Yes	2027	1 x Ku
NA.24z	OnGrade	Hornsby C	3.6 m lintel (all grades	0.5	10	0	0.2	309073.5	6244579	Yes	2028	1 x Ku
N.AO	Node				1.489	0		309081	6244553		2029	
NB.1	OnGrade	Dummy	Unlimited capacity	4	17.009	0	0.2	308395.3	6245060	No	1991	1 x Ku
NB.2	OnGrade	Hornsby C	3.6 m lintel (all grades	2.1	16.882	0	0.2	308394.4	6245052	No	1992	1 x Ku
ND.1	OnGrade	Dummy	Unlimited capacity	4	17.658	0	0.2	308439.4	6245067	No	1997	1 x Ku
NF.1	OnGrade	Dummy	Unlimited capacity	4	17.675	0	0.2	308509.4	6245075	No	2001	1 x Ku
NF.2	OnGrade	Hornsby C	3.6 m lintel (all grades	1.3	16.563	0	0.2	308502.6	6245024	No	2002	1 x Ku
NH.1	OnGrade	Dummy	Unlimited capacity	4	16.307	0	0.2	308574.4	6245050	No	2008	1 x Ku
NJ.1	OnGrade	Dummy	Unlimited capacity	4	13.956	0	0.2	308685.6	6245101	No	2013	1 x Ku
NJ.2	OnGrade	Hornsby C	3.6 m lintel (all grades	1.4	13.072	0	0.2	308679.2	6245049	No	2014	1 x Ku
NJ.3	OnGrade	Hornsby C	3.6 m lintel (all grades	1	12.038	0	0.2	308664.5	6244951	No	2015	1 x Ku
O XE.6	Node				21.067	0		307686.3	6244279		8027	

N361	Node				30	0		309128.9	6244583		476728	
N365	Node				30	0		308237.7	6244651		588808	
N428	Node				30	0		307638.6	6244033		588881	
XZ.1	OnGrade	Hornsby C 3.6 m lintel (all grades		2.2	26.926	0	0.2	307629.2	6244042	No	1	1 x Ku
N429	Node				30	0		307674.1	6244059		588888	
N430	Node				30	0		307696.3	6244128		588899	
N434	Node				30	0		307673.8	6244268		588915	
N439	Node				30	0		307839	6244123		588922	
X1.2	OnGrade	Hornsby C 3.6 m lintel (all grades		3.9	22.314	0	0.2	307830.6	6244125	No	1790	1 x Ku
X1.3	OnGrade	Hornsby C 3.6 m lintel (all grades		3.6	21.991	0	0.2	307817.2	6244142	No	1793	1 x Ku
X1.4	OnGrade	Hornsby C 3.6 m lintel (all grades		2.9	21.24	0	0.2	307796.5	6244171	No	1794	1 x Ku
X1.5	OnGrade	Hornsby C 3.6 m lintel (all grades		2.5	20.66	0	0.2	307794.7	6244195	No	1798	1 x Ku
X1.6	OnGrade	Hornsby C 3.6 m lintel (all grades		1.5	20.378	0	0.2	307796	6244217	No	1799	1 x Ku
X1.7	OnGrade	Hornsby C 3.6 m lintel (all grades		0.7	19.989	0	0.2	307799.8	6244238	No	1800	1 x Ku
N440	Node				30	0		307816.5	6244118		588930	
X5.1	OnGrade	Hornsby C 3.6 m lintel (all grades		2.7	22.342	0	0.2	307822	6244125	No	1791	1 x Ku
X5.2	OnGrade	Hornsby C 3.6 m lintel (all grades		4.3	22.141	0	0.2	307814.5	6244130	No	1792	1 x Ku
N441	Node				30	0		307855.9	6244136		588933	
X1.1	OnGrade	Dummy	Unlimited capacity	2	21.737	0	0.2	307850.1	6244137	No	8001	1 x Ku
N442	Node				30	0		307809	6244127		588939	
N443	Node				30	0		307822.2	6244144		588945	
N444	Node				30	0		307788.2	6244167		588948	
N445	Node				30	0		307775.3	6244169		588956	
X4.1	OnGrade	Hornsby C 3.6 m lintel (all grades		2.9	21.258	0	0.2	307786.1	6244174	No	1796	1 x Ku
X4.2	OnGrade	Hornsby C 3.6 m lintel (all grades		1.2	20.874	0	0.2	307788.4	6244188	No	1797	1 x Ku
N446	Node				30	0		307780.6	6244190		588964	
N447	Node				30	0		307815.1	6244188		588967	
X6.1	OnGrade	Hornsby C 3.6 m lintel (all grades		3.1	20.682	0	0.2	307808.6	6244188	No	1795	1 x Ku
N448	Node				30	0		307803.4	6244196		588979	
N449	Node				30	0		307786	6244218		588984	
N450	Node				30	0		307821.5	6244227		588987	
X2.1	OnGrade	Hornsby C 3.6 m lintel (all grades		3.4	20.011	0	0.2	307814.4	6244227	No	1786	1 x Ku
X 2.2	OnGrade	Hornsby C 2.4 m lintel (all grades		2.5	19.84	0	0.2	307818.2	6244241	No	624794	1 x Ku
N452	Node				30	0		307786.6	6244238		588995	
N454	Node				30	0		307819.9	6244250		589012	
N455	Node				30	0		307802.9	6244264		589015	
N456	Node				30	0		307774.2	6244250		589026	
N457	Node				30	0		307818.7	6244277		589027	
G.1	OnGrade	Hornsby C 3.6 m lintel (all grades		2.9	19.352	0	0.2	307806.4	6244277	No	13	1 x Ku
G.2A	OnGrade	Hornsby C 3.6 m lintel (all grades		3.3	19.149	0	0.2	307811.7	6244315	No	14	1 x Ku
G.2	OnGrade	Hornsby C 2.4 m lintel (all grades		2.6	18.3	0	0.2	307814.2	6244335	No	624820	1 x Ku
G.2z	OnGrade	Hornsby C 3.6 m lintel (all grades		2.5	19.345	0	0.2	307827	6244333	Yes	16	1 x Ku
G.3	OnGrade	Hornsby C 3.6 m lintel (all grades		2.1	18.797	0	0.2	307837.7	6244406	No	17	1 x Ku
G.4	OnGrade	Hornsby C 3.6 m lintel (all grades		2	18.571	0	0.2	307841.6	6244431	No	18	1 x Ku
G.5	OnGrade	Hornsby C 3.6 m lintel (all grades		1	18.173	0	0.2	307894.9	6244427	No	20	1 x Ku
G.6	OnGrade	Hornsby C 3.6 m lintel (all grades		2	17.852	0	0.2	307938.3	6244420	No	21	1 x Ku
G.6A	OnGrade	Hornsby C 3.6 m lintel (all grades		1.7	18.576	0	0.2	307944.7	6244465	No	22	1 x Ku
G.7	OnGrade	Dummy	Unlimited capacity	2.2	18.993	0	0.2	307949	6244500	No	23	1 x Ku
N458	Node				30	0		307830.1	6244314		589033	
N460	Node				30	0		307787	6244361		589045	
H.1	OnGrade	Hornsby C 3.6 m lintel (all grades		4	19.1	0	0.2	307817.6	6244353	No	8000	1 x Ku
N461	Node				30	0		307846	6244405		589048	
N462	Node				30	0		307811.5	6244417		589053	
I.1	OnGrade	Hornsby C 3.6 m lintel (all grades		0.7	18.855	0	0.2	307825.6	6244414	No	8003	1 x Ku
N463	Node				30	0		307829.2	6244444		589057	
N464	Node				30	0		307896.2	6244452		589060	
N468	Node				30	0		307892.9	6244355		589069	
N469	Node				30	0		307938.3	6244386		589073	
N472	Node				30	0		307869.5	6244015		589088	
N473	Node				30	0		307870.8	6244029		589093	
N475	Node				30	0		307842.7	6244066		589100	
N476	Node				30	0		307855.3	6244108		589105	
N477	Node				30	0		307914.3	6244113		589108	
B.1	OnGrade	Hornsby C 3.6 m lintel (all grades		3.4	23.205	0	0.2	307905.1	6244116	No	1893	1 x Ku
B.2	OnGrade	Hornsby C 3.6 m lintel (all grades		3.2	22.997	0	0.2	307915.1	6244126	No	1894	1 x Ku
B.3	OnGrade	Hornsby C 3.6 m lintel (all grades		2.9	22.692	0	0.2	307933	6244141	No	8005	1 x Ku
N478	Node				30	0		307923.8	6244121		589112	
N479	Node				30	0		307941.1	6244136		589116	
N480	Node				30	0		307952.6	6244152		589120	
N481	Node				30	0		307996.9	6244181		589124	
N482	Node				30	0		308008.7	6244190		589129	
N483	Node				30	0		308019.6	6244198		589134	
N488	Node				30	0		307939.8	6244230		589141	
N489	Node				30	0		307918	6244236		589147	
N490	Node				30	0		307896.5	6244247		589150	
K.1A	OnGrade	Hornsby C 3.6 m lintel (all grades		2	19.734	0	0.2	307896.3	6244255	No	1914	1 x Ku
N491	Node				30	0		307916	6244284		589155	
AD.1	OnGrade	Hornsby C 3.6 m lintel (all grades		2	18.544	0	0.2	307921.2	6244293	No	8004	1 x Ku
N492	Node				30	0		307939.4	6244289		589161	
N493	Node				30	0		308134.1	6244301		589164	
N494	Node				30	0		308215.9	6244303		589168	
N495	Node				30	0		308176.3	6244329		589172	
N496	Node				30	0		308067.9	6244206		589176	
D.2	OnGrade	Hornsby C 3.6 m lintel (all grades		2.2	21.689	0	0.2	308065.7	6244219	No	1904	1 x Ku
N497	Node				30	0		308067.9	6244288		589180	

O.1	OnGrade	Hornsby C 3.6 m lintel (all grades	4	19.747	0	0.2	308051.7	6244295	No	1936	1 x Ku
O.2	OnGrade	Hornsby C 3.6 m lintel (all grades	2.1	17.846	0	0.2	308059.6	6244351	No	1939	1 x Ku
O.3	OnGrade	Hornsby C 3.6 m lintel (all grades	2.5	16.953	0	0.2	308066.7	6244404	No	1942	1 x Ku
O.4	OnGrade	Hornsby C 3.6 m lintel (all grades	1.8	16.42	0	0.2	308072	6244436	No	1943	1 x Ku
O.5	OnGrade	Hornsby C 3.6 m lintel (all grades	1.7	15.957	0	0.2	308073.7	6244465	No	1944	1 x Ku
N498	Node			30	0		308081.6	6244347		589184	
N499	Node			30	0		308087.1	6244403		589188	
N500	Node			30	0		308091	6244436		589192	
N501	Node			30	0		307963.8	6244439		589196	
N502	Node			30	0		308009.2	6244409		589201	
N505	Node			30	0		307979.4	6244467		589207	
N509	Node			30	0		308088.4	6244469		589214	
N510	Node			30	0		308113.3	6244454		589223	
N511	Node			30	0		308135.1	6244438		589227	
N520	Node			30	0		308154.4	6244480		589260	
N521	Node			30	0		308163.4	6244480		589261	
N522	Node			30	0		308017.8	6244487		589270	
N525	Node			30	0		308091.4	6244503		589276	
N527	Node			30	0		308076.5	6244544		589285	
N528	Node			30	0		308038.4	6244571		589289	
N529	Node			30	0		308095.3	6244547		589295	
N530	Node			30	0		308050.5	6244659		589299	
N531	Node			30	0		308137.9	6244676		589300	
N532	Node			30	0		308134.1	6244615		589301	
N533	Node			30	0		308128.9	6244582		589302	
N534	Node			30	0		308159.9	6244518		589321	
N535	Node			30	0		308171.3	6244601		589326	
N537	Node			30	0		308289.8	6244633		589340	
N538	Node			30	0		308433.9	6244582		589345	
N540	Node			30	0		308197.4	6244802		589355	
N541	Node			30	0		308195.1	6244748		589359	
N542	Node			30	0		308208.6	6244768		589368	
U.1A	OnGrade	Hornsby C 3.6 m lintel (all grades	4	14.77	0	0.2	308213	6244781	No	1957	1 x Ku
N543	Node			30	0		308165.2	6244728		589372	
N544	Node			30	0		308305.5	6244747		589376	
N547	Node			30	0		308353.8	6244757		589391	
N550	Node			30	0		308362.8	6244677		589399	
N551	Node			30	0		308485.8	6244661		589403	
N555	Node			30	0		308553	6244829		589410	
N560	Node			30	0		308539.8	6244697		589425	
N561	Node			30	0		308587.9	6244714		589432	
N562	Node			30	0		308680.4	6244575		589435	
A.26	OnGrade	Hornsby C 3.6 m lintel (all grades	0.7	10.839	0	0.2	308805.6	6244648	Yes	40	1 x Ku
A.O	Node			0	0		308870.2	6244578		41	
N564	Node			30	0		308243	6244994		589440	
N565	Node			30	0		308405.9	6245061		589444	
N566	Node			30	0		308372	6244974		589448	
N567	Node			30	0		308408.4	6244971		589453	
N568	Node			30	0		308430.5	6244970		589457	
N569	Node			30	0		308446.1	6244996		589461	
N570	Node			30	0		308441.1	6244962		589466	
N571	Node			30	0		308483.9	6244954		589472	
N572	Node			30	0		308516.3	6245035		589475	
N573	Node			30	0		308528.1	6244949		589480	
N574	Node			30	0		308543.2	6244983		589484	
N575	Node			30	0		308573.1	6244971		589489	
N576	Node			30	0		308565.6	6244944		589497	
N577	Node			30	0		308626	6244920		589501	
N578	Node			30	0		308641.3	6244911		589502	
N580	Node			30	0		308741.1	6245058		589518	
N1864280	Node			13.2	0		308226.9	6244728		4417924	
EX CSA1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	12.168	0	0.2	308585.8	6244668	No	10026	1 x Ku
EX ESA1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	12.177	0	0.2	308375	6244719	No	10027	1 x Ku
EX ESB1	OnGrade	Dummy Unlimited capacity	4	12.278	0	0	308384.8	6244706	No	10028	1 x Ku
EX GSA1	OnGrade	Hornsby C 1.2 m lintel (all grades	4	15.556	0	0.2	308171	6244463	No	10031	1 x Ku
EX MA1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	15.767	0	0.2	308061.7	6244477	No	10033	1 x Ku
EX MA2	OnGrade	Junction Pi Junction - Solid Cover	0.5	15.719	0	0	308060	6244484	No	10034	1 x Ku
EX R1	OnGrade	Hornsby C 2.4 m lintel (all grades	4	16.217	0	0.2	308166.4	6244430	No	10036	1 x Ku
EX S1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	17.251	0	0.2	308315.1	6244451	No	10040	1 x Ku
EX S2	OnGrade	Hornsby C 3.0 m lintel (all grades	2.1	16.876	0	0.2	308280.5	6244456	No	10041	1 x Ku
S3	OnGrade	Hornsby C 1.8 m lintel (all grades	1.8	16.666	0	0.2	308266.5	6244458	No	10042	1 x Ku
EX SA1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	16.145	0	0.2	308235.3	6244474	No	10043	1 x Ku
MSA2	OnGrade	Sutherland Grated pit with 0.9 m ›	2.1	16.077	0	0.2	308228.1	6244463	No	10044	1 x Ku
MSA3	OnGrade	Sutherland Grated pit with 0.9 m ›	1.3	16.063	0	0.2	308216.3	6244465	No	10045	1 x Ku
MSA4	OnGrade	Sutherland Grated pit with 0.9 m ›	0.6	15.996	0	0.2	308204.4	6244466	No	10046	1 x Ku
MSA5	OnGrade	Hornsby C 0.9 m lintel (all grades	1	15.684	0	0.2	308191	6244468	No	10047	1 x Ku
MSA1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	16.376	0	0.2	308242	6244462	No	10048	1 x Ku
GS1	OnGrade	Hornsby C 3.0 m lintel (all grades	4	15.719	0	0.2	308182.6	6244462	No	10049	1 x Ku
EX D1	OnGrade	Sutherland Grated pit with 0.9 m ›	4	22.709	0	0.2	308134.2	6244209	No	10058	1 x Ku
EX D2	OnGrade	Sutherland Grated pit with 0.9 m ›	2.6	22.317	0	0.2	308107.1	6244213	No	10059	1 x Ku
EX D3	OnGrade	Hornsby C 3.0 m lintel (all grades	2.7	21.963	0	0.2	308085	6244216	No	10060	1 x Ku
SS1	OnGrade	Junction Pi Junction - Solid Cover	0.9	22.083	0	0	308089.8	6244221	Yes	10053	1 x Ku
SS2	OnGrade	Junction Pi Junction - Solid Cover	0.5	22.159	0	0	308099	6244217	Yes	10054	1 x Ku
SS3	OnGrade	Junction Pi Junction - Solid Cover	2.5	22.728	0	0	308136.5	6244211	Yes	10055	1 x Ku
SS4	OnGrade	Hornsby C 3.0 m lintel (all grades	0.6	20.478	0	0.2	308148.6	6244295	No	10056	1 x Ku

SS5	OnGrade	Hornsby C	3.0 m lintel (all grades	0.6	17.886	0	0.2	308166.8	6244422	No	10057	1 x Ku
EX MSB1	OnGrade	Sutherland	Grated pit with 0.9 m x	0.5	15.36	0	0.2	308531.3	6244477	No	10064	1 x Ku
EX MSB2	OnGrade	Junction Pi	Junction - Solid Cover	3	15.316	0	0	308530.4	6244480	No	10065	1 x Ku
EX MSC1	OnGrade	Hornsby C	0.9 m lintel (all grades	4	14.797	0	0.2	308526.5	6244492	No	10066	1 x Ku
N5059185	Node				10	0		308808.4	6244923		10975586	
N5059186	Node				10	0		308863.7	6244928		10975589	
N5059187	Node				10	0		308944.4	6244920		10975590	
N5059188	Node				10	0		309041.5	6244903		10975592	
N5059189	Node				10	0		309100.1	6244893		10975594	
N5059190	Node				10	0		309111	6244865		10975596	
N5059191	Node				10	0		309116.3	6244858		10975598	
N5059192	Node				10	0		309092.6	6244823		10975600	
N5059193	Node				10	0		309040.1	6244771		10975602	
N5059194	Node				10	0		309005.6	6244670		10975604	
Pit1	OnGrade	Junction Pi	Junction - Solid Cover	0.5	21.9	0	0.2	308017.5	6244212	No	9656978	1 x Ku
SS0	OnGrade	Junction Pi	Junction - Solid Cover	0.5	21.53	0	0	308047.7	6244226	No	10052	1 x Ku

DETENTION BASIN DETAILS

Name	Elev	Volume	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng
basW.1	12.353	0	0	Pit/Sump				Hornsby C	3.6 m lintel	308398.3	6244806	No		
	12.403	0.67												
	12.453	5.3												
	12.503	18												
	12.553	42.7												
	12.653	144												
basA.2	25.926	0	0	Pit/Sump				Hornsby C	3.6 m lintel	307888.5	6244017	No		
	25.976	0.28												
	26.026	2.22												
	26.076	7.5												
	26.126	17.8												
	26.151	25.3												
	26.176	34.76												
	26.226	60												
AC.1	25.46	0	0	Pit/Sump				Hornsby C	1.8 m lintel	307922.1	6244052	No		
	25.51	0.2												
	25.56	1.5												
	25.61	5												
	25.66	12												
	25.71	24												
	25.76	41												
	25.81	65												
	25.96	190												
bas2.2	19.84	0	0	Pit/Sump				Hornsby C	2.4 m lintel	307815.4	6244242	No		
	19.89	0.2												
	19.94	1.7												
	19.99	5.6												
	20.04	13.3												
	20.09	71.5												
	20.24	208												
basG.2	18.3	0	0	Pit/Sump				Hornsby C	2.4 m lintel	307808.8	6244338	No		
	18.4	0.23												
	18.5	1.8												
	18.6	6.2												
	18.7	14.7												
	18.8	28.7												
	18.9	49.7												
	19	78.9												
	19.1	118												
	19.3	230												
	19.8	775												
basA.14	17.3	0	0	Pit/Sump				Hornsby C	3.6 m lintel	307948	6244406	No		
	17.4	1.5												
	17.5	12												
	17.8	190												
	18.1	520												
	18.3	1517												
	18.5	2658												
Basin65	17.8	0	0	Pit/Sump				Hornsby C	4.2 m lintel	307996.2	6244397	No		
	17.9	1.07												
	18	8.6												
	18.1	29												
	18.3	135												
	18.8	1078												
Bas A.19	13.78	0	0	Pit/Sump				Hornsby C	2.4 m lintel	308199.7	6244627	No		
	13.88	8.3												
	13.98	66												
	14.08	225												
	14.13	357												
	14.28	1041												
	14.33	1386												
NJ.4	11.586	0	0	Pit/Sump				Hornsby C	2.4 m lintel	308669.6	6244923	No		
	11.686	3.9												
	11.786	31.24												
	11.836	61												
	11.886	105												

	12.086	488

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %
C MS12	MS12	0.0001	99	1	0	1	5	0						
C XE.1	XE.1	0.3	90	10	0	5	5	0						
C XE.2	XE.2	0.55	90	10	0	5	7	0						
C XF.6	XF.6	0.105	90	10	0	5	9	0						
C XJ.1	XJ.1	0.713	90	10	0	5	9	0						
C X.3.1	X3.1	0.6	90	10	0	5	5	0						
C XF.5	XF.5	0.275	90	10	0	5	7	0						
C L.1	L.1	0.66	90	10	0	5	8	0						
C MS2	MS2	0.2611	90	10	0	5	6	0						
C MS5	MS5	0.1251	90	10	0	5	6	0						
C MS6	MS6	0.0988	90	10	0	5	6	0						
C EX S4	MS8	0.4056	90	10	0	5	6	0						
C N.1	N.1	0.15	90	10	0	5	5	0						
C M.1	M.1	0.32	90	10	0	5	5	0						
C LR.3	LR.3	0.4	90	10	0	5	6	0						
C P.4	P.4	0.18	90	10	0	5	5	0						
C P.1	P.1	0.49	90	10	0	5	6	0						
C P.3	SS8	0.6	90	10	0	5	7	0						
C Q.1	Q.1	0.38	90	10	0	5	6	0						
C R.1D	R.1D	0.3	90	10	0	5	10	0						
C R.1	EX R2A	0.3	90	10	0	5	10	0						
C A.5z	A.5z	0.0001	90	10	0	5	8	0						
C A.6	A.6	0.17	90	10	0	5	5	0						
C A.A1	A.A1	0.225	90	10	0	5	5	0						
C AB.1	AB.1	0.823	90	10	0	5	9	0						
C A.1	A.1	1.07	90	10	0	5	9	0						
C c.1	c.1	0.91	90	10	0	5	8	0						
C K.1	K.1	0.47	90	10	0	5	7	0						
C AG.1	AG.1	0.33	90	10	0	5	5	0						
C AH.1z	AH.1z	0.16	90	10	0	5	5	0						
C T.1	T.1	0.72	90	10	0	5	7	0						
C U.1y	U.1y	0.0001	90	10	0	6	11	0						
C U.1	U.1	2.11	90	10	0	6	11	0						
C Z.1	Z.1	1.09	40	60	0	6	11	0						
C W.1z	W.1z	0.001	90	10	0	7	15	0						
C W.3z	W.3z	0.0001	90	10	0	5	11	0						
C W.3y	W.3y	0.06	90	10	0	5	11	0						
C W.2	W.2	0.76	90	10	0	5	8	0						
C NA.1	NA.1	0.35	90	10	0	5	6	0						
C NB.1	NB.1	0.39	90	10	0	5	6	0						
C ND.1	ND.1	1.25	90	10	0	5	9	0						
C NF.1	NF.1	0.79	90	10	0	5	8	0						
C NH.1	NH.1	1.03	90	10	0	5	8	0						
C NJ.1	NJ.1	0.6	90	10	0	5	7	0						
C NJ.3	NJ.3	0.68	90	10	0	5	7	0						
C A.20	N365	0.06	90	10	0	5	5	0						
C XZ.1	N428	0.52	90	10	0	5	7	0						
C XE.4	N429	0.37	90	10	0	5	6	0						
C XE.5	N430	0.86	90	10	0	5	8	0						
C XE.6	N434	0.88	90	10	0	5	8	0						
C X.1.2	N439	0.057	90	10	0	5	5	0						
C X.5.1	N440	0.505	90	10	0	6	6	0						
C X.1.1	N441	0.096	90	10	0	5	5	0						
C X.5.2	N442	0.051	90	10	0	5	5	0						
C X.1.3	N443	0.012	90	10	0	5	5	0						
C X.1.4	N444	0.072	90	10	0	5	5	0						
C X.4.1	N445	0.317	90	10	0	6	6	0						
C X.4.2	N446	0.167	90	10	0	5	5	0						
C X.6.1	N447	0.215	90	10	0	5	5	0						
C X.1.5	N448	0.01	90	10	0	5	5	0						
C X.1.6	N449	0.165	90	10	0	5	5	0						
C X.2.1	N450	0.107	90	10	0	5	5	0						
C X.1.7	N452	0.023	90	10	0	5	5	0						
C X.2.3	N454	0.0001	90	10	0	5	5	0						
C X1.8	N455	0.0001	90	10	0	5	5	0						
C X1.9	N456	0.075	90	10	0	5	7	0						
C G.1	N457	0.29	90	10	0	5	5	0						
C G.7	G.7	0.24	90	10	0	5	5	0						
C G.2A	N458	0.2	90	10	0	5	6	0						
C H.1	N460	0.24	90	10	0	5	5	0						
C G.3	N461	0.24	90	10	0	5	5	0						
C I.1	N462	0.23	90	10	0	5	5	0						
C G.4	N463	0.12	90	10	0	5	5	0						
C G.5	N464	0.3	90	10	0	5	5	0						
C J.1z	N468	0.0001	90	10	0	5	7	0						
C J.2	N469	0.29	90	10	0	5	7	0						
C A.2A	N472	0.122	90	10	0	5	9	0						
C A.3	N473	0.0001	90	10	0	5	9	0						
C A.4	N475	0.5	90	10	0	5	6	0						

C A.5	N476	0.78	90	10	0	5	8	0
C B.1	N477	0.33	90	10	0	5	5	0
C B.2	N478	0.29	90	10	0	5	5	0
C B.3	N479	0.43	90	10	0	5	6	0
C B.4A	N480	0.1	90	10	0	5	5	0
C B.4	N481	0.21	90	10	0	5	5	0
C B.5A	N482	0.092	90	10	0	5	7	0
C B.5	N483	0.46	90	10	0	5	7	0
C A.11	N488	0.24	90	10	0	5	5	0
C A.12	N489	0.46	90	10	0	5	6	0
C K.1A	N490	0.1	90	10	0	5	5	0
C AD.1	N491	0.08	90	10	0	5	5	0
C A.13	N492	0.33	90	10	0	5	5	0
C R.1C	N493	0.076	90	10	0	5	10	0
C Q.2	N494	0.35	90	10	0	5	6	0
C P.2	N495	0.16	90	10	0	5	5	0
C D.2	N496	0.31	90	10	0	5	5	0
C O.1	N497	0.68	90	10	0	5	7	0
C O.2	N498	0.27	90	10	0	5	5	0
C O.3	N499	2.31	90	10	0	6	11	0
C O.4	N500	0.48	90	10	0	5	6	0
C G.6	N501	0.3	90	10	0	5	5	0
C A.15	N502	0.225	90	10	0	5	8	0
C G.6A	N505	0.1	90	10	0	5	5	0
C O.5	N509	0.27	90	10	0	5	5	0
C R.1B	N510	0.7	90	10	0	5	10	0
C R.1A	N511	0.17	90	10	0	5	10	0
C A.18	N520	0.37	90	10	0	5	6	0
C A.18z	N521	0.1	90	10	0	5	6	0
C L.2	N522	0.4	90	10	0	5	6	0
C M.5	N525	0.0001	90	10	0	5	6	0
C M.4	N527	0.37	90	10	0	5	6	0
C M.3	N528	1.04	90	10	0	5	8	0
C N.5	N529	0.17	90	10	0	5	5	0
C M.2	N530	0.66	90	10	0	5	7	0
C N.2	N531	0.15	90	10	0	5	5	0
C N.3	N532	0.3	90	10	0	5	5	0
C N.4	N533	0.21	90	10	0	5	5	0
C AH.1	N534	0.0001	90	10	0	5	5	0
C AH.2	N535	1.56	90	10	0	5	10	0
C A.22	N537	2.55	90	10	0	6	12	0
C V.1	N538	1.1	40	60	0	6	11	0
C U.1z	N540	0.0001	90	10	0	6	11	0
C T.2z	N541	0.0001	90	10	0	5	7	0
C U.1A	N542	0.27	90	10	0	6	11	0
C T.2	N543	0.53	90	10	0	5	7	0
C T.3	N544	0.81	90	10	0	5	9	0
C W.1y	N547	0.001	90	10	0	7	15	0
C T.4	N550	1.35	70	30	0	5	9	0
C AP7	N551	1.4458	10	90	0	5	20	0
C W.3	N555	1.92	90	10	0	5	11	0
C A.24z	N560	0.17	90	10	0	5	5	0
C A.25	N561	3.3	10	90	0	7	13	0
C A.26	N562	6.07	90	10	0	8	17	0
C NA.2	N564	0.09	90	10	0	5	5	0
C NB.2	N565	0.46	90	10	0	5	6	0
C NA.3	N566	0.97	90	10	0	5	8	0
C NA.4	N567	0.27	90	10	0	5	5	0
C NA.5	N568	0.33	90	10	0	5	5	0
C NA.6	N569	0.24	90	10	0	5	5	0
C NA.6z	N570	0.0001	90	10	0	5	5	0
C NA.7	N571	0.45	90	10	0	5	6	0
C NF.2	N572	0.25	90	10	0	5	5	0
C NA.9	N573	0.17	90	10	0	5	5	0
C NA.10	N574	0.47	90	10	0	5	6	0
C NA.11	N575	0.27	90	10	0	5	5	0
C NA.11z	N576	0.0001	90	10	0	5	5	0
C NA.12	N577	0.63	90	10	0	5	7	0
C NA.13	N578	0.1	90	10	0	5	5	0
C NJ.2	N580	0.68	90	10	0	5	7	0
C W.1	basW.1	4.8	90	10	0	7	15	0
C A.2	basA.2	0.0001	90	10	0	5	10	0
C AC.1	AC.1	0.31	90	10	0	5	5	0
C X.2.2	bas2.2	0.137	90	10	0	5	5	0
C G.2	basG.2	0.3	90	10	0	5	6	0
C A.14	basA.14	0.19	90	10	0	5	5	0
C AF.5	Basin65	0.495	90	10	0	5	8	0
C A. 19	Bas A.19	0.17	90	10	0	5	10	0
C NA.14	NJ.4	0.0001	90	10	0	5	5	0
C EX CSA	EX CSA1	0.1932	30	70	0	5	3	0
C EX ESA	EX ESA1	0.095	100	0	0	5	0	0
C EX ESB	EX ESB1	0.665	100	0	0	10	0	0
C EX GSA	EX GSA1	0.0247	90	10	0	5	6	0
C EX MA1	EX MA1	0.1338	90	10	0	5	6	0
C EX R1	EX R1	0.0579	90	10	0	5	6	0

C S.1	EX S1	0.28	90	10	0	5	5	0
C S.2	EX S2	0.14	90	10	0	5	5	0
C S.3	S3	0.45	90	10	0	5	6	0
C EX SA1	EX SA1	0.1515	100	0	0	5	5	0
Cat475	MSA2	0.12	90	10	0	5	7	0
Cat476	MSA3	0.12	90	10	0	5	7	0
Cat477	MSA4	0.12	90	10	0	5	7	0
Cat474	MSA1	0.12	90	10	0	5	7	0
C GS1	GS1	0.1226	90	10	0	5	6	0
C EX D1	EX D1	0.1889	90	10	0	5	7	0
C EX D2	EX D2	0.1687	90	10	0	5	7	0
C EX D3	EX D3	0.1899	90	10	0	5	7	0
C SS4	SS4	0.052	90	10	0	5	6	0
C SS5	SS5	0.0801	90	10	0	5	6	0
C NA.15	N5059185	4.34	90	10	0	7	15	0
C NA.17	N5059186	2.37	90	10	0	6	12	0
C NA.18	N5059187	6.94	90	10	0	9	17	0
C NA.20	N5059188	1.13	90	10	0	5	9	0
C NA.19	N5059189	1.76	90	10	0	5	10	0
C NA.21	N5059190	0.39	90	10	0	5	6	0
C NA.21z	N5059191	0.0001	90	10	0	5	6	0
C NA.22	N5059192	0.38	90	10	0	5	6	0
C NA.23	N5059193	1.92	90	10	0	5	11	0
C NA.24	N5059194	2.05	90	10	0	5	11	0

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg
PL.2z	L.2z	M.6	35.254	13.29	12.6	1.96	Concrete, ι	900	900	0.3	Existing	1	L.2z	0
PM.6	M.6	A.17	18.879	12.6	12.5	0.53	Concrete, ι	1500	1524	0.3	Existing	1	M.6	0
PA.17	A.17	A.18	54.276	12.5	12.35	0.28	Box Culver	2.1W x 1.2H		0.3	Existing	1	A.17	0
PA.18	A.18	A.18z	11.91	12.35	12.17	1.51	Concrete, ι	1350	1370	0.3	Existing	2	A.18	0
PA.18z	A.18z	A.19B	25.897	12.17	12.09	0.31	Concrete, ι	1350	1370	0.3	Existing	2	A.18z	0
PA.19B	A.19B	A.19A	75.242	11.93	11.55	0.51	Concrete, ι	1500	1524	0.3	Existing	2	A.19B	0
PA.19B	A.19B	A.19A	75.242	12.09	11.71	0.51	Concrete, ι	1500	1524	0.3	Existing	2	A.19B	0
PA.19A	A.19A	A.L1	7.489	11.55	11.49	0.8	Box Culver	2.1W x 1.2H		0.3	Existing	1	A.19A	0
PA.19A	A.19A	A.L1	7.489	11.71	11.65	0.8	Box Culver	2.1W x 1.2H		0.3	Existing	1	A.19A	0
PA.L1	A.L1	AJ.1	47.15	11.49	9.78	3.63	Box Culver	2.1W x 1.2H		0.3	Existing	1	A.L1	0
PA.L1	A.L1	AJ.1	47.15	12.61	10.9	3.63	Box Culver	2.1W x 1.2H		0.3	Existing	1	A.L1	0
Pipe610	AJ.1	A.19	2	10.9	10.9	0	Concrete, ι	2700	2700	0.3	Existing	2	AJ.1	0
PA.19	A.19	A.19z	42.63	10.9	10.69	0.49	Box Culver	1.8W x 0.9H		0.3	Existing	1	A.19	0
PA.19q	A.19	A.20	48.319	10.9	10.66	0.5	Concrete, ι	1350	1370	0.3	Existing	1	A.19	0
PA.19z	A.19z	A.20	24.214	11.71	11.59	0.5	Box Culver	1.8W x 0.9H		0.3	Existing	1	A.19z	0
PA.20	A.20	A.22	84.806	10.66	10.03	0.74	Concrete, ι	1350	1370	0.3	Existing	1	A.20	0
PAM.1	A.20	AP2	69.279	11.59	11.25	0.49	Concrete, ι	1350	1370	0.3	Existing	1	A.20	0
PA.22	A.22	A.23	75.878	10.03	9.82	0.28	Concrete, ι	1500	1524	0.3	Existing	1	A.22	0
PA.23	A.23	AP7	108.985	9.821	9.44	0.35	Box Culver	2.6W x 0.85H		0.3	Existing	1	A.23	0
P EX ES3	AP7	AP8	48.049	9.44	8.897	1.13	Concrete, ι	1500	1524	0.3	Existing	1	AP7	0
P EX ES3	AP7	AP8	48.049	9.44	8.897	1.13	Concrete, ι	1500	1524	0.3	Existing	1	AP7	0
P EX ES4	AP8	AP9	50.854	8.98	8.378	1.18	Concrete, ι	1500	1524	0.3	NewFixed	1	AP8	0
P888	AP8	AP9	50.854	8.98	8.378	1.18	Concrete, ι	1500	1524	0.3	Existing	1	AP8	0
P AP9	AP9	AP10	23.123	8.35	8.281	0.3	Concrete, ι	1350	1370	0.3	NewFixed	1	AP9	0
PA.25	AP9	A.26	217.747	8.378	4.86	1.62	Concrete, ι	1650	1676	0.3	Existing	1	AP9	0
P AP10	AP10	AP11	99.284	8.231	7.932	0.3	Concrete, ι	1350	1370	0.3	NewFixed	1	AP10	0
P AP11	AP11	MS12	87.298	7.882	7.62	0.3	Concrete, ι	1650	1676	0.3	NewFixed	1	AP11	0
P MS12	MS12	MS13	67.162	7.57	7.234	0.5	Concrete, ι	2100	2100	0.3	NewFixed	1	MS12	0
PXE.1	XE.1	XE.2	114.379	25.38	21.51	3.38	Concrete, ι	375	375	0.3	Existing	1	XE.1	0
PXE.2	XE.2	XE.4	52.337	21.51	21.01	0.96	Concrete, ι	450	450	0.3	Existing	1	XE.2	0
PXE.4	XE.4	XE.5	53.375	21.01	19.3	3.2	Concrete, ι	375	375	0.3	Existing	1	XE.4	0
PXE.5	XE.5	XE.6	128.325	19.3	17.22	1.62	Concrete, ι	450	450	0.3	Existing	1	XE.5	0
Pipe232	XE.6	XF.6	26.6	17.22	17.22	0	Concrete, ι	675	675	0.3	Existing	1	XE.6	0
P XE.6	XF.6	XE.O	21.402	17.22	17.006	1	Concrete, ι	900	900	0.3	Existing	1	XF.6	0
PXJ.1	XJ.1	XE.6	76.458	17.98	17.22	0.99	Concrete, ι	375	375	0.3	Existing	1	XJ.1	0
PX3.1	X3.1	X2.3	10.767	18.7	18.63	0.65	Concrete, ι	300	300	0.3	Existing	1	X3.1	0
PX2.3	X2.3	X1.8	15.978	18.63	17.83	5.01	Box Culver	1.2W x 0.6H		0.3	Existing	2	X2.3	0
PX1.8	X1.8	X1.9	17.687	17.83	17.71	0.68	Box Culver	1.2W x 0.6H		0.3	Existing	2	X1.8	0
PX1.9	X1.9	XF.5	28.124	17.71	17.51	0.71	Concrete, ι	525	525	0.3	Existing	2	X1.9	0
Pipe231	XF.5	XF.6	41	17.51	17.22	0.71	Concrete, ι	525	525	0.3	Existing	2	XF.5	0
PL.1	L.1	L.2A	21.746	16.19	15.57	2.85	Concrete, ι	300	300	0.3	Existing	2	L.1	0
PL.2A	L.2A	MS1	69.884	15.57	14.2	1.96	Concrete, ι	600	600	0.3	Existing	2	L.2A	0
P MS1	MS1	MS2	21.324	14.2	13.835	1.71	Concrete, ι	1050	1070	0.3	Existing	1	MS1	0
P MS2	MS2	MS3	5.433	13.835	13.747	1.62	Concrete, ι	1050	1070	0.3	Existing	1	MS2	0
P MS3	MS3	MS4	16.297	13.747	13.48	1.64	Concrete, ι	1050	1070	0.3	Existing	1	MS3	0
P MS4	MS4	MS - GPT	10.624	13.43	13.331	0.93	Concrete, ι	1350	1370	0.3	Existing	2	MS4	0
P MS - GP	MS - GPT	MS5	55.219	13.331	12.767	1.02	Concrete, ι	1350	1370	0.3	Existing	2	MS - GPT	0
P MS5	MS5	MS6	14.144	12.717	12.575	1	Concrete, ι	1350	1370	0.3	Existing	2	MS5	0
P MS6	MS6	MS7	32.825	12.575	12.247	1	Concrete, ι	1650	1676	0.3	Existing	1	MS6	0
P MS7	MS7	MS8	67.175	12.15	11.814	0.5	Concrete, ι	1650	1676	0.3	Existing	1	MS7	0
P MS8	MS8	MS9	63.213	11.514	11.198	0.5	Concrete, ι	1650	1676	0.3	Existing	1	MS8	0
P MS9	MS9	MS10	85.176	11.148	10.722	0.5	Concrete, ι	1650	1676	0.3	Existing	1	MS9	0
P MS10	MS10	MS11	97.684	10.672	10.184	0.5	Concrete, ι	1650	1676	0.3	NewFixed	1	MS10	0
P MS11	MS11	MS12	42.548	10.15	7.62	5.95	Concrete, ι	1650	1676	0.3	NewFixed	1	MS11	0
PN.1	N.1	N.2	29.743	14.72	14.49	0.77	Concrete, ι	450	450	0.3	Existing	1	N.1	0
PN.2	N.2	N.3	58.551	14.49	14.07	0.72	Concrete, ι	525	525	0.3	Existing	1	N.2	0
PN.3	N.3	N.4	44.451	14.07	13.64	0.97	Concrete, ι	600	600	0.3	Existing	1	N.3	0

PN.4	N.4	N.5	29.956	13.64	13.28	1.2	Concrete, ı	675	675	0.3	Existing	1	N.4	0
PN.5	N.5	M.5	39.731	13.28	12.63	1.64	Concrete, ı	750	750	0.3	Existing	1	N.5	0
PM.5	M.5	M.6	6.663	12.63	12.6	0.45	Concrete, ı	1350	1370	0.3	Existing	1	M.5	0
PM.1	M.1	M.2	53.249	14.73	14.28	0.85	Concrete, ı	525	525	0.3	Existing	1	M.1	0
PM.2	M.2	M.3	99.314	14.28	13.61	0.67	Concrete, ı	750	750	0.3	Existing	1	M.2	0
PM.3	M.3	M.4	12.779	13.61	13.51	0.78	Concrete, ı	1050	1070	0.3	Existing	1	M.3	0
PM.4	M.4	M.5	36.172	13.51	12.63	2.43	Concrete, ı	1050	1070	0.3	Existing	1	M.4	0
PLR.3	LR.3	M.4	49.57	14.2	13.51	1.39	Concrete, ı	300	300	0.3	Existing	1	LR.3	0
PP.4	P.4	A.19B	2.424	12.12	12.09	1.24	Concrete, ı	750	750	0.3	Existing	1	P.4	0
PP.1	P.1	P.2	22.596	18.78	17.91	3.85	Concrete, ı	375	375	0.3	Existing	1	P.1	0
PP.2	P.2	SS7	127.212	17.91	12.45	4.29	Concrete, ı	525	525	0.3	Existing	1	P.2	0
P SS7	SS7	SS - GPT	8.118	12.439	12.358	1	Concrete, ı	1350	1370	0.3	Existing	1	SS7	0
P SS - GP	SS - GPT	SS8	7.63	12.358	12.282	1	Concrete, ı	1350	1370	0.3	Existing	1	SS - GPT	0
P SS8	SS8	MS7	11.584	12.262	12.146	1	Concrete, ı	1350	1370	0.3	Existing	1	SS8	0
PQ.1	Q.1	Q.2	8.173	19.16	18.94	2.69	Concrete, ı	450	450	0.3	Existing	1	Q.1	0
PQ.2	Q.2	P.2	39.909	18.94	17.91	2.58	Box Culver	0.6W x 0.3H		0.3	Existing	1	Q.2	0
PR.1D	R.1D	R.1C	17.908	18.5	18	2.79	Concrete, ı	375	375	0.3	Existing	1	R.1D	0
PR.1C	R.1C	R.1B	143.427	17.986	13.97	2.8	Concrete, ı	375	375	0.3	Existing	1	R.1C	0
PR.1B	R.1B	R.1A	14.844	13.969	13.68	1.95	Concrete, ı	600	600	0.3	Existing	1	R.1B	0
PR.1A	R.1A	EX R2A	29.416	13.671	13.1	1.94	Concrete, ı	600	600	0.3	Existing	1	R.1A	0
P EX R2A	EX R2A	SS6	26	13.1	12.58	2	Concrete, ı	600	600	0.3	NewFixed	1	EX R2A	0
P SS6	SS6	SS7	12.078	12.58	12.459	1	Concrete, ı	1200	1200	0.3	Existing	1	SS6	0
PA.5z	A.5z	A.5	112.5	23.906	22.5	1.25	Concrete, ı	450	450	0.3	Existing	1	A.5z	0
PA.5	A.5	A.6	169.681	22.5	20.36	1.26	Concrete, ı	450	450	0.3	Existing	1	A.5	0
PA.6	A.6	A.6z	22.726	20.36	19.53	3.65	Concrete, ı	525	525	0.3	Existing	1	A.6	0
PA.6z	A.6z	A.11	49.57	19.53	17.37	4.36	Concrete, ı	525	525	0.3	Existing	1	A.6z	0
PA.11	A.11	A.12	16.981	17.73	17.17	3.3	Concrete, ı	825	825	0.3	Existing	1	A.11	0
PA.12	A.12	A.12z	13.347	17.17	17.03	1.05	Concrete, ı	525	525	0.3	Existing	1	A.12	0
PA.12z	A.12z	A.13	40.915	17.03	16.59	1.08	Concrete, ı	525	525	0.3	Existing	1	A.12z	0
PA.13	A.13	A.14	111.092	16.59	15.4	1.07	Concrete, ı	525	525	0.3	Existing	2	A.13	0
PA.14	A.14	A.15	58.382	15.4	14.56	1.44	Concrete, ı	1050	1070	0.3	Existing	1	A.14	0
PA.15	A.15	EX A15A	99.302	14.56	13.62	0.95	Concrete, ı	1050	1070	0.3	Existing	1	A.15	0
P EX A15A	EX A15A	EX A15B	16.901	13.62	13.47	0.89	Concrete, ı	1050	1070	0.3	Existing	1	EX A15A	0
P EX A15B	EX A15B	MS4	3.744	13.467	13.43	0.99	Concrete, ı	1050	1070	0.3	NewFixed	1	EX A15B	0
PAA.1	A.A1	A.2	52.867	24.76	24.48	0.53	Concrete, ı	375	375	0.3	Existing	1	A.A1	0
PA.2	A.2	A.3	12.994	24.48	24.41	0.54	Concrete, ı	375	375	0.3	Existing	1	A.2	0
PA.3	A.3	A.4	47.59	23.45	22.85	1.26	Concrete, ı	375	375	0.3	Existing	1	A.3	0
PA.4	A.4	A.5	28.097	22.85	22.5	1.25	Concrete, ı	450	450	0.3	Existing	1	A.4	0
PAB.1	AB.1	A.2	20.425	24.59	24.48	0.54	Concrete, ı	375	375	0.3	Existing	1	AB.1	0
PA.1	A.1	A.2A	65.835	24.85	23.56	1.96	Concrete, ı	375	375	0.3	Existing	1	A.1	0
PA.2A	A.2A	A.2	7.168	23.56	23.45	1.53	Concrete, ı	375	375	0.3	Existing	1	A.2A	0
Pc.1	c.1	B.4A	101.388	24.098	21.29	2.77	Concrete, ı	375	375	0.3	Existing	1	c.1	0
PB.4A	B.4A	B.4	43.389	21.29	20.65	1.48	Concrete, ı	525	525	0.3	Existing	1	B.4A	0
PB.4	B.4	B.5A	10.924	20.65	20.49	1.46	Concrete, ı	525	525	0.3	Existing	1	B.4	0
PB.5A	B.5A	B.5	15.127	20.49	20.41	0.53	Concrete, ı	525	525	0.3	Existing	1	B.5A	0
PB.5	B.5	B.5z	14.866	20.41	19.99	2.83	Concrete, ı	525	525	0.3	Existing	1	B.5	0
Pipe829	B.5	Pit1	10	20.41	19.65	7.6	Concrete, ı	1200	1200	0.3	Existing	1	B.5	0
PB.5z	B.5z	A.6z	16.105	19.99	19.53	2.86	Concrete, ı	525	525	0.3	Existing	1	B.5z	0
PJ.1	J.1	J.1z	19.455	17.11	16.82	1.49	Concrete, ı	900	900	0.3	Existing	1	J.1	0
PJ.1z	J.1z	J.2	62.081	16.82	15.9	1.48	Concrete, ı	900	900	0.3	Existing	1	J.1z	0
PJ.2	J.2	A.14	18.249	15.9	15.4	2.74	Concrete, ı	900	900	0.3	Existing	1	J.2	0
PK.1	K.1	J.1z	14.845	18.08	17.78	2.02	Concrete, ı	450	450	0.3	Existing	1	K.1	0
PAG.1	AG.1	A.15	37.92	15.71	15.52	0.5	Concrete, ı	375	375	0.3	Existing	1	AG.1	0
PAH.1z	AH.1z	AH.1	59.775	11.81	11.51	0.5	Concrete, ı	750	750	0.3	Existing	1	AH.1z	0
PAH.1	AH.1	AH.2	89.129	11.51	11.07	0.49	Concrete, ı	750	750	0.3	Existing	1	AH.1	0
PAH.2	AH.2	AJ.1	33.115	11.07	10.9	0.51	Box Culver	1.2W x 0.6H		0.3	Existing	1	AH.2	0
PT.1	T.1	T.2z	102.378	16.08	11.54	4.43	Concrete, ı	375	375	0.3	Existing	1	T.1	0
PT.2z	T.2z	T.2	12.636	11.54	11.5	0.32	Concrete, ı	675	675	0.3	Existing	1	T.2z	0
PT.2	T.2	AP2	84.779	11.5	11.25	0.29	Concrete, ı	675	675	0.3	Existing	2	T.2	0
P AP2	AP2	AP - GPT	46.7	11.25	10.863	0.83	Box Culver	2.1W x 0.9H		0.3	NewFixed	1	AP2	0
P920	AP2	AP - GPT	46.7	11.25	10.863	0.83	Concrete, ı	1350	1370	0.3	Existing	1	AP2	0
P AP - GP	AP - GPT	AP3	44.728	10.863	10.49	0.83	Box Culver	2.1W x 0.9H		0.3	NewFixed	1	AP - GPT	0
P925	AP - GPT	AP3	44.728	10.863	10.49	0.83	Concrete, ı	1350	1370	0.3	New	1	AP - GPT	0
P AP3	AP3	AP5	20	10.602	10.422	0.9	Box Culver	2.1W x 0.9H		0.3	NewFixed	1	AP3	0
P929	AP3	AP5	20	10.486	10.306	0.9	Concrete, ı	1500	1524	0.3	New	1	AP3	0
P EX ES1	AP5	AP6	22.055	10.24	9.969	1.23	Concrete, ı	1500	1524	0.3	Existing	1	AP5	0
P EX ES1	AP5	AP6	22.055	10.24	9.969	1.23	Concrete, ı	1500	1524	0.3	Existing	1	AP5	0
P EX ES2	AP6	AP7	64.952	9.969	9.44	0.81	Concrete, ı	1500	1524	0.3	NewFixed	1	AP6	0
P958	AP6	AP7	64.952	9.969	9.44	0.81	Concrete, ı	1500	1524	0.3	Existing	1	AP6	0
PU.1y	U.1y	U.1z	51.777	11.88	11.68	0.39	Concrete, ı	525	525	0.3	Existing	1	U.1y	0
PU.1z	U.1z	U.1	29.969	11.68	11.57	0.37	Concrete, ı	525	525	0.3	Existing	1	U.1z	0
PU.1	U.1	T.2z	7.478	11.57	11.54	0.4	Concrete, ı	675	675	0.3	Existing	2	U.1	0
PZ.1	Z.1	V.1	172.364	13.81	11.52	1.33	Concrete, ı	450	450	0.3	Existing	1	Z.1	0
PV.1	V.1	AP5	94.254	11.523	10.26	1.34	Concrete, ı	450	450	0.3	Existing	1	V.1	0
PW.1z	W.1z	W.1	70.581	10.67	10.48	0.27	Concrete, ı	450	450	0.3	Existing	1	W.1z	0
PW.1	W.1	W.1y	72.94	10.67	10.48	0.26	Concrete, ı	1050	1070	0.3	Existing	2	W.1	0
PW.1y	W.1y	AP6	44.524	10.477	9.965	1.15	Concrete, ı	1050	1070	0.3	Existing	2	W.1y	0
PW.3z	W.3z	W.3	56.25	10.79	10.45	0.6	Concrete, ı	450	450	0.3	Existing	1	W.3z	0
PW.3	W.3	W.3y	9.674	10.45	10.39	0.62	Concrete, ı	1050	1070	0.3	Existing	1	W.3	0
PW.3y	W.3y	EX ESF1	104.959	10.39	9.75	0.61	Concrete, ı	1050	1070	0.3	Existing	1	W.3y	0
P EX ESF1	EX ESF1	AP8	34.607	9.756	9.4	1.03	Concrete, ı	1200	1200	0.3	Existing	1	EX ESF1	0
PW.2	W.2	W.3	52.747	10.67	10.45	0.42	Concrete, ı	525	525	0.3	Existing	1	W.2	0
PNA.1	NA.1	NA.2	15.622	14.52	14.31	1.34	Concrete, ı	375	375	0.3	Existing	1	NA.1	0
PNA.2	NA.2	NA.3	134.498	14.31	12.12	1.63	Concrete, ı	375	375	0.3	Existing	1	NA.2	0
PNA.3	NA.3	NA.4	28.433	11.836	11.551	1	Concrete, ı	750	750	0.3	New	2	NA.3	0

PNA.4	NA.4	NA.5	15.821	11.322	11.164	1	Concrete, u	1050	1070	0.3	New	2	NA.4	0
PNA.5	NA.5	NA.6	14.295	10.224	10.081	1	Concrete, u	1350	1370	0.3	New	2	NA.5	0
PNA.6	NA.6	NA.6z	8.995	9.876	9.786	1	Concrete, u	1500	1524	0.3	New	2	NA.6	0
PNA.6z	NA.6z	NA.7	47.931	9.756	9.277	1	Concrete, u	1350	1370	0.3	Existing	1	NA.6z	0
PNA.7	NA.7	NA.9	49.212	9.247	8.755	1	Concrete, u	1500	1524	0.3	New	2	NA.7	0
PNA.9	NA.9	NA.10	9.383	8.725	8.631	1	Concrete, u	1650	1676	0.3	New	2	NA.9	0
PNA.10	NA.10	NA.11	13.397	8.601	8.467	1	Concrete, u	1650	1676	0.3	New	2	NA.10	0
PNA.11	NA.11	NA.11z	11.214	8.437	8.325	1	Concrete, u	1650	1676	0.3	New	2	NA.11	0
PNA.11z	NA.11z	NA.12	83.003	8.295	7.465	1	Concrete, u	1650	1676	0.3	New	2	NA.11z	0
PNA.12	NA.12	NA.13	12.561	7.435	7.309	1	Concrete, u	1800	1800	0.3	New	2	NA.12	0
PNA.13	NA.13	Pit22	15.586	7.279	7.05	1.47	Concrete, u	1800	1800	0.3	New	2	NA.13	0
PNA.14	Pit22	NA.15	140.153	5.866	4.464	1	Concrete, u	1800	1800	0.3	New	2	Pit22	0
PNA.15	NA.15	NA.17	55.186	4.434	3.882	1	Concrete, u	1800	1800	0.3	New	2	NA.15	0
PNA.17	NA.17	NA.18	82.044	3.852	3.032	1	Concrete, u	1800	1800	0.3	New	2	NA.17	0
PNA.18	NA.18	NA.20	104.377	3.002	1.958	1	Concrete, u	1800	1800	0.3	New	2	NA.18	0
PNA.20	NA.20	NA.19	56.129	1.928	1.367	1	Concrete, u	1800	1800	0.3	New	2	NA.20	0
PNA.19	NA.19	NA.21	6.043	1.337	1.276	1	Concrete, u	2700	2700	0.3	New	2	NA.19	0
PNA.21	NA.21	NA.21z	8.677	1.246	1.159	1	Concrete, u	2700	2700	0.3	New	2	NA.21	0
PNA.21z	NA.21z	NA.22	43.367	1.129	0.696	1	Concrete, u	2700	2700	0.3	New	2	NA.21z	0
PNA.22	NA.22	NA.23	75.109	0.666	-0.085	1	Concrete, u	2700	2700	0.3	New	2	NA.22	0
PNA.23	NA.23	NA.24	123.299	-0.115	-1.348	1	Concrete, u	2700	2700	0.3	New	2	NA.23	0
PNA.24	NA.24	NA.24z	36.54	-1.378	-1.744	1	Concrete, u	2700	2700	0.3	New	2	NA.24	0
PNA.24z	NA.24z	N.AO	27.25	-1.774	-2.046	1	Concrete, u	2700	2700	0.3	New	2	NA.24z	0
PNB.1	NB.1	NB.2	8.178	14.89	14.87	0.24	Concrete, u	375	375	0.3	Existing	1	NB.1	0
PNB.2	NB.2	NA.3	69.96	14.87	12.12	3.93	Concrete, u	375	375	0.3	Existing	1	NB.2	0
PND.1	ND.1	NA.5	83.856	14.14	11.22	3.48	Concrete, u	375	375	0.3	Existing	1	ND.1	0
PNF.1	NF.1	NF.2	52.091	13.7	12.38	2.53	Concrete, u	375	375	0.3	Existing	1	NF.1	0
PNF.2	NF.2	NA.7	57.567	12.38	10.21	3.77	Concrete, u	450	450	0.3	Existing	1	NF.2	0
PNH.1	NH.1	NA.11	87.431	12.82	8.84	4.55	Concrete, u	375	375	0.3	Existing	1	NH.1	0
PNJ.1	NJ.1	NJ.2	52.447	10.48	9.61	1.66	Concrete, u	375	375	0.3	Existing	1	NJ.1	0
PNJ.2	NJ.2	NJ.3	98.957	9.61	7.57	2.06	Concrete, u	450	450	0.3	Existing	1	NJ.2	0
PNJ.3	NJ.3	Pit22	28.657	7.57	7.06	1.78	Concrete, u	600	600	0.3	Existing	1	NJ.3	0
Pipe264	N365	A.20	10	29.065	12.534	165.31	Concrete, u	300	300	0.3	New	1	N365	0
Pipe268	N428	XZ.1	10	29.065	25.991	30.74	Concrete, u	300	300	0.3	New	1	N428	0
PXZ.1	XZ.1	XE.4	56.471	22.88	21.01	3.31	Concrete, u	375	375	0.3	Existing	1	XZ.1	0
P271	N429	XE.4	10	29.065	23.969	50.96	Concrete, u	300	300	0.3	New	1	N429	0
Pipe288	N430	XE.5	10	29.065	22.379	66.86	Concrete, u	300	300	0.3	New	1	N430	0
Pipe290	N434	XE.6	10	29.065	20.132	89.33	Concrete, u	300	300	0.3	New	1	N434	0
Pipe292	N439	X1.2	10	29.065	21.379	76.86	Concrete, u	300	300	0.3	New	1	N439	0
PX1.2	X1.2	X1.3	21.707	18.96	18.74	1.01	Concrete, u	375	375	0.3	Existing	1	X1.2	0
PX1.3	X1.3	X1.4	35.738	18.74	18.38	1.01	Concrete, u	375	375	0.3	Existing	1	X1.3	0
PX1.4	X1.4	X1.5	23.67	18.62	18.38	1.01	Concrete, u	375	375	0.3	Existing	1	X1.4	0
PX1.5	X1.5	X1.6	22.214	18.38	18.16	0.99	Concrete, u	525	525	0.3	Existing	1	X1.5	0
PX1.6	X1.6	X1.7	21.695	18.16	17.94	1.01	Concrete, u	525	525	0.3	Existing	1	X1.6	0
PX1.7	X1.7	X1.8	16.284	17.94	17.83	0.68	Box Culver 1.2W x 0.6H			0.3	Existing	2	X1.7	0
Pipe294	N440	X5.1	10	29.065	21.407	76.58	Concrete, u	300	300	0.3	New	1	N440	0
PX5.1	X5.1	X5.2	9.313	19.08	18.99	0.97	Concrete, u	375	375	0.3	Existing	1	X5.1	0
PX5.2	X5.2	X1.3	12.328	18.99	18.74	2.03	Concrete, u	375	375	0.3	Existing	1	X5.2	0
Pipe296	N441	X1.1	10	29.065	20.802	82.63	Concrete, u	300	300	0.3	New	1	N441	0
PX1.1	X1.1	X1.2	22.876	19.19	18.96	1.01	Concrete, u	375	375	0.3	Existing	1	X1.1	0
Pipe298	N442	X5.2	10	29.065	21.206	78.59	Concrete, u	300	300	0.3	New	1	N442	0
Pipe300	N443	X1.3	10	29.065	21.056	80.09	Concrete, u	300	300	0.3	New	1	N443	0
Pipe302	N444	X1.4	10	29.065	20.305	87.6	Concrete, u	300	300	0.3	New	1	N444	0
P305	N445	X4.1	10	29.065	20.323	87.42	Concrete, u	300	300	0.3	New	1	N445	0
PX4.1	X4.1	X4.2	14.307	18.85	18.57	1.96	Concrete, u	375	375	0.3	Existing	1	X4.1	0
PX4.2	X4.2	X1.5	9.315	18.57	18.38	2.04	Concrete, u	450	450	0.3	Existing	1	X4.2	0
P309	N446	X4.2	10	29.065	19.939	91.26	Concrete, u	300	300	0.3	New	1	N446	0
P316	N447	X6.1	10	29.065	19.747	93.18	Concrete, u	300	300	0.3	New	1	N447	0
PX6.1	X6.1	X1.5	15.649	18.54	18.38	1.02	Concrete, u	375	375	0.3	Existing	1	X6.1	0
Pipe322	N448	X1.5	10	29.065	19.725	93.4	Concrete, u	300	300	0.3	New	1	N448	0
Pipe325	N449	X1.6	10	29.065	19.443	96.22	Concrete, u	300	300	0.3	New	1	N449	0
Pipe327	N450	X2.1	10	29.065	19.076	99.89	Concrete, u	300	300	0.3	New	1	N450	0
PX2.1	X2.1	X 2.2	15.219	18.81	18.7	0.72	Concrete, u	375	375	0.3	Existing	1	X2.1	0
PX2.2	X 2.2	X2.3	10.851	18.7	18.63	0.65	Concrete, u	375	375	0.3	Existing	1	X 2.2	0
Pipe331	N452	X1.7	10	29.065	19.054	100.11	Concrete, u	300	300	0.3	New	1	N452	0
Pipe333	N454	X2.3	10	29.065	18.63	104.35	Concrete, u	300	300	0.3	New	1	N454	0
Pipe335	N455	X1.8	10	29.065	18.816	102.49	Concrete, u	300	300	0.3	New	1	N455	0
Pipe337	N456	X1.9	10	29.065	18.776	102.89	Concrete, u	300	300	0.3	New	1	N456	0
Pipe339	N457	G.1	10	29.065	18.417	106.48	Concrete, u	300	300	0.3	New	1	N457	0
PG.1	G.1	G.2A	38.521	17.67	17.45	0.57	Concrete, u	375	375	0.3	Existing	1	G.1	0
PG.2A	G.2A	G.2	20.512	17.45	17.34	0.54	Concrete, u	375	375	0.3	Existing	1	G.2A	0
PG.2	G.2	G.2z	12.678	17.34	17.21	1.03	Concrete, u	525	525	0.3	Existing	1	G.2	0
PG.2z	G.2z	G.3	73.467	17.21	16.79	0.57	Concrete, u	375	375	0.3	Existing	1	G.2z	0
PG.3	G.3	G.4	25.195	16.79	16.48	1.23	Concrete, u	525	525	0.3	Existing	1	G.3	0
PG.4	G.4	G.5	53.402	16.48	16.13	0.66	Concrete, u	600	600	0.3	Existing	1	G.4	0
PG.5	G.5	G.6	44.215	16.13	15.82	0.7	Concrete, u	600	600	0.3	Existing	1	G.5	0
PG.6	G.6	G.6A	46.164	15.82	15.7	0.26	Concrete, u	825	825	0.3	Existing	1	G.6	0
PG.6A	G.6A	G.7	34.962	15.7	15.61	0.26	Concrete, u	825	825	0.3	Existing	1	G.6A	0
PG.7	G.7	L.2A	16.349	15.61	15.57	0.24	Concrete, u	900	900	0.3	Existing	1	G.7	0
Pipe341	N458	G.2A	10	29.065	18.214	108.51	Concrete, u	300	300	0.3	New	1	N458	0
Pipe346	N460	H.1	10	29.065	18.165	109	Concrete, u	300	300	0.3	New	1	N460	0
PH.1	H.1	G.2	18.52	17.56	17.34	1.19	Concrete, u	375	375	0.3	Existing	1	H.1	0
Pipe348	N461	G.3	10	29.065	17.862	112.03	Concrete, u	300	300	0.3	New	1	N461	0
Pipe350	N462	I.1	10	29.065	17.92	111.45	Concrete, u	300	300	0.3	New	1	N462	0
PI.1	I.1	G.3	14.196	18.07	16.79	9.02	Concrete, u	375	375	0.3	Existing	1	I.1	0

Pipe352	N463	G.4	10	29.065	17.636	114.29	Concrete, ι	300	300	0.3	New	1	N463	0
Pipe354	N464	G.5	10	29.065	17.238	118.27	Concrete, ι	300	300	0.3	New	1	N464	0
Pipe356	N468	J.1z	10	29.065	17.637	114.28	Concrete, ι	300	300	0.3	New	1	N468	0
Pipe358	N469	J.2	10	29.065	16.733	123.32	Concrete, ι	300	300	0.3	New	1	N469	0
Pipe364	N472	A.2A	10	29.065	25.031	40.34	Concrete, ι	300	300	0.3	New	1	N472	0
Pipe366	N473	A.3	10	29.065	24.641	44.24	Concrete, ι	300	300	0.3	New	1	N473	0
Pipe370	N475	A.4	10	29.065	23.126	59.39	Concrete, ι	300	300	0.3	New	1	N475	0
Pipe372	N476	A.5	10	29.065	22.5	65.65	Concrete, ι	300	300	0.3	New	1	N476	0
Pipe374	N477	B.1	10	29.065	22.27	67.95	Concrete, ι	300	300	0.3	New	1	N477	0
PB.1	B.1	B.2	13.814	21.71	21.57	1.01	Concrete, ι	300	300	0.3	Existing	1	B.1	0
PB.2	B.2	B.3	23.481	21.57	21.41	0.68	Concrete, ι	375	375	0.3	Existing	1	B.2	0
PB.3	B.3	B.4A	28.544	21.41	21.29	0.42	Concrete, ι	450	450	0.3	Existing	1	B.3	0
Pipe376	N478	B.2	10	29.065	22.062	70.03	Concrete, ι	300	300	0.3	New	1	N478	0
Pipe378	N479	B.3	10	29.065	21.757	73.08	Concrete, ι	300	300	0.3	New	1	N479	0
Pipe380	N480	B.4A	10	29.065	21.517	75.48	Concrete, ι	300	300	0.3	New	1	N480	0
Pipe382	N481	B.4	10	29.065	21.096	79.69	Concrete, ι	300	300	0.3	New	1	N481	0
Pipe384	N482	B.5A	10	29.065	21.149	79.16	Concrete, ι	300	300	0.3	New	1	N482	0
Pipe386	N483	B.5	10	29.065	21.037	80.28	Concrete, ι	300	300	0.3	New	1	N483	0
Pipe388	N488	A.11	10	29.065	19.389	96.76	Concrete, ι	300	300	0.3	New	1	N488	0
Pipe390	N489	A.12	10	29.065	19.185	98.8	Concrete, ι	300	300	0.3	New	1	N489	0
Pipe392	N490	K.1A	10	29.065	18.799	102.66	Concrete, ι	300	300	0.3	New	1	N490	0
PK.1A	K.1A	A.12z	31.436	18.3	17.99	0.99	Concrete, ι	750	750	0.3	Existing	1	K.1A	0
Pipe394	N491	AD.1	10	29.065	17.609	114.56	Concrete, ι	300	300	0.3	New	1	N491	0
PAD.1	AD.1	A.13	11.14	17.66	17.55	0.99	Concrete, ι	375	375	0.3	Existing	1	AD.1	0
Pipe396	N492	A.13	10	29.065	17.6	114.65	Concrete, ι	300	300	0.3	New	1	N492	0
Pipe398	N493	R.1C	10	29.065	19.416	96.49	Concrete, ι	300	300	0.3	New	1	N493	0
Pipe400	N494	Q.2	10	29.065	20.174	88.91	Concrete, ι	300	300	0.3	New	1	N494	0
Pipe402	N495	P.2	10	29.065	18.694	103.71	Concrete, ι	300	300	0.3	New	1	N495	0
Pipe404	N496	D.2	10	29.065	20.754	83.11	Concrete, ι	300	300	0.3	New	1	N496	0
PD.2	D.2	B.5	59.313	20.89	20	1.5	Concrete, ι	525	525	0.3	Existing	1	D.2	0
Pipe406	N497	O.1	10	29.065	18.812	102.53	Concrete, ι	300	300	0.3	New	1	N497	0
PO.1	O.1	O.2	56.54	17.44	15.6	3.25	Concrete, ι	450	450	0.3	Existing	1	O.1	0
PO.2	O.2	O.3	53.559	15.6	14.3	2.43	Concrete, ι	450	450	0.3	Existing	1	O.2	0
PO.3	O.3	O.4	32.793	14.3	13.96	1.04	Concrete, ι	900	900	0.3	Existing	1	O.3	0
PO.4	O.4	O.5	28.422	13.96	13.64	1.13	Concrete, ι	900	900	0.3	Existing	1	O.4	0
PO.5	O.5	MS4	25.582	13.64	13.48	0.63	Concrete, ι	900	900	0.3	Existing	1	O.5	0
Pipe408	N498	O.2	10	29.065	16.911	121.54	Concrete, ι	300	300	0.3	New	1	N498	0
Pipe410	N499	O.3	10	29.065	16.018	130.47	Concrete, ι	300	300	0.3	New	1	N499	0
Pipe412	N500	O.4	10	29.065	15.485	135.8	Concrete, ι	300	300	0.3	New	1	N500	0
Pipe414	N501	G.6	10	29.065	16.917	121.48	Concrete, ι	300	300	0.3	New	1	N501	0
Pipe416	N502	A.15	10	29.065	16.126	129.39	Concrete, ι	300	300	0.3	New	1	N502	0
Pipe418	N505	G.6A	10	29.065	17.641	114.24	Concrete, ι	300	300	0.3	New	1	N505	0
Pipe420	N509	O.5	10	29.065	15.022	140.43	Concrete, ι	300	300	0.3	New	1	N509	0
Pipe422	N510	R.1B	10	29.065	15.541	135.24	Concrete, ι	300	300	0.3	New	1	N510	0
Pipe424	N511	R.1A	10	29.065	15.306	137.59	Concrete, ι	300	300	0.3	New	1	N511	0
Pipe440	N520	A.18	10	29.065	14.367	146.98	Concrete, ι	300	300	0.3	New	1	N520	0
P443	N521	A.18z	10	29.065	14.396	146.69	Concrete, ι	300	300	0.3	New	1	N521	0
Pipe446	N522	MS1	10	29.065	15.361	137.04	Concrete, ι	300	300	0.3	New	1	N522	0
Pipe448	N525	M.5	10	29.065	14.929	141.36	Concrete, ι	300	300	0.3	New	1	N525	0
Pipe454	N527	M.4	10	29.065	14.978	140.87	Concrete, ι	300	300	0.3	New	1	N527	0
Pipe456	N528	M.3	10	29.065	15.065	140	Concrete, ι	300	300	0.3	New	1	N528	0
Pipe460	N529	N.5	10	29.065	15.065	140	Concrete, ι	300	300	0.3	New	1	N529	0
P467	N530	M.2	10	29.065	15.707	133.58	Concrete, ι	300	300	0.3	New	1	N530	0
P466	N531	N.2	10	29.065	15.489	135.76	Concrete, ι	300	300	0.3	New	1	N531	0
P465	N532	N.3	10	29.065	15.373	136.92	Concrete, ι	300	300	0.3	New	1	N532	0
Pipe462	N533	N.4	10	29.065	15.065	140	Concrete, ι	300	300	0.3	New	1	N533	0
Pipe476	N534	AH.1	10	29.065	14.278	147.87	Concrete, ι	300	300	0.3	New	1	N534	0
Pipe478	N535	AH.2	10	29.065	13.036	160.29	Concrete, ι	300	300	0.3	New	1	N535	0
Pipe484	N537	A.22	10	29.065	12.434	166.31	Concrete, ι	300	300	0.3	New	1	N537	0
Pipe486	N538	V.1	10	29.065	12.544	165.21	Concrete, ι	300	300	0.3	New	1	N538	0
Pipe492	N540	U.1z	10	29.065	14.288	147.77	Concrete, ι	300	300	0.3	New	1	N540	0
Pipe494	N541	T.2z	10	29.065	13.488	155.77	Concrete, ι	300	300	0.3	New	1	N541	0
Pipe497	N542	U.1A	10	29.065	13.835	152.3	Concrete, ι	300	300	0.3	New	1	N542	0
PU.1A	U.1A	U.1z	18.271	11.75	11.68	0.38	Concrete, ι	525	525	0.3	Existing	1	U.1A	0
Pipe499	N543	T.2	10	29.065	13.047	160.18	Concrete, ι	300	300	0.3	New	1	N543	0
Pipe501	N544	AP2	10	29.065	11.879	171.86	Concrete, ι	300	300	0.3	New	1	N544	0
Pipe507	N547	W.1y	10	29.065	11.179	178.86	Concrete, ι	300	300	0.3	New	1	N547	0
Pipe509	N550	AP5	10	29.065	11.332	177.33	Concrete, ι	300	300	0.3	New	1	N550	0
Pipe511	N551	AP7	10	29.065	10.957	181.08	Concrete, ι	300	300	0.3	New	1	N551	0
Pipe513	N555	W.3	10	29.065	11.054	180.11	Concrete, ι	300	300	0.3	New	1	N555	0
Pipe519	N560	AP8	10	29.065	11.051	180.14	Concrete, ι	300	300	0.3	New	1	N560	0
Pipe521	N561	AP9	10	29.065	11.248	178.17	Concrete, ι	300	300	0.3	New	1	N561	0
Pipe523	N562	A.26	10	28.99	9.829	191.61	Concrete, ι	375	375	0.3	New	1	N562	0
PA.26	A.26	A.O	95.217	4.86	3.778	1.14	Concrete, ι	1650	1676	0.3	Existing	1	A.26	0
Pipe525	N564	NA.2	10	29.065	16.506	125.59	Concrete, ι	300	300	0.3	New	1	N564	0
Pipe527	N565	NB.2	10	29.065	15.947	131.18	Concrete, ι	300	300	0.3	New	1	N565	0
Pipe529	N566	NA.3	10	29.065	14.695	143.7	Concrete, ι	300	300	0.3	New	1	N566	0
Pipe532	N567	NA.4	10	29.065	14.539	145.26	Concrete, ι	300	300	0.3	New	1	N567	0
Pipe534	N568	NA.5	10	29.065	14.832	142.33	Concrete, ι	300	300	0.3	New	1	N568	0
Pipe536	N569	NA.6	10	29.065	14.843	142.22	Concrete, ι	300	300	0.3	New	1	N569	0
Pipe539	N570	NA.6z	10	29.065	14.89	141.75	Concrete, ι	300	300	0.3	New	1	N570	0
Pipe542	N571	NA.7	10	29.065	14.372	146.93	Concrete, ι	300	300	0.3	New	1	N571	0
Pipe544	N572	NF.2	10	29.065	15.628	134.37	Concrete, ι	300	300	0.3	New	1	N572	0
Pipe546	N573	NA.9	10	29.065	13.67	153.95	Concrete, ι	300	300	0.3	New	1	N573	0
Pipe549	N574	NA.10	10	29.065	13.734	153.31	Concrete, ι	300	300	0.3	New	1	N574	0

Pipe551	N575	NA.11	10	29.065	13.328	157.37	Concrete, u	300	300	0.3	New	1	N575	0
Pipe557	N576	NA.11z	10	29.065	13.028	160.37	Concrete, u	300	300	0.3	New	1	N576	0
Pipe559	N577	NA.12	10	29.065	11.009	180.56	Concrete, u	300	300	0.3	New	1	N577	0
P562	N578	NA.13	10	29.065	10.722	183.43	Concrete, u	300	300	0.3	New	1	N578	0
Pipe569	N580	NJ.2	10	29.065	12.137	169.28	Concrete, u	300	300	0.3	New	1	N580	0
Pipe665	basW.1	W.1	10	10.69	10.67	0.2	Concrete, u	1050	1070	0.3	Existing	1	basW.1	0
Pipe630	basA.2	A.2	10	23.51	23.52	-0.1	Concrete, u	375	375	0.3	Existing	1	basA.2	0
PAC.1	AC.1	A.3	47.37	25	24.41	1.25	Concrete, u	375	375	0.3	Existing	1	AC.1	0
Pipe639	bas2.2	X 2.2	10	18.775	18.71	0.65	Concrete, u	375	375	0.3	Existing	1	bas2.2	0
Pipe641	basG.2	G.2	10	17.453	17.35	1.03	Concrete, u	525	525	0.3	Existing	1	basG.2	0
Pipe649	basA.14	A.14	10	15.54	15.4	1.4	Concrete, u	1050	1070	0.3	Existing	1	basA.14	0
P AF.1	Basin65	A.15	55	16.78	14.58	4	Concrete, u	375	375	0.3	Existing	1	Basin65	0
Pipe659	Bas A.19	AJ.1	10	10.9	10.9	0	Concrete, u	2400	2400	0.3	Existing	1	Bas A.19	0
Pipe623	NJ.4	Pit22	1	7.066	7.05	1.6	Concrete, u	900	900	0.3	Existing	1	NJ.4	0
P EX CSA	EX CSA1	AP9	9.815	10.948	10.849	1.01	Concrete, u	300	300	0.3	Existing	1	EX CSA1	0
P EX ESA	EX ESA1	AP3	15.422	11.69	11.524	1.08	Concrete, u	450	450	0.3	Existing	1	EX ESA1	0
P EX ESB	EX ESB1	AP3	1.728	11.16	11.14	1.16	Concrete, u	450	450	0.3	NewFixed	1	EX ESB1	0
P EX GSA	EX GSA1	SS8	9.132	14.285	13.985	3.29	Concrete, u	300	300	0.3	Existing	1	EX GSA1	0
P EX MA1	EX MA1	EX MA2	7.123	14.772	14.701	1	Concrete, u	375	375	0.3	Existing	1	EX MA1	0
P EX MA2	EX MA2	MS3	2.655	14.681	14.527	5.8	Concrete, u	375	375	0.3	Existing	1	EX MA2	0
P EX R1	EX R1	SS6	9.015	14.67	14.52	1.66	Concrete, u	450	450	0.3	Existing	1	EX R1	0
P EX S1	EX S1	EX S2	35.21	16.335	16.16	0.5	Concrete, u	375	375	0.3	Existing	1	EX S1	0
P EX S2	EX S2	S3	13.863	16.16	15.832	2.37	Concrete, u	375	375	0.3	Existing	1	EX S2	0
P S3	S3	MS8	13.95	15.832	15.48	2.52	Concrete, u	375	375	0.3	Existing	1	S3	0
P EX SA1	EX SA1	MSA2	13.175	14.97	14.73	1.82	Concrete, u	375	375	0.3	Existing	1	EX SA1	0
P MSA2	MSA2	MSA3	11.911	14.63	14.51	1.01	Concrete, u	525	525	0.3	NewFixed	1	MSA2	0
P MSA3	MSA3	MSA4	11.978	14.46	14.34	1	Concrete, u	525	525	0.3	NewFixed	1	MSA3	0
P MSA4	MSA4	MSA5	13.502	14.29	14.155	1	Concrete, u	600	600	0.3	NewFixed	1	MSA4	0
P MSA5	MSA5	MS7	3.854	14.1	14.062	0.99	Concrete, u	600	600	0.3	NewFixed	1	MSA5	0
P MSA1	MSA1	MSA2	14.024	15.276	14.68	4.25	Concrete, u	375	375	0.3	NewFixed	1	MSA1	0
P GS1	GS1	SS8	2.524	12.3	12.27	1.19	Concrete, u	375	375	0.3	Existing	1	GS1	0
P EX D1	EX D1	EX D2	27.274	21.73	19.62	7.74	Concrete, u	300	300	0.3	Existing	1	EX D1	0
P EX D2	EX D2	EX D3	22.319	19.62	19.397	1	Concrete, u	300	300	0.3	Existing	1	EX D2	0
P EX D3	EX D3	SS1	6.539	19.397	19.327	1.07	Concrete, u	375	375	0.3	NewFixed	1	EX D3	0
P SS1	SS1	SS2	10.006	19.15	19.1	0.5	Concrete, u	1200	1200	0.3	Existing	1	SS1	0
P SS2	SS2	SS3	37.85	19.05	18.861	0.5	Concrete, u	1200	1200	0.3	Existing	1	SS2	0
P SS3	SS3	SS4	85.053	18.81	18.087	0.85	Concrete, u	1200	1200	0.3	Existing	1	SS3	0
P SS4	SS4	SS5	80.307	18.03	15.51	3.14	Concrete, u	1200	1200	0.3	Existing	1	SS4	0
P SS5	SS5	SS6	64.358	15.46	12.63	4.4	Concrete, u	1200	1200	0.3	Existing	1	SS5	0
P EX MSB	EX MSB1	EX MSB2	3.351	14.56	14.34	6.57	Concrete, u	300	300	0.3	Existing	1	EX MSB1	0
P EX MSB	EX MSB2	MS12	8.005	14.34	14.17	2.12	Concrete, u	450	450	0.3	Existing	1	EX MSB2	0
P EX MSC	EX MSC1	EX MSB2	12.41	14.4	14.34	0.48	Concrete, u	300	300	0.3	Existing	1	EX MSC1	0
Pipe1013	N5059185	NA.15	10	8.755	8.655	1	Concrete, u	600	600	0.3	New	1	N5059185	0
Pipe1012	N5059186	NA.17	10	8.83	8.73	1	Concrete, u	525	525	0.3	New	1	N5059186	0
Pipe1011	N5059187	NA.18	10	8.59	8.49	1	Concrete, u	750	750	0.3	New	1	N5059187	0
Pipe1010	N5059188	NA.20	10	9.065	7.528	15.37	Concrete, u	300	300	0.3	New	1	N5059188	0
Pipe1009	N5059189	NA.19	10	8.99	7.65	13.4	Concrete, u	375	375	0.3	New	1	N5059189	0
Pipe1008	N5059190	NA.21	10	9.065	7.765	13	Concrete, u	300	300	0.3	New	1	N5059190	0
Pipe1007	N5059191	NA.21z	10	9.065	7.824	12.41	Concrete, u	300	300	0.3	New	1	N5059191	0
Pipe1006	N5059192	NA.22	10	9.065	8.106	9.59	Concrete, u	300	300	0.3	New	1	N5059192	0
Pipe1005	N5059193	NA.23	10	8.908	8.356	5.52	Concrete, u	450	450	0.3	New	1	N5059193	0
Pipe1004	N5059194	NA.24	1	7	2.42	458	Concrete, u	600	600	0.3	Existing	1	N5059194	0
Pipe828	Pit1	SS0	30	19.65	19.35	1	Concrete, u	1200	1200	0.3	Existing	1	Pit1	0
P SS0	SS0	SS1	42.425	19.35	19.21	0.33	Concrete, u	1200	1200	0.3	Existing	1	SS0	0

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Widtl (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Deptl Major Storı (m)	SafeDepth Minor Storı (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id
F A.17	A.17	A.18	1				15m wide ı	0.3	0.25	0.6	4.077	100	8419
F A.18	A.18	A.18z	1				15m wide ı	0.3	0.25	0.6	0.762	100	8420
F AH.1A	A.18z	AH.1	1				8 m wide r	0.3	0.15	0.4	1	0	382143
OF380	AJ.1	Bas A.19	1				8 m wide r	0.3	0.15	0.4	1	0	664824
OF a.19	A.19	Bas A.19	1				8 m wide r	0.3	0.15	0.4	1	0	624715
F A.20	A.20	A.22	1				Pathway 4	0.3	0.15	0.6	0.319	100	8444
F A.22	A.22	A.23	6				Pathway 4	0.3	0.15	0.6	0.502	100	8439
OF394	A.23	AP5	1				Pathway 4	0.3	0.15	0.6	1	0	664840
OF3	AP7	AP8	0.5				Dummy us	0.2	0.05	0.6	1	0	7702931
OF305	AP8	AP9	1				15m wide ı	0.3	0.25	0.6	1	0	589428
OF230	AP9	A.26	1				Pathway 4	0.3	0.15	0.6	1	0	476742
F XE.1	XE.1	XZ.1	1				Pathway 4	0.3	0.15	0.6	1.13	100	8485
F XE.2	XE.2	XE.4	1				8 m wide r	0.14	0.14	0.6	3.223	100	8486
F XE.4	XE.4	XE.5	1				15m wide ı	0.3	0.25	0.6	1.897	100	8488
F XE.5	XE.5	XE.6	1				15m wide ı	0.3	0.25	0.6	2.808	100	8489
F XE.6	XE.6	O XE.6	2				8 m wide r	0.14	0.14	0.6	0.124	100	8509
OF392	XF.6	O XE.6	1				8 m wide r	0.3	0.15	0.4	1	0	664838
OF198	XJ.1	XE.6	1				15m wide ı	0.3	0.25	0.6	1	0	382117

F X3.1	X3.1	X2.3	1	8 m wide r	0.14	0.14	0.6	1.531	100	8504
F X2.3	X2.3	X1.8	1	8 m wide r	0.14	0.14	0.6	2.363	100	8505
F X1.8	X1.8	X1.9	1	15m wide r	0.3	0.25	0.6	3.012	100	8506
F XF.5	XF.5	X1.9	1	Dummy us	0.2	0.05	0.6	8.383	100	8508
F L.1	L.1	L.2A	1	15m wide r	0.3	0.25	0.6	6.534	100	8369
F L.2A	L.2A	MS1	1	15m wide r	0.3	0.25	0.6	3.22	100	8370
F L.2	MS1	O.5	1	15m wide r	0.3	0.25	0.6	0.796	100	8371
O MS2	MS2	EX MA1	1	Dummy us	0.2	0.05	0.6	1	0	10073003
F N.1	N.1	N.2	1	8 m wide r	0.3	0.15	0.4	0.163	100	8372
F N.2	N.2	N.3	1	15m wide r	0.3	0.25	0.6	0.034	100	8373
F N.3	N.3	N.4	1	15m wide r	0.3	0.25	0.6	0.162	100	8374
F N.4	N.4	N.5	1	15m wide r	0.3	0.25	0.6	0.5	100	8375
F N.5	N.5	M.5	5	8 m wide r	0.14	0.14	0.6	0	100	8376
F M.5	M.5	A.17	5	15m wide r	0.3	0.25	0.6	0.62	100	8382
F M.1	M.1	M.2	1	8 m wide r	0.3	0.15	0.4	0.803	100	8377
F M.2	M.2	M.3	3	15m wide r	0.3	0.25	0.6	0.374	100	8378
F M.3	M.3	M.4	1	15m wide r	0.3	0.25	0.6	1	100	8379
F M.4	M.4	M.5	1	15m wide r	0.3	0.25	0.6	1.38	100	8381
F LR.3	LR.3	M.4	1	Pathway 4	0.3	0.15	0.6	2.797	100	8380
F P.4	P.4	AH.1	1	15m wide r	0.3	0.25	0.6	2.075	100	8426
F P.1	P.1	P.2	1	15m wide r	0.3	0.25	0.6	0.091	100	8427
F P.2	P.2	SS8	1	15m wide r	0.3	0.25	0.6	2.464	100	8430
F P.3	SS8	MSA5	1	Dummy us	0.2	0.05	0.6	0.907	100	8436
F Q.1	Q.1	Q.2	1	8 m wide r	0.3	0.15	0.4	4.725	100	8428
F Q.2	Q.2	P.2	1	15m wide r	0.3	0.25	0.6	3.814	100	8429
F R.1D	R.1D	R.1C	1	8 m wide r	0.14	0.14	0.6	1.907	100	8431
F R.1C	R.1C	R.1B	1	8 m wide r	0.3	0.15	0.4	3.485	100	8432
F R.1B	R.1B	R.1A	1	8 m wide r	0.3	0.15	0.4	1.993	100	8433
F R.1A	R.1A	EX R2A	2	8 m wide r	0.14	0.14	0.6	4.873	100	8434
F R.1	EX R2A	EX GSA1	1	Dummy us	0.2	0.05	0.6	2.451	100	8435
F A.5z	A.5z	A.5	1	15m wide r	0.3	0.25	0.6	14.158	100	8384
F A.5	A.5	X1.2	1	Pathway 4	0.3	0.15	0.6	1.587	100	8393
F A.6	A.6	A.11	1	15m wide r	0.3	0.25	0.6	1	0	382133
F A.11	A.11	A.12	1	15m wide r	0.3	0.25	0.6	2.22	100	8403
F A.12	A.12	A.12z	1	15m wide r	0.3	0.25	0.6	1.096	100	8404
OF1018	A.12z	A.13	1	15m wide r	0.3	0.25	0.6	1	0	9895306
F A.13	A.13	basA.14	2	15m wide r	0.3	0.25	0.6	2.316	100	8407
OF1055	A.14	basA.14	1	Dummy us	0.2	0.05	0.6	1	0	10014209
F A.15	A.15	O.5	7	Pathway 4	0.3	0.15	0.6	1.494	100	8413
F A.A1	A.A1	basA.2	1	Pathway 4	0.3	0.15	0.6	1.36	100	8385
OF386	A.2	basA.2	1	8 m wide r	0.3	0.15	0.4	1	0	664830
F A.3	A.3	A.4	1	Pathway 4	0.3	0.15	0.6	2.94	100	8391
F A.4	A.4	B.1	1	15m wide r	0.3	0.25	0.6	6.9	100	8392
F AB.1	AB.1	basA.2	1	15m wide r	0.3	0.25	0.6	0.087	100	8386
F A.1	A.1	A.2A	1	15m wide r	0.3	0.25	0.6	0.328	100	8387
F A.2A	A.2A	basA.2	1	15m wide r	0.3	0.25	0.6	0.397	100	8388
OF390	c.1	B.4A	1	Pathway 4	0.3	0.15	0.6	1	0	664836
F B.4A	B.4A	B.4	1	15m wide r	0.3	0.25	0.6	2.077	100	8397
F B.4	B.4	B.5A	1	8 m wide r	0.14	0.14	0.6	2.413	100	8398
F B.5A	B.5A	B.5	1	15m wide r	0.3	0.25	0.6	6.644	100	8399
F B.5	B.5	A.11	1	15m wide r	0.3	0.25	0.6	3.52	100	8402
F J.1	J.1	J.2	1	Pathway 4	0.3	0.15	0.6	1.098	100	8408
F J.2	J.2	basA.14	2	Dummy us	0.2	0.05	0.6	0.685	100	8410
F K.1	K.1	J.1	1	Pathway 4	0.3	0.15	0.6	0.699	100	8409
F AG.1	AG.1	EX MA1	5	8 m wide r	0.14	0.14	0.6	2.176	100	8412
F AH.1z	AH.1z	AH.1	1	8 m wide r	0.14	0.14	0.6	0	100	8440
F AH.1	AH.1	AH.2	1	15m wide r	0.3	0.25	0.6	0.023	100	8441
F AH.2	AH.2	Bas A.19	1	15m wide r	0.3	0.25	0.6	0.496	100	8442
F T.1	T.1	T.2z	1	15m wide r	0.3	0.25	0.6	2.232	100	8445
OF388	T.2z	T.2	1	Dummy us	0.2	0.05	0.6	1	0	664832
F T.2	T.2	N1864280	4	15m wide r	0.3	0.25	0.6	1.22	100	8449
OF301	AP2	AP3	1	15m wide r	0.3	0.25	0.6	1	0	589382
OF995	AP3	AP5	1	15m wide r	0.3	0.25	0.6	1	0	9657153
OF992	AP5	AP6	1	15m wide r	0.3	0.25	0.6	1	0	9657150
OF214	AP6	AP7	1	15m wide r	0.3	0.25	0.6	1	0	382162
F U.1y	U.1y	U.1z	1	Pathway 4	0.3	0.15	0.6	1.471	100	8446
F U.1z	U.1z	U.1A	1	Pathway 4	0.3	0.15	0.6	3.262	100	8448
OF212	U.1	T.2z	1	Pathway 4	0.3	0.15	0.6	1	0	382154
F Z.1	Z.1	V.1	6	15m wide r	0.3	0.25	0.6	1.939	100	8450
F V.1	V.1	A.23	2	15m wide r	0.3	0.25	0.6	1.462	100	8451
F W.1z	W.1z	basW.1	1	15m wide r	0.3	0.25	0.6	1.354	100	8452
F W.1y	W.1y	AP5	1	8 m wide r	0.14	0.14	0.6	0.163	100	8454
F W.3z	W.3z	W.3	1	15m wide r	0.3	0.25	0.6	0.046	100	8455
F W.3	W.3	W.3y	3	8 m wide r	0.3	0.15	0.4	0.391	100	8457
F W.3y	W.3y	EX ESF1	1	8 m wide r	0.3	0.15	0.4	1.029	100	8458
OF985	EX ESF1	AP8	1	Dummy us	0.2	0.05	0.6	1	0	9657143
F W.2	W.2	W.3	1	Pathway 4	0.3	0.15	0.6	0.077	100	8456
F NA.1	NA.1	NA.2	1	15m wide r	0.3	0.25	0.6	2.382	100	8459
F NA.2	NA.2	NA.3	1	15m wide r	0.3	0.25	0.6	2.382	100	8460
F NA.3	NA.3	NA.4	1	15m wide r	0.3	0.25	0.6	2.44	100	8463
F NA.4	NA.4	NA.5	1	15m wide r	0.3	0.25	0.6	0.483	100	8464
F NA.5	NA.5	NA.6	1	Dummy us	0.2	0.05	0.6	2.694	100	8466
F NA.6	NA.6	NA.7	2	15m wide r	0.3	0.25	0.6	1.062	100	8467
F NA.7	NA.7	NA.9	1	15m wide r	0.3	0.25	0.6	5.221	100	8470
F NA.9	NA.9	NA.10	1	15m wide r	0.3	0.25	0.6	0.678	100	8471

F NA.10	NA.10	NA.11	1		8 m wide r	0.14	0.14	0.6	0.288	100	8472
F NA.11	NA.11	NA.11z	1		15m wide r	0.3	0.25	0.6	1.006	100	8474
F NA.11z	NA.11z	NA.12	1		15m wide r	0.3	0.25	0.6	0.279	100	8475
F NA.12	NA.12	NA.13	1		Dummy us	0.2	0.05	0.6	0.396	100	8476
F NA.13	NA.13	NJ.4	1		15m wide r	0.3	0.25	0.6	2.493	100	8477
F NA.15	NA.15	NA.17	1		8 m wide r	0.14	0.14	0.6	0	100	8482
F NA.17	NA.17	NA.18	1		8 m wide r	0.14	0.14	0.6	0	100	8483
F NA.18	NA.18	NA.20	1		8 m wide r	0.14	0.14	0.6	0	100	8484
OF228	NA.20	NA.19	1		Dummy us	0.2	0.05	0.6	1	0	476740
OF226	NA.19	NA.21	1		Dummy us	0.2	0.05	0.6	1	0	476738
OF224	NA.21	NA.21z	1		Dummy us	0.2	0.05	0.6	1	0	476736
OF222	NA.21z	NA.22	1		Dummy us	0.2	0.05	0.6	1	0	476734
OF218	NA.22	NA.23	1		Dummy us	0.2	0.05	0.6	1	0	476730
OF217	NA.23	NA.24	1		Dummy us	0.2	0.05	0.6	1	0	476729
OF216	NA.24	N361	1		Dummy us	0.2	0.05	0.6	1	0	476727
F NB.1	NB.1	NB.2	2		8 m wide r	0.14	0.14	0.6	1.597	100	8461
F NB.2	NB.2	NA.3	1		Pathway 4	0.3	0.15	0.6	1.53	100	8462
F ND.1	ND.1	NA.5	1		15m wide r	0.3	0.25	0.6	2.16	100	8465
F NF.1	NF.1	NF.2	1		8 m wide r	0.3	0.15	0.4	2.346	100	8468
F NF.2	NF.2	NA.7	1		8 m wide r	0.3	0.15	0.4	2.039	100	8469
F NH.1	NH.1	NA.11	1		15m wide r	0.3	0.25	0.6	2.559	100	8473
F NJ.1	NJ.1	NJ.2	1		15m wide r	0.3	0.25	0.6	1.587	100	8478
F NJ.2	NJ.2	NJ.3	1		15m wide r	0.3	0.25	0.6	0.264	100	8479
F NJ.3	NJ.3	NJ.4	1		8 m wide r	0.14	0.14	0.6	0.316	100	8480
F XZ.1	XZ.1	XE.4	1		8 m wide r	0.14	0.14	0.6	2.078	100	8487
F X1.2	X1.2	X5.1	1		Pathway 4	0.3	0.15	0.6	3.644	100	8491
F X1.3	X1.3	X1.4	1		8 m wide r	0.14	0.14	0.6	2.43	100	8494
F X1.4	X1.4	X4.1	1		8 m wide r	0.14	0.14	0.6	1.346	100	8495
F X1.5	X1.5	X1.6	1		8 m wide r	0.14	0.14	0.6	1.786	100	8499
F X1.6	X1.6	X1.7	1		8 m wide r	0.14	0.14	0.6	1.273	100	8500
F X1.7	X1.7	X1.9	1		8 m wide r	0.14	0.14	0.6	2.054	100	8501
F X5.1	X5.1	X5.2	1		Dummy us	0.2	0.05	0.6	1.019	100	8492
F X5.2	X5.2	X1.3	1		8 m wide r	0.14	0.14	0.6	1.938	100	8493
F X1.1	X1.1	X6.1	1		8 m wide r	0.3	0.15	0.4	6.416	100	8490
F X4.1	X4.1	X4.2	1		8 m wide r	0.14	0.14	0.6	2.731	100	8497
F X4.2	X4.2	X1.5	1		8 m wide r	0.14	0.14	0.6	4.407	100	8498
F X6.1	X6.1	X2.1	1		8 m wide r	0.14	0.14	0.6	10.275	100	8496
F X2.1	X2.1	bas2.2	1		8 m wide r	0.14	0.14	0.6	1.753	100	8502
OF384	X 2.2	bas2.2	1		8 m wide r	0.3	0.15	0.4	1	0	664828
OF275	G.1	G.2A	1		15m wide r	0.3	0.25	0.6	1	0	589031
F G.2A	G.2A	basG.2	1		15m wide r	0.3	0.25	0.6	4.449	100	8359
OF382	G.2	basG.2	1		8 m wide r	0.3	0.15	0.4	1	0	664826
F G.3	G.3	G.4	2		15m wide r	0.3	0.25	0.6	0.9	100	8363
F G.4	G.4	G.5	5		Pathway 4	0.3	0.15	0.6	0.9	100	8364
F G.5	G.5	G.6	2		Pathway 4	0.3	0.15	0.6	0.239	100	8365
F G.6	G.6	J.2	1		15m wide r	0.3	0.25	0.6	2.006	100	8366
F G.6A	G.6A	G.6	1		15m wide r	0.3	0.25	0.6	2.724	100	8367
F G.7	G.7	G.6A	2		15m wide r	0.3	0.25	0.6	2.629	100	8368
F H.1	H.1	I.1	1		15m wide r	0.3	0.25	0.6	0.816	100	8360
F I.1	I.1	G.4	1		Dummy us	0.2	0.05	0.6	0.863	100	8362
F B.1	B.1	B.2	1		15m wide r	0.3	0.25	0.6	0.061	100	8394
F B.2	B.2	B.3	1		15m wide r	0.3	0.25	0.6	1.321	100	8395
F B.3	B.3	B.4A	2		15m wide r	0.3	0.25	0.6	30.95	100	8396
F K.1A	K.1A	AD.1	1		15m wide r	0.3	0.25	0.6	1.295	100	8405
F AD.1	AD.1	A.13	1		15m wide r	0.3	0.25	0.6	2.422	100	8406
F D.2	D.2	O.1	2		Dummy us	0.2	0.05	0.6	1.205	100	8401
F O.1	O.1	O.2	2		15m wide r	0.3	0.25	0.6	3.674	100	8414
F O.2	O.2	O.3	1		8 m wide r	0.14	0.14	0.6	1.662	100	8415
F O.3	O.3	O.4	1		15m wide r	0.3	0.25	0.6	1.667	100	8416
F O.4	O.4	O.5	1		15m wide r	0.3	0.25	0.6	1.632	100	8417
F O.5	O.5	M.5	5		15m wide r	0.3	0.25	0.6	0.926	100	8418
F U.1A	U.1A	N1864280	1		Dummy us	0.2	0.05	0.6	3.413	100	8447
OF231	A.26	A.O	1		Pathway 4	0.3	0.15	0.6	1	0	476743
F W.1	basW.1	W.1y	1	12.503	15m wide r	0.3	0.25	0.6	0.376	100	8453
F A.2	basA.2	AC.1	1	26.151	15m wide r	0.3	0.25	0.6	0.367	100	8389
F AC.1	AC.1	A.4	1	25.71	Pathway 4	0.3	0.15	0.6	2.5	100	8390
F X2.2	bas2.2	X3.1	1	20.19	8 m wide r	0.14	0.14	0.6	0.933	100	8503
F G.2	basG.2	H.1	2	19.1	15m wide r	0.3	0.25	0.6	0.22	100	8361
F A.14	basA.14	A.15	5	17.8	Pathway 4	0.3	0.15	0.6	0.509	100	8411
F AF.1	Basin65	A.15	1	18.1	15m wide r	0.3	0.25	0.6	1	0	624700
F A.19	Bas A.19	N1864280	2	14.13	15m wide r	0.3	0.25	0.6	0.272	100	8437
F NA.14	NJ.4	NA.15	1	11.836	8 m wide r	0.14	0.14	0.6	1.793	100	8481
OF773	N1864280	AP2	1		15m wide r	0.3	0.25	0.6	1	0	4417929
OF1050	EX CSA1	EX MSC1	3		15m wide r	0.3	0.25	0.6	1	0	9895338
OF1048	EX ESA1	AP3	1		Dummy us	0.2	0.05	0.6	1	0	9895336
OF1057	EX ESB1	AP3	1		Dummy us	0.2	0.05	0.6	1	0	10014211
OF1036	EX GSA1	MS6	1		15m wide r	0.3	0.25	0.6	1	0	9895324
OF1045	EX MA1	O.5	1		Dummy us	0.2	0.05	0.6	1	0	9895333
F EX R1	EX R1	EX R2A	0.5		Dummy us	0.2	0.05	0.6	1	0	12100325
F S.1	EX S1	EX S2	1		15m wide r	0.3	0.25	0.6	0.916	100	8421
F S.2	EX S2	S3	1		15m wide r	0.3	0.25	0.6	1.371	100	8422
F S.3	S3	MSA1	1		15m wide r	0.3	0.25	0.6	15.262	100	8423
OF939	EX SA1	MSA2	1		Dummy us	0.2	0.05	0.6	0.01	100	9656917
F S.4	MSA2	MSA3	1		15m wide r	0.3	0.25	0.6	1.429	100	8424
OF948	MSA3	MSA4	1		15m wide r	0.3	0.25	0.6	1	0	9656926

OF949	MSA4	MSA5	1	15m wide ı	0.3	0.25	0.6	0.8	0	9656927
F S.5	MSA5	P.4	1	15m wide ı	0.3	0.25	0.6	3.611	100	8425
OF937	MSA1	MSA2	1	15m wide ı	0.3	0.25	0.6	2.1	0	9656915
OF1041	GS1	SS8	1	8 m wide r	0.3	0.15	0.4	1	0	9895329
OF1000	EX D1	EX D2	1	Dummy us	0.2	0.05	0.6	1	0	9776244
OF1001	EX D2	EX D3	1	15m wide ı	0.3	0.25	0.6	1	0	9776245
F D.1	EX D3	D.2	1	15m wide ı	0.3	0.25	0.6	11.717	100	8400
OF1005	SS4	P.1	1	Dummy us	0.2	0.05	0.6	1	0	9776255
OF1007	SS5	EX R1	1	15m wide ı	0.3	0.25	0.6	1	0	9776257

Appendix C

Community Submissions

Liverpool city council
creating our future together

LIVERPOOL CENTRAL BUSINESS DISTRICT
FLOODPLAIN MANAGEMENT STUDY

Survey for Commercial or Industrial Premises

Item 1 – Business Details

a) *Business Managers Name:* Halil Mustafa

b) *Business Type:* Real Estate

c) *Business Name* The Real Estate Shop

d) *Street Address:* 2/86 Bathurst St Liverpool

Item 2 – How long have you been managing these business premises? ....Year's...2...months

Item 3- In that time, has the premises had any problems due to flooding? (tick appropriate box)

☑	No	Go to Item 4 overleaf
☐	Yes	Please indicate the year(s) this happened

a) What effects did the floods have?

Damaged Items	Description of item
Damage to stock	
Damage to the building	
Damage to equipment	
Damage to fixtures	
Personal Injury	
Loss of Access to building	
Other	

Other Damage. Please make additional comments as desired ....

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b) What year was the last flood of your business? ....N/A........

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?

....

ii. Can you recall the approximate depth of flooding in metres?

....

iii. Can you recall how long the flooding lasted in terms of the number of hours?

....

iv. How much business was lost as a result of last flood? (Including the actual flood and clean up time)?

1. Estimated loss of Business $_________
2. Estimated cost of clean up $_________

Total $_________

c) What year was the worse flood to your business?........N/A........

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?

....

ii. Can you recall the approximate depth of flooding in meters?

....

iii. Can you recall how long the flooding lasted in terms of the number of hours?

....

iv. Can you estimate how often this type of flooding would occur? – ie the depth described above and the length of days(Eg: once a year, once a month)?

....

v. How much business was lost as a result of last flood? (Including the actual flood and clean up time?

1. Estimated loss of Business $_________
2. Estimated cost of clean up $_________

Total$_________

Item 4 Does this business premises have a current insurance policy for flooding?

Yes...

....

....

Item 5- Does this business premises have a current procedure for flood management and evacuation? NO

If so, describe in a few words who an employee would need to contact if a flood did occur? ....

....

....

If so, describe in a few words what would happen next? ....

....

....

Item 6 – Do you as the business manager have any suggestions for the Liverpool City Council for preventing or managing floods?

.............................Better planning of development.............

....

....

....

Do you have any other concerns relating to flooding? Please briefly describe

....

....

....

Thankyou for your assistance.

Liverpool city council
creating our future together

LIVERPOOL CENTRAL BUSINESS DISTRICT
FLOODPLAIN MANAGEMENT STUDY

Survey for Commercial or Industrial Premises

Item 1 – Business Details

a) *Business Managers Name:* KEVIN SHAW

b) *Business Type:* HEALING CENTRE

c) *Business Name* RAINBOW HEALING CENTRE

d) *Street Address:* - Shop 1 86 Bathurst St Liverpool.
Previous address where flooding took place
- Shop 4 76-78 Bathurst St

Item 2 – How long have you been managing these business premises? 10 Year's.........months

Item 3- In that time, has the premises had any problems due to flooding? (tick appropriate box)

☐	No	Go to Item 4 overleaf
☑	Yes	Please indicate the year(s) this happened 2000, 2002

a) What effects did the floods have?

Damaged Items	Description of item
Damage to stock	
Damage to the building	WALLS, , CARPETS,
Damage to equipment	
Damage to fixtures	Desks, Cupboards
Personal Injury	
Loss of Access to building	
Other	

Other Damage. Please make additional comments as desired ....

All stock was up in cupboards all computers & equipment off ground because of knowledge of flooding.

b) What year was the last flood of your business? ....2002..

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?
........rising from drains..

ii. Can you recall the approximate depth of flooding in metres?
........50 - 60 mm..

iii. Can you recall how long the flooding lasted in terms of the number of hours?
........20 - 30 min..

iv. How much business was lost as a result of last flood? (Including the actual flood and clean up time)?

1. Estimated loss of Business $ 500
2. Estimated cost of clean up $ 500

Total $ 1000

c) What year was the worse flood to your business?........2002..

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?
........rising from drains..

ii. Can you recall the approximate depth of flooding in meters?
.........5 - .6 m..

iii. Can you recall how long the flooding lasted in terms of the number of hours?
........20 - 30 min..

iv. Can you estimate how often this type of flooding would occur? – ie the depth described above and the length of days(Eg: once a year, once a month)?
........2 years..

v. How much business was lost as a result of last flood? (Including the actual flood and clean up time?

1. Estimated loss of Business $ 500
2. Estimated cost of clean up $ 500

Total$ 1000

Item 4 Does this business premises have a current insurance policy for flooding?
No
....
....
....

Item 5- Does this business premises have a current procedure for flood management and evacuation?

If so, describe in a few words who an employee would need to contact if a flood did occur? New Premises not affected. all fixtures off the ground, block front door.

If so, describe in a few words what would happen next? Stop water access as best as possible.

Item 6 – Do you as the business manager have any suggestions for the Liverpool City Council for preventing or managing floods? Units across road 3 stories high cover full block, force water down into the stormwater which cannot cope too much water. Not affected prior to units being built.

Do you have any other concerns relating to flooding? Please briefly describe

Thankyou for your assistance.

LIVERPOOL CENTRAL BUSINESS DISTRICT

FLOODPLAIN MANAGEMENT STUDY

Survey for Commercial or Industrial Premises

Item 1 – Business Details

a) *Business Managers Name:* SANDRA JUKIC

b) *Business Type:* RESIDENTIAL CONSTRUCTION.

c) *Business Name* BERNARD CONSTRUCTIONS P/L

d) *Street Address:* Unit 4 / 80 BATHURST ST LIVERPOOL NSW 2170.

Item 2 – How long have you been managing these business premises? 5 Year's……… months

Item 3- In that time, has the premises had any problems due to flooding? (tick appropriate box)

☐ No	Go to Item 4 overleaf
☑ Yes	Please indicate the year(s) this happened 2003.

a) What effects did the floods have?

Damaged Items	Description of item
Damage to stock	
Damage to the building	
Damage to equipment	
Damage to fixtures	
Personal Injury	
Loss of Access to building	BATHURST ST WAS KNEE-HIGH FLOODED & THIS RESTRICTED ACCESS TO OUR PREMISES.
Other	

Other Damage. Please make additional comments as desired ....

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b) What year was the last flood of your business? .... 2003. ....

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?

....

ii. Can you recall the approximate depth of flooding in metres?

.... 0.5 m. ....

iii. Can you recall how long the flooding lasted in terms of the number of hours?

.... 1 Hour ....

iv. How much business was lost as a result of last flood? (Including the actual flood and clean up time)?

1. Estimated loss of Business $_________

2. Estimated cost of clean up $_________

Total **$** NIL.

c) What year was the worse flood to your business?........ As Above. ....

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?

....

ii. Can you recall the approximate depth of flooding in meters?

....

iii. Can you recall how long the flooding lasted in terms of the number of hours?

....

iv. Can you estimate how often this type of flooding would occur? – ie the depth described above and the length of days(Eg: once a year, once a month)?

....

v. How much business was lost as a result of last flood? (Including the actual flood and clean up time?

1. Estimated loss of Business $_________

2. Estimated cost of clean up $_________

Total$_________

Item 4 Does this business premises have a current insurance policy for flooding?

.... No ....

....

....

Item 5- Does this business premises have a current procedure for flood management and evacuation? No.

If so, describe in a few words who an employee would need to contact if a flood did occur? ....

....

....

If so, describe in a few words what would happen next? ....

....

....

Item 6 – Do you as the business manager have any suggestions for the Liverpool City Council for preventing or managing floods? No.

....

....

....

....

Do you have any other concerns relating to flooding? Please briefly describe

....

....

....

Thankyou for your assistance.

Liverpool city council
creating our future together

LIVERPOOL CENTRAL BUSINESS DISTRICT FLOODPLAIN MANAGEMENT STUDY

Survey for Commercial or Industrial Premises

Item 1 – Business Details

a) *Business Managers Name:* Jim Kovacs

b) *Business Type:* Sporting Goods Retail

c) *Business Name* Wilderness Sea n Ski

d) *Street Address:* 137 George St
Liverpool

Item 2 – How long have you been managing these business premises? 27 Year's……… months

Item 3- In that time, has the premises had any problems due to flooding? (tick appropriate box)

☐	No	Go to Item 4 overleaf
☑	Yes	Please indicate the year(s) this happened 6 Times

a) What effects did the floods have?

Damaged Items	Description of item
Damage to stock	All Stock that is on Floor
Damage to the building	Carpet + Floor Coverings all Wooden Fittings
Damage to equipment	All Power Equipment
Damage to fixtures	
Personal Injury	Nil.
Loss of Access to building	2 Hours per Flood
Other	

Other Damage. Please make additional comments as desired ....

b) What year <u>was the last flood</u> of your business? ......2004......

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?

Yes From Rising Water on George St

ii. Can you recall the approximate depth of flooding in metres?

6" Through out Shop

iii. Can you recall how long the flooding lasted in terms of the number of hours?

2 Hours

iv. How much business was lost as a result of last flood? (Including the actual flood and clean up time)?

1. Estimated loss of Business $ 5000
2. Estimated cost of clean up $ 2000 – 5,000

Total $_________

c) What year <u>was the worse flood to</u> your business?....Flooding occures Every year.

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?

Yes

ii. Can you recall the approximate depth of flooding in meters?

....

iii. Can you recall how long the flooding lasted in terms of the number of hours?

....

iv. Can you estimate how often this type of flooding would occur? – ie the depth described above and the length of days(Eg: once a year, once a month)?

....

v. How much business was lost as a result of last flood? (Including the actual flood and clean up time?

1. Estimated loss of Business $_________
2. Estimated cost of clean up $_________

Total$_________

Item 4 Does this business premises have a current insurance policy for flooding?

Yes

....

....

Item 5- Does this business premises have a current procedure for flood management and evacuation? NO

If so, describe in a few words who an employee would need to contact if a flood did occur? All Staff are called in.

If so, describe in a few words what would happen next? Towels under Door, lift everthing up

Item 6 – Do you as the business manager have any suggestions for the Liverpool City Council for preventing or managing floods?
This problem has been going on for 25 years. why should they start worrying now. Is there an election happening?

Do you have any other concerns relating to flooding? Please briefly describe
Water Damage to Brickwork + Front of Building needs to be Repaired

Thankyou for your assistance.

Liverpool city council
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LIVERPOOL CENTRAL BUSINESS DISTRICT
FLOODPLAIN MANAGEMENT STUDY

Survey for Commercial or Industrial Premises

Item 1 – Business Details

a) *Business Managers Name:* Dr. R. CHANG

b) *Business Type:* MEDICAL PRACTICE

c) *Business Name*

d) *Street Address:* 2/76-78 BATHURST ST
LIVERPOOL 2170

Item 2 – How long have you been managing these business premises? SINCE 1987 ....Year's.........months

Item 3- In that time, has the premises had any problems due to flooding? (tick appropriate box)

☐	No	Go to Item 4 overleaf
☑	Yes	Please indicate the year(s) this happened CAN'T REMEMBER

BUT 3 BIG FLOODS INTO PREMISES

b) What year was the last flood of your business? ……………………………………………………

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?
FROM STREET (EACH EPISODE BATHURST ST. WAS LIKE A RIVER FLOWING!)

ii. Can you recall the approximate depth of flooding in metres?
APPROX 1/3 METRES

iii. Can you recall how long the flooding lasted in terms of the number of hours?
FEW HOURS

iv. How much business was lost as a result of last flood? (Including the actual flood and clean up time)?

1. Estimated loss of Business $ 2 DAYS WORTH OF BUSINESS EACH EPISODE (IN THOUSANDS)
2. Estimated cost of clean up $_________ ← Incalculable as lots of manhours & staff work involved.

Total $_________

c) What year was the worse flood to your business? ALL 3 APPROX SAME AS ABOVE

CANNOT REMEMBER EXACT YEARS BUT NOTED 3 BAD FLOODS FROM 1987 to DATE.

i. Can you recall if the flooding was a result of water flowing from the street or from rising water depths nearby?
FROM POOR DRAINAGE OF STREET.

ii. Can you recall the approximate depth of flooding in meters? 1/3

iii. Can you recall how long the flooding lasted in terms of the number of hours?
As above

iv. Can you estimate how often this type of flooding would occur? – ie the depth described above and the length of days(Eg: once a year, once a month)?
……………………………………………………

v. How much business was lost as a result of last flood? (Including the actual flood and clean up time?

1. Estimated loss of Business $_________ As mentioned above.
2. Estimated cost of clean up $_________

Total$_________

Item 4 Does this business premises have a current insurance policy for flooding?

YES.

a) What effects did the floods have?

Damaged Items	Description of item
Damage to stock	CABINETS, EQUIPMENT, ELECTRICAL POINTS
Damage to the building	PAVING INFRONT, FLOORING/CARPETS/DOORS, WALLS
Damage to equipment	ELECTRICAL EQUIPMENT
Damage to fixtures	DOORS, CARPETS, CURTAINS PARTS OF PARTITIONS
Personal Injury	NIL
Loss of Access to building	1-2 DAYS EACH EPISODE
Other	

Other Damage. Please make additional comments as desired ....

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Item 5- Does this business premises have a current procedure for flood management and evacuation? NO.

If so, describe in a few words who an employee would need to contact if a flood did occur? THE BOSS.

If so, describe in a few words what would happen next?

Item 6 – Do you as the business manager have any suggestions for the Liverpool City Council for preventing or managing floods?

THE DRAINAGE SYSTEMS HAVE TO BE IMPROVED ON STREETS – FLOODED STREETS + "WASH" FROM PASSING VEHICLES ~~ADD~~ TOGETHER RESULT IN FLOODING OF MY PREMISES.

Do you have any other concerns relating to flooding? Please briefly describe

LOTS OF LOSSES IN; MONEY TERMS
LOSS OF BUSINESS
~~LOSS OF~~ HEALTH CONCERNS (CONTAMINATION)
DAMAGE TO PROPERTY.

Thankyou for your assistance.

STILL WORRY ABOUT FUTURE RISK.
UNNECESSARY STRESS
AFTER ALL, THESE EVENTS ARE PREVENTABLE.

Appendix D

Floodplain Risk Management Option Assessment Matrix

Liverpool CBD Floodplain Management Study

Floodplain Risk Management Option Assessment Matrix

Revision: Draft

Issues	**Weighting**	**Options** Do Nothing	Flood Proofing of Buildings	Voluntary Purchase of High Hazard Properties	Flood Insurance and Recovery	Public Flood Awareness Scheme	Structural Drainage Solution - Section A	Structural Drainage Solution - Section A + B
Social issues								
Flood hazard reduction	5	1	1	2	1	1	4	5
Increase in property values	1	1	4	4	2	1	4	5
Community growth	3	1	3	3	3	1	4	5
Short Term Community disruption	3	5	2	2	4	4	2	1
Long Term Community disruption	3	1	3	3	1	2	4	5
Environmental issues								
Ecology, WSUD	4	3	3	5	3	3	2.5	2
Pollution	3	2	2	4	2	2	3	4
Energy and resources to implement	2	5	3	2	5	4	3	2
Future energy and resources	2	5	5	4	5	4	4	4
Weighted Intangible Score		**68%**	**71%**	**86%**	**73%**	**64%**	**92%**	**100%**
Economic Issues								
Costs								
Present Value Capital Costs		$ -	$ 6,953,000	$ 73,755,000	$ -	$ 40,000	$ 7,395,000	$ 9,895,000
Present Value Ongoing Costs		$ -	$ -	$ 229,000	$ 5,428,000	$ 46,000	$ -	$ -
Total		$ -	$ 6,953,000	$ 73,984,000	$ 5,428,000	$ 86,000	$ 7,395,000	$ 9,895,000
Benefits								
Savings in Average Annual Damage		$ -	$ 202,000	$ 405,000	$ 202,000	$ 4,000	$ 303,000	$ 405,000
Present Value in Damage Savings		$ -	$ 3,109,000	$ 6,217,000	$ 3,109,000	$ 62,000	$ 4,646,000	$ 6,217,000
Benefit/ Cost Ratio		**0.00**	**0.45**	**0.08**	**0.57**	**0.72**	**0.63**	**0.63**
BCR Factored with Intangible Score		**0.00**	**0.32**	**0.07**	**0.42**	**0.46**	**0.58**	**0.63**

Liverpool CBD Floodplain Management Study

Additional Works

Revision: Draft

NOTE: The preliminary cost estimates presented in this section have been developed for the purposes of comparing options and may be used for preliminary budgeting. They are not to be used for any other purpose. The scope and quality of the works has not been fully defined and therefore the estimates are not warranted by GHD. These estimates are typically developed based on cost curves, budget quotes for some equipment items, extrapolation of recent similar project pricing and GHD experience. The accuracy of the estimates is not expected to be better than about ± 30% for the items described in this report. A functional design is recommended for budget setting purposes.

SCHEDULE OF ESTIMATED QUANTITIES

PAY ITEM	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT	NOTES
1	**Establishment**					
1.1	Establishment	1	item	30000	$ 30,000	Allowance only
	SUBTOTAL				**$ 30,000**	
2	**Demolition**					
2.1	Demolition - break up and remove bitumen paving (small quantity)	500	m2	6	$ 3,000	Disposal extra
2.2	Disposal charge for surplus material	150	m3	45	$ 6,750	Assume no contamination
	SUBTOTAL				**$ 9,750**	
3	**Earthworks**					
3.1	Excavate 1200mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	327	m	210	$ 68,670	Assuming clay soil
3.2	Excavate 900mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	65	m	95	$ 6,175	Assuming clay soil
	SUBTOTAL				**$ 74,845**	
4	**Services Diversions and Relocations**					
4.1	Relocate Telstra services	1	item	10000	$ 10,000	-
	SUBTOTAL				**$ 10,000**	
5	**Drainage**					
5.1	Pipe - Supply, deliver, lay and join 900mm RCP (Class 3)	327	m	610	$ 199,470	Rubber ring joint; excavation excluded
5.2	Manhole/pit - supply and install junction pit; large; with heavy duty cover	5	each	2600	$ 13,000	-
5.3	Pipe - Supply, deliver, lay and join 600mm RCP (Class 2)	65	m	240	$ 15,600	Rubber ring joint; excavation excluded
5.4	Break into existing pit and make good	7	each	230	$ 1,610	-
	SUBTOTAL				**$ 229,680**	
6	**Reinstatement**					
6.1	Pavement - Asphalt; 40mm AC10 wearing course, 175mm basecourse (1 layer AC10 over 2 layers AC20), 195mm sub-base lean mix, 7mm primer seal, 300mm select material CBR>15%	460	m2	170	$ 78,200	-
	SUBTOTAL				**$ 78,200**	
7	**Miscellaneous**					
7.1	Erosion and sediment control	1	item	5000	$ 5,000	Allowance only
7.2	Traffic control	1	item	20000	$ 20,000	Allowance only
	SUBTOTAL				**$ 25,000**	
	SUBTOTAL ITEMS 1-7				**$ 457,475**	
8	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs (10%)	10	%	-	$ 45,748	-
	SUBTOTAL				**$ 45,748**	
9	**Contingencies**					
9.1	Contingencies - General (25%)	25	%	-	$ 114,369	-
	SUBTOTAL				**$ 114,369**	
	TOTAL (Ex-GST)				**$ 617,591**	

Liverpool CBD Floodplain Management Study

Additional Works

Revision: Draft

NOTE: The preliminary cost estimates presented in this section have been developed for the purposes of comparing options and may be used for preliminary budgeting. They are not to be used for any other purpose. The scope and quality of the works has not been fully defined and therefore the estimates are not warranted by GHD. These estimates are typically developed based on cost curves, budget quotes for some equipment items, extrapolation of recent similar project pricing and GHD experience. The accuracy of the estimates is not expected to be better than about ± 30% for the items described in this report. A functional design is recommended for budget setting purposes.

SCHEDULE OF ESTIMATED QUANTITIES

PAY ITEM	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT	NOTES
1	**Establishment**					
1.1	-	-			$ -	
	SUBTOTAL				**$ -**	
2	**Demolition**					
2.1	Demolition - break up and remove bitumen paving (small quantity)	62	m2	6	$ 371	Disposal extra
2.2	Disposal charge for surplus material	19	m3	45	$ 835	Assume no contamination
	SUBTOTAL				**$ 1,206**	
3	**Earthworks**					
3.1	Excavate 2000mm wide trench by machine, backfill with same material and compact, up to 3.0m deep	52	m	340	$ 17,528	Assuming clay soil
	SUBTOTAL				**$ 17,528**	
4	**Services Diversions and Relocations**					
4.1	Nominal amount	1	item	5000	$ 5,000	-
	SUBTOTAL				**$ 5,000**	
5	**Drainage**					
5.1	Pipe - Supply, deliver, lay and join 1350mm RCP (Class 2)	19	m	950	$ 17,575	Rubber ring joint; excavation excluded
5.2	Pipe - Supply, deliver, lay and join 1350mm RCP (Class 4)	33	m	1400	$ 46,276	Rubber ring joint; excavation excluded
5.3	Pipe - Supply, deliver, lay and join 1500mm RCP (Class 4)	- 33	m	1700	-$ 55,803	Rubber ring joint; excavation excluded
5.4	Pipe - Supply, deliver, lay and join 1650mm RCP (Class 4)	33	m	1900	$ 62,368	Rubber ring joint; excavation excluded
	SUBTOTAL				**$ 70,416**	
6	**Reinstatement**					
6.1	Pavement - Asphalt; 40mm AC10 wearing course, 175mm basecourse (1 layer AC10 over 2 layers AC20), 195mm sub-base lean mix, 7mm primer seal, 300mm select material CBR>15%	62	m2	170	$ 10,517	-
	SUBTOTAL				**$ 10,517**	
7	**Miscellaneous**					
7.1	-	-			$ -	
	SUBTOTAL				**$ -**	
	SUBTOTAL ITEMS 1-7				**$ 104,667**	
8	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs (10%)	10	%	-	$ 10,467	-
	SUBTOTAL				**$ 10,467**	
9	**Contingencies**					
9.1	Contingencies - General (25%)	25	%	-	$ 26,167	-
	SUBTOTAL				**$ 26,167**	
	TOTAL (Ex-GST)				**$ 141,301**	

Liverpool CBD Floodplain Management Study

Additional Works

Revision: Draft

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SCHEDULE OF ESTIMATED QUANTITIES

PAY ITEM	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT	NOTES
1	**Establishment**					
1.1	-	-			$ -	
	SUBTOTAL				**$ -**	
2	**Demolition**					
2.1	-	-			$ -	
	SUBTOTAL				**$ -**	
3	**Earthworks**					
3.1	-	-			$ -	
	SUBTOTAL				**$ -**	
4	**Services Diversions and Relocations**					
4.1	Relocate Telstra services	1	item	5000	$ 5,000	-
	SUBTOTAL				**$ 5,000**	
5	**Drainage**					
5.1	Pipe - Supply, deliver, lay and join 825mm RCP (Class 2)	- 22	m	420	-$ 9,240	Rubber ring joint; excavation excluded
5.2	Pipe - Supply, deliver, lay and join 1050mm RCP (Class 2)	- 113	m	640	-$ 72,320	Rubber ring joint; excavation excluded
5.3	Pipe - Supply, deliver, lay and join 1500mm RCP (Class 3)	135	m	1400	$ 189,000	Rubber ring joint; excavation excluded
	SUBTOTAL				**$ 107,440**	
6	**Reinstatement**					
6.1	-	-			$ -	
	SUBTOTAL				**$ -**	
7	**Miscellaneous**					
7.1	-	-			$ -	
	SUBTOTAL				**$ -**	
	SUBTOTAL ITEMS 1-7				**$ 112,440**	
8	**Supervision, Project Management & Contractor On-Costs**					
8.1	-	-		-	$ -	
	SUBTOTAL				**$ -**	
9	**Contingencies**					
9.1	Contingencies - General (25%)	25	%	-	$ 28,110	-
	SUBTOTAL				**$ 28,110**	
	TOTAL (Ex-GST)				**$ 140,550**	

Liverpool CBD Floodplain Management Study

Additional Works

Revision: Draft

NOTE: The preliminary cost estimates presented in this section have been developed for the purposes of comparing options and may be used for preliminary budgeting. They are not to be used for any other purpose. The scope and quality of the works has not been fully defined and therefore the estimates are not warranted by GHD. These estimates are typically developed based on cost curves, budget quotes for some equipment items, extrapolation of recent similar project pricing and GHD experience. The accuracy of the estimates is not expected to be better than about ± 30% for the items described in this report. A functional design is recommended for budget setting purposes.

SCHEDULE OF ESTIMATED QUANTITIES

PAY ITEM	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT	NOTES
1	**Establishment**					
1.1	Establishment	1	item	30000	$ 30,000	Allowance only
	SUBTOTAL				**$ 30,000**	
2	**Demolition**					
2.1	Demolition - break up and remove bitumen paving (small quantity)	214	m2	6	$ 1,285	Disposal extra
2.2	Disposal charge for surplus material	64	m3	45	$ 2,892	Assume no contamination
	SUBTOTAL				**$ 4,177**	
3	**Earthworks**					
3.1	Excavate 600mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	237	m	63	$ 14,931	Assuming clay soil
3.2	Excavate 900mm wide trench by machine, backfill with same material and compact, up to 2.0m deep	80	m	95	$ 7,600	Assuming clay soil
	SUBTOTAL				**$ 22,531**	
4	**Services Diversions and Relocations**					
4.1	Nominal amount	1	item	5000	$ 5,000	-
	SUBTOTAL				**$ 5,000**	
5	**Drainage**					
5.1	Pipe - Supply, deliver, lay and join 375mm RCP (Class 2)	52	m	120	$ 6,240	Rubber ring joint; excavation excluded
5.2	Pipe - Supply, deliver, lay and join 450mm RCP (Class 3)	185	m	180	$ 33,300	Rubber ring joint; excavation excluded
5.3	Pipe - Supply, deliver, lay and join 600mm RCP (Class 3)	80	m	270	$ 21,600	Rubber ring joint; excavation excluded
5.4	Manhole/pit - supply and install junction pit; large; with heavy duty cover	5	each	2600	$ 13,000	-
5.4	Break into existing pit and make good	6	each	230	$ 1,380	-
	SUBTOTAL				**$ 75,520**	
6	**Reinstatement**					
6.1	Pavement - Asphalt; 40mm AC10 wearing course, 175mm basecourse (1 layer AC10 over 2 layers AC20), 195mm sub-base lean mix, 7mm primer seal, 300mm select material CBR>15%	214	m2	170	$ 36,414	-
	SUBTOTAL				**$ 36,414**	
7	**Miscellaneous**					
7.1	Erosion and sediment control	1	item	5000	$ 5,000	Allowance only
7.2	Traffic control	1	item	10000	$ 10,000	Allowance only
	SUBTOTAL				**$ 15,000**	
	SUBTOTAL ITEMS 1-7				**$ 188,642**	
8	**Supervision, Project Management & Contractor On-Costs**					
8.1	Supervision, Project Management & Contractor On-Costs (10%)	10	%	-	$ 18,864	-
	SUBTOTAL				**$ 18,864**	
9	**Contingencies**					
9.1	Contingencies - General (25%)	25	%	-	$ 47,160	-
	SUBTOTAL				**$ 47,160**	
	TOTAL (Ex-GST)				**$ 254,667**	

Appendix E

Public Meeting Presentation

Liverpool CBD Floodplain Management Study

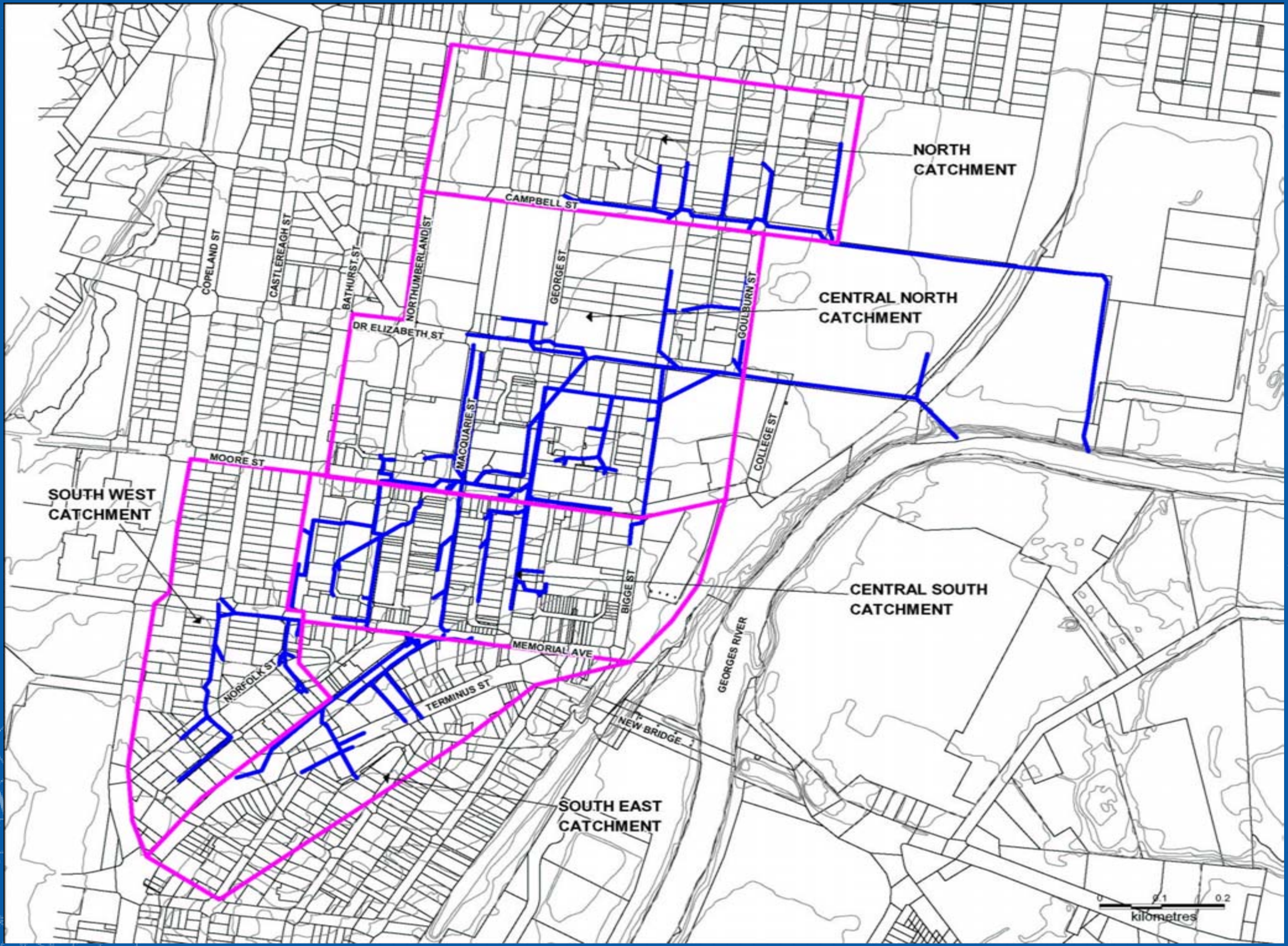
Purpose of this Public Meeting

- To present the preliminary findings of the Liverpool CBD Floodplain Management Study to the community
- To identify any further community issues and concerns relating to flooding of the Liverpool CBD
- To present possible measures to reduce the impacts of flooding in the Liverpool CBD

Liverpool CBD Floodplain Management Study

"The Liverpool CBD is at risk of extensive overland flooding potentially affecting commerce and public safety"

Study Area:



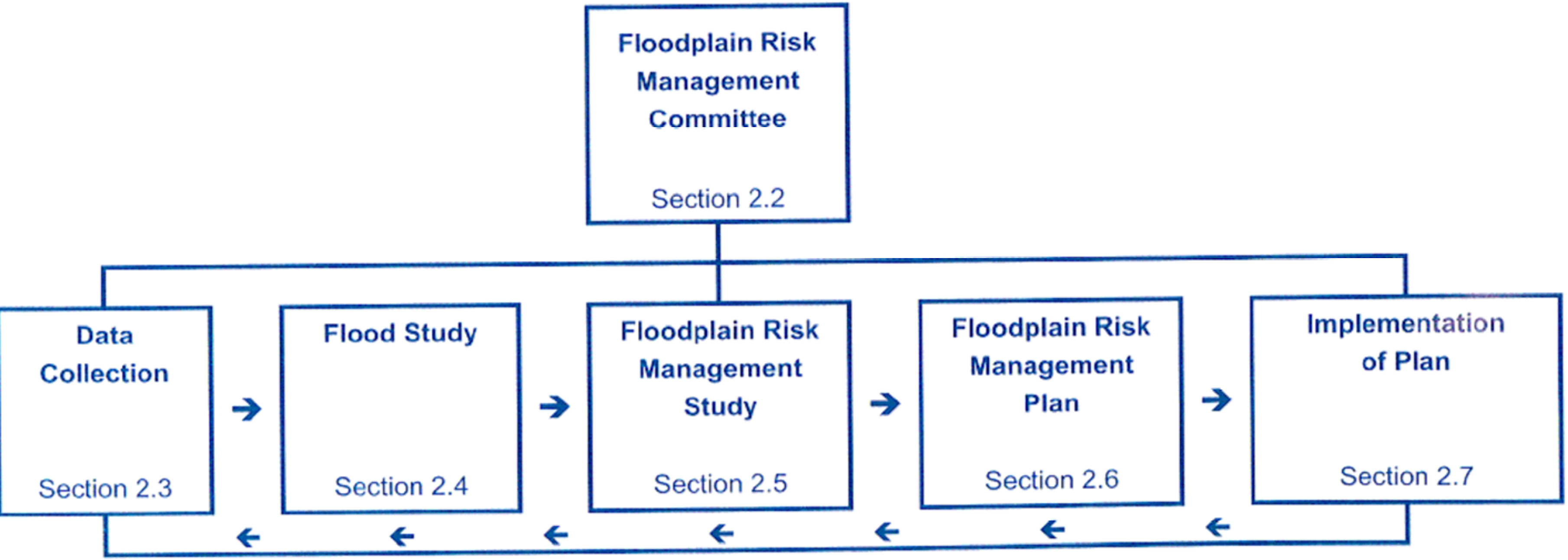
NORTH CATCHMENT
CENTRAL NORTH CATCHMENT
SOUTH WEST CATCHMENT
CENTRAL SOUTH CATCHMENT
SOUTH EAST CATCHMENT
CAMPBELL ST
COPELAND ST
CASTLEREAGH ST
BATHURST ST
NORTHUMBERLAND ST
GEORGE ST
GOULBURN ST
DR ELIZABETH ST
MACQUARIE ST
COLLEGE ST
MOORE ST
BIGGE ST
MEMORIAL AVE
NORFOLK ST
TERMINUS ST
NEW BRIDGE
GEORGES RIVER
0
0.1
0.2
kilometres

Purpose of Study

- Review flood data & calculate flood levels
- Categorise flood risk
- Undertake community consultation
- Examine social/economic effects
- Develop flood management options
- Assess flood management options
- Make recommendations on flood management options

Context of Study

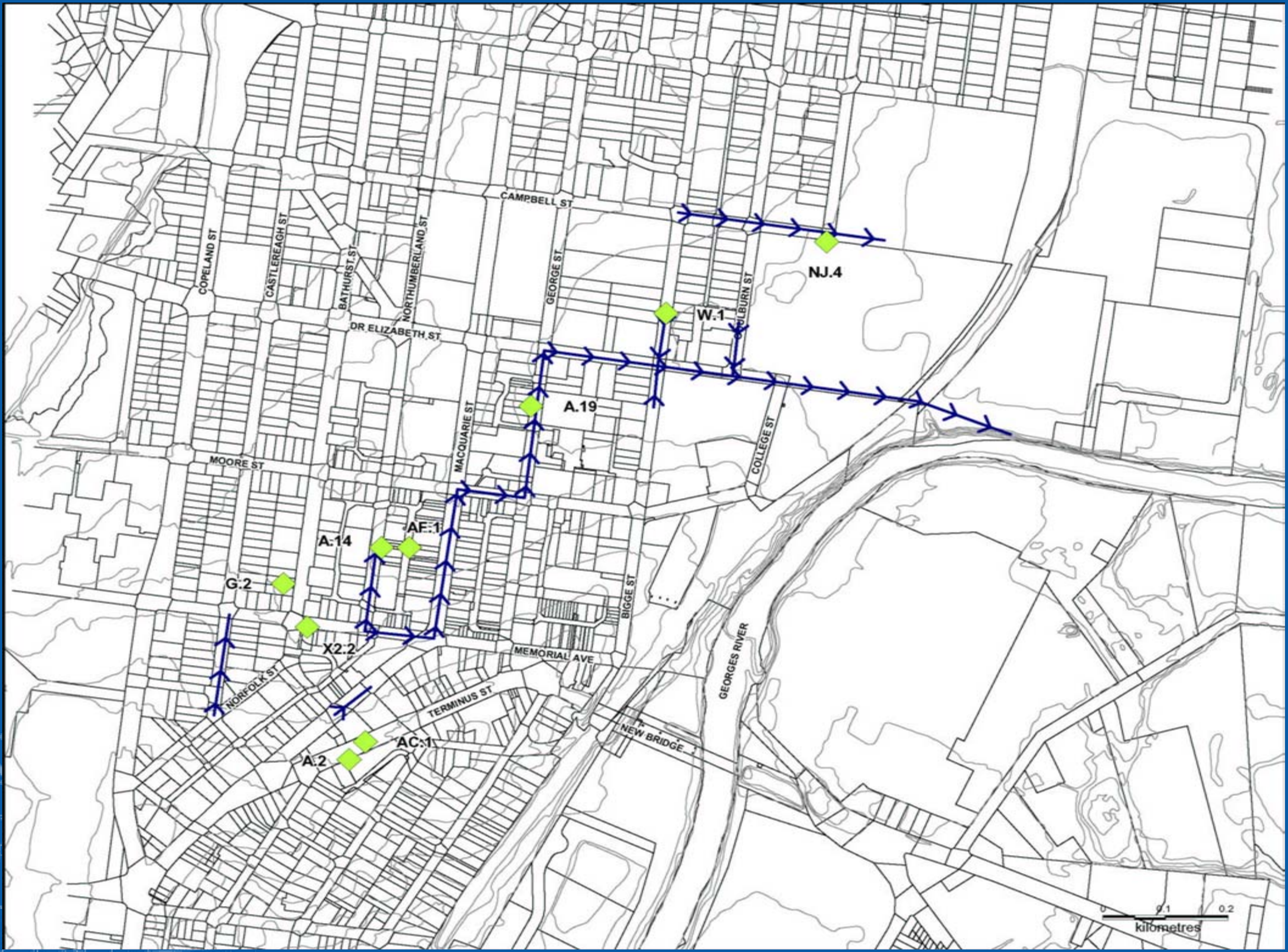
- Part of the Floodplain Risk Management Process set by NSW Government



Flood Behaviour:

- Flood behaviour was determined using a stormwater model which simulates storm events;
- CBD has pit and pipe system to convey stormwater that is mostly undersized
- Runoff exceeds system capacity (even for the 5-yr event)
- Large overland flows plus a number of sag/ponding areas
- Overflows generally flow north-eastwards across the CBD towards the Georges River

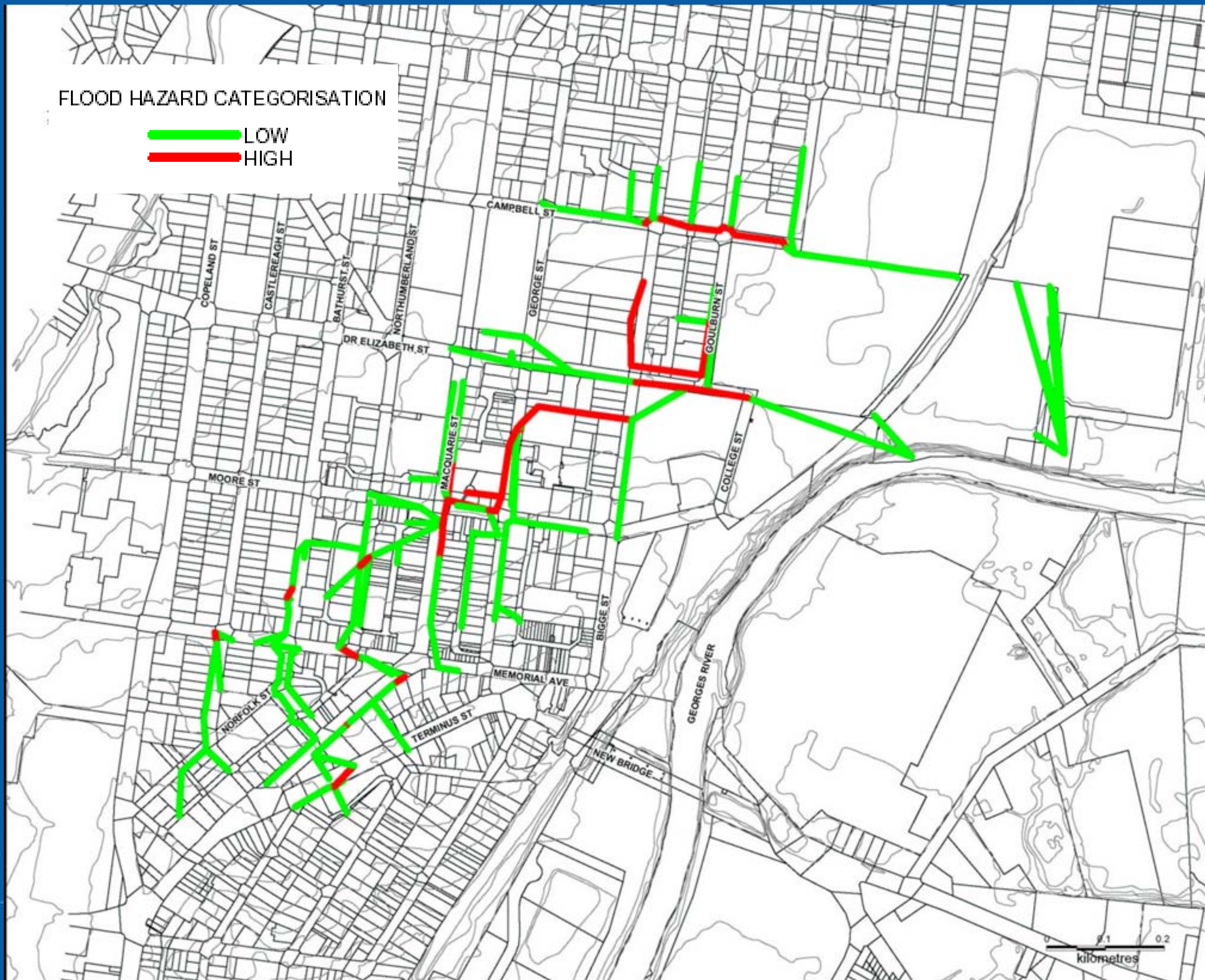
Flood Behaviour



Flood Categorization

- Identify Floodways & Flood Storage Areas
- Undertake Flood Hazard Categorization
  - High Hazard: Possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings. (D > 0.6m)
  - Low Hazard: Should it be necessary, trucks could evacuate people and their possession; able-bodied adults would have little difficulty in wading to safety. (D<0.2m)
  - CBD Context:depth, velocity, flood readiness,evacuation, pedestrian movements, shop levels, foot paths, flood duration, access

Flood Hazard Categorization



Community Consultation

- Community Consultation activities:
  - Stakeholder Notification
  - Business Community Survey
  - Public Meeting
  - Public Exhibition & Submission Review
- Findings to date
  - A low percentage of businesses surveyed for the study indicated that they had experienced flood impacts
  - This may be due to changes in ownership, tenancy or management
  - Low level of 'flood awareness' and 'flood readiness'
  - Previous flooding had ranged from 0.3-0.5m and lasted approx 30 minutes to a few hours
  - Impacts have included damages to buildings, retail stock, furnishings, clean-up, access, and anxiety

Social and Economic Impacts

- Tangible impacts (Direct and Indirect) and Intangible impacts
- Direct:
  - Structural damage
  - Stock and equipment damage
  - Clean-up costs
  - Infrastructure damage
- Indirect:
  - Loss of revenue/profit
  - Disruption to employment
  - Loss of productivity
  - Drop in property values
- Intangible:
  - Stress and anxiety
  - Loss of sentimental items
  - Lifestyle changes
  - Loss of amenity

Flood Management Options

Category	Potential Floodplain Management Measures
Property Modification	•Land Use Planning •House raising or flood proofing of buildings •Voluntary purchase of high hazard properties
Response Modification	•Flood warning systems and evacuation plans •Flood insurance and recovery •Public flood awareness schemes
Flood Modification	•Retro fitting On-Site Detention tanks and detention basins •Structural drainage solutions

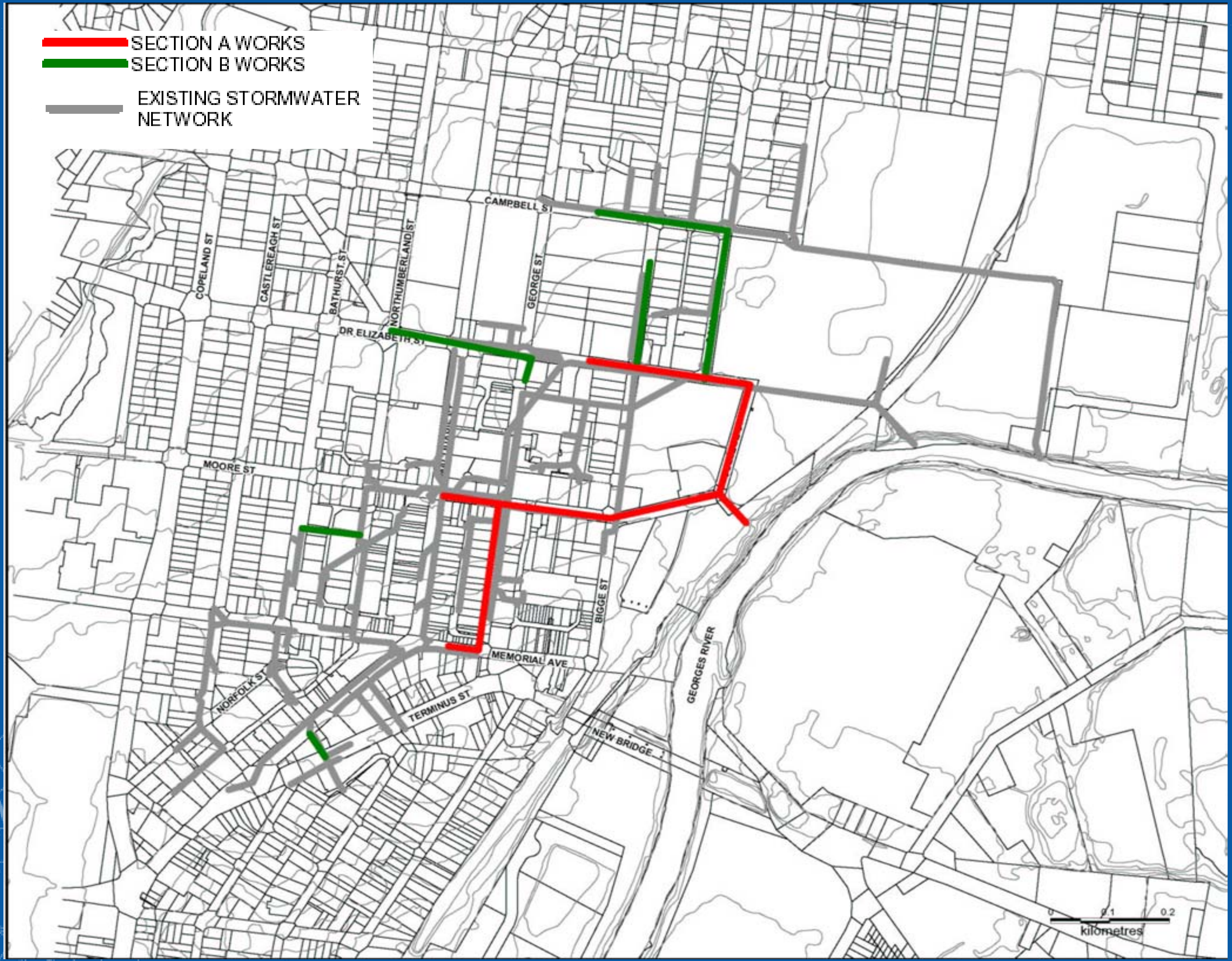
Assessment Criteria

Category	Issues
Social	•The capacity of the option to reduce flood hazards and personal safety risks to the community, •How the option will influence property values; •The capacity of the option to promote community growth; and •The level of disruption to the community, either through implementing the option or through the resulting floodplain behaviour.
Economic and Financial	•The capital costs associated with implementing the option; •The ongoing or maintenance costs of the option; and •The costs or savings of flood damage after the option is implemented.
Environmental	•Change to ecology, habitats, riparian vegetation, and the "natural state" of the catchment; •Pollution; •Energy and resources required to implement the option •Energy and resources required for maintaining and decommissioning the option.

Option Assessment

Option	Benefit/Cost Ratio Factored with Intangible Score
Do Nothing	0
Flood Proofing of Buildings	0.32
Voluntary Purchase of High Hazard Properties	0.07
Flood Insurance and Recovery	0.42
Public Flood Awareness Scheme	0.46
Structural drainage solution – Section A	0.58
Structural drainage solution – Section A+B	0.63

Structural Drainage Solution



Conclusions

- The Liverpool Central Business District (CBD) is at risk of extensive overland flooding, potentially affecting commerce and public safety. Runoff exceeds the capacity of the existing local stormwater network.
- A number of floodways and flood storage areas exist throughout the CBD. (Macquarie, George and Moore Streets). Overland flow have been designated as High Hazard areas.
- Social and economic investigation revealed that the impact by flooding is likely to reduce if the community is prepared for a flood event.
- Flood management options include:
  - Property Modification
  - Response Modification
  - Flood Modification
- The study has shown that the flood modification option is the most desirable solution.
- In particular, the two structural drainage solutions (Section A works and both Section A and B works) have highest benefit/cost ratio followed by the public flood awareness scheme.

Appendix F

Submissions

Summary of submissions

Two (2) submissions were received during the exhibition period (attached). A summary of the key issues raised and the respective responses are detailed in the table below:

Issues Presented	Response
Property owners were not notified of the Floodplain Management Study	All owners identified in the study as affected by flooding were sent written notification of the study and invited to a public meeting. As well as being sent to the owners address the invite was also sent to the property address, so that all relevant stakeholders would be notified. On the completion of the Study, Council placed the Draft report on exhibition for 60 days at the CBD Offices, the Liverpool Library and Council's Administration Centre. Advertisements for the exhibition were placed in the Liverpool Leader on 24th August, 31st August and the 7th September 2005.
Major property owners, and those worst affected should have been approached specifically.	A large proportion of the most severely affected properties were surveyed during the study. Some major property owners affected by flooding had not been specifically surveyed during the study, but in response to this point discussions have now been held with representatives from the Liverpool RSL Club, Peter Warren Properties and M&M Prpic Pty Ltd.
Owners were not surveyed	The survey was undertaken on foot and randomly captured a range of tenants and property owners within the CBD. All property owners and tenants however were informed in writing about the study and invited to a public meeting for further information and comments.
No Flooding has been experienced at some properties within the CBD	Council has received a number of complaints about flooding in the CBD and has witnessed flooding events in recent years. The study modelled storm events larger than has been experienced previously in the CBD in order to assess the likely impact of such events and plan how best to manage the risk. This approach is in accordance with the State Government Guidelines for the development of Floodplain Management Plans
Request that owners are again notified in writing and allowed time for comment.	A 60 day public exhibition period has been undertaken with widespread community notification. Specific stakeholders identified in the submission as not previously being consulted have now been approached.
Low flood awareness attributed to change in tenancy or ownership a false conclusion.	Wording of report has been changed to reflect that the statements are one possible explanation of the low flood awareness.
Council will obtain funds for mitigation works through developer contributions	The study was aimed at assessing the current flooding conditions and the works required to mitigate the current risks. Any future development is unlikely to contribute significant additional stormwater to the network as the area

Issues Presented	Response
	is already substantially impervious. There is no proposal to seek specific contributions for the mitigation works from developers.
Photos in report indicate flooding from a drain that is not cleaned, and do not indicate high flood waters.	The photos provided were from a business that regularly experiences flooding due to the inadequate capacity of the system. The drainage pipes have been checked for blockages and none exist. The pictures were taken during a minor storm well below the intensity of the storms modeled in this report.
Table 6 List of Stakeholders does not include major landowners in CBD.	Landowners are identified in the text as the major stakeholder in the project, and the major reason for the study being undertaken. Table 6 details other stakeholders.
Flood damages calculations using research based on the Kempsey flooding is not an accurate comparison.	The research completed on flood damages at Kempsey represents best data available for estimating flood damages in this setting. Considering the nature and setting of the flooding it is considered that the estimates provided are a reasonable indication of likely flood damages.

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-
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Document Status

Rev No.	Authors	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
DRAFT for Council Review only.	K Wilkinson, N Deeks, R Berg	N Deeks	onfile	R Berg	onfile	28/04/2005
DRAFT 1	N Deeks R Berg	N Deeks	onfile	R Berg	onfile	23/05/2005
Report (public meeting issue)	R Cottrell R Berg	Minor changes	na	R Berg	na	05/07/2005
Report (FPM issue)	R Berg	Minor changes	na	R Berg	na	14/07/2005
Final issue	R Berg	Minor changes	na	R Berg	onfile	11/01/2006

Warren Smith & Partners

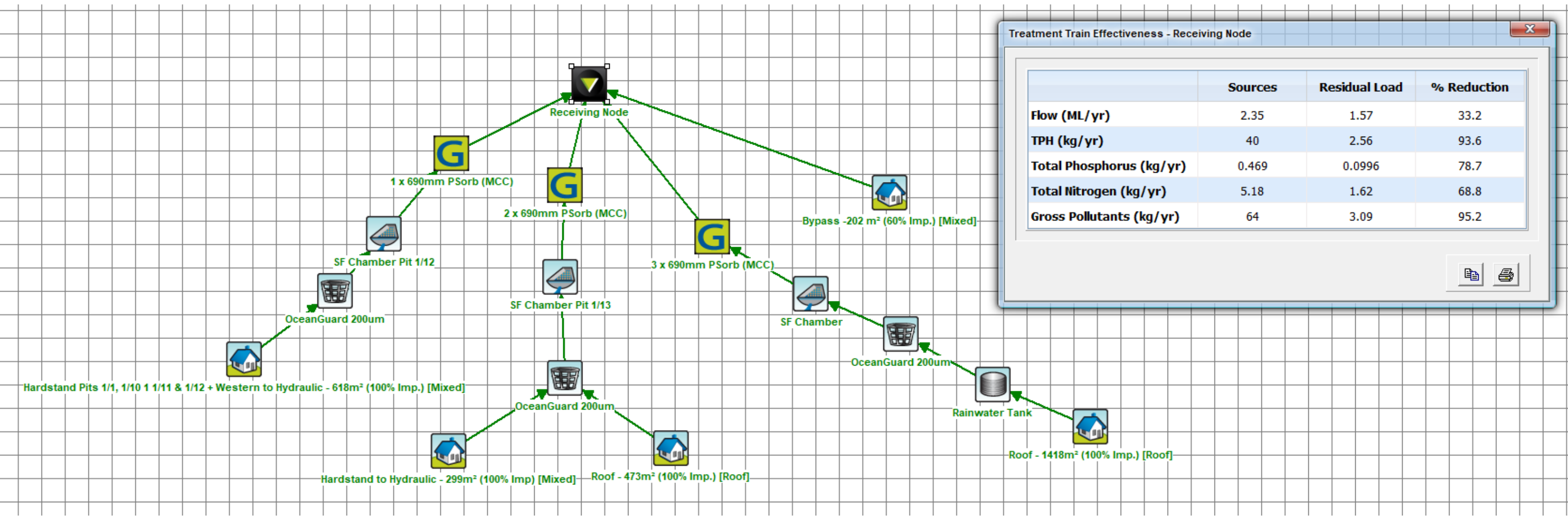
SCHEDULE 4 MUSIC MODELLING RESULTS

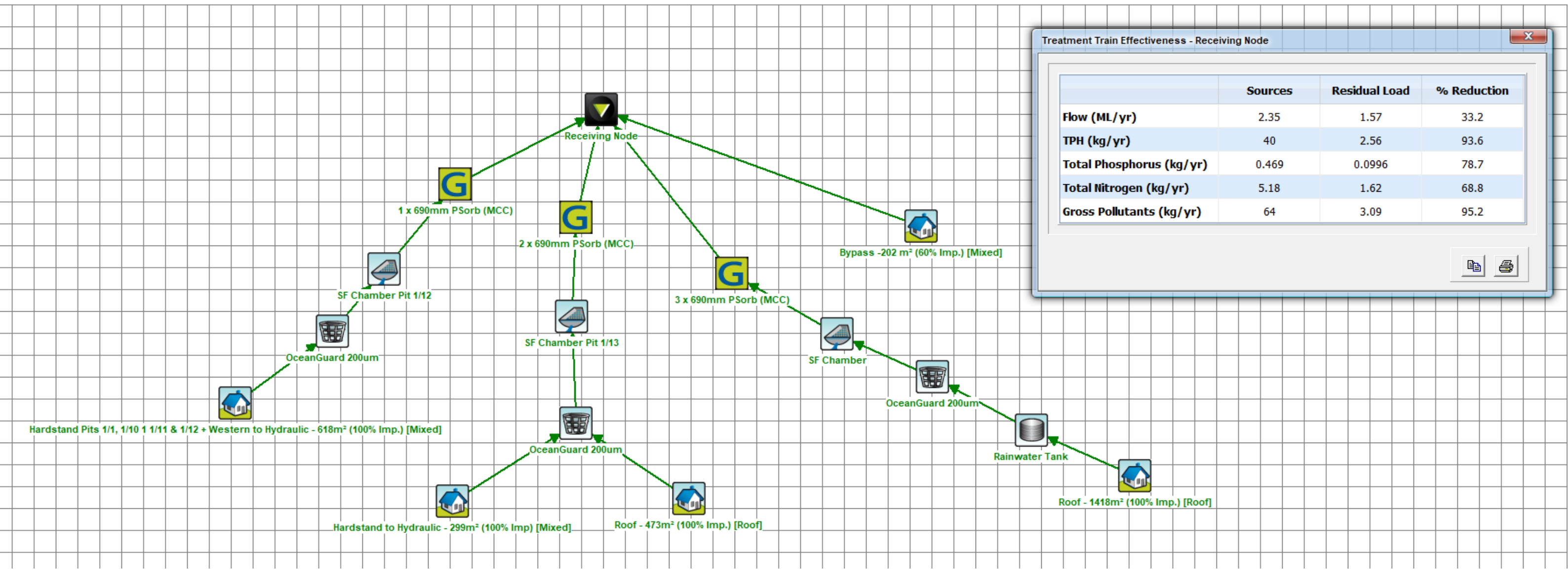
Receiving Node

11/12/2020 4:28:51 PM

Treatment Train Effectiveness

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Sources	2.35	186	0.470	5.15	64.0
Residual Load	1.57	27.1	99.7E-3	1.62	3.09
% Reduction	33.2	85.4	78.8	68.6	95.2





LIVERPOOL CITY COUNCIL

music link

MUSIC-*link* Report

Project Details		Company Details	
Project:	Liverpool Civic Phase B	**Company:**	Warren Smith & Partners
Report Export Date:	11/12/2020	**Contact:**	Martyna Czarnota
Catchment Name:	Liverpool Civic Centre Phase B [01]	**Address:**	
Catchment Area:	0.301ha	**Phone:**	0410352997
Impervious Area*:	97.32%	**Email:**	martyna@warrensmith.com.au
Rainfall Station:	67035 LIVERPOOL(WHITLAM		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1967 - 31/12/1976 11:54:00 PM		
Mean Annual Rainfall:	857mm		
Evapotranspiration:	1171mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.33		
Study Area:	Liverpool Clay Soil		
Scenario:	Liverpool Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	33.2%	Rain Water Tank Node	1	Urban Source Node	5
TSS	84.9%	Sedimentation Basin Node	3		
TP	79%	GPT Node	3		
TN	68.7%	Generic Node	3		
GP	95.2%				

Comments

Refer to MUSIC results for the reduction targets of Free Oils and TPH

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	OceanGuard 200um	Hi-flow bypass rate (cum/sec)	None	99	0.02
GPT	OceanGuard 200um	Hi-flow bypass rate (cum/sec)	None	99	0.02
GPT	OceanGuard 200um	Hi-flow bypass rate (cum/sec)	None	99	0.02
Rain	Rainwater Tank	% Reuse Demand Met	None	None	45.72
Receiving	Receiving Node	% Load Reduction	None	None	33.2
Receiving	Receiving Node	GP % Load Reduction	90	None	95.2
Receiving	Receiving Node	TN % Load Reduction	45	None	68.7
Receiving	Receiving Node	TP % Load Reduction	65	None	79
Sedimentation	SF Chamber	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber	High Flow Bypass Out (ML/yr)	None	None	0
Sedimentation	SF Chamber Pit 1/12	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber Pit 1/12	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber Pit 1/12	Extended detention depth (m)	0.25	1	0.77
Sedimentation	SF Chamber Pit 1/12	High Flow Bypass Out (ML/yr)	None	None	0
Sedimentation	SF Chamber Pit 1/13	% Reuse Demand Met	None	None	0
Sedimentation	SF Chamber Pit 1/13	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber Pit 1/13	Extended detention depth (m)	0.25	1	0.77
Sedimentation	SF Chamber Pit 1/13	High Flow Bypass Out (ML/yr)	None	None	0
Urban	Bypass -202 m� (60% Imp.)	Area Impervious (ha)	None	None	0.011
Urban	Bypass -202 m� (60% Imp.)	Area Pervious (ha)	None	None	0.008
Urban	Bypass -202 m� (60% Imp.)	Total Area (ha)	None	None	0.02
Urban	Hardstand Pits 1/1_ 1/10 1 1/11 & 1/12 + Western to Hydraulic - 618m� (100% Imp.)	Area Impervious (ha)	None	None	0.062
Urban	Hardstand Pits 1/1_ 1/10 1 1/11 & 1/12 + Western to Hydraulic - 618m� (100% Imp.)	Area Pervious (ha)	None	None	0
Urban	Hardstand Pits 1/1_ 1/10 1 1/11 & 1/12 + Western to Hydraulic - 618m� (100% Imp.)	Total Area (ha)	None	None	0.062
Urban	Hardstand to Hydraulic - 299m� (100% Imp)	Area Impervious (ha)	None	None	0.03
Urban	Hardstand to Hydraulic - 299m� (100% Imp)	Area Pervious (ha)	None	None	0
Urban	Hardstand to Hydraulic - 299m� (100% Imp)	Total Area (ha)	None	None	0.03
Urban	Roof - 1418m� (100% Imp.)	Area Impervious (ha)	None	None	0.142
Urban	Roof - 1418m� (100% Imp.)	Area Pervious (ha)	None	None	0
Urban	Roof - 1418m� (100% Imp.)	Total Area (ha)	None	None	0.142
Urban	Roof - 473m� (100% Imp.)	Area Impervious (ha)	None	None	0.047
Urban	Roof - 473m� (100% Imp.)	Area Pervious (ha)	None	None	0
Urban	Roof - 473m� (100% Imp.)	Total Area (ha)	None	None	0.047

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Receiving	Receiving Node	TSS % Load Reduction	85	None	84.9
Sedimentation	SF Chamber	Extended detention depth (m)	0.25	1	1.35
Sedimentation	SF Chamber	Notional Detention Time (hrs)	8	12	0.238
Sedimentation	SF Chamber	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber	Total Suspended Solids - k (m/yr)	8000	8000	1
Sedimentation	SF Chamber Pit 1/12	Notional Detention Time (hrs)	8	12	0.115
Sedimentation	SF Chamber Pit 1/12	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber Pit 1/12	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber Pit 1/12	Total Suspended Solids - k (m/yr)	8000	8000	1
Sedimentation	SF Chamber Pit 1/13	Notional Detention Time (hrs)	8	12	0.115
Sedimentation	SF Chamber Pit 1/13	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber Pit 1/13	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber Pit 1/13	Total Suspended Solids - k (m/yr)	8000	8000	1
Urban	Hardstand to Hydraulic - 299m� (100% Imp)	Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.19	0.19	0

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