management consultants &
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EG FUNDS MANAGEMENT PTY LTD

Summer Hill Flour Mill Site
(MP10-0180)
Stage 1 Project Application

Flooding, Stormwater and Utilities

October 2012
Job No.2521

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Executive Summary

The Summer Hill Flour Mill site is bounded by Longport Street and Old Canterbury Road to the north and south respectively and Edward/Smith Streets to the west and the former Rozelle goods railway line corridor to the east (refer Figure 1).

EG Funds Management Pty Ltd (EG Funds) proposes to redevelop the site for a mixed use development incorporating residential, commercial and retail land uses. It will form the western side of an important transport orientated development supporting the proposed Lewisham West station as part of the Sydney Light Rail Extension along the former goods railway corridor. On the eastern side, the McGill Street Precinct Masterplan, as adopted by Marrickville Council, contemplates a similar mixed use development to support the Lewisham West Station.

The Part 3A Concept Plan Application for the entire site has been approved and the consent conditions are included at Appendix B. EG Funds now propose to submit a Part 3A Project Application for Stage 1 of the project (refer to Figure 2). The Director General's Requirements (DGRs) for the Stage 1 application are included at Appendix A.

This report addresses the flooding, stormwater and utility issues associated with the Stage 1 Project Application. It also includes 2-D flood modelling for the entire development which was a requirement of the Concept Plan approval and specifically from Sydney Water who are the owner of the Hawthorne Canal.

The design of the proposed development has responded to the flooding conditions on the site such that it conforms to the NSW Floodplain Development Manual by minimising risk to flood damages and personal safety. The adopted residential and commercial floor levels and driveway entry crest to basement car parking provide freeboards above the 100yr ARI flood levels which are considered appropriate and readily exceed the requirements.

Sensitively testing has been undertaken to review the robust nature of the redevelopment design with respect to the potential impacts of climate change on rainfall intensity and possible blockage. Again, the freeboards to residential and commercial floor levels and basement driveway crests are considered adequate to manage the risk of damage and personal safety.

The 2-D flood modelling of the overall development highlighted three issues:-

- inflow of flood waters from the rail corridor onto the site upstream of the Mungo Scott building (Building 2A on Figure 6);
- interaction of light rail access to the proposed station with flood flows along the rail corridor;
- minor impacts on flood levels due to buildings 4A, 4B and 4C.

The inflow of floodwaters from the rail corridor upstream of the Mungo Scott building was blocked without significant adverse impacts on flood levels in the corridor or on adjacent lands.

Transport NSW has agreed to an elevated accessway from the site to the proposed light rail station as proposed on Figures 8 and 9. Transport NSW has agreed to lower the western side of the rail corridor to lower flood levels and allow floodwaters to pass under the accessway without significant obstruction or increase in flood levels.

The minor impacts on flood levels caused by Building 4A, 4B and 4C were mitigated by the inclusion of additional stormwater drainage in Edward and Smith Streets. This will have the added benefit of reducing the overland flows in Smith Street during lesser flood events and improving access for all local residents during storms.

Residential floor levels and basement driveway crests in the development would have a minimum freeboard of 500mm above the 100yr ARI flood level. In fact most of the floor and crest levels have considerably more than this minimum freeboard. The proposed floor/crest levels and freeboards for the entire development are presented in Table 3.

A draft Emergency Flood Response Plan has been prepared for the entire site and the Stage 1 development for floods up to the Probable Maximum Flood (PMF). In all buildings except Building 1C, vertical evacuation is available above PMF levels. Also, there is ready access to basements which can be accessed by emergency vehicles or to areas external to the site above PMF levels.

Proposed retail areas in retained and new buildings which have to relate to access and amenity requirements would be floodproofed up to 500mm above the 100yr ARI flood level to reduce the potential for flood damages.

Water sensitive urban design (WSUD) features would be incorporated into the Stage 1 development to ensure the stormwater runoff quality achieved the SWC pollutant reduction targets and reduced use of potable water. These features would include:-

- capture and reuse of roof runoff for non potable uses within the building;
- bio retention swale to treat road runoff; and
- Gross pollutant trap to remove coarse sediments, trash and debris.

These features would ensure runoff from the site contributed to the long term improvement in water quality in Hawthorne Canal. The Stormwater Drainage Concept Plan is presented at Figure 15.

The Integrated Water Management Plan and the Infrastructure Management Plan are detailed in Sections 6 and 8 of this report. They incorporate the above WSUD features, the stormwater system, the inbuilding potable water use reduction features and the connection of the stormwater system to the Hawthorne Canal.

The Stage 1 development would be serviced as follows:-

- electricity supplied from substation in Smith Street;
- existing sewer in Edward Street;
- water from existing mains in either Edward and/or Smith Streets;
- telecom infrastructure would be upgraded to suit the development timeframe; and
- gas would be provided if considered commercially viable.

1.0 Introduction

EG Funds Management proposes to seek Part 3A Project Approval for the Stage 1 development of a mixed use residential, retail and commercial development on the former Allied Flour Mills site at 2-32 Smith Street, Summer Hill. The Director General's Requirements (DGR's) for the Stage 1 Project application are included at Appendix A.

The Part 3A Concept Plan for the development of the entire site has been approved and the consent conditions are included at Appendix B.

The location of the site is presented on Figure 1 and the portion of the site included in the Stage 1 development is depicted on Figure 2.

This report deals with the issues of flooding, stormwater and external servicing of the site at its boundary.

The DGR's issued on 22 August 2012, require consideration of the following with respect to these issues (refer to Appendix A):-

A. Key Issues – Stage 1 Project Application

22. Public Domain / Open Space

The EA shall include details of measures to manage flood risk within the public domain.

24. Drainage / Flooding

The EA shall identify any water management structures proposed to service the Stage 1 Project Application, including any dams, swales or detention basins. Information regarding the size, location, capacity and purpose of any water management structures.

25. Staging and Infrastructure

The EA shall address how the Stage 1 Project Application development will integrate with the overall Concept Plan proposal including details of infrastructure work required to ensure that Stage 1 is fully serviced and provided with an appropriate level of infrastructure.

B. Plans and Documents – Stage 1 Project Application

4. A Stormwater and Drainage Plan.

7. An Integrated Water Management Plan and Infrastructure Management Plan.

The consent conditions for the Concept Plan approval (refer Appendix B) require detailed flood modeling of the entire site to demonstrate the appropriate management and mitigation of flood risks within the proposed development. The detailed flood modeling requirement was requested by Sydney Water (SWC) and therefore this modeling was undertaken using the SWC, Marrickville and Ashfield Councils' flood model and their flood consultants, WMAwater. The Concept Plan consent conditions which are relevant to this application are:-

- 26. Document flood levels, flood hazards and management measures;
- 27. Freeboard to residential floors and basement entry crests along with flood study covering sensitivity to climate change and blockage;
- 28. Details of piping stormwater flows from Smith Street and evidence of consultation with SWC;
- 29. Draft flood emergency response plan and adopted alarm level (RL 10.8mAHD);
- 31. Evidence of consultation with Transport NSW regarding flood impacts of light rail access;
- 32. No wall along the rail corridor boundary unless it can be demonstrated that there are no adverse flood impacts on adjacent lands;
- 33. Evidence of consultation with SWC regarding entry of flows into the canal on the site and fencing of high flood hazard areas;
- 34. Water supply and sewerage connections as per SWC letter dated 23 August 2012 and runoff water quality control as per the stated pollutant removal rates;
- 35. Need for treatment of stormwater prior to discharge to the canal or groundwater;
- 38. Stormwater drainage concept plan.

This report therefore deals with the flood behaviour for the entire development as well as specifically for the Stage 1 development.

2.0 Existing Site Description

2.1. General

The site is bounded by Smith Street, Edward Street, Longport Street, Old Canterbury Road and the former goods rail line corridor (refer to Figure 1).

The former goods rail line corridor has been approved for a light rail extension with a station to be located near to the Mungo Scott building (Building 2A on Figure 6). Construction has commenced on the light rail project.

2.2. Drainage

2.2.1 Overall Site

The Hawthorne canal, which is owned by Sydney Water, traverses the northern section of the site (refer Figure 1). It serves the site as the main drainage line for the site as well as serving an upstream catchment of approximately 265ha.

Upstream of the subject site, Hawthorne Canal flows under the Old Canterbury Road and extends to the goods railway line as an open channel. It then passes under the railway and existing buildings on the subject site as a covered channel. It is an open channel through the northern end of the subject site before passing under the Longport Street overpass in a 3.8m diameter culvert.

The Smith Street drainage system enters from the west and joins to the main Hawthorne Canal channel at the northern end of the site. The McGill Street Precinct Masterplan area is generally drained by 1200mm diameter pipe extending under the railway line corridor and joining with main Hawthorne Canal channel immediately downstream of the Longport Street crossing.

The top of the concrete walls in the canal on the subject site generally vary from RL 5.7m AHD adjacent to the railway to RL 4m AHD at the Longport Street embankment. In the northern section of the site, steep banks rise from these walls to levels of RL 8.5 to 9m AHD on the western side and to levels around RL 10-11m AHD on the eastern side. They also rise to around RL 14.5m AHD on the Longport Street road crossing of the canal and adjacent rail corridor.

The Smith Street Branch of the Hawthorne Canal system has limited pipe capacity (around a 5 yr ARI) with overland flow ponding in the low point in Smith Street opposite the site east of the Ausgrid substation (Building 2C on Figure 6). It overflows the kerb and flows into the site down the tree corridor to the open section of the canal.

Similarly, the Longport Street culvert does not have sufficient capacity to convey the peak 100yr ARI flood flows in the canal.

2.2.2 Stage 1 Project Application Area

There is limited pipe drainage in the Stage 1 Project Application area. The site area generally falls to the east towards the open canal adjacent to the northern wall of the corrugated iron building attached to the Mungo Scott building. Any pipe drainage would not be retained for the Stage 1 Project area.

2.3. Site Topography

The site topography levels are presented on Figure 3. The site ground levels generally rise away from the low point adjacent to where the Hawthorne Canal emerges on the site from the railway corridor.

The Edward Street frontage varies in level from RL 15m AHD at the southern end to generally RL 11m AHD at the northern end. Smith Street rises from approximately RL 9.7m AHD at its low point to RL 10.6m AHD at the intersection with Edward Street and continues to rise to the west as do other streets extending westwards from Edward Street.

The Longport Street crossing has levels generally between RL 14.5 and 15m AHD.

The heritage buildings on the site have the following approximate ground/base levels (refer Figure 6):-

- Mungo Building – RL 9.05m AHD (Building 2A);
- Storage Silos 6 – RL 11m AHD (Building 5A); and
- Storage Silos 4 – RL 11.5m AHD (Building 3C).

The railway corridor forms a crest between the subject site and the McGill Street Precinct Masterplan area to the east. This crest level varies from around RL 12m AHD at the Old Canterbury Road overpass to approximately RL 9.5m AHD at the Longport Street overpass.

The site topography in the McGill Street Precinct Masterplan area generally falls to the north western corner from Old Canterbury Road.

2.4. Flooding

2.4.1 Overall Site

The flooding assessment has been undertaken by WMAwater and the report is at Appendix C.

The flooding behaviour on the site in the 100yr ARI event is generally controlled by the flow capacity of the Longport Street culvert which is insufficient to cater for the 100yr ARI peak flow. Floodwaters backup upstream of the culvert inundating a portion of the northern end of the site. Flood flows also backup upstream on the McGill Street Precinct upstream of the rail corridor and then upstream of Old Canterbury Road causing flows along the rail corridor and back onto the subject site mainly downstream of the Mungo Scott building and downstream of Building 1A (refer Figure 6). There are also two small gaps in the buildings upstream of the Mungo Scott building which allow relatively minor flood flows from the rail corridor onto the subject site. The 100yr ARI flood extents and levels on and around the subject site are presented on Figure 4. The flood hazards (velocity x depth) are categorized over the site for existing conditions on Figure 5.

2.4.2 Stage 1 Project Area

The existing flooding conditions relevant to the Stage 1 Project area in the 100yr ARI event consist of two main sources (refer Figure 4). The overland flows from the west come along Smith Street and the laneway immediately to the south of Smith Street which merge at the intersection of Smith and Edward Streets. These flows ultimately overtop the kerb in the low point of Smith Street and flow onto the site and join with ponding waters from the canal backed up behind the Longport Street overpass.

The peak 100yr ARI flood levels vary from RL 11.4m AHD in Edward Street opposite the Stage 1 area to RL 9m to 9.2m near the Mungo Scott building (Building 2A).

3.0 Proposed Development

3.1 Overall Development

The proposed development is presented on Figure 6. The mixed use development will form an important transport orientated node with the proposed Lewisham West Light Rail station located on the former goods railway line adjacent the development. It will encourage pedestrian movements from Smith Street along a dedicated pathway through the site which incorporates the existing significant trees and provides a visual connection to the light rail station. Pedestrian linkage from Edward Street is provided a new street leading into the site. It is important that this redevelopment incorporate retail and commercial use opportunities along with residential development to support the use of the light rail and to provide an activated public access through the site.

Retention of significant heritage buildings is also an important outcome of the development. This includes retention of the significant tree corridor between Smith Street and Hawthorne Canal. The buildings to be retained and reused will be (the locations of the buildings are depicted on Figure 6):-

- Mungo Scott Building (2A and 2B)
  - Uses will include retail on the ground floor and commercial on the first to fifth floors ;
  - Ground floor will have a level of approximately RL 9.05m AHD with a first floor level of approximately RL 13m AHD;
- Storage Silos – Group of 4 Silos (3C)
  - Residential at all levels;
  - Minimum ground floor level of approximately RL 11.5m AHD;
- Storage Silos – Group of 6 Silos (5A)
  - Uses will include retail at ground floor with residential above;
  - Minimum ground floor levels will be approximately RL 10.7m AHD for retail and approximately RL 11.5m AHD for residential;
- Amenities Block (5E)
  - Uses will include retail and community uses;
  - Ground floor level – RL 11.3m AHD;
  - First floor level – RL 14.3m AHD.

The relevant details of the proposed new and adaptively re-used buildings are:

- Building (1A) – New multi-story residential building
  - Minimum residential floor level approximately RL 11.5m AHD;
  - Basement driveway entry crest level of approximately RL 10.8m AHD;
  - First floor level of RL 14m AHD;
  - Pedestrian bridge connection from first floor level of approximately RL 14m AHD to Longport Street at RL 14.5m AHD;
  - Pedestrian access from first floor to Smith Street at RL 10.3m AHD; and
  - Evacuation available to higher floors.

- Building 1C – 1 storey
  - Two level retail with elevated floor at level of approximately RL 9.75m AHD;
  - Light weight structure supported on columns so as to not obstruct floodwaters;
  - Ready access to Building 2A for evacuation.

- Building 2A – Mungo Scott Building – multi storey retail and commercial building
  - Heritage building to be retained and refurbished with existing floor levels;
  - Ground floor level at approximately RL 9.05m AHD with retail use and internal stair access to first floor at approximately RL 13.9 AHD;
  - Commercial uses all floors above;
  - Covered walkway connection between Buildings 2A and 3A at first floor level approximately (RL 13.9 AHD);
  - Provides flood free access to basement of Building 3A via walkway connection.

- Building 2B – 2 Storeys – Administration Building
  - Heritage building to be retained and refurbished with existing floor levels;
  - Ground floor at approximately RL 9.05m AHD with retail use;
  - First floor at approximately RL 13.9m AHD with retail/commercial use;
  - Has ready access to Buildings 2A and 3A for severe floods.

- Building 2C – 1 Storey
  - Ausgrid electrical substation is a heritage building to be retained;
  - Floor level at approximately RL 9.7 AHD to be refurbished for retail use.

- Building 3 – 1-13 Storeys

- Uses
  - 3A – residential over 9 storeys – ground floor approximately RL 11.5m AHD;
  - 3B – retail 1 storey – ground floor approximately RL 12.0m AHD;
  - 3C – residential re-use of existing silos – ground floor approximately RL 12.0m AHD;
  - 3D – residential over 6-7 storeys – ground floor approximately RL 12m AHD.
- Basement entry crest level – approximately RL 13m AHD

- Building 4 – 2-6 Storeys

- Uses
  - 4A – retail – ground floor level approximately RL 10.8m AHD;
  - 4A - residential over 4 storeys – residential ground floor approximately RL 11.5m AHD;
  - 4B – residential over 6 storeys – ground floor approximately RL 12.0m AHD;
  - 4C – residential over 2 to 3 storeys – ground floor approximately RL 11.9m – 12.5m AHD;
- Basement entry crest level approximately RL 11.7m AHD.

- Building 5 – 2 - 6 Storeys

- Uses
  - 5A – retail – ground floor approximately RL 10.7m AHD;
  - 5A – residential re-use of silos – residential ground floor approximately RL 11.5m AHD;
  - 5B – residential over 6 storeys – ground floor approximately RL 11.9m AHD;
  - 5C – residential over 2 to 3 storeys – ground floor approximately RL 13.9m – 14.2m AHD;
  - 5D – residential over 3 to 6 storeys – ground floor approximately RL 11.8 – 12.8m AHD;
  - 5E – retail/commercial over 2 storeys with ground floor approximately RL 11.3m AHD and first floor at approximately RL 14.3m AHD.
- Basement entry driveway crest level approximately RL 13m AHD.

3.2 Stage 1 Project

The Stage 1 Project development will consist of:-

- Buildings 4A, 4B and 4C;
- Buldings 1C;
- Light Rail station pedestrian access from Smith St to the sites eastern boundary; and
- Elevated pedestrian access to match with Transport for NSW elevated accessway at the site eastern boundary for access to the light rail system.

The ground floor layout of the proposed buildings 4A, 4B and 4C is depicted on Figure 7 and includes the proposed floor levels and basement driveway entry crest level.

Building 1C will be a lightweight construction supported on columns so it would not obstruct floodwaters. It would be floodproofed up to a level 0.5m above the 100yr ARI flood level to minimize flood damages. It would have ready access to higher levels in Buildings 2A and 3A in severe floods.

The layout of the pedestrian access development including the details of the elevated platform access to the light rail station are depicted on Figures 8 and 9.

Agreement was reached in discussions with Transport for NSW as to the form of the elevated pedestrian access to the light rail station such that the 100yr ARI flood flows could pass unobstructed under the elevated accessway on the western side of the rail corridor. Transport for NSW would construct the works in the rail corridor including the elevated accessway and the lowering of the western side of the rail corridor to RL 9.2m AHD over the area indicated on Figure 7. The accessway level at the site boundary was adopted as RL 10.9m AHD (walkway level) with a maximum structure depth of 0.5m. The accessway would ramp gradually down from this level at a constant slope to match existing levels on the site (refer to Figure 7). This would ensure appropriate flood access and no significant obstruction to flood flows up to the 100yr ARI event.

4.0 Flooding

The flood modelling assessment for this report has been undertaken by WMAwater using the SWC, Ashfield and Marrickville Councils' flood model for Hawthorne Canal and the report is presented in Appendix C.

4.1. NSW Floodplain Development Manual

This Manual presents a merit based assessment process which has the objectives of appropriate management of the risk of flood damages and flood related risk to personal safety while not adversely impacting on flood levels for adjacent development. This flood report has been prepared in accordance with the Manual as well as undertaking sensitivity testing for the potential impacts of climate change and reduction in flow capacity of the various culverts at Old Canterbury Road, under the rail corridor and under Longport Street.

4.2. Council Flood Policies

The local government boundary between Ashfield and Marrickville Councils runs along the Hawthorne Canal. As such, the proposed building in the north eastern corner of the site (Building 1A) is located in Marrickville Council while the remainder of the development is located in Ashfield Council.

The Council flood policies conform to the NSW Floodplain Development Manual in that they are merit based policies with objectives which conform to the Manual. Ashfield Council recommend a minimum freeboard of 0.3m for residential floors while Marrickville Council recommends 0.5m freeboard. The Part 3A Concept Plan approval requires a minimum freeboard of 0.5m to residential floor levels for the 100yr ARI flood.

4.3. Existing Flood Behaviour

4.3.1 Overall Site

The existing flood behaviour affecting the subject site can be summarised into three separate areas being the light rail corridor, open channel downstream of the rail corridor and the Smith Street branch. The overview of the flood behaviour in each of these areas is as follows (refer Figure 4):-

1. Rail Corridor

- The Hawthorne Canal is covered by the rail corridor and the culvert has a capacity less than the 20yr ARI flow;
- Flood flows pond above the open channel in the McGill Street Precinct Masterplan area and gradually overtop and flow north down the eastern side of the rail corridor;
- The flood levels in this area and upstream of Old Canterbury Road gradually rise to overtop the rail line and flow onto the western side of the rail corridor; and
- Floodwaters enter the site mainly downstream of the Mungo Scott building and adjacent to the Longport Street overpass. There are two minor locations in the upstream areas of the site through which floodwaters in the rail corridor enter the site.

2. Open Channel

- Flows from the railway corridor enter the open channel on the subject site immediately downstream of the Mungo Scott building and adjacent to the Longport Street overpass;
- The channel is deep and readily accommodates the 20yr ARI flow;
- The 100yr ARI flows exceed the capacity of the canal culvert under the Longport Street overpass;
- Floodwaters gradually pond and inundate low areas of the subject site until they cross the rail line and exit through the rail tunnel under the Longport Street overpass at a level around RL 9.5m AHD; and
- As floodwaters continue to pond in say the probable maximum flood (PMF), floodwaters escape around the
. Longport Street overpass.

3. Smith Street Branch

- This branch services the catchment to the west along Smith Street;
- Smith Street rises to the west from a trapped low point along the frontage to the subject site;
- The system has limited capacity and a significant portion of the flows arrive at the site as overland flow on the road;
- The pipe system for this branch is aligned along the southern side of Smith Street at the subject site and joins with the main Hawthorne Canal in the subject site;
- Overland flows pond in Smith Street adjacent the site until they overtop the boundary and flow along the alignment of the established tree corridor on the site to the open channel of Hawthorne Canal; and
- In the 100yr ARI flood, the flood waters ponding on the site would extend onto Smith Street and as such flows down Smith Street would discharge into this pond of floodwaters on the site.

4.3.2 Stage 1 Project Area

The flood behaviour which affects the Stage 1 Project area is related to overland flows in Smith and Edward Streets, waters ponding upstream of the Longport Street culvert and flooding from the rail corridor which affect the access to the proposed light rail station.

Buildings 4A, 4B and 4C front the overland flows in Edward and Smith Streets (refer Figure 4). The southern portion of this development area and further south along Edward Street is high enough to be not affected by the 100yr ARI overland flows in the Smith Street catchment.

The Smith Street overland flows enter the subject site downstream of these proposed buildings along the Smith Street boundary prior to joining the canal flows.

In addition, flood flows exit the rail corridor and flow into Hawthorne Canal on the subject site near the proposed location of the light rail station. The station will have a level of RL 11.15m while the Mungo Scott building and surrounding pedestrian areas on the subject site will have a level of around RL 9m. As such, an elevated pedestrian accessway is required from the site to the station and it needs to allow the passage of the 100yr ARI flood flows under the accessway without significant adverse impacts on flood levels.

4.4 Flood Management Issues

4.4.1 Overall Site

The flooding related issues for the overall development and the proposed mitigation measures are:-

- inflow of floodwaters onto the site upstream of the Mungo Scott Building causing high hazard flows through the development – mitigated by preventing inflows through the site;
- safe access to light rail station – an integrated approach agreed with Transport NSW in which there would be an elevated access ramp from the mid point of the subject site to the light rail station. Transport NSW would lower the western area of the rail corridor to provide additional flow area under a proposed elevated accessway. This would lower the flood levels in the rail corridor so that they pass under the elevated accessway without adverse impact on flood levels;
- safe access to rail station through the subject site would be provided by:-

  - dedicated and sign posted pedestrian access path west of existing substation from Smith Street (Building 2c);

  - an elevated access walkway from middle of subject site to light rail platform bridging the high hazard flood areas; and

  - provide inlets and two 900mm diameter stormwater pipes in Edward and South Streets to mitigate increases in flood levels and reduce the overland flows and flood hazards on the site.
- habitable floor levels in the development – set a minimum floor level with a freeboard of 500mm to the 100yr ARI flood level;
- management of buildings with retail floor levels without full freeboard to 100yr ARI flood levels:

  - provide flood proofing up to 0.5m above the 100yr ARI flood level to minimize flood damages;

  - provide safe access in emergencies to flood free areas;

  - provide an appropriate emergency response plan.
- basement carpark driveway crests set at a minimum of 500mm above the 100yr ARI flood level.

4.4.2 Stage 1 Project Area

The flooding related issues relevant to the Stage 1 development and the proposed mitigation measures are:-

- minimum habitable floor and basement driveway crest levels – to be set with a minimum freeboard of 500mm above the 100yr ARI flood levels;
- retail floor levels – these have been set to maximize the social and amenity outcomes for the development and the NSW government approved light rail infrastructure – where floor levels have less than 500mm freeboard, the buildings will be floodproofed to this freeboard level and emergency response design aspects will be incorporated to manage personal safely;
- the proposed building footprints of Buildings 4A, 4B and 4C are slightly larger than existing buildings with minor impacts on flood levels in Smith Street – extra drainage is proposed in the development to mitigate these impacts as discussed above.
- overland flow from Smith Street have been reduced with a pipe drainage system which (as described above) will reduce the extent of high flood hazard over the open space area within the development;
- elevated pedestrian access to the light rail station – as discussed above; and
- fencing of area around the open section of Hawthorne Canal with a palisade type fence to improve safety.

4.5 Predicted Flood Levels and Hazards

The predicted flood levels and hazards on the subject site with the proposed development and the flood mitigation measures are presented in Figures 10 and 11.

The impact of the proposed development on the existing 100yr ARI flood levels on the site and in surrounding areas is presented on Figure 12. This demonstrates that there will be no significant adverse impacts on flooding of adjacent developments. Any increases in flood levels within the subject site would be accommodated within the building designs.

4.6 Flood Sensitivity Testing

The flood model for the developed scenario with the proposed mitigation measures was used to test the sensitivity of the predicted flood levels to changes such as climate change, culvert blockage and changes to catchment roughness for the 100yr ARI flood. The results of the sensitivity testing are presented in Table 1 for seven locations as depicted on Figure 13.

Table 1 – 100yr ARI Flood Level Sensitivity

Location	Description	Existing	Adopted Developed	Blockage		Roughness		Climate Change	
				10%	25%	+20%	-20%	+10% Rain	10% Block
1	OCR - Railway	13.02	13.02	13.07	13.14	13.05	13.00	13.11	13.15
2	OCR - Channel	11.77	11.78	11.81	11.86	11.81	11.75	11.84	11.86
3	US - SmithSt	10.85	10.83	10.83	10.83	10.88	10.79	10.86	10.86
4	DS - SmithSt	9.36	9.35	9.51	10.04	9.36	9.35	9.75	10.13
5	Longport - Railway	10.06	10.06	10.07	10.12	10.09	10.03	10.12	10.14
6	Longport - Channel	8.86	8.95	9.45	10.00	8.86	9.01	9.69	10.09
7	Railway	10.10	10.09	10.11	10.16	10.12	10.07	10.16	10.18

Climate change has the potential to change rainfall patterns in Sydney and possibly increase rainfall intensity. There is limited data available to provide accurate predictions of likely extents of possible changes however from a review of recent research an increase of 10% in rain intensity has been adopted for the sensitivity testing.

The change in rainfall intensity increased the peak flow rates but has minimal impact on flood levels other than in the ponded areas upstream of the culvert under the Longport Street culvert. Flood levels in this area would increase generally by between 0.4 to 0.75m with 100yr ARI flood levels in this ponded area increasing to around RL 9.75m AHD.

The Hawthorne Canal has numerous transitions from culverts to open channels, rail and road crossings and a highly urbanized catchment which will limit the likely extent of blockage at each major control location. At Longport Street, the culvert is 3.8m in diameter and this size and a considerable head of water driving flow through this culvert (over 7m) will limit the extent of any blockage. For the sensitivity, blockage factors of 10% and 25% have been adopted and applied to all the critical crossings at Old Canterbury Rd, the rail corridor and at the Longport Street culvert.

The blockage had minimal impact on flood levels other than for the ponded areas at the northern end of the site. The ponded levels increased to around RL 10m AHD in this area for 25% blockage in the 100yr ARI flood.

The changes to catchment roughness had minimal impact on the flood levels on and adjacent to the site.

The combination of the rainfall intensity increase due to climate change and 10% blockage factor also had minimal impact on flood levels other than in the ponded area over the northern portion of the site. Flood levels in this area increased to around RL 10.15m AHD in the 100yr ARI flood for the combination of climate change and blockage.

The general trend from this sensitivity testing is that the flood levels over the site and in adjacent areas are insensitive other than for the ponded area in the northern portion of the site. The extent of this ponding is expected to be up to RL 10.15m AHD based on the allowances for climate change and blockage in the sensitivity testings.

4.7 Flood Mitigation Measures

The proposed flood mitigation measures for the overall development are described below and those specifically relevant to the Stage 1 Project area are also detailed.

4.7.1 Overall Site

4.7.1.1 Inflow of Floodwaters

There are two minor openings at present which permit inflow of floodwaters to the subject site upstream of the Mungo Scott Building. It is proposed to close these openings along the rail corridor between the proposed buildings. The proposed platform or closure levels at each of the buildings along the rail corridor are listed in Table 2.

4.7.1.2 Access to Light Rail Station

Transport NSW has agreed to an elevated accessway from the subject site to be proposed light rail platform and lowering of the existing ground surface to RL 9.2m over a width of approximately 10m on the western side of the rail corridor in the vicinity of the light rail station (refer to Figures 8 and 9). This would permit the 100yr ARI flood flows to pass under the soffit of the pedestrian accessway. Flow onto the site from the rail corridor would be blocked until the southern edge of this elevated accessway to the light rail station.

The accessway is proposed to have a level of approximately RL 10.9m at the subject site boundary and RL 11.15m at the platform. The accessway structure depth will need to be minimized and not to be any deeper than 500mm to allow the unimpeded passage of floodwaters. This would ensure no significant impact on flood levels in the rail corridor or on adjacent properties. It would also allow safe access for pedestrians during the 100yr ARI flood event. The 100yr ARI flood levels at the accessway location are presented on Figure 14.

4.7.1.3 Smith Street Overland Flows

The main access to the site from Smith Street will be along the eastern side of the Stage 1 Project area and then eastwards towards the light rail station and the Mungo Scott building (refer Figure 8). This access path along with the elevated accessway to the light rail station will be located in a low flood hazard area or span the high hazard areas in the rail corridor. Also, there is ready access to high rise buildings or other areas on the site outside the 100yr ARI flood affected areas.

The canal would be fenced with a palisade type fence to improve safety to users of the development while also permitting flood flows to enter the canal. The extent of this type of fencing is indicated on Figure 8.

Inlet pits in Edward and Smith Streets would be incorporated to serve two 900mm stormwater pipes to reduce the overland flows in flood conditions. The inlets and pipes would be designed for a capacity of 1.8m^3/s in Edward Street and 1.7m^3/s in Smith Street. These improvements would provide reductions in overland flows in Smith Street especially in smaller flood events.

4.7.2 Stage 1 Project

The flood mitigation measures to be implemented in the Stage 1 project include:-

- elevated accessway to the eastern boundary of the site;
- inlet pits and two 900mm diameter stormwater pipes from Edward and Smith Streets (the size and configuration of these elements can be varied but need to achieve a combined peak flow of 3.5m^3/s in 100yr ARI flood).

4.8 Flood Risk Management

4.8.1 Levels along Rail Corridor Boundary

The minimum levels recommended along the rail corridor boundary to prevent inflow of floodwaters have been selected after consideration of the 100yr ARI flood levels and the sensitivity testing. A minimum level adopted is the 100yr ARI level with a 500mm freeboard. Flood flowpaths from the corridor to the canal would be retained adjacent to the Longport Street overpass and immediately downstream of the proposed elevated accessway to be light rail station. The recommended levels relative to the proposed building footprints are presented in Table 2.

Table 2
Development Boundary – Minimum Wall Levels along Rail Corridor

Building	Minimum Recommended Levels in AHD	
	Northern End	Southern End
1A	10.65	10.7
1C	10.7	10.7
2A	11.1	11.4
3A	11.5	11.9
3B	11.9	12.0
3C	12.05	12.25
3D	12.3	12.5
Southern End	13.5	13.5

4.8.2 Freeboard to Floor Levels

4.8.2.1 Overview

All the residential buildings have appropriate freeboards to habitable floor levels and to basement driveway entry crest levels to provide acceptable levels of risk for flood damage and personal safety. Personal safety issues are dealt with in more detail in Section 4.9.

The significant heritage buildings to be retained on site are buildings 2A/2B/2C, 3C, 5A and 5E. Buildings 3C and 5A are the storage silos and the lowest residential floors have been set at RL 11.3m AHD which provides adequate freeboard to the 100yr ARI flood level. These buildings will have access to a basement car park which will serve the entire footprint of Buildings 3 and 5 and provide flood free access to a level of RL 13m AHD at the driveway entry.

The proposed retail areas are very important to the success of this transport orientated development to service residents in the development but more importantly to attract people to the light rail station and provide amenity for the community and light rail users. These retail areas need to be accessible to the main pedestrian pathways to the station and present well to adjacent open space to maximise the amenities for users. These retail areas will include specialty activities such as cafés, newsagencies, corner shops etc.

4.8.2.2 Overall Site

The 100yr ARI flood levels can be categorized into the three main areas of influence on the design floor levels for the development:-

- Edward Street;
- Entry to site off Smith Street;
- Area of ponded water over the northern portion of the site.

The flood levels in Edward Street would influence floor levels in apartments fronting this street in Building 4C. The peak 100yr ARI flood level in Edward Street is RL 11.6m AHD ramping down in both directions along Edward Street. There was negligible influence on this flood level due to climate change and blockage. The minimum floor levels adopted for the apartments fronting Edward Street are 500mm above the 100 ARI flood level.

The 100yr ARI flood levels at the new road entry from Smith Street adjacent Building 2C range from RL 10.4 to 9.8m AHD. The influence of climate change and blockage on flood levels is significant in the lower ponding areas but dissipates to negligible influence around proposed entry area. The minimum residential floor level in this area (Buildings 4A and 4B) has been set at RL 11.5m AHD which provides over a metre freeboard to the 100yr ARI flood levels. The small retail area proposed in Building 4A has a minimum floor level of RL10.8m AHD. This area will be floodproofed to RL 10.9m AHD to match the 100yr ARI flood level (RL 10.4m AHD) plus 0.5m freeboard.

The ponding area over the northern portion of the site provides the flood level relevant to the remainder of the site. The 100yr ARI flood level for this area ranges from RL 9 to 9.2m AHD. This can increase to around RL 10.15m AHD with the influence of climate change and blockage. Minimum residential floor levels have been set at RL 11.3m AHD throughout the remainder of the development to provide a freeboard of over a metre above the 100yr ARI flood level with allowance for blockage and climate change. The retail areas would be floodproofed up to RL 10.3m AHD in order to minimize the potential for flood damages. All basement driveway crests will be above the minimum residential floor level of RL 11.3m AHD.

The proposed levels for the residential floors, retail floors and basement driveway crests are detailed in Table 3 along with a summary of the freeboards proposed in the development.

In summary, the overall development has freeboards beyond the requirement of 500mm above the 100yr ARI flood level for residential and basement driveway crests and retail areas would be adequately floodproofed.

4.8.3 Stage 1 Project

A summary of the risk management measures for the Stage 1 development related to flooding are (refer Figure 7):-

•	Building 4C	- minimum residential floor level is the higher of 500mm above 100yr ARI flood level or 300mm above gutter level;
•	Buildings 4A and 4B	- minimum floor level residential is RL 11.5m AHD which is 1.1m above the 100yr ARI flood level;
•	Basement	- driveway crest level is RL 11.7m AHD – provides a freeboard of 1.3m above the 100yr ARI flood level and 300mm above gutter level in road;
•	Building 1C	- will be floodproofed to RL 10.3m AHD which is 150mm above levels predicted for the 100yr ARI flood level plus climate change and blockage. This building will be lightweight and supported on columns with a floor level of RL 9.75m AHD so as not to obstruct flood flows;
•	Elevated Accessway to Light Rail Station	- elevated to allow 100yr ARI floodwaters to pass under without obstruction or adverse impact on flood levels;

Table 3
Impact of Flood Levels on Proposed Buildings

Building	100yr ARI Flood Level m AHD	Minimum Floor Level m AHD			Freeboard m (freeboard including cc+blockage)		
		Residential	Retail	Basement crest	Residential	Retail	Basement
1A residential	9-9.2 (10.15 with cc+blockage)	11.5	n/a	10.8	2.3 (1.35)	n/a	1.6 (0.65)
1C retail	9-9.2 (10.15 with cc+blockage)	n/a	9.75	n/a	n/a	0.55 (-0.4)	n/a
2A-2B retail and commercial	9-9.2 (10.15 with cc+blockage)	n/a	9.05	n/a	n/a	-0.15 (-1.05)	n/a
3A residential	9-9.2 (10.15 with cc+blockage)	11.5	n/a	n/a	2.3 (1.35)	n/a	n/a
3B, 3C and 3D retail and residential	9-9.2 (10.15 with cc+blockage)	12.0	n/a	13.0	2.8 (1.85)	n/a	3.8 (2.85)
4A and 4B	10.4	11.5	10.8	11.7	1.1	0.4	1.3
4C	11.4 – 11.3	11.9 - 12.5	n/a	n/a	0.5	n/a	n/a
5A	9 – 9.2 (10.15 with cc+blockage)	11.5	10.7	13.0	2.3 (1.35)	1.5 (0.55)	3.8 (2.85)
5B	9-9.2 (10.15 with cc+blockage)	11.9	n/a	n/a	2.7 (1.75)	n/a	n/a
5C	9-9.2 (10.15 with cc+blockage)	13.9	n/a	/a	4.7 (3.75)	n/a	n/a
5D	9-9.2 (10.15 with cc+blockage)	11.8	n/a	n/a	2.6 (1.65)	n/a	n/a
5E	9-9.2 (10.15 with cc+blockage)	11.3	n/a	n/a	2.1 (1.15)	n/a	n/a

4.9 Emergency Flood Response Plan

An emergency flood response plan has been formulated for the site to cater for the flood risk for floods between the 100yr ARI and Probable Maximum Flood (PMF) floods. The estimated PMF level for the site is RL 13.2mAHD. While the 100yr ARI flood is the adopted flood standard for establishing floor levels, an emergency flood response plan is required to appropriately manage the risk to personal safety during more severe floods up to the PMF event.

The proposed emergency flood response plan for the development consists of:-

- Vertical evacuation to higher floor levels above the flood levels to make the plan self- sufficient;
- An alarm sounds when floodwaters on the site reach RL 9.4m AHD requiring residents and workers to move to higher floors above the PMF level;
- Requirement for each body corporate to be responsible for the plan including nomination of people to be wardens in the building, training of all residents/workers and instigating annual drills to practice the plan requirements;
- Provision of signs and lighting to inform people of the evacuation route; and
- Access for emergency services if required during a flood.

The alarm would sound at approximately the 100yr ARI flood level in the northern portion of the site. This will allow time for wardens to arrange for the lower floor apartments to be evacuated to higher levels.

All residential buildings have floor levels above the PMF level so vertical evacuation provides flood free refuge for all floods. Residents of Buildings 2, 3, 4 and 5 would also have access to flood free land by walking west along Wellesley Street.

Similarly residents of Building 1A would have access to refuge above the PMF level within the building or via pedestrian access from the first floor level at RL 14m AHD to the Longport Street overpass.

The small retail buildings 1C and 2C have ready access to adjacent tall buildings or areas along or west of Edward Street providing refuge above PMF levels.

The retail ground floor of Buildings 2A and 2B would have access to the first levels at RL 13.9m AHD which is above the PMF level. Higher floors in Building 2A provide further refuge as there would be a connection between Buildings 2A and 2B at the first floor level. In case of emergency requiring say medical attention, access would be provided by covered gantry from Building 2A to 3A and then to the combined basement under Buildings 3 and 5. Emergency vehicles could obtain access to the basement up to flood levels of RL 13m AHD.

The ground floor retail in the one storey Building 3B has a floor level of RL 12m AHD and has ready access to flood refuge floors in Building 3A.

The ground floor retail at the northern end of Building 4A has a floor level of RL 10.8m AHD with ready access to flood refuge floors in the same building.

The retail and community uses in the two storey Building 5E has internal access to the first floor level at RL 14.3m AHD above the PMF level or ready access to higher levels in the adjacent Building 5D.

The ground floor retail in Building 5A, has a floor level of RL 10.7mAHD and ready access to floors above the PMF level in the same building.

This emergency response plan along with the design of the development provides appropriate management of the flood risk to personal safely.

5.0 Stormwater Concept Drainage Plan

The stormwater modelling has been undertaken by Civil Certification and the details are contained in Appendix D.

5.1. Overall Management

The proposed stormwater management system will adopt a water sensitive urban design (WSUD) approach in order to reduce potable water use through harvesting roof runoff for non- potable water uses, reduce pollutant loads in runoff to below existing conditions with onsite treatment, provision of a stormwater pipe collection system and safe overland flow paths for runoff. This will be achieved as an integrated solution with the site landscape plan.

5.2. Stormwater Drainage Concept Plan

The WSUD stormwater concept plan is depicted on Figures 15 and 16. The plan incorporates a pipe drainage system with a 20yr ARI capacity connected to the open channel of the Hawthorne Canal on the site. Flows in excess of this capacity will be incorporated in overland flow paths safe for pedestrian access. Runoff will be treated in two bioretention swales, and a gross pollutant trap to reduce pollutant loads to target levels. This will be aided by roof stormwater harvesting which will reduce the volume of runoff. Stormwater detention would not be provided as the site discharges directly into the Hawthorne Canal and given the sites location at the upper end of a large catchment, the provision of onsite detention has the ability to adversely affect downstream flood levels.

5.3. Runoff Water Quality

The SWC target stormwater quality for runoff from the developed site into Hawthorne Canal for the post development would be a reduction in the average pollutant load in runoff of:-

- total gross pollutants - 90% reduction;
- total suspendable solids - 85% reduction;
- total phosphorus - 60% reduction;
- total nitrogen - 45% reduction.

This would reduce the pollutant loads in runoff to well below the case for the existing site and therefore contribute to the long term improvement in water quality in the Hawthorne Canal.

MUSIC modelling has been undertaken to verify the size of WSUD features required in the development to achieve these targets.

The WSUD features proposed in the development to meet these targets are depicted on the Stormwater Drainage Concept Plan (refer Figures 15 and 16) and consist of:-

- Bioretention Swales — 2 swales – surface area 179m²;
- Rainwater harvesting — rainwater tank volume – 100kL;
- Gross pollutant trap — 1 off.

The incorporation of WSUD features as proposed in the Concept Plan and in the Stage 1 Project Application both exceed the SWC requirements above for reduction in runoff pollutant loads.

The reductions in runoff pollutant load for the Stage 1 Project Application development have been estimated to be:-

- total gross pollutants - 99% reduction;
- total suspendable solids - 94% reduction;
- total phosphorus - 68% reduction;
- total nitrogen - 52% reduction.

This performance readily exceeds the SWC targets and would contribute to the long term improvement in water quality in the Hawthorne Canal.

6.0 Integrated Water Management Plan

A detailed account of the ESD strategy for the proposed development over the entire Summer Hill site is provided in the ARUP report titled "Ecologically Sustainable Development Report" Issue 2, March 2011.

This same ESD strategy is proposed for Stage 1.

The water management components of the ESD strategy are summarised as follows:

- Rainwater capture from all residential roof areas, storage in tank/s totalling 100KL located in the basement space and recycled on site for
    - Landscape irrigation;
    - Wash down areas (*plant rooms, car wash areas*);
    - Toilet flushing and other non-potable uses;
- Landscaping will be water sensitive;
    - Native / low water requirement plants;
- Stormwater runoff from the site will be moderated by soft landscape elements ;
- The sewerage will be a standard gravity feed arrangement;
    - Reduced effluent flows by use of low flow fixtures and fittings;
- The kitchens and bathrooms will have water efficient fittings including;
    - 3 star (*minimum*) showerheads, taps ;
    - Low flush toilet;
    - Water efficient dishwasher.

The ESD strategy target for water is equivalent to that required by BASIX, which means a 40% reduction in water consumption will be achieved compared to the average NSW dwelling.

Based on the ESD strategy for Stage 1 over 90% of the catchment will either be captured for reuse or detained and treated in bio-retention systems before being discharged into Hawthorne Canal.

Wastewater generated by the development will be reduced compared to the average NSW dwelling. Blackwater treatment is not proposed. Discharge of wastewater will be to the nearby Sydney Water infrastructure.

A recycled effluent connection is currently not available to the site nor is it likely to be available in the near future due to the established density of the surrounding suburbs. Based on this, a third pipe (ie to accommodate some future recycled water connection) is not proposed for the subject site.

Potable water will be supplied to the site by Sydney Water via nearby water mains. However note that the proposed WSUD strategy will minimise the size of potable water infrastructure and the demand on this limited resource.

7.0 Utilities

7.1 Sewerage

Sydney Water has advised that there is adequate capacity in existing sewers to cater for the entire development.

Sydney Water has requested that development connect to the existing sewer at the corner of Edward and Smith Streets.

An existing sewer is aligned north south along the rear of existing residential lots on the eastern side of Edward Street. This sewer turns into Edward Street under the proposed Stage 1 project area. This sewer will have to be either relocated to the proposed new road in the Stage 1 area or be protected under the proposed building. The most appropriate option will be selected in conjunction with Sydney Water at the detailed design stage.

7.2 Potable Water

Sydney Water has advised that there is adequate capacity in existing water mains to service the entire development.

Sydney Water has requested that the development connect to the existing water main in either South Street (300mm dia.) or Edward Street (500mm dia.).

The Stage 1 development will incorporate rainwater reuse and water saving devices to minimize the potable water use in the development. These aspects are detailed in the Environmental Sustainable Development report.

7.3 Power

Energy Australia has advised that the Stage 1 development can be serviced from the existing substation in Smith Street. Servicing of further development on the site will need to be negotiated with Energy Australia however they have indicated that the existing Dulwich Hill Zone Substation has adequate capacity to service the entire development.

7.4 Gas

There is a primary and a local gas main in Edward Street north of Wellesley Street. In addition to these mains, there is also a secondary gas main in Edward Street south of Wellesley Street. These significant supply mains would have significant capacity to service the proposed development. However, the servicing of the development would be a decision made by Jemena/AGL depending on their consideration of the commercial viability of this supply.

7.5 Telecom

Telecom would provide adequate services to the site to match the redevelopment rate.

8.0 Infrastructure Management Plan

The proposed rainwater tanks, bio retention systems, GPT and drainage system will be managed onsite as part of strata or community title arrangement. A recommended maintenance regime is as follows:

- Periodic (*6 monthly*) inspection of the stormwater system and removal of any gross pollutants & coarse sediment that is deposited in the bio-retention systems and replacement of vegetation as necessary;
- Periodic (*3 monthly*) and episodic (*post storm greater than 1 yr ARI*) inspection of the stormwater system and if required removal of trapped pollutants from all GPTs/litter baskets; and
- Periodic (*annually)* inspection (*and flushing if required*) of the stormwater system and the bio-retention systems.

Connection of the proposed trunk drainage infrastructure to Hawthorne canal will be undertaken in accordance with the requirements of Sydney Water Corporation (SWC). The location of the outlet has been selected to streamline with the existing channel flows. It is intended that the new outlet will not extend into the existing channel flow area. The new outlet is likely to be higher than the existing channel invert and is proposed to be constructed of sandstone or similar to give a natural appearance

Hawthorne canal (other than the new drainage connection) will remain unaffected by the proposed development. New safety fencing will be installed around the perimeter of the canal to ensure no unauthorised access into SWC controlled land.

Access will be provided to permit SWC to gain entry to the canal for maintenance purposes.