Appendix C

LIST OF DIAGRAMS Part A

LIST OF DIAGRAMS Part B

LIST OF PHOTOS

Part A: DOBROYD CANAL PRELIMINARY OPTION ASSESSMENT

A.1. Hotspot D01 – Heighway Avenue, Croydon

A.1.1. Option FM0102: Underground Detention Basin, Heighway Avenue

This option proposes an under-road detention basin in Heighway Avenue. Its purpose is to temporarily store water during frequent rainfall events, and discharge the flow at a later time where the outflow is regulated through flow-control structures.

The option involves a 2.4 m diameter pipe installed at Frederick Street, where water is diverted from the existing pipe network into the new pipe and discharges flow into a detention basin (dimensions L 80 m x W 4.7 m x H 1.5 m) beneath Heighway Avenue, between Frederick Street and just east of Dobroyd Canal. A small 150 mm diameter pipe at the detention basin outlet passes water back into the existing pipe network where it travels a small distance before joining with Dobroyd Canal.

Diagram A1 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, the option is shown to decrease peak flood levels on Heighway Avenue itself by up to 0.1 m in comparison to existing depths in excess of 0.5m. There are however increased flood levels in the canal by 0.1 m. In the 1% AEP event the option has only minor localised benefits at the upstream end of the upgraded Frederick Street pipe, and negligible impacts on Heighway Avenue. Existing depths in the 1% AEP exceed 1.5m. As a result the option has no discernible impact on flood hazard in either event.

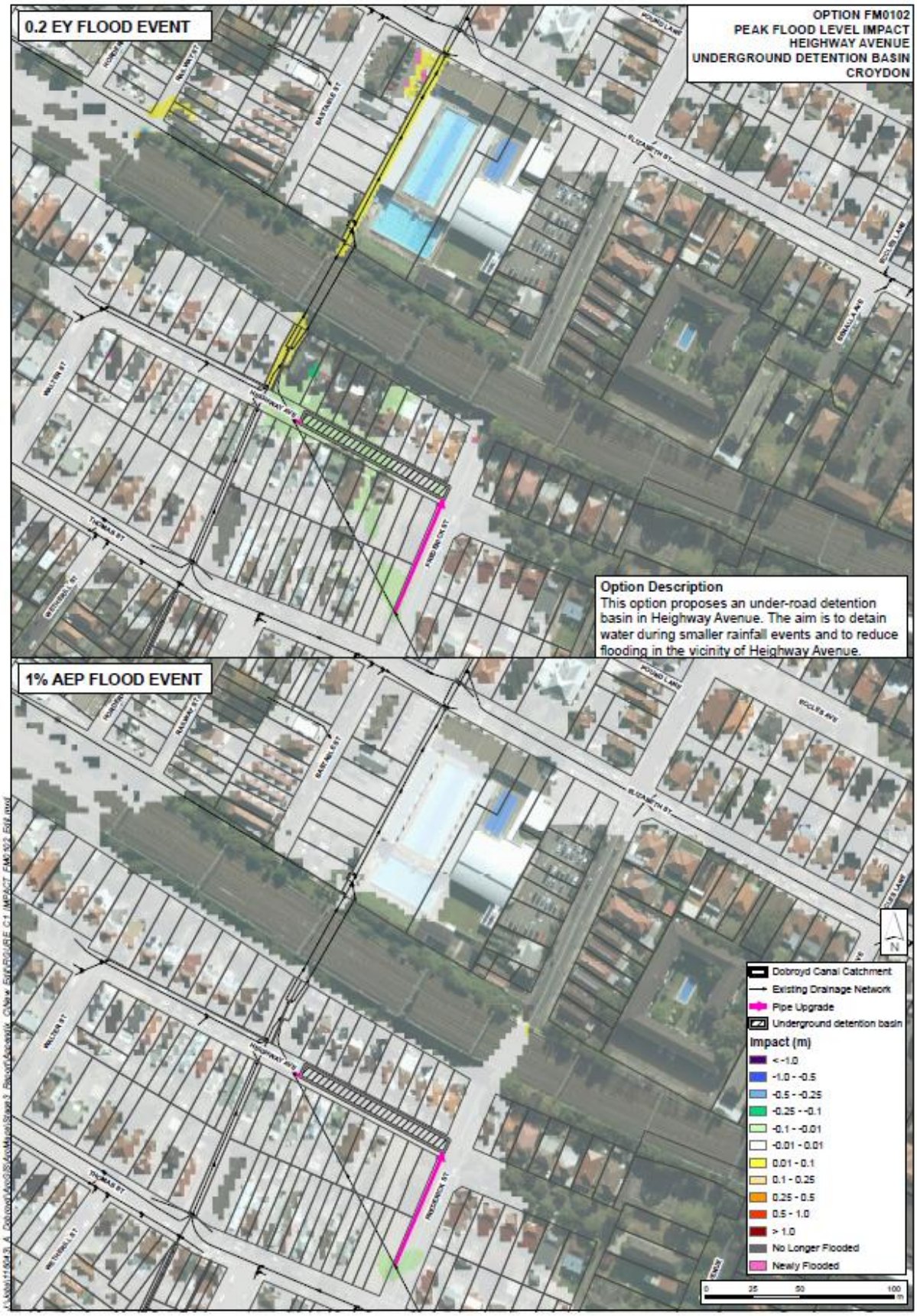
Table 1 – Over floor Property Affectation FM0102

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0102)**	**Change**
0.5EY	23	23	0
0.2EY	66	66	0
10% AEP	132	132	0
5% AEP	209	209	0
2% AEP	301	301	0
1% AEP	399	399	0
PMF	1339	1339	0

The marginal flood impacts are a result of the detention basin reaching full capacity in the 0.5 EY event (the most frequent event modelled). Once the detention basin reaches capacity, its effectiveness diminishes and the same downstream flow as the existing case occurs. This indicates that the detention basin is too small for the incoming volume of flood waters, however it is not physically feasible to increase the size of the basin.

The limited impact on peak flood levels would result in no change to property over floor affectation in the Dobroyd Canal catchment (Table 1). As a result of the negligible impact on flood behaviour this option is not recommended for further consideration.

Diagram A1: Option FM0102 Schematisation and Impacts 0.2 EY and 1% AEP Events



A.1.2. Option FM0102B: Drainage Upgrade, Heighway Avenue

This option proposes the pipe duplication of the Sydney Water drainage network between the intersection of Thomas Street and Frederick Street and Heighway Avenue where flow is discharged into Dobroyd Canal. The drainage upgrade includes the duplication of the existing irregular shaped culvert (1 m diameter semicircle pipe) and a 1.83 m diameter pipe between Heighway Avenue and Dobroyd Canal.

Diagram A2 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

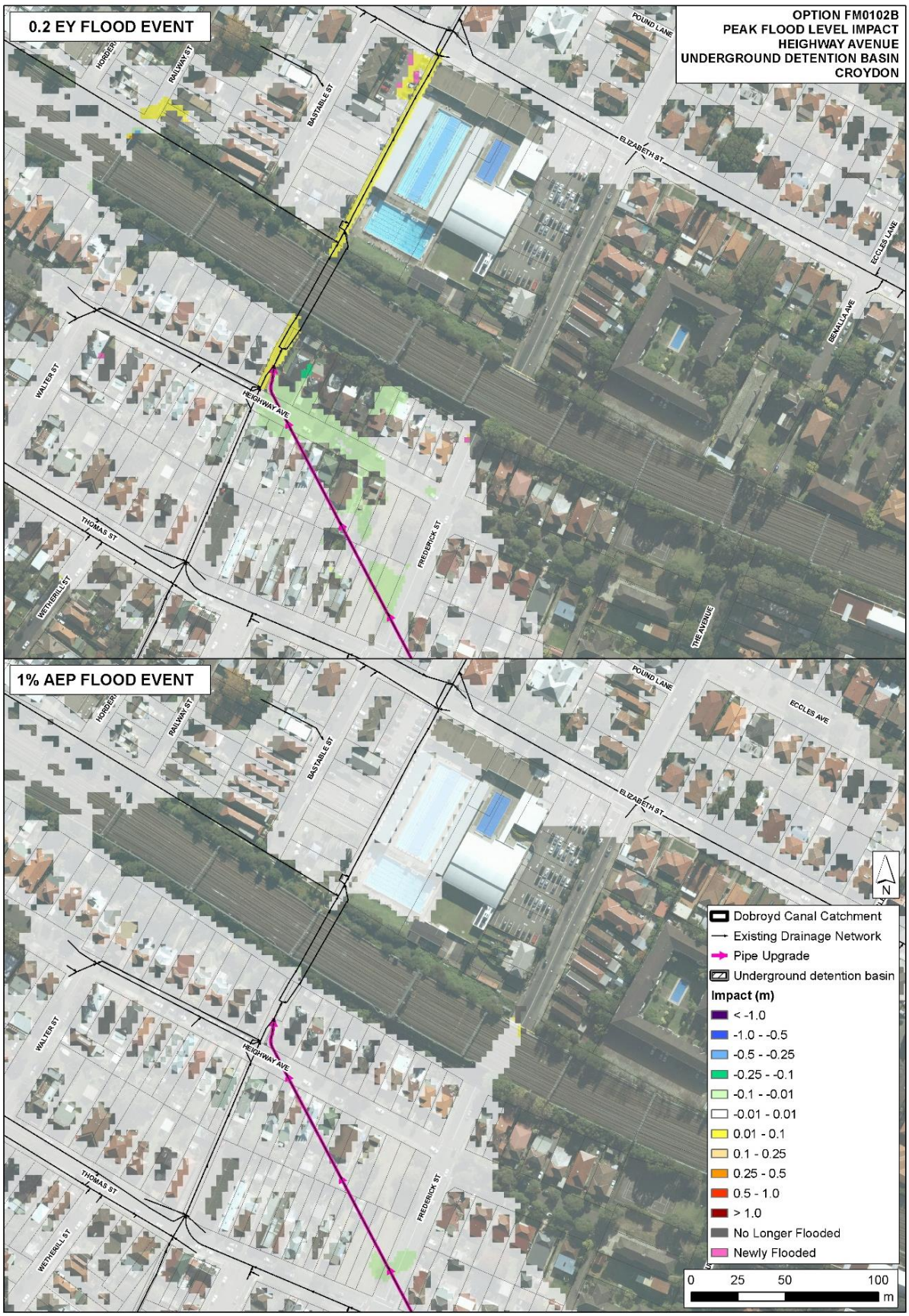
In the 0.2 EY event, the option is shown to decrease peak flood levels on Heighway Avenue by up to 0.1 m, in comparison to existing depths in excess of 0.5m. There are however increased flood levels in the canal by 0.1 m. In the 1% AEP event the option has only minor localised benefits at the upstream end of the upgraded Frederick Street pipe, and negligible impacts on Heighway Avenue. Existing depths in the 1% AEP exceed 1.5m.

Table 2 – Over floor Property Affectation FM0102B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0102B)**	**Change**
0.5EY	23	23	0
0.2EY	66	66	0
10% AEP	132	132	0
5% AEP	209	209	0
2% AEP	301	301	0
1% AEP	399	399	0
PMF	1339	1339	0

The limited impact on peak flood levels would result in no change to property over floor affectation in the Dobroyd Canal catchment (Table 2). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram A2: Option FM0102B Schematisation and Impacts 0.2 EY and 1% AEP Events



A.1.3. Option FM0103: Underground Detention Basin, Milton Street

This option proposes an under-road detention basin in Milton Street North. The detention basin is designed to store overland flow originating from Liverpool Road to the south. The detention was designed with a 0.9 m diameter pipe installed at Liverpool Road (at a topographical low point between Dobroyd Canal and Milton Street North). The pipe is aligned to follow the road corridor to Milton Street North where several inlet pits collect water from the road corridor. The pipe then discharges into the under-road detention basin at the northern end of Milton Street North (dimensions L 100 m x W 10 m x H 1.5 m). A small 150 mm diameter pipe at the detention basin outlet passes water back into the existing pipe network (1 m diameter pipe) where it travels a small distance before joining with Dobroyd Canal.

Diagram A3 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, there is a reduction in peak flood levels up to 0.1 m observed in Milton Street North, Thomas Street, Dobroyd Canal (between Liverpool Road and Thomas Street). In the 1% AEP event, a reduction of peak flood levels up to 0.1 m are primarily observed along Liverpool Road and Milton Street North and adjacent properties. Existing depths on Milton Street North are 0.5m and 0.8m in the 0.2EY and 1% AEP events, respectively. In both of these flood events, the flood depths within Milton Street and Thomas Street still remain in excess of 0.3 m from a 0.2 EY and 1% AEP event, which is considered unsafe for traffic.

The detention basin reaches full capacity during the 0.5 EY event (the most frequent event modelled). It was also found that there was minimal change to the peak flow or time of peak flow within the existing Council owned pipe that the detention basin discharges into during the 0.5 EY event. This indicates that the detention basin is too small for the incoming volume flood waters, however it is not physically feasible to increase the size of the basin.

The limited impact on peak flood levels result in limited change to property over floor affectation in the Dobroyd Canal catchment as shown below in Table 3. The option results in an additional two properties being flooded over floor in the 2% AEP. As a result of the negligible benefits on flood behaviour this option is <u>not recommended</u> for further consideration.

Table 3 – Over floor Property Affectation FM0103

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0103)**	**Change**
0.5EY	23	23	0
0.2EY	66	65	-1
10% AEP	132	131	-1
5% AEP	209	210	1
2% AEP	301	303	2
1% AEP	399	397	-2
PMF	1339	1338	-1

Diagram A3: Option FM0103 Schematisation and Impacts 0.2 EY and 1% AEP Events

A.1.4. Option FM0104: Underground Detention Basin, Heighway Avenue and Milton Street

This option proposes to combine the two under-road detention basins assessed in FM0102 (Heighway Avenue) and FM0103 (Milton Street North). The aim is to increase the available storage of flood water during smaller rainfall events, and reduce flooding between Liverpool Road and the downstream flowpath. The same configuration is assumed as discussed in Sections A.1.1 and A.1.3.

Diagram A4 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

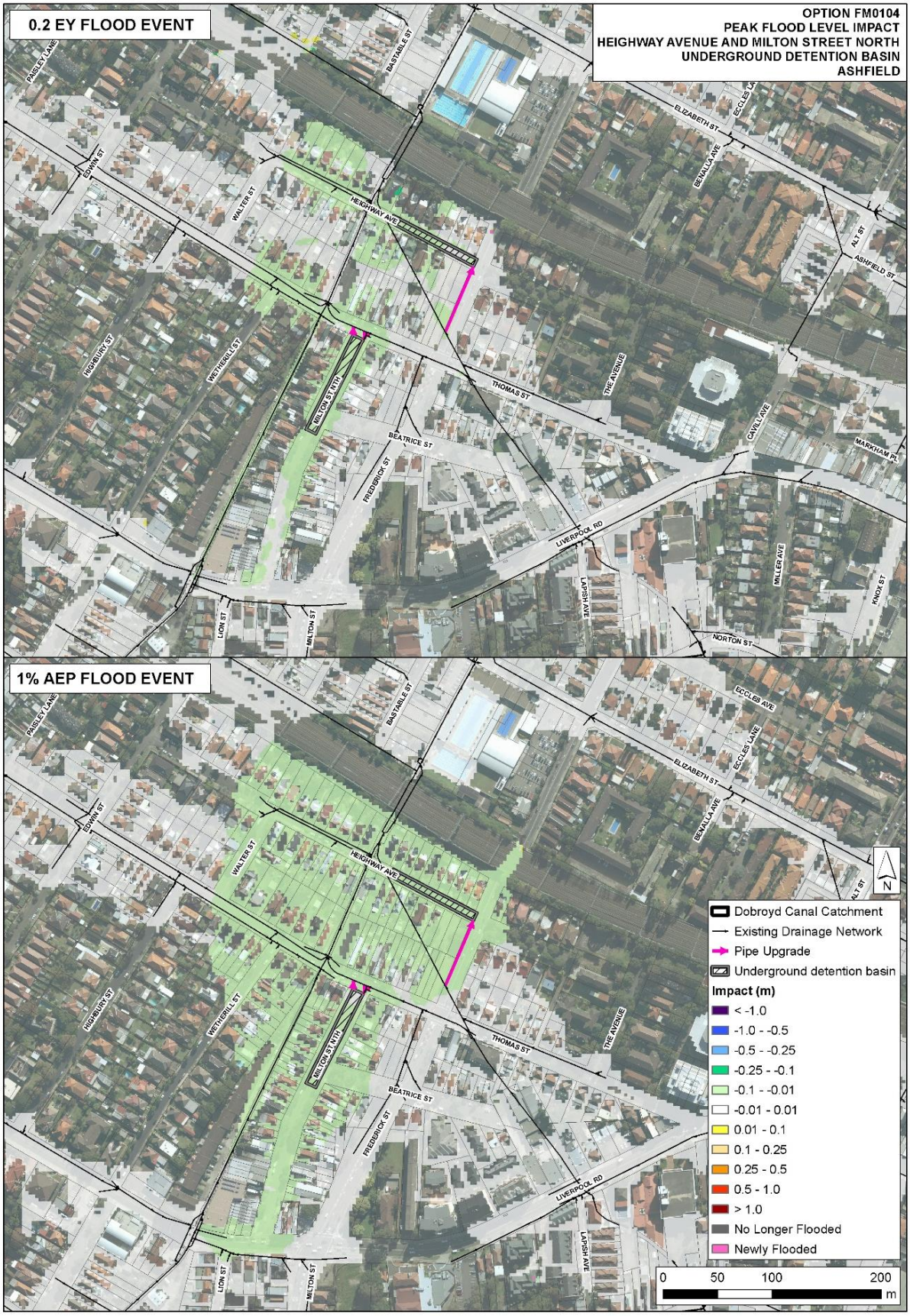
In the 0.2 EY event, there is a reduction in peak flood levels up to 0.1 m observed in Milton Street North, Thomas Street, Dobroyd Canal (between Liverpool Road and Thomas Street). In the 1% AEP event, a reduction of peak flood levels up to 0.1 m extends to include Walter Street and Wetherhill Street. In a 0.2 EY event, the flood depths remain in excess of 0.3 m which is considered unsafe for traffic. Depths in the 1% AEP are in the order of 0.8m.

There would be some, albeit limited, benefit to property over floor affection in the area (Table 4), however this would be marginal, especially when considering the significant construction and maintenance costs. In order to achieve a BCR of between 0.5 – 1.0, this option would need to be costed at between $1.15 and $2.23 Million. As a result of the minor impact on flood behaviour and the likely costs, this option is <u>not recommended</u> for further consideration.

Table 4 – Over floor Property Affectation FM0104

Properties Flooded Over floor			
Event	**Current**	**With Option (FM0104)**	**Change**
0.5EY	23	23	0
0.2EY	66	65	-1
10% AEP	132	131	-1
5% AEP	209	208	-1
2% AEP	301	301	0
1% AEP	399	397	-2
PMF	1339	1338	-1

Diagram A4: Option FM0104 Schematisation and Impacts 0.2 EY and 1% AEP Events



A.1.5. Option FM0106A: Duplication of Dobroyd Canal

This option proposes the duplication of the Dobroyd Canal trunk drainage system from upstream at Norton Street through to the confluence with Iron Cove. The aim is to increase the capacity of Dobroyd Canal minimising the downstream constraint to convey larger amounts of flow from the upper catchment, especially upstream of the railway embankment at Heighway Avenue to reduce the flooding. As part of the duplication, 5.4 km of Dobroyd Canal would be upgraded, including 6 bridges. This option would require a number of property acquisitions to be feasible.

Diagram A5 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, there is a minimal change to peak flood levels across the study area. The open channel does not reach 100% capacity during this flood event and thus does not present a constraint to drainage. As such, the duplication of the open channel does not alleviate flooding behaviour across the study area in this event. In frequent flood events, overland flooding is primarily driven by local drainage networks exceeding capacity. In the existing 1% AEP event, the open channel reaches capacity and causes overbank flooding in many locations. The duplication results in small decreases of up to 0.1 m around Thomas Street and adjacent properties as well as some localised pockets in other locations. Depths remain in excess of 0.3m for this event. Increases in flood levels are observed within the trunk system downstream of Parramatta Road and within Queen Street.

In the 1% AEP event, there is a large area between the railway embankment at Heighway Avenue (existing depth 1.5m) and Thomas Street (existing depth 0.8m) where flood levels have reduced by up to 0.5 to 1.0 m. Further to this, there is a decrease in flood levels of up to 0.25 m along Milton Street North (existing depth 0.8m) and a small section along Liverpool Road near Dobroyd Canal. The decreases observed upstream of the railway are assumed to mostly be controlled by the culvert under the railway.

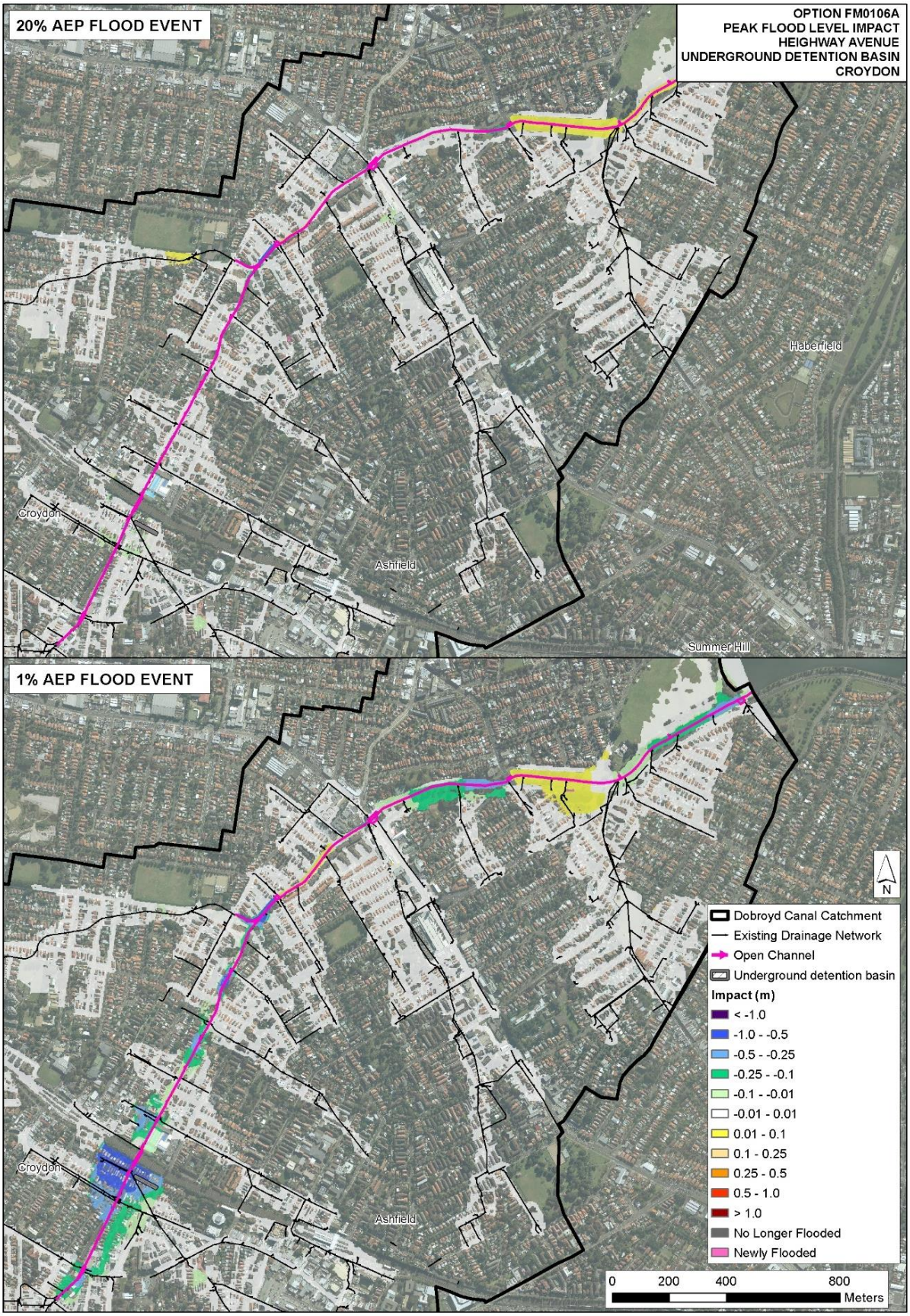
A previous option, FM0105 proposed a secondary box culvert (3.3 m W x 3.3 m H) to pass under the railway. The impacts for the 0.2 EY showed no discernible impacts whilst the 1% AEP event was observed to decrease flood levels by 0.6 m upstream, whilst increasing flood levels in the order of 0.01 and 0.2 m downstream of the railway to the confluence of Iron Cove, affecting a large number of properties adjacent to the canal.

Table 5 – Over floor Property Affectation FM0106A

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0106A)**	**Change**
0.5EY	23	23	0
0.2EY	66	66	0
10% AEP	132	132	0
5% AEP	209	209	0
2% AEP	301	301	0
1% AEP	399	399	0
PMF	1339	1339	0

As a result of the minimal overall improvement to property over floor affectation (Table 5) or large reductions in flood impacts, significant costs and technical challenges associated with the construction, this option is not recommended for further consideration.

Diagram A5: Option FM0106A Schematisation and Impacts 0.2 EY and 1% AEP Events



A.2. Hotspot D02 – Queen Street, Croydon

A.2.1. Option FM0201, FM0202, FM0203 and FM0206A: Queen Street and Centenary Park Detention Basin

These three options proposed various extents of lowering the ground levels in Centenary Park to increase the temporary storage area available during flood events, as described below. Diagram A6, Diagram A7and Diagram A8 show a schematisation of the options and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

Option	Configuration
FM0201	Located at the cricket nets with a gradient sloping from 8.8 m AHD at the north-east corner of the basin to 7.7 m AHD at the south-east corner. The levels along the eastern side on the basin are the same level as the basketball courts (part of Centenary Park). The approximate capacity of the basin is 3,500m^3.
FM0202	Lowering of ground levels across the eastern portion of the playing fields to a uniform 7 m AHD to enable the soccer fields to be still used, whilst also being approximately 0.2 m lower than the road level along Queen Street to divert flow from the street during rainfall events. The approximate capacity of the basin is 89,000m^3.
FM0203	Lowering of ground levels across the entire playing fields to a uniform 7 m AHD to enable the soccer fields to be still used, whilst also being approximately 0.2 m lower that the road level along Queen Street to divert flow from the street during rainfall events. The approximate capacity of the basin is 177,000m^3.

In the 0.2 EY event for Option FM0201, there is a minor reduction in flood levels along Queen Street and adjacent properties of up to 0.1 m, in comparison to existing depths in excess of 1m. The maximum flood depth for this option within Queen Street remains around 1.4 m. In the 1% AEP event, there are little changes to peak flood levels. Subsequently, this option results the removal of over floor flooding at one property only in the 0.2 EY. There is also an increase in over floor affectation in the 2% and 5% AEP events (3 and 2 properties, respectively).

In the 0.2 EY event for Option FM0202, there is some very localised reduction in flood levels along Queen Street of up to 1 m (in comparison to depths over 1m in the existing case), and a minor reduction in flood levels of up to 0.1 m within Iron Cove Creek. In the 1% AEP event, there are localised reductions in flood levels of up to 0.5 m along Queen Street (in comparison to depths in excess of 1.5m in the existing case), and a reduction in flood levels of up to 0.25 m within Iron Cove Creek. While the option results in an overall improvement in over floor property affectation, there is both an increase and decrease in the number of properties affected in the 5% and 2% AEP events. The overall change in over floor flood affectation is shown in Table 6.

Table 6 – Over floor Property Affectation FM0202

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0202)**	**Change**
0.5EY	23	23	0
0.2EY	66	64	-2
10% AEP	132	130	-2
5% AEP	209	207	-2 (2)
2% AEP	301	300	-1 (4)
1% AEP	399	394	-5
PMF	1339	1330	-9

Note: Values in brackets are the number of additional properties inundated over floor during that event.

In the 0.2 EY event for Option FM0203, there is some localised reduction in flood levels along Queen Street of over 1m, and a minor reduction in flood levels of up to 0.1 m within Iron Cove Creek. In the 1% AEP event, there are localised reductions in flood levels of over 1 m along Queen Street, and a reduction in flood levels up to 0.25 m within Iron Cove Creek. While the option results in a greater overall improvement in over floor property affectation, there is both an increase and decrease in the number of properties affected again in the 5% and 2% AEP events. The overall change in over floor flood affectation is shown in Table 7.

Table 7 – Over floor Property Affectation FM0203

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0203)**	**Change**
0.5EY	23	23	0
0.2EY	66	64	-2
10% AEP	132	130	-2
5% AEP	209	207	-2 (2)
2% AEP	301	299	-2 (4)
1% AEP	399	392	-7
PMF	1339	1322	-17

Note: Values in brackets are the number of additional properties inundated over floor during that event.

Diagram A6: Option FM0201 Schematisation and Impacts 0.2 EY and 1% AEP Events

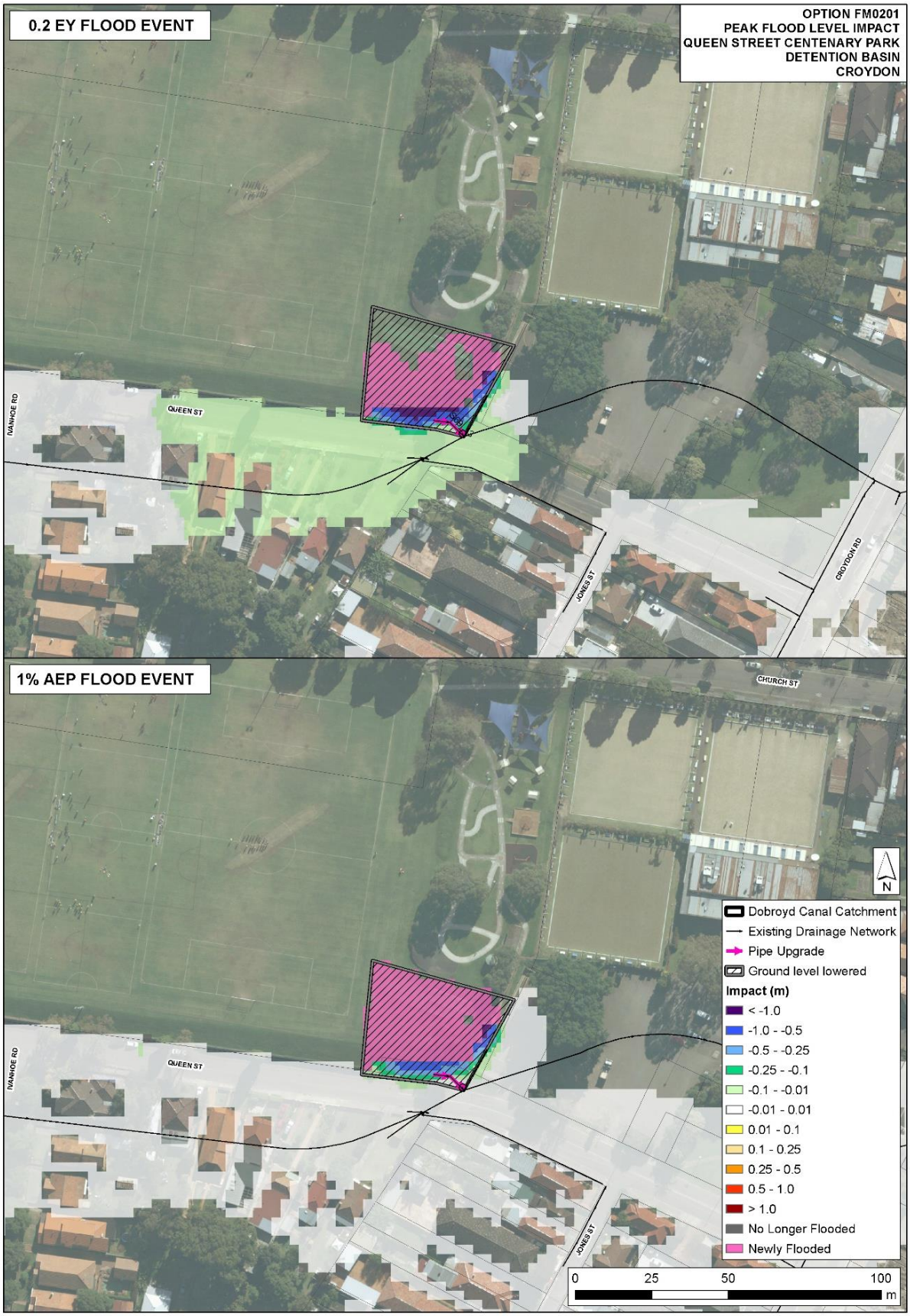


Diagram A7: Option FM0202 Schematisation and Impacts 0.2 EY and 1% AEP Events

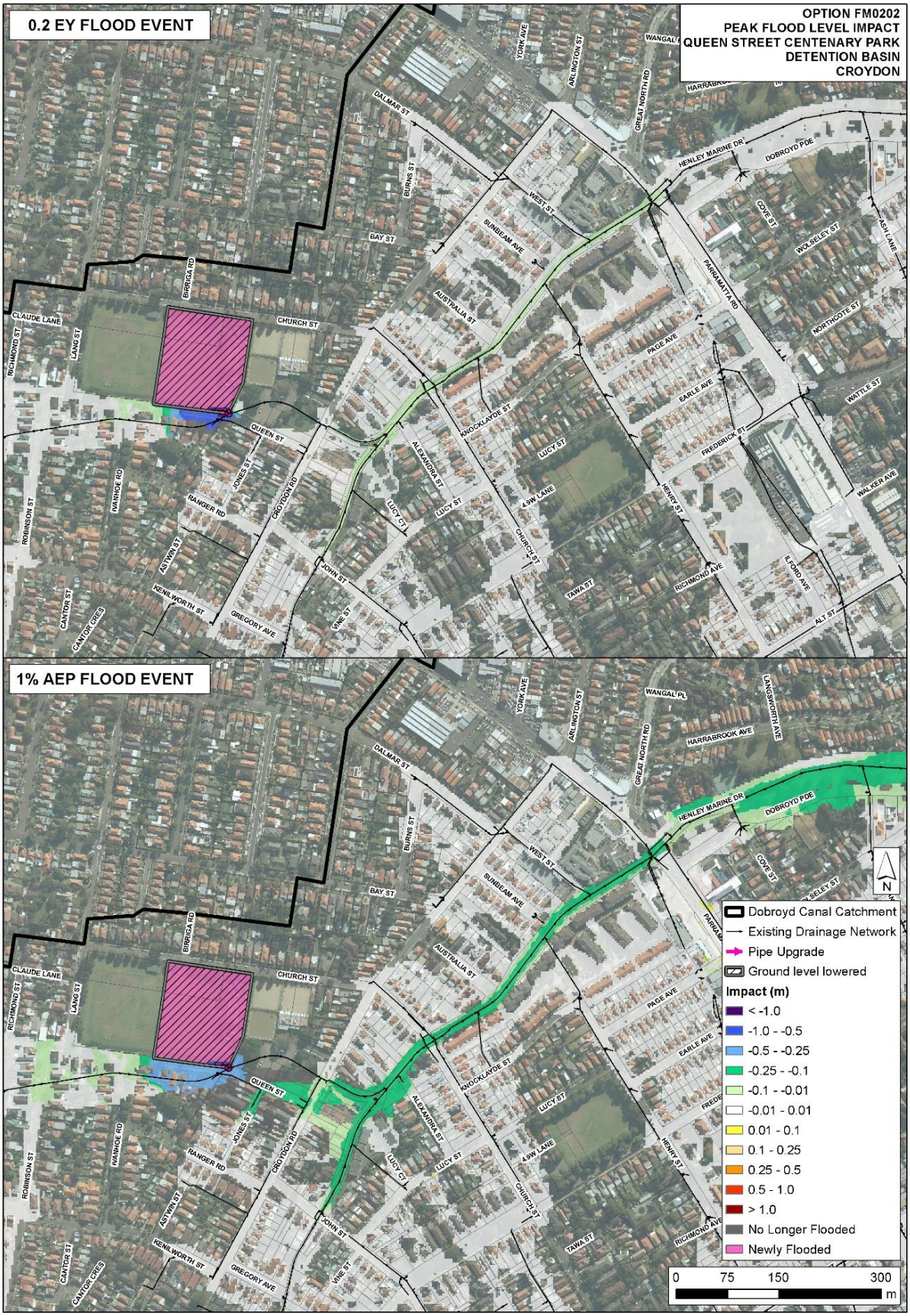
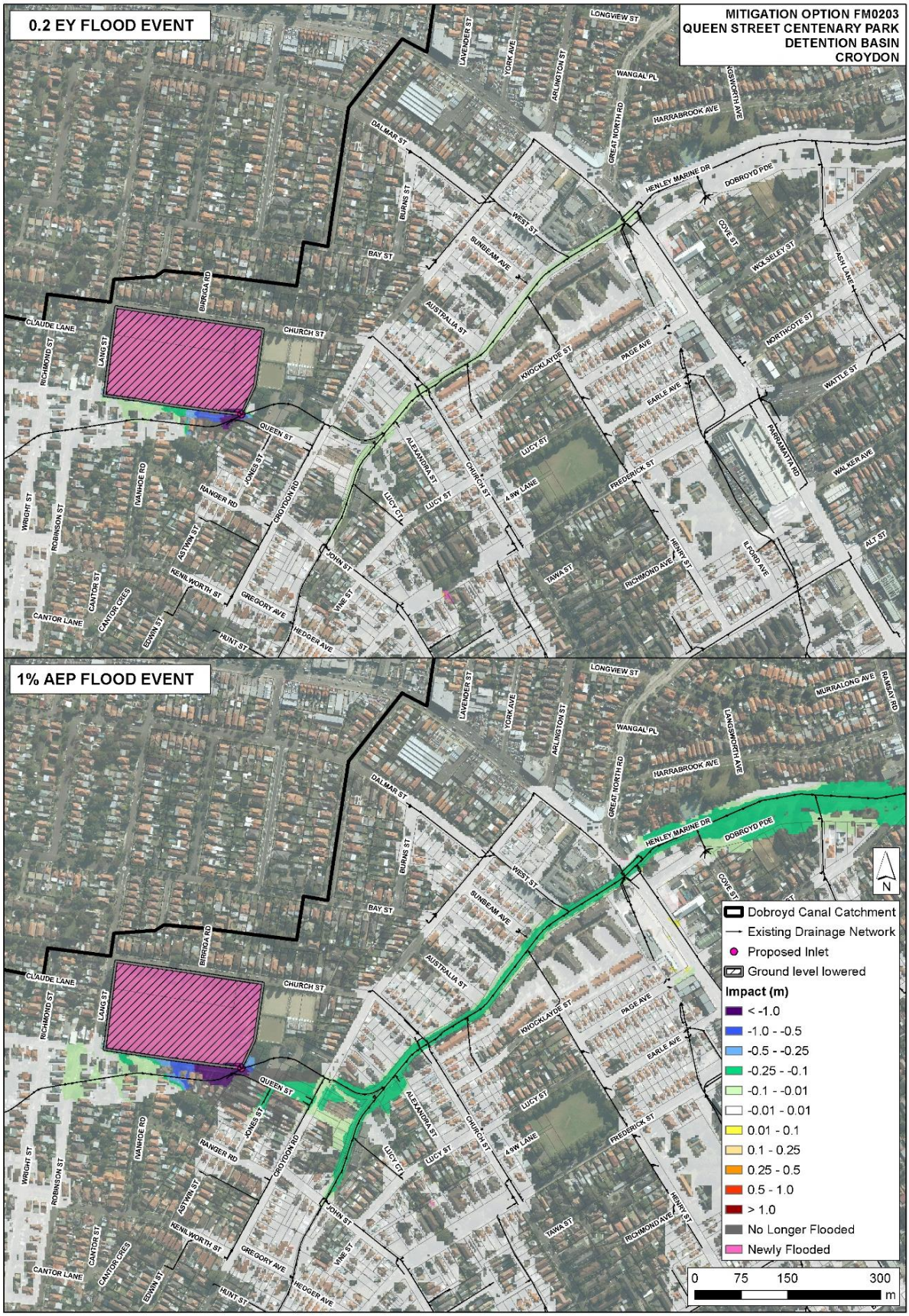


Diagram A8: Option FM0203 Schematisation and Impacts 0.2 EY and 1% AEP Events



The limited extent of reduced peak flood levels for FM0201 results in no change to property over floor affectation in the Dobroyd Canal catchment. FM0202 and FM0203 result in broader reductions in peak flood levels and subsequently show an overall decrease in the number of properties flooded over floor, however both options also result in an increase in the number of properties affected over floor in the 2% and 5% AEP events.

As a result of the minor impact on flood behaviour (FM0201) and the increases in property affectation (FM0202 and FM0203) these options are not recommended for further consideration.

A.2.2. Option FM0205: Queen Street Centenary Park Underground Detention Basin

This option proposes an under-ground detention basin running along the south-west boundary of Centenary Park, beneath the cricket nets and sports fields. The detention basin is designed to store overland flow from Queen Street. The aim is to allow greater capacity within the Council owned pipes for flow from overland flow paths and so reduce flooding. The proposed detention basin has the following dimensions - L 140 m x W 35 m x H 3 m. The inlet to the detention basin is located along southern boundary over a 140 m length. A small 150 mm diameter pipe at the detention basin outlet passes water back into the existing SWC owned pipe where it travels a small distance before joining with Dobroyd Canal.

Diagram A9 shows the schematisation of the option and the impact on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, there is a minor reduction in flood levels running along Queen Street and adjacent properties of up to 0.5 m, in comparison to existing depths of over 1 m. In the 1% AEP event, there is little change in the peak flood levels. In the vicinity of the Queen Street, flood levels decrease by up to 0.1 m, with depths in excess of 1.5 m remaining. This decrease is also observed further downstream in Dobroyd Canal. There are both increases and decreases in the overall property affectation. The change to over floor flood affectation is shown in Table 8.

Diagram A9: Option FM0205 Schematisation and Impacts 0.2 EY and 1% AEP Events

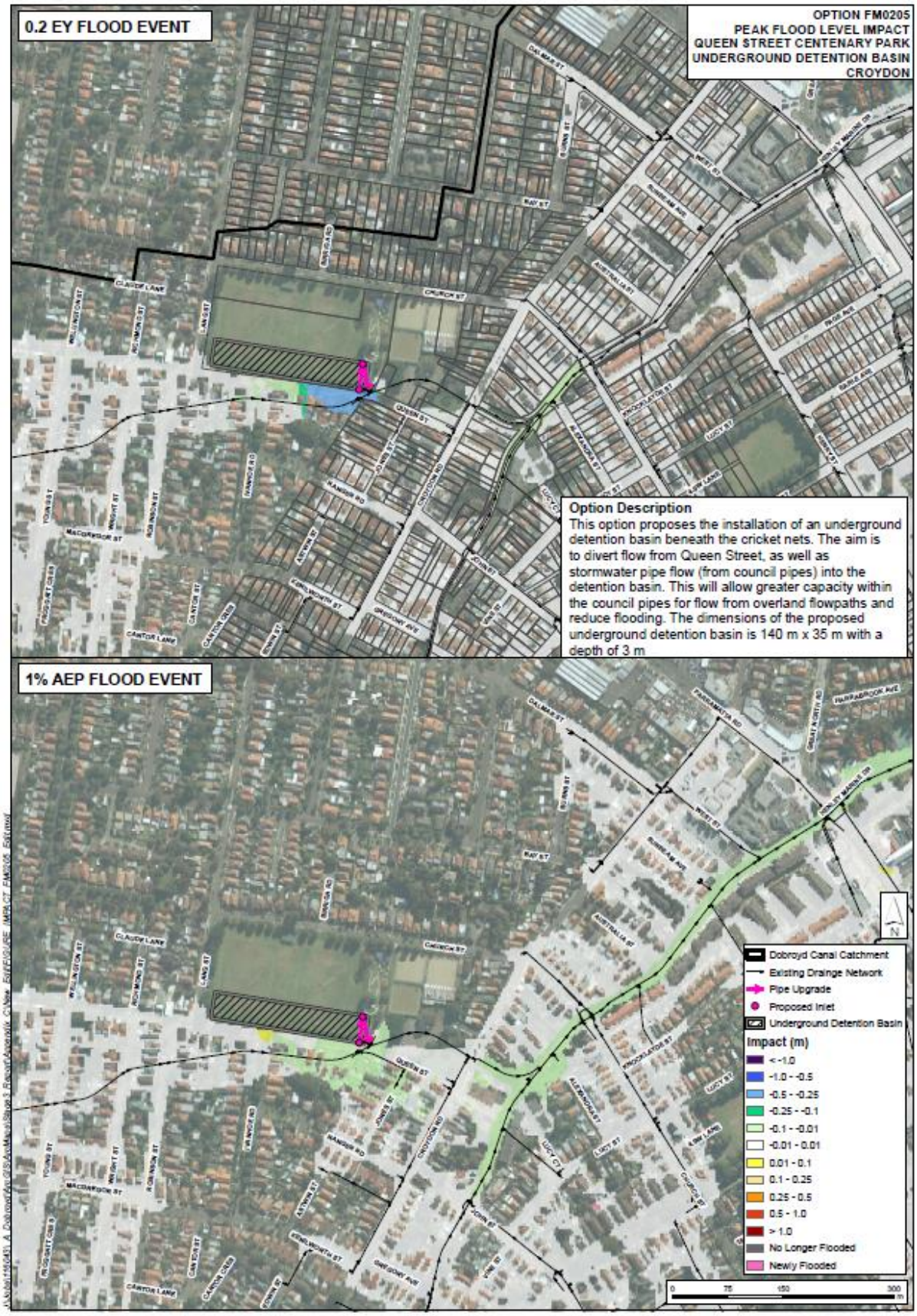


Table 8 – Over floor Property Affectation FM0205

Properties Flooded Over floor			
Event	**Current**	**With Option (FM0205)**	**Change**
0.5EY	23	23	0
0.2EY	66	64	-2
10% AEP	132	137	5
5% AEP	209	209	0 (2)
2% AEP	301	306	5
1% AEP	399	398	-1
PMF	1339	1313	-26

Note: Values in brackets are the number of additional properties inundated over floor during that event.

The limited extent of reduced peak flood levels results in a mixture of increases and decreases in the number of properties inundated over floor in the Dobroyd Canal catchment. As a result, this option is not recommended for further consideration.

A.3. Hotspot D03 – Brown Street, Ashfield

Four options were considered for this location, an underground detention basin and three drainage upgrades.

A.3.1. Option FM0301B, FM0302B: Brown Street Drainage Upgrade

These three options proposed various combinations of drainage upgrade in Brown Street and Elizabeth Street, as described below. Earlier iterations of FM0301B and FM0302B, FM0301 and FM0302 were also assessed and discarded.

Option	Configuration
FM0301B	Increase the feeder pipes in Brown Street to 0.3 m
FM0302B	Upgrade of the existing Council pipes (from 1.2 m x 0.9 m box culverts) to 2.4 m x 0.9 m box culverts from Bland Street (beneath the railway), along Elizabeth Street to Dobroyd Canal. The aim is to allow overland flow to escape more readily.

Diagram A10 and Diagram A11 show the schematisation of the options and their impact on peak flood levels for the 0.2 EY and 1% AEP events for Option FM0301B and Option FM0302B

Diagram A10: Option FM0301B Schematisation and Impacts 0.2 EY and 1% AEP Events

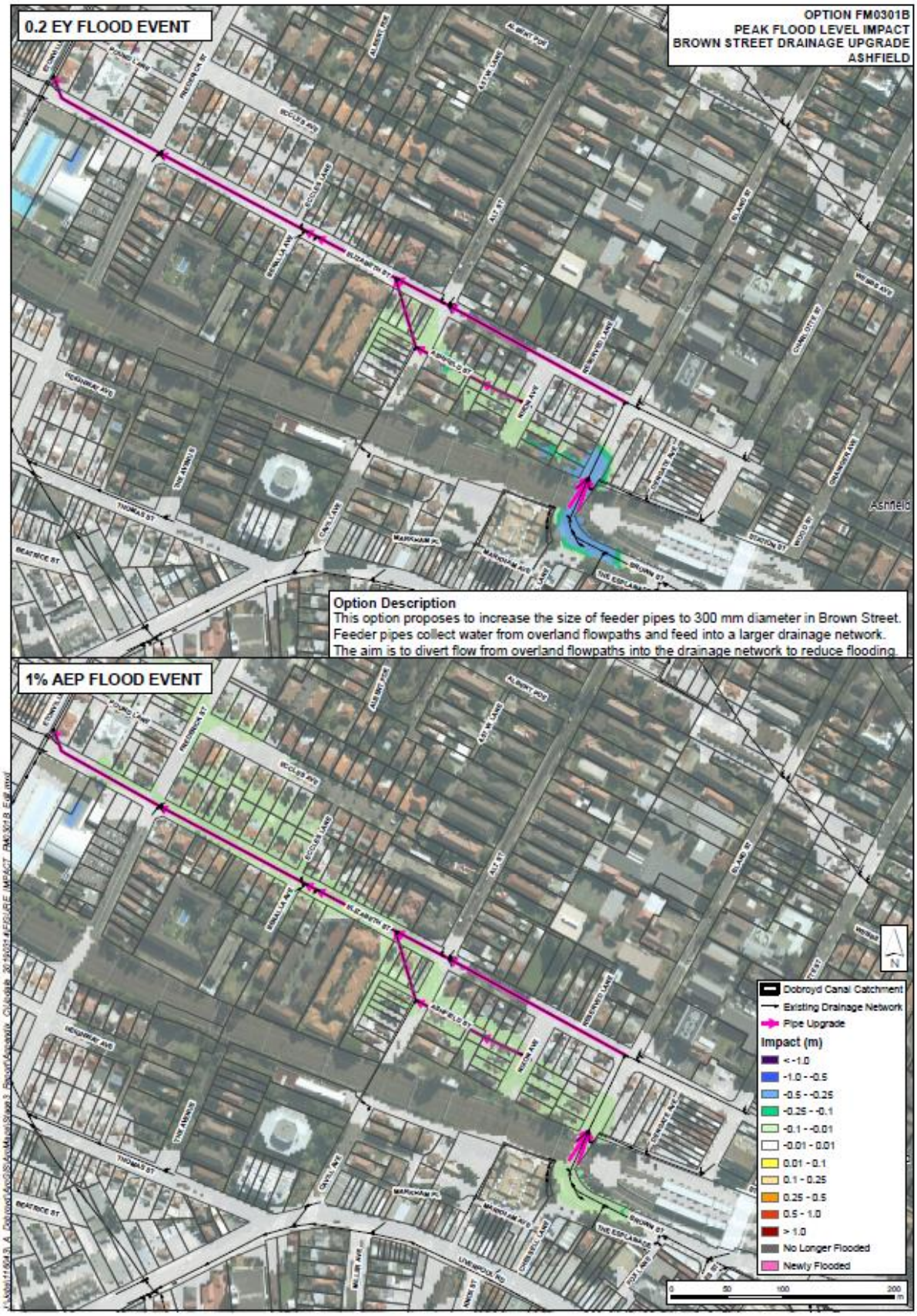
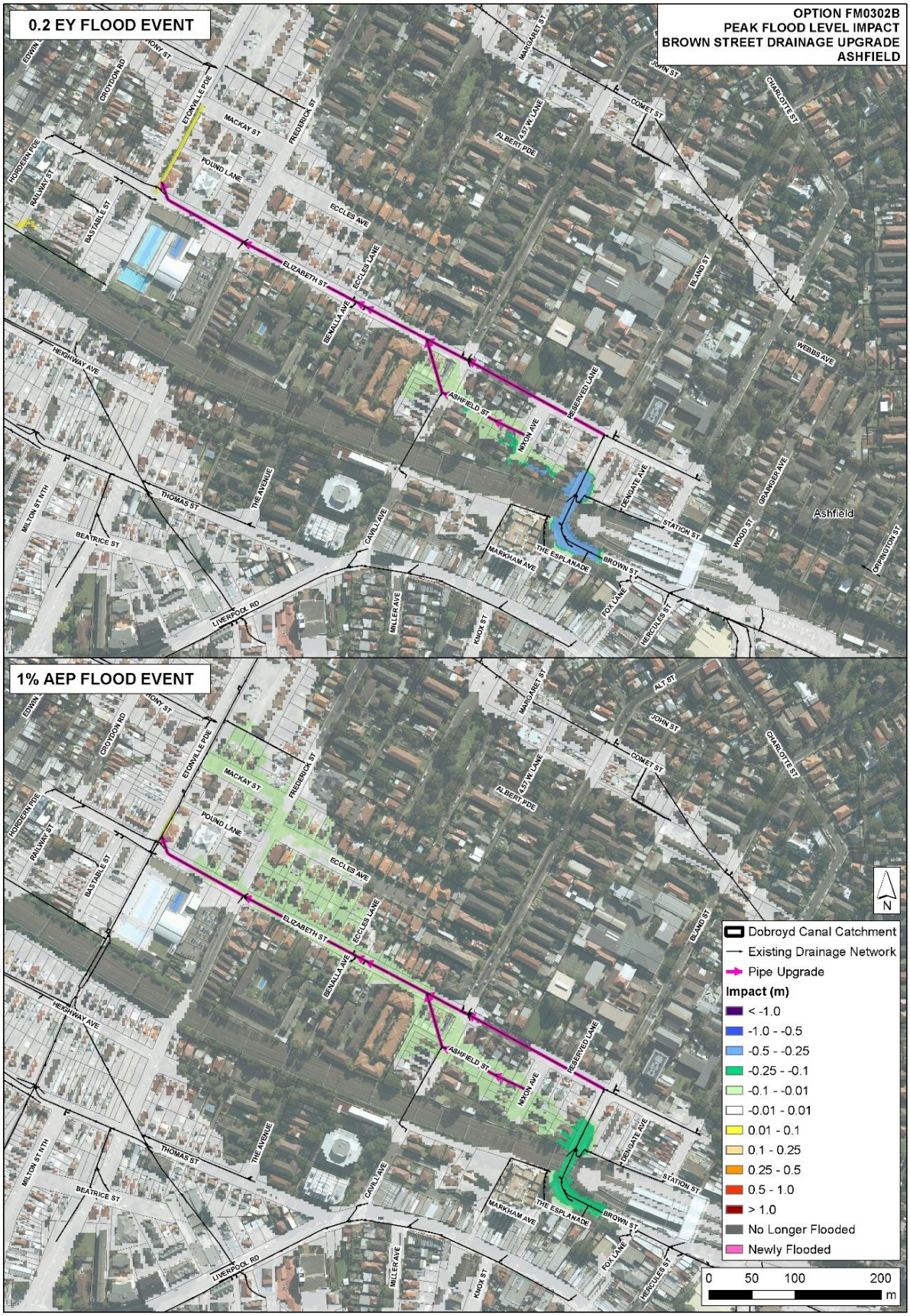


Diagram A11: Option FM0302B Schematisation and Impacts 0.2 EY and 1% AEP Events



In the 0.2 EY event for FM0301B, peak flood levels decrease by up to 0.5 m along Brown Street, under the railway as well as decreasing by up to 0.1 m along the flowpath between Brown Street and Ashfield Street. Existing depths in Brown Street are in excess of 1.5 m and 2.0 m in the 0.2EY and 1% AEP, respectively. In the 1% AEP event, reduction in peak levels of up to 0.1 m are shown along Brown Street and Elizabeth Street, in comparison to an existing depth of around 0.3 m. The option results in a minor overall decrease to property affectation, with additional properties inundated over floor in the 2% and 5% AEP events (Table 9).

Table 9 – Over floor Property Affectation FM0301B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0301B)**	**Change**
0.5EY	23	22	-1
0.2EY	66	65	-1
10% AEP	132	130	-2
5% AEP	209	208	-1 (2)
2% AEP	301	300	-1 (3)
1% AEP	399	399	0
PMF	1339	1339	0

Note: Values in brackets are the number of additional properties inundated over floor during that event.

In the 0.2 EY event for FM0302B, the peak flood levels decrease by up to 0.5m along Brown Street, under the railway. Decreases in flood levels of 0.1 m are also observed along the flowpath between Brown Street and Ashfield Street. In the 1% AEP event, there is a smaller change in peak flood levels with flood levels decreasing by up to 0.25 m along Brown Street and up to 0.1 m downstream of Brown Street towards Dobroyd Canal. The option results in a minor overall decrease to property affectation, with additional properties inundated over floor in the 2% and 5% AEP events (Table 10).

Table 10 – Over floor Property Affectation FM0302B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0302B)**	**Change**
0.5EY	23	22	-1
0.2EY	66	65	-1
10% AEP	132	130	-2
5% AEP	209	208	-1 (2)
2% AEP	301	302	1 (3)
1% AEP	399	398	-1
PMF	1339	1339	0

Note: Values in brackets are the number of additional properties inundated over floor during that event.

The limited extent of reduced peak flood levels for both options results in a mixture of increases and decreases in the number of properties inundated over floor in the Dobroyd Canal catchment. As a result of the minor impact on flood behaviour these options are <u>not recommended</u> for further consideration.

A.3.2. Option FM0303: Brown Street Underground Detention Basin

This option comprises of an under-road detention basin in Brown Street. The aim is to detain water during smaller rainfall events and reduce flood levels in the vicinity of Bland Street and the downstream flow path along Elizabeth Street. Its purpose is to temporarily store water during frequent rainfall events and discharge the flow at a later time where the outflow is regulated through flow-control structures.

The option includes directing water from an existing Council owned box culvert (1.2 m x 0.9 m) along Brown Street (under the railway line) into a detention basin (dimensions L 75 m x W 10 m x H 1.8 m) beneath Brown Street, just north of the railway line to the intersection of Elizabeth Street. A small 150 mm diameter pipe at the detention basin outlet would pass water back into the existing pipe network where it travels along Elizabeth Street before joining with Dobroyd Canal.

Diagram A12 shows the schematisation of the option and the impact on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, there is a reduction in peak flood levels of up to 0.25 m along Brown Street, under the railway, and decreases of up to 0.1 m along the flowpath between Brown Street and Ashfield Street. Existing depths in Brown Street are in excess of 1.5 m and 2.0 m in the 0.2EY and 1% AEP, respectively. In the 1% AEP event, there is a smaller change in peak flood levels, decreasing by up to 0.1 m from Brown Street downstream to Dobroyd Canal. The option results in a minor overall decrease to property affectation, with additional properties inundated over floor in the 2% and 5% AEP events (Table 11).

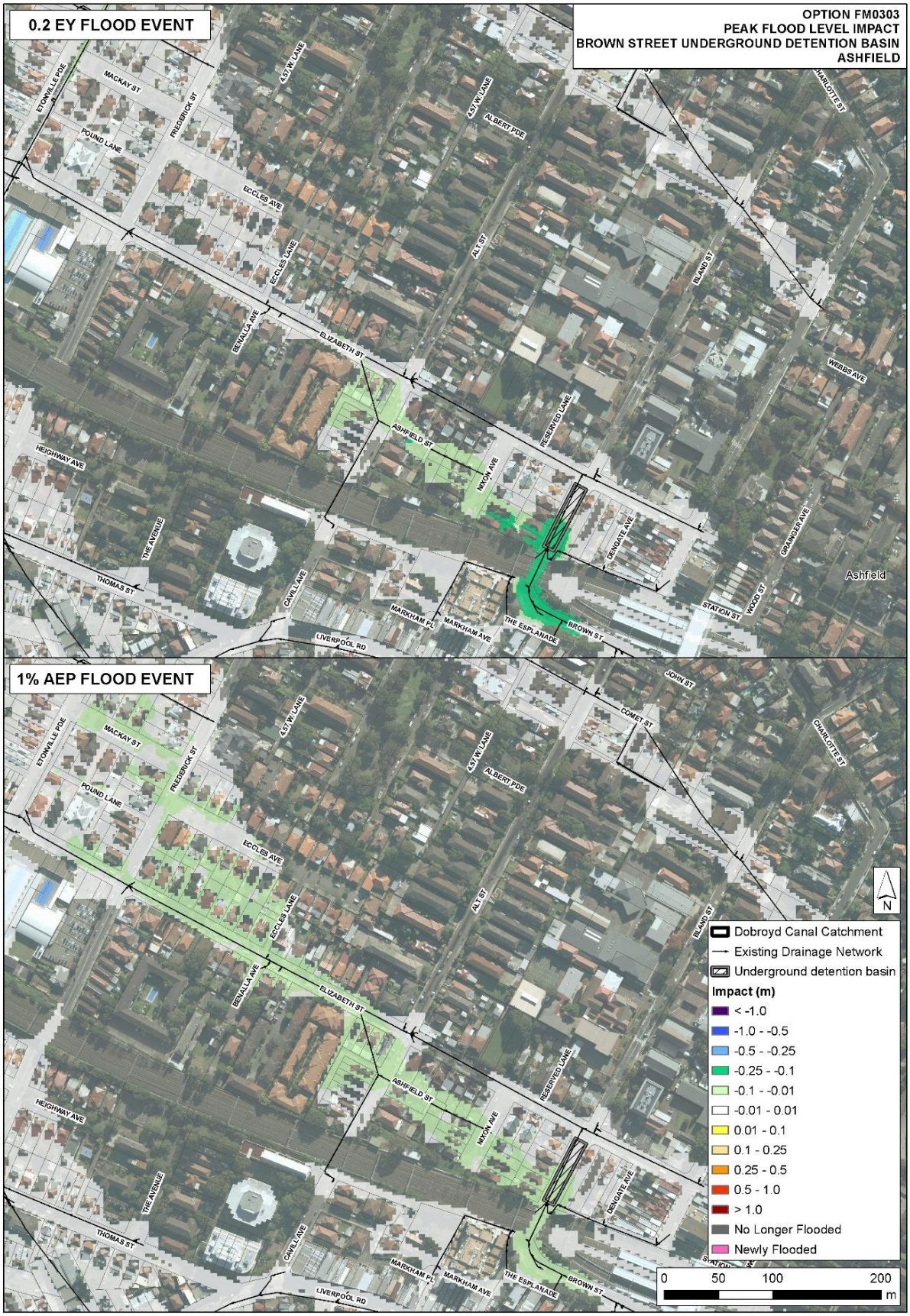
Table 11 – Over floor Property Affectation FM0303

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0303)**	**Change**
0.5EY	23	23	0
0.2EY	66	65	-1
10% AEP	132	131	-1
5% AEP	209	209	0 (2)
2% AEP	301	303	2 (3)
1% AEP	399	399	0
PMF	1339	1339	0

Note: Values in brackets are the number of additional properties inundated over floor during that event.

The limited extent of reduced peak flood levels would result in limited change to property affectation in the Dobroyd Canal catchment. As a result of the minor impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram A12: Option FM0303 Schematisation and Impacts 0.2 EY and 1% AEP Events



A.4. Hotspot D06 – Algie Park, Haberfield

A.4.1. Option FM0601B: Algie Park Detention Basin, Levee and Drainage Upgrade

This option proposes the extension of an existing concrete levee in Algie Park, running along the western boundary of the park, to increase storage capacity of an existing above-ground detention basin. The aim is to reduce excess flow from properties on Ramsay Street and Alt Street. The proposed design for the extended concrete levee includes the installation of a 1 m high concrete levee for a length of 53 m along the east boundary of 197 Ramsay Street. This will join with the existing levee. The majority of Algie Park has ground levels (around 5.25 m AHD) lower than the surrounding residential properties (at around 7 m AHD). The extension of the levee wall allows a larger portion of the park to be used as an above-ground detention basin.

An earlier iteration of FM0601B, FM0601 was also assessed and discarded. As an alternative an underground detention basin was also considered, FM0602, however was found to result in no change in flood behaviour and was discarded.

Diagram A13 shows the schematisation of the option and the impact on peak flood levels for the 0.2 EY and 1% AEP events.

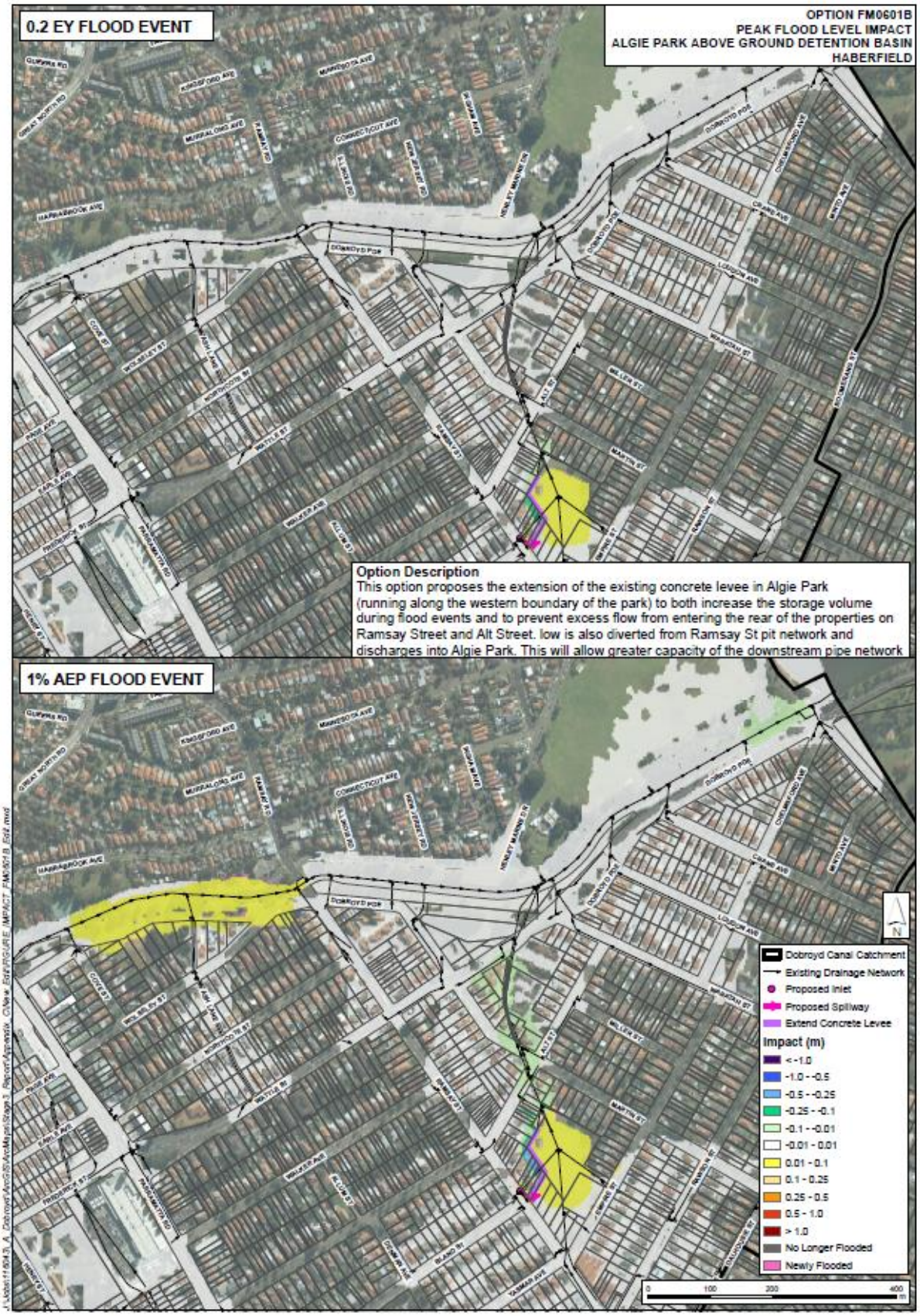
In the 0.2 EY event, there is a minor reduction in peak flood levels up to 0.2 m (in comparison to existing depths of 0.4 m) within the rear backyards of properties along Ramsay Street that back onto the proposed levee. Minor decreases up to 0.1 m are observed directly downstream. In the 1% AEP event, similar decreases to the 0.2 EY event are observed, however, the decrease in flood levels extends to Dobroyd Canal and existing depths through the backyards are up to 0.8 m under existing conditions . In addition during the 1% AEP event the change to flow timing as a result of the option causes an increase in flood levels through the Dobroyd Parade branch and subsequently increases property affection (Table 12).

Table 12 – Over floor Property Affectation FM0601

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0601)**	**Change**
0.5EY	23	23	0
0.2EY	66	66	0
10% AEP	132	132	0
5% AEP	209	211	2
2% AEP	301	304	3
1% AEP	399	399	0
PMF	1339	1341	2

The limited, and in some locations, increase in peak flood levels would result worsening of property affectation in the Dobroyd Canal catchment. As a result this option is <u>not recommended</u> for further consideration.

Diagram A13: Option FM0601B Schematisation and Impacts 0.2 EY and 1% AEP Events



A.5. Dobroyd Canal - Other

Three options were considered, an above and an underground detention basin at Pratten Park, and an underground detention basin on Arthur Street.

A.5.1. Option FM0701, FM0701B: Pratten Park Detention Basins

These options are based on detention basins in Pratten Park. FM0701 proposes an above ground basin and FM0701B an underground basin.

Option	Configuration
FM0701	The aim is to divert overland flow as well as stormwater pipe flow from the existing Council owned pipes (0.9 m diameter) at the southern boundary of Pratten Park into a detention basin (dimensions L130 m x W 80 m x H 1.2 m) beneath Pratten Park. A small 150 mm diameter pipe at the detention basin outlet would pass water back into the existing pipe (0.75 m diameter). This option also includes removing an existing 0.9 m pipe under Pratten Park.
FM0701B	Installation of an above ground detention basin in Pratten Park. The aim is to divert flow during rainfall events to the detention basin. This allows greater capacity for flow from overland flowpaths to enter the pipe network and to reduce flooding down to Dobroyd Canal.

Diagram A14 and Diagram A15 show the schematisation of the options and their impact on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY and 1% AEP events for FM0701, the peak flood levels decrease by up to 0.1 m between the proposed detention basin and Dobroyd Canal, in comparison to existing depths between 0.4 m and 0.7 m and 0.7 m and 1.5m, in the 0.2EY and 1% AEP respectively. In the 0.2 EY and 1% AEP event, 9 and 18 properties respectively are no longer flooded above floor level and there is a broad reduction in properties impacted (Table 13).

Table 13 – Over floor Property Affectation FM0701

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0701)**	**Change**
0.5EY	23	22	-1
0.2EY	66	57	-9
10% AEP	132	112	-20
5% AEP	209	192	-17
2% AEP	301	289	-12
1% AEP	399	381	-18
PMF	1339	1332	-7

In the 0.2 EY and 1% AEP events for FM0701B, the peak flood levels decrease by up to 0.1 m between the proposed detention basin and Dobroyd Canal.

Whilst there is an improvement to flooding behaviour with a number of properties no longer being flooded above floor level, there are large costs associated with the construction as well as the social disruption (the park would be out of commission for a long period of time), this option is not recommended for further consideration. An option combining a basin in Pratten Park and addition storage in Arthur Street (FM0703 – Section 10.2.9.6) was found to offer greater benefits and is assessed further.

Diagram A14: Option FM0701 Schematisation and Impacts 0.2 EY and 1% AEP Events

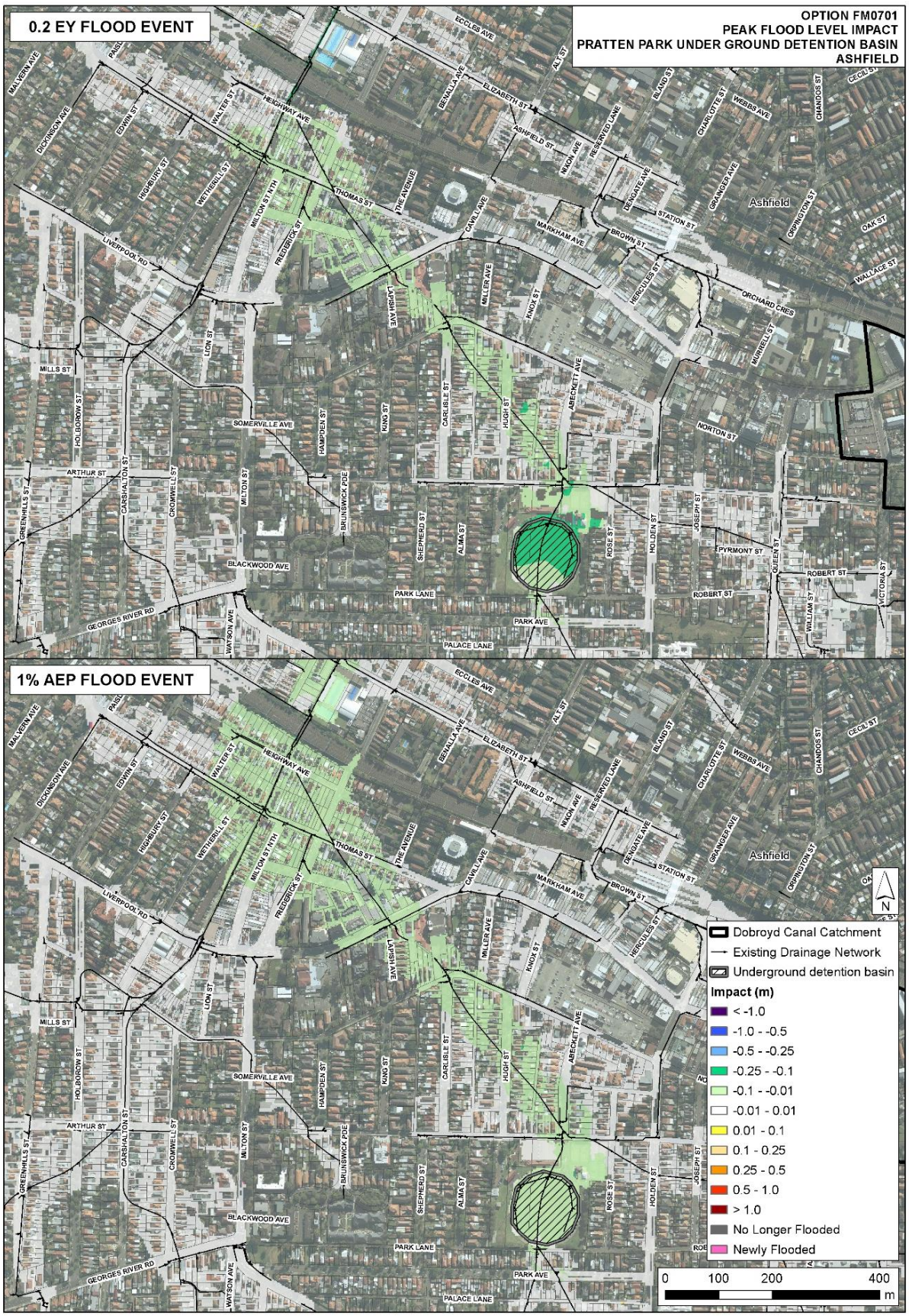
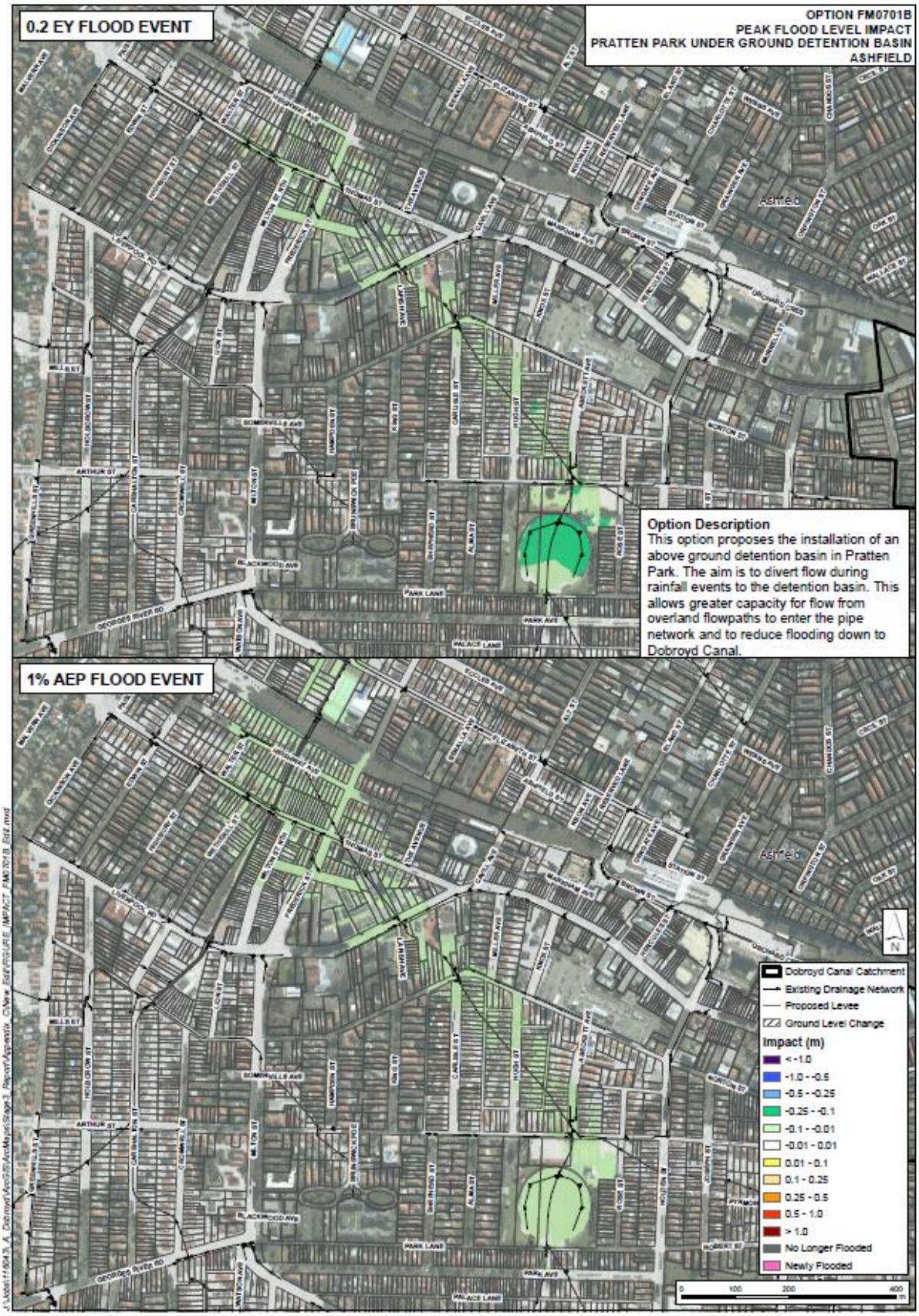


Diagram A15: Option FM0701B Schematisation and Impacts 0.2 EY and 1% AEP Events



A.5.2. Option FM0702: Arthur Street Underground Detention Basin

This option proposes the installation of a detention basin beneath the tennis courts along Arthur Street. The aim is to divert overland flow as well as stormwater pipe flow into the basin. This allows greater capacity for flow from overland flow paths to enter the pipe network to reduce overland flooding down to Dobroyd Canal.

The option includes directing water from an existing SWC owned pipe (1 m diameter) at the eastern boundary of the tennis courts into a 1.2 m diameter pipe before discharging into a detention basin (dimensions L 70 m x W 40 m x H 3 m) beneath the tennis courts. A small 150 mm diameter pipe at the detention basin outlet would pass water back into the existing pipe (1 m diameter pipe).

Diagram A16 shows the schematisation of the option and the impact on peak flood levels for the 0.2 EY and 1% AEP events.

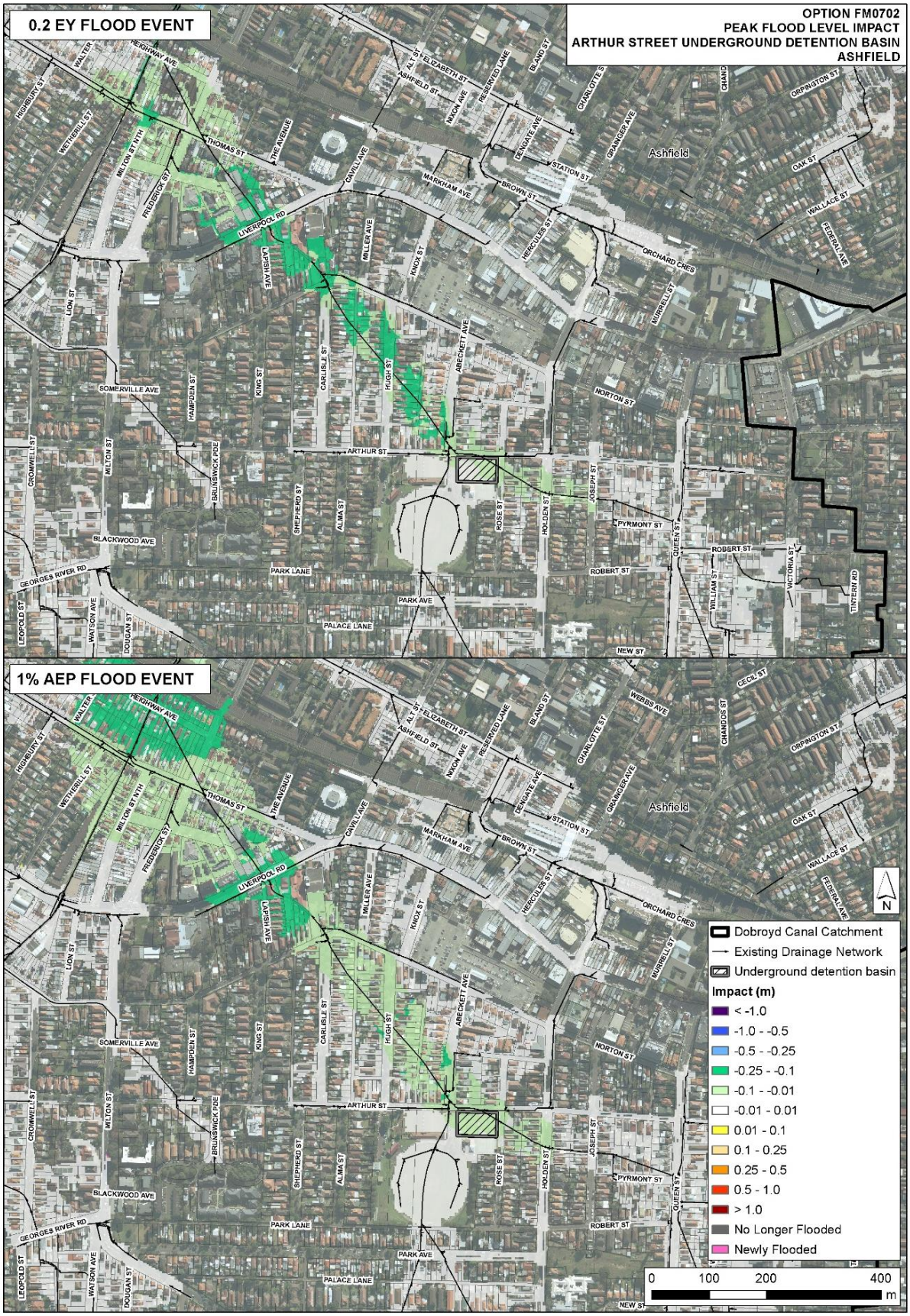
In the 0.2 EY event, the peak flood levels typically decrease by 0.15 m downstream of the proposed detention basin to Dobroyd Canal. In the 1% AEP event, the peak flood levels decrease by up to 0.1 m along the flowpath downstream. In comparison the existing depths along this flowpath are between 0.4 m and 0.7 m and 0.7 m and 1.5m, in the 0.2EY and 1% AEP respectively. At Liverpool Road and Heighway Avenue, the decreases in flood levels are in the order of 0.15 m in comparison to 0.5m and 1.5m existing depth. In the 0.2 EY event and 1% AEP event, 17 and 24 properties respectively are no longer flooded above floor and there is a broad reduction in properties impacted (Table 14).

Table 14 – Over floor Property Affectation FM0702

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0702)**	**Change**
0.5EY	23	19	-4
0.2EY	66	49	-17
10% AEP	132	102	-30
5% AEP	209	179	-30
2% AEP	301	277	-24
1% AEP	399	375	-24
PMF	1339	1328	-11

Whilst there is an improvement to flooding behaviour with a number of properties no longer being flooded above floor level, there are large costs associated with the construction, acquisition of the site as it is currently not a Council owned asset as well as the social disruption (road closures), this option is <u>not recommended</u> for further consideration. An option combining addition storage in Arthur Street with a basin in Pratten Park (FM0703 – Section 10.2.9.6) was found to offer greater benefits and is assessed further.

Diagram A16: Option FM0702 Schematisation and Impacts 0.2 EY and 1% AEP Events



Part B: HAWTHORNE CANAL PRELIMINARY OPTION ASSESSMENT

B.1. Hotspot H01 – Queen Street to Hawthorne Canal (Ashfield)

B.1.1. FM0101A Yeo Park (North of Primary School) Detention Basin

This option proposes a new 750 mm diameter pipe beginning in Queen Street where water from an existing Council owned pipe is diverted into the new pipe that travels along Harland Avenue and across Victoria Street to the north-east corner of Yeo Park. Water is then diverted to a detention basin (dimensions L 80 m x W 80 m x H 4.0 m) beneath Yeo Park running parallel to Victoria Street. A small 150 mm diameter pipe at the detention basin outlet transfers flow from the detention basin into an existing 450 mm Council owned pipe network located at the south-east of the memorial in Yeo Park.

The aim of diverting flow into the detention basin is to increase the capacity of the existing drainage network to enable more surface flow and reduce the flood levels.

Diagram B1 shows the schematisation of the option and their impacts on peak flood levels for the 0.2 EY and 1% AEP events.

The required invert levels along Harland Street (a minimum pipe invert of 40.5 m AHD) for the proposed pipe along Harland Street would require approximately a 6 m deep trench to be dug for construction.

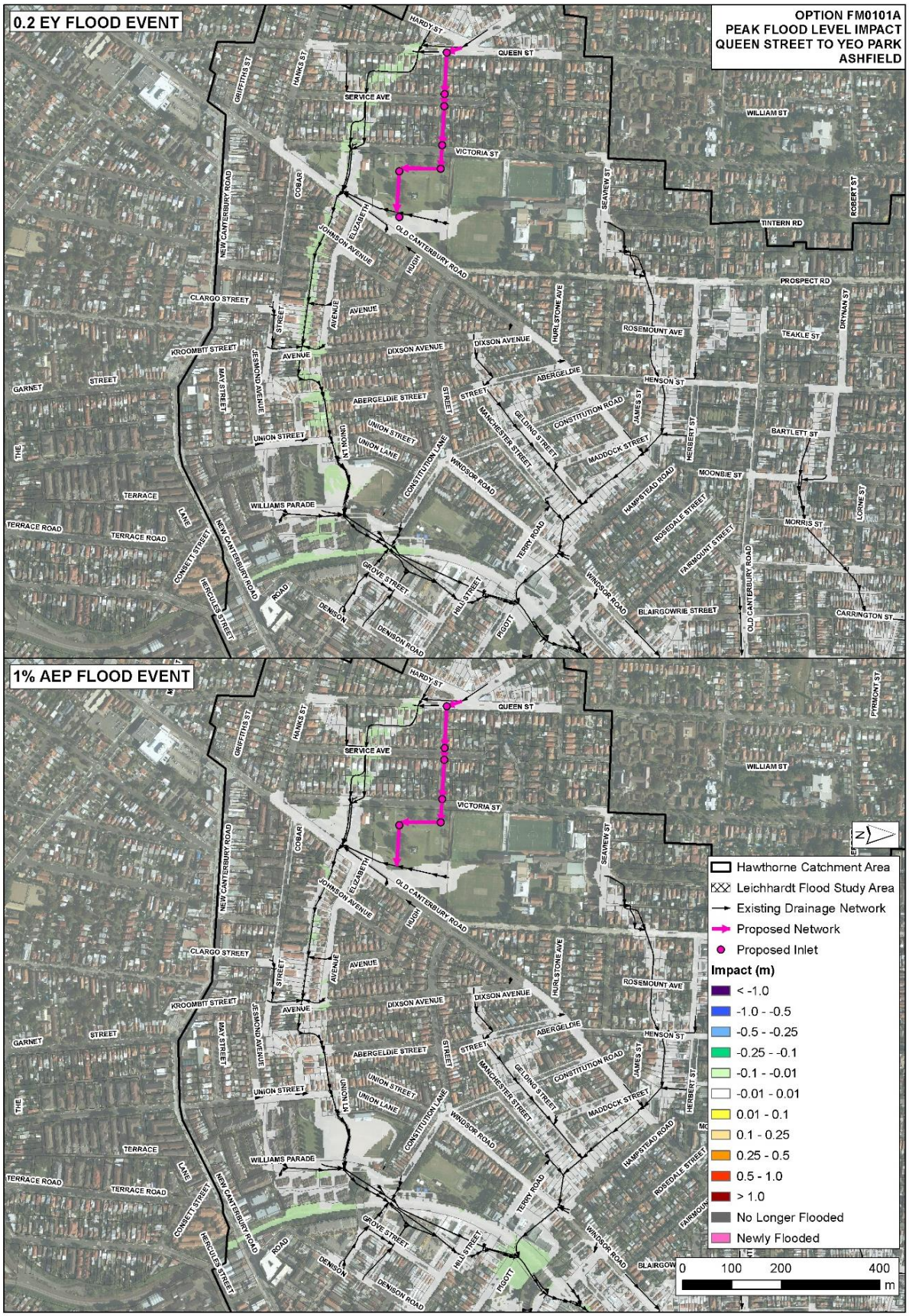
In the 0.2 EY event, there is a reduction in flood levels along the flowpath from between Queen Street and Hawthorne Canal of up to 0.1 m, in comparison to existing depths of between 0.2 m and 0.6 m. There is no change to the number of properties affected by flooding during this event. In the 1% AEP event, peak flood levels decrease by up to 0.1 m between Queen Street and Victoria Street with small pockets of minor decreases located along the downstream flowpath. Existing depths in the 1% AEP event are between 0.5 m and 0.8 m.

There would be some, albeit limited, benefit to property over floor affection in the area (Table 15) however this would be marginal (and thus limited changes to the estimated AAD), especially when considering the significant construction associated with deep trenching. In order to achieve a BCR of less than 1.0, this option would need to be costed at less than $400,000. As a result of the minor impact on flood behaviour and the likely costs, this option is <u>not recommended</u> for further consideration.

Table 15 – Over floor Property Affectation FM0101A

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0101A)**	**Change**
0.5EY	12	12	0
0.2EY	37	37	0
10% AEP	53	52	-1
5% AEP	75	75	0
2% AEP	100	99	-1
1% AEP	120	119	-1
PMF	537	512	-25

Diagram B1: Option FM0101A Schematisation and Impacts 0.2 EY and 1% AEP Events



B.1.2. FM0101B Drainage Upgrade Queen Street to Yeo Park

This option proposes a new 750 mm diameter pipe beginning in Queen Street where water from an existing Council owned pipe is diverted into the new pipe that travels along Harland Avenue and discharges into Yeo Park (north west corner) where an above-ground detention basin would temporarily stores flood water. The above ground-detention basin is formed by raising the ground levels along the current pedestrian walkway running parallel to Victoria Street and then turning east running from Victoria Street to Old Canterbury Road and then travelling north parallel to Old Canterbury Road. The total length of the raised ground is 330 m. A small 150 mm pipe would slowly discharge flood waters from the detention basin into an existing 450 mm Council owned pipe network located at the south east of the memorial in Yeo Park.

The required invert levels along Harland Street (a minimum pipe invert of 40.5 m AHD) for the proposed pipe along Harland Street would require approximately a 6 m of trench to be dug for construction which is not feasible.

Diagram B2 shows the schematisation of the option and their impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, there is a decrease in flood levels of up to 0.1 m from Queen Street extending down to Old Canterbury Road, in comparison to existing depths of between 0.2 m and 0.6 m. Small areas of increased flood levels (up to 0.05 m) and newly flooded areas are observed downstream within the road corridor of Fred Street and adjacent areas (enters properties). In the 1% AEP event, the majority of flood levels between Queen Street and Old Canterbury Road decrease by up to 0.1 m, in comparison to existing depths up to 0.8 m. Decreases in flood levels of up to 0.2 m are observed between Fred Street and Old Canterbury Road including on a number of properties.

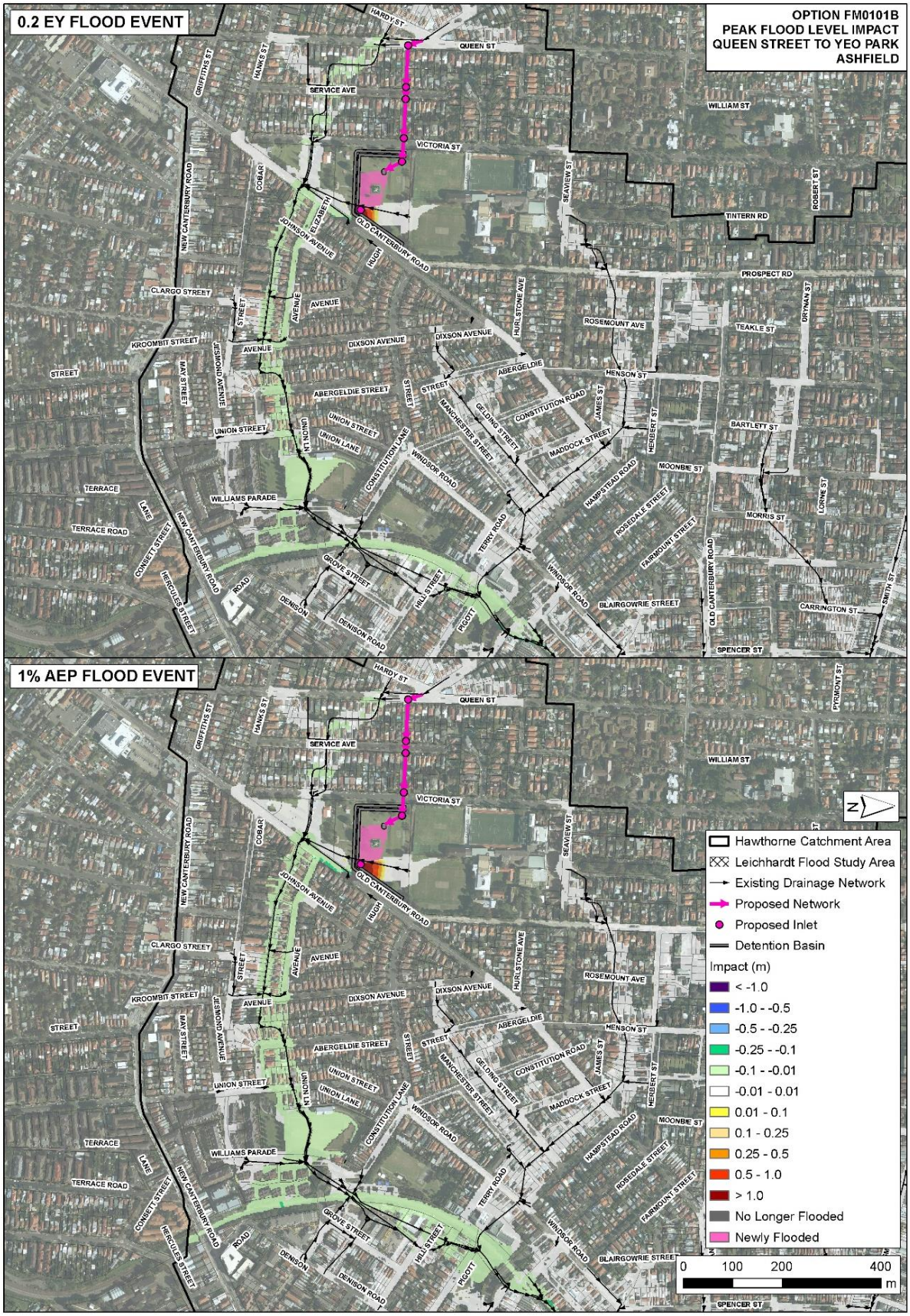
The numbers of properties that become no longer flood affected are 1 and 2 for the 0.2 EY and 1% AEP events respectively (Table 16).

Table 16 – Over floor Property Affectation FM0101B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0101B)**	**Change**
0.5EY	12	12	0
0.2EY	37	36	-1
10% AEP	53	52	-1
5% AEP	75	73	-2
2% AEP	100	99	-1
1% AEP	120	118	-2
PMF	537	531	-6

There would be some, albeit limited, benefit to property over floor affection in the area (Table 16) however this would be marginal (and thus limited changes to the estimated AAD), especially when considering the significant construction associated with deep trenching. In order to achieve a BCR of less than 1.0, this option would need to be costed at less than $490,000. As a result of the minor impact on flood behaviour and the likely costs, this option is <u>not recommended</u> for further consideration.

Diagram B2: Option FM0101B Schematisation and Impacts 0.2 EY and 1% AEP Events



B.1.3. FM0102A Yeo Park (South of Primary School) Detention Basin

This option proposes to utilise Yeo Park (south of the primary school) as an above-ground detention basin. The aim is to reduce flow along the downstream flowpath. The proposed design is to excavate an area of 275 m^2 to a ground level of 34.75 m AHD. The current ground levels are approximately 35.2 m AHD (just to the south of the primary school) and slope up to approximately 38 m AHD at the southern side of the proposed basin. Overland flow from Victoria Street is directed into the basin at the north-west corner of the basin where a 150 mm outlet pipe would slowly discharge water into the existing 1 m pipe.

Diagram B3 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

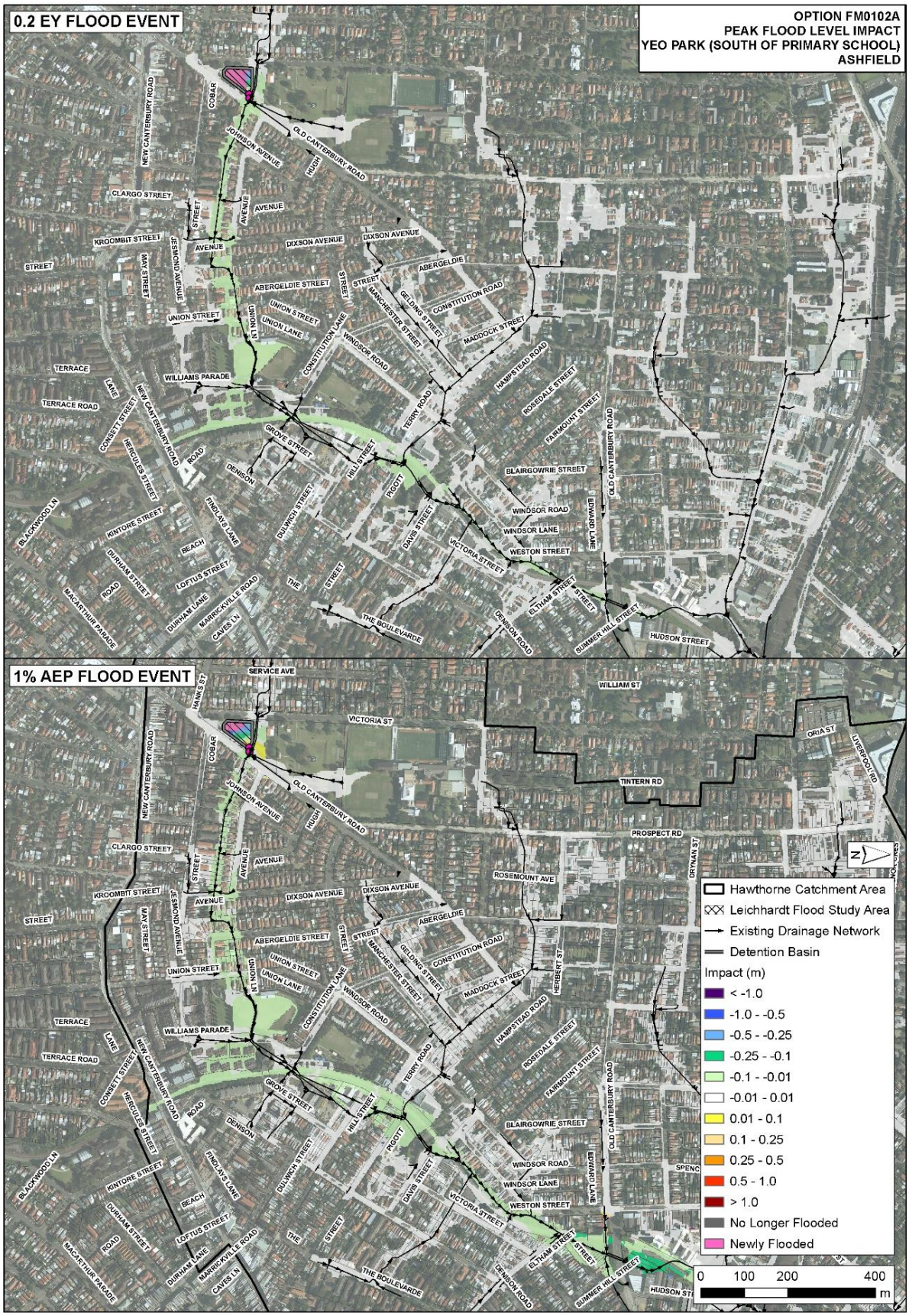
In the 0.2 EY and 1% AEP event, the peak flood levels decrease by up to 0.1 m for the flowpath extending downstream to Old Canterbury Road affecting a number of properties including adjacent to the Canal. This reduction is in comparison to existing depths of between 0.2 m and 0.6 m. One property is no longer affected above floor level for the 0.2 EY event, and two properties in the 1% AEP (Table 17). There is no adverse impact to Yeo Park Infants school. However, in the 1% AEP event, there is an increase in flood levels east of the school (between the school and Old Canterbury Road). This presents an increased risk adjacent to the school.

Table 17 – Over floor Property Affectation FM0102A

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0102A)**	**Change**
0.5EY	12	12	0
0.2EY	37	36	-1
10% AEP	53	52	-1
5% AEP	75	74	-1
2% AEP	100	99	-1
1% AEP	120	118	-2
PMF	537	513	-24

There would be some, albeit limited, benefit to property over floor affection in the area however this would be marginal (and thus limited changes to the estimated AAD), especially when considering the additional risks due to flood depths in an area adjacent to an infants school. As a result of the minor impact on flood behaviour, this option is <u>not recommended</u> for further consideration.

Diagram B3: Option FM0102A Schematisation and Impacts 0.2 EY and 1% AEP Events



B.1.4. FM0103A: Elizabeth Avenue Drainage Upgrade

This option proposes a pipe upgrade beginning at Old Canterbury Road. The proposed 1200 mm diameter pipe would travel north along Old Canterbury Road, before travelling along Elizabeth Avenue, Dixson Avenue and between properties (same location as existing SWC system). The aim is to increase pipe capacity and reduce flooding along the existing overland flowpaths.

Diagram B4 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

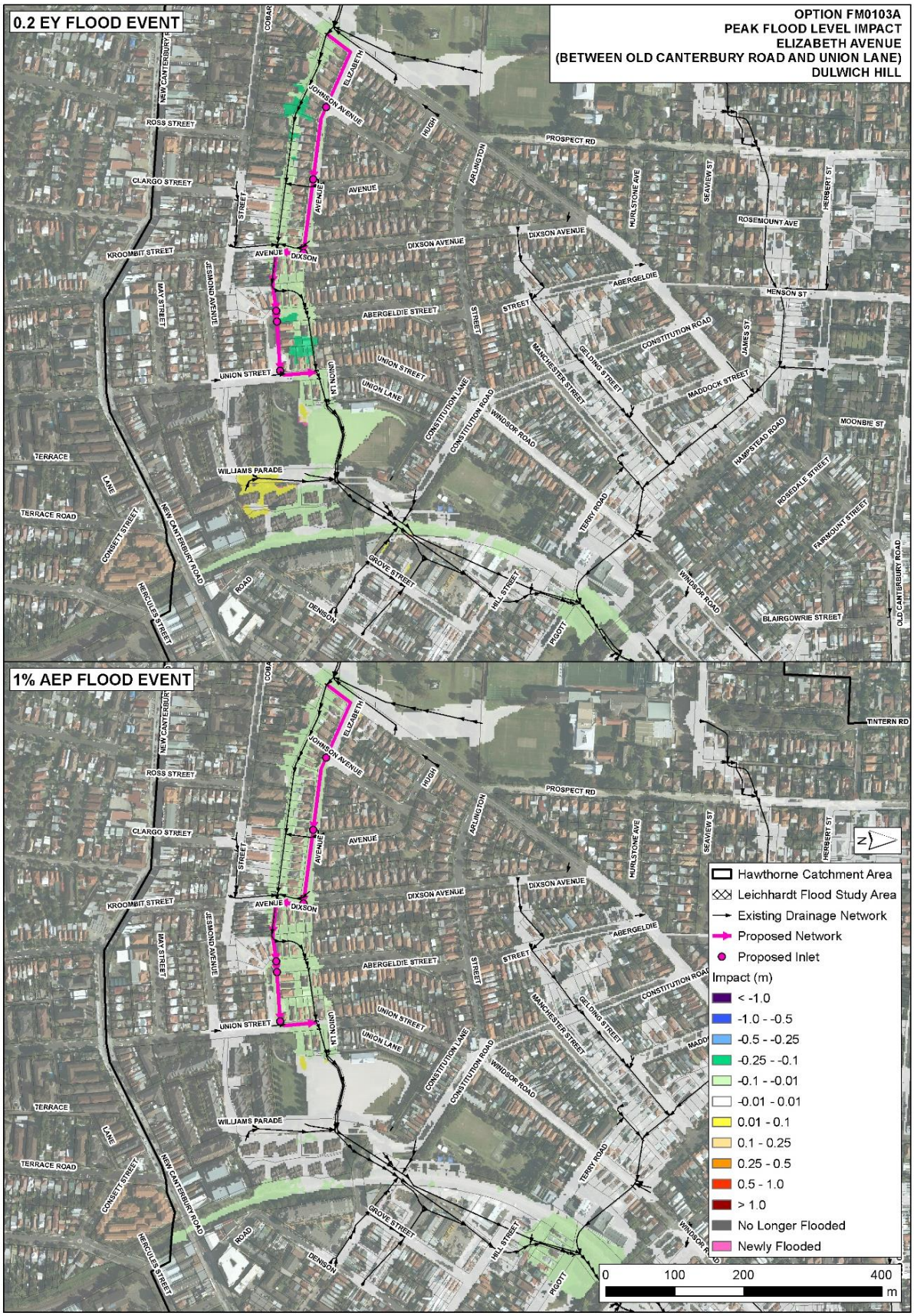
In the 0.2 EY event, the peak flood levels typically decrease by 0.01 to 0.1 m between Old Canterbury Road and Hawthorne Canal, in comparison to existing depths of between 0.2 m and 0.6 m. Several locations are observed to have decreases in flood levels up to 0.25 m including Abergeldie Street and properties between Elizabeth Avenue and Cobar Street. An increase in flood level is observed in the area surrounding Williams Parade (downstream). This is due to stormwater network reaching capacity earlier upstream due to the proposed pipe network preventing flow around Williams Parade entering the stormwater system. In the 1% AEP event, peak flood levels typically decrease by up to 0.1 m between Old Canterbury Road and Union Lane, in comparison to existing depths of up to 0.8m. One property becomes not flood affected above floor in both the 0.2EY and 1% AEP event (Table 18).

Table 18 – Over floor Property Affectation FM0103A

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0103A)**	**Change**
0.5EY	12	11	0
0.2EY	37	36	-1
10% AEP	53	52	-1
5% AEP	75	74	-1
2% AEP	100	99	-1
1% AEP	120	119	-1
PMF	537	535	-2

As a result of the negligible impact on flood behaviour and substantial costs this option is <u>not recommended</u> for further consideration.

Diagram B4: Option FM0103A Schematisation and Impacts 0.2 EY and 1% AEP Events



B.1.5. FM0104C & FM0104D: Arlington Recreation Grounds Detention Basin

These two options are based on utilising Arlington Recreation Grounds as an above-ground detention basin during flood events. For both options, the proposed design includes replacing the existing metal fence that is along the eastern boundary (parallel to Williams Parade) with a 0.6 m high impermeable wall. The wall would extend from the club house at the north-east corner of the site (as seen in Photo 1) and continue along the eastern boundary and approximately 25 m along the southern boundary. A wall height of 0.6 m would ensure that the club house is not affected above floor by inundation.

Photo 1 – Arlington Recreational Grounds - existing fence and club house along the eastern boundary

A ramp for roadway access to the grounds would be located at the current location (south east boundary of the site). Option FM0104C would have a permanent ramp, extending from Williams Parade up to 0.6 m above ground level to line up with the impermeable wall. Two other ramp heights of 0.15 m and 0.3 m were also assessed which produced no benefit mainly due to reduced storage and were not further considered. In option FM0104D a flood gate is also considered at the same location as the roadway. The floodgate would be triggered, and the fence would close, during events greater than the 5% AEP event. In both of these scenarios, the total storage available is approximately 8,300m^3. A floodgate has the potential for failure in floods due to poor maintenance or an unforseen issue arising during the event.

Diagram B5 and Diagram B6 show the schematisation of the options and their impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event for FM0104C, peak flood levels decrease by up to 0.1 m downstream of the proposed detention basin in comparison to existing depths of up to 0.5 m. In the 1% AEP event, the decrease in flood levels is more significant, with flood levels within Hawthorne Canal and adjacent properties decreasing in the order of 0.01 to 0.5 m, in comparison to existing depths of between 0.7 m and 0.9 m. The number of properties no longer affected above floor level is 1 and 2 for the 0.2 EY and 1% AEP events respectively.

In the 0.2 EY event for FM0104D, peak flood levels decrease up to 0.1 m downstream of the proposed detention basin. In the 1% AEP event, the decrease in flood levels is more significant, with flood levels within Hawthorne Canal and adjacent properties decreasing in the order of 0.01 to 0.5 m. The number of properties no longer affected above floor level is 1 and 2 for the 0.2 EY and 1% AEP events respectively (Table 19).

In order to achieve a BCR of less than 1.0, both options would need to be costed at less than $500,000.

Table 19 – Over floor Property Affectation FM0104C and FM0104D

Event	Properties Flooded Overfloor		
	Current	With Option (FM0104C and FM00104D)	Change
0.5EY	12	12	0
0.2EY	37	36	-1
10% AEP	53	51	-2
5% AEP	75	74	-1
2% AEP	100	99	-1
1% AEP	120	118	-2
PMF	537	533	-4

As a result of the negligible impact on flood behaviour, and potential high costs associated with flooding and damaging the turf, this option is not recommended for further consideration.

Diagram B5: Option FM0104C Schematisation and Impacts 0.2 EY and 1% AEP Events

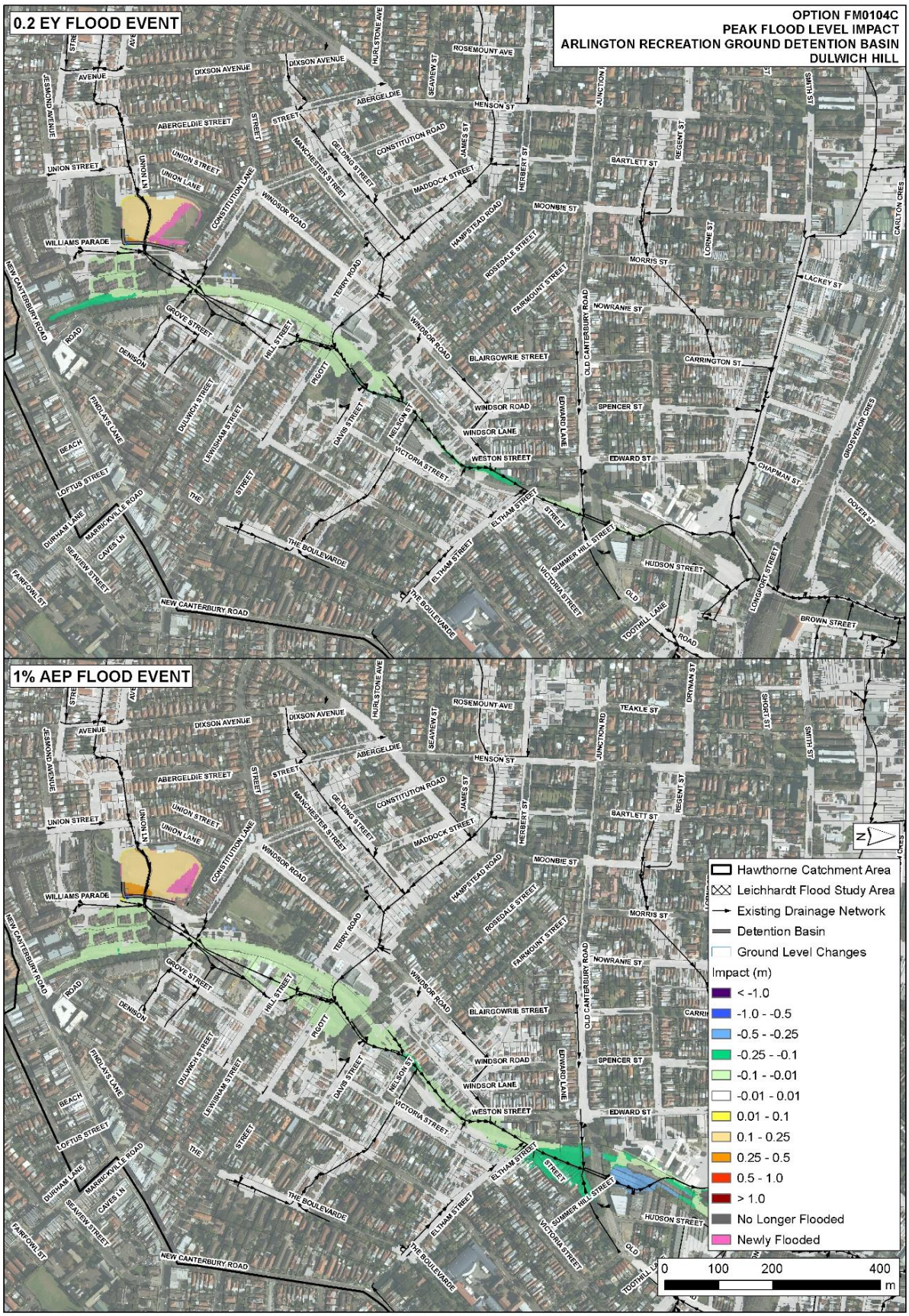


Diagram B6: Option FM0104D Schematisation and Impacts 0.2 EY and 1% AEP Events

B.2. Hotspot H03 – Light Rail Track

B.2.1. FM0301B: The Boulevarde to Hawthorne Canal Drainage Upgrade

This option proposes a pipe duplication of an existing 750 mm diameter pipe extending from The Boulevarde, through Dennis Road and Victoria Street, then into Hawthorne Canal. This option includes modification to the pipe network under the light rail track. The aim is to reduce flooding along The Boulevarde flowpath.

An earlier iteration of option FM0301B, FM0301A was also considered and discarded.

Diagram B7 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, the peak flood levels decrease by up to 0.1 m between The Boulevarde and Hawthorne Canal, in comparison to existing depths up to 0.4 m. Minor decreases are also within Hawthorne Canal. In the 1% AEP event, peak flood levels decrease by up to 0.1 m between The Boulevarde and Hawthorne Canal, in comparison to existing depths up to 0.6 m.

Table 20 – Over floor Property Affectation FM0301B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0301B)**	**Change**
0.5EY	12	12	0
0.2EY	37	37	0
10% AEP	53	53	0
5% AEP	75	75	0
2% AEP	100	100	0
1% AEP	120	120	0
PMF	537	537	0

The limited impact on peak flood levels would result in no change to property affectation (Table 20) in the Hawthorne Canal catchment. As a result of the negligible impact on flood behaviour and high likely costs this option is <u>not recommended</u> for further consideration.

Diagram B7: Option FM0301B Schematisation and Impacts 0.2 EY and 1% AEP Events

B.2.2. FM0302A: The Boulevarde to Hawthorne Canal Underground Detention Basin

This option proposes an under-road detention basin and rain-garden on the road and verge of The Boulevarde. The aim is to detain water within the detention basin, alleviating flooding along The Boulevarde flowpath. The option involves two existing 0.3 m diameter pipes along The Boulevarde discharging flow into a detention basin (dimensions L 42 m x W 10 m x H 1.5 m) beneath the road. A small 150 mm diameter pipe at the detention basin outlet would pass water back into the existing 0.75 m diameter pipe where it continues downstream and eventually discharging into Hawthorne Canal.

Diagram B8 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, the peak flood levels decrease by up to 0.1 m between The Boulevarde and Hawthorne Canal, in comparison to existing depths up to 0.4 m. However, an increase in flood levels is observed within Hawthorne Canal. This is due to flow being discharged into Hawthorne Canal at a later time where it converges with the peak flow from upstream. In the 1% AEP event, there are no discernible impacts on flood levels. This is likely due to the detention basin not having enough capacity.

Table 21 – Over floor Property Affectation FM0302A

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0302A)**	**Change**
0.5EY	12	12	0
0.2EY	37	37	0
10% AEP	53	53	0
5% AEP	75	75	0
2% AEP	100	100	0
1% AEP	120	120	0
PMF	537	533	-4

The limited impact on peak flood levels would result in no change to property affectation in the Hawthorne Canal catchment (Table 21). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B8: Option FM0302A Schematisation and Impacts 0.2 EY and 1% AEP Events

B.2.3. FM0303A: Denison Road to Old Canterbury Road Drainage Upgrade

This option includes a 900 mm diameter pipe beginning at the intersection of Hunter Street and Denison Road, which travels along Dension Road, Hobbs Street and Jubilee Street before connecting to the existing drainage network on Old Canterbury Road. The aim is to divert flow from the surface into the stormwater pipe so flooding is reduced along the overland flowpath between Denison Road and Old Canterbury Road.

Diagram B9 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

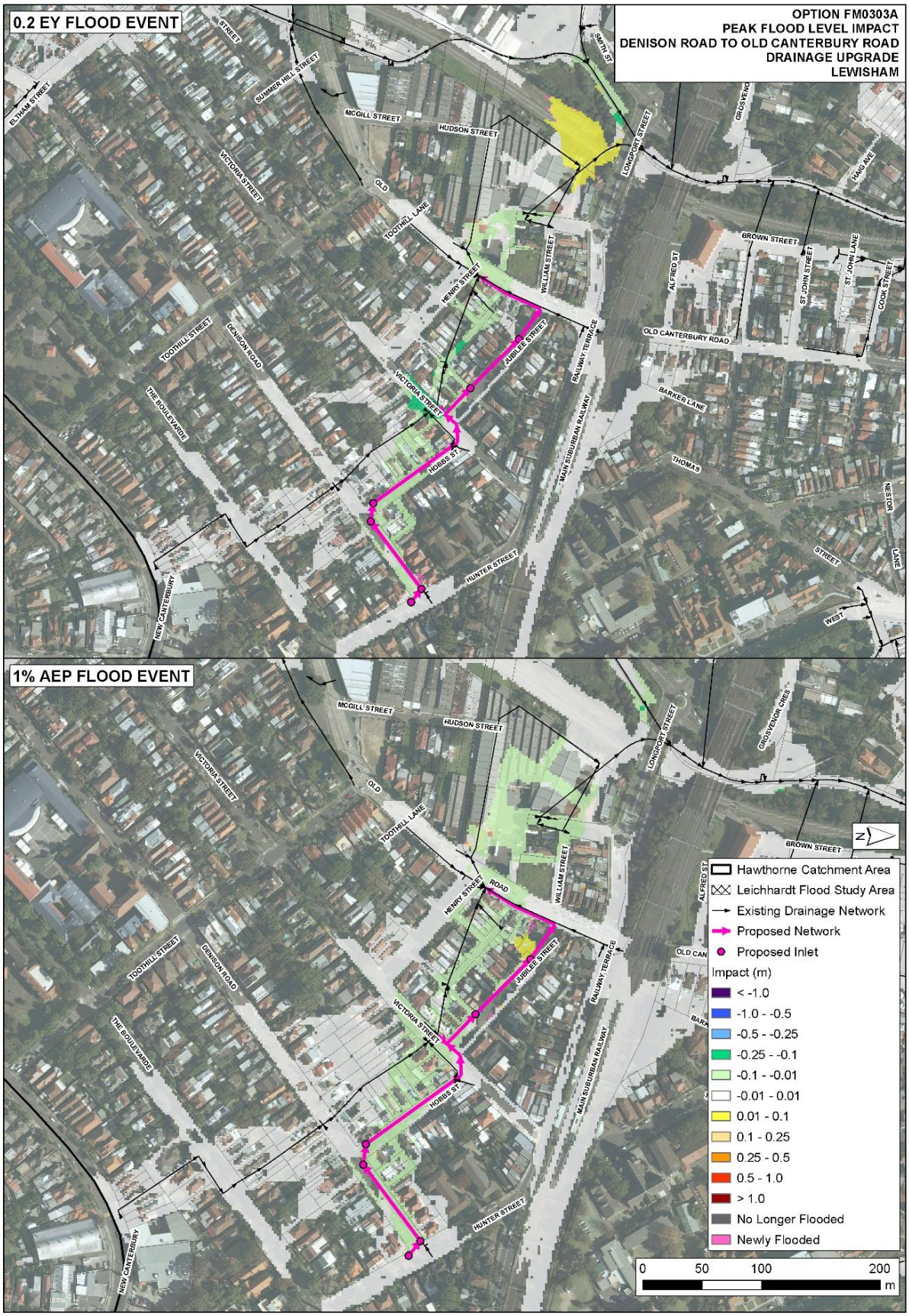
In the 0.2 EY event, the peak flood levels typically decrease by up to 0.1 m between the intersection of Hunter Street and Denison Road and William Street, in comparison to existing depths up to 0.4 m. However, an increase in flood levels is observed within Hawthorne Canal. This is due more flow discharging into Hawthorne Canal. In the 1% AEP event, the peak flood levels typically decrease by up to 0.1 m between the intersection of Hunter Street and Denison Road and William Street, in comparison to existing depths up to 0.7 m. An increase in flood levels is observed in properties along Jubilee Street due to the proposed pipe reaching capacity and the pit surcharging.

Table 22 – Over floor Property Affectation FM0303A

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0303A)**	**Change**
0.5EY	12	12	0
0.2EY	37	36	-1
10% AEP	53	51	-2
5% AEP	75	75	0
2% AEP	100	100	0
1% AEP	120	120	0
PMF	537	518	-19

The limited impact on peak flood levels would result in limited to property affectation in the Hawthorne Canal catchment (Table 22). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B9: Option FM0303A Schematisation and Impacts 0.2 EY and 1% AEP Events



B.2.4. FM0303B: Denison Road to Old Canterbury Road Drainage

This option proposes a new drainage network starting at the intersection of Hunter Street and Denison Road. A 900 mm diameter pipe is proposed that travels along Denison Road, Hobbs Street and Jubilee Street before connecting to the existing box culvert (1 m W x 0.9 m H) at Old Canterbury Road.

Diagram B10 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

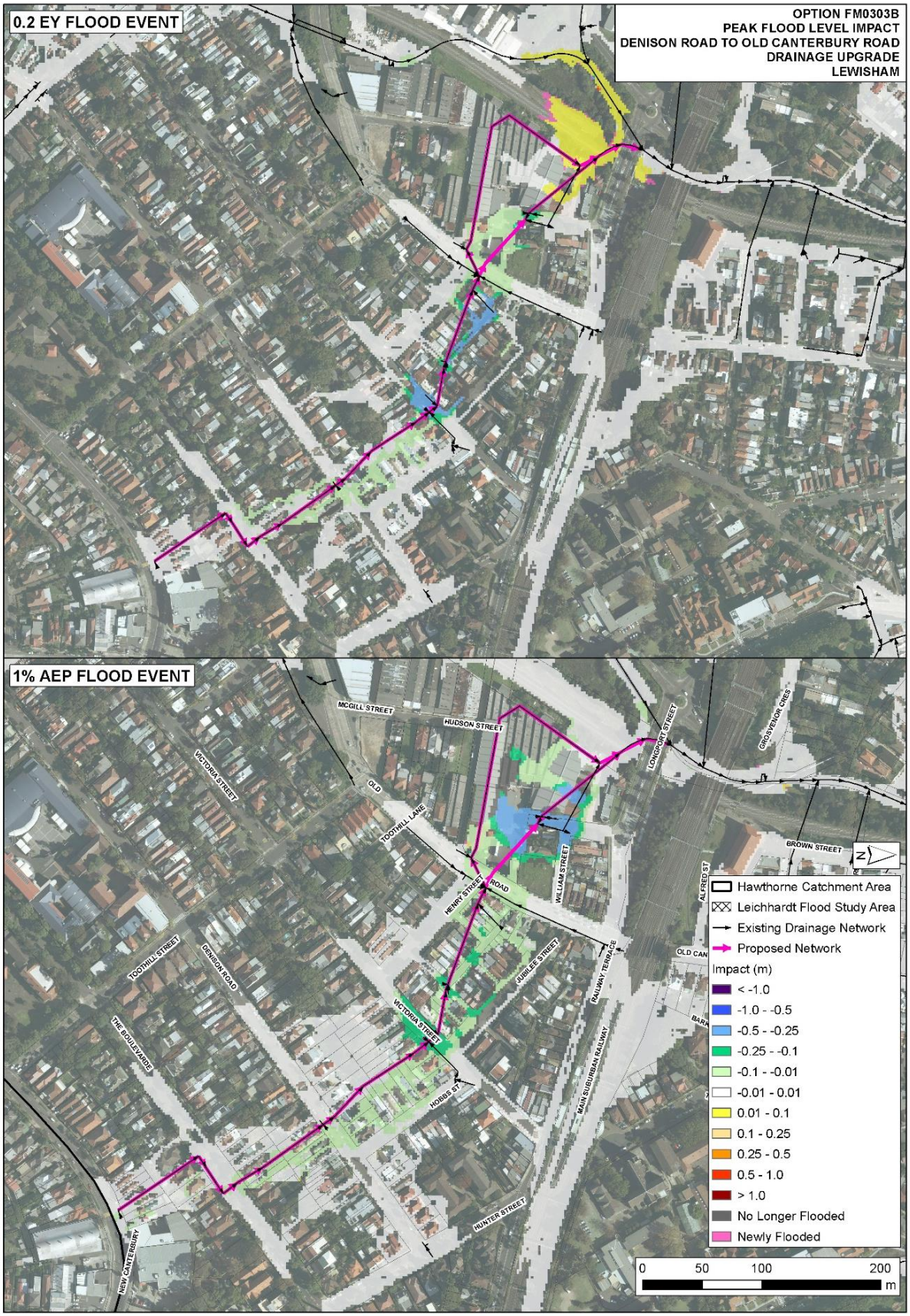
In the 0.2 EY event, decreases in flood levels are observed along the flowpath between Denison Road and Hawthorne Canal. Between Victoria Street and Old Canterbury Road, the decreases are between 0.01 and 0.4 m, in comparison to existing depths up to 0.5 m. However, there is an increase in flood levels of up to 0.1 m where the proposed drainage network discharges into Hawthorne Canal. In the 1% AEP event, the decreases are similar to that in the 0.2 EY event, however, there are no increases in flood levels. Considering existing depths in the order of 0.7 m, up to 0.2 m depths remain.

Table 23 – Over floor Property Affectation FM0303B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0303B)**	**Change**
0.5EY	12	12	0
0.2EY	37	36	-1
10% AEP	53	51	-2
5% AEP	75	75	0
2% AEP	100	100	0
1% AEP	120	120	0
PMF	537	518	-19

The limited impact on peak flood levels would result in limited change to property affectation in the Hawthorne Canal catchment (Table 23). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B10: Option FM0303B Schematisation and Impacts 0.2 EY and 1% AEP Events



B.3. Hotspot H02 – Grosvenor Crescent, Summer Hill

B.3.1. FM0401A: Grosvenor Crescent Underground Detention Basin

This option proposes an under-road detention basin in Grosvenor Crescent. Its purpose is to temporarily store water during frequent rainfall events, and discharge the flow at a later time where the outflow is regulated through flow-control structures.

The option involves an inlet pit at a topographical low point in Grosvenor Crescent where overland flow is diverted into a detention basin (dimensions L 47 m x W 8.0 m x H 0.6 m) beneath the road. A small 150 mm diameter pipe at the detention basin outlet would pass water back into the existing 550 mm diameter pipe where it travels underneath the railway embankment.

Diagram B11 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

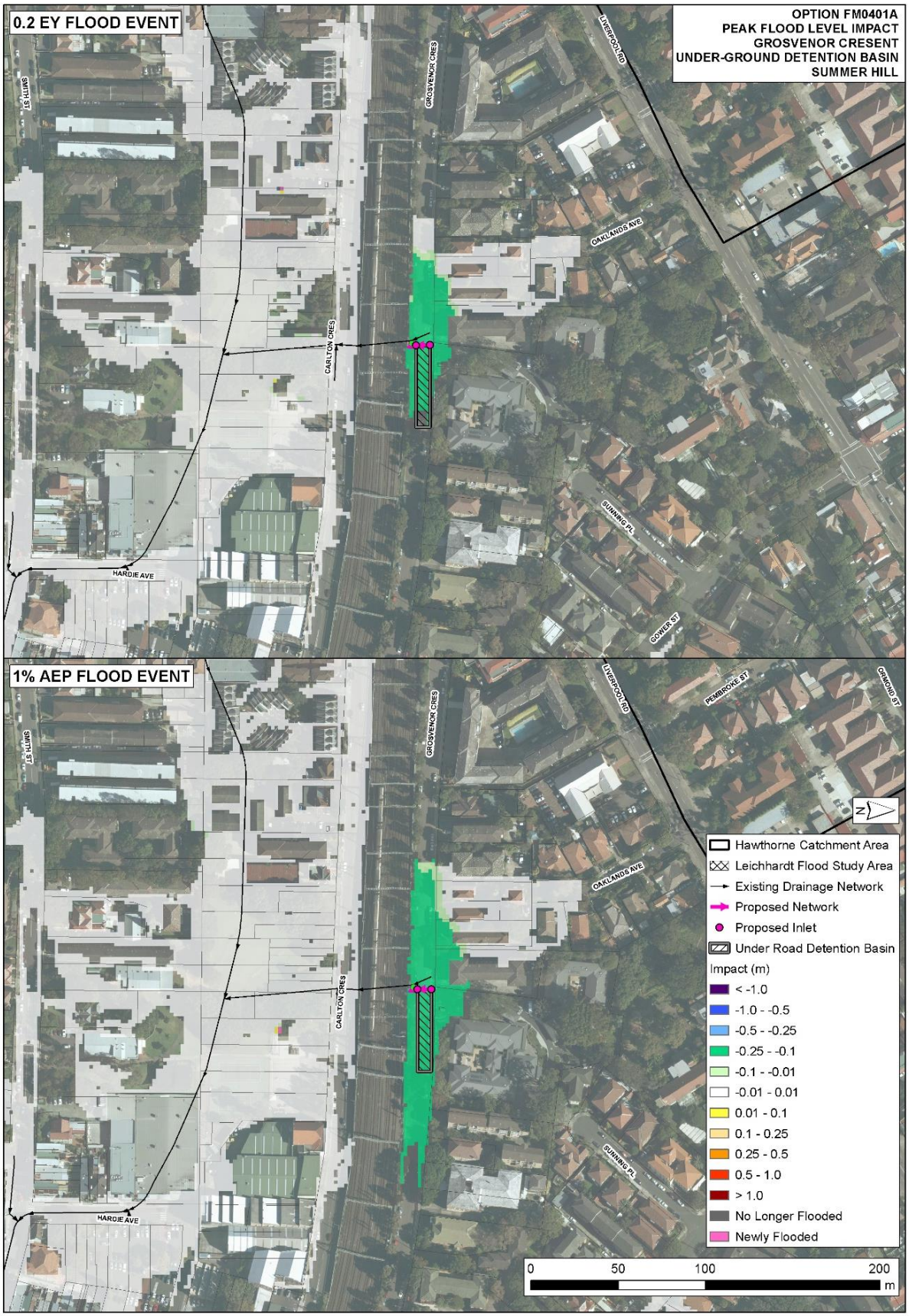
In both the 0.2 EY and 1% AEP events, the peak flood levels in Grosvenor Crescent decrease by 0.2 m and 0.1 m respectively. This is in comparison to existing depths of 0.9 m and 1.5 m for the same two events. The road would still be considered cut-off during all flood events. There is no change to the flood behaviour downstream of the railway embankment. The aim of this option is to improve road trafficability and as such has limited impact on over floor inundation (Table 24).

Table 24 – Over floor Property Affectation FM0401A

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0401A)**	**Change**
0.5EY	12	12	0
0.2EY	37	37	0
10% AEP	53	53	0
5% AEP	75	75	0
2% AEP	100	99	-1
1% AEP	120	120	0
PMF	537	535	-2

As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B11: Option FM0401A Schematisation and Impacts 0.2 EY and 1% AEP Events



B.3.2. FM0404B: Nowranie Street to Hawthorne Canal Drainage Upgrade

This option proposes a 1.2 m diameter pipe beginning within a drainage easement between Morris Street and Nowranie Street diverting flow from an existing Council pipe. The proposed pipe will travel east along Wellesley Street, between properties along Edward Street before spilling into Hawthorne Canal. The aim is to divert water from the existing stormwater pipe to allow a greater capacity for overland flow and reduce flooding between Nowranie Street and Smith Street through to Hawthorne Canal.

An earlier iteration of option FM0404B, FM0404A was also considered and discarded.

Diagram B12 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY and 1% AEP event, the peak flood levels typically decrease by up to 0.1 m between Morris Street and Edward Street, in comparison to existing depths of up to 0.7 m. However, in both events, an increase in flood levels is observed in Hawthorne Canal and adjacent properties upstream of where the proposed pipe discharges. This is likely due to the area where the proposed pipe discharges into being highly sensitive to flow change as it is located between two hydraulic structures.

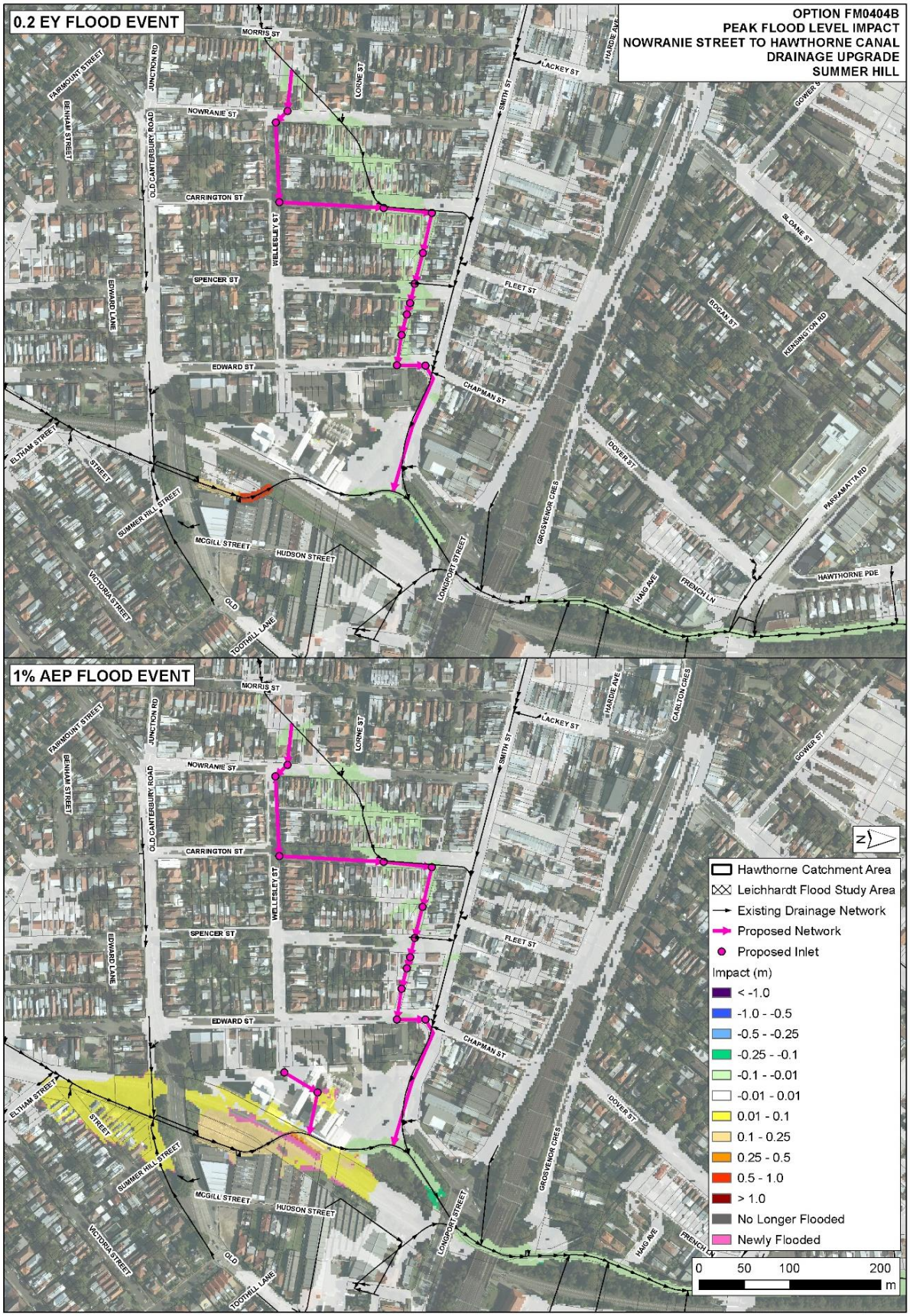
Table 25 – Over floor Property Affectation FM0404B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0404B)**	**Change**
0.5EY	12	12	0
0.2EY	37	35	-2
10% AEP	53	53	0
5% AEP	75	72	-3
2% AEP	100	100	0
1% AEP	120	121	1
PMF	537	532	-5

The limited impact on peak flood levels would result in limited change to property affectation in the Hawthorne Canal catchment (Table 25). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

FM0404C also considered a pipe upgraded through this area, was shown to provide greater benefit and is assessed further in Section 10.2.9.2.

Diagram B12: Option FM0404B Schematisation and Impacts 0.2 EY and 1% AEP Events



B.4. Hawthorne Canal - Other

B.4.1. FM0501C, FM0501D, FM0501E, FM0501F Petersham Park Above Ground Detention Basin

This option proposes to utilise Petersham Park as an above-ground detention basin during flood events. Various configurations were modelled to assess the impacts on peak flood levels and these are discussed below.

FM0501C: At the northern boundary of Petersham Park (parallel to Station Street) the ground levels would be raised to 14.4 m AHD (0.5 m to 2 m higher than current ground levels) for approximately 130 m along the pedestrian walkway that surrounds the oval. A spillway, at a level of 14.15 m AHD would be installed at the current vehicle access point (currently at approximately 12.5 m AHD). The approximate storage of the proposed basin would be 2,350,000 m^3. Vehicle access would still be available. That is, the entry and exit grade from ground level to the top of the spillway would still allow for access to the Park.

Diagram B13 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, peak flood levels between Petersham Park and Hawthorne Canal typically decrease by up to 0.1 m, whilst some areas (particularly properties along Station Street) decrease by up to 0.2 m. The proposed detention basin does not spill during this event. In the 1% AEP event, flood levels decrease by between 0.1 m – 0.5m along the downstream flowpath. The capacity of the detention basin is exceeded, and flow overtops predominately around the western side of the cricket field, newly flooding the north western portion of Petersham Park. In the 1% AEP event, 4 properties are no longer flooded above floor level. There is no change to property affectation in the 0.2EY.

FM0501D: Ground levels at the current vehicle access along the north boundary of Petersham Park (in Station Street) would be increased from 12.5 m AHD to 12.9 m AHD. This will increase the amount of flood storage of the park whilst reducing the amount of construction. The approximate storage of the proposed basin is 570,000 m^3. Vehicle access will be maintained for this option.

Diagram B14 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, isolated areas along the downstream flowpath have a decrease in peak flood levels up to 0.1 m. For the 1% AEP event, there is an increase in flood levels where the detention basin overtops at the vehicle access and pedestrian pathway just to the east. This results in a number of properties along Station Street being affected with an increase of 0.2 m of flooding. In the 1% AEP event, only one property is no longer flooded above floor level. There is no change to property affectation in the 0.2EY.

FM0501E & FM0501F: At the northern boundary of Petersham Park (parallel to Station Street) the current pedestrian walkway would be redesigned to increase the ground levels to create a large storage basin. The current vehicle access point would be increased from 12.5 m AHD to 13.2 m AHD and would act as the spillway. Vehicle access to the park will be maintained with a ramp installed. On the western side of the vehicle access, the pedestrian walkway will ramp from 13.2 m AHD to 14.2 m AHD and tie in with existing ground levels approximately 40 m away. On the eastern side of the vehicle access, the pedestrian walkway will ramp from 13.2 m AHD to 13.9 m AHD and also tie in with existing ground levels approximately 20 m away.

As the proposed design alters ground levels to the west of the vehicle access point, an existing heritage stone wall extending along the pedestrian walkway will need to be reinstalled.

Diagram B15 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event, peak flood levels between Petersham Park and Hawthorne Canal typically decrease by up to 0.1 m, this is in comparison to existing depths between 0.6 m and 0.9 m. The proposed detention basin does not spill during this event. In the 1% AEP event, flood levels decrease by between 0.1 m – 0.5m along the downstream flowpath, in comparison to existing depths of 0.8 m and 1.5 m. The capacity of the detention basin is exceeded, where flow overtops predominately around the eastern side of the cricket field, inundating the north eastern portion of Petersham Park. In the 1% AEP event, only one property is no longer flooded above floor level. There is no change to property affectation in the 0.2EY.

The boundary of the Marrickville Council LGA is located at Parramatta Road, approximately 90 m downstream of Petersham Park. As such, only a small number of properties between Station Street and Parramatta Road are included in the floor level assessment. As a result, the full monetary benefit of this option has not been evaluated.

The limited impact on peak flood levels would result in limited or no change to property affectation in the Hawthorne Canal catchment. As a result of the negligible impact on flood behaviour these options are <u>not recommended</u> for further consideration.

An option considering an alternative arrangement (FM0404C – Section 10.2.9.2) was found to offer greater benefits and is assessed further.

Diagram B13: Option FM0501C Schematisation and Impacts 0.2 EY and 1% AEP Events

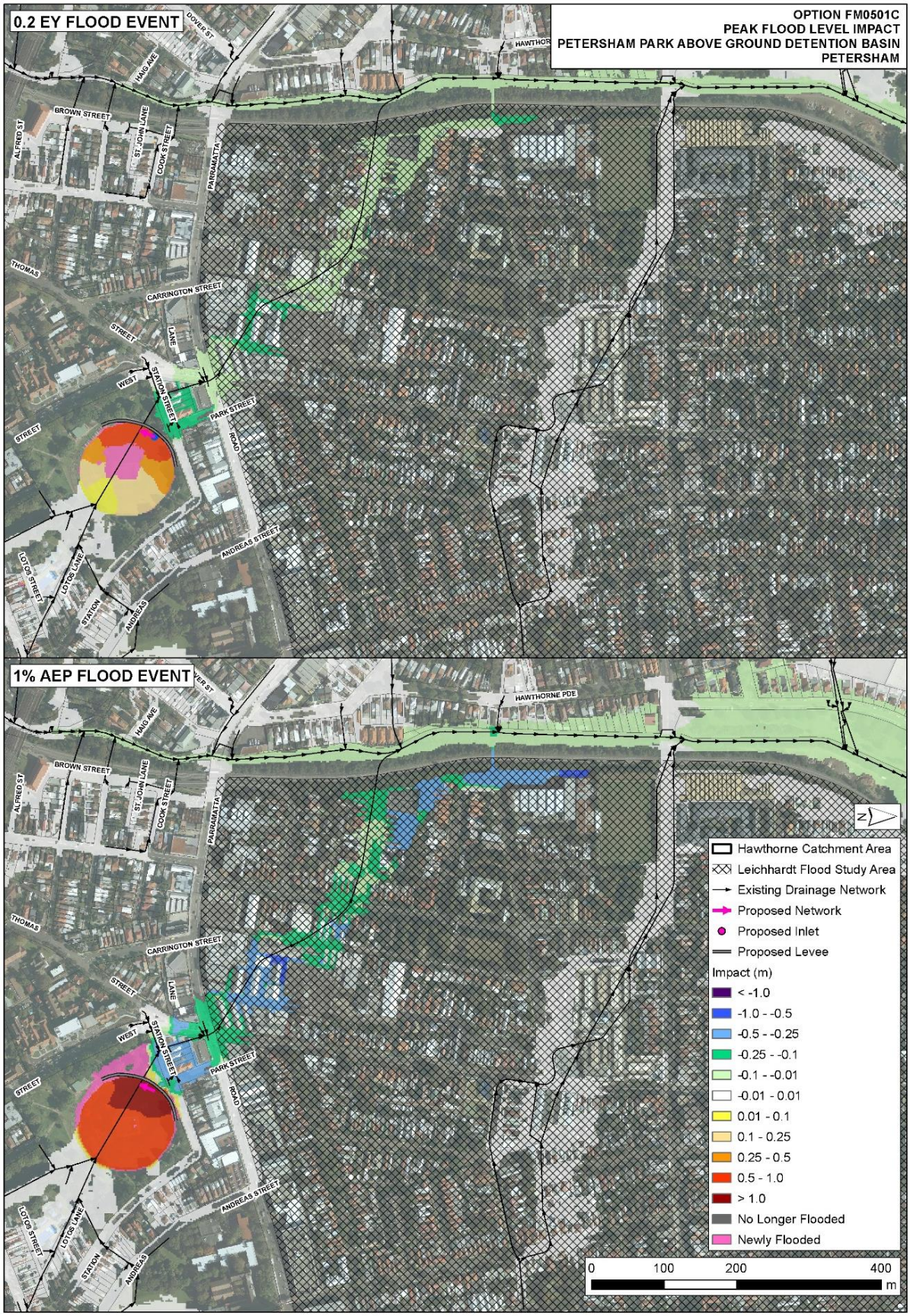


Diagram B14: Option FM0501D Schematisation and Impacts 0.2 EY and 1% AEP Events

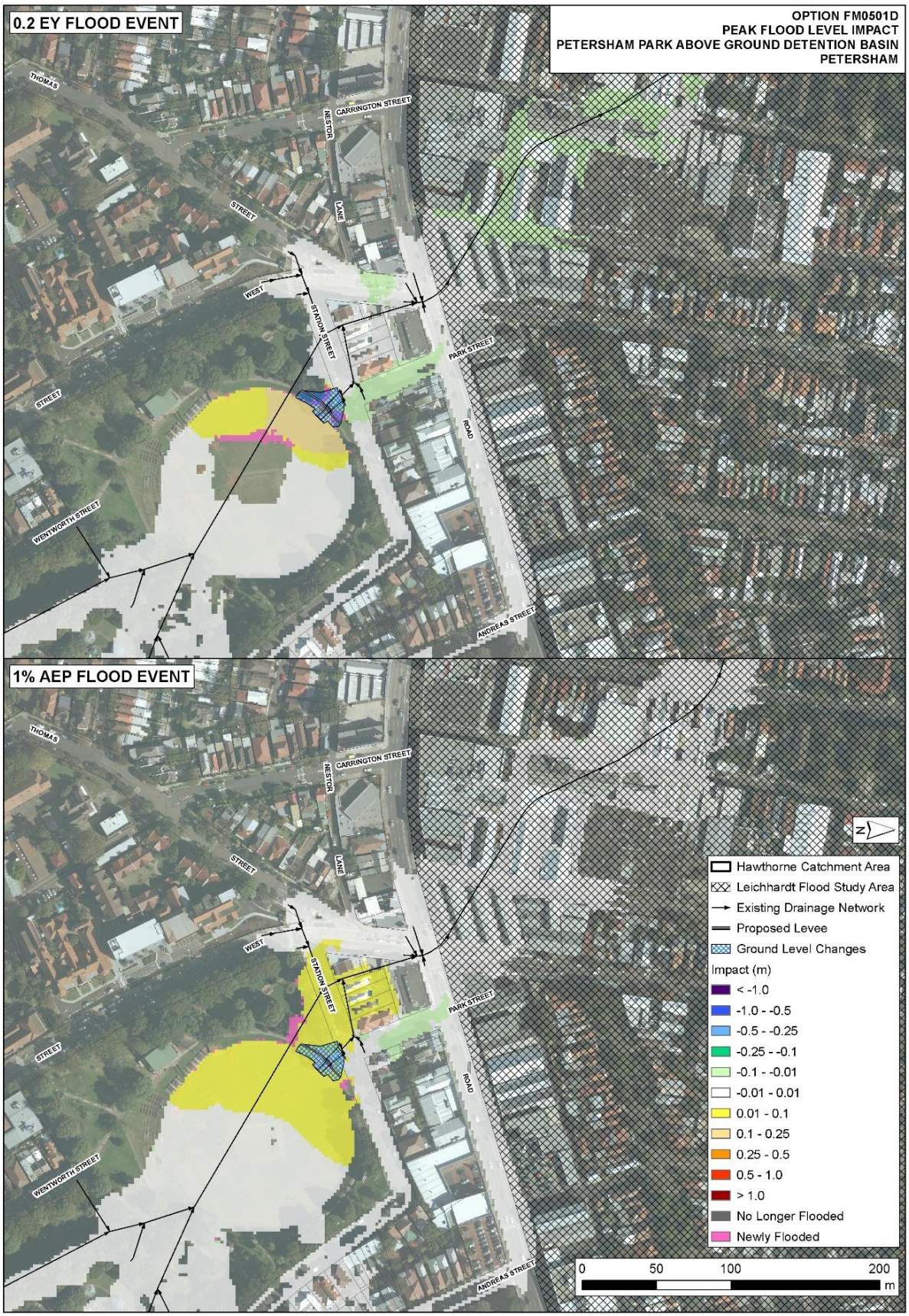
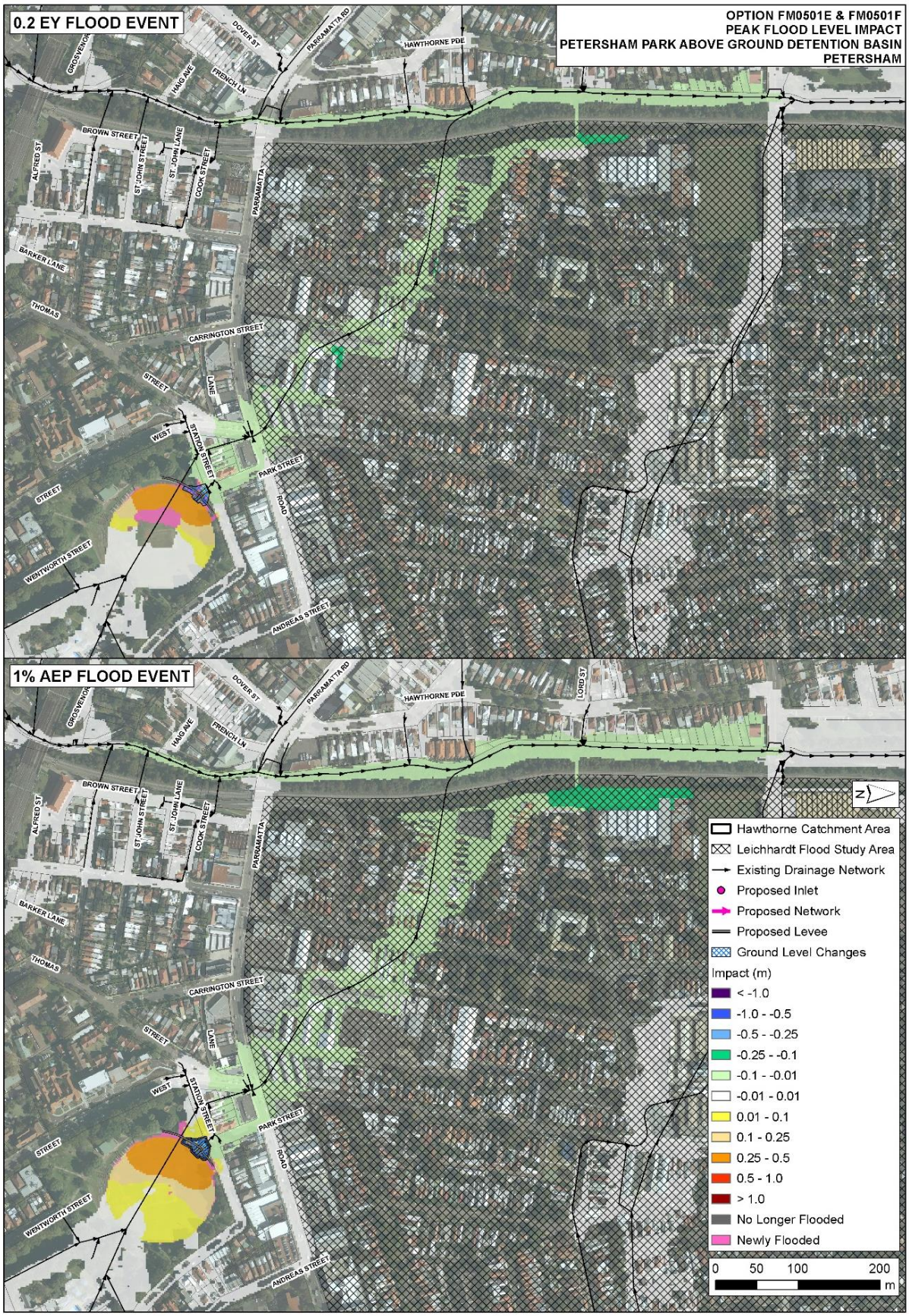


Diagram B15: Option FM0501E & FM0501F Schematisation and Impacts 0.2 EY and 1% AEP Events



B.5. Hotspot H04 – Sloane Street, Summer Hill/Haberfield

B.5.1. FM0601B: Ashfield Park to Hawthorne Canal Drainage Upgrade

This option proposes a new 0.9 m diameter drainage network extending from Ashfield Park, travelling along St Davids Road and through Daragh Lane where it connects into the existing Council owned drainage network. The aim is to reduce flooding in the O'Connor Street flowpath.

Other iterations of option FM0601B, FM0601A and FM0601C were also considered and discarded.

Diagram B16 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

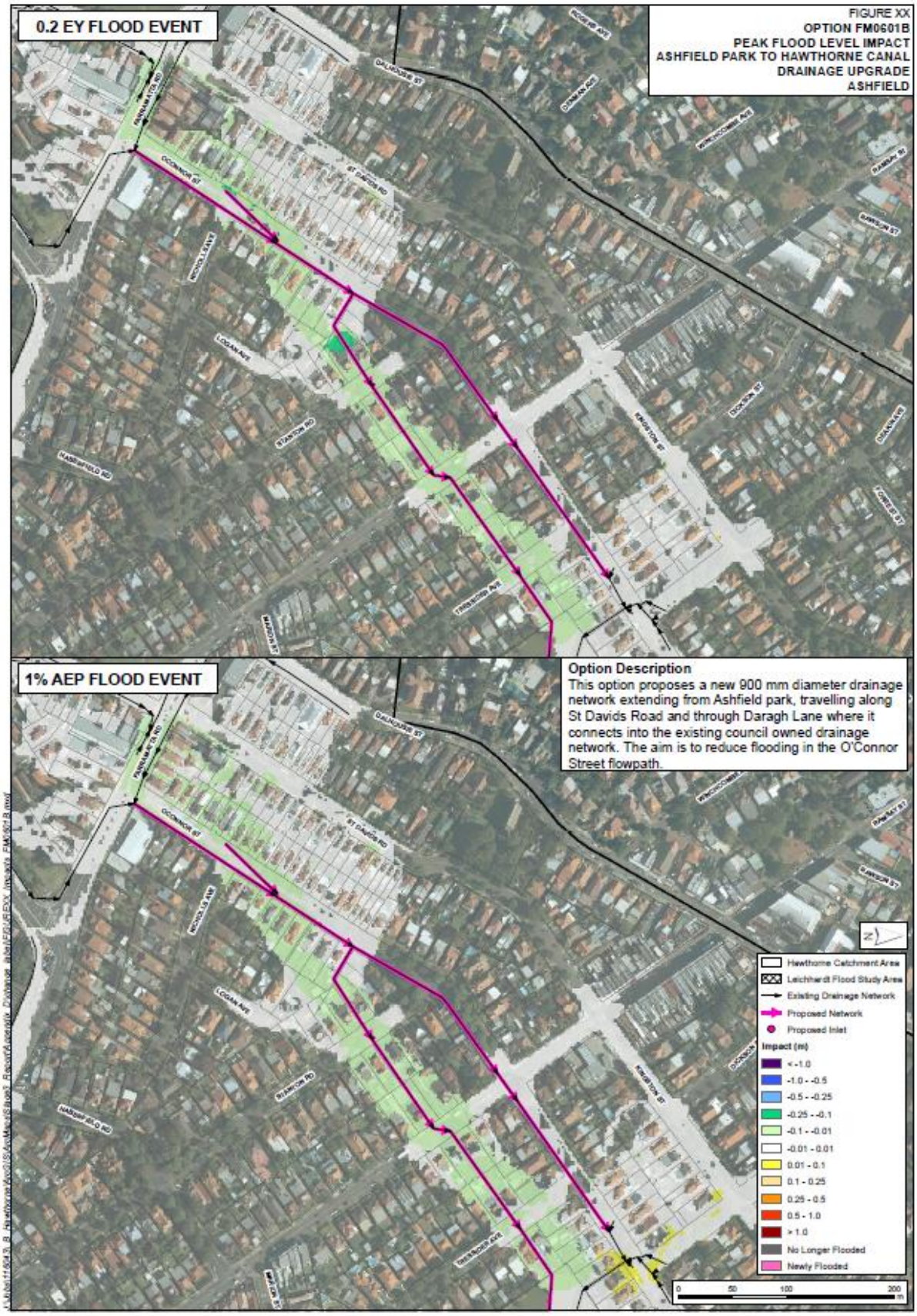
In the 0.2 EY event, the peak flood levels have decreased by up to 0.1 m between Parramatta Road and Tressider Avenue, in comparison to existing depths of 0.4 m. Similar decreases are observed in the 1% AEP event, in comparison to existing depths of 0.7 m. There are increases in flood levels of 0.03 m along Deaks Avenue, O'Connor Street as well as several properties on the downstream side of O'Connor Street adjacent to the drainage reserve. These increases are due to flow surcharging from the pits in this location.

Table 26 – Over floor Property Affectation FM0601B

	Properties Flooded Overfloor		
Event	**Current**	**With Option (FM0601B)**	**Change**
0.5EY	12	12	0
0.2EY	37	37	0
10% AEP	53	52	-1
5% AEP	75	73	-2
2% AEP	100	97	-3
1% AEP	120	118	-2
PMF	537	536	-1

The limited impact on peak flood levels would result in limited change to property affectation in the Hawthorne Canal catchment (Table 26). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B16: Option FM0601B Schematisation and Impacts 0.2 EY and 1% AEP Events



B.5.2. FM0605A, FM0605B: Sloane Street Drainage Upgrade

These options propose to alleviate overland flooding from Sloane Street through to Hawthorne Canal by providing drainage upgrades. Various configurations were modelled to assess the impacts on peak flood levels. These are discussed below.

Option FM0605A proposes a drainage network commencing at the intersection of Sloane Street and Parramatta Road where flow within two existing pipes (0.6 m and 0.45 m diameter) are diverted into a 1.2 m diameter pipe travelling under Parramatta Road, along Sloane Street and Lord Street where it then discharges into Hawthorne Canal. This option includes maintaining the existing drainage network. The aim is to reduce flooding on Parramatta Road near Sloane Street and the downstream flowpath.

Diagram B17 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

Option FM0605B proposes a drainage network commencing at the intersection of Sloane Street and Parramatta Road. Flow within an existing 0.6 diameter pipe travelling under Parramatta Road would be diverted into a new 1.2 m diameter pipe that travels a short distance along Parramatta Road, then along Sloane Street, Lord Street and then discharges into Hawthorne Canal. This option includes maintaining the existing drainage network. The aim is to reduce flooding on Parramatta Road near Sloane Street and the downstream flowpath.

Diagram B18 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In the 0.2 EY event for Option FM0605A, peak flood levels decrease within Paramatta Road by 0.15 m, however the road is still cut-off due to the flood depths up to 0.25 m. Downstream of this location, flood levels decrease by 0.3 m within 4 properties whilst the majority of the flowpath decreases by 0.1 m. This continues down to Hawthorne Canal with a small section of Hawthorne Canal also decreasing by around 0.1 m. Two properties are no longer affected above floor level. In the 1% AEP event, peak flood levels decrease by up to 0.1 m for the majority of the flowpath, in comparison to existing depths of up to 0.7 m. Increases in flood levels of approximately 0.01 m are observed within Hawthorne Canal and a number of adjacent properties. Five properties are no longer affected above floor level in the 1% AEP event (Table 27).

Table 27 – Over floor Property Affectation FM0605A

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0605A)**	**Change**
0.5EY	12	12	0
0.2EY	37	35	-2
10% AEP	53	46	-7
5% AEP	75	68	-7
2% AEP	100	94	-6
1% AEP	120	115	-5
PMF	537	534	-3

In the 0.2 EY event for Option FM0605B, peak flood levels decrease by 0.1 m from Parramatta Road through to Hawthorne Canal. The flood levels for approximately six properties decrease by 0.2 m. Two properties are no longer affected above floor level. In the 1% AEP event, peak flood levels decrease by up to 0.1 m between Parramatta Road to Hawthorne Parade. Increases in flood levels of approximately 0.01 m are observed within Hawthorne Canal and a number of adjacent properties. Four properties are no longer affected above floor level (Table 28).

Table 28 – Over floor Property Affectation FM0605B

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0605B)**	**Change**
0.5EY	12	12	0
0.2EY	37	35	-2
10% AEP	53	47	-6
5% AEP	75	71	-4
2% AEP	100	97	-3
1% AEP	120	116	-4
PMF	537	524	-13

There would be some, albeit limited, benefit to property over floor affection in the area, however this would be marginal, especially when considering the significant construction costs. As a result of the minor impact on flood behaviour and the likely costs, this option is <u>not recommended</u> for further consideration.

Diagram B17: Option FM0605A Schematisation and Impacts 0.2 EY and 1% AEP Events

Diagram B18: Option FM0605B Schematisation and Impacts 0.2 EY and 1% AEP Events

B.5.3. FM0606A: Sloane Street Underground Detention Basin

This option proposes an under-road detention basin in Sloane Street near the intersection of Parramatta Road. Its purpose is to temporarily store water during frequent rainfall events, and discharge the flow at a later time where the outflow is regulated through flow-control structures.

The option involves high inlet pits across Sloane Street to capture overflow flow travelling towards Parramatta Road. Flow is diverted into a detention basin (dimensions L 60 m x W 7.05 m x H 1.2 m) beneath the road. A small 150 mm diameter pipe at the detention basin outlet would pass water back into the existing 0.6 m diameter pipe where it travels underneath Parramatta Road and continues downstream to Hawthorne Canal.

Diagram B19 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

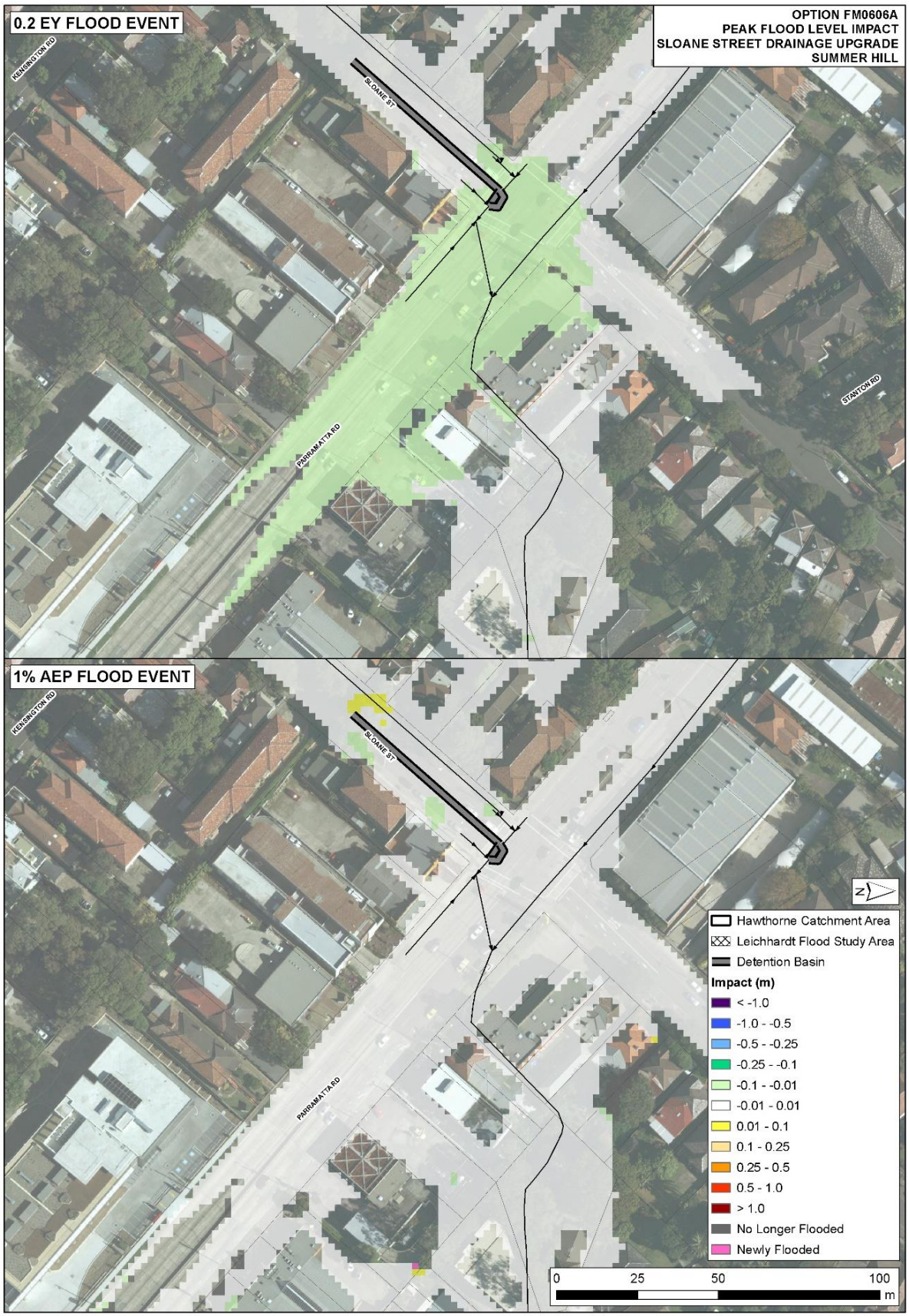
In the 0.2 EY event, reductions of peak flood levels are observed only within the road corridor at the intersection of Sloane Street and Parramatta Road and several properties on the downstream side of Parramatta Road, flood depths of 0.25 m remain. In the 1% AEP event, there is no reduction in peak flood levels. From the 0.2 EY event, the flood depths within Parramatta Road exceed 0.3 m, which is considered not accessible.

Table 29 – Over floor Property Affectation FM0606A

	Properties Flooded Ove floor		
Event	**Current**	**With Option (FM0606A)**	**Change**
0.5EY	12	12	0
0.2EY	37	35	0
10% AEP	53	51	-2
5% AEP	75	75	0
2% AEP	100	99	-1
1% AEP	120	118	-2
PMF	537	536	-1

The limited impact on peak flood levels would result in limited change to property affectation in the Hawthorne Canal catchment (Table 29). As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B19: Option FM0606A Schematisation and Impacts 0.2 EY and 1% AEP Events



B.6. Hotspot H06 – Hawthorne Canal

B.6.1. FM0701A: Dudley Street to Hawthorne Canal Upgrade

This option proposes a 0.6 m diameter pipe beginning in Dudley Street, running along Waratah Street and spilling into Hawthorne Canal. Inlet pits in Dudley Street would capture water from the upstream catchment, diverting water from entering the existing drainage network. The aim is to allow greater pipe capacity and reduced flooding between Dudley Street and Kingston Street.

Diagram B20 shows a schematisation of the option and the impacts on peak flood levels for the 0.2 EY and 1% AEP events.

In both the 0.2 EY event and 1% AEP events, there is a decrease in flood levels between Dudley Street and Hawthorne Parade by around 0.1 m. Existing flood depths are up to 0.4 m and 0.6 m for both events. For both flood events, one property no longer becomes flood affected (Table 30).

Table 30 – Over floor Property Affectation FM0701A

Properties Flooded Overfloor			
Event	**Current**	**With Option (FM0701A)**	**Change**
0.5EY	12	12	0
0.2EY	37	36	-1
10% AEP	53	52	-1
5% AEP	75	75	0
2% AEP	100	98	-2
1% AEP	120	119	-1
PMF	537	523	-14

The limited impact on peak flood levels would result in limited change to property affectation in the Hawthorne Canal catchment. As a result of the negligible impact on flood behaviour this option is <u>not recommended</u> for further consideration.

Diagram B20: Option FM0701A Schematisation and Impacts 0.2 EY and 1% AEP Events