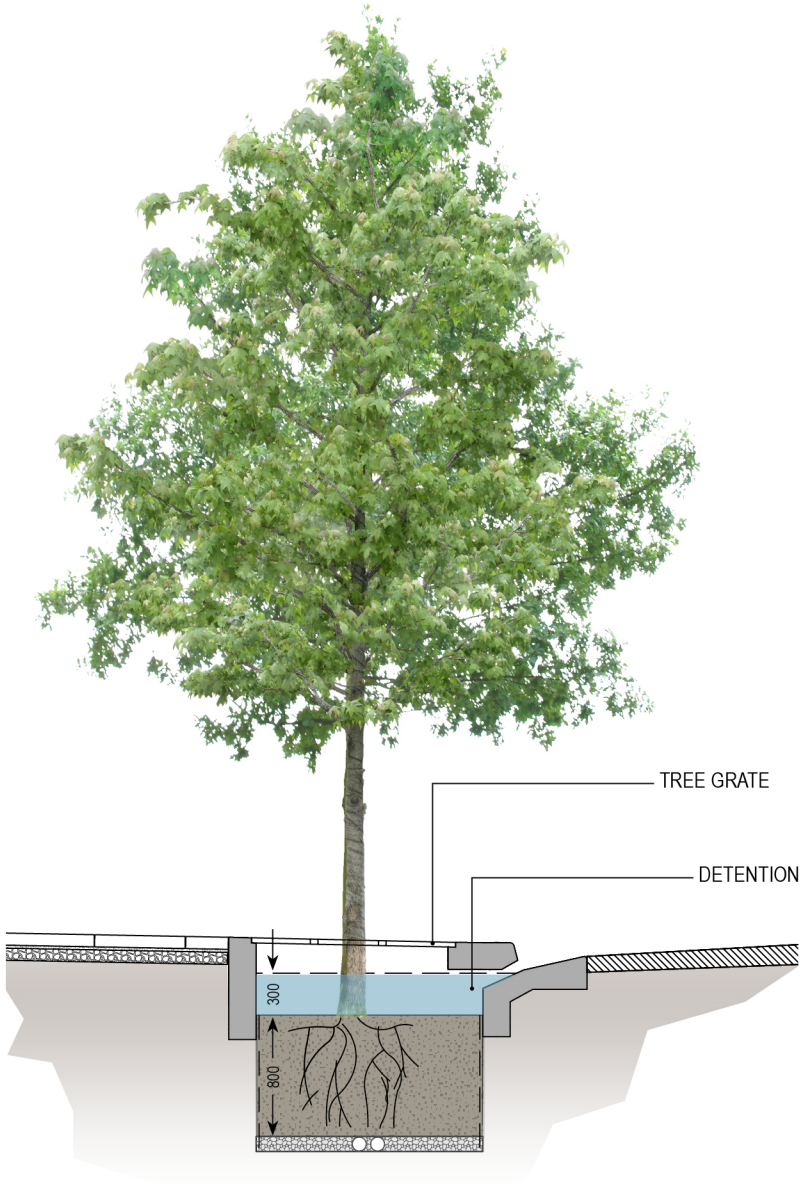
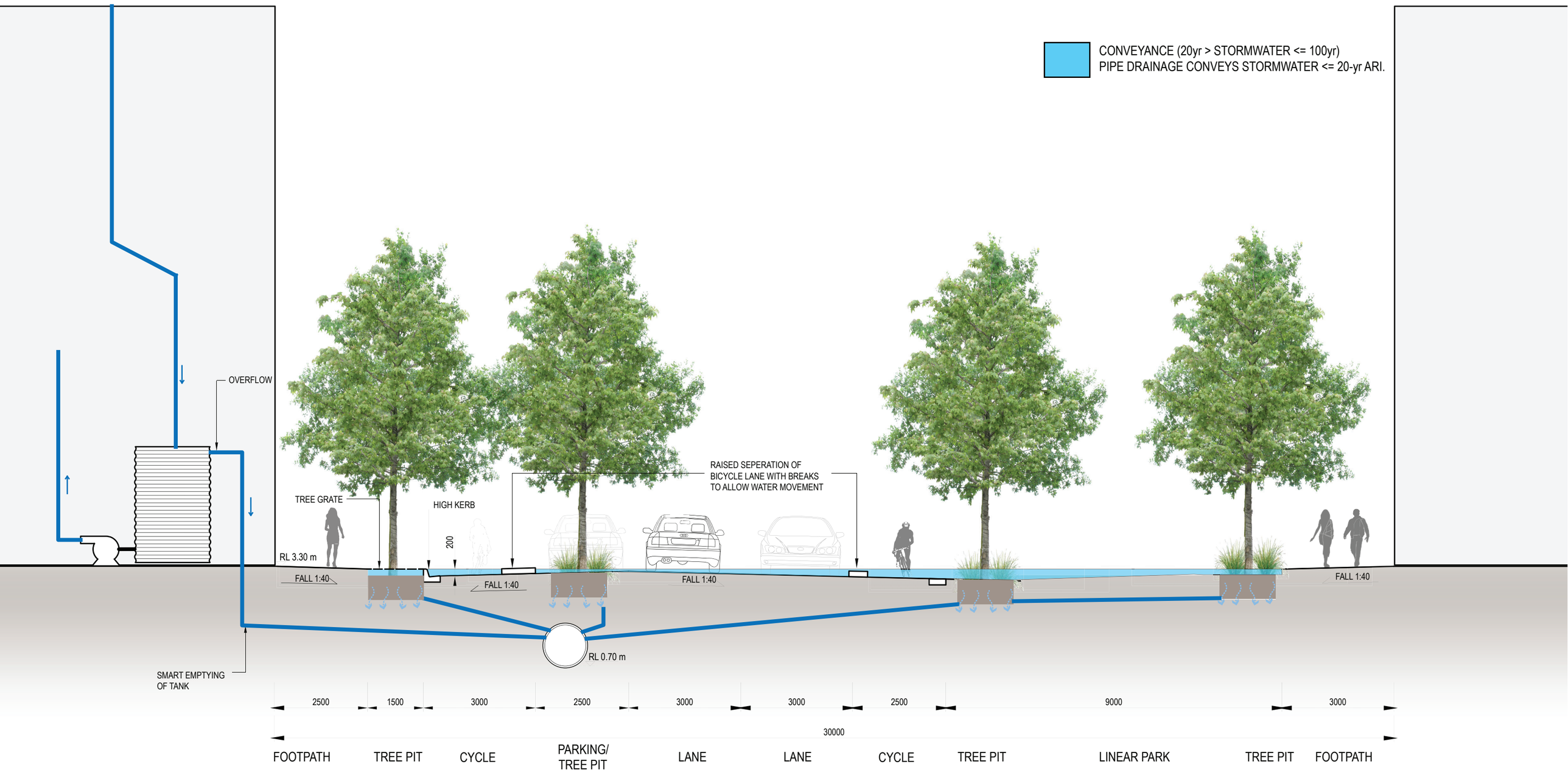

TREE GRATE
DETENTION
300
800

Attachment 5

GHD cross-sections v4 for Steering Committee meeting on 24th Oct

CONVEYANCE (20yr > STORMWATER <= 100yr)
PIPE DRAINAGE CONVEYS STORMWATER <= 20-yr ARI.



TYPICAL STREET SECTION WITH NO STORAGE

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

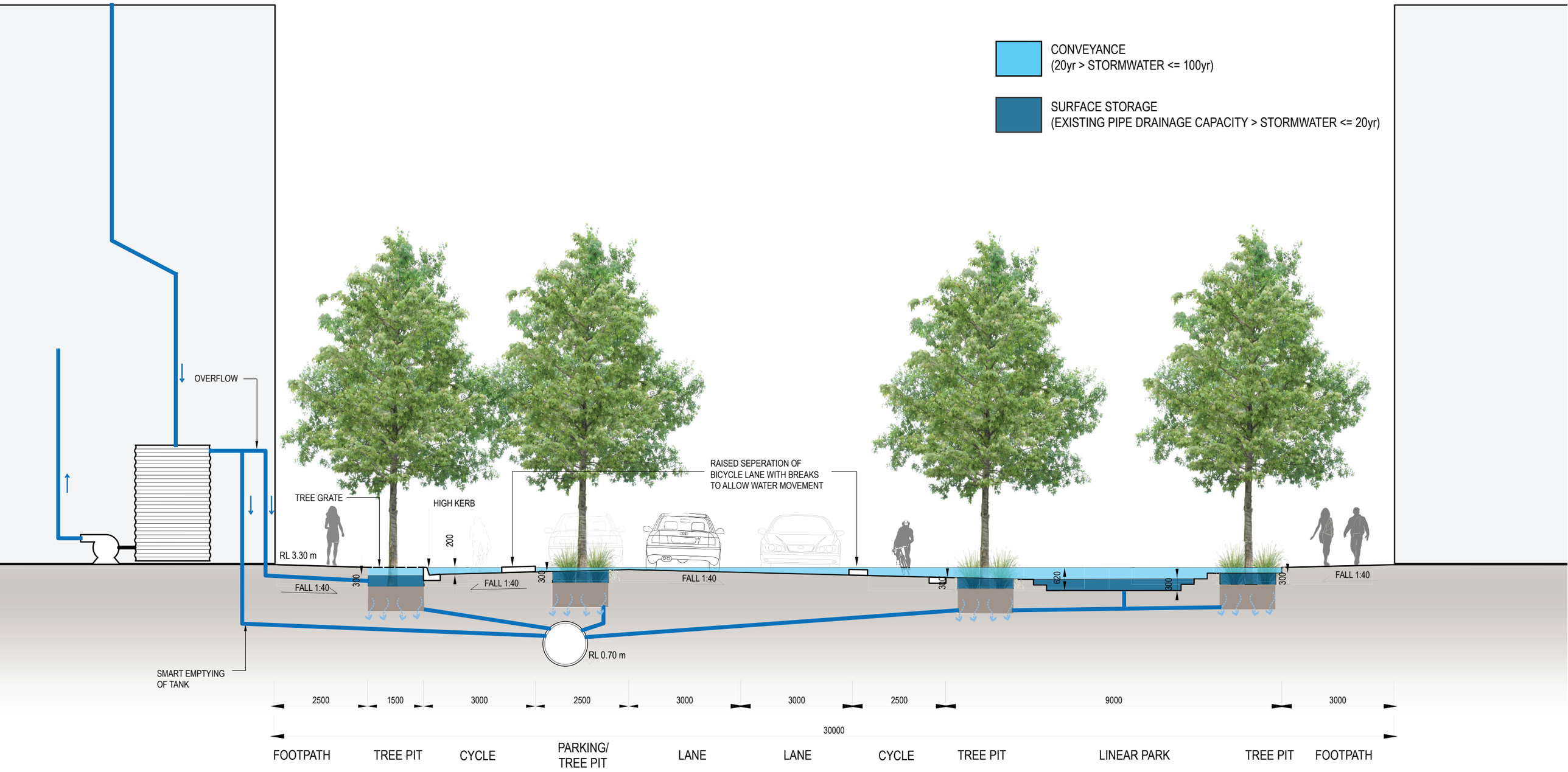
GREEN STREET - WITHOUT STORAGE

Original Size: **A3**
Date: **05.12.2018**
Rev: **A**

GHDWOODHEAD

CONVEYANCE
(20yr > STORMWATER <= 100yr)

SURFACE STORAGE
(EXISTING PIPE DRAINAGE CAPACITY > STORMWATER <= 20yr)



TYPICAL STREET SECTION WITH STORAGE

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITH STORAGE

Original Size: **A3**

Date: **05.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

FALL 1:40

300

200

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 5 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITH STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

200

FALL 1:40

300

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 10 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITHOUT STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

200

FALL 1:40

300

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 20 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITHOUT STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

200

FALL 1:40

300

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 100 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITHOUT STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

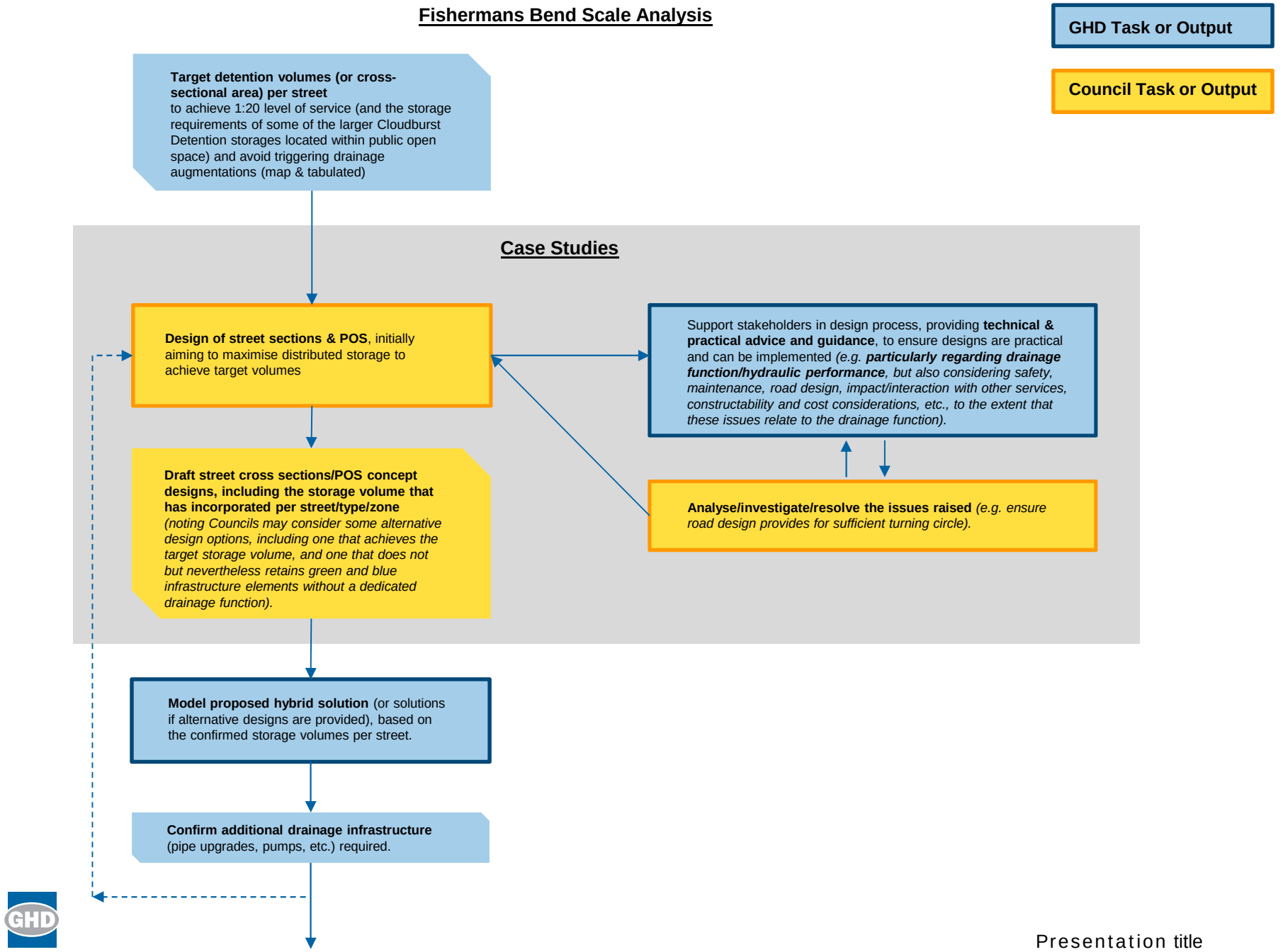
Attachment 6

Proposal workflow diagram

Fishermans Bend

WSC Drainage and Flood Management Strategy

Fishermans Bend Scale Analysis



Working Group Meeting Mark-Ups 6th September

Fishermans Bend Scale Analysis

GHD Task or Output

Council Task or Output

Target detention volumes (or cross-sectional area) per street
to achieve 1:20 level of service (and the storage requirements of some of the larger Cloudburst Detention storages located within public open space) and avoid triggering drainage augmentations (map & tabulated)

Clarify format and level of detail (i.e. spatial scale) of output

Case Studies

Design of street sections & POS, initially aiming to maximise distributed storage to achieve target volumes

Support stakeholders in design process, providing **technical & practical advice and guidance**, to ensure designs are practical and can be implemented *(e.g. **particularly regarding drainage function/hydraulic performance**, but also considering safety, maintenance, road design, impact/interaction with other services, constructability and cost considerations, etc., to the extent that these issues relate to the drainage function).*

What level of design of drainage related elements (functional, detailed) … what information will be shown on cross-sections and plans?

Is this a separate output, or is it incorporated into the council cross-section or plan? If the latter, how does this work?

Draft street cross sections/POS concept designs, including the storage volume that has incorporated per street/type/zone *(noting Councils may consider some alternative design options, including one that achieves the target storage volume, and one that does not but nevertheless retains green and blue infrastructure elements without a dedicated drainage function).*

What level of design?
What exact outputs?
What format?

Analyse/investigate/resolve the issues raised *(e.g. ensure road design provides for sufficient turning circle).*

This is a starting position. Is this realistic? Where might Council need support?

Probably need to represent a step in here that is scaling up the case study learnings to the typologies across all of study area to enable the modelling

Model proposed hybrid solution (or solutions if alternative designs are provided), based on the confirmed storage volumes per street.

Confirm additional drainage infrastructure (pipe upgrades, pumps, etc.) required.

There is some decision point, *to select a particular option, or revisit/refine the option*, that could be represented

Attachment 7

Opportunities and Constraints Workshop Presentation

Opportunities & Constraints

GHD Water

Potential Constraints & Benefits

Services
- Routing

Robustness of Solution
- Pumping
- Pipe Augmentation
- Floor Level Controls

Maintenance
- Hydrocarbons
- Gross Pollutants
- Sediments
- Access
- Inspections

Safety
- Pedestrians
- Vehicles
- Wildlife

Access
- Property Access
- Vehicular Movements
- Pedestrian Movement

Environmental Benefits
- Urban Cooling
- Air Quality
- Water Quality
- Flora & Fauna

Liveability
- Visual Appeal

Construction
- Contaminated Soils
- Vegetation Selection

Groundwater
- Groundwater Level
- Groundwater Quality

Cost
- Capital Cost
- Maintenance Cost

Four Main Typologies for Drainage

- Blue Laneways
- Green Streets
- Cloudburst Boulevards
- Cloudburst Detention

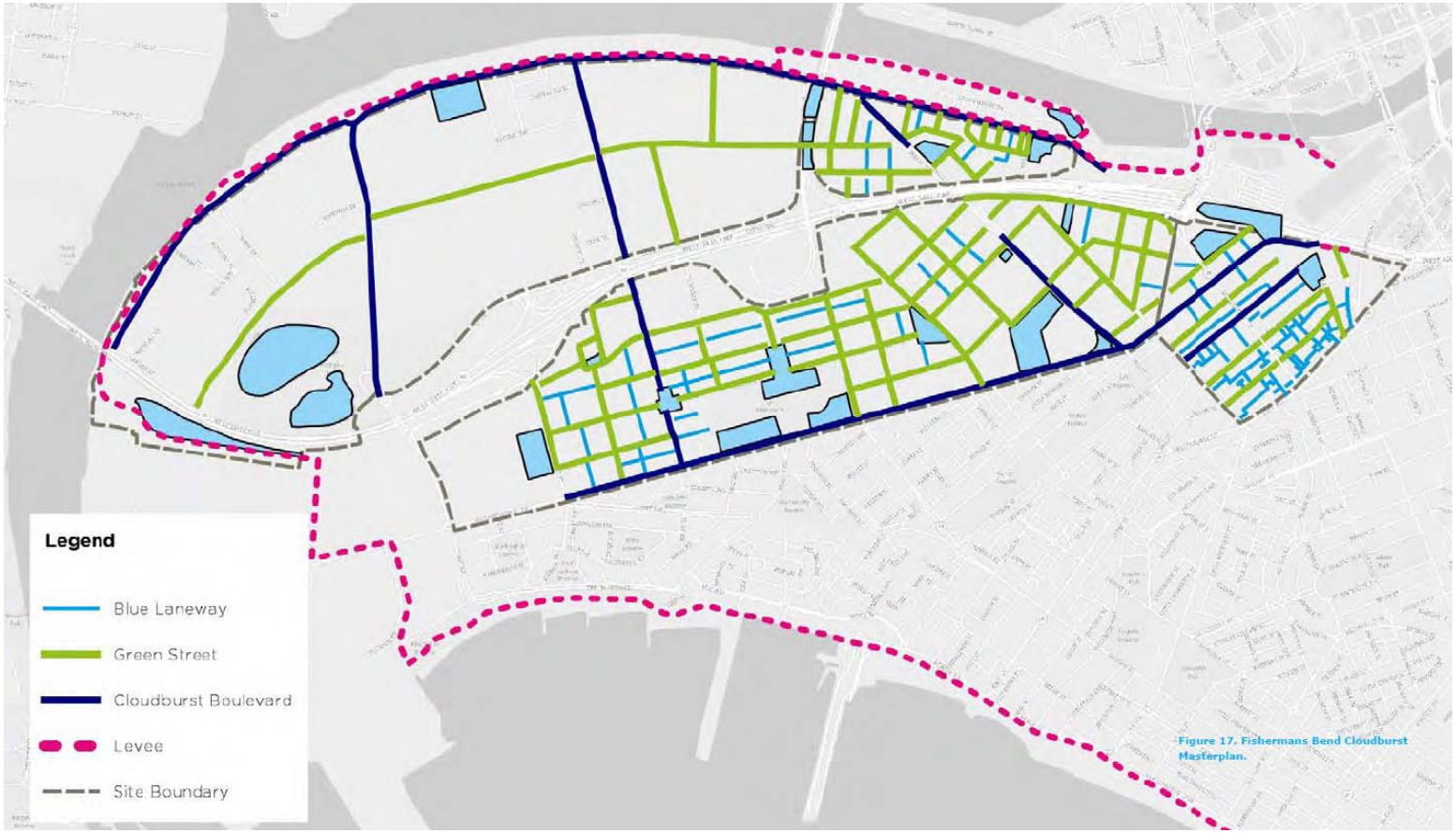


Figure 17. Fishermans Bend Cloudburst Masterplan.

Blue Laneways

Storage Requirements

- Average 2m width and 0.3m depth

Rambol impression:

Green Streets

Storage Requirements

- Average 8m width and 0.4m depth

Rambol impression:

Cloudburst Boulevards

Storage Requirements

- Average 10m width and 0.4m depth

Rambol impression:

Cloudburst Detention

Storage Requirements

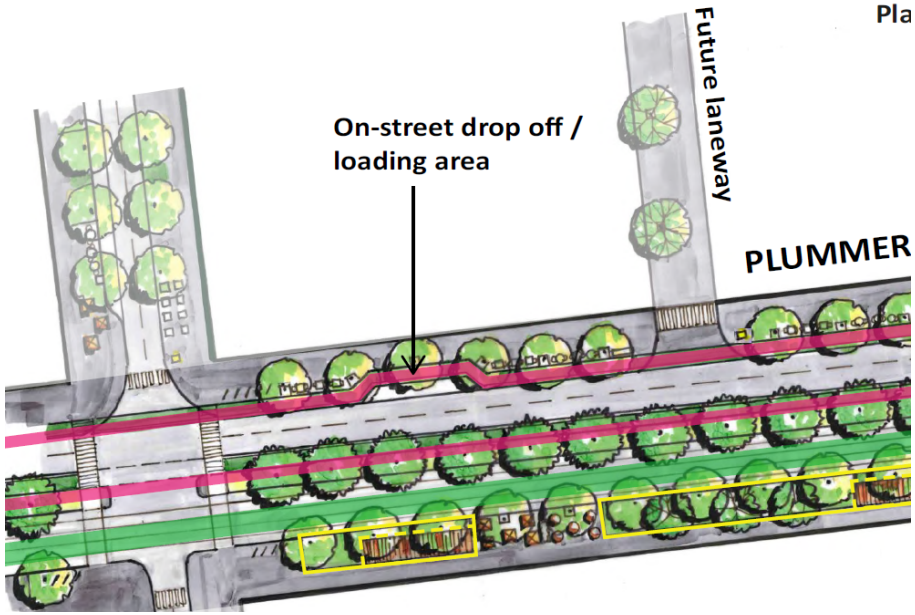
- Average 1.0m depth

Rambol impression:

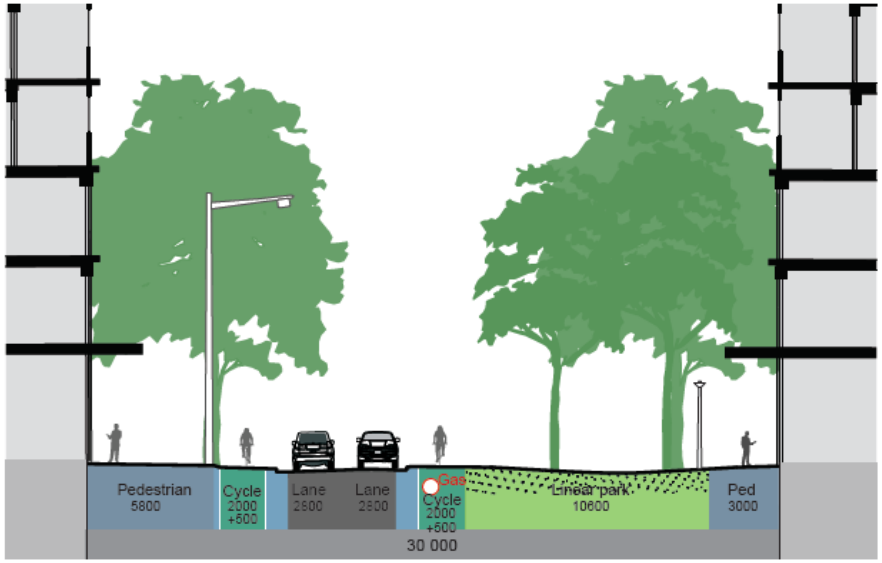
Examples of Outputs

Examples of Outputs

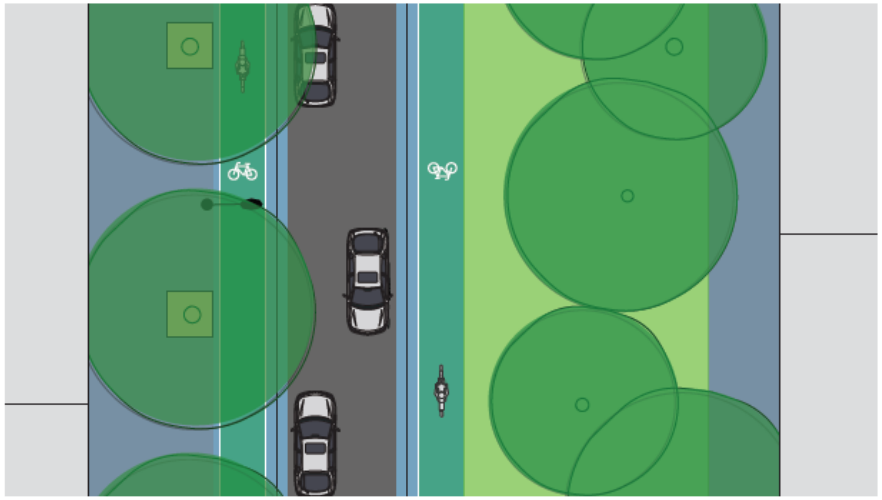
Concept Outputs:



5.10 Buckhurst Street



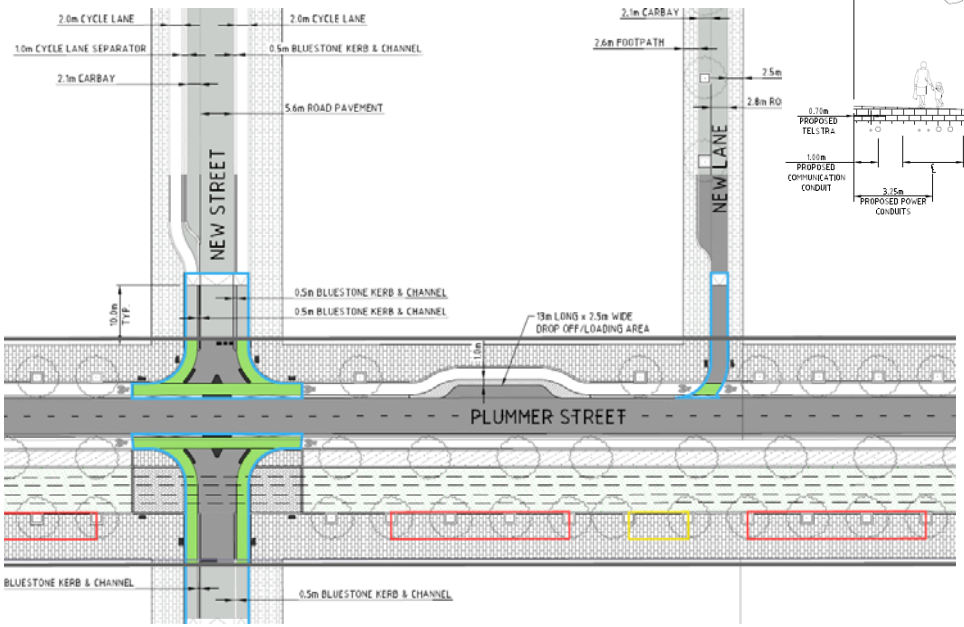
Typical profil

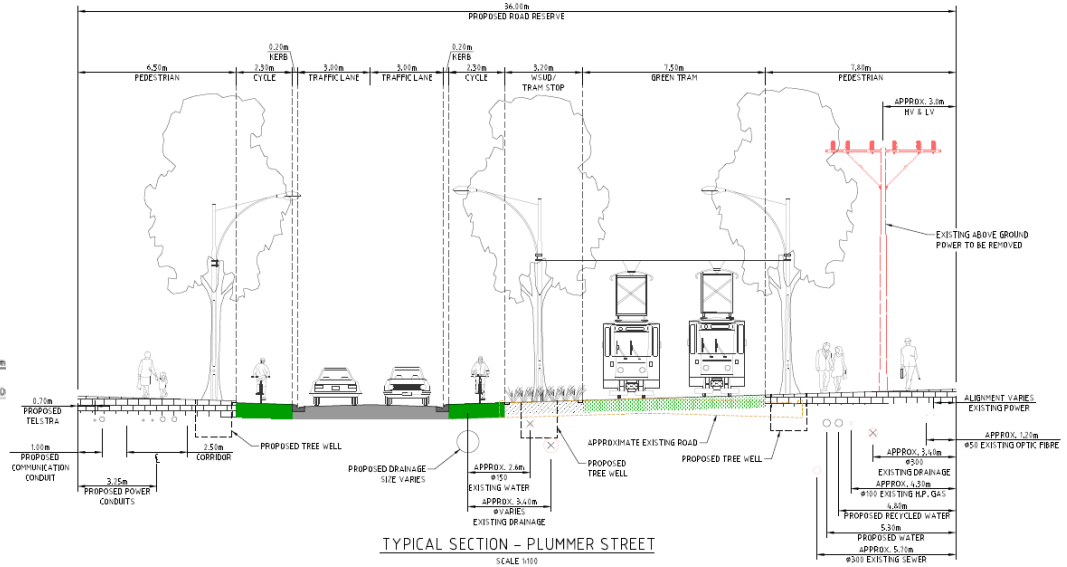


Typical plan

Examples of Outputs

Functional Outputs:





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Attachment 8

Cross Section & Case Study Review Memorandum

Memorandum

05 October 2018

To	Shelley Bennett (CoPP), Alex Robinson (CoM)		
Copy to	Theodora Hogan (Melbourne Water), Todd Berry (DELWP)		
From	David Howard	Tel	+61 3 8687 8789
Subject	Fishermans Bend Streetscape Case Study Review	Job no.	3136555

1 Introduction

1.1 Purpose of this memorandum

The purpose of this memorandum is to provide a high level summary of our initial critique of the preliminary case study streetscape cross sections provided the City of Port Phillip (CoPP) and City of Melbourne (CoM).

This memorandum is provided to facilitate collaborative discussion and allow for further iterative modifications to be made to the initial streetscape cross. ***We propose to provide additional alternative streetscape configurations for the Graham St case study next Monday (08/10/2018)***. ***This includes an alternative cycle path arrangement***. Further exploration of the opportunities and challenges associated with the case study streetscape cross sections and JL Murphy Reserve will be undertaken in the coming weeks. This includes accommodation of services in the streetscape.

2 General Feedback –CoPP Case Study Streetscape Cross Sections

Provision for Flood Detention

The provision of flood detention areas generally appears to be adequate when compared to the Ramboll breakdowns for blue laneways, green streets and cloudburst boulevards.

Provision for Flood Conveyance

The provision of flood conveyance areas (100 yr ARI) generally appear to be inadequate when compared to GHD's flood modelling. This is particularly relevant to the streetscapes that carry flood waters in the 100 yr ARI event and include sections of the following streetscapes across the entire Fishermans Bend precinct:

- Todd Rd
- Williamstown Rd
- Cook St
- Prohasky St
- Salmon St
- Graham St
- Woolboard Rd
- Bertie St
- Ingles St
- Boundary St
- Lorimer St

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From a flood conveyance perspective, a tailored streetscape approach in each of these locations will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). For this reason, we have prepared a specific review of the Green Street (34 m linear park) and applied it to one of the above streets. The attached Graham St cross section provides a before and after comparison of the provision of flood conveyance in the streetscape. In this scenario the initial cross sectional area (assuming a Green St of 34 m with linear park typology applies) provided a conveyance area of 4 sq m whilst GHD's modelling indicated a required conveyance area of 10 sq m. Modifications to the cross section provides the additional 6 sq m required. Further collaborative work is required here.

Drainage Functionality

From a drainage functionality perspective, a tailored streetscape approach will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). Refer to the attached Graham St cross section for a before and after comparison of how the streetscape drainage functionality can be improved. Further collaborative work is required here.

Vertical depth of detention systems

The vertical depth of detention systems will also need to be tailored based on the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy, location if the catchment, and the local conditions (i.e. topography, tail water constraints). Further collaborative work is required here.

Streetscape Cross Fall, Grades & Drop Offs

The existing sections do not provide adequate vertical detail to critique streetscape cross fall, grades and drop-offs. Refer to the attached Graham St cross section for a before and after comparison of how the streetscape cross fall, grades & drop offs can be improved. Further collaborative work is required here.

Conflicts with Existing & future Provision of Services

The future service requirements are yet to be confirmed (TBC by Taskforce in the coming weeks/months). This will impact the need and desire to relocate services.

Based on our review of the Plummer St cross section there appears to be conflicts between the tree pit detention and existing services based on the Mesh Funding and Financing Infrastructure Case Studies.

Refer to the attached Graham St cross section for a review of existing services.

3 General Feedback –CoPP JL Murphy Reserve

Based on the review of the Graham St cross as an example, the depth of detention areas within the streetscape is likely to be a minimum 1.5 m below the ground level (current sections show a 1.0-1.35 m deep approach). With this as a starting point the JL Murphy Reserve would need to (not consider broadening the catchment area, which would likely deepen the detention requirement or part thereof). Any future detention requirements should consider future smart tank consideration, retention, and reuse on open space (i.e. not all the water draining to JL Murphy needs to be pumped to a receiving waterway/Port Phillip Bay).

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Further exploration of the opportunities and challenges associated with the JL Murphy Reserve will be explored further in the coming weeks.

4 General Feedback –CoM Case Study Streetscape Cross Sections

Provision for Flood Detention
The provision of flood detention areas generally appears to be adequate when compared to the Ramboll breakdowns for blue laneways, green streets and cloudburst boulevards.
Section A should provide some level of detention (0.6 sq m as per Ramboll blue lane way detention interpretation). Further collaborative work is required here.

Provision for Flood Conveyance
The provision of flood conveyance areas (100 yr AR) will need to be explored in further detail with GHD's flood modelling. From a flood conveyance perspective, a tailored streetscape approach in each of these locations will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). Further collaborative work is required here.

Drainage Functionality
From a drainage functionality perspective, a tailored streetscape approach will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). Refer to the attached Graham St cross section for a before and after comparison of how the streetscape drainage functionality can be improved. Further collaborative work is required here.

Vertical depth of detention systems
The vertical depth of detention systems will also need to be tailored based on the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy, location if the catchment, and the local conditions (i.e. topography, tail water constraints). Further collaborative work is required here.

Streetscape Cross Fall, Grades & Drop Offs
The existing sections do not provide adequate vertical detail to critique streetscape cross fall, grades and drop-offs. Further collaborative work is required here.

Conflicts with Existing & future Provision of Services
The future service requirements are yet to be confirmed (TBC by Taskforce in the coming weeks/months). This will impact the need and desire to relocate services. Further collaborative work is required here.

5 Specific Feedback – Graham St

Refer to the attached Graham St cross section for a before and after comparison of how the streetscape drainage functionality, vertical depth of detention systems, streetscape cross-falls/grades/drop-offs, and conflict with existing/future provision of services can be improved.

A detention area exceeding the 3.2 sq m target can be provided (based on Ramboll green street detention interpretation).

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A conveyance area equivalent to 10 sq m can be provided (in accordance with GHD modelled area), and is based on:

- Tree pits/raingardens providing an average 400 mm of conveyance (1.66 sq m);
- Road and parking bay providing an average 350 mm of conveyance (2.84 sq m);
- Cycle path providing an average 325 mm of conveyance (1.95 sq m); and
- Linear park providing an average 350 mm of conveyance (3.60 sq m).

The maximum allowable depth of flooding was assumed to be 400 mm at any one point in the streetscape.

We propose to provide additional alternative streetscape configurations for the Graham St case study next Monday (08/10/2018).

6 Challenges & Innovative Considerations in Streetscape Design

Table 1 presents challenges and innovative considerations in the streetscape design. A hierarchy and level of flood protection are provided for each component of the streetscape.

Table 1 Challenges and Innovative Consideration in Streetscape Design

Hierarchy of Flood Protection	Level of Flood Protection	Challenges/Potential Conflicts with Other Objectives	Innovative Considerations
Footpath (or path thereof)	Flood free in 100 yr ARI.	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens Cross fall grade on footpath means step downs into street trees and road required. Accommodation of services through street trees.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath) Exploration of new innovative servicing approach, i.e. footpath v centre median (TBC based the need for larger services) Provision of services through tree pits using structural soils and root control. Kerb break throughs to allow for passive irrigation of street trees and increase in streetscape conveyance area
Tram line	Flood free in 100 yr ARI.	Potential desire for passively irrigated green tram lines. Accommodation of tram stops in the streetscape (potential impacts on flood conveyance)	Drought proof vegetation selection (i.e. sedum) along tramways (refer case study). Storage under tram lines. Innovative tram stop design (include access) to minimise impacts to conveyance.

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Hierarchy of Flood Protection	Level of Flood Protection	Challenges/Potential Conflicts with Other Objectives	Innovative Considerations
Cycle Path	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Lane separators impacts path of low flows from road to street trees/detention zones. Maintaining access during 100 yr ARI flood event.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath). Raise part of cycle path above 100 yr ARI flood level. Relocation of cycle paths adjacent to footpaths and allow road drainage to filter into linear park. As a results cycle path remains flood free in 100 yr ARI. Relocation/future services under cycle path.
Road & Parking Bays	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens. Position of street trees to maximise passive irrigation/detention and provide shading of pedestrians and cyclists	Street trees in centre median of road if road is inverted Two way cross fall to maximise passive irrigation/detention. Permeable pavements in parking bays to street trees for detention/irrigation. Larger street tree footprint and detention volumes (i.e. strata cells under parking bays).
Linear Park	Some detention in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Intersection treatments. Streetscape furniture & vegetation impacts conveyance capacity. Egress over linear park during flood events. DDA compliant grading and access.	Streetscape furniture selection. Vegetation selection. Bridging to provide egress at regular intervals.

Regards,

David Howard
Team Leader, Water Strategy
(03) 86878789

Attachments (2 No.) Graham St Streetscape Mark-ups

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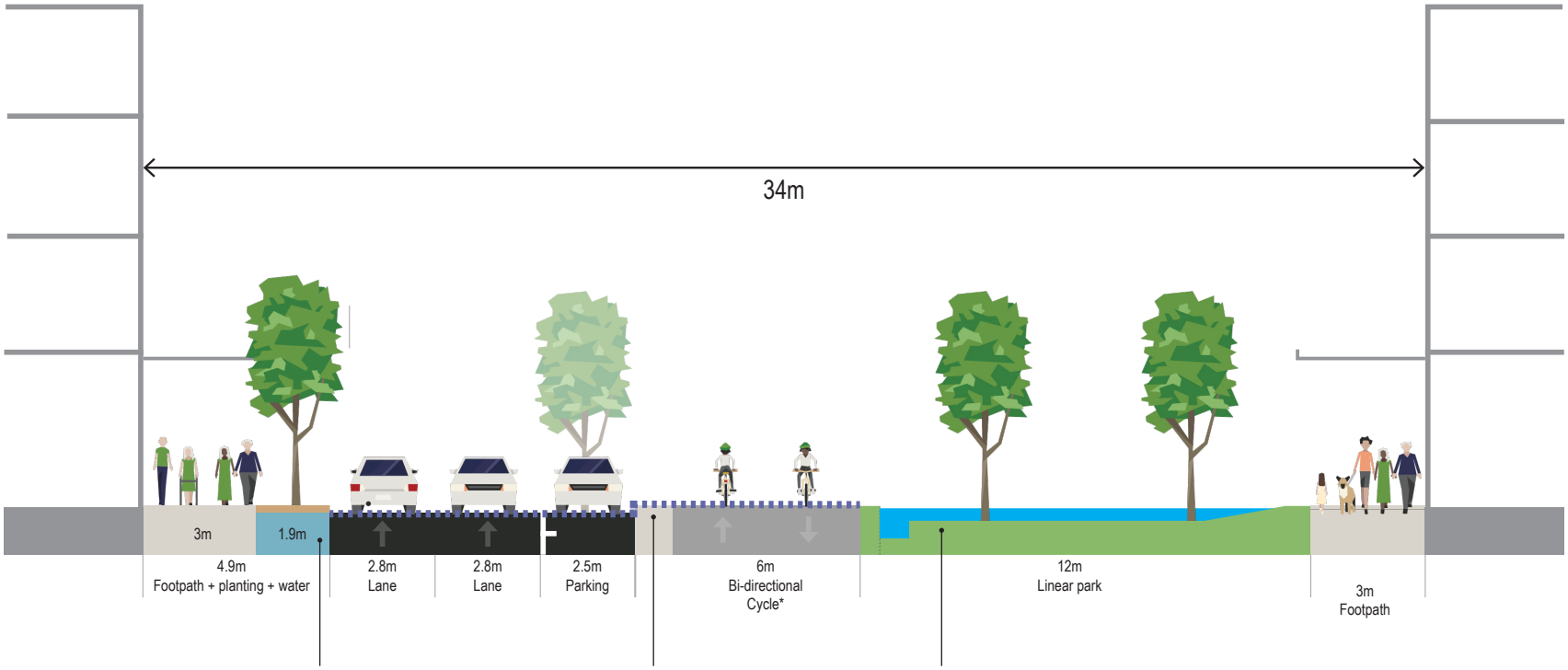
Green Street

New street (34m with linear park)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*6m separated bi-directional cycle = 5m cycle lane + 1m buffer (to car parking)

*Option for trees and stormwater planters within parking lane (e.g. interspersed with car parks).

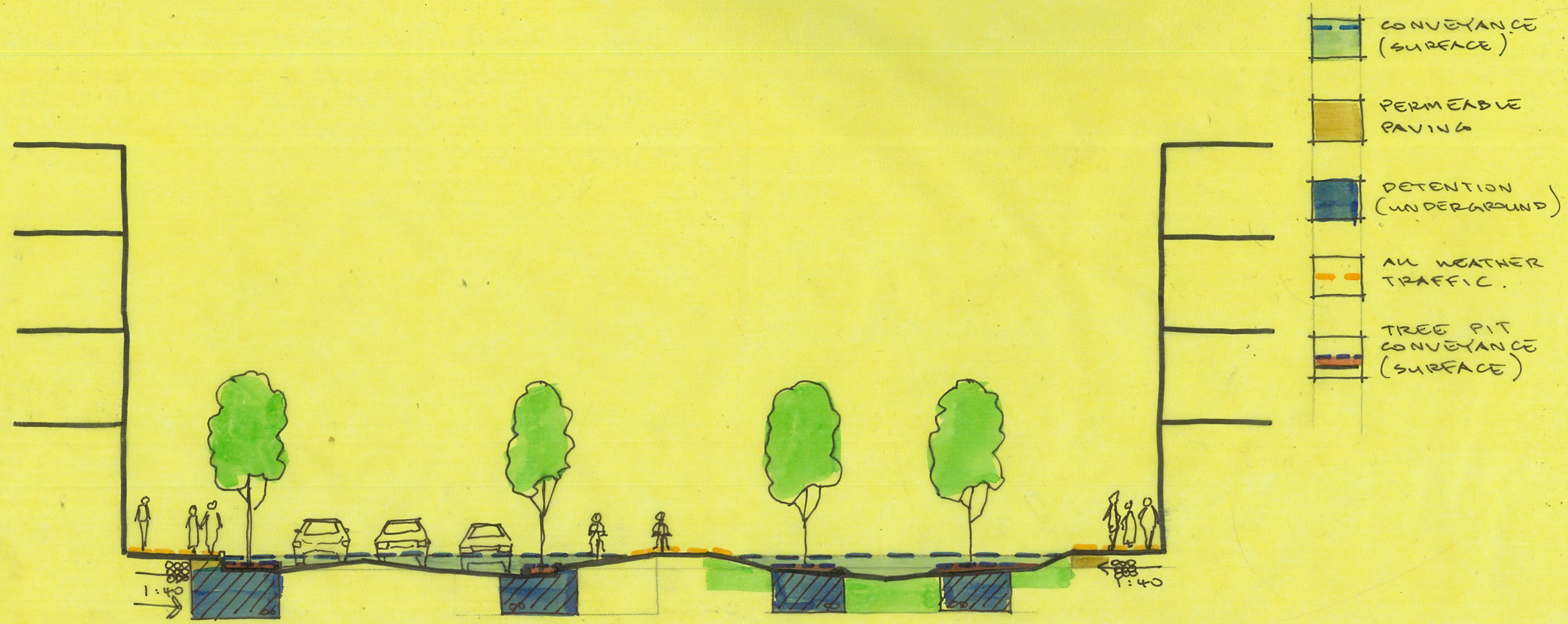
* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.

* Services to be located underneath footpaths

Permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

Small-scale channel + lowered linear park (to contain a mix of passive & active uses, softscape & hardscape areas)



3M FOOTPATH | 1.9M | 2.6M LANE | 2.6M LANE | 2.5M PARKING | 6M CYCLE | 12M LINEAR PARK | 3M FOOTPATH.

2M FOOT PATH. — 2.9M PERMEABLE PAVEMENT. & STRUCTURAL SOIL W/ STORAGE.

TREE PIT W/ CONVEYANCE

TREE PIT W/ CONVEYANCE & STRUCT. SOIL.

ALL WEATHER CYCLE

TREE PIT W/ CONVEY. & STRUCT. SOIL.

TREE PIT W/ CONVEY. & STRUCT. SOIL.

GREEN STREET ALTERNATE CONFIGURATION SK01.

NTS GHDW.

5.10.2016.

Attachment 9

Case Study Review Workshop Presentation

Fishermans Bend Drainage Strategy – Case Study Review

Progress Workshop – 10 October 2018

Agenda

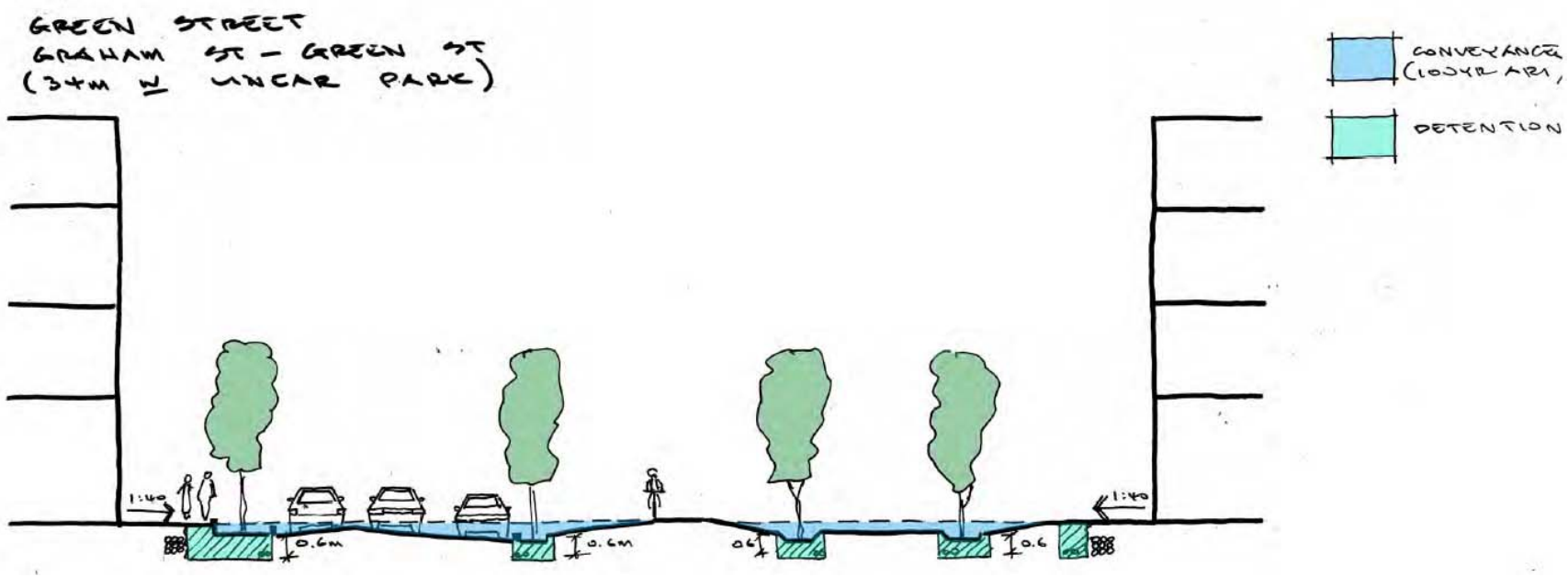
Item	Time
Recap on scope of review	5 mins
How do we manage conveyance and storage in streetscape?	15 mins
Street conveyance capacities from flood modelling	10 mins
Detention storage requirements	5 mins
Achieving detention storage elsewhere	5 mins
Recap on CoPP/CoM streetscape sections	5 mins
General Comments on CoPP & CoM streetscape sections Challenges and innovative considerations in streetscape design	5 mins
Detailed Review of CoPP Green St (34 m wide with Linear Park) – Graham St Application	15 mins
CoPP Cloudburst Boulevard Review	5 mins
CoPP Green St (22 m) Review	5 mins
CoPP Blue Laneways (6 m & 9 m) Review	5 mins
Next Steps	5 mins

Recap on Scope of Review

Our review of CoPP and CoM Streetscapes focused on a critique of:

- Provision for Flood Detention
- Provision for Flood Conveyance
- Drainage Functionality
- Vertical depth of detention systems
- Streetscape Cross Fall, Grades & Drop Offs
- Conflicts with Existing & Future Provision of Services
- Streetscape integration with JL Murphy Reserve

How do we manage conveyance and storage in streetscape?



Street conveyance capacities from flood modelling

Street Names	Length (m)	Length Flooded (m)	% Flooded	Ave. Conveyance Area (m2)	Ave. Road Width (m)	Likely to be impacted by CoPP pipes downstream
Bertie Street	829	531	64%	7.2	32	-
Boundary Street	1392	277	20%	6.5	31	-
Cook Street	1097	535	49%	5.9	30	Yes
Fennel Street	599	168	28%	2.5	32	-
Graham Street	770	514	67%	10.5	30	Yes
Ingles Street	1454	605	42%	4.1	42	-
Lorimer Street	4722	941	20%	2.3	30	-
Prohasky Street	459	267	58%	4.5	38	Yes
Salmon Street	1616	528	33%	4.2	32	Yes
Todd Road	1627	699	43%	9.2	35	Yes
Williamstown Road	2677	2174	81%	6.6	30	Yes
Woodboard Road	320	118	37%	1.3	39	Yes
All Others	47809	0	0%	N/A	N/A	N/A
Total	**65373**	**7357**	**11%**			

Detention storage requirements

Ramboll's Detention Requirements:

- Cloudburst Blvd 4.0 sq m
- Green Streets 3.2 sq m
- Blue Laneways 0.6 sq m

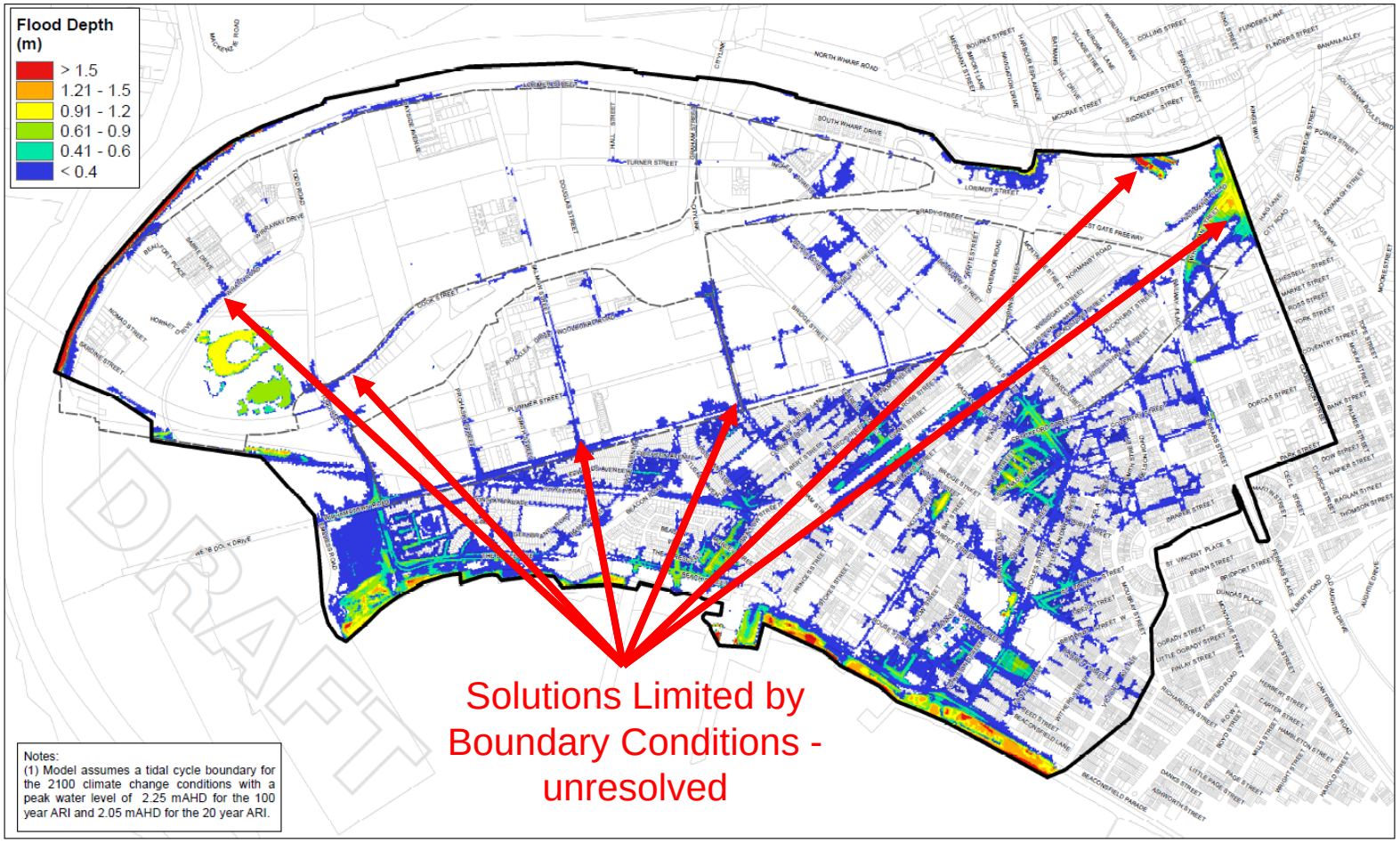
Degree of caution required given the location and nature of streetscape is continually evolving.

Achieving detention storage elsewhere

Trade-offs:

- More rainwater tanks
- Private realm
- Public realm
- Flood certain streets over others

2018 Base Case Drainage Plan



Paper Size A3
0 70 140 280 420 560
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

LEGEND
Model Boundary
Precinct Boundaries

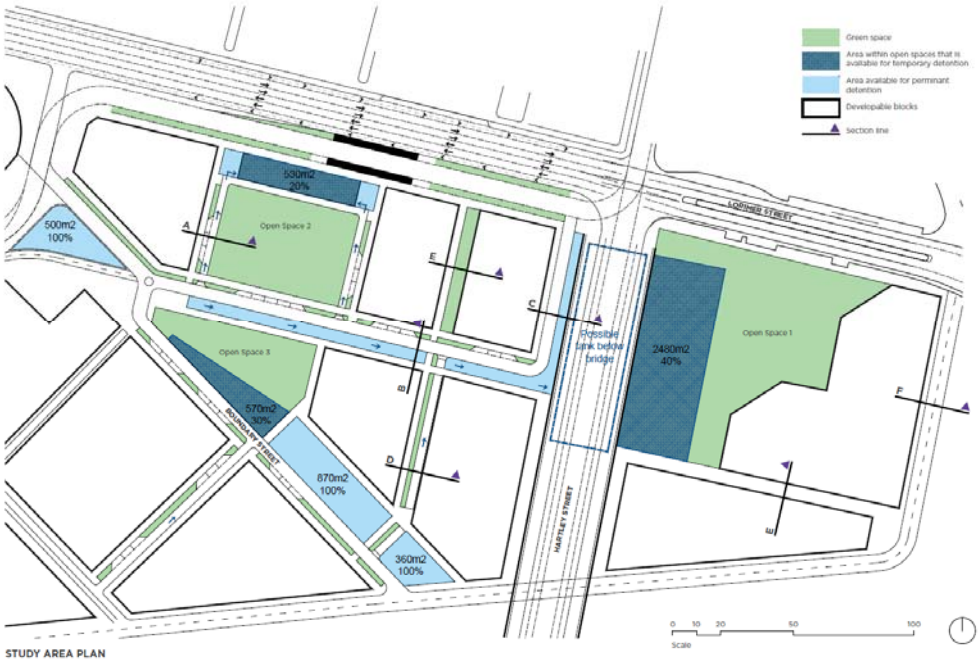
MELBOURNE WATER
FISHERMAN'S BEND DRAINAGE PLAN
Baseline drainage plan
100 year ARI

Job Number 31-35713
Revision A
Date 27/07/2018

Figure C2

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

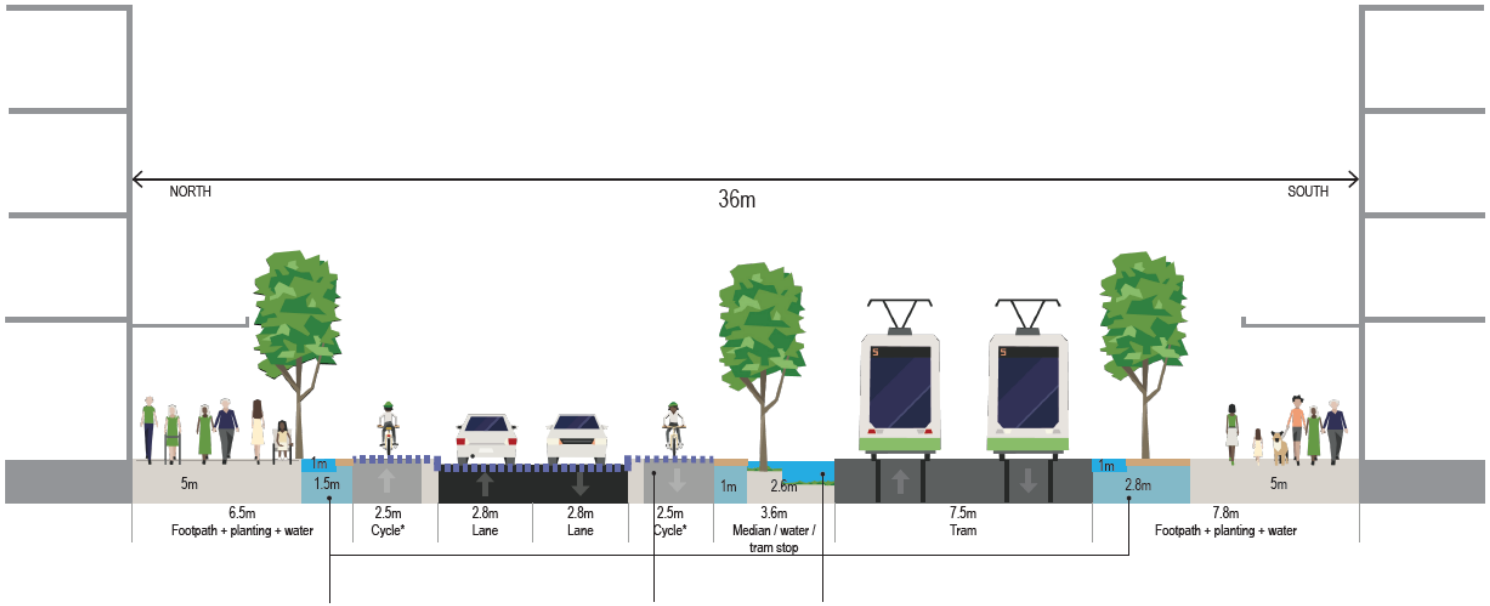
Recap on COPP/COM Streetscape Sections



STUDY AREA PLAN

Cloudburst Boulevard

Plummer Street Civic Boulevard (36m)



Conveyance
Detention (surface)
Permeable Paving
Detention (underground)

NOTES:

* 2.5m separated cycle lane = 2m cycle lane, 0.5m buffer
* Tram stop - minimum 2.4m wide
* Option for 1-way traffic in some areas?
*Option to treat carriageway as a shared space (no kerbs)?
* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.
* Services to be located underneath footpaths

Small-scale channel (1m) + permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

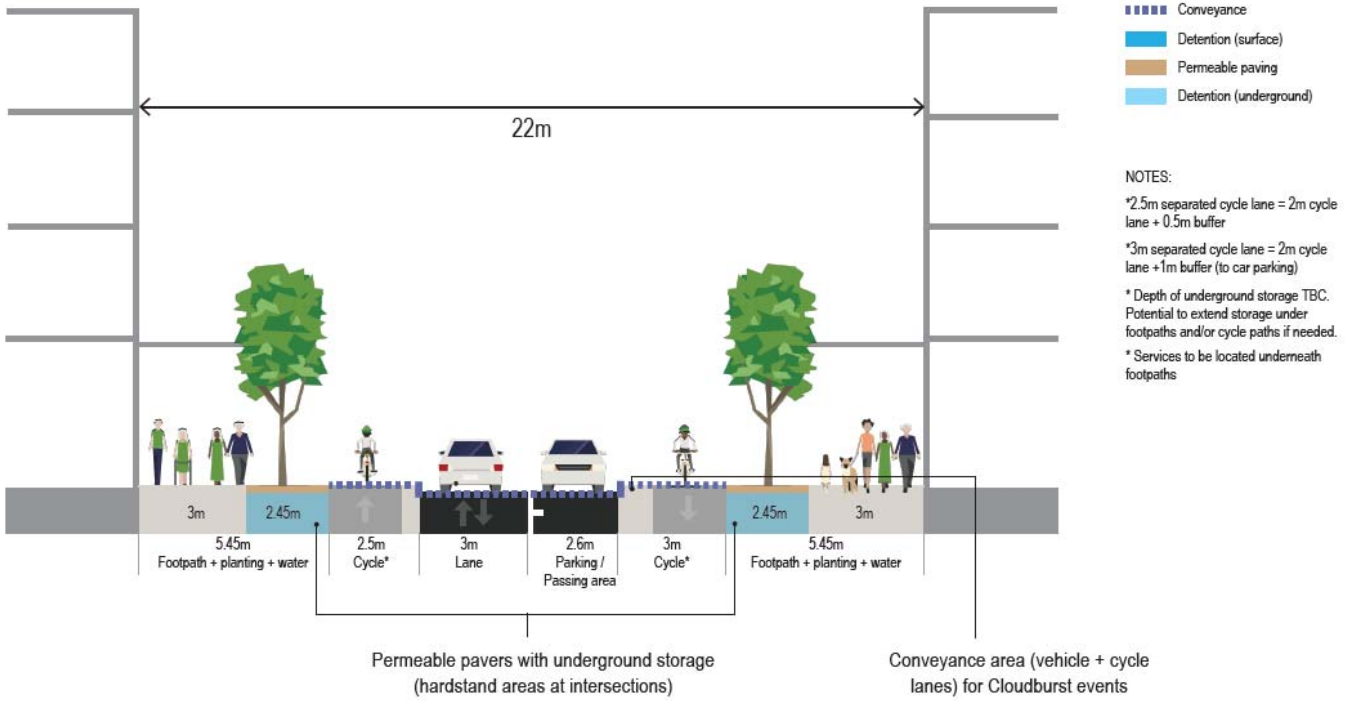
* Option for some stormwater planters (e.g. around trees)

Stormwater planters + permeable paving buffer (hardstand areas at tram stops / intersections)

All intersections / tram stops / pedestrian crossings will be paved.

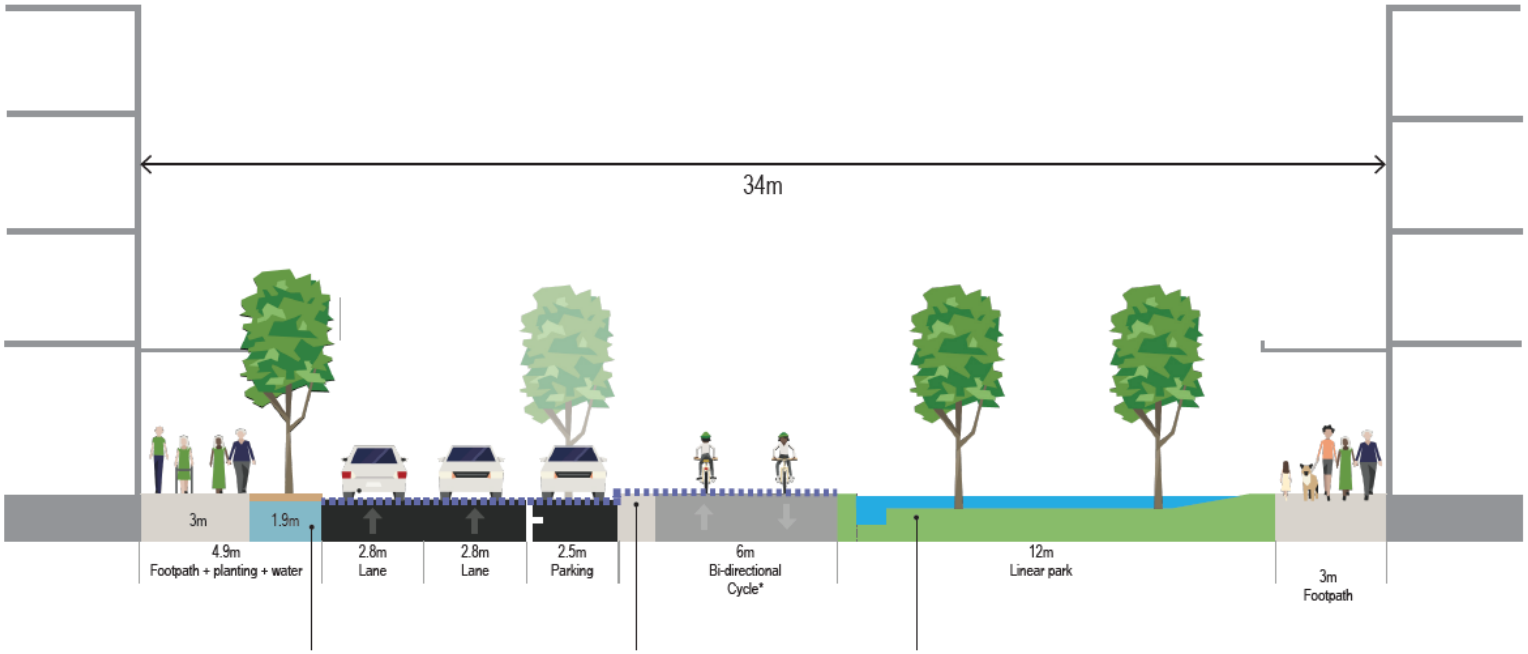
Green Street

New street (22m)



Green Street

New street (34m with linear park)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*6m separated bi-directional cycle = 5m cycle lane + 1m buffer (to car parking)

*Option for trees and stormwater planters within parking lane (e.g. interspersed with car parks).

* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.

* Services to be located underneath footpaths

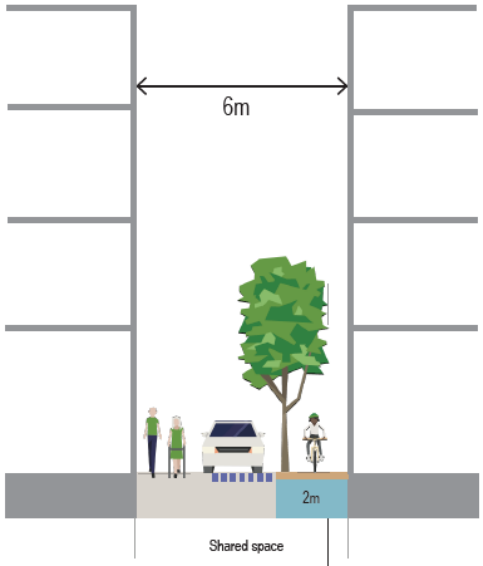
Permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

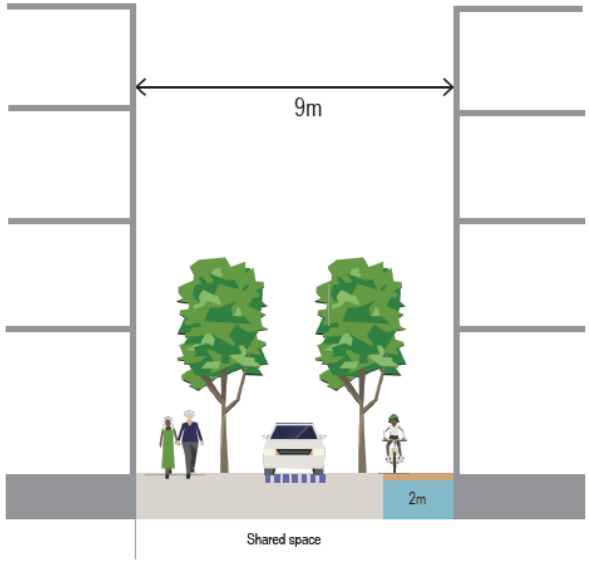
Small-scale channel + lowered linear park (to contain a mix of passive & active uses, softscape & hardscape areas)

Blue Laneway

New laneway (6m)



Permeable pavers with underground storage
(hardstand areas at intersections)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*Taskforce preference for 6m wide laneways. CoPP requested 9-12m wide laneways through panel process.

*Laneways assumed to be shared spaces.

* Depth of underground storage TBC. Potential to extend storage under footpaths or bike paths if needed.

SECTION A

LOCAL STREET ADJACENT TO OPEN SPACE

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

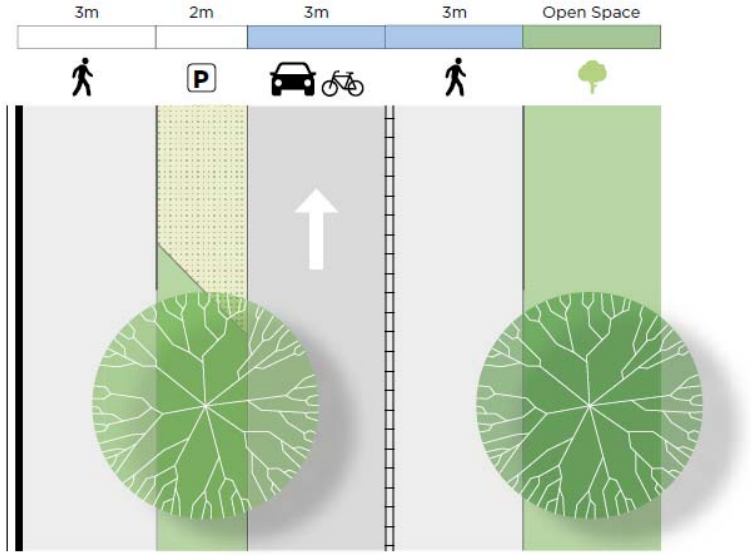
Low-volume street without transit routes. 3m width for one way traffic, focusing on place making over vehicle movement.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to vehicular lane and secondary pedestrian footpath.

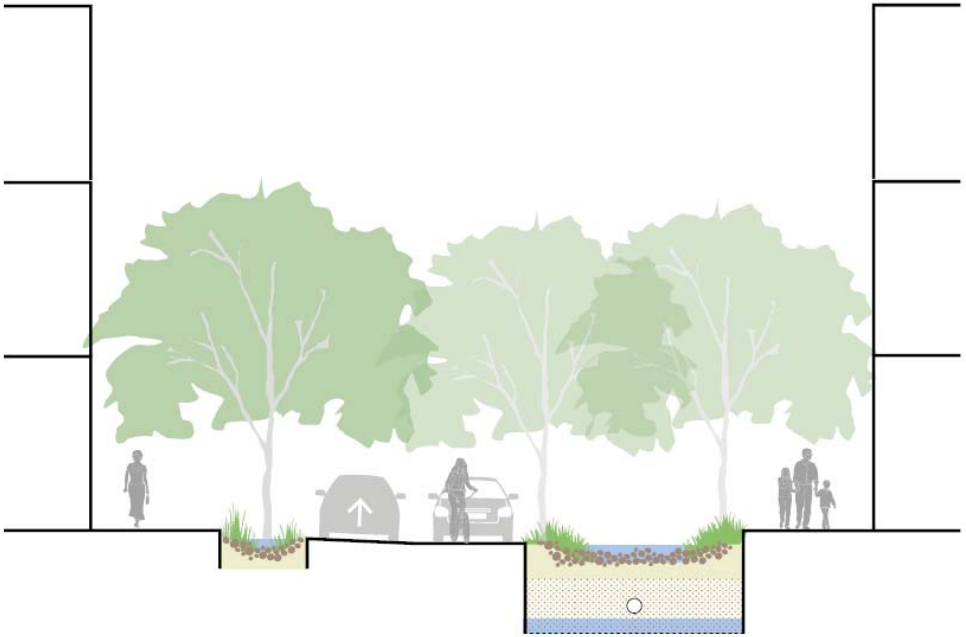
Parking

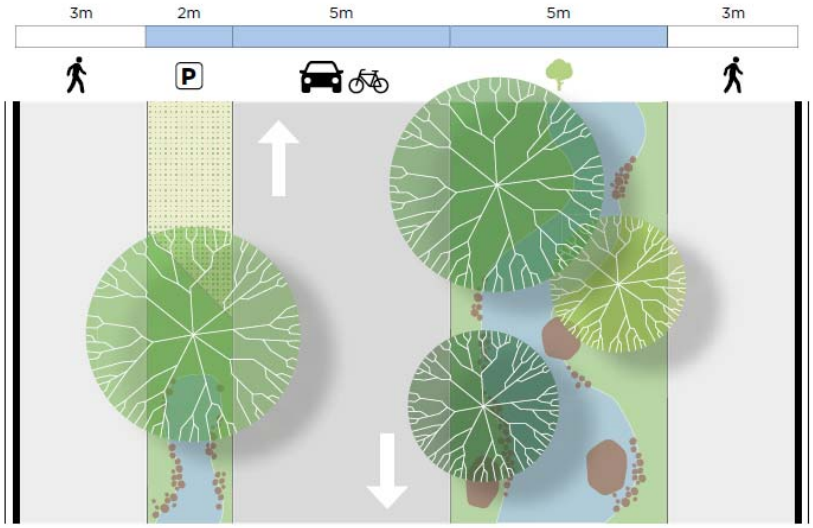
Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION B

LOCAL STREET WITH LINEAR PARK





Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane and linear park.

Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.

SECTION C

LOCAL STREET ADJACENT TO PROPOSED TRAM BRIDGE

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

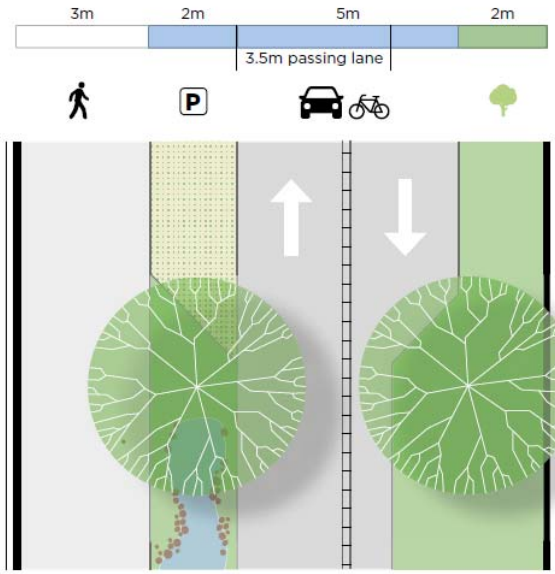
5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass. 3.5 m passing lanes are introduced for further traffic calming.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane.

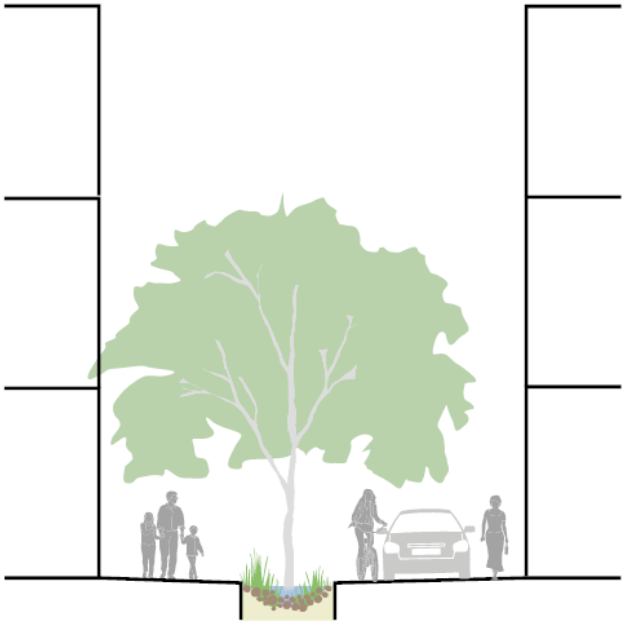
Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION D

ONEWAY LANEWAY



Function

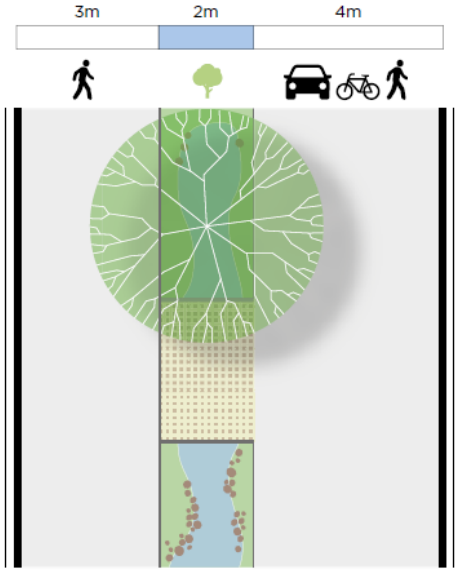
Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

Low-volume street without transit routes. 4m width for one way traffic as part of a shared surface, focusing on place making over vehicle movement.

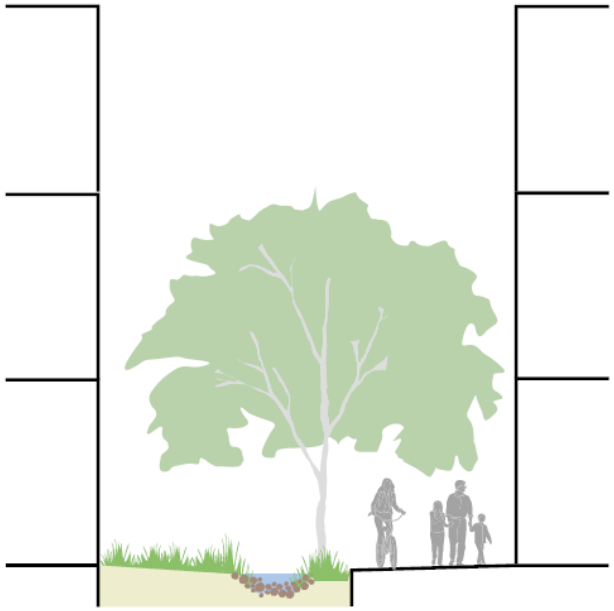
Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to central rain gardens.



SECTION E

PEDESTRIAN LANEWAY



Function

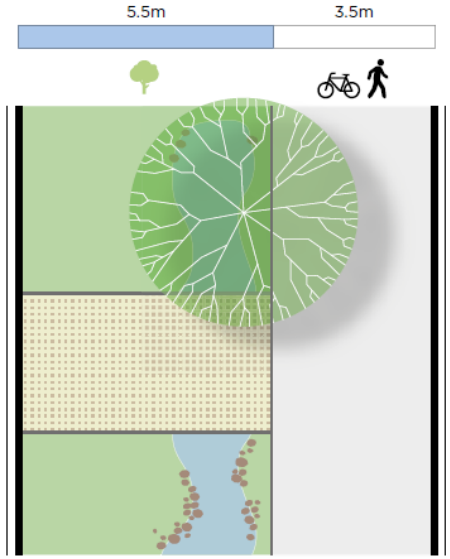
Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

Off limits to private vehicles, however do allow emergency vehicular access.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to green space.



SECTION F

SERVICE ROAD

Function

Dedicated service access, concentrating larger vehicles (local freight, waste collection, parking access and servicing) to the perimeter of the precinct.

Vehicle Movement + Access

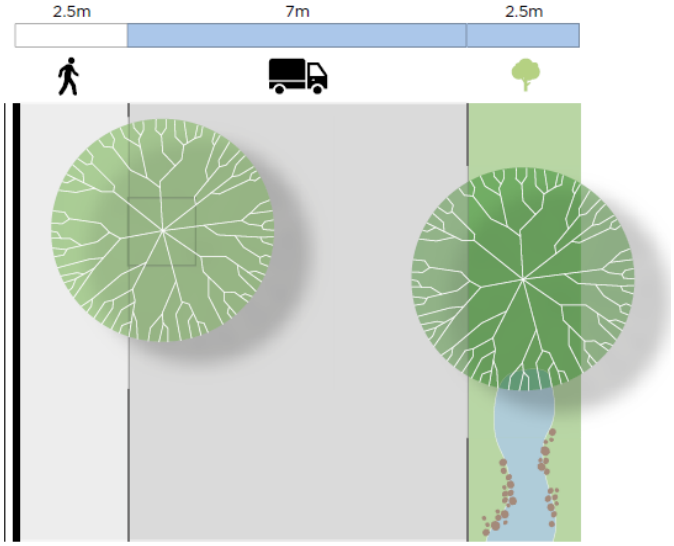
7 m width for two lane traffic. Tree planting introduced for further traffic calming.

Water management

Working as a Green Street to store flood waters at the source.

Parking

No on street parking.



General Comments on CoPP & CoM streetscape sections

Provision for Flood Detention - generally adequate in CoPP and CoM sections relative to Ramboll requirements.

Provision for Flood Conveyance - generally inadequate in CoPP and CoM sections relative to GHD's modelling. Need to tailor streetscape solution for each street on its merits noting there are streets that will have additional factors at play that may limit the ability to get the desired flooding outcome (i.e. due to boundary conditions).

Drainage Functionality – balance of how we get water safely into detention and conveyance areas without compromising amenity (permeable pavements, lowered bike paths, trees next to roads). Can & should be tailored.

Vertical depth of detention systems – subject to individual street characteristics and flood strategy. Can & should be tailored.

Streetscape Cross Fall, Grades & Drop Offs – More detail provided in critique (vertical exaggeration of CoPP sections), balance of drainage function, storage and amenity.

Conflicts with Existing & future Provision of Services

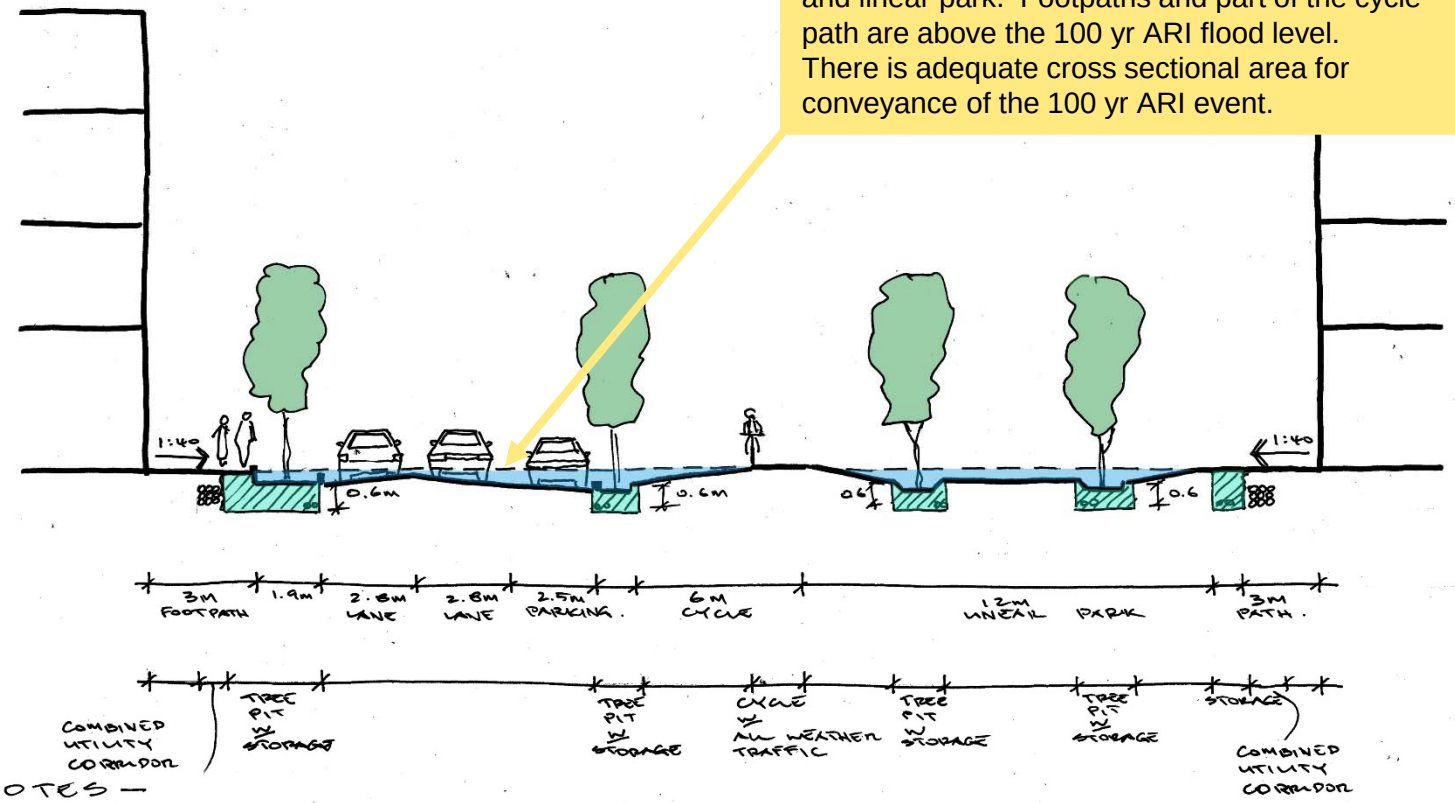
The future service requirements are yet to be confirmed (weeks/months). This will impact the need and desire to relocate services. Integrating services into street tree root ball has benefits (refer City of Toronto case study).

Challenges and Innovative Consideration in Streetscape Design

Hierarchy of Flood Protection	Level of Flood Protection	Challenges/Potential Conflicts with Other Objectives	Innovative Considerations
Footpath (or path thereof)	Flood free in 100 yr ARI.	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens Cross fall grade on footpath means step downs into street trees and road required. Accommodation of services through street trees.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath) Exploration of new innovative servicing approach, i.e. footpath v centre median (TBC based the need for larger services) Provision of services through tree pits using structural soils and root control. Kerb break throughs to allow for passive irrigation of street trees and increase in streetscape conveyance area
Tram line	Flood free in 100 yr ARI.	Potential desire for passively irrigated green tram lines. Accommodation of tram stops in the streetscape (potential impacts on flood conveyance)	Drought proof vegetation selection (i.e. sedum) along tramways (refer case study). Storage under tram lines. Innovative tram stop design (include access) to minimise impacts to conveyance.
Cycle Path	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Lane separators impacts path of low flows from road to street trees/detention zones. Maintaining access during 100 yr ARI flood event.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath). Raise part of cycle path above 100 yr ARI flood level. Relocation of cycle paths adjacent to footpaths and allow road drainage to filter into linear park. As a results cycle path remains flood free in 100 yr ARI Relocation/future services under cycle path.
Road & Parking Bays	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens. Position of street trees to maximise passive irrigation/detention and provide shading of pedestrians and cyclists	Street trees in centre median of road if road is inverted Two way cross fall to maximise passive irrigation/detention. Permeable pavements in parking bays to street trees for detention/irrigation.

Detailed Review of CoPP Green St (34 m wide with Linear Park) – Graham St Application

GREEN STREET
GRAHAM ST – GREEN ST (34M W LINEAR PARK)



NOTES –

- ALL TREE PITS W 2NO. MIN. AGI FOR CONVEYANCE
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3–4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION = $3.6m^2$ (TARGET $3.2m^2$ BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE = $10m^2$ BASED ON (A) TREEPIT / RAINGARDENS AVG. 400MM / $1.66m^2$
  (B) ROAD AVG. 350MM / $2.84m^2$
  (C) CYCLE PATH AVG. 325MM / $1.95m^2$
  (D) LINEAR PARK AVG. 350MM / $3.60m^2$.

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

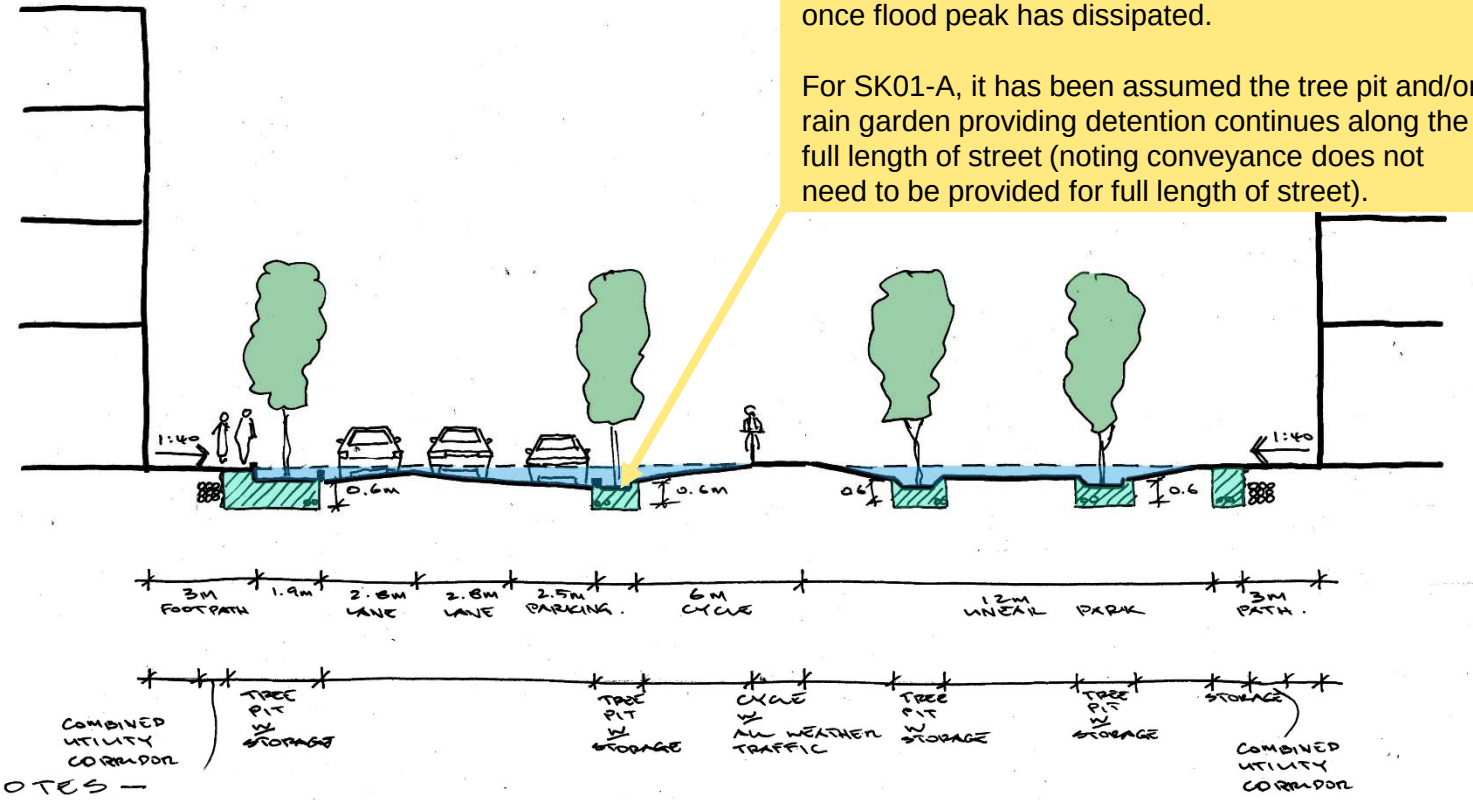
GREEN STREET
GRAHAM ST – GREEN ST (34m W LINEAR PARK)

Tree pits provide conveyance and detention (assuming gravel backfill below root ball in lined storage). Tree pit detention free drains via ag lines once flood peak has dissipated.

For SK01-A, it has been assumed the tree pit and/or rain garden providing detention continues along the full length of street (noting conveyance does not need to be provided for full length of street).

CONVEYANCE (100YR ARI)

DETENTION



NOTES –

- ALL TREE PITS W 2NO. MIN. AGI FOR CONVEYANCE
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3–4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION ~ 3.6m² (TARGET 3.2m² BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE ~ 10m² BASED ON (A) TREEPIT / RAINGARDENS AVG. 400mm / 1.66m²
  (B) ROAD AVG. 350mm / 2.84m²
  (C) CYCLE PATH AVG. 325mm / 1.95m²
  (D) LINEAR PARK AVG. 350mm / 3.60m².

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

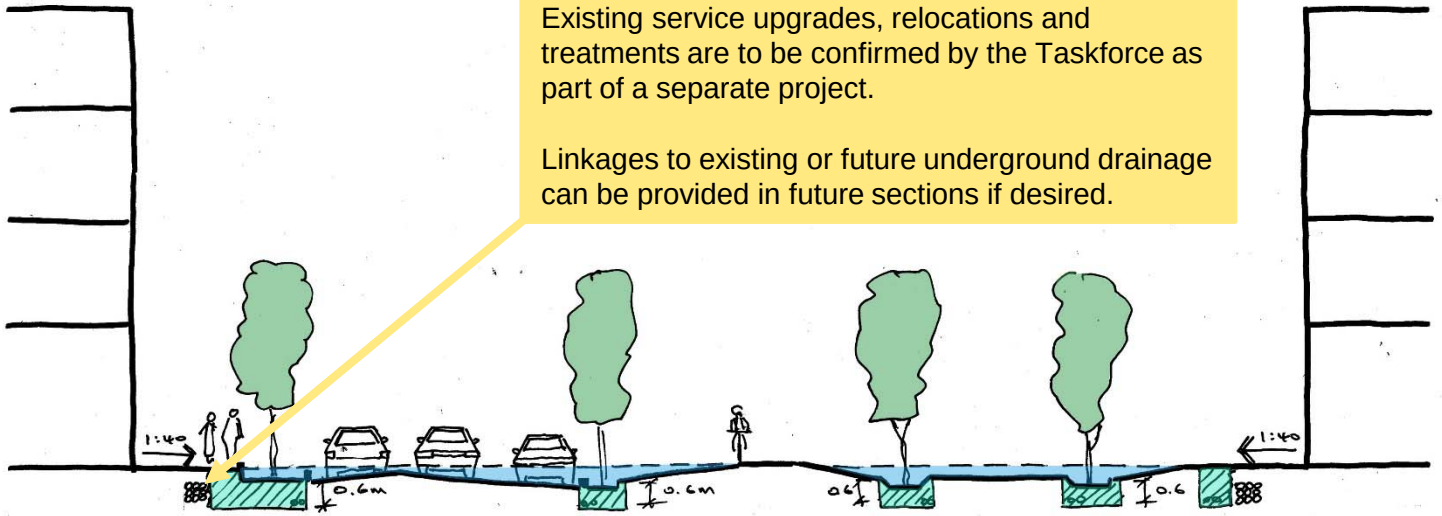
GREEN STREET
GRAHAM ST – GREEN ST
(34M W LINEAR PARK)

CONVEYANCE (100YR ARI)

DETENTION

Existing service upgrades, relocations and treatments are to be confirmed by the Taskforce as part of a separate project.

Linkages to existing or future underground drainage can be provided in future sections if desired.



NOTES –

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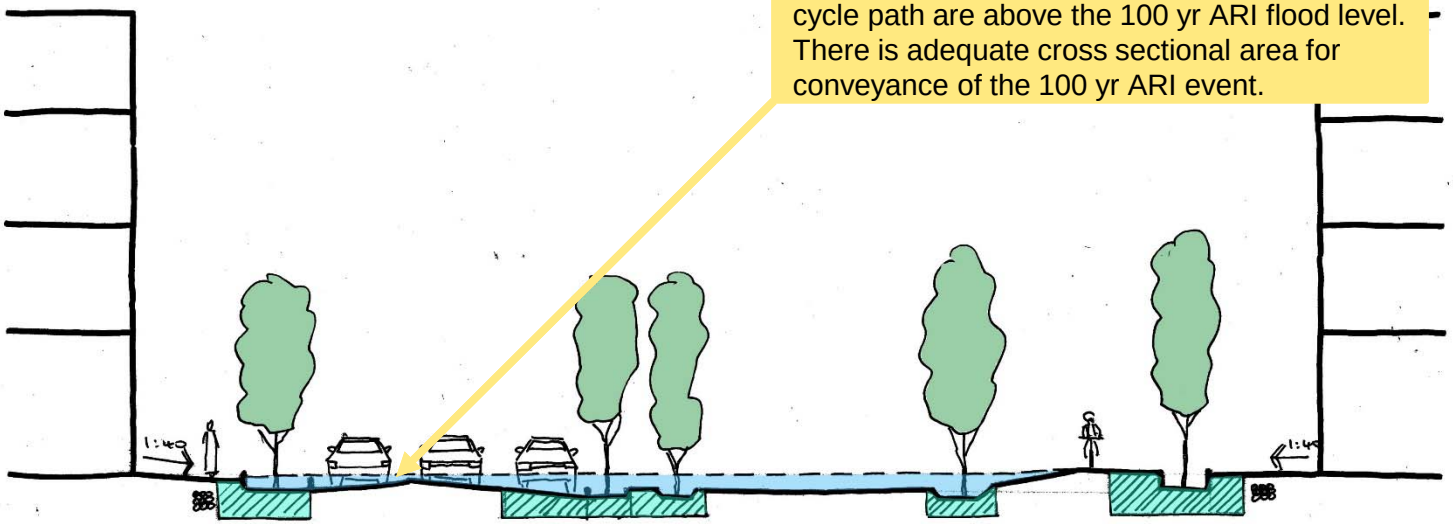
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3–4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION W $3.6m^2$ (TARGET $3.2m^2$ BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE W $10m^2$ BASED ON (A) TREEPIT / RAINGARDENS AVG. 400MM / $1.66m^2$
  (B) ROAD AVG. 350MM / $2.84m^2$
  (C) CYCLE PATH AVG. 325MM / $1.95m^2$
  (D) LINEAR PARK AVG. 350MM / $3.60m^2$.

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

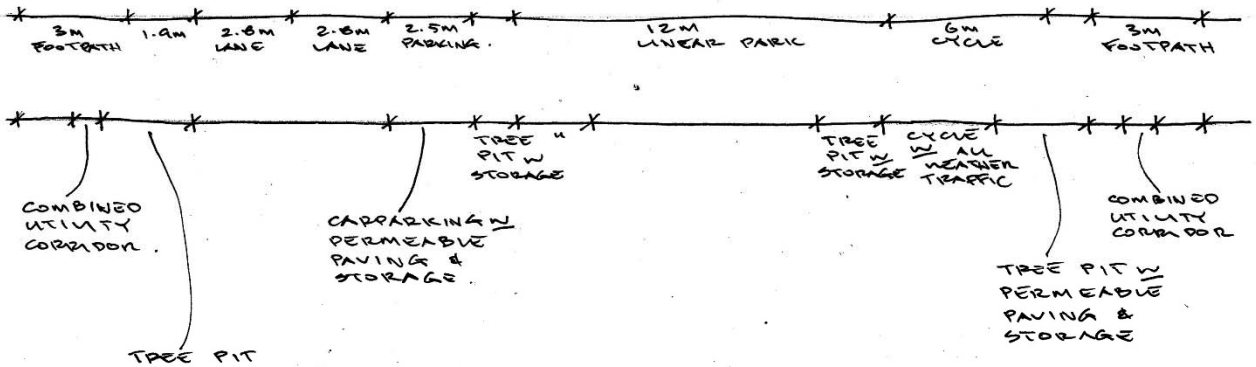
GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)

The 100 yr ARI flood event is confined to road and linear park. Footpaths and part of the cycle path are above the 100 yr ARI flood level. There is adequate cross sectional area for conveyance of the 100 yr ARI event.



CONVEYANCE (100YR ARI)

DETENTION

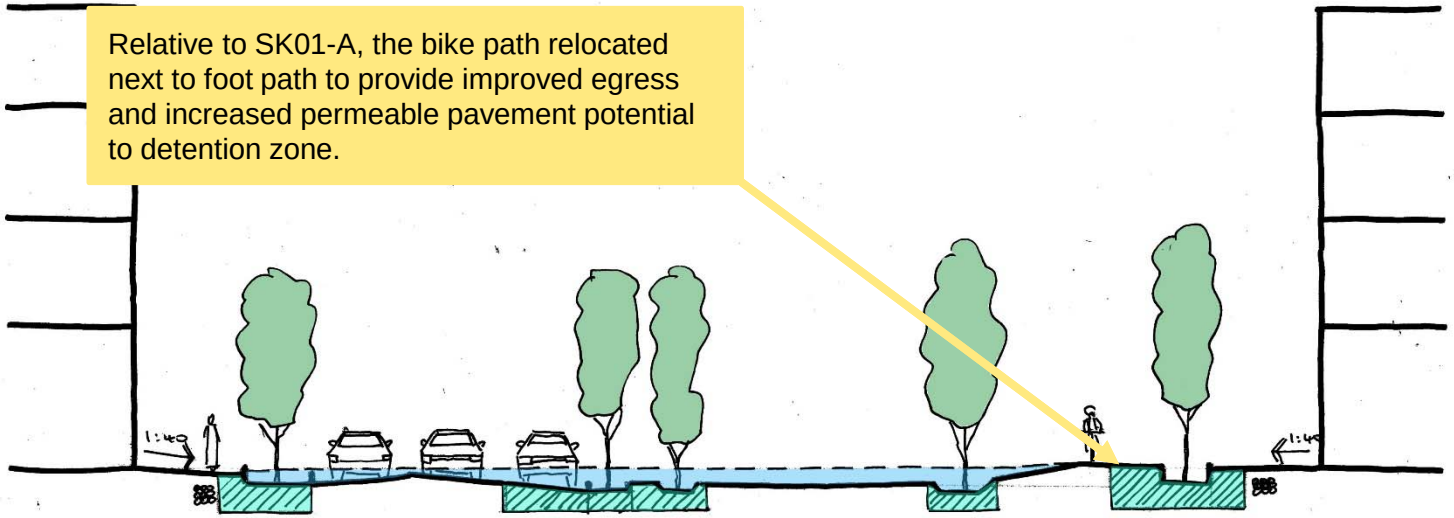


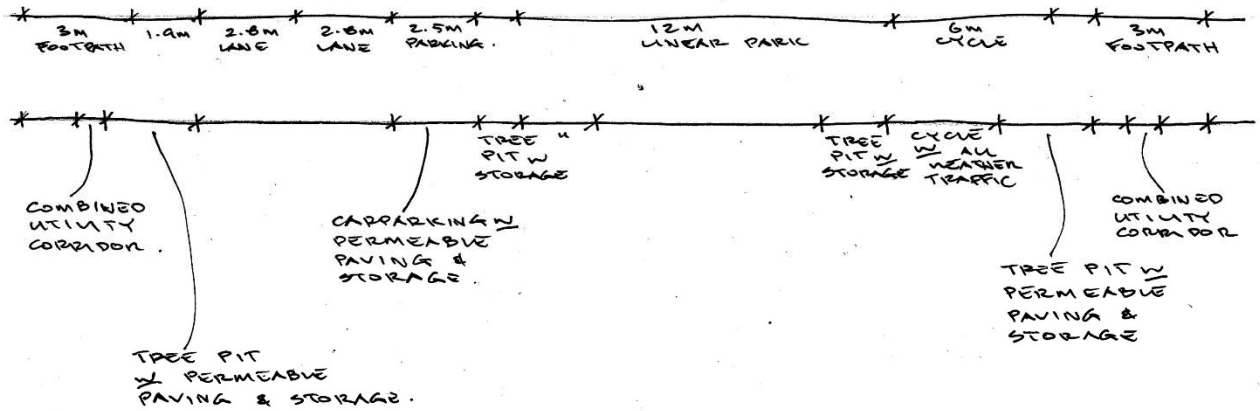
NOTES - AS PER SK01-A.

GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.

GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)

Relative to SK01-A, the bike path relocated next to foot path to provide improved egress and increased permeable pavement potential to detention zone.





NOTES - AS PER SK01-A.

GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.

Appendix B – Documentation of the Development of the Hybrid Approach: All Cross-Sections and Presentations

Appendix B – Hybrid Street Section Development

This document summarises the development of the street cross-sections incorporating flood storage, and the overall case studies, as part of the *Water Sensitive Drainage and Flood Management Strategy for Fishermans Bend*, collaboratively developed by the Fishermans Bend Taskforce Drainage Working. This documents the evolution in thinking from September through to December 2018. This includes the iteration of the draft cross sections (summarised in Table 1) and documents from the various key meetings (summarised in Table 2). It excludes minutes from the various meetings and workshops and the various iterations of Council cross-sections, plans and strategy documents throughout the project.

Table 1 Cross-Section Versions

Phase	Attachment
Council Reference Cross-Sections provided 18th – 25th Sep	1
GHD cross-sections v1 for Working Group workshop on 10th Oct	2
GHD cross-sections v2 for Steering Committee meeting on 24th Oct	3
GHD cross-sections v3 for Council meetings on 31st Oct – 2nd Nov	4
GHD cross-sections v4 for Steering Committee meeting on 24th Oct	5

Table 2 Presentations from Key Meetings/Workshops

Phase		Document	Attachment
Initial scoping/alignment meetings (6th Sep – 10th Sep)		Proposal workflow diagram	6
Opportunities/constraints workshop (11th Sep)		Workshop presentation	7
Case Study/ Cross-Section Development	26th Sep workshop (GHD, CoPP, CoM, FB TF)	NA	*Refer attachment 1*
	10th Oct workshop (GHD, CoPP, CoM, FB TF, MWC, CRCWSC)	Cross section & case study review memorandum Case study review workshop presentation	8 and 9
	24th Oct steering group meeting	GHD input slides for meeting	10
	31st Oct meeting (GHD, CoPP)	Case study assessment slides	11
	2nd Nov meeting (GHD, CoM)	Case study assessment slides	12
	15th Nov workshop (GHD, CoPP, CoM, FB TF, MWC, CRCWSC)	Progress meeting slides	13
	21st Nov workshop (GHD, CoPP, CoM, FB TF, MWC, SEW, CRCWSC)	Progress meeting slides	14
Strategy:	6th Dec steering group meeting	Final steering committee presentation	15

Attachment 1

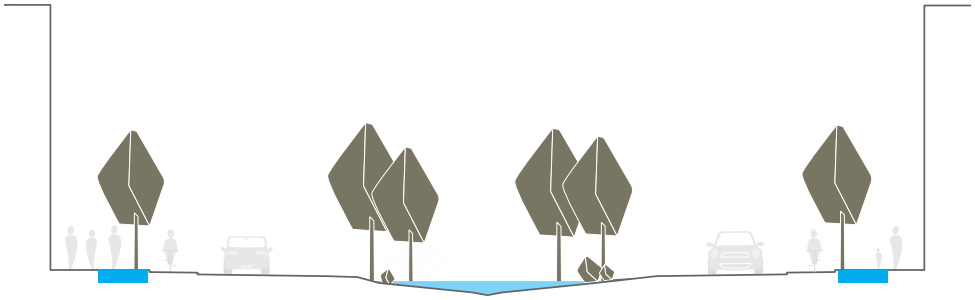
Council Reference Cross-Sections provided 18th – 25th Sep

City of Port Phillip Street and Laneway Cross Sections

Cloudburst masterplan

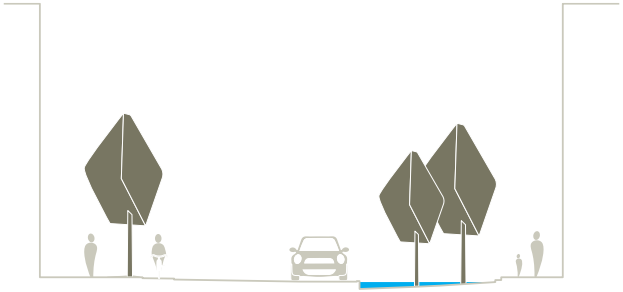
Ramboll Final Report

Case study area



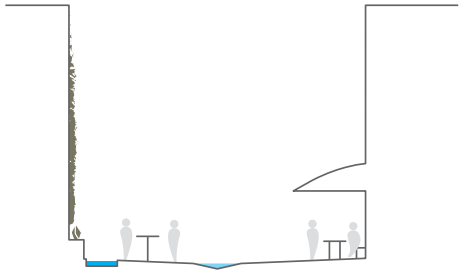
Cloudburst Boulevard

Potential detention: 10m width x 0.4m depth. Conveyance area?



Green Streets

Potential detention: 8m width x 0.4m depth. Conveyance area?



Blue laneways

Potential detention: 2m width x 3m depth. Conveyance area?

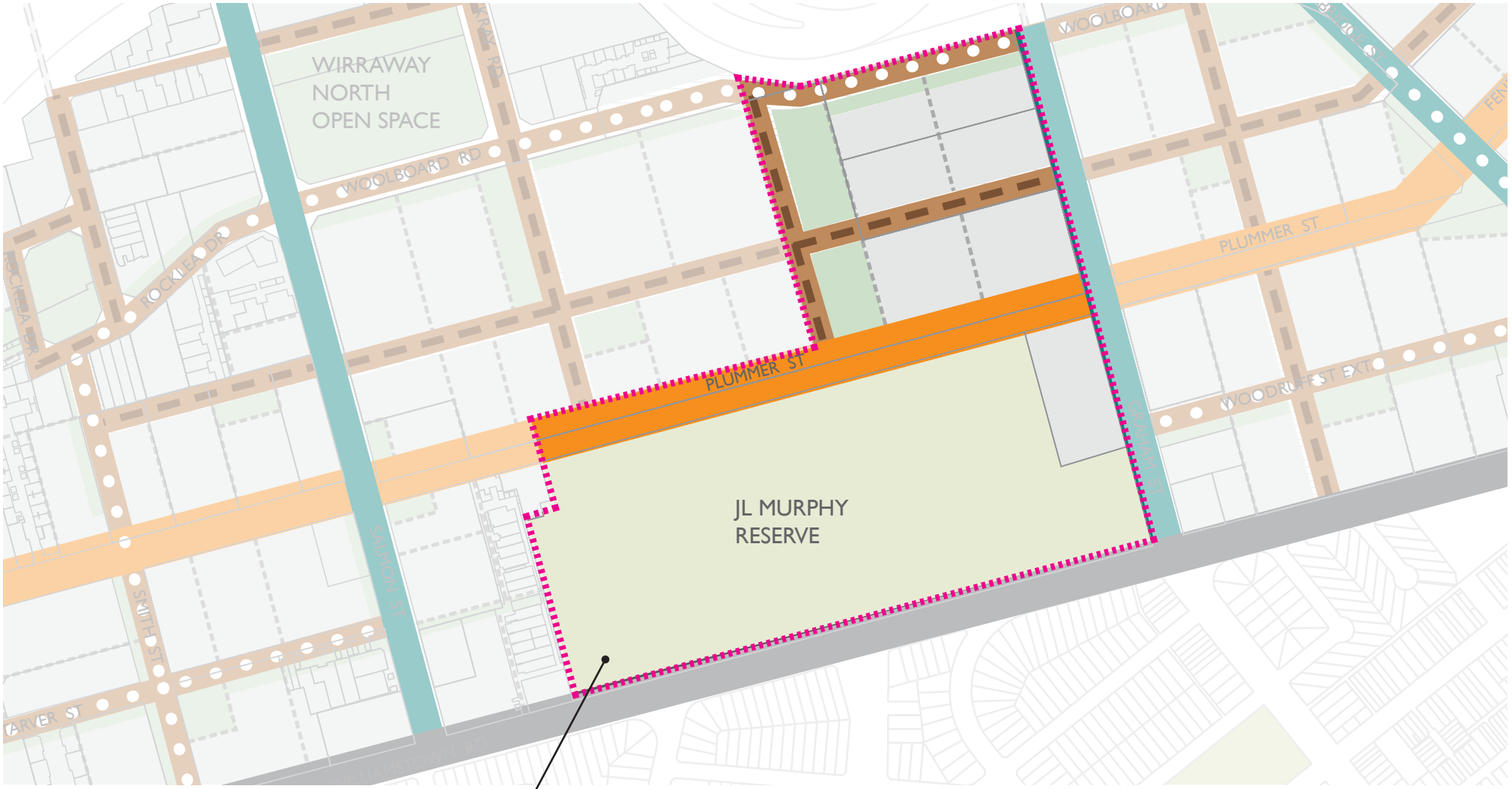
Key

Detention

Conveyance

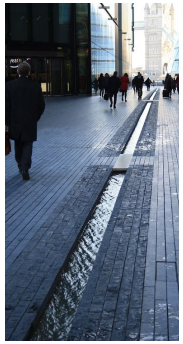
Street hierarchy / types

CoPP



Street interventions

Small-scale channels

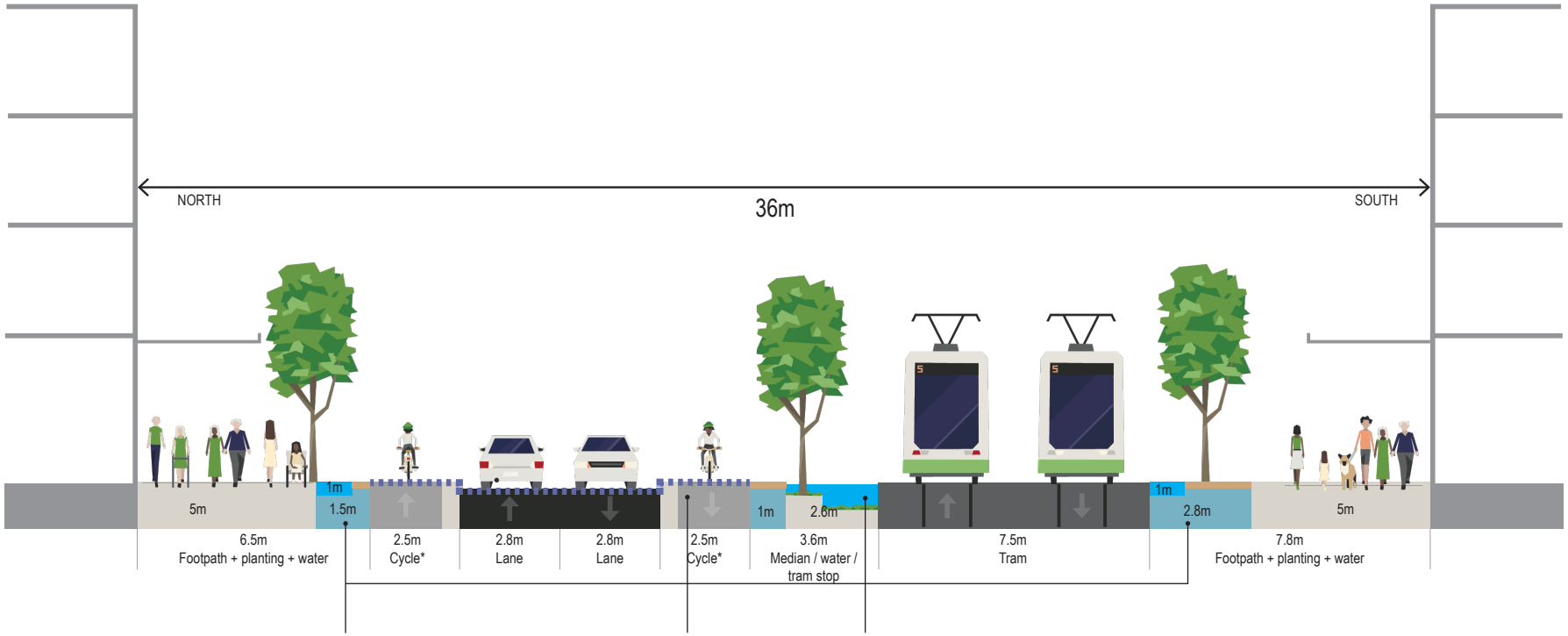


Permeable paving + underground storage

Stormwater planters

Cloudburst Boulevard

Plummer Street Civic Boulevard (36m)



Conveyance
Detention (surface)
Permeable Paving
Detention (underground)

NOTES:

* 2.5m separated cycle lane = 2m cycle lane, 0.5m buffer

* Tram stop - minimum 2.4m wide

* Option for 1-way traffic in some areas?

*Option to treat carriageway as a shared space (no kerbs)?

* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.

* Services to be located underneath footpaths

Small-scale channel (1m) + permeable pavers with underground storage (hardstand areas at intersections)

* Option for some stormwater planters (e.g. around trees)

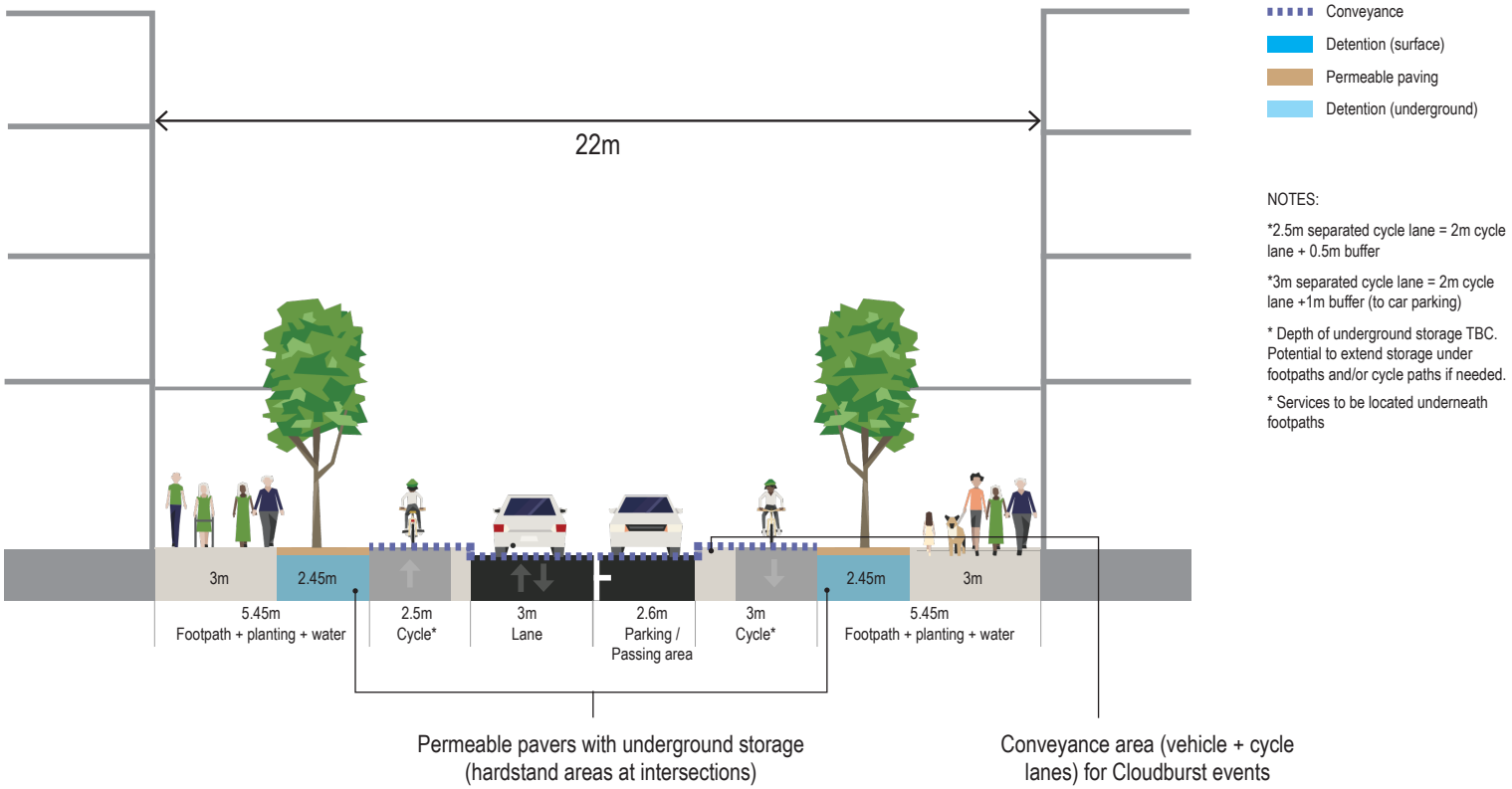
Conveyance area (vehicle + cycle lanes) for Cloudburst events

Stormwater planters + permeable paving buffer (hardstand areas at tram stops / intersections)

All intersections / tram stops / pedestrian crossings will be paved.

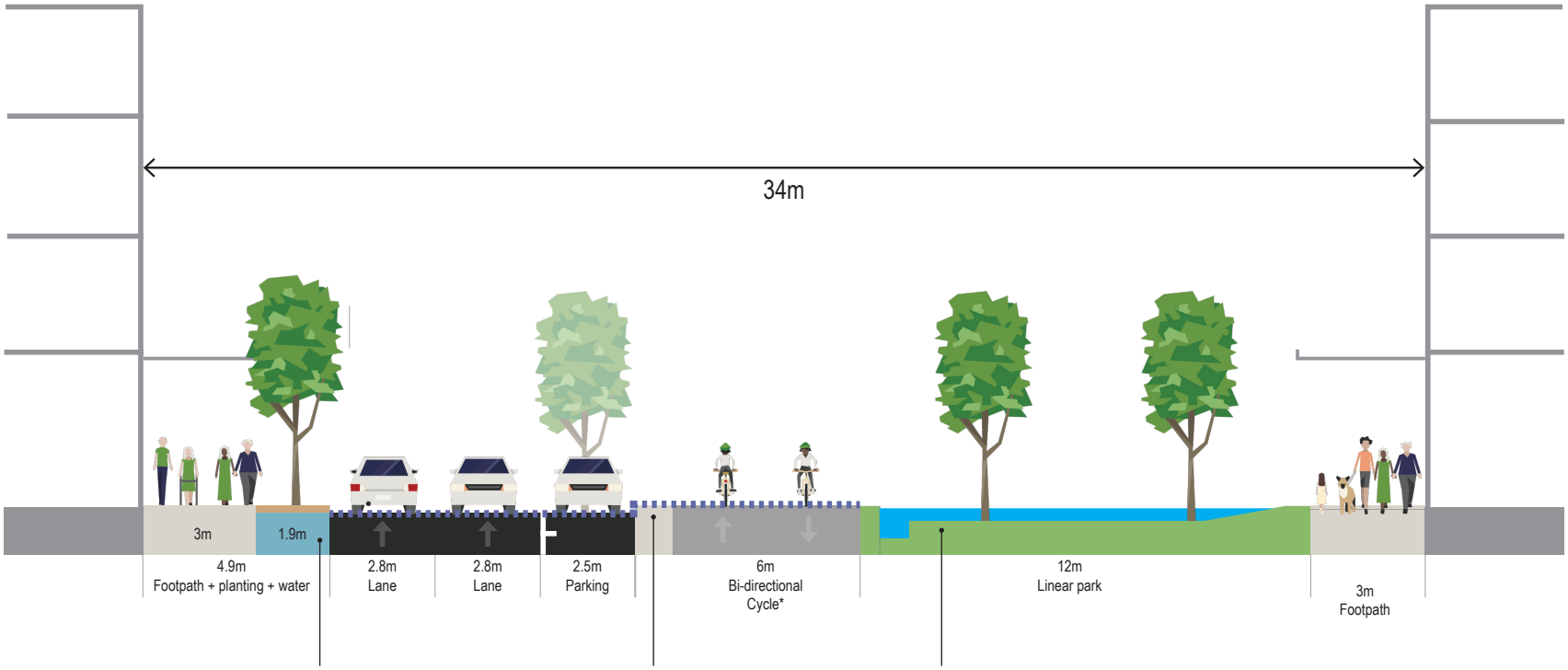
Green Street

New street (22m)



Green Street

New street (34m with linear park)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*6m separated bi-directional cycle = 5m cycle lane + 1m buffer (to car parking)

*Option for trees and stormwater planters within parking lane (e.g. interspersed with car parks).

* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.

* Services to be located underneath footpaths

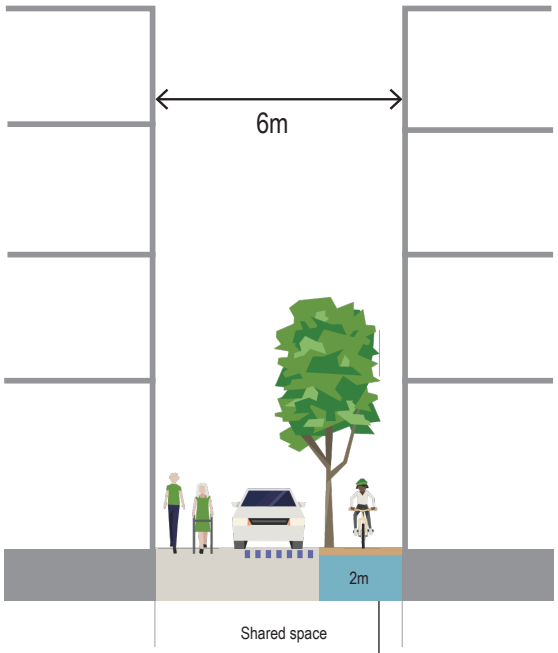
Permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

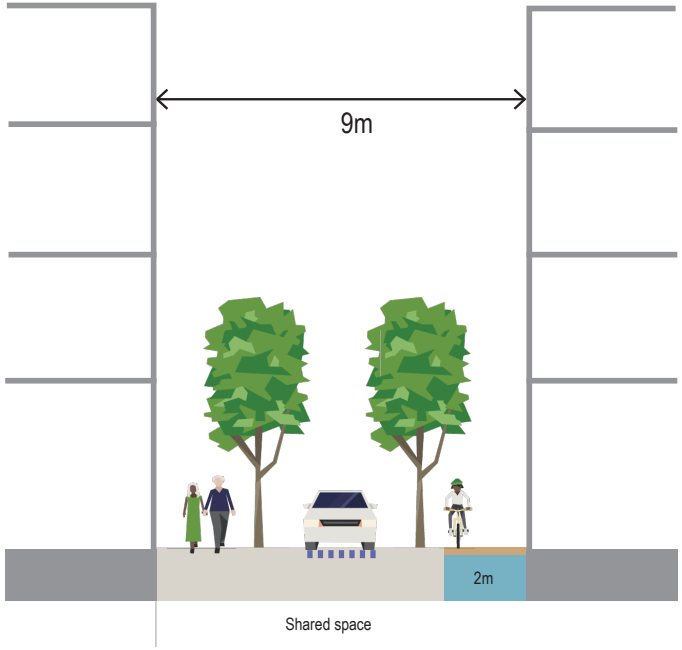
Small-scale channel + lowered linear park (to contain a mix of passive & active uses, softscape & hardscape areas)

Blue Laneway

New laneway (6m)



Permeable pavers with underground storage
(hardstand areas at intersections)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*Taskforce preference for 6m wide laneways. CoPP requested 9-12m wide laneways through panel process.

*Laneways assumed to be shared spaces.

* Depth of underground storage TBC. Potential to extend storage under footpaths or bike paths if needed.

City of Melbourne and Laneway Cross Sections

SECTION A

LOCAL STREET ADJACENT TO OPEN SPACE

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

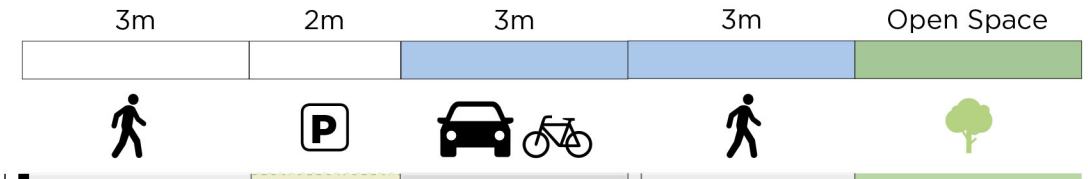
Low-volume street without transit routes. 3m width for one way traffic, focusing on place making over vehicle movement.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to vehicular lane and secondary pedestrian footpath.

Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION B

LOCAL STREET WITH LINEAR PARK

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

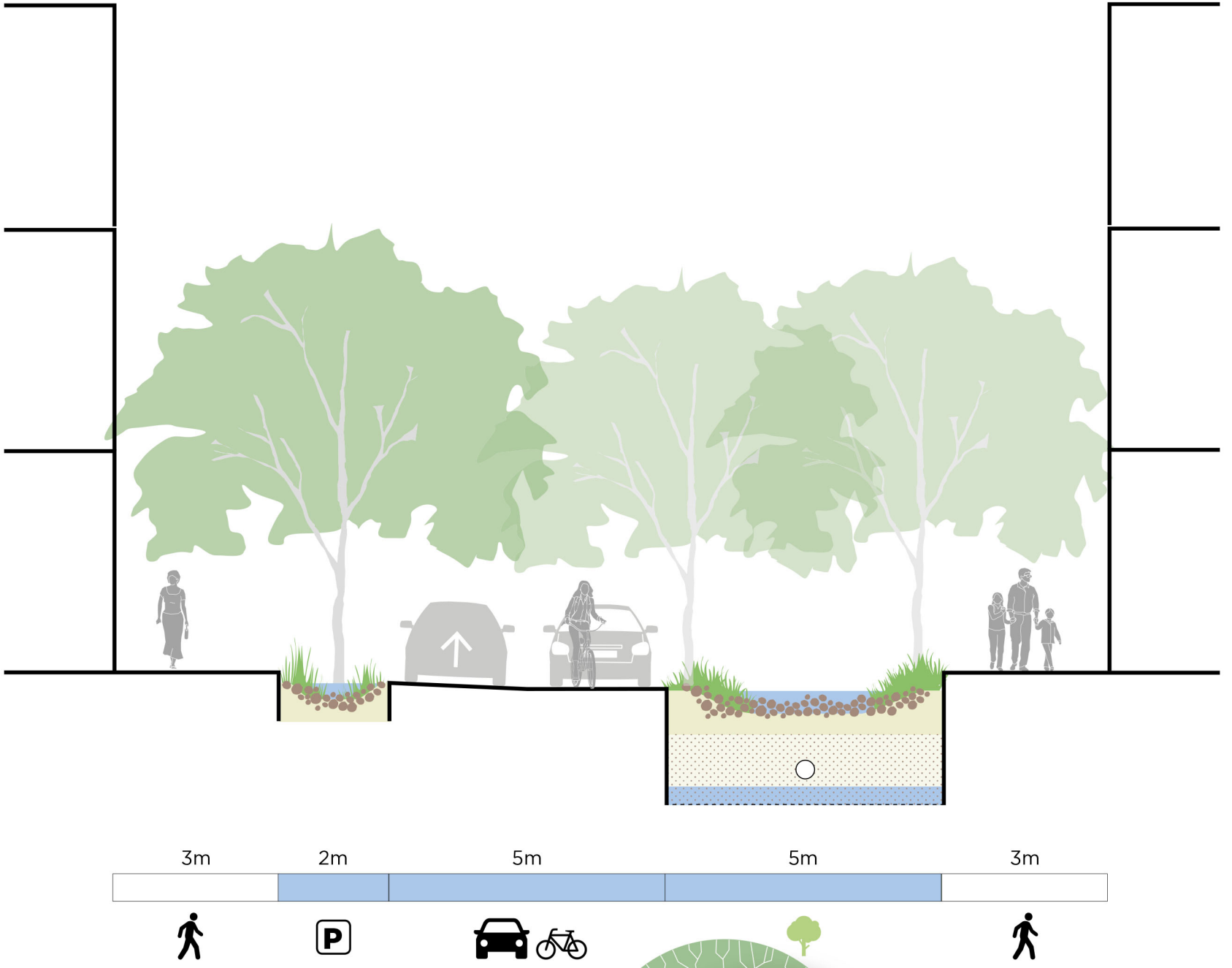
5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane and linear park.

Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION C

LOCAL STREET ADJACENT TO PROPOSED TRAM BRIDGE

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

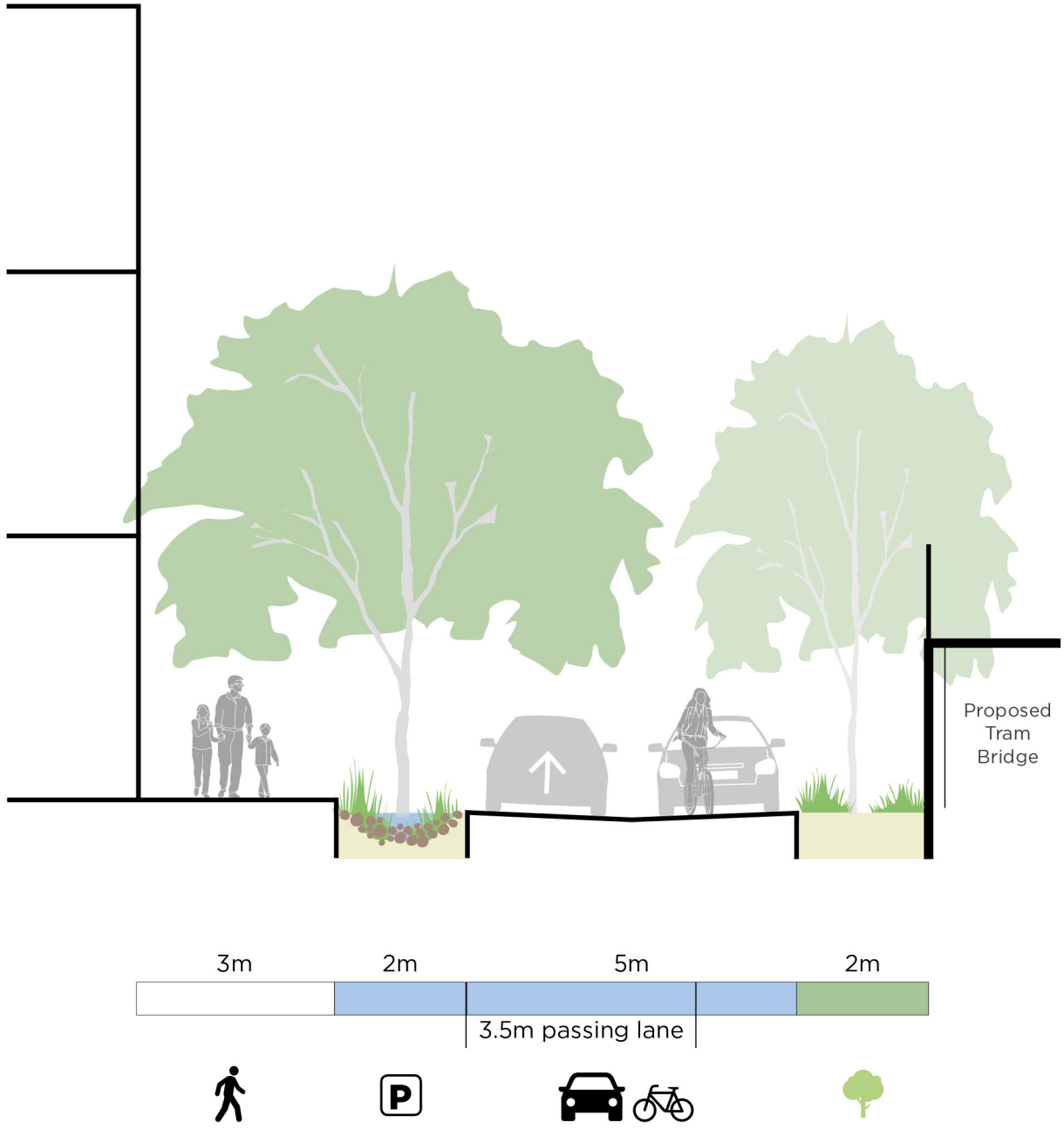
5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass. 3.5 m passing lanes are introduced for further traffic calming.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane.

Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION D

ONEWAY LANEWAY

Function

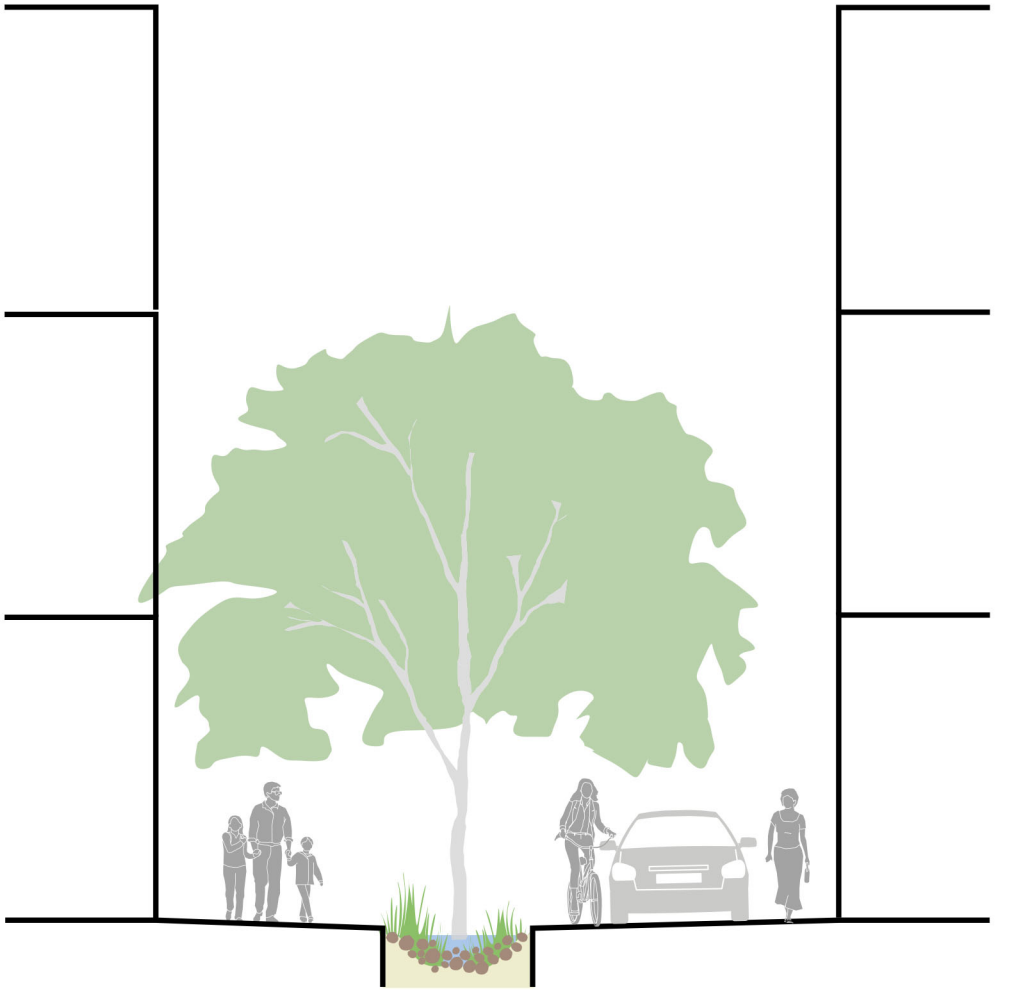
Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

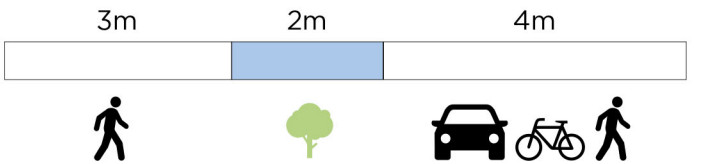
Vehicle Movement + Access

Low-volume street without transit routes. 4m width for one way traffic as part of a shared surface, focusing on place making over vehicle movement.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to central rain gardens.





SECTION E

PEDESTRIAN LANEWAY

Function

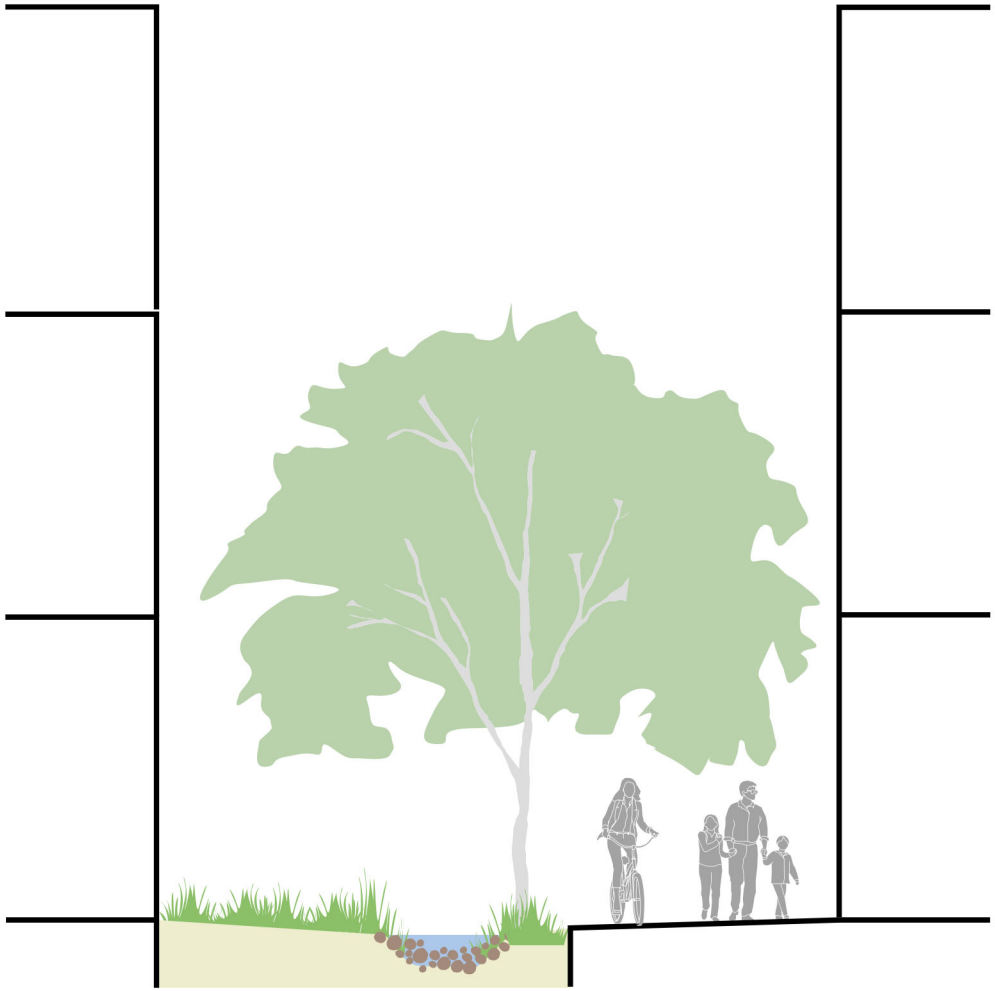
Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

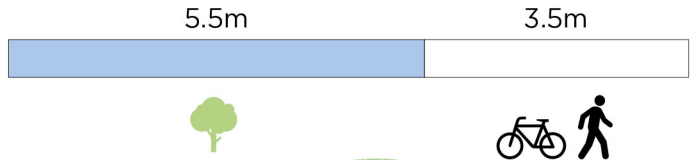
Vehicle Movement + Access

Off limits to private vehicles, however do allow emergency vehicular access.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to green space.





SECTION F

SERVICE ROAD

Function

Dedicated service access, concentrating larger vehicles (local freight, waste collection, parking access and servicing) to the perimeter of the precinct.

Vehicle Movement + Access

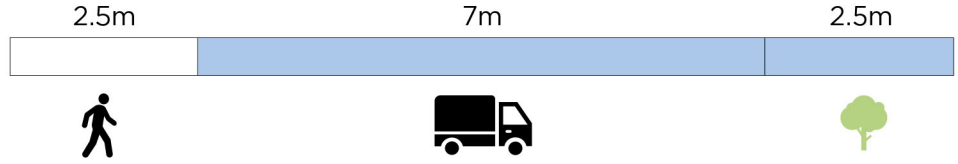
7 m width for two lane traffic. Tree planting introduced for further traffic calming.

Water management

Working as a Green Street to store flood waters at the source.

Parking

No on street parking.



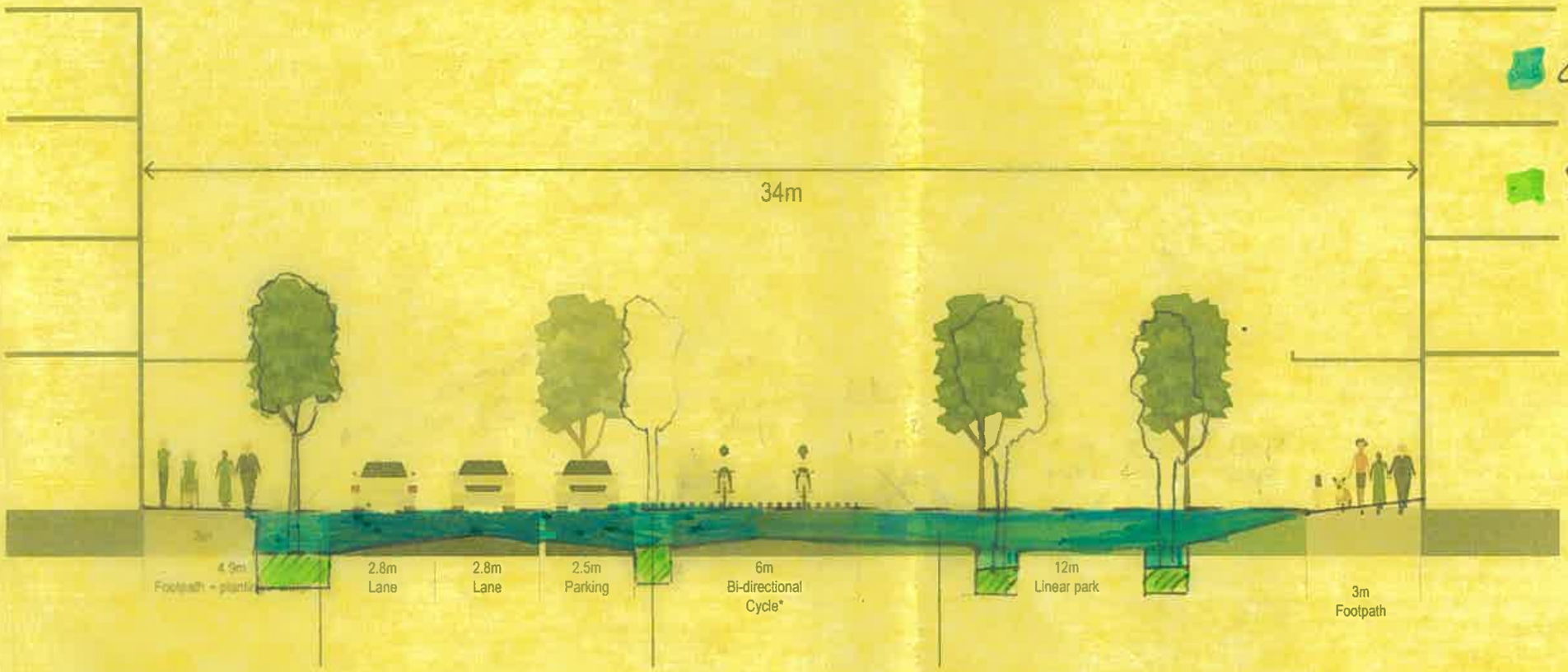
Attachment 2

GHD cross-sections v1 for Working Group workshop on 10th Oct

Green Street

New street (34m with linear park)

Graham St – Green St (34m with Linear Park)



Permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

Small-scale channel + lowered linear park (to contain a mix of passive & active uses, softscape & hardscape areas)

Detention ~ 3.6 m² (target 3.2 sq m based on (a) tree pits/raingardens avg. 600mm / 1.66 m2

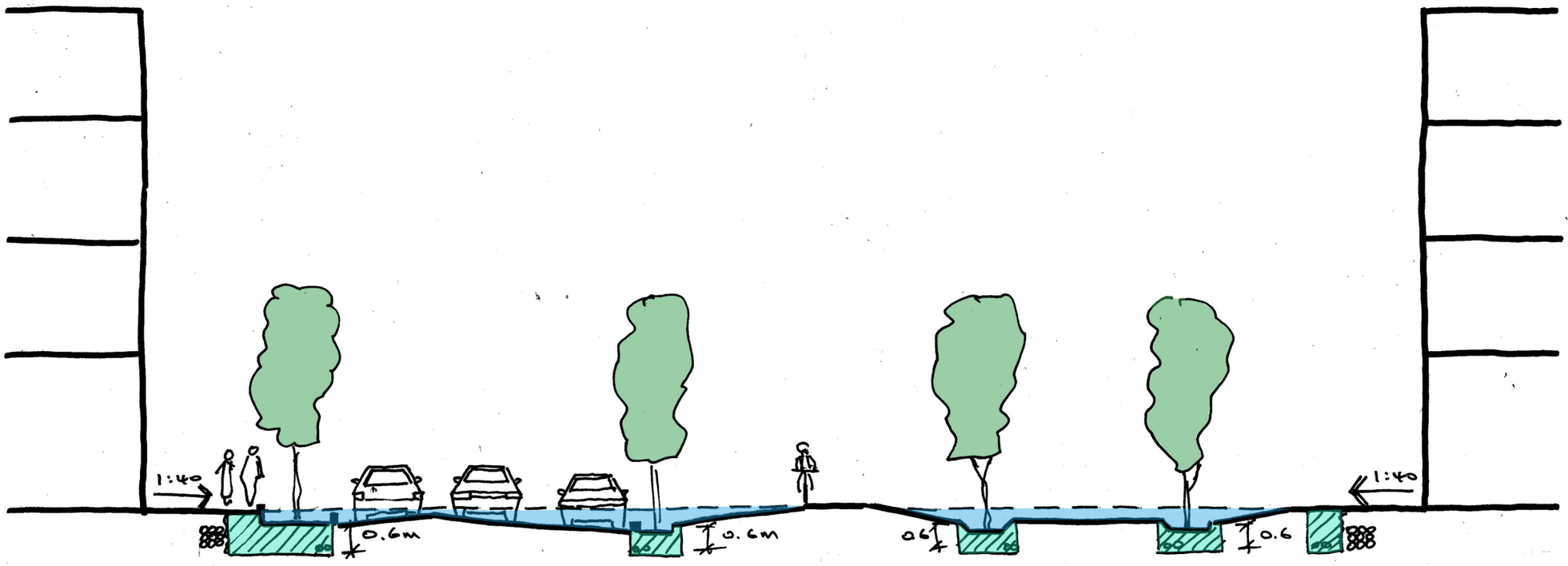
Conveyance ~ 10 m²

(b) road avg. 350 mm / 2.54 m2

(c) Cycle path avg. 325 mm / 1.95 m2

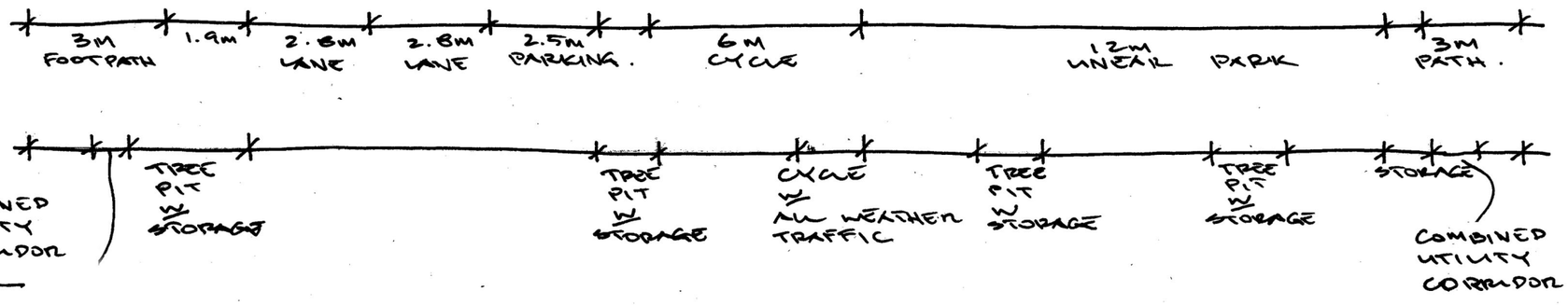
(d) linear park avg. 350mm / 3.60 m2

GREEN STREET
GRAHAM ST - GREEN ST
(34m W LINEAR PARK)



CONVEYANCE (100YR ARI)

DETENTION



NOTES –

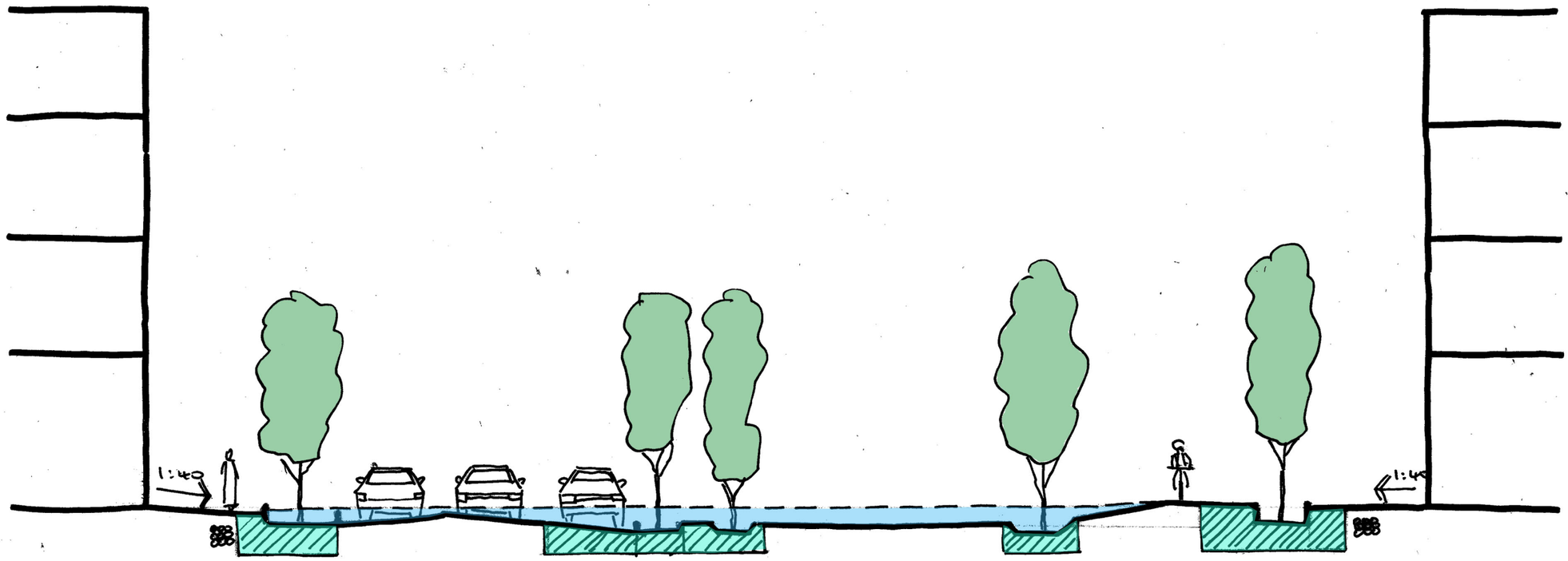
- ALL TREE PITS W 2NO. MIN. AGI FOR CONVEYANCE
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3-4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION W $3.6m^2$ (TARGET $3.2m^2$ BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE ~ $10m^2$ BASED ON (A) TREEPIT / RAINGARDENS AVG. 400MM / $1.66m^2$
  (B) ROAD AVG. 350MM / $2.84m^2$
  (C) CYCLE PATH AVG. 325MM / $1.95m^2$
  (D) LINEAR PARK AVG. 350MM / $3.60m^2$.

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)

CONVEYANCE (100YR ARI)

DETENTION



3M FOOTPATH
1.9M
2.8M LANE
2.8M LANE
2.5M PARKING.
12M LINEAR PARK
6M CYCLE
3M FOOTPATH

COMBINED UTILITY CORRIDOR.
TREE PIT W PERMEABLE PAVING & STORAGE.
CARPARKING W PERMEABLE PAVING & STORAGE.
TREE PIT W STORAGE
TREE PIT W STORAGE
CYCLE W ALL WEATHER TRAFFIC
TREE PIT W PERMEABLE PAVING & STORAGE
COMBINED UTILITY CORRIDOR

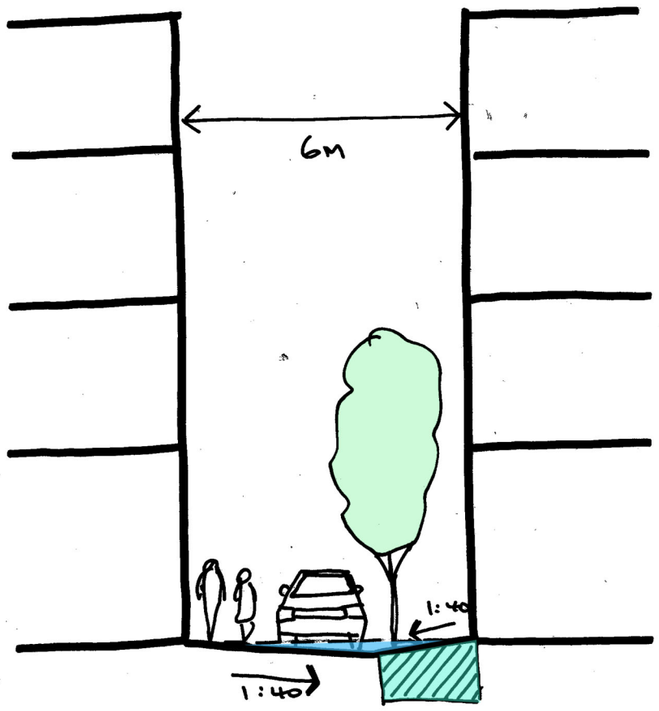
NOTES - AS PER SK01-A.

GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.

CONVEYANCE (100YR ARI)

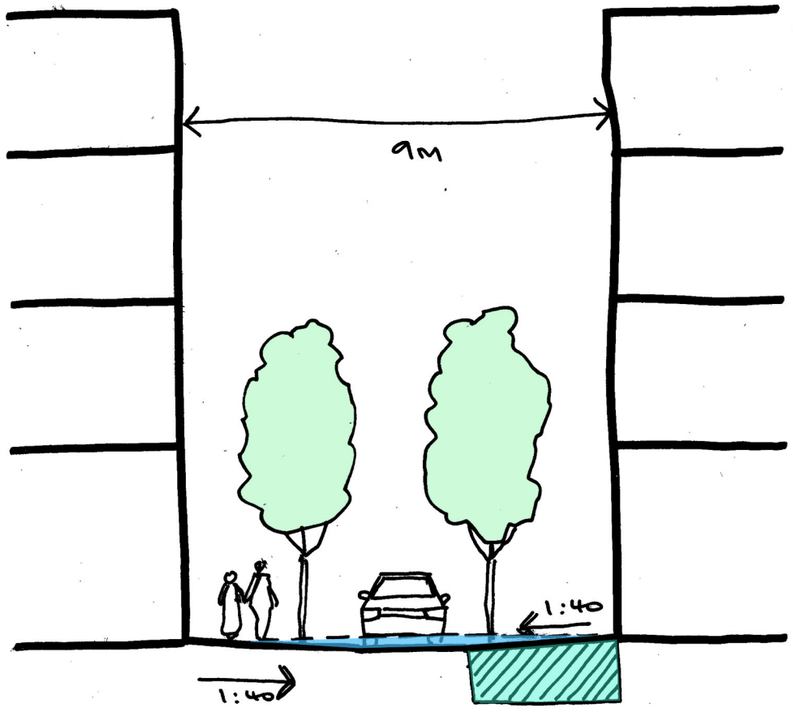
DETENTION

BLUE LANEWAY.
NEW LANEWAY (6M & 9M.)



4M SHARED SPACE

2M FOOTPATH W/ TREE PIT & STORAGE



3.25M FOOTPATH W/ TREE PIT & STORAGE

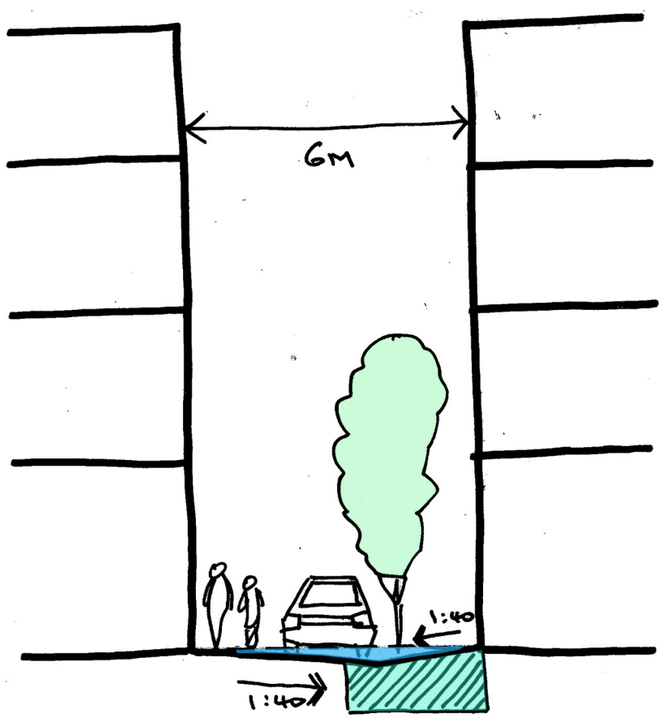
2.5M

3.25M FOOTPATH W/ TREE PIT & STORAGE

CONVEYANCE (100YR ARI)

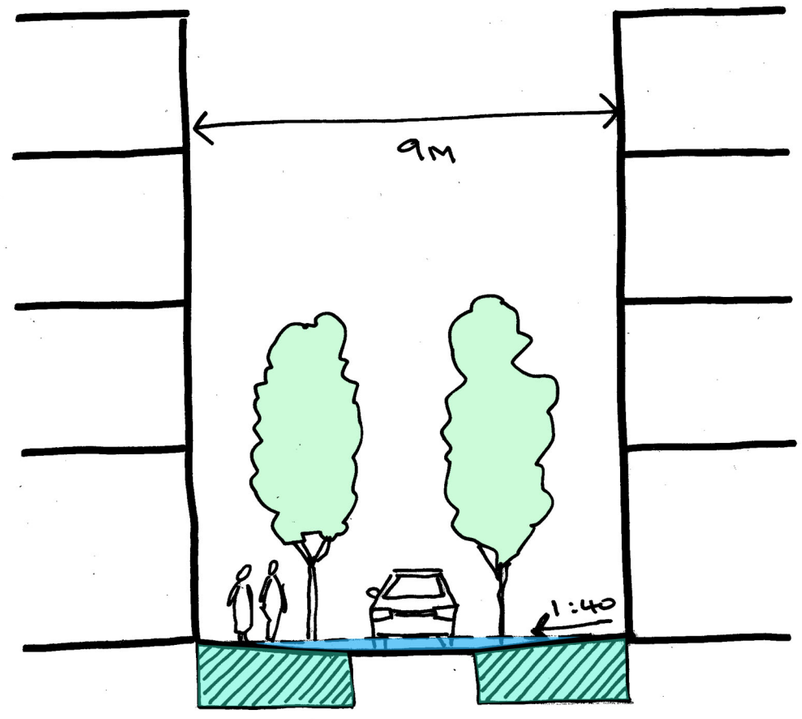
DETENTION

BLUE LANEWAY ADDITIONAL STORAGE OPTION
NEW LANEWAY (6M & 9M.)



3M SHARED SPACE

3M FOOTPATH W TREE PIT & STORAGE



3M FOOTPATH W TREE PIT & STORAGE

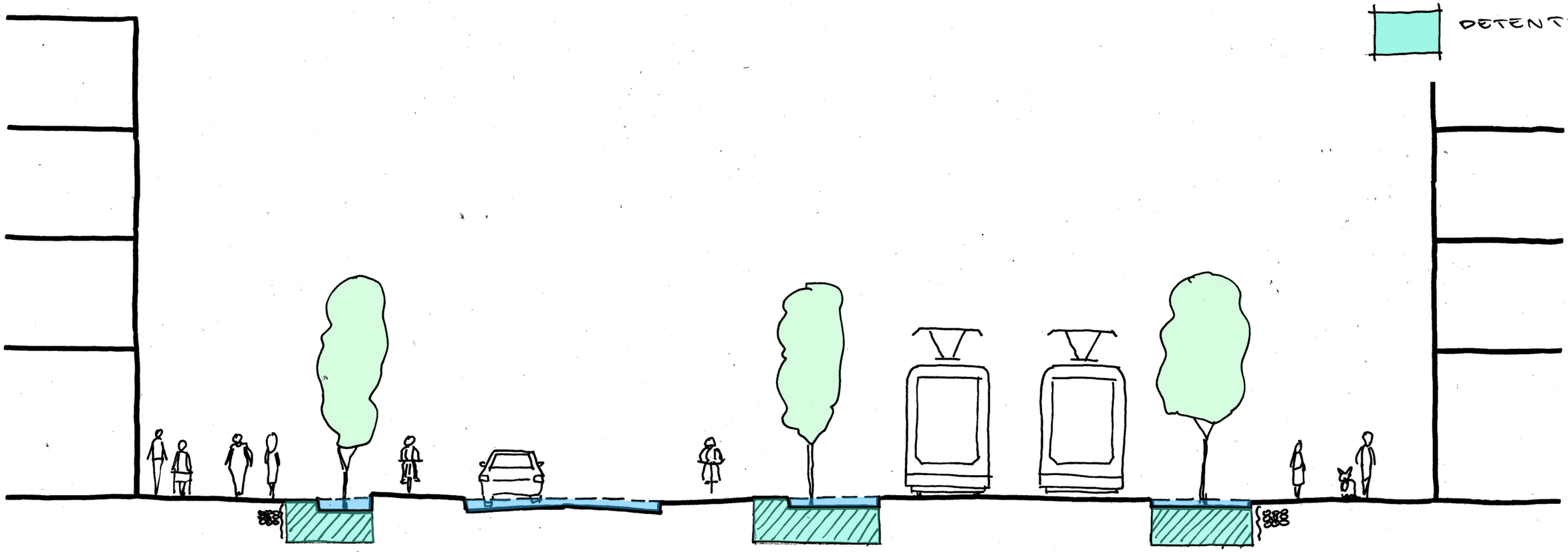
3M

3M FOOTPATH W TREE PIT & STORAGE.

CLOUDBURST BOULEVARD
PLUMMER ST. CIVIC (36m)
FENNELL ST.

CONVEYANCE (100YR ARI)

DETENTION



6.5m PATH
2.5m CYCLE
2.8m LANE
2.8m LANE
2.5m CYCLE
3.6m MEDIAN / WATER / TRAM STOP
7.5m TRAM
2.8m
5m FOOTPATH

COMBINED UTILITY CORRIDOR

INCREASED TREE PIT STORAGE

INCREASED TREE PIT STORAGE

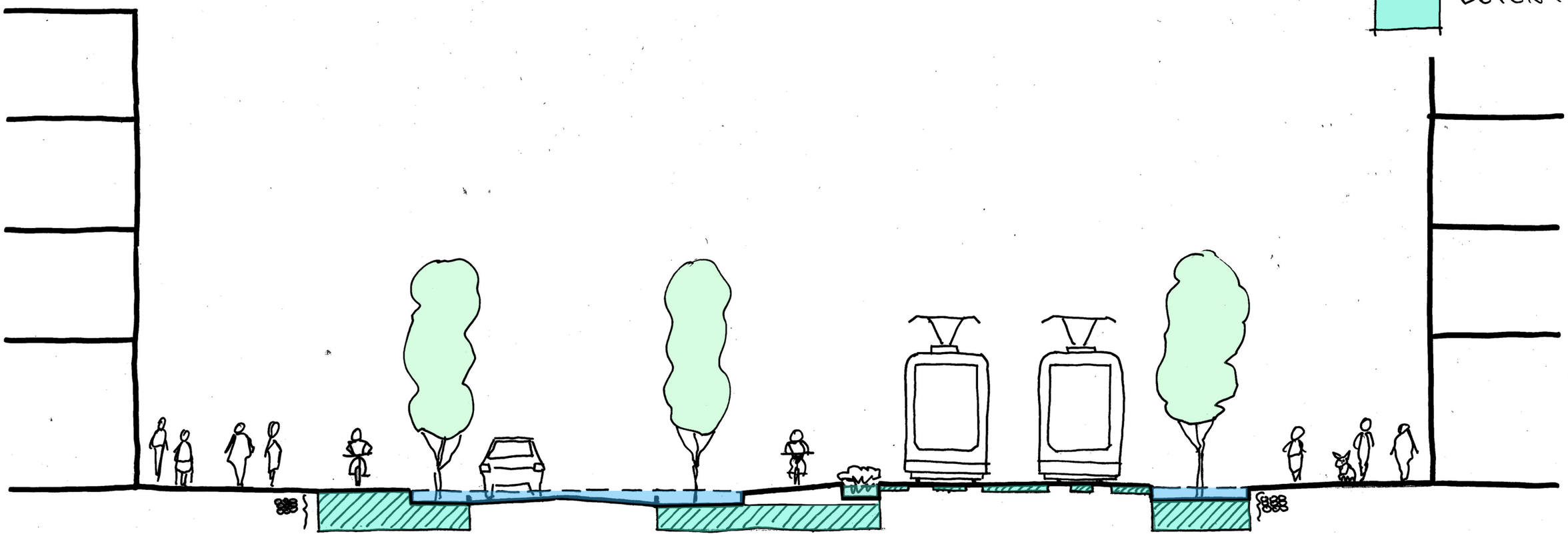
INCREASED TREE PIT STORAGE

COMBINED UTILITY CORRIDOR.

CLOUDBURST BOULEVARD ADDITIONAL STORAGE OPTION.
PLUMMER ST CIVIC (36M)
FENNEL ST.

CONVEYANCE (100YR ARI)

DETENTION



6.5M PATH

2.5M CYCLE

2.8M LANE

2.8M LANE

2.5M TREE PIT W ADD. STORAGE.

2.5M CYCLE

7.5M TRAM W. GRASS TRACK OR SEDUM TRACK

2.8M TREE PIT

5M FOOTPATH.

COMBINED UTILITY CORRIDOR

TREE PIT W ADD. STORAGE

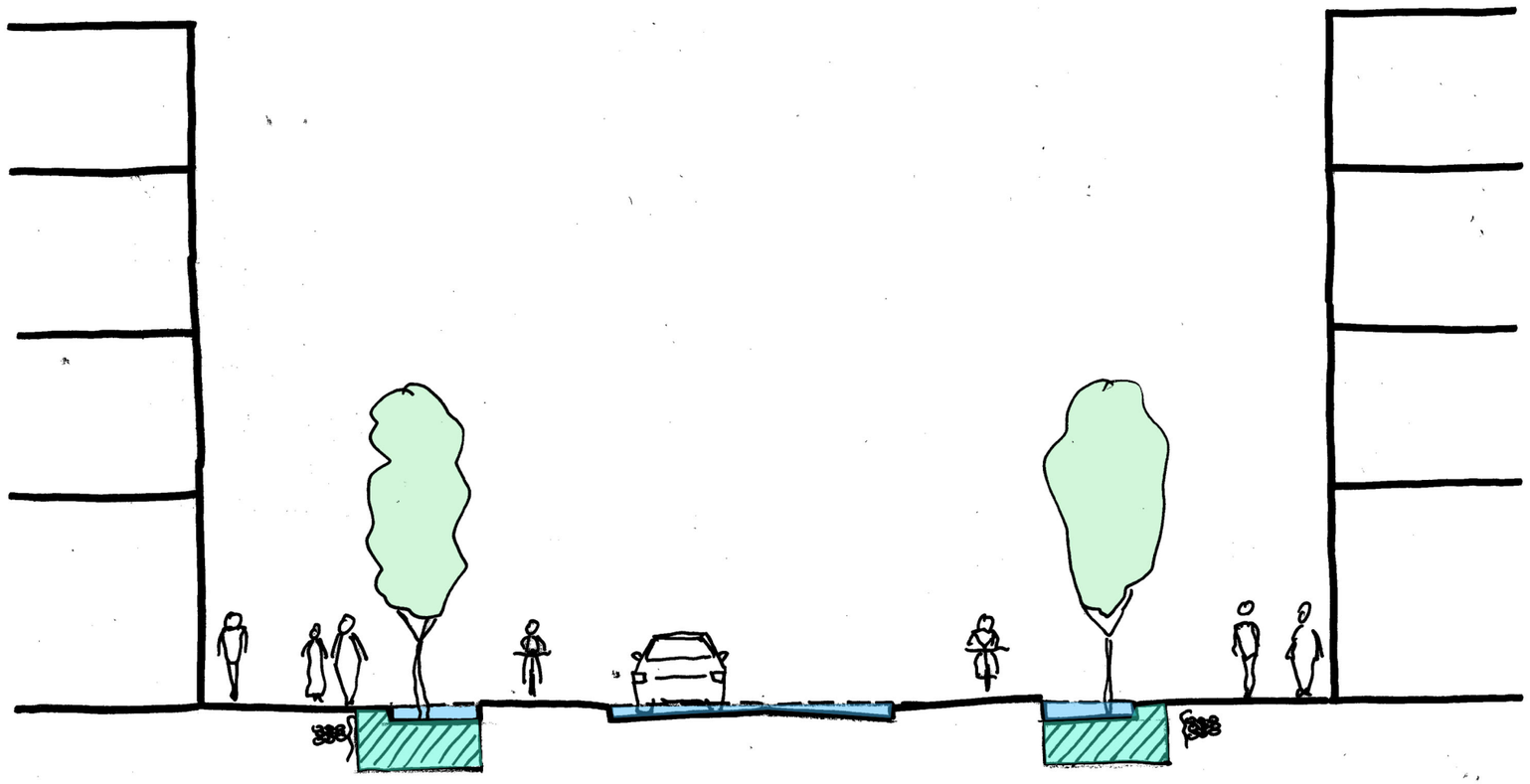
1M PLANTED VERGE.

COMBINED UTILITY CORRIDOR

CONVEYANCE (100YR ARI)

DETENTION

GREEN STREET
NEW STREET (22m)



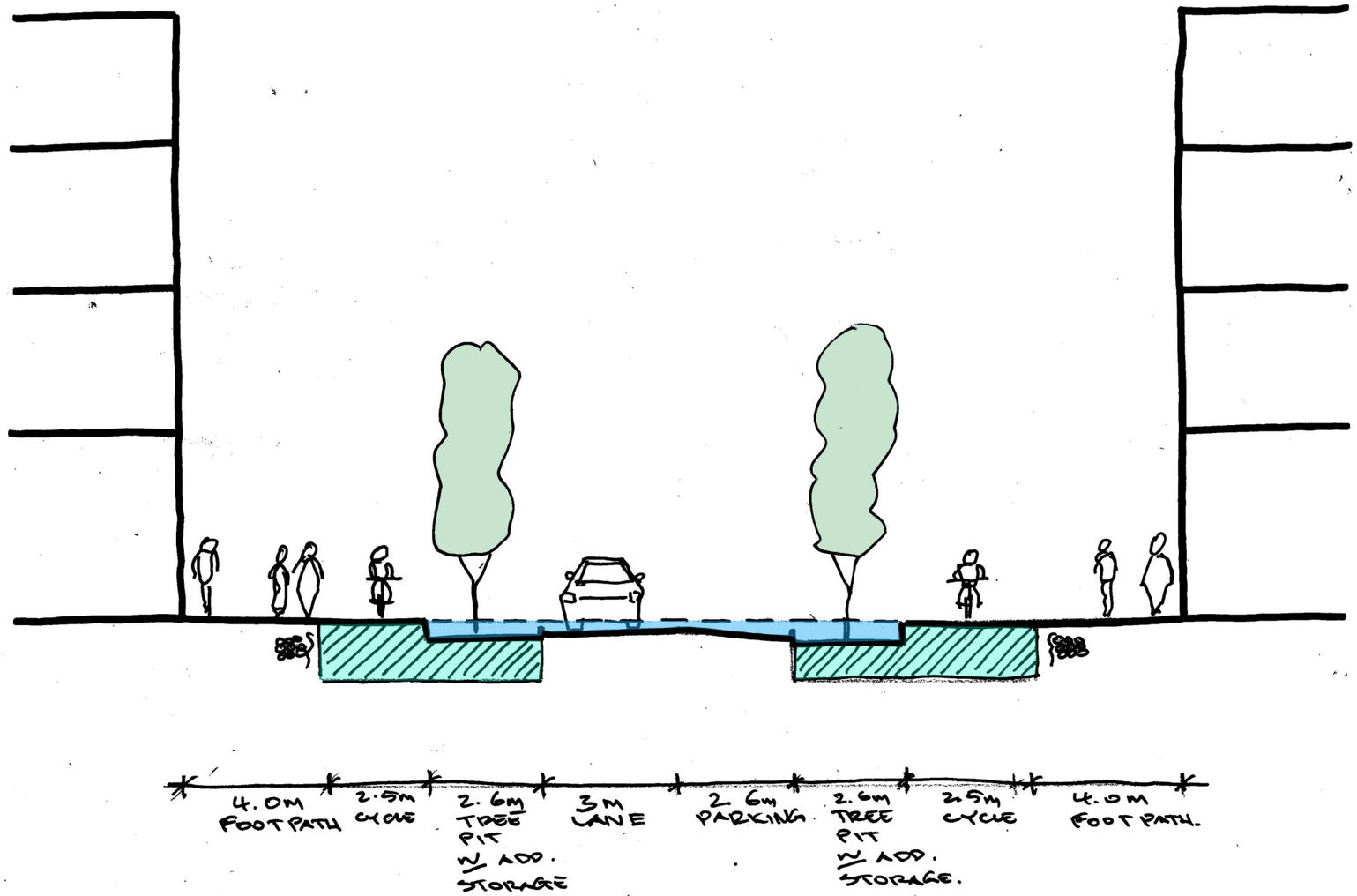
4.0M FOOTPATH
1.5M TREE PIT
2.5M CYCLE
3M LANE
2.6M PARKING
3M CYCLE
1.5M TREE PIT
4.0M FOOTPATH

GREEN STREET
NEW STREET (22M)

ADDITIONAL STORAGE OPTION.

CONVEYANCE (100YR ARI)

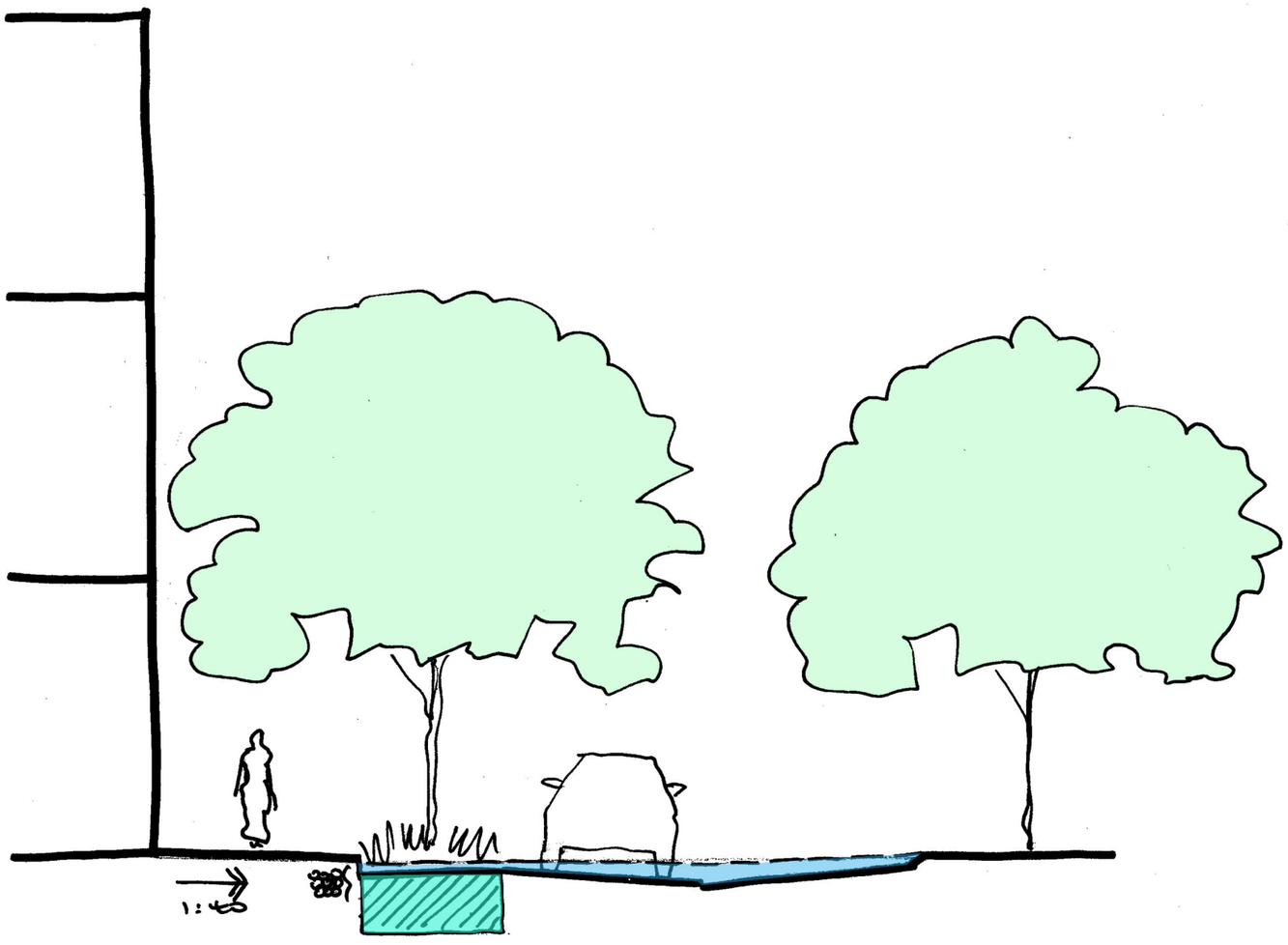
DETENTION

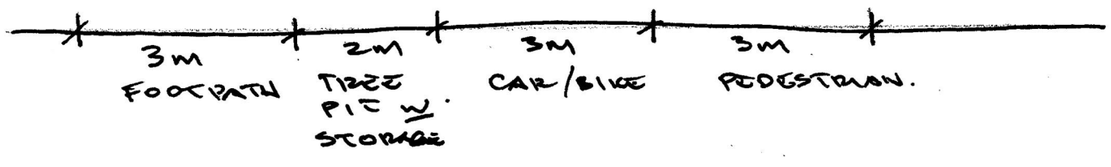


SECTION A
LOCAL STREET ADJACENT TO OPEN SPACE.

CONVEYANCE (100YR ARI)

DETENTION

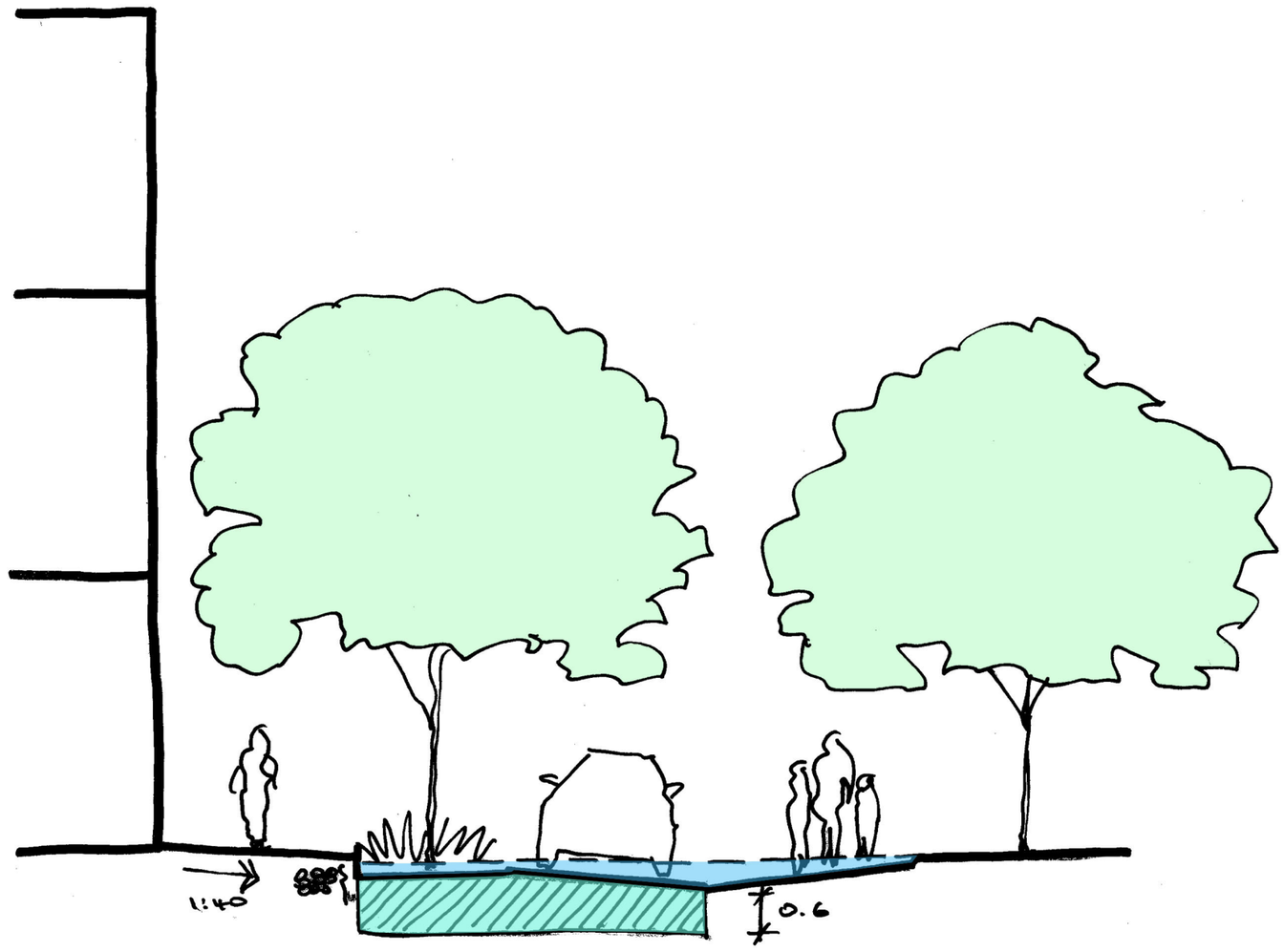




SECTION A
LOCAL STREET ADJACENT TO OPEN SPACE.
ADDITIONAL STORAGE OPTION.

CONVEYANCE (100YR ARI)

DETENTION



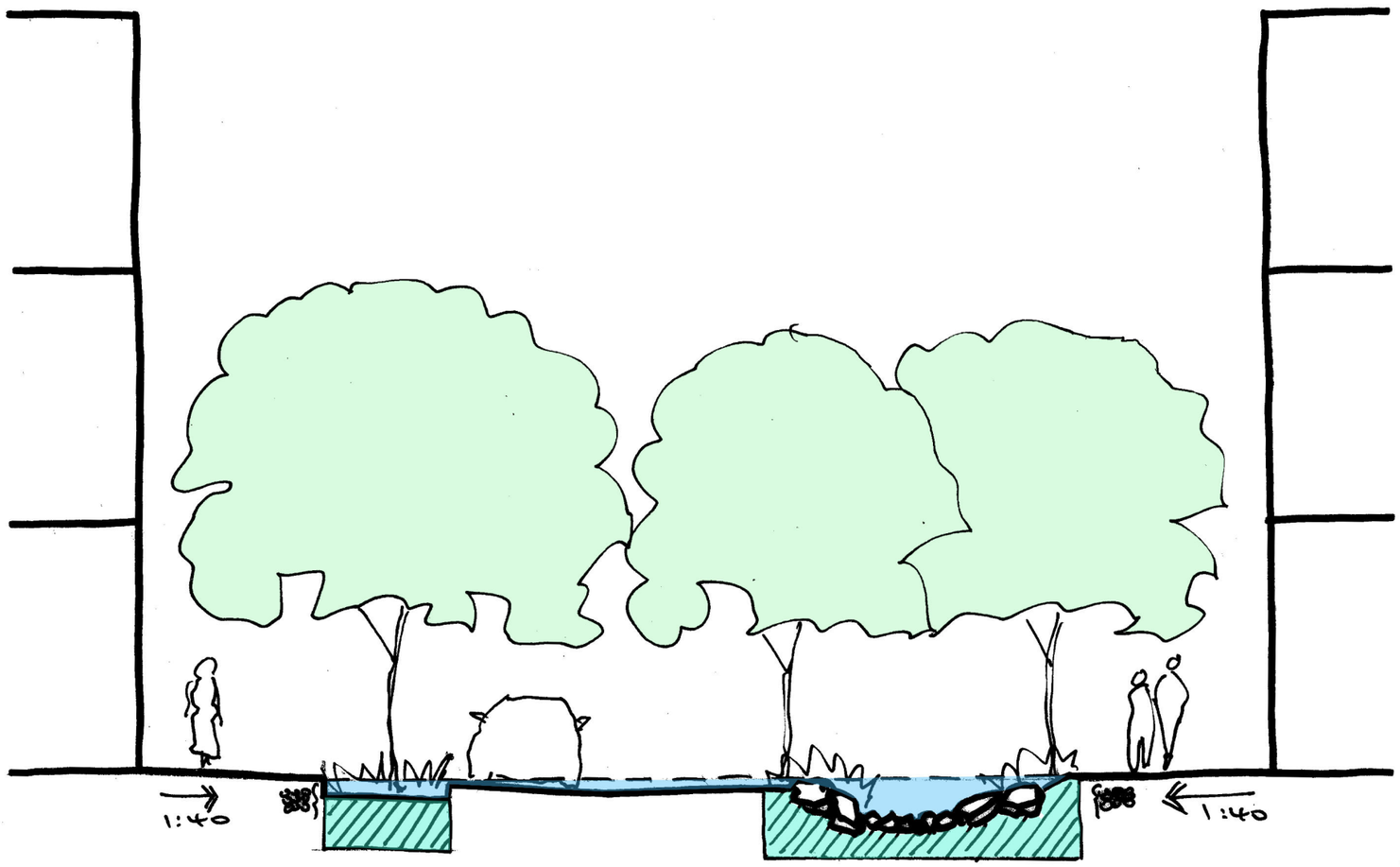
3M FOOTPATH. 2M TREE PIT W STORAGE 3M CAR/BIKE 3M PEDESTRIAN.

5M STORAGE.

CONVEYANCE (100YR ARI)

DETENTION

SECTION B
LOCAL STREET W LINEAR PARK.



3M FOOTPATH

2M TREE PIT W STORAGE

5M CAR & BIKE

5M DETENTION & CONVEYANCE.

3M FOOTPATH.

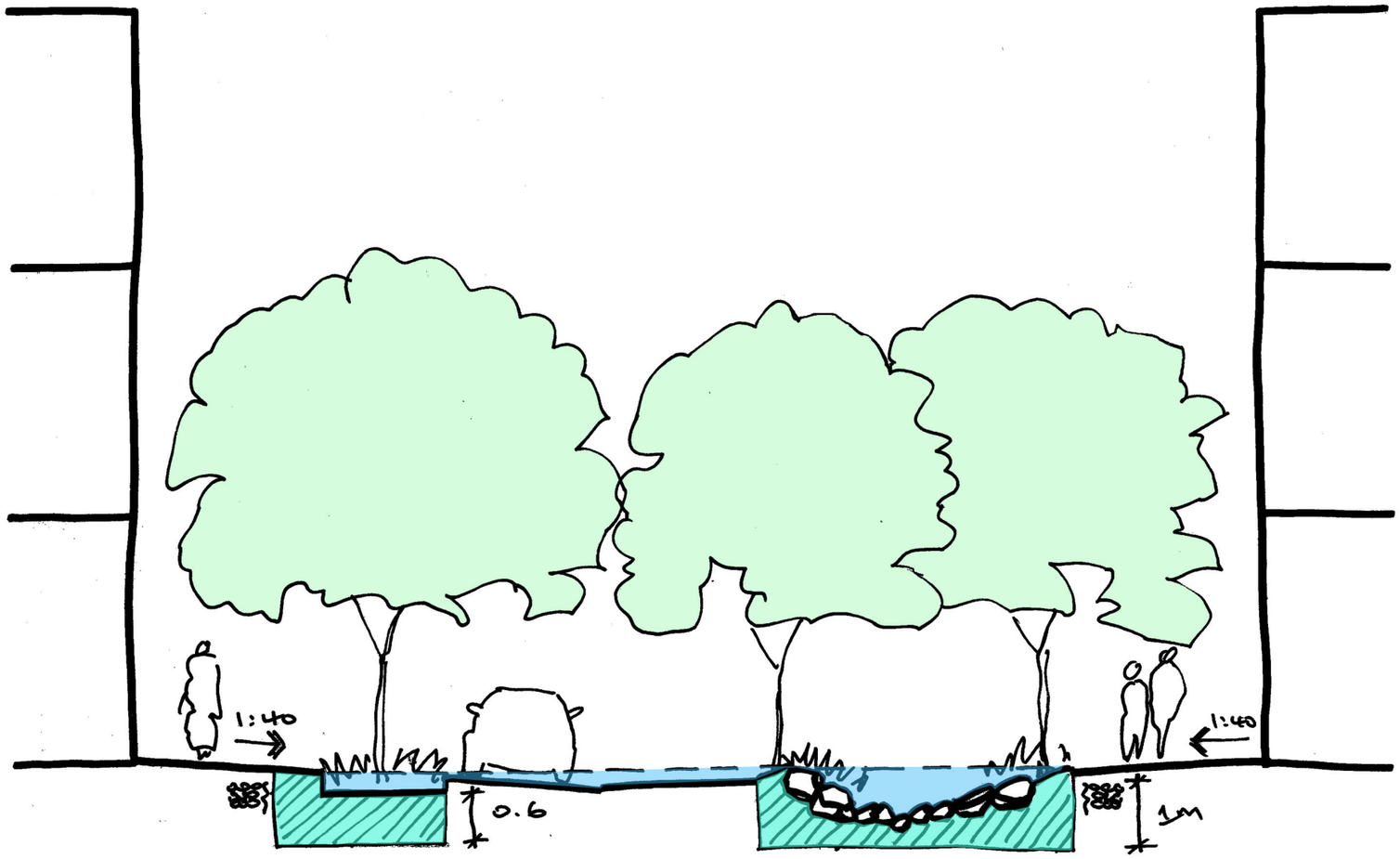
CONVEYANCE (100YR ARI)

DETENTION

SECTION B

LOCAL STREET W LINEAR PARK.

ADDITIONAL STORAGE OPTION.



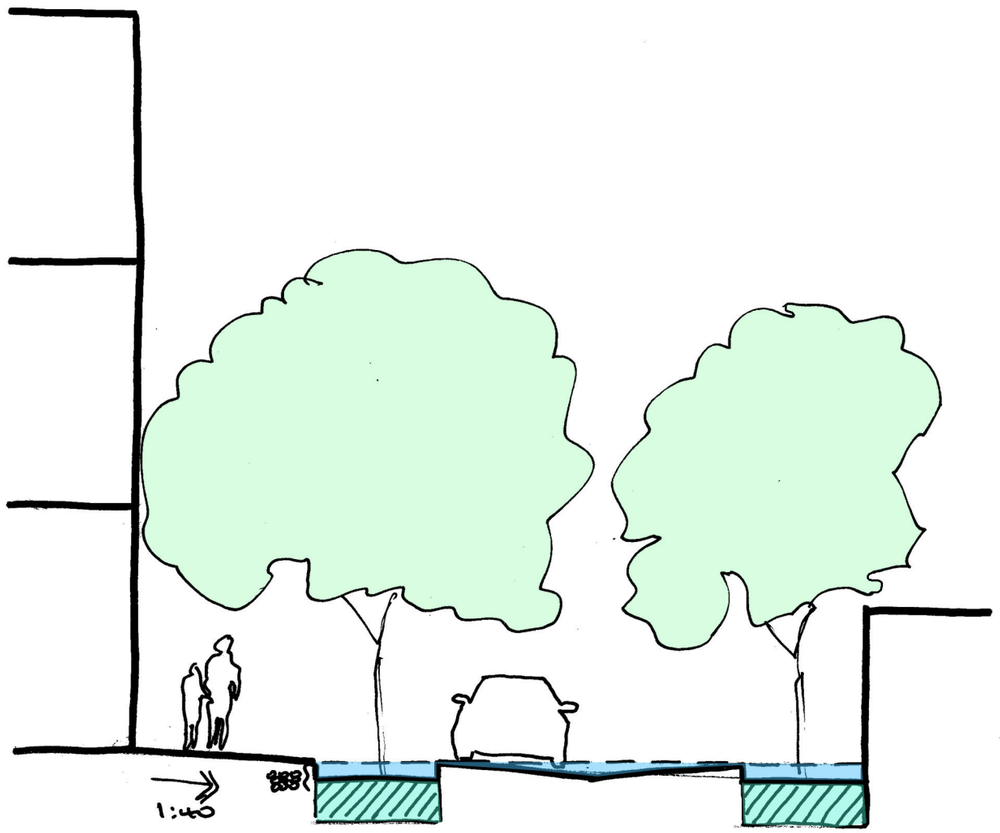
3M FOOTPATH | 2M TREE PIT W STORAGE | 5M CAR & BIKE | 5M DETENTION & CONVEYANCE | 3M FOOT PATH.

3M ADDITIONAL STORAGE

CONVEYANCE (100YR ARI)

DETENTION

SECTION C
LOCAL STREET ADJ. TO TRAM BRIDGE



3M FOOTPATH | 2M TREE PIT W STORAGE | 3.5M PASSING LANE | 1.5M BIKE | 2M TREE PIT W STORAGE

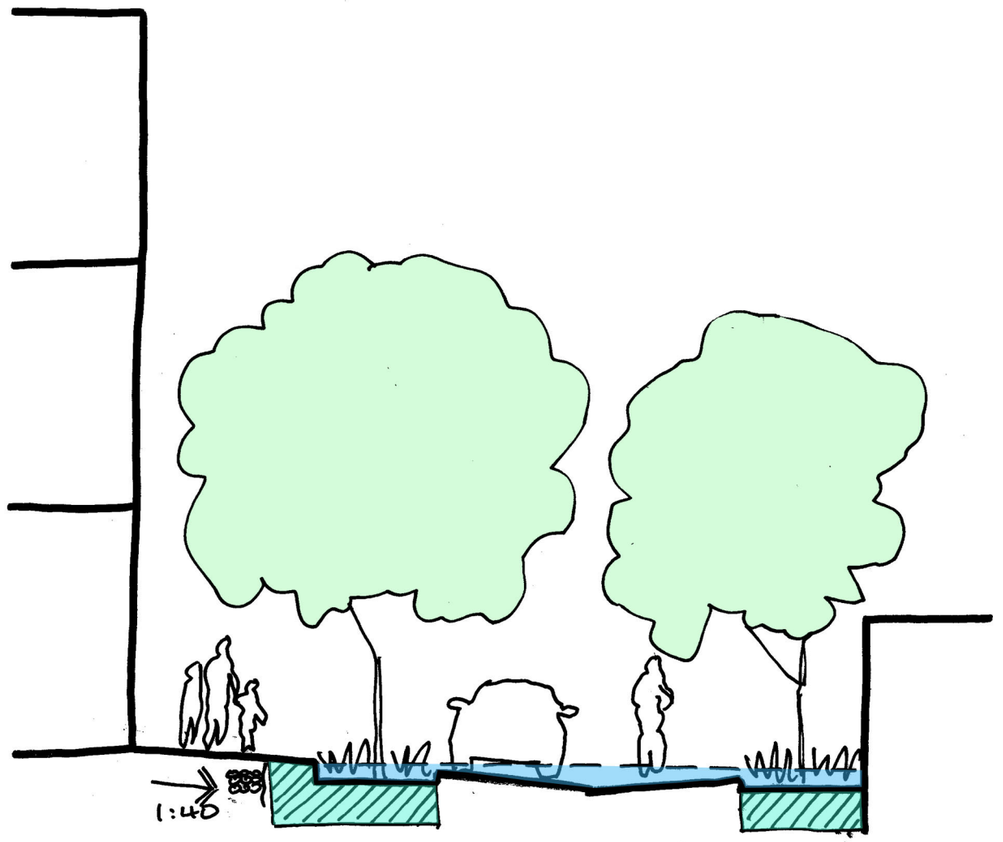
CONVEYANCE (100YR ARI)

DETENTION

SECTION C

LOCAL STREET ADJ. TO TRAM BRIDGE.

ADDITIONAL STORAGE OPTION.



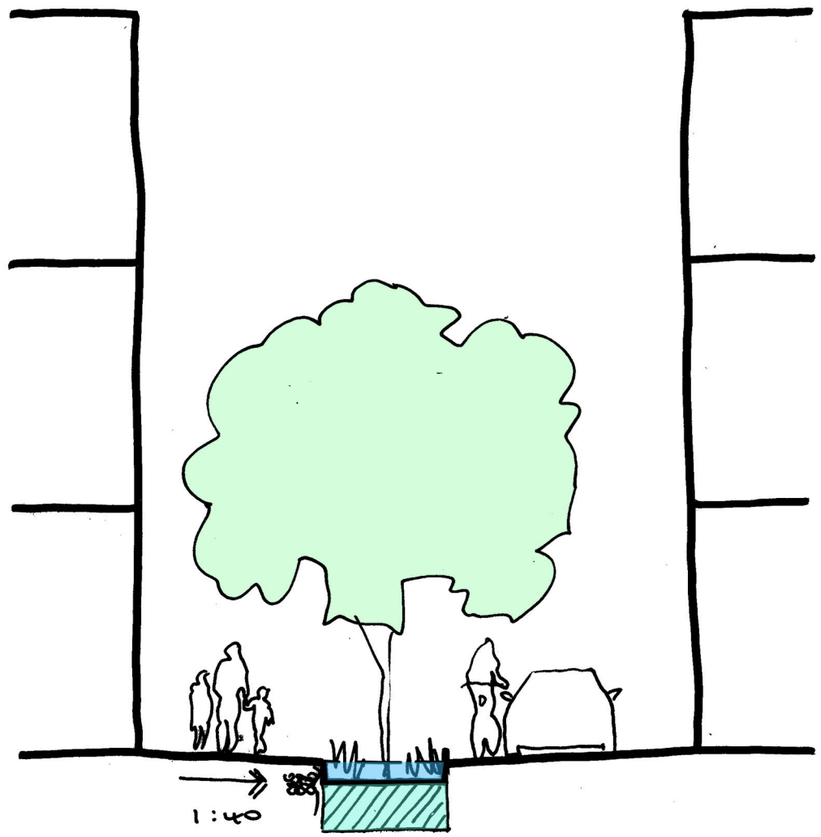
3M FOOTPATH | 2M TREE PIT W STORAGE | 3.5M PASSING LANE | 1.5M BIKE | 2M TREE PIT W STORAGE

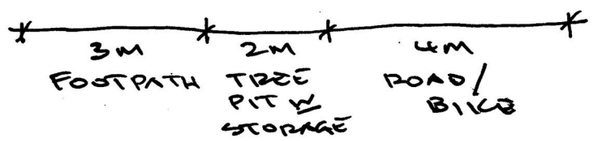
CONVEYANCE (100YR ARI)

DETENTION

SECTION D.

ONEWAY LANEWAY





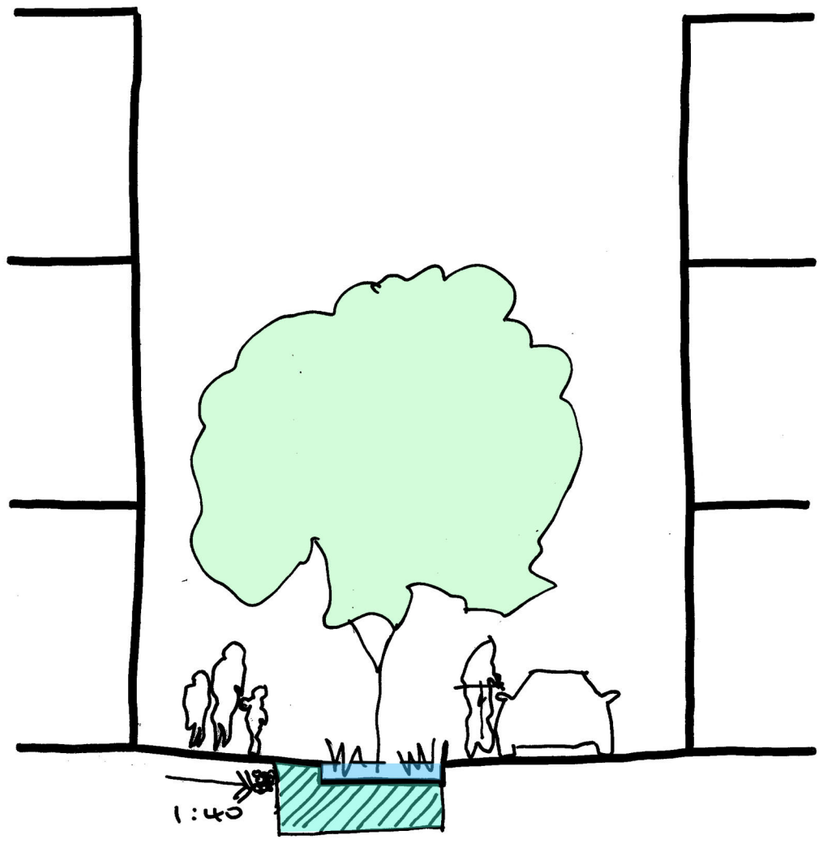
CONVEYANCE (100YR ARI)

DETENTION

SECTION D.

ONEWAY LANEWAY.

ADDITIONAL STORAGE OPTION.



3M FOOTPATH

2M TREE PIT W STORAGE

4M ROAD/ BIKE

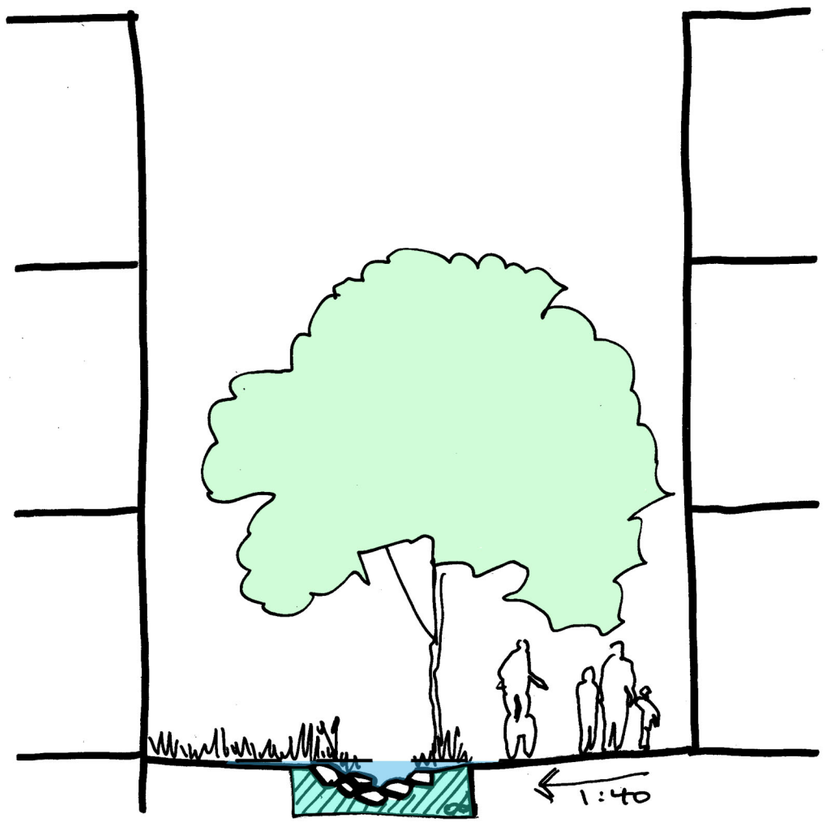
3M ADDITIONAL STORAGE.

CONVEYANCE (100YR ARI)

DETENTION

SECTION E

PEDESTRIAN LANEWAY.



5.5M
CONVEYANCE & STORAGE

3.5M
BIKE & PEDESTRIANS.

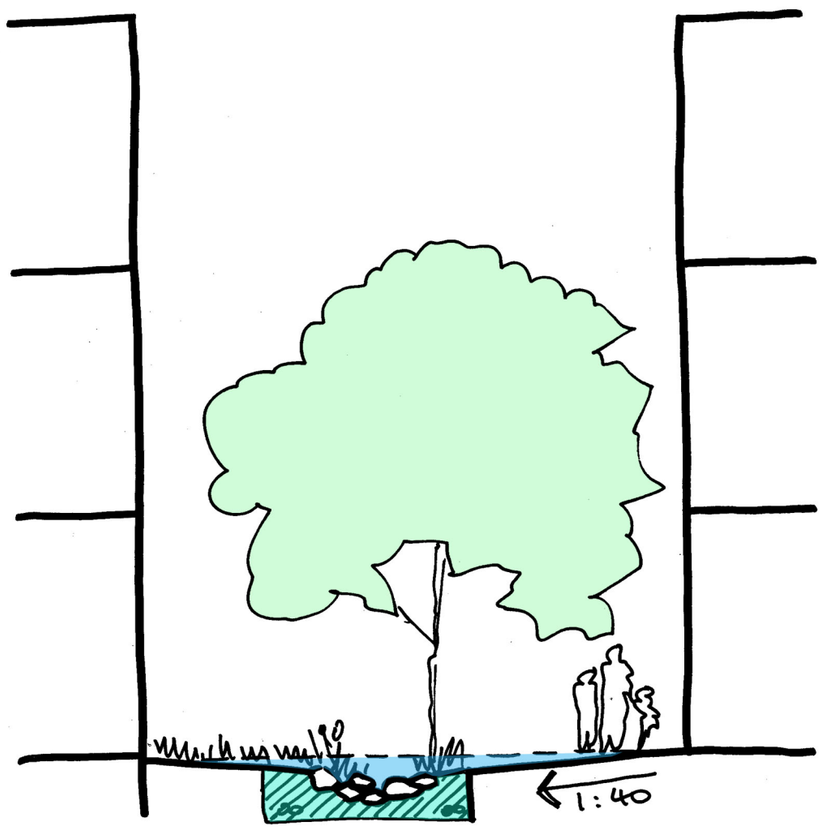
CONVEYANCE (100YR ARI)

DETENTION

SECTION E

PEDESTRIAN LANEWAY.

ADDITIONAL STORAGE OPTION.



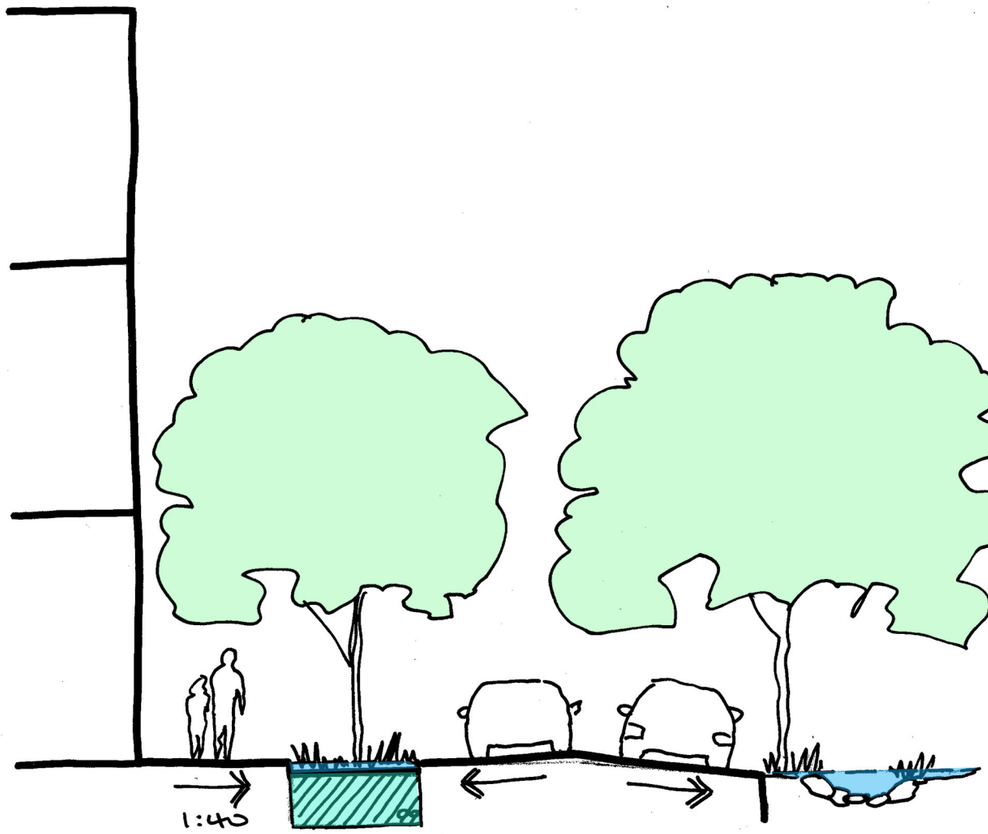
5.5m
CONVEYANCE & STORAGE

3.5m
BIKE & PEDESTRIAN.

CONVEYANCE (100YR ARI)

DETENTION

SECTION F
SERVICE ROAD.



2.5M FOOTPATH

7M LANE

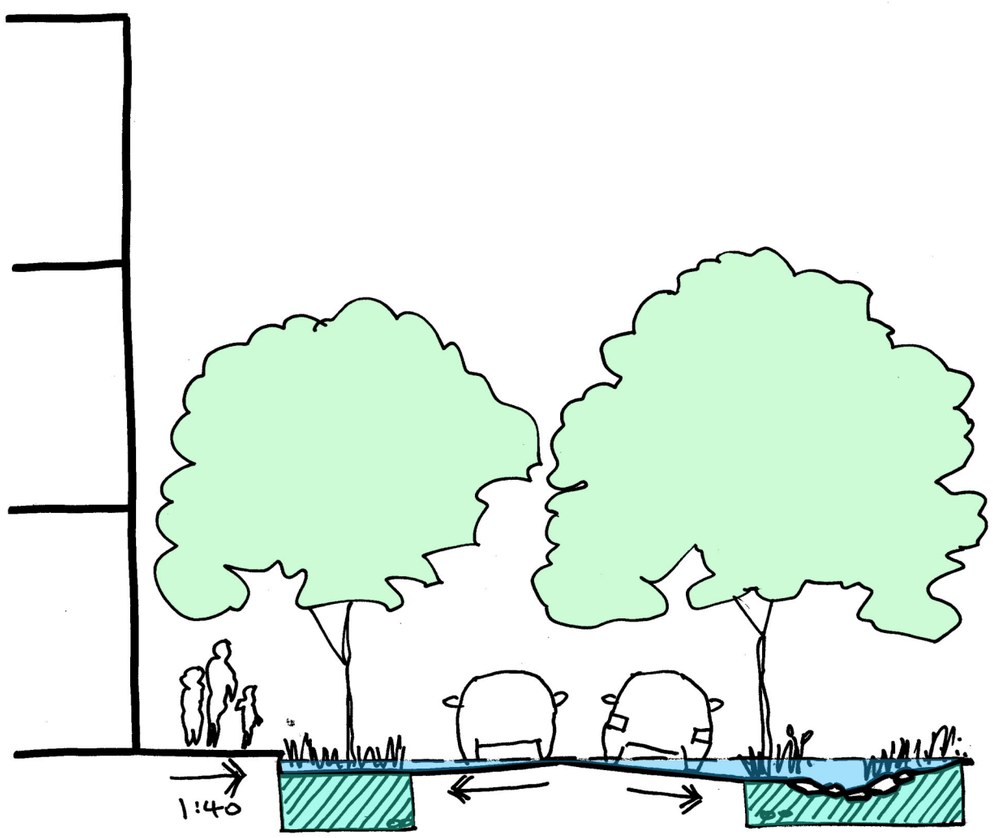
2.5M VERGE/ STORAGE

2M STORAGE

CONVEYANCE (100YR ARI)

DETENTION

SECTION F
SERVICE ROAD.
ADDITIONAL
STORAGE
OPTION.



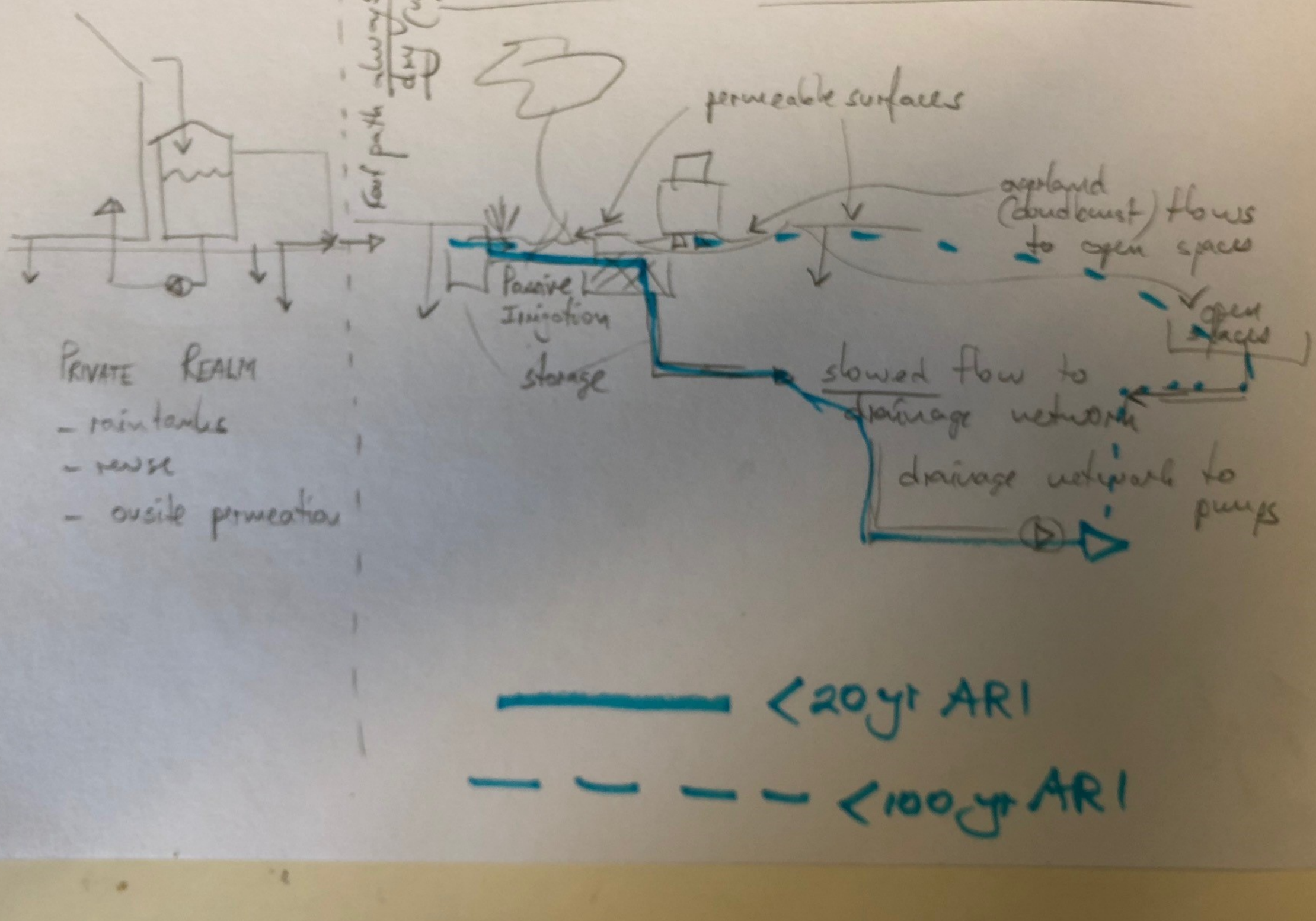
2.5M
FOOTPATH

7M
LANE

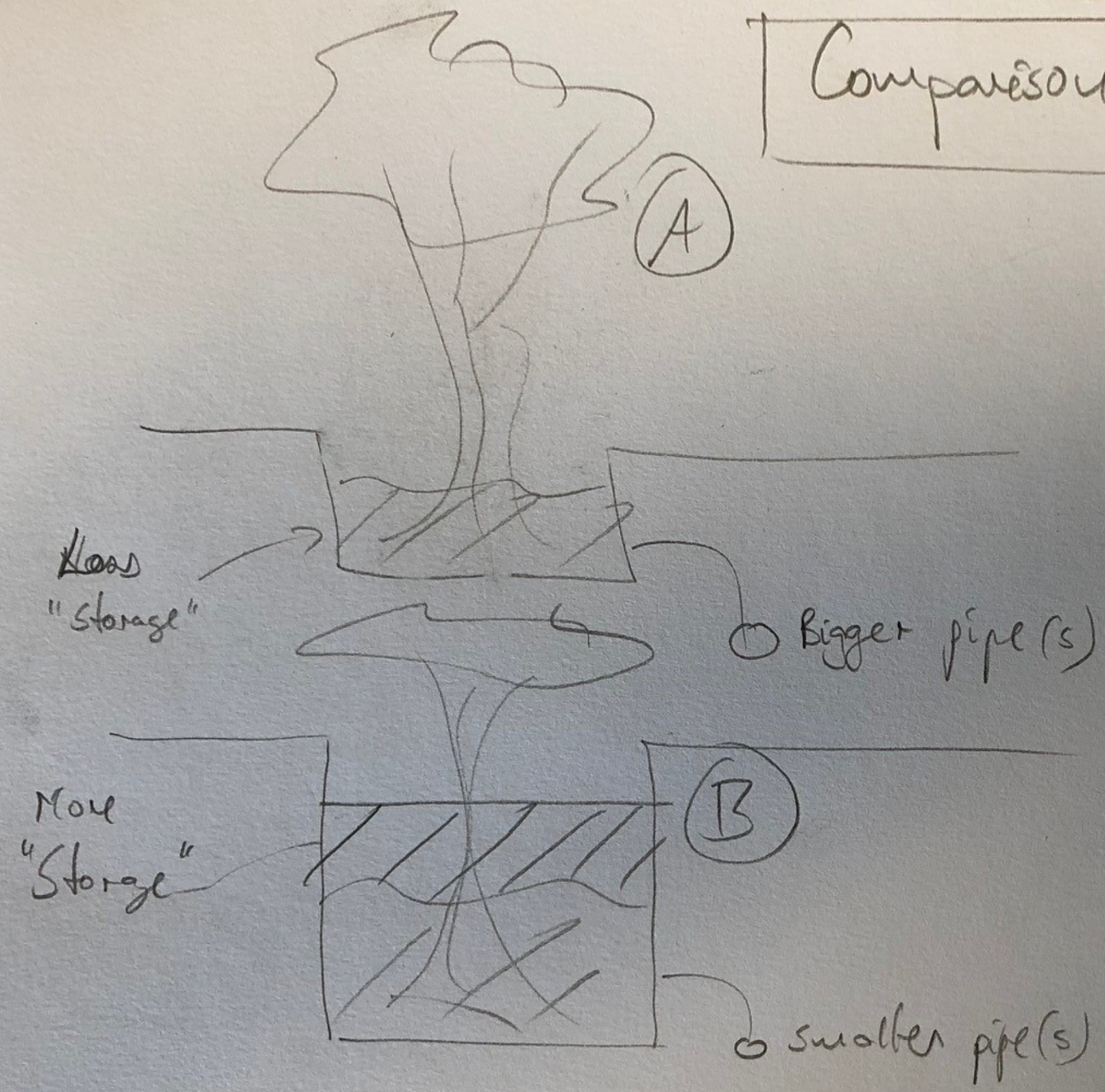
2.5M
VERGE/
STORAGE

2M
STORAGE

Summary of "mixed" strategy



Comparison



Item	Costs A	B
Pipes/ pumps	More	Less
Excavation	Less	More
Cleaning/ Local Maintence	Less	More
Construction of stuff costs	Less	More
Benefits?		